Triton Knoll Offshore Wind Farm Project

Supply Chain Plan

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PROJECT DETAILS

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NOTES ON PUBLICATION - Some of the information contained within this document is commercially sensitive, publication of which could impact the economics of the project.			
Project details			
Project name	Triton Knoll Offshore Wind Farm	**Project size (in MW installed capacity)**	Maximum generation capacity 900MW
Project commissioning date	2020/2021	**Project location**	The TKOWFL site is located in the southern North Sea, approximately 33 km off the Lincolnshire coast and 48 km off the coast of North Norfolk
Is a Contract for Difference (CfD) application intended to be made?	Yes	**Ownership structure**	50/50 Joint Venture, Innogy Renewables UK Ltd/ Statkraft UK Limited
Maturity of project	A DCO for the offshore array was granted in July 2013 and a separate DCO for the associated electrical system was granted in September 2016. The project is being developed for potential CfD delivery years of 2021-2023, with FID expected in Q2 2018		

INTRODUCTION

1.1.1 Triton Knoll Offshore Wind Farm Limited (TKOWFL) is a 50:50 joint venture between two leading international energy companies; Innogy Renewables UK Ltd ('Innogy') and Statkraft UK. Innogy is the UK subsidiary of the German renewable energy company Innogy SE (part of RWE AG). Statkraft UK ('Statkraft') is a subsidiary of the Norwegian Statkraft Group. The Triton Knoll Offshore Wind Farm (Triton Knoll) is a Round 2 UK offshore wind farm project. A high level construction timetable representing the central case for project planning purposes is shown in Figure 1 below. It shall be noted that this is subject to change, the actual project delivery schedule being dependent on the final awarded CfD.

1.1.2 This Supply Chain Plan (SCP) is submitted to The Department of Business, Energy and Industrial Strategy (BEIS) as part of the eligibility requirements to enable TKOWFL to apply for a CfD for Triton Knoll. TKOWFL and its shareholders are committed to BEIS's aims for a strong and sustainable UK offshore wind supply chain, in which competition, innovations and skills are maximised to ensure the safe, efficient and economic construction and operation of the wind farm and for the wider growth of the UK offshore wind industry.

This SCP has a series of appendices

- Appendix A: End notes
- Appendix B: Executive summary
- Appendix C: Structure of statements
- Appendix D: List of SCP sub-criteria and identifiers
- Appendix E: List of evidence[1]
- Appendix F: Evidence documents (provided as individual files)

1.2 Guidance for readers

1.2.1 This document is formed from a number of statements (see Appendix C, each of which includes:

- A commitment made by TKOWFL, its shareholders and/ or its potential suppliers (in bold)
- The impact of that commitment, both on Triton Knoll and the wider industry, and

[1] Appendix E indicates the level of confidentiality of each item of evidence. In general, all evidence is confidential unless it is already in the public domain.

- The evidence to support the commitment and its impact.

1.2.2 BEIS's guidance document presents sub-criteria for competition, innovation and skills. To avoid repetition, an identifier is used to show which sub-criteria are being addressed and these will be cross-referenced (see list of subcriteria and identifiers in Appendix D) by way of superscript. [C4]

1.2.3 Each item of evidence has a unique identifier and this is referenced by way of superscript e.g "[EV001]". If the relevant information refers to a specific part of the evidence document, then the reference will be written by way of superscript " [EV001(X)]" where X is the page of the evidence document. Note that the number given is the number of pages from the first page of the evidence document. In many cases, several documents (for example from one company) have been combined and the page number written on the document may not be the one to which the reference indicates.

1.2.4 Some of the information contained within this document is commercially sensitive, publication of which could affect the economics of the project. Text underlined with a dotted line is confidential at CfD award but not at the Milestone Delivery Date (MDD). Text underlined with a solid line remains confidential at MDD. For figures, if the caption is underlined, the figure itself is also confidential.[2]

1.2.5 To support this SCP each main supplier to TKOWFL shall provide their own supplier Supply Chain Plan. To assess suppliers' SCPs objectively and establish how well they meet BEIS's guidance criteria, TKOWFL developed a scoring matrix that considered:

- The number of relevant actions or commitments made by suppliers
- The type of impact, ie which of the UK Government's assessment criteria they met
- To what extent, the actions and commitments would impact the Triton Knoll project or the wider offshore wind supply chain
- To what extent, the commitments and their impacts were backed up by evidence, either as submitted documentation or from public sources.

The SCP score was calculated as $= \sum_{i}^{n} (\mathrm{IP_i} + \mathrm{II_i}) \times \mathrm{EQ_i}$

Where n = total number of commitments; i = commitment number; IP = impact on the project; II = impact on the industry; EQ = the quality of the evidence. The assessment framework is shown in more detail in Appendix F.[EV032]

1.2.6 This SCP presents some key commitments by TKOWFL's potential suppliers. These are shown in alphabetical order by company name and do not imply any procurement preferences.

1.2.7 In total, this SCP presents 198 actions or commitments made by TKOWFL, its shareholders and its potential suppliers, of which 75 relate to the competition criterion, 71 to the innovation criterion, and 52 to the skills criterion.

[2] Confidential means the document must not be circulated outside relevant Government departments without permission of the relevant company or companies

2 COMPETITION

2.1.1 Statkraft and Innogy have taken significant steps to improve the competitiveness of the offshore wind supply chain. TKOWFL is building on the work of its shareholders and has developed a highly experienced project team, almost all of whom have worked on at least one offshore wind farm [EV132]. TKOWFL's shareholders have been responsible for the development, construction and operation of almost 4GW of offshore wind capacity in Europe. One of the ways the project team is driving supply chain benefits is through a requirement that bidders for all major packages submit a detailed SCP. The project's port strategy coupled with actions and commitments taken by TKOWFL to strengthen competition in the supply chain will significantly influence opportunities for local suppliers and therefore will drive overall UK content. This section will therefore consider in turn:

- The actions and commitments of TKOWFL shareholders Statkraft and Innogy
- The actions and commitments of TKOWFL
- The actions and commitments of suppliers wishing to be considered as direct suppliers to TKOWFL
- The selection of ports during the construction phase, and
- The UK content that will result from these actions and commitments.

2.1.2 To ensure that all the criteria have been addressed by all parts of the supply chain, an analysis has been made of the statements included in this document. Figure 2 shows the number of commitments or actions by (a) package and (b) by the competition subcriteria. The alphanumeric labels are defined in Appendix D.

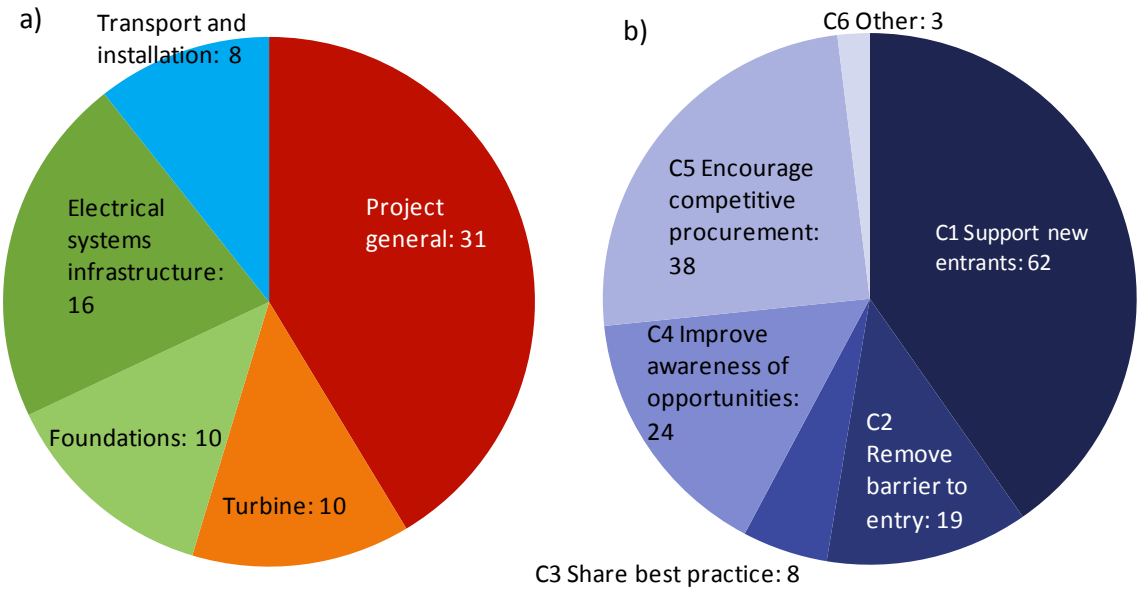

Figure 2 Number of commitments or actions for the competition criterion by a) package and b) subcriterion. The totals are different because many commitments meet more than one subcrierion.

2.2 TKOWFL shareholders

2.2.1 **TKOWFL commits to drawing upon best-practice with representatives of other shareholder projects to inform TKOWFL**.[C3] This will include work done by shareholders who have disseminated lessons:

- Through a SharePoint area on procurement lessons learned.[EV106]
- Through lessons-learned workshops with package and engineering managers with individuals who have worked on other offshore wind farms owned by Innogy or Statkraft. At these events, they discussed the problems they have encountered and how they can be avoided or resolved.[EV105]
- Through interactions between TKOWFL procurement staff and shareholders' staff with experience from previous projects.[EV105]

2.2.2 **TKOWFL team members and shareholders have also shared their experience to the benefit of the industry**.[C3] This has been mainly though industry working groups, standing committees, industry conferences and other events.[EV012,EV104]

2.2.3 **TKOWFL shareholders have made wind and soil data from offshore wind farms publicly available through The Crown Estate's Marine Data Exchange**.[C3] This includes Innogy data from the Atlantic Array, Greater Gabbard and Gwynt y Môr projects. This data will be invaluable in informing wind farm design and engineering for future wind farms.[1]

2.2.4 **TKOWFL shareholders participated in the 'Developer Days' organised by The Crown Estate.** [C3] These aim to achieve cost reduction in offshore wind through sharing best practice and knowledge across the UK offshore wind programme. As of September 2016, The Crown Estate has organized eight Developer Days and TKOWFL has been represented by at least one of its shareholders on each occasion. Innogy has twice presented lessons learned at these events and had a direct interest in a third on Greater Gabbard given by SSE.[EV134]

2.2.5 **TKOWFL's shareholders have significant experience in wind farm supply chain engagement**.[C1] Innogy has held events for Atlantic Array, Gwynt y Môr, Galloper and several onshore wind farms.[2][EV136,EV144,EV145,EV172] Supply chain engagement events have also been held for Statkraft's Sheringham Shoal and Dudgeon wind farms.[EV138]3

2.2.6 **TKOWFL's shareholders have supported supply entrants**:[C1]

- Innogy supported the market entry of JDR Cables, giving it its first major renewable contract, which helped JDR Cables make its decision to build its factory in Hartlepool. Innogy has further cemented JDR Cables's position with contract awards for the Gwynt y Môr and Galloper wind farms. The company is now a leading supplier of array cables.[EV174]

- Innogy gave Granada Material Handling its first offshore wind contract, for the supply of davit cranes at Gwynt y Môr[3, 4]. Granada has since secured a 3-year O&M contract with Gwynt y Mor, delivered 56 cranes to Galloper (both innogy) and supplied 69 cranes to Dudgeon (Statkraft).
- Innogy worked closely with Corus in 2009 to build a business case for an investment in a monopile manufacturing facility on Teesside, successfully securing a grant from the government to progress the initial build requirements of the new manufacturing facility.[EV173]
- Innogy supported the entrance of Petrofac to the market through its joint venture with GE Grid Solutions for the Galloper project and the re-entry of Heerema Fabrication at Hartlepool. This support sustained 250 direct jobs during a time of downturn in the oil and gas industry[EV175]
- Through its ownership of the Scira joint venture for Sheringham Shoal, Statkraft awarded a turbine installation contract to Gulf Marine Services, a new entrant to the market.[5]

2.3 TKOWFL

2.3.1 TKOWFL promotes competition by:

- Adopting a multicontract approach for the initial approach to market to accommodate existing UK capability and promoting the TK project as competitive and hence attractive for the supply industry through pre-engagement contact and participation in supplier events (see paragraphs 2.3.2-2.3.3).
- Running an informed, flexible and competitive procurement process (see paragraphs 2.3.4-2.3.6).
- Aligning the actions of main suppliers with the BEIS criteria (see paragraphs 2.4.1-2.4.6).
- Engaging with a wide range of potential suppliers, to maximise the awareness of the project and its supply chain needs (see paragraphs 2.4.7-2.4.16).

Multicontract approach

2.3.2 **TKOWFL has adopted a multicontracting strategy for its initial approach to market to maximise the competition in the supply chain and encourage new entrants**.[C5] By approaching the market with 10 smaller (rather than several larger contracts) scopes, TKOWFL has created opportunities for many more potential suppliers. This effect is compounded by TKOWFL's requirement for potential tier 1 suppliers to provide their own SCP (see paragraph 2.4.1). TKOWFL's approach will have a profound effect on development of the supply chain. To successfully deliver this procurement approach, TKOWFL has built a UK project team of about 70 people, some of which will work with suppliers and deliver the best technical solution for the lowest cost of energy. BEIS's guidance criteria identify good

[3] http://www.gmh.co.uk/granada-help-meet-uk-content-targets-for-offshore-wind-farms/
[4] http://www.gmh.co.uk/granada-awarded-contract-for-operation-and-maintenance-at-gwynt-y-mor-the-worlds-second-largest-operating-offshore-wind-farm/
[5] http://scira.co.uk/news/news22_12_10.php

practice in the supply chain. By assessing suppliers' SCPs, TKOWFL creates an incentive to improve.[EV022]

2.3.3 For all major packages, procurement is at an early stage and no final awards have been made. In almost all cases, at least three suppliers are under consideration as of December 2016.[C5] All potential suppliers have been asked to provide drafts of their own (supplier) supply chain plan as part of the procurement process. The extent to which they meet the UK Government's criteria for competition, innovation and skills - will form part of the assessment of each supplier.[EV036]

Flexible and competitive procurement

2.3.4 **TKOWFL commits to a procurement strategy that offers the widest opportunity for UK entrants to participate and maximises competition**.[C1,C5] TKOWFL adopted a flexible multicontract approach to the market. It is executing a procurement process with 10 work streams: wind turbines, wind turbine foundations, transport and installation, and seven electrical covering the OSP structure, electrical equipment and onshore facilities and cables. The timetable for the procurement programme and suppliers that have been considered are included in Appendix F.[EV036]

2.3.5 **TKOWFL commits to a programme of work to identify and mitigate supply chain bottlenecks**.[C5] A well-designed competitive procurement strategy must be based on a deep understanding of the supply chain. TKOWFL has undertaken a programme of work to identify uncompetitive areas and this underpins TKOWFL's contracting strategy.[EV107,EV001(10),EV025(13)EV024(11)]

2.3.6 **TKOWFL commits to approaching a minimum of three suppliers for all main contract packages**.[C5] This will not only ensure competitive pricing for Triton Knoll but also, by giving new entrants (ie companies which have not supplied a UK offshore wind farm) vital experience in bidding for large-scale offshore wind projects, which even if they are not ultimately selected, enhances the overall competitiveness of the supply chain. The current offshore turbine market suffers from a lack of competition and the industry needs at least three strong suppliers to maximise the cost of energy benefits of new, large offshore turbine technology.[EV035]

2.4 TKOWFL's supply chain

2.4.1 **TKOWFL has requested or will request that all bidders of main packages submit a SCP that sets out how they intend to meet BEIS's criteria**.[C1,C2,C3,C4,C5] All bidders wereor will be asked to produce an SCP that complies with BEIS's guidance and provides the data needed to meet the terms of agreement of the Offshore Wind Industry Council that UK offshore wind farms will report their UK content data to RenewableUK. This approach ensures not only that TKOWFL benefits from suppliers' commitment but also, by focusing tier 1 suppliers on BEIS's aims for a strong and sustainable supply chain, provides a culture change in the sector that can lead to lower project risk and cost of energy in the longer term.[EV035] TKOWFL has received over 50 SCPs to date and believes that this process has been the largest exercise so far undertaken ahead of project FID in aligning the offshore wind industry with the UK

Government's objectives. It estimates that a third of bidders had not previously submitted SCPs for other projects. TKOWFL encountered significant misunderstanding of BEIS's criteria. For example, several suppliers responded that they could not submit a plan because they had no significant UK activities and others assumed the process was only about local content. The process is therefore likely to have had a significant positive impact on the supply chain's understanding of BEIS's objectives

2.4.2 **TKOWFL commits to assessing supplier's compliance to BEIS's guidance on SCPs as part of the procurement process for supplier selection**.[C1,C2,C3,C4,C5] This ensures that TKOWFL suppliers are assessed on the strength of their commitments to the development of the supply chain.[EV035]

2.4.3 **TKOWFL has worked to ensure that bidders explain in their SCPs how they promote competition in the offshore wind supply chain to the benefit of the Triton Knoll project and the wider industry**. [C1,C4] To achieve this, formal guidance was issued to suppliers on how they can best meet the objectives of the UK Government. [EV108] TKOWFL reviewed drafts from suppliers and gave feedback, providing an opportunity to explain further TKOWFL's priorities for each package: turbines[EV038,EV039,EV040], foundations[EV041,EV042,EV043,EV044,EV045], E1 electrical systems[EV153], E2 offshore substation[EV154] platforms, E4/E6 subsea cables[EV155], E5/E7 subsea cable installation[EV156], and transport and installation.[EV157]

2.4.4 **Bidders SCPs have been or will be formally assessed using an assessment framework**.[C1,C2,C3,C4,C5] This will form part of the overall assessment for each bidder. (The other assessment criteria are corporate responsibility, financial credentials, contractual terms and conditions, commercial, technical, health and safety, and quality.) [EV032]

2.4.5 **TKOWFL will monitor the implementation of the supply chain plan commitments of successful bidders.** This will extend to all commitments they make. On completion of the wind farm, TKOWFL will request a post-build report, which will be submitted as evidence to TKOWFL's post-build report.

2.4.6 **TKOWFL asks that its successful bidders to declare a willingness to participate in meet-the-buyer events and agree to provide an easily accessible website registration page for potential suppliers with details of their requirements**.[C1,C2,C4,C5] These actions will ensure that the opportunities are widely understood by the local supply chain thus stimulating competition. Even if these suppliers are ultimately unsuccessful, the process will strengthen their ability to be successful for other projects.[EV108] The specific commitments made by individual bidders are presented from paragraph 2.7.5 to the end of the Competition chapter.

2.4.7 **TKOWFL will maximise the opportunities for new entrants by working with bidders and stakeholders.**[C1,C2] Most of these opportunities will be for tier 2 suppliers (or below) to TKOWFL. Its focus is on working with its bidders and public and industry organisations, particularly in the Humber region, to maximise these opportunities. TKOWFL has split the scope into 10 packages to enable smaller UK-based suppliers to participate in the tendering (a greater number of UK tier 1 suppliers

provides greater opportunities for UK suppliers at lower levels). It will also consider modifications to the scope suggested by tenderers if this demonstrates an increase in value to the project. [EV035]

2.4.8 **TKOWFL has set up a project website to help keep potential suppliers up to date with the project status**.[C4] The site went online in July 2016.[4] [EV111] It will be regularly updated to help ensure that potential suppliers can find out the technical requirements of the project, when meet-the-buyer events are planned, when opportunities will arise and which company will be the customer.[EV035]

2.4.9 **TKOWFL has developed a supplier registration portal on its website**.[C2,C4] The portal went live with the launch of the Triton Knoll website and will ensure that the capabilities of registering suppliers are brought to the attention of the relevant person, either within TKOWFL or one of its suppliers. The portal will be used to build up a contact list of suppliers that TKOWFL can use to promote opportunities for support that can lower barriers to entry.[EV035]

2.4.10 **TKOWFL will encourage its selected suppliers to use procurement services such as Achilles and CompeteFor.com, a free service developed for London 2012 Olympic tenders**. [C2,C4] Through these services, suppliers can ensure that opportunities are promoted as widely as possible. [EV035]

2.4.11 **TKOWFL has published a guide to supply chain opportunities at Triton Knoll**.[C1,C2,C4] This ensures that all conversations between TKOWFL, its tier 1s and potential suppliers have a clear starting point when discussing the opportunities that arise from the construction and operation of Triton Knoll.[EV037]

2.4.12 **TKOWFL commits to continue producing a supply chain e-newsletter with updates on opportunities on the project**.[C1,C4,C5] This will identify opportunities and provide key contacts for TKOWFL and its main suppliers.[EV035] TKOWFL will benefit from Innogy's experience of delivering effective communications to businesses.[EV160,EV161,EV162,EV163]

2.4.13 **TKOWFL commits to organizing and participating in meet-the-buyer events, working with LEPs and other local or regional business support organisations**.[C1,C4,C5] TKOWFL's shareholders have found such events valuable in communicating opportunities and understanding the barriers facing new entrants. They also enable suppliers to share their experiences of offshore wind and build partnerships with other local suppliers. A significant focus is the Humber area because of the specifically opportunities created from the construction of the onshore grid connection, the likely location of the construction port and the operation of the wind farm. TKOWFL has begun discussions with local organisations, including the Greater Lincolnshire LEP, Grimsby Renewable Partnership, Humber LEP and Team Humber Marine Alliance, and is pleased to have their support. Outside the Humber region, TKOWFL will seek opportunities to work with business organisations such as the East of England Energy Group and NOF Energy. The project team will also ensure that the synergies with events organized by other projects in the portfolios of Innogy and Statkraft.[EV035] [EV035,EV119,EV131,EV150]

2.4.14 **TKOWFL commits to establishing the post of Supply Chain Adviser who can be the focal point for suppliers**. [C1,C2,C3,C4,C5] The individual will work with business organisations to build up the knowledge of

local suppliers, and track and implement all the commitments contained in this SCP. Through this, TKOWFL can promote opportunities to suppliers and help them address barriers to entry.[EV035,EV110]]

2.4.15 **TKOWFL commits to continue encouraging its suppliers - and their suppliers - to explore ways to support market entry for lower tier suppliers**.[C1,C2,C4,C5] TKOWFL will initiate discussions with its potential suppliers on how they intend to get local lower tier suppliers into the supply chain. This will be part of negotiations with suppliers during the collaborative tender process.[EV035]

2.4.16 **TKOWFL commits to supporting the regional response to recent job losses in the Scunthorpe area and the ongoing local concerns for job security**.[C1] North Lincolnshire Council has set up a task force aimed at helping local businesses to diversify in order to grow and employ more local people. This aims to tackle local unemployment and job insecurity resulting from downsizing and uncertainty at the region's dominant employer. TKOWFL will provide information on the skills and services required by TKOWFL and will invite affected contractors that can diversify to attend meet-the-buyer events.[EV167]

2.5 Ports

2.5.1 TKOWFL will decide its port solution in discussion with its turbine supplier, based (not necessarily in this order) on:

- Location – its logistical advantages, which lower costs to the project and the consumer.
- Cost – to minimise the cost to the project and the consumer.
- UK content – the degree to which it can create sustainable infrastructure and employment.
- Port specification – the degree to which it can provide the space and quayside for the project.
- Programme and availability – whether it is available and there is sufficient time to undertake any development before construction starts.[C6].

2.5.2 TKOWFL has analysed the available ports to establish the advantages and disadvantages of several locations on the UK's east coast and at existing Continental ports equipped for offshore wind.[C5] [redacted]

2.5.3 **TKOWFL commits to including UK east coast ports in the procurement process and any eventual [redacted] would create for the UK a major infrastructure asset**.[C1] It can be a catalyst for further investment, with an employment impact at the site of [redacted].[EV003(420]] Recognising this potential, TKOWFL has held discussions with [redacted] and has prepared a set of heads of terms for negotiating an agreement for lease to maximise the chances of the development of the site.[EV169]

2.5.4 **TKOWFL's shareholders were active contributors to the *Strategic Review of UK East Coast Staging and Construction Facilities***.[5][C3] By doing so, they shared their knowledge of the barriers to investment and the demand from major offshore wind projects, outlined their support for a 'large cluster' and staging facility and clarified the demand for port infrastructure from future UK offshore wind projects, which will ensure robust competition for offshore wind business.[6]

2.5.5 TKOWFL recognises that the *Strategic Review of UK East Coast Staging And Construction Facilities* concluded that there may be [redacted]. If so, TKOWFL will launch a competitive tendering process and in this is likely to involve new UK entrants.[C1] TKOWFL will engage with port owners to make them aware of the opportunity, help them understand its needs and establish how any barriers to participation in the tender can be resolved.[EV169]

2.5.6 **TKOWFL will use a UK operations and maintenance base at an east coast port in the UK**.[C1] The base case is that TKOWFL will adopt a shore-based operations and maintenance strategy using crew transfer vessels but the option of an offshore strategy using service operation vessels is being retained. In both cases, TKOWFL will use a local port, creating business opportunities in servicing the operations base and the maintenance vessels and in providing maintenance services. About 300 jobs will be created locally, either directly at operations base and or on the supply chain.[EV035(15). EV003(25)]

2.6 UK content

2.6.1 **TKOWFL commits to working to deliver 50% and an aspiration of 55% UK content (total value of contracts) placed to suppliers trading and operating as UK companies**.[C1] Although UK content does not form part of the assessment criteria for SCPs, TKOWFL believes it is important for the sustainability of the offshore wind supply chain. An assessment of the UK content in Triton Knoll has been made based on the information provided by suppliers and comparable studies from other projects. It was made using the RenewableUK methodology for UK content reporting in which the construction of the transmission assets is treated as CAPEX.[7] This suggests that the commitments made by its supply chain are likely to lead to a UK content in total expenditure greater than 50%. UK content in CAPEX is likely to be about 26.8% and UK content in OPEX is likely to be about 72.1% (see Figure 3).[EV031][EV103]

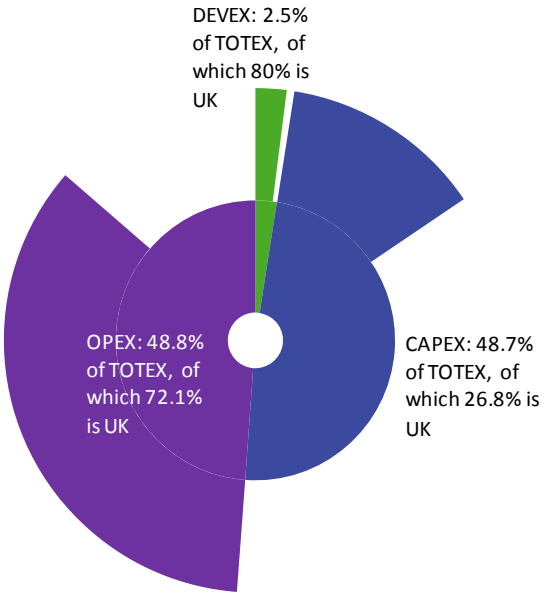

Figure 3 Preliminary assessment of UK content in total expenditure. The inner circle shows the cost breakdown between DEVEX, CAPEX and OPEX. The outer circle shows the contribution that each makes UK content in total expenditure.

2.6.2 **TKOWFL will insert a contract clause to require its main tier 1 suppliers to report UK content**.[C1,] Both of TKOWFL's shareholders are members of the Offshore Wind Industry Council (OWIC)and supported

the introduction of the UK content reporting framework. By ensuring that its main suppliers are fully committed to the fraemwork, TKOWFL will generate timely and robust data to show how new businesses in the UK are responding to the opportunities in offshore wind. It will also incentivise suppliers to consider UK entrants to the supply chain.[EV035]

2.6.3 **TKOWFL commits to undertaking discussions with key suppliers to identify whether a contract from Triton Knoll will stimulate inward investment**.[C1] TKOWFL is not content to allow its suppliers with higher than average UK content to become complacent. While market conditions may not favour imminent new investments, TKOWFL has sought clarity on long-term investment strategies and a commitment to strengthen competition. These discussions will be used to inform the activities of UK Trade and Investment and to alert suppliers to the business opportunities that emerge. TKOWFL has also worked with the Department for International Trade to develop the supply chain to serve the domestic and export markets. [EV035]

2.7 Commitments for specific packages

Wind turbines

2.7.1 **Innogy has a history of sustaining a competitive offshore turbine market**.[C1] Innogy was an investor in Thornton Bank 1, the first commercial project to use a 5MW offshore turbine through the selection of the REPower (now Senvion) 5M turbine. It subsequently signed a framework agreement for up to 250 turbines. This has been important in the offshore turbine supply market, where competition has been weak, and this agreement helped to sustain competition to the main two suppliers.[8] Innogy is one of only two developers to have contracted three different offshore turbine manufacturers (eg Senvion at Nordsee Ost, Siemens at Gwynt y Môr and Vestas at North Hoyle).

2.7.2 **TKOWFL is maintaining flexible package boundaries up to award, creating the best value in terms of cost and risk**.[C1,C2,C3] Key areas of opportunity are with the WTG, ESI and T&I packages.[EV001]

2.7.3 **TKOWFL undertook a market analysis and long-listing process to identify all the offshore turbines designs potentially available to the market on the timescales planned for Triton Knoll**.[C5] In all 30 models were identified. Of these 20, were excluded because of their rating (below 6MW) or their rotor diameter (below 140m). A further five were rejected because of their inexperience of operating turbines offshore or the lack of a European service division. Five suppliers were issued with a pre-qualification questionnaire (PQQ): [redacted]. TKOWFL then issued a request for information (RfI) as the basis for shortlisting and suppliers were evaluated on technical maturity, capacity, product development programmes and other suitability parameters. Among those approached, four of the five offered turbine platforms or variants that would be new to the UK market. This approach ensured that the competition was as strong as possible.[EV118(4)]

2.7.4 [redacted]

[redacted]

2.7.5 [redacted]

2.7.6 [redacted]

2.7.7 [redacted]

2.7.8 [redacted]

2.7.9 [redacted]

- [redacted]
- [redacted]
- [redacted]

2.7.10 [redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

Foundations

2.7.12 **TKOWFL assessed the available and emerging structure support technologies and selected a monopile foundation for both the wind turbines and the offshore substation platforms as offering the lowest possible LCOE**. The procurement strategy is included in Appendix F.[EV025]

2.7.13 **TKOWFL issued a request for information from the widest possible list of potential suppliers**.[C1,C5] The UK market has been led by the [redacted] with some success from [redacted] TKOWFL assessed the capabilities of five suppliers which were issued with a request for interest: [EV025,EV036]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

2.7.14 Of these, two would be new entrants to the monopile fabrication market [redacted] TKOWFL has therefore worked to strengthen competition in the market. [redacted] declined to bid and [redacted] did not tender for the complete scope.

2.7.15 **TKOWFL requested SCPs from all four suppliers and these will be used as part of supplier selection**.[C1,C2,C3,C4,C5,C6] Initial submissions were reviewed against the BEIS guidance and revised SCPs requested to ensure that they met the criteria as clearly as possible.[EV041, EV042, EV043, EV044, EV045]

[redacted]

2.7.16 **All bidders committed to:**

- **Participate in TKOWFL meet-the-buyer events if awarded contract**[C1,C4,C5]
- **Create a specific supplier registration portal for event if awarded contract**[C1,C4,C5]
- **Provide UK content data if awarded contract**, and[C1]
- **Maximise synergies at TKOWFL's chosen construction port**.[C1]

This will ensure that the widest possible range of lower tier suppliers are aware of the opportunity to supply the project. Many will be new entrants and the process will lower the barriers to entry. Even those that are unsuccessful gain valuable experience in bidding for offshore wind contracts.[EV041, EV042, EV043, EV044, EV045]

2.7.17 [redacted] **has invested** [redacted] **in** [redacted]**, a serial manufacturer of offshore wind foundations**.[C1] The plant enabled [redacted] to enter the market and since it has started up it is proving that it can achieve a new competitive level of foundation provision.[EV080]

2.7.18 [redacted]**has explored taking a** [redacted] **site for final foundation assembly**.[C1] This initiative will give UK suppliers a chance to participate in a competitive supply chain. This site will allow additional capacity to fit out transition pieces for Triton Knoll, and thus help the project with security of supply, storage, while also attempting to keep costs neutral with a European supply base.[EV080]

2.7.19 [redacted] **have invested in a new** [redacted] **for the production of** [redacted] [redacted][C1] The facility, owned by [redacted] will include new investments in equipment and increase competition in the offshore wind foundation market.[EV081]

2.7.20 [redacted] **will develop the UK supply chain through engagement with regional development organisations such as** [redacted].[C1] The company has already qualified several UK suppliers: [redacted] With a UK fabrication presence, the use of UK sub-contractors will expand even further.[EV081]

2.7.21 [redacted] **have between them identified 54 subcontractors, covering 20 areas of supply, from 10 different countries**.[C1] Of these, 13 are UK based. This demonstrates the competitive sourcing strategy of these suppliers.[EV082,EV083]

2.7.22 [redacted]**has a multiple supplier sourcing strategy and never relies on only one supplier for a certain product**. It also looks for long-term cooperation over the projects and is therefore willing to invest its expertise and time in new suppliers. For a recent project, [redacted] has introduced two UK suppliers to supply parts that up until that date were sourced in [redacted]. In 2016, a major part of secondary steel production for an offshore wind project was subcontracted to a UK firm, [redacted], to full satisfaction of [redacted] and the end client. [EV083(6)]

2.7.23 [redacted] **is developing a cooperation agreement with** [redacted]**, a new entrant highly experienced in the oil and gas sector**.[C1,C2,C6] The cooperation would involve the fabrication and

installation of secondary steel, coating of transition pieces and technical appurtenances, and completion ready for installation on [redacted]. This would create a significant new supplier in the offshore wind sector. There are likely to be further opportunities for the partnership which could develop into a strategic collaboration.[EV084(50]

2.7.24 By weighting the impact of their commitments, the probability of each supplier being selected and the likely UK content for each supplier, TKOWFL forecasts that the UK content in the foundation package is likely to be[redacted]

Electrical systems infrastructure

2.7.25 For the electrical systems infrastructure (ESI) work, TKOWFL launched a procurement process for seven packages:

- E1: Electrical system
- E2: Offshore substation structures
- E3: Onshore export cable supply and installation
- E4: Subsea export cable supply
- E5: Subsea export cable install
- E6: Array cable supply, and
- E7: Array cable install.[EV022]

This multicontracting approach provides significant flexibility to making it accessible to specialist suppliers (as found in the UK) as well as larger main contractors to strengthen competition.[C5]

2.7.26 **TKOWFL has reviewed the supply chain and concluded that each of the packages has enough credible suppliers to achieve competitive pricing**.[C5] The supply chain is complex with contractors capable of fulfilling different combinations of these packages. To maximise competition, TKOWFL is operating separate procurement processes but is being flexible in combining packages where this offers savings and reduces interface risk. Overall, 25 suppliers were invited to tender. This includes four new industry entrants, 10 new UK entrants. Ten of the suppliers are UK based.[EV107(8)][EV036]

2.7.27 **TKOWFL has developed a plan to maximise local content in the electrical system in conjunction with Lincolnshire stakeholders**.[C1,C6] Tier 1 suppliers once appointed will be required to help implement this plan.[C1] Stakeholders include Boston Borough Council, East Lindsey District Council, The Greater Lincolnshire Local Enterprise Partnership and Business Lincolnshire Growth Hub. Many of the skills needed to develop the onshore infrastructure in particular can be transferred from other sectors and therefore provides a significant opportunity to consider new entrants.[EV035][EV113]

2.7.28 By weighting the probability of each supplier being selected and the likely UK content for each supplier, TKOWFL forecasts that the UK content for the entire ESI package is [redacted].[EV031]

E1: Electrical system

2.7.29 The scope of this package covers the onshore substation and the electrical equipment for the offshore substation. TKOWFL received responses to a request for information from three suppliers: [redacted]. Key commitments for the competition criterion included in these responses are:

- [redacted] **has a supply chain development manager who is tasked with bringing in new entrants to the supply chain.**[C1,C4,C5] This role carries out audits within the [redacted] supply chain and provides feedback where required on those areas in which the supply chain needs to improve on, which in turn provides a qualitative aspect to the project.[EV046(2)]
- [redacted] **has a UK sourcing department that has key commodity coordinators whose role is to search the supply chain for new suppliers**. [C1,C4,C5] The coordinators have counterparts in various parts of the world with whom they can discuss new entrants. Once a new entrant has been found they are sent a questionnaire to complete and invited to a face-to-face meeting. If new entrants have a shortfall in any of the areas such as safety, environmental, technical competence, cost, [redacted] will work with them to help them achieve the agreed level of competence.[EV047(3)]
- [redacted] **has been committed to UK supply chain, particularly in the area of fabricated steel structures**.[C5] Its experience of working with these suppliers is such that it can leverage mutual lessons learned by working with these suppliers to reduce both risk and cost. [EV048(9)]

E2: Offshore substation platform

2.7.30 The scope of this package covers the engineering, procurement and fabrication of the offshore substation topsides structure. TKOWFL issued requests for interest to 14 suppliers. Some examples of their commitments for the competition criterion are included below.

2.7.31 [redacted] **has developed a sourcing model to increase competitiveness and secure a wider supplier base**.[C5] By utilising updated sourcing tools and methods, [redacted] will lever a competitive procurement model to ensure project value engineering and procurement.[EV052(6)]

2.7.32 [redacted] **recently centralised its procurement function to make it more accessible to the wider supply chain.**[C1,C3,C5] This enables wider UK supply chain involvement, allows new suppliers to understand how to enter the market, and helps [redacted] to understand what barriers should be addressed to facilitate wider involvement.[EV055(3]

2.7.33 [redacted] **commits to undertake supply chain mapping exercise in collaboration with TKOWFL to identify critical suppliers and participate in workshops with key members of the supply chain to jointly develop approaches to assist tier 3 and 4 suppliers and SMEs**.[C1,C4,C5] This will identify potential new entrants and seek ways of lowering their barriers to entry.[EV061(4)]

2.7.34 TKOWFL has also received SCPs from [redacted]

E3: onshore export cable

2.7.35 TKOWFL has initially conducted a procurement process for the FEED and issued requests for interest from four suppliers, with [redacted] being selected.

2.7.36 [redacted] **set up a local recruitment programme In order to engage with local stakeholders about employment opportunities.**[C4,C5] [redacted] operates a strategic relationship with Job Centre Plus across the UK. This approach fulfills its commitment to sustainability by contributing to a 'healthy community', improving economic conditions and giving new opportunities and training to local skilled and unskilled labour.[EV148(6)] [redacted].

E4/E6: subsea cable supply

2.7.37 TKOWFL issued a request for interest to nine suppliers, which included two new entrants to the UK offshore wind market [redacted] and one UK supplier [redacted] Some examples of their commitments for the competition criterion are included below. Four suppliers are currently under consideration: [redacted].

2.7.38 [redacted] **commits to meeting with potential new UK suppliers of raw materials for HV cable manufacture.**[C1,C4,C5] [redacted] already sources the lead sheathing for its high voltage cables from a UK supplier, which represents 4% of cable cost.[EV063(5)]

2.7.39 [redacted] **introduced a continuous supply chain improvement process using the** [redacted].[C5] The system fosters competition, enabling more suppliers to participate in future projects.[EV069(20-24)]

2.7.40 TKOWFL also received SCPs from [redacted].

E5/E7: cable installation

2.7.41 TKOWFL issued a request for interest to eight suppliers, which included three new entrants to the UK offshore wind market [redacted] and three UK suppliers [redacted]. Four suppliers are currently being considered: [redacted].

2.7.42 [redacted] **is a steering committee member of** [redacted] **which promotes the renewables supply chain in** [redacted]. [redacted] members have invested almost £400 million to meet the demands of the renewables market and employ 6,000 people in the region. Through this role, [redacted] shares its experience and supports the development of the region's supply chain.[EV072(9),9

2.7.43 [redacted] **facilitates access to contracts by the broadest possible range of potential subcontractors**.[C1,C4] The strategic importance of the renewable energy sector in the Humber LEP area means that there are already a large number of interventions in place to support supply chain development. [redacted] has identified three primary interlinked areas of focus:

- Opportunities for the involvement of existing local suppliers

- Opportunities for new and emerging suppliers and individuals, and
- Employment opportunities for local residents.[EV074(5)]

2.7.44 [redacted] **uses the** [redacted] **and will encourage new suppliers to prequalify**. [C1.C5] [redacted] recognises that these tools are not necessarily suitable for lower tier suppliers and other processes are needed to address the circumstances of SMEs.[EV075(6)]

2.7.45 [redacted] **has commissioned a consultancy that are specialists in the subsea cabling supply chain to brief** [redacted] **on the experience of UK cable laying subcontractors**.[C1,C5] This will increase the pool of [redacted] suppliers and stimulate competition.[EV076(9-10)]

2.7.46 [redacted] **has made significant efforts to increase competition by seeking new UK suppliers.**[C1,C5] In 2015 [redacted] created framework agreements with several agencies that provide external personnel for its projects, of which 60% are UK based suppliers, which mainly supply UK residents. Half of its active subcontracts are with UK suppliers. From 2013 to 2015 [redacted], used 354 suppliers on UK projects in total; 63% of these suppliers were UK based and represented 33% of the turnover.[EV164(12)]

2.7.47 TKOWFL also received SCPs from [redacted]

Transport and installation

2.7.48 For the transport and installation (T&I) package, TKOWFL issued a single ITT covering individual lots for foundation, turbine and substation installation. A range of contractors was included:

- Pure engineer, procure, construct and install (EPCI) contractors without significant vessel assets
- EPCI contractors with a range of vessels, some of which are also suitable for cable installation
- Specialist offshore wind T&I contractors with a jack-up vessel fleet.

2.7.49 **TKOWFL's strategy is flexible** [redacted] **process solution that recognises the importance of both the LCOE and UK content**.[C5] This approach utilises the strengths of the suppliers while intensifying competition.[EV029(6)] Overall, 13 suppliers were invited to express an interest. This includes one new entrant and two UK suppliers. All bidders were invited to submit SCPs ahead of the invitation to tender. The quality of the SCPs were assessed as part of the determination of which suppliers would be invited to tender.[EV036] TKOWFL includes the SCP from [redacted] to enable BEIS to better understand the commitments to a sustainable offshore wind supply chain.

2.7.50 Seven suppliers have been invited to tender: [redacted]. Reviews of SCP were undertaken and comments sent to each company.[7] [EV0153] Among the significant commitments in the revised SCPs are:

- [redacted] **will promote competition and facilitate broader access for UK suppliers to all of its supplier opportunities**. [C1,C5] [redacted] has identified 517 relevant UK suppliers. Based on all

[7] Since submitting its SCP, Bilfinger Offshore Systems has been acquired by Van Oord

invoices from relevant UK projects 365 suppliers have been placed in well-defined sourcing categories and 245 of the 365 have been identified as being relevant for Triton Knoll. [EV097(3)]

- [redacted], **together with its sister companies** [redacted], **held a series of meet-the-buyer events** [redacted]. [C1,C4,C5] These included four in the east of England [redacted]) with an overall attendance of 500 delegates. During these events, [redacted] held one-to-one meetings with over 200 companies.[EV098(1)]
- [redacted] **will in many cases invite suppliers to offer a wider range of services.** [C5] This gives them the opportunity to win multiple contract awards. Combining different scopes from a single supplier creates the opportunity to obtain materials/ equipment for a more competitive price.[EV096(10)]
- [redacted] **plans to develop its mobilisation and demobilisation facility at Teesport as a staging port for east coast wind farms**.[C1] [redacted] has a heritage in ship building, steel fabrication, and oil and gas services, which has created a competitive pool of relevant local suppliers. This will be strengthened with [redacted] planned new infrastructure.[EV090(5-6,15)]
- [redacted] **commits to including information on its website that will provide guidance to potential new suppliers on how to register and apply to become an approved supplier**.[C1,C2,C4] [redacted] has developed a competitive local supply chain over several years. It now purchases 80-90% of all of the consumables that the vessels require, from deck tools and equipment through to galley and medical supplies, from UK companies. [EV095(8)]
- [redacted] **has identified several areas where there may be opportunities for new entrants**.[C1,C4,C5] these include survey and positioning, noise measurement, noise mitigation, pile installation frame, pile followers and grillages, pile cleaning and relief drilling, grouting, and transportation services and logistics.[EV093(1-4)]
- [redacted] **commits to visiting known and new suppliers and subcontractors on a regular basis.** [C5] This results in knowledge sharing with the suppliers and better understandig of quality and capacity level. The feedback works both ways, giving [redacted] a better understanding of the suppliers' capabilities and of developments in the market.[EV091(10)]

2.7.51 By weighting the probability of each supplier being selected and the likely UK content for each supplier, TKOWFL forecasts that the UK content in the transport and installation package is [redacted].

3 INNOVATION

3.1.1 While adopting and adapting innovations from a decade of invention and optimisation, TKOWFL will continue to look for further innovative solutions in the offshore wind sector.[I6] Triton Knoll will be the last UK Round 2 project to be built. It will benefit from a decade of innovation in offshore wind. At the same time, by adopting many proven technologies, risks are better understood, and this provides opportunities for new innovations in wind farm technology and wind farm project execution. Figure 4 shows the number of commitments or actions by (a) package and (b) by the competition subcriteria. The alphnumeric labels refer to the BEIS guidance subcriteria listed in Appendix D.

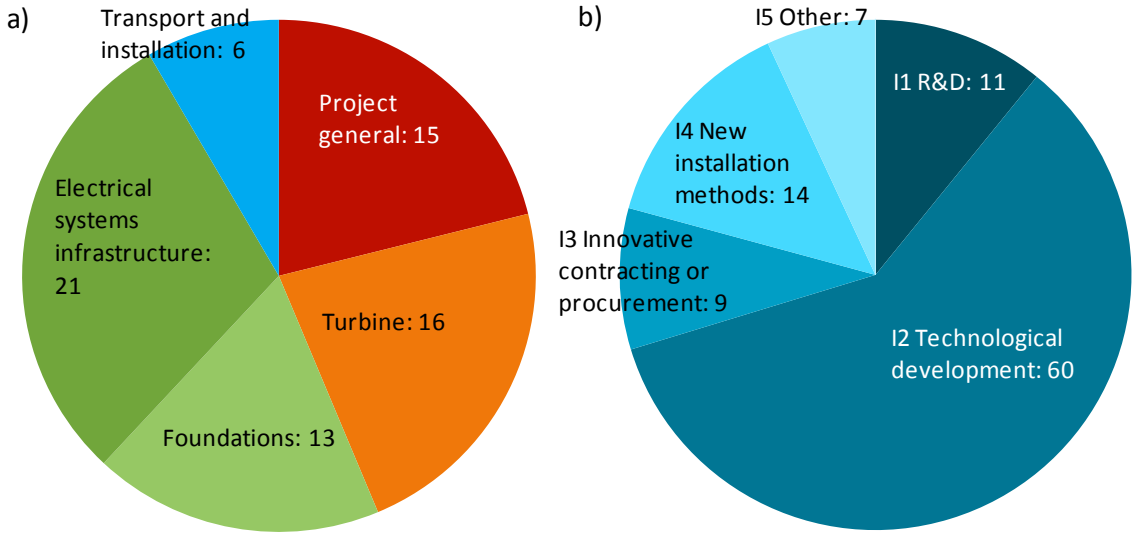

Figure 4 Number of commitments or actions for the innovation criterion by a) package and b) subcriterion. The totals are different because many commitments meet more than one subcriterion.

3.1.2 This section is structured as follows:

- Past and current innovations by TKOWFL's shareholders (paragraphs 3.2.1-3.2.10).
- TKOWFL innovations at the project or wind farm level (paragraphs 3.3.1-3.3.6).
- Innovations by TKOWFL, TKOWFL shareholders and TKOWFL bidders relating to each contract package. (paragraphs 3.4.1-3.4.41)

3.2 TKOWFL shareholders

3.2.1 **Innovation is a key part of TKOWFL's shareholders' parent companies' ethos.**[I2] Statkraft's innovation strategy builds on its overall business strategy and is closely linked to the strategies of the core business. Innogy wants to ensure through a stream of continuous innovations that it always has optimum solutions to meet the challenges and targets in its core processes and areas of business. Innogy developed the UK's first commercial offshore wind farm at North Hoyle and the first 5MW on gravity base foundations at Thornton Bank.

3.2.2 **TKOWFL's shareholders commit to continue working to reduce the LCOE of offshore wind energy.**[I2] Innovation is the main driver for long term sustainable cost reduction in offshore wind and TKOWFL's

shareholders have a track record supporting innovation in the sector.[I6] Both have undertaken strategic action to target LCOE reduction:

- Innogy and Statkraft have both joined an industry initiative to ensure that the LCOE of offshore wind is below £100/MWh by 2020.[10]
- Statkraft commissioned and published a study in 2015 that established how advances in technology, the supply chain and policy have combined to drive down the cost of energy for projects about to go into construction.[EV015]
- Innogy is a signatory to an industry pledge to reduce costs to below €80/MWh by 2025.[EV143]

3.2.3 **TKOWFL's shareholders commit to continuing involvement in industry R&D projects**.[I1,I2] Both Innogy and Statkraft are members of the Carbon Trust Offshore Wind Accelerator. Highlights of their involvement are:

- A two-year trial at Gwynt y Môr Offshore Wind Farm to collect wind speed data at sea, using innovative LIDAR mounted on floating buoys[11]
- Testing the feasibility of vibro piling to reduce foundation installation costs, and[12]
- The PISA (Pile Soil Analysis) project which investigated and developed improved design methods for offshore wind turbine monopile foundations.[13]

3.2.4 **TKOWFL's shareholders owners were among the first offshore wind farm operators to commit to supply wind farm data as part of the SPARTA (System Performance, Availability and Reliability Trend Analysis) project**.[I2] The project will create a database of anonymised offshore wind farm performance and maintenance data. This will help to identify operational improvements and cost reduction opportunities at both company and sector-wide levels.[14]

3.2.5 **Innogy was a driving force in establishing the Dutch Far and Large Offshore Wind (FLOW) joint research programme**.[I1,I2] Among the projects that Innogy has supported in the programme are a project in the Dutch North Sea to explore the performance of a met-ocean buoy with LiDAR, a study on wake effects, the testing of strain gauges on turbines at Rhyl Flats, testing a screen to mitigate the effects on wildlife of piling noise.[15] These and other examples of Innogy innovation are shown in Appendix F.[EV011]

3.2.6 **Statkraft innovates to develop and strengthen competitive advantages in its core activities and to identify and promote new business development opportunities**.[I1] In addition, innovation is an important measure of Statkraft's long-term competence building and to secure good future framework conditions for renewable energy generation. In 2015, Statkraft spent NOK195 million on innovation.[EV170(1)]

3.2.7 **Statkraft runs the Competitive Wind Power Program to enable it to be among the top players with regards to cost efficiency**.[I2] As part of the programme, Statkraft is a member of the Norwegian Centre for Offshore Wind Energy (NORCOWE), which is an interdisciplinary resource centre for the

exploitation of offshore wind energy, and the Norwegian Research Centre for Offshore Wind Technology (NOWITECH).[16,17] Specific projects have looked at cover low frequency AC transmission and blade erosion.[18] Statkraft has also been participant in the Swedish Vindforsk programme, which leads research on offshore wind integration into the grid, dynamic ratings and synthetic inertia .[19]

3.2.8 **Statkraft established a venture capital unit called Statkraft Ventures**.[I5] This initiative will invest €10 million annually in energy related start-ups. An example is DEPsys, which provides solutions to operators of the low voltage grid to cope with the constraints of decentralized production of renewable energy sources.[EV008],[20]

3.2.9 **TKOWFL's shareholders have a track record of innovation and TKOWFL will apply this learning where appropriate**.[I2] To minimise the LCOE of Triton Knoll, the project team has reviewed innovations supported by its shareholders and identified those with the greatest potential for incorporation in Triton Knoll. It considered the outputs from several R&D projects:

- The [redacted], which developed a better understanding on the loads on offshore wind monpiles to enable a significant improvement in de and cost[EV114(3)]
- A [redacted], which offers a cost saving from the removal of 15t of secondary steel, and[EV114(2)]
- The [redacted] which has the potential reduce costs to the Triton Knoll project through better understanding of the performance of long AC cables.[EV114(5)]

3.2.10 **TKOWFL's shareholders have pioneered innovative technologies at other wind farms**.

- Innogy is a shareholder in C-Power, developer of the first offshore wind farm with 5MW turbines and deep-water gravity base foundations.[I2]21
- Statkraft, as part of the Scira joint venture, chose a radical two-year service agreement at Sheringham Shoal.[I5]22
- Innovative spring bearings designed to prevent grouting problems, an industry wide issue, were installed in wind turbines at the Sheringham Shoal and made available to others.[I2]
- Both shareholders, as part of the Forewind consortium, used suction bucket foundations on the two met masts at Dogger Bank. Recommended practice industry guidance has now been issued. [I2]
- The condition of the met masts at Dogger Bank have been inspected using a drone.[I3]23

3.3 TKOWFL innovations at the project or wind farm level

3.3.1 **TKOWFL has undertaken [redacted] studies during wind farm development**.[I3] At additional cost, this has enabled TKOWFL to consider different options, keeping competition in the supply chain and maintaining opportunities for innovation.[EV176]

3.3.2 **TKOWFL commits to provide an opportunity for testing or demonstration of an innovative technology within the wind farm site.**[I2] TKOWFL will make reasonable efforts to provide the opportunity to supplier partners/R&D organisations to demonstrate an innovative technology on the site if certain key conditions are met, which includes:

- A suitable technology, funding source and supplier can be found
- There is no net decrease in value to TKOWFL compared with the base case technical solution (including management)
- There is no material increase in risk (safety, construction or technology), and
- The solution is bankable, operable and has no effect on warranties.

The most promising technologies for potential trial are:

- Vibration piling technology, which is up to 10 times faster than hammered installation and causes a significant reduction in noise emissions
- Blue piling technology, which is a variant where an explosion is used to raise a mass of water while the pile is being driven into the sea bed
- Use of a slotted monopile, which is a variant on a traditional monopile and has the advantage of having no vertical welds in the can, and
- Anchor penetration trials, which aim to recue the threat to subsea cables from vessel anchors.[EV102]

These innovations have the potential to reduce the cost of energy by hastening the commercialisation of technologies and reducing future project risks.

3.3.3 **Following CfD award, TKOWFL will consult with its preferred suppliers, the UK Government and offshore wind R&D organisations, such as the Offshore Renewable Energy Catapult and the Offshore Wind Accelerator, on suitable technologies for consideration**. If the conditions are met a selection will be made in consultation with the project teams for forthcoming Innogy and Statkraft projects, notably through the Forewind consortium. TKOWFL engaged with tenderers to identify opportunities to advance new technologies on Triton Knoll.[EV115]

3.3.4 **TKOWFL commits to supporting suppliers with innovative technologies to engage with Tier 1 suppliers.**[I2] As part of the procurement process TKOWFL has asked for tenderers to consider innovative solutions in their proposals. Turbine and electrical supply and installation manufacturers have been directly engaged to explore value opportunities to fit within the value management framework.[EV105]

3.3.5 **TKOWFL will progress an innovative financing strategy, developing awareness of risk in the lending community and helping to minimise cost of capital for offshore wind.**[I5] TKOWFL aims to develop and improve on the non-recourse financing structure first used at Galloper Offshore Wind Farm[I3] by pushing boundaries through careful dialogue with lenders, investors and advisors. TKOWFL will

challenge the lending community's preconceptions on risk and contract structure to ensure an optimum contracting strategy can be achieved which minimizes LCOE and encourages competition, while still remaining bankable on favourable terms and be attractive to equity investors.

3.3.6 [redacted] Collaboration has the advantage of incentivising the supplier to work with TKOWFL to reduce costs but brings with it the challenges of cultural change in both TKOWFL and the contractor as the process relies on a high degree of trust. TKOWFL has chosen this approach for [redacted]. To support this process, TKOWFL has appointed behavioural consultants.[EV115(3)] For [redacted] TKOWFL concluded that a more traditional approach with early selection would have benefits.[EV022(4)]

3.4 Innovations at the package level

Wind turbines

3.4.1 TKOWFL is executing a collaborative tendering process for the wind turbines intended to result in early selection of a preferred turbine supplier.[I3] This is an innovative means by which the project can optimise wind farm design and logistics to help provide the UK consumer with the lowest possible cost of offshore renewable energy. The process includes:

- An in-depth prequalification of shortlisted suppliers which will ensure that they understand the process and TKOWFL's expectations, also enabling TKOWFL to select the most suitable candidates to take forward into the collaboration/final selection phase.
- A collaborative value engineering, concept optioneering and bid reception phase, run between the project team and finalist suppliers, resulting in the submission of their collaboratively produced offer. The culmination of this phase will be the selection of a preferred bidder selected on the basis of the value the collaborative offers give to the overall project.
- Further collaboration with the preferred bidder ahead of CfD bid to jointly optimise the concept with a common goal of creating the best value proposal. The turbine procurement process is integrated with the procurement processes of the other main packages in order to optimise the project's LCOE.

3.4.2 **TKOWFL undertook detailed reviews and held face-to-face meetings with turbine bidders to enhance the quality of their SCPs**. These sessions challenged the bidders on the commitment on innovations they are making and ensure that they explain clearly how they meet the BEIS guidance criteria and provide the evidence to substantiate their statements. [EV044,EV038, 039, 120]

3.4.3 **TKOWFL has developed an innovative turbine array layout and agreed measures with the Trinity House and the Maritime and Coastguard Agency to preserve safe navigation in and around the wind farm**.[I5] [redacted]

. An irregular 'perimeter layout' has the potential to increase the risks for vessels and aircraft navigating across the wind farm. TKOWFL has collaborated with Maritime and Coastguard Agency and Trinity House to develop a layout that maximises yields while maintaining clear navigation corridors.[EV171]

3.4.4

3.4.5

3.4.6 [redacted]:

- [redacted]
- [redacted]
- [redacted]

3.4.7 [redacted]

- [redacted]
- [redacted]

Foundations

3.4.8 **TKOWFL will use XL monopiles with a conventional transition piece**.[I5] This benefits from the industry experience of the over 2,000 monopiles now installed in European waters. TKOWFL and its supply chain will adopt many incremental innovations in design (including through the PISA project) serial fabrication, handling and installation strategies to minimise the LCOE. [EV114]

3.4.9 **TKOWFL will retain flexible package scope boundaries for the foundation contract**.[I3] The starting assumption is that it will include the design and fabrication of the monopiles. The procurement process retains options to extend the scope to include installation or include it within the turbine scope if this provides opportunities to reduce the LCOE.[EV025]

3.4.10 **TKOWFL shareholders were partners in the SLIC (Structural Lifecycle Industry Collaboration) joint industry project in partnership with Cranfield University**.[I1,I2] Design standards for offshore structures has been largely based on those developed for the oil and gas industry. The SLIC project aimed to develop standards based on the loads experienced by offshore wind structures as a basis for reducing offshore wind foundation costs. [EV133]

3.4.11 TKOWFL's four foundation bidders have made the following innovation commitments.

3.4.12 [redacted] **in an innovative new offshore wind serial foundation manufacturing plant in** [redacted].[6] [I2] The plant uses robotic welding equipment and features Europe's largest gantry crane, with a 95m hook height. These innovations will both increase the speed at which new foundations can be fabricated and loaded out, reducing the cost.[EV080(3)]

3.4.13 [redacted] **has invested in state-of-the-art transition piece and monopile production equipment**. [I2] This includes a tool that achieves higher accuracy milling and reduces weld failure rates. [EV080(45)]

3.4.14 [redacted] has made the following innovation commitments:

- [redacted] **invested in submerged arc welding technology and in-line milling to increase plant capacity in** [redacted] **in 2016**.[I2][EV081(11)]
- [redacted] **worked with** [redacted] **to develop a state of the art blast and paint facility adjacent to the** [redacted] **manufacturing site**.[I2][EV081(11)]
- [redacted] **developed bespoke handling equipment with** [redacted] **to simplify the upstanding of transition pieces**.[I2][EV081(11)]

3.4.15 [redacted] have made the following innovation commitments:

- [redacted] **participated in the** [redacted] **project led by** [redacted] [redacted].[I1][EV082(2)]
- [redacted] **is developing its** [redacted] **which reduces the number of welding hours needed to weld the tubular structures together**. [I2][EV082(2)]
- [redacted] **has contributed to the R&D programme of** [redacted]. [I1,I2] [EV135]

3.4.16 [redacted] has made the following innovation commitments:

- [redacted] **has a cooperation with** [redacted] **headquarters for welding technology and metallurgy**.[I2][EV84(7)]
- [redacted] **launched the innovative** [redacted] **which tackles of health-and-safety-related attitudes and behaviours by communication and sensitisation**.[I6] [EV84(8)]

Electrical systems infrastructure

3.4.17 **TKOWFL has developed seven ESI packages covering the supply, transport and installation of the electrical system**.[I3] The supply chain is complex with many suppliers capable of taking on different combinations of the scope and more or less willing to deliver an EPCI contract. TKOWFL will work collaboratively with the electrical system suppliers to undertake a FEED study to fully optimize the design whilst retaining competition. Maintaining flexibility in the procurement process is therefore vital to secure the best value and strongest combination of skills.[EV024]

3.4.18 **TKOWFL will explore the use of 'overplanting' and dynamically rated cables to maximize the use of the electrical system and minimise LCOE**.[I2] TKOWFL is considering sizing the wind farm to maximise the utilisation of the transmission system. Because the turbines are not operating at their full capacity all of the time, the full rating of the export cable system is rarely fully used. This could be a cost effective alternative to a full rated system.[EV017(7-8)]

3.4.19 **TKOWFL will take an innovative approach by aggressively optimising offshore substation design to strip out any unnecessary equipment and operational facilities**.[I2] The offshore substation design will take a 'bare bones' approach to both minimise direct cost and enable the use of a monopile foundation and installation by a smaller vessel further improving the value of the project.[EV017(7-8)]

3.4.20 Some examples of bidders' innovation commitments are shown in the paragraphs below.

E1: Electrical systems

3.4.21 [redacted] **new compact gas-insulated switchgear is over** [redacted] **smaller than its predecessor**.[I2] This reduces substation footprint, lowers the height of buildings creating savings on installation, civil construction and site commissioning.[EV046(6)]

3.4.22 [redacted] **digital substation technology allows interconnection of the substation equipment via fibre optic based communications systems**.[I2] It dispenses with large amounts of traditional multicore cable resulting in reduced costs. [EV047(8)]

3.4.23 [redacted] has several significant university collaborations on energy systems.[I1]

- **At the University of** [redacted]**, it sponsors the** [redacted] **for Wind Energy Systems with two PhD study subjects currently mentoring of DTC students**.[EV048(11)]
- **At the University of** [redacted]**, it modelled the tow out and installation sequence for a HVDC float-over type platform**.[EV048(12)]
- **At the University of** [redacted]**, it has collaborated on research projects relating to network analysis and HVDC technology**.[EV048(12)]

E2: Offshore substation platform

3.4.24 [redacted] **is building** [redacted] The [redacted] is a world first and [redacted] will work closely with [redacted] to support its development.[EV050(14)],24

3.4.25 [redacted] **will help develop the** [redacted] **foundation R&D for application offshore substation foundations**.[I2,I4] A team of [redacted] engineers will be involved in the analysis and development of the [redacted] to determine where potential efficiencies can be found with regards to fabrication and to extend service life.[EV054(10)

3.4.26 [redacted] **is currently involved in a project with** [redacted] **with the aim of industrialising a new welding technology**.[I2] This will be installed at [redacted] Facility and will improve fabrication efficiency and productivity.[EV051(3)]

E3: Onshore export cable

3.4.27 [redacted] **is looking at alternative ways to deliver 20-year O&M contracts for OFTOs**.[I3,I5] It is working with local, smaller scale service providers who are able to work directly with Balfour Beatty rather than by contracting via the wind farm developer.[EV148(3)]

E4/E6: Subsea cable supply

3.4.28 [redacted] **has led the development of** [redacted] **array cables**.[I2] Working with the [redacted] has produced a cable design that does not contain [redacted] material and has a significant effect on cost, weight and the handling requirements of cable. The company won its first order for its 66kV for the European Ofshore Wind Demonstration Centre.[EV067(1)]

3.4.29 [redacted] **partners the** [redacted] **to develop new materials for HVDC cables**.[I1,I2] The work will be valuable in reducing the cost of far-shore wind farms.[EV068(6)]

3.4.30 [redacted] **will apply its experience with dynamic cable rating calculations to optimise the Triton Knoll cable design**.[I2] This can reduce the size of export cable needed to meet the requirements of the wind farm at a lower capital cost. Other opportunities are using aluminium armouring, rather than steel or polyethylene, to reduce costs and losses, and the implementation of new factory step joints to enable cables of different cross sections to be joined together, avoiding the need for an offshore joint.[EV063(7)]

3.4.31 [redacted] **has a subsea cable testing programme at its** [redacted] **laboratory in** [redacted] The laboratory provides a central resource for [redacted] worldwide manufacturing of high voltage power transmission cable up to [redacted].[EV069(9)]

E5/E7: Subsea cable installation

3.4.32 [redacted] **works with** [redacted] **in developing links with the five universities** [redacted] **that are working together to address challenges in the industry, and develop innovation in new products or services**.[I4] The work will widen knowledge on non-commercially sensitive aspects of the business and increase knowledge and experience of the academic community of the innovation challenges in offshore wind.[EV072(13)]

3.4.33 [redacted] **to optimise the lay down areas and multi-use facilities within the port**. It ia also working with cable manufacturers' technical departments to ensure handling techniques are optimised.[I2,I4] [EV074(17)]

3.4.34 [redacted] **is undertaking in R&D into autonomous underwater vehicles**.[I4,I5] It is working with the [redacted] on the development of autonomous underwater vehicles for cable surveys. It is also working with a leading European academic institution as well as a technology developer and supplier of subsea robotic technology.[EV075(x)]

3.4.35 [redacted] **is developing cable burial solutions using dredging technology**.[I4] Based on the high cable failure rates experienced in cable installation projects, it is researching less intrusive methodologies that are more "surgical" in their interaction with the sea bed so that less force is placed on the cables during installation.[EV076(6)]

3.4.36 [redacted] **is developing the** [redacted] **concept, which has three tools for three different purposes: boulder clearance, pre-trench ploughing and backfilling the trench with product**.[I4] The [redacted] concept is being developed to provide the most cost effective services on each project. [redacted] is currently working in the basic design phase with a go ahead from the board of directors.[EV164(20)]

Transport and installation

3.4.37 [redacted] **is collaborating with the University** [redacted] **on vessel performance and design and is exploring with** [redacted] **potential opportunities for collaborative research into marine**

logistics.[I1,I4] **These form part of** [redacted] **ongoing programme of improvements, which have already reduced offshore health safety risks and increased vessel capability**. Specific examples are crane modifications (complete), installation of a helicopter landing structure (complete), assessment of new components handling tool (ongoing) and the design of vessel upgrades (complete).[EV097(5)]

3.4.38 [redacted] **has introduced several new innovations in monopile installation**:

- A cage installation aid was used on [redacted] to install secondary steel cage (anode cages, access platform, boat landing system) on a transition-piece-less monopile.[I4]
- A J-tube installation aid, was used on [redacted] to install J-tubes on the monopile.[I4]
- A boat landing installation aid was used on [redacted] to install the bottom part of boat landing system on the monopile.[I4][EV098(1)]

3.4.39 [redacted] **is a funder and participant in a joint industry project to investigate the use of** [redacted] The design guidelines currently available for leg-pile connections for jacket substructures in the offshore wind industry are based on historical testing carried out by the oil and gas industry. This project will carry out fatigue testing on samples representative of leg-pile connections for jacket substructures to develop guidance that is more appropriate for offshore wind applications, ensuring efficient design and reducing risk.[EV096(88)]

3.4.40 [redacted] **has invested** [redacted] **in the detail design of the next generation of installation vessel**.[I4] [redacted], was contracted to incorporate best practice from over a decade of experience combined with the latest technological innovations. When built, [redacted]

3.4.41 **Seajacks has recently invested in** [redacted]**, the** [redacted] **jack-up vessel designed specifically to service the offshore wind industry**.[I4] This enables the cost effective installation of [redacted]. The capability of [redacted] enables clients to install larger components and to carry more components per installation cycle, therefore increasing project efficiency, driving down the overall cost of installation activities.[EV095(11)]

3.4.42 [redacted] **is supporting** [redacted] **to** [redacted][I4] It has signed an agreement with [redacted] to build a prototype that will be used for live tests on monopile installation. Following positive results this technology will be further developed.[EV091(16)]

4 SKILLS

4.1.1 **TKOWFL's shareholders have a strong track record of supporting skills development for offshore wind farms and the energy sector more generally**.[S3,S4] This heritage will be developed and enhanced through the construction of TKOWFL. Most of TKOWFL's work is local to the Humber region because of the long-term skills requirement for the operation of Triton Knoll. The wider skills development needed for Triton Knoll will be addressed in partnership with its chosen suppliers and this section includes a selection of the skills activities bidders are undertaking.

4.2 TKOWFL's shareholder's skills development

4.2.1 **Innogy has played a key role in several industry skills groups.**[S3,S4,S6] Through these groups, Innogy also shares best practice with other major employers in the sector and helps to drive strategy to improve the availability of skills**:**

- It is a member of the National Skills Academy for Power, which is one of several employer-led centres of excellence, delivering the skills required by each sector of the economy.[S3,S4,S6] Innogy helped in the development of interactive information for potential entrants to the power sector, undertook sector attractiveness work for the industry and developed a workforce planning model.[25]
- It was a founding member of the RenewableUK Skills Group.[S3,S4,S5,S6] Through this it has supported research into employment trends in the sector, an apprenticeship framework and associated qualifications and participate in the production of renewable industry careers guides.[EV012]

4.2.2 **Innogy has delivered some significant initiatives to enhance skills in the offshore wind and the energy sector more widely**, through:[S3,S4,S5]

- A wind turbine technican apprenticeship scheme (see Paragraph 4.2.3).[EV013,EV126,EV127,EV128]
- A range of education initiatives, such as CREATE days at Inverbain Hydro Scheme, which give young people an insight into the working of a sustainable energy business.[EV004][EV151]
- Work associated with Gwynt y Môr wind farm, investing in our engineers of the future which Innogy funded through the Engineering Education Scheme Wales.[EV006]
- The Power Technician Scheme, accredited by the Institution of Engineering and Technology (IET), which provides a sound understanding of the technical and practical skills needed to be tomorrow's power technical specialists. The programme contains a blend of academic study and practical skills training at Innogy's specialist in-house training facility.[26]

4.2.3 **Innogy's Wind Turbine Apprenticeship Programme was created with Grwp Llandrillo Menai in North Wales to generate skilled technicians that can meet the future needs of Innogy and the wider renewables industry.**[S3,S4] The programme teaches skills that are highly transferable, with apprentices

working across onshore wind, offshore wind and hydro for various companies and across a mix of turbine and technology types. The programme has been recognized by several awards:

- RenewableUK Apprentice of the Year, 2014.
- Grwp Llandrillo Menai Apprentice of the Year, 2015 (against over 2,000 apprentices).
- Wales Green Energy Awards for Skills and Training, 2015
- Apprenticeship Awards Cymru Work-based Learning Assessor and Tutor of the Year, 2016

Apprentices act as ambassadors, promoting STEM in local schools and career fairs. At least half of the apprenticeship posts after training are located in rural areas, where opportunities for skilled engineering jobs are limited. TKOWFL's skills requirements may differ from the needs in North Wales but TKOWFL is committed to drawing on the expertise acquired through this programme.

4.2.4 **As operator of Sheringham Shoal wind farm, Statkraft promoted skills development in Norfolk**.[S3,S4]

- It runs a bursary Scheme to help young people from low-income families in Norfolk to study engineering at one of three Norfolk colleges.[27]
- It published a careers factsheet presenting the skills needed for the life of the wind farm.[EV139]

4.2.5 **Statkraft has pan-European schemes to develop the skills and experience of the energy sector for students and people at the early stage of their careers**.[S4] These include summer positions for students, summer projects and international trainee programs.[EV009]

4.2.6 **TKOWFL benefits from the skills developed from previous projects in the Innogy and Statkraft portfolios**.[S6] Nearly all of the TKOWFL project team have worked on other offshore wind projects not only for TKOWFL's shareholders. Innogy and Statkraft are partners in Forewind. As the projects in the Dogger Bank zone progress they will benefit increasingly from the skills developed by TKOWFL.[EV132]

4.3 TKOWFL skills development

4.3.1 A number of offshore wind projects have been developed off the UK's east coast and specifically out of the Humber estuary, which is TKOWFL's preferred construction and O&M base location. This means that the region has already enjoyed a significant investment in skills development such that several training providers are available, offering a range of apprenticeship schemes, vocational training, offshore wind skills development and safety courses. Although this is reassuring, TKOWFL recognises that the number and scale of additional projects planned for the region could result in intense competition for key resources. Figure 5 shows the number of commitments or actions by (a) package and (b) by the competition subcriteria. The alphnumeric labels are defined in Appendix D.

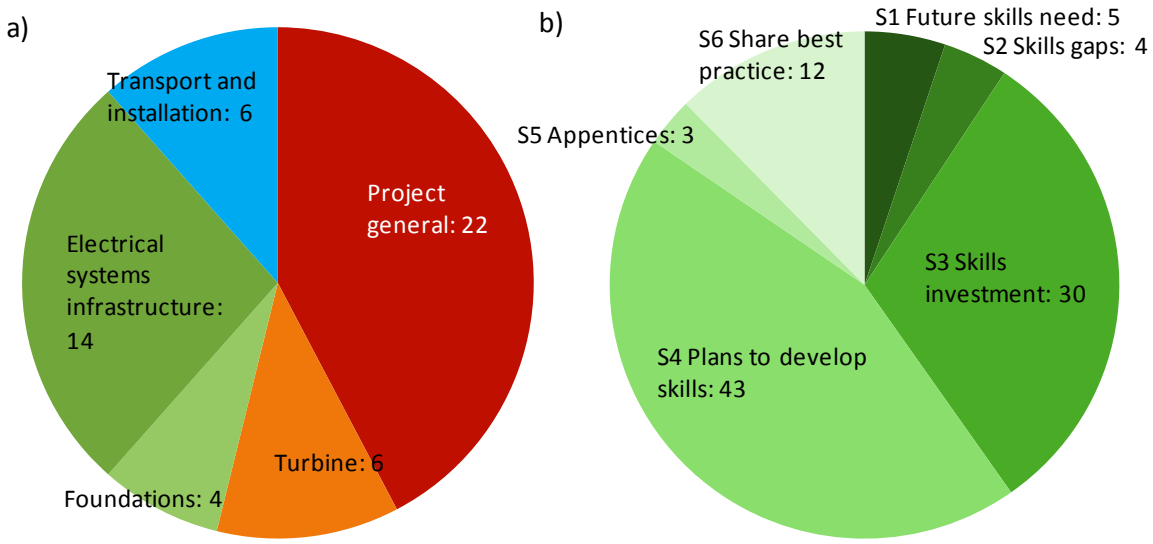

Figure 5 Number of commitments or actions for the skills criterion by a) package and b) subcriterion. The totals are different because many commitments meet more than one subcrierion.

TKOWFL skills strategy

4.3.2 **TKOWFL has developed its skills strategy to reflect TKOWFL's long-term needs, the competing needs of other offshore wind farms, the local skills base and the significant work already underway to ensure the Humber region meets the skills needs of the industry.**[S1,S2,S3,S4,S6] This strategy will be informed by work by TKOWFL's shareholders on operating wind farms. TKOWFL's actions for all of its skills commitments will have direct or indirect benefits on a significant proportion of the UK's offshore wind industry. Triton Knoll is just one of eight wind farms in the immediate Humber area that are either operating or in construction. [EV117,EV129] A first step is to build a strong evidence base on which to inform further actions and TKOWFL commits to building detailed quantitative and qualitative assessments of the skills needed by the TKOWFL and its supply chain.[EV130] [S1]

4.3.3 TKOWFL has completed a quantitative analysis of the skills needed by the wind farm.[S1]

- **During the construction phase, TKOWFL will create 2,600 direct and indirect full-time equivalents (FTEs) annually**. The largest source of employment will be turbine manufacture and foundati°n manufacture.[EV003(24)]
- **During operation, TKOWFL will create 290 FTEs annually, of which 70 are direct and 220 are indirect jobs**.[EV003(25)]

4.3.4 **TKOWFL commits to undertaking a comprehensive skills audit for each stage of the project and to take action to bridge any skills gaps.**[S1,S4] This work will involve assessing the roles that the project needs, the ability of the local labour market to meet these needs and an assessment of the actions needed to bridge any skills shortages, eg apprenticeship programmes, re-skilling schemes and undergraduate sponsorship. This work will begin when a decision on the construction base is made. TKOWFL has developed a draft scope of work for the skills audit and plans to undertake this work in

collaboration with a consultancy. This exercise will have a valuable role in informing the Triton Knoll skills plans, the work of Humber Local Enterprise Partnership (LEP), local training providers and other local organisations seeking to maximise the offshore wind skills base in the local area.[EV035(32),EV130]

4.3.5 **TKOWFL is taking early action to ensure there are sufficient resources in the area to ease any resource constraints**. It is:

- Encouraging students into science and engineering. It is already sponsoring Humber University Technical College (UTC) (see paragraph 4.3.6) and a commitment to supporting STEM work in local schools, to encourage growth of the skills pool (see paragraph 4.3.6).[S4]
- Supporting local efforts to retrain skilled personnel to support the offshore wind industry, such as through North Lincolnshire Council's British Steel Response Task Force (see paragraph 4.3.7).[S4]
- Supporting the development of the Humber Energy Campus as a regionally coordinated initiative to grow relevant local skills (see paragraph 4.3.8).[S4]
- Undertaking a range of actions with the Humber LEP and other local organisations to engage with the skills and recruitment sector in the Humber region in order to learn from peers and share our experience and concerns with local employers, the training providers and the wider skills stakeholders. (see paragraphs 4.3.9-4.3.12).[S6]

4.3.6 **TKOWFL has partnered with the Humber UTC from the beginning of the 2016/17 educational year**.[S3,S4] TKOWFL has sponsored the electrical workshop and will set project coursework for the students. It will review every three years for the lifetime of the wind farm, providing a valuable investment in skills training and supporting closely linked to the requirements of TKOWFL and other wind farm operators in the Humber area.[EV035(31)]

4.3.7 **TKOWFL commits to supporting the regional response to recent job losses in the Scunthorpe area and the ongoing local concerns for job security**.[S3,S4] North Lincolnshire Council have a Task Force aimed at helping local businesses to diversify in order to grow and employ more local people. This is a concerted effort to respond to local unemployment and job insecurity resulting from uncertainty in traditional areas of Humberside employment. TKOWFL will provide data to North Lincolnshire Council on the skills and services it requires to help achieve the objectives of both organisations.[EV035(33)]

4.3.8 **TKOWFL commits to supporting the development of the Humber Energy Campus**.[S3,S4,S6] The initiative led by the Humber LEP is a collaboration between employers, the University of Hull, further education colleges and specialist training providers to build on the region's expertise and become a centre of excellence for energy skills.[28] TKOWFL believes the initiative could become a vital source of skilled personnel that the project needs. TKOWFL will initially commit to providing a case study on the project with indicative workforce data and skills needed for delivery. This will illustrate the potential skills needed in the area and help promote the Humber Energy Campus courses.[EV035(34)]

4.3.9 **TKOWFL and its shareholders commit to supporting the Humber LEPs local skills and training initiatives.**[S3,S4,S6] TKOWFL has signed a memorandum of understanding (MOU) with the Humber LEP committing TKOWFL to partner with local employment groups, and data provision and careers advice initiatives following FID. This MOU is at the heart of TKOWFL's skills strategy.[EV116]

4.3.10 **TKOWFL has signed the Humber Skills Pledge**.[S3,S4,S5] The pledge is an initiative of the Humber LEP and has six components:

- Invest in increasing the skills of your workforce.
- Mentor a budding entrepreneur.
- Offer a work placement to a young person or adult.
- Offer an apprenticeship or traineeship.
- Employ a graduate.
- Support the development of employability skills.[29]

Some of these components have already been achieved and TKOWFL will work towards achieving all of them after the project FID.[EV035(36),EV159]

4.3.11 **TKOWFL commits to supporting the Humber LEPs work in helping to provide great careers advice to local people through the Bridging the Gap initiative**.[S3,S4] Bridging the Gap is an online careers advice portal which has been developed to raise awareness of career pathways and increase access to impartial, effective and current advice and guidance. TKOWFL will work with Humber LEP to create branded web material as a case study for engineering and renewables careers.[EV035(35)]

4.3.12 **TKOWFL commits to holding its supply chain events for the Triton Knoll project, supported by LEPs and other local or regional business support organisations and participating in local supply chain events held by other organisations**.[S3,S4] These events will be attended by TKOWFL team members and its suppliers. They form a valuable role not only in promoting business opportunities to potential lower-tier suppliers but also enable new entrants to understand what skills they need to acquire to be successful in the industry.[EV035(12)]

4.3.13 **TKOWFL encourages students to consider careers in renewables and we have already supported four student placements at its London project office**.[S3] Project team members have also presented masterclasses to share latest advances in offshore geotechnics, geophysics and site investigations with MSc students at Bangor University and Imperial College London.

4.4 Skills developments at the package level

Wind turbines

4.4.1 **Triton Knoll will create 45 wind turbine technician jobs for the lifetime of the project.**[S2] **During the service agreement most will be employees of the turbine supplier and after this all will be permanently employed by TKOWFL**. Because of the number of wind farms in the Humber area, these commitments have a significant value to the wider local industry.[EV003]

4.4.2 [redacted]

4.4.3 [redacted]

4.4.4 [redacted]

4.4.5 [redacted]

4.4.6 [redacted]

Foundations

4.4.7 [redacted] **has a close relationships with several universities that are closely engaged in offshore wind education.**[6] [S4] These include the [redacted], and [redacted] provides [redacted] intern positions each year for students to apply their theoretical skills in practice and approximately [redacted] of interns come back and join the [redacted] offshore wind installation team.[S3] [redacted] also has cooperation framework agreements with two universities in [redacted] of the [redacted]

4.4.8 [redacted] **holds competency matrices for all roles within the business**.[S3,S6] These are reviewed on an on-going basis, in line with ISO 9001. It has learnt from regional offshore fabricators to apply best practice to this industry.[EV081(12)]

4.4.9 [redacted] **trains young people to become construction mechanics and industrial clerks under an apprenticeship scheme**.[S4] Recently the first [redacted] construction mechanics finished their apprenticeship at [redacted] and now continue within the company. New apprentices are recruited through cooperation with schools in the region and by participation at job fairs in [redacted] and the region around.[EV084(27)]

4.4.10 [redacted] **followed a skill assessment that showed it would not be able to follow the market development of [redacted] at its factory in [redacted]** This led to investment in its [redacted] factory that includes a coating facility, which had previously been a contracted out service.[EV082(3)]

Electrical systems infrastructure

E1: Electrical systems

4.4.11 [redacted] **runs a schools programme geared towards supporting the long-term needs of the sector**.[S4] It supports the teaching of the key STEM subjects in schools local to its engineering office in [redacted]. It provides a progression routes for pupils onto [redacted] apprenticeships and work placements, and offers financial support through university and ultimately employment opportunities. {EV046(15)]

4.4.12 [redacted]**works with local colleges to provide training to apprentices and new starters in various areas**.[S4] An important area is welding where the cooperation with colleges has been successful.[EV047(14)]

4.4.13 [redacted] **and has been able to build an experienced offshore grid connection engineering and delivery organisation in the UK**.[S4] These skills have been developed on UK projects. Constructing Triton Knoll would provide additional investment justification for future recruitment as well as supporting the existing workforce.[EV048(20)]

E2: Offshore substation platform

4.4.14 [redacted] **has recently committed itself to training to achieve higher standards.**[S3] It is working towards [redacted] safety certificate for contractors) and is extend its knowledge on the CDM Construction (Design and Management) Regulations, which will facilitate collaborations with UK fabricators such as [redacted].[EV057(12)]

4.4.15 [redacted]**, promotes sharing of knowledge and best practice within the business by holding regular "lunch and learn" presentations in its offshore wind business**.[S6] By increasing the level of knowledge within [redacted] it can provide greater assistance to clients and partners, improving the level of understanding across the industry.[EV059(20)]

E3: Onshore export cable

4.4.16 [redacted] **has set up a national UK training academy**.[S4,S6] This follows the award of [redacted] will more than match the funding, through cash and in kind investment with a further [redacted] to be invested into establishing the academy and new training opportunities. A more standardised approach will mean that these qualifications are transferable across the business and the industry.[EV148(10)]

E4/E6: Subsea cable supply

4.4.17 [redacted] **ensures that its clients have a detailed understanding of its technologies and how they can be applied within the sector**.[S6] [redacted] participates in formal industry forums such as those organised by the IET or CIGRE UK as well as hosting bespoke technology awareness and training events both in the UK and in its technology centres overseas.[EV065(5)]

4.4.18 [redacted] **has an engineering development programme for newly qualified or young engineers**.[S3] It has five new graduates in this programme, which improves skills and expertise within [redacted].[EV067(5)]

4.4.19 [redacted] **encourages individuals to develop offshore wind skills** through:[S4]

- Cooperation with the universities of [redacted] in electrical and mechanical engineering
- [redacted], an initiative to support [redacted]
- Visits from engineering students, exhibitions at local universities, student research projects in its laboratories, seminars, conferences and training. These are organised through [redacted]

E5/E7: Subsea cable installation

4.4.20 [redacted] **manages the development of skills and capabilities of its personnel through its internal training and development policy and procedure**.[S3,S4] The purpose of training and development is to outline a coherent policy with regard to training and development.[EV072(16)]

4.4.21 [redacted] **attracts new workforce to the sector**, through:

- Internships, thesis or dissertation support, recruitment directly from university, site visits, company visits for students
- Cooperation with [redacted] and public institutes.
- Investing in training simulators, accessible to students.
- Attendance at (job) events or on open door events at nautical schools.[S3,S4]

4.4.22 [redacted] **proposes a new** [redacted] **for increasing specialist offshore wind skills in the UK**.[S3,S4] It will have three main areas of work: an apprenticeship programme; a recruitment programme; and an education-based public engagement programme.[EV075(34)]

4.4.23 [redacted] **aims to attract a new workforce to the offshore wind industry**.[S4] This will include recruiting from the oil and gas industry, where there has been very high level of redundancies and there are highly skilled people in this industry with a wealth of subsea experience.[EV076(19)]

4.4.24 [redacted] **parent company runs the** [redacted] This offers an opportunity to people to get to know the activities of the offshore energy division. This programme lasts 12 months and comprises training relevant to the challenges of the offshore industry.[EV164(26)]

Transport and installation

4.4.25 [redacted] **collaborates with** [redacted] **on an apprenticeship programme to develop offshore wind capabilities**.[S4] The programme focuses on transferring skills and on local engineering students. The plan is to constantly have 1-2 interns at [redacted] as assistant project managers to gain skills to support the future development of the UK supply chain.[EV097(16)]

4.4.26 [redacted] **offers internships to college and university students.**[S4] These provide on the job learning in the fields of offshore engineering, related to transport, installation and maintenance of offshore renewable energy farms. These internships are open to all nationalities.[EV098(1)]

4.4.27 [redacted] **runs the** [redacted] **which is the training centre for its employees**.[S3] JDN Group had always provided a lot of training sessions organised and managed by each division or department. In 2016, all of these training sessions are managed and coordinated in through the [redacted]. At present it is still geared to project staff members and people in [redacted] offices providing supporting services to our projects but over time the scheme will support all employees in the company.[EV09(18)]

4.4.28 [redacted] **is a member of the** [redacted].[S3,S4,S6] These organisations seek to develop the abilities and meet the skills gap in the [redacted] area. Winning further UK projects would provide a significant opportunity for [redacted] to increase its involvement with these organisations, which will help [redacted] to attract and develop new personnel.[EV090(21)]

4.4.29 [redacted] **has supported a new energy engineering degree courses at the** [redacted].[S4] [redacted] has worked closely with [redacted], helping to develop and deliver the curriculum, and providing summer placements for students.[EV096(14)]

4.4.30 [redacted] **holds lessons learned meetings from past projects for the whole team.**[S6] Most of [redacted] offshore wind experience has been on monopile-transition piece projects where lessons get shared with the wider installation team. Many of these insights have also been shared with the wider industry.[EV091(25)]