Forewind Ltd

Dogger Bank
Offshore Wind Farm
Economic Benefits Study

Technical Paper

March 2014

Joseph's Well, Hanover Walk, Leeds LS3 1AB t: 0113 245 2200 f: 0113 245 0110 www.genecon.co.uk

Forewind Ltd

Dogger Bank
Offshore Wind Farm
Economic Benefits Study

Technical Paper

March 2014

Reviewed and approved by:

Signature(s):	
Name(s):	David Tuck
Job Title(s):	Managing Partner
Date:	09/04/2014

GENECON
This report contains 57 pages
Ref: DT/DC

Table of Contents

Introduction

GENECON and Parsons Brinkerhoff (PB) were commissioned by Forewind Ltd to undertake an economic benefits study of potential impacts on the UK and two of its constituent regions, North East and Yorkshire and Humber (NE&YH), of realising up to six offshore wind farms planned for development within the Round 3 Dogger Bank zone.

This technical paper presents the methods, justifications and results of the research and supports a headline findings document and two models – a Scenario Cost Model and an Economic Benefits Model.

Key Definitions

Full Time Equivalent (FTE) employment
In this study, one FTE job is equivalent to 10 years employment for one full time worker

Gross Value Added (GVA)
The contribution to an economy by an individual producer, industry or sector. It is the UK Governments primary method of assessing economic impacts.

Original Equipment Manufacturer (OEM)
Defined in this study as facilities for the main components required for a Wind Turbine Supply Agreement – i.e. nacelles, bladesets and towers. Other OEMs that could develop in this definition include the potential for additional cable manufacturing (onshore and offshore).

UK/Regional Content
Defined based on the location where the activity occurs and employment benefit from the investment will arise, regardless of company structures or ownership.

Abbreviations

ASHE	Annual Survey of Hours and Earnings
BIS	Department for Business, Innovation and Skills
bn	Billion
BoP	Balance of Plant
BRES	Business Register and Employment Survey
BVG	BVG Associates
CAPEX	Capital Expenditure
CB	Creyke Beck
CE	Compensation of Employee
DECC	Department for Energy and Climate Change
EA	Environment Agency
EIA	Environmental Impact Assessment
ESA	European System of Accounts
EU	European Union
FDI	Foreign Direct Investment
FT	Full Time
FTE	Full-Time Equivalent
GBS	Gravity Based Structure
GVA	Gross Value Added
GW	Gigawatt
HDD	Horizontal Directional Drilling
HMRC	Her Majesties Revenues and Customs
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
LQ	Location Quotient
m	Million
MMO	Marine Management Organisation
MW	Megawatt
n.e.c.	not elsewhere classified
NE&YH	North East and Yorkshire and Humber
NOMIS	ONS official labour market statistics hub
NPV	Net Present Value
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OFTO	Offshore Transmission Owner
ONS	Office for National Statistics
OPEX	Operational Expenditure
OSP	Offshore Substation Platform
OWIC	Offshore Wind Industry Council
OWPB	Offshore Wind Programme Board
PM	Project Management
PPE	Personal Protective Equipment
PT	Part Time
RAB	Renewables Advisory Board
ROI	Return on Investment
RUK	Renewable UK
SIC	Standard Industrial Classification
TCE	The Crown Estate
UK	United Kingdom
UKTI	UK Trades and Industries
WBS	Work Breakdown Structure
WTG	Wind Turbine Generator
WTIV	Wind Turbine Installation Vessel

1 Summary Methods and Assumptions

1.1 Summary methods

This section outlines the bottom-up approach to quantifying the economic benefits to the UK and North East and Yorkshire and Humber (NE&YH) regions for the pre-construction, construction and operation & maintenance stages of the proposed Dogger Bank Offshore Wind Farm.

Our approach has been to profile the likely supply chain for the wind farm based around the technical requirements of delivering between 2 and 6 projects[1]. Cost assumptions for the major wind farm assemblies and activities (a wind turbine, an offshore substation, a construction port, export cable installation, etc.) were collated and mapped to the programme. A supply chain review determined the current or potential location for where each activity could take place.

From this, a series of model-based scenarios have been developed for delivering each activity in either the UK or within the combined NE&YH Region. The scenarios developed reflect development assumptions regarding the level of supply chain activity captured at these geographic levels, coupled with forecast projections for offshore wind generation from the Department for Energy and Climate Change (DECC) and The Crown Estate (TCE).

A range of economic metrics and weightings were then applied to determine the likely direct gross and net Full Time Equivalent (FTE) employment gains that could be supported by supply chain expenditure under each scenario. The likely Gross Value Added[2] (GVA) and induced employment estimates were then calculated for each scenario, with a range of metrics and weightings derived from national accounts and industry reporting.

A summary of our approach is provided below, followed by a more detailed outline of each stage, and the assumptions developed within the analysis:

- ***Stage 1:*** Profile existing and potential supply chain for the Dogger Bank Offshore Wind Farm; define the programme and technical requirements. This included:
  - Project Definition - Define basic Dogger Bank Zone project scope -, including content, components and numbers relating to the Zone and projects
  - Parts List / WBS Identification - Use TCE document as baseline supplement with experience
  - Programme Identification - Use Renewables UK (RUK) and TCE documents to produce Outline Programme, supplemented with Forewind information
- ***Stage 2:*** Develop cost assumptions and scenarios for potential investment in UK and NE&YH. This comprised high-level cost estimation for identified parts / activities and assessment of spend profile against time. For identified parts / activities, typical potential suppliers were identified on regional, national and international basis. Using forecasts developed by DECC and TCE, and comparing them with options for the development of Dogger Bank, High, Medium and Low scenarios were defined.
- ***Stage 3:*** Define CAPEX[3] and OPEX[4] (throughout the lifecycle of the wind farm), based on the assumed cost of each component of the Dogger Bank and determine a likely spend profile for each phase[5] and for each project.

[1] Each wind farm Project is defined as a 1.2GW development

[2] GVA measures the contribution to the economy of each individual producer, industry or sector. It is the primary measure of productivity in the UK.

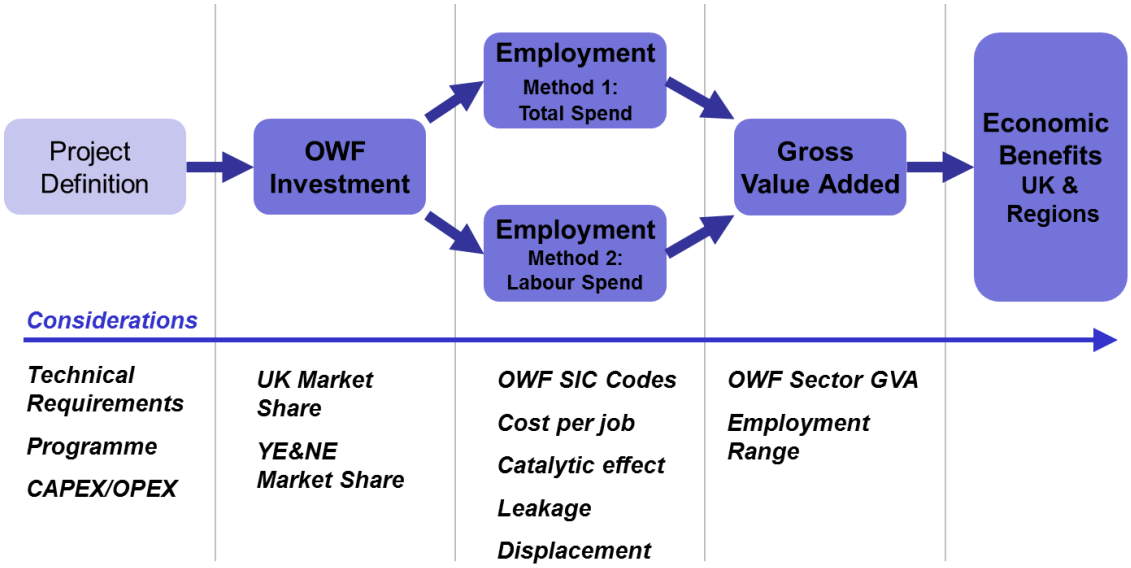
[3] Capital Expenditure

[4] Operational Expenditure

[5] Wind farm phases comprise Project Management, Development, Construction, Installation and Operation & Maintenance

- ***Stage 4:*** Develop Economic Benefits Model that applies scenario-based expenditure, including suitable adjustments for trans-boundary leakage and determine net present value of the investment (at 3.5% discount rate) over the wind farm lifecycle.
- ***Stage 5:*** Define Standard Industrial Classification (SIC) employment sectors for supply chain activities/expenditure.
- ***Stage 6:*** Determine gross and net direct FTE employment estimates at UK and NE&YH level. Use two approaches to quantify the range of benefits:
  - ***Method 1:*** Apply turnover per job estimates in relevant business sectors (based on Department for Business, Innovation and Skills (BIS) Business Population Statistics) and apply to total Dogger Bank expenditure in each scenario.
  - ***Method 2:*** Apply Office for National Statistics (ONS) earnings data to assumptions for labour expenditure reported by the Renewables Advisory Board (RAB) and based on the findings of a survey of businesses engaged in wind farm supply chains.
- ***Stage 7:*** Determine GVA impacts using ONS Regional Accounts; GVA per worker data for Method 1 and GVA Compensation of Employee data for Method 2.
- ***Stage 8:*** Determine net Induced FTE employment and GVA using multipliers
- ***Stage 9:*** Apply a discount factor to GVA to determine the net present value to society

Two models have been developed to arrive at Employment and GVA estimates. The first is a Cost Model, which profiles the likely expenditure and programme dates for each phase of each project. The product of the Cost Model is profiled annual time series expenditure in the three Scenarios. Outputs from the Cost Model were then inputted into a second model. The Economic Benefits Model converted the expenditure profiles into likely gross and net direct and induced employment and GVA. A summary of this model is provided below, including a list of multiplier adjustments and considerations applied at each stage:



2 Detailed Methodology and Assumptions

2.1 Stage 1: Project definition and supply chain mapping

2.1.1 Dogger Bank projects and phased development

The study assumes a total of 7.2GW generation capacity will be installed as part of a phased development of the Dogger Bank zone, to be developed as 6 x 1.2GW projects, each with a 1GW grid connection. The projects are Dogger Bank Crekye Beck A and B and Dogger Bank Teesside A, B, C and D. Each project will be developed through four broad delivery phases (development, manufacture, installation and operations and maintenance (O&M)), with project management occurring throughout the duration of the project. Investment assumptions in the following phases are included in the Cost Model:

Phase	Activities
Project Management	All costs from original Zone bidding, licence agreement, strategic development, through project development, concept design and consenting / Environmental Impact Assessment (EIA), including surveys
Development	
Manufacture	Procurement, manufacture and fabrication of components (Wind Turbine Generator (WTG), Offshore Substation Platform (OSP), onshore substation, substructure / foundations, cables, etc.), including construction of any construction port / assembly yard infrastructure required
Installation	Pre-assembly onshore / at assembly port, installation offshore, commissioning and onshore construction (substations, cables, O&M facilities, etc.)
O&M	During 5 year Original Equipment Manufacturer (OEM) warranty period and beyond, for total of 25 years
Repowering / Decommissioning	Excluded from analysis

2.1.2 Project definition

Using evidence from various sources including Forewind literature and RUK, and verified by Forewind, the aspects used to define the project are outlined below.

Component	Zone	Creyke Beck A&B	Teesside A&B	Teesside C&D
R3 Zone	Zone 3 - Dogger Bank			
Developer	Forewind – consortium of SSE, RWE npower Renewables, Statkraft and Statoil			
Total Capacity (GW)	7.2	2.4 (2 x 1.2)	2.4 (2 x 1.2)	2.4 (2 x 1.2)
Project Life	25 years			
Wind Farms and capacities		Creyke Beck A – 1GW grid connection, 1.2GW windfarm capacity Creyke Beck B – 1GW grid connection, 1.2GW windfarm capacity	Teesside A, – 1GW grid connection, 1.2GW windfarm capacity Teeside B – 1GW grid connection, 1.2GW windfarm capacity	Teesside C – 1GW grid connection, 1.2GW windfarm capacity Teeside D – 1GW grid connection, 1.2GW windfarm capacity
Dates	See programme			
Likely WTG size	6-10MW			
WTG Numbers		Max 2 x 200	Max 2 x 200	Max 2 x 200
Met masts	2 during development stage (already installed), then up to 5 per project	2 x 5	2 x 5	2 x 5
Offshore platforms		1 OSP (converter station) per project 2-4 collector stations per project Up to 2 offshore accommodation or helicopter platforms for O&M, per project	1 OSP (converter station) per project 2-4 collector stations per project Up to 2 offshore accommodation or helicopter platforms for O&M, per project	1 OSP (converter station) per project 2-4 collector stations per project Up to 2 offshore accommodation or helicopter platforms for O&M, per project

Component	Zone	Creyke Beck A&B	Teesside A&B	Teesside C&D
Foundations	Inc. scour protection and seabed preparation Assume jacket for this study (Forewind Ltd, FL) but could be of several forms (monopile, Gravity Based Structure (GBS), jacket, etc.)			
Inter-array cable	Between WTG, WTG and collector platforms, link to met masts and accommodation platforms	2 x 950km 33-72.5kV, OD up to 250mm HVAC	Assume as CB	Assume as CB
Inter-platform cables	Between collector platforms, between collector platforms and converter platforms	2 x 320km 132-400kV, OD up to 300mm	Assume as CB	Assume as CB
Export cable (offshore)	High Voltage Direct Current (HVDC)	1 HVDC export pair per project Up to 300mm OD, up to 550kV A: 420km B: 378km	Assume as CB	Assume as CB
Subsea cable protection	Crossing structures for existing subsea cables and pipelines; cable protection measures where necessary	Up to 27 crossings for A, 20 for B. 16 per project	Assume as CB	Assume as CB
Landfall	Cable landfall and transition bays	North of Ulrome	Between Redcar and Marske-by-the-Sea	
Onshore cable	HVDC from landfall to converter station Horizontal Directional Drilling (HDD) crossing	1 x 1000MW HVDC circuit (2 cables) per project, 30km HVDC 1 x HVAC 1000MW circuit (3 High Voltage Alternative Current (HVAC) cables) per project, 2km HVAC Up to 31 possible HDD per project, totalling approx. 4km (typical 100-200m, max 650m)	Assume as CB	Assume as CB
Grid Connection	1 x 1000MW onshore converter station per project Onshore HVAC connection from converter station to existing substation Connection bay at existing substation 1GW grid connection per project	Creyke Beck, nr Cottingham, East Riding	Lackenby, Teesside;	C&D: Area south of the Tees, Teesside

Component	Zone	Creyke Beck A&B	Teesside A&B	Teesside C&D
Marine support during construction	Up to 10 vessel mooring buoys per project Up to 900 return helicopter trips per project	Up to 5150 return trips to port for construction vessels per project Up to 850 component deliveries to port per project	Assume as CB	Assume as CB
O&M	Up to 28 vessels, up to 683 return journeys, up to 900 helicopter trips per year per project			

2.1.3 Project programme

The project programme was defined using information provided by Forewind Ltd. The assumed indicative programme is as follows, with ranges of dates given when different dates are assumed for different scenarios.

Indicative Dogger Bank Programme			
Phase	**Creyke Beck A&B 2 x 1200MW**	**Teesside A&B 2 x 1200MW**	**Teesside C & D 2 x 1200MW**
Project Management	2011-2023/24/25	2011-2025/26/27/29	2017/21-2028/30
Development	2010-2017/18/19	2010-2019/20/21/23	2017/21-2022/24
Manufacture	2018/19/20-2020/21/22	2020/21/22/24-2022/23/24/26	2023/25-2025/27
Installation	2021/22/23-2023/24/25	2023/24/25/27-2025/26/27/29	2026/28-2028/30
O&M	2024/25/26-2048/49/50	2026/27/28/30-2050/51/52/54	2029/31-2053/55

2.2 Stage 2: Supply-chain scenario development

Five scenarios have been developed which outline the differing levels of supply chain activity that could feasibly take place in the UK. The scenarios concern whether Dogger Bank supply chain expenditure could support employment generating activity in the UK or overseas; and therefore where economic benefits are likely to be realised. Typical potential suppliers for each identified activity were assessed on a regional, national and international basis. This was not a detailed supply chain mapping exercise, but identified (and illustrated where possible) examples of the viable numbers of suppliers at regional, national and international scale. This was completed on an agreed definition of UK content.

2.2.1 Defining UK and regional content

For the purposes of the Economic Benefits Study the level of economic activity generated by the Dogger Bank supply chain that is retained in the UK and in the NE&YH regions is a key issue. The definition of 'UK content' is therefore a key consideration.

Businesses within the Dogger Bank supply chain will often operate on pan-country scales – and from various locations across regions. There has been increased interest in recent years to boost the proportion of the supply chain that is delivered in the UK, bolstered by the recently published Offshore Wind Industrial Strategy (August 2013).

Increased globalization and trans-boundary operations, together with higher levels of Foreign Direct Investment (FDI), has meant that the concept of 'UK content' is increasingly difficult to define – this is particularly true of large-scale capital investment in major infrastructure, where capital expenditure requires the input of global operators to realize projects.

Examples of possible supply chain business structures may include:

- A German owned turbine manufacturer with production facilities based in Denmark and installation activities in the UK;
- A UK operated fleet of installation vessels that are manufactured in Korea, registered in Holland with a Dutch parent company; or
- A construction port in NE&YH that is owned and operated by a conglomerate of internationally owned firms.

There is very little literature available on what defines UK and non-UK content, or regional content. Whilst maintaining absolute project confidentiality, informal consultations on the regional / national split question were undertaken across Parsons Brinckerhoff globally and through various public sector organizations. Available definitions across sectors and across relevant Government departments and agencies have been reviewed including:

- BIS
- ONS
- DECC
- UK Trade and Investment (UKTI)

- Her Majesty's Revenues and Customs (HMRC)
- The European Union (EU)
- Eurostat.

In traditional national accounting, a business may be defined in terms of its registered head office or its primary business address, but this fails to include subsidiary operations, the offshoring of companies or businesses operating across multiple sites. Recent efforts in national accounting have sought to measure local sites (units) to include separate areas of operational activity. This is in part a response to a long term trend in business restructuring, where head office locations are increasingly detached from mainstay activities – the locations that will likely see the greatest benefits from investment activities of a business.

In terms of industry wide efforts, TCE has undertaken an annual gap analysis of the UK supply chain for the past three years and the Industrial Strategy outlines that TCE and BIS will continue to perform this analysis, supplemented by a high level assessment of the UK supply chain capability during Autumn 2013 - although at the time of drafting, outputs from this analysis were not yet reported.

The Industrial Strategy (DECC, 2013) also highlights that the Offshore Wind Industry Council (OWIC), Developers and the newly established Offshore Wind Programme Board (OWPB) will measure and share information on UK content in offshore wind developments for both CAPEX and OPEX, using the methodology being developed by the OWPB, and will review progress on increasing UK content from 2013 onwards – to date, there has been no reporting of this work but developers have agreed to measure UK content for capital and operating expenditure which will help to identify where the UK is delivering a strong competitive supply chain and where further interventions are needed.

In the absence of a clear definition of UK content, the Industrial Strategy points to work undertaken by BVG for E.On Climate and Renewables to identify the local and UK content activity for Scroby Sands and Robin Rigg wind farms. This has sought to accurately define employment and GVA gains at local and national levels through analysis of the 'activity locations' of contractors, using data collected post-construction. As both reports sought to identify where the *beneficial outcomes* of expenditure were seen locally, nationally or overseas, their definition of content focuses on where the operational activity occurs in terms of employment as opposed to the administrative location of the business.

The most significant and tangible benefits from the Dogger Bank investment will be through gains in employment as a consequence of the construction and operation of the Dogger Bank and its constituent elements. This study is thus essentially an employment impact study – indeed, our expenditure and impact model is designed to estimate employment, from which GVA estimates are derived.

We have therefore taken a similar approach to BVG – **The UK and regional content is defined based on the location where the activity occurs and employment benefit from the investment will arise, regardless of company structures or ownership**.

2.2.2 UK and regional scenarios

A range of scenarios for the proportion of supply chain activity that could be delivered in the UK and the NE&YH region have been developed. These represent an optimistic but achievable view of supply chain activity in each location, based on the levels of current, proposed or potential activity that could occur in each locality (based on the supply chain review), coupled with our assessment of the propensity of the UK and the NE&YH regions to attract supply chain activity (based on evidence of the UK's competitive and comparative advantage in capturing market opportunities). Based on a content definition of the location where activity occurs and where economic benefits will be realised (see section 2.2.1), the developed scenarios are as follows:

Scenario	Possible NE&YH content	Possible UK content	Possible International Content	Comment
2.4GW No OEM	**38%**	**40%**	**97%**	2.4GW capacity by 2025; No OEMs
2.4GW With OEM	**64%**	**76%**	**97%**	2.4GW capacity by 2025; With OEMs
4.8GW No OEM	**38%**	**40%**	**97%**	4.8GW capacity by 2029; No OEMs
4.8GW With OEM	**64%**	**76%**	**97%**	4.8GW capacity by 2029; With OEMs
7.2GW No OEM	**38%**	**40%**	**97%**	7.2GW capacity by 2030; No OEMs
7.2GW With OEM	**64%**	**76%**	**97%**	7.2GW capacity by 2030; With OEMs

A number of assumptions have been included in the developing the scenarios. These include the following:

- Cost averaged across spend (ie not up front, milestones, on completion, etc)
- Bid stage costs are included (predevelopment)
- Repowering and decommissioning costs NOT considered
- WTG includes nacelle, blade set and tower; UK content of components is negligible at present
- Assume single source supply at required volumes is possible (doesn't allow for manufacturing limits or supply chain constraints / competition) – other than installation vessels and foundations.

2.2.3 Scenario development – including OEM definition

In understanding the range between the high (with OEM) and low (without OEM) UK and regional scenarios, this study has developed a number of assumptions regarding the added value of OEMs and other supply chain requirements becoming established in the UK and within NE&YH. OEM in this study is defined as facilities for the main components required for a Wind Turbine Supply Agreement – i.e. nacelles, bladesets and towers. Other OEMs that could develop in this definition include the potential for additional cable manufacturing (onshore and offshore).

The high regional / UK supply content scenarios therefore includes OEM's becoming established in the UK or NE&YH, which this study anticipates could generate an uplift of between 23 and 26 percentage points in supply chain content. Whilst the presence of OEMs forms a significant proportion of the range between low and high scenarios, additional supply activity is also included in the high scenarios that may occur with or without OEM's becoming established. The overall difference between the scenarios is 36 percentage points in UK scenarios and 26 percentage points in NE&YH scenarios. This is based on variations defined in Annex 1 of the Technical Report (Cost Model Assumptions) and these specific variations are further outlined in Annex 3 (Low/High Scenario Variations). The specific differences are in the following:

- Environmental Surveys;
- Wind Turbine;
- Cables – export and onshore;
- Turbine foundation including design;
- Technicians and technician / equipment transfer;
- Offshore accommodation

2.2.4 Context for UK and Regional scenarios

The following sections provide the context for which the above scenarios were developed. These consider both the contribution of the zone in terms of national projected capacity for offshore wind in the UK and also the context for which the regional share of activities has been arrived at.

Context for UK Scenarios

Clearly 76% UK content is aspirational and this scenario is reliant on securing an OEM supplier in the UK – this needs to be tempered by the reality of the supply chain establishing itself (including inward investment from major OEMs) in time and to the quality that Forewind and the OEMs would require. Securing OEM capacity will be dependent on sufficient demand for products such that the volume of production required does not outstrip the required supply of products. UK generation targets will have a significant bearing on the likely demand for products, as generation targets influence the levels of development that will take place. The high scenario therefore considers higher targets for offshore wind generation in the UK. The location of OEM facilities would also have bearing on the level of offshore wind supply chain locating within an area, acting as a driver for accelerating an agglomeration effect in industry clustering. This is also considered in the high scenario.

For foundations, assuming that an optimistic 100 foundations per year can be produced by a single yard, and that there is not sufficient space available to hold excessive stock levels, 2-5 fabrication yards will be required. With UK steel fabrication realistically limited to 4 yards at present, fabrication should not be expected to exceed 50%.However, the significant influence on this high UK content is the assumed presence of a WTG OEM in the UK. If this does not come to fruition, the UK content would drop from 76% to 53% or less, therefore the presence of an OEM is likely to be critical for meeting any aspiration to 50% UK content.

From the assumed 7.2GW Construction Programme, 40-200 WTG (plus their associated foundations, therefore 80-400 structures, not including OSP, accommodation platforms or met masts) would need to be installed per year between 2021 and 2030. Assuming the offshore construction window is April to October (7 months or 214 days) with 20% downtime due to weather (and no down time due to other reasons – transit for crew change / bunkering / resupply, industrial action, Acts of God, etc.) this gives 171 working days per year. Assuming one foundation or WTG can be installed per vessel per day, this requires at least 1-2 Wind Turbine Instillation Vessel (WTIV) working on each of the 6 projects full time for the duration. Considering that other wind farms, and the oil and gas industry, will be competing for the same vessels, and that only about 18% of the 30 or so currently suitable vessels are based in the UK, an optimistic limit on installation might be 15%.

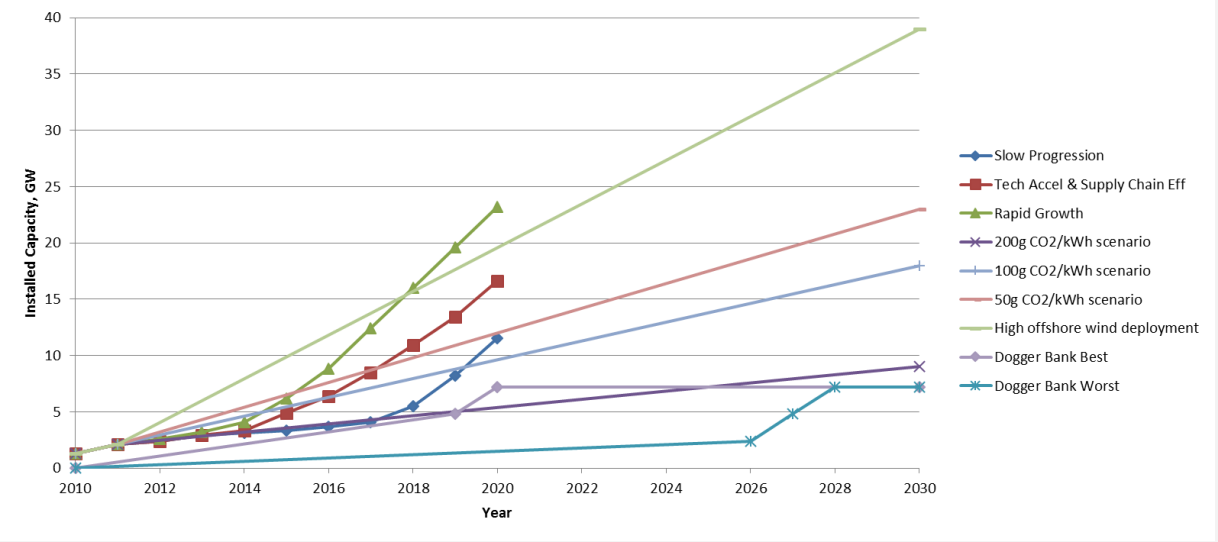
To ensure the credibility of scenarios, and to highlight the zones potential contribution to national generation, the build out programme for each of the scenarios was considered in the context of existing national projections for UK offshore wind. A number of build-out scenarios for the UK offshore wind sector have been developed by TCE and DECC, and these have been considered in the context of scenario development for this study.

Three basecase scenarios were developed for generation from the zone. These are as follows:

- *Six Projects* - This has 7.2GW built out by 2030, based on about 18% of the total UK capacity for High Offshore Wind Deployment.
- *Four Projects – This has 4.8GW being built out by 2029 (12% of total UK capacity for High Offshore Wind Deployment).*
- *Two Projects* - This scenario has 2.4GW constructed by 2025, which represents just 6% of UK capacity for a High Offshore Wind Deployment model, but if following the 200g CO2/kWh trend, would represent approximately 27% of UK capacity.

The figure below illustrates these scenarios in the context of the "worst" and "best" case build out scenarios developed for this study.

Dogger Bank Build Out scenario development – UK generation context[6]



[6] The national build out scenarios considered in the context of this study are as follows: *The Crown Estate – Offshore Wind Cost reduction Pathways Study 2012 (*Slow Progression, Technology Acceleration & Supply Chain Efficiency and Rapid Growth scenarios) and *DECC: Delivery Plan consultation and EMR implementation programme; 31 July 2013 (*200g CO2/kWh, 100g CO2/kWh, 50g CO2/kWh and High offshore wind deployment scenarios

Context for regional share of activity

If suppliers were spread evenly throughout the UK, the NE&YH would contain 12.1% of national employment in relevant supply chain employment sectors; based on the current levels of national supply activities and derived from SIC Codes (List of SICs provided later in this report).

The propensity of potential suppliers to locate within the NE&YH regions will, as with most investments, depend on a number of company decisions surrounding various supply and demand factors; such as having a ready-skilled pool of labour or cost efficiencies etc. The competitive and comparative advantages of NE&YH over other areas will be an important factor in understanding the likely levels of the supply chain expenditure for the Dogger Bank to be captured in the region. It is anticipated that the two regions will capture a significant share of UK supply chain activity for the Dogger Bank The justifications for this include:

- Proximity to the Dogger Bank offshore wind farm, proposed cable corridors and construction ports.
- Logistically, the transport of wind farm components is a significant operation; cost efficiencies can be made by locating closer to assembly ports.
- Existing skilled workforce in large scale manufacturing, offshore oil and gas, engineering and logistics – higher than the UK average – a fifth of all national manufacturing and a seventh of all national energy production jobs are located in NE&YH.
- Identified port-side employment land around the Humber, Tees, Wear (Sunderland), Tyne and Blyth.
- Significant historic and continued ports and renewables sector led promotion activities within the Humber, Tees Valley, Wear, Tyne and Blyth areas.

This evidence supports assumptions for the proportion of activity that could be delivered in the NE&YH regions being similar to the levels of the supply chain that could be captured nationally.

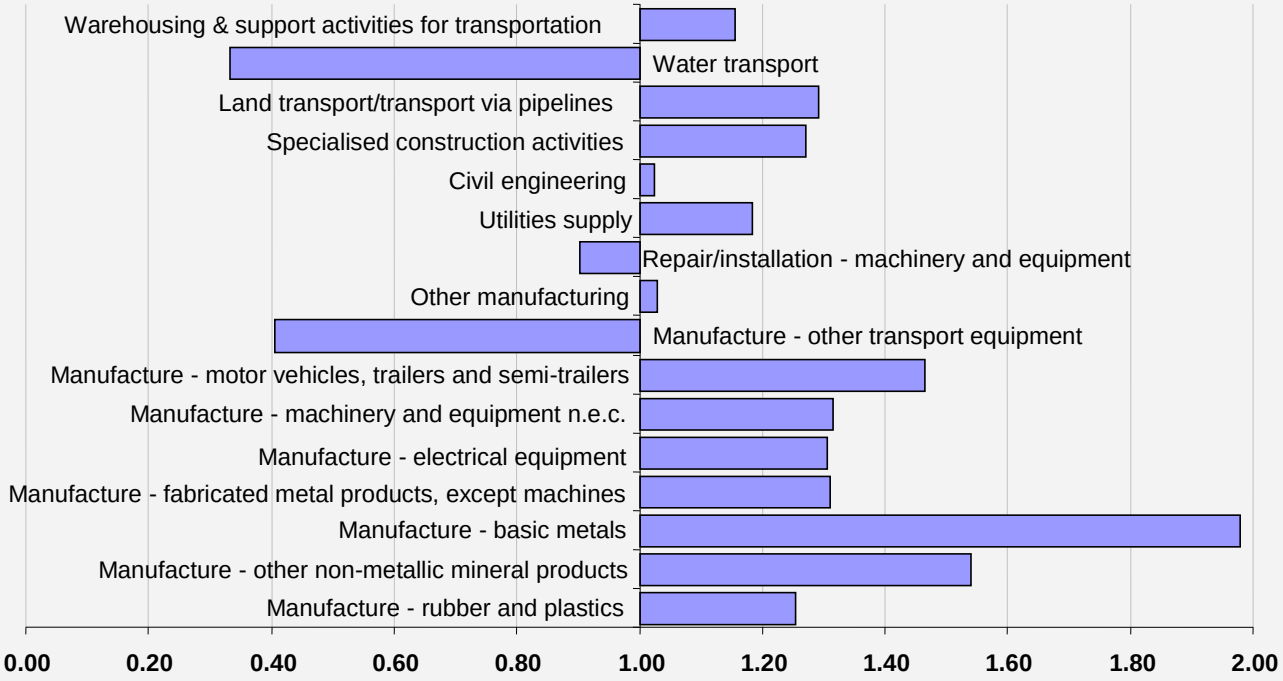
Project Management, Development and Operation and Maintenance phases

Project Management, Development and Consenting activity for the Dogger Bank is largely taking place at Forewind's offices in Reading, although some activities may be based in NE&YH, such as vessel survey work and local consultation. This may involve considerable Project Management and Development activities within NE&YH alongside such activities in Reading. Similarly, for the operation and maintenance phase, it is likely that the majority of monitoring and repair operations will be carried out from locations close to the zone.

Manufacturing and Installation phases

Location Quotient (LQ) analysis is a useful tool for understanding the relative levels of employment in industry sectors operating in one spatial level compared to another, regardless of size differences between those geographies. Essentially an LQ of +2 represents twice the levels of employment in NE&YH compared to the average level of employment in the same sector for the UK.

Location Quotients – UK and NE&YH – strengths in northern manufacturing, engineering, construction and logistics sectors.



The table above highlights NE&YH's existing strengths in manufacturing, construction and logistics, relative to the UK. In 2010, a total of 469,400 employees worked across relevant sectors (manufacturing, construction and logistics) in NE&YH. This was just over 25% higher than the average UK concentration in these sectors which implies the significant capabilities of NE&YH as more "oven-ready" destinations for the supply chain.

Already higher levels of supply chain capabilities in NE&YH means that it is reasonable to assume an uplift in supply contracts in NE&YH, beyond those companies already identified as part of the supply chain review. This is because as offshore wind activity gathers pace, it is likely that an increased number of firms will locate or that demand for supply activity will result in existing companies changing their operational focus in NE&YH.

Market forces will therefore drive economic restructuring towards clusters of wind farm supply. This agglomeration/catalytic effect has been well documented in literature and results in industry cluster formation within localities. The benefits that firms accrue by locating in existing or emerging clustering is also well documented in economic theory. These can include reduced production costs, increased productivity and greater networking potential. It is this cluster of supply chain companies that offers the most benefit from creating jobs, increasing capacity and reducing costs (Offshore Wind Industrial Strategy, August 2013).

The catalytic or agglomeration effect of offshore wind development has been recognised in various media outputs, but the effect has yet to be measured and quantified in academic literature. PD Ports and Clean Energy Pipeline undertook some research to identify the potential for offshore wind farm supply chain clustering, surveying 70 senior executives in the supply chain across Europe. Their report *UK Offshore Wind Farm Supply Chain: Why clusters matter* (2012) found that NE&YH was the most favourable region in the UK for clusters to develop due to a strong industrial heritage in offshore oil and gas, the proximity to various offshore wind farm zones and the presence of existing ports infrastructure capacity.

The potential effect in securing OEM capabilities in the NE&YH region would likely act as a driver for industry clustering and accelerate any agglomeration effects. This could have a significant bearing on the UK and regional content outcomes.

2.3 Stage 3: Defining CAPEX and OPEX and cost modelling

2.3.1 Defining CAPEX and OPEX

An assumed investment cost for each major required component of the wind farm was derived from cost assumptions in *A Guide to an Offshore Wind Farm* (TCE, 2010) and was supplemented with team experience in offshore wind projects to date. Aligned to the project definition, this provided an estimated total capital and operational spend for the delivery of six projects, with a more detailed breakdown of costs for each major component of the wind farm.

Note that this was not undertaken for each detailed part / Work Breakdown Structure (WBS) – it focused on main activities, major components and assemblies, not minor components or sub-components. Examples of items not included (and assumed to be covered by other identified items) comprised cable connectors, sealants and seals, coatings, composite access products, hydraulic hoses and components, fastenings, load monitoring systems, Personal Protective Equipment (PPE), aggregate, grout, steel, security, regulators costs, compressed air, ship brokering / agents, etc. This list is by no means exhaustive.

2.3.2 Scenario Cost Model

The capital and operational investment costs were modelled against the technical requirements and programme for the delivery of each project. Total costs for each broad components were averaged across delivery timescales for each phase (i.e. not up front, milestones, on completion, etc). Bid stage (predevelopment) costs are included in the Cost Model, so Year 1 represents 2010. Repowering and decommissioning costs are not considered, as there is considerable uncertainty surrounding timescale and costs for such activities. WTG includes blade set and tower; UK content of components is negligible at present.

The Cost Model assumes a single source supply at required volumes is possible. It does not allow for manufacturing limits, supply chain constraints or market competition – other than for installation vessels and foundations. Costs for these were based on assumptions outlined in Appendix I of this report. The product of this exercise was an assumed cost profile for total expenditure for use in economic modelling for each scenario.

2.4 Stage 4: Economic benefits modelling

2.4.1 Economic Benefits Model

The headline profiled expenditure scenarios were then used to inform a developed Economic Benefits Model – this model takes the profiled spend, applies the scenarios and adjustments for economic effects and then converts the outputs of this exercise into gross and net direct employment estimates. From this, estimates of GVA are then modelled based on a series of metrics. Adjustments and justifications for the conversions are outlined in the sections below.

2.4.2 Leakage in trans-national and pan-regional businesses

Some of the activity benefits from project expenditure will 'leak' to other locations, within and outside of the UK and its regions, as expenditure flows through the supply-chain – this is inevitable given the complex component supply-chains associated with offshore wind farms. In addition, in the case of foreign-owned companies operating in the UK, some expenditure may be absorbed into management / administration costs for the parent company. This supply 'leakage' effect is taken into account in the Economic Benefits Model through an adjustment to gross investment impact – **for modelling purposes, a leakage adjustment factor of 5% to account for these effects**. Further leakage effects are included in the regional model to account for commuting from outside of the NE&YH region.

2.5 Stage 5: Aligning supply chain to Standard Industrial Classifications (SIC)

In the UK, the Standard Industrial Classifications (SIC) is a coded system used to classify groups of related industries into sector bands. It is a tiered classification that begins with broad sectors descending into increasingly narrower specialisms, indicated by a lower tier of SIC. For example, 1 Digit SIC includes *Agriculture* as a broad sector, while 2 Digit SIC includes *Growing of perennial crops* as one of seven sub-set agricultural activities. Increasingly refined specialisms correspond to a higher number of "digits" in the national coding system (up to 7 Digit SIC). When analysing lower tiered SICs, the accuracy of data becomes compromised so we have undertaken a higher level review of relevant SIC codes to improve the reliability in the data. A review of SIC codes up to 2 Digit SIC has been undertaken against supply chain elements to identify a list of relevant SICs for wind farm activity. The SICs have been aligned to the five main development stages of wind farm activity for use throughout the model.

At 1 Digit SIC Group level the relevant industry sectors used in the analysis were:

- ❑ Professional, Scientific and Technical
- ❑ Manufacturing
- ❑ Construction
- ❑ Electricity, gas, steam and air conditioning supply

At 2 Digit SIC 2007 Division level the relevant industry sectors used in the analysis were:

22. Manufacture of rubber and plastic products	49. Land transport and transport via pipelines
23. Manufacture of non-metallic mineral products	50. Water transport
24. Manufacture of Basic Metals	52. Warehousing and support activities for transportation
25. Manufacture of fabricated metal products, except machinery and equipment	55. Accommodation
27. Manufacture of electrical equipment	56. Food beverage and service activities
28. Manufacture of Machinery and equipment n.e.c.+	68. Real estate activities
29. Manufacture of motor vehicles, trailers and semi-trailers	69. Legal and accounting services
30. Manufacture of other transport equipment	70. Activities of head offices; management consultancy activities
32. Other manufacturing	71. Architectural and engineering activities, technical testing and analysis
33. Repair and Installation of machinery and equipment	72. Scientific research and development
35. Electricity, gas, steam and air conditioning supply	74. Other professional , scientific and technical activities
42. Civil engineering	81. Services to buildings and landscape activities
43. Specialised construction activities	82. Office administration, office support and other business support activities

This aligned offshore wind activities to SIC codes which enabled the use of published data on employment values in the sectors to be applied in estimating economic benefits.

2.6 Stage 6: Direct and induced employment gains

2.6.1 Employment definitions

The Employment Benefits Model seeks to distinguish between "direct" and "induced" employment gains. Typical assessments of job creation seek to identify direct, indirect and induced employment. Direct employment normally relates to those directly employed on-site, indirect employment usually relates to those in the supply chain and induced employment is typically those jobs generated as a result of business and employee spending activity in the wider economy.

Since this study has taken a bottom-up approach that identifies jobs in the supply chain, and because of the offshore nature of the development, we have treated direct and indirect effect as a single category. These employment effects are therefore defined as the following:

- ***Direct employment:*** Jobs created directly as a result of the wind farm development, including all employment in the supply chain for the pre-construction, construction, and operational phases of the wind farm
- ***Induced employment:*** Jobs generated by downstream expenditure in businesses in the supply chain and their employees spending within the economy, which has a multiplier effect as rounds of spending occur.

The majority of reports seeking to identify employment generated through offshore wind have focussed on the number of direct (and indirect jobs) created per MW or per turbine installed. This high level top-down approach does not include detailed analysis of supply activity, or employment gains from the remaining aspects of a wind farm (balance of plant etc). Supply chain spend data provides a more accurate basis for estimates of employment gains in large scale infrastructure developments and so employment estimates have been derived from the expenditure scenarios. Two approaches have been developed to identify direct jobs; the outputs of which provide the range of direct job creation in each scenario. Broadly these are as follows:

- **Method 1:** uses national level turnover per employee data from across relevant SIC sectors and the total wind farm expenditure profile to arrive at an employment impact estimate
- **Method 2:** utilises industry survey data from a Renewables Advisory Board (RAB) commissioned survey to estimate the likely spend on labour costs and employee earnings data by relevant SIC sector to arrive at an employment estimate

This two-pronged approach reduces the uncertainty in the accuracy of standardised ratios used to derive the number of jobs and provides a range of potential direct employment effects. Both methods carry equal standing in the assessment and neither method represents a more accurate picture of employment than the other. Each method is discussed further in the sections below.

These methods have generated a range of gross direct employment gains under each scenario. Outputs from both methods were then adjusted to account for leakage and displacement effects, providing estimates for net direct jobs generated. A multiplier factor has been applied to quantify induced employment gains. Both methods provide estimates for annual employment generated. The number of Full-Time Equivalent (FTE) jobs has then been calculated – based on a ratio of 10 years employment per FTE.

2.6.2 Employment Method 1: Total expenditure approach

Estimates of turnover per employee in the supply chain for the Dogger Bank wind farm have been derived from analysis of sector turnover data; using datasets published by BIS in its Business Demography series. The dataset includes sector based turnover data by business size at 1-Digit SIC 2007 Group level. Although this is headline data, across broad sectors, it acts as a useful proxy for understanding the different ratios of turnover/employee amongst sectors.

A review of 2 Digit SIC Division level codes for related industries has been undertaken to identify total employment in wind farm related sectors across the UK – by mapping the five main stages of a wind farm development against SIC codes. This allowed for quantified estimates to be calculated that for annual cost per jobs in each location for each main stage of wind farm supply chain. The outputs of this analysis are provided below.

The results of this exercise then provided the multiplier from which employment estimates were derived for Employment Method 1. These essentially give an estimated level of expenditure required to support each job in the UK within the five main stages. These are as follows:

- ***Project Management:*** an annual cost of £101,300 per job
- ***Development:*** an annual cost of £101,300 per job
- ***Manufacture:*** an annual cost of £156,100 per job
- ***Installation:*** an annual cost of £110,800 per job
- ***Operations and Maintenance:*** an annual cost of £736,300 per job

Turnover per employee and total employment in relevant offshore wind SIC sectors					
Main Stage of activity	**Relevant Sector (SIC 2007 Division)**	**Turnover per employee (£)**		**Employment (Total jobs, FT/PT, 2012)**	
		UK	**NE&YH**	**UK**	**NE&YH**
PM / Development	68. Real estate activities	106,817	70,261	542,333	52,143
PM / Development	69. Legal and accounting services	86,724	79,331	527,700	45,708
PM / Development	70. Activities of head offices; management consultancy activities	152,255	79,331	410,272	42,162
PM / Development	71. Architectural and engineering activities, technical testing and analysis	102,062	79,331	121,689	8,075
PM / Development	72. Scientific research and development	253,038	79,331	132,326	17,075
PM / Development	74. Other professional , scientific and technical activities	77,264	79,331	607,961	51,361
PM / Development	81. Services to buildings and landscape activities	34,090	52,788	346,613	47,234
PM / Development	82. Office administration, office support and other business support activities	112,628	52,788	114,284	16,556
Manufacture	22. Manufacture of rubber and plastic products	132,069	145,780	144,492	22,099
Manufacture	23. Manufacture of non-metallic mineral products	136,635	145,780	83,061	15,399
Manufacture	24. Manufacture of Basic Metals	233,764	145,780	71,009	18,419
Manufacture	25. Manufacture of fabricated metal products, except machinery and equipment	103,027	145,780	295,171	47,087
Manufacture	27. Manufacture of electrical equipment	144,000	145,780	89,785	14,421
Manufacture	28. Manufacture of Machinery and equipment n.e.c.+	153,216	145,780	184,411	28,903
Manufacture	29. Manufacture of motor vehicles, trailers and semi-trailers	287,650	145,780	123,144	22,172
Manufacture	30. Manufacture of other transport equipment	200,157	145,780	127,144	6,352
Manufacture	32. Other manufacturing	97,264	145,780	84,058	10,440
Installation	33. Repair and Installation of machinery and equipment	123,356	145,780	89,000	9,961
Installation	42. Civil engineering	182,092	102,621	668,801	101,698
Installation	43. Specialised construction activities	77,663	102,621	489,835	76,328
Installation	49. Land transport and transport via pipelines	70,997	729,77	12,657	526
Installation	50. Water transport	370,722	729,77	407,071	55,592
Installation	52. Warehousing and support activities for transportation	168,946	729,77	407,548	37,139
Operations & Maintenance	35. Electricity, gas, steam and air conditioning supply	736,268	326,556	189,350	23,486

Source: BIS Business Population Estimates, 2012 and ONS Business Register and Employment Survey, 2012

- UK turnover per employee data provided at 2 Digit SIC 2007 (Group), Regional turnover per employee data provided at 1 Digit SIC 2007 (Division); numbers are for corresponding 2 Digit Group – Data is for all private sector enterprises. N.e.c = not elsewhere classified

2.6.3 Employment Method 2: Labour expenditure approach

Total expenditure for each of the scenarios includes costs for materials, labour and other factors. To define the likely proportion of this expenditure spent on labour costs, the model draws on analysis undertaken by BVG Associates on behalf of the RAB, in the report *Value Breakdown for the Offshore Wind Sector (2010).*

The BVG survey found that 35% of CAPEX and OPEX for offshore wind farms is spent on labour across the sector, with differing levels of labour spend for different aspect of the supply chain. The report also provides a detailed percentage breakdown of spend across each aspect of wind farm construction and operation and this detailed breakdown has been applied to determine the likely levels of direct expenditure on labour in each aspect of the supply chain. The labour breakdown is summarised below.

CAPEX and OPEX on labour for an Offshore Wind farm		
Aspect	**Percentage of offshore wind farm aspect spent on labour**	**Percentage of total offshore wind farm expenditure spent on labour**
CAPEX		
Development and Consent	60% of 4% Expenditure	2.4%
Turbine excluding tower	51% of 33% Expenditure	17%
Balance of Plant	26% of 37% Expenditure	9%
Installation and commissioning	25% of 26% Expenditure	6%
OPEX		
Operation and Maintenance	35% of 100% Expenditure	35%

Source: RAB/BVG Associates, 2010

Aligning these to the wind farm stages within the model, we have therefore assumed that 2.4% of costs are spent on Project Management and Development (1.2% 50:50 split), 26% for Manufacturing, 6% for Installation and 35% for Operations and Maintenance. Annual earnings data taken from ONS Annual Survey of Hours and Earnings (ASHE, 2011) at 2 Digit SIC has been used to determine the cost of a job within each stage of the wind farm. A nominal 15% increase has been applied to the earnings data to account for on-costs (national insurance, pension contributions etc.) thus providing a labour cost per job; data provided below.

This analysis provides the following cost per job estimates for the UK in each location as a proportion of labour spend under Employment Method 2:

- ***Project Management:*** an annual cost of £35,900 per job
- ***Development:*** an annual cost of £35,900 per job
- ***Manufacture:*** an annual cost of £34,900 per job
- ***Installation:*** an annual cost of £33,900 per job
- ***Operations and Maintenance:*** an annual cost of £44,100 per job

Mean annual earnings and labour costs per job in relevant offshore wind farm SIC sectors					
Main Stage of activity	**Relevant Sector (SIC 2007 Division)**	**Mean annual earnings**		**Labour cost per job (includes on-costs)**	
		UK	**NE&YH**	**UK**	**NE&YH**
PM / Development	68. Real estate activities	34,542	22,904	39,723	26,339
PM / Development	69. Legal and accounting services	46,424	25,316	53,388	29,113
PM / Development	70. Activities of head offices; management consultancy activities	35,994	27,285	41,393	31,378
PM / Development	71. Architectural and engineering activities, technical testing and analysis	45,256	30,431	52,044	34,996
PM / Development	72. Scientific research and development	28,545	31,009	32,827	35,660
PM / Development	74. Other professional , scientific and technical activities	14,847	23,821	17,074	27,394
PM / Development	81. Services to buildings and landscape activities	26,903	15,386	30,938	17,694
PM / Development	82. Office administration, office support and other business support activities	38,372	19,408	44,128	22,319
Manufacture	22. Manufacture of rubber and plastic products	25,575	23,750	29,411	27,312
Manufacture	23. Manufacture of non-metallic mineral products	30,466	29,991	35,036	34,490
Manufacture	24. Manufacture of Basic Metals	34,584	31,488	39,772	36,211
Manufacture	25. Manufacture of fabricated metal products, except machinery and equipment	27,182	26,756	31,259	30,770
Manufacture	27. Manufacture of electrical equipment	27,716	25,440	31,873	29,256
Manufacture	28. Manufacture of Machinery and equipment n.e.c.+	32,703	32,862	37,608	37,791
Manufacture	29. Manufacture of motor vehicles, trailers and semi-trailers	33,505	28,784	38,531	33,102
Manufacture	30. Manufacture of other transport equipment	38,429	-	44,193	-
Manufacture	32. Other manufacturing	26,368	-	30,323	-
Installation	33. Repair and Installation of machinery and equipment	34,843	-	40,069	-
Installation	42. Civil engineering	28,120	28,029	32,338	32,234
Installation	43. Specialised construction activities	27,340	24,817	31,441	28,539
Installation	49. Land transport and transport via pipelines	31,770	24,251	36,536	36,536
Installation	50. Water transport	31,388	20,681	36,096	23,783
Installation	52. Warehousing and support activities for transportation	16,545	29,774	19,027	34,240
Operations & Maintenance	35. Electricity, gas, steam and air conditioning supply	32,987	34,325	37,935	39,474

Source: ONS, Annual Survey of Hours and Earnings (ASHE), 2012

- = Data not available; UK averages included as proxy in the calculations

2.6.4 Weighting for levels of additionality

Not all benefits will be accrued within the project area. A proportion of the expenditure on the wind farm will be on activities outside the defined project area, and therefore some labour requirements are likely to also be outside of the UK and NE&YH. Other direct jobs in the supply chain are likely to already be present in the study area, with existing workforces transferred from current operations to complete contracts. Adjustments have therefore been made to the overall direct employment estimates to account for these leakage and displacement effects. These comprise:

Leakage effects

Leakage effects comprise economic benefits that occur outside the defined area of impact and therefore need to be deducted from the analysis of gross project benefits. For example, if a proportion of the suppliers to Dogger Bank are expected to be outside of the area of impact, then adjustments will need to be made to the employment effects associated with the purchase of those supplies.

Leakage effects are generally quite small, typically in the order of a 5-15% adjustment to gross impacts. It is of course highly influenced by the selected area of impact – the tighter the impact area the greater the potential for leakage.

The detailed supply chain review has identified likely activities in and outside of the UK, reducing the likely levels of leakage in our assessment. However, as the supply chain review has sought to identify a high level list of component parts, it is likely that smaller component parts will be produced outside of the UK. **A 10% reduction in the UK and NE&YH scenario has therefore been included in the model, to account for production of component parts outside of the impact areas.**

In terms of employment leakage arising from in/out commuter flows, it is assumed that no leakage will occur in the UK scenarios. Understanding the probable leakage of benefits outside of NE&YH is a more problematic exercise, in part due to factors such as daily commuting flows and higher levels of inter-regional trading between firms; unlike the UK, the NE&YH region is not entirely bounded by the sea.

The levels of self-containment of wind farm supply chain workforces within NE&YH is likely to be fairly high due to the following reasons:

- Much of the knowledge intensive activity (in Project Management and Development) will take place outside of the NE&YH region – through outsourced engineering or environmental consultancies or at Forewind's offices in the South East – this is already accounted for in the supply chain review.
- The NE&YH region an extensive and production activity is likely to be focused in the eastern sub-regions of the study area, limiting feasible west-east and north-south commuting from outside of the regions due to long journey times.
- There is a greater potential for leakage from south-north commuting from the East Midlands particularly if activity is concentrated in the Humber area. Limited connectivity between the North and South of the Humber Estuary, exacerbated by Humber Bridge Tolls (despite recent reductions in tolls), reduces potential leakage from supply activities taking place on the North Bank of the Humber. Although there is significant potential for

supply chain development on the South Bank of the Humber, settlement distribution and transport networks across Lincolnshire reduces labour market interaction and thus levels of leakage.

- For the offshore workforce, the majority of vessel crew may originate from beyond the NE&YH region, although this figure may reduce with longer term contracting and permanently stationed vessels. Some benefits will be accrued through induced impacts from temporary spending patterns of workers when based in onshore accommodation facilities.

Given the higher potential for leakage in the regional analysis than in the UK analysis, the Economic Benefits Model includes an additional **reduction of 5% in the Manufacturing, Installation and O&M stages for NE&YH** – leakage in the remaining stages has already been accounted for in the Supply Chain review.

Displacement/Substitution effects

Displacement is defined as the proportion of project outputs/outcomes accounted for by reduced outputs/outcomes elsewhere within the area of impact. Consequently, the direct benefits of the wind farm have been adjusted to reflect the potential for displacement in order that the benefits claimed for the impact area are wholly net additional. As with leakage effects, displacement adjustments will vary depending on the area of impact under analysis – the tighter the area of impact the lower the propensity for displacement/substitution effects.

For direct employment impacts, a proportion of the staff employed for the Dogger Bank supply chain activities will be transferred from existing jobs within the area of impact. The scale of any direct job displacement may be mitigated if persons who were previously economically inactive are attracted back into the labour market because of the new opportunity for work.

A 15% reduction in net benefit in the UK and a 12.5% reduction in net benefit to NE&YH have been included in the estimates, to account for displacement[7].

[7] This is in line with estimates in the English Partnerships Additionality Guide (2008) for Lower levels of displacements in national and regional developments.

2.7 Stage 7: GVA estimates

GVA (Gross Value Added) measures the contribution to an economy of an individual producer, industry or sector, and is used to measure national, regional and sub-regional economic performance (Wainman and others, 2010). It is the UK Government's preferred measure of economic impact.

GVA estimates within the Economic Benefits Model have been calculated based on the number of expected jobs generated by the wind farm; using the job estimates derived in Employment Methods 1 and 2. As with employment estimates, two methods have been used to determine the range of GVA for each scenario – this enables an appropriate methodology for each Employment Method.

2.7.1 GVA Method 1

This method has been applied to Employment Method 1, as it relates to overall expenditure, from which employment estimates have been derived. Input data for this has been sourced from ONS Sub-national GVA estimates for 2012, which offers current estimates of GVA per worker at broad SIC sector level and at national and regional geographies; derived from analysis of national accounts. Direct and Induced employment estimates across each of the scenarios have been multiplied by GVA per worker data across averages for the relevant sectors for the UK, to arrive at total GVA estimates in each scenario.

The corresponding broad sectors and the GVA per worker (2012) co-efficients in each location are provided below.

GVA Method 1 Metrics

Wind farm Stage	Broad Industry Sector	Total Jobs (2011)		Headline GVA (m) (2010)		GVA per worker (£)	
		UK	NE&YH	UK	NE&YH	UK	NE&YH
Project Management	Professional, Scientific and Technical	1,926,275	179,510	94,146	6,040	48,875	33,647
Development	Professional, Scientific and Technical	1,926,275	179,510	94,146	6,040	48,875	33,647
Manufacture	Manufacturing	2,323,752	355,549	141,711	20,035	60,984	56,349
Installation	Construction	1,216,550	160,367	83,280	8,847	68,456	55,167
Operations and Maintenance	Electricity, gas, steam and air conditioning supply	114,284	16,556	19,408	2,565	169,823	154,929

Source: ONS Subnational Estimates of GVA, Workplace based / ONS Business Register and Employment Survey 2011, via NOMIS

2.7.2 GVA Method 2

This method has been applied to Employment Method 2 because the method is closely linked to labour expenditure. The estimate is derived from Workplace based Compensation of Employee (CE) data by Broad Industrial Sector at regional level published annually by ONS. CE is a statistical term used in accounting to provide total gross wages paid by employers to employees. In national accounting CE is defined as "the total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the latter during the accounting period". It therefore effectively represents a total expenditure on labour by an employer.

Total CE GVA is reported by ONS, but ONS do not report GVA CE per worker at regional level. Totals for CE per worker in the relevant SIC sectors have been arrived at by dividing total GVA CE by equivalent employment data taken from the ONS Business Register and Employment Survey (BRES, 2011). From this we arrive at an estimate of GVA generated per job in each stage of the wind farm, summarised in the table below. This has then been multiplied by the employment estimates for Employment Method 2, to arrive at a total GVA figure in each scenario.

Added Value per Job through Compensation of Employee analysis							
Wind farm Stage	**Broad Industry Sector**	**Total Jobs (2011)**		**Headline GVA CE (m) (2010)**		**GVA CE per worker (£)**	
		UK	**NE&YH**	**UK**	**NE&YH**	**UK**	**NE&YH**
Project Management	Professional, Scientific and Technical	1,926,275	179,510	58,555	3,686	30,398	20,534
Development	Professional, Scientific and Technical	1,926,275	179,510	58,555	3,686	30,398	20,534
Manufacture	Manufacturing	2,323,752	355,549	99,854	14,478	42,971	40,720
Installation	Construction	1,216,550	160,367	44,166	1,884	36,304	11,748
O&M	Electricity, gas, steam and air conditioning supply	114,284	16,556	6,377	855	55,800	51,643

Source: ONS Subnational Estimates of GVA, Workplace based Compensation of Employees / ONS Business Register and Employment Survey 2011, via NOMIS

2.8 Stage 8: Induced employment and GVA estimates

2.8.1 Induced employment

Businesses in the supply chain and their employees generate spend within the economy, which has a multiplier effect as rounds of spending occur. This then supports additional employment effects (Induced employment). Induced (or multiplier) effects themselves arise from the process through which the local spending of staff, clients and the wind farm helps to support other businesses within a defined area of impact, contributing to the wages and salaries of employees and covering material overheads.

Some personnel will be employed in offshore Installation and surveying activities, where they cannot spend wages. This has not been accounted for in the model, as we have assumed that wages saved while offshore, will be spent while onshore at some point. The distribution of wages amongst other family members will also reduce the effects of this occurring.

An employment multiplier of 1.4 has been applied to Net employment estimates to account for induced employment effects[8]. This is in line with current estimates contained in existing economic impact studies for offshore wind farms[9].

2.8.2 Induced GVA

The induced employment impacts in turn generates additional GVA. **A total GVA per worker figure for the UK of £43,200 has been applied to the 0.4 additional jobs estimate**, based on ONS estimates (2011). This differs from GVA analysis performed on Direct Gross and Net calculations (as outlined above). No sector breakdown has been used to determine the GVA from induced employment because induced employment is not sector specific and could occur across all sectors, not just those identified as being of relevance for offshore wind farm supply chains.

2.9 Stage 9: Discount factors

The Cost Model and Economic Benefits Model use current values in their assumptions. All values are presented as prices in 2010 (Year 1 of the project). Discount factors have therefore not been used to account for inflation. Discount factors have however been included in the model to account

[8] English Partnerships Additionality Guide (2008). This is based on regional multipliers for induced employment in which estimate a multiplier of between 1.3 and 1.5 depending on Low or Medium levels of local supply.

[9] Analysis of Employment Effects of O&M in Offshore Wind Parks in the UK, Oxford Economics (2010); Dogger Bank Creyke Beck Environmental Statements (Chapter 22, Socio-Economics, 2013), UK Content Analysis of Robin Rigg Offshore Wind Farm Operation and Maintenance, BVG for E.On (July 2012) etc.

for the present value of the investment. Present values have been calculated because, as a whole, society prefers to defer costs to future generations (and receive goods and services sooner rather than later).

A discount rate of 3.5% has been applied throughout the lifecycle of the wind farm – this is based on HM Treasury Guidance. The headline results (presented below and in the Headline Report) include the applied discount factor to GVA only, as a monetised economic benefit. The results presented in Annex IV take an alternative approach, by applying the 3.5% discount factor to the investment spend profile, as an economic cost to the investor. This discounted investment profile has then been used to calculate economic benefits (jobs and GVA) – therefore in Annex IV jobs and GVA are discounted. Both sets of analyses are compared in Section 3.5 Interpreting the results.

The two approaches adopted reflect different methods for measuring the value of the proposed development:

- The headline results depict the current value of the economic benefits – reflecting the fact that jobs will be created at the point of investment.
- The discounted results depict the present value of the economic benefits to society – reflecting that as a whole, society prefers to receive a benefit sooner rather than later.

3 Headline results

The following tables present the headline results of the economic modelling exercise. These present the following for each scenario:

- Estimated expenditure for realising six projects and the proportion of that spend
- Net present value of that expenditure
- Gross direct jobs and GVA
- Net direct jobs and GVA
- Total net benefits (including multiplier effects for induced benefits)

3.1 Estimated expenditure

The table below outlines the total estimated gross expenditure for realising up to six projects and the estimated proportion of that spend under each scenario for the UK and NE&YH regions.

Scenario Investment in the Dogger Bank															
Scenario	Total Investment*			Estimated UK content (£bn)						Estimated NE&YH content (£bn)					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Total Expenditure															
Investment	27.8	18.5	9.3	20.0	10.6	13.4	7.0	6.7	3.5	14.0	8.3	9.3	5.5	4.7	2.8

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date.
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.2 Gross direct employment and GVA estimates

This table below provides estimates for gross direct benefits in terms of gross jobs years, gross FTE employment and discounted gross GVA under each scenario and at UK and NE&YH regional level.

Gross Direct Benefits of the Dogger Bank															
Scenario	Total Investment*			Estimated UK content						Estimated NE&YH content					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Gross Direct Employment															
Job years (range)	167,850	111,950	55,850	121,200	63,800	80,750	42,550	40,350	21,200	102,050	63,800	68,000	40,400	34,000	20,150
	178,600	119,050	59,500	128,950	67,850	85,950	45,250	43,000	22,600	108,600	67,850	72,400	43,000	36,200	21,500
FTEs** (range)	16,800	11,200	5,600	12,100	6,400	8,100	4,250	4,050	2,100	10,200	6,400	6,800	4,050	3,400	2,000
	17,850	11,900	5,950	12,900	6,800	8,600	4,500	4,300	2,250	10,850	6,800	7,250	4,300	3,600	2,150
Gross Value Added															
Gross GVA (discounted range)	£6.5bn	£4.4bn	£2.4bn	£4.7bn	£2.5bn	£3.2bn	£1.7bn	£1.8bn	£900m	£3.5bn	£2.1bn	£2.3bn	£1.4bn	£1.3bn	£750m
	£4.3bn	£2.9bn	£1.6bn	£3.1bn	£1.6bn	£2.1bn	£1.1bn	£1.2bn	£600m	£2.4bn	£1.4bn	£1.6bn	£950m	£900m	£550m

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date.
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.3 Net direct employment and GVA estimates

The table below provides estimates for net direct benefits for net job years, net FTE Employment and discounted net GVA under each scenario and at UK and NE&YH regional level.

Net Direct Benefits of the Dogger Bank															
Scenario	Total Investment*			Estimated UK content						Estimated NE&YH content					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Net Direct Employment															
Job years (range)	125,900	83,950	41,900	90,900	47,850	60,550	31,750	30,250	15,900	74,000	43,950	49,300	29,300	24,600	14,650
	133,950	89,300	44,650	96,700	50,900	64,450	33,100	32,350	16,950	78,700	46,750	52,500	31,150	26,250	15,500
FTEs** (range)	12,600	8,400	4,200	9,100	4,850	6,050	3,150	3,050	1,600	7,400	4,400	4,950	2,950	2,450	1,450
	13,400	8,950	4,450	9,650	5,900	6,450	3,300	3,200	1,700	7,850	4,650	5,250	3,100	2,600	1,550
Gross Value Added															
Gross GVA (discounted range)	£4.9bn	£3.3bn	£1.8bn	£3.5bn	£1.9bn	£2.4bn	£1.2bn	£1.3bn	£700m	£2.6bn	£1.5bn	£1.7bn	£1.0bn	950m	£550m
	£3.2bn	£2.2bn	£1.2bn	£2.3bn	£1.2bn	£1.6bn	£800m	£900m	£450m	£1.8bn	£1.0bn	£1.2bn	£700m	£650m	£400m

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date.
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.4 Total net benefits (net direct and induced)

The table below outlines the results of the economic modelling exercise for each scenario and the total expenditure. This comprises total investment figures and estimates of direct benefits for net job years, net FTE Employment and discounted net GVA under each scenario and at UK and NE&YH regional level.

Net Total Benefits of the Dogger Bank															
Scenario	Total Investment*			Estimated UK content						Estimated NE&YH content					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Net Total Direct Employment															
Job years (range)	176,250	117,500	58,650	127,250	67,000	84,850	44,650	42,350	22,300	103,600	61,500	69,000	41,000	34,450	20,450
	187,500	125,000	62,500	135,400	71,250	90,250	47,500	45,150	23,750	110,200	65,450	73,350	47,500	36,750	21,800
FTEs** (range)	17,650	11,750	5,900	12,750	6,700	8,500	4,450	4,250	2,250	10,350	6,150	6,900	4,100	3,450	2,050
	18,750	12,500	6,250	13,550	7,150	9,050	4,750	4,500	2,400	11,000	6,550	7,350	4,350	3,750	2,200
Gross Value Added															
Gross GVA (discounted range)	£6.3bn	£4.2bn	£2.3bn	£4.5bn	£2.4bn	£3.4bn	£1.6bn	£1.7bn	£900m	£3.3bn	£2.0bn	£2.2bn	£1.3bn	£1.2bn	£750m
	£4.5bn	£3.0bn	£1.6bn	£3.3bn	£1.7bn	£2.7bn	£1.1bn	£1.2bn	£650m	£2.5bn	£1.5bn	£1.7bn	£1.0bn	£950m	£550m

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.5 Interpreting the results

The following tables present a refined interpretation of the upper range employment estimates to the UK and YH&NE in each scenario. The analysis combines the headline employment and GVA gains, broken down by economic benefits estimated during the construction and operational phase, followed by net total employment estimates (as listed above). It then outlines the discounted value of the total estimated job gains as presented in Annex IV. Please note, totals for the construction and operational phase employment estimates may not sum to total estimates. Small differences are due to the effects of rounding.

Upper range UK employment benefits					
		Economic benefit	**Development/ Construction**	**Operation/ Maintenance**	**Interpretation**
UK economic benefits					
Scenario 1	2.4GW by 2025 without OEM	Headline FTE's	1,750	500	In this scenario, 17,500 annual years of employment are estimated to be created in the UK during the development and construction phases, equivalent to 1,750 net additional FTE jobs with an expectation that 500 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 2,400 net additional FTE jobs in the UK would be created overall in this scenario, which would generate £650m in GVA to the UK economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 1,500 long term, full time jobs.
		Discounted FTE's	1,300	150	
		GVA	£530m	£80m	
	2.4GW by 2025 with OEM	Headline FTE's	3,350	900	In this scenario, 33,500 annual years of employment are estimated to be created in the UK during the development and construction phases, equivalent to 3,350 net additional FTE jobs with an expectation that 900 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 4,500 net additional FTE jobs in the UK would be created overall in this scenario, which would generate £1.2bn in GVA to the UK economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 2,850 long term, full time jobs.
		Discounted FTE's	2,450	250	
		GVA	£1.0bn	£150m	

Scenario 2	4.8GW by 2029 without OEM	Headline FTE's	3,550	950	In this scenario, 35,500 annual years of employment are estimated to be created in the UK during the development and construction phases, equivalent to 3,550 FTE jobs with an expectation that 900 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 4,750 net additional FTE jobs in the UK would be created overall in this scenario, which would generate £1.1bn in GVA to the UK economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 2,700 long term, full time jobs.
		Discounted FTE's	2,350	250	
		GVA	£970m	£130m	
	4.8GW by 2029 with OEM	Headline FTE's	6,750	1,850	In this scenario, 67,500 annual years of employment are estimated to be created in the UK during the development and construction phases, equivalent to 6,750 FTE jobs with an expectation that 1,850 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 9,050 net additional FTE jobs in the UK would be created overall in this scenario, which would generate £2.7bn in GVA to the UK economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 5,150 long term, full time jobs.
		Discounted FTE's	4,450	450	
		GVA	£1.8bn	£240m	
Scenario 3	7.2GW by 2030 without OEM	Headline FTE's	5,300	1,450	In this scenario, 53,000 annual years of employment are estimated to be created in the UK during the development and construction phases, equivalent to 5,300 net additional FTE jobs with an expectation that 1,450 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 7,150 net additional FTE jobs in the UK would be created overall in this scenario, which would generate £1.7bn in GVA to the UK economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 4,050 long term, full time jobs.
		Discounted FTE's	3,500	350	
		GVA	£1.4bn	£190m	
	7.2GW by 2030 with OEM	Headline FTE's	10,100	2,750	In this scenario, 101,000 annual years of employment are estimated to be created in the UK during the development and construction phases, equivalent to 10,100 net additional FTE jobs with an expectation that 2,750 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 13,550 net additional FTE jobs in the UK would be created overall in this scenario, which would generate £3.3bn in GVA to the UK economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 7,700 long term, full time jobs.
		Discounted FTE's	6,700	650	
		GVA	£2.8bn	£360m	

Upper range NE&YH employment benefits					
		Economic benefit	**Development/ Construction**	**Operation/ Maintenance**	**Interpretation**
NE&YH economic benefits					
Scenario 1	2.4GW by 2025 without OEM	Headline FTE's	1,700	450	In this scenario, 17,000 annual years of employment are estimated to be created in NE&YH during the development and construction phases, equivalent to 1,700 net additional FTE jobs with an expectation that 450 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 2,200 net additional FTE jobs in NE&YH would be created overall in this scenario, which would generate £550m in GVA to the NE&YH economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 1,200 long term, full time jobs.
		Discounted FTE's	1,200	150	
		GVA	£470m	£70m	
	2.4GW by 2025 with OEM	Headline FTE's	2,850	800	In this scenario, 28,500 annual years of employment are estimated to be created in NE&YH during the development and construction phases, equivalent to 2,850 net additional FTE jobs with an expectation that 800 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 3,750 net additional FTE jobs in NE&YH would be created overall in this scenario, which would generate £950m in GVA to the NE&YH economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 2,050 long term, full time jobs.
		Discounted FTE's	2,000	250	
		GVA	£800m	£120m	
Scenario 2	4.8GW by 2029 without OEM	Headline FTE's	3,350	900	In this scenario, 33,500 annual years of employment are estimated to be created in NE&YH during the development and construction phases, equivalent to 3,350 net additional FTE jobs with an expectation that 900 net additional FTE jobs would be created throughout the operational phase.
		Discounted FTE's	2,150	450	

		GVA	£850m	£110m	When combined, a total of 4,350 net additional FTE jobs in NE&YH would be created overall in this scenario, which would generate £1.0bn in GVA to the NE&YH economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 2,200 long term, full time jobs.
	4.8GW by 2029 with OEM	Headline FTE's	5,700	1,550	In this scenario, 57,000 annual years of employment are estimated to be created in NE&YH during the development and construction phases, equivalent to 5,700 net additional FTE jobs with an expectation that 1,550 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 7,350 net additional FTE jobs in NE&YH would be created overall in this scenario, which would generate £1.7bn in GVA to the NE&YH economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 3,700 long term, full time jobs.
		Discounted FTE's	3,600	350	
		GVA	£1.4bn	£190m	
Scenario 3	7.2GW by 2030 without OEM	Headline FTE's	5,050	1,350	In this scenario, 50,500 annual years of employment are estimated to be created in NE&YH during the development and construction phases, equivalent to 5,050 net additional FTE jobs with an expectation that 1,350 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 6,550 net additional FTE jobs in NE&YH would be created overall in this scenario, which would generate £1.5bn in GVA to the NE&YH economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 3,300 long term, full time jobs.
		Discounted FTE's	3,250	300	
		GVA	£1.3bn	£160m	
	7.2GW by 2030 with OEM	Headline FTE's	8,500	2,300	In this scenario, 85,000 annual years of employment are estimated to be created in NE&YH during the development and construction phases, equivalent to 8,500 FTE jobs with an expectation that 2,300 net additional FTE jobs would be created throughout the operational phase. When combined, a total of 11,000 net additional FTE jobs in NE&YH would be created overall in this scenario, which would generate £2.5bn in GVA to the NE&YH economy. When discounted to reflect the increased value of a job today rather than tomorrow this gives 5,550 long term, full time jobs.
		Discounted FTE's	5,450	550	
		GVA	£2.1bn	£280m	

Annex I – Cost Model assumptions

A public domain baseline has been used for the cost assumptions, in the form of The Crown Estate's report "A Guide to an Offshore Wind Farm". This is Source 2 in the tables below. This has been supplemented with PB experience (Source 1) as appropriate. The table combines a high level parts list with a work breakdown structure for the main activities. However, it must be noted that this is not a complete / detailed parts list / WBS – it focuses on the main activities and major components / assemblies, not the minor components / sub-components. Examples of items not included (and assumed to be covered by other identified items) include, in no particular order, cable connectors, sealants and seals, coatings, composite access products, hydraulic hoses and components, fastenings, load monitoring systems, PPE, aggregate, grout, steel, security, regulators costs, compressed air, ship brokering / agents, etc. This list is by no means exhaustive.

The assumptions made for the activities within the defined phases are identified below. Alphanumeric prefixes refer to the Source 2 reference. If no alphanumeric prefix, it is not identified in that document.

Project Management

This covers professional support activities running across the duration of the project.

Item		Assumed	Source	Content	Supply Chain	Comment
Predevelopment costs (before award of Zone licence)Award)	The activity undertaken to win the Dogger Bank Zone license – from approximately 2008-2010.	Assume a total of £1m across all 6 projects	1		Forewind activity	Assume 90% national and 10% Norway
Project management	Includes programme management and risk management. Typically 0.5-1% of capex	0.5% of capex	1	Project management, risk management, procurement support, value engineering	**Regional:** PB, Mott MacDomald, Ramboll, Amec **National:** GLGH, RPS, PMSS **International:** Bechtel, KBR	Regional and national possible 100%
Offshore Management / Supervision / Client Rep	Assumed to be included elsewhere	0	1	Offshore Management / Supervision / Client Rep for surveys and construction	**Regional:** PB, GeoMarine, Cathie Associates, Senergy, freelancers **National:** GLGH, Ramboll, Intertek	Regional and national possible 100%

Item		Assumed	Source	Content	Supply Chain	Comment
Health and Safety	Inc. CDMC, HAZOP Not included - Safety training for all offshore personnel. - Developer, consultants and suppliers / contractors? Offshore survival, medicals, rope access, etc. Regional suppliers would include Falck Nutec, South Tyneside College, Advanced Industrial Solutions	1% of capex	1		**Regional:** PB, SRC	Regional and national possible 100%
Reliability, availability, maintainability and safety (RAMS)	Assumed to be included elsewhere	0	1			
Systems and software assurance	Assumed to be included elsewhere	0	1			
Environmental Management Systems		0.5% of capex	1		**Regional:** PB, WSP, WYG, MWH, Atkins, Amec	Regional and national possible 100%
QA systems	Assumed to typically be 1-2% of capex	1% of capex	1		**Regional:** PB	Regional and national possible 100%
Owners engineer	Typically 0.5-2.5% of capex, but generally assumes the items described above, but by a different name	0	1		**Regional:** PB, SKM, Mott Mcdonald, Ramboll **National:** Fichtner, GLGH	Regional and national possible 100%

Development

This covers activities from license bidding through to consent approval. Generally the items identified under D0: Development and Consent, but with some additions. TCE estimate of 4% does not match its own subtotals.

Item		Assumed	Source	Content	Supply Chain	Comment
D1:Environmental Surveys	TCE £4m/500MW WF underestimates its own subtotals. Regulators costs (e.g. MMO) have not been included	£4.3m per project	2	Planning and Consultation (marine and terrestrial) - EIA (marine ecology, archaeology, marine traffic, radar impact, bird studies, etc.); Fisheries liaison; Environmental (benthic, pelagic, ornithological, sea mammal and onshore)	**Regional:** PB, Haskoning, Aecom, Amec **National:** Natural Power, PMSS, RPS; Gardline, EMU, Cefas, APEM, SMRU	50% regional and100% national possible
D2: Coastal process Surveys	Assume included elsewhere	0	1			
D3:Met station and related surveys	TCE estimates £3-5m per met mast, 1-3 met masts per installed GW. FL indicates 2 met masts for whole development at development stage, then up to 5 per project.	£3m/ met mast. 6 met masts for each of the first two projects, then 5 each for remaining 4 projects.	2 FL	Suction can foundation, platform, mast design and construction; personnel access system; sensors and auxiliary systems.	**Regional:** RES **National:** H&W	Regional and national possible 100%
D4:Seabed surveys	TCE estimates GI at approx. 0.6% of capex. PB would suggest 1% of capex is likely, possibly reducing to 0.6% over time / experience.	1% capex	1	Geophysical, Geotechnical, Cable Route	**UK:** Gardline, Coastal, EMU **International:** Fugro	National possible 100%

Item		Assumed	Source	Content	Supply Chain	Comment
Onshore site investigation and topographic survey	Typically 0.25-1% of onshore substation costs	0.25% of onshore substation capex	1		**Regional:** AEG, ESG, Fugro	Regional and national possible 100%
Pre-FEED Design	Concept engineering / selection, FEED scoping	£2m/project	1		**Regional:** PB, SKM, Mott MacDonald, Senergy, TNEI, Atkins, Ramboll **UK:** Xodus, GLGH, etc.	Regional and national possible 100%
D5:Front End Engineering and Design Studies	TCE £1m per 500MW WF. However, assume that at concept and FEED stages, whether farm is 500MW or 1200MW makes little difference to design requirements	£1m/project	2		**Regional:** PB, SKM, Mott MacDonald, Senergy, TNEI, Atkins, Ramboll **UK:** Xodus, GLGH, etc.	Regional and national possible 100%
Planning and Consultation	Marine and terrestrial, including EIA and fisheries liaison. Excludes costs incurred by Regulators (LPA, MMO, Natural England, Cefas, EA, Planning Inspectorate, etc.)	£1m/project	1		**Regional:** PB, AMEC, Haskoning	Regional and national possible 100%
OFTO work	Work undertaken by potential OFTO – cannot assess (commercially sensitive)	Not included	1		Regional suppliers include BB Investment	
Finance	Including legal advisors, financial advisors, engineering and other due diligence	Assume a total of £1m across all 6 projects	1		**Regional legal advisors:** Eversheds, Muckles, Dickinson Dees, Watson Burton **Regional Engineering**	Regional and national possible 100%

Item		Assumed	Source	Content	Supply Chain	Comment
					Advisors: PB, SKM, Mott Mcdonald	
Insurance		Assume a total of £1m across all 6 projects	1			National possible
Land purchase		Assume a total of £1m across all 6 projects	1		**Regional Land Purchase:** GVA, DTZ, BNP Paribas, etc.	Regional and national possible 100%
PR / supply chain engagement		Assume a total of £1m across all 6 projects	1			Regional and national possible 100%

OFTO work / costs has not been included at this stage. It is noted that, in 2010, nine projects were included in the first round of competitive OFTO tender, with an estimated total value of over £1bn.

Manufacture Stage

Generally the items identified under T0: Wind Turbine and B0: Balance of Plant, with some additions. Note that general BoP indicated by TCE to be approximately 30% of CAPEX

Item		Assumed	Source	Content	Supply Chain	Comment
T0:Wind Turbine	TCE estimates £6m/5MW WTG – whilst costs might increase for larger WTG, numbers would reduce, therefore assume total remains the same and cost assumption reasonable. In reality WTG TSA would also include installation, commissioning and 5 year warranty period O&M, but installation covered elsewhere	£6m/WTG	2	Includes nacelle, bladeset and tower.	**Regional:** For nacelle, no UK supplier but several OEMs known to be considering a UK facility **International:** Siemens, REPower, Vestas, Gamesa, Alstom, Areva, Mitsubishi, Samsung, etc.	No UK blade supplier, but could establish co-located with WTG factory. No UK tower supplier. Mabey Bridge supplies to onshore industry but not offshore Assume no UK or regional at present, but possible in a high delivery scenario (50% regional, 75% UK)
B1.1:Export cable	TCE assumed £60m per 500MW WF. Should really be related to number, length and type of cable. PB estimates £285-451/m supplied (not installed) depending on type.	£285/m Average 40km per project	1, FL		**Regional:** JDR in future? Others in future? Duco? **International:** ABB, Prysmian, J-Power, Nexans	Assume no UK or regional at present, but possible in a high delivery scenario (50% regional / UK)
B1.2:Array cable (inter array and inter platform)	TCE assumed £20m per 500MW WF. Should really be related to number, length and type of cable. PB estimates £285-451/m	£285/m 1270km per project	1, FL		**Regional:** JDR. Others in future? Duco? **International:** ABB, Prysmian, J-Power, Nexans	Assume regional and national possible

Item		Assumed	Source	Content	Supply Chain	Comment
	supplied (not installed) depending on type.					
B1.3:Cable protection	TCE assumed £700k/500MW WF.	£700k/project	2			Assume UK content possible
Onshore cables	2 x 500MW HVDC, 30km per project 3 x HVAC, 3km per project PB estimates £128-202/m, assume £180	£180/m 69km per project	1, FL		Assume as subsea	Assume no UK content at present, more possible in high delivery scenario (50% regional / national(
B2:Turbine foundation inc. design	Variable, dependent on water depth, foundation type, etc. Assume based on jacket foundation. TCE estimates £3m/WTG. PB estimates £2.6-2.85m/M WTG in 30m water, jacket, monopile, GBS	£3m/WTG	2	**Design** **Regional:** PB, Atkins, Senergy, Arup, Cathie, GeoMarine, Mott Mcdonald **National:** GLGH, Ramboll, Xodus **International:** ISC, NGI	**Fabrication** **Regional:** TAG, OGN, potentially A&P, Corus **National:** Mabey Bridge, Bifab, H&W, Global Energy? Smulders, Skanska, Costain, Hochtief (UK GBS yard or European owner?) **International:** Bladt, OWEC Tower, SMIT, Aker Solutions, Bilfinger Berger, Cuxhaven Steel Construction, Ambau, Smulders, SIAG, WeserWind, Chinese	Will depend on foundation type – monopile, tripod, jacket, GBS, hybrid, floating, etc. Local supply chain for components e.g. sacrificial anodes from Global Anodes. Assume regional and UK content possible, but UK not exceeding 50% due to capacity constraints, at present with an optimistic increase to 75% regional / 100% national in future.
B3:Offshore substation (OSP) inc. structure and design (converter station)	TCE estimates £50m per OSP inc. structure, design and electrical plant. FL advises 1 x OSP per project. PB estimates £200/kW to cover both	£100m / OSP	1		**Regional:** Topside fabrication: Heerema, Aker, Wilton, possibly A&P	Assume DC. CG supply AC substations but not DC Foundations as for WTG

Item		Assumed	Source	Content	Supply Chain	Comment
	onshore and offshore converter station.				**International:** Topside design – ISC Topside plant - Alstom, ABB, Siemens	Assume 90% of cost is international, 10% regional / national
Offshore collector station inc. structure and design	FL advises 2-4 x collector stations per project, but assume 2	£50m each (estimate) 2 per project	1		Assume as OSP	Assume 90% of cost is international, 10% regional / national
B4:Onshore substation	Includes foundations, buildings, M&E, design and construction. TCE indicates half the cost of offshore (suggesting £25m), but also indicates £40m per SS. PB estimates £200/kW to cover both onshore and offshore converter station.	£50m each, one per project	1		**Regional:** Construction BBES **International:** OEM - Siemens, ABB, Alstom	Assume DC CG supply AC not DC Assume 70% cost international, 30% regional / national

Installation

Generally the items identified under I0: Installation and Commissioning, with some additions

Item		Assumed	Source	Content	Supply Chain	Comment
I1:Export cable-laying	TCE assumed £80m per 500MW WF. Should really be related to number, length and type of cable. PB estimates £80-100k/km, assume 90.	£90k/km 400km per project	1		**Regional:** Deepocean, Reef, TOWL, VSMC, Modus **National:** Global Marine **International:** DEME, Jan de Nul,	Assume 100% UK and regional possible
I2:Foundation installation	Variable, dependent on water depth, distance offshore, foundation type, seabed preparation, etc. Assume based on jacket foundation. TCE estimates £1m/WTG. PB estimates £0.4-0.65m/5MW WTG depending on type	£0.65m/WTG	1		**Regional:** MPI **National:** Fugro Seacore (UK or Dutch?), Seajacks **International:** A2Sea, DEME (inc. Scaldis), Heerema, Seaway, Ballast Nedam, Mammoet van Oord, GeoSea, Muhibbah Marine, Windcarrier, Master Marine, RWE, Hochtief, Fred Olsen, Jumbo, MT Hojgaard	Assume 15% regional and UK possible, due to capacity constraints.
I3:Array cable-laying	TCE assumed £60m per 500MW WF. Should really be related to number, length and type of cable – clarification needed. PB estimates £40-50k/km, assume 45.	£45/m 1270km per project	1		As export cables	Assume 100% UK and regional possible
Onshore cable lay	Assume 65km per project (69km total – 4km HDD)	£320/m 65km per project	1		**Regional:** BBUS	Assume 100% UK and regional possible
Onshore HDD	FL indicates 4km per project	£650/m 4km/project	1			Assume 100% UK possible
I4:Construction port	TCE estimates around 1% of capex spent on port	£15m/project	2	Port facilities include design and	**Regional:** Blyth, Tyne, Sunderland, Tees & Hartlepool, Humber. Port	Assume 100% UK and regional possible

Item		Assumed	Source	Content	Supply Chain	Comment
	related activities during installation, between £10m and £15m for a 500MW WF. Zone could be from one port or several.			construction of piled jetties/Heavy Load Quay design; Landside infrastructure - storage areas, paving, workshops etc.	infrastructure contractors include Balfour Beatty, BAM Nuttall **National:** Scottish ports, Gt Yarmouth, Harwich, etc. Port infrastructure contractors include Volker Stevin **International:** Ejsberg, Bremerhaven, etc.	
I5:Offshore substation installation (converter station)	TCE estimates £10m/OSP. FL advises 1 OSP per project	£10m/OSP	2		**International**: Scaldis, etc	Assume 100% international
Offshore collector station installation	Assume same as OSP at this stage, 2 -4 per project, assume 2	£10m/each 2 per project	1		**International**: Scaldis, etc	Assume 100% international
I6:Sea-based support	Crew vessels, anchor handling, barges, dive support, ROV handling, guard boats, etc. Assume this includes 10 moorings also. Port fees not included.	£1m/project	1		**National:** Briggs Marine **International:** Installation and cable lay contractors plus Boskalis, Subsea7, Saipem, Technip	Assume 5% regional, 15% UK
I7:Turbine installation	Should be included in scope of TSA for WTG OEM, but include here at this stage. TCE estimates £1.4m/WTG	£1.4m/WTG	2		Assume as per foundation installation	Assume 15% regional and UK possible, due to capacity constraints.
I8:Commissioning	Assume included in scope of WTG OEM TSA	0	2		Included in WTG OEM TSA	

Operation & Maintenance

Generally the items identified under O0: Operations and maintenance, with some additions

Item		Assumed	Source	Content	Supply Chain	Comment
O1:Operations	TCE estimates £25-40m for a typical 500MW (100WTG) WF.	£400k/WTG	2	Technicians, facilities, crew transfer, shore staff	**Regional:** Spice, SKM, RES, etc	Assume 100% regional and UK
O2.1:O&M Port	TCE estimates £5m/yr. Based on 20 years (25 – 5yr warranty)	£5m/yr/project	2		**Regional:** Blyth, Tyne, Sunderland, Tees & Hartlepool, Humber **National:** Not appropriate **International:** Not appropriate	O&M port needs to be local – assume 100% regional
O2.2:Technician and equipment transfer	Assume 12 technicians per CTV (Crew Transfer Vessel), £1500/day charter, 0.5 technicians per WTG. Vessels used to shuttle technicians from OSV to WTG – assume 6 in total	£1500/boat day	1,2	Should also include Personnel access systems, vessels, helicopters	**Regional:** Vessels - North Sea Logistics, Wind Support Services Heliport - Newcastle, Blyth, Durham Tees Valley, Humberside, etc. **National:** Gardline	Assume 50% regional/ UK, increasing to 75% in future
Technician	Assume 0.5 technicians / WTG / day for 20 years, at a salary of £40k	£40k / man year	1		**Regional:** Spice, SKM, RES Technician and other training providers include Newcastle College, Newcastle University, Northumberland College	Assume 90% UK (50% regional), increasing to 100% in future
O2.3:Offshore accommodation	Assume OAV (offshore accommodation vessels) required for offshore working support ('flotel') – will still require smaller CTV's to ferry staff from accommodation vessel to WTGs, unless gangway	£20k/vessel/day	1		**Regional:** Wind Support Services	Assume 75% UK and regional, increasing to 100% in future

Item		Assumed	Source	Content	Supply Chain	Comment
	systems used. Assume 200 technicians per vessel, 3 vessels needed. Assume 20 years. Note FL indicates up to 2 accommodation platforms per project – however, exclude at this stage since details unclear, therefore assumptions based on OAV approach.					
O2.4:Large component replacement	Assume zero at this stage	0	1			

Annex II - Economic Benefits Model assumptions

A series of assumptions have been developed into a range of multipliers for use in the Employment Model. These are summarised below. The justification for each is explained in the detailed methodology.

Summary table of adjustments / multipliers		
Assumption	**Adjustment / Multiplier - UK**	**Adjustment / Multiplier - NE&YH**
Content – With OEMs	76%	64%
Content – Without OEMs	40%	38%
Supply Leakage	-5%	-5%
M1* - Cost per job - PM	£101,262	£69,520
M1 - Cost per job – Development	£101,262	£69,520
M1 - Cost per job - Manufacture	£156,098	£145,780
M1 - Cost per job - Installation	£110,755	£89,555
M1 - Cost per job - O&M	£736,268	£326,556
M2** - % labour cost – PM	1.2% of expenditure	1.2% of expenditure
M2 - % labour cost - Development	1.2% of expenditure	1.2% of expenditure
M2 - % labour cost - Manufacture	28% of expenditure	28% of expenditure
M2 - % labour cost – Installation	6% of expenditure	6% of expenditure
M2 - % labour cost - O&M	35% of expenditure	35% of expenditure
M2 - Cost per job - PM	£35,897	£25,143
M2 - Cost per job - Development	£35,897	£25,143
M2 - Cost per job - Manufacture	£34,868	£29,675
M2 - Cost per job - Installation	£33,895	£28,868
M2 - Cost per job - O&M	£44,128	£22,319
Leakage – General	-10%	-10%
Leakage – Commuter Flows	0%	-5%
Displacement	-15%	-12.5%
Induced Employment Multiplier	1.4	1.4
Induced GVA Multiplier	£43,236	£43,236

** M1 = Employment Method 1 ** M2 = Employment Method 2*

Annex III – Low/High Scenario Variations

The following provides specific outline of the variations in Low and High Scenarios developed for both the UK and regional content. This has been based on the findings of the supply chain review of broad components as outlined in Annex I.

Low/High Scenario Variations								
Item		Low Content (%)			High Content (%)			Annex I Description
		NE&YH	UK	Int'nl	NE&YH	UK	Int'nl	
D1	Environmental Surveys	50	100	100	50	100	100	Regional and national possible 100%
T0	Wind Turbine	0	0	100	**50**	**75**	100	No UK blade supplier, but could establish co-located with WTG factory. No UK tower supplier. Mabey Bridge supplies to onshore industry but not offshore. Assume no UK or regional at present, but possible in a high delivery scenario
B1.1	Export cable	0	0	100	**50**	**50**	100	Assume no UK or regional at present, but possible in a high delivery scenario
	Onshore cables	0	0	100	**50**	**50**	100	Assume limited UK content at present, more possible in high delivery scenario
B2	Turbine foundation including design	50	50	100	**75**	**100**	100	Will depend on foundation type – monopile, tripod, jacket, GBS, hybrid, floating, etc. Local supply chain for components e.g. sacrificial anodes from Global Anodes. Assume regional and UK content possible, but UK cannot exceed 50% due to capacity constraints, and regional likely to be limited to 25% for same reasons. Will depend on foundation type – monopile, tripod, jacket, GBS, hybrid, floating, etc. Local supply chain for components e.g. sacrificial anodes from Global Anodes. Assume regional and UK content possible, but UK cannot exceed 50% due to capacity constraints, and regional likely to be limited to 25% for same reasons.
O2.2	Technician and equipment transfer	50	50	50	**75**	**75**	**25**	Assume 50% regional, 50% UK
	Technician	50	90	100	**100**	**100**	100	Assume 90% UK (50% regional)
O2.3	Offshore accommodation	75	75	100	**100**	**100**	100	Assume 75% UK and regional

Annex IV – Discounted Results

The following tables present the results of the economic modelling exercise with an annual discount factor of 3.5% included to the expenditure. All economic benefits (jobs and GVA) have then been calculated from this discounted investment profile. The following are presented for each scenario:

- Estimated expenditure for realising six projects and the proportion of that spend
- Net present value of that expenditure
- Gross direct jobs and GVA
- Net direct jobs and GVA
- Total net benefits (including multiplier effects for induced benefits)

3.6 Estimated expenditure

The table below outlines the total estimated gross expenditure and total discounted expenditure for realising up to six projects and the estimated proportion of that spend under each scenario for the UK and NE&YH regions. This table also outlines the net present value to society of the expenditure.

Scenario Investment in the Dogger Bank															
Scenario	Total Investment*			Estimated UK content (£bn)						Estimated NE&YH content (£bn)					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Total Expenditure															
Investment (Undiscounted)	27.8	18.5	9.3	20.0	10.5	13.4	7.0	6.7	3.5	14.0	8.3	9.3	5.5	4.7	2.8
Present Value	15.6	10.5	5.8	11.3	5.9	7.6	4.0	4.2	2.2	8.8	5.3	5.9	3.5	3.3	1.9

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date.
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.7 Gross direct employment and GVA estimates

This table below provides discounted estimates for gross direct benefits in terms of gross jobs years, gross FTE employment and gross GVA under each scenario and at UK and NE&YH regional level.

Discounted Gross Direct Benefits of the Dogger Bank															
Scenario	Total Investment*			Estimated UK content						Estimated NE&YH content					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Gross Direct Employment															
Job years (range)	108,500	72,600	39,700	78,300	41,200	52,400	27,600	28,700	15,100	62,000	36,800	41,450	24,650	22,850	13,550
	101,500	67,650	37,500	73,300	38,550	48,850	25,700	27,150	14,300	54,500	32,350	36,350	21,600	20,100	11,950
FTEs** (range)	10,850	7,250	3,950	7,850	4,100	5,200	2,750	2,850	1,500	6,200	3,700	4,150	2,450	2,300	1,350
	10,150	6,750	3,750	7,350	3,850	4,900	2,550	2,700	1,450	5,450	3,250	3,650	2,150	2,000	1,200
Gross Value Added															
Gross GVA (range)	£7.4bn	£4.9bn	£2.7bn	£5.3bn	£2.8bn	£3.5bn	£1.9bn	£1.9bn	£1.0bn	£3.4bn	£2.0bn	£2.3bn	£1.3bn	£1.2bn	£750m
	£4.4bn	£2.9bn	£1.6bn	£3.2bn	£1.7bn	£2.1bn	£1.1bn	£1.2bn	£650m	£2.1bn	£1.3bn	£1.4bn	£850m	£800m	£450m

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date.
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.8 Net direct employment and GVA estimates

The table below provides discounted estimates for net direct benefits for net job years, net FTE Employment and net GVA under each scenario and at UK and NE&YH regional level.

Discounted Net Direct Benefits of the Dogger Bank															
Scenario	Total Investment*			Estimated UK content						Estimated NE&YH content					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Net Direct Employment															
Job years (range)	81,350	54,450	29,800	58,750	30,900	39,300	20,500	21,500	11,300	44,950	26,700	30,050	17,850	16,550	9,850
	76,150	50750	28,200	54,950	28,950	36,650	19,300	20,350	10,700	39,500	23,450	26,350	15,650	14,550	8,650
FTEs** (range)	8,150	5,450	3,000	5,850	3,100	3,950	2,050	2,150	1,150	4,500	2,650	3,000	1,800	1,650	1,000
	7,600	5,100	2,800	5,500	2,900	3,650	1,950	2,050	1,050	3,950	2,350	2,650	1,550	1,450	850
Gross Value Added															
Gross GVA (range)	£5.6bn	£3.7bn	£2.0bn	£4.0bn	£2.1bn	£2.7bn	£1.4bn	£1.5bn	£750m	£2.4bn	£1.5bn	£1.6bn	£950m	£900m	£550m
	£3.3bn	£2.2bn	£1.2bn	£2.4bn	£1.3bn	£1.6bn	£850m	£900m	£450m	£1.5bn	£900m	£1.0bn	£600m	£550m	£350m

Currencies have been rounded to nearest £5m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date.
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)

3.9 Total net benefits (net direct and induced)

The table below outlines the discounted results of the economic modelling exercise for each scenario and the total expenditure. This comprises total investment figures and estimates of direct benefits for Net job years, net FTE Employment and net GVA under each scenario and at UK and NE&YH regional level.

Discounted Net Total Benefits of the Dogger Bank															
Scenario	Total Investment*			Estimated UK content						Estimated NE&YH content					
	7.2 GW	4.8 GW	2.4 GW	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM	7.2GW OEM	7.2GW No OEM	4.8GW OEM	4.8GW No OEM	2.4GW OEM	2.4GW No OEM
Net Total Direct Employment															
Job years (range)	113,900	76,200	41,700	82,250	43,300	55,000	28,950	30,100	15,850	62,900	37,350	42,100	25,000	23,150	13,750
	106,550	71,050	39,450	76,950	40,500	51,300	27,000	28,500	15,000	55,300	32,850	36,900	21,900	20,400	12,100
FTEs** (range)	11,400	7,600	4,150	8,200	4,350	5,500	2,900	3,000	1,600	6,300	3,750	4,200	2,500	2,300	1,400
	10,650	7,100	3,950	7,700	4,050	5,150	2,700	2,850	1,500	5,550	3,300	3,700	2,200	2,050	1,200
Gross Value Added															
Gross GVA (range)	£7.0bn	£4.7bn	£2.5bn	£5.0bn	£2.6bn	£3.4bn	£1.8bn	£1.8bn	£950m	£3.2bn	£1.9bn	£2.2bn	£1.3bn	£1.2bn	£700m
	£4.6bn	£3.1bn	£1.7bn	£3.3bn	£1.8bn	£2.2bn	£1.2bn	£1.2bn	£650m	£2.2bn	£1.3bn	£1.5bn	£900m	£800m	£500m

Currencies have been rounded to nearest £50m and numbers have been rounded to nearest 50
All data is constrained to the period up to 2055 – O&M costs will likely extend beyond this date
* Total investment covers all international and UK investment – Figures are based on metrics derived for the UK
** FTE is equivalent to 10 annual jobs (providing headline figures for jobs)