

Calculating the economic contribution of Beatrice Offshore Windfarm Limited

Methodology document

Contents

Background	2
Input-Output Model methodology	3
Direct, indirect and induced impacts	3
Gross Value Added and years of employment supported	3
Expenditure	4
Direct GVA Impacts	4
Indirect GVA Impacts	5
Induced GVA Impacts	6
Total GVA Impacts	7
Direct, Indirect and Induced Employment Impacts	7
Modelling assumptions	8
Key data sources and definitions	9
Data treatment	10
Further reading	10

Background

The quantification and publication of the economic contribution of major investment projects, like offshore windfarms, is important. It demonstrates to local communities that they can benefit from these investments, while helping to guide future decisions and enhance those benefits in the future. The BOWL project partners¹ are therefore committed to working with its supply chain partners, alongside agencies and government bodies, to create an environment where local people and communities feel the economic benefit of these very large offshore wind farm investments.

This latest research on the economic contribution of Beatrice Offshore Windfarm Limited (BOWL) was carried out by SSE with support from NEF Consulting. It demonstrates that both the UK and Scottish economies stand to benefit significantly from the Beatrice Offshore Windfarm. The key findings of the analysis can be found online at www.sse.com/beingresponsible/reporting-and-policy.

This document provides an overview of the methodology used by SSE, and reviewed by NEF Consulting, to calculate these findings.

¹ BOWL is a joint venture project, with SSE Plc as the largest partner. SSE Plc owns 40% of BOWL, Copenhagen Infrastructure Partners owns 35% and Red Rock Power Limited owns 25%.

Input-Output Model methodology

Input-Output (I-O) modelling was used to evaluate the economic impact in the UK and in Scotland from the development expenditure and capital expenditure for Beatrice Offshore Windfarm Limited (BOWL)². This economic technique is used for calculating the direct, indirect and induced impacts of localised economic activity on the overall economy. The model³ generates the Gross Value Added (GVA) to the economy and the years of employment supported within the economy as economic indicators of impact. The sum of direct, indirect and induced impacts equals the total GVA and employment supported.

This section will summarise the methodology used to calculate these impacts on the UK and Scottish economies.

Direct, indirect and induced impacts

Expenditure on large infrastructure projects like BOWL impacts the wider economy at three levels:

- (1) **Direct impact:** increased post-tax profit, wages and employment produced directly by project expenditure associated with 'Tier 1' expenditure.
- (2) **Indirect impact:** increased post-tax profit, wages and employment created from 'Tier 1' employment of sub-contractors and demand for goods and services from suppliers down the supply-chain.
- (3) **Induced impact:** increased post-tax profit, wages and employment generated from greater demand and spending on goods and services such as accommodation, food, fuel and retail by employees who are employed as a result of the direct and indirect impacts.

Using the I-O model, the GVA and years of employment supported can be calculated at each of these impact levels, as a result of BOWL project expenditure.

Gross Value Added and years of employment supported

Gross Valued Added (GVA) measures the post-tax profit and wage contribution to the economy from an industry, business, or project in a country or region. The sum of GVA from all of these areas equates to the total economic output of a country: the country's Gross Domestic Product (GDP). In this case GVA measures the contribution of a project, Beatrice Offshore Windfarm, to the Scottish

² The data for the total 'Tier 1' expenditure of £2.6bn was provided by BOWL, a joint venture between SSE and its investment partners, broken down to where this money has been spent geographically and by type of spend, or supplier name where possible, up to when the project construction is due to be finished in 2018. This data does not include operational expenditure and the information is not publicly available.

³ The Input-Output models for both geographies are based on data provided by the relevant national statistics authorities. To calculate the employment-to-output ratios, used in the estimation of employment supported, we also use sectoral employment data from the Office for National Statistics (ONS).

and UK economies. BOWL's total GVA is the sum of post-tax profits and wages generated from the direct, indirect and induced impacts.

The total number of **years of full-time employment supported** is the sum of the employment generated at each impact level as a result of BOWL's expenditure. The total number of years of full-time employment supported relates to different numbers of people all working for different lengths of time. For example, ten years of full-time employment supported could be ten people working for a year, four people working for two and a half years each, or any combination.

Expenditure

To compute the direct, indirect and induced GVA and employment impacts, all 'Tier 1' expenditure had to be categorised and matched to a relevant economic sector before it could be inputted into the I-O model. This was done for actual project development and construction spend up to March 2017, then for expected project spend for the remainder of the construction period which is due to be completed in 2018.

The I-O modelling consisted of four key stages:

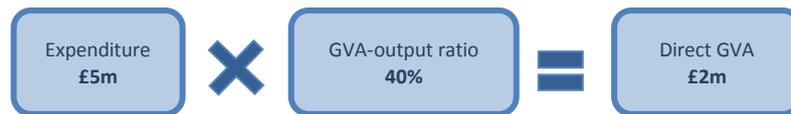
- (1) Identify whether expenditure is UK or non-UK. If UK, go on to identify whether spend is Scottish or non-Scottish.
- (2) Using the description of spend or supplier name to match expenditure to the relevant economic sector(s) and assign the relevant industry codes (Standard Industrialisation Classification (SIC)). Each type of economic activity within the economy can be matched to the relevant SIC code.
- (3) Matching the SIC codes to the I-O sector group numbers.
- (4) Inputting the I-O sector-matched data for the relevant countries into the I-O models and generating the output.

For all categorised expenditure, the I-O model generated direct, indirect, induced and total impacts for both GVA and employment in Scotland and UK. These results were then used to produce the results shown in the GVA and jobs supported section of this report.

Direct GVA Impacts

Direct GVA impacts are calculated in the I-O model using 'GVA-output ratios'. These measure the relative GVA increase per unit increase of output, and are published by the UK and Scottish governments. These nationally published ratios are equal to the national/regional average GVA increase per unit increase of output for each of these sectors. National/regional average ratios were used instead of independently derived ratios, which would be specific to SSE, so that comparisons with other companies can be made.

To compute the direct GVA impact, sector-matched expenditure (which is equal to output) is multiplied by the relevant GVA-output ratios for either the UK or Scotland. For example, if £5m is spent in Scotland in ‘sector X’ and ‘sector X’ has a GVA-output ratio in Scotland of 40%, then the direct GVA impact in Scotland is equal to £2m added to the Scottish economy.



Although the majority expenditure may be within one sector, simply multiplying the total spend by the GVA-output ratio associated with that sector would not generate an accurate estimate of direct GVA. To calculate a more granular estimate of direct GVA, expenditure which does not fall within this sector and which will have different GVA-output ratios must be taken into account as these ratios can vary significantly. A more robust approach, such as the one taken for the BOWL, sector-matches all expenditure to the relevant economic sector, computes the direct GVA for each, then sums the individual GVAs to calculate the total direct GVA estimate.

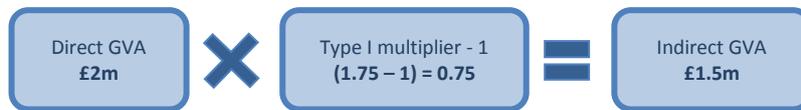
An even more granular approach would be to collect primary data on the exact increase in post-tax profit, wages and employment that each stakeholder experienced as a result of the installation of Beatrice Offshore Windfarm and then sum these findings. In reality however there are many thousands of stakeholders which would have been economically impacted by the project. Consequently, due to the huge complexity, the value added to this study would not outweigh the financial costs of performing such a task. As noted, economic indicators such as sector-specific GVA-output ratios generate results that are acceptably accurate given the confines of this report.

Indirect GVA Impacts

Indirect GVA impacts are calculated in the I-O model using ‘Type I multipliers’. These measure the relative GVA increase of indirect impacts per unit increase in direct GVA. Scottish Type I multipliers are publicly available and derived by the Scottish Government; however UK Type I multipliers must be derived⁴. As Type I multipliers take all supply-chain links between all sectors of the economy into account, Scottish Type I multipliers will generally be smaller than UK Type I multipliers. This is because trade between Scotland and the rest of the UK is considered as exporting and will be excluded within the Scottish I-O model, whereas all UK trade is internal and counted within the UK I-O model.

To compute the indirect GVA impact, direct GVA is multiplied by the relevant Type I multiplier for either the UK or Scotland. The Type I multiplier includes both direct and indirect impacts, and therefore to isolate just the indirect GVA impact, the unit increase of direct GVA is subtracted from the Type I multiplier. For example, the direct GVA for ‘sector X’ was calculated to equal £2m. If the Scottish Type I multiplier for ‘sector X’ is equal to 1.75, then the combined direct and indirect GVA impact is equal to £3.5m and the indirect GVA impact alone is equal to £1.5m.

⁴ This was undertaken as part of SSE’s wider sustainability agenda and followed government recognised methodology.

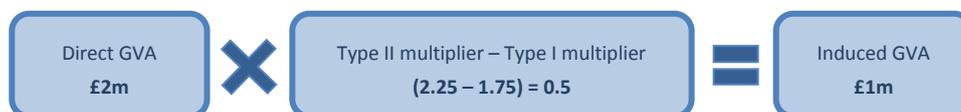


As with direct GVA, a granular approach is taken in order to achieve an acceptably accurate estimate of indirect GVA. This means that the sector-specific direct GVA which has been calculated from the sector-matched expenditure must be used, and each must be multiplied by the relevant sector-specific Type I multiplier.

Induced GVA Impacts

Induced GVA impacts are calculated in the I-O model using 'Type II multipliers'. These measure the relative GVA increase of both the indirect and induced impacts per unit increase in direct GVA. Again, Scottish Type II multipliers are publicly available and derived by the Scottish Government, however UK Type II multipliers must be derived⁵. Scottish Type II multipliers will also generally be smaller than UK Type II multipliers for the same reason that Scottish Type I multipliers are smaller than UK Type I multipliers. Type II multipliers take all household expenditure on all economic sectors into account and therefore measure how an increase in wages adds value into the economy. Consequently, even if direct and indirect employees in Scotland purchase only goods and services in Scotland, the supply-chain for these goods and services will generally not be exclusively Scottish. As noted previously, trade between Scotland and the rest of the UK is considered as exporting and is excluded within the Scottish I-O model, whereas all UK trade is internal and counted within the UK I-O model.

To compute the induced GVA impact, direct GVA is multiplied by the relevant Type II multiplier for either the UK or Scotland. The Type II multiplier includes direct, indirect and induced impacts and therefore to isolate just the indirect GVA impact, the Type I multiplier is subtracted from the Type II multiplier. For example, the direct GVA for 'sector X' was calculated to equal £2m. If the Scottish Type II multiplier for 'sector X' is equal to 2.25, and we know that the 'sector X' Scottish Type I multiplier is equal to 1.75, then the induced GVA impact is equal to £1m.



As with direct and indirect GVA, a granular approach is taken in order to achieve an acceptably accurate estimate of induced GVA. This means that the sector-specific direct GVA which has been calculated from the sector-matched expenditure must be used, and each must be multiplied by the relevant sector-specific Type II multiplier.

⁵ This was undertaken as part of SSE's wider sustainability agenda and followed government recognised methodology.

Total GVA Impacts

In the example above, from an initial 'Tier 1' spend of £5m in Scotland in 'sector X', the contribution to Scottish GDP is equal to:

$$\begin{aligned} & \mathbf{\pounds 2m \text{ (direct GVA)} + \pounds 1.5m \text{ (indirect GVA)} + \pounds 1m \text{ (induced GVA)}} \\ & \mathbf{= \pounds 4.5m \text{ (total GVA)}} \end{aligned}$$

Total GVA and jobs supported for the Scottish economy are therefore equal to the sum of direct, indirect and induced GVA and employment generated by Scottish expenditure in different economic sectors. Likewise, total GVA and jobs supported for the UK economy are equal to the sum of direct, indirect and induced GVA and employment generated from UK 'Tier 1' expenditure in many economic sectors.

Direct, Indirect and Induced Employment Impacts

Direct, indirect and induced jobs supported can be calculated following the same method used for calculating the direct, indirect and induced GVA.

To calculate the number of direct jobs supported, GVA-output ratios should be replaced with employment-output ratios. To calculate the number of indirect jobs supported, Type I GVA multipliers should be replaced with Type I employment multipliers. To calculate the number of indirect jobs supported, Type II GVA multipliers should be replaced with Type II employment multipliers.

Modelling assumptions

1. All analysis is done in gross terms and we have not assessed the net contribution of BOWL to the economy (i.e. we have not considered what would have happened in the economy if the project did not happen).
2. We have used two stand-alone models to estimate BOWL economic contribution in the UK and Scotland. These models are not linked and the results presented are, therefore, only related to the direct expenditure in both geographies. They do not take into account feedback loops between geographies. For example, when looking at the Scottish economic contribution, when goods are purchased from an English supplier, and that English supplier sources goods from Scotland to meet SSE's demand, this additional spending in Scotland is not captured. The results, therefore, represent a conservative estimate of SSE's economic contribution (particularly in Scotland). For this reason, SSE's contribution in England, Wales and Northern Ireland cannot be derived by calculating the difference between the results for the UK and Scotland.
3. Impacts that are expected to occur in the future have been discounted to present value using the UK government's social discount rate of 3.5%.
4. To account for future productivity changes, employment impacts expected to occur in future years an adjusted was made using estimates for labour productivity changes over the course of the project to derive a labour productivity adjustment factor. The latest Office of Budget Responsibility's economic and fiscal outlook was used to forecast future productivity forecasts which covered the project period. The adjustment factor was then weighted by the proportion of the project spend expected to occur in that year and then applied to the estimate for the employment contribution.
5. To account for future inflation, the rate was forecast over the duration of the project and a deflation factor obtained. The deflation factor in each year was then weighted by the proportion of the project expenditure expected to occur in each year and then applied to the employment contribution estimates.

Key data sources and definitions

The following tables provide an overview of the key data sources and definitions that were used for the Input-Output (I-O) modelling.

Key data sources for our Input-Output models		
Data type	Country/ entity	Source
<i>Input-Output tables</i>	UK	ONS – UK Input-Output Analytical Tables, 2010
	Scotland	Scottish Government – Input-Output Analytical Tables, 2012
<i>Employment data</i>	UK and Scotland	ONS -Business Register and Employment Survey
<i>Inflation data</i>	UK and Scotland	ONS -GDP deflators
<i>Labour productivity</i>	UK and Scotland	ONS-Labour Productivity Statistics
<i>Household income</i>	UK	ONS-UK Economic Accounts
	Scotland	Scottish Government-Quarterly National Accounts Scotland
<i>Expenditure data</i>	BOWL expenditure	BOWL

Key definitions	
Indicators	Definition
<i>GVA</i>	GVA is a measure of the value generated in the economy and represents the difference between the value of goods and services sold and the goods and services used as an input to their production. Hence, it is the company-level equivalent of GDP: adding up the GVA of all individual companies in the economy is equivalent to a country's GDP after adjusting for taxes and subsidies on products, a component of GDP which is not included in the calculation of GVA.
<i>Years of full-time employment</i>	We estimate employment as years of full-time employment.
<i>Discounting</i>	Discounting is a technique used to compare costs and benefits that occur in different time periods. It is based on the principle that, generally, people prefer to receive goods and services now rather than later. This is known as 'time preference'.

Data treatment

Only development expenditure and capital expenditure have been included in this analysis, with operational expenditure excluded. SSE's work with NEF Consulting estimates that 45% of this expenditure for the BOWL project will be UK content. To ensure consistency when comparing spending across years, all data have been discounted to 2016 prices where relevant. Future expenditure has been converted to 2016 prices based on an extrapolation of the ONS UK GDP deflator series from historic trends. Therefore all results are provided in 2016 prices unless otherwise stated.

National Input-Output tables were compiled in 2010 and 2012 for the UK and Scotland respectively. These were updated to better reflect the economy in 2016, using data on changes in labour productivity and inflation. This type of adjustment does not capture structural changes in the economy that occur between the Input-Output table year and the year of analysis. This means that estimates should be treated with caution for sectors that have changed significantly since the preparation of these Input-Output tables.

BOWL partner employees who will work on the BOWL project may often operate across a variety of projects. Therefore to ensure a conservative estimate of overall economic impact, we have not included any direct BOWL partner employment in our analysis.

Further reading

The offshore wind industry in the UK, while in a period of rapid growth, has not yet reached the maturity of the onshore wind industry. That means further research and learning is required to understand the potential economic contribution of this industry.

While not directly comparable, there are some other recent studies that have been carried out to assess the impacts of the offshore wind industry in the UK. Work by Offshore Renewable Energy Catapult, *The Economic Value of Offshore Wind*⁶, demonstrated that a one year snap shot of the offshore industry (construction and maintenance) includes 32% UK content. A further study by the Offshore Wind Programme Board commissioned from BVG Associates, *The UK Content of Operating Offshore Wind Farms*⁷, found that the total aggregated UK content for the projects included in this analysis was 43%. This overall figure was from aggregated UK content in development expenditure of 57%, UK content in capital expenditure of 18% and UK content in operational expenditure of 73%. Within this study, these different categories contribute 1%, 9% and 33% to UK content in total expenditure respectively.

⁶ <https://ore.catapult.org.uk/download/24232/>

⁷ <http://www.renewableuk.com/news/279486/The-UK-Content-of-Operating-Offshore-Wind-Farms.htm>