Calculating the economic contribution of 10 years of onshore wind at SSE – 2008 to 2018

Methodology document

Contents

Background

The quantification and publication of the economic contribution of major investment projects, like onshore windfarms, is important. It demonstrates the significant value created from these investments, while helping to guide future decisions and enhance those benefits in the future. SSE is 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 onshore wind investments.

This latest research on the economic contribution of SSE's onshore wind over the period April 2008 – March 2018 was carried out in-house by SSE with peer review by Little Blue Research Ltd, an independent economic consultancy. It demonstrates that the UK, Scottish and Irish economies have benefitted significantly from the development of onshore wind energy. This document provides an overview of the methodology used by SSE to calculate these findings. The key findings of the analysis can be found online at www.sse.com/beingresponsible/reporting-and-policy.

Involvement of Little Blue Research Ltd.

SSE commissioned technical support from Little Blue Research, Ltd. to help provide independent challenge/peer review on economic modelling used to measure the impact of SSE's onshore wind farms across the UK, Scotland and Ireland over the ten-year period 2008-2018.

Little Blue Research Ltd. supported SSE by reviewing the impact model and its documentation to:

- Understand model calculations and assumptions, through re-performing calculations (such as derivation of GVA multipliers, inflation and productivity adjustments);
- Match data back to sources;
- Check through model assumptions and model documentation;
- Conduct sensitivity testing; and
- Provide clarity as to the potential for future development and improvement and long-term development of the model and approach.

SSE selected several suggestions to take forward to help develop and improve their model.

Input-output model methodology

Input-Output (I-O) modelling was used to evaluate the economic impact in Scotland, the UK and Ireland from the development expenditure, capital expenditure, operational expenditure and decommissioning costs for SSE's onshore wind portfolio April 2008 – March 2018, including committed spend for these projects in the period up to 2040.

This economic technique is used for calculating the direct, indirect and induced impacts of localised economic activity on the overall economy. The model 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, Scottish and Irish economies. Whilst three standalone models were used to calculate the impacts in each geography, the same approach was followed. The full list of projects included in the analysis can be found in Appendix 1 and details of other economic contribution reports by SSE can be found in Appendix 2.

Overview of input-output analysis

Input-Output (I-O) multipliers can be used to assess the regional (or national) economic impacts from an activity. Multipliers are derived from an I-O table or matrix. An I-O matrix is a representation of national or regional economic accounting that records the way industries both trade with one another and produce for consumption and investments. The use of I-O multipliers for economic impact assessment rests on the fact that the direct effects of spending for a service are followed by indirect and induced effects. These two types of effects are observed respectively because purchasing links with other industries in the region exist and employees who work in the value chain spend their incomes on regional goods and services.

General definitions: If there is an increase in final demand for a particular industry output, it can be assumed that there will be an increase in the output of that industry, as producers react to meet the increased demand; this is the **direct effect**. As these producers increase their output, there will also be an increase in demand on their suppliers and so on down the supply chain; this is the **indirect effect**. As a result of the direct and indirect effects the level of household income throughout the economy will increase as a result of increased employment. A proportion of this increased income will be re-spent on final goods and services: this is the **induced effect.**

Type I multipliers sum together direct and indirect effects while Type II multipliers also include induced effects.

In SSE's model:

- GVA per output % is calculated by GVA effects / GVA multiplier where:
- GVA effects - total increase in GVA due to a unit increase of final demand for x
- GVA multiplier - the increase in GVA throughout the UK economy that results from a change of £1 of GVA in each industry (Type I direct and indirect)
- Direct effect of the increase on GVA is calculated as:

- Direct effect = Expenditure * GVA per output %
- Indirect effect measures the relative GVA increase of indirect impacts per unit increase in direct GVA and is calculated as follows:
- Indirect effect = (GVA multiplier – 1) * direct effect

For example, '77 – Rental and leasing services' has an estimated GVA per output % of 62.45% calculated from 0.872 (GVA effects) / 1.396 (GVA multiplier). The indirect effect for SIC 77 is (1.396-1) * Direct effect on GVA.

A proportion of this increased income will be re-spent on final goods and services: this is the induced effect.

Direct, indirect and induced impacts

Expenditure on large infrastructure projects 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 project expenditure or committed future spend.

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. It 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. 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 many different onshore wind projects, to the Scottish, UK and Irish economies. 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 project 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 and committed spend

To compute the direct, indirect and induced GVA and employment impacts, all 'Tier 1' expenditure and committed spend had to be categorised and matched to a relevant economic sector before it could be inputted into the I-O model.

The I-O modelling consisted of four key stages:

(1) Identify whether expenditure and committed spend is UK, Irish or non-UK/non-Irish. If UK, go on to identify whether spend is Scottish or non-Scottish. All Scottish expenditure and committed spend is also categorised as UK.

(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 for Scotland, the UK and Ireland.

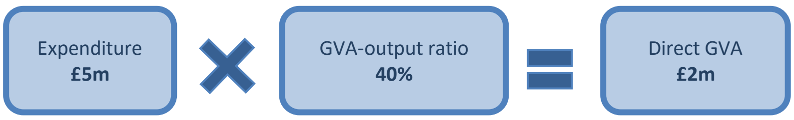
(4) Inputting the I-O sector-matched data for the relevant countries into the country-specific I-O model and generate the output.

For all categorised expenditure, the I-O model generated direct, indirect, induced and total impacts for both GVA and employment in Scotland, the UK and Ireland. 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, Scottish and Irish governments. These nationally published ratios are equal to the national/regional average GVA increase per unit increase of output for each of these sectors.

To compute the direct GVA impact, sector-matched expenditure and committed spend is multiplied by the relevant GVA-output ratios for either the UK, Scotland or Ireland. 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.



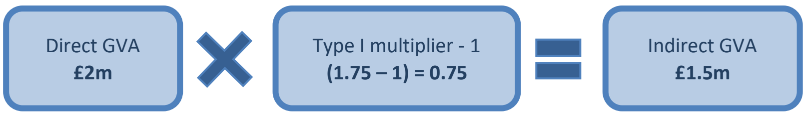
Although the majority expenditure may be within one sector, simply multiplying the total spend by the GVA-output ratio associated with that sector would not generate an accurate estimate of direct GVA. To calculate a more granular estimate of direct GVA, expenditure which does not fall within this sector 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 this analysis, 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 each project's expenditure and committed spend, 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'. 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.



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. 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.

Direct GVA	×	Type II multiplier – Type I multiplier	=	Induced GVA
£2m		**(2.25 – 1.75) = 0.5**		**£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.

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:

£2m (direct GVA) + £1.5m (indirect GVA) + £1m (induced GVA)
= £4.5m (total GVA)

Total GVA and jobs supported for the Scottish, UK and Irish economies are therefore equal to the sum of direct, indirect and induced GVA and employment generated by Scottish, UK and Irish expenditure and committed expenditure respectively in different 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.

Key data sources

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

Data type	**Country/entity**	**Source**
Input-Output tables	UK	ONS – UK Input-Output Analytical Tables, 2010
	Scotland	Scottish Government – Input-Output Analytical Tables, 2012
	Ireland	Central Statistics Office – Input-Output Tables, 2010
Employment data	UK	ONS – Annual Employment Statistics
	Scotland	Scottish Government – Input-Output Analytical Tables, 2012, and ONS Annual Employment Statistics
	Ireland	CSO – Quarterly National Household Survey and Earnings Hours and Employment Costs Survey
Expenditure data	Development, construction and operational expenditure April 2008 – March 2018	SSE
	Projected future operational and decommissioning expenditure and committed spend April 2018 – March 2040	SSE

Modelling assumptions

1. Input-Output Analytical Tables and employment statistics from the UK Office for National Statistics (ONS), Ireland's Central Statistics Office (CSO) and the Scottish Government were used to create the economic models which, in conjunction with the data provided by SSE, enabled the estimation of SSE's indirect and induced economic contribution. To calculate the employment-to-output ratios, used in the estimation of employment supported, sectoral employment data was used. Where multipliers were derived (rather than taken from publicly available sources), this was undertaken as part of SSE's wider sustainability agenda and followed government recognised methodology.

2. All analysis is done in gross terms and has not assessed the net contribution of SSE's investment in onshore wind to the economy (i.e. what would have happened in the economy if SSE's projects did not happen has not been considered).

3. SSE used three stand-alone models to estimate the economic contribution in Scotland, the UK and Ireland. These models are not linked and the results presented are, therefore, only related to the direct expenditure in each geography. 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.

4. The I-O tables have been updated to better reflect changes in labour productivity and inflation since their creation. 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.

5. The estimated economic contribution for UK, Scotland and Ireland is based on total SSE expenditure in these regions. For example, the economic contribution for Ireland reflects the purchases of the entire SSE Group from suppliers within Ireland, not just the purchases made by SSE Ireland.

6. SSE used its judgement to map the incurred supplier expenditure to the relevant sector of the economy and the geographical location of the supplier. In certain instances, data for a certain phase or time period for a project was not readily available. Conservative estimates were inputted into the model in these cases, based on expenditure on projects of a similar size in similar geographies.

7. To ensure consistency when comparing spending across years, data was adjusted to 2018 prices where required before inclusion in the economic model. All results are therefore listed in 2018 prices.

8. To account for productivity changes, employment impacts expected to occur in previous or future years were 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.

9. To account for inflation changes, a deflation factor was obtained and rates were forecast over the duration of the project.

10. The analysis looks at the economic contribution of SSE's onshore wind portfolio 2008-2018. Development, construction and operational costs incurred during this period are therefore included in the economic modelling. This includes the operational costs of wind farms constructed before 2008, however the development and construction costs associated with these projects are not included. The future operational costs and decommissioning costs of all wind farms which were operational at the end of 2018 have been included in the analysis, with final costs incurred no later than 2040.

11. For joint venture projects, only SSE's share of total committed costs was included in the analysis. In instances where a project has moved from being fully owned by SSE to a joint venture, full costs were included only up to the point of the project becoming a joint venture, after which only the SSE share was included. For operational costs of joint ventures, this was also the case regardless of whether SSE or its partner operates the site.

12. For divested and decommissioned projects, expenditure was included in the model only up to the point at which the wind farm was divested or decommissioned.

Appendix 1: Wind farms included in analysis

Wind farm name	Location	Capacity (MW) as of 31 March 2018	Commissioning date (Financial year)
Achany	Scotland	38.0	2011
Ardrossan**	Scotland	30.0	Pre-2008
Artfield Fell	Scotland	19.5	Pre-2008
Athea	Ireland	34.4	2014
Balmurrie Fell	Scotland	9.1	2013
Bessy Bell 1***	Northern Ireland	5.0	-
Bessy Bell 2	Northern Ireland	9.0	2009
Bhlaraidh	Scotland	110.4	2018
Bin Mountain**	Northern Ireland	9.0	Pre-2008
Bindoo	Ireland	48.0	Pre-2008
Boggeragh*	Ireland	27.5	2010
Braes of Doune**	Scotland	72.0	Pre-2008
Bu*** (decommissioned)	Scotland	2.7	-
Calliachar	Scotland	32.2	2014
Carcant**	Scotland	6.9	2011
Cathkin Braes	Scotland	3.0	2014
Clyde****	Scotland	339.3	See footnote
Coomacheo	Ireland	41.4	2009
Coomatalin	Ireland	6.0	Pre-2008
Corneen	Ireland	3.0	Pre-2008
Culliagh	Ireland	11.9	Pre-2008
Curragh	Ireland	18.4	2010
Dalswinton**	Scotland	30.0	Pre-2008
Dromada	Ireland	28.5	2010
Drumderg	Scotland	36.8	Pre-2008
Dunmaglass	Scotland	94.0	2018
Dunneill	Ireland	11.1	2010
Fairburn	Scotland	40.0	2010
Galway Wind Park*	Ireland	120.0	2018
Gartnaneane	Ireland	15.0	Pre-2008
Glenconway	Northern Ireland	46.0	2014
Gordonbush	Scotland	70.0	2013
Griffin	Scotland	156.4	2012
Hadyard Hill	Scotland	119.6	Pre-2008
Keadby	England	68.0	2015
Kingsmountain	Ireland	25.0	Pre-2008
Knockastanna	Ireland	6.0	2009
Langhope Rig**	Scotland	16.0	2016
Leanamore	Ireland	18.0	2018
Meentycat	Ireland	72.4	Pre-2008
Meentycat (Cark Ext)	Ireland	9.2	2010

Meentycat (Meenbog Ext)	Ireland	6.9	2010
Midas*	Ireland	16.2	Pre-2008
Minsca**	Scotland	36.8	Pre-2008
Mullananalt	Ireland	7.5	Pre-2008
Rathcahill	Ireland	12.5	2012
Richfield	Ireland	27.0	Pre-2008
Slieve Divena 2	Northern Ireland	18.8	2018
Slieve Divena**	Northern Ireland	30.0	Pre-2008
Slieve Kirk	Northern Ireland	27.6	2011
Spurness	Scotland	10.0	Pre-2008
Strathy North	Scotland	67.7	2016
Stronelairg	Scotland	228.0	2019
Tangy	Scotland	12.8	Pre-2008
Tangy Ext	Scotland	6.0	2012
Tappaghan**	Northern Ireland	28.5	Pre-2008
Tievenameenta	Northern Ireland	34.5	2017
Port of Tilbury **	England	9.2	2014
Toddleburn	Scotland	27.6	2011
Tournafulla	Ireland	7.5	Pre-2008
Tournafulla 2	Ireland	19.5	2012

* Joint venture
** Divested asset
*** Project purchased by SSE post-construction
**** At point of sale in March 2016, Clyde's total installed capacity was 349.6MW. This has since been extended to 522.4MW. Two further sales have reduced SSE's holding, as of June 2018, to 50% of 522.4MW

Appendix 2: Other economic contribution reports by SSE plc

SSE plc's annual economic contribution reports

SSE is one of the only companies to calculate and publish its economic contribution to GDP and jobs at direct, indirect and induced level each year alongside its financial results. For financial years 2011/12 to 2017/18 inclusive, SSE has worked with professional services firm PwC to calculate this economic contribution it makes to the UK, Scottish and Irish economies using the input-output economic model. Results from each year and an overview of the methodology and approach used each year can be found on http://sse.com/beingresponsible/reporting-and-policy/.

SSE single-issue economic contribution reports

Over the past five years SSE has undertaken analysis to better understand the economic impact of some of its largest infrastructure projects. This has been done this using the input-output economic model, with the contribution to GDP and jobs reported for each project. In all cases, the analysis has been carried out in-house, with peer review in some cases by organisations like PwC and NEF Consulting.

Published reports include:

- The Beatrice Offshore Windfarm Limited Project Socio-economic Impact Report;
- The Galway Wind Park Sustainability Impact Report;
- The Keadby Wind Farm Sustainability Impact Report;
- The Clyde Extension Wind Farm Economic Impact Report;
- The Caithness-Moray Transmission Project Socio-economic Impact Report;
- The Wyndford Estate District Heating Project Sustainability Impact Report;
- Case studies on the economic contribution of the Beauly-Denny transmission line and Fairburn onshore wind farm can be found within SSE's FY12&13 Economic Contribution to the UK Report.

All of these reports can be found on http://sse.com/beingresponsible/reporting-and-policy/.