

*The economic contribution
of the Clyde Extension wind
farm construction project*



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Purpose and scope of this study

This is a PwC study commissioned by SSE plc, a major energy company operating in the UK. The report estimates the gross¹ contribution to UK and Scottish Gross Domestic Product (GDP) and employment, from the construction of SSE’s Clyde Extension wind farm project (‘Clyde Extension’), which is expected to be completed in 2017.

In the past, SSE has estimated the contribution of constructing its Keadby and Fairburn windfarms to the UK economy, based on its expenditure with suppliers located in the UK. These previous analyses did not consider any contributions to the UK economy resulting from expenditure on the wind turbines, because these were sourced from overseas suppliers. This may underestimate the full impact of wind farm construction, since foreign wind turbine producers may still source products from UK firms and so could still support GDP and employment in the UK.

SSE and Siemens plc (‘Siemens’, who is due to supply wind turbines for Clyde Extension) therefore agreed to collaborate to better understand the economic contribution, to the UK and Scottish economies, from wind turbine manufacture and installation. Both SSE and Siemens agreed to provide data to PwC about their respective expenditures with suppliers in the UK. Data supplied by Siemens provides more detailed information about their spending in the UK than is available from SSE’s data alone. As Siemens is based in Germany, this expenditure would otherwise have been assumed by SSE to occur outside the UK.

Since Siemens is expected to be the single largest project contractor, constituting more than half of SSE’s projected expenditure on Clyde Extension, this represents a significant step forward in SSE’s understanding of its contribution to the UK and Scottish economies.

In this report, we present the economic contribution of the construction project as a whole, reflecting the full contribution of SSE’s expenditure. To do this we have combined data obtained from SSE, relating to its spending with its suppliers, with data obtained from Siemens, relating to its spending with its own suppliers in turn.

Limitations

This report does not look at any other economic, social and environmental impacts created by the wind farm’s activities or value chain. It only considers the construction phase of the project, and does not consider the economic footprint of the operation and end of life of the wind farm.

¹All analysis is done in gross terms and we have not assessed the net contribution of Clyde Extension to the economy (i.e. we have not considered what would have happened in the economy if the project did not happen).

²Report, by Siemens, forthcoming.

Table 1.1: Indicators assessed for this report

Indicator covered in the study	Measured as	Definition
Contribution to GDP	Gross Value Added (GVA)	GVA measures the value generated in the economy by businesses, and represents the difference between the value of goods and services sold and the goods and services used as an input to their production.
Employment supported	Person years of employment	One person year of employment is the equivalent of employing an individual for a full year.

The Appendix to this report contains more information on our methodology and indicators.

The respective roles of SSE, Siemens, and PwC in this project

SSE and Siemens provided PwC (‘we’ or ‘us’) with the input data for our estimates – including profits, wages, expenditure and person years of employment. Both also provided the geographical location, and sector of the economy, of the companies with which they expect to spend their money, using their professional judgement and published guidance from statistics authorities. We used these data, as well as data from statistics authorities, as inputs to estimate the economic contribution from construction of the Clyde Extension wind farm project, using economic models built by us. A list of data sources used is available in the Appendix of this report.

We have not tested or audited any of the data provided by either SSE or Siemens, nor those obtained from statistics authorities, that have been used within the models. Hence, we provide no assurance over these data or any outputs based on these data.

PwC has separately been commissioned by Siemens to estimate a broader range of impacts resulting from their activities relating to Clyde Extension, across the wind turbines’ full operational life (including both construction and operation)². This report only considers the construction phase of Clyde Extension. The data relating to Siemens’ expenditure during the construction phase of the project (including turbine manufacture and installation) was used for both analyses.

About the Clyde Extension wind farm project

Clyde Extension is a planned addition to the original Clyde wind farm, located in South Lanarkshire, Scotland. The original Clyde wind farm is a 152 turbine, 350MW onshore wind farm that occupies around 47 square kilometres and became operational in summer 2014. SSE is planning to extend this wind farm by adding 54 turbines with the potential to generate an additional 173 MW of electricity.

£201m is expected to be spent during the construction of Clyde Extension, with over 50% of this spent on the wind turbines. Of the remaining costs, 98% is expected to be spent with UK suppliers.

Construction started early in 2015 and is expected to last approximately 2 years, coming to a close in 2017.



Photo source: SSE

Figure 1.1: Clyde Extension in summary

54 Additional onshore turbines ³	173MW Additional generation capacity ³	£201m Total expenditure on construction ³	£108.2m Total estimated contribution to UK GDP ⁴	1,830 Total estimated person years of employment supported in the UK ⁴
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³ SSE

⁴ PwC analysis

Working closely with Siemens

SSE has measured its contribution to the UK, Scottish and Irish economies since 2012. At a more local level, it has also published estimates of the economic contribution of two of its infrastructure projects – Fairburn and Keadby wind farms. These impact assessments have been based on SSE expenditure with UK suppliers. However, these studies did not assess the contribution to the UK economy from spending on wind turbines, which were sourced from foreign suppliers. These studies may, therefore, underestimate the contribution to the UK economy, if wind turbine producers source products from UK firms, because such indirect spending in the UK is not considered.

To develop and improve the approach for Clyde Extension, SSE and Siemens agreed to collaborate, with Siemens providing additional data to PwC about its spending in the UK associated with its provision of wind turbines. Since Siemens is expected to be the single largest project contractor, representing more than half of SSE's total projected expenditure, this represents a significant step forward in SSE's understanding of its contribution to the UK and Scottish economies. Our results show that Siemens' activity during the construction phase of Clyde Extension is expected to contribute £20.2m to UK GDP of which £16.5m contributes toward Scottish GDP (see Figures 1.4 and 1.7). It is also expected to support 370 person years of employment in the UK, including 270 in Scotland (see Figures 1.5 and 1.8). At the UK level this represents over 19% of the total GVA contributed, and 20% of the employment supported, by Clyde Extension. In Scotland, Siemens' contribution represents 22% of Clyde Extension's contribution to GVA and 20% of the employment it supports. Without the collaboration between SSE and Siemens, it would not have been possible to capture this component of the economic contribution in our analysis.

SSE's contribution via its expenditure with Siemens is only part of the picture. To understand SSE's overall economic impact we have considered Siemens' impact as a primary supplier to the wind farm, alongside SSE's broader expenditure on other construction-related activities with UK suppliers.



Photo source: SSE

Measuring economic contribution at the project level

We have estimated the economic contribution of Clyde Extension to the UK and Scottish economies using two indicators:

- Contribution to GDP: Measured in terms of Gross Value Added (GVA)
- Employment supported: Expressed as person years of employment (a full definition of this term is provided Table A.2)

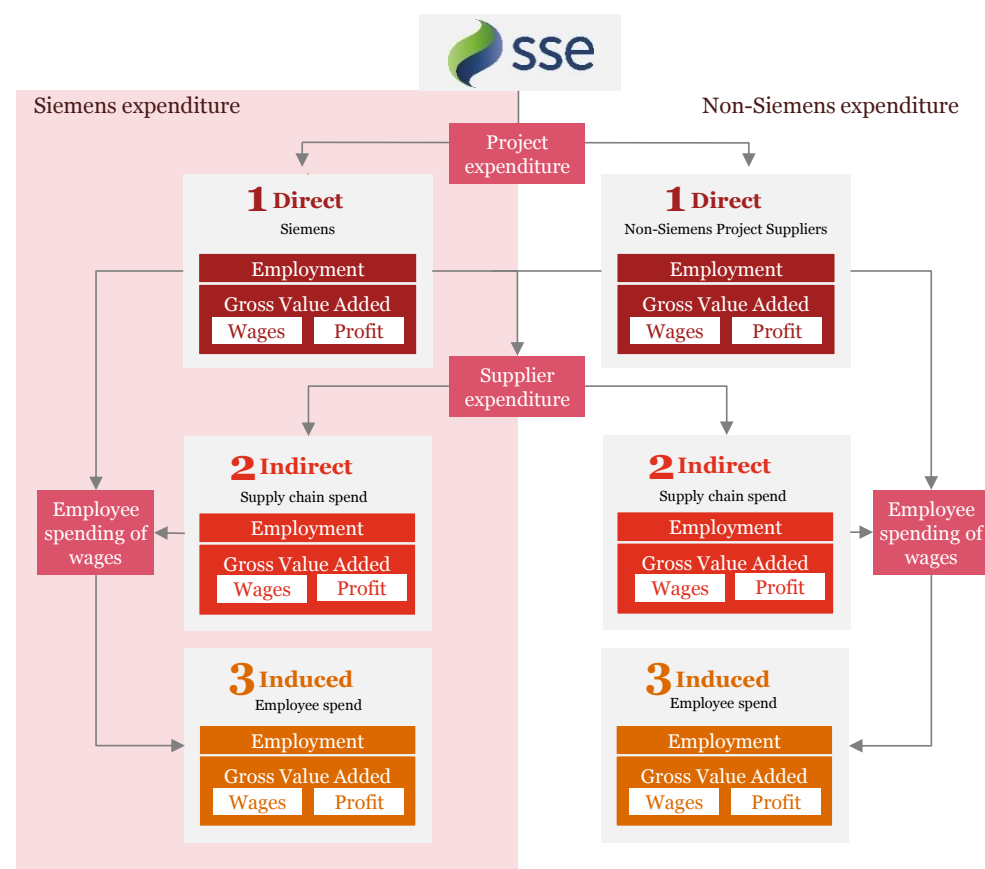
GVA is a measure of the value generated in the economy and represents the difference between the value of goods and services sold and the goods and services used as inputs to their production. Hence, it is the company-level equivalent of GDP: adding up the GVA of all individual companies in the economy is equivalent to a country's GDP⁵. GVA is distributed as profits (before interest, taxes, depreciation and amortisation) and wages.

The contribution to GDP and employment are both divided into three levels:

- 1. Direct contribution:** The GDP and employment attributable to direct suppliers' supply of goods and services to the project, including Siemens', as a result of SSE's expenditure;
- 2. Supply chain spend contribution (indirect):** The GDP and employment from the firms producing the goods and services needed by direct suppliers to the construction project. This is often known as the 'indirect contribution';
- 3. Employee spend contribution (induced):** The GDP and employment in the wider economy as a result of wages being spent by the employees of direct suppliers to the project, and those of their suppliers in turn. This is often known as the 'induced contribution'.

Using the data provided by SSE on its expenditure (including the sector and location of direct suppliers) we estimated all three levels of economic contribution generated by the spending with non-Siemens suppliers using Input-Output modelling. We used the same methodology and models to estimate the additional impact generated by Siemens, through its supply chain spend contribution and employee spend contribution. For Siemens' direct economic contribution we used data provided directly by Siemens.

Figure 1.2: The three levels of economic contribution



Source: PwC

⁵ After adjusting for taxes and subsidies on products - components of GDP which are not included in the calculation of GVA.

The contribution of Clyde Extension construction to the UK economy



SSE expects to spend £201m over the course of the construction of Clyde Extension. Over 50% of the project expenditure is expected to be spent with Siemens for the supply of the wind turbines. Of the remaining cost, 98% (£90.8m) is expected to be spent with UK based suppliers. Our analysis of SSE and Siemens expenditure suggests that Clyde Extension is expected to contribute £108.2m to UK GDP, with £20.2m of this associated with Siemens' expenditure from its supply of wind turbines.

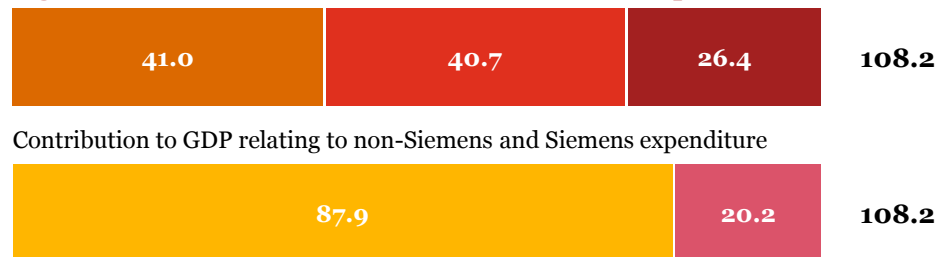
Clyde Extension is also expected to support a total of 1,830 person years of employment in the UK, with 370 of these person years associated with Siemens'. This implies that Clyde Extension will support approximately 810 jobs, on average, in each full year of the construction phase⁶. For every £1m spent with UK suppliers to the project, 20.1 UK person years of employment are expected to be supported^{7,8}.

Figure 1.3: Person years of UK employment per £1m spent with UK project suppliers



Source: SSE, Siemens, and PwC analysis

Figure 1.4: Total contribution to UK GDP (£m in 2015 prices)⁹



■ Direct
 ■ Supply chain
 ■ Employee spend
■ Contribution resulting from non-Siemens expenditure
■ Contribution relating to Siemens expenditure

Source: SSE, Siemens, PwC analysis.

⁶ The construction phase is expected to take place between the start of 2015 through to early 2017. To estimate the average employment in one full year we assume that construction will be completed by end Q1 2017 and therefore divide total employment by 2.25.

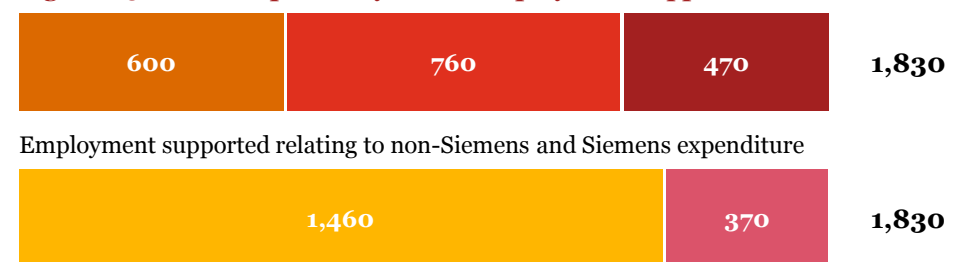
⁷ Jobs and GVA are different indicators that are driven by the same underlying economic activity. They should not be added together or otherwise considered additional to one another.

⁸ These results refer to the construction of Clyde Extension only. They do not include any contribution resulting from the operation of the wind farm once complete.

⁹ Future impacts have been discounted to present (2015) values and are also presented in 2015 prices.

Please note that due to rounding some of the figures may not sum to the totals presented.

Figure 1.5: Total UK persons years of employment supported



■ Direct
 ■ Supply chain
 ■ Employee spend
■ Employment supported by non-Siemens expenditure
■ Employment supported by Siemens expenditure

Source: SSE, Siemens, PwC analysis. Rounded to nearest 10 person years of employment.

The contribution of Clyde Extension construction to the Scottish economy



Of the £90.8m that SSE expects to spend with its UK based suppliers, £70.2m is expected to be spent within Scotland. Our analysis suggests that this will contribute £59.6m to Scottish GDP, with an additional £16.5m associated with Siemens' expenditure with its Scottish suppliers; an overall contribution to Scottish GDP of £76.1m.

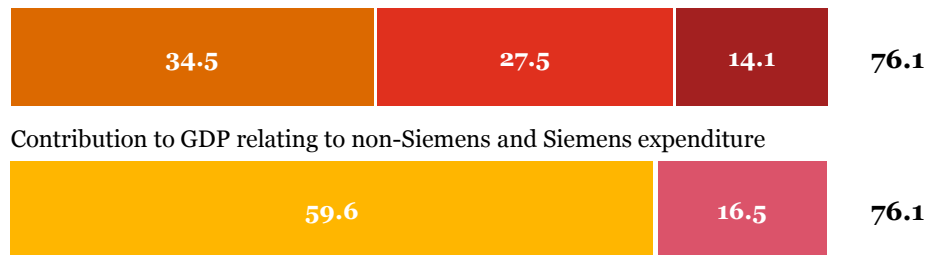
Clyde Extension is expected to support a total of 1,350 person years of employment in Scotland, with 270 of these person years supported by Siemens expenditure with its Scottish suppliers. This implies that Clyde Extension will support approximately 600 jobs, on average, in each full year of the construction phase¹⁰. For every £1m spent with Scottish suppliers to the project, 19.3 Scottish person years of employment are expected to be supported^{11,12}.

Figure 1.6: Person years of Scottish employment per £1m spent with Scottish project suppliers



Source: SSE, Siemens, and PwC analysis

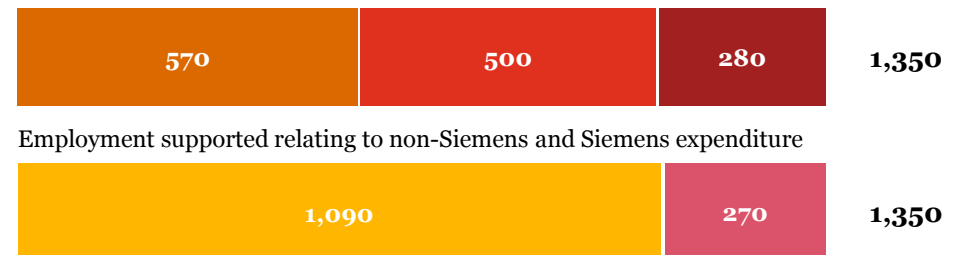
Figure 1.7: Total contribution to Scottish GDP (£m in 2015 prices)¹³



■ Direct
 ■ Supply chain
 ■ Employee spend
■ Contribution resulting from non-Siemens expenditure
■ Contribution relating to Siemens expenditure

Source: SSE, Siemens, PwC analysis.

Figure 1.8: Total Scottish person years of employment supported



■ Direct
 ■ Supply chain
 ■ Employee spend
■ Employment supported by non-Siemens expenditure
■ Employment supported by Siemens expenditure

Source: SSE, Siemens, PwC analysis. Rounded to nearest 10 person years of employment.

¹⁰ The construction phase is expected to take place between the start of 2015 through to early 2017. To estimate the average employment in one full year we assume that construction will be completed by end Q1 2017 and therefore divide total employment by 2.25.

¹¹ Jobs and GVA are different indicators that are driven by the same underlying economic activity. They should not be added together or otherwise considered additional to one another.

¹² These results refer to the construction of Clyde Extension only. They do not include any contribution resulting from the operation of the wind farm once complete.

¹³ Future impacts have been discounted to present (2015) values and are also presented in 2015 prices.

Please note that due to rounding some of the figures may not sum to the totals presented.

Appendix

Appendix

Overview of approach

Clyde Extension’s economic contribution is defined in terms of its gross contribution to GDP and employment.

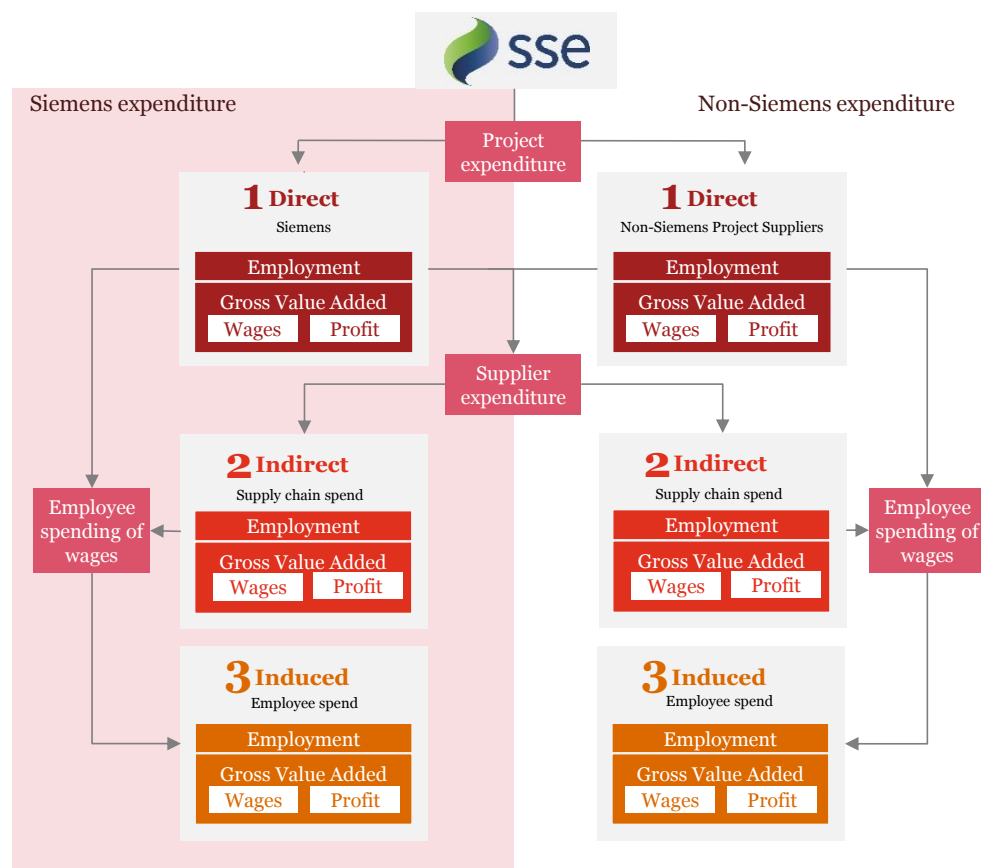
Contribution to GDP is measured in terms of Gross Value Added (GVA). GVA is a measure of the value a company adds during its production process. It is the difference between the value of its products (outputs) and the cost of the inputs it uses in producing these (or intermediate consumption). GVA is an alternative term for GDP at factor cost, which is GDP before taxes and subsidies on products. As such, GVA is the company-level equivalent of GDP. GVA is distributed as profits (before interest, taxes, depreciation and amortisation) and wages.

The contributions to GDP and employment are estimated at the direct, indirect and induced levels. For this assessment, we define direct contribution as that resulting from the operations of the suppliers directly contracted to deliver work, including Siemens (‘Tier 1’ suppliers from the perspective of SSE). It includes the people employed directly by Tier 1 suppliers and the value added the companies directly create. The indirect contribution is generated in the project suppliers’ supply chains, through their procurement of inputs. The induced contribution is generated through the spending by employees throughout the value chain from their earnings. In our report these contributions have been called direct, supply chain spend and employee spend to make it easier for readers not familiar with the economic terminology.

SSE and Siemens have provided us the input expenditure data required to estimate the economic contribution. We also rely upon data from statistics authorities to build the economic Input-Output models used in our calculations (as described on the following pages). We did not carry out any testing of, and do not provide any assurance over, the underlying data provided by SSE and Siemens, nor those obtained from the other external sources. Hence, we do not provide any assurance over outputs based on such data.

A more detailed explanation of our approach can be found on the following pages.

Figure A.1: The three levels of economic contribution



Source: PwC

Appendix

Approach to estimating economic contribution

The economic contribution of Clyde Extension is estimated using Input-Output models for both the UK and Scotland. These models describe how different industries of an economy relate to each other and can be used to estimate how activity by one company stimulates activity elsewhere in the economy.

As outlined above, the direct contribution of Clyde Extension refers to the GVA created by direct suppliers to the project and the employment that this supports. Siemens provided data on their direct employment, and profits and wages associated with the project (which we used to calculate their direct GVA contribution). For other Tier 1 project suppliers, we applied sector level GVA and employment-to-output ratios to estimate the direct economic contribution related to expenditure with non-Siemens suppliers.

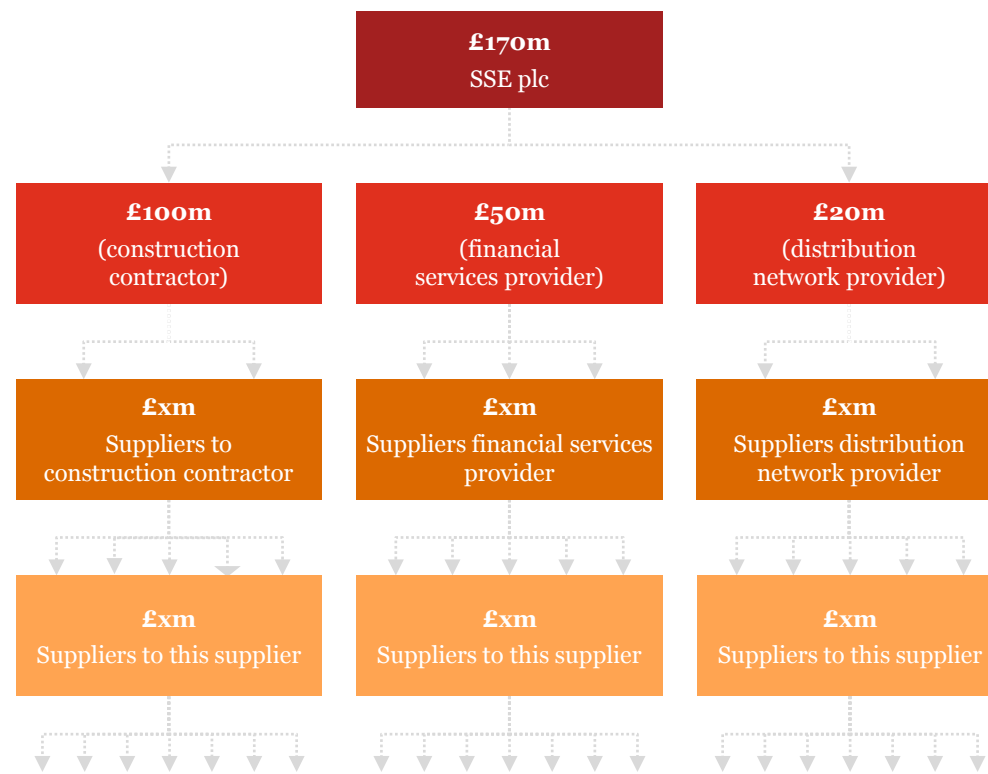
Indirect (or supply chain) contribution is estimated using expenditure data provided by SSE and Siemens. SSE provided its budget for the construction of Clyde Extension, which it analysed to identify from which sectors of the economy and from which country it expects to purchase its inputs. Siemens conducted the same exercise to map all of its expected procurement spend relating to the construction of the turbines. The Input-Output models show the inputs required from other sectors of the economy for a given sector to produce one unit of its own output. In this way, we estimate Clyde Extension's input requirements through the entire supply chain and estimate the total value of production stimulated. This process - of one company stimulating economic activity in other companies - is often referred to as the 'multiplier effect'.

We applied GVA to output ratios to the production value stimulated by SSE's expenditure to estimate the total GVA in the supply chain by sector. We estimated the average output per employee by sector and applied it to the production value stimulated in each sector in the supply chain. In this way, we estimated the indirect GVA and employment supported by SSE's spending on Clyde Extension.

We repeated these steps to estimate the induced contribution, by extending our models to include wage payments throughout the supply chain, and the economic activity stimulated when people spend these on goods and services (e.g. accommodation, food and entertainment).

The Input-Output models for each geography 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).

Figure A.2: A simplified representation of the relation between SSE and its supply chain (hypothetical numbers used below)



Appendix

Key data sources and definitions

Table A.1: 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, 2011
<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>	SSE expenditure	SSE
	Siemens expenditure	Siemens

Table A.2: 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>Person years of employment</i>	<p>We estimate employment as person years of employment. One person year of employment is the equivalent of employing an individual for a full year. The way this can be interpreted is as follows:</p> <ul style="list-style-type: none"> • 1 person year of employment over 1 year equals 1 job (or 'headcount') over this period; • 2 person years of employment over 1 year equal 2 jobs over this period; • 2 person years of employment over 2 years equal 1 job over this period. <p>This way of expressing employment is particularly important as we assess employment creation over a period of more than one year.</p>
<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'.

Appendix

Data treatment and modelling assumptions

Data treatment

- To ensure consistency when comparing spending across years, all data have been discounted to 2015 prices where relevant. SSE provided its budgeted expenditure in expected outturn prices for each year of construction (2015-2017). We have converted future expenditure to 2015 prices based on an extrapolation of the ONS UK GDP deflator series from historic trends. Siemens provided all of its expenditure data in 2015 prices. Therefore all results are provided in 2015 prices unless otherwise stated.
- The latest national Input-Output tables were compiled in 2010 and 2011 for the UK and Scotland respectively. We have updated these to better reflect the economy in 2015, 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 our estimates should be treated with caution for sectors that have changed significantly since the preparation of the most recent Input-Output tables.
- Based on discussions with SSE, we understand that any SSE staff who will work on Clyde Extension will operate across a variety of projects and it is, therefore, difficult to attribute the employment directly to Clyde Extension. To be conservative, we have not included any direct SSE employment in our analysis.
- Siemens' direct GVA for Clyde Extension is composed of its expected wage payments and profits relating to the project. Expected profits have been assigned to the UK and Scotland based on the share of expected wage payments to these countries.
- Suppliers which have been identified by SSE as non-UK have been excluded from our analysis with the exception of Siemens. This represents less than 2% of the project expenditure spent with non-Siemens suppliers.

Modelling assumptions

- All analysis is done in gross terms and we have not assessed the net contribution of Clyde Extension to the economy (i.e. we have not considered what would have happened in the economy if the project did not happen).
- We have used two stand-alone models to estimate Clyde Extension's 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 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.
- 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%.

Appendix

Comparing this report with Siemens' report on Clyde Extension

PwC has been separately commissioned by Siemens plc to estimate the impact of their expected activities to support Clyde Extension. That separate analysis has a broader scope. In addition to estimating Siemens' contribution to the global economy (as well as the UK and Scottish economies), it assesses environmental and human capital impacts. Moreover, the analysis conducted for Siemens considers the full operational life of Clyde Extension, beyond the construction phase (which it splits into manufacturing and installation).

This report for SSE only considers the construction phase of the project, and does not consider the economic footprint of the operation and end of life of the wind farm. It does not look at any other economic, social and environmental impacts created by the wind farm's activities or value chain.

Due to the difference in scope the results contained in this report can not be directly compared with those presented to Siemens. However, the data, input-output models, and methodology used to estimate the contribution to GVA and employment in the UK and Scotland, are consistent across both analyses.

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