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The Power of Onshore Wind

June 2018

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BVG Associates

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Industrial Strategy: Onshore wind delivers on the five foundations of productivity

People	Infrastructure	Ideas	Business Environment	Places
Good jobs and greater earning power for all	A major upgrade to the UK's infrastructure	The world's most innovative economy	The best place to start and grow a business	Prosperous communities across the UK
Onshore wind creates highly skilled and long-term jobs for the operational life of a wind farm.	*Onshore wind provides new low carbon generating capacity, increasing the UK's security of electricity supply.*	*Onshore wind is a proven technology and the lowest cost form of new generating capacity in the UK. It is developed within a technology-driven industry with a strong culture of innovation and cost reduction.*	*Onshore wind supports new supply chain businesses and is an increasingly attractive industry in which to invest.*	*Onshore wind creates local employment opportunities in areas where new economic opportunities are welcomed*

Five 1GW Contract for Difference auctions could deliver

18,000 jobs during peak construction, and 8,500 long term skilled jobs supporting the operation of the wind farms	**£6 billion of investment in** new clean generation	A strike price of **£49.4/MWh in 2019, falling to £45/MWh in 2025 (2017 prices)** (£45.6/MWh and £41.6/MWh in 2012 prices) **£1.6 billion** net payback to the consumer over the 15 year CfD period	A **UK content of 68%** for projects built in 2021, increasing to almost **70%** for projects built in 2027	**£12 billion** of gross value-added **60%** of the jobs will be created in Scotland, **23%** in England and **17%** in Wales

Executive summary

The UK Government published its Industrial Strategy in November 2017 with the aim of boosting productivity in the UK, developing skills and promoting industrial growth in every part of the country.[3]

Onshore wind, as the lowest cost form of new-build electricity generation in the UK, is already delivering on the Industrial Strategy's objectives; delivering for British businesses across the country, creating jobs and economic growth across the UK.

This study analysed onshore wind projects currently in development. It builds a picture of the cost and location of the projects, and the economic impacts in terms of UK and national content, and gross value-added and job creation.

This report shows the contribution onshore wind can make to the UK Government's Industrial Strategy alongside its contribution to renewable targets across the UK, if supported by UK Government policy through Contracts for Difference (CfD) auctions for established electricity generation technologies.

Investment opportunity

According to the analysis, 126 projects could be supported by five auctions, with a total private sector investment of £6 billion over the lifetime of the projects. During the 2020s, £600,000 would be invested each day on average.

Cost reductions and consumer benefit

Analysis showed that the clearing price for the first auction could be £49.4/MWh, reducing to £45/MWh (2017 prices) (£45.6/MWh and £41.6/MWh in 2012 prices). These prices are consistent with auction prices elsewhere in Europe. Reductions will come from more efficient and reliable turbines, better site selection and the competitive pressure of auctions. Data from the Department for Energy and Industrial Strategy (BEIS) suggests that the UK wholesale electricity price would exceed the levelised cost of onshore wind backed by a competitively auctioned CfD from 2023.[15] Over the 15-year CfD period, the net payback to the consumer would be more than £1.6 billion, benefiting household bills.

Efficient locations

The competitive CfD auction process ensures that only the most cost-effective projects are built (with a planning system supporting projects in the most suitable locations). The results show that the most efficient projects are in Scotland and Wales, together accounting for 98% of the projects that are constructed. Less than 2% would be built in England, made up of small scale (sub-50MW) projects (see Figure 0.1). These small wind farms would be a type typically developed by communities.

Key results

- Onshore wind is the cheapest form of low carbon electricity generation available to the UK. New projects' costs are forecast to drop beneath BEIS's forecast wholesale electricity price from 2023, demonstrating net benefit for UK consumers.
- If five CfD auctions are held at 18 month intervals between 2019 and 2025 with a 1GW ceiling in each, the net payback to the consumer could be more than £1.6 billion over the 15 year CfD period, benefiting household bills up and down the country.
- The auction clearing prices are forecast to be £49.4/MWh in 2019 falling to £45/MWh by 2025 (2017 prices) (£45.6/MWh and £41.6/MWh in 2012 prices).
- Over the five auctions modelled using projects in the Renewable Energy Planning Database, 86% of the projects by capacity would be built in Scotland and 12% in Wales. Less than 2% would be built in England made up of small scale projects (sub-50MW) of a type typically developed by communities.
- The total investment opportunity is up to £6 billion.
- The series of CfD auctions creates a demand for goods and services leading to new investments in the UK supply chain which would otherwise not happen.
- Whole-life UK content in recently built onshore wind farms is about 66%. A clear commitment to five auctions could stimulate investment, leading to UK content increasing to 70%. The pipeline volume and market certainty can lead to new UK investments in the UK. The biggest opportunities will be in the turbine supply chain, with the potential for greater supply of towers and blades, part refurbishment and the development of UK installation teams. The most competitive UK suppliers will find export opportunities.
- The five auctions would lead to investments that generate £12 billion in undiscounted GVA in the UK.
- The auctions can create about 18,000 jobs during the peak years of construction. About 8,500 people will be employed in long-term skilled jobs when all the wind farms are operating.
- It is anticipated that 60% of the jobs will be created in Scotland, 17% in Wales and 23% in England (where many HQs are located).

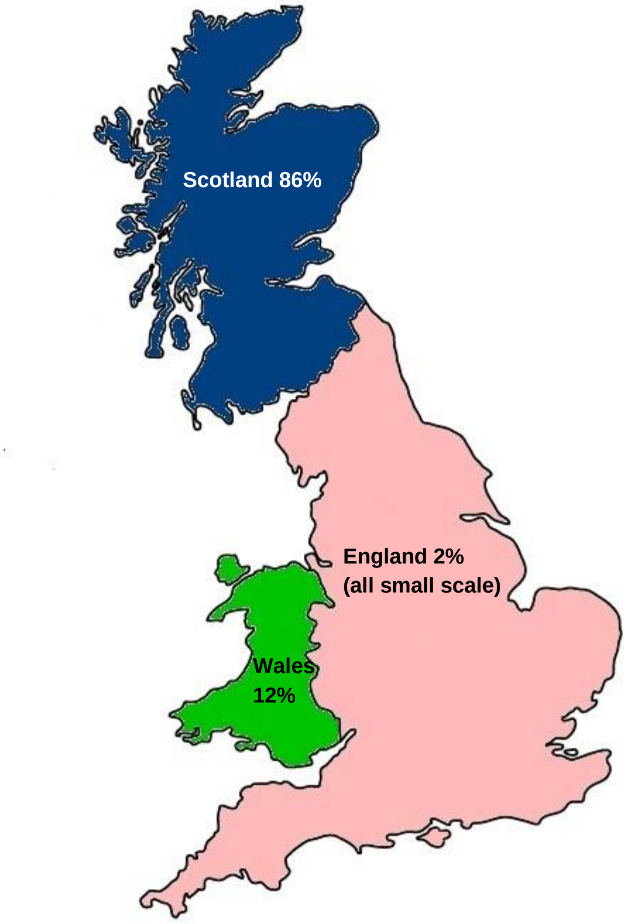

Figure 0.1 National distribution of wind farms built following the five CfD auctions.

UK and national content

The UK and national content for onshore wind is high, delivering right across the UK.

The series of CfD auctions creates a demand for goods and services leading to new investments in the UK supply chain which would otherwise not happen.

A sustainable onshore wind market in the UK will stimulate new investment in manufacturing and repair facilities, and in skills development, and increase the already high levels of local content.

Analysis of the UK onshore wind supply chain showed that the UK content for the projects built from the first CfD auction would be 68% and this could increase to 70% for the fifth auction. This is most likely to be achieved through greater localisation of the turbine supply chain, notably towers, installation teams and potentially blades. All other areas of the supply chain, such as civil and electrical works, and wind farm operation, maintenance and service, already have high levels of local content.[7]

The average UK content over the five auctions was forecast to 69.4% (see Figure 0.2).

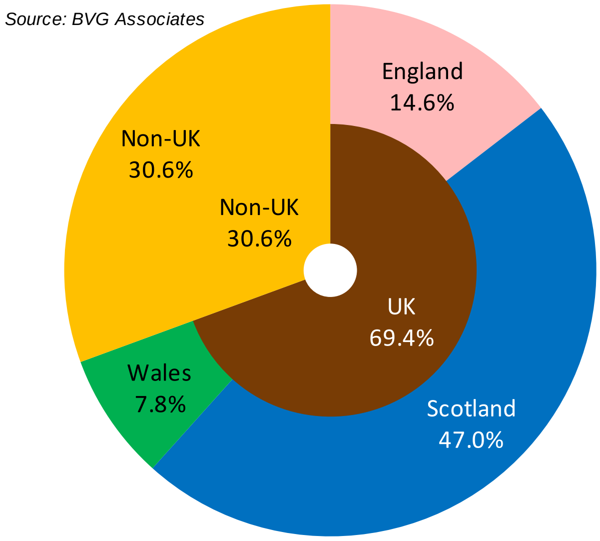

Figure 0.2 Overall national and UK content across wind farms built following the five CfD auctions.

Job creation

The five auctions will generate up to 18,000 jobs during the peak time of construction between 2024 and 2027. About 8,500 long term jobs are created during the operational phase. Figure 0.3 shows that most of these are created in Scotland. England creates more jobs per MW installed than Scotland or Wales because England is a net 'exporter' to Scottish and Welsh projects because of the location of company headquarters and the greater contribution it makes at the lower tiers of the supply chain.

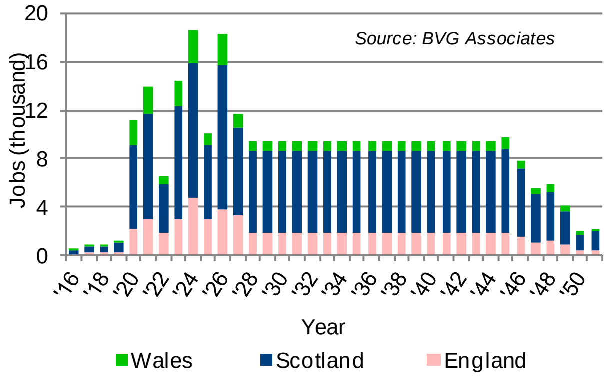

Figure 0.3 Jobs (full-time equivalents) in England, Wales and Scotland created by the five CfD auctions.

Economic impact

The wind farms built following the five CfD auctions will generate £12 billion in undiscounted GVA and £8 billion discounted GVA.[1] In 2024, the onshore wind could contribute 0.1% to UK GDP.[2] Figure 0.4 shows this peaks in 2024 at about £750 million.

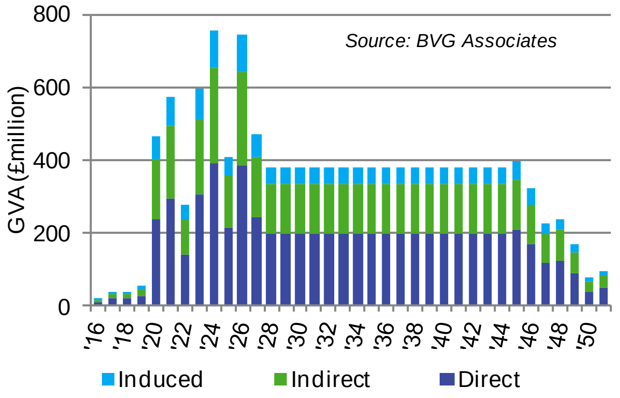

Figure 0.4 UK gross value-added (undiscounted) in England, Wales and Scotland created by the five CfD auctions, split by direct, indirect and induced impacts.

[1] Using a discount rate of 3.5%, as recommended by The Green Book: Central Government Guidance On Appraisal And Evaluation, HM Treasury, 2018. Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf. Last accessed June 2018

[2] Assuming an average annual growth of 2%

1. Introduction

The landscape

The UK Government published its Industrial Strategy in November 2017 with the aim of boosting productivity in the UK, developing skills and promoting industrial growth in every part of the country.

Onshore wind, as the lowest cost form of new-build electricity generation in the UK, is already delivering on the Industrial Strategy's objectives; delivering for British businesses across the country, creating jobs and economic growth across the UK. In doing so, further deployment of the technology can continue to deliver on the Grand Challenge of Clean Growth, set out in the UK Government's Industrial Strategy.[3]

Long considered the cheapest form of large scale new-build electricity generation in UK[4], the mature sector's levelised cost of energy (LCOE) is forecast to continue to fall further over the next decade as innovation progresses. Onshore wind is also a technology with widespread public support. The Energy and Climate Change Public Attitudes Tracker published in April 2018 demonstrated that support for onshore wind across UK consumers lay at 76%.[5]

Regionally, the Scottish Government, too, launched its own Energy Strategy in December 2017, establishing an ambitious new target of 50% of energy (not just electricity) demand to be generated from renewables by 2030. The associated Onshore Wind Policy Statement confirmed the Scottish Government's vision for onshore wind's role in powering the Scottish economy for the future.[6]

In addition, the Welsh Government has set a target of generating 70% of its electricity consumption from renewable energy by 2030.

As a mature sector, onshore wind is ready to deliver lowest cost electricity decarbonisation under a market stabilisation Contract for Difference (CfD). A market stabilisation CfD is needed to de-risk upfront capital investment, reducing the overall cost of onshore wind. With the retirement of old technologies such as coal plant, and the investment required in new lower carbon generation, the UK Government can play a key role in ensuring this investment is forthcoming at a cost-effective rate and in the volumes required to ensure security of supply.

Long-term market certainty is critical for investment decisions and a regular pipeline of projects is needed to sustain the established onshore wind supply chain and facilitate further investment in the UK.

This analysis

To demonstrate the benefits of onshore wind, ScottishPower Renewables, Innogy, Statkraft and Vattenfall commissioned this analysis. The aim of the study was to build a picture of the cost and location of onshore wind projects and the economic impacts in terms of UK and national content, gross value-added (GVA) and job creation. It uses the same economic impact methodology as the analysis undertaken by BVGA for ScottishPower Renewables in September 2017 and applies many of the findings from this work.[7]

This report explores the contribution onshore wind can make in the UK Government's future Industrial Strategy alongside its contribution to renewable targets across the UK, if supported by UK Government policy through CfD auctions for established electricity generation technologies.

Sustaining the onshore wind market in the UK could potentially stimulate new investment in new skills and manufacturing facilities, and increase the already high levels of local content.[7] The 2017 study found that UK content in recent ScottishPower Renewables onshore wind farms was 66%. A strong and sustained onshore wind market in the UK has the potential to increase the economic benefits further.

This analysis tests these benefits and seeks to quantify them.

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[3] *Industrial Strategy: Building a Britain fit for the future*, HM Government, November 2017. Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf . Last accessed June 2018

[4] *Energy generation cost projections*, Department for Business, Energy and Industrial Strategy, 2016, Available online at https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016. Last accessed June 2018

[5] *The Energy and Climate Change Public Attitude Tracker: Wave 25*, April 2018, Department for Business, Energy and Industrial Strategy. Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/702640/Wave_25_Summary_Report.pdf. Last accessed June 2018

[6] Onshore Wind Policy Statement, Scottish Government, December 2017. Available online at http://www.gov.scot/Resource/0052/00529536.pdf. Last accessed June 2018

[7] *Economic benefits from onshore wind farms*: A report for ScottishPower Renewables, BVG Associates, September 2017. Available online at https://bvgassociates.com/economic-benefits-onshore-wind-farms. Last accessed June 2018

2. Methodology

The work was undertaken in the following stages:

- Bid price forecasting and impact on consumer bills
- CfD auction modelling
- UK and national content modelling, and
- Economic impact modelling.

For the purposes of this study, we defined 'national' as referring to one of England, Scotland or Wales.

2.1. Bid price forecast and impact on consumer bills

Cost forecast

CfD auction bid prices for onshore wind have continued to fall and we expect further reductions as the underlying LCOE falls. This is mainly due to improvements in turbine design (including size) and consolidated learning by developers and suppliers. We also anticipate an 'auction effect' and this is likely to drive efficiencies in the industry and lead to keener pricing.

We developed a baseline for the clearing price of CfD auctions using data on recent costs of onshore wind projects and developed a forward trajectory, considering recent bid prices in Europe and likely developments in the technology, scale and competitiveness of the industry.

Impact on consumer bills

The impact on consumer bills was calculated by using BEIS's 2017 reference scenario for wholesale electricity price.[8] We assumed that CfDs are awarded for 15 years and inflation adjusted. The total cost to consumers for each auction is therefore the net difference between the strike price (assumed to be the highest LCOE of each auction) and the wholesale price for each of the 15 years of the CfD.

2.2. CfD auction modelling

The analysis was based on five theoretical CfD auctions held first in spring 2019 and at 18 month intervals thereafter. Each had a maximum capacity of 1GW. We assumed that a wind farm becomes operational two years after the CfD auction and operates for 25 years.

To establish the indicative size and locations of projects, we used the April 2018 version of the Renewable Energy Planning Database (REPD)[9], which is published monthly by Department for Business, Energy & Industrial Strategy. We excluded projects for which consent had been refused or expired as of June 2018. We also excluded projects with capacities less than 5MW, since these are ineligible for a CfD. We assumed that only projects that have already received consent would be eligible for the first auction. In total, 4.8GW of project capacity was considered.

In practice, not all the projects included on the REPD will get built because consent expires and additional, lower cost projects will enter the system and be constructed. Uneconomic projects were unsuccessful in the auction scenarios, so it was reasonable to assume that the economically attractive projects in the planning system were representative of any new projects that will be developed in the future.

We built a cost merit order of individual projects in planning based on the following criteria:

- Site annual mean wind speed
- Turbine size, as indicated in the REPD
- Project size, as indicated in the REPD
- Distance to grid, and
- Land rent.

For annual mean wind speed, we used geographical data at 100m height from DTU/World Bank. To derive site annual wind speed, we adjusted this to hub height assuming a typical wind shear profile. We used turbine size (tip height) and a best-fit representative relationship for UK projects to estimate hub height. If no tip height was available, then we used a representative relationship with turbine size (MW) instead.

We assumed that projects greater than 30MW would need to connect to the transmission grid. For these, we assumed there was an additional cost of £300,000 per km for underground cabling.

For land rent, we used national data on the relative cost of agricultural land.[10]

[8] Updated energy and emissions projections 2017. Annex M: Growth assumptions and prices. January 2018. Available online at https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017. Last accessed June 2018

[9] Renewable Energy Planning Database, Department for Business, Energy and Industrial Strategy, Last updated May 2018. Available online at https://data.gov.uk/dataset/a5b0ed13-c960-49ce-b1f6-3a6bbe0db1b7/renewable-energy-planning-database-repd. Last accessed June 2018.

[10] *Market Survey: GB Agricultural Land*, Savills World Research, 2017. Available online at https://pdf.euro.savills.co.uk/uk/rural---

Appendix B contains a set of LCOE modelling assumptions used in the analysis.

Merit order

We established a merit order of projects and used this to select the projects that would be successful in each auction, by taking the lowest cost eligible projects first.

We then analysed project locations and placed each in the appropriate nation.

2.3. UK and national content modelling

One of the aims of the study was to forecast where the economic benefits occur and how this might change over time. This study applies the principles of the UK content methodology developed by BVGA for the offshore wind industry that has already been applied to onshore wind in a number of published reports.[11]

Content is defined as “The value of all supplies sourced from within the area that accrues as earnings from employment and business profits. It is the sum of 'direct' plus 'indirect' impacts”.

Elements of the supply chain can be categorised as either project or non-project specific.

The project specific supply chain (such as service technicians) depends on the precise location of the wind farm, whereas non-project specific supply chain (such as tower manufacture) can be located well away from the wind farm, although there is likely to be a national bias.

Project-specific content

We assumed that all wind farms in the UK show the same level of project-specific content and this was allocated to each nation in proportion to the capacity of wind farms successful in each CfD auction.

We assumed that the level of project-specific content was the same for all projects and would not change over time. Appendix B shows the representative project-specific content used in this study for all nations.

Non-project specific content

Current

For each nation, we researched the likely national content for all projects for the first CfD auction, which was based on:

- Analysis of the onshore wind supply chain, previously undertaken for ScottishPower Renewables[12]
- Supplier lists from the funding partners of this study, and
- RenewableUK membership and project data.[13]

Future

To help understand what could be achieved with a strong pipeline of UK onshore wind projects, we drew on discussions with suppliers and developers. We assumed that the government commits to all five auctions at a maximum 1GW at the outset, providing significant market certainty to investors.

National content was therefore calculated for each auction by combining the content that is local using the assumptions shown in Appendix B and the content that is common to all wind farms in each nation.

We used the supply chain categories shown in Appendix B to describe the national supply chains and as the basis for the quantitative analysis.

2.4. Economic impact modelling

To model the impacts of the wind farm development, construction and operation, we used a methodology which is based on a detailed understanding of wind and transmission industry supply chains. The methodology uses a structured ‘content’ analysis from a modelling methodology originally developed by BVGA for the Offshore Wind Programme Board.[11] We analysed the following:

- Direct and indirect gross value added (GVA)
- Direct and indirect earnings, and
- Direct and indirect full-time equivalent (FTE) job years.

other/agricultural-land-market-survey-2017.pdf. Last accessed June 2018

[11] Methodology for measuring the UK content of UK offshore wind farms, May 2015, BVG Associates for Department of Energy and Climate Change, The Crown Estate and RenewableUK. Available online at https://bvgassociates.com/publications. Last accessed June 2018

[12] Economic benefits from onshore wind farms: A report for ScottishPower Renewables, BVG Associates, September 2017. Available online at https://bvgassociates.com/economic-benefits-onshore-wind-farms. Last accessed June 2018

[13] https://www.renewableuk.com/page/SupplyChainMap. Last accessed June 2018

FTE employment is derived from an understanding of:

- Typical profit margins
- Costs of employment, and
- Salary levels.

This information has been established through historical discussions with industry and was supplemented with additional research.

Direct impacts in this case arise from the work undertaken by the developer, the turbine manufacturer and the civil and electrical works contractor.

Indirect impacts relate to employment generated by the purchase of supplies and services by the companies that create the direct impacts.

Induced impacts are those that arise from the expenditure of workers employed by the companies that create the direct or indirect impacts. The induced values for these measures were calculated using historical data from other sectors because expenditure patterns of workers in wind are unlikely to differ significantly from those in other sectors with comparable average earnings.

The methodology allocates value to the place of work. Some contractors hire workers resident locally so we treated local workers engaged to work on the projects as directly employed but with a place of work the same as the place of residence.

The figures only include the impacts from building, operating and decommissioning the wind farms and from the owners' contributions to the maintenance of the transmission grid. They do not consider the impacts of profits made by owners or from central UK Government revenue generated through taxes. OPEX is assumed to be spread evenly over the operating life of the wind farm.

The impacts are offset from the date of turbine commissioning; for example, the civil works will typically be done the previous year.

The methodology is illustrated in Figure 1.

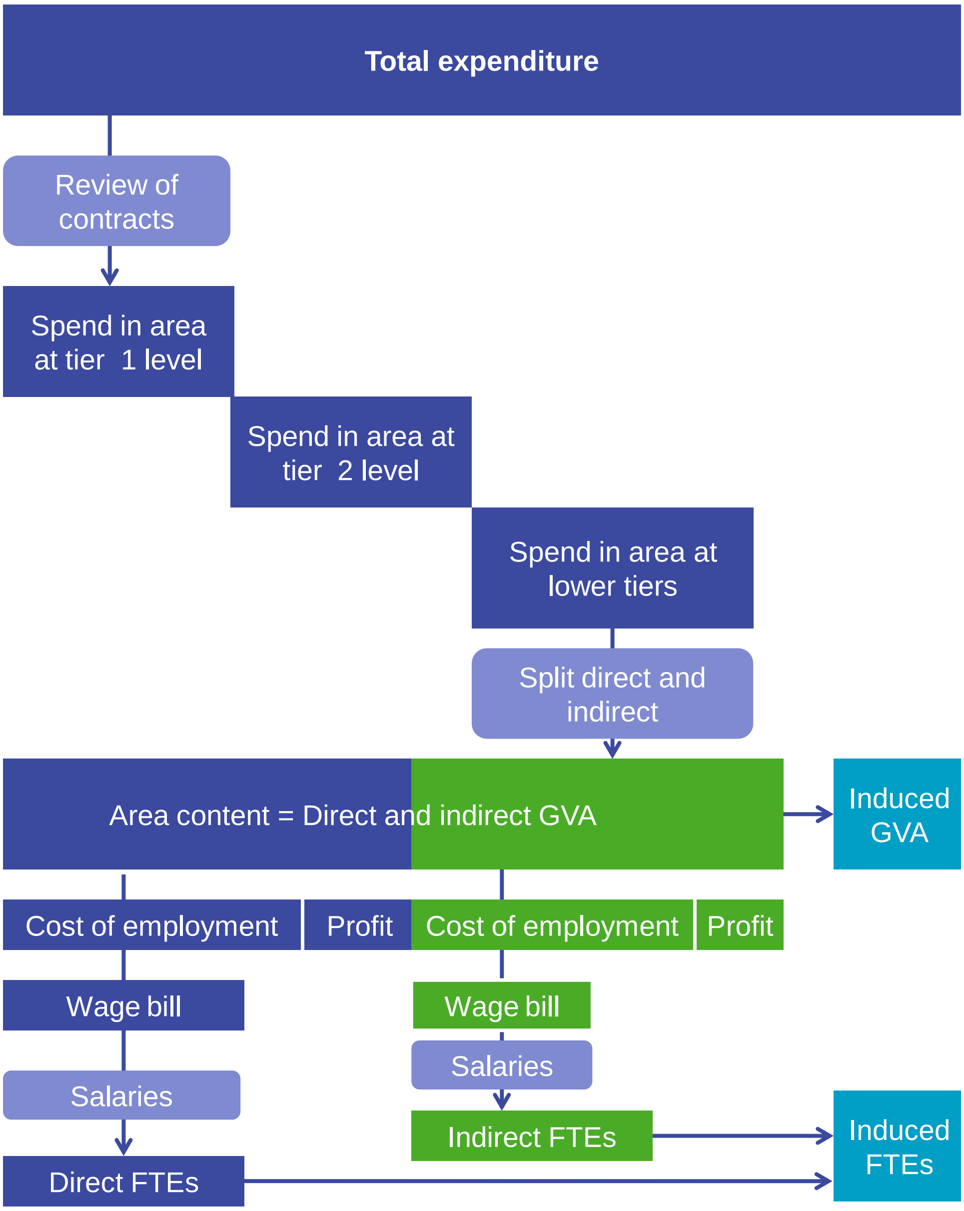

Figure 1 Economic impact methodology.

3. Results

This study analysed the onshore wind projects currently in development to build a picture of the cost and location of the projects and economic impacts in terms of UK and national content, GVA and job creation.

3.1. Bid price forecast and impact on consumer bills

Bid price forecast

Figure 2 shows the forecasted clearing prices for each of the five auctions. These figures represent the prices at FID, and therefore the price for a project built in 2021 would correspond to a project successful in a 2019 auction. To ensure consistency with the Baringa report commissioned by Scottish Renewables in 2017[14], we assumed that the project with the highest LCOE in the first auction, (which sets the clearing price) is £49.4/MWh (in 2017 prices) (£45.6/MWh in 2012 prices).

The LCOEs and therefore clearing prices for subsequent auctions are likely to decrease because of:

- Developments in turbine technology with better energy production and increased reliability
- Lower costs of finance as a result of lower project risk and increased appetite from investors
- Competitive pressures of auctions, and
- Consolidation of learning among fewer developers and suppliers.

For the final auction, in 2025, we forecast that the clearing price will be £45/MWh (in 2017 prices) (£41.6/MWh in 2012 prices).

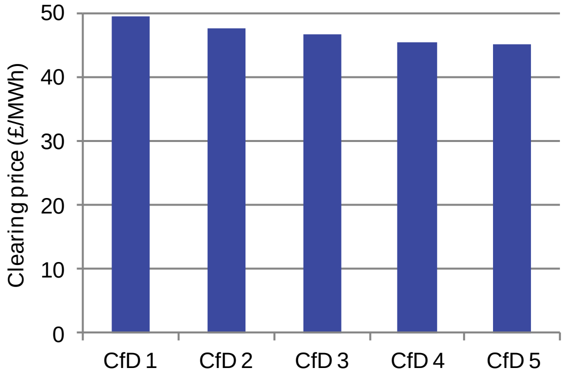

Figure 2 Clearing prices for each CfD auction in 2017 prices.

Impact on consumer bills

Figure 3 shows the BEIS central forecast of electricity price to 2035. As the BEIS data ends at 2035 and the 15-year CfD contracts will extend beyond this date, we have assumed that prices stay constant after this date

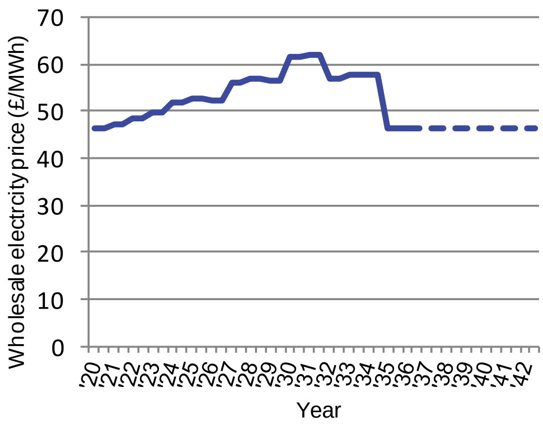

Figure 3 BEIS reference scenario of electricity prices. Prices are at 2017 values.[15]

Figure 4 shows the net payback to the consumer. It shows that by 2023, the consumer is a net beneficiary and for the duration of the CfDs from all five auctions, the payback to the consumer is £1.6 billion.

It is also worth noting that the consumer benefits from the 'merit effect' of onshore wind, where low marginal cost generation displaces more expensive thermal plant in the wholesale price merit order, hence, having a downward impact on the wholesale electricity price

[14] An analysis of the potential outcome of a further 'Pot 1' CfD auction in GB. A report for Scottish Renewables, April 2017. Available online at https://www.baringa.com/getmedia/99d7aa0f-5333-47ef-b7a8-1ca3b3c10644/Baringa_Scottish-Renewables_UK-Pot-1-CfD-scenario_April-2017_Report_FINA/. Last accessed June 2018

[15] Updated energy and emissions projections 2017. Annex M: Growth assumptions and prices. Available online at https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017. Last accessed June 2018

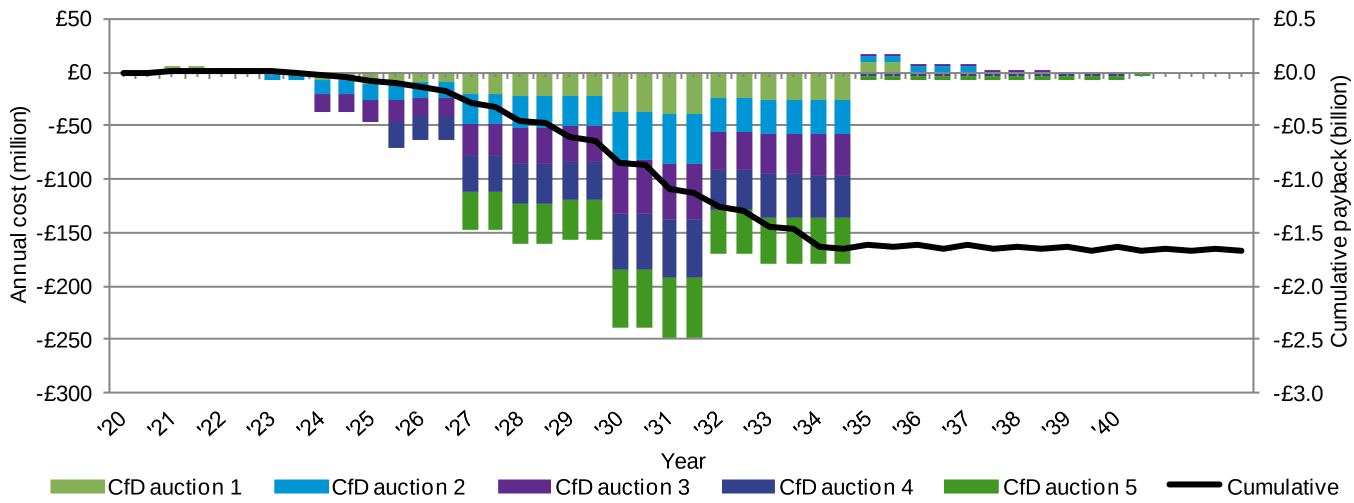

Figure 4 Net payback to consumer from the five CfD auctions.

3.2. CfD auction modelling

Table 1 shows the auction results split by nation for large scale projects >50MW and Table 2 for small scale projects ≤50MW. They show that a large proportion of projects are in Scotland. This reflects a favourable wind resource and low population densities in some areas. Wales has similar features but as a smaller nation, there is less area to develop and significant areas are within national parks. Small-scale English projects, of a type often brought forward by communities, continue to compete where there is a good wind resource and a short distance to grid. Table 3 and Figure 5 show the combined results for all projects.

Table 1 Auction results for projects >50MW.

	CfD auction					
	1	2	3	4	5	Total
England	0	0	0	0	0	0
	0%	0%	0%	0%	0%	0%
Scotland	314.5	557	429.2	414.3	491.2	2,206
	76%	100%	100%	65%	100%	87%
Wales	102	0	0	219	0	321
	24%	0%	0%	35%	0%	13%

Table 2 Auction results for projects ≤50MW.

	CfD auction					
	1	2	3	4	5	Total
England	0	12	21.04	7.5	31	71.54
	0%	3%	5%	2%	6%	3%
Scotland	472	367.9	427.1	273.8	336.5	1,877
	87%	86%	91%	87%	70%	84%
Wales	72.9	47.5	17.5	36	116	289.9
	13%	11%	4%	11%	24%	13%

Table 3 Auction results for all projects.

	CfD auction					
	1	2	3	4	5	Total
England	0	12	21.04	7.5	31	71.54
	0%	1%	2%	1%	3%	2%
Scotland	786.5	924.9	856.3	688.1	827.7	4,083
	82%	94%	96%	72%	85%	86%
Wales	174.9	47.5	17.5	255	116	610.9
	18%	5%	2%	27%	12%	12%

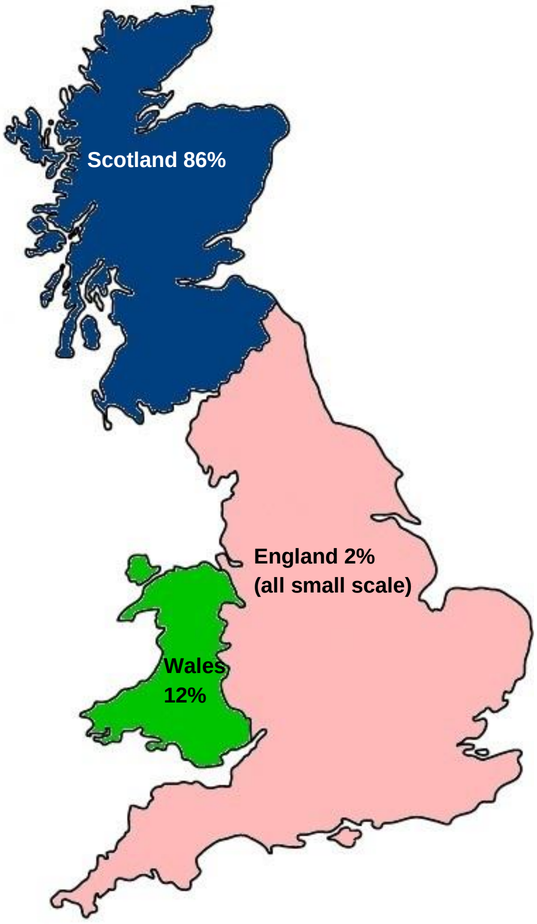

Figure 5 National distribution of wind farms built following the five CfD auctions.

3.3. UK and national content

The UK and national content for onshore wind is high delivering in local and national economies across the UK.

The series of CfD auctions creates a demand for goods and services leading to new investments in the UK supply chain which would otherwise not happen.

The sections below describe the project-specific and non-project-specific supply chains and how the non-project specific supply chain could change over time.

Project development and management

The project-specific supply chain includes stakeholder management, land services and some environmental services.

The non-project-specific supply chain includes technical, consenting, legal and environmental services. It also includes the work undertaken by the developer.

The project development and management supply chain is unlikely to change over time.

Turbine

The project specific supply chain includes only the accommodation and catering needed by installation teams during construction. Nevertheless, the costs can be significant over a few months.

In the past, turbine blades have been manufactured in the UK for the onshore market. Onshore blades were manufactured by Vestas at its Isle of Wight factory (south east of England region), close to the site of its research facility at which offshore blades are being manufactured (by MHI Vestas Offshore Wind). The Siemens-Gamesa Renewable Energy factory at Hull (England Yorkshire and Humberside) supplies blades to the offshore market exclusively. Neither Siemens Gamesa nor Vestas has indicated that they would consider onshore blade manufacture in the UK, but strong demand across Europe could lead to existing facilities being used to meet some of the demand from the UK market.

The only UK tower factory is in Campbeltown (Scotland Argyll and Dunbartonshire region) and is owned by CS Wind. There is likely to be significant demand for towers from this factory, for example Vattenfall has signed a public MoU with CS Wind on potential supply contracts. A buoyant onshore wind market could create additional demand for UK towers. This study demonstrates that there will be significant demand for towers in south west Scotland and the Campbeltown factory is well located given the difficulty of moving large numbers of towers by road.

The installation teams used for UK onshore wind farms typically travel from the turbine manufacturer's home market. The costs of accommodating these teams in the UK during construction are significant and there are benefits in growing a UK team close to the main wind farm development areas. The large number of projects in the south west of Scotland and the good air connections from Glasgow Airport would make this region a logical place to base a UK installation team. Only the market leaders are likely to contemplate such an investment.

Additional national content comes from specialist road transport companies such as ALE and Collet.

Civil works

The non-project specific supply chain consists mainly of large civil engineering contractors and these typically have a significant national bias. For example Jones Bros, based in North Wales, has been most successful in winning work in that region; Glasgow-headquartered RJ McLeod has been primarily involved in Scottish wind farms.

The project specific supply chain supports construction and operation, such as site security and some plant hire, as well as workforce subsistence such as accommodation, catering and some transport. The amount of accommodation can vary depending on how close the wind farm is to population centres and therefore the available local workforce.

Given the existing high UK content in civil works, a strong pipeline of onshore wind farms is likely to maintain existing investment in this area of the supply chain.

Electrical works

Electrical work is specialist and there is unlikely to be a project-specific supply chain beyond workforce subsistence such as accommodation, catering and some transport.

There is a limited UK supply chain for electrical components. Prysmian manufactures land cables at its Wrexham factory (North Wales region). There are also UK suppliers of medium voltage electrical equipment in the West Midlands in particular. The electrical components for wind farm are also supplied to several other industrial sectors and even a strong pipeline of UK projects is unlikely to have a significant effect on supply chain investment.

Transmission and distribution operation, maintenance and service (OMS)

Wind farms incur a range of system charges, which vary depending on whether they connect to the transmission or distribution network. These typically cover the maintenance costs and capital investment costs which are charged to generators.

There is no project-specific supply chain in this area.

Wind farm OMS

By its nature, much of wind farm OMS is located at the wind farm, generally by teams that support several wind farms in an area. Wind farm owners and/or their service providers will also typically have a national operation base. Replacement components under warranty will be imported or refurbished by the original manufacturers. After this, there are UK companies that offer refurbishment services.

There is already a high level of national and UK content in wind farm OMS and it is unlikely to increase overall. With a growth in the market, service operations are likely to be set up closer to wind farms as areas achieve the critical mass.

Decommissioning

The decommissioning supply chain is likely to be similar to that for civil works, with the addition of salvage and recycling contractors.

Total UK and national content

Figure 6 shows UK and national content in the lifetime expenditure on the five CfD rounds.

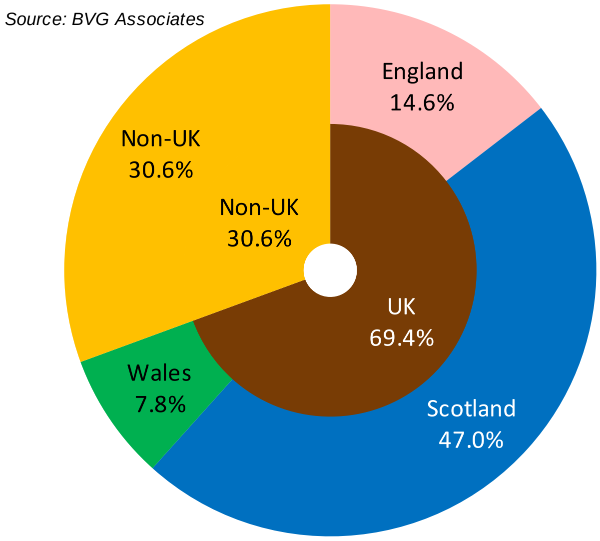

Figure 6 UK and national content in the lifetime expenditure following the five CfD rounds.

3.4. Economic impact

Gross value-added

The construction of wind farms following the five CfD auctions will create in total over £12 billion in GVA, peaking at £750 million in 2024 (see Figure 7).

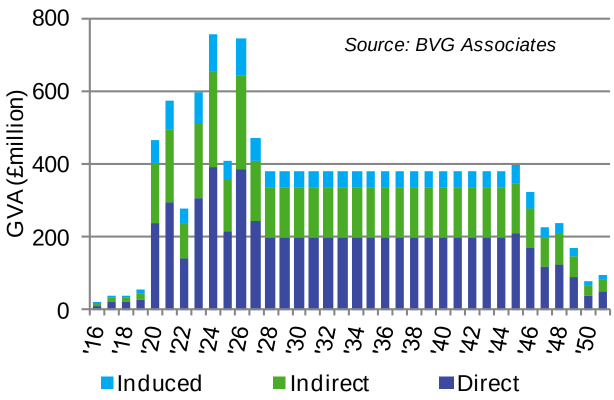

Figure 7 Direct, indirect and induced GVA generated by projects built following the five CfD auctions.

Figure 8 shows that the greatest sources of GVA are wind farm OMS and civil works. Investments in the turbine supply chain mean this becomes a significant contributor in the mid-2020s.

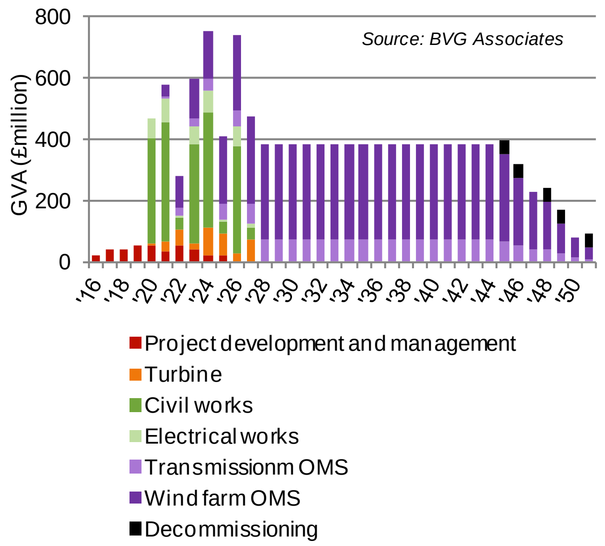

Figure 8 GVA generated by projects built following the five CfD auctions by supply chain area.

Employment

Figure 9 shows that the number of jobs created by the five CfD auctions peaks in 2024 at about 18,000. About 8,500 long term jobs are generated in the operation phase. These jobs are created not only by the companies that own and operate the wind farms but also indirectly through the operation of the transmission and distribution infrastructure and in the wide range of general business services needed by all companies.

The jobs created by OMS have particular value because many are long-term skilled jobs and a local workforce can be trained to meet demand. The jobs are sustainable and are less sensitive to fluctuations in the build rate of new wind farms.

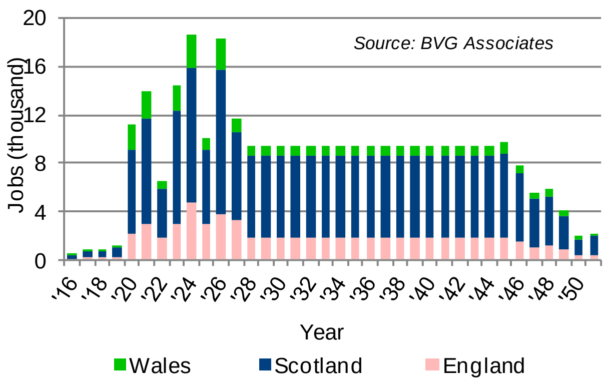

Figure 9 Jobs (full-time equivalents) created in England, Wales and Scotland following the five CfD auctions.

Local jobs during construction are created by local construction services and material supply, and from locally engaged labour by the civil works contractor. Significant indirect jobs are also created in the hotel, catering and transport industries.

Appendix A: Background data

Table A.1 UK and national content for each CfD auction.

	CfD1	CfD2	CfD3	CfD4	CfD5	Total (average)
England	13.2%	14.2%	15.2%	15.0%	15.3%	14.6%
Scotland	46.1%	48.4%	48.7%	45.2%	47.1%	47.0%
Wales	8.6%	6.6%	6.1%	9.8%	7.6%	7.8%
UK	67.8%	69.2%	70.0%	70.0%	70.0%	69.4%
Non-UK	32.1%	30.8%	30.0%	30.0%	30.0%	30.6%

Appendix B: Modelling assumptions

Table B.1 Supply chain area definitions.

Expenditure	Supply chain area	Description
DEVEX	Project development and management	The processes up to the point of financial close or placing firm orders to proceed with wind farm construction. It also includes project management costs incurred by the project developer.
CAPEX	Turbine	The activity by wind turbine manufacturers and their suppliers covering nacelle component manufacture and assembly and blade and tower manufacture. It includes transport, installation and commissioning. It excludes the turbine service agreement.
	Civil works	The activity by civil contractors and their suppliers covering roads and drainage, crane pads, turbine foundation, meteorological mast foundations, cable trenches and buildings for electrical switch gear, SCADA equipment and its installation, and an operational base and spare part facility.
	Electrical works	The activity by electrical contractors and their suppliers, covering cables, electrical switch gear, protection and control system, maintenance facilities and grid connection.
OPEX	Transmission operations, maintenance and service (OMS)	Activity during the lifetime operation of the wind farm, covering grid connection and transmission costs.
	Wind farm OMS	Activity during the lifetime operation of the wind farm, including land rental costs, business rates, operations, planned maintenance and unplanned service costs relating to the wind farm, community benefit funds and environmental costs.
	Decommissioning	The costs associated with the removal of the wind farm components and re-instatement of land at the end of the wind farm's operating life.

Table B.2 Project specific content assumptions.

Expenditure	Supply chain area	Local content
DEVEX	Project development and management	10%
CAPEX	Turbine	1%
	Civil works	5%
	Electrical works	1%
OPEX	Transmission OMS	0%
	Wind farm OMS	30%
	Decommissioning	5%

- Wind farm life is 25 years
- Wind farms are operating two years after CfD auction
- For the purposes of content, GVA and jobs calculations, expenditure does not vary with location