Economic benefits from the development of wind farms in the Western Isles

A report for EDF Energy Renewables on behalf of Lewis Wind Power

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Document history

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BVG Associates

BVG Associates is a technical consultancy with expertise in wind and marine energy technologies. The team probably has the best independent knowledge of the supply chain and market for wind turbines in the UK. BVG Associates has over 150 career-years' experience in the wind industry, many of these being "hands on" with wind turbine manufacturers, leading RD&D, purchasing and production departments. BVG Associates has consistently delivered to customers in many areas of the wind energy sector, including:

- Market leaders and new entrants in wind turbine supply and UK and EU wind farm development
- Market leaders and new entrants in wind farm component design and supply
- New and established players within the wind industry of all sizes, in the UK and on most continents, and
- UK Government, RenewableUK, The Crown Estate, the Energy Technologies Institute, the Carbon Trust, Scottish Enterprise and other similar enabling bodies.

The views expressed in this report are those of BVG Associates. The content of this report does not necessarily reflect the views of EDF Energy Renewables or Lewis Wind Power.

Contents

List of figures

List of tables

Summary

Lewis Wind Power (LWP) wishes to construct two consented wind farms on the Isle of Lewis: Stornoway Wind Farm and Uisenis Wind Farm. EDF Energy Renewables (EDF ER), one of LWP's parent companies, commissioned BVG Associates (BVGA) and Steve Westbrook (University of the Highlands and Islands) to analyse the economic benefits to the Western Isles and the UK from the construction and operation of wind farms on the Western Isles and an HVDC grid connection. We were also asked to consider the impact of community payments from wind farm owners and community ownership of wind farms. This study builds on a previous BVGA study on the UK content of the Isle of Lewis wind farms.

We based our analysis on a scenario in which a high voltage grid connection with a 600MW capacity is built, both EDF ER wind farms are built to their consented capacity (342MW) by 2021 plus a further 180MW of onshore wind farms. This additional capacity includes the consented 46MW Tolsta project plus a number of smaller wind farms.

Table 0.1 shows a summary of the impact for the Western Isles under this scenario. The impacts are greatest in 2020, when both the HVDC grid connection and EDF ER wind farms are under construction. Table 0.2 shows a summary of the UK analysis (excluding community benefits). The benefits peak in 2020 for reasons mentioned above. A notable impact is from the construction of the HVDC grid connection. Table 0.3 shows that the impacts for the Western Isles from community income, either from payments made by the wind farm owners to the community or through wind farm ownership. These benefits are overall larger than those shown in Table 0.1. They peak in the late 2020s, when all the wind farms are operational.

Table 0.1 Summary of economic impacts (direct, indirect and induced) for the Western Isles from the development, construction, and operation of the HVDC grid connection and onshore wind farms.[1]

	LVA 2016-2050 (£million)			FTE years 2016-2050		Earnings 2016-2050 (£million)		
	Undiscounted		Discounted	Undiscounted		Undiscounted		Discounted
	Total	Peak	Total	Total	Peak	Total	Peak	Total
HVDC grid connection	16.0	5.4	13.4	380	130	10.7	3.6	9.0
EDF ER wind farms	119.9	20.4	79.1	2,770	620	71.3	18.0	48.8
Other renewable energy projects	120.4	6.2	71.5	2,820	160	71.8	4.7	44.1
Total	256.3		164.0	5,970		153.8		101.9

Table 0.2 Summary of economic impacts (direct, indirect and induced) for the UK from the development, construction, and operation of the HVDC grid connection and onshore wind farms.

	GVA 2016-2050 (£million)			FTE years 2016-2050		Earnings 2016-2050 (£million)		
	Undiscounted		Discounted	Undiscounted		Undiscounted		Discounted
	Total	Peak	Total	Total	Peak	Total	Peak	Total
HVDC grid connection	435.4	78.5	315.1	7,370	2,050	265.4	44.4	189.8
EDF ER wind farms	536.0	76.8	367.6	8,750	1,730	286.0	53.3	201.6
Other renewable energy projects	300.4	15.7	177.3	4,880	50	159.6	8.9	96.8
Total	1,271.8		860.0	21,010		711.0		488.1

[1] LVA = local value-added; GVA = gross value-added; FTE = full time equivalent. One FTE year is one full-time position held for one year or equivalent. Discounted figures use a rate of 3.5% based on the recommendation of HM Treasury *in The Green Book: Appraisal and Evaluation in Central Government. The peak is the highest figure for a single year. The peak year for the each source of economic impact differs. LVA is analogous to GVA but is used is this report because GVA is strictly a national concept.*

Table 0.3 Summary of economic impacts (direct, indirect and induced) for the Western Isles from community income and exports to other north-west Scotland wind farms.

	LVA 2016-2050 (£million)			FTE years 2016-2050		Earnings 2016-2050 (£million)		
	Undiscounted		Discounted	Undiscounted		Undiscounted		Discounted
	Total	Peak	Total	Total	Peak	Total	Peak	Total
Wind farm related exports	16.6	0.7	8.7	270	10	9.8	0.4	5.1
Community benefit	436.4	22.5	243.7	12,930	670	290.9	15.0	162.4
Total	453.0		252.4	13,200		300.7		167.5

These results show a local benefit for the Western Isles that is greater than would be seen by other local communities with other mainland onshore wind farms. There are two main reasons for this: there is a significant pool of available construction workers; and there a high priority being placed on community ownership by Western Isles Development Trust and Comhairle Nan Eilean Siar.

The Western Isles has a suffered from a long-term population decline and many workers seek employment on construction projects on the mainland. A series of major infrastructure projects should encourage a substantial number of workers to return to the Western Isles where many could find accommodation in family homes in the short term. Because of accessibility, contractors will find it more costly than on the mainland to bring in workers. Enquiries with companies on the Western Isles suggested that up to 300 workers could be recruited locally. Returning workers would stimulate further economic benefits by increasing demand for housing and other infrastructure.

To place the job creation in context, 2015 data from the Business Register and Employment Survey, published by the Office of National Statistics, indicates that about 10 thousand people are in employment in the Western Isles. Our analysis shows that about 800 FTE years are created during the 2020s and 2030s. While a significant number are self-employed in the Western Isles, the new jobs would increase combined employment and self-employment by more than 5%.

In the scenario used for this study, 150MW of the 520MW of new onshore capacity was in community ownership, including 84MW of the EDF ER wind farms. This ownership provides a major economic stimulus. This community ownership would require about £200 million in investment. Although some of this investment will come from private investment, a significant proportion of the equity for the Stornoway wind farm is likely to be held by the Stornoway Trust, which can secure finance for the investment. The Trust typically spends its revenues to the benefit of the community. The economic impacts profiled from such expenditure were based on historical investments.

Although not quantified in this analysis, the investment in wind farms could lead to additional investments. In particular, there are early plans for a 200MW pumped storage facility. As well as the impacts from the construction and operation of the facility, it would also enable the grid connection to support increased wind farm capacity on the Western Isles.

Economic rejuvenation on the Western Isles will support investments in communication and transport, potentially providing a business case for more ferry services, investments in and around Stornoway (as described in Stornoway Port Authority's new development strategy), and better broadband links.

The analysis provides significant evidence for an 'Island Effect' in that the investments lead to local economic benefits that would not typically be seen for onshore wind development. The EDF ER wind farms provide the catalyst for this effect. Without their eligibility for a CfD, they are unlikely to be economically viable and without them the business case for the high voltage grid connection is significantly weakened.

1. Introduction

Lewis Wind Power (LWP) has planning consent for two onshore wind projects on the Isle of Lewis: Stornoway wind farm and Uisenis wind farm. These are unusual onshore wind farms because they will require additional investment in a high voltage direct current (HV DC) grid connection.

EDF Energy Renewables (EDF ER), one of LWP's parent companies, commissioned this analysis from BVG Associates (BVGA) on the national (UK) and local (Western Isles) economic benefits created by the Stornoway and Uisenis wind farms, the HVDC grid connection, and other new generation capacity on the Western Isles that could use the HVDC grid connection.[2] The study was also intended to establish the secondary benefits of the developments on the local economy and how they might differentiate island wind projects from onshore wind.

The work was delivered in partnership with Steve Westbrook[3], an experienced economist who has worked closely with Highlands and Islands Enterprise and is experienced in analysing the secondary impacts from infrastructure investments, the socioeconomic issues facing the Western Isles and the strategies of local councils.

This analysis builds on a previous analysis of the UK content for the Stornoway and Uisenis wind farms, which is included in Appendix A.

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[2] Throughout this report, the Stornoway and Uisenis wind farms will be described as the EDF ER wind farms

[3] https://www.uhi.ac.uk/en/media/find-an-expert/steve-westbrook

2. Methodology

The construction of the EDF ER wind farms is dependent on the development of a HVDC connection to the mainland grid (the Western Isles Link). This, in turn, creates an opportunity for additional renewable energy investments.

We considered the impacts from the following sources:

1. The HVDC grid connection to the Isle of Lewis and Isle of Harris (also known as the Western Isles Link)
2. EDF ER's Stornoway and Uisenis wind farms.
3. Additional renewable energy investments in the Western Isles
4. Wind sector export opportunities for the Western Isles to wind farms in north-west Scotland
5. Expenditure in the Western Isles from net income received by communities that either own turbines or receive pre-agreed community benefit funding from wind farm owners

We also discussed the potential of additional (non-renewable energy) investments made possible by the HVDC grid connection and significant levels of local generation capacity.

We also explored the impact of these investments on the wider socioeconomic challenges faced by the local population in the Western Isles.

2.1. Investment scenario

The impacts from the sources listed above are dependent on assumptions on the timing and cost of projects. For each source, we developed a single indicative capacity and timing assumption, as stated in Table 1. We did not consider the impacts of existing generation but this has been included in the table to help show the amount of additional generating capacity that could be connected to the new grid connection before it reaches its export capacity.

We assumed a 20-year life for the wind farms and did not consider life extension for any of the wind farms or their repowering with new turbines. We did assume that the HVDC grid connection became a permanent part of the UK grid infrastructure but did not consider any further investments or upgrades to the link.

Table 1 Existing and assumed new grid and generating capacity on the Western Isles.

Projects	Capacity	Timing
HVDC grid connection	600MW	Assumed operational 2021
Existing renewable energy	47MW (as of December 2015)[4]	Operational
Diesel generators	33MW Battery Point, (23MW) and Arnish (10MW)	Operational
EDF ER wind farms	340MW Stornoway (180MW) and Uisenis (160MW) wind farms	Assumed operational 2021
Additional renewable energy projects	180MW Tolsta wind farm (46MW) Other wind farms (<10MW each)	Assumed operational 2022 Assumed operational 2023-2030

HVDC grid connection

The HVDC connection will consist of:

- Converter stations at Stornoway and Beauly
- An onshore land cable from Beauly to the coast, and
- An offshore land cable linking the Isle of Lewis to the mainland

The high voltage alternating current (HVAC) connection from wind farms to the converter station is considered in the impacts from those wind farms.

The grid connection date for the EDF ER wind farm is Q3 2021. We have assumed that the work will take place over two years, starting in 2019.

[4] Renewable electricity by local authority, September 2016, Office of National Statistics. Available online at https://www.gov.uk/government/statistics/regional-renewable-statistics. Last accessed January 2017

EDF ER wind farms

We have assumed that Stornoway wind farm will have a rated capacity of 180MW and use 36 5MW turbines and that Uisenis wind farm with have a rated capacity of 160MW and use 45 3.55MW turbines. The differences in the turbine choices do not have significant implications for the supply chain. There will be subtle differences between the cost profiles due to the differences in turbine size but these will have only minor implications for the wind farms' economic impacts.

It has been assumed that the Stornoway and Uisenis wind farms will be built in parallel, with civil works in 2020 and turbine installation in 2021.

As well as providing jobs in the construction and operation of the wind farms, EDF ER have made provision for shares of the wind farms (20% for Stornoway and 30% for Uisenis) to be acquired by or on behalf of the community, and the net revenues from these will also generate economic impacts. EDF ER will also make community payments, assumed to be
£5 thousand/MW/year, and Stornoway wind farm will also make payments to a community landowner and crofters.

These impacts will be considered in the community benefits section below.

Additional renewable energy projects

The HVDC grid connection creates an opportunity to build additional renewable energy projects in Lewis and Harris. Although offshore wind, wave and tidal projects are theoretically possible, the lack of special CfD provision for wave and tidal and the lack of offshore wind development areas mean that new onshore wind projects are most likely.

There is 80MW of existing generating capacity (33MW oil and 47MW renewables) and a 22MW link to the Isle of Skye. As current peak demand is only about 25MW, the existing wind farms are constrained during periods of high wind

The only significant consented wind farm other than the two EDF ER developments is the 46MW Tolsta Wind Farm, but the construction of the high voltage transmission link is also likely to stimulate the development of other projects, some of which have already been notified to SSE in relation to their assessment of potential usage of the new connection.

We have assumed that the Tolsta wind farm is completed in 2022, and that approximately 20MW of other new capacity is built annually between 2023 and 2029 in developments each of less than 10MW capacity.

The developer of Tolsta Wind Farm, 2020 Renewables, plans to use 3.3MW turbines. At this stage, there are no reasons for concluding that the supply chain for the Tolsta Wind Farm (and any other projects that follow) will be different from the EDF ER projects. We have therefore made similar assumptions on cost and local content.[5]

We have assumed that half of the wind farms built after the Tolsta wind farm will be under community ownership, which reflects local consultation, including discussions with Community Energy Scotland.

Western Isles wind exports

The construction of the wind farms on the Western Isles will develop new skills that can be exported to other areas in north-west Scotland. BVGA developed a market forecast for repowered sites in north west Scotland and estimated the potential Western Isles content in these wind farms, and modelled the economic impact using the methodology described above.

2.2. Economic methodology

To model the impacts of the grid connection and wind farms' construction and operation, we used a robust, innovative method which is based on an understanding of the wind and transmission supply chains and avoids the need to rely on standard industry classification (SIC) data collected by the Office of National Statistics. This is important because research suggests SIC codes do not map well onto the wind industry supply chain. The concept s explained in Appendix B and uses a structured local content (defined as the direct and indirect value added) analysis using a modelling methodology originally developed by BVGA. By making assumptions on product costs, salary levels, profit margins and the cost of employment, estimates for the following are derived:

- Direct and indirect gross value added (GVA) and local value-added (LVA)[6]
- Direct and indirect earnings, and
- Direct and indirect full-time equivalent (FTE) years

The induced values for these measures were calculated using historical data from other sectors because expenditure patterns of workers in other sectors with comparable average earnings are unlikely to differ significantly.

The methodology assigns value to the place of work. Some mainland contractors are likely to hire workers resident in the Western Isles 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.

[5] http://www.2020renewables.com/news-and-events/tolsta-wind-farm-approved-by-comhairle-nan-eilean-siar/

[6] Gross value-added is a national measure. The term local value-added is used to capture the value to the Western Isles.

All costs used are in 2016 values.

The UK figures do not take account of displacement. If support for the Western Isles wind farms is provided from the pot 2 of the Levy Control Framework, then this will be at the expense of other projects, which are mostly likely to be offshore wind projects. If displacement were considered, the UK economic impacts would therefore not be significant.

The UK figures only include the impacts from building and operating the wind farms. They do not consider the impacts of profits made wind farm owners or from central UK Government revenue from taxes.

Grid connection

Indicative costs for the grid connection between the wind farms and the HVDC convertor station were agreed in discussion with SSE Transmission. Local content assumptions were based on BVGA's knowledge of the offshore wind supply chain, which is likely to be similar to the system design and component manufacture and installation for the HVDC grid connection.

Table 2 shows the cost elements used in the analysis.

Table 2 Cost elements considered in the analysis of the grid connection.

Element	Subelement
Construction	Electrical supply and installation
	Onshore cable supply
	Onshore cable installation
	Offshore cable supply
	Offshore cable installation
Operation, maintenance and service	Onshore transmission operation, maintenance and service
	Offshore transmission operation, maintenance and service

The UK content analysis considered the supply chain for more than 50 products and services used in development, construction and operation. UK content assessments were made using insight gathered from previous analyses undertaken by both BVGA and Steve Westbrook

EDF ER wind farms

EDF ER has not started turbine procurement and these assumptions do not imply a favoured manufacturer or model.

Local content assessments were made in discussion with:

- Quantity surveyor Castle Hayes Pursey LLP (which drew up capital expenditure (CAPEX) budgets for the Stornoway and Uisenis wind farms)
- Civil contractor RS McLeod
- Tower manufacturer CS Wind (UK)
- EDF ER

Further assumptions were applied from similar analyses undertaken previously by BVGA.

Costs were provided by EDF ER. We conducted the analysis using the categories shown in Table 3.

Table 3 Cost elements considered in the analysis of the EDF ER wind farms.

.Element	Subelement
Development and project management	Project development
	Project management
Turbine	Rotor and nacelle
	Tower
	Installation
Balance of plant	Wind farm civils Wind farm electrical
Operation, maintenance and service	Turbine maintenance and service
	Wind farm operation, overheads and fixed costs
Decommissioning	Decommissioning

Additional renewable energy projects

For additional renewable energy projects we followed the same methodology as for the EDF ER wind farm. We assumed that the technology, costs and supply chain are the same.

Community benefits

The Western Isles economy will benefit from community payments made by the owner/operator of the additional projects or through ownership of part or all of the wind farms.

The communities that would directly benefit from wind farm ownership or payments from community benefit funds distributed by wind farms in their local area would be in Lewis and Harris. The Western Isles Development Trust (WIDT) and Comhairle nan Eilean Siar (CnES) (as potential owners of 30% of the Uisenis wind farm) may choose to use the income to support communities elsewhere in the Western Isles.

Revenue

We assumed that community benefits are paid by non-community owned wind farms at a rate of £5 thousand/MW/year, unless there is available information that suggests otherwise. For example, 2020Renewables has indicated that payments of £7 thousand /MW/year would be made for the Tolsta wind farm.[7]

Using data from EDF ER, we have assumed a baseline rate for income from community ownership per MW per year for wind farms. For the EDF ER wind farms, we have assumed that this figure falls by a third after the expiry of the 15-year CfD period. We have assumed that smaller wind farms built after the EDF ER projects do not require a CfD because they will probably connect to the local distribution network so will therefore not incur the same level of transmission charges. We assumed that the loss of CfD income is balanced by the lack of transmission charges. Overall, therefore, the income from non-EDF ER community owned wind farms is the same as the EDF ER wind farms during the CfD period.

Table 4 shows the level of ownership we have assumed following discussion with EDF ER. This suggests a total community investment of about £200 million. This is a significant sum and will require community investors to secure loans from financial institutions, private investors, trusted institutions or new companies formed for wind farm development and operation.

Table 4 Assumed community ownership.

Wind farms	Community ownership	
	Percentage	Effective capacity
Stornoway	20%	36MW
Uisenis	30%	48MW
Additional wind farms	50%	67MW

Impact methodology

The community benefit methodology used here is based on an analysis by Steve Westbrook in December 2005 for the WIDT. In this, he profiled indicative employment impacts in terms of FTE years from expenditures by the WIDT and communities in the Western Isles (including crofting townships and grazing committees). WIDT's business plan showed that it intended to support activities under three strands (see Table 5).

[7] http://www.2020renewables.com/news-and-events/tolsta-wind-farm-approved-by-comhairle-nan-eilean-siar. Last accessed February 2017

Table 5 Activities supported by the Western Isles Development Trust.

Support strands		Spend per £million of income
Strand 1	Business projects	£200,000
	Community projects	£500,000
Strand 2	Alternative and renewable energy research	£150,000
Strand 3	Energy efficiency schemes	£150,000
Total		£1,000,000

The assumptions on the employment impacts in the Western Isles from indicative spending under each of these strands took into account LVA from construction costs, operational costs, skills development, external funding (such as from the National Lottery) towards community development projects, tourist spend generated by new heritage, archaeology and environmental facilities (including additional overnight stays).

This gave, in a typical year, an estimated 770 FTE years generated for every £10 million of spend by WITB and community representative groups. This figure included direct, indirect and induced impacts. Taking into account earnings inflation since 2005, reduced National Lottery funding for community projects and reduced EU funding for eligible projects after 2020, we have adjusted the figure to 500 FTE years per £10 million of spending (1 FTE year per £20 thousand of spend).

Additional investments

There are infrastructure projects that could be associated with the development of particular wind farms but which are not covered by the analysis described above.

We have not sought to quantify these benefits as the nature and probability of these occurring are uncertain. We instead undertook a qualitative assessment based on discussions with CnES and potential developers and from publicly available documents.

Investments could include additional infrastructure in Stornoway (particularly around the harbour), progress on plans for a marine engineering facility on Goat Island near Stornoway, infrastructure at Arnish to diversify activity, harbour developments around the islands to promote leisure sailing, causeways and bridges to reduce travel times, upgraded roads to new zones of housing, etc. Funding for such developments could come from the

Scottish Government, Highlands and Islands Enterprise, community contributions, landowner spend (including the Stornoway Trust), or CnES spending (for example from the additional business rates income it will receive from annual wind farm operations).

Secondary impacts

Secondary impacts are generated by the retention of the people who work on the wind farms or grid connection or as a result of projects that spend income from community ownership or benefit funds. This retained workforce will generate an increased demand for housing, educational facilities, roads and other new infrastructure.

They will also be generated through energy supplied directly to local users where this enables new business or community projects to be built or makes existing provision (such as community halls and indoor recreational facilities) more viable through reducing annual operating costs.

Where quantified impacts are assigned to such local spending (such as on house building, school extensions and new businesses that are heavy energy consumers such as data centres), we took care not to double count the kinds of impact from community income described above.

For earnings and LVA and GVA, we calculated both discounted and undiscounted impacts. We used a discount rate of 3.5% in line with the guidance in HM Treasury's 'Green Book'.[8]

[8] *The Green Book: Appraisal and Evaluation in Central Government,* November 2016, HM Treasury. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf. Last accessed January 2017

3. Results

3.1. UK and Western Isles content

UK content was modelled in BVGA's previous analysis (see Appendix A) and the high-level results are shown here. Table 6 shows the UK content in the HVDC grid connection

Table 7 shows the UK content in the EDF ER and other Western Isles wind farms. The analysis is described in greater detail in Appendix B.

Table 6 UK content in the HVDC grid connection. (DEVEX[9] is included in CAPEX.)

Category	% of TOTEX	Country	% content of TOTEX	% content of category
CAPEX	73.8%	UK	15.6%	21.1%
		Non UK	58.2%	78.9%
OPEX[10]	26.2%	UK	21.0%	80.0%
		Non UK	5.2%	20.0%
TOTEX[11]	100.0%	UK	36.6%	36.6%

Table 7 UK content in EDF ER and other Western Isles wind farms.

Category	% of TOTEX	Country	% content of TOTEX	% content of category
DEVEX	4.8%	UK	4.3%	90.0%
		Non UK	0.5%	10.0%
CAPEX	49.2%	UK	13.3%	27.1%
		Non UK	35.8%	72.9%
OPEX	46.1%	UK	38.9%	84.5%
		Non UK	7.1%	15.5%
TOTEX	100.0%	UK	56.5%	56.5%

Western Isles content was calculated for:

- HVDC grid connection
- Western Isles onshore wind farms
- Wind farm related exports.

HVDC grid connection

We considered the Western Isles content in the following areas of supply:

1. Electrical supply and installation
2. Onshore cable supply
3. Onshore cable installation
4. Offshore cable supply
5. Offshore cable installation
6. Onshore transmission operation, maintenance and service
7. Offshore transmission operation, maintenance and service.

Electrical supply and installation

We assumed that none of the components would come from the Western Isles. These are specialist items sourced primarily from the pan-European supply chain. Little of this is in the UK and none in the Western Isles.

For substation installation, the contract is likely to be awarded to a UK-based company with no facilities in the Western Isles. For the HV converter station on the Isle of Lewis, the contractor will draw on local services to support the construction site directly and provide subsistence to workers brought in, which will be spent on catering and accommodation. The contractor will also draw on the local labour force and heavy plant hire, but the latter stages of the work will overlap with the civil works for the EDF ER wind farms (see below) and this will limit the availability of local capacity. Overall, we calculated that the Western Isles content in electrical supply and installation will be 2%.

Onshore cable supply

There is no UK capability to produce HVDC land cable. Prysmian has a factory in North Wales for AC land cables up to 132kV but we assumed there is no Western Isles content.

Onshore cable installation

Only a small section of the onshore HVDC cable route will be on the Isle of Lewis because the converter station will be close to the landfall for the offshore cable.

There will be AC links from the converter station to the wind farms and this will provide a limited opportunity for local services and labour force.

Offshore cable supply

The offshore HVDC cable will be provided from a factory on mainland Europe and we assumed no Western Isles content.

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[9] Development expenditure

[10] Operational expenditure

[11] Total expenditure

Offshore cable installation

The offshore cable installation work will be undertaken by the cable manufacturer or contracted to one of several European specialist subsea cable installation companies. Western Isles content was calculated to be 2%, based on the work associated with the beach landing and in providing services for the installation vessels.

Onshore transmission operation, maintenance and service

The operation, maintenance and service of the onshore transmission will not require permanent staffing as it can be remotely monitored. We calculated Western Isles content of 1%, which comesfrom the provision of local services during regular visits.

Offshore transmission operation, maintenance and service

Offshore cables require little maintenance. In the event of cable failures, contractors may draw on limited local services. We calculated Western Isles content to be 1%.

Table 8 shows that the Western Isles content in the grid connection is 1.3%.

Table 8 Western Isles content in the HVDC grid connection.

Category	% of TOTEX	Geography	% content of TOTEX	% content of category
CAPEX	73.8%	Western Isles	1.1%	1.5%
		Non Western Isles	72.7%	98.5%
OPEX	26.2%	Western Isles	0.3%	1.0%
		Non Western Isles	26.0%	99.0%
TOTEX	100.0%	Western Isles	1.3%	1.3%

Western Isles onshore wind farms

For the EDF ER wind farms and subsequent onshore wind projects, we considered the Western Isles content in the following areas of supply:

- Development and project management
- Turbines (supply and installation)
- Balance of plant (supply and installation)
- Operation, maintenance and service

In general, all the wind farms being built will draw from a similar supply chain. Differences in local content will only arise from the availability of local labour to support construction work

Development and project management

Development and project management for EDF ER's projects will be undertaken by Lewis Wind Power (LWP). The project team is based in its shareholders' offices in London, Edinburgh, Newcastle and Sunderland. Western Isles content in development of 2% was calculated, from the provision of local services to companies from the mainland undertaking wind resource assessments, site investigations and environmental impact assessments.

There will be an onsite project management team during construction and we calculated a Western Isles content in project management of 1% from the use of local subsistence services. For those later Western Isles wind farms that are community owned, more of the development and project management work may be done locally, although the projects will still draw on specialist consultancies located elsewhere.

Turbines (supply and installation)

None of the turbine components will come from the Western Isles. Turbine towers could in theory be manufactured locally at Arnish but the cost of investment and the time to qualify a new supplier mean that it is highly unlikely. A local workforce is likely to be recruited to assist with turbine installation and provide support services, leading to a 10% Western Isles content in turbine installation. We calculated 0.5% Western Isles content in the turbine package overall.

Balance of plant (supply and installation)

Balance of plant covers the civil and wind farm (non-turbine) electrical works. For the civil works, much of the material can be sourced on the Western Isles, although steel reinforcement will be imported. There is a significant local labour force which a contractor is likely to draw on. For the non-EDF ER wind farms, we calculated this will lead to a Western Isles content of 55%. For the EDF ER wind farms, a lower figure of 45% will be reached because the local labour supply will only partially meet demand.

For the electrical works, all components will be imported and the availability of accredited medium voltage electrical engineers in the Western Isles is limited. We calculated a Western Isles content of 10% will be achieved for all the wind farms and this will come from less specialist services for the installation work and from local subsistence services.

Operation, maintenance and service

The OMS content is considered for the turbine OMS and the fixed costs. The Western Isles wind farms will support the employment of a small number of dedicated wind farm technicians. Asset management services will be undertaken by LWP or a third party, and will only generate Western Isles content during visits to the sites. In the event of major component repair or replacement, specialist services will be imported which will draw on some local services. Overall, we calculated Western Isles content in the turbine OMS to be 30%.

Excluding grid charges, the main fixed costs are landowner rent, insurance and business rates.[12] The Western Isles content in landowner rent will vary depending on the landowner in question. We understand that the landowner for EDF ER's Uisensis project will continue to administer the estate from the UK mainland and the Western Isles content will be small. The landowners for the other wind farms are likely to be locally based and we conclude that the Western Isles content will reach an average of 50% for in these cases. The other 50% share of rental income will go to crofters individually and the economic benefits of are considered as induced impact rather than as local content.

Currently, business rates are not directly retained by CnES. Instead, most of the Council's funding comes from a Scottish Government grant. Given the high priority given to economic development in the Western Isles, we have assumed that the net retention of the wind farm business rates will be 100%. Insurance policies taken out by project developers will not generate any Western Isles content. Overall, we have concluded that the Western Isles content in fixed costs for EDF ER wind farms (combined) is 20% and for other wind farms is 40%.

Table 9 shows that the Western Isles content in the EDF ER wind farms is 12.9%.

Table 9 Western Isles content in the EDF ER wind farms.

Category	% of TOTEX	Geography	% content of TOTEX	% content of category
DEVEX	4.8%	Western Isles	0.2%	5.0%
		Non Western Isles	4.5%	95.0%
CAPEX	49.2%	Western Isles	2.7%	5.6%
		Non Western Isles	46.4%	94.4%
OPEX	46.1%	Western Isles	9.9%	21.5%
		Non Western Isles	36.2%	78.5%
TOTEX	100.0%	Western Isles	12.9%	12.9%

Table 10 shows that the Western Isles content in other Western Isles wind farms is 24.3%. The main reason for the difference is that the larger size of the EDF ER wind farms creates a demand for construction workers that the Western Isles cannot meet and more workers are therefore brought in to complete the work. The EDF ER Uisenis wind farm will also yield less rental income for local expenditure than most of the subsequent wind farms.

[12] Note that community payments are not included in this part of the analysis.

Table 10 Western Isles content in the other Western Isles wind farms.

Category	% of TOTEX	Geography	% content of TOTEX	% content of category
DEVEX	4.8%	Western Isles	1.9%	40.0%
		Non Western Isles	2.9%	60.0%
CAPEX	49.2%	Western Isles	5.5%	11.1%
		Non Western Isles	43.7%	88.9%
OPEX	46.1%	Western Isles	17.1%	37.0%
		Non Western Isles	29.0%	63.0%
TOTEX	100.0%	Western Isles	24.4%	24.4%

Table 11 Western Isles content in the onshore wind farms in north-west Scotland.

Category	% of TOTEX	Geography	% content of TOTEX	% content of category
DEVEX	4.8%	Western Isles	0.0%	0.0%
		Non Western Isles	4.8%	100.0%
CAPEX	49.2%	Western Isles	0.2%	0.4%
		Non Western Isles	49.0%	99.6%
OPEX	46.1%	Western Isles	0.1%	0.3%
		Non Western Isles	45.9%	99.7%
TOTEX	100.0%	Western Isles	0.3%	0.3%

Wind farm related exports

The construction and operation of wind farms on the Western Isles has the potential to generate skills and experience that could lead to business opportunities working on other onshore wind projects. Our conclusion is that the size of the market in the Western Isles is not sufficiently large to create a centre of expertise that will displace established suppliers in mainland Scotland. The likely demand for construction services is not significant either and since this will mostly be for repowering existing wind farm farms, there will no significant increase in demand for OMS services. Nevertheless, we anticipate that the Western Isles content in wind farm civil construction for other projects in north-west Scotland can reach 2% and that Western Isles content in turbine OMS in other projects in western Scotland can reach 1%.

Table 11 shows that the Western Isles content in the onshore wind farms elsewhere is 0.3%.

3.2. Local and gross value added

Table 12 shows the LVA generated in the Western Isles from the investments in grid and new generating capacity.

Figure 1 Figure 2 and show that the annual LVA peaks in 2033 at £32.0 million. This is the first year in which all the wind farms are operational. Figure 1 shows that the largest impact comes from community income (from equity and owner payments).

This shows that the indirect impacts are important, particularly in the operating phase of projects. This is because revenue from rent and business rates has significant economic impacts.

LVA averages £36 thousand/FTE year between 2016 and 2050, which is a combination of gross earnings, business and self-employment profits retained in the Western Isles, eventual pension payments from employers' pension contributions, and depreciation on assets used in the course of the person's employment where the asset depreciating was constructed or sourced in the Western Isles.

In these figures (and others in Section 3), data is presented to 2050, which is the projected date for the final decommissioning of the EDF ER wind farms, although economic impacts from other wind farms will continue beyond 2050. There is also likely to be a good case for either life extension or repowering after this but the impacts of this have not been modelled. There will also continue to be economic impacts from the maintenance of the grid connection and other renewable energy investments.

Table 12 Local value-added in the Western Isles, 2016 to 2050.

		local value-added (£million)	
Source	**Type**	**Undiscounted**	**Discounted**
High voltage grid connection	Direct	7.0	6.0
	Indirect	6.4	5.2
	Induced	2.7	2.2
	Total	16.0	13.4
EDF ER wind farms (340MW)	Direct	41.9	29.2
	Indirect	58.0	36.7
	Induced	20.0	13.2
	Total	119.9	79.1
Other renewable energy projects (180MW)	Direct	39.2	25.4
	Indirect	61.1	34.2
	Induced	20.1	11.9
	Total	120.4	71.5
Wind farm related exports	Direct	8.2	4.2
	Indirect	5.4	2.9
	Induced	3.0	1.6
	Total	16.6	8.7
Community benefit	Payments	104.0	60.0
	Ownership	332.4	183.7
	Total	436.4	243.7
Total	Direct	96.3	64.7
	Indirect	130.9	79.0
	Induced	45.8	28.9
	Combined community	436.4	243.7
	Total	709.4	416.3

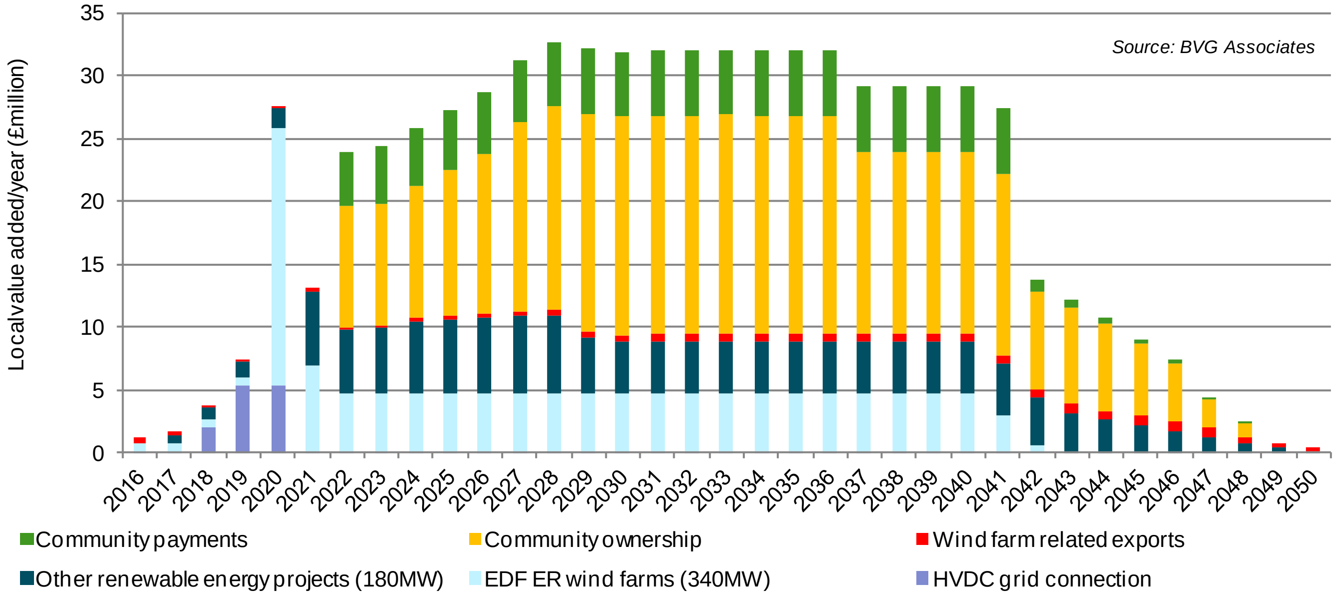

Figure 1 Undiscounted Western Isles local value-addedbroken down by source of impact.[13]

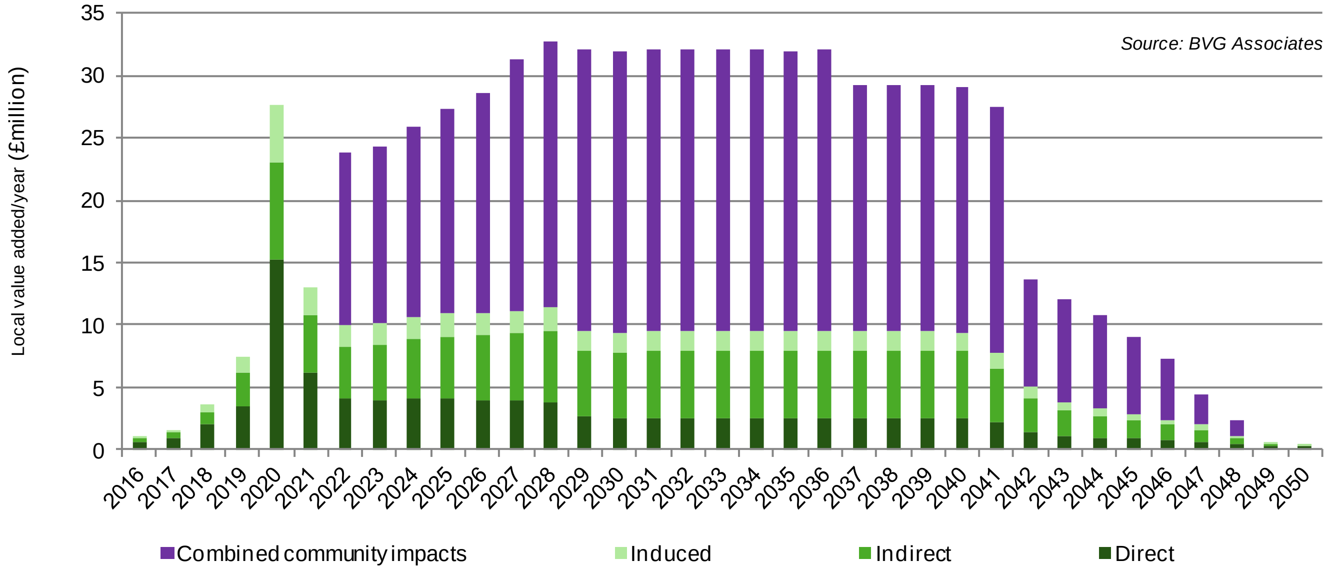

Figure 2 Undiscounted Western Isles local value-added broken down by direct, indirect, induced and community impacts. Combined community impacts include direct, indirect and induced impacts.[13]

[13] The impacts decline after 2040 as the wind farms reach the end of their design life. Life extension or repowering of wind farms is likely and will sustain economic impacts in the longer term.

Table 13 shows the GVA generated in the UK from the investments in grid and new generating capacity up to 2050.

Figure 3 and Figure 4 show that the annual GVA peaks in 2022 at about £159 million, the time at which the later stages of the construction of the HVDC grid connection and the civil works of the EDF ER wind farms are underway. Figure 4 shows that the indirect impacts are significant, particularly during the operation phases through expenditure of fixed costs.

Table 13 Gross value-added in the UK, 2016 to 2050.

		Gross value-added (£million)	
Source	Type	Undiscounted	Discounted
High voltage grid connection	Direct	148.1	109.1
	Indirect	218.1	155.7
	Induced	69.1	50.3
	Total	435.4	315.1
EDF ER wind farms (340MW)	Direct	161.5	121.1
	Indirect	277.0	179.7
	Induced	97.5	66.8
	Total	536.0	367.6
Other renewable energy projects (180MW)	Direct	96.5	61.3
	Indirect	149.4	83.9
	Induced	54.4	32.1
	Total	300.4	177.3
Total	Direct	406.1	291.5
	Indirect	644.6	419.3
	Induced	221.1	149.1
	Total	1,271.8	860.0

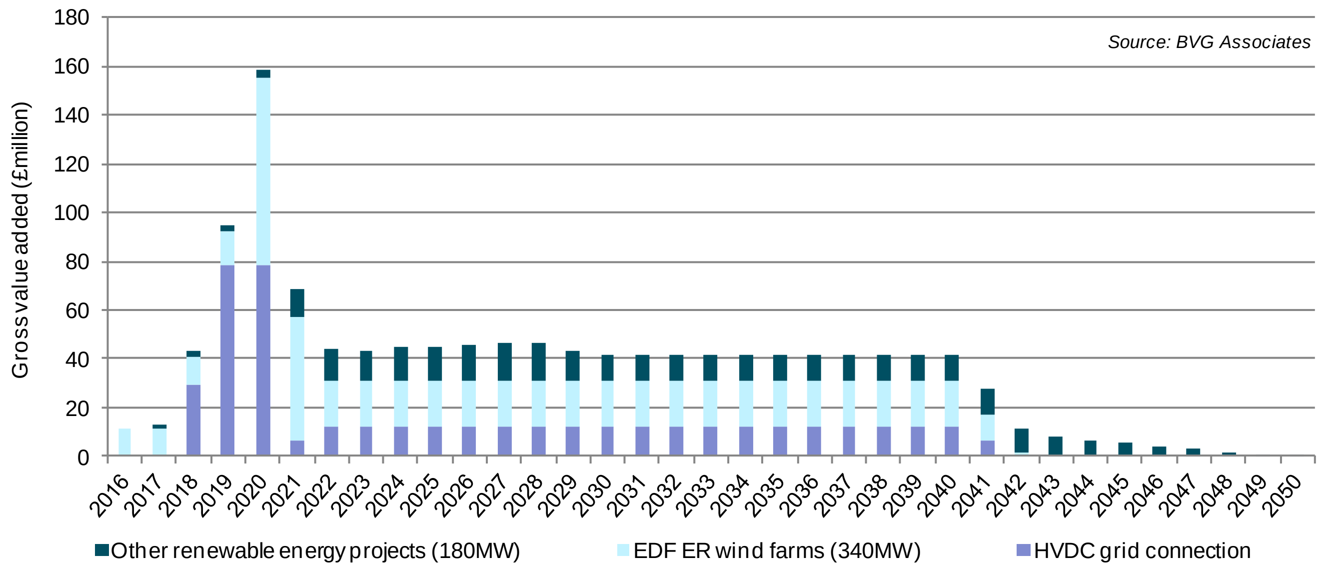

Figure 3 Undiscounted UK gross value-added broken down by source of impact.[13]

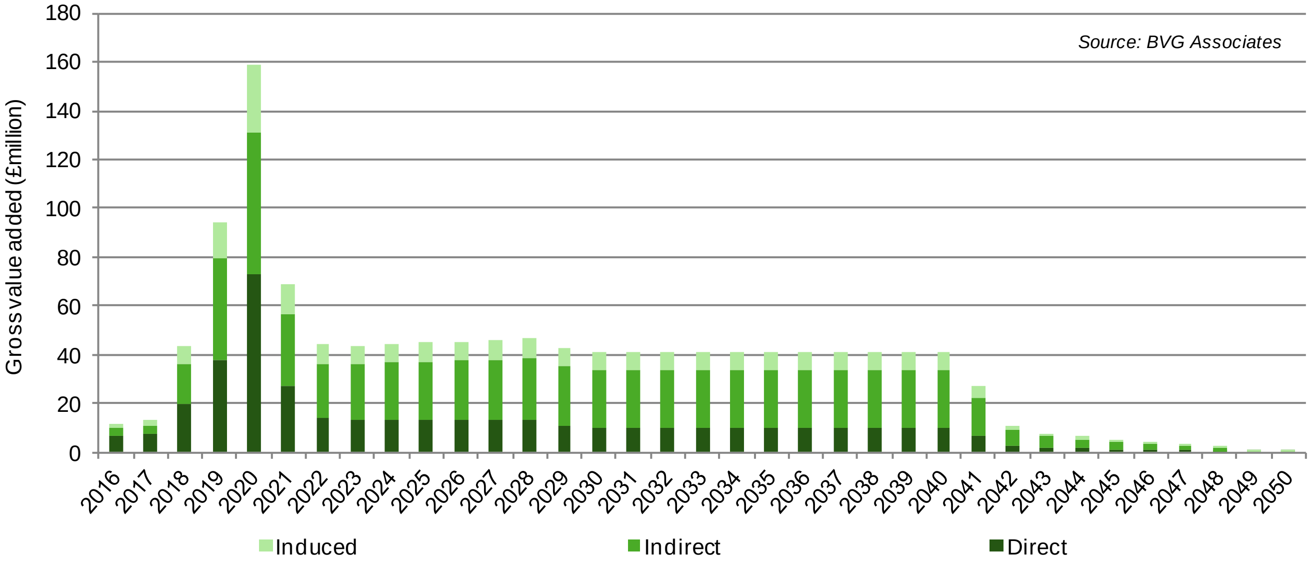

Figure 4 Undiscounted UK gross value-added broken down by direct, indirect and induced impacts.[13]

3.3. Full-time equivalent years employment

Table 14 shows the FTE years employment generated in the Western Isles. Figure 5 and Figure 6 show that the number of FTEs peaks in 2033 at 870 As with the LVA results in Section 3.2, the biggest impact comes from community benefits.

Figure 7 and Figure 8 show that the UK FTE years peaks during the construction of the wind farms. Most of these benefits come from the direct employment of construction workers.

Table 14 Undiscounted full-time equivalent years employment generated in the Western Isles, 2016 to 2050.

Source	Type	FTE years
High voltage grid connection	Direct	140
	Indirect	190
	Induced	50
	Total	380
EDF ER wind farms (340MW)	Direct	830
	Indirect	1,580
	Induced	360
	Total	2,770
Other renewable energy projects (180MW)	Direct	790
	Indirect	1,660
	Induced	370
	Total	2,820
Wind farm related exports	Direct	110
	Indirect	110
	Induced	50
	Total	270
Community benefit	Payments	3,080
	Ownership	9,850
	Total	12,930
Total	Direct	1,880
	Indirect	3,540
	Induced	820
	Combined community	12,930
	Total	19,170

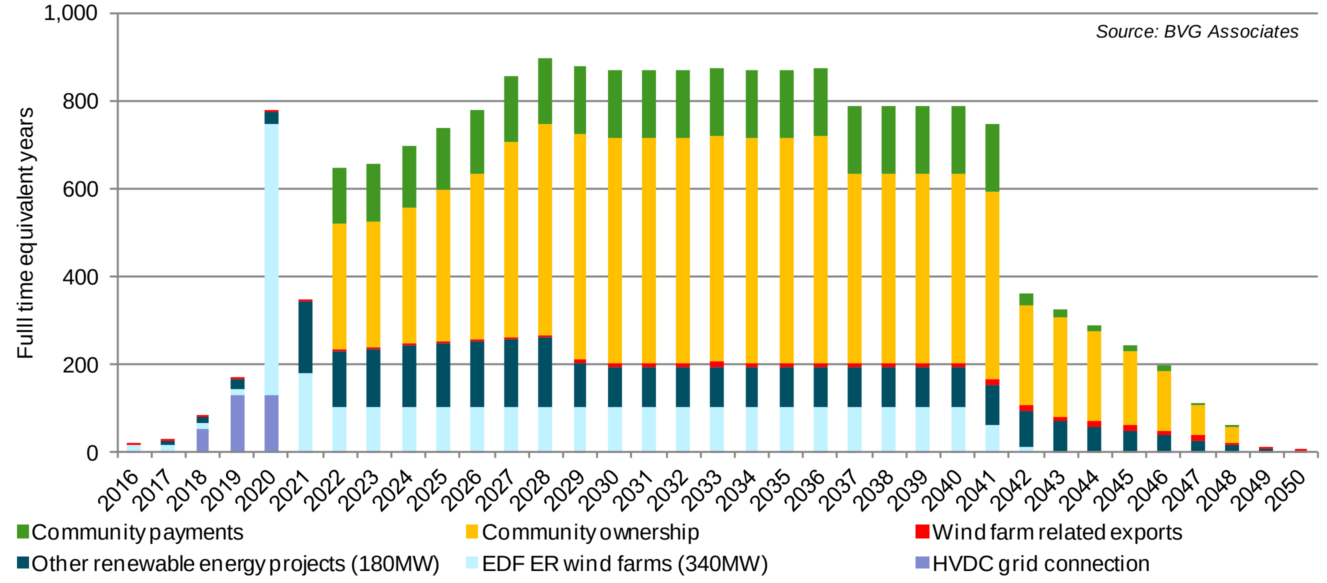

Figure 5 Undiscounted Western Isles full time equivalent years employment broken down by source of impact.[13]

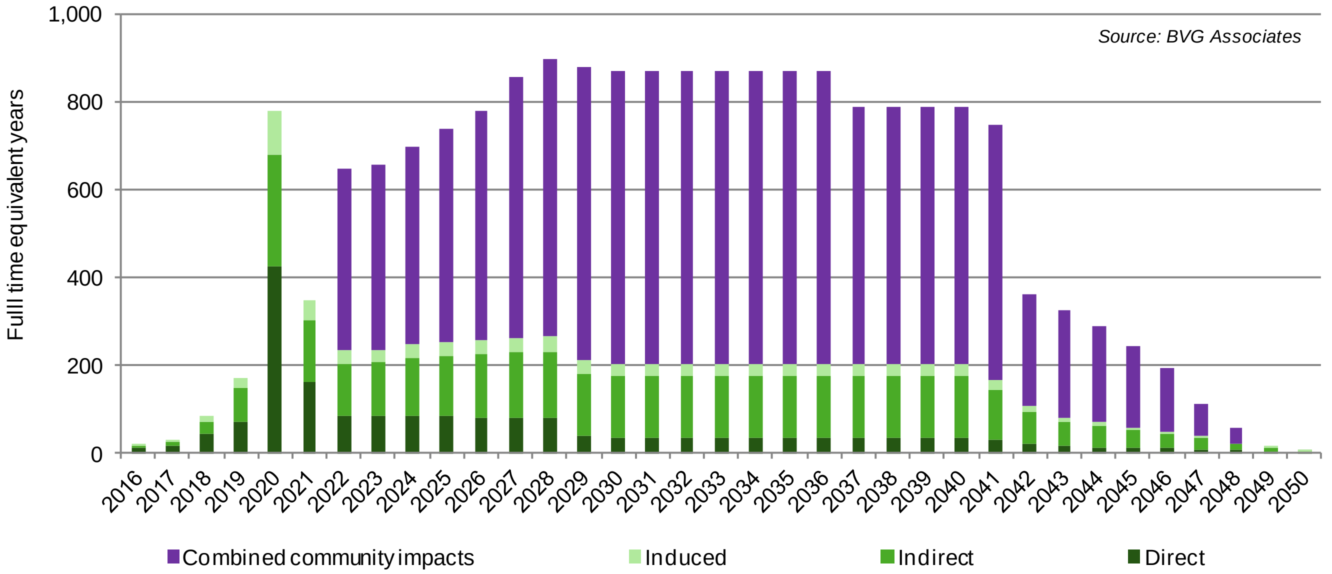

Figure 6 Undiscounted Western Isles full time equivalent years employment broken down by direct, indirect, induced, and community impacts. Combined community impacts include direct, indirect and induced impacts.[13]

Table 15 shows the FTE years employment generated in the UK. Figure 5 and Figure 6 show that the number of FTEs peaks in 2020 at 3,000. As for the GVA results in Section 3.2, the biggest impacts come from the civil engineering work on the wind farms and the HVDC grid connection.

Figure 7 and Figure 8 show that when the wind farms are operational, the wind farms provide more employment than the grid connection because of the higher maintenance requirements of the wind turbines.

Table 15 Undiscounted full-time equivalent years employment generated in the UK, 2016 to 2050.

Source	Type	FTE years
High voltage grid connection	Direct	2,120
	Indirect	4,040
	Induced	1,210
	Total	7,370
EDF ER wind farms (340MW)	Direct	2,400
	Indirect	4,910
	Induced	1,450
	Total	8,760
Other renewable energy projects (180MW)	Direct	1,410
	Indirect	2,660
	Induced	810
	Total	4,880
Total	Direct	5,930
	Indirect	11,610
	Induced	3,470
	Total	21,010

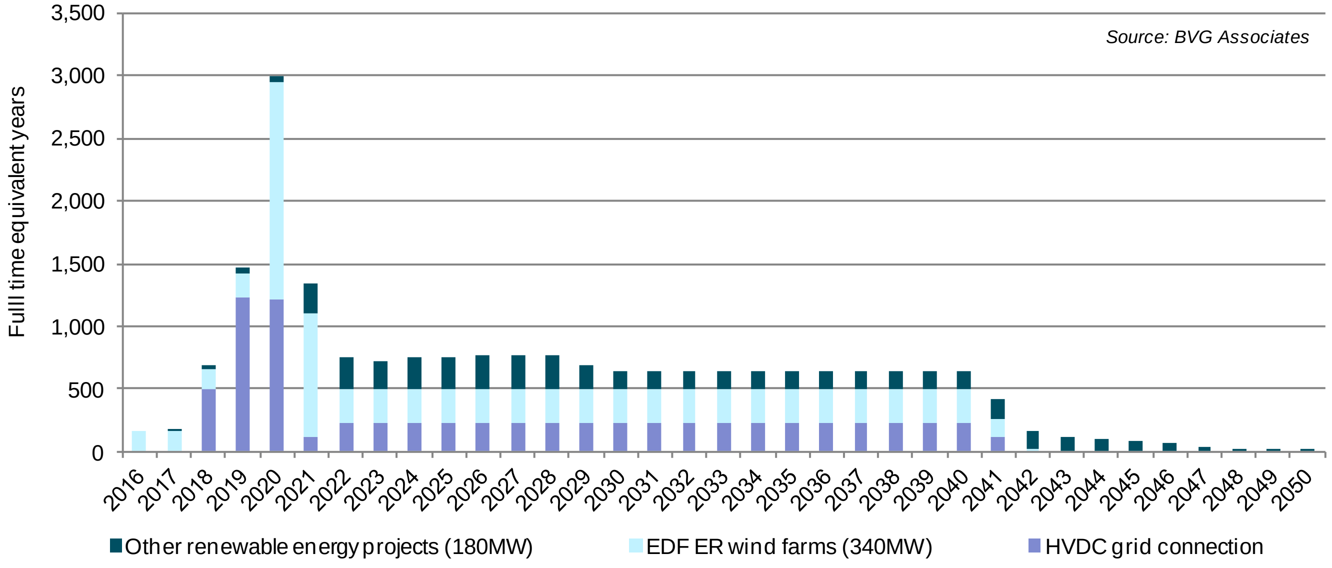

Figure 7 Undiscounted full time equivalent years employment in the UK broken down by source of impact.[13]

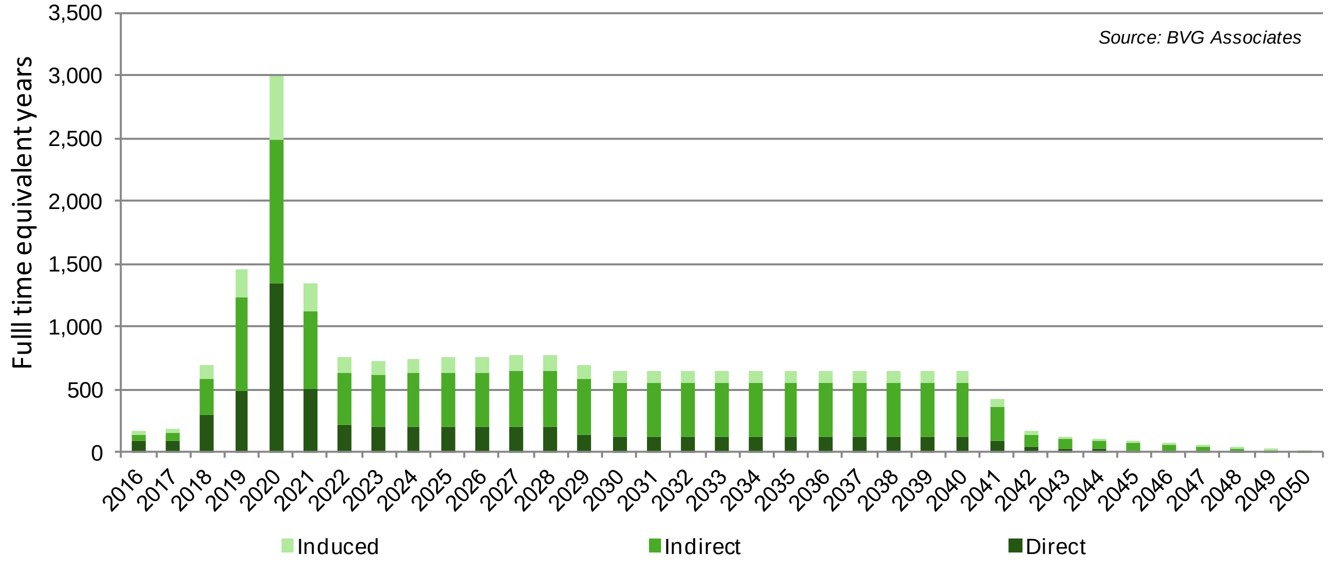

Figure 8 Undiscounted full time equivalent years employment in the UK broken down by direct, indirect and induced impacts.[13]

3.4. Earnings

Table 16 shows the total earnings generated in the Western Isles.

Figure 9 and Figure 10 show that annual earnings peak in 2033 at £20.0 million.

Annual earnings are on average £13,000/FTE year between 2016 and 2050, which takes into account the range of jobs (direct, indirect and induced) that would be generated by the types of expenditure as shown above from the analysis previously carried out for the WIDT.

Table 16 Earnings generated in the Western Isles, 2016 to 2050.

		Earnings (£million)	
Source	**Type**	**Undiscounted**	**Discounted**
High voltage grid connection	Direct	5.0	4.4
	Indirect	4.5	3.7
	Induced	1.1	1.0
	Total	10.7	9.0
EDF ER wind farms (340MW)	Direct	28.8	21.2
	Indirect	34.9	22.4
	Induced	7.6	5.2
	Total	71.3	48.8
Other renewable energy projects (180MW)	Direct	27.4	18.5
	Indirect	36.7	20.9
	Induced	7.7	4.7
	Total	71.8	44.1
Wind farm related exports	Direct	4.9	2.5
	Indirect	3.7	2.0
	Induced	1.2	0.6
	Total	9.8	5.1
Community benefit	Payments	69.4	40.0
	Ownership	221.6	122.5
	Total	290.9	162.4
Total	Direct	66.0	46.7
	Indirect	79.9	48.9
	Induced	17.7	11.6
	Combined community	290.9	162.4
	Total	454.6	269.6

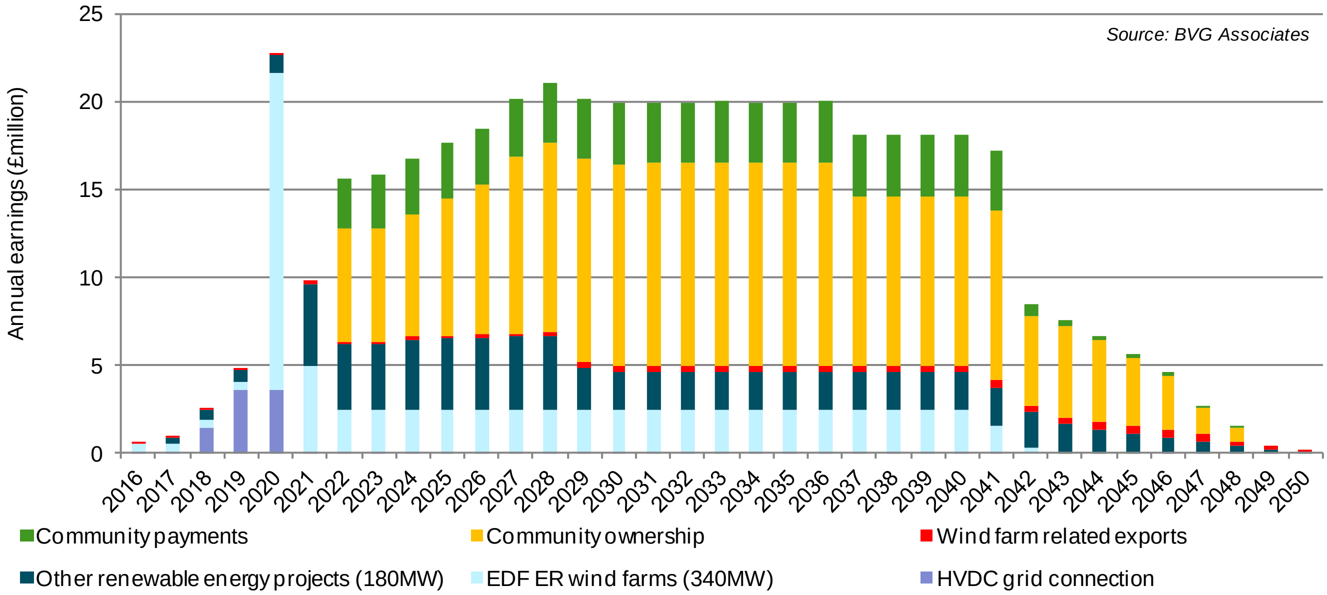

Figure 9 Undiscounted Western Isles earnings broken down by source of impact.[13]

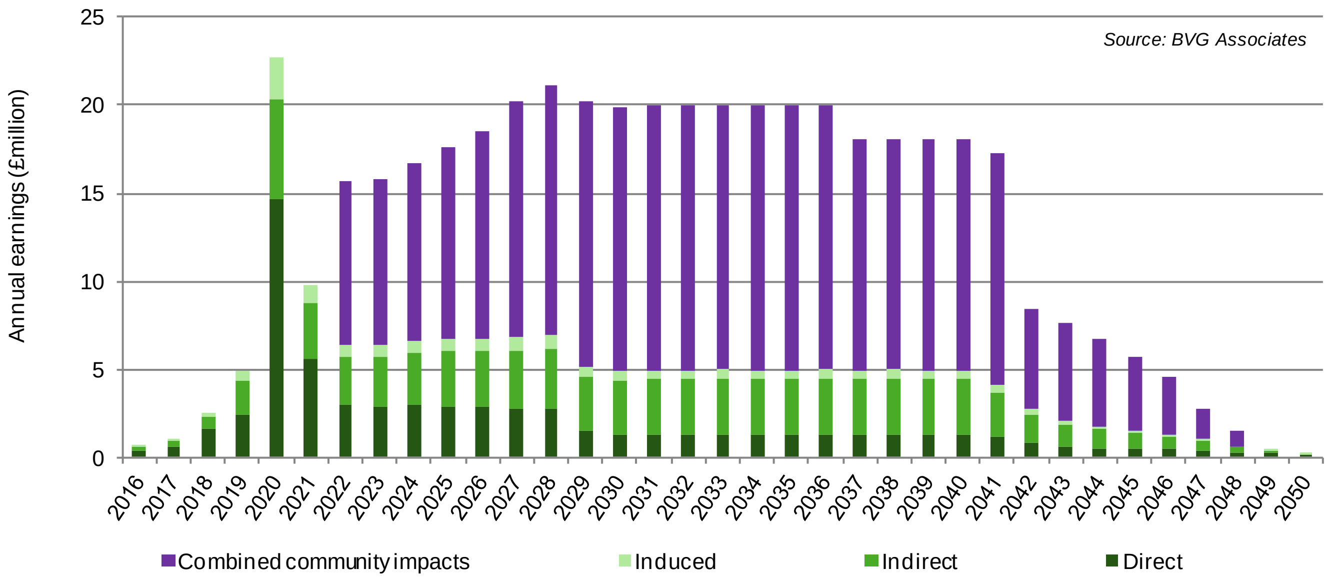

Figure 10 Undiscounted Western Isles earnings broken down by direct, indirect, induced and community impacts. Combined community impacts include direct, indirect and induced impacts.[13]

Table 17 shows the total earnings generated in the UK.

Figure 9 and Figure 10 show that annual earnings peak in 2020 at £99.8 million.

Table 17 Earnings in the UK, 2016 to 2050.

		Earnings (£million)	
Source	**Type**	**Undiscounted**	**Discounted**
High voltage grid connection	Direct	83.7	60.7
	Indirect	148.9	105.5
	Induced	32.8	23.5
	Total	265.4	189.8
EDF ER wind farms (340MW)	Direct	90.3	71.0
	Indirect	160.3	105.7
	Induced	35.4	24.9
	Total	286.0	201.6
Other renewable energy projects (180MW)	Direct	53.0	35.3
	Indirect	86.8	49.5
	Induced	19.7	12.0
	Total	159.6	96.8
Total	Direct	227.0	167.0
	Indirect	396.0	260.7
	Induced	88.0	60.4
	Total	711.0	488.1

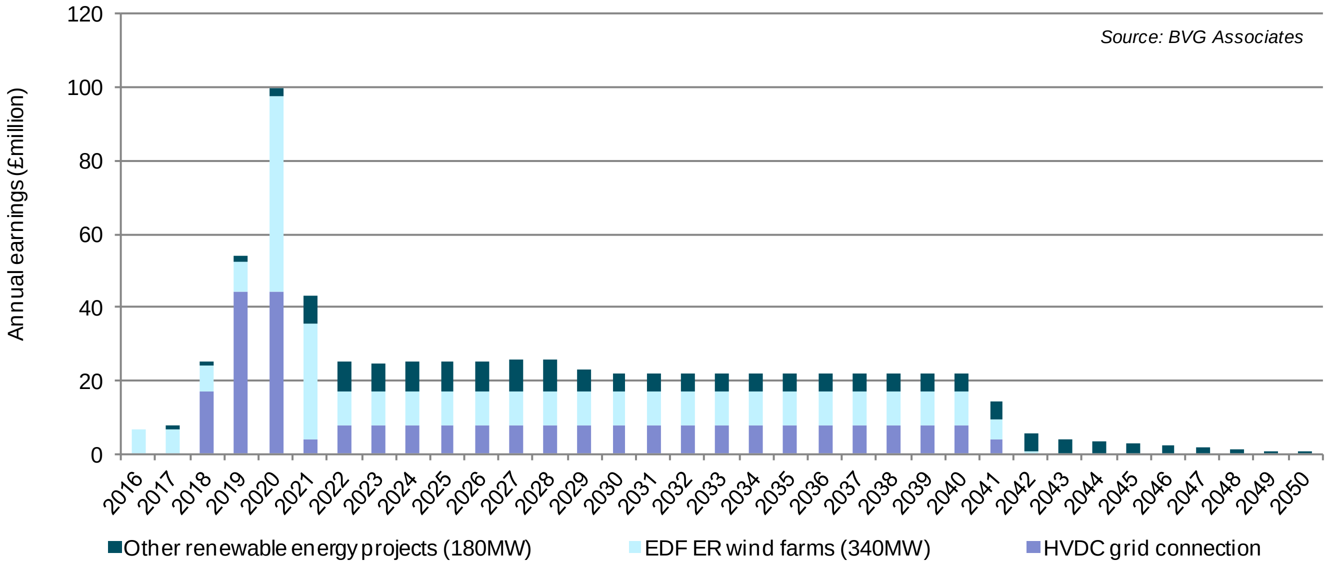

Figure 11 Undiscounted UK earnings broken down by source of impact.[13]

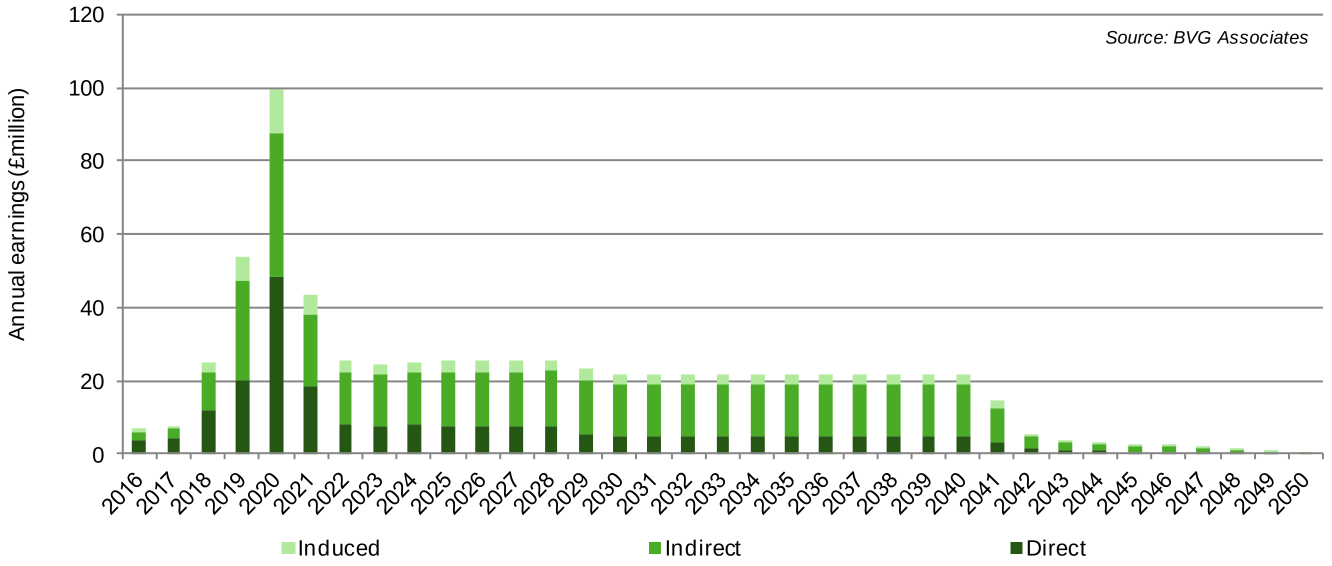

Figure 12 Undiscounted UK earnings broken down by direct, indirect and induced impacts.[13]

3.5. Additional investments

Examples of potential additional investments were given in Section 2.2. Actual developments and projects that will benefit from those investments will largely be dependent on:

- Partnership funding being provided by the Scottish Government and other relevant support agencies,
- Businesses that will benefit from enhanced infrastructure (through their own investment or annual payments),
- Political decisions made nationally and locally, and
- The ways in which the Western Isles economy evolves over the next 40 years.

Few of the potential infrastructure projects are well defined. An exception is a proposal to build a 200MW pumped electricity storage facility on the Isle of Lewis. Based on the assumption that it is a civil engineering project with similarities to the wind farm balance of plant, it is likely that the project could create about 400 FTE years employment over the course of the two year construction period. In theory, a pumped storage facility could increase the generating capacity on the Western Isles that is supported by the HVDC grid connection and therefore further increase the economic benefits. Demand for pumped storage output capacity is likely to be at times of low wind resource. Generation would only need to be curtailed in periods when the pumped storage facility was full and combined generating capacity exceeded the capacity of the grid connection.

The wind farms may also support the case for investment at the port of Stornoway. The Stornoway Port Authority has developed a masterplan to stimulate business in a range of sectors, including onshore wind. The economic stimulus we have described in the sections above could build a case for a second ferry crossing, which could address capacity problems in the tourist season. The masterplan states that its implementation could create £580 million in GVA over 30 years, a figure not far short of the total Western Isles LVA associated with the wind farms' development (see Table 12).[14] The impacts described in this report and those in the port masterplan are not easy to link directly, however.

The availability of significant generating capacity on the Western Isles removes an obstacle to investments in energy-intensive industries. (An opportunity might arise for data centres, for example.) The development of investment proposals is unlikely until investment decisions are made on the wind farms and it would therefore speculative to include them.

3.6. Secondary impacts

The more that the islands' population grows compared with the counterfactual scenario of decline expected without the onshore wind farm and grid connection impacts as assessed above, the greater will be population-related secondary investments. This would include new and improved housing, community facilities funded by CnES, and increased infrastructural spend in local areas where increased populations are concentrated. Without such growth, there will be a decline in the islands' working population as residents' age and younger people move away (or fail to move to the islands) due to lack of employment opportunities (other than in low paid care jobs). Also, once the initial grid connection to the mainland is fully utilised, there is the prospect of further enhanced grid capacity in Lewis and Harris and a new connector between Harris and the Uists.

These developments and the additional renewable energy projects that would trigger their construction, would, in turn, generate substantial further impacts throughout the islands, including enabling the offshore marine renewables resources of the islands to become more viably exploitable.

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[14] *Draft Masterplan for Stornoway Port*, Stornoway Port Authority, November 2016. Available online as www.stornowayportauthority.com/wp-content/uploads/2014/12/Stornoway-Port-Authority-Port-Masterplan-29.11.16.pdf. Last accessed February 2017

4. Discussion

4.1. Comparison with existing data

The most recent analysis of the economic impacts on the Western Isles from the development of wind farms was undertaken in 2016 by Baringa on behalf of the Scottish Government.[15] This study employed three scenarios, of which the central scenario is closest to the one adopted here. This central scenario involved the construction of 550MW of new onshore wind capacity (on a similar timetable to our scenario) and 50MW of shoreline wave generation capacity. It did not include the economic impacts of the grid connection.

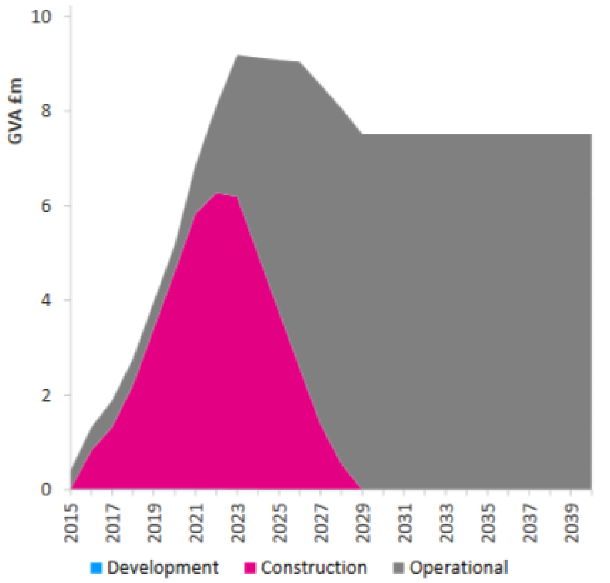

Figure 13 Gross value-added for the Western Isles calculated by Baringa under its central scenario.

Figure 13 shows the GVA calculated by Baringa under its central scenario.[16] It shows that GVA from construction peaks in 2023 at about £6 million while our equivalent figure is about £22 million. The total undiscounted GVA from construction was not presented by Baringa but an approximate calculation based on Figure 13 indicates a figure of about £42 million, while our equivalent figure is about £47 million. The difference is therefore primarily about the timing of the impacts and our assumption, based on guidance from EDF ER, that the civils works for the Stornoway and Uisenis projects would be undertaken in a single year. These projects represent 65% of the assumed new onshore wind capacity and they therefore determine when the greatest impacts from construction occur.

The remaining difference in the data is likely to stem from our assumption that a greater proportion of construction workers will be recruited locally. Baringa used estimates of local content from a 2012 RenewableUK study undertaken by Biggar Economics that categorised expenditure into local, regional and national (UK).[17] The remoteness of the Western Isles projects is likely to mean that the balance of local and regional impact is more focused towards the local.

Baringa's figures of GVA during operation are similar to those presented here and the small differences are probably caused by methodological differences.

In this study, we also considered the economic impacts from the construction of the HVDC grid connection. Although the Western Isles is unlikely to capture a significant fraction of the total benefits, the facts that a significant amount of the work will be undertaken on the mainland and the size of the investment means that the Western Isles will still benefit significantly.

Baringa calculated community impacts separately in terms of income from ownership only. It concluded that it would peak at about £4 million in 2033 based on 94MW in community ownership, or £42 thousand/MW/year, which is lower than the figure we have assumed.

4.2. Community ownership

Our analysis shows that the community ownership has, potentially, the greatest economic impact on the Western Isles from the sources considered here. We have assumed that 84MW of the EDF ER wind farms will be in community ownership and 67MW of other onshore wind farm capacity. This would require about £200 million of investment. We have been convinced that this is a plausible scenario because of the high priority given to community ownership by EDF ER and CnES.

4.3. The 'island effect'

At a national (UK) level, there is likely to be no significant net economic benefit from the development of wind farms on the Western Isles as it is most likely that they would be built instead of other electricity generation projects. At a local level, however, the picture is different.

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[15] *Economic Opportunities of Renewable Energy for Scottish Island Communities*, March 2016. Baringa for the Scottish Government. Available online at www.gov.scot/Resource/0049/00495193.pdf. Last accessed February 2017

[16] Baringa use of the term GVA is likely to be equivalent to our use of the term LVAin this report.

[17] *Onshore Wind: Direct & Wider Economic Impacts*, May 2012. Biggar Economics for RenewableUK and the Department of Energy and Climate Change. Available online at www.gov.uk/government/uploads/system/uploads/attachment_data/file/48359/5229-onshore-wind-direct--wider-economic-impacts.pdf. Last accessed February 2017

The results for the Western Isles show a local benefit greater than for other mainland onshore wind farms. There are two main reasons for this:

- There is a significant pool of available construction workers; and
- There a high priority being placed on community ownership by WIDT and CnES.

This first point is the basis for the difference between impacts modelled here and by Baringa, as discussed above. The Western Isles has a suffered from a long-term population decline and many workers have sought employment on construction projects on the mainland. A series of major infrastructure projects should see a substantial number of workers return to the Western Isles where many could find accommodation in family homes in the short term. The main contractors for the projects are likely to seek local workers to minimise the costs of bringing in labour from the mainland. Enquiries with companies on the Western Isles suggested that up to 300 workers could be recruited locally. Returning workers would stimulate further economic benefits by increasing demand for housing and other infrastructure.

As a result of the socioeconomic challenges faced by the Western Isles, economic rejuvenation is a high political priority. CnES also recognises that renewable energy provides a means of invigorating the local economy.

As well as the benefits that flow from the investments in the HVDC grid connection and the wind farms, the increase in business activity on the Western Isles will support investments in communication and transport. This will potentially providing a business case for more ferry services, investments in and around Stornoway (as described in Stornoway Port Authority's new development strategy), and better broadband links.

Although not quantified in this analysis, the investment in wind farms could lead to additional investments. In particular, there are early plans for a 200MW pumped storage facility. As well as the impacts from the construction and operation of the facility, it would also enable the grid connection to support increased wind farm capacity on the Western Isles.

The analysis provides significant evidence for an 'island effect' in that the investments lead to local economic benefits that would not typically be seen for onshore wind development. The greater retention of workers for construction projects over several years will stimulate demand for new housing. The community impacts are probably also greater because the income can leverage additional public funding.

The EDF ER wind farms provide the catalyst for this effect. Without their eligibility for a CfD, they are unlikely to be economically viable and without them the business case for the HVDC grid connection is significantly weakened.

Appendix A: A UK content analysis of Isle of Lewis wind farms

A UK content analysis of Isle of Lewis wind farms

A report for EDF Energy Renewables

November 2016

Document history

Revision	Description	Circulation classification	Authored	Checked	Approved	Date
1	Final report	Client discretion	AER	CLW	BAV	14 November 2016

BVG Associates

BVG Associates is a technical consultancy with expertise in wind and marine energy technologies. The team probably has the best independent knowledge of the supply chain and market for wind turbines in the UK. BVG Associates has over 150 career-years experience in the wind industry, many of these being “hands on” with wind turbine manufacturers, leading RD&D, purchasing and production departments. BVG Associates has consistently delivered to customers in many areas of the wind energy sector, including:

- Market leaders and new entrants in wind turbine supply and UK and EU wind farm development
- Market leaders and new entrants in wind farm component design and supply
- New and established players within the wind industry of all sizes, in the UK and on most continents, and
- The UK Government), RenewableUK, The Crown Estate, the Energy Technologies Institute, the Carbon Trust, Scottish Enterprise and other similar enabling bodies.

The views expressed in this report are those of BVG Associates. The content of this report does not necessarily reflect the views of EDF Energy Renewables

Cover picture: EDF Energy: High Hedley wind farm

Contents

List of figures

List of tables

1. Introduction

EDF Energy Renewables (EDF ER) has planning consent for two onshore wind projects on the Isle of Lewis: Stornoway wind farm and Uisenis wind farm. These are unusual onshore wind farms because they will require additional investment in the transmission infrastructure and EDF ER wants the UK Government to classify them as 'less established' renewable technologies so that they qualify for pot 2 in the upcoming Contract for Difference (CfD) auctions.

EDF ER believes its case will be strengthened by a robust assessment of the likely UK content of the developments. It commissioned BVG Associates (BVGA) to undertake this work using the UK content methodology it developed to allow RenewableUK to report the UK content in UK offshore wind farms.[1] By applying the same methodology, EDF ER seeks to make a direct comparison with offshore wind projects competing in the CfD auctions.

1.1. Scope of work

Proposed wind farms

EDF ER has not made a decision on the generating capacity and turbine size of the two projects. For the purpose of this analysis, we have assumed that Stornoway wind farm will have a rated capacity of 180MW and use 36 5MW turbines and Uisenis wind farm with have a rated capacity of 160MW and use 45 3.55MW turbines. EDF ER has not started turbine procurement and these assumptions do not imply a favoured manufacturer or model.

Grid connection

The UK content methodology covers both the generation assets and offshore transmission assets associated with the wind farm.

The Isle of Lewis wind farms will be connected to the grid using high voltage direct current (HVDC) infrastructure rated at 600MW (see Figure 1). This consist of a converter station close to the planned Stornoway Wind Farm, a submarine cable providing a link to the mainland and a land cable to the Scottish Hydro Electric Transmission (SHE Transmission) section of the Beauly-Denny line at Beauly. High voltage alternating current (HVAC) links will connect both Isle of Lewis Wind farms to the HVDC converter station.

The design of the connection has not been finalised and the procurement process has not started.

As the developer of the two wind farms, EDF ER will bear some of the cost of the new infrastructure through transmission use of system charges. The UK content methodology treats transmission investment as CAPEX so we have attributed a portion of the transmission cost to the wind farms.

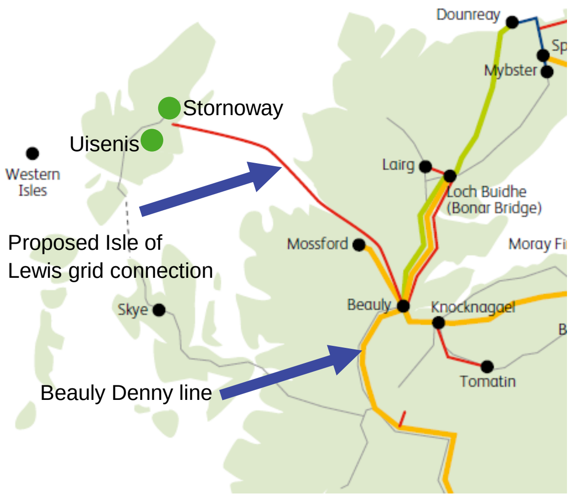

Figure 1 Approximate location of the proposed Isle of Lewis wind farms and the route of the proposed Isle of Lewis grid connection.

Data sources

The UK content methodology defines three expenditure stages of a wind farm's life:

- Development expenditure (DEVEX), which are costs incurred up to the point of final investment decision
- Capital expenditure (CAPEX), which are costs incurred from final investment decision up until the end of wind farm commissioning, and
- Operational expenditure (OPEX), which are costs incurred from the end of wind farm commissioning to the end of wind farm decommissioning.

We refer to the combined lifetime expenditure for the project as the total expenditure (TOTEX).

This analysis considered nine sets of expenditure data (see Table 1). Transmission decommissioning was excluded because the HVDC connection is likely to be upgraded rather than decommissioned at the end of the wind farms' life.

Methodology for Measuring the UK Content of UK Offshore Wind Farms, BVG Associates for RenewableUK, Department of Energy and Climate Change and The Crown Estate, May 2015. Available online at [1] http://ruk.pixl8-hosting.co.uk/download.cfm/docid/505E3697-6930-45C9-9388BBA8DA2D8CF7. Last accessed October 2016

Table 1 Data sets analysed.

Infrastructure	Data sets
Stornoway wind farm	DEVEX, CAPEX and OPEX
Uisenis wind farm	DEVEX, CAPEX and OPEX
Transmission (including new HVAC and HVDC infrastructure	DEVEX, CAPEX and OPEX (excluding decommissioning)

Cost data for wind farms DEVEX, CAPEX and OPEX was supplied by EDF ER. The Uisenis DEVEX included an estimate of costs incurred by the previous owner of the project.

High level DEVEX, CAPEX and OPEX data for the transmission system was derived from discussion with SHE Transmission and data published by National Grid.[2] These costs were attributed to the wind farms proportionately by dividing the combined capacity of the wind farms (340MW) by the capacity of the grid connection (600MW).

Although there is some uncertainty about the cost data for the wind farm and grid connection given the status of engineering studies and procurement, BVGA believes that it is adequate for the purpose of forecasting UK content.

For this analysis, we further subdivided the data for each stage as follows:

- DEVEX
    - Project development
- CAPEX
    - Project management
    - Turbines
    - Civil works
    - Wind farm electrical works
    - Transmission construction
- OPEX
    - Wind farm operation, maintenance and service (OMS)
    - Transmission OMS
    - Decommissioning.

Where a complete data set was not available, we made assumptions about project costs. These are shown in Table 2.

The cost assumptions were the same for the components and services of both projects but the relative costs of the projects were different, mainly due to the difference in the turbine sizes used. We assumed a turbine size of 5MW for Stornoway and 3.55MW for Uisenis. Although the cost of the turbine per MW is the same, the use of larger turbines at Stornoway meant lower costs for civil works, wind farm electrical and wind farm O&M. Uisenis will also have a longer HVAC transmission link between the wind farm and the HVDC converter station, leading to a slightly higher transmission CAPEX per MW. EDF ER has also secured different terms with the landowners. The cost breakdowns are shown in Table 3.

UK content analysis

UK content, as defined by the methodology, is the percentage of the total expenditure by the generation asset owner (EDF ER) and transmission asset owner (SHE Transmission) that is ultimately spent through contracts awarded to companies operating in the UK. It excludes the value of contracts to UK companies that is spent on subcontracts to companies not operating in the UK. It includes the value of contracts to non-UK companies that is spent on subcontracts to companies operating in the UK.

The UK content methodology is based on undiscounted expenditure to ensure that the long-term benefits from wind farm investments are fully recognised. The methodology in effect captures the value added by labour and therefore ensures that the data correlates well with any forecast employment created by the wind farms.

The Stornoway and Uisenis wind farms may ultimately use different supply chains and different levels of UK content. At this stage in the projects' development, however, there were no differences between the projects that could lead to different UK content assumptions.

[2] *UK Electricity Interconnection: Driving competition and innovation in the HVDC supply chain*, January 2016, National Grid. Available online at https://www.ofgem.gov.uk/ofgem-publications/99126. Last accessed October 2016.

Table 2 Expenditure assumptions.

	Expenditure item	Assumptions
DEVEX	Project development	Used budget supplied by EDF ER. Before EDF ER acquired the Uisenis project, the owner invested £10 million in development.
CAPEX	Project management	Used budget supplied by EDF ER.
	Turbines	Used a representative cost for both projects of £836 thousand /MW provided by EDF ER. Tower cost based on data provided by a tower manufacturer with an assumed 20% margin.
	Wind farm civil works	Used budget supplied by EDF ER.
	Wind farm electrical works	Used budget supplied by EDF ER.
	Transmission construction	Used EDF ER estimate of £250,000/km for HVAC link between wind farms and converter station. Derived budget for HVDC link from Beauly to Isle of Lewis based on discussion with SHE Transmission.
OPEX	Wind farm OMS	Used budget supplied by EDF ER based on cost per turbine.
	Transmission OMS	Derived budget for HVDC link maintenance from Beauly to Isle of Lewis based on discussion with SHE Transmission. Used local charge estimate of £10/MWh for Transmission Use of System.
	Decommissioning	Used budget supplied by EDF ER.

Table 3 Cost breakdowns of Uisenis and Stornoway wind farms.

	Budget item	Percentage of TOTEX	
		Stornoway	Uisenis
DEVEX	Project development	2.5%	2.9%
CAPEX	Project management	1.4%	0.9%
	Turbines	20.4%	20.9%
	Wind farm civil works	2.4%	6.0%
	Wind farm electrical works	2.5%	1.1%
	Transmission construction	29.6%	30.8%
OPEX	Wind farm OMS	30.4%	26.3%
	Transmission OMS	10.6%	10.8%
	Decommissioning	0.2%	0.3%

2. Results

BVGA made UK content assessments using the approach and assumptions shown in Table 4.

Table 4 Source of UK content assumptions.

Budget item		Methodology
DEVEX	Project development	Assumptions drawn from previous BVGA analyses. The work was assumed to be mainly based in the UK.
CAPEX	Project management	Assumptions drawn from previous BVGA analyses. The work was assumed to be mainly based in the UK.
	Turbines	Towers sourced from supplier CS Wind UK. UK content derived from discussions with the company. All other turbine components imported.
	Wind farm civil works	UK content was established through discussion with quantity surveyors Castle Hayes Pursey, which drew up the budgets for the wind farms. This was validated through discussions with civil engineering and building contractor RJ McLeod.
	Wind farm electrical works	UK content was derived from BVGA understanding of UK electrical component manufacturing and from discussion with quantity surveyors Castle Hayes Pursey.
	Transmission construction	Assumptions drawn from previous BVGA analyses. Onshore works were assumed to be undertaken by UK contractors. Subsea cable installation may be undertaken by a UK contractor and the analysis used a weighted probability to reflect this. The subsea and land cables were assumed to be produced by an overseas supplier.
OPEX	Wind farm OMS	UK content was established through discussion with EDF ER and from data held by BVGA. The work was assumed to be undertaken on site by technicians employed in the UK by the turbine manufacturer. The asset management was assumed to be undertaken by EDF ER in the UK.
	Transmission OMS	Onshore maintenance was assumed to be by UK contractors or in house by SHE Transmission. Subsea cable maintenance was assumed to be done by a UK contractor.
	Decommissioning	Work was assumed to be undertaken by UK civil contractor.

2.1. UK content in TOTEX

Figure 5 and Table 2 show the UK content in TOTEX to be 52.9%. Of this, OPEX contributes the largest share, 34.3%, with CAPEX contributing 16.2%.

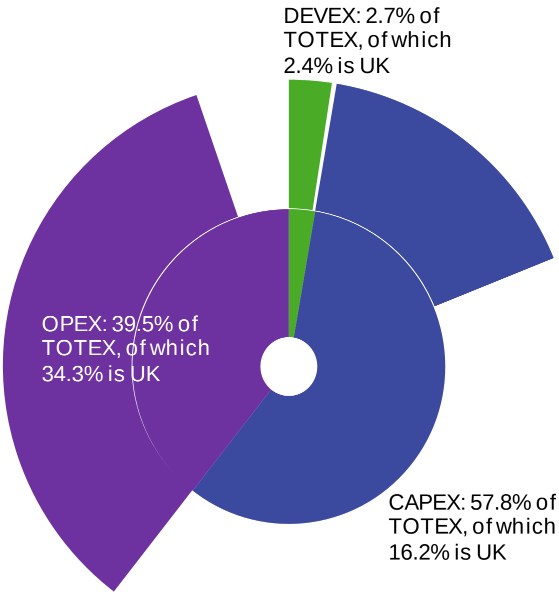

Figure 2 UK content in TOTEX. The inner circle shows the cost breakdown between DEVEX, CAPEX and OPEX. The outer circle shows the contribution that each makes UK content in TOTEX.

Table 5 UK content in TOTEX.

Category	% of TOTEX	Country	% content of category	% content of TOTEX
DEVEX	2.7%	UK	90.0%	2.4%
		Non UK	10.0%	0.3%
CAPEX	57.8%	UK	28.0%	16.2%
		Non UK	72.0%	41.7%
OPEX	39.5%	UK	86.8%	34.3%
		Non UK	13.2%	5.2%
TOTEX	100.0%	UK	52.9%	52.9%
		Non UK	47.1%	47.1%

2.2. UK content in CAPEX

Figure 3 and Table 6 show UK content in CAPEX to be 28.0%. Transmission construction is the largest part of CAPEX and makes the largest contribution to UK content in CAPEX (14.3%). Turbines and wind farm civil works contribute 4.3% and 5.8% respectively.

Although we have assumed that CS Wind UK supplies the towers, this component forms only 12% of turbine CAPEX. The selection of a UK tower manufacturer therefore only has a modest impact on turbine UK content. Indeed, turbine installation contributes almost as much UK content.

UK content in transmission construction is quite low (27.5%) because few of the substation components are manufactured in the UK and there are no UK high voltage subsea cable manufacturers. The UK does have subsea cable installation contractors but there are also many experienced overseas competitors and it is considered more likely that one of these will be selected.

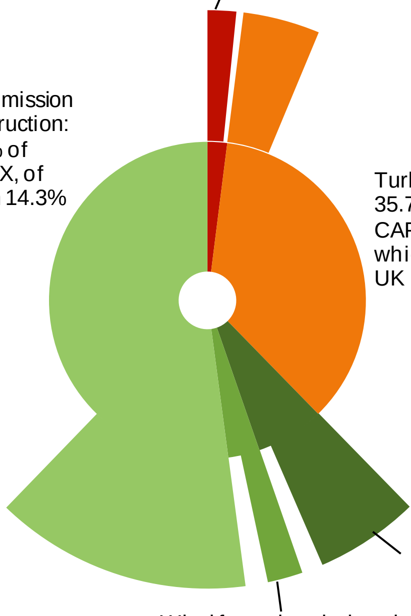

Figure 3 UK content in CAPEX. The inner circle shows the cost breakdown between the main budget items. The outer circle shows the contribution that each makes UK content in CAPEX.

Table 6 UK content in CAPEX.

Category	% of CAPEX	Country	% content of category	% content of CAPEX
Project management	2.0%	UK	80.2%	1.6%
		Non UK	19.8%	0.4%
Turbines	35.7%	UK	12.0%	4.3%
		Non UK	88.0%	31.4%
Wind farm civil works	7.0%	UK	68.2%	5.8%
		Non UK	31.8%	1.2%
Wind farm electrical works	3.2%	UK	61.2%	2.0%
		Non UK	38.8%	1.2%
Transmission construction	52.1%	UK	27.5%	14.3%
		Non UK	72.5%	37.8%
CAPEX	100.0%	UK	28.0%	28.0%
		Non UK	72.0%	72.0%

2.3. UK content in OPEX

Figure 4 and Table 7 show UK content in OPEX to be 86.7%. The largest proportion is from wind farm OMS because most of the services are delivered locally or by UK national service centres. Most of the non-UK content comes from the use of imported equipment and spares.

Decommissioning is a minor cost but UK content is likely to be similar to construction civil works (83%).

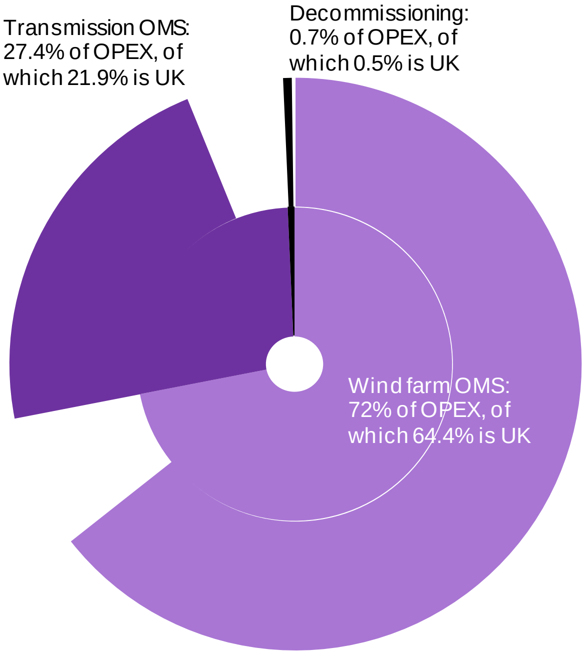

Figure 4 UK content in OPEX. The inner circle shows the cost breakdown between the main budget items. The outer circle shows the contribution that each makes UK content in OPEX.

Table 7 UK content in OPEX.

Category	% of OPEX	Country	% content of category	% content of OPEX
Wind farm OMS	2.7%	UK	89.5%	64.4%
		Non UK	10.5%	7.5%
Transmission OMS	57.9%	UK	80.0%	21.9%
		Non UK	20.0%	5.5%
Decommissioning	39.4%%	UK	70.0%	0.5%
		Non UK	30.0%	0.2%
OPEX	100.0%	UK	86.8%	86.8%
		Non UK	13.2%	13.2%

2.4. Comparison between Uisenis and Stornoway

We made the same UK content assumptions for the two wind farms but the differences in the cost breakdown mean that their UK content figures differ slightly. In particular, Stornoway wind farm has a lower UK content in CAPEX than Uisenis wind farm but a higher UK content in OPEX and a higher UK content in TOTEX (see Table 8).

These differences primarily reflect the significantly higher cost of civil works for Uisenis wind farm. This is primarily due to the smaller turbines assumed for this wind farm (3.55MW compared with 5MW for Stornoway), which leads to proportionately higher costs for civil and electrical engineering. The fact that smaller turbines were assumed for Uisenis also means that CAPEX forms a larger percentage of TOTEX than at Stornoway. Because UK content in civil and electrical works is lower than UK content in OPEX (from the use of imported heavy plant), the result is a lower UK content in TOTEX for Uisenis. Stornoway has a higher UK content in OPEX than Uisenis because its landowner costs are significantly higher and these are associated with a higher UK content than some other aspects of OPEX.

Table 8 Comparison between UK content for Uisenis and Stornoway wind farms.

Expenditure type	UK content	
	Uisenis	Stornoway
DEVEX	90.0%	90.0%
CAPEX	29.6%	26.5%
OPEX	86.0%	87.3%
TOTEX	52.5%	53.2%

3. Discussion

These results can be compared with data reported for other onshore and offshore wind farms.

3.1. Onshore wind comparison

The most comprehensive analysis of UK content in onshore wind was undertaken by GL Garrad Hassan and published by RenewableUK in 2010.[3] Table 9 shows a summary of the results. UK content across the TOTEX of 18 projects built between 2009 and 2010 was reported to be 53.9%, with 24% UK content in CAPEX and 92% in OPEX. In several budget lines in the RenewableUK report, UK content is 100%, which suggests that the definition of UK content subsequently developed by BVGA for the offshore sector was different from that used in the RenewableUK study. The data suggests the projects did not use UK towers because the RenewableUK study reported a UK content figure for turbines of only 4%.

A second study was undertaken by Biggar Economics and published by RenewableUK in 2015 and it analysed data from 20 wind farms built between 2011 and 2014.[4] This report provided less detail on the UK content calculations than the earlier study and the results are shown in Table 10. The report does include cost data and our analysis suggests that the UK content in CAPEX can only be achieved if UK content in all non-turbine expenditure is 100%. The UK content figure published is not dissimilar to our own but the OPEX percentage of TOTEX is significantly higher than ours. This is likely to be because of the HVDC grid CAPEX and the larger turbines assumed in our study and because we assumed a 20-year life rather than the 25 years used in the RenewableUK study.

Table 9 RenewableUK 2010 onshore wind UK content results.

Expenditure type		Percentage of TOTEX	UK content
DEVEX	***Subtotal***	***2.0%***	***100%***
CAPEX	Turbine supply (including installation)	2.5%	4%
	Civil works	7.9%	100%
	Electrical works	1.0%	66%
	Grid connection works	4.5%	80%
	Subtotal	***56.2%***	***24%***
OPEX	Turbine maintenance	5.1%	93%
	BOP maintenance	1.5%	73%
	Business rates	5.6%	91%
	Electricity network operator charges	1.7%	100%
	Community benefits	2.6%	100%
	Land rent	6.5%	99%
	Insurance	1.7%	100%
	Subtotal	***41.8%***	***92%***
TOTEX		**100.0%**	**53.9%**

Table 10 RenewableUK 2015 onshore wind UK content results.

	Percentage of TOTEX	Percentage UK content
DEVEX	5%	98%
CAPEX	45%	47%
OPEX	50%	87%
TOTEX	100%	69%

[3] *Onshore Cost / Benefits Study*, November 2010, GL Garrad Hassan for RenewableUK. No longer available online.

[4] *Onshore Wind: Economic Impacts in 2014*, April 2015, Biggar Economics for RenewableUK. Available online at http://www.renewableuk-cymru.com/wp-content/uploads/2015/04/Benefits-of-onshore-wind-report.pdf. Last accessed September 2016

If adjustments are made to reflect differences in the definition of UK content, it is likely that UK content (using our definition) in the Isle of Lewis wind farms is slightly higher than the RenewableUK studies. This is primarily because we have assumed that UK towers will be used for the Isle of Lewis wind farms.

3.2. Offshore wind comparison

The Offshore Wind Programme Board published offshore wind UK content data for DEVEX, CAPEX and OPEX (see Figure 5).[5] The UK content for offshore wind farms greater than 100MW completed by 2014 shows an average UK content in TOTEX of 43%. UK content in CAPEX was 18%. This is lower than the figure for the Isle of Lewis wind farms because of the strong non-UK supply chain for offshore foundations and the use of non-UK vessels and contractors for installation. UK content in OPEX is also lower because of the use of non-UK vessels and contractors. UK content in DEVEX varies considerably because most development work is undertaken at the wind farm owner's headquarters and, for leading developers such as DONG Energy and Vattenfall, this has not been in the UK.

The Offshore Wind Developers Forum (the predecessor to the Offshore Wind Industry Council) declared in 2012 a 'vision' that the UK content in offshore wind farms would be 50%. Although this is not a formal target, some wind farm owners see this as the benchmark against which their wind farms will be judged. ScottishPower Renewables made an explicit commitment to achieving 50% UK content for its East Anglia One wind farm, which is likely to begin construction in 2018. Although the change from 43% to 50% appears small, almost all this increase must come from a higher UK content in CAPEX because UK content in OPEX is unlikely to change significantly. If OPEX is 50% of TOTEX, a 10% increase in UK content in TOTEX can therefore only be achieved by a 20% increase in UK content in CAPEX. A 50% target is therefore more challenging than it initially appears.

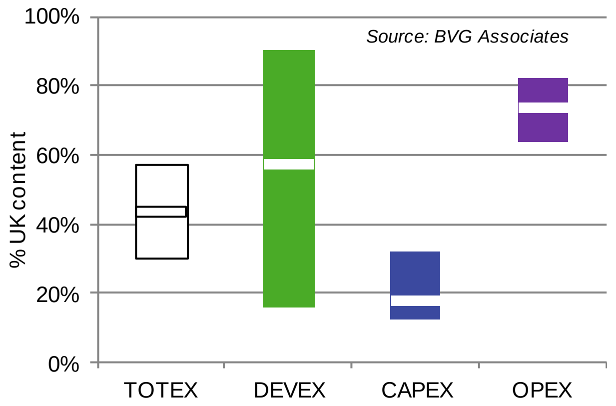

Figure 5 UK content in offshore wind farms. The bars show the range of results from different wind farms.

There are several developments in the offshore wind industry that will have an impact on future UK content.

For turbine supply, both Siemens Wind Power and MHI Vestas have both committed to produce turbine blades in the UK, and CS Wind UK (formerly Wind Towers Scotland) has announced new investment. The establishment of Offshore Structures (Britain) and the greater use of jacket foundations will also lead to higher UK content.

A downside is that the UK seen the withdrawal from the market of several of its cable-laying contractors, including Subocean/Technip, Global Marine Systems and Reef Subsea.[6]

A shift in operational strategies may also have a negative impact. Currently, operating UK wind farms predominantly use shore-based strategies that use small crew transfer vessels operating daily out of a UK port, leading to a high UK content. Several upcoming UK wind farms will use offshore-based strategies with floating or fixed offshore bases. These break the supply chain link with the mainland and may lead to lower UK content.

In conclusion, although some future offshore wind farms may achieve 50% UK content in TOTEX, none is likely to exceed this significantly. The Isle of Lewis wind farms, with their associated transmission infrastructure, are likely to have a UK content that is higher than the average for offshore wind farms built on a similar timescale.

3.3. Comparison with Shetland Islands projects

The Viking Project proposed for the Shetland Islands has similarities with the Isle of Lewis wind farms in that it also requires a new HVDC link to the mainland and it therefore

[5] *The UK Content of Operating Offshore Wind Farms*, November 2015, BVG Associates for the Offshore Wind Programme Board. Available online at http://www.renewableuk.com/news/279486/The-UK-Content-of-Operating-Offshore-Wind-Farms.htm. Last accessed September 2016

[6] Global Marine Systems is now seeking to re-enter the market.

also needs more price support than conventional onshore wind farms.[7]

The economic benefits from the developments were considered in a 2013 analysis for DECC and the Scottish Government.[8] Data from wind, wave and tidal projects were combined and the results study were expressed in terms of job creation using data gathered as part of the environmental impact assessment. Comparisons are therefore difficult. Table 11 shows that the Western Isles projects created fractional more jobs per MW installed that the Shetland Islands projects.

Table 11 Comparison of the jobs created by the Western Isles and Shetland Islands

	Capacity (MW)	UK jobs	Jobs/MW
Western Isles	450	1,599	3.6
Shetland Islands	600	2,105	3.5

A significant difference between the Isle of Lewis projects and the Viking Project on the Shetland Islands is that the HVDC link for the latter has a longer subsea cable and a shorter onshore cable. The UK content for a subsea cable is lower than a UK onshore cable because the onshore works will typically use UK civil engineering contractors, whereas the subsea cable laying can be undertaken by one of several cable installers, many of which are based outside the UK. If all other procurement decisions are the same, therefore, the Isle of Lewis wind farms have an inherent UK content advantage.

3.4. Impact of HVDC grid connection

The inclusion of the transmission assets in the Isle of Lewis analysis makes only a marginal difference to UK content in CAPEX. This is because UK content in transmission CAPEX (27.5%) is similar to UK content in total CAPEX (28.0%). The increased UK benefit from the construction of the two Isle of Lewis wind farms with associated transmission compared with conventional onshore wind farms therefore comes from the absolute level of UK expenditure rather than the percentage UK content.

This analysis considered the UK content in transmission CAPEX and OPEX by considering the duration of the wind farms' lives and the proportion of transmission capacity they will use. In practice, the transmission link is likely to be used for other projects and for a longer period. The link therefore provides benefits beyond those considered directly in this study in that there will be long-term maintenance of the link and new projects have the potential to create further economic benefits.

[7] *Shetland HVDC Link Project: Consultation*, SSE Power Distribution, August 2016. Available online at https://www.ssepd.co.uk/WorkArea/DownloadAsset.aspx?id=11668 Last accessed October 2016

[8] *Scottish Islands Renewable Project: Final Report*, May 2013, TNEI and Redpoint for DECC and the Scottish Government. Available online https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199038/Scottish_Islands_Renewable_Project_Baringa_TNEI_FINAL_Report_Publication_version_14May2013__2_.pdf. Last accessed October 2016

Appendix B: A new economic impact methodology for offshore wind

A new economic impact methodology for offshore wind

Dr Alun Roberts, Associate Director, BVG Associates

Steve Westbrook, Director of the Economic Intelligence Unit, University of the Highlands and Islands

White paper, January 2017

BVG Associates developed the local content methodology for UK offshore wind, working closely with industry and government. Together with the University of the Highlands and Islands, it has extended it to create a new tool for modelling the full range of economic impacts. The tool can be adapted for use in other industries and geographies.

Why demonstrate economic impacts?

There are many justifications for offshore wind projects, including:

- The moral (to meet climate change objectives)
- The practical (to increase security of supply)
- The financial (to reduce the cost of renewable energy), and
- The economic (to stimulate job creation).

In the political context, however, job creation can be the most visible effect.

Many industrial sectors publish employment impact figures. Often these are unrealistically high and lead to cynicism. If the offshore wind sector is to cultivate political support and play a responsible role in the wider energy debate, it needs to have a transparent and straightforward methodology that produces credible figures.

BVG Associates and the Economic Intelligence Unit at the University of the Highlands and Islands (UHI) have worked together to develop a method of modelling economic impacts for offshore wind that is more robust and more transparent to the industry lay-reader than existing economic analyses.

> "Many industrial sectors publish employment impact figures. Often these are unrealistically high, and the offshore wind sector needs to have a transparent methodology if it is to avoid cynicism."

A new model based on detailed industry knowledge

Conventional modelling of economic impacts for most industrial sectors relies on Government statistics. In the UK, for example, the Office of National Statistics (ONS) categorises certain industries using standard industry classification (SIC) codes to produce 'input-output' tables and other production and employment ratios.

Key findings

- The industry needs a robust but comprehensible way to demonstrate the economic benefits of renewable energy projects locally and nationally if it is to retain local and government support.
- Many "conventional" impact methodologies rely on information and data that are not suitable for new industries, such as offshore wind.
- By understanding the offshore wind supply chain in detail and applying economic and business rigour to that understanding, we have developed a benchmark standard in measuring local and national value added from offshore wind developments.
- It builds on BVG Associates's existing UK content methodology to derive measures for other economic indicators such as gross value added (GVA), full time equivalent (FTE) jobs and earnings.
- Our method can be applied to any level of geography – global, continental, country or region. It can be used to model the impacts of a single product or service, a set of projects, or the industry as a whole over a given period. It can also be applied to different industries, provided sufficient knowledge is available.
- The method uses a transparent set of assumptions that can be easily validated, building confidence in the data.

SIC code data can be appropriate for traditional industries at a national level. The development of new SIC codes for a maturing sector, however, takes time. This means that conventional economic analyses of offshore wind need to map existing SIC data onto offshore wind activities. Analyses using SIC codes also have to rely on generalised data. For example, generalised 'input-output' data tables show that the demand for steel in the UK has a substantial impact on UK economic activity in steel production. This is not the case in offshore wind, as the generalised data fails to reflect that the UK has little capacity to produce the type of steel used for offshore wind turbine towers and monopile foundations (see Box 1).

Offshore wind is ideally suited to a more robust approach that considers current and future capability of local supply chains because:

- Projects tend be large and have distinct procurement processes from one another, and
- Projects tend to use comparable technologies and share supply chains.

It therefore enables a realistic analysis of the local, regional and national content of projects even where there are gaps in the data.

What does local content mean?

The offshore wind industry is unique in having a formal UK content reporting framework.[1] BVGA developed the methodology adopted by industry and government through the Offshore Wind Industry Council, and a key part of this is a definition of local content, which is:

The aggregated local value generated at each tier of the supply chain.[2]

UK offshore wind farm owners have committed to submit details of the UK content of each wind farm once it has reached final investment decision (FID). In compiling their data, wind farm owners will have asked all their suppliers with contracts greater than £10 million to provide a UK content estimate.

Our definition of "content", which can relate to the local, regional or national supply chain, differs from the term "content" when used to identify where the companies that obtain the main contracts that together comprise the costs of a development are located. This original definition of "content" does not recognise that the principal contractors on a project will "import" some (or many) of their supplies and services.

BVGA's calculation method for UK content is the key building block in this new approach to economic impact modelling, and is already being used by the offshore wind industry, thereby minimising the additional analysis required.

"… it is better to seek to understand the supply chain than to model it using misleading generalised data"

Box 1: Value added and job creation from UK-manufactured towers

The table below shows the activity breakdown for a tower manufacture and the SIC codes that most closely match each activity. With a conventional approach using data from the Office of National Statistics, the manufacture of towers in the UK for a 500MW wind farm (60 to 70 towers) would create 633 direct and indirect full time equivalent job years (FTE years).

Feedback from Scottish manufacturer CS Wind UK suggests that it would employ about 240 direct FTEs with to achieve a theoretical annual capacity of 100 offshore towers, and this closely matches our forecast calculated using our innovative new model, based on a UK content of about 40%. All models by definition are only representation of the real world but our method can be easily updated to include new industry data as it becomes available. It therefore becomes ever more accurate with time.

The difference between the methods is that the conventional approach uses SIC code multipliers that are based on data that shows that the UK produces much of the steel it uses domestically. The UK does not, however, currently produce steel plate of the thickness and size that is suitable for offshore wind turbine towers; most of it is produced in Austria and Germany. For our method, knowing the offshore wind supply chain enables us to calculate a more accurate estimate of the value added and job creation than the use of generalised SIC code data. Our approach enables the forecasting of direct employment, visible at UK suppliers active in offshore wind.

Activity	Standard industry classification (SIC) code and description
Steel plate	SIC codes 24.1-24.3: Manufacture of basic iron and steel
Flanges	SIC code 25OTHER: Manufacture of fabricated metal products
Coatings	SIC code 20.3: Manufacture of paints, varnishes and similar coatings, printing ink and mastics
Internals	SIC code 25OTHER: Manufacture of fabricated metal products
Equipment (asset depreciation)	SIC code 28: Manufacture of machinery and equipment
Transport	SIC codes 49.3-49.5: Land transport services and transport services via pipelines, excluding rail transport
Labour and overheads	SIC codes 24.1-24.3: Manufacture of fabricated metal products

[1] *Methodology for measuring the UK content of UK offshore wind farms*, BVG Associates for the Offshore Wind Programme Board, May 2015. Available online at www.renewableuk.com/general/custom.asp?page=UKcontent. Last accessed October 2016

[2] *Before assessing induced impacts.*

GVA and other measures of value added

Gross value-added (GVA) is one of the most widely used measures of economic impact. The UK Office of National Statistics defines GVA as:

"income generated by resident individuals or corporations in the production of goods and services."[3]

In economic impact terminology, total GVA comprises direct, indirect and induced impacts for a sector such as offshore wind, where:

- Direct relates to work undertaken by a contractor's own staff in the impact area
- Indirect relates to employment generated by the purchase of supplies and services by the contractor in the impact area
- Induced is generated by the spending in the impact area by direct and indirect employees from their additional income (and from locally retained profits). Induced impacts can also be generated where contractors not based in an area and their staff spend their own money in the area where on-site for a period (for example, on overnight accommodation).

GVA is a national concept; although annual GVA figures for the UK are also disaggregated by Governments by region as a proxy for where this national annual total originates.

From local content to GVA

In quantifying "local content", using our definition, we capture (without excessive collation and analysis of small transactions), impacts that accrue in an area from employment (gross earnings plus employers' pension contributions), self-employed profit, and use of buildings, plant and equipment. These generate local value added when the investment was undertaken, and profit as a return on risk and investment that stays in the area.

Local content, as we have defined it, is therefore equivalent to combined direct and indirect GVA.

Figure 1 shows the principle at work. A tier 1 contract worth £100 million can be divided into profit (including a return on previous relevant capital investment), labour and supply chain costs. Each of these may accrue within an impact area or elsewhere. At this tier, local profit and earnings from employment (in this example £30 million – the combined tier 1 blue bars) can be "banked" as local GVA. We then turn our attention to the £20 million that has been spent on local supply chain at tier 2 level. Again, we bank the local profit and earnings before looking further at tier 3 local spend; and so on. In theory, the process can continue until the final tier of the supply chain is reached, but in practice, before this is reached the sums become insignificant, as Figure 1 shows.

In this example, of the £100 million, £40 million (or 40%; the blue bars for tiers 1 to 5) is local direct and indirect GVA; that is local content as we have defined it.

In the example, none of the non-local supply chain has its own local supply chain – although this is possible.

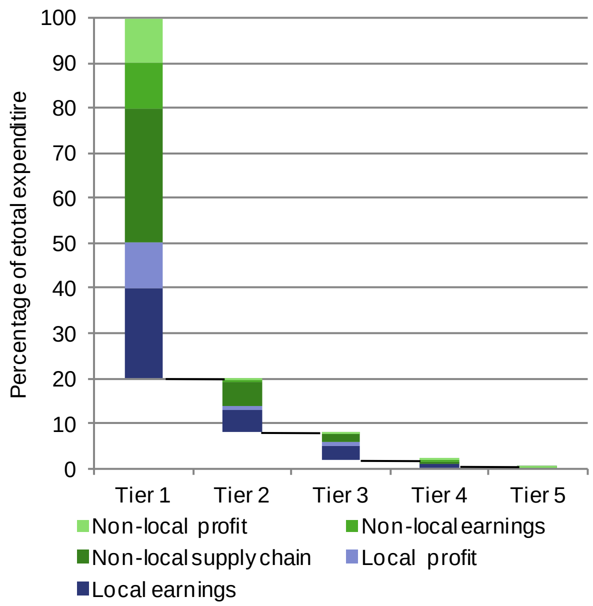

Figure 1 Local content methodology. The blue bars (local profit and local earnings) show the local content from direct and indirect GVA.

This example relates to a capital development project (which could span several years, including the R&D and planning phases before the component manufacturing and construction phases). The same methodology can also be applied to operations and maintenance, which will generate annual impacts for 20 or more years.

Induced impacts

Induced impacts are less tangible than the direct and indirect benefits and as a result some prefer to omit them from their analysis.

Our UK content methodology captures direct and indirect GVA. To calculate induced GVA, we need induced multipliers. Here, appropriate generalised national, regional or local ratios are used – taking into account the relatively high earnings associated with the direct and indirect employment. This is a valid approach because individuals' expenditure patterns are unlikely to differ between sectors.

[3] www.ons.gov.uk/economy/grossvalueaddedgva/qmis/regionalgrossvalueaddedincomeapproachqmi

From GVA to jobs

GVA is the aggregate of labour costs and operational profits (with depreciation added back). We can therefore model full time equivalent (FTE) employment from GVA, provided we understand some key variables. In our economic impact methodology, employment impacts are calculated using the following equation:

$$FTE_a = \frac{(GVA - M)}{Y_a + W_a}$$

Where:

FTE_a = Annual FTE employment

GVA = Gross value added (£ or other currency)

M = Total operating margin (£ or other currency)

Y_a = Average annual wage (£ or other currency), and

W_a = Non-wage average annual cost of employment (£ or other currency).

To make robust assessments, therefore, we consider each major component in the offshore wind supply chain and estimate typical salary levels, costs of employment and profit margins, bringing together BVGA's specific sector knowledge and data that has been collected by the UHI's Economic Intelligence Unit. This data can be adjusted to reflect current or likely future trends.

Earnings

Offshore wind salaries are typically higher than the average salaries found in generic tables, and the number of FTEs alone does not fully demonstrate the value of offshore wind to the economy.

It is useful for a well paying sector such as offshore wind to demonstrate earnings impacts per FTE as well as employment and GVA. This is particularly important for those local economies where earnings are currently not increasing faster than inflation.

Gross earnings can also be calculated as:

$$E_a = Y_a \times FTE_a$$

Where E_a = gross annual earnings.

As a refinement, it is possible to split earnings from employment into that received by people working in an area they live in, and that received by people who are temporarily in the area to carry out the work.

Conclusion

This paper has been focused on the impacts from investments in offshore wind and the method applied first to UK regions. There is no obstacle, however, to its application in other sectors and other territories.

The great advantage of the approach presented here is that it takes the mystique out of economic analyses and creates a method that can be led by industry experts with input from economists. Until now, economic analyses have been impenetrable to the layman and excessively difficult to compare. Here, the inputs and outputs are comprehensible to the industry in question, meaning that any surprising outputs can be easily explored. Our economic impact methodology identifies visible, tangible jobs that can be associated with specific facilities, which is important in helping politicians understand the impacts of investments.

Overall, the result will be greater confidence in the data that is published and better evidence-based policy.

Contact

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