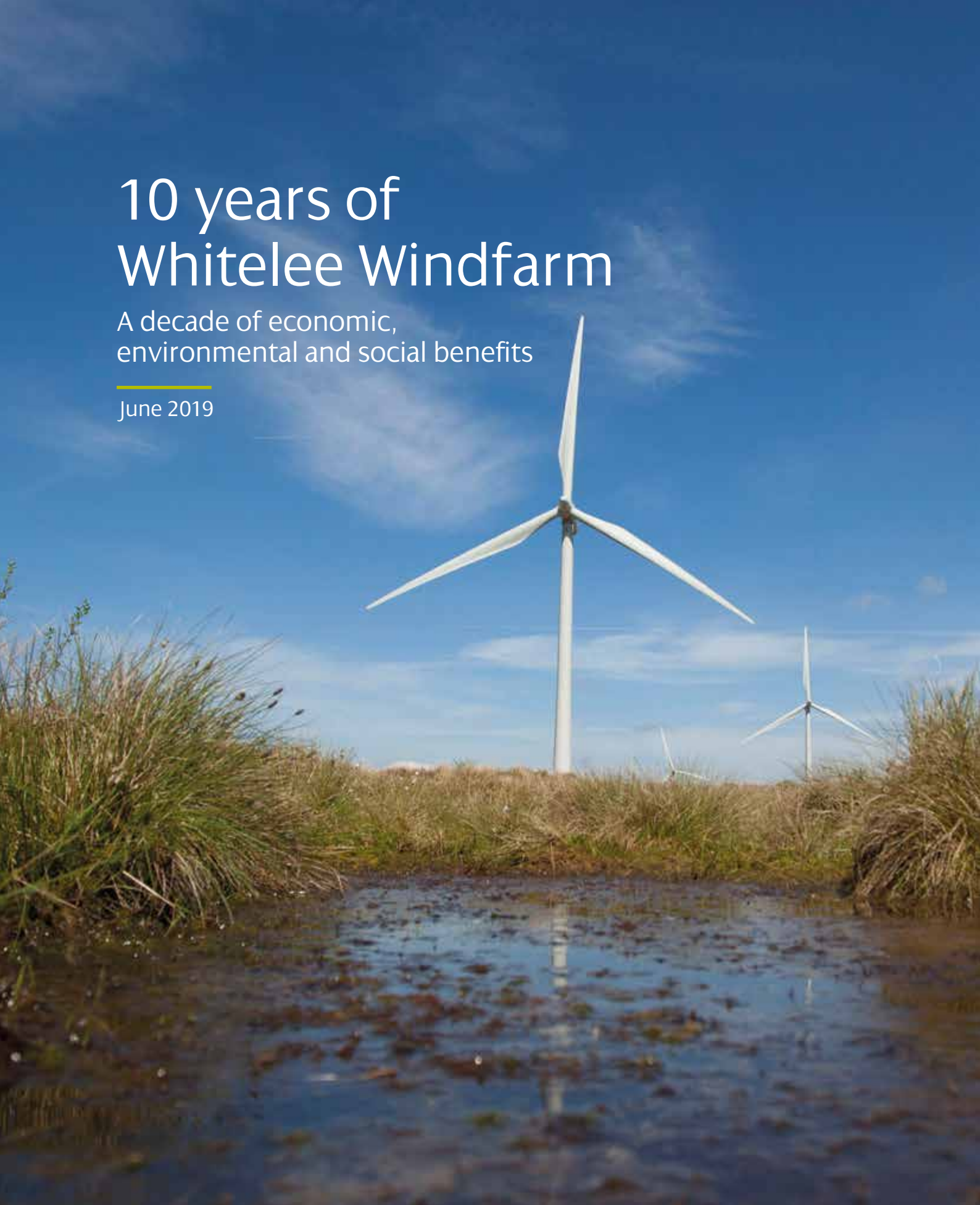


10 years of Whitelee Windfarm

A decade of economic,
environmental and social benefits

June 2019



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Foreword

Ministerial Foreword

Scotland declared a Global Climate Emergency in April 2019, inspired by many young protestors and campaigners, and the Scottish Government has promised to lead by example, to halt Scotland's contribution to climate change and to protect our incredible natural environment.

In May, the Committee on Climate Change (CCC) published their recommendations on Scotland's decarbonisation goals and pathways to achieving them. Based on scientific imperative, practical feasibility and manageable cost, CCC concluded that Scotland must reach net-zero emissions by 2045 to play our part in averting the most catastrophic impacts of climate change.

The Scottish Government embraced the advice given in the report entirely and we acted immediately by lodging amendments to our Climate Change Bill. If the Bill is passed, Scotland will, again, have the most stringent and world leading statutory targets. This time they will result in Scotland's contribution to the causes of climate change being ended within one generation.

Achieving net-zero emissions by 2045 is ambitious, at a time when ambition is needed. To fulfil that ambition will require stronger than ever collaboration between the public and private sectors, and with individuals and communities, to make the necessary, lasting changes in the UK and Scottish energy markets.

We will continue to provide support through

legislation, clear and positive planning policy and guidance, combined with the spirit and determination of investors and innovators, and the openness and appetite of communities across the country to become involved themselves.

Internationally, Scotland has an excellent reputation for our wind energy resource, and for the ways in which successive Scottish Governments have supported and encouraged the development of onshore and offshore wind projects.

As a result, we met the equivalent of 74.6% of electricity demand from renewables in 2018. Representing tremendous progress towards our target of 100% by 2020, and a significant contribution to our new target for 50% of all of Scotland's energy needs from renewable sources by 2030.

While our intention remains to ensure that these targets are met from as wide and diverse a range of renewables technologies as possible, there can be no question about the dominant and hugely valuable role played by onshore wind and indeed, the part that Whitelee Windfarm plays.

Alongside the production of renewable electricity, Whitelee Windfarm has significant economic and social benefits to the local communities. The site has generated highly skilled jobs throughout its planning, construction and 10 years of operation.

The visitor centre promotes STEM subjects to the thousands of school children who visit

annually, helping to ensure that Scotland has a skilled and diverse workforce for the future.

Whitelee Windfarm's community benefit programme funds local groups to deliver community backed initiatives, delivering for local people in East Ayrshire, East Renfrewshire and South Lanarkshire. The site also offers a green space for recreational activities; where people from Glasgow and beyond enjoy events and clean air.

Indeed, Whitelee has become an integral part of the community and landscape and has paved the way for future developments in Scotland, I am proud of this landmark scheme and all it represents in terms of the fight against climate change.

The Scottish Government will continue working to make sure that onshore wind, the cheapest form of electricity generation at scale, has a home in Scotland. Doing so will ensure we deliver on our climate change and energy targets and protect and complement our natural environment for the benefit of current and future generations of local people.



**Paul Wheelhouse, MSP
Minister for Energy, Connectivity
and the Islands**

Chief Executive Foreword



2019 has been a remarkable year in the history of ScottishPower Renewables. Not only does it mark the 10th anniversary of the UK's largest onshore wind farm, ScottishPower has also transitioned to 100% green generation, leaving carbon behind and putting Whitelee Windfarm firmly at the centre of ScottishPower's green revolution.

The site delivers clean electricity for homes and businesses across the UK, having produced on average almost 5% of all renewable electricity generated in Scotland over the last 10 years. Whitelee wind farm is central to Scotland's low carbon economy, delivering 60% UK content, and has facilitated the expansion of many locally based companies into the wider renewables sector. Whitelee also supports 600 long term jobs, including those related to the operation and maintenance of the plant – these jobs are highly skilled and sustainable, clearly demonstrating the long term economic opportunities that investing in renewable generation can bring.

Whitelee Windfarm also delivers for the local community, having made community benefit payments of £9m since 2009, and is enjoyed by

the public with over two million feet having walked across the site. Whitelee also hosts activities, events and school groups with over 46,000 school children having attended an educational programme at the Whitelee Visitors Centre, inspiring future generations of young engineers.

Whitelee is a hub of innovation and at its heart is our industry leading national control centre from which ScottishPower Renewables manage a fleet of over 1,150 wind turbines and works with National Grid to provide a range of services that help maintain the stability of the grid. As technologies advance, I'm also looking forward to seeing how the deployment of battery storage at Whitelee and other strategic sites in our fleet will shape the future of the electricity system in Scotland to keep delivering clean, green and cost effective electricity to customers.


I would like to thank all the staff, stakeholders and suppliers that have worked on the project over the last 10 years, and I look forward celebrating the next 10 years of operation. With the urgent need to decarbonise our economy at the cheapest cost and with 79% of the UK public support onshore wind, why don't we build more?

**Lindsay McQuade
Chief Executive ScottishPower Renewables**

Summary

Economic impacts

Whitelee Windfarm represents a total lifetime investment of **£1.5 billion** by ScottishPower Renewables



46% Scottish companies
60% UK companies

Scottish and UK content - Almost half of expenditure (46%) has been spent with Scottish companies, 60% with UK companies



£1bn GVA in UK,
including £790m
Scottish value added

Whitelee supported over **4,000 FTE jobs** during the peak years of construction. About **600 FTE jobs** are supported every year through operating and maintaining Whitelee


over 4,000 FTE jobs



Earnings in Scotland of **£512 million** over the lifetime of Whitelee - on average this is **£26,000/ FTE**, with earnings of **£670m in UK**


£512m in Scotland
£670m in UK

Environmental impacts



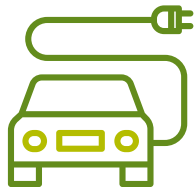
8,600GWh

Over **8,600GWh** to date, producing an average of **almost 5%** of all the renewable electricity generated in Scotland over the last **ten years**



Whitelee total generation to date has been enough to provide **9 times** the annual household electricity consumption of Glasgow

Whitelee produces enough energy per year to power **all the electric vehicles in the UK**



Over **5 million tonnes** of carbon emissions saved

Saving enough CO₂ emissions per day to offset **two days'** worth of domestic flights to and from Heathrow and Gatwick




Whitelee produces the equivalent annual CO₂ emissions saving a forest the size of over **40,000 football pitches** maintained for 10 years



A single revolution of the blades on a Whitelee turbine produces enough energy to charge **300 mobile phones**


ScottishPower Renewables is delivering on its commitment to restoring **900 hectares** of previously forested peatland habitat

Social impacts



750,000

Over **750,000 total visits** to the visitor centre since opening



200,000 people a year visit Whitelee for recreational activities such as walking, running or cycling

46,000
46,000 school pupils have attended an educational programme at Whitelee Visitors Centre to date



£9 million to date Whitelee Windfarm community benefit funds have awarded over **£9 million to local projects**. The funds have supported many local projects, like the Kilmarnock Railway Station Heritage Trust



Executive summary

Whitelee Windfarm, developed and operated by ScottishPower Renewables, is the largest onshore wind project in the UK and second largest in Europe. With the first phase commissioned in 2009, the site has now been in operation for 10 years.

Whitelee is delivering for British businesses, creating long term jobs for the Scottish economy and generating renewable electricity for homes and families across the UK.

Whitelee Windfarm has laid the foundations for a low-carbon future. It has allowed ScottishPower to leave carbon behind and transition to a 100% green generation portfolio; it has helped reduce the cost of onshore wind, the lowest-cost form of new build electricity generation in the UK; and will help the Scottish and UK governments meet net-zero greenhouse gas emissions by 2045 and 2050 respectively.

The electricity generated at Whitelee supports the Scottish Government's Energy Strategy to reach the target of 50% of energy demand to be generated from renewables by 2030. Whitelee has a strong Scottish and UK supply-chain, with a wide range of local and national businesses benefitting through the development, construction and operations phases.

The experience gained by the supply chain in supporting Whitelee has contributed to the successful expansion of onshore wind as an employer, both in Scotland and the UK.

Innovation in the onshore wind sector has helped reduce costs across the energy system, bringing down the cost of wind energy and upskilling employees; readying the industry for a low-carbon future.

In addition to significant economic benefits, Whitelee Windfarm has made a substantial contribution to Scotland's low-carbon energy system transition. This has been done hand in hand with an ambitious and successful programme of environmental protection and habitat restoration.

Local communities and residents of the nearby villages, towns and cities have enjoyed the benefits of Whitelee, be that directly through the voluntary community benefit fund, via the educational outreach programme or simply by taking advantage of the recreational amenities the site offers.

The first 10 years of Whitelee Windfarm have proved the benefits of onshore wind to its neighbours, to the nation and to the world. These benefits can be expected to accrue and continue for many years, leaving a true legacy for future generations to enjoy.

Economic impacts

- Whitelee Windfarm represents a total lifetime investment of £1.5 billion by ScottishPower Renewables.
- Almost half of expenditure (46%) will be spent with Scottish companies, and 60% with UK companies.
- Whitelee Windfarm will boost the UK economy by over £1 billion, with over £790 million in Scotland.
- Whitelee created over 4,000 FTE jobs in Scotland during the peak years of construction. About 600 Scottish FTE jobs are generated per year through the operations phase, including the long-term skilled jobs in directly operating and maintaining Whitelee.
- Whitelee will generate earnings in Scotland of £512 million over its lifetime, this equates to £26,000/FTE.

Environmental impacts

- To date Whitelee Windfarm has generated over 8,600GWh of electricity, producing an average of almost 5% of all the renewable electricity generated in Scotland over the last ten years.
- Over 5 million tonnes of carbon emissions saved compared to equivalent fossil fuel based generation.
- ScottishPower Renewables is delivering on its commitment to restoring 900 hectares of previously forested peatland – a critically important natural habitat.

Social impacts

- Almost 46,000 school pupils have attended an educational programme at Whitelee Windfarm Visitors Centre to date.
- Over 750,000 total visits to the visitor centre.
- An estimated 200,000 people a year visit Whitelee for recreational activities such as walking, running or cycling.
- Whitelee Windfarm community benefit funds have awarded over £9 million so far to local projects.
- Over the current remaining lifetime of Whitelee further community benefit funds of over £14.5 million are still to be paid.

Future impacts

- Whitelee allows an opportunity for continued technology and innovation research and development.
- Potential co-location of battery storage will allow Whitelee to offer additional services to the grid, helping to balance electricity demand and supply and adding resilience to the system.



1. Introduction

1.1. Whitelee Windfarm

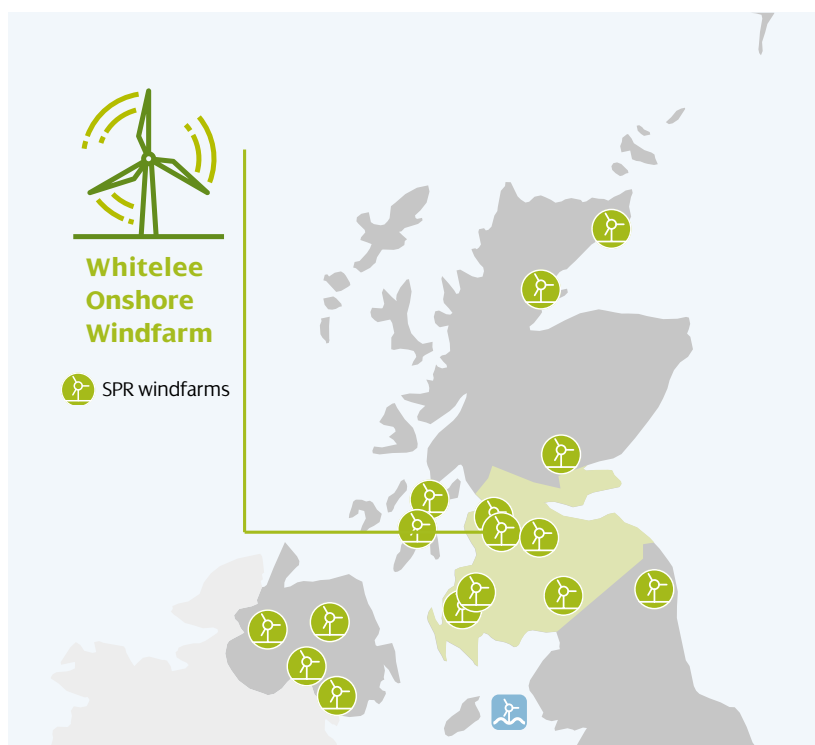
Whitelee Windfarm is the largest onshore wind project in the UK. The wind farm, developed and operated by ScottishPower Renewables (SPR), consists of 215 turbines generating up to 539MW of electricity. The site was built in two phases, Whitelee (322MW) and Whitelee extension (217MW). The output from Whitelee makes a significant contribution to the decarbonisation of the UK and Scottish economies with the ability to power around 300,000 homes, displacing around 500,000 tonnes of carbon emissions each year.

Whitelee is located on Eaglesham Moor to the south of Glasgow. It covers an area of over 83km² across three local authority areas and is leased from nine landowners including Scottish Water, Forestry and Land Scotland and private landowners.

The development of Whitelee began 20 years ago. The site was selected due to a combination of favourable characteristics including good wind resource, grid infrastructure, accessibility and local electricity demand from the greater Glasgow area. It was also an area with low environmental sensitivities where ecology and wildlife impacts could be managed easily.

Whitelee achieved planning consent for an initial 322MW of capacity in early 2006 and began construction later that year. The first turbine was erected in late 2007 and began exporting power to the grid shortly after. The project was completed in July 2009. The 217MW project extension started generation in 2012, bringing the total generating capacity to the full 539MW in operation today.

Alongside the generation of renewable electricity, Whitelee has also become a visitor attraction, aided by an onsite visitor centre that opened in 2009. The Whitelee Windfarm Visitor Centre is host to an interactive exhibition room, cafe, shop and education hub. The visitor centre also gives access to a network of over 130km of tracks



for cyclists, walkers and horse riders. The visitor centre offers an education programme developed by Glasgow Science Centre and offers activities for education and community groups.

Whitelee Windfarm also houses the state of the art SPR operations centre, opened in 2015 by First Minister Nicola Sturgeon, where the SPR team works 24 hours a day to manage their 1,150 onshore wind turbine fleet.

Whitelee Windfarm and SPR have received numerous awards

recognising the positive impact of the project including: Best Renewable Energy Project at the Scottish Green Energy Awards, Top Award at the Scottish Awards for Quality in Planning, the RSPB Nature of Scotland Sustainable Development Award, and the prestigious Queen's Award for Enterprise in Sustainable Development. The visitor centre is also the first wind energy facility in Scotland to have joined the Association of Scottish Visitor Attractions and has a Visit Scotland four-star rating.

1.2. Renewable energy generation in the UK

This year is a critical time in the global effort to tackle climate change. The Committee on Climate Change's May 2019 publication, Net Zero - The UK's contribution to preventing global warming, recommends a new emissions target for the UK of net-zero greenhouse gas emissions by 2050. Scotland has greater potential to remove pollution from its economy than the UK overall, and can credibly adopt a more ambitious target of reaching net-zero greenhouse gas emissions by 2045. The report recognises that the supply of renewable electricity is a key foundation to achieving these targets.

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

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

Onshore wind, as the lowest cost form of new-build electricity generation in the UK, is already delivering on these

government objectives; delivering for businesses across the country, creating jobs and economic growth across the UK. In doing so, further deployment can continue to deliver on the Grand Challenge of Clean Growth set out in the UK Government's Industrial Strategy and help meet the goals set by the Committee on Climate Change.

Long considered the cheapest form of large scale new-build electricity generation in UK, the levelised cost of energy (LCOE) of onshore wind is forecast to continue to fall over the next decade as innovation progresses and the UK adopts the latest advances in turbine technology.

Onshore wind is a technology with widespread public support. The Department of Business, Energy and Industrial Strategy Public Attitudes Tracker, published in May 2019, demonstrated that support for onshore wind across UK consumers currently lies at 79%, an all-time high.

With the retirement of old technologies such as coal plant, and the investment required in new low carbon generation, the Scottish and UK Governments can play a key role in ensuring this continued investment is forthcoming at a cost-effective rate, with the associated economic and environmental benefits flowing to homes and businesses across the whole of the UK.

1.3. The 10-year anniversary study

This year marks the 10-year anniversary of the completion of the initial Whitelee Windfarm project. Over the past decade Whitelee has made valuable economic, environmental and social contributions at both local and national levels. This study reflects on the impacts of Whitelee to date across these areas.

The analysis of economic benefits considers the value of contracts placed for the development, construction and operation of Whitelee, including where this benefit occurs. From this, the economic impacts in terms of gross value-added, employment and earnings over the lifetime of Whitelee are derived.

The environmental impacts are considered in quantitative and qualitative terms. The quantitative analysis relates to the electricity generated and the reduction in carbon emissions that result from the operation of the project. The qualitative impacts relate to the steps taken to preserve and enhance the wildlife and ecological habitats on and around the Whitelee project area.

The social benefits analysis documents the wide-ranging impacts of Whitelee and the visitor centre on the local community. The study reflects on Whitelee as a visitor destination and the educational programmes it promotes, the community projects supported through allocation of the Whitelee community benefit fund, and the skills developed throughout the course of the project.

2. Economic impacts

2.1. The Whitelee supply chain

The Whitelee Windfarm project developed and operated by SPR has been supported by a wide range of supply chain expertise. Hundreds of companies are involved in the development, construction and operation of a wind farm, with suppliers based locally and internationally. Whitelee has been able to draw on local experience and skills in each of these phases and in some cases introduced companies to the wind energy sector. Some of the many companies that have supplied Whitelee are listed below.

Development	Construction	Operation
 <p>Arup, Derek Lovejoy Partnership, DGA Forestry, EDAW, Hoare Lea Acoustics, Ingenco, Ironside Farrar, Jacobs, MacArthur Green, Met Office, NATS Natural Research Projects, RTS Forestry, RPS Group, Shepherd and Wedderburn, SgurrEnergy</p>	 <p>ABB, Alstom, Balfour Kilpatrick, Barr Construction, Donaldson Associates, I & H Brown, John Sisk & Son, Morrison Construction, Prysmian, Raeburn, Roadbridge, Schneider, Siemens, ScottishPower Energy Networks</p>	 <p>ABB, Adler and Allan, AMD Contracts, CBRE, East and West Storage, Flender, Freedom Group, Galt Transport, GE Renewable UK, Heightec, Met Office, Moventas, Siemens Gamesa Renewable Energy, Speedy, Veolia, Vodafone UK, W Barr CS</p>
<p>“ Whitelee has been a significant project in the growth and success of MacArthur Green. We provided ecology services over a 2-year period when we were a start-up. It gave us the stability we needed to grow. We now employ nearly 30 full-time staff in Glasgow.”</p> <p>MacArthur Green</p>	<p>“ I & H Brown played a part in what is a fantastic renewable energy project at the Whitelee Windfarm. We undertook the advance civil engineering works for the 75 turbine extension. This gave us invaluable experience which equipped us to act as main contractor in our own right on future large onshore wind farm schemes.”</p> <p>I & H Brown</p>	<p>“ We’ve been providing civils and maintenance works at Whitelee for 10 years, building a great relationship with SPR and seeing first-hand how the civil works have also benefitted the wider community. The relationship and experience have led to us working on other wind farms in Scotland.”</p> <p>W Barr CS Ltd</p>

2.2. Investment in the UK

- **Whitelee Windfarm represents a total lifetime investment of over £1.5 billion by ScottishPower Renewables.**
- **Almost half of expenditure (46%) will be spent with Scottish companies, 60% with UK companies.**

UK and Scottish content

Figure 1 shows the UK content at Whitelee is 60% and 46% is Scottish content (77% of the UK content figure). Non-UK content accounts for 40% of expenditure at Whitelee. The total investment across the wind farm is £1,523 million, equivalent to £2.83 million per MW. A summary of weighted Scottish and other UK content by expenditure category is shown in Table 1.

Table 1 Summary of content by geographic region aggregated across Whitelee.

Category	Region	% content of total spend	% content of category
DEVEX	Scottish	1.6%	64.9%
	UK	2.2%	92.1%
CAPEX	Scottish	9.5%	23.8%
	UK	10.9%	27.4%
OPEX	Scottish	34.6%	59.9%
	UK	46.5%	80.5%
TOTAL	Scottish	45.7%	45.7%
	UK	59.6%	59.6%

Source: BVG Associates

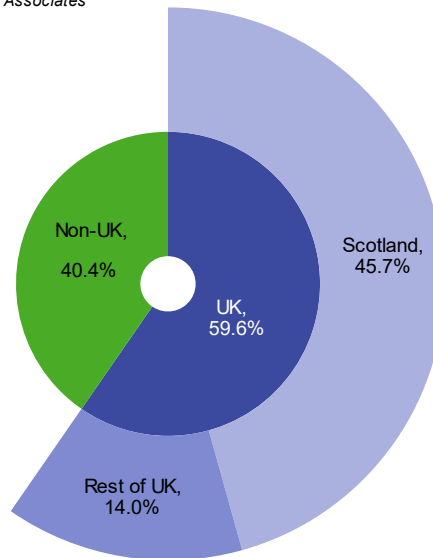
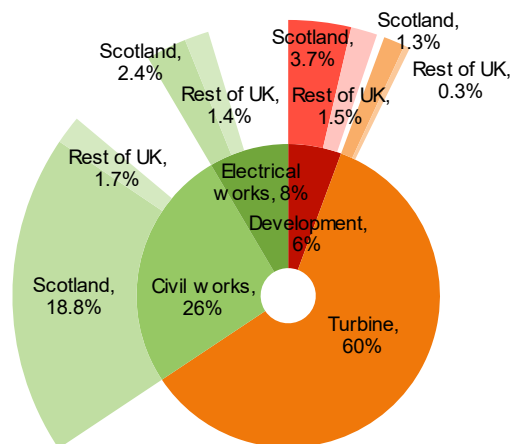


Figure 1 Content by geographic region aggregated across Whitelee.

Development and capital expenditure

Figure 2 shows UK content in development expenditure (DEVEX) and capital expenditure (CAPEX) to be 31%. Table 2 shows 26% of this is Scottish content (84% of the UK figure). The largest contribution to UK content in DEVEX and CAPEX is through civil engineering and construction works, which contributes two-thirds of the UK content. Wind turbine purchase is the largest expenditure category within the DEVEX and CAPEX but it contributes a smaller amount (1.6%) to UK content than the other expenditure categories.



Source: BVG Associates

Figure 2 Whitelee Scottish and UK content in DEVEX and CAPEX.

Table 2 Whitelee Scottish and UK content within DEVEX and CAPEX expenditure categories.

Category	Region	% content in DEVEX + CAPEX	% content in category
Development	Scottish	3.7%	64.9%
	UK	5.2%	92.1%
Turbine	Scottish	1.3%	2.1%
	UK	1.6%	2.7%
Civil works	Scottish	18.8%	72.6%
	UK	20.4%	79.0%
Electrical works	Scottish	2.4%	28.0%
	UK	3.8%	44.7%
Total DEVEX and CAPEX	Scottish	26.1%	26.1%
	UK	31.1%	31.1%

Operational and decommissioning expenditure

Figure 3 shows the UK content in operational expenditure (OPEX) and decommissioning expenditure (DECEX) to be 81%. Table 3 shows 60% of this is Scottish content (74% of the UK figure). The largest contribution to UK content in OPEX is through wind farm operations maintenance and servicing (OMS), which contributes 56% to the UK content. This expenditure goes beyond simply operations and maintenance costs relating to the wind farm and includes land rental costs, business rates, community benefit funds and environmental costs related to the project.

Source: BVG Associates

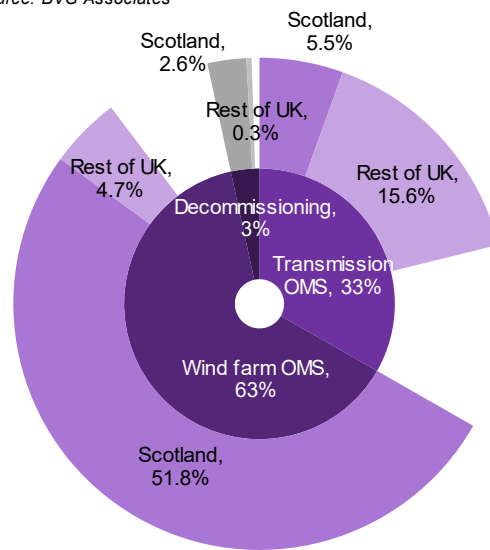


Figure 3 Whitelee Scottish and UK content in OPEX and DECEX.

Table 3 Whitelee Scottish and UK content within OPEX and DECEX expenditure category.

Category	Region	% content in OPEX + DECEX	% content of category
Transmission OMS	Scottish	5.5%	16.5%
	UK	21.1%	63.6%
Wind farm OMS	Scottish	51.8%	81.7%
	UK	56.4%	89.1%
Decommissioning	Scottish	2.6%	75.0%
	UK	2.9%	85.0%
Total OPEX and DECEX	Scottish	59.9%	59.9%
	UK	80.5%	80.5%

2.3. Economic impact analysis

- **Whitelee Windfarm will boost the UK economy by over £1 billion, with over £790 million in Scotland.**
- **Whitelee created over 4,000 FTE jobs during the peak years of construction. About 600 FTE jobs are generated per year through operating and maintaining Whitelee.**
- **Whitelee will generate earnings in Scotland of £512 million over its lifetime.**

The economic impacts are considered in terms of gross value-added, employment and earnings projected over the current expected 25-year lifetime of Whitelee Windfarm. For the purpose of this study, OPEX has been averaged over this lifetime. The methodology and classification of supply chain sub-elements for the calculation of economic impacts are given in Appendix A and Appendix B respectively.

The gross value-added, employment and earnings by supply chain expenditure and direct, indirect and induced are summarised in Appendix C.

Appendix D includes graphs showing the annual impacts.

Gross value-added

Gross value-added is a measure of a project's contribution to the gross domestic product of a region. Whitelee has created over £790 million in gross value-added in Scotland to date, including £57 million alone during the peak year of construction contracting (see Figure 4). Figure 5 shows that the greatest sources of gross value-added in Scotland are wind farm operations, maintenance and service (OMS) and

civil works. On an annual basis Whitelee contributes £23.7 million to the Scottish economy during the operational phase.

Employment

Full-time equivalent (FTE) employment is a measure of the total number of people in paid work as the result of a project. One FTE job year is equal to one person employed full-time for one year. The number of FTE jobs created over the lifetime of Whitelee is estimated to be 19,500 in Scotland and a total of 25,300 in the UK.

Employment is created not only by SPR owning and operating Whitelee but also indirectly through the operation of the transmission and distribution infrastructure and in the wide range of general business services purchased on behalf of the wind farm.

Scottish employment during construction was created by construction services and materials supply and from locally engaged labour by the civil works contractors. Significant indirect jobs are also created in the accommodation, catering and transport industries. Many of the jobs created by OMS are sustainable, skilled, long-term jobs.

Earnings

The total UK earnings created over the lifetime of the project is estimated to be £670 million, of this £512 million are Scottish earnings. Annual Scottish earnings are on average over £26,000/FTE year over the lifetime of Whitelee Windfarm, benefiting both rural and urban based employees.

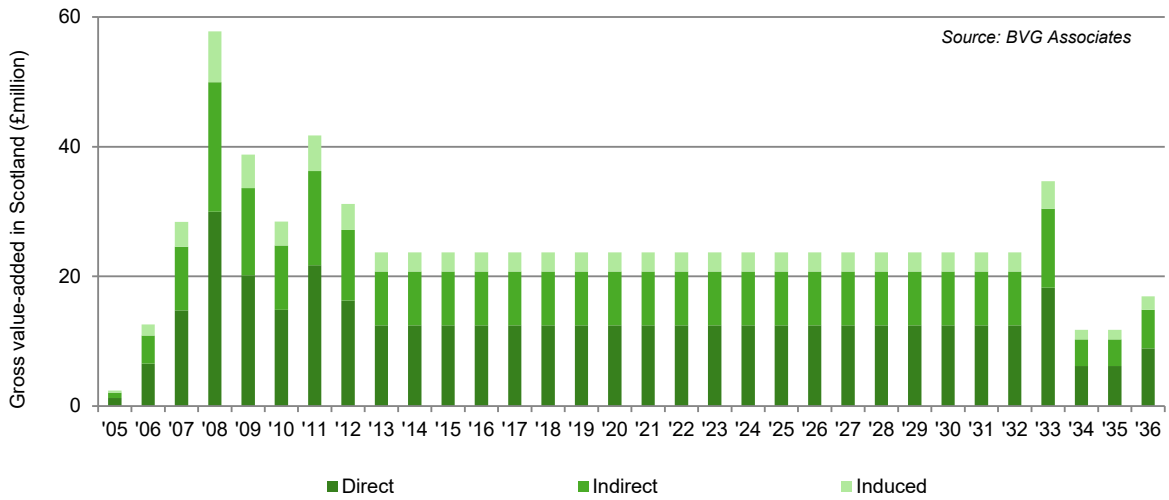


Figure 4 Scottish direct, indirect and induced value-added generated by Whitelee.

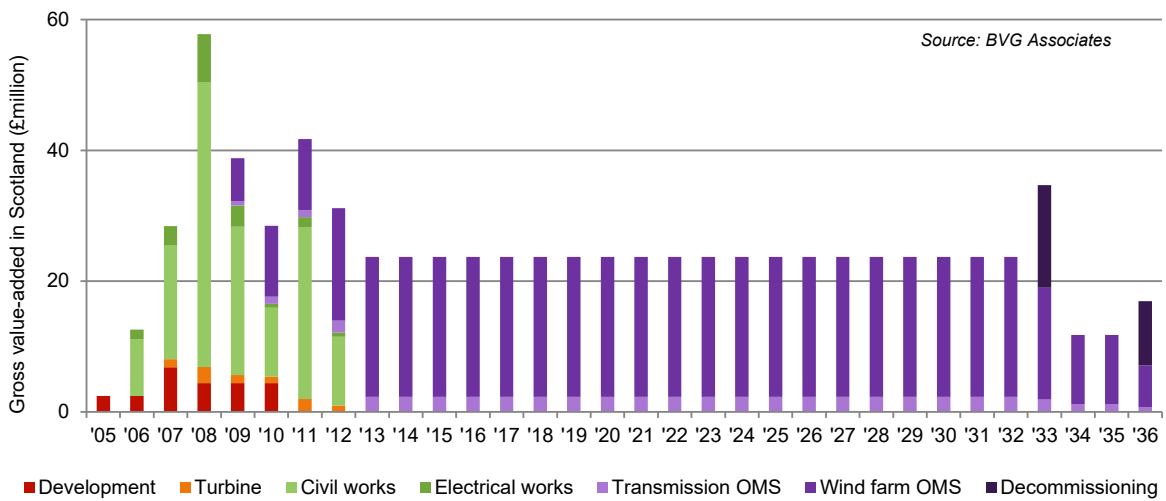


Figure 5 Scottish value-added generated by Whitelee by supply chain area.

3. Environmental impacts

Onshore wind farms make a substantial contribution to the transition towards a low-carbon energy system. In addition to this global environmental benefit, significant effort is made to ensure that impacts on local wildlife and habitats are minimised and mitigated. SPR has implemented a wide range of innovative environmental initiatives to ensure that this is the case at Whitelee,

including a programme of habitat improvement.

SPR understands the importance of long-term sustainability and has committed to a multi-million pound investment in the biodiversity at Whitelee, to clearly demonstrate that wildlife and wind farms can co-exist successfully.

Case study: UN Sustainable Development Goals

SPR incorporates the United Nations Sustainable Development Goals into their business strategy. Whitelee Windfarm contributes to meeting these goals in many ways, including:

- **Sustainable development goal 12:** All new control buildings at SPR onshore wind farms are now given an overall energy rating for an Energy Performance Certificate, and at Whitelee the control centre and assessed operational buildings have all been rated A+ or above. The Whitelee visitor centre has also been rated carbon neutral.
- **Sustainable development goal 13:** SPR are rolling out a programme of electric vehicle charging stations across their wind farms and have installed them at Whitelee.

“Forestry and Land Scotland is proud to be one of the land managers hosting Whitelee Windfarm – the largest in the UK. Our aim through developments like this is to support the Scottish Government’s renewable energy targets and in turn minimise the impacts of climate change. Over the last ten years, the rental income from Whitelee has also enabled Forestry and Land Scotland to undertake a huge range of beneficial work on Scotland’s national forests and land. Very importantly, local people have also benefited through community benefit payments which in turn have empowered them to fund local projects.”

Forestry and Land Scotland

3.1. Renewable electricity generation

- **To date Whitelee Windfarm has generated over 8,600GWh of electricity, almost 5% of all the renewable electricity generated in Scotland over the last ten years.**
- **This equates to over 5 million tonnes of carbon emissions saved compared to equivalent fossil fuel based generation.**

Whitelee Windfarm is the largest onshore wind farm in the UK and has over the last ten years produced over 800GWh per year on average.

consumption from renewables by 2030.

The share of renewable energy in Scotland’s electricity mix has more than tripled since Whitelee was fully commissioned in 2009. Figure 6 shows Whitelee Windfarm has played a significant part in this, generating an average of almost 5% of all the renewable energy generated in Scotland over the last ten years.

The Scottish Government has set a target of generating 100% of Scotland’s electricity demand from renewables by 2020, as well as delivering 50% of Scotland’s total energy

“As we face the reality of a climate emergency we must massively accelerate the deployment of renewable energy. Whitelee, the UK’s largest onshore wind farm, has helped decarbonise our power sector and provide the platform for us to remove the fossil fuels from our cars and buildings. If Scotland is to meet net zero emissions by 2045 it is important that onshore wind farms, like Whitelee, continue to be developed and deliver low cost renewable energy to homes and businesses across Scotland.”

WWF Scotland

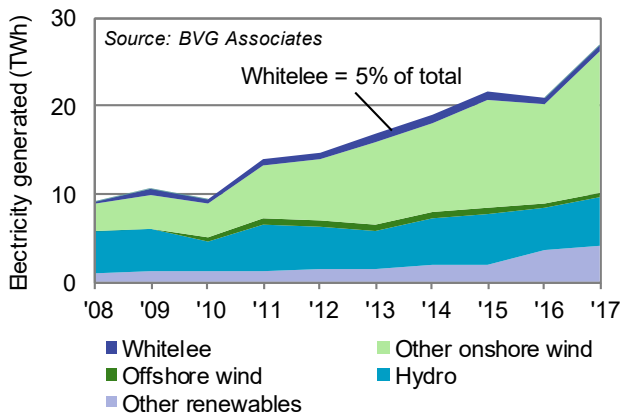


Figure 6 Renewable electricity generation in Scotland.

An analysis of electricity production at Whitelee shows the substantial contribution that has been made to date:

- Over 8,600GWh of renewable electricity has been produced by Whitelee Windfarm to date.
- Whitelee total generation to date has been enough to provide 9 times the annual household electricity consumption of Glasgow.
- Whitelee is also expected to go on to produce enough electricity to meet the future annual household demand of Glasgow over its remaining lifetime.
- Whitelee's total generation to date has been enough to provide 87% of the current yearly household electricity consumption of Scotland
- Whitelee produces enough energy per year to power all the electric vehicles in the UK.
- One single Whitelee turbine produces around 11.5MWh of electricity per day, enough to provide electricity for over 1,100 houses.
- A single revolution of the blades on one Whitelee turbine produces enough energy to fully charge 300 mobile phones.

3.2. Reduction in carbon emissions

The Scottish Government is legislating on new greenhouse gas emissions targets, pledging net-zero carbon emissions by 2045, with interim targets of 70% reduction by 2030 and 90% reduction by 2040.

For the next five years the Scottish targets are to reduce CO₂ emissions by an average of 1,237,800 tonnes per year. Figure 7 shows how projects like Whitelee could contribute to reaching this target. Whitelee Windfarm has to date offset an average of around 500,000 tonnes of CO₂ per year compared to the equivalent fossil fuel based generation.

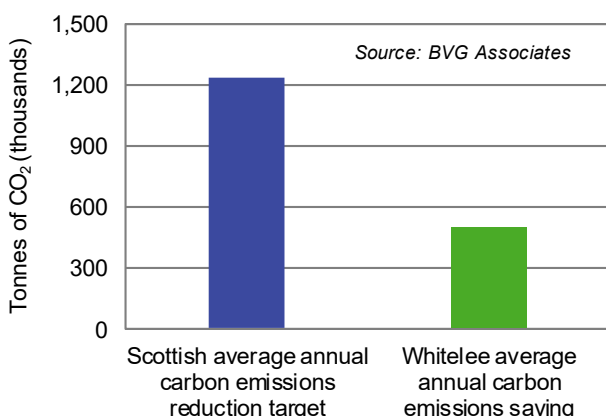


Figure 7 Carbon reduction from electricity generation at Whitelee compared to Scottish carbon reduction target.

This analysis shows that Whitelee Windfarm in particular, and onshore wind in general, makes a significant contribution to emissions reduction within Scotland and the UK. Governments need to build on this contribution and ensure that this low-cost technology continues to contribute in the future:

- In total over 5,000,000 tonnes of carbon emissions have been saved from generation by Whitelee compared to equivalent fossil fuel based generation.
- The carbon emissions saved every year from generation by Whitelee compared to equivalent fossil fuel based generation is equivalent to every car in Glasgow driving a lap of the UK mainland coastline.
- The carbon emissions saved from generation by Whitelee compared to equivalent fossil fuel based generation in a day is enough to offset two days' worth of domestic flights to and from Heathrow and Gatwick.
- Whitelee produces the equivalent annual CO₂ emissions saving as a forest the size of over 40,000 football pitches maintained for 10 years.

3.3. Ecological management

“ RSPB Scotland has been impressed with SPR’s commitment to delivering high quality habitat management and enhancement at its wind farm sites. In particular, the quality of their peatland restoration work at Blacklaw and Whitelee wind farms led us to nominate them for a Nature of Scotland Award, which they won. SPR’s track record and openness has helped to instil confidence in us as stakeholders throughout the development process”

RSPB Scotland

Whitelee Windfarm is located in an area of Scotland that is home to a number of notable habitats and species. SPR has taken great care throughout the design, construction and operation of Whitelee to maintain these habitats, restore previous ecological damage and to improve conditions for plant and wildlife species.

Managing ecological impacts during design and construction

The Whitelee site presented the design and construction team with some unique ecological challenges. Most of the turbine locations were in varying depths of peat, which requires a careful approach to foundation design, drainage and construction in order to minimise impacts. To make matters more challenging, before construction got under way, many of the turbine locations were under areas of commercial forestry plantation, so conditions at each location were not fully known until turbine location works had commenced. 40% of the site area falls within the catchment of public water supplies for the Kilmarnock district and SPR worked closely with Scottish Water to mitigate any impact on this important water supply.

SPR along with their construction and design contractors adopted a flexible approach to the design and installation of the foundation at each turbine location, allowing the specific circumstances at each site to be considered and the best solution identified, including mitigation of peat stability and hydrology impacts.

SPR and their suppliers took a proactive approach to environmental management throughout the construction phase, including the appointment of a team that worked closely with key stakeholders and was focussed solely on the identification and mitigation of environmental impacts

during the construction phase. As well as focussing on minimising disturbance to habitats and species, there was a significant focus on maintaining water quality in all water courses across the site. This included a detailed programme of silt control, dust suppression, pollution control and ongoing water quality monitoring.

“ We strongly support the work that ScottishPower Renewables are doing on their wind farm sites. They are working hard to deliver precisely the benefits we are seeking from wind farm development and we hope that other developers will follow suit. ScottishPower Renewables have demonstrated that biodiversity net gain is achievable on wind farm sites in Scotland with Whitelee providing an example of good practice, and their work to restore peatland habitats sets a high standard for others to follow.”

Scottish Natural Heritage

Improving biodiversity during operations

The biodiversity measures implemented at Whitelee deliver improved habitats and safeguard peat bogs and wildlife species.

A working group including members of RSPB, Scottish Natural Heritage and Forestry and Land Scotland was established to improve the biodiversity value of a 25km² habitat management area at Whitelee. The key aim is to enhance the ecological habitat and create an environmental legacy, rather than simply minimising the impact of the project. The habitat management working group has worked to improve the conditions for native species such as the Black Grouse, as well as a variety of upland wildlife.



Case study: Peatland ecology



©Lorne Gill/-SNH April 2014

SPR has approached new wind farm developments with an aim to minimise significant environmental effects through sensitive design and providing mitigation and enhancement. This approach has delivered significant benefits for the important peatland habitats at Whitelee.

Many areas of upland Scotland are subject to high rainfall and cold temperatures which lend themselves to the formation of peatland. Peatland is an important ecosystem, it purifies water and is one of the most efficient systems we have for carbon storage. Many peatlands were planted with commercial forestry during the post-war era in a bid to boost domestic timber production. This in turn caused a legacy of damaging impacts on peatland habitats.

As part of the Whitelee development SPR committed to restoring 900 hectares of previously forested peatland habitat. Methods of achieving this were previously poorly understood and the scientific evidence was limited, which led SPR to undertake research and experiments in order to understand how forested peatlands function and to investigate new restoration techniques.

SPR and partners developed a restoration technique involving un-ploughing and smoothing the ground by extracting tree stumps, and spreading forestry residues in a particular way that results in a flattened surface with protection from erosion.

Monitoring has revealed that this technique allows the water level to move closer to the surface, returning the peatland to a good condition and allowing key specialist bog plants to re-establish. Almost one third of the peatland habitat at Whitelee has so far been restored, with the remaining restoration planned over the next five years.

The value of this work has been recognised to have benefits beyond the wind industry. SPR was asked by the International Union for Conservation of Nature in 2017 to be the lead author of a report as part of the "Commission of Inquiry into Peatlands", due to be published in 2019.

The extensive research and innovative techniques developed by SPR through the Whitelee Windfarm Habitat Management Plan are now being implemented across the UK by numerous conservation bodies as part of a coordinated effort to restore peatland habitats.



Case study: Breeding merlin

Whitelee continues to host around two breeding pairs of merlin, a specially protected bird of prey with an estimated population of only 433 pairs in the whole of Scotland.

During construction a pair nested in open ground in the centre of the site, which presented a major challenge to the project team. A protection plan was developed which involved an exclusion zone of 500m around the nest where no work could be carried out, and plans were revised to redistribute efforts into other areas of the site until breeding was completed.

The pair successfully fledged several young birds confirming the construction work had managed to avoid any impacts occurring, a significant achievement given the scale and complexity involved in building such a large project.



4. Social impacts

- **Almost 46,000 school pupils have attended an educational programme at Whitelee Windfarm Visitors Centre to date.**
- **Over 750,000 total visits to the visitor centre.**
- **An estimated 200,000 people a year visit Whitelee for recreational activities such as walking, running or cycling.**

4.1. Visitor destination

Visitor Centre

Glasgow Science Centre has been engaged by SPR to help develop and manage the visitor centre at Whitelee Windfarm since it opened in September 2009. Glasgow Science Centre is an independent charity that works with a range of organisations to promote science literacy and to encourage young people into science careers.

Visitors can experience hands-on interactive exhibitions, which explore the most efficient designs for turbines and their placement within a wind farm.

Guided bus tours are available for those wishing to explore the wind farm itself, learn about the ecology of the site and get up close to a turbine. Visitors can also relax and take in the view of the wind farm from the café, while enjoying a range of goods from local suppliers.

Schools and youth groups regularly take advantage of the education programme run by Glasgow Science Centre. The programme consists of four workshops aimed at early years through to senior secondary school age groups, and aims to help each age group discover more about where electricity comes from and how we generate it.



Whitelee Countryside Ranger Service

The Whitelee Countryside Ranger Service (WCRS) helps visitors access and enjoy all of the recreational opportunities available at Whitelee Windfarm. The WCRS is funded by SPR through a community benefit fund, and from 2007 to 2018 the fund has contributed over £1.5 million to develop, run and promote the ranger service.

The funds have enabled the delivery of a mountain bike trail, walking paths, orienteering courses, equestrian routes and benches. Three ranger posts are based at Whitelee to deliver these services, which cover sustainability, wind and water cycles, natural history field studies and more informal guided walks. The rangers run outdoor events all year to promote the site and maintain parts of the infrastructure. They also work with organised groups, such as Scouts and Guides, running activities and visits.

In addition to helping other organisations and groups run their own events, an annual events programme set up and run by the rangers is aimed at demonstrating the variety of opportunities Whitelee Windfarm holds ensuring that there is something for everyone to enjoy.

This programme includes a variety of activities from guided woodland walks and pond searches, to learning wildflower apothecary and the opportunity for children to take part in summer holiday clubs like 'Boggy Beasties'.

Between ranger-led events and educational school visits the rangers have supported over 650 groups with over 19,000 participants so far.

Stroller Striders, one of the groups that regularly uses Whitelee Windfarm, have held 360 meetings with nearly 3,000 participants, and is a group for expectant and new parents that provides them with the opportunity to meet other parents and get some exercise in the fresh air.

The services on offer continue to evolve and this year will see the arrival of the Boma Wheelchair Hire Scheme. Boma all-terrain powered wheelchairs are made in Scotland and will allow all visitors the opportunity to explore the site.

Events at Whitelee Windfarm

Whitelee Windfarm provides an inspiring location and backdrop for a range of events. Some of the bigger events hosted on site include Run the Blades and ScottishPower Renewables Family Fun Day.

Over the past four years, SPR has worked with a third party to host a unique running festival, Run the Blades, incorporating three running distances of a 10km, a half marathon and a 50km ultra route over one weekend. The size and scope of the event has developed over the years, and now incorporates an event village with a range of activities for spectators. The event enters its fifth year in July 2019 and hopes to attract over 1,600 competitors and 3,000 visitors to the local area over the weekend.

ScottishPower Renewables Family Fun Day is supported by all the partners on site, the WCRS and the visitor centre. Having run for several consecutive years, there is a range of fun outdoor activities for visitors to take part in that focus on renewable energy and educating visitors on the site's natural heritage.

The Family Fun Day has proven a great success, with an estimated 5,000 visitors in 2018, and will return in 2019.





4.2. Community benefit fund

- **Whitelee Windfarm community benefit funds have awarded over £9 million so far to local projects**
- **Over the current remaining lifetime of Whitelee further funds of over £14.5 million are still to be paid.**

SPR has voluntarily awarded £30m in community benefit across the UK to date. At Whitelee over £9 million in community benefits have been distributed to the three local councils around the wind farm: East Ayrshire, East Renfrewshire and South Lanarkshire. The councils allocate these funds to a variety of community initiatives through their own Renewable Energy Funds.

The Whitelee Windfarm original community benefit fund is paid at a rate of £1000/MW installed/year, and is split between East Ayrshire, East Renfrewshire and South Lanarkshire Councils. The Whitelee Windfarm extension phase 1 and phase 2 community benefit fund is awarded at a rate of £2500/MW installed/year, and is given exclusively to East Ayrshire Council.

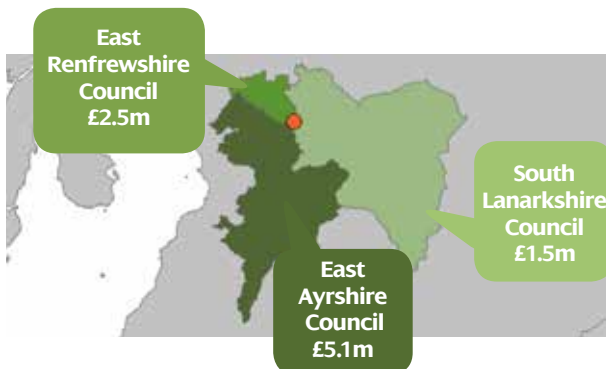


Figure 8 Distribution of community benefit funds from Whitelee Windfarm to date.

“ Thanks to the funding received from Whitelee Windfarm, we have been able to run an exciting 3-part project to create a more welcoming, inclusive and user-friendly environment in our hall. The young people and adult volunteers now have access to new environmentally friendly toilet facilities, which have been completely refurbished. The recently installed traverse wall has already proved very popular with the young people in the Scout Group, who use it for games, challenges and team building exercises.”

28th Glasgow Giffnock Scout Group

“ The Whitelee Windfarm Fund has been a major success and has enabled significant community-led investment into local facilities and activities. Considerable improvements have been made to local infrastructure from the funding and will continue for the future.”

East Renfrewshire Council

Case study: Auchenback Resource Centre

Auchenback Active Ltd. was awarded over £20,000 in 2016.

The Auchenback Resource Centre (ARC) is managed by the community-led organisation Auchenback Active Ltd, which works to strengthen the local community through bringing residents together to identify issues that are important to them and offering health, safety and education focussed activities.

The Centre provides space for the community to use, with additional opportunities such as signposting services, computer classes, dance groups and a café which is run by local volunteers. The ARC has also been the focal point for the delivery of a climate challenge project to raise community awareness of the need to reduce carbon emissions and by changing behaviours towards energy use.

The Whitelee Windfarm community benefit fund supported an energy efficiency refurbishment programme within the ARC facility that lowered operating costs whilst enabling a reliable source of heating to provide comfortable conditions conducive to sustaining public use of the centre.

“ The Trust is extremely grateful for the grant received from the East Ayrshire Renewable Energy Fund. As part of a million pound grants package, it has allowed us to regenerate the heart of the town bringing a derelict grade B listed building back into use and providing not only a thriving community hub, but also bringing five new businesses into the town and creating 15 jobs.”

Galston Community Development Trust

Case study: Kilmarnock Railway Station Heritage Trust

Kilmarnock Railway Station Heritage Trust has been awarded approximately £400,000 since 2014.

The funding awarded to the Kilmarnock Station Railway Heritage Trust from East Ayrshire Council's Renewable Energy Fund has supported their mission to bring several disused railway offices and rooms into community use.

The station buildings have since been transformed into a thriving collection of community spaces offering a range

of activities. The funds were used to refurbish the rooms to create office spaces, meeting rooms, a book shop, coffee shop, active travel hub and a records office for the Glasgow & South Western Railway Association.

Today the Trust facilities host a range of events and activities including local art exhibitions, yoga and charity comedy nights, and run projects that support individuals in the community affected by social isolation to recover, rediscover skills and interests, and re-connect with those around them.



Image courtesy of Kilmarnock Railway Station Heritage Trust

Case study: South Lanarkshire College

South Lanarkshire College awarded £50,000 in 2016 for the construction of their low carbon low energy teaching facility.

The South Lanarkshire College Low Carbon Low Energy Teaching facility opened in February 2016 and is housed on the grounds of the East Kilbride based South Lanarkshire College campus. It is the first building in the UK to be awarded a BREEAM 'Outstanding' rating under the 2014 standards. BREEAM rated developments are more sustainable environments that are considered to enhance the well-being of the people who live and work in them, and demonstrate that they help protect natural resources. The South Lanarkshire College building achieved a 100.8% reduction in CO2 emissions compared to the 2010 legislative emission requirements.

It is unlike most other new buildings due to its high levels of insulation, integrated design with a ground source heat pump, photovoltaic panels and rainwater harvesting. The building does not rely on standard levels of fossil fuel use for heat or power, and is carbon neutral in operation due to renewable energy technologies, the materials selected and the properties of the building.

The facility is fitted with eight classrooms which are available to students, local community groups and local businesses, who can all come together and experience interacting with a low-energy, sustainable building and its resources.

The building has had near full utilisation since it's opening. It has successfully delivered what it set out to do – to



Image courtesy of South Lanarkshire College

provide a high-quality learning experience within a low carbon sustainable environment.

The college has used it to share best practice with planners, architects, universities, local authorities and community groups and the building's impact reaches well beyond the immediate student population.

“ The college has a key role to play in educating this generation about environmental sustainability. We are both grateful and delighted that the Whitelee Community Benefit Fund identified the importance of this project and contributed to its success. We know the project has already had a big impact and that it will have a lasting legacy in the education and training of thousands of people for decades to come.”

South Lanarkshire College

4.3. Skills development

The Whitelee Visitor Centre is committed to promoting STEM (Science Technology Engineering Mathematics) learning through providing workshops that align with the Science and Technology Experiences and Outcomes that are laid out in the Scottish Government's Curriculum for Excellence guidelines. This means that the courses offered here are integrated with wider learning programmes delivered in schools.

The centre also run fun weekend workshops with a science background and promotes STEM topics. In 2018 the centre ran a Summer Science Club which explored a different area of science every week for six weeks and this programme is to be expanded this year. Feedback on the school programme has been overwhelmingly positive and participants have rated all the centre's workshops and activities as excellent or very good.

As well as promoting learning for future generations, Whitelee also continues to contribute to skills and career development directly within SPR and indirectly through its suppliers.

Case study: Skills development

Tom Connell works on the Whitelee Windfarm site as an operational wind farm controller. Based in the Whitelee Windfarm control centre, Tom and his colleagues monitor and manage all of SPR's onshore and offshore wind farms across Europe, 24 hours a day, seven day a week, providing ongoing safety and operational notifications and a vital communications link between a wide array of wind farm stakeholders.

Tom has enjoyed a 30 year career with ScottishPower, during a time that has seen a great deal of change in how electricity is generated in Scotland. He first joined what was then the South of Scotland Electricity Board (the state-owned predecessor of ScottishPower). His first position was as a youth trainee laboratory technician at the Cockenzie coal fired power station in East Lothian, testing coal samples. He later transferred to the Longannet coal fired power station in Fife, until its closure in 2016.

The closure of Longannet and Cockenzie have been significant steps taken in ScottishPower's low-carbon transition, from a largely fossil-fuel based generating portfolio to one now based entirely on wind power. When Longannet closed, Tom faced employment uncertainty, having gained all his experience in coal fired power stations.

However, SPR recognised Tom's valuable skills and experience, understanding how they could transfer to a position at Whitelee. Since joining the SPR team 2016, Tom has gained significant experience of wind farm operations and has completed a number of internal and external training courses specific to wind turbine technology and wind farm operations.



He now finds himself part of team that operates one of Europe's largest fleets, 1,150 wind turbines, and has become a strong advocate of the shift towards a low carbon generating system.

“ I see wind farms as being part of the future. Whilst I spent the first part of my career in coal fired power stations, I now really appreciate working in the clean environment of a wind farm control centre. We can look outside the control centre windows and see the Whitelee turbines turning – it's a constant reminder that we are part of something positive. My career change from coal plants to wind farms has been a great adventure, a new chapter in my life and a great challenge.”

**Tom Connell, Operational Controller,
Whitelee Windfarm Control Centre**



5. Looking forward

- **Whitelee Windfarm still has a significant range of economic, environmental and social benefits to come.**
- **Whitelee allows an opportunity for continued technology and innovation research and development.**
- **Potential co-location of battery storage will allow Whitelee to offer additional services to the grid, helping to balance electricity demand and supply and adding resilience to the system.**

5.1. Innovation and ongoing work



The ongoing operation of an onshore wind farm involves a wide range of activities, including management of the wind farm site, servicing and maintaining the wind turbines, managing health and safety of all site staff and implementing programmes to manage the site infrastructure, including electrical equipment, roads and drainage. Ongoing work also includes vital environmental management and habitat restoration initiatives.

All of these activities generate secure jobs for direct

and contracted staff and will continue throughout the operational life of the wind farm. The control centre at Whitelee provides round the clock operations support not just for the turbines on site, but for 1,150 wind turbines across Europe.

Whitelee also provides SPR with a substantial opportunity for continued research and development. Technological innovations can be developed and tested at scale for the benefit of the entire operating fleet of wind energy projects through the world.

Case study: Testing leading edge protection

At Whitelee, SPR have been testing the latest technology on leading edge protection (LEP) proposed by Siemens Gamesa Renewable Energy for their blades. The Power Edge solution is a polyurethane based pre-casted shell that has been retrofitted on the blades of two of our turbines as part of a trial project. The project has been running for over 2.5 years, and the blades were inspected last year, showing outstanding performance of the LEP.

This onshore trial allowed SPR to test and assess a future LEP solution for one of the most challenging topics in the wind industry, erosion of the blades leading edge. This issue is particularly critical offshore, where the blades are exposed to severe conditions such as high wind speeds, rainfall and salinity.

Onshore trials add significant value to the offshore wind industry since the access to the turbines and logistics requirements are not as complex as offshore.



Case study: Whitelee battery storage

SPR has recently submitted a planning application for a 50MW battery storage facility at Whitelee Windfarm.

Once operational the battery will allow Whitelee to offer additional services to the National Grid, helping to balance electricity demand and supply, and adding resilience to our electricity system.

The battery will also allow Whitelee to store excess renewable energy at times of high wind and release during times of low wind.



Case study: Aviation

During the development of Whitelee, SPR worked with Glasgow Airport and NATS to develop the first significant mitigation solution for the impacts of wind turbines on air traffic control radars, building a new radar at Kincardine and releasing over 800MW of wind energy in Scotland.

SPR continues to innovate in the area of radar, sponsoring Project Green Blade which uses Aveillant Theia 3D holographic radar technology to differentiate between wind turbines and aircraft. Project Green Blade could provide a sustainable aviation solution for onshore and offshore wind, as aviation stakeholders assume responsibility for their radar systems being wind farm tolerant.

5.2. Future potential

This report has highlighted the many ways in which Whitelee Windfarm has made a difference to Scotland and to the local area.

Since starting operation in 2009 the project has made a significant contribution to the Scottish economy and has provided ongoing support to many local businesses and the surrounding communities.

It has made a significant contribution in Scotland's transition to a low-carbon economy, has delivered direct local environmental improvement and has given job security to a wide range of people.

There is more to come. A wind farm like Whitelee is expected to operate for between 25 and 30 years, so we can expect up to another 20 years of economic and societal benefit to flow from the project.

Whilst wind farms such as Whitelee were originally expected

to operate for 20 to 25 years, wind farm owners are gaining knowledge from operating large projects and learning how to safely prolong operational life.

By making use of advanced approaches to operational management, by installing modern wind turbine system upgrades and by applying cutting-edge wind turbine engineering techniques, wind farm owners can expect projects such as Whitelee to increase their safe operational period by at least a further 5 to 10 years. This means greater social, economic and environmental contributions through a prolonged operational life, and better use being made of valuable resources and investments.

At some point in the future, the original wind turbine hardware will reach the end of its efficient

operational life. When this time is reached, it is expected that most wind farm owners will seek new planning permission for projects and for the wind farm to be rebuilt. This affords the opportunity to use larger, more efficient turbines so the sites can generate even more clean electricity, helping to meet the decarbonisation targets of Scotland and the UK.

Renewable energy is expected to remain a core part of Scotland's electricity generating mix for many generations to come, and onshore wind farms are expected to continue to have a major contribution to make.

The opportunity exists for sites such as Whitelee to host wind farms far into the future, ensuring that future generations can also benefit from their social, environmental and economic legacy.

Thanks...

ScottishPower Renewables wish to thank all the stakeholders, supporters, suppliers and staff that have contributed to Whitelee Windfarm over the past 10 years.

Special thanks to those who contributed to the creation of this report:

- Auchenback Resource Centre
- East Renfrewshire Council
- Forestry and Land Scotland
- Galston Community Development Trust
- Giffnock Scout Group
- Glasgow Science Centre
- I & H Brown
- Kilmarnock Railway Station
- Heritage Trust
- MacArthur Green
- Paul Wheelhouse, MSP
- RSPB Scotland
- Scottish Natural Heritage
- South Lanarkshire College
- W Barr CS
- Whitelee Countryside Ranger Service
- WWF Scotland
- 25 West Design

Appendix A:

Economic impact assessment methodology

Conventional modeling of economic impacts for most industrial sectors relies on government statistics, for example those based on Standard Industry Classification (SIC) codes and use input-output tables and other production and employment ratios, for example those produced by the Office of National Statistics.

SIC code data can be appropriate for traditional industries at a national level. The development of new codes for a maturing sector, however, takes time. This means that conventional SIC analyses of wind projects need to map existing NAICS data onto wind project activities, which is not easy and a source of error. Analyses using SIC codes also have to rely on generalised data.

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

- **Projects tend to 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.

The methodology proposed here has been developed jointly by BVGA and Steve Westbrook of the University of the Highlands and Islands and has been used for a series of major clients.

The methodology's first input is the cost per MW of each of the 18 supply chain sub-elements at the time of wind farm completion.

The remaining expenditure is analogous to the direct and indirect gross value added (GVA) created. GVA is the aggregate of labour costs and operational profits. 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 (£)

M = Total operating margin (£)

Y_a = Average annual wage (£), and

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

To make robust assessments, therefore, we consider each major component in the wind project supply chain and estimate typical salary levels, costs of employment and profit margins, bringing together BVGA's specific sector knowledge and research into typical labor costs for the work undertaken in each supply chain subelement.

Appendix B: Classification of supply chain

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

Appendix C: Economic impact assessment methodology

Supply chain element	Type	Scottish value-added (£million)	UK value-added (£million)	Scottish FTE years	UK FTE years	Scottish earnings (£million)	UK earnings (£million)
Development	Direct	£14.2	£20.2	171	242	£6.7	£9.6
	Indirect	£9.5	£13.4	283	402	£6.7	£9.4
	Induced	£3.6	£5.1	52	74	£1.4	£2.0
	Total	£27.3	£38.8	506	718	£14.8	£21.0
Turbine	Direct	£4.6	£6.3	97	132	£2.6	£3.5
	Indirect	£3.1	£4.2	101	137	£2.4	£3.2
	Induced	£1.1	£1.5	20	27	£0.5	£0.7
	Total	£8.9	£11.9	219	295	£5.5	£7.4
Civil works	Direct	£72.5	£79.0	1,857	2,023	£49.2	£53.6
	Indirect	£48.3	£52.6	1,259	1,371	£32.7	£35.7
	Induced	£18.8	£20.5	404	440	£8.5	£9.3
	Total	£139.6	£152.1	3,520	3,834	£90.4	£98.5
Electrical works	Direct	£9.1	£13.9	197	300	£6.2	£9.5
	Indirect	£6.1	£9.3	143	219	£4.2	£6.3
	Induced	£2.6	£3.9	51	77	£1.1	£1.6
	Total	£17.8	£27.2	391	596	£11.4	£17.4
Transmission OMS	Direct	£29.1	£111.3	598	2,288	£19.7	£75.5
	Indirect	£19.4	£74.2	564	2,158	£13.3	£50.7
	Induced	£7.6	£29.1	137	525	£3.4	£13.1
	Total	£56.1	£214.5	1,300	4,971	£36.4	£139.3
Wind farm OMS	Direct	£272.1	£297.6	6,597	7,215	£184.7	£202.0
	Indirect	£181.4	£198.4	5,228	5,718	£122.9	£134.4
	Induced	£64.1	£70.1	1,270	1,389	£31.9	£34.9
	Total	£517.6	£566.1	13,095	14,322	£339.5	£371.3
Decommissioning	Direct	£13.5	£14.1	240	252	£6.3	£6.7
	Indirect	£9.0	£9.4	268	282	£6.3	£6.6
	Induced	£3.1	£3.2	50	53	£1.3	£1.4
	Total	£25.5	£26.8	558	587	£14.0	£14.7
Total	Direct	£415.2	£542.4	9,756	12,452	£275.5	£360.3
	Indirect	£276.8	£361.6	7,848	10,287	£188.4	£246.4
	Induced	£100.9	£133.5	1,984	2,585	£48.1	£62.9
	Total	£792.8	£1,037.4	19,589	25,324	£512.0	£669.6

Appendix D: Economic impact graphs

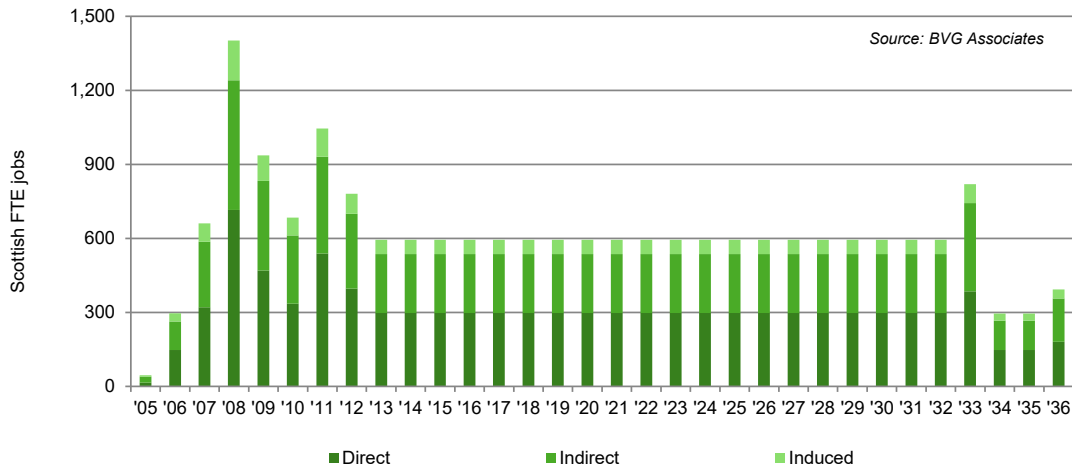


Figure 9 Scottish direct, indirect and induced employment generated by Whitelee.

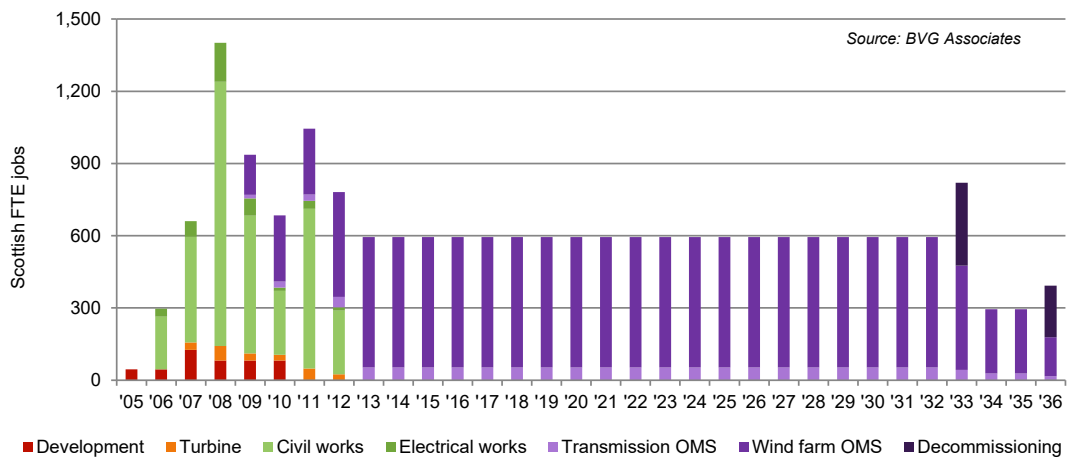


Figure 10 Scottish employment generated by Whitelee by supply chain area.

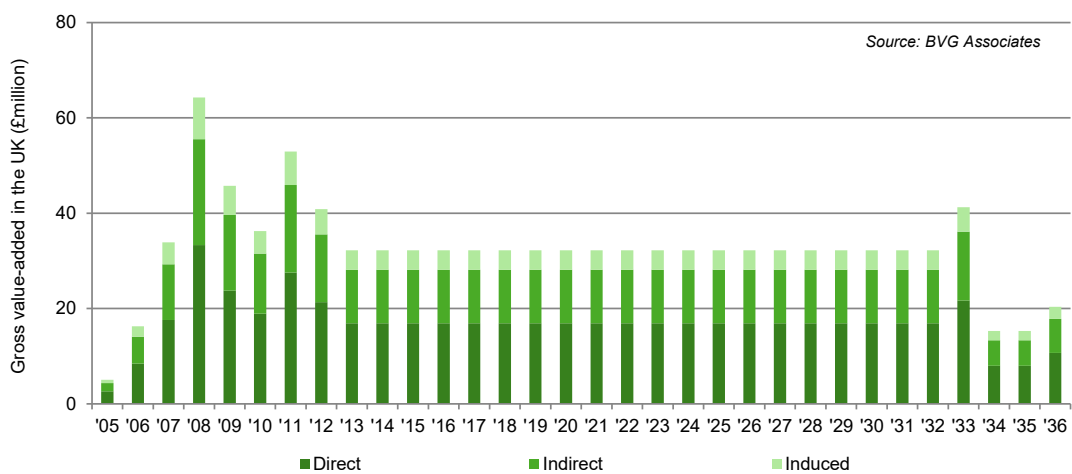


Figure 11 UK direct, indirect and induced value-added generated by Whitelee.

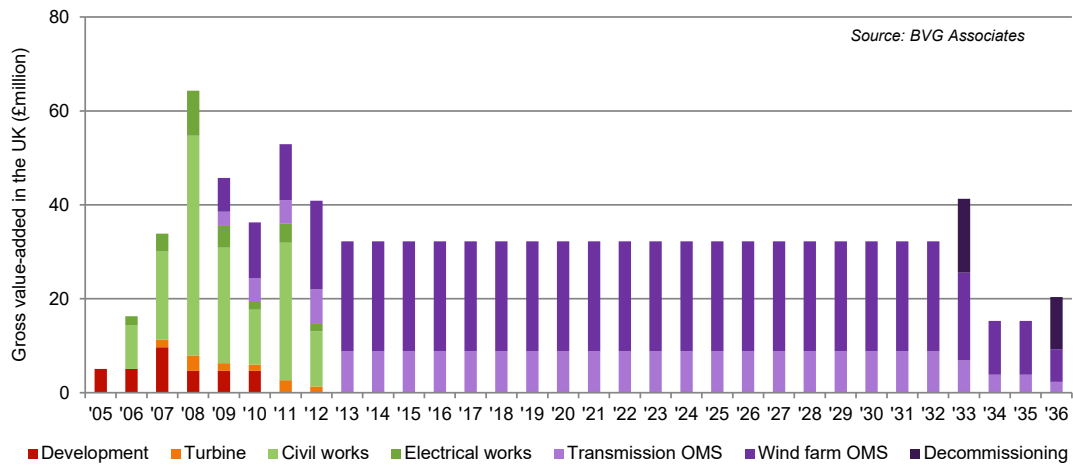


Figure 12 UK value-added generated by Whitelee by supply chain area.

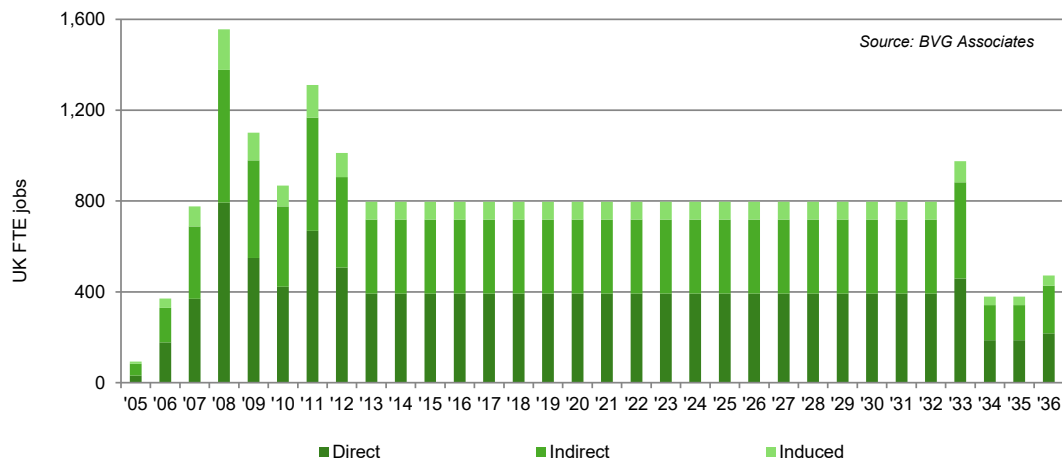


Figure 13 UK direct, indirect and induced employment generated by Whitelee.

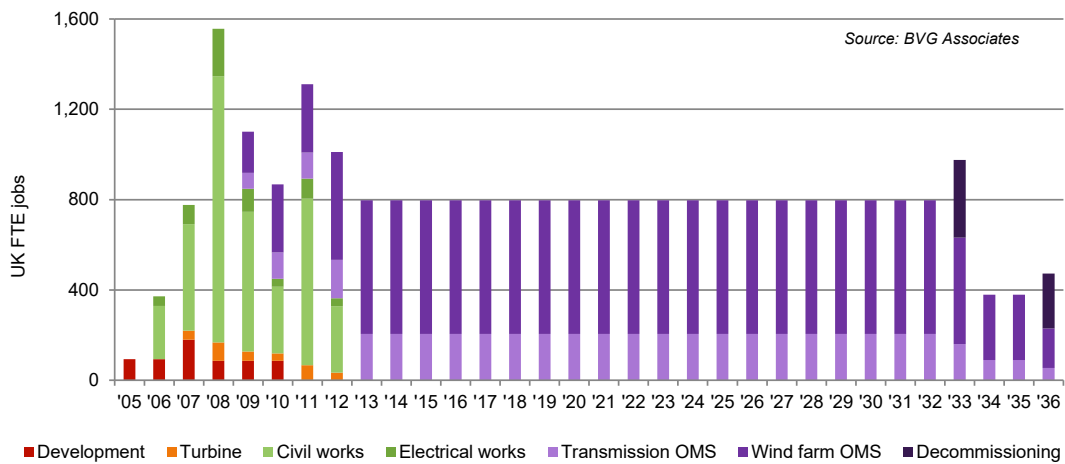


Figure 14 UK employment generated by Whitelee by supply chain area.

Appendix E: References

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- Our highly experienced team has an average of over 10 years' experience in renewable energy.
- Most of our work is advising private clients investing in manufacturing, technology and renewable energy projects.
- We've also published many landmark reports on the future of the industry, cost of energy and supply chain.

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