

TECHNICAL APPENDIX 11 – SOCIO-ECONOMICS, RECREATION AND TOURISM

TA11.1: Socio-economic Impact of Consented Scheme

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TECHNICAL APPENDIX 11.1 SOCIO-ECONOMIC IMPACT OF CONSENTED SCHEME

11.1 Executive Summary

- 11.1.1 In 2018, Strathy South Wind Farm (“the Consented Scheme”) was consented on the basis of 39 turbines, each with a capacity of 3.4 MW, with an overall installed capacity of 132.6 MW. Based on this installed capacity, it was estimated that during the development and construction phase the Consented Scheme could generate up to:
- £2.1 million Gross Value Added (GVA) and 33 job years of employment in Caithness and Sutherland;
 - £25.7 million GVA and 373 job years of employment in Highland; and
 - £71.2 million GVA and 1,071 job years of employment in Scotland.
- 11.1.2 It was estimated that each year during the operation and maintenance phase the Consented Scheme would generate:
- £0.7 million GVA and 11 jobs in Caithness and Sutherland;
 - £2.5 million GVA and 34 jobs in Highland; and
 - £4.5 million GVA and 65 jobs in Scotland.
- 11.1.3 It is expected that there would be community benefit funding of £331,500 annually associated with the Consented Scheme.
- 11.1.4 Throughout its operation, the Consented Scheme would also contribute to local public finances and in this way supporting the provision of public services locally. It was estimated that the Consented Scheme could contribute £1.5 million each year in non-domestic rates.

11.2 Introduction

- 11.2.1 In 2018, Strathy South Wind Farm (“the Consented Scheme”) was consented on the basis of 39 turbines, each with a capacity of 3.4 MW, with an overall installed capacity of 132.6 MW. This Technical Appendix sets out the potential economic impacts associated with the Consented Scheme’s development and construction, and operation and maintenance.
- 11.2.1 The assessment in this Technical Appendix focuses only on those areas where some difference might be expected between the Consented Scheme and the Proposed Varied Development and where the assessment methodology has changed, that is, the quantitative analysis of the local and national economic impacts during the development and construction phase and during the operation and maintenance phase.
- 11.2.2 The assessment of the Consented Scheme did not include a tourism and recreation assessment. However, the tourism and recreation assessment contained in Chapter 11: Socio-economics, Recreation and Tourism (EIAR Volume 2) has been reviewed to determine whether the differences between the Consented Scheme and the Proposed Varied Development would change any of the conclusions of the assessment and it has been concluded that there would be no material changes to the tourism and recreation assessment.
- 11.2.3 This assessment provides the basis for a comparison between the Consented Scheme and the Proposed Varied Development, which consists of 39 turbines, each with a capacity of up to 5.6 MW. The methodology for assessing economic impacts has developed since the Consented Scheme was assessed. This Technical Appendix allows for a like-for-like comparison between the Consented Scheme and the Proposed Varied Development, by assessing the economic impact of the Consented Scheme using the latest economic impact methodology. This includes, for example, taking account of the evidence that is now available on the economic impact of the Strathy North Wind Farm.

11.3 Methodology

Scope of the Assessment

- 11.3.1 The assessment in this chapter covers two key topics and accordingly the study area for each aspect has been defined based on the nature of the potential effects arising from the Consented Scheme.
- 11.3.2 The study areas for the socio-economic impact analysis are presented on Figure 11.1.1 and are as follows:
- Caithness and Sutherland, comprising the electoral wards of East Sutherland and Edderton; North, West and Central Sutherland; Thurso and Northwest Caithness; and Wick and East Caithness;
 - Highland, comprising the local authority area (and including Caithness and Sutherland); and
 - Scotland (including Highland).

Assessment of Residual Effects

- 11.3.3 The assessment of economic effects was undertaken using a model that has been developed by BiGGAR Economics specifically to estimate the socio-economic effects of wind farm developments. This model was also the basis of an assessment of the UK onshore wind sector for the then Department of Energy and Climate Change (DECC) and RenewableUK in 2012¹, which was subsequently updated in 2015². These assessments were based on case studies of the local,

¹ Department of Energy and Climate Change, RenewableUK. (2012). Onshore Wind: Direct and Wider Economic Impacts.

² RenewableUK. (2015). Onshore Wind: Economic Impacts in 2014.

regional and national socio-economic effects of wind farms that have been developed in the UK and has been updated to reflect changes in the industry in recent years.

11.3.4 This approach is considered industry best practice in the assessment of the socio-economic effects of the onshore wind sector. This model has been used by BiGGAR Economics to assess the socio-economic effects of numerous wind farms across the UK, with the results being accepted as robust at several public inquiries.

11.3.5 The assumptions made have been based on three main sources:

- the analysis undertaken in 2019 by BiGGAR Economics, on behalf of the Applicant, of the economic impact of the neighbouring Strathy North Wind Farm. This report considered the value and types of contracts that were awarded throughout all stages of the project and used this to estimate the economic impact in Caithness and North Sutherland, Highland and Scotland³;
- the analysis undertaken in the 2015 report on behalf of RenewableUK², which uses evidence from wind farms around the UK. This report examined the size and location of contracts for their development, construction, and operation and maintenance phases; and
- assessment of the economies of the study areas, based on analysis of local, regional and national statistics.

11.3.6 The units of measurement which are used to quantify the economic impacts of the Consented Scheme are:

- GVA - this is a measure of the economic value added by an organisation or industry and is typically estimated by subtracting the non-staff operational costs from the revenues of an organisation;
- Job Years of employment - this is a measure of employment which is equivalent to one person being employed for an entire year and is typically used when considering short term employment impacts, such as those associated with construction; and
- Jobs - this is a measure of employment which considers the headcount employment in an organisation or industry.

11.3.7 To begin estimating the economic activity supported by the Consented Scheme, it is first necessary to calculate the expenditure during the development and construction, and operation and maintenance phases. The total expenditure figure is then divided into its main components using calculated assumptions regarding the share that could be expected by main and sub-contractors. This provides an estimate for each main component contract that can be secured by companies in Caithness and Sutherland, Highland and Scotland.

11.3.8 There are the three sources of economic activity:

- component contracts and the jobs they support;
- wider spending in the supply chain (indirect effect); and
- spending of people employed in these contracts (induced effect).

11.3.9 There are four key stages of this model:

- estimation of total capital expenditure;
- estimation of the value of component contracts that make up total expenditure;
- assessment of the capacity of businesses in the study area to perform and complete component contracts; and
- estimation of economic impact from resultant figures.

³ BiGGAR Economics. (2020). Economic Analysis of Strathy North Wind Farm.

11.3.10 The calculations presented in this Technical Appendix have been undertaken using an economic model. The results of the calculations presented are rounded to the nearest 1%, £0.1 million, job year and job.

11.4 Potential Significant Effects

Potential Development and Construction Effects

11.4.1 In order to estimate the economic impacts arising from spending in the construction and development of the Consented Scheme, expenditure was attributed to:

- development;
- turbines;
- balance of plant; and
- grid connection.

11.4.2 The estimation of costs was based on a combination of per MW and per turbine costs for each of the components, which were derived from the analysis undertaken on behalf of RenewableUK².

11.4.3 The Consented Scheme consists of 39 turbines of up to 3.4 MW each, with a combined installed capacity of up to 132.6 MW. On this basis, it was estimated that the total cost of the Consented Scheme would be £194.8 million. Of this, it is expected that turbines would account for 57.8% of expenditure (£112.6 million) and balance of plant would be 25.6% of spend (£49.9 million), as shown in Table 11.1.1.

	% of Capex	Value (£m)
Development	10.2%	19.9
Turbines	57.8%	112.6
Balance of Plant	25.6%	49.9
Grid Connection	6.3%	12.3
Total	-	194.8

SOURCE: BiGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

11.4.4 Assumptions were then made about how much of each component contract could be secured in each study area. This was based on the findings of the RenewableUK research² and BiGGAR Economics' assessment of Strathy North Wind Farm³.

11.4.5 This research suggested that Caithness and Sutherland could secure 3% of contracts, worth up to £5.1 million, Highland could secure 20% of contracts, worth up to £38.2 million, and Scotland could secure 43% of contracts, worth up to £84.1 million.

11.4.6 Balance of plant would be the largest opportunity for each of the study areas, with Caithness and Sutherland securing up to 10% of contracts (£4.8 million), Highland securing 55% of contracts (£27.7 million), and Scotland securing 75% of contracts (£37.7 million). Turbine contracts would also represent an opportunity in Scotland, which could secure 19% (£21.6 million), as shown in Table 11.1.2.

	Caithness and Sutherland		Highland		Scotland	
	% Capex	£m	% Capex	£m	% Capex	£m
Development	0%	-	10%	2.0	63%	12.5
Turbines	0%	-	4%	4.2	19%	21.6
Balance of Plant	10%	4.8	55%	27.7	75%	37.7
Grid Connection	3%	0.4	35%	4.3	100%	12.3
Total	3%	5.1	20%	38.2	43%	84.1

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

11.4.7 In order to estimate the direct GVA associated with each category of spend, each category was split into its component contracts, which were then assigned a sector. The spend associated with each contract would represent an increase in turnover to businesses in the study area, and therefore the GVA impact was estimated by applying the turnover/GVA ratio for the relevant sector from the Annual Business Survey⁴.

11.4.8 The direct impact was estimated to be £1.8 million GVA in Caithness and Sutherland, £19.1 million GVA in Highland, and £42.1 million GVA in Scotland (Table TA11.1.3).

	Caithness and Sutherland	Highland	Scotland
Development	-	1.4	8.5
Turbines	-	1.9	9.8
Balance of Plant	1.7	14.0	18.8
Grid Connection	0.1	1.7	5.0
Total	1.8	19.1	42.1

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

11.4.9 Similarly, the direct employment impact was estimated by applying the relevant turnover/employee ratio from the Annual Business Survey. For temporary impacts, such as construction, employment is reported in terms of job years, with one job year representing one year of employment for an individual.

11.4.10 In this way, it was estimated that during the construction and development phase, the Consented Scheme would directly support 29 job years in Caithness and Sutherland, 283 job years in Highland, and 645 job years in Scotland (Table TA11.1.4).

⁴ ONS. (2019). Annual Business Survey Provisional Results 2017.

	Caithness and Sutherland	Highland	Scotland
Development	-	19	119
Turbines	-	34	175
Balance of Plant	27	204	276
Grid Connection	2	26	75
Total	29	283	645

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

11.4.11 In addition to the direct economic activity supported by the Consented Scheme, its construction and development is expected to have an impact associated with contractors spending in their supply chain, which is known as the indirect effect.

11.4.12 In order to capture this effect, direct GVA and employment impacts were multiplied by Type I multipliers for the relevant sectors, which are produced by the Scottish Government and capture spending within Scotland⁵. These were then discounted by the amount of supply spending that is expected to take place in each study area. For example, Caithness and Sutherland contractors would be expected to spend 10% of Scottish supplier spending in Caithness and Sutherland and 40% in Highland.

11.4.13 On this basis it was estimated that the indirect effect would support £0.1 million GVA and 2 job year of employment in Caithness and Sutherland, £2.6 million GVA and 41 job years in Highland, and £16.3 million GVA and 263 job years in Scotland (Table TA11.1.5).

	Caithness and Sutherland	Highland	Scotland
GVA (£m)	0.1	2.6	16.3
Job years	2	41	263

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

11.4.14 There would also be impacts associated with workers spending their wages in the study area, which is known as the induced effect. This is captured by subtracting Type II multipliers (which combine indirect and induced effects) from Type I multipliers (the indirect effect) for the relevant sector.

11.4.15 This was then discounted to account for spending taking place in each study area. For example, for workers in Caithness and Sutherland 40% of Scottish spending was assumed to take place in Caithness and Sutherland, and for workers in Caithness and Sutherland and Highland 70% of Scottish spending was assumed to take place in Highland.

11.4.16 Therefore, it was estimated that staff spending would support £0.2 million GVA and 3 job years in Caithness and Sutherland, £4.1 million GVA and 49 job years in Highland, and £12.8 million GVA and 164 job years in Scotland (Table TA11.1.6)

⁵ Scottish Government. (2018). Input-Output Tables 2015.

Table TA11.1.6: Development and Construction Induced Impact			
	Caithness and Sutherland	Highland	Scotland
GVA (£m)	0.2	4.1	12.8
Job years	3	49	164

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

- 11.4.17 Overall, the Consented Scheme was expected to support £2.1 million GVA and 33 job years in Caithness and Sutherland, £25.7 million GVA and 373 job years in Highland, and £71.2 million GVA and 1,071 job years in Scotland (Table TA11.1.7).

Table TA11.1.7: Economic Impact During Development and Construction			
	Caithness and Sutherland	Highland	Scotland
GVA (£m)	2.1	25.7	71.2
Job years	33	373	1,071

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

- 11.4.18 The effect on the Caithness and Sutherland economy as well as the Highland economy was assessed as **minor beneficial**, and the effect on the Scottish economy was assessed as **negligible beneficial** and so not significant in EIA terms.

Potential Operational Effects

Economic Impact

- 11.4.19 The Consented Scheme is also expected to have a socio-economic impact throughout its operation.
- 11.4.20 Based on the RenewableUK study it was estimated that annual operations and maintenance spending would be £6.8 million. As an illustration, over 25 years this would amount to £170.5 million. In order to estimate the economic impact from spending in operations and maintenance, assumptions were made about the share of spending that could be secured in each study area.
- 11.4.21 Therefore, it was assumed that 16% of spend would be secured in Caithness and Sutherland (£1.1 million), 50% would be secured in Highland (£3.4 million), and 80% would be secured in Scotland (£5.5 million), with the remainder being secured from outside the study areas (Table TA11.1.8).

Table TA11.1.8: Direct Impact of Annual Operations and Maintenance Expenditure						
	Caithness and Sutherland		Highland		Scotland	
	% Opex	£m	% Opex	£m	% Opex	£m
Operation	16%	1.1	50%	3.4	80%	5.5

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

- 11.4.22 In order to estimate the GVA and employment impact associated with the annual operations and maintenance spend, the value of contracts carried out by each study area was divided by the relevant turnover/GVA and turnover/job ratios from the Annual Business Survey.
- 11.4.23 In this way, it was estimated that each year spending, from operation and maintenance, would generate £0.7 million GVA and 9 jobs in Caithness and Sutherland, £2.0 million GVA and 28 jobs in Highland, and £3.0 million GVA and 44 jobs in Scotland (Table TA11.1.9).

Table TA11.1.9: Direct Impact of Annual Operations and Maintenance Expenditure			
	Caithness and Sutherland	Highland	Scotland
GVA (£m)	0.7	2.0	3.0
Jobs	9	28	44

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

- 11.4.24 After estimating indirect and induced effects, using the same method as with construction and development, it was estimated that the total impact would be £0.7 million GVA and 11 jobs in Caithness and Sutherland, £2.5 million GVA and 34 jobs in Highland, and £4.5 million and 65 jobs in Scotland (Table TA11.1.10).

Table TA11.1.10: Total Impact of Annual Operations and Maintenance Expenditure			
	Caithness and Sutherland	Highland	Scotland
GVA (£m)	0.7	2.5	4.5
Jobs	11	34	65

SOURCE: BIGGAR ECONOMICS CALCULATIONS. NOTE, TOTALS MAY NOT SUM DUE TO ROUNDING.

- 11.4.25 The effect on the Caithness and Sutherland economy as well as the Highland economy was assessed as **minor beneficial**, and the effect on the Scottish economy was assessed as **negligible beneficial**, neither of which are significant in EIA terms.

Community Benefit

- 11.4.26 The Applicant is committed to sharing the benefits of the Consented Scheme with the community and community benefit payments are currently expected to be £2,500 per MW, or £331,500 per year. Over an illustrative period of 25 years this would amount to £8.3 million.

Non-Domestic Rates

- 11.4.27 The Consented Scheme would be liable for non-domestic rates, the payment of which would contribute directly to public sector finances. Analysis of the rateable values of several wind farms nearby suggests that the average rateable value per MW is £22,300. On this basis the total rateable value would be £3.0 million for the Consented Scheme.
- 11.4.28 Applying a poundage rate of £0.516 per £1 of rateable value⁶ it is estimated that the Consented Scheme could contribute £1.5 million annually to public finances. However, the actual contribution would depend on variables such as the actual load factor.
- 11.4.29 These non-domestic rates, by providing an additional revenue stream, would support the delivery of local government services. Over an illustrative 25 years, non-domestic rates contributions are expected to be £38.1 million⁷.
- 11.4.30 The effect on the Highland economy was assessed as **negligible beneficial** and so not significant in EIA terms.

Potential Decommissioning Effects

- 11.4.31 The Consented Scheme would have an economic impact during the decommissioning phase. Very few onshore wind projects to date have been fully decommissioned in the UK and as a result there is minimal data regarding the current costs of this phase. Given that decommissioning activity would take place in future decades it is difficult to predict what local economic conditions at that time would be. For these reasons the decommissioning costs and impacts have not been quantified in this assessment.

⁶ https://www.highland.gov.uk/info/2/business_rates/404/business_rates/3 [22/01/2020]

⁷ Note, total may not sum to due to rounding.

- 11.4.32 The scale of the economic activity during the decommissioning phase would likely be less than that of the construction phase. Therefore, the effect on the economies studied would be less than that assessed in the construction phase.
- 11.4.33 The effect on the Caithness and Sutherland economy was assessed as **minor beneficial**, and the effect on the Highland economy and the Scottish economy was assessed as **negligible beneficial** and so not significant in EIA terms.

Potential Cumulative Construction Effects

- 11.4.34 The presence of the other wind farm sites does not change the socio-economic assessment of the Consented Scheme. This assessment has been undertaken using data generated from one of these wind farms, Strathly North, and the existence of the others does not affect the quantitative of qualitative assessments of the Consented Scheme. The presence of continual economic opportunities from multiple wind farm sites being constructed in sequence in Caithness and Sutherland is likely to represent stability for firms in the area that are involved in this activity.
- 11.4.35 The Applicant has experience in the local area as a result of developing and building Strathly North Wind Farm, which is located nearby.
- 11.4.36 BiGGAR Economics has recently undertaken an assessment of its economic impact³, which found that 3% of development and construction contracts by value are secured in Caithness and Sutherland, and that 19% of are secured in Highland, compared to the national average for local authorities of 12%.
- 11.4.37 The Applicant's experience of developing and constructing a wind farm in the local area with a higher than average share of local content suggests that it has a strong relationship with local contractors and would be expected to achieve similarly high shares of local content for the Consented Scheme.
- 11.4.38 This is expected to have a **minor** beneficial effect in Caithness and Sutherland, and Highland, and a **negligible** beneficial effect in Scotland.

Potential Cumulative Operational Effects

- 11.4.39 Similarly, the share of Opex contracts which are secured for Strathly North Wind Farm is expected to be 19% in Caithness and Sutherland, and 45% in Highland, compared to the national average for local authorities of 42%. This suggests that similar shares of Opex contracts would be secured for the Consented Scheme.
- 11.4.40 This is expected to have a **minor** beneficial effect in Caithness and Sutherland, and a **negligible** beneficial effect in Highland and Scotland.

11.5 Assessment of Residual Effects

Residual Construction Effects

- 11.5.1 Development and construction of the Consented Scheme would likely result in:
- a **temporary minor beneficial** economic effect in Caithness and Sutherland, which is not significant;
 - a **temporary minor beneficial** economic effect in Highland, which is not significant; and
 - a **temporary negligible beneficial** economic effect in Scotland, which is not significant.

Residual Operational Effects

- 11.5.2 Operation and maintenance of the Consented Scheme is likely to result in:
- a **minor beneficial** economic effect in Caithness and Sutherland, which is not significant;

- a **negligible beneficial** economic effect in Highland, which is not significant;
- a **negligible beneficial** economic effect in Scotland, which is not significant; and
- a **negligible beneficial** economic effect in Highland associated with payment of non-domestic rates, which is not significant.

Residual Decommissioning Effects

- 11.5.3 Decommissioning of the Consented is likely to result in:
- a **temporary minor beneficial** economic effect in Caithness and Sutherland, which is not significant;
 - a **temporary negligible beneficial** economic effect in Highland, which is not significant; and
 - a **temporary negligible beneficial** economic effect in Scotland, which is not significant.

Cumulative Effects

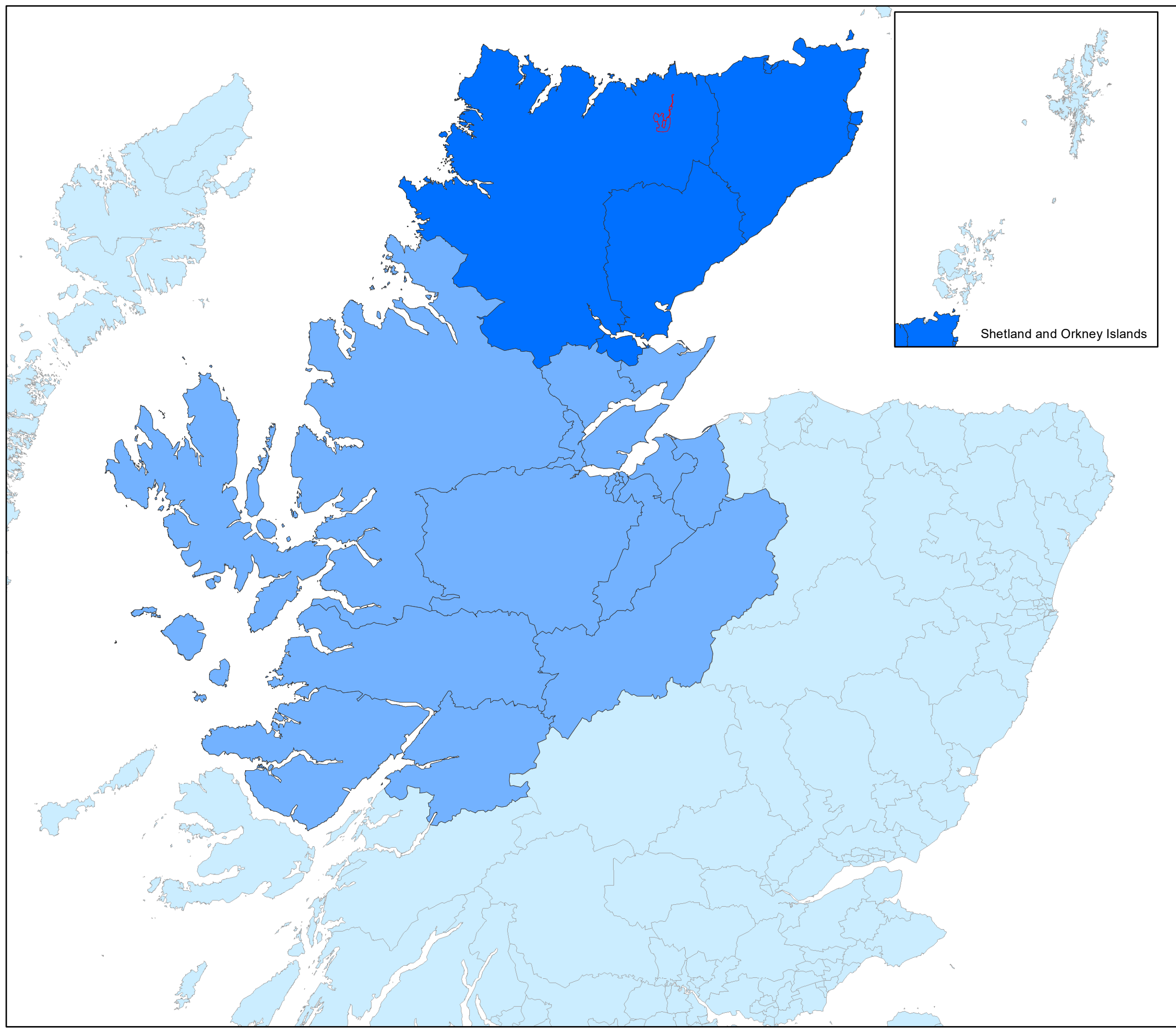
- 11.5.4 There could be beneficial cumulative effects associated with the development of an existing supply chain in the Highland, which could increase the beneficial impact associated with construction of the Consented Scheme. The predicted residual cumulative construction effects are as follows:
- a **temporary minor** economic beneficial effect in Caithness and Sutherland, which is not significant;
 - a **temporary minor** economic beneficial effect in Highland, which is not significant; and
 - a **temporary negligible** economic beneficial effect in Scotland, which is not significant.
- 11.5.5 There could also be beneficial cumulative effects associated with the development of an existing supply chain in the Highland, which could increase the beneficial impact associated with operation of the Consented Scheme. The predicted residual cumulative operation effects are as follows:
- a **minor** beneficial economic effect in Caithness and Sutherland, which is not significant;
 - a **negligible** beneficial economic effect in Highland, which is not significant; and
 - a **negligible** beneficial economic effect in Scotland, which is not significant.

11.6 Summary and Conclusions





- 11.6.1 Based on an installed capacity of 132.6 MW, it was estimated that during the development and construction phase the Consented Scheme could generate up to:
- £2.1 million GVA and 33 job years of employment in Caithness and Sutherland;
 - £25.7 million GVA and 373 job years of employment in Highland; and
 - £71.2 million GVA and 1,071 job years of employment in Scotland.
- 11.6.2 It was estimated that each year during the operation and maintenance phase the Consented Scheme would generate:
- £0.7 million GVA and 11 jobs in Caithness and Sutherland;
 - £2.5 million GVA and 34 jobs in Highland; and
 - £4.5 million GVA and 65 jobs in Scotland.
- 11.6.3 It is expected that there would be community benefit funding of £331,500 annually associated with the Consented Scheme, which would build on the existing Strathly North Joint Community Fund.
- 11.6.4 Throughout its operation, the Consented Scheme would also contribute to local public finances and in this way supporting the provision of public services locally. It was estimated that the Consented Scheme could contribute £1.5 million each year in non-domestic rates.

11.6.5 Residual effects are presented in Table TA11.1.11 which shows that the Consented Scheme would not result in any significant effects.

Table TA11.1.11: Summary of Potential Significant Effects of the Consented Scheme			
Potential Significant Effect (without mitigation)	Mitigation Proposed	Means of implementation/ Timing	Outcome/ Residual Effect
Construction			
Economic Impact in Caithness and Sutherland	n/a	n/a	Temporary minor beneficial (not significant)
Economic Impact in Highland	n/a	n/a	Temporary minor beneficial (not significant)
Economic Impact in Scotland	n/a	n/a	Temporary negligible beneficial (not significant)
Operation			
Economic Impact in Caithness and Sutherland	n/a	n/a	Minor beneficial (not significant)
Economic Impact in Highland	n/a	n/a	Negligible Beneficial (not significant)
Economic Impact in Scotland	n/a	n/a	Negligible Beneficial (not significant)
Payment of Non-Domestic Rates in Highland	n/a	n/a	Negligible Beneficial (not significant)
Decommissioning			
Economic Impact in Caithness and Sutherland	n/a	n/a	Temporary minor beneficial (not significant)
Economic Impact in Highland	n/a	n/a	Temporary negligible beneficial (not significant)
Economic Impact in Scotland	n/a	n/a	Temporary negligible beneficial (not significant)
Cumulative Construction			
Economic Impact in Caithness and Sutherland	n/a	n/a	Temporary minor beneficial (not significant)
Economic Impact in Highland	n/a	n/a	Temporary minor beneficial (not significant)
Economic Impact in Scotland	n/a	n/a	Temporary negligible beneficial (not significant)
Cumulative Operation			
Economic Impact in Caithness and Sutherland	n/a	n/a	Minor beneficial (not significant)
Economic Impact in Highland	n/a	n/a	Negligible Beneficial (not significant)
Economic Impact in Scotland	n/a	n/a	Negligible Beneficial (not significant)



Key
Legend

-  Site Boundary
-  Caithness and Sutherland
-  Highland
-  Rest of Scotland

Shetland and Orkney Islands

Scale 1:1,100,000 @ A3
0 50 Km



Figure 11.1.1
Socio-economic Study Areas

Strathy South Wind Farm
EIAR 2020

TECHNICAL APPENDIX 12 – OTHER ISSUES

TA12.1: Carbon Calculator

TA12.1: Carbon Calculator

STRATHY SOUTH WIND FARM

Technical Appendix 12.1

Carbon Calculator

Prepared for: **SSE Generation Ltd**

BASIS OF REPORT

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CONTENTS

1.0 INTRODUCTION	1
2.0 RESULTS	3
3.0 CONCLUSIONS	4

DOCUMENT REFERENCES

PLATES

Plate 2-1 Estimated Payback Period for 39 No. 5.6 MW Turbines	3
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1.0 Introduction

The 'carbon calculator' is the Scottish Government's tool provided to support the process of determining wind farm developments in Scotland. The purpose of the tool is to assess, in a comprehensive and consistent way, the carbon impact of wind farm developments. This is done by comparing the carbon costs of wind farm developments with the carbon savings attributable to the wind farm.

The assessment presented in this Technical Appendix 12.1 has been produced to provide an update in the carbon emission calculation generated in the construction, operation and decommissioning of the Proposed Varied Development at Strathy South. The carbon calculator spreadsheet and online tool calculates payback time for wind farms sited on peatlands using methods given in Nayak et al, 2008¹ and revised equations for Greenhouse Gas (GHG) emissions (Nayak et al, 2010² & Smith et al, 2011³), and the Wind Farm and Carbon Savings Technical Note⁴ v.2.10.0.

Input Parameters

The carbon calculator (Online version H823-UAJR-7P81) allows a range of data to be input in order to utilise expected, minimum and maximum values, where relevant and applicable. However, if several parameters are varied together, this can have the effect of 'cancelling out' a single parameter change. For this reason, the approach for this assessment, has been to include 'maximum values' as those values which would result in the longest (maximum) payback period; and 'minimum values' as those values which would result in the shortest (minimum) payback period. The expected value is based on the most realistic option for the site.

The final turbine choice is not yet finalised but would likely be 5.6 MW. For this reason, the factors which have been used in this assessment include the following:

- The recommended capacity factor within the calculation spreadsheet has been amended to site-specific values, ranging between 40 and 50 %.
- Site-specific measurements for carbon content of peat have been undertaken previously at the site. The anticipated content of 48% has therefore been used as the expected value. To ensure variations are accounted for with regard to peat, variable parameters have been used, based on those recorded from samples taken on-site, ranging from 38% (minimum) to 56% (maximum). This reflects a range of values typical of the carbon content anticipated from Scottish Peatlands (Birnie et al 1991)⁵. The value of 48% is generally consistent with an average value for Scottish peatlands and is representative of a typical peat from the area. This value is also consistent with peat values researched by Lindsay (2010)⁶.
- Generic hydrological parameters have been used for average groundwater. A value of 0.1 m has been used as the expected value. A 'maximum' value of 0.05 m has been used to represent areas of intact

¹ Nayak D.R., Miller D., Nolan A., Smith P., Smith J.U. (2008) *Calculating carbon savings from windfarms on Scottish peat lands: a new approach*. Scottish Government.

² Nayak D.R., Miller D., Nolan A., Smith P., Smith J.U. (2010) *Mires and Peat*, Article 09 4, 1-23 <http://www.mires-and-peat.net/>, ISSN 1819-754X.

³ Smith J.U., Graves P., Nayak D.R., Smith P., Perks M., Gardiner B., Miller D., Nolan A., Morrice J., Xenakis S., Waldron S., Drew S. (2011) *Carbon implications of windfarms located on peatlands – update of the Scottish Government Carbon Calculator tool*. Final Report, RERAD Report CR/2010/05

⁴ Scottish Government (2016). *Calculating Potential carbon losses and savings from wind farms on Scottish peatlands. Technical Note – Version 2.10.0*

⁵ Birnie R.V., Clayton P., Griffiths P., Hulme P.D., Robertson, R.A., Sloane B.D., and S.A. Ward. (1991). *Scottish peat resources and their energy potential*. Department of Energy

⁶ Lindsay, R. (2010). *Peatbogs and Carbon: a critical synthesis*. RSPB

peat (the higher the water table the longer the payback period), and a 'minimum' value of 0.3 m has been used to represent areas of eroded peat.

- The extent of drawdown on drainage features due to excavations on-site is based on the analysis in the Chapter 10: Soil and Water (EIA Volume 2). Assuming an average peat thickness of 1.23 m then the extent of drawdown around infrastructure, such as turbine bases, roads and crane pads using the site derived permeability values for the peat is an average of approximately 5 m.
- The most recent values for the three required counterfactual factors provided in the online carbon calculator have been included and are: Grid mix: 0.25358 t CO₂ MWh⁻¹, fuel mix: 0.45 t CO₂ MWh⁻¹ and coal: 0.92 t CO₂ MWh⁻¹
- Access tracks. Modifications of track length, the extent of floating road and excavated roads have been used as outlined in Chapter 2: Description of Development (EIA Volume 2).
- Detail regarding the estimated excavation size for turbine foundations and hard standings is provided.
- An estimate of the total volume of concrete has been included, based on an anticipated 860 m³ concrete being required for each foundation.
- The choice of methodology for calculating the emission factors uses the 'Site-Specific methodology' defined within the calculation spreadsheet.

2.0 Results

A summary of the anticipated carbon emissions and carbon payback of the Proposed Varied Development are presented in Plate 2-1.

Plate 2-1
Estimated Payback Period for 39 No. 5.6 MW Turbines

RESULTS	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO₂ eq.)	565,172	292,375	754,425
Carbon Payback Time			
...coal-fired electricity generation (years)	0.7	0.3	1.1
...grid-mix of electricity generation (years)	2.6	1.2	3.9
...fossil fuel-mix of electricity generation (years)	1.5	0.7	2.2
Ratio of soil carbon loss to gain by restoration (not used in Scottish applications)	1.88	0.29	No gains!
Ratio of CO₂ eq. emissions to power generation (g/kWh) (for info. only)	13.13	6.11	19.72

3.0 Conclusions

The calculations of total carbon dioxide emission savings and payback time for the Proposed Varied Development indicates the overall payback period for 39 turbines with an installed capacity around 5.6 MW would be around 0.7 to 2.2 years, when compared to the fossil fuel mix of electricity generation.

This means that the Proposed Varied Development is anticipated to take around 18 months (1.5 years) to repay the carbon exchange to the atmosphere (the CO₂ debt) following its construction; the site would, in effect, be in a net gain situation following this time period and could then claim to contribute to Scottish Government's national objectives on reducing emissions⁷.

The results of the carbon calculator for the Proposed Varied Development can be compared against the Consented Scheme assessment which indicated the overall payback period for 39 turbines with an installed capacity around 3.4 MW would be around -0.5 to 4.6 years, when compared to the fossil fuel mix of electricity generation.

This shows that the Proposed Varied Development would have a significantly shorter estimated maximum payback time.

⁷ Climate Change (Emissions Reduction Targets) (Scotland) Act 2019

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