Chapter 10 Air Quality

10.1 Introduction

1 Changes in air quality have the potential to occur through the release of exhaust emissions from vessels associated with the construction, operation and maintenance, and decommissioning of the development. Other atmospheric effects considered in this section include potential localised changes to meteorology such as fog.

10.2 Guidance and Legislation

2 Neart na Gaoithe will not produce atmospheric emissions from the operation of the permanent infrastructure required for the project. All atmospheric emissions from the project will be produced by the vessels used in the construction and operation phases and latterly the decommissioning phase. In light of this, the only regulations applicable to atmospheric emissions will be the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended).

3 The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 implements Annex VI (Prevention of Air Pollution from Ships) of the International Convention for the Prevention of Pollution from Ships (MARPOL) in the UK and establishes controls on marine engines and marine fuel in order to limit emissions, in particular nitrogen oxides (NO_x) and sulphur dioxide (SO_2). The Neart na Gaoithe Offshore Wind Farm will require various installation and support vessels during its lifetime and all vessels will need to have the appropriate United Kingdom Air Pollution Prevention Certificate (UKAPP) or International Air Pollution Prevention Certificate (IAPP) in place as required.

4 The general assessment method for atmospheric emissions from Neart na Gaoithe has used the approach outlined in Development Control: Planning for Air Quality (2010 update), produced by Environmental Protection UK (Environmental Protection UK, 2010). Although this guidance is primarily for onshore urban assessment, the general approach provides a good structure for the Neart na Gaoithe assessment.

10.3 Data Sources

5 A number of published reports and publically available datasets were used in completing this chapter. Collecting suitable ambient air quality data offshore is difficult and expensive. The inherent difficulty in collecting offshore data, combined with a variety of adjacent onshore ambient air quality and meteorological data, and modelled offshore emissions data, meant it was not considered necessary to undertake an air quality survey within the study area. Full references for the various data sources are provided within the technical report in Appendix 10.1: Air Quality Technical Report.

10.3.1 Desk Study

10.3.1.1 Literature Review

- Department of Energy and Climate Change (DECC) (2011a), The offshore Energy Strategic Environmental Assessment (SEA) 2;
- DECC (2011b), Digest of UK Energy Statistics 2011;
- Department for Environment, Food and Rural Affairs (Defra) (2007), Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Volume 2;
- Intergovernmental Panel on Climate Change (IPCC) (2007), Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change;
- Institute of Petroleum (2000), Guidelines for the calculation of estimates of energy use and gaseous emissions in the decommissioning of offshore structures; and
- Marine Scotland (2010), Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report.

10.3.1.2 Statistical Datasets

6 The following datasets were used in the compilation of this chapter:

- Defra (2010), UK Ship Emissions Inventory;
- Met Office (2011), Royal Air Force (RAF) Leuchars meteorological site 2010 wind analysis data, and Firth of Forth visibility data;
- Scottish Government (2011), Scottish Air Quality Data;
- Mainstream (2011), vessel type and vessel strategy data; and
- National Atmospheric Emissions Inventory (NAEI) Emissions Factor Database (Defra, 2009).

10.4 Engagement and Commitments

10.4.1.1 Strategic and Site Level Requirements

Source	Comment	Relevance/reference
Scoping Opinion (East Lothian Council Advice)	The Environmental Statement (ES) should include an assessment of any micro-climatic changes (changes to local weather systems especially where this may affect the adjacent land area, resulting in changes in biodiversity). Also should include long term effects (including future climate change projections) and cumulative impacts with other proposals. If no impacts are expected please state with description of methodology.	See Section 10.6: Impact Assessment, which details the assessment of Neart na Gaoithe on air quality (including climate change) and meteorological effects. Section 10.8: Cumulative and In-Combination Impacts, considers the cumulative impacts of these effects.
Scoping Opinion (Royal Society for the Protection of Birds (RSPB) Comment)	RSPB Scotland would wish to see details of the full carbon balance budget for the proposed development detailed in the ES. This may include, for example, the amount of carbon required for equipment manufacturing and any carbon dioxide (CO_2) which may leak from the seabed.	Section 1.6: Impact Assessment, considers the effects on climate change from CO_2 emissions. Full consideration of the carbon budget is presented in Appendix 10.1: Air Quality Technical Report and Appendix 10.2 Life Cycle Analysis.

Table 10.1: Strategic and site level commitments and requirements – air quality

10.5 Impact Assessment Methodology

7 The atmospheric emissions associated with the development of Neart na Gaoithe have been assessed using the methodology detailed in Chapter 6: The Approach to Environmental Impact Assessment.

10.5.1 The Rochdale Envelope

8 In assessing vessel emissions a number of scenarios for construction, and operation and maintenance were considered. The Rochdale Envelope parameters of relevance for each scenario were:

- Construction: The construction vessel types, and estimated construction schedules which included the number and frequency of vessel movements based on: the number and type of foundations; the number of wind turbines; the number of collector substations; the length and number of export cables; and the length of array cable required;
- Operation and Maintenance: The maintenance and support vessel types, and estimated maintenance schedules which included the number and frequency of vessel movements based on: annual maintenance requirements for each piece of infrastructure; the number and type of wind turbines and collector substations; the length and number of export and array cables; and
- Decommissioning: As a decommissioning plan has not yet been developed, and is likely to evolve with changes in technology and techniques, decommissioning emissions were conservatively based on the construction parameters, excluding cable emissions which were assumed to be left buried.

9 In considering potential displacement of emissions, the array capacity and predicted capacity factor were considered for each array option.

Project design element	Parameter	Value
Turbine	Capacity	3.6 MW
	Number	128
	Concurrent installation	2 Max
	Installation duration per unit	2 days
Substation	Number	2
	Installation duration per unit	9.5 days
Gravity base foundation	Installation duration per unit	21 days
Inter-array cables	Length	140 km
	Installation duration per unit	79 days
Export cables	Number	2
	Length (per cable)	33 km
	Installation duration per unit	13 days
Vessel parameters		
Installation vessels	Cable laying vessel	
	Cable post-lay burial vessel	
	Diver support vessel	
	Grout support vessel	
	Heavy lift vessel	
	Jack-up installation vessel	
	Pile installation vessel	
	Pre-lay grapnel vessel	
	Rock-dumping vessel	
	Rock-dumping/scour protection vessel	
	Remotely operated vehicle support vessel	
	Safety boat	
	Tug	
Operation and maintenance vessels	Sea energy marine	
	Catamaran	
	Jack-up	

Table 10.2: Rochdale Envelope worst (realistic) case parameters for air quality

10.5.2 Study Area

10 Due to the nature of their potential impacts, atmospheric emissions have been assessed at the local (less than 5 km), regional (100s of kilometres), and global level. At a local level, effects on mass emissions and meteorology have been considered within the study area. At a regional and global level, effects have been considered in context with other national level vessel emissions.

10.5.3 The Approach to Impact Assessment

10.5.3.1 Magnitude of Effect

11 Table 10.3 below details the magnitude of effects criteria. As noted in Section 10.4.2 air quality effects can be local, regional and global in nature, and this is reflected in the definitions of the different category levels.

12 Magnitude of effects associated with construction and decommissioning have been considered in the context of individual installations (i.e., individual foundations and wind turbines), due to their temporal and spatial distribution.

Characteristic	Categories	Definition/description
Spatial Extent (S)	Negligible	Effects are likely to be noticeable between 0 - 5 km.
	Low	Effects are likely to be noticeable between 5 - 20 km.
	Medium	Effects are likely to be noticeable from 20 - 100s of km.
	High	Effects are likely to be noticeable from 100s of km.
Duration (D)	Negligible	Effects likely to last from hours – days.
	Low	Effects likely to last from days to weeks.
	Medium	Effects likely to last from weeks to months.
	High	Effects likely to last from months to years.
Frequency (f)	Negligible	Less than 1 occurrence per year.
	Low	Between 1 occurrence per year and 1 per month.
	Medium	Between 1 occurrence per month and 1 per week.
	High	Occurs every day.
Severity (v)	Negligible	Less than 10% change on baseline values.
	Low	Between 10 - 25% change on baseline values.
	Medium	Between 25 – 50% change on baseline values.
	High	Greater than 50% change on baseline values.

Table 10.3: Magnitude of effect category definitions for air quality

10.5.3.2 Vulnerability

13 Table 10.4 details the characteristics of vulnerability used to develop a view of the overall significance of any effects arising as a result of the proposed development.

Characteristic	Categories	Definition/description
Adaptability (A)	None	No change to normal behaviour and/or little effort.
	Low	Requires/results in small changes to normal behaviour and/or some effort.
	Medium	Requires/results in change to normal behaviour and/or great effort.
	High	Impossible to avoid or adapt.
Tolerance (T)	None	No effect on quality of life/health.
	Low	Minor effect on quality of life/health.
	Medium	Moderate effect on quality of life/health.
	High	Major effect on quality of life/health.
Recoverability (R)	None	Recovery within hours.
	Low	Recovery within weeks.
	Medium	Recovery within months.
	High	Recovery within years/no recovery.
Value (V)	None	Common and locally abundant species.
	Low	Nationally/internationally common but locally rare species.
	Medium	Protected species.
	High	Protected and rare species.

Table 10.4: Vulnerability of receptor category definitions for air quality

10.5.3.3 Overall Significance

14 In assessing the overall significance some consideration has been given to the potential for more than one activity (e.g., multiple foundation installation) occurring at the same time, and within the same vicinity.

10.5.4 Cumulative and In-Combination Impact Assessment Approach

15 Effects of cumulative and in-combination atmospheric emissions at a local scale can be reasonably well defined and considered. The cumulative effects associated with other offshore wind farms in the region; the Inch Cape Scottish territorial waters (STW) development and the Firth of Forth Round 3 Zone 2 development (refer to Chapter 5: Project Description for more information), have been considered at a regional and global level. However, the regional and global nature of effects associated with atmospheric emissions, make it difficult to define a boundary where other projects could, or could not, be reasonably considered to contribute to in-combination emissions.

16 Because of the difficulty in defining an in-combination boundary - and in the case of CO_2, the uncertainty of the potential impacts - it is not considered reasonable in the context of this development to try to assess the cumulative significance of global CO_2 emissions, or the potential long-range transboundary impacts of national NO_X and SO_2 emissions. These issues are being considered and managed through international agreements such as the Kyoto Protocol and the United Nations Economic Commission for Europe (UNECE) convention on long-range transboundary air pollution.

10.7 Baseline Description

10.7.1 Site-Specific

17 Within Neart na Gaoithe, emissions considered will be those generated by vessels used in the construction, operation and maintenance, and decommissioning phases of the wind farm. The pollutants of concern from these sources are NO_X, SO_2, and CO_2. Air quality data concerning these pollutants are not collected offshore, however it is possible to use modelled emissions data and monitored onshore data to estimate the baseline conditions in an offshore area.

18 Additional information is available in Appendix 10.1: Air Quality Technical Report.

10.7.1.1 Air Quality

Mass Emissions

19 The Defra UK ship emissions inventory (Defra, 2010) used shipping movements within waters surrounding the UK to create a 5 km x 5 km grid of atmospheric emissions based on 2007 shipping data. Figures 10.1 to 10.3 present the annual NO_X, SO_2, and CO_2 mass emissions data from the UK ship emissions inventory that corresponds to Neart na Gaoithe and the surrounding area.

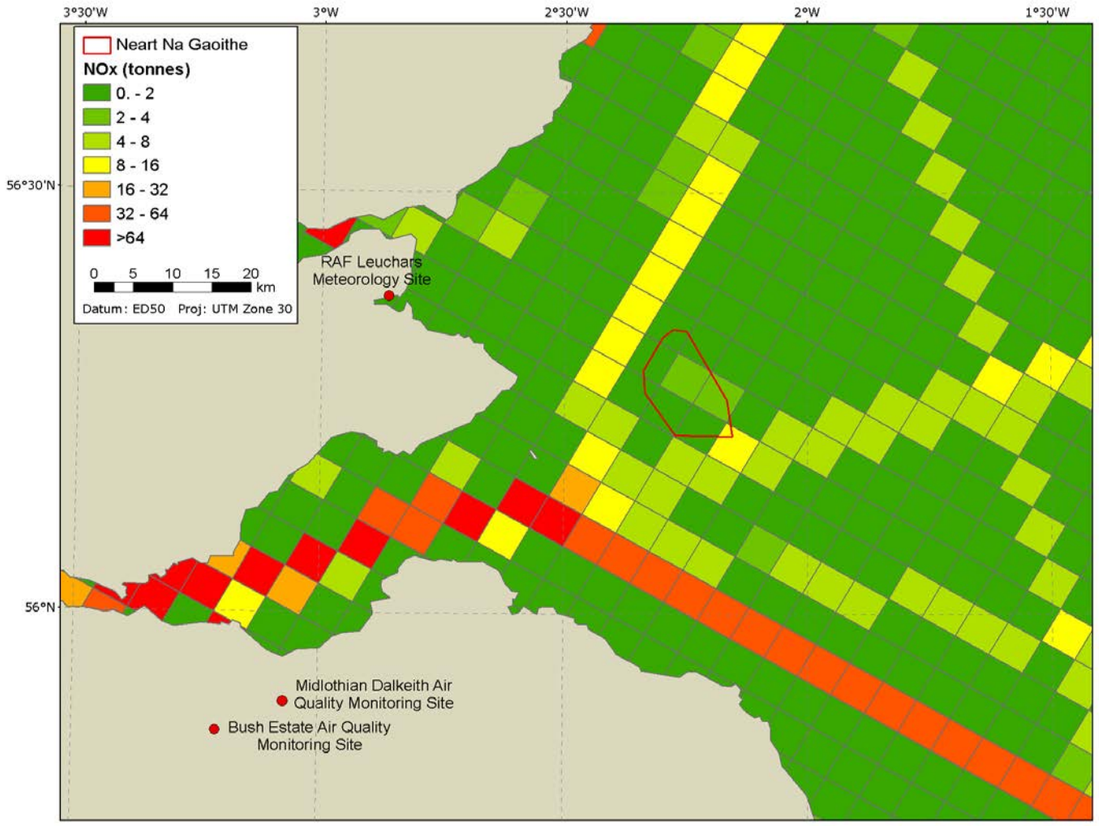

Figure 10.1: Annual mass emissions of NO_X within Neart na Gaoithe and the surrounding area in 2007

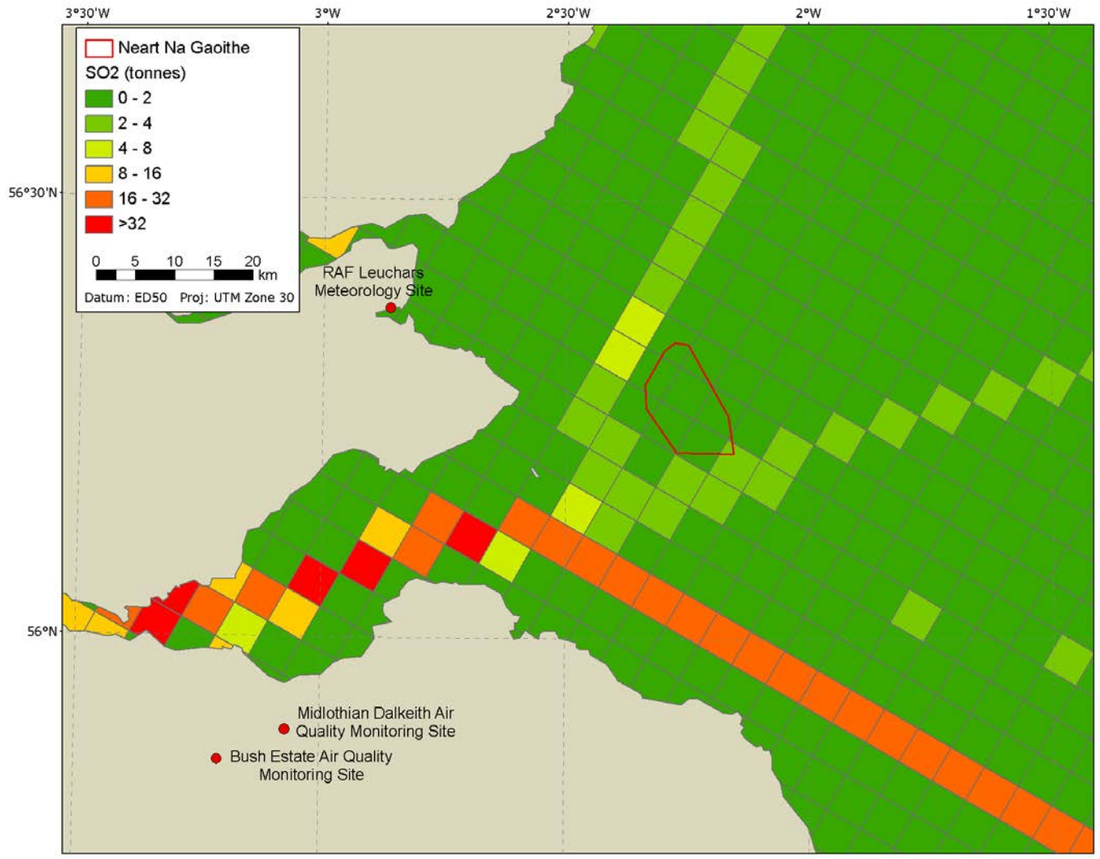

Figure 10.2: Annual mass emissions of SO2 within Neart na Gaoithe and the surrounding area in 2007

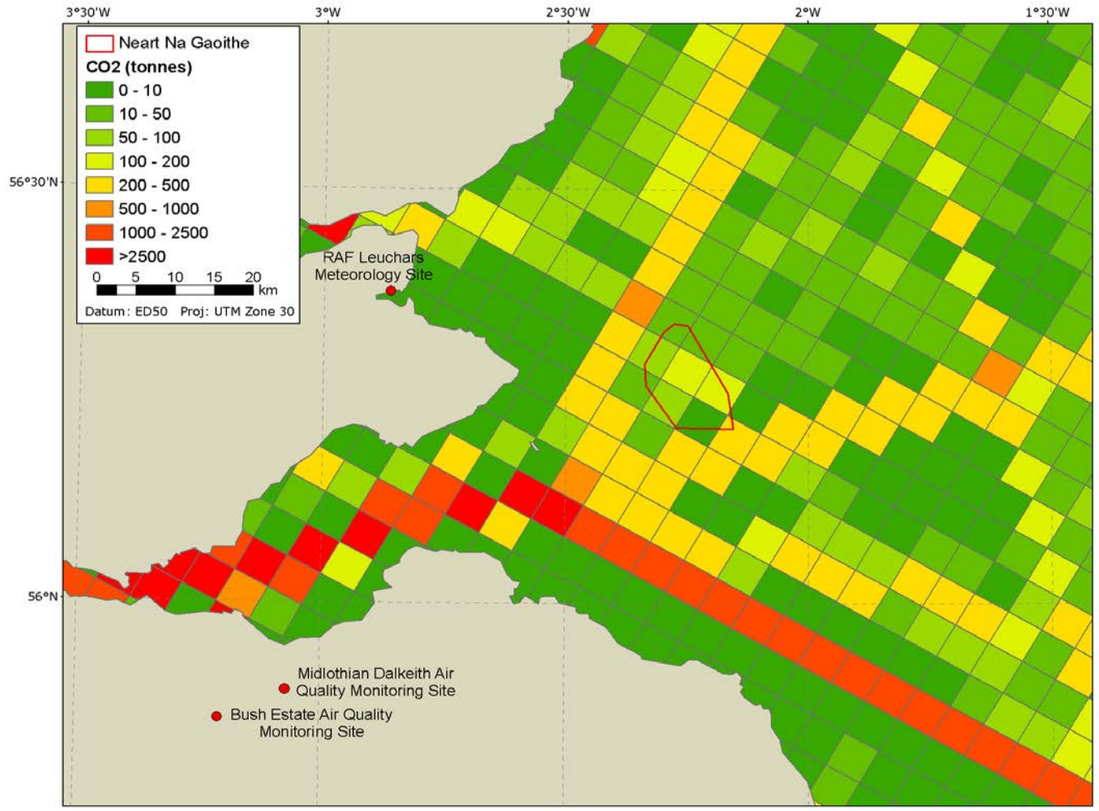

Figure 10.3: Annual mass emissions of CO_2 within Neart na Gaoithe and the surrounding area in 2007

20 The total annual mass emissions of NO_X, SO_2, and CO_2 within the study area in 2007 (most recent available data) are presented in Table 10.5. The data represent the effective baseline for emissions within the study area. Full details of the calculations are provided in Appendix 10.1: Air Quality Technical Report. As vessel emissions associated with the cable route will be a very minor contributor to the total development emissions, the cable route has not been included in the baseline calculation.

Gaseous emission	Total annual emissions (tonnes (t))
NO_X	7.33
SO_2	2.60
CO_2	340.38

Table 10.5: Total modelled annual mass emissions within Neart na Gaoithe

Concentrations

21 The Scottish Government reports air quality data from a number of sites throughout Scotland. Each site is set up to meet various objectives (e.g., ecosystem impacts, or identifying vehicle pollution areas). The pollutants recorded at each monitoring site will be dependent on the site's objective as not every site records the full range of pollutants. This means that to obtain assumed background concentrations for Neart na Gaoithe, data need to be sourced from more than one alternative equivalent location. Two sites were used: Bush Estate (for NO_2) and Midlothian Dalkeith (for SO_2). Both sites showed maximum values to be well below UK air quality standards. As CO_2 is not considered to be a direct local or regional health issue, CO_2 measurements are not recorded locally.

10.7.1.2 Meteorology

Wind Regime

22 The site meteorological conditions will have an effect on the movement of atmospheric emissions as they are released, helping to disperse the emissions. The data used for the assessment of wind speed and direction were obtained from the RAF Leuchars monitoring site (see Figure 10.1 for the location).

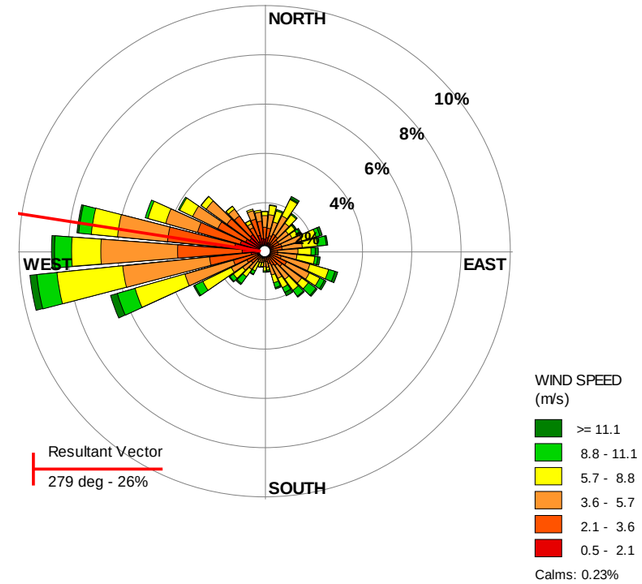

Figure 10.4: 2010 wind rose for RAF Leuchars meteorology site

23 A wind rose plots the frequency of wind from a particular direction, and uses coloured bands to show wind speed ranges. The RAF Leuchars data show a predominant westerly wind direction (see Figure 10.4), with a resultant vector of 279° - this direction is away from the local coast. Offshore winds tend to be more stable and stronger than onshore winds, hence the wind speeds at the Neart na Gaoithe site are expected to be higher than those recorded at RAF Leuchars monitoring site, however wind direction will be comparable.

Visibility

24 Visibility data are recorded by the UK Met Office for the Firth of Forth - a summary of the recorded observations between 1981 and 2010, are presented in Table 10.6. Visibility of less than 1 km is considered to be fog. The observed data (Table 10.6) shows that conditions of fog have occurred 1.1% of the time between 1981 and 2010.

Parameter	Measurement									
Visibility (m)	0 - 40	50 - 190	200 - 490	500 - 990	1000 - 1990	2000 - 3990	4000 - 9990	10000 - 19990	20000 - 49990	50000 +
Occurrence (%)	0.1	0.5	0.2	0.3	0.6	1.5	8	27	56.4	5.4

Table 10.6: Firth of Forth visibility data 1981 - 2010

10.8 Impact Assessment

25 Mass emissions from the three main stages of the offshore wind farm development (construction, operation and maintenance, and decommissioning) have been determined through an emissions inventory, and the realistic worst case assessed. The emissions inventory was compiled using infrastructure data (number of turbines, number of collector substations, foundation type, and length of cables), vessel type, and vessel strategy data identified in the Rochdale Envelope.

26 Emission factors for the calculation of the emission inventories have been taken from the NAEI Emissions Factor Database (Defra, 2009). The emission factors used were for IPPC definition international shipping, consuming fuel oil. Vessel fuel consumption values are based on average consumption values for vessels in the Institute of Petroleum guidelines (Institute of Petroleum, 2000) and estimates provided by the developer. Full calculations and summary tables are detailed in the technical report in Appendix 10.1: Air Quality Technical Report. Potential impacts on local meteorology have also been considered in the operational stage of the development.

10.8.1 Impact Assessment – Construction

10.8.1.1 Offshore Site and Export Cables Route

Air Quality

27 Effects on air quality at the construction stage of the development have the potential to impact on marine species and humans at the local level, as well as a wide variety of habitats and species at the regional and global level (through acid deposition and climate change).

28 Meteorological effects only have the potential to occur once Neart na Gaoithe is operational, as such they have not been considered in the assessment of construction impacts.

29 Total construction emissions associated with Neart na Gaoithe are presented in Table 10.7 below. The estimate uses the most likely worst case scenario of gravity base foundations, and assumes that the installation of the foundations and turbines is evenly distributed across two years, and the substation and all cable installation, occurs in the first year.

Development year	Total fuel use (t)	Total emissions (t)		
		CO_2	NO_X	SO_2
1	141,761	456.9	11.0	7.6
2	14,185	45.7	1.1	0.8

Table 10.7: Annual Neart na Gaoithe construction emissions

30 The assessment of the significance of these impacts is summarised in Table 10.8.

Source	Pathway	Receptor	Magnitude of effect	Vulnerability of receptor	Significance of impact	Qualification of significance
Exhaust emissions from construction vessels	Inhalation	Marine mammals and humans	Negligible	Negligible	Not significant	Installation activities will be of short duration and spatially distributed. For most vessels being used, elevated concentrations would only be detectable 10s of metres away. A conservative estimate of the worst-case vessels (jack-ups, due to the elevated exhaust height) would lead to short term elevated concentrations of pollutants that are unlikely to be detectable beyond 1.5 km. Human receptors include other sea users and Neart na Gaoithe offshore staff - emissions will not be detectable onshore. The dispersive nature of offshore winds means concentrations of pollutants will return to background levels quickly.
NO_X and SO_2 emissions from construction vessels	Acid deposition	Multiple	Negligible	Negligible	Not significant	Impacts from these pollutants cover a large geographical extent. However, these pollutants will not result from the emissions associated with the Neart na Gaoithe development in isolation, which alone, would represent an insignificant contribution to total emissions. Acid deposition occurs in the form of "acid rain" and can result in the acidification of soil and water sources 100s of kilometers from the source. Note, once operational Neart na Gaoithe is likely to have a net negative effect on these emissions through displacing traditional fossil fuel powered electricity generation.
CO_2 emissions from construction vessels	Climate change	Multiple	Negligible	Negligible	Not significant	Impacts from these pollutants cover a large geographical extent; however the effects of climate change will occur incrementally over a long period, and will not result from the emissions associated with the Neart na Gaoithe development in isolation - which would represent an insignificant contribution to total global emissions. The slow process of climate change provides time for adaptation. Note, once operational Neart na Gaoithe is likely to have a net negative effect on these emissions through displacing traditional fossil fuel powered electricity generation.

Table 10.8: Impact assessment conclusions for construction phase for air quality

10.8.2 Impact Assessment – Operation and Maintenance

10.8.2.1 Offshore Site and Export Cables Route

31 The ongoing operation and maintenance emissions for Neart na Gaoithe are much lower than the emissions associated with the construction. Additionally, once operational Neart na Gaoithe will be generating electricity which will provide a net negative contribution towards CO_2, NO_X, and SO_2 emissions, through the potential reduction in electricity generation from traditional thermal generation stations. As such, the assessment for construction impacts will also apply to operation and maintenance (and may provide a net positive impact), and is not presented in Table 10.11.

32 Potential meteorological effects due to the operation of the blades have been considered and the impacts assessed in Table 10.11.

33 Total operation and maintenance emissions associated with Neart na Gaoithe are presented in Table 10.9 below. The estimate uses the most likely worst case scenario of a "mother vessel" strategy. These emissions do not include the potential reduction in emissions associated with the displacement of traditional thermal generation sources.

Development year	Total fuel use (t)	Total emissions (t)		
		CO_2	NO_X	SO_2
Each Operational Year	1,694	5,460.4	131.7	91.4

Table 10.9: Annual Neart na Gaoithe operational emissions

34 Equivalent annual emissions of CO_2, NO_X, and SO_2 from Neart na Gaoithe and other traditional thermal generation sources are presented in Table 10.10 below. The estimate is based on the most likely worst case prediction for Neart na Gaoithe electricity generation (i.e., the lowest predicted gigawatt hours (GWh) per year). It should be noted that the coal and gas emissions relate only to emissions from fuel burnt, and do not take into account other sources of emissions associated with thermal power generation such as collection, processing, and transport of fuel, and emissions associated with maintenance.

Generation source	Total annual emissions (t) for equivalent GWh		
	CO_2	NO_X	SO_2
Neart na Gaoithe	5,460.4	131.7	91.4
Coal	1,303,687.8	2,614.5	2,046.6
Natural Gas	570,811.6	1.0	N/A

Table 10.10: Equivalent annual emissions for equivalent GWh

35 Table 10.11 details the summary significance.

Source	Pathway	Receptor	Magnitude of effect				Vulnerability of receptor				Significance of impact	Qualification of significance
			S	D	f	v	A	T	R	V		
Wind turbines	Spinning of blades creating/enhancing sea fog	Humans and Birds	Negligible				Negligible				Not Significant	It is considered unlikely that wind turbines would create additional fog, however they may enhance the effect local to turbines, under conditions where fog is already present. Given the low percentage of fog in the Firth of Forth this is not considered significant.

Table 10.11: Impact assessment conclusions for operation and maintenance phase for air quality

10.8.3 Impact Assessment – Decommissioning

10.8.3.1 Offshore Site and Export Cables Route

36 A detailed decommissioning plan will be developed following the submission of the ES and full details are not currently available. As a result of this, effects associated with the decommissioning of Neart na Gaoithe have been considered to be identical to those associated with the construction with the exception of array and export cables emissions which it has been assumed will be left buried. As such the impact assessment is identical to that presented in Table 10.8.

37 Total decommissioning emissions are presented in Table 10.12 below.

Decommissioning year	Total fuel use (t)	Total annual emissions (t)		
		CO_2	NO_X	SO_2
27	65,810	212.1	5.1	3.5
28	72,635.0	234.1	5.6	3.9

Table 10.12: Annual Neart na Gaoithe decommissioning emissions

10.9 Mitigation and Residual Impacts

38 As all atmospheric emissions associated with the development are from vessel emissions, total emissions will be reduced by taking total vessel emissions/fuel use into account when designing the final installation, operation and maintenance, and decommissioning strategies to minimise as far as practicable the number of vessel movements and installation time required. Additionally, all vessels employed during the project development will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 and where sensible, contracts with the vessels will include a requirement for energy management, to minimise energy usage.

39 The mitigation outlined will have a minimal effect on the final impact assessment and will not change the final significance ratings. The effects on air quality from Neart na Gaoithe are considered to have no more than an insignificant impact and during operation a potentially positive impact, and further mitigation options are unnecessary. No mitigation options are considered necessary for localised meteorological impacts.

10.10 Cumulative and In-Combination Impacts

40 At a local level cumulative impacts from other offshore wind farm developments would only arise where other construction or decommissioning activities are being undertaken within a very close temporal and spatial scale. It is likely that the Inch Cape offshore wind farm and the Round 3 Firth of Forth Zone 2 development will have some construction activities occurring at the same time. However, due to the nature of atmospheric dispersion (i.e., separated sources would, for the most part, have their emissions carried in the same direction, rather than toward each other), it is highly unlikely that even activities being undertaken at the same time, within a few hundred metres, would have any additional noticeable effect. Receptor sensitivity remains the same; as such, the significance rating for cumulative impacts at the local level is considered to remain insignificant. This also applies to potential in-combination impacts from other industry/commercial/recreational vessels, and there are no other significant emission sources with the potential to contribute to local pollutant levels at Neart na Gaoithe.

41 At a regional and global level, cumulative impact from atmospheric emissions associated with the installation, operation, and decommissioning of other offshore wind farm developments, would still not contribute significantly to the total CO_2, NO_X, and SO_2 emissions released into the atmosphere within the UK or globally, and once operational each development is likely to provide a net negative impact on regional and global CO_2, NO_X, and SO_2 emissions, through the displacement of traditional thermal sources of electricity generation.

42 In-combination impacts on a regional and global scale could potentially include: other industry/commercial/recreational vessels, oil and gas projects, and onshore UK emission sources such as power stations (or in the case of climate change - all global CO_2 and greenhouse gas emissions). However, it is not reasonable in the context of this development to try and assess the significance of global CO_2 emissions, or the potential long-range transboundary impacts of national NO_X and SO_2 emissions. These issues are being considered and managed through international agreements such as the Kyoto Protocol and the UNECE convention on long-range transboundary air pollution, and as such are beyond the scope of this assessment.

10.11 Monitoring

43 No ongoing monitoring of atmospheric emissions or air quality is considered necessary at Neart na Gaoithe.

10.12 Summary and Conclusions

44 Atmospheric emissions associated with the construction, operation and maintenance, and decommissioning of Neart na Gaoithe are a result of the exhaust emissions of the various vessels required at each stage. Emissions associated with the development are only from vessels, which will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, and vessel efficiency will be taken into account in designing the final installation, operation and maintenance, and decommissioning strategies to minimise as far as practicable the number of vessel movements and installation time required. These factors ultimately mean that the effects on air quality are considered to be as low as reasonably practical (ALARP).

45 Neart na Gaoithe will have no more than an insignificant impact on air quality throughout the life of the project, with the largest impacts occurring during the construction phase. Once operational Neart na Gaoithe is likely to have a net positive effect on regional and global air quality, in particular a reduction in CO_2 emissions where they replace traditional thermal generation sources.

46 Effects on local meteorology could potentially occur in the form of enhancement of sea fog. It is not considered likely that the operation of the wind turbines will create additional fog. Given the low percentage of fog conditions recorded in the Firth of Forth the potential enhancement of fog is not considered to be a significant impact.

47 It is considered highly unlikely that there would be any cumulative or in-combination effects at a local level. The assessment outcomes indicate that cumulative effects at a regional and global level would not be significant and once operational, the cumulative effects of Neart na Gaoithe, Inch Cape and the Round 3 Firth of Forth Zone are likely to have a positive effect. An in-combination boundary is difficult to define or assess due to the global and regional nature of air emissions. These issues are being considered and managed through international agreements such as the Kyoto Protocol and the UNECE convention on long-range transboundary air pollution, and as such are considered to be beyond the scope of this assessment.

48 A summary of the final significance ratings of the impacts associated with air quality and local meteorology is presented in Table 10.13.

Source	Pathway	Receptor	Significance	Mitigation	Significance post mitigation	Cumulative/in-combination impact significance	Qualification of significance
Exhaust Emissions from Vessels	Inhalation	Marine mammals	Not significant	Efficiency considered in construction, operation and maintenance, and decommissioning strategies.	Not significant	Not significant	None.
Exhaust Emissions from Vessels	Inhalation	Humans	Not significant	Efficiency considered in construction, operation and maintenance, and decommissioning strategies.	Not significant	Not significant	None.
NO_X and SO_2 Emissions from Vessels	Acid deposition	Multiple	Not significant (once operational may have positive effects)	Efficiency considered in construction, operation and maintenance, and decommissioning strategies.	Not significant (once operational may have positive effects)	Cumulative effects are considered to be: Not significant. In-combination impacts have not been assessed	It is not reasonable in the context of this development, to try and assess the significance of global CO_2 emissions, or the potential long-range transboundary impacts of national NO_X and SO_2 emissions. These issues are being considered and managed through international agreements such as the Kyoto Protocol and the UNECE convention on long-range transboundary air pollution, and as such are beyond the scope of the local developer.
CO_2 Emissions from Vessels	Climate change	Multiple	Not significant (once operational is likely to have positive effects)	Efficiency considered in construction, operation and maintenance, and decommissioning strategies.	Not significant (once operational may have positive effects)	Cumulative effects are considered to be: Not significant. In-combination impacts have not been assessed	
Wind Turbines	Spinning of blades creating/enhancing sea fog	Humans and birds	Not significant	None	Not significant	Not significant	There is very little published evidence of turbines creating fog, however there is some anecdotal evidence which is further detailed in: Appendix 10.1: Air Quality Technical Report and Appendix 10.2 Life Cycle Analysis.

Table 10.13: Impact assessment conclusions for air quality

10.13 References

DECC (Department of Energy and Climate Change), 2011a. *The Offshore Energy Strategic Environmental Assessment 2 Post Consultation Report*. Department of Energy and Climate Change.

DECC (Department of Energy and Climate Change), 2011b. *Digest of UK Energy Statistics 2011*. Department of Energy and Climate Change. London, TSO.

Defra (Department for the Environment and Rural Affairs), 2007. *Air Quality Strategy for England, Scotland, Wales and Northern Ireland. V*olume 2. London, TSO. Available online from: *http://www.defra.gov.uk/publications* [accessed 18 Oct 2011].

Defra (Department for the Environment and Rural Affairs), 2009. *National Atmospheric Emissions Inventory Emission Factors Database*, Defra. Available online from: *http://naei.defra.gov.uk/emissions/* [accessed 27 Oct 2011].

Defra (Department for the Environment and Rural Affairs), 2010. *UK Ship Emissions Inventory.* London, Defra.

Environmental Protection UK, 2010. *Development Control: Planning For Air Quality (2010 Update)*. Brighton, Environmental Protection UK.

Institute of Petroleum, 2000. *Guidelines for the Calculation of Estimates of Energy use and Gaseous Emissions in the Decommissioning of Offshore Structures*. London, Institute of Petroleum.

IPCC (Intergovernmental Panel on Climate Change), 2007. *Summary for Policy Makers*. In*: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available online from: *http://www.ipcc.ch/publications_and_data* [accessed 18 Oct 2011].

Mainstream, 2011. Duncan, A. (ahd01@emulimited.com), 19 September 2011. *FW: NnG - Rochdale Envelope.* Email to L. Furniss (lance.furniss@xodusgroup.com).

Marine Scotland, 2010. *Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters, Volume 1: Environmental Report*. Edinburgh, Marine Scotland. Available online from: http://www.scotland.gov.uk/Resource [accessed 27 Oct 2011].

Met Office, 2011. *RAF Leuchars monitoring site ADMS 4 Dataset*. Fitzroy Road, Exeter, Met Office.

Scottish Government, 2011. *Scottish Air Quality Data.*

Appendices

Appendix 10.1: Air Quality Technical Report

Appendix 10.2: Life Cycle Carbon Analysis