9 Air quality

9.1 Introduction

This chapter provides a qualitative assessment of potential impacts of the AMETS on air quality during the construction, operational and decommissioning phases.

Construction relates to the offshore marking of the test areas at the fifty and one-hundred metre water depths, the cable laying operations and the WEC deployment, mooring and recovery operations. Vessel emissions associated with these activities are not anticipated to contribute significantly to national air emissions and their impacts are predicted to be negligible. Similar emissions related to offshore activities will occur during the operational and decommissioning phases, but again their impact overall will be negligible.

Onshore activities will include cable duct installation, cable joint bay construction and substation site construction and landscaping. Emissions from construction equipment and traffic associated with the site will arise principally during the construction and decommissioning phases, as traffic during the operational phase will be low. Overall impact is again predicted to be negligible following the implementation of mitigation measures incorporated into the site construction plan.

9.2 Approach and methodology

Potential impacts and mitigation measures have been identified using background data from other marine energy test sites, such as EMEC, professional experience of impacts associated with marine and onshore construction works and appropriate mitigation measures from previous projects.

The significance of impacts on air quality has been assessed taking account of the magnitude of change and the importance and/or sensitivity of the receptor.

The **magnitude** of an impact can be defined as large, medium, small or negligible.

- Large impacts have effects on a global, continental or national scale
- Medium impacts have effects on a regional scale
- Small impacts have effects on a small area, within a 1–5km radius from the source
- Negligible impacts have effects that are limited to the immediate vicinity (less than 1km) of the source.

Receptor **sensitivity** can be described as high, medium or low.

- High-sensitivity receptors include designated areas, public buildings and industries with very high air-quality requirements
- Medium-sensitivity receptors include schools, small enterprises and residential areas
- Low-sensitivity receptors include farmland and heavy industry settings.

The **significance** of an impact is classified as very significant, moderate, slight or none.

- Very significant impacts cause irreversible change with possible extensive effect over wide areas over a long time period (greater than twenty years)

- Moderate impacts create effects that are just outside the accepted limits of normal variation, with some effects that are either contained or have small impact offsite. They may also be observed within a medium time-period (five to ten years).
- Slight impacts create effects that are only just detectable within the site and surrounding areas over a short timescale (less than ten years)
- Impacts whose effects are not readily noticeable are classified as 'None'.

9.3 Baseline and receiving environment

9.3.1 Baseline air quality

The Environmental Protection Agency (EPA) is an independent public body charged with the statutory protection of the environment in Ireland. In conjunction with individual local authorities, it undertakes ambient air quality monitoring at specific locations throughout the country in both urban and rural environments. It prepares an annual air quality report based on data from twenty-eight monitoring stations and a number of mobile air quality monitoring units. Air quality data is also provided by the Mace Head Coastal Research Station (53° 19'N, 9° 54'W) operated by NUI Galway, near Carna on the west coast. This station is an important Global Atmosphere Watch (GAW) measurement site and is designated as a clean marine background station for atmospheric aerosol research. It contributes to the World Data Centre on Greenhouse Gases.

The EPA's most recent report, *Air Quality in Ireland 2010 – Key Indicators of Ambient Air Quality* (published in 2011), indicates that, overall, air quality in Ireland continues to be good and remains the best in Europe. Measured values of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM10 and PM2.5), heavy metals, benzene and polycyclic aromatic hydrocarbons (PAH) were all below limit and target values set out in the Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (transposed into Irish law by the Air Quality Standards Regulations 2011 – SI 180 of 2011), and the 4th Daughter Directive. The report noted, however, that levels of particulate matter and nitrogen dioxide (NO_2) continue to remain of concern, and levels of polycyclic aromatic hydrocarbons (PAH) are a possible concern for the future in some areas. PAH arise from domestic fuel burning and vehicle exhaust emissions.

Traffic is identified as the primary source of nitrogen dioxide and is also one of the main sources of particulate matter. Domestic solid fuel use is also identified as a main source of particulate matter in air in Ireland, with particular impact on air quality in areas where the sale of bituminous coal is permitted. As a result, the level of particulate matter in smaller towns is similar or higher to that seen in cities, where the sale of bituminous coal is banned.

The national air quality network includes a station at Castlebar in Co. Mayo, where NOx, NO_2, O_3 and PM10 are monitored. At this station, annual mean of NOx was 17 µg/m^3 which is below the limit value of 30µg/m^{3,} and of NO_2 was 10 µg/m^3 which is below the limit value of 40 µg/m^3. The annual mean of 8-hour mean concentrations of ozone was 49 µg/m^3, against a target limit of 120 µg/m^3 on no more than 25 days averaged over three years. The mean concentration of particulate matter (PM10) was 15 µg/m^3, below the annual limit value of 40 µg/m^3.

Other air quality indicators measured as part of the national network included the following:

- Sulphur dioxide: 2010 concentrations were well below the daily limit of 125 µg/m3
- CO: well below the limit of 10,000 µg/m3

- PM2.5 or 'fine' particulate matter: below both the stage one and stage two limit values of 25 µg/m3 and 20 µg/m3
- Benzene: below the annual limit of 5 µg/m3
- Heavy metals (lead, arsenic, cadmium, nickel): all below the limit values for these metals. Although mercury was measured at one site, there is no target deposition value set in the Directive.

Since air quality targets are being met across the country, particularly in urban settings such as Castlebar, it is assumed that air quality is also satisfactory in the Belmullet region, a less densely populated area.

9.3.2 Receiving environment

The receiving environment will be the marine area where the AMETS test areas are located, the place where the cable ship will land the cable, and the location of the substation. The nearest potential receptors are likely to be the existing residential premises close to Belderra Strand and the substation location in the Cross area, and the recreational users of the area.

9.4 Potential impacts

9.4.1 Construction phase – onshore

During the construction phase, there is potential impact at the cable landing location, the cable joint bay location and the substation construction site.

Plant exhaust emissions and dust emissions could arise from construction works associated with the cable landfall activities as follows:

- Excavation of four trenches from the low-water mark at Belderra Strand to the cable interface transition joint bay located behind the car park at the road; installation of cable ducts
- Excavation of the area at the car park; installation of the cable interface transition joint bay
- Excavation of a trench from the cable interface transition joint bay to the substation through the field in which the substation will be located; installation of cable ducts
- Casting of concrete cable interface transition joint bay, involving concrete delivery, formwork erection, pouring and vibration of concrete
- Winching of the four cables to shore, using a 20-tonne winch
- Backfilling of all excavations using backhoes

Plant exhaust emissions and dust emissions could also arise from construction works associated with the substation and access road construction as follows:

- Site preparation works, including topsoil removal and storage, rock breaking and contouring
- Removal of excess spoil from the construction site
- Delivery of road-making materials; construction of the access road
- Concrete foundation work involving delivery of concrete loads, formwork, concrete pouring and vibration

- Delivery of materials for substation construction (concrete blocks, cladding, slates, timber, glass)
- Construction of the substation building fabric; fitting out
- Delivery and installation of the substation transformer
- Construction of earthen berms; landscaping
- Road reinstatement works

Emissions to air from construction and staff vehicles travelling to and from the site will also occur, with a small number of additional vehicle movements per day predicted for the local L5233 road and the R313 from Binghamstown to Belmullet during the construction phase. It is likely that construction of the substation will occur in parallel with the installation of the cable ducts and the construction of the cable interface joint bay. The substation construction is predicted to take six months overall, with cable ducting and joint bay requiring a much shorter period.

Potential impacts from fugitive dust and resultant nuisance impacts are likely to be insignificant. Construction of the small cable interface joint bay is predicted to take about one month. Cable duct trenches are estimated to take about two weeks to complete. Any emissions will therefore be temporary in nature. Construction plant will satisfy relevant national legislative requirements with respect to emission standards; this will be ensured through proper maintenance of equipment. The level of increased traffic along the L5233 and the R313 will be relatively low (Chapter 11) and the resultant increased emissions to air are unlikely to result in significant impacts on recreational users or local residents. It is also unlikely that increased traffic and construction activities will result in any breach of national air quality standards protective of human health, given that national background concentrations are well below the limits set in those standards.

9.4.2 Construction phase – offshore

Offshore activities by their nature are weather-dependent, and the estimates for the duration of construction and vessel operation on-site are based on acceptable weather conditions. Should inclement weather conditions result in more prolonged vessel activity, the predicted emissions will increase accordingly, but will still be insignificant in terms of potential impact on receptors in the area.

The cable landing operation is anticipated to involve one cable laying vessel, a guard vessel and several small support vessels. It will involve cable collection and transport to the test site, as well as initial route clearance by a suitably sized vessel using grapnels along the proposed cable corridor from the 100m test area location.

As four cables are to be deployed, it is anticipated that four grapnel runs will be required (two to the 100m water depth test area and two to the shallower test area).

Cables will then be deployed along the cleared routes. Four cable runs will be required. Cables will subsequently be protected by burial, requiring an additional four vessel runs, or by rock armouring over a total of approximately 8km. A post-lay cable survey will be undertaken to confirm the cable position and protection.

Estimates of total fuel consumption for offshore operations are provided in Table 9-1(based on the number of days required for each task by various cable construction vessels). The operational time for offshore vessels totals 208 days. It is likely that some vessel operations will

occur simultaneously, so this is likely to be an overestimation of the actual duration of offshore operations.

Table 9-1: Estimates of fuel consumption – construction phase, offshore

Vessel	Duration (Days)	Fuel consumption * (tonnes)
Cable collection	90	1,215
Pre-lay grapnel run	14	189
Offshore cable laying	30	405
Guard vessel	30	405
Cable burial	20	270
Rock armouring	20	270
Post-lay survey	4	54
Total	**208**	**2,808**

** Based on typical consumption of 15m^3/d for cable laying vessels and a marine fuel density of 900Kg/m^3*

DEFRA's *UK Greenhouse Gas Inventory, 1990 to 2005* (published in April 2007) provides emission factors for the combustion of liquid fuels for coastal shipping and international marine fuel. Emission factors for carbon, nitrogen oxides (NOX), SO_2, CO and non-methane volatile organic compounds (NMVOC), as published in the DEFRA inventory, are presented in Table 9-2.

Table 9-2: Estimated emissions to air – construction phase, offshore

Component	Emission factor (Kg/tonne)	Estimated emissions (tonnes)
CO_2	879	2,468
NO_x	72.3	203
SO_2	52.9	149
NMVOC	3.5	10

Emissions of CO_2 are estimated to be approximately 2,468 tonnes representing less than 0.005% of Ireland's total average national projected CO_2 emissions of some 63.0 Mtonnes of CO_2 per annum over the period 2008-2012 (EPA, April 2011).

Emissions of NO_X, SO_2 and non-methane volatile organic carbons (NMVOC) are estimated to be significantly less than those of CO_2, at 203, 149 and 10 tonnes respectively.

These emissions will be rapidly dispersed by the prevailing westerly winds and will not impact on receptors in and around the Belderra landfall area.

9.4.3 Operational phase impacts – onshore

Following construction of the substation, access road, and transition joint bay, and installation of the cables, emissions from the substation site will be limited to small vehicle movements. Although the site will be unmanned, there will be routine inspections of the substation equipment, maintenance of the waste water collection system and site visits by WEC developers who will use the substation site when their equipment is being deployed at sea, occasionally during operations and also during recovery operations. There will also be some

vehicle movement to and from Frenchport Pier, as Rigid Inflatable Boats (RIBs) will be launched from this location as part of the routine operation of the test areas. The emissions from these operational activities will comprise a small fraction of local traffic. There will be no significant impacts on receptors in the area.

9.4.4 Operational phase impacts – offshore

The operational phase of the test site will involve deployment and testing of WECs and their subsequent recovery over a fifteen-year period. It is also likely that the integrity of the submarine electricity cables will be checked annually by suitable vessels. It is anticipated that a maximum of ten WECs would be accommodated by the test site at any one time. These would be deployed in two arrays at test area A. Their deployment and recovery would involve vessel movement (WECs towed to and from the test area) and mooring operations (emplacement of anchoring systems and connection to submarine cable). WECs will be deployed using vessels such as four-point moored barges, multi-category work boats, and anchor-handling tugs (AHTs) with integrated dynamic GPS, enabling them to stay on station without mooring hardware. Standard multi-category vessels for use within a wave farm would be around 25m in length, 11m in beam, and 3m draft with gross/deadweight tonnage of approximately 500 tonnes; these vessels will undertake lighter activities.

Mooring operations using AHTs may require multiple trips to the test area from the port where equipment will be stored, as it is unlikely that the vessel used would have sufficient capacity to carry all the equipment in one trip. It is also possible that mooring equipment will be brought to site on multi-category vessels for deployment by the AHTs. Mooring operations are likely to take several weeks to accurately install the mooring systems for up to ten WECs.

WECs will be towed to the site using a multi-category vessel and connected to the installed mooring system and flexible dynamic riser of the submarine electricity cable. This operation will be completed within two days for each WEC.

Estimates of the fuel consumption for vessel activity during a one-year operational phase are provided in Table 9-3.

Table 9-3: Estimates of fuel consumption – operational phase, offshore

Vessel	Duration (days)	Fuel consumption* (tonnes)
Cable survey	5	68
Vessel mobilisation from home port	30	405
Mooring deployment AHT tugs	65	878
WEC deployment – multi-category	20	270
WEC recovery – multi-category	20	270
	140	**1,890**

** Based on typical 15m^3/d for cable laying vessels and a marine fuel density of 900Kg/m^3*

Based on the DEFRA emission factors used above, this would result in the estimated emissions to air from the vessel operations shown in Table 9-4.

Table 9-4: Estimated emissions to air – operational phase, offshore

Component	Emission factor Kg/tonne	Estimated emissions (tonnes)
CO_2	879	2,373
NO_x	72.3	195
SO_2	52.9	143
NMVOC	3.5	9

The estimated emissions are similar to those for cable deployment. Even if the maximum number of WECs is deployed at the site at any one time, their overall impact would be insignificant. It is also probable that deployment and maintenance of WECs would occur over dispersed time intervals, resulting in reduced emissions and potentially lower impacts than predicted. No significant impacts on receptors in the area are anticipated.

There will be a slight positive impact, as deployed WECs are expected to generate renewable electricity which will be exported to the grid. Although this would be small, it is estimated that every megawatt hour of power exported will result in a national reduction of one tonne of CO_2.

9.4.5 Decommissioning phase – onshore

A decommissioning plan will be agreed with the local authority, and all decommissioning operations will be carried out in accordance with this plan. Decommissioning may entail substation and compound demolition and site reinstatement. This will involve the use of equipment similar to that used in the construction phase and transport of demolition materials offsite to an approved waste landfill. This will result in vehicle emissions to air. The main potential impact on the receptors in the area will be from dust. Decommissioning will be for a fixed, short duration and is likely to take about two months. Impacts are likely to be insignificant.

9.4.6 Decommissioning phase – offshore

Decommissioning of the test area will involve removal of the WEC mooring system and cardinal marker buoys. This will require anchor-handling tugs as previously described. It is estimated that this operation will take approximately three months to complete and result in estimated emissions to air as shown in Table 9-5.

Table 9-5: Estimated emissions – decommissioning phase, offshore

Component	Estimated emissions (tonnes)
CO2	593
NOx	49
SO2	36
NMVOC	2.4

Estimated emissions during the decommissioning stage are less than those for the construction and operational phases, and no significant impact is anticipated.

9.5 Mitigation

9.5.1 Construction phase – onshore

Traffic-related effects and material storage are the principal potential sources of airborne dust and these can be managed through a comprehensive construction management plan for the site, setting out the mitigation measures set out below and detailing how they will be enforced:

- Transport of materials to and from the site will take place in normal working hours and along routes agreed with the local authority.
- Vehicle speeds will be restricted on haul roads.
- Vehicles will be routinely maintained to minimise emissions.
- Site haul roads will be dampened down with water during prolonged dry periods if necessary.
- Dusty materials such as excavated materials will be stored and handled appropriately (for example, by covering where necessary and minimising the drop heights of materials).
- Materials likely to be a source of dust will be transported in an appropriate manner (for example, by covering the load).
- Suitable hoardings will be used at the construction site to prevent dispersal of materials by wind.
- Site management practices will incorporate appropriate dust monitoring.
- All construction will be completed in a timely fashion.

Any impacts of construction on air quality will be of short duration and will be rendered negligible by implementation of these mitigation measures through the construction management plan.

9.5.2 Construction phase – offshore

It is assumed that vessels employed for offshore construction will be maintained throughout the short cable laying operation and will meet relevant emissions standards. No specific mitigation measures are proposed and it is not anticipated that offshore construction will result in a significant or prolonged incremental increase in emissions in the project area.

9.5.3 Operational phase

During the operational phase, there will be no significant impacts on receptors in the area onshore, and no specific mitigation measures are proposed.

Offshore, all vessels will be expected to be routinely maintained to minimise emissions to air and their overall impact on air quality will be insignificant. No specific mitigation measures are proposed.

9.5.4 Decommissioning phase – onshore

Decommissioning of the substation site will involve demolition of the building and compound and restoration of the site. It will be undertaken in accordance with a decommissioning plan agreed with the local authority. The mitigation measures outlined in 9.5.1 will be incorporated

into the decommissioning plan. It is anticipated that impacts on air quality from onshore activities will not be significant during this phase of the project.

9.5.5 Decommissioning phase – offshore

Routine maintenance of vessels used during the offshore decommissioning phase will ensure minimal impact on air quality; no specific mitigation measures are proposed.

9.6 Conclusion

Emissions from offshore vessels constitute a small fraction of one percent of national air emissions. Emissions associated with this project will be of short duration, and during the operational phase will be offset to a small extent by renewable energy generation from the site. Considering the low levels of air pollutants in the receiving environment and the rapid dispersion in the area, the impact on air quality from emissions associated with construction, operation and decommissioning of the test site is predicted to be negligible.

Emissions from onshore activities will principally arise during construction and decommissioning, and will arise from vehicles and equipment used in the process. Implementation of a management plan for these phases of the project, incorporating agreed mitigation measures, will ensure minimal emissions with negligible impact on receptors in the project area.

Overall, the impacts on air quality will be negligible, both in the national context and in the immediate receptor area.