Offshore Wind
OPERATIONS & MAINTENANCE

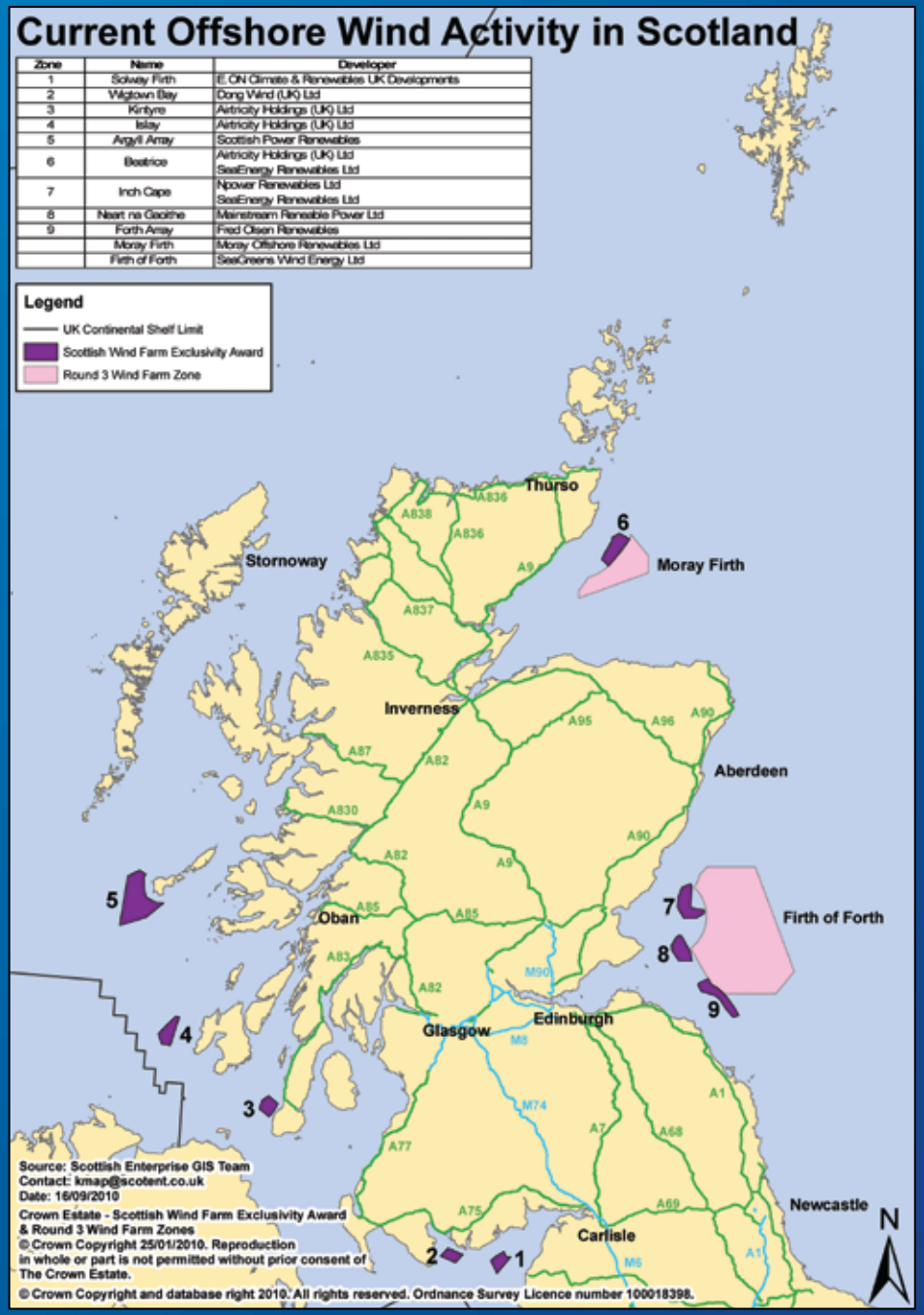
A National Renewables Infrastructure Plan Stage 2
Information Paper

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

Scottish Enterprise

Current Offshore Wind Activity in Scotland

Zone	Name	Developer
1	Solway Firth	E.ON Climate & Renewables UK Developments
2	Wigtown Bay	Dong Wind (UK) Ltd
3	Kintyre	Airtricity Holdings (UK) Ltd
4	Islay	Airtricity Holdings (UK) Ltd
5	Argyll Array	Scottish Power Renewables
6	Beatrice	Airtricity Holdings (UK) Ltd SeaEnergy Renewables Ltd
7	Inch Cape	Npower Renewables Ltd SeaEnergy Renewables Ltd
8	Neart na Gaoithe	Mainstream Renewable Power Ltd
9	Forth Array	Fred Olsen Renewables
	Moray Firth	Moray Offshore Renewables Ltd
	Firth of Forth	SeaGreens Wind Energy Ltd



With investment of £100 billion planned over the next 10 years, the offshore wind sector offers a huge opportunity for Scottish businesses.

In Scottish waters alone 10.6 GW of generating capacity is scheduled across 12* sites with exclusivity agreements in place with 10 different developers/ development companies.

In total, more than 2,000 additional five MW turbines are expected to be constructed off Scotland's coast in the next decade, (although these turbines may get bigger over time).

Over their 20 year+ lifespan these machines will require regular maintenance and a closely controlled operating process to maximise generating capacity and keep downtime to a minimum.

With operations and maintenance (O&M**) expected to make up 25% of the costs of a wind farm during its lifetime, it is expected that each development site will require a land-based hub for day-to-day O&M activity.

Depending on how far the turbines are from shore, this hub may be supported by an offshore workstation within the wind farm development.

A facility will also be required for major repairs although this is likely to be separate from routine day-to-day maintenance and may be concentrated around one or two land-based locations operating in a shared capacity between development sites.

With the first significant offshore wind development in Scottish waters expected to start within the next five years, the time is now right for developers to begin the process of engaging with port owners and supply chain companies on potential requirements for O&M facilities.

**In May 2010 it was announced that SSE Renewables and Fluor had decided not to progress the development of the Bell Rock offshore wind farm due to complications with radar activity in the area. At this time, it is unclear as to the future of this site.*

*** O&M is the term used by the offshore wind industry to describe this activity. It is similar in nature to Inspection, Repair and Maintenance (IRM), an activity that a number of Scottish ports provide for the Oil & Gas industry.*

Scotland – opportunities for O&M facilities

Opportunities to develop O&M facilities in Scotland are numerous given the number of Scottish Territorial Water (STW) sites and the two Round 3 sites located around the Scottish coast.

The focus of this brochure is on day-to-day operations and maintenance. Examples of such O&M facilities exist in the UK, two of which, Greater Gabbard O&M facility at Lowestoft Port and Robin Rigg O&M facility at Workington Port, are used as case studies in this publication.

Opportunities within the major repair part of the O&M process are in their infancy with a range of methodologies being considered and used.

At existing UK sites such as Robin Rigg or Greater Gabbard all major repairs are generally serviced through the warranty contract with the manufacturer and parts sourced from mainland Europe.

As the sector expands, the question arises as to whether developers require individual major repair bases for each wind farm development or if there may be opportunities to collaborate to create one or two major repair hubs.

The role of an O&M facility

An O&M facility is designed to support the lifetime operation of a wind farm to minimise any disruption to energy generation and maximise output.

The operations side of the O&M function is largely a management role currently undertaken by the developers themselves and involves monitoring the performance of the wind farm, organising maintenance schedules and supplier interaction.

The maintenance element of the O&M function involves routine and non-routine observation, service and repair.

Identifying the correct location – key considerations

For developers, a large number of factors must be taken into consideration when identifying a suitable port location for an O&M facility.

These include:

- **Proximity to wind farm/size of wind farm -** the closer an O&M facility is to the wind farm the better to minimise travel distance. As wind farms move into deeper water further offshore, there will be an increasing requirement for land-based facilities supported by an offshore accommodation hub to house workers during planned maintenance periods.
- **24/7 quayside access required –** While most O&M facilities currently operate within a 12 hour daily working window it is essential that 24 hour access is available to facilitate 24 hour operation as required.
- **Speed restrictions –** the location of an O&M facility within a port environment and travel distance through the port are key considerations. An O&M facility located deep within a large port may prove less attractive when compared to a smaller port further away and not subject to the same speed restrictions.
- **Conflicting traffic –** a busy port can impact dramatically on the ability of an O&M operator to respond to an emergency meaning that a quieter port with less conflicting traffic is the preferred choice.
- **Tidal constraints –** can impact on travel time and quayside access.
- **Flexibility of the port owner –** the ability of a port owner to work closely with the developer is vital particularly since the facility is likely to remain operational for at least 20 years.
- **Site configuration, location and existing infrastructure -** examples of such requirements are provided as case studies below.
- **Local, skilled workforce –** while a developer and the associated turbine manufacturer will provide the specific training required to operate and maintain a wind farm development, a local, skilled workforce is essential.
- **Turbine manufacturer requirements –** manufacturers will often have their own preferred specification list for an O&M facility which needs to be considered. They also provide a dedicated maintenance team who will work as part of the team during the initial warranty period – usually five years.
- **Provision of a helicopter service –** for larger, more remote wind farms, transport to and from the site may be supported by a dedicated helicopter service. Transportation by sea is also greatly reliant on stable weather conditions which can restrict access to the wind farm by up to 50% in any given year. A helicopter service will greatly increase the ability to access the wind farm in poor weather conditions. It is likely that most developers will require a dedicated helicopter facility on the same site as the O&M building to minimise transfer times for maintenance crew and equipment.
- **Proximity to an airport/airstrip (with a training facility) -** the ability to 'land' maintenance crew onto a nacelle in less than ideal weather conditions by helicopter is a health and safety hazard and requires specialist training. At Lowestoft, SSE and RWE npower renewables use Norwich airport to provide a dedicated training facility and training course to support their O&M function.

O&M Case Studies

There is currently no typical O&M facility. Each facility will be tailored to the port location, distance to wind farm and the size of the scheme. Much will also be dependent on the type of infrastructure already available at the chosen port. O&M facilities are already in operation at major UK ports including Lowestoft and Workington.

Lowestoft Port
Greater Gabbard

Owned and operated by Associated British Ports, Lowestoft is Britain's most easterly port and has facilities for container, bulk and general cargo handling as well as a fish harbour and marina.

Scottish and Southern Energy (SSE) and RWE npower renewables have recently completed their O&M facility at the port in preparation for the 'switching on' of the first round of wind turbines within their Greater Gabbard wind farm.

Lowestoft is located 57km from the top of the wind array which covers an area of 147km and, when complete, will consist of 140 Siemens SWT 3.6MW turbines. The port was identified as the best possible location by SSE and RWE npower renewables with the port owner, who provided a turnkey solution to SSE and RWE npower renewables' quayside requirement.

SSE and RWE npower renewables have converted part of a former fish market building to create an O&M facility with dedicated quayside access to Waveney Dock. The 1700 sq m building houses a large storage room/workshop as well as extensive additional areas including a control room, meeting rooms, staff and other admin facilities, while the adjacent car park can accommodate 55 vehicles. Waveney Dock is located within the outer harbour and comprises a sheltered, quiet dock, with unrestricted access to the North Sea.

An additional 1500 sq m quayside laydown area contains a 25,000 litre fuel tank to supply workboats,

while a one tonne crane has been erected quayside for vessel loading.

SSE and RWE npower renewables have a helicopter on permanent charter from Bond who have supplied a team of five staff and have constructed a helipad and hanger on the quayside.

Four 18m catamarans plus one smaller vessel are on permanent charter from Windcat which includes approximately 20 personnel and have a permanent berth within the port's Trawl Dock. SSE and RWE npower renewables have also constructed a 'bow-on' pontoon system for four catamarans within the Waveney Dock to facilitate loading and crew transit.

Lowestoft O&M facility is primarily designed for day-to-day operations and maintenance.

Major repair work and part replacement may be conducted from Lowestoft or another suitable port depending on the works and vessels available. However, there is no dedicated major repairs facility in place.

Workington Port
Robin Rigg

Workington port was originally built to service the steel industry. It is now owned and operated by Cumbria County Council who have invested heavily in port infrastructure improvements.

The port comprises the Prince of Wales Dock, an enclosed dock with seven berths and a total quay frontage of 772.7 m. In addition there is a small tidal harbour for fishing and leisure uses. It handles 600,000 tonnes of cargo a year and around 300 ship movements annually with room for further expansion.

In April 2010, E.ON completed the construction of Robin Rigg comprising 60 Vestas v90 Mark 8 – three MW offshore wind turbines 14km off the Cumbrian coast in the Solway Firth. The first turbines started generating power in September 2009.

The wind farm is designed as two separate arrays hosting 30 turbines, with each array having a separate landing site/grid connection point.

Built on a vacant 3200 sq m site, the O&M facility at Workington is designed for day-to-day small scale operations and maintenance only and is not suitable for major repair and part replacement. The building comprises approximately 1000 sq m office/industrial facility comprising a large warehouse and a mix of office and staff accommodation over two floors with car parking for around 25 vehicles.

There is limited lay down space and no large parts are stored at Workington.

Due to the relatively short distance of the Robin Rigg wind farm from the shore, no helicopter facility is provided with access dependent on seaborne transportation. There is a full-time crew of four people and two shallow draft vessels, each seating 12 engineers, are available for 24 hour dedicated use and are permanently berthed at Workington.

E.ON have created an access platform underneath the quay which allows access to the vessels at all tide levels and have also installed at the quayside a fuel tank, electricity and water supply and a small 300 kg crane to offload small parts onto the vessels from the quay.

Due to space constraints at the port, the building is remote from the quayside. Whilst not ideal, this is acceptable for day-to-day maintenance as engineers are not moving large parts to and from the quay. A dedicated pedestrian route has been provided by the port between the building and the quay with access available 24 hours a day. A vehicular route is also available between the O&M building and the quayside, however, access can be restricted during busy periods.

Operations & maintenance

Robin Rigg

Having been fully operational for some months, Robin Rigg has a detailed O&M programme in place.

The facility has 30 staff including:

- Eight E.ON staff including four engineers
- 15 Vestas staff including 12 engineers and three support supervisors
- Four vessel crew
- Three additional contract workers

E.ON staff manage the overall O&M programme but also currently have responsibility for maintenance of offshore substations and HV cable and grid connection.

Vestas staff are responsible for day-to-day maintenance and servicing of the turbines and are integrated with and managed by the E.ON team.

Vessel crew are on hand to provide 24/7 support while the lifeboat service based at Workington Port have also adapted their vessel to lock on to the turbines in case of emergency.

Apart from general day-to-day maintenance, each turbine is serviced annually. It currently takes the team approximately two months to service 30 turbines or half the wind farm array. To minimise generating capacity, no more than three turbines are turned off at any one time for a routine service.

All offshore activity is controlled from the control room which gives an operator real time knowledge of which turbine is being serviced and by whom. Each turbine is self-monitoring and will automatically report any fault back to the control room.

A turbine is connected through a broadband communication link contained within the array cables and brought back to shore at the HV landing hub. It is, therefore, essential that a port is connected to a broadband network to allow the operator to create a link between the control room and the wind farm array.

Supply chain

The typical supply chain for an O&M facility can include:

- **Specialist consultants/architect/planning teams -** required to deliver the project build from concept to completion.
- **Turbine manufacturer -** typically there will be a five year warranty period for the wind farm array and the manufacturer will provide a dedicated maintenance team to work with the developer during this period. As the market matures there is an opportunity for specialist offshore maintenance companies to step into this role.
- **Vessel charter -** ideally the developer will want a dedicated crew as part of this charter to run the vessels during the contract period. This crew will form part of the overall developer team.
- **Helicopter charter -** as with the vessel charter, a dedicated crew should be provided to work with the developer team.
- **Security and facilities management -** providing a support service to the efficient running of the O&M facility.
- **Survey teams -** regular substructure surveys will be required and will be out with the scope of the turbine manufacturer's warranty. This will require specialist underwater survey teams and temporary vessel charters.
- **Training -** provision of training is essential in the local area. All teams are usually derived from a local workforce and will require a period of training for this specialist sector, e.g., training of engineers for winching onto the top of a nacelle from a helicopter.

Lease terms

A lease term for an O&M facility will generally relate directly to the projected life cycle of a wind farm development although a developer may wish to retain an element of flexibility.

A typical wind farm life cycle is 25 years plus one year for decommissioning.

Job creation

The developer and associated contractors which form the O&M team will prefer to train a workforce close to the O&M facility ensuring there is benefit for local communities.

SSE and RWE npower renewables directly and indirectly through the contractors based on site employ a dedicated team of approximately 100 at their Greater Gabbard O&M facility in Lowestoft to service 140 turbines while E.ON employ a team of 30 at Robin Rigg servicing 60 turbines.

By a rough rule of thumb, this would suggest approximately one job per two turbines.

If all 2000 offshore turbines are constructed over the next 10 years within Scottish waters (STW and Round 3 sites), this could lead to 1000 direct jobs in the O&M industry plus a significant number of supporting supply chain opportunities.

Space requirements

The larger the wind farm, the larger the team required to service the turbines which could lead to a bigger O&M facility and increased vessel and helicopter support.

The following table provides a summary of the existing space requirements for the two case studies used in this publication.

Case Study	Number of Turbines in Wind Array	Approx. O&M Facility Size (sq m)	Approx External Storage Area (sq m)	Car Parking Spaces	Approx Dedicated Quayside Length (m)	Number of Vessels	Helipad
Workington Port	60	1000	500	25	c. 70m incl berthing area	2	No
Lowestoft Port	140	1700	1500	55	c. 100m plus 'bow-on' pontoon and additional berthing area of c. 25m	5	Yes

As wind farms increase in size it is likely that developers will use a number of turbine manufacturers to construct the offshore wind arrays. This will add to the complexity of the O&M function with separate engineering teams responsible for each turbine type, particularly during the warranty period. This could vastly increase the size of an O&M facility and therefore the demand for space and dedicated quayside access.

However, greater efficiencies can be derived as wind farms increase in size and additional factors must be taken into account such as distance from shore, where an offshore accommodation facility may be necessary, reducing the need for a large onshore facility.

Large scale repairs will require an alternative approach to day-to-day O&M. Whilst it is entirely possible that each individual wind farm will require a dedicated day-to-day O&M land based hub, large scale repairs could be contained within one or two key locations and will service a number of wind farms. The lay down space requirements are likely to be significant, extending to numerous hectares and will need direct access to deep water quays with an ability to manoeuvre massive pieces of equipment onto barges and jack-up vessels.

The way forward

O&M for offshore wind is an evolving service.

Given the lead in time necessary for site identification, planning and design and construction phases, there is an immediate requirement for developers, ports and key supply chain companies to start engaging with each other to discuss the long term opportunities in the sector.

This is just the first step in the process. Scottish Enterprise & Highlands and Islands Enterprise are keen to facilitate or support engagement where possible, so please do not hesitate to contact us via: **offshorewind@scotent.co.uk** or **renewables@hient.co.uk.**

Acknowledgements

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For further information on the National Renewables Infrastucture Plan go to:
http://www.scottish-enterprise.com/your-sector/energy/energy-background/energy-reports/energy-renewable-energy-reports.aspx

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