PREFACE

This Environmental Statement (ES) has been prepared in support of a planning application for a proposed wind farm and energy storage facility (Proposed Development) at Upper Ogmore, between Blaengwynfi, Nantymoel and Blaengarw in Bridgend.

The ES is contained within four separate volumes:

Volume 1 Non Technical Summary of the detailed Environmental Statement.
Volume 2 Full text of the Environmental Statement.
Volume 3 Figures and plans referred to in the text of Volume 2.
Volume 4 Appendices referred to in the text of Volume 2.

A separate Planning Statement and Design and Access Statement have been prepared to accompany the planning application.

The ES has been prepared by RES Ltd (RES) in consultation with the Planning Inspectorate Wales, Bridgend County Borough Council, Neath Port Talbot County Borough Council, various statutory consultees and in collaboration with the following specialist consultants:

Landscape and Visual LUC 28 Stafford Street Edinburgh EH3 7BD	**Cultural Heritage** Archaeology Collective The Office Leeds 1 Aire Street Leeds LS1 4PR	**Ecology and Biodiversity** BSG Ecology Merlin House 1 Langstone Business Park Langstone Newport NP18 2HJ
Planning David Stewart Planning Ltd The Eyrie Eagle Farm Baythorne End CO9 4AF	**Noise assessment** RES Ltd Beaufort Court Egg Farm lane Kings Langley, WD4 8LR	**Public Access, Land Use and Socioeconomics** Oxford Economics Lagan House Sackville Street Lisburn BT27 4AB

The full ES may be viewed on the Project Website www.upperogmore-windfarm.co.uk

Hard copies of the full ES are available to purchase from RES at a cost of £200. Copies of the full ES are available on CD-ROM free of charge. Hard copies of the non-technical summary are available free of charge. Requests for documents should be made in writing, including payment if purchase of the full ES is required, to RES Ltd, Cedar House, Greenwood Close, Cardiff Gate Business Park, Cardiff, CF23 8RD or to chris.jackson@res-group.com.

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All figures are listed in Volume 3 of this ES

RES has an Environmental Management System which actively encourages the reduction of paper consumption and promotes recycling where possible. To further reduce paper use, RES would prefer that the ES is viewed on the project website or that copies of the ES are requested in CD format.

INTRODUCTION

Renewable Energy Systems Ltd ('RES') is applying for planning permission to develop a wind farm and energy storage facility at Upper Ogmore between Blaengwynfi, Nantymoel and Blaengarw in Bridgend. The Site is centred on grid ref: 29150 19450 and is shown on Figure 1.1: Site Location.

The Proposed Development comprises seven horizontal axis wind turbines. Four of the turbines are up to a maximum tip height of 149.9m and three are up to a maximum tip height of 130m. The seven turbines will have a total installed capacity of approximately 25.2MW. The Proposed Development would include an improved site entrance, new access tracks, crane hardstandings, control building and substation compound, electricity transformers, underground cabling, energy storage containers, drainage works and upgrades to a forestry track and associated tree felling (see Figure 3.1: Infrastructure Layout). The Proposed Development would be operational for a period of up to thirty-five (35) years.

The Proposed Development would produce sufficient electrical energy to meet the average requirements of nearly 22,000 homes, equivalent to more than a third of the homes in Bridgend County Borough. The proposal is the culmination of over seven years' work by RES, during which time the site's suitability and detailed environmental interests have been assessed.

RES (the applicant) is one of the world's leading wind energy companies and has constructed or developed medium to large-scale wind farms around the world, with a combined capacity of over 16,000MW.

RES's award winning eco-friendly headquarters and education centre in Kings Langley, Hertfordshire, is self-sufficient in renewable energy which is generated on-site and includes solar power, energy crops, and a wind turbine next to the M25. RES also has a number of regional offices in key markets worldwide, including its Welsh office in Cardiff.

ENVIRONMENTAL IMPACT ASSESSMENT

The aims of the Environmental Impact Assessment (EIA) are:

- To gather information on the existing environment and identify environmental constraints and opportunities associated with the development of the area which may be affected by the Proposed Development
- To identify and assess potential effects that may arise from the construction, operation and decommissioning of the Proposed Development
- To outline measures and/or design criteria that may be pursued to mitigate potential concerns or effects.

The Environmental Statement (ES) has been prepared to accompany an application for planning permission for the Proposed Development. The EIA process considers all significant effects that the Proposed Development is likely to have on the environment. The findings of the EIA process are reported in the ES.

NEED FOR THE PROJECT

The background to the current drive to increase the use of renewable sources of energy has its roots in the recognition that the burning of fossil fuels has an adverse effect on the climate of the world as a whole and that global measures are required

to deal with it. International, European and UK policies have, over the last 28 years, become ever more focussed on the concerns about global warming. The use of renewable resources as an increasing proportion of our total energy consumption is seen as a key part of the ultimate sustainable solution, alongside energy efficiency and conservation, especially as it does not rely on the consumption of fossil fuels for its fuel supply, and needs to be developed alongside a campaign of increasing awareness by the public and industry of the need for energy efficiency. These objectives are defined in both European Union law (for example the Directive on Renewables 2009/28/EC of June 2009), and in UK law and policy such as the UK Government Climate Change Programme, the 2007 White Paper on Meeting the Energy Challenge the Climate Change Act 2008, the Renewable Energy Strategy 2009, the UK Renewable Energy Roadmap 2011 and its 2012 and 2013 Updates.

There are three further benefits of using renewable resources. One is the issue of security of supply, since the creation of electricity from renewable resources within the UK provides a source that is not open to interruption by the actions of foreign governments or others. The ability to ensure electricity supplies from sources that are not open to foreign intervention is one of the key planks of the national energy policy. Another benefit is the creation of further electricity generation capacity at a time when older plant is being decommissioned. The third benefit is the issue of economic development. From its beginnings in the UK about 28 years ago, the very slow growth in the development of new renewable technologies has meant that other countries which had already branched out into these technologies (with wind energy being the prime example) were able to utilise their established manufacturing capacity to supply the emerging UK wind industry's demands. This is now changing as the recent growth in the number of sites and the number of turbines on each site is creating the potential for the development of a home-based manufacturing industry. All these are benefits identified in the Renewable Energy Strategy published by the Government in July 2009 and set out in the UK Low Carbon Transition Plan, also in July 2009.

These initiatives have been followed by a series of further statements at the UK and EU level over the last nine years. The UK Committee on Climate Change published its Renewable Energy Review in May 2011, expressing concern that the 2020 targets set out for achieving delivery of energy from renewables required large-sale investment and new policies to tackle the barriers to the uptake of renewable sources of energy to assist in the decarbonisation of the power industry. The UK Electricity Market Reform White Paper 2011 set out a package of measures to attract investment, reduce the impact on consumer bills and create a secure mix of electricity sources including gas, new nuclear, renewables and carbon capture and storage. The same month saw the publication of the first UK Renewable Energy Road Map, which set out the main aim of achieving 15% of all UK energy demand from renewable sources by 2020, and this has since been supplemented by the Updates of 2012 and 2013 which have highlighted the difficulties in delivering not only the 30% of electricity supply from renewable sources by 2020, but also the targets for the heating and transport sectors of the economy, where progress towards much lower targets was far below the trajectory needed.

Since then, there have been published the Energy Security Strategy and the Energy Act which completed its parliamentary passage in December 2013, with the intention of introducing major reforms to the electricity market to result in greater stability and certainty for investors in energy infrastructure.

Since 2015, there has been accelerating interest across the UK in the take-up of electricity as the power source (or at least part of the power source) for vehicular powering, with the current aims of Government being to have all vehicles able to run

on electricity by 2040. The pressure to switch away from diesel for pollution reasons, as well as because it is a fossil fuel, has led to moves across Europe to develop not just the vehicles but also the supply system to enable a major switch to electrically driven vehicles to take place. The UK's strategy had assumed that there would be a significant reduction in the use of fossil fuels for transport by 2020, but assumed that the main advances would be through use of biofuels. Now that this is instead to come from electricity, that places a greater burden on the electricity supply industry to provide the extra capacity to enable this to happen, and, more importantly, to ensure that the proportion of the overall supply that comes from renewables is not eroded.

The National Assembly for Wales had already begun its own contribution to the debate on renewable energy in the 1990s. The Assembly's Economic Development Committee published its Final Report on Renewable Energy in January 2003, identifying a benchmark for production of electricity from renewable sources of 4 TWh per year by 2010 which equated to a little over 10% of Welsh electricity production. The Wales Spatial Plan was published in 2004. One of the key objectives of this Plan was the importance of reducing negative environmental impacts. The plan identified that Wales' CO2 emissions are running at double the capacity of the natural environment to absorb them. Opportunities remained however as Wales had the wind and tidal resources to make a major contribution to producing renewable energy and so reducing the emission of greenhouse gases. The Plan also identified guidance on where Wales should maximise renewable energy production. This was carried forward into TAN8 in July 2005, with its approach to the identification of seven Strategic Search Areas for a further 800MW of additional onshore wind by 2010.

Since 2005, there have been further policy pronouncements including "One Wales" in which the Welsh Assembly Government (WAG) set out its strong commitment to tackling climate change and the New Renewable Energy Route Map published in February 2008. The latter set out proposals for moving Wales towards self-sufficiency in renewable electricity in a generation whilst at the same time driving towards increased energy efficiency and a greater level of heating requirements being supplied from renewable sources. The route map envisaged that microgeneration and other small scale technologies could play a significant role in delivering these proposals. This was supported by the actions in One Wales: One Planet (2009) and the draft Climate Change Strategy (2009) to remove barriers to the installation of microgeneration.

The publication of the March 2010 Energy Policy Statement (EPS) by the WAG radically changed the position on targets. Whereas the position since 2005 had been that the target for 2020 was set at 7TWh of electricity output from renewables, the EPS set out the potential for a new, greatly enhanced potential for 2025 of 22,500MW of installed capacity of renewables. Of this, 8,000MW of onshore and offshore wind was expected to be provided in the main by 2015-17, which can be compared with the 800MW of strategic onshore wind envisaged to be installed between 2005 and 2010 under TAN8 on top of about 300MW which was already in place by 2005. This can be seen as a formal response by the Welsh Government to the UK Government's publication of the Renewable Energy Strategy in 2009 with its greatly increased UK national figure of, at least, 30% of electricity from renewables by 2020, and this was later confirmed by a written statement from the Welsh Government in June 2010.

The Climate Change Strategy for Wales (2010) outlined the importance of renewable energy generation in meeting the energy demand in Wales and sets out a vision for Wales till 2050. This was followed by Energy Wales: a Low Carbon Transition Plan in 2012. More recently, the Cabinet Secretary for Environmental and Rural Affairs, Lesley Griffiths, announced in a recent statement on the climate change provisions

of the Environment Act, her intention to develop further renewable energy generation targets (following on from the ones that had been set out in earlier policy documents), as part of the drive to decarbonise the economy in Wales, and has now done so with a statement in September 2017 that she has set a figure of Wales generating 70% of its electricity consumption from renewable energy by 2030.

DESCRIPTION OF THE PROJECT

The project has been identified and designed through consideration of a wide range of relevant documented information and on-site studies. RES has applied its own stringent site selection criteria to confirm the suitability of the Upper Ogmore site for a wind farm:

- Wind Speeds/Energy Yields: Sufficiently high wind speeds to ensure energy production from the wind turbines that would yield an adequate return on investment;
- Planning: A site which complies with planning policy and in particular, avoids unacceptable effects on areas that have been designated by statutory agencies; maintains appropriate distances from dwellings to avoid unduly impacting local amenity; and avoids impeding or interfering with major electromagnetic transmission and airport communication systems;
- Area of Site: A site must have sufficient area to accommodate the number of wind turbines required for economic viability;
- Access: Adequate vehicular access to a site using existing roads wherever possible to minimise the amount of civil works, particularly during the construction phase;
- Local Terrain and Topography: Terrain and topography affect wind flow across a site and need to be considered in relation to turbine performance, specification and life-span;
- Ground Conditions: A site must have suitable ground conditions for the construction of wind turbine foundations, erection of the turbines and the provision of access tracks and cables.

Detailed consultations were undertaken with a wider range of statutory and non-statutory consultees to determine the appropriateness of the site. Site visits were also made by staff from RES's development, technical and engineering teams, as well as external consultants. This process confirmed the suitability of the site for a wind farm of this scale.

The layout of the Proposed Development evolved in response to specialist surveys and community consultation, including eight public exhibitions in 2017 and 2018, to ensure that potential adverse environmental effects were minimised, while maximising the operation of the wind farm.

The land take for a wind farm development is relatively small. The wind turbines have to be spaced apart so as not to interfere aerodynamically with one another (to avoid array losses). The actual permanent land take is limited to the area of the towers themselves and the gravel path around them, the access tracks leading to them, the crane hardstandings, the control building, external transformers, met mast, and the substation and energy storage facility.

Each turbine would begin by generating power automatically at a wind speed of around 3-4 m/s and would shut down at a wind speed of around 25 m/s. A typical wind turbine is illustrated in Figure 3.2. The likely colour and finish of the wind turbines will be a pale grey colour with a semi-matt finish.

The on-site substation is proposed to be located centrally within the site and all electrical cabling between the turbines and the substation would be underground. The connection to the electricity grid would also be underground until approximately 1km from the western boundary of the site, from where it is likely to be an overhead line supported on wood poles down to its connection to the electricity network in Pyle. The Distribution Network Operator (Western Power Distribution) is responsible for installing and maintaining the grid connection and an application for consent for the export cable will be made separately by them.

Construction of the wind farm will take approximately 10 months and construction of the energy storage facility approximately 6 months. This timing is somewhat weather dependent and could be affected by ground conditions found at the site.

Access tracks would be built to provide access to each turbine (see Figure 3.1) and would be approximately 5m wide with widening on bends and at passing places and would be made of crushed and graded stone. The access tracks have been designed to minimise environmental disturbance, landtake, and to avoid disruption to farming activity where practicable.

Each foundation typically consists of a tapered octagonal block of concrete with its base approximately 2.5-3.5 m below ground level. The volume of concrete used to make each foundation is typically 350-500 m^3, which is reinforced by approximately 40-55 tonnes of steel bar. The depth of the excavation below foundation varies for each turbine location according to the depth to suitable formation level. The excavation area for each foundation will be approximately 650-1000 m^2. The foundation surface would lie up to 1m below the normal ground surface and is back filled with soil and reinstated.

Wind farms are operated remotely from a central computer system. Because of this a large amount of infrastructure is not required. The Proposed Development would not be permanently manned, and traffic would be limited to small maintenance vehicles with typically four maintenance crew visits per month. In addition a local person may be employed to regularly inspect the Proposed Development, generally on a weekly basis.

Each turbine would have its own internal control system interfaced to a central control system located in the sub-station. The turbines would be automatic in their everyday operation. Were a fault to develop which required an operator to intervene then the supervisory control system would make contact with on-duty staff via a mobile messaging system. The operators would be able to shut down one or all of the wind turbines remotely.

The expected operational life of the wind farm and energy storage facility (ESF) is 35 years from the date of commissioning. At the end of this period a decision would be made as to whether to refurbish, remove, or replace the turbines.

If a decision were to be taken to decommission the Proposed Development this would entail the removal of all the turbine components, transformers, the substation and associated buildings. Some of the access tracks could be left on site to ensure the continued benefit of improved site access for the landowners, or they could be reinstated. It is not usual to remove the buried concrete foundations from the site as this would cause more land damage than leaving them in situ. The entire foundation would be graded over with soil.

One advantage of wind power generation over other forms of energy production is the ease of decommissioning. A wind farm can be easily and quickly dismantled and the site restored, leaving no visible trace of its existence, and no pollution for future generations.

The ESF would be housed in 25 permanent containers and will include energy storage devices, inverters and other ancillary equipment. The ESF will be positioned adjacent to the control building and substation compound on hardstanding used originally for the wind farm temporary construction compound. Please see Figure 3.7: Energy Storage Layout Plan and Figure 3.8: Energy Storage Elevations. These units are a means of storing electrical energy just like a rechargeable battery, cell phone or electric car and provide the means by which power can be stored and released.

One of the roles of energy storage is to act as a power reserve, when electricity generation drops below demand. This reserve capacity can be called on at a moment's notice to enable the necessary balancing of the emerging low carbon electrical system.

Another example of the flexibility services that energy storage could provide includes distribution, reinforcement and deferral services. These enable existing electrical network assets such as substations and overhead lines to have their capacity increased, without the need for building new grid infrastructure.

All of these uses of energy storage involve charging a battery system with electricity, storing electricity for a period and discharging electricity. Ultimately the Proposed Development will make a valuable contribution to a secure, low carbon and affordable electrical system.

LANDSCAPE AND VISUAL

The landscape and visual impact assessment considers the effects of the Proposed Development on landscape character and visual amenity within a study area up to 15 km from the site. The assessment has been undertaken in accordance with all relevant published guidance on the topic, and has involved desk-based and field-based assessments. The approach and scope of the assessment was agreed through scoping and through consultation with local planning authorities.

The baseline for the assessment includes landscape and visual receptors. The landscape of the site and study area is described through observations made in the field, and drawing on published landscape character assessments and the LANDMAP database. Visual receptors include people in settlements, using the local area for recreation, and travelling through the area on roads. Representative viewpoints have been selected to assess the range of visual receptors, and these viewpoints were agreed through consultation.

The assessment of effects considers the embedded mitigation achieved through the design process, as set out in the Environmental Statement Chapter 2 Design Evolution.

Localised significant landscape effects are predicted during the construction stage, affecting the site itself and the local area of the Mynydd Llangeinwyr Uplands LCA. Due to local topography, construction works will not be widely visible from adjacent valley landscapes.

During operation, the introduction of seven large turbines will give rise to a major (significant) effect on the landscape of the site and the surrounding Mynydd Llangeinwyr Uplands LCA. Significant (moderate) effects on landscape character are

likely to be experienced across an area extending no more than 2 km from the proposed turbines, and much less to the north and west. The area where significant effects would occur is approximately bounded by the ridge of Craig Ogwr to the east, the summit of Mynydd William Meyrick, the settlement of Price Town, the south end of the main ridge of Mynydd Llangeinwyr, the settlement of Blaengarw, the summit of Mynydd Caerau, and the hairpin bend on the A4107 to the north. Beyond this area effects on landscape character would reduce to minor or negligible, and not significant.

The majority of the wind energy developments forming the cumulative baseline are operational schemes. There are a number of consented but unbuilt wind farms, and one unconsented scheme, in the study area, but none are in the same LCA or within the immediate landscape context of the Proposed Development. As such, no other wind farms would be experienced at the same time as the Proposed Development in such a way that would lead to an additional cumulative effect on landscape character.

The viewpoint assessment identifies significant effects on sensitive visual receptors up to 4.8 km from the Proposed Development, with effects judged as major being limited to within 2 km. Minor (not significant) effects were identified at locations up to 11.5 km from the Proposed Development, and effects at more distant viewpoints were judged to be negligible.

Significant effects are predicted for people within parts of Blaengarw (Viewpoint 4), Blaengwynfi (Viewpoint 6), Price Town, Ogmore Vale and particularly Nant-y-moel (Viewpoint 5), where there would be views of the turbines, due to the appearance of the Proposed Development on the skyline. Significant effects on views are predicted to be experienced by recreational users crossing the high ground of Werfa, Mynydd y Gelli and Mynydd Llangeinwyr (Viewpoint 2), and those accessing the surrounding hills such as Mynydd William Meyrick (Viewpoint 7) and Pen y Foel (Viewpoint 10).

Cyclists using the NCN routes 883 and 884 in the Ogwr and Garw valleys are predicted to experience significant (moderate) effects. Effects on users of the A4061 and A4107 will be moderate (significant) for limited localised sections near the site. Significant effects on more distant receptors, such as people visiting the Brecon Beacons, are not anticipated.

As with effects on landscape, there are relatively few consented or proposed wind farms, and the majority are sited close to operational developments such that they would not change the pattern of development that is viewed in the area. No significant cumulative effects on views are predicted.

ECOLOGY

The ecological assessment considers potential effects on habitats and protected species at each of the construction, operational and decommissioning phases of the proposed Development.

Consultation with consultees, including Natural Resources Wales, has been extensive throughout the assessment process and baseline data was collected between April 2014 and July 2020.

Survey work at the site to inform the assessment has included:

- An extended Phase 1 Habitat Survey of the site and proposed access route
- A Phase 2 botanical survey of an area of higher quality habitat

- Vantage point bird survey (two years)
- Targeted honey buzzard survey
- Moorland breeding bird survey
- Wintering bird walkover survey
- Targeted breeding merlin survey
- Bat activity survey (seasonal walked transect and automated detector)
- Bat roost survey
- Great crested newt survey
- Water vole survey

The assessment has fully considered the principles of and guidance provided by Planning Policy Wales 10, TAN 5, the Environment Wales Act, the Bridgend LDP, Strategic Policy 4 and associated Policies ENV4, 5 and 6. In particular, consideration has been given to international responsibilities and the protection of designated sites. From an ornithological and ecological perspective, the scheme is compatible with all relevant recommendations of these policy documents.

There are no sites designated for ecological interest on the Site and it is unlikely that any designated sites would be affected by the Proposed Development.

The assessment has accounted for measures designed into the Development and those that will be committed to in the project Construction Environment Management Plan.

The construction of the Proposed Development will result in the loss of small areas of improved grassland, acid and marshy grassland and wet modified bog. However this will have a minimal impact on the habitats present.

A range of bird species typical of upland moorland habitats were recorded during the surveys, and included red kite, goshawk, peregrine, merlin, kestrel and golden plover. The majority of recorded flights involved single birds. The assessment has concluded that effects of displacement and collision risk are likely to be minimal. Use of the airspace by kestrel indicates that it is possible that an effect on the local population will occur if other wind farms in the area are also impacting on the population.

Bat survey work recorded low-level activity for Nathusius' pipistrelle, common pipistrelle, soprano pipistrelle, long-eared bat species and species in the genus *Myotis*. No evidence of use of the buildings within the Werfa Mast compound by roosting bats was found. The overall risk to all species of bat recorded at Upper Ogmore has been assessed as being "Low" in accordance with assessment methods outlined in current industry standard guidance. Whilst a curtailment regime is not considered necessary, turbine blades will be pitched out of the wind (feathered) to reduce their rotation speeds to below 2 rpm when idling.

Overall, construction and operational phase ecological and ornithological effects are likely to be very localised.

CULTURAL HERITAGE

Cadw and the Glamorgan Gwent Archaeological Trust were consulted on the scope of the cultural heritage assessment, the study area and the methodologies to be used.

The assessment principally involved site visits and consultation of readily available archaeological and historical information from documentary and cartographic sources. The major repositories of information included:

- Information held by the Glamorgan Gwent Historic Environment Record on known archaeological sites, monuments and findspots within 1km of the Site;
- Maps and documents held by the Glamorgan Archives and online;
- The National Heritage List for Wales curated by Cadw;
- Aerial photographs held by the Central Register for Aerial Photography in Wales; and
- Records made during a site visit in May 2017 and July 2018.

The Site contains three designated historic assets and a further 284 designated historic assets are within the 10km study area. There are four known non-designated historic assets within the Site and a further 85 within 1km of the Site.

Through careful design, there are no designated historic assets or known non-designated historic assets within the footprint of the Proposed Development. Accordingly, the Proposed Development will not have a direct effect on any designated or known non-designated historic assets and there will be no physical change to any of these assets.

Whilst it is possible that the Proposed Development will have a direct effect on other previously unknown archaeological remains, the Site has a generally low archaeological potential. Although it is not possible to determine the sensitivity of unknown remains, the available evidence suggests that any such assets would be of at most low sensitivity.

The indirect effect on heritage assets, as result of the Proposed Development, has been assessed as small, reverting to neutral upon decommissioning, in all cases, except for two scheduled monuments. The indirect impact of the Proposed Development on these two monuments is assessed as medium, reverting to neutral upon decommissioning.

Accordingly, no heritage assets are unacceptably affected by the Proposed Development.

HYDROLOGY AND HYDROGEOLOGY

Possible impacts on water and geology from the Proposed Development are related to the potential for erosion and sediment transport, pollution affecting ground water and surface water quality, and alteration of natural surface and groundwater flows, as a result of construction activities. The sensitive features on and around the site include watercourses, drainage ditches and the groundwater system.

The site is located on a thin covering of clay, gravel and cobbles, overlaying mudstones, siltstones, sandstones and coal seams, between the catchments of the Afon Garw to the west and the Ogwr Fawr to the east.

There is no licensed groundwater or surface water abstraction in the vicinity of the site. However, private water supplies take water from springs and wells close to the site for domestic and farm use.

An assessment was undertaken to review the potential effects on sensitive features during construction, operation and decommissioning. Potential effects such as reduction in available water, fuel or chemical spills, alteration of flow patterns and contamination of surface and groundwater were considered.

Mitigation to reduce or eliminate potential effects has been undertaken through careful design of the project and during construction would be managed according to best practise guidelines, including environmental monitoring. These factors have been considered in the assessment of potential effects. Particular attention was paid to the risk of affecting private water supplies, pollution prevention and interruption of surface water flows.

With the necessary mitigation in place, it is considered that the proposed development would have only negligible to minor impacts on the water hydrology and hydrogeology of the area.

TRAFFIC AND TRANSPORT

An assessment of the potential impact of the Proposed Development on traffic and transport was undertaken, involving consultation with the local Highway Authorities, Network Rail, and South Wales Trunk Roads.

The proposed access route for abnormal loads (turbine components) is from Swansea Docks, which has been used previously for wind farm component deliveries. From Swansea Docks, the route will travel east on the A483, joining the M4 at Junction 42 and leaving at Junction 43 onto the A465 heading 30 km northeast towards Hirwaun. The route exits the A465 onto the A4061 to the Pen y Cymoedd Wind Farm site access, the route continues along the Pen y Cymoedd Wind Farm / NRW Forestry tracks (off the public highway), exiting onto the A4107 eastbound for approximately 1km to the proposed site access.

Works will be required to upgrade the access off the A4107. The works will be planned and agreed in consultation with Bridgend County Borough Council.

It is assumed that vehicles from most suppliers based in the area would follow the M4 and A465 onto the A4061 to approach the site from the north along the A4061 and subsequently the A4107.

Prior to construction commencing a Construction Traffic Management Plan (CTMP) will be developed in consultation with the relevant local authorities. Implementation of the CTMP will minimise the temporary disruption to road users.

The route for transporting abnormal loads and construction traffic has received no objections from the local Highway Authorities, Network Rail, or South Wales Trunk Roads. Abnormal loads would be scheduled to occur during off-peak periods, at times to be agreed with the Police and the local authorities. The residual effect would therefore be minimal.

The abnormal load route and the HGV routes have been assessed as acceptable in the ES. The assessment demonstrates that the construction of the Proposed Development would result in a short-term increase in traffic levels on identified sections of the A4107, A4061, and A465. These increases are considered to be insignificant due to the expected low percentage increase in traffic on these roads.

ACOUSTIC

An assessment of the acoustic impact from both the construction and operation of the Proposed Development was undertaken taking into account the identified nearest residential properties.

The operational noise impact was assessed according to the guidance described in the ‘The Assessment and Rating of Noise from Wind Farms’, referred to as ‘ETSU-R-97’, as recommended for use in relevant planning policy. The methodology described in this document was developed by a working group comprised of a cross section of

interested persons including environmental health officers, wind farm operators and independent acoustic experts. It provides a robust basis for assessing the noise impact of a wind farm and has been applied at the vast majority of wind farms currently operating in the UK.

ETSU-R-97 makes clear that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that would arise through the development of renewable energy sources. The assessment also adopts the latest recommendations of the Institute of Acoustics 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'.

Representative baseline conditions (the "background noise level") at nearby residential properties were established by undertaking noise surveys. These measured levels were then used to infer the background noise levels at other nearby residential properties as the ETSU-R-97 document recommends. As background noise levels depend upon wind speed, as indeed do wind turbine noise emissions, the measurement of background noise levels at the survey locations were made concurrent with measurements of the wind speed and wind direction. These wind measurements are made at the wind turbine site rather than at the survey locations, since it is this wind speed that would subsequently govern the wind farm's noise generation.

A sound propagation model was used to predict the noise levels due to the proposed wind farm at nearby residential properties over a range of wind speeds, taking into account the position of the proposed wind turbines, the nearest residential properties, and the candidate wind turbine type. The model employed (which considered downwind conditions at all times) took account of attenuation due to geometric spreading, atmospheric absorption, ground effects and barriers. It has been shown by measurement based verification studies that this model tends to slightly overestimate noise levels at nearby residential properties.

The relevant noise limits were then determined through analysis of baseline conditions and the criteria specified by the ETSU-R-97 guidelines. The general principle regarding the setting of noise criteria is that limits should be based relative to existing background noise levels, except for very low background noise levels, in which case a fixed limit may be applied. This approach has the advantage that the limits can directly reflect the existing noise environment at the nearest residential properties and the impact that the wind farm may have on this environment. Different limits are applicable depending upon the time of day. The daytime limits are intended to preserve outdoor amenity, while the night-time limits are intended to prevent sleep disturbance.

The predicted operational noise levels are within noise limits at nearby residential properties at all considered wind speeds. The Proposed Development therefore complies with the relevant guidance on wind farm noise and the impact on the amenity of all nearby properties would be regarded as acceptable.

A cumulative operational noise assessment has also been undertaken. Considering the mitigation measures identified the predicted cumulative noise levels are within noise limits at nearby residential properties. Compliance with relevant guidance implies that the cumulative impact on the amenity of nearby properties would be regarded as acceptable.

A construction noise assessment, incorporating the impact due to increased traffic noise, indicates that noise levels at the nearest residential properties could exceed construction noise criteria although appropriate mitigation measures have been identified.

An acoustic assessment of the proposed energy storage facility in accordance with BS 4142: 2014 shows that the impact would be low and the levels insignificant in comparison to the cumulative wind farm noise levels.

SHADOW FLICKER

In sunny conditions, any shadow cast by a wind turbine will mirror the movement of the rotor. When the sun is high, any shadows will be confined to the wind farm area but when the sun sinks to a lower azimuth moving shadows can be cast further afield and potentially over adjacent properties. Shadow flicker is generally not a disturbance in the open as light outdoors is reflected from all directions. The possibility of disturbance is greater for occupants of buildings when the moving shadow is cast over an open door or window; since the light source is more directional.

Whether shadow flicker is a disturbance depends upon the observer's distance from the turbine, the direction of the dwelling and the orientation of its windows and doors from the wind farm, the frequency of the flicker and the duration of the effect, either on any one occasion or averaged over a year.

In any event and irrespective of distance from the turbines, the flickering frequency will depend upon the rate of rotation and the number of blades. It has been recommended (Clarke, 1991) that the critical frequency should not be above 2.5 Hz, which for a three-bladed turbine is equivalent to a rotational speed of 50 rpm. The turbines at the Proposed Development would rotate at a maximum of approximately 16 rpm, well below this threshold.

A related visual effect to shadow flicker is that of reflected light. Theoretically, should light be reflected off a rotating turbine blade onto an observer then a stroboscopic effect would be experienced. In practice a number of factors limit the severity of the phenomenon and there are no known reports of reflected light being a significant problem at wind farms.

A limiting factor is that wind turbines have a semi-matt surface finish which means that they do not reflect light as strongly as materials such as glass or polished vehicle bodies.

Secondly, due to the convex surfaces found on a turbine, light will generally be reflected in a divergent manner.

Thirdly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience the phenomenon.

There is no guidance on shadow flicker in Welsh planning policy. However, the Update to Shadow Flicker Evidence Base (2011), published by the then Department for Energy and Climate Change (DECC), states that assessing shadow flicker effects within ten times the rotor diameter of wind turbines has been widely accepted across different European countries, and is deemed to be an appropriate area.

In accordance with the DECC report, the starting point for analysis would be performing analysis on all occupied houses within ten rotor diameters of any proposed wind turbine.

This shadow flicker assessment is based on turbines with a 105m rotor diameter and the planning application includes a 50m micro-siting distance for infrastructure. As such, this 50m distance is added to the ten-rotor diameter 1050m distance to give a total distance of 1100m from any turbine.

Analysis should be undertaken for shadow flicker at all properties within 1100m from any wind turbine.

With due reference to the DECC report, and an allowance for 50m micro-siting, there are no inhabited houses within 1100m of any wind turbine and thus no flicker is predicted.

It is therefore concluded that the Proposed Development will not cause a material reduction to residential amenity owing to shadow flicker.

SOCIOECONOMICS LAND USE AND PUBLIC ACCESS

The Proposed Development will consist of seven turbines, with a total capacity of approximately 25.2 MW and a planned operational lifespan of 35 years.

It is anticipated that the Proposed Development will have a capacity factor of approximately 38%, generating enough energy to power nearly 22,000 homes.

The estimated quantifiable benefits of the construction and operational phase of the Proposed Development have been considered – focussing on employment, gross value added (GVA) and wages. An assessment of the potential fiscal and environmental benefits is also included and an overview of the pertinent socioeconomic conditions at the regional and local level. Furthermore an insight into current global and national topics and a brief analysis of links concerned with tourism and visitor perceptions is addressed and conclusions are drawn relating to the socioeconomic impact of the Proposed Development. Finally, the likely effects on land use and public access associated with the construction and operation of the Proposed Development is considered, including in relation to the Llangeinor Common.

The Proposed Development will offer economic and environmental benefits to the local area and region as a whole. Given the economic and social need to create new job opportunities, private sector investment should be viewed favourably. Construction of the Proposed Development will provide jobs suited to the skills profile of the local area.

During the operational phase of the Proposed Development, business rates payable to the local and regional government will increase. The Proposed Development will also further efforts to reach energy targets set by both the Welsh Government and the UK Government.

The Proposed Development is estimated to involve a capital spend of £22.49 million. Of this amount, £8.18 million will be realised in Wales. The 10-month construction phase is estimated to create or sustain an estimated 104-86 job years of employment, £3.44-2.81 million in wages and £3.52-£2.93 million in GVA to the Welsh economy.

The Proposed Development is also expected to create or sustain the equivalent of 35 direct job years of employment, £1.49 million in direct wages and £4.58 million in direct GVA over its 35-year operational lifespan.

A fiscal injection from the Proposed Development is also expected. During the construction phase tax receipts are likely to reach between £1.62 million and £1.33 million (including direct, indirect and induced wage impacts). While the operational phase is estimated to generate an addition £1.01 million in tax revenue.

Based on rateable values of £37,000 per MW, the Development will increase rateable value by £932,400 per year. From these values business rates are calculated and collected for local councils and the Welsh Government. By applying the fixed non-domestic rate, common to all 22 Welsh councils, estimated additional business rates of £479,254 each year will be paid.

The amount of electricity that could be produced by the Proposed Development, is estimated to meet the needs of nearly 22,000 homes each year, over a third of the current (2016) housing stock in the Bridgend County Bourgh. In addition, the Proposed

Development is likely to reduce $C0_2$ emissions by over 38,500 tonnes each year (equivalent to an estimated 29,200 newly registered cars).

There are several public rights of way crossing the site, including a bridleway linking Cwmparc with the Garw Valley, and footpaths linking to the other surrounding valleys, and following the ridge of Mynydd Llangeinwyr south. Being unenclosed upland grazing, most of the site is open access land, with the exception of the enclosed pastures in the east.

The Proposed Development includes proposals for permanent diversions to bridleway BW64GWV and footpath FP103GWV in order to maintain a suitable distance from the wind turbines. The proposed diversions are shown in Figure 12.1: Public Rights of Way Diversions. The permanent diversions represent an increase in length of approximately 260 m over the existing footpath and bridleway.

A temporary diversion, during the construction period only, to footpath FP31 OGV is proposed to maintain a suitable set back distance from the borrow pits. Details of the proposed diversion is shown in Figure 12.1. The temporary diversion represents an increase in length of approximately 100 m over the existing footpath. Both the permanent and temporary diversions proposed all follow similar terrain to the existing routes and do not encroach into any environmental constraints.

Should planning permission for the Proposed Development be granted, RES would lodge an application to divert the rights of way under the Town and Country Planning Act 1990, and any other consents that may be necessary, in consultation with Bridgend County Borough Council.

Given the relatively short length of the diversions, the similar nature of the terrain and the fact that no environmentally constrained areas will be affected, effects of the Proposed Development on public rights of way are not deemed to be significant.

Land cover on the Site consists of upland grassland, used as rough grazing, and includes registered common land. The summit of Werfa features an OS trig point and two communications masts within a fenced compound. The compound is accessed via a track from the A4107 and is serviced by a low-voltage overhead power line on wood poles which runs from the Garw Valley.

Following the completion of construction of the Proposed Development grazing will be able to continue around the infrastructure.

As a result of the Proposed Development RES would seek to de-register 16.81 ha of common land to make way for the Proposed Development and temporary construction area. To off-set this RES has secured 16.81 ha of replacement land directly bordering the existing common, which will be available from the start of construction. The habitat of the replacement land is semi-improved grassland with areas of improved grassland, marshy grassland and flush habitats. When taken out of active agricultural improvement, the replacement land would develop into an acid and marshy grassland mosaic, reflective of the common land occupied by the Proposed Development.

RES has reached agreements with the active commoners to compensate them for any temporary disturbance during construction.

The proposed changes to the common land are illustrated in Figure 12.2: Common Land Swap Plan. An application to cover the proposed changes to the common land will be submitted along with the planning application in accordance with Section 16 of the Commons Act (2006).

RES undertook consultation with the operators of the two communications masts at Werfa during the design stage of the Proposed Development. As a result the turbines

have been located at suitable set back distances so as not to cause interference to the masts. Occasional access to the masts is required for maintenance via a small existing track, which crosses the proposed wind farm track at one location. RES will ensure that access to the masts is maintained during construction and throughout the lifetime of the Proposed Development. The 11 kV overhead line which serves the communications masts will be diverted and undergrounded in the vicinity of turbine T7, in agreement with Western Power Distribution, to ensure suitable clearance distances are achieved.

Taking into account the mitigation in terms of replacement common land, grazing compensation during construction, and the set back distances of the turbines from the existing communications masts and infrastructure, effects on land use are not significant.