Project Acronym: SERVE
REF EC: (Project Number) TREN07/FP6EN/S.07.71106/038382
REF (project coordinator org.):
DOCUMENT: Large Wind Option for Eco-Village
REF.: Deliverable 7.2a

Project Coordinator: Seamus Hoyne
Project coordination org.: Tipperary Rural and Business Development Institute
Date: 3 December 2009
Revision: 2.0

Deliverable Report
Deliverable No.: 7.2a
Work Package No: 7

CONCERTO INITIATIVE
SERVE

Sustainable Energy for the Rural Village Environment

Report Title:

Large Wind Option for Eco-Village

Date: 3 December 2009

Author: Christine Barbier, Senergy Econnect

Version: 2.0

CONCERTO is co-funded by the European Commission

Table of contents

TABLE OF CONTENTS 2
1 INTRODUCTION 3
2 APPENDIX 1: LARGE WIND OPTION FOR ECO-VILLAGE 4

1 Introduction

Work package 7 within the SERVE Project focuses on specific research related to sustainable electricity supply. The main objective of this research is to investigate and make recommendations which will lead to the implementation of methods and technologies to achieve sustainable electricity supplies within the Eco-village, in particular, and also in the wider SERVE Region. The activities include:

a) Community Purchasing of Energy (SERVE Region)
b) Local grid development and control (Eco-Village)
c) Future on-site renewable electricity supply options (Eco-Village)

Initial work has commenced on the last objective with the development of an assessment of the options for large wind energy generation at the site. This report has been produced by Senergy Econnect. The report outlines the key issues that require consideration in order to progress the development of a large wind energy scheme at the site. The assessment has identified key technical and environmental constraints relevant for the preparation of a planning permission application, an indicative turbine location and specifications, an outline of costs and potential revenue, and relevant recommendations for the planning phase. The initial scoping report is provided in Appendix 1 and forms Deliverable 7.2a.

2 Appendix 1: Large Wind Option for Eco-Village

SERVE Project

D7.2a Large Wind Option for Eco-Village

Pre-Planning Feasibility Study and Business Case for On-Site Wind Generation at the Cloghjordan Site

Project number: 2061

Prepared for	Seamus Hoyne Serve Project Coordinator Tipperary Institute Nenagh Rd, Thurles Co. Tipperary Ireland

SENERGY ECONNECT LIMITED

STOCKBRIDGE HOUSE, QUAYSIDE, NEWCASTLE UPON TYNE NE1 2HJ, UNITED KINGDOM

T: +44 191 2387300 F: +44 191 2387399 E: econnect@senergyworld.com

REGISTERED IN SCOTLAND SC347794 REGISTERED OFFICE: 15 BON ACCORD CRESCENT, ABERDEEN, AB11 6DE

www.senergyworld.com/econnect

Executive Summary

A desktop study was undertaken to determine the technical, financial and environmental feasibility of a wind energy scheme at the Cloghjordan site. Initial assessments indicate that the site has reasonable wind speeds favouring the development of a wind turbine. However, the turbine location is constrained by the proximity of dwellings.

Turbine location and specification have been determined on the basis of an evaluation of a number of constraints and technical parameters. A preliminary assessment indicates that the site has a year load of 375 MWh and therefore a 750KW turbine would be suitable to meet demand.

A development consisting of a 750 kW wind turbine would result in an annual revenue of €152,416 with a payback period of 9.0 years and net lifetime profit in the order of €2.03M.

During the evaluation, a number of issues were highlighted which may conflict with the development of a wind energy scheme and will require further assessment. Key issues include:

- Three aviation stations located within 50 km of the development. The evaluation has highlighted aviation and radar issues which may require further assessment in conjunction with the relevant stakeholders.
- Sogaboy Hog Natural Heritage Area (NHA) is located within 5 km of the proposals, but is unlikely to be affected by a turbine development. An ornithological survey may be required to assess potential flight paths and collision risks associated with a wind energy scheme.
- The proposed development is also located close to sites of cultural heritage and landscape interest. Impacts on these designations are likely to be minor, although assessment will be required.

Recommendations

Subject to a positive outcome of the site visit, Senergy Econnect On-site Generation (OSG) recommends that an initial formal consultation is undertaken with the CAA followed by a full consultation exercise to provide a realistic assessment of the feasibility of the proposals, and to identify the level of environmental assessment required, prior to a potential planning submission.

Wind yield and turbulence effects can only be confirmed by the installation of an anemometer (met mast). Following the outcome of the project feasibility review, it is recommended that an anemometer be installed to provide an accurate model of the site feasibility in terms of wind yield.

Table of Contents

1	**Introduction**		**5**
	1.1	**Scope of Report**	**5**
	1.2	**Site Description**	**5**
	1.3	**Senergy Econnect OSG**	**6**
	1.4	**Report Structure**	**6**
2	**Wind Energy Resource**		**7**
	2.1	**Wind Speed**	**7**
3	**Planning Constraints**		**8**
	3.1	**Planning Policy Context**	**8**
	3.1.1	Government Planning Policy Guidance	8
	3.1.2	Regional Planning Policy Guidance	8
	3.1.3	Environmental Impact Assessments (EIA)	9
	3.2	**Environmental Constraints**	**9**
	3.2.1	Ecology	9
	3.2.2	Cultural Heritage	10
	3.2.3	Landscape and Visual Amenity	11
	3.2.4	Shadow Flicker	12
	3.2.5	Noise	13
	3.3	**Aviation Concerns**	**13**
	3.4	**Local Infrastructure**	**14**
	3.4.1	Topple distance	14
	3.4.2	Communication Links	15
4	**Site Constraints**		**15**
	4.1	**Ground Conditions**	**15**
	4.2	**Access and Delivery**	**15**
	4.3	**Grid Connection**	**16**
5	**Turbine Sitting and Selection**		**16**
	5.1	**Constraints Map and Turbine Sitting**	**16**
	5.2	**Turbine Selection**	**18**
	5.3	**Turbine Procurement**	**18**
	5.4	**Energy Output Calculation**	**18**
	5.5	**Revenue Streams**	**19**
	5.5.1	Imported Energy Displacement	19
	5.5.2	Exported Energy	19

5.5.3 Green Benefits 20
5.6 Power Purchase Agreements (PPAs) 20
5.7 Greenhouse Gas Emissions Reduction 20
5.8 Wind Turbine Business Case 22
5.8.1 Capital Expenditure (CAPEX) 22
5.8.2 Operating Expenditure (OPEX) 23
5.8.3 Revenue Prediction / Payback Period 24
5.8.4 Rate of Return Options 24
6 Conclusions and Recommendations 27
6.1 Conclusions 27
6.2 Recommendations 27

1 Introduction

1.1 Scope of Report

At the request of Sustainable Energy for the Renewable Village Environment ("The Serve Project"), Senergy Econnect OSG has carried out an initial feasibility assessment for a wind energy scheme at the Cloghjordan site. The scheme would provide a secure, direct supply of green energy for the eco village.

The purpose of this document is to provide an indication of the key issues that require consideration in order to progress the development of a wind energy scheme at the above site. The objectives of the assessment are as follows:

- To identify the key technical and environmental issues that need to be considered prior to the preparation of a planning application relating to the installation of a wind turbine within the site;
- To identify an indicative turbine location and appropriate turbine specification;
- To provide indicative capital costs, operational costs, and potential revenue that a project of the capacity proposed could expect; and
- To provide relevant recommendations to progress the development to the planning phase.

Senergy Econnect OSG would emphasise that this report represents an initial desktop assessment, and that issues not considered in this report may arise as the project progresses and such issues may impact on both the costs and/or the probability of the proposed project receiving planning approval.

1.2 Site Description

The Cloghjordan site is located in the county of Tipperary, approximately 10 km north east of Nenagh and 10 km west of Roscrea. Access to the site is provided via R490, R491, and local roads. Within the site boundary, residential dwellings are located to the south, east and west of the site. The site is characterised by arable land and trees interspersed with developed plots. The site location is shown in Figure 1.

Econnect

Cloghjordan site

CREATED	Martin Sanchez
DATE	01/08/08
PROJECT	SERVE PROJECT
TITLE	Site description

Figure 1. Site Location

1.3 Senergy Econnect OSG

Econnect, formed in 1995, was purchased by Senergy Group in 2008 becoming Senergy Econnect. With a 500 strong client base including utilities, developers, manufacturers, banks, government and trade associations. By 2005, Senergy Econnect had been involved in over 50% of all wind projects constructed in the UK, and were also involved in 85% of all wind farms constructed in 2007. Senergy Econnect's experience spans across 20GW of renewable projects in 32 countries including onshore and offshore wind, wave, tidal, hydro, landfill gas, CHP, photovoltaics, energy from waste, biomass and On-site Generation projects.

From this experience Senergy Econnect On-site Generation was born through strategic business partnerships with companies highly rated in their own areas of expertise including wind measurement and environmental and planning services.

1.4 Report Structure

The available wind energy is a critical factor in the consideration of any wind turbine development and is discussed in Section 2. Section 3 covers key legislative issues that require consideration prior to submitting a planning application. The practicalities of installing a wind turbine development on the Cloghjordan site are then outlined in Section 4 before assessing suitable turbine size and location within the site in Section 5. Also included in Section 5 are energy output calculations, determined from the predicted average wind speed and selected turbine data. The business case with predicted revenues and costs is presented in Section 6 before final conclusions are drawn and recommendations made in Section 7.

2 Wind Energy Resource

Assessment of site wind speed is critical in determining the amount of energy[1] that can be generated by the wind turbine and is a key factor in assessing the economic viability of any scheme. As power output is proportional to the cube of the wind speed i.e. doubling of the wind speed would create eight times more power output, small changes in site wind speed can have significant impacts on energy generation.

2.1 Wind Speed

At most sites, gale force winds (>17m/s) are rare and light to moderate wind speeds (3 – 8m/s) more common; in addition, there is potential for wind speed variation across a site. Typical variation is normally described using a Weibull distribution, as shown in Figure 2, showing the probability of the wind blowing at various speeds around a mean wind speed at a typical site:

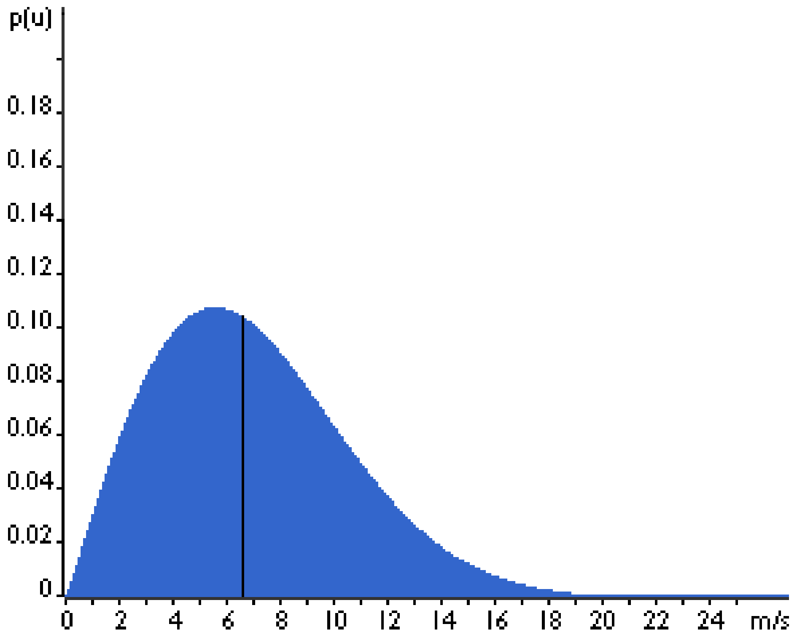


Figure 2. Weibull distribution of wind speeds around an example 6.7m/s mean wind speed
(Source Danish Wind Energy Association)

The most accurate method of determining the average wind speed on any site is through the installation of an anemometer or equivalent device for a period of twelve months or more. In the first instance, however, a much cheaper (but much less accurate) method is to use predicted mean wind speed figures which have been calculated for each square kilometre. This is achieved using Meteorological Office data and airflow models that predict the effect of topography on wind speed (although not local features such as buildings, trees etc which can have a significant effect).

This database gives predicted average wind speeds at 45m above ground level. For the area within the Cloghjordan site the predicted average wind speed is 7.0 m/s. In the energy output calculations (Section 5.3) this wind speed is extrapolated to the hub height of the selected turbine.

Risks and Recommendations

An estimated wind speed of 7.0 m/s indicates that the site has sufficient wind energy resource for the development of an economic wind energy scheme (not taking into account possible planning

[1] Expressed in megawatt hours (MWh), calculated from power multiplied by time.

and site constraints). However, this wind speed has been calculated based on an average wind speed for the site derived from a computer model based on 1 km^2 resolution and does not take into account the effects of wind shading and turbulence from features such as forestry and buildings.

Given the close proximity to possible sources of turbulence effects, such as the numerous buildings and trees, and the lack of available meteorological information for the area, Senergy Econnect OSG would advise Cloghjordan site to undertake a wind monitoring assessment through the installation of an anemometer or equivalent device on site for a minimum period of twelve months. This data would be required to:

- Determine final turbine specification for turbine procurement [2];
- Finalise turbine layout to maximise energy yield;
- Accurately calculate energy output - crucial in determining the financial viability of any wind turbine development

3 Planning Constraints

This section initially outlines the governmental and regional planning policy context and follows on to discuss specific constraints set by legislation that must be taken into account in any planning application for a wind energy scheme development.

3.1 Planning Policy Context

Compliance with national, regional and local planning policy is a key test for wind energy scheme developments. Any planning submission must demonstrate consistency with the Local Development Framework and National Spatial Strategy and should contribute to the aims and objectives of the relevant plans, in order to have a high probability of achieving consent.

3.1.1 Government Planning Policy Guidance

Planning applications for even small wind farm developments can incur great expense on developers. It is recommended therefore that pre-planning consultations with the planning department precede all applications. Developers shall be familiar with the “Windfarm Development Guidelines for Planning Authorities”. The greatest impact of a wind farm and its grid connection is its visual impact. It is recommended, therefore, that developers provide an assessment of the visual impact of the proposed development at pre-planning stage. In conservation areas such as Special Areas of Conservation (SAC) and Special Protection Areas (SPA) the developer is advised to consult with the Department of Environment, Heritage and Local Government (DoEHLG) prior to making an application. In the absence of this information the effectiveness of a pre-planning discussion is significantly reduced.

3.1.2 Regional Planning Policy Guidance

A planning submission must demonstrate consistency with the Local Development Framework and National Spatial Strategy and should contribute to the aims and objectives of the relevant plans.

[2] Some turbine manufacturers require wind monitoring data prior to procurement to be able to warrant the performance of the turbine.

3.1.3 Environmental Impact Assessments (EIA)

An Environmental Impact Assessment (EIA) must be carried out where required by the prescribed regulations. The Planning Authority may require the submission of an Environmental Impact Statement (EIS) with a planning application in other cases, where the size of the development does not exceed the statutory threshold requirements. A formal procedure for determining the requirement for EIA (Screening) has been established to comply with the regulations. The scale and location of this development indicate that the proposals are highly unlikely to require a full EIA, rather it is likely the submission will only require supporting documentation addressing the key issues such as those outlined in Section 3.2.

It is recommended that a Screening Opinion be obtained from the Tipperary County to comply with formal procedures set out in the above regulations. A comprehensive outline of the policy context of the proposed development should form part of any planning submission.

3.2 Environmental Constraints

Environmental constraints can have a critical impact on the feasibility of a wind energy scheme. A summary of potential constraints and identified issues is provided below.

3.2.1 Ecology

Protected species and habitats found in the vicinity of a site may be affected by the construction or operation of a wind turbine. Wind turbines can particularly impact birds through issues such as collision risk with rotating turbine blades, displacement as a result of construction, or due to the presence of the operating wind turbines close to nesting or feeding sites or habitual flight routes.

Identification of important species / habitats in the vicinity of a wind energy proposal may require surveys to establish baseline populations or the extent of a specific feature. Similarly, features off site, such as breeding or wintering bird populations may also affect the feasibility of a project. Proximity to key habitats or species may in some cases prohibit development.

This report identifies statutory natural heritage designations within 10 km and 5 km of the proposed wind energy scheme, as summarised below:

Internationally Designated Sites

Sites of international importance are designated under various European Directives and are effectively afforded the highest possible protection under planning law.

There is no international designated site within 10 km of the proposed site.

Nationally Designated Sites

Nationally designated sites include Special Areas of Conservation (SAC), and Special areas of Protection (SAP). A number of sites have been identified within 10 km of the site boundary as summarised in Table 1 below.

Nationally Designated Site	Distance (Km)	Designation	Issue
Lough Derg	10 km W	SPA & SAC	Vegetation and fish habitat
Liskeenan Fen	10 km N	SAC	Vegetation habitat
Scogaboy Hog	5 km N	NHA	Vegetation and birds habitat
Congort Bog	10 km NE	NHA	Vegetation habitat

Table 1. Nationally designated sites within 10 km of the site**.**

Locally Designated Sites

A Local Nature Reserve (LNR) is a statutory designation made by local authorities. LNR's are of local, but not necessarily national, importance.

No LNR's have been identified within 5 km of the development.

Risks and Recommendations

The proposed site is not located within the immediate vicinity of designations which are normally at risk from wind energy developments. However, Scogaboy Hog NHA, 5.5 km from the site houses a large diverse population of breeding birds, wintering wildfowl and waders. An ornithological survey may be required to assess potential flight paths and collision risks associated with the proposed wind energy scheme. Consultation with National Parks & Wildlife service is recommended to identify any potential adverse impacts of the development with respect to ornithological issues. Dialogue with the Council or County Ecologist will also highlight any non-statutory designations which may require appraisal as part of a planning submission.

3.2.2 Cultural Heritage

Cultural heritage features such as scheduled monuments, listed buildings and locally important archaeological sites may be affected either directly by a wind energy development (i.e. disturbance of buried features), or indirectly (impacts of the 'setting' of a feature). Senergy Econnect OSG has assessed the area surrounding the site for any sites of cultural heritage.

No designated features have been recorded within the site boundary; however a number of scheduled monuments, historic parks & gardens are located within the site boundary as summarised in Table 2 below.

Feature	Distance (Km) & Location	Designation
Cloghjordan house, oxpark	Cloghjordan	Archaelogical Artistic Historical Social
Shinrone Road,	Cloghjordan	Architectural, classic buildings
Moneygall Road	Cloghjordan	Architectural, classic buildings
SS Michael's and John's Roman Catholic Church	Cloghjordan	Architectural Artistic Historical Social

Feature	Distance (Km) & Location	Designation
Deerpark,	Cloghjordan	Architectural Artistic
Distillery Cottage, Borrisokane Road	Cloghjordan	Artistic Historical Social
Mullenkeagh House, Borrisokane Road	Cloghjordan	Architectural, classic buildings
The Old Presbytery, Borrisokane Road	Cloghjordan	Architectural Artistic Historical Social
Main Street, Cloughjordan,	Cloghjordan	Architectural, classic buildings
R. O' Hara, Main Street	Cloghjordan	Architectural, classic buildings
Galbraith, Main Street	Cloghjordan	Architectural, classic buildings
Saint Kieran's Church of Ireland Church, The Square	Cloghjordan	Architectural Artistic Historical Social
1 - 5 Church Street, Cloughjordan,	Cloghjordan	Architectural, classic buildings
Methodist Church, Main Street, Cloughjordan	Cloghjordan	Architectural Artistic Historical Social

Risks and Recommendations

Impacts on those setting are unlikely to be key issues for consideration during planning. Following consultation with the Local Planning Authority, County Archaeologist and National Inventory & Architectural Heritage it is recommended that the Landscape and Visual Assessment considers these key cultural heritage receptors. This is considered further in Section 3.2.3 below.

3.2.3 Landscape and Visual Amenity

The impacts on the surrounding landscape and visual setting are key issues to consider during the development of a wind energy scheme. Impacts on the setting of landscape designations and the surrounding area are often the most important and emotive issues for local residents and the general public. This report has assessed the relevant statutory landscape designations and potential cumulative impacts surrounding the site.

Landscape Designations

The Cloghjordan site is located approximately 15km from the city of Nenagh. Impacts on these designations are likely to be minor, although assessment will be required. See table bellow.

Feature	Distance (Km)	Designation
Views between Cloghjordan and Nenagh	15 km SW	none

Table 2. Landscape features

Cumulative Issues

Whilst one wind energy scheme alone may not have a significant impact on the landscape, in some areas the proliferation of wind energy schemes is seen as detrimental to landscape quality. Considering the local area around the Cloghjordan site there are several schemes submitted (in planning), consented, under construction or operational wind developments within 20 km of the site as listed in Table 3:

Wind Farm	Distance (Km)	Capacity & Status
Skehanagh	15 km N	4.25 MW connected
Ballinlough	15 km S	2.55 MW connected
Ballinveny	15 km S	2.55 MW connected
Curraghgraigue	20 km SW	2.55 MW connected

Table 3. Cumulative Impact

Risks and Recommendations

Initial assessments indicate that there are no major landscape designations which are likely to affect the feasibility of the project at this stage. Although the surrounding area is reasonably flat, visibility of the turbines above the tree line from towns and villages to the south of the development is likely and the installation of wind turbines on the site will impact the existing landscape. It is recommended that any planning submission includes a full Landscape and Visual Assessment to be carried out with an impact appraisal of local landscape designations (i.e. conservation areas) and in consultation with the Local Authority and Natural Parks & Wildlife Service. The assessment would include a Zone of Theoretical Visibility (ZTV) of the area showing the zone of visual intrusion that the turbines will create (i.e. the area from which the turbines will be partially or wholly visible) in addition to photomontages and wireframes showing how the turbines will look from various pre-determined viewpoints.

3.2.4 Shadow Flicker

Under certain combinations of geographical position and time of day the sun may be seen behind the rotors of a wind turbine and cast a shadow over neighbouring properties. When the blades rotate the shadow flicks on and off; this is known as shadow flicker. The extent to which it affects local residences is dependent on factors including the location of properties relative to the turbines, distance from turbines, turbine height / rotor diameter and weather conditions. Buildings with rooms containing only a single window are most likely to be worst affected but only for a few minutes at certain times of the day during short periods of the year.

Calculations of the impact of shadow flicker can be made, based on the worst case of bright sunlight, which throws distinct shadows. In the European climate, the likelihood of bright sunlight at the times in which shadow flicker would occur through a window is substantially less than 100%.

Risks and Recommendations

Properties more than ten Rotor Diameters (RD) from a turbine, are unlikely to be affected by shadow flicker due to the diminishing effects of the shadows at this distance. A number of residential receptors are located within the ten RD radius of the proposed turbine, as such, the Local Authority will require a shadow flicker assessment as part of a planning submission. However, established methods to control shadow flicker have been developed to mitigate impacts. In addition, residential dwellings that are located to the south of the development are highly unlikely to experience shadow flicker effects.

3.2.5 Noise

Modern wind turbines have relatively low noise levels, however some noise is generated from turbine blades passing through the air as the hub rotates, and also from the mechanical action of the gearbox and generator in the nacelle. Adopted assessment guidelines on noise generation from wind developments are based on existing background noise levels and proximity of sensitive receptors such as residential dwellings. In line with this approach, and to protect residential amenity, Senergy Econnect OSG endeavour to choose turbine locations with an adequate distance to residential dwellings. For comparison of the noise levels a turbine can generate, indicative noise levels of commonly occurring events can be seen in Table 4.

Source	Noise level (dB)
Threshold of pain	140
Jet aircraft at 250m	105
Pneumatic drill at 7m	95
Truck at 30mph at 100m	65
Busy general office	60
Car at 40mph at 100m	55
Wind turbine at 350m	35-45
Quiet bedroom	35
Rural night time background	20-40
Threshold of hearing	0

Table 4. Indicative common noise levels

Currently, the closest known residential dwellings to the Cloghjordan site are located approximately 500m from the proposed turbine location and do not present a constraint. The site is located in a predominantly rural and residential area.

Risks and Recommendations

Although the residential dwellings surrounding the project site are not particularly close, the low background noise levels of a rural location must be taken into consideration. For this reason, the Local Authority is likely to request a noise modelling exercise be undertaken to demonstrate that noise does not exceed the limits required for the residential receptors.

3.3 Aviation Concerns

The proximity of safeguarded aerodromes, light airfields and heliports can significantly conflict with wind energy scheme development, and can often be prohibitive to development.

At Cloghjordan, the site is located within the statutory safeguarded areas of three minor airports;

- Birr Flying Club, Roscrea, 15 km SW.
- Tipperary aviation Ltd., Nenagh, 15 km E.
- Mr Part Maher in Templeton, 20 km SE.

The Limerick Military aviation station is 50 km from the site and as such should not be impacted by the wind turbine project.

Wind turbines present two hazards to aviation, which are considered in the following paragraphs.

Physical obstruction

Wind turbines are of concern to the aviation authorities if they breach what is termed as the 'obstacle limitation surface' or OLS surrounding an airport. The OLS defines the height and distance from an airport that tall structures can be located without interfering with air traffic operations. Any proposed structure that contravenes the OLS and hence could impact on aircraft safety will be objected to by the Civil Aviation Authority (CAA) and the airport concerned.

Radar interference

Although wind turbines have a fixed location, most radar systems will register the rotation of the turbine blades as a trace until they recognise that the 'movement' is fixed in one location and not travelling across the ground. However if the turbine then starts to rotate on its horizontal axis as it yaws into the wind, this may again register as a trace on any radar screens in the proximity, and it is this unpredictable radar signature and the fact that it can be misinterpreted as an aircraft in flight which causes a headache for radar operators who are operating advanced early warning systems in the case of the National Air Traffic Control System (NATS) or local civil and military runway approach radar.

Risks and Recommendations

Turbine development is not prohibited within safeguarded areas, however further assessment is likely to be requested to assess the impact on radar and surveillance systems. It is recommended that:

- Early consultation is carried out with the CAA, NATS via standard procedures.
- An Aviation Impact Assessment should be commissioned following a positive outcome of the consultation phase.

3.4 Local Infrastructure

3.4.1 Topple distance

Senergy Econnect OSG recommend that the wind turbines are located at a distance of the height of the turbine (to the blade tip) plus a safe contingency distance away from major transport and utility infrastructure such as main roads, railway lines, overhead electricity distribution and transmission lines, and gas storage cylinders/holders.

Initial assessments indicate that there are no potential gas pipelines, railways, motorways, dual carriageways or electrical overhead lines on the site which need to be investigated further.

Risks and Recommendations

Although during initial investigation no physical constraints were found, consultation with relevant bodies should still be undertaken and should include contact with relevant organisations including Network Rail, the Highways Authority, Waterways etc to ascertain that the proposed location is acceptable. Full service searches should also be carried out with the relevant utility companies.

3.4.2 Communication Links

Any tall structure can cause interference to microwave links (and hence mobile communications) by introducing reflected waves into the link. A true assessment of wind turbine interference with microwave links is complex and inexact but a simpler assessment can be used as a credible basis for discussion when dealing with communications agencies.

In a similar way, a household's TV reception can experience interference if the wind turbine lies between the house in question and the TV transmitter to which the household's receiver is tuned. However TV interference is relatively straightforward to remedy now that digital services are increasingly available.

Risks and Recommendations

In most cases technical issues relating to link interference can be resolved by full assessment and negotiation with appropriate link operators. It is essential that the consultation exercise includes relevant link operators to determine the concentration of links in the area. Further assessment may be required to plot links and assess levels of interference.

4 Site Constraints

4.1 Ground Conditions

Identification of flood risk or contaminated land on a site can seriously affect the economic and technical feasibility of a project. Furthermore, soft or reclaimed ground may mean that pilings are required to secure the turbine foundations which will add to the cost of the civil works. No specific issues have been highlighted at the Cloghjordan site during this initial assessment phase and the site is outside the modelled flood plain area.

Risks and Recommendations

The Local Authority may request some assessment to determine previous development and risk of contaminated land. Consultation with the Environmental Protection Agency Irealnd would highlight any issues associated with groundwater and surface water quality.

4.2 Access and Delivery

The other aspect of the site that will impact on civil costs is access for the lifting equipment and the haulage vehicles that will be used to transport and erect each turbine. Access for at least two cranes (a main lift and a tailing crane) and a number of long haulage vehicles to carry the various elements of the turbine will be required. This generally involves the construction of temporary roads and hard standings up to and alongside each turbine location, but may involve a widening of site entrance and access roads. Again, the actual extent of the onsite works required will be assessed at the feasibility stage (although an estimate has been included in the capital costs in Section 6.4). An initial appraisal of the immediate access route indicates that the site benefits from good existing access from dual carriageways; R490 and R491. Turbine installation is not constrained by gradient.

Risks and Recommendations

The desktop assessment indicates that it is unlikely that the route to site will be a significant constraint to development. However the local authority may request an assessment (a swept path analysis) or route evaluation to determine whether the road network is able to physically accommodate the abnormal load vehicles necessary to transport turbine components. Standard consultation with the Local Authority and / or the National Roads Authority is recommended.

4.3 Grid Connection

Grid integration costs are dependent on the strength of the existing distribution network on site and the distance (including accommodating site obstructions) to the nearest suitable connection point. The electrical distribution network has not been assessed at this early stage of evaluation.

Risks and Recommendations

A grid connection assessment and cost estimate require a Detailed Grid Integration Study to be carried out; this can be provided at a later date. For the purposes of the financial model, it has been assumed that there is a suitable connection to an 11kV substation available on-site requiring approximately 500 meters of cable run to the indicated turbine located in figure 3 (site investigation required for confirmation).

5 Turbine Sitting and Selection

5.1 Constraints Map and Turbine Sitting

Two indicative turbine positions for each turbine size have been proposed based on a series of constraints identified in Sections 4 and 5 of this study. The accompanying constraints map shown in Figure 3 provides an illustration of the proposed turbine location. The turbine location may require some vegetation removal. In addition to the turbine, ancillary infrastructure will also be required. Additional components are likely to comprise an anemometer, access tracks (upgrades and / or new tracks), a small substation or transformer enclosure, underground cabling, temporary lay-down area and crane-pad. The layout of ancillary infrastructure will be determined at a later date subject to geotechnical and construction assessments.

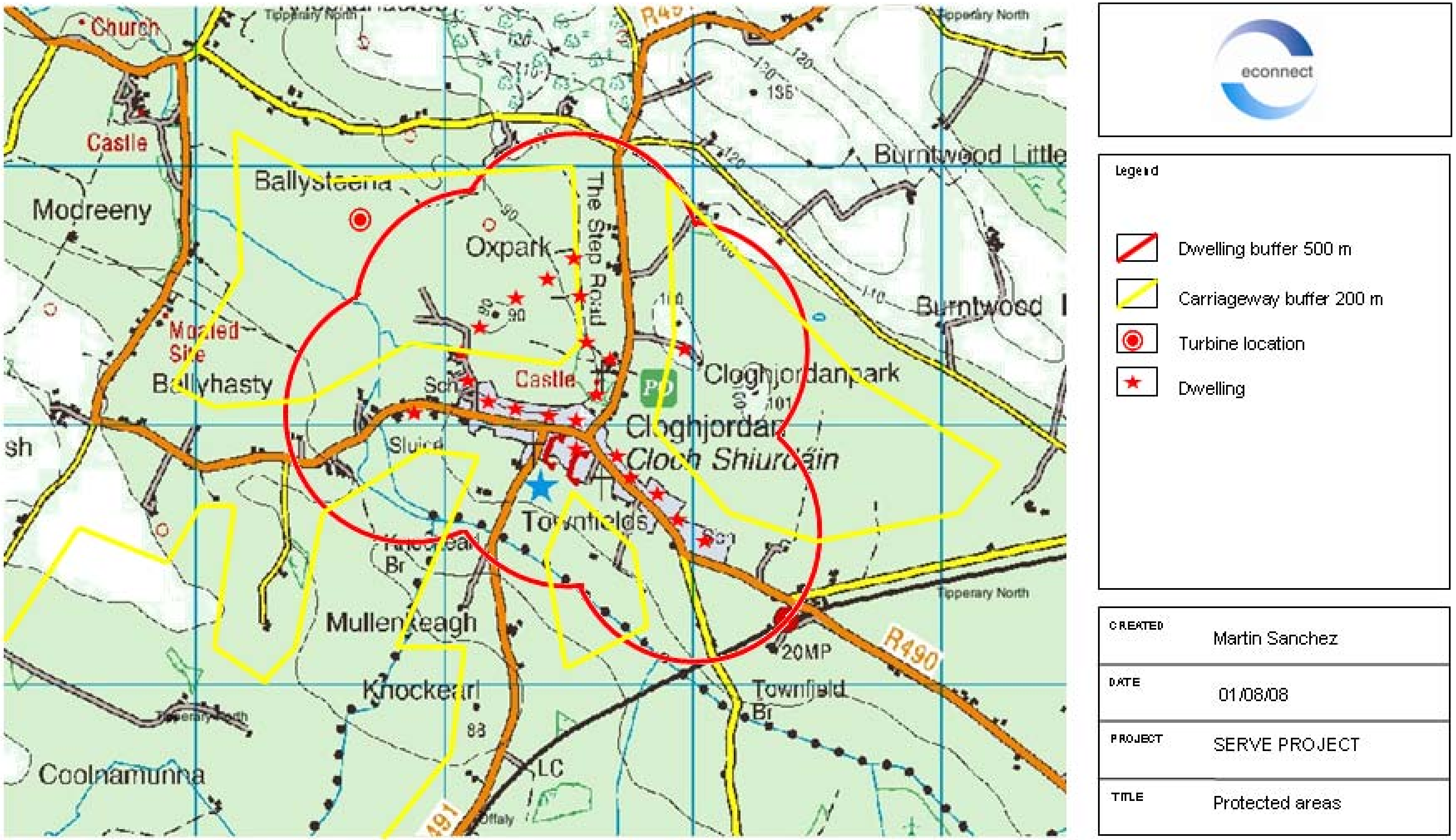


Figure 3. Constraints Map

5.2 Turbine Selection

The key drivers in turbine selection are planning restrictions, site constraints, energy output potential and cost. These determine the optimum number and size of turbines for any site. Generally the most economic solution is to select the largest capacity turbine that meets planning and site constraints.

The Cloghjordan site is not heavily constrained by any restrictions. This report has been based on information provided by the client stating that the 150 dwellings have an annual average load of 2.5 MWh per dwelling making a total annual load of 375 MWh. This demand, coupled with the constraints identified in this report, result in a recommendation that the feasibility of a 750kW turbine model be investigated.

5.3 Turbine Procurement

Due to the rapid growth of wind power development world-wide and re-powering of existing wind farm developments there is a shortage in the supply of new turbines of 1MW and above, however current lead times are approximately 6 months for 750KW turbines. There is also a corresponding shortage of second-hand turbines of any capacity in the market currently. Due to demand, second-hand machines may fetch a premium price once they become available. There is also a reliability and increased maintenance risk with choosing second-hand turbines over new turbines. Should Cloghjordan site wish to consider second hand turbines, Senergy Econnect OSG would only procure turbines that had been regularly serviced and were recently in operation. Senergy Econnect OSG may recommend refurbishment, depending on the age of the turbine in question.

This report has been based on procurement of new turbines.

5.4 Energy Output Calculation

A key factor in the energy output of a turbine is the wind power density at hub height. This is a function of air density which in turn is a function of average atmospheric pressure and annual average temperature. The wind power density curve illustrates the amount of power available in the wind and is a function of the probability of a certain wind speed multiplied by the energy available in the wind at that speed. The example in Figure 4 shows that the bulk of the energy available is at wind speeds above the mean:

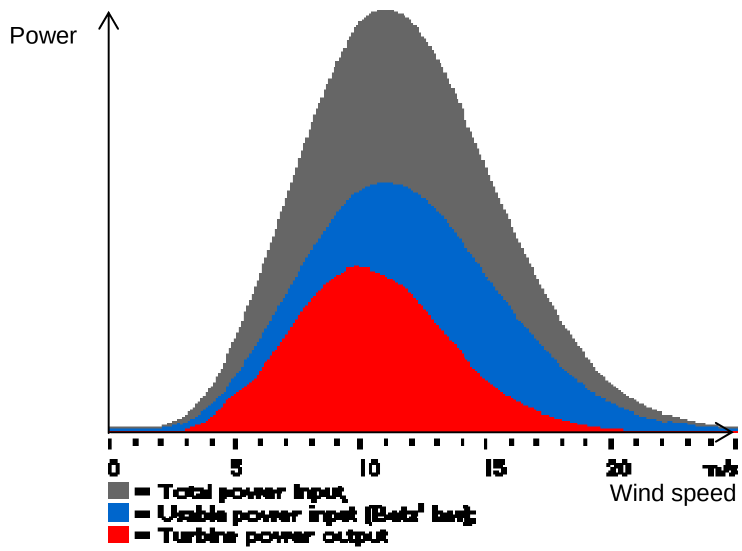


Figure 4. Wind power density curve for an example 7m/s mean wind speed
(Source Danish Wind Energy Association)

To calculate the electrical energy available from the generator we must use the power curve of the particular turbines of interest. The power curve gives the electrical power output that the manufacturer has measured at particular wind speeds for a particular turbine; however these figures are not guaranteed as the actual power output of the turbine will depend on the level of turbulence on site (i.e. how much the wind speed and direction fluctuates).

Finally, allowance must be made for unavailability of the turbine due to unscheduled and scheduled maintenance etc, and loss of energy production due to high wind cut-outs, utility outage, and blade soiling either through bugs or ice accretion. This methodology is used to ensure that figures in the generation assessment calculations outlined in Section 6.6 are representative of a realistic scenario.

For this site, assuming a candidate U54 Union Co. 750 KW turbine with a rotor span of 46m and predicted average wind speed of 7.0 m/s at 45m hub height, the calculated annual energy output is 1,942 MWh – enough energy to power the equivalent of 413 average households, or 776 average energy efficient Irish households.

5.5 Revenue Streams

The revenue streams that the project creates have a key role in the commercial viability of any wind turbine scheme. The constituent elements of the revenue stream for a wind turbine project are outlined below, as well as the form of contract in which the negotiated value of each revenue element will be stipulated.

5.5.1 Imported Energy Displacement

Knowledge of the onsite demand curve, i.e. the site electricity usage over the course of a weekday, weekend day and over a year, is important in determining the percentage of the wind turbine's output that will be used on site (i.e. that will displace energy that would otherwise be imported), and whether any generated power will be exported (or 'spilled') back onto the local distribution network. This has implications as to which revenue stream the energy can be allocated to and will affect the overall financial return on the project. Until a finalised turbine has been selected and the wind resource has been properly assessed it is difficult to clearly define the values for energy offset and spill, however Senergy Econnect OSG would undertake this as part of the detailed feasibility stage of the project and incorporate the results into the financial models.

5.5.2 Exported Energy

Any energy exported (or 'spilled') by an on-site generation scheme reduces the amount of energy that the purchasing supplier has to purchase from large, transmission-connected generation plant. To offset the higher overheads of contracting with small generators, the prices that suppliers offer for exported energy from on-site plant are usually somewhat lower than the prices that they would pay for larger volumes.

Certain suppliers will offer a flat rate €/MWh tariff. Other suppliers will offer a 'seasonal time of day' (STOD) tariff for the energy output of an embedded generation scheme. This tariff will consist of a matrix of prices, in units of €/MWh. Generally speaking, the prices paid for energy exported during working hours will be higher than the prices paid at nights and during weekends. Moreover, the prices paid for energy exported during the winter months will be higher than the prices paid in the summer. The wholesale price offered is also likely to be affected by the duration of the Power Purchase Agreement (PPA) (discussed in Section 6.2) sought, with lower prices for longer contracts.

5.5.3 Green Benefits

There are various government measures in place that have been designed to encourage industry to reduce energy consumption and harness renewable sources of energy. These measures deliver significant financial benefits to operators of 'green' electricity generating plants.

Ireland has selected the Renewable Energy Feed in Tariff (REFIT) as its main instrument. From 2006, this scheme is expected to provide some investor certainty, due to a 15-year feed-in tariff guarantee.

The Commission for Energy Regulation (CER) has the power under the Electricity Regulation Act 1999 to issue licences for the generation, distribution, transmission and supply of electricity in Ireland. Developers wishing to construct a new generating station or reconstruct an existing generating station must have an authorisation to construct from the CER prior to commencing work. Generators must also be in possession of a licence to generate from the CER before commencing generation. Following the publication of CER decisions CER/07/128 and CER/08/161, the application process by which a generator becomes authorised and licensed as well as associated obligations and requirements are determined by the maximum installed capacity of the generator. It should be noted that the definition of maximum installed capacity for the purposes of the licensing and authorisation process is based on the actual generating capacity (nameplate rating) of the generator and not the export capacity (MEC). The maximum installed capacity thresholds are:

Less than or equal to 1 MW capacity: Such generators are authorised to construct and/or licensed to generate by Order, the relevant terms and conditions that pertain being set out in those Orders.

Generators authorised to construct and/or licensed to generate are subject to specific terms and conditions as set out in the relevant Orders, see CER/07/128.

Supplementary information, in addition to that required in the application forms, may be requested by the CER where this is considered appropriate.

5.6 Power Purchase Agreements (PPAs)

The power output from on-site generation schemes can be sold to electricity supply companies, or to other organisations involved in electricity trading. PPAs between such parties and on-site generators usually cover the wholesale energy.

In effect, the site owner would require three PPAs, one for the energy supplied to site, one for any energy exported from the site, and a third to realise the green benefits for the energy that is generated and used on site. One supplier can contract for all three PPAs, or they can each be contracted with different suppliers.

The exact terms of these agreements are a matter for negotiation between generators and suppliers, and contract prices will depend on factors such as the predicted output and geographical location of the generation scheme, the generation technology, the amount of energy consumed on site and the duration of the contract. Senergy Econnect OSG can provide specialist energy trading services.

5.7 Greenhouse Gas Emissions Reduction

The greenhouse gas (GHG) emission reductions generated by the installation of the wind turbine have been calculated using a power generation fuel source efficiency model. The model calculates the generation efficiency and the production of three greenhouse gases namely carbon dioxide, nitrous oxide, and methane, and converts this into an equivalent tonnes of carbon dioxide emitted per Megawatt hour (MWh) generated. This is the amount of carbon dioxide which would be offset should each MWh be generated using non-fossil fuel sourced technologies. The equivalent greenhouse gas emission reductions for the turbines proposed given in Table 5 assume a displacement of coal-fired generation which is generally more expensive per unit output than other sources of generation such as gas or nuclear, and hence is first to be displaced by any zero fuel cost generation such as wind.

Greenhouse Gas Emissions Reduction		
Predicted Annual Output	Estimated	1,940,000 kWh
Energy generated equivalent	Average UK households	419 households
Greenhouse Gas Emission Reduction (displacing coal fired generation)	Equivalent tonnes CO_2,	2216 tonnes

Table 5. Annual greenhouse gas reductions.

5.8 Wind Turbine Business Case

5.8.1 Capital Expenditure (CAPEX)

The CAPEX total assumes that the development is based one U54 Union Co, 750KW turbine installed on conventional gravity foundations (no pilings), with an underground cable connection into an existing 11kV substation requiring no more than 0.5 km of cable run and a repowering of the actual transformer. A further electrical study may be needed if further review indicates that the existing 11kV line needs reinforcement. The details of the capital expenditure are shown in Table 6 below.

Capital Expenditure			
Description	**Detail**	**Cost**	**Totals**
Civil Works	Temporary road access (0.12km estimated)	€15,000	
	Highway access/entrance(none assumed)	€0	
	Crane bases	€18,500	
	Turbine foundations (conventional gravity)	€62,500	
	Pilings (assumed none)	€0	
	Transformer foundations	€3,750	
	Final reinstatement	€12,500	
	Civil design & project management	€16,838	
	Total		**€129,088**
Electrical Works (11kV busbar connection, 0.5 km cable run)	Cabling	€254,000 (underground cable)	
	Transformers		
	Switchgear		
	Terminations		
	Earthing	€3,900	
	Total		**€257,900**
Turbine Supply	Turbines, transport and erection		**€660,000**
Project Development & Management	Planning, development & construction		**€62,500**
Insurances	Construction (€12,500 per MW)		**€9,375**
Contingency	€18,500 per MW		**€13,875**
CAPEX TOTAL			**€1,132,738***

Table 6. Capital expenditure

*Note that these capital expenditures are generic estimates based on Senergy Econnect OSG experience on similar UK projects and as such may vary once conditions on the site have been fully investigated. A currency conversion rate of 1.25 has been used in this report.

5.8.2 Operating Expenditure (OPEX)

The details of operating expenditure are shown below in Table 7.

Operating Expenditure		
Description	**Detail**	**Cost (per annum)**
Warranty	Manufacturers warranty for first year	**€0**
Metering /Communications		**€6,250**
Commercial management & billing		**€1,875**
Electrical equipment Operation & Maintenance		**€3,125**
Turbine Operation & Maintenance	Monthly reporting	**€12,500**
	6/12 month inspections and maintenance	
	Emergency call out	
Insurances	Operational[$] (€3,500 per MW)	**€3,281**
Rates	(€10,000 per MW)	**€9,375**
Contingency	To cover faulted equipment	**€10,000**
OPEX TOTAL	**Years 1 to 20**	**€46,406 per annum**

Table 7. Operational expenditure

[$] Note that the insurance market for both construction and operational insurance is now very competitive and that this may drive down premium costs

5.8.3 Revenue Prediction / Payback Period

The revenue estimates shown in Table 8 are based on a predicted energy output total over a twenty year turbine lifetime assuming an export onto the wider electricity network of 80.7%, based on information provided by Serve Project in the form of an energy bill, and use of system charges cost as follows:

It should be noted the following analysis does not take account of costs associated with occasional import from the grid during periods of high consumption and low wind. These costs could be assessed in a more detailed assessment using actual wind speed and half hourly consumption data.

Current cost of energy 15.9 c€/kWh

Estimated energy sell price 5.9 c€/kWh (REFIT prices)

Revenues		
Predicted Annual Output	Estimated 1 x 750kW U54 Union Co. @ 7.0 m/s average wind speed (@ hub height 45m above ground level) 5% losses	**1,942,000 kWh**
Power purchase price.	assuming 80.7% export assuming 19.3% load	**5.9 c€/kWh** **15.99 c€/kWh**
Gross Annual Revenue	**Less OPEX (yr1-20)**	**€152,416**
Net Annual Revenue		**€106,010**
CAPEX TOTAL		**€1,132,738**
Payback	**Net Annual x 20yrs**	**9.0 years**
Lifetime Profit		**€2,034,604**
Lifetime Revenue		**€4,095.461**

Table 8. Revenue return

5.8.4 Rate of Return Options

The following two tables are examples of likely rate of return. The tables have been produced making some current financial assumptions such as a lending rate of 10% and an annual inflation rate of 3.3%. Senergy Econnect OSG have produced two examples, Table 9 showing a model financed completely by SERVE and Table 10 showing a model representing external financial investment of 80% of the capital costs.

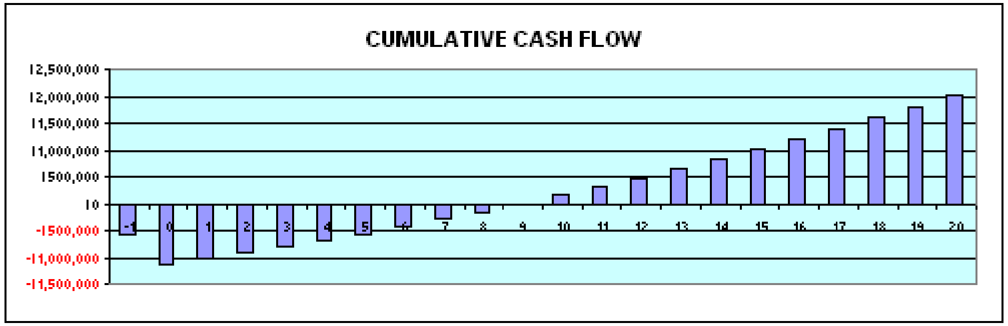
KEY POINTS	
1,132,738	CAPITAL EXPENDITURE (€)
46,406	OPERATIONAL EXPENDITURE (€) Year 1-5
46,406	OPERATIONAL EXPENDITURE (€) Year 1-6
20	LIFE CYCLE (years)
3.00%	AVERAGE ANNUAL INFATION (%)
1942000	PREDICTED ANNUAL OUTPUT (Kwh)
375000	PREDICTED ANNUAL LOAD (kwh)
100%	PERCENTAGE CAPITAL
10	LOAN LIFE (YEARS)
10%	LOAN RATE (%)
0.1599	INITIAL PRICE OF PURCHASE ENERGY (€)
0.059	INITIAL PRICE OF EXPORT ENERGY (€)

11.10%	IRR (%)
9.01	PAYBACK (years)
2.03	FINAL PROFIT 20 Years (M€)
4.10	TOTAL REVENUE (M€)

PROJECT NUMBER: 2061
CLIENT:
SITE: Serve Project
BUSINESS CASE: 100% of the capital cost provided by the client

YEAR	-1	0	1	2	3	4	5	6	7	8	9
LOAN (€/YEAR)			€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
REPAYMENT (€/YEAR)			€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
INTEREST (€/YEAR)			€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
energy price	€ 0.0000	€ 0.0000	€ 0.1599	€ 0.1647	€ 0.1696	€ 0.1747	€ 0.1800	€ 0.1854	€ 0.1909	€ 0.1967	€ 0.2026
total price for load	€ 0.0000	€ 0.0000	**€ 0.1599**	**€ 0.1647**	**€ 0.1696**	**€ 0.1747**	**€ 0.1800**	**€ 0.1854**	**€ 0.1909**	**€ 0.1967**	**€ 0.2026**
export price	€ 0.0000	€ 0.0000	€ 0.0590	€ 0.0608	€ 0.0626	€ 0.0645	€ 0.0664	€ 0.0684	€ 0.0704	€ 0.0726	€ 0.0747
total price for export	€ 0.0000	€ 0.0000	**€ 0.0590**	**€ 0.0608**	**€ 0.0626**	**€ 0.0645**	**€ 0.0664**	**€ 0.0684**	**€ 0.0704**	**€ 0.0726**	**€ 0.0747**
REVENUE (€/YEAR)	€ 0	€ 0	€ 152,416	€ 156,988	€ 161,698	€ 166,549	€ 171,545	€ 176,691	€ 181,992	€ 187,452	€ 193,075
LOAN (€/YEAR)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
OPEX (€/YEAR)	€ 0	€ 0	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406
CASH-FLOW (€/YEAR)	-€ 566,369	-€ 566,369	€ 106,010	€ 110,582	€ 115,292	€ 120,143	€ 125,139	€ 130,285	€ 135,586	€ 141,046	€ 146,669
CUMULATIVE cf (€/YEAR)	-€ 566,369	-€ 1,132,738	-€ 1,026,729	-€ 916,147	-€ 800,855	-€ 680,712	-€ 555,573	-€ 425,288	-€ 289,702	-€ 148,656	-€ 1,987
LOAN (€)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0

YEAR	10	11	12	13	14	15	16	17	18	19	20
LOAN (€/YEAR)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
REPAYMENT (€/YEAR)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
INTEREST (€/YEAR)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
energy price	€ 0.2086	€ 0.2149	€ 0.2213	€ 0.2280	€ 0.2348	€ 0.2419	€ 0.2491	€ 0.2566	€ 0.2643	€ 0.2722	€ 0.2804
total price for load	**€ 0.2086**	**€ 0.2149**	**€ 0.2213**	**€ 0.2280**	**€ 0.2348**	**€ 0.2419**	**€ 0.2491**	**€ 0.2566**	**€ 0.2643**	**€ 0.2722**	**€ 0.2804**
export price	€ 0.0770	€ 0.0793	€ 0.0817	€ 0.0841	€ 0.0866	€ 0.0892	€ 0.0919	€ 0.0947	€ 0.0975	€ 0.1004	€ 0.1035
total price for export	**€ 0.0770**	**€ 0.0793**	**€ 0.0817**	**€ 0.0841**	**€ 0.0866**	**€ 0.0892**	**€ 0.0919**	**€ 0.0947**	**€ 0.0975**	**€ 0.1004**	**€ 0.1035**
REVENUE (€/YEAR)	€ 198,868	€ 204,834	€ 210,979	€ 217,308	€ 223,827	€ 230,542	€ 237,458	€ 244,582	€ 251,920	€ 259,477	€ 267,262
LOAN (€/YEAR)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
OPEX (€/YEAR)	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406
CASH-FLOW (€/YEAR)	€ 152,462	€ 158,428	€ 164,573	€ 170,902	€ 177,421	€ 184,136	€ 191,052	€ 198,176	€ 205,514	€ 213,071	€ 220,856
CUMULATIVE cf (€/YEAR)	€ 150,475	€ 308,903	€ 473,475	€ 644,377	€ 821,799	€ 1,005,935	€ 1,196,987	€ 1,395,163	€ 1,600,677	€ 1,813,748	€ 2,034,604
LOAN (€)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0



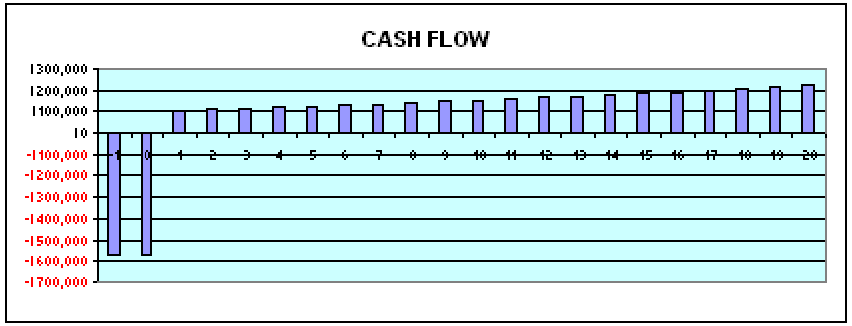


Table 9. Capital cost not financed.

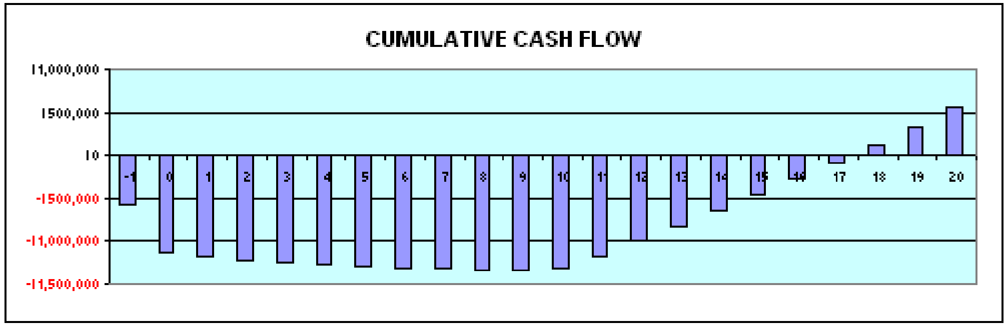
KEY POINTS	
1,132,738	CAPITAL EXPENDITURE (€)
46,406	OPERATIONAL EXPENDITURE (€) Year 1-5
46,406	OPERATIONAL EXPENDITURE (€) Year 1-6
20	LIFE CYCLE (years)
3.00%	AVERAGE ANNUAL INFATION (%)
1942000	PREDICTED ANNUAL OUTPUT (Kwh)
375000	PREDICTED ANNUAL LOAD (kwh)
20%	PERCENTAGE CAPITAL
10	LOAN LIFE (YEARS)
10%	LOAN RATE (%)
0.1599	INITIAL PRICE OF PURCHASE ENERGY (€)
0.059	INITIAL PRICE OF EXPORT ENERGY (€)

5.75%	IRR (%)
17.39	PAYBACK (years)
0.56	FINAL PROFIT 20 Years (M€)
4.10	TOTAL REVENUE (M€)

PROJECT NUMBER: 2061
CLIENT:
SITE: Serve Project
BUSINESS CASE: 20% of the capital cost provided by the client

YEAR	-1	0	1	2	3	4	5	6	7	8	9
LOAN (€/YEAR)			€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478
REPAYMENT (€/YEAR)			€ 56,859	€ 62,545	€ 68,800	€ 75,680	€ 83,248	€ 91,572	€ 100,730	€ 110,803	€ 121,883
INTEREST (€/YEAR)			€ 90,619	€ 84,933	€ 78,679	€ 71,799	€ 64,231	€ 55,906	€ 46,749	€ 36,676	€ 25,595
energy price	€ 0.0000	€ 0.0000	€ 0.1599	€ 0.1647	€ 0.1696	€ 0.1747	€ 0.1800	€ 0.1854	€ 0.1909	€ 0.1967	€ 0.2026
total price for load	€ 0.0000	€ 0.0000	**€ 0.1599**	**€ 0.1647**	**€ 0.1696**	**€ 0.1747**	**€ 0.1800**	**€ 0.1854**	**€ 0.1909**	**€ 0.1967**	**€ 0.2026**
export price	€ 0.0000	€ 0.0000	€ 0.0590	€ 0.0608	€ 0.0626	€ 0.0645	€ 0.0664	€ 0.0684	€ 0.0704	€ 0.0726	€ 0.0747
total price for export	€ 0.0000	€ 0.0000	**€ 0.0590**	**€ 0.0608**	**€ 0.0626**	**€ 0.0645**	**€ 0.0664**	**€ 0.0684**	**€ 0.0704**	**€ 0.0726**	**€ 0.0747**
REVENUE (€/YEAR)	€ 0	€ 0	€ 152,416	€ 156,988	€ 161,698	€ 166,549	€ 171,545	€ 176,691	€ 181,992	€ 187,452	€ 193,075
LOAN (€/YEAR)	€ 0	€ 0	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478	€ 147,478
OPEX (€/YEAR)	€ 0	€ 0	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406
CASH-FLOW (€/YEAR)	-€ 566,369	-€ 566,369	-€ 41,469	-€ 36,896	-€ 32,187	-€ 27,336	-€ 22,339	-€ 17,193	-€ 11,892	-€ 6,432	-€ 809
CUMULATIVE cf (€/YEAR)	-€ 566,369	-€ 1,132,738	-€ 1,174,207	-€ 1,211,103	-€ 1,243,290	-€ 1,270,626	-€ 1,292,965	-€ 1,310,158	-€ 1,322,050	-€ 1,328,483	-€ 1,329,292
LOAN (€)	€ 906,190	€ 906,190	€ 849,331	€ 786,786	€ 717,986	€ 642,307	€ 559,059	€ 467,486	€ 366,757	€ 255,954	€ 134,071

YEAR	10	11	12	13	14	15	16	17	18	19	20
LOAN (€/YEAR)	€ 147,478	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
REPAYMENT (€/YEAR)	€ 134,071	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
INTEREST (€/YEAR)	€ 13,407	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
energy price	€ 0.2086	€ 0.2149	€ 0.2213	€ 0.2280	€ 0.2348	€ 0.2419	€ 0.2491	€ 0.2566	€ 0.2643	€ 0.2722	€ 0.2804
total price for load	**€ 0.2086**	**€ 0.2149**	**€ 0.2213**	**€ 0.2280**	**€ 0.2348**	**€ 0.2419**	**€ 0.2491**	**€ 0.2566**	**€ 0.2643**	**€ 0.2722**	**€ 0.2804**
export price	€ 0.0770	€ 0.0793	€ 0.0817	€ 0.0841	€ 0.0866	€ 0.0892	€ 0.0919	€ 0.0947	€ 0.0975	€ 0.1004	€ 0.1035
total price for export	**€ 0.0770**	**€ 0.0793**	**€ 0.0817**	**€ 0.0841**	**€ 0.0866**	**€ 0.0892**	**€ 0.0919**	**€ 0.0947**	**€ 0.0975**	**€ 0.1004**	**€ 0.1035**
REVENUE (€/YEAR)	€ 198,868	€ 204,834	€ 210,979	€ 217,308	€ 223,827	€ 230,542	€ 237,458	€ 244,582	€ 251,920	€ 259,477	€ 267,262
LOAN (€/YEAR)	€ 147,478	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
OPEX (€/YEAR)	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406	€ 46,406
CASH-FLOW (€/YEAR)	€ 4,983	€ 158,428	€ 164,573	€ 170,902	€ 177,421	€ 184,136	€ 191,052	€ 198,176	€ 205,514	€ 213,071	€ 220,856
CUMULATIVE cf (€/YEAR)	-€ 1,324,308	-€ 1,165,881	-€ 1,001,308	-€ 830,406	-€ 652,985	-€ 468,848	-€ 277,796	-€ 79,620	€ 125,894	€ 338,965	€ 559,820
LOAN (€)	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0



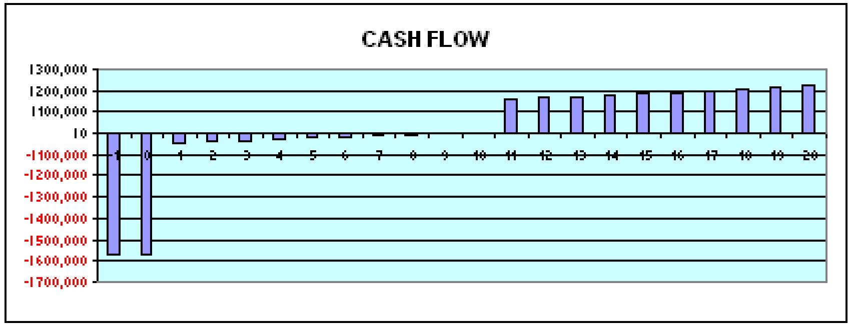


Table 10. 80% capital cost financed

Risks and Recommendations

These revenue estimates are based on a predicted energy output total assuming 80.7% export into the wider electricity network (i.e. partial imported energy displacement), and on an average of Cloghjordan's energy and use of system charges cost (15.99c€/kWh). The amount of energy output consumed on-site, and the state of the market at the time of negotiation for the remaining load requirements will have an impact on the financial model.

The rate of return tables provides an indication of cash flow and more importantly an example, using a loan system, of how, even when Cloghjordan is undertaking the developments themselves, financial risks may be reduced further. Table 10 provides a cash flow scenario on the basis of 100% funding by Cloghjordan and illustrates an Internal Rate of Return (IRR) at 11.10% with a total profit of €2.03M. Table 11 provides a cash flow scenario on the basis of 20% funding by Cloghjordan and 80% funding on a Loan and illustrates an IRR of 5.75% with a total profit of €0.56M; however this version means that upfront financial risk to Cloghjordan is considerably reduced.

These figures should be used as a guide to potential revenue returns and not relied upon for financial planning. A more accurate financial model will be gained from 12 month wind speed data measurements, final turbine selection (subject to wind speed data measurements and planning consultations) and typical half-hourly on-site electricity usage data.

6 Conclusions and Recommendations

6.1 Conclusions

The initial feasibility study demonstrates that the site may be suitable for a wind energy scheme due to:

- Reasonable wind speed;
- Quality of route to site; and
- Ground conditions.

Should the project progress then Senergy Econnect OSG would recommend, at this stage, that a 750kW turbine be used as the basis for further assessment.

A number of other technical and environmental issues also require consideration, and need to be addressed prior to submitting a planning application to the local authority. These include:

- Potential impacts to wintering and breeding birds associated with the national heritage areas and designated sites;
- Proximity to Cloghjordan city;
- Cumulative impact with other existing wind farm developments

Assuming the above issues are addressed, and planning permission granted for the development using a 750kW turbine operating at a predicted average wind speed of 7.0 m/s at 45m agl hub height, financial modelling predicts an initial capital expenditure of €1,132,738, annual revenue of €152,416 with a payback period of 9.01 years and net lifetime revenue in the order of €2.03M**.**

6.2 Recommendations

Subject to a positive outcome of the site visit, Senergy Econnect OSG recommends that an initial formal consultation is undertaken with the CAA followed by a full consultation exercise to provide a realistic assessment of the feasibility of the proposals, and to identify the level of environmental assessment required, prior to a potential planning submission. Consultees would include:-

- Natural Parks & wildlife service;
- National Inventory & archaeological Heritage;
- Environment Agency;
- Relevant link operators;
- Civil Aviation Authority;
- NATs;
- Irish Waterways;
- Utility Companies;
- Irish Rail;
- National Roads Authority;
- Network Rail; and
- Additional local groups, trusts and stakeholders as recommend.

Following consultation with the relevant stakeholders, a full assessment of the feasibility of the project can be determined, including an accurate assessment of the scope and cost of the environmental assessment required to support a planning submission.

Following the outcome of the project feasibility review, it is recommended that a met mast be installed to provide an accurate model of the site feasibility in terms of wind yield.

Incorporating this measured wind speed data, a finalised turbine selection, the half-hourly electricity demand data from site, site specific operating costs, and the full breakdown of the supply day/night kWh rates into the financial model would then allow a more comprehensive assessment of the financial viability of the project to be established

	Name	Date	Signature
Prepared By	Martin Sanchez	23 Oct 2008	
Checked By	Elizabeth Hutchinson	06 Nov 2008	
Approved By	Patrick Smart	06 Nov 2008	

Document History		
Issue No	**Description**	**Date**
01	Original Document Issue	07 Nov 2008
02	Reissued with new Deliverable number and name	03 Dec 2009