Wind Power Feasibility Study

Report for

Fetlar Developments Limited

18th March 2013

Ecodyn Limited
Fliskmillan Steadings
Fliskmillan, Newburgh
Fife KY14 6HN
Tel: 01337 870249
Fax: 01337 870279
email: info@ecodyn.com
http://www.ecodyn.com

This document has been prepared in accordance with the requirements of the integrated management system operated by Ecodyn Limited. This system has been certified to ISO 9001:2000 and ISO 14001:2004.

The information contained in this proposal is for the internal use of Fetlar Developments Ltd and should not be divulged to any other parties.

Approved for issue:

Duncan Oswald
Director

Date: 18th March 2013

CONTENTS

1. INTRODUCTION

Ecodyn has been invited by Fetlar Developments Limited (FDL) to undertake a feasibility study into the possibility of installing a renewable energy system at their site. This report sets out the aims of the project, constraints and potential solutions.

1.1 Project summary

The aim of the project is to install sufficient wind generation capacity to meet the electricity, hot water and space heating needs of the school, the house and the proposed electric vehicle.

2. SITE SURVEY

The site comprises a field with space for one or two turbines. Acoustic separation may be tight for a second turbine but this would likely be an issue of nuisance rather than a planning consideration, given the financial connection between the house and the proposed installation.

50m 100m 150m 200m 250m

Scale: 1:2500, paper size: A3

The proposed turbine location(s) would be along the western march fence. This is the highest point on land that would be available to the development; everything outside the site ownership boundary is thought to have too much archaeological and ornithological protection to be worth considering.

2.1 Access

Access to the site should be reasonable for off-road vehicles, particularly if it is possible to arrange for work to be carried out in the summer months. Concrete will have to be batch-mixed on site but Ecodyn has done this before for another site a few hundred meters away and it is not a significant problem.

Cable runs have already been discussed. The proposed run would be fine, as would an alternative, running along the fence line to the house, then down the road to the electric vehicle building and on to the school.

3. FEASIBILITY

The proposed design solution suggested in the tender brief centres around two large, insulated hot water storage tanks. These would act as a buffer, allowing excess energy to be dumped to hot water, for subsequent use in hot water and space heating systems in the school and house.

The tender brief suggests two CF20 wind turbines. C&F have had issues with reliability and service response, particularly in remote locations however it appears that matters are improving and of course, having two turbines would increase the overall reliability of the installation. A simpler, more robust alternative was suggested in the Bergey 10kW turbine, however this simply would not provide enough power unless several were installed. This would bring the nearest turbine too close to the house; the Bergey is a noisy turbine, so this was not considered a viable solution.

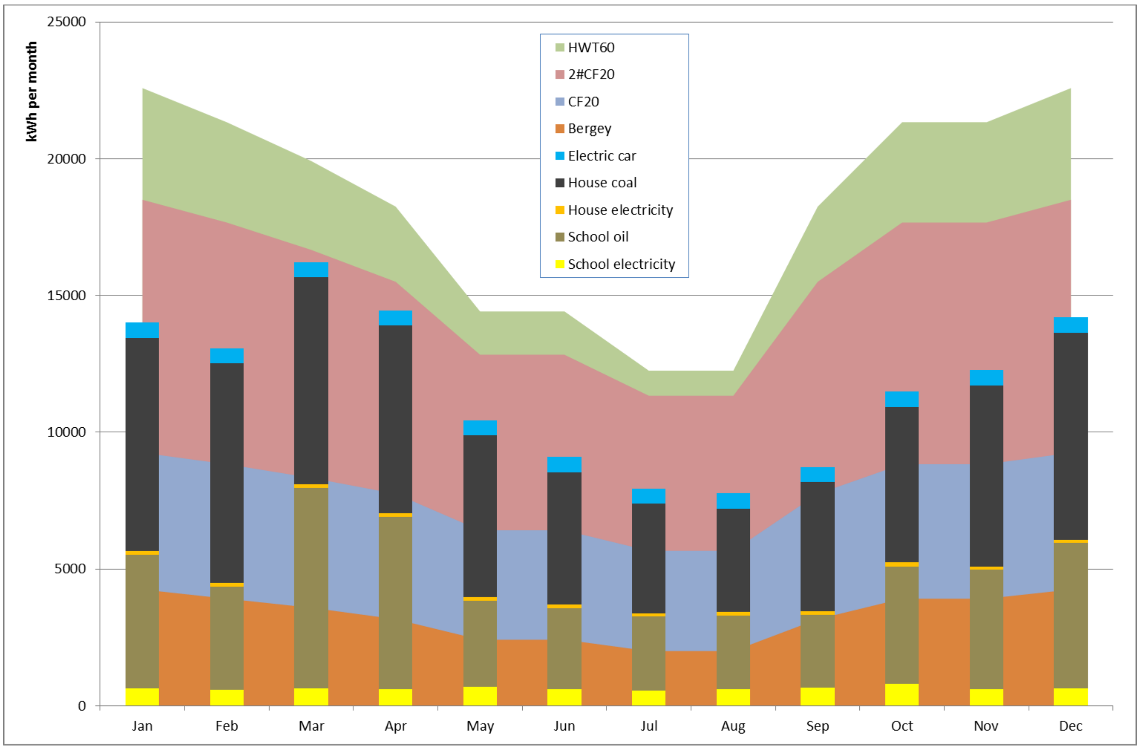
In the 20kW range, there is only one other turbine: the Westwind. This has such a bad reputation in Shetland that it would not be sensible to suggest one. This may be a little unfair, since the terrible reputation these turbines have was earned by an older model and the standard, tried and tested design solution was repeatedly experimented with (without the consent of Westwind) largely unsuccessfully and largely by Shetland Wind Power.

Moving up the scale, there are no turbines on the market in the UK above 20kW until you get to the 50kW range. This is represented by C&F, Harbon, Endurance, WES, Seaforth and some others. FDL have tacit approval from SNH for one or two turbines up to 27m to tip, so the WES, at 34m is probably ruled out. The Seaforth turbine is too noisy for the site and the site is too windy for an Endurance. That leaves the CF50 and Harbon. Neither has a long history but Harbon has a slight edge, having operated one turbine on Coll for almost two years now (with another dozen or so now up, mainly in Caithness). Also, the Harbon is designed to Class 1, whereas C&F do not appear to provide a survival rating for their design. The Harbon has some other advantages in this context as well: its output can be reduced to pretty much any level within around ten seconds, it is cheaper, comes on a hydraulic tower for easier maintenance and is now fitted with more efficient blades which include failsafe mechanical tip brakes.

Having discussed these issues with FDL, we have restricted further calculations to Bergey, CF20 and Harbon turbines.

3.1 Data

Data on consumption of electricity and oil have been supplied by FDL. These have been supplemented by anecdotal figures provided during the site visit (e.g. coal consumption in the house) and by publicly available data (e.g. monthly average wind data for the site which have been used to estimated generation output, average temperatures throughout the year used to estimate heat requirements in buildings). These data and calculations based on them, are summarised below:



This summary graph shows (in columns, by month) the anticipated demand for electricity, space heating and hot water for the school, house and electric vehicle. Behind the columns is shown the predicted output of the various turbine combinations discussed. The latter are based on published monthly average wind speeds for Lerwick and assume that the stated wind speeds are for hub height, so the figures arrived at will be on the conservative side.

Assuming the data, estimates and calculations are near enough correct, this suggests that a single Bergey turbine would simply not provide enough power (two Bergeys were considered too noisy as the second turbine would have to be too close to the house), a single CF20 would provide almost enough, two CF20s a little too much and a single Harbon considerably too much power (particularly given that the new Harbon blades are expected to yield 10-15% more output). That said, these figures are all based on a 100% constrained connection, with no export to grid allowed. If any export is permitted, or if other loads can be found, the case for the bigger turbine might become more compelling.

It is also worth bearing in mind that these figures are monthly averages; the match between instantaneous supply and demand will never be quite as neat. The proposed design solution will go a long way toward ironing out any mismatch in supply and demand but even so, it would be better to err on the side of oversupply.

Original data, assumptions and calculations are supplied as an Excel spreadsheet with the electronic version of this report.

3.2 Costs and payback

Ignoring for now the additional costs of cabling, tanks, energy management system etc., the following table gives an outline of the relative costs and expected income from the proposed turbine installations:

Turbine	Bergey 10kW	CF20	2# CF20s	Harbon 60kW
Generation tariff	0.21p/kWh	0.21p/kWh	0.21p/kWh	0.21p/kWh
Income	£ 8,190	£ 19,530	£ 39,060	£ 45,973
Estimated installation costs	£ 45,000	£ 80,000	£ 160,000	£ 225,000
Simple payback	5.5	4.1	4.1	4.9
Simple project value	£ 118,800	£ 310,600	£ 621,200	£ 694,450

This table is based on payback only from the generation element of the feed-in tariff. FDL may be able to improve on this by charging for supply of electricity.

3.3 Preferred turbine solution

Both in terms of matching supply to demand and in terms of value and payback, the preferred solution appears to be two CF20 turbines, as suggested in the tender brief. This arrangement has the advantage that with two turbines, there is more chance of at least one of them working at any one time but may have a disadvantage in securing planning approval for two turbines, rather than one.

The Harbon solution is more expensive and gives a longer payback period, however if the (currently unreleased) figures for output with the new blade design are taken into account then the difference in payback reduces almost to nothing (they are reported to give 10-15% more generation overall). As well as being a single turbine, the Harbon also has the advantage that its output is more or less infinitely variable: the rated output of the turbine is 60kW but it can be turned down using a software command, reducing output in about 10 seconds. Although this would do nothing for income generated by the installation, it could be a useful feature in balancing demand and supply, particularly in the event that there is some fault or problem elsewhere in the system.

On paper, the best solution appears to be two CF20s but we would recommend not ruling out the Harbon turbine as a viable alternative.

3.4 Grid connection

Shetland is not connected to the National Grid, which presents the District Network Operator with difficulties in balancing supply and demand, particularly as wind power generation capacity increases with each installation. As a result, all grid connections on Shetland are constrained under the Northern Isles New Energy Solutions (NINES) Project. In discussions with SSE, they have suggested that a connection offer would be made in this case, however it would be constrained. The constraint system works on an annual basis, so the initial offer may be only be constrained by, say 10% but the following year, it could be constrained by 100%, meaning that the installation can still be connected to the grid but no export is permitted.

This situation means that any design solution must be viable when there is zero export.

Currently, the school and house each have their own private connection to the mains distribution network; the school has a three-phase connection and the house a single phase connection. However, there is a three-phase cable running from the transformer to the house which is not currently in use; it might be possible to use this existing cable run to save costs on connecting three-phase power to the house.

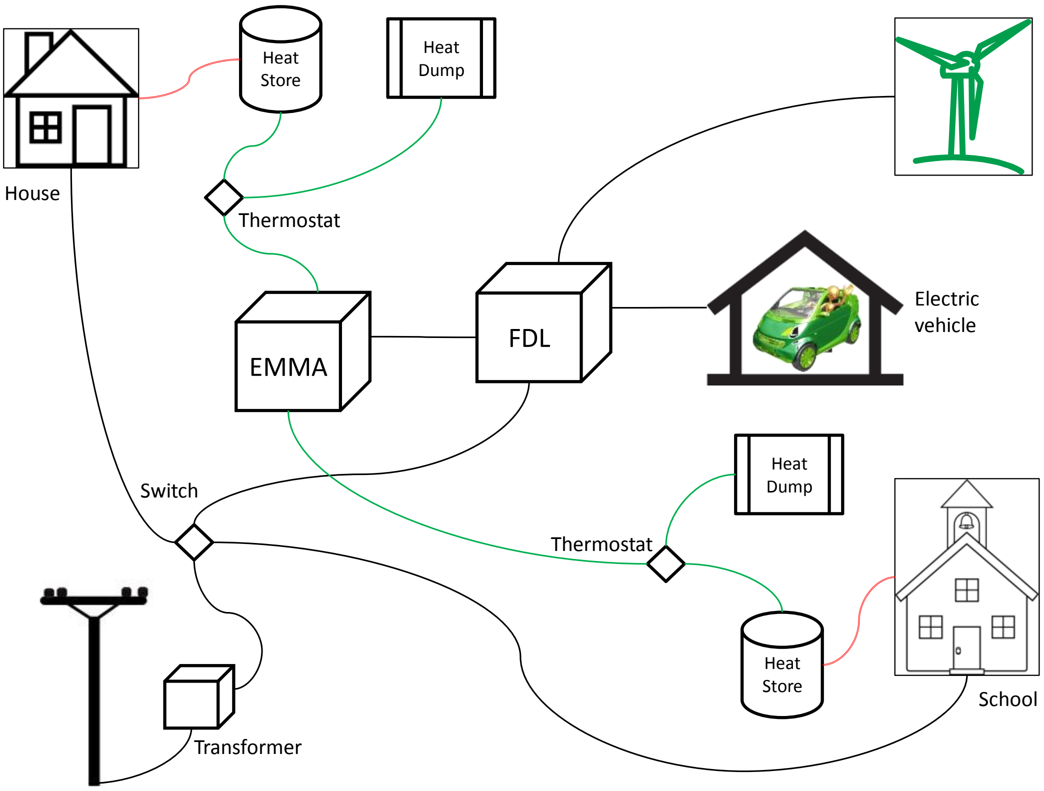
3.4.1 ESCo

One aim of the project is to supply electricity to the house, the school and the electric vehicle charging station. While this is entirely feasible from a technical point of view, from a bureaucratic point of view there would be some obstacles to overcome. In the UK, regulations governing competition in supply require that anyone can change electricity supplier at any time (subject to contract). This means that FDL would be able to supply electricity to both the house and school but could not prevent either from changing supplier in the future. With the house, this would likely be less of a problem but with the school, which is operated by Shetland Islands Council (which presumably has a bulk tariff from a single supplier) it might be more difficult.

It is not permissible to have two supplies connected at the same time, so one potential solution might be to have a two-way switch, so that the school and house could be connected either from the turbines, or direct from the mains. If the switch was connected to the turbines and the wind stopped blowing, the house and school would be supplied with electricity from the turbine connection point, which would be paid for by FDL. The switches would be there as a last resort, for use in the event that FDL's apparatus suffered a catastrophic failure. It would also mean that the school in particular was still technically connected directly to the mains, which should provide some comfort to the Council.

4. DESIGN SOLUTION

The proposed design solution uses an EMMA system to manage the distribution of electricity to the house, vehicle charging station and school, with export constrained by up to 100%. It is summarised below:



This design will ensure that all energy generated by the turbines is used on site, unless the grid constraint is relaxed, in which case the EMMA controller can be reprogrammed to allow export, if required.

If no electricity is being generated, this solution requires that electricity is supplied by FDL, however the existing mains connections remain, so that the whole system can be switched back to the mains in the event of a system failure.

4.1 EMMA

The EMMA system distributes energy to a number of circuits, each of which can carry no more than 3kW. The largest system available (the TP45/270) has 15 relays, so allowing 7 to be connected to each thermal store, which would require 7 immersion heaters, each with a capacity of 3kW.

In the event that the thermal stores are at capacity, a thermostat switches the load to a heat dump. This can be located either in the electric vehicle enclosure or at the house and/or school. This is intended as a last resort safety feature only.

4.2 Thermal Stores

Current heating systems in place at both house and school are based on a wet radiator system which can readily be adapted to draw off the heat store, so that the current systems can remain in place as a backup. This will require a certain amount of plumbing, using thermostatically controlled mixing valves to ensure that stratification is maintained in the thermal store.

Stratification is an essential principle of thermal storage; the idea being that it is far more useful to have a small volume of very hot water than a large volume of tepid water. If cooler water is required, this very hot water can be blended with colder water. Stratification is achieved by heating and drawing water off the top of the tank; the natural tendency of hot water to float on top of colder water maintains the layering.

It should be noted that the thermal store system would of course not be 100% efficient as there would be some loss of stored heat through the insulated lining. In terms of matching supply to demand, this would have the effect of increasing the apparent demand, making a closer match to either two CF20s or a single Harbon.

We visited the Shetland Composites factory in Lerwick and spoke to them about the project and about their tank. Based solely on this visit, we have estimated the maximum heat loss from the tank at around 5kWh per day, which is about 1% of the minimum generation output, so this is not expected to be a significant issue.

5. FINANCE

Various financial models have been discussed and these will no doubt be refined further should the project go ahead. The favoured model is probably to set up a co-operative, which would allow anyone to invest in the project (most likely favouring the local community). This model would also allow the investment to qualify for the Entrepreneurs Investment Scheme and would convey partnership status, allowing payment of tax to be devolved back to partners.

6. SUMMARY

In summary, the project appears to be viable in terms of planning, access, technical feasibility, finance, and economics. A viable design solution has been sketched out in this report, based on data supplied and on the site survey carried out. While this will require some refinement prior to installation, particularly with integration into existing heating systems, we are confident that it will work according to the requirements of the tender.

In conclusion, we would recommend that FDL proceed with an application for grid connection and planning permission.