Options Review for West Harris and Barvas Local Energy Supply

March 2017

Executive Summary

Three methods of connecting local renewable energy generation with local demand were investigated – Sleeving, Virtual Meter Point Administration Number (MPAN) and On-site Supply. The first two models were assessed for an existing community turbine matched with a nearby salmon hatchery in West Harris; the third for an existing salmon hatchery in Barvas matched with a proposed community-owned wind turbine. The opportunities, risks and barriers associated with each were looked at, as well as the market for suppliers. A cost-benefit analysis was also carried out; the results of which are presented below. It was decided that, whilst sleeving is technically feasible, it is unlikely to bring any tangible benefit to either party for this scale of generation and demand. The Virtual MPAN model could lead to economic benefits for both the generator and the demand, and it is proposed that the community group continue discussions with Community Energy Scotland and Energy Local. On-site supply in Barvas may be a model worth pursuing, but there are a number of uncertainties surrounding its viability, such as obtaining funding. The grid constraints currently in place in the Western Isles are a major barrier to connecting new renewable energy projects, but it is recommended that the community group stays in touch with Community Energy Scotland and Local Energy Scotland regarding future developments in this area.

Introduction

A partnership comprising West Harris Renewables Ltd, Urras Oighreachd Bharabhais (Barvas Estate Trust), Community Energy Scotland and Scottish Salmon Company was awarded grant funding through the Scottish Government's Infrastructure and Innovation Fund, delivered by Local Energy Scotland, to investigate three different ways of connecting local renewable energy generation with local demand. West Harris Renewables Ltd (WHRL, a wholly owned subsidiary of community landowner the west Harris Trust) own a 53kW Harbon wind turbine, located in Scarista in the Isle of Harris. The turbine has a grid connection of 50kW, and exports around 3kW directly to a local demand. The Scottish Salmon Company (SSC) own a salmon hatchery in nearby Geocrab; connected on the same network as the WHRL turbine. Since this turbine is already installed and grid connected, there is an opportunity to link it to the local demand, thus creating a local energy economy where energy which is produced locally is also consumed locally. Following previous work on other projects, it was

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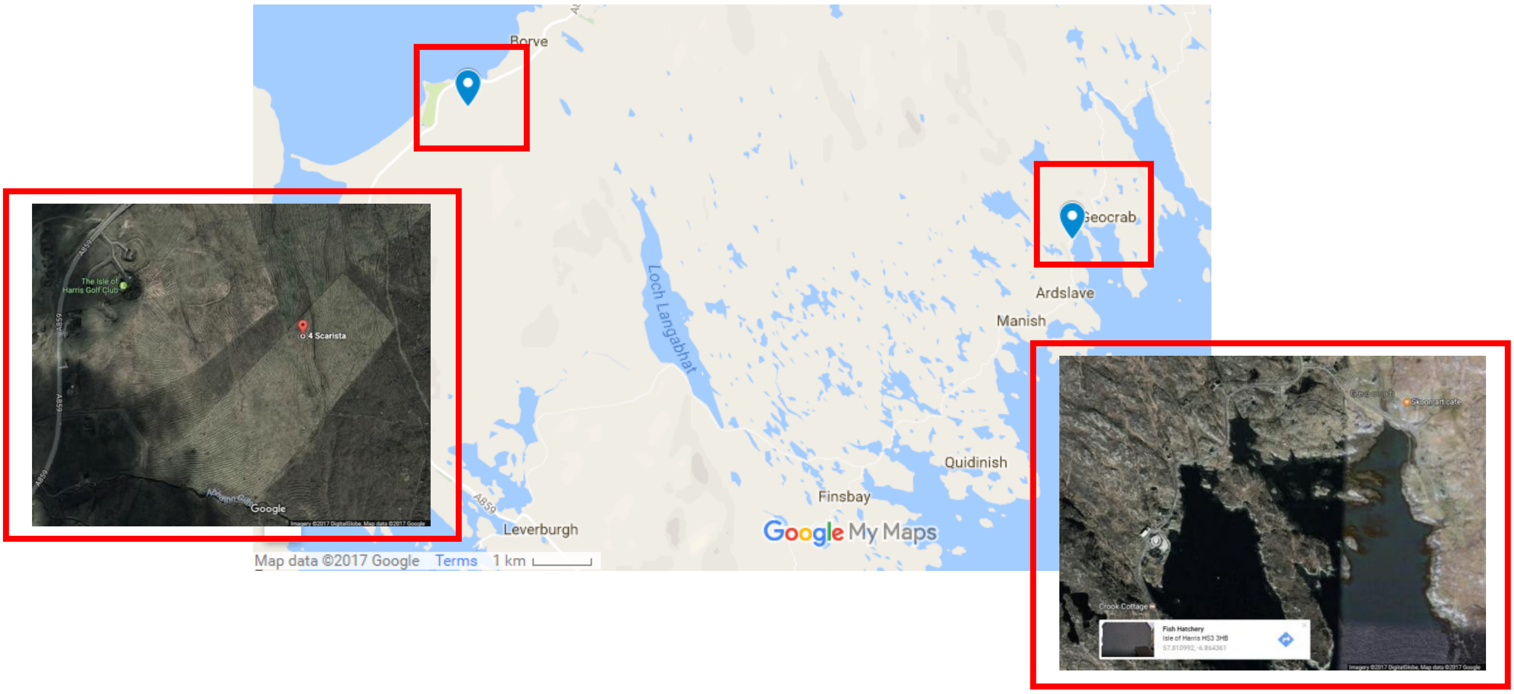
felt that the two most relevant local supply models in this case are "Sleeving" and "Virtual MPAN". These are discussed in more detail below.



Map showing locations of Scarista Wind Turbine (Left) and Geocrab Hatchery (Right)

Urras Oighreachd Bharabhais (UOB) is a community group based in Barvas, Isle of Lewis. The group is keen to investigate the potential for renewables of all scales on its community-owned estate. Due to the grid constraints currently in place throughout the Western Isles, it is very difficult for renewable generation to connect to the grid. SSC also own and operate a salmon hatchery in Barvas, and it was felt that this presented an opportunity for UOB to investigate whether a UOB-owned wind turbine could supply power locally, to this hatchery. This model is referred to as "On-site Supply".

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Map showing location of Barvas Hatchery

There are other models currently being proposed and tested, such as Local Balancing Units, which is similar to the virtual MPAN model being considered here, which would make it easier for community renewable energy generation to be sold locally, with benefit to the generator as well as the end user. Many of these are more relevant to groups of generators and/or consumers, rather than the one-to-one generation and consumption which is being considered here. A summary of some of these models can be found in “Local Supply: Options for Selling Your Energy Locally[1]”.

Community Energy Scotland (CES)’s role in the project is to provide learning from other, similar projects, and to assist WHRL and UOB in investigating further the three chosen models. Community Energy Scotland have carried out modelling of the demand and generation for both sites, as well as some basic financial modelling, to inform to a cost-

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benefit analysis. Energy Local were commissioned to carry out demand and generation and financial modelling for the Virtual MPAN model suggested for the Scarista and Geocrab sites. The findings are presented below.

1. Sleeving

Sleeving involves a variation of the 'Power Purchase Agreement' (PPA) contract for sale of power by a generator to a fully licensed supply company. Electricity is sold as normal, however a local business also arranges to purchase its power from the same supply company. The generator and business agree a bespoke long term price between themselves, to which the supplier adds its margin.

This supply option requires very little set up time or expense, and is already tried and tested. Using a sleeving agreement means that the generator does not have to become its own licensed supply company. It would only offer limited gains, however. Significant cost savings are unlikely as the supplier still takes its normal margin; and supply companies will normally require a certain minimum volume of power to make the administrative time worthwhile. Meanwhile, the need for fixed long term purchase agreements means sleeving is, at the moment, really only possible with industrial or commercial, rather than domestic, consumers.

Sleeving is mainly used for marketing purposes and for the end-user to demonstrate sustainability and Corporate Social Responsibility, as they can show that they are sourcing their electricity from renewables. Marks and Spencer, for example, use sleeving to secure 'sustainable energy' claims for their stores. The establishment of a formal commercial relationship between local generators and loads does, however, have a second potential benefit. If incorporated into a demand side management scheme, where demand is controlled and switched on during times when there is generation available, it could provide a mechanism for rewarding the load for services to generation, or even produce some cost benefit through demonstrating low or zero balancing costs between the generator and a dedicated electricity supply point (commonly referred to via its unique reference number, or Meter Point Administration Number (MPAN)). Controlling demand is outwith the scope of this project, since in the case of the Harbon turbine and the Geocrab hatchery, demand greatly exceeds the generation, and the generation is already grid-connected, but demonstrating low or zero balancing costs is something which is addressed in the virtual MPAN model (detailed below) and which could prove to be very useful in terms of cost benefits.

Utilising demand side management to reduce balancing costs and/or allow increased connection of renewable generation as part of a local supply agreement appears to be the most promising avenue to begin investigation; although this would not be a simple task. The initial challenges for increased connection of renewable generation include:

- Securing co-operation with the DNO and establishment of new connection protocols – this would need to be approached through close communication with the DNO to see what is acceptable to them, as well as with Ofgem who are becoming more interested in innovation and in increasing competition, and who may be open to new ideas which are well-founded.
- Reduced balancing costs requiring suppliers to transparently separate out balancing costs from other supply costs in their PPA agreement, which will require co-operation from electricity suppliers as this is currently not a standard process

A sleeving agreement could form a natural first step in the establishment of a more comprehensive form of local supply in the long term. If this is the case, however, then there would need to be a clear exit clause built into the contract, allowing the parties to roll the sleeving agreement into this larger supply arrangement without breaking terms of the original contract.

Risks

The risks of sleeving are fairly low, and mainly revolve around PPA prices and electricity sale prices, and reputational risk. For an existing scheme, the generator and end-user should be no worse-off than they currently are, provided they have signed up to a suitable deal, and if the agreement was to come to an end the generator could go back to selling directly to the grid, and the end-user to buying directly from the grid as before.

Barriers

Implementing such a scheme requires an agreeable generator, end-user, and licensed supply company. While sleeving is not a new model, and there are plenty of examples of sleeving agreements around the country, the amounts of generation and demand in this project are fairly low, and both parties would have to be sure that the licensed supplier did not charge more than the project could afford; otherwise it may end up costing the generator and/or the end-user more.

There is unlikely to be a cost benefit to either the generator or the consumer since the licensed supply company will take a cut of any benefits which are available.

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Technically, this solution should not be difficult to implement as it just requires an agreement between all the parties. This is something which could be worked on by a lawyer, should the group decide to proceed with this model. The group could procure the services of a lawyer who has experience in this area, or could use templates from previous, similar projects.

Suppliers

Following the Market Research Questionnaire (see Appendix 2) which was published on the Public Contracts Scotland (PCS) website, no responses which directly addressed sleeving were received. From a wider view of the current market, it appears that the market is not yet willing to offer sleeved PPAs for the volumes of generation and demand being assessed here, with separate tariffs for generation and demand which are “matched”, and generation and demand which are not “matched”.

2. Virtual MPAN

Via the Virtual MPAN model, generation and demand is aggregated “virtually” before negotiating with a licensed supplier for half-hourly settlement of this aggregated profile. This could involve a number of domestic properties as well as commercial premises and various forms of generation, as long as they can be metered half-hourly and aggregated. This model is currently being trialled by Energy Local[2] in Bethesda, Wales, where a number of regulatory barriers are being identified and addressed. In the case of West Harris, the aggregation would only involve one source of demand – the SSC hatchery at Geocrab – and one source of generation – the WHRL turbine at Scarista. The output of the turbine and the demand of the hatchery would be aggregated by a third party, creating one demand curve which would then used for half-hourly settlement with a licensed supplier.

Through this model there is the potential for balancing costs to be reduced – aggregating demand from a number of domestic properties, for example, gives a smoother profile which is easier to balance than balancing each property individually. There is also the potential for reduced costs when local demand is being supplied by local generation; if it can be shown that the demand is at the same time as the generation then transmission charges can be lessened as it can be demonstrated that the power is being consumed nearby. The “Cost-benefit Analysis” section below gives the results of the modelling which was carried out in order to establish how well-matched generation and demand is at both sites, and the benefits which could be achieved by using the Virtual MPAN model.

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Risks
The main risk to the generator and consumer as it stands at the moment is the need to sign up to the same electricity supplier, who is willing to carry out the netting of generation and demand. This may cause issues for the generator if they are signed up to a long-term Power Purchase Agreement which would need terminated, and similarly for the consumer if they are signed up to a long-term electricity tariff with a supplier. Whilst the new supplier may offer a lower tariff to the generator and consumer when the generation and demand is matched, the price for sale to grid and purchase from grid during times when they are not matched may not be as favourable as tariffs from other suppliers. This is something which should be taken into account as part of the financial considerations of WHRL and SSC. Modelling has been carried out to estimate how well-matched the generation from the Scarista turbine and the demand at the Geocrab hatchery are, and the potential benefits which could be realised (See Section 4. Cost-benefit Analysis of Sleeving and Virtual MPAN at Scarista/Geocrab). The better-matched the generation and demand, the lower the risk that the project will be affected by unfavourable costs in this way.

Barriers
There are a number of regulatory barriers which would need to be addressed, for example electricity supply regulations which must be adhered to, and there may also be issues around thing like defining MPANs, and how the DNO operates the grid and how it is regulated and interacts with a licensed supplier. The DNOs obligations are mainly around maintaining their systems and keeping the lights on, and as a result there is often not a lot of leverage with them. Assuming that there is no change to Distribution Use of System (DUoS) charging, there would be no need to obtain permission from the DNO, although consultation would be required.

There is also a need to be able to meter half-hourly, which may be overcome by the use of smart-meters, but which may be difficult for properties for whom smart-meters will not work as intended (e.g. those areas with poor mobile phone or broadband signal). Signal can vary significantly even within small areas – in West Harris, half-hourly data from the Scarista turbine is easily accessed, but half-hourly data from the Geocrab hatchery cannot be captured at the moment due to poor signal. There may be workarounds such as collecting the data manually through USB and submitting readings that way.

Ofgem's regulatory "sandbox"[3] may provide an opportunity to trial various innovative proposals such as local generators receiving a discount on the usual charges if they are meeting local demand.

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Suppliers

Following the Market Research Questionnaire (see Appendix 2) which was published on the Public Contracts Scotland (PCS) website, no responses which directly addressed virtual MPAN were received. From discussions CES have previously had with various companies, it was decided that Energy Local should be approached to provide further information on their model. Energy Local is already offering Virtual MPAN services as a trial project in Wales. They were commissioned to refine their current model in order to estimate the costs and approach which could be taken for a project such as this, where one renewable generator is supplying one point of demand.

3. On-site Supply

On-site Supply refers to a fairly “standard” model, where renewable electricity is generated on the same site as the demand to which it is directly supplied. In this case, a proposed wind turbine in Barvas would generate electricity which would be directly supplied to the SSC hatchery in Barvas. The generation can either be grid-connected or off-grid, and it is important that the generation and demand is as well-matched as possible in order for the economics to stack up.

Benefits of such a system would include the hatchery being able to use locally-produced renewable electricity directly, thereby reducing their energy costs and having a more sustainable way of working. The community should also benefit from the sale of their electricity at a higher price to SSC than they would obtain by selling their electricity to the grid.

If the turbine is grid-connected, the system could be set up in such a way that the turbine generation is first sold to the hatchery, then, if generation exceeds demand, any excess generation is sold to the grid. Similarly, the hatchery firstly purchases any available electricity from the turbine then, if demand exceeds generation, SSC would buy electricity from the grid. Off-grid systems could include the turbine being off-grid but supplying an identified load at the hatchery site, or the whole site being off-grid, with backup generation being supplied by a back-up generator.

Risks

Risks of this system depend on how the system is set up. If the turbine is grid-connected there are less technical risks, but a major barrier in the form of grid constraint. If the turbine is off-grid, there are more technical risks but no grid constraint to consider. The turbine must have the ability to either be switched off, or there must be somewhere for the

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turbine to dump any excess electricity if generation exceeds demand. The hatchery will also need to ensure that it maintains supply at all times, whether this is from the turbine, the grid, or a back-up generator. Financial risks and barriers are explained in more detail below. While this project would be good for both groups reputationally, there is also a reputational risk involved in the project not working for any reason. There would have to be a favourable agreement between UOB and SSC in terms of the sale of electricity to the hatchery site; ideally one where SSC are paying less than their current tariff for buying from the grid, and UOB are paid more for what they generate than they would get for sale to grid. A major financial risk is that of the degressing Feed-in Tariff rate.

Barriers

Unfortunately there are some major barriers to this system being used in Barvas. There is currently a high level of grid constraint in place throughout the whole of the Western Isles, meaning that only G83 projects, i.e. projects exporting no more than 3.68kW per phase, can connect to the grid. This would limit the size of turbine/s output to around 10kW if the turbine was to be grid-connected. Demand and generation modelling and financial modelling have been carried out for this scenario, and are discussed further in Section 5. Cost-benefit Analysis of On-site Supply at Barvas. Projects such as this are not as financially viable as they used to be, due to degression in the FiT rate.

If the project could be installed off-grid the grid constraint would not apply, but extra control equipment would be required which would significantly add to the capital costs. No quotes have yet been obtained for such a control system, but quotes could be sought as part of the design stage of this project, if desired. It is unlikely that taking the whole site off-grid would be acceptable to SSC, as the risks to their electricity supply would be too great. The cost of a larger turbine (50-100kW) feeding the whole site, with a diesel generator for back-up, could cost something in the order of £100,000 for an extra diesel generator and controls. Again, accurate quotes could be sought as part of the design stage of this project.

Suppliers

Any installer could install and grid-connect a turbine below G83. Locally, the only known installer for turbines of this size is West Coast Energee. Depending on the model of turbine, manufacturers may provide their own installer.

If a control system or on-site load is to be used, it is likely that this would have to be sourced separately. This is outwith the scope of this report but could be looked at as part of the design phase or as part of another project.

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4. Cost-benefit Analysis of Sleeving and Virtual MPAN at Scarista/Geocrab

Sleeving

There is unlikely to be a cost benefit to either the generator or the consumer since the licensed supply company will take a cut of any benefits which are available. No suppliers were found who would look at sleeving at this scale, therefore no further cost-benefit analysis was carried out.

Virtual MPAN

Energy Local were commissioned to carry out modelling work to assess the potential for using the Energy Local model of virtual MPAN for the Scarista wind turbine and the Geocrab hatchery. Various scenarios were run to establish the potential for matching supply with demand and to estimate potential savings, costs and the procedures involved in setting up an Energy Local Model.

A full set of half-hourly power output data for the constrained Harbon wind turbine at Scarista was available for the period 1st January to 31st December 2015, equating to a total annual production of 207,195kWh. PPA contracts and values were also available and were used in the model.

Half-hourly demand data for Geocrab was unavailable so the following methodology was used to estimate half-hourly demand figures:

- Total annual electricity demand figure for Geocrab was available
- Monthly bills for 2016 were available, showing tariffs and estimated day/night demand.
- Day/night consumption figures were available for August and December 2015 (figures were not available for other months). In order to develop a seasonal model, local climate data were used to create a synthetic distribution of half-hourly demand. This was tested against the months and found to match total consumption.
- A variability parameter was included in the model to account for changes in demand from one half-hour period to another.

The Energy Local model pairs a generator and a local demand which are both connected to the same primary substation. The generator and demand require a PPA agreement and supply agreement, respectively, with the same licensed supplier offering an Energy Local tariff, as well as half-hourly metering so that their MPANs can be aggregated and the net generation or demand can be settled on a half-hourly basis. A "match tariff" is agreed between generator and demand customer for power that is generated and used within the same half-hour segment. Surplus power is exported through a new PPA and additional

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power is supplied under a new supply agreement from the licensed supplier. It is assumed here that generator Distribution Use of System charges are unchanged by these arrangements.

Firstly, the proportion of demand matched by local generation was assessed, with a variability factor introduced to provide a more realistic idea of how well-matched the generation and demand are. A base case was set up using existing day/night tariffs and export payment. In this case, base income to the generator from PPA payments is around £10,000 per annum.

Initially, variables such as the match tariff and day/night rate were varied to investigate the effects on the generator and supplier. Each scenario was modelled using 0% and 75% half-hourly demand variability; with 75% being the more realistic scenario. Other scenarios were then modelled where the "base case" had changed due to export PPA increasing (therefore less benefit to the generator from selling locally, compared to exporting), or the licensed supplier increasing their unit charges due to the smaller volumes of imported electricity being required by the demand customer. In each case, the increase in generator income and reduction in demand cost (i.e. savings to the demand customer) were calculated, as well as the total combined benefit. The benefit to the generator and demand customer can be shared between them in different ways by varying the match tariff.

From a legal perspective, establishing an Energy Local model depends on aligning the export, supply, metering and other arrangements for both the generator and the demand customer and ensuring that these services are provided by organisations who understand (and whose processes can accommodate) the Energy Local model. On the basis that the generator's PPA and the supplier to the demand customer is the same licensed supplier, the arrangements between the relevant parties can be agreed through appropriately synchronised bilateral contracts (the PPA and the supply agreement). This simplifies the administration of the arrangement and avoids the accounting and other costs that are involved in the creation and operation of a new separate legal entity.

There are a number of costs involved in setting up and running an Energy Local model. Meter Operator (MOP) and Data Collection and Aggregation (DC/DA) contracts may need to be terminated on both the generator and demand side, and new meters may need fitted. Half-hourly meters with suitable communications for remote data reading will be required, and an agreement will need to be prepared between the generator and demand customer covering their participation in the arrangement and specifying termination provisions, the process for agreeing the match price etc. Recurring costs include MOP and potentially

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DC/DA contracts, which should not be much different from current annual charges, and membership of Energy Local.

The conclusion drawn from the study is that although there are many uncertainties in the modelling, an Energy Local project does have the potential to be economically beneficial for both parties. Taking the best reasonable case, the net annual benefit to generator and demand customer could be around £5,000 each. The worst reasonable case modelled could result in a net annual benefit of around £2,700 each.

Uncertainties in the modelling which should be taken into consideration include modelling of the demand data, which may not be accurate; costs of imported electricity under the new supply contract, which may be significantly more than the current supply contract price; new meters which may need to be fitted at both the generator and demand customer sites; match tariffs which will need to be reviewed regularly as relative benefits to each party will vary with changing PPA and supply contract prices; and DUoS charging and embedded benefits which may change.

5. Cost-benefit Analysis of On-site Supply at Barvas

Modelling was carried out in order to establish how well-matched the demand at the Barvas hatchery would be with generation from a proposed wind turbine. It should be noted that Community Energy Scotland are not financial specialists, and any financial modelling information should be verified with a financial expert before decisions are made.

Generation and Demand Modelling

It was not possible to access half-hourly demand data from the Barvas hatchery, but this demand was modelled using total yearly electricity demand, adjusted according to seasonal variations. Due to the level of demand, it was felt that a turbine of around 50-100kW would be best suited, but, due to grid constraints, only turbines of up to 11.04kW can be grid-connected (3.68kW per phase). Because of the impressive wind regime of the Western Isles, not all wind turbines are suitable to be installed here. Turbines such as Britwind (formerly Evance), Kingspan (formerly Proven), Aircon and Harbon are already installed in the Western Isles and are therefore deemed to be able to handle the Class 1 wind regime. It was decided to model a 60kW Harbon turbine and 2 x 5kW Britwind R9000 turbines. If these proved to be economically favourable then other models could be considered.

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A full set of half-hourly power output data for the Enercon E44 turbine at Galson was available for the period 1st January to 31st December 2015. Wind speeds were extrapolated from this data using the E44 power curve.

Power curves for two smaller turbine models (Britwind R9000 @ 5kW and Harbon HWT60 @ 60kW) were then used to estimate power outputs based on the same wind data, modified using the wind profile power law for the lower height of these turbine models (18m and 24m respectively, as opposed to 55m for the E44).

Where the available E44 output data shows zero output, it is unknown whether this was due to low windspeeds, high windspeeds (above cut-off speed) or turbine downtime. The model assumes that low windspeeds were the cause.

Half-hourly demand data for Barvas was unavailable so the following methodology was used to create estimated half-hourly demand figures:

- Total annual electricity demand figure for Barvas was available, allowing an average hourly demand to be calculated
- This average was adjusted for day and night using monthly day/night usage figures available as above
- This average was also adjusted for "winter" months (September to April) and "summer" months (May to August), based on estimated usage information from Scottish Salmon Company.

The demand figures were deducted from the turbine output figures on a half-hourly basis to calculate estimated on-site consumption for each of the two turbine types (for the Britwind model, it was assumed that two identical turbines would be deployed). It was assumed that any surplus output would be exported.

Financial Modelling

Indicative costs were obtained from turbine suppliers and installers and from groups, and these were used for the modelling. It is, however, worth noting that these are estimates and that the full site logistics would have to be explored further with an installer in order to obtain a more accurate figure. Figures were run through CES' financial model, and the inputs and outputs are summarised below.

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2 x 5kW Britwind Turbines

Assumptions

- Total Capacity – 10kW
- Capital Cost – £50,000 (the cost may be higher than this in reality, since one 5kW turbine can range from £27,000-£31,000, but some costs would be shared between the two turbines)
- FiT rate – 8.19p/kWh from Ofgem Feed-in Tariff Table for 1st April to 30th June 2017[4]
- Assumed deemed metering would be in place (where it is assumed that 50% of the electricity generated by the turbine is sold to the grid – this will be the case unless an export meter is installed)
- Assumed 100% of the electricity is used on-site, at a more favourable rate than sale to grid. (This may not always be the case.)
- Capacity Factor – 35% (this is fairly conservative)
- Output from the turbines – 30,660kWh per annum
- Sale of electricity to Barvas hatchery is at a flat rate
- Operating Costs are assumed to be £700 per year for Service and Maintenance in the first 10 years, increasing to £1,200 from year 11 to account for wear and tear and additional parts replacement; insurance similarly is at £600 for years 1-10, increasing to £1,200 in year 11; decommissioning costs of £400 are included in year 20
- For scenarios where loans are used, the Resource Efficient Scotland loan for SMEs is used as an example; this is an 8 year loan at 5% interest rate.

Using the figures above as inputs to the model, the amount that the community can contribute was varied, along with the tariff that SSC would pay for any electricity provided by the turbines. Due to the size of the turbines and the generation-demand matching modelling which was carried out, it was assumed that all of the electricity generated would be used on site. Below is a summary of the findings. It can be seen that the viability of such a project is borderline. It would be up to the group to make a final decision, but it should be borne in mind that there may be unforeseen costs during the lifetime of the turbine, and therefore having only a narrow margin of income may prove risky for the group.

The figures presented in the tables below are modelled figures, and are based on market conditions at the time of writing. If a decision is made to proceed with a project, these figures would need to be revisited and updated, as they will undoubtedly have changed.

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Contribution/ Private Grant (£)	SSC Tariff (p/kWh)	Annual Income Year 1-8 (£)	Annual Income Year 9-10 (£)	Annual Income Year 11-19 (£)	Annual Income Year 20 (£)	Total income over 20 years (£)
50,000	7	4047	4047	2947	2547	69542
	8	4354	4354	3254	2854	75674
	9	4660	4660	3560	3160	81806
35,000	7	1768	4047	2947	2547	51312
	8	2075	4354	3254	2854	57444
	9	2382	4660	3560	3160	63576
20,000	7	-510	4047	2947	2547	33082
	8	-204	4354	3254	2854	39214
	9	103	4660	3560	3160	45346

Table 1: Summary of Results of Financial Modelling Scenarios

The table above shows, in the left hand column, the contribution that would be made towards the total cost either from the group's own funds or from private grant funds. FiTs are paid for every kWh of electricity generated, provided that public grant funding is not used to pay for the turbine/s. Using public grant funding for a wind turbine would make it ineligible to claim FiTs, resulting in less income. In the second and third sections, where the contribution is less than the total cost, it is assumed that a loan is being used to make up the difference. As mentioned in the assumptions, this loan is assumed to be an 8 year loan at 5% interest rate.

The second column in the table above shows the tariff that SSC would pay UOB for the electricity coming from the turbine. Three tariffs are shown for each scenario – 7p/kWh, 8p/kWh and 9p/kWh. For the purposes of this modelling, it is assumed that the turbine tariff would be at a flat rate.

The third, fourth, fifth and sixth columns in the table above show the expected annual income under each scenario. The income is from FiT payments, payments from SSC for the electricity, and payments from an energy company for exported electricity (assumed to be 50% of the electricity generated). The figure varies due to loan payments and operating costs (as explained in the assumptions). The final column shows the potential total income to the group after 20 years.

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As expected, the higher the SSC tariff and the lower the loan contribution, the more viable the project is in terms of payback. Although this would not have been likely in the past few years, the degression of the FiT is making the grant-funding of projects such as this more likely, and it may be that, in future, it is possible to obtain grant funding and to forego the FiT and to still have a viable project. If such a project was not grid-connected, and extra control gear had to be purchased, it is doubtful that the project could bear such an extra cost and still be viable, unless the control gear could be grant-funded. Quotes for such a control system should be sought before a final decision is made; perhaps as part of the design phase of this project.

60kW Harbon Turbine

Assumptions

- Total Capacity – 60kW
- Capital Cost – £250,000 (the cost may be higher than this in reality, depending on the site)
- FiT rate – 5.97p/kWh from Ofgem Feed-in Tariff Table for 1st April to 30th June 2017[4] (this would be increased to 8.19p/kWh for a 50kW turbine, and a summary table is shown in Appendix 3 assuming that 84% of the output from a 50kW turbine is used on site)
- Assumed 84% of the electricity is used on-site, at a more favourable rate than sale to grid. 16% of the electricity generated is therefore sold to grid at 4.5p/kWh
- Capacity Factor – 35% (this is fairly conservative)
- Output from the turbine – 183,960kWh per annum
- Sale of electricity to Barvas hatchery is at a flat rate
- Operating Costs are assumed to be £2,000 per year for Service and Maintenance in the first 10 years, increasing to £3,500 from year 11 to account for wear and tear and additional parts replacement; insurance similarly is at £1,500 for years 1-10, increasing to £2,500 in year 11; land rental is £500 for the 20 years of the project; monitoring and communications £300 for the 20 years of the project; metering £270 for the 20 years of the project; decommissioning costs of £800 are included in year 20
- For scenarios where loans are used, a loan of 10 years at 7% is used as an example

This turbine was modelled similarly to the turbines above, where the figures above were used as inputs to the model, and the amount that the community can contribute was varied, along with the tariff that SSC would pay for any electricity provided by the turbines. It was assumed that 84% of the electricity generated would be used on site, and the rest would be exported to grid. Below is a summary of the findings. Again, it can be seen that the viability

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of such a project is borderline and that in some cases the project would not stack up. It would be up to the group to make a final decision, but it should be borne in mind that there may be unforeseen costs during the lifetime of the turbine, and therefore having only a narrow margin of income may prove risky for the group.

The figures presented in the tables below are modelled figures, and are based on market conditions at the time of writing. If a decision is made to proceed with a project, these figures would need to be revisited and updated, as they will undoubtedly have changed.

Contribution/ Private Grant (£)	SSC Tariff (p/kWh)	Annual Income Year 1-8 (£)	Annual Income Year 9-10 (£)	Annual Income Year 11-19 (£)	Annual Income Year 20 (£)	Total income over 20 years (£)
250,000	7	18554	18554	16054	15254	345280
	8	20099	20099	17599	16799	376180
	9	21644	21644	19144	18344	407080
125,000	7	1138	1138	16054	15254	171120
	8	2683	2683	17599	16799	202020
	9	4228	4228	19144	18344	232920
50,000	7	-5228	-5228	20138	19338	148300
	8	-3683	-3683	21683	20883	179200
	9	-2138	-2138	23228	22428	210100
25,000	7	-12796	-12796	16054	15254	31780
	8	-11250	-11250	17599	16799	62690
	9	-9705	-9705	19144	18344	93590

Table 2: Summary of Results of Financial Modelling Scenarios

Again, as expected, the higher the SSC tariff and the lower the loan contribution, the more viable the project is in terms of payback. Currently, this size of project could not be grid-connected, and extra control gear would have to be purchased. It is doubtful that the project could bear such an extra cost and still be viable, unless the control gear could be grant-funded. Although this would not have been likely in the past few years, the degression of the FiT is making grant-funding projects such as this more attractive, and it may be that, in future, it is possible to obtain grant funding and to forego the FiT and to still have a viable project. Quotes for such a control system should be sought before a final decision is made; perhaps as part of the design phase of this project.

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Summary and Recommendations

Sleeving entails a generator and a customer signing up to the same licensed supply company in order to show that their generation and demand are being matched. While sleeving provides a more established model of connecting local generation with local demand, there are few known examples in the UK of sleeving at this scale. Whilst it is technically possible, the likely result would be that there would be no cost benefit to either the generator or the end-user, since the sleeving company would have to recover their costs.

Virtual MPAN allows for generation and demand to be aggregated “virtually” before negotiating with a licensed supplier for half-hourly settlement of this aggregated profile. This model could lead to cost savings for both the generator and demand customer through agreeing a new, “match tariff”, as well as providing services to the DNO through the aggregated supply/demand profile being smoother, making it easier to balance. There is also future potential for reduced charges as a result of demonstrating that generation is being consumed locally.

For the Scarista and Geocrab site (West Harris), it is recommended that the virtual MPAN options with Energy Local be pursued. Although there are some uncertainties in the modelling, it seems likely that a cost saving could be realised for both WHRL and SSC. There is little risk to each group, since they could at any time revert back to their existing arrangements. Next steps include actions for Energy Local to finalise arrangements with potential supply companies and establish template agreements. Energy Local and CES would then work with SSC and West Harris Trust to obtain quotes from the new supplier for combined purchase/supply contract, to confirm costs associated with MOP and DC/DA termination, and to finalise arrangements.

On-site supply has been seen in the past as a fairly standard model, where renewable electricity is directly supplied to an on-site demand. In the case considered here, the hatchery would be fed directly by locally-produced renewable electricity, and would benefit from reduced energy costs and greater sustainability. The community would also benefit from the sale of their electricity at a higher price to SSC than they would obtain by selling their electricity to the grid. There are, however, a number of technical barriers to the implementation of such a project – the biggest being the grid constraint currently facing renewable energy generators in the Western Isles.

For the Barvas site, it is recommended that, in the first instance, UOB investigate the likelihood of obtaining private grant funding for a turbine, and the likely level of grant, as well as the possibility of obtaining grant funding for a control system. If UOB then wish to proceed with a project and it is agreed within the project group, UOB could put out a tender for design of a 50-100kW system for use at Barvas, which would include a wind turbine and control gear to keep the grid export within the allowed limits. This tender should give an idea of the costs involved, as well as which type of system may be best (i.e. batteries, what type of back-up generator, which parts are grid connected/off-grid). It is recommended that UOB maintain contact with CES and Local Energy Scotland in order to be kept informed of any developments in these areas.

In the words of the "Community Energy – The way forward" report by 10:10[5]:

"...the outlook for new UK community-led renewables schemes in the near-term looks extremely challenging. To move forwards, we will have to keep experimenting, innovating and evolving until we find new ways to prosper. The world is changing rapidly, and the old 20th century model for energy provision is on its way out."

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Appendix 1: References and Further Reading

1. "Local Supply: Options for Selling Your Energy Locally", 2nd Edition, March 2016, *Stephens Scown and Regen SW,* available online at: https://www.regensw.co.uk/local-supply-options-for-selling-your-energy-locally
2. Energy Local website: http://www.energylocal.co.uk/
3. "Ofgem Regulatory Sandbox: calling for expressions of interest", available online at: https://www.ofgem.gov.uk/publications-and-updates/regulatory-sandbox-calling-expressions-interest
4. "Feed-in Tariff (FiT) Generation and Export Payment Rate Table 01 October – 31 December 2016", available online at: https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-fit-generation-export-payment-rate-table-01-october-31-december-2016
5. "Community energy – The way forward", *10:10*, available online at: http://files.1010global.org/Community-energy-the-way-forward.pdf

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Appendix 2: Market Research Questionnaire

A Market Research Questionnaire was published on the Public Contracts Scotland website on 24th November 2016 with a deadline of 15th December 2016. One formal response was submitted, and another phone call was received. In summary, the written response offered to carry out a feasibility study in order to see if sleeving or virtual MPAN would be viable for this size of generation and demand, and the phone call provided information on the company's other work to date, with the promise of further information to follow. At the time of writing, this information has not been received. The Market Research Questionnaire can be seen below:

Community Energy Scotland
Cumhachd Coimhearsnachd na h-Alba
Empowering Communities

West Harris Trust

Making energy work for you

Market Research Questionnaire

West Harris Trust and Community Energy Scotland are seeking to gather information on supplier interest in, and potential cost of, the project outlined below. Any cost information at this stage is understood to be indicative only, and will be used to inform financial modelling and budgeting for a potential future project.

Project Summary

West Harris Trust, a community group on the Isle of Harris, Scotland, own an installed 53kW grid-connected wind turbine, currently exporting up to 50kW to grid. A demand of a similar scale has been identified nearby, on the same network, and West Harris Trust are keen to identify opportunities for their locally-produced electricity to be used locally. Funding has been approved through the Scottish Government's Infrastructure and Innovation Fund, delivered by Local Energy Scotland, for West Harris Trust to work in partnership with Community Energy Scotland and two other partners on investigating the potential for local energy use.

Two models are being considered specifically as part of this project – Sleeving and Aggregation. It is hoped that suppliers can be identified and indicative costs obtained through this market research in order to establish whether either model will be viable for both the group and the end-user in terms of set-up and operational costs, income to the group, and possible reduction in electricity costs for the end-user.

Market Research Questionnaire

1	**Please provide details of similar types of work you have carried out (sleeving/aggregation/both)**
2	**Please highlight what you see as the benefits and disadvantages/risks of either/both models**
3	**Please provide details of how the desired outcomes could be achieved**
4	**Please give indicative timescales and costs for setting up and operating either/both models**
5	**Please give an estimate and details of any potential income/savings resulting**
6	**Please advise of any resource requirement that may be required from the group and/or the end-user**

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Appendix 3 – Summary Table for Harbon Constrained to 50kW

The table below shows expected income for a Harbon 60kW turbine constrained to 50kW, which exports 16% of its generation. Various levels of community contribution/private grant are shown in the left hand column, as explained in Section 5.

The figures presented in the tables below are modelled figures, and are based on market conditions at the time of writing. If a decision is made to proceed with a project, these figures would need to be revisited and updated, as they will undoubtedly have changed.

Contribution / Private Grant (£)	SSC Tariff (p/kWh)	Annual Income Year 1-8 (£)	Annual Income Year 9-10 (£)	Annual Income Year 11-19 (£)	Annual Income Year 20 (£)	Total income over 20 years (£)
250,000	7	18103	18103	15603	14803	336260
	8	19391	19391	16891	16091	362020
	9	20679	20679	18179	17379	387780
125,000	7	687	687	15603	14803	162100
	8	1975	1975	16891	16091	187860
	9	3262	3262	18179	17379	213610
50,000	7	-9763	-9763	15603	14803	57600
	8	-8475	-8475	16891	16091	83360
	9	-7188	-7188	18179	17379	109110
25,000	7	-13246	-13246	15603	14803	22770
	8	-11958	-11958	16891	16091	48530
	9	-10671	-10671	18179	17379	74280

Table 3: Summary of Results of Financial Modelling Scenarios

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