Local Energy Plan

for Brae

July 2018

A Local Energy Plan for Brae

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This Local Energy Plan has been developed to enable the Brae community to look at its existing and future energy needs in terms of power, heat and transport and determine where it sees priorities for action. A separate non-technical summary document is also available that provides an overview of the plan.

The development of the plan is supported by Delting Community Council and has been led by a steering group of residents and representatives from Local Energy Scotland, Home Energy Scotland and Shetland Islands Council.

The development of the plan has been funded as part of the COBEN project (**CO**mmunity **BEN**efits of Civic Energy), an EU Interreg (North Sea Region) funded programme with fifty per cent match funding through the Scottish Government's Community and Renewable Energy Scheme (CARES). CARES is delivered by Local Energy Scotland. Technical support and plan development has been undertaken by Wood Environment & Infrastructure Solutions UK Limited. Community consultation support has been provided by Beyond Green Advisors Limited.

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1. Introduction

1.1 About Local Energy Plans

A Local Energy Plan (LEP) enables the local community to look at its existing and future energy needs (in terms of power, heat and transport) and state where it sees priorities for action. It also identifies opportunities that the community determines offer practical action to support its current and future energy system developments.

Local Energy Plans are created by local communities rather than being developed for them by other bodies (e.g. local authorities or National Government). They set out key priorities and opportunities identified by the community, assisted by a range of other organisations who have an interest in this community. These include local residents, businesses, community organisations, local authorities, distribution network operators and local generators.

A key aspect of the development process is the ability for the local community to understand its own energy and transport systems, but also place them in context within the wider changes taking place across Scotland. It can therefore look for opportunities that offer local benefits consistent with national low carbon targets. These benefits can be:

- Direct - such as the generation of electricity or heat for local use displacing more expensive imported grid supplied electricity or fossil fuel.
- Economic - developing employment opportunities associated with energy supply (e.g. in hydrogen production) or enhanced efficiency (e.g. insulation and glazing work on homes).
- Indirect – such as a switch from diesel to electric vehicles reducing local emissions of particulates in car exhaust emissions and improving air quality
- Social – Production of local energy to supply homes in fuel poverty can reduce stress and enhance health outcomes for residents.
- Strategic – using energy storage mechanisms to maximise outputs from community owned generators, or use of technology to enable better trading of locally produced energy offer the community more effective use of its local resources

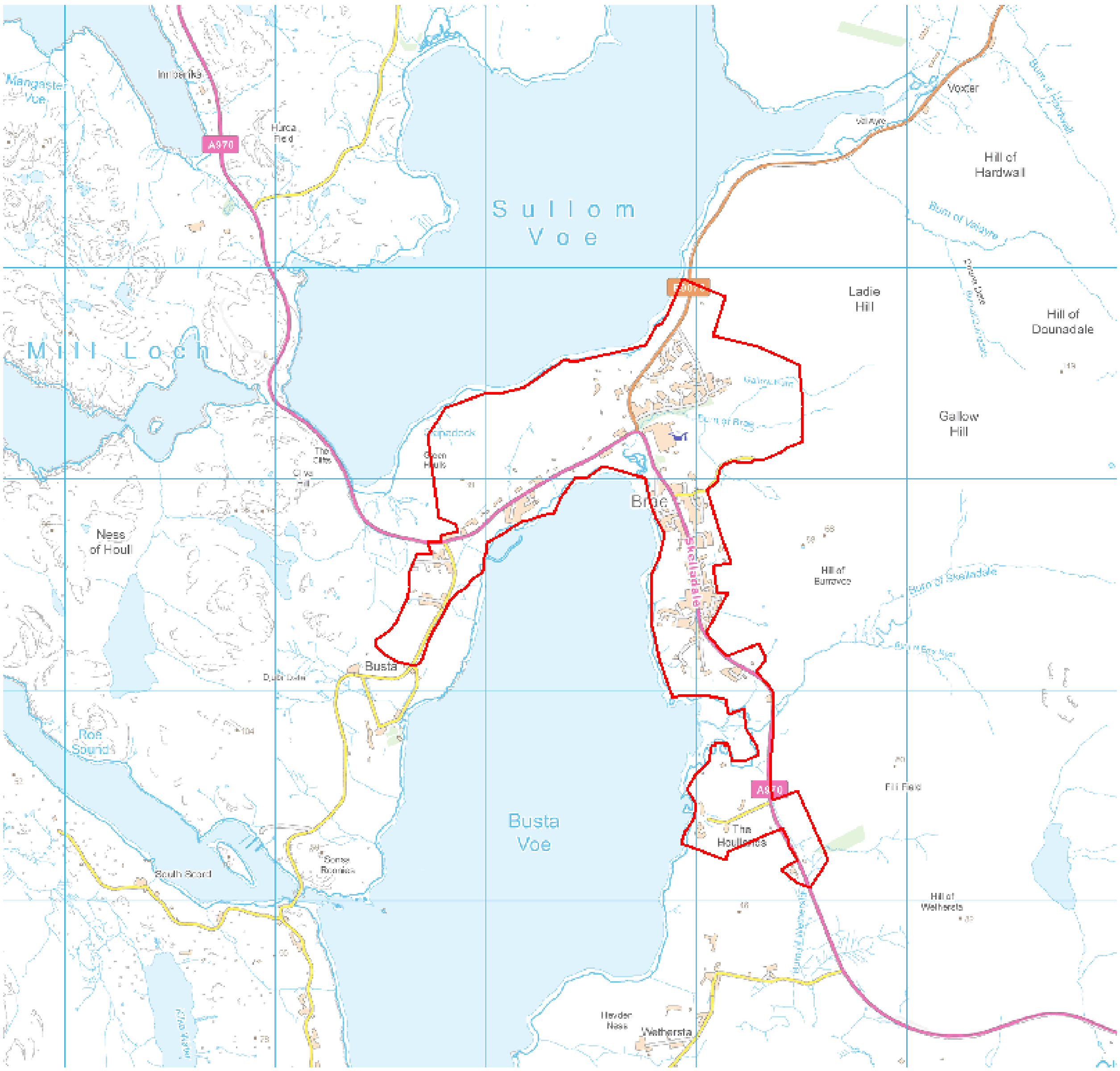
The LEP provides a start in the community's engagement with its energy needs. It offers a focus for immediate opportunities that can be developed in the short term. It also provides scope for longer term planning for further changes in the future.

1.2 Overview of 'whole system' approach

Our energy needs, and how these are met reliably, cost effectively and without long term environmental consequences, are one of the key considerations for every community. UK and Scottish Government commitments to global efforts to reduce greenhouse gas (GHG) emissions mean significant changes to the way in which we supply, store and use energy. For this reason, the present and future energy needs of a community are most usefully considered in a 'whole system' approach. In this way the overlapping impacts of how we use power, heat and transport can be considered at the same time, rather than being seen in isolation.

In order to apply a ‘whole system’ approach there needs to be a study boundary drawn in order to provide a primary area of focus. This doesn’t exclude the linkages with neighbouring areas or opportunities that may be available within close proximity of the LEP area (e.g. land available for energy generation). The study boundary selected for use in the present plan for Brae is shown here.

Figure 1 Brae LEP area



1.3 Aims and objectives

The Aims and Objectives of the Local Energy Plan, which have been gathered as part of the consultation undertaken with the local ambassadors and with the local steering group, are:

- Opportunity to look at all of the energy needs for Brae in a comprehensive and planned approach
- Opportunity to raise awareness around energy issues and energy saving measures
- Provide an educational energy framework
- Support wider aims of economic resilience, education, good health and well being
- Opportunity to help reduce domestic energy bills
- Opportunity to improve economic profile of Brae
- Reduce health implications of poorly heated homes, including fuel poverty, energy efficiency measures and high energy costs

2. Local Infrastructure

Local Infrastructure Summary

Electricity – The size of local energy generators that can be connected to the existing grid network is currently constrained by sub-station capacity

Heating – There is no mains gas network serving Brae nor any existing district heating

Water – There are no water supply or wastewater treatment works in the LEP area

Transport – Existing local bus services provide links to Lerwick and Sullom Voe

2.1 Electricity

2.1.1 Strategic Electricity Provision

Shetland is not currently connected to the electricity network that serves mainland Great Britain and therefore meets all its own electricity needs. Shetland's electricity supply is primarily provided by the diesel fuelled Lerwick Power Station which was expected to close in 2020 because it would no longer have met European emissions standards. However, legislative changes relating to small, isolated power systems (such as this) mean that the Lerwick Power Station can remain operational until at least 2025.

A subsea electricity distribution link from Shetland to mainland Great Britain was rejected by Ofgem in 2017. Scottish and Southern Energy Networks (SSEN) have confirmed to Ofgem that the security of supply could be provided until 2025 through a combination of the Lerwick Power Station and additional supporting measures[1].

In December 2017, the UK Government released a consultation which included proposals to enable remote island wind projects to apply for a Contract for Difference (CfD). It is understood the UK

[1] https://www.ofgem.gov.uk/publications-and-updates/new-developments-result-fresh-approach-securing-shetland-electricity-supply

Government intends for these changes to be implemented before the next CfD auction, planned for Spring 2019. Depending on the outcome of the consultation, and whether wind developments in the islands can apply for CfD, means there is a possibility of an interconnector link between the mainland and Shetland in the future which would be capable of importing and exporting electricity.

2.1.2 Local Electricity Provision

Brae receives its electricity from the Lerwick Power Station as described above; however, there are a small number of households who have incorporated micro renewables to generate their own electricity. This includes micro wind turbines and solar panels predominantly. It is also understood that one property powers their electric car from the renewable electricity they generate.

There is a single primary substation in Brae that acts as the local point on the distribution network. The transformer is a 33 kV/ 11kV step down. The sub-station is presently constrained and the Shetland Grid Supply Point is also constrained. As detailed in Section 2.1.1 if proposed wind developments on Shetland can apply for CfD this may enable an interconnector link between Shetland and mainland Great Britain, which is capable of exporting and importing electricity and would assist with the current constrained supply. Planning consent has been granted for a 33.5 m to blade tip wind turbine to the east of Brae (Planning Application Reference: 2015/178/PPF) which has not been implemented to date. Supporting information submitted with the planning application indicated that, if constructed, the proposed wind turbine would connect to a meter at the school and provide the school with renewable energy.

2.2 Heat

Brae is also not connected to the mainland gas network that serves Great Britain. The primary fuel types for heating are electricity (supply capacity explained above) and oil. It is understood oil is predominantly distributed by the two suppliers in Lerwick, Scottish Fuels and Highland Fuels Ltd.

There are also some properties which are heated by air source heat pump, ground source heat pump and solid fuel as well as a very small percentage, 3%, with no central heating.

A 195 kW_{th} rated output biomass boiler is located close to the all-weather sports pitch in Brae. It provides heat to the North Mainland Leisure Centre, the pavilion at the all-weather sports pitch and the Brae Health Centre.

2.3 Water

Water is supplied to Brae from the Eela Water Treatment Works which is located in Ollaberry to the north of Brae. The treatment of waste is provided by the Brae Septic Tank located at the old playing fields in Brae, close to the Brae Community Hall.

2.4 Transport

The main road for Shetland, A970, runs through Brae connecting it to the South and North of the Mainland, including Lerwick (the main port of the Shetland Islands with a daily overnight ferry service to Aberdeen) and Sumburgh Airport, the main airport operating services to mainland UK and Bergen. The B9076 connects Brae to the North West including Scatsta Airport, which predominantly serves the offshore industry (there are also commercial flights) and the Sullom Voe Oil Terminal.

Brae is served by local bus services, 21 and 23, which provide a link to Lerwick and to Sullom Voe for commuters. The bus service also has stops in Tingwall, Girlsta, Nesting, Voe, Urafirth, Hillswick, Mossbank and Toft.

3. Characterisation of local area

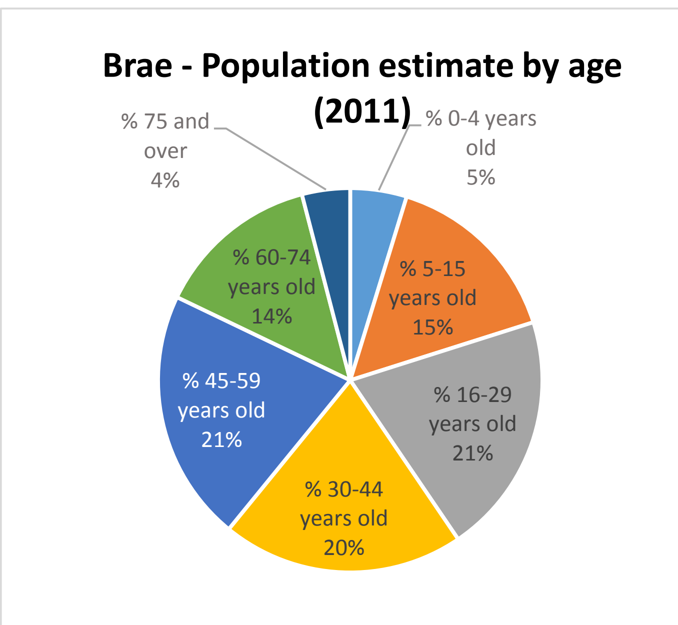
3.1 Population of Brae

Population and Employment - summary

- The population has increased by 8% (2011 Census figures)
- Under-16s comprise 20% of the total population; 16 – 60 year olds 62%; Over 60s 18%
- 83% of the population are economically active and typically travel to work by car

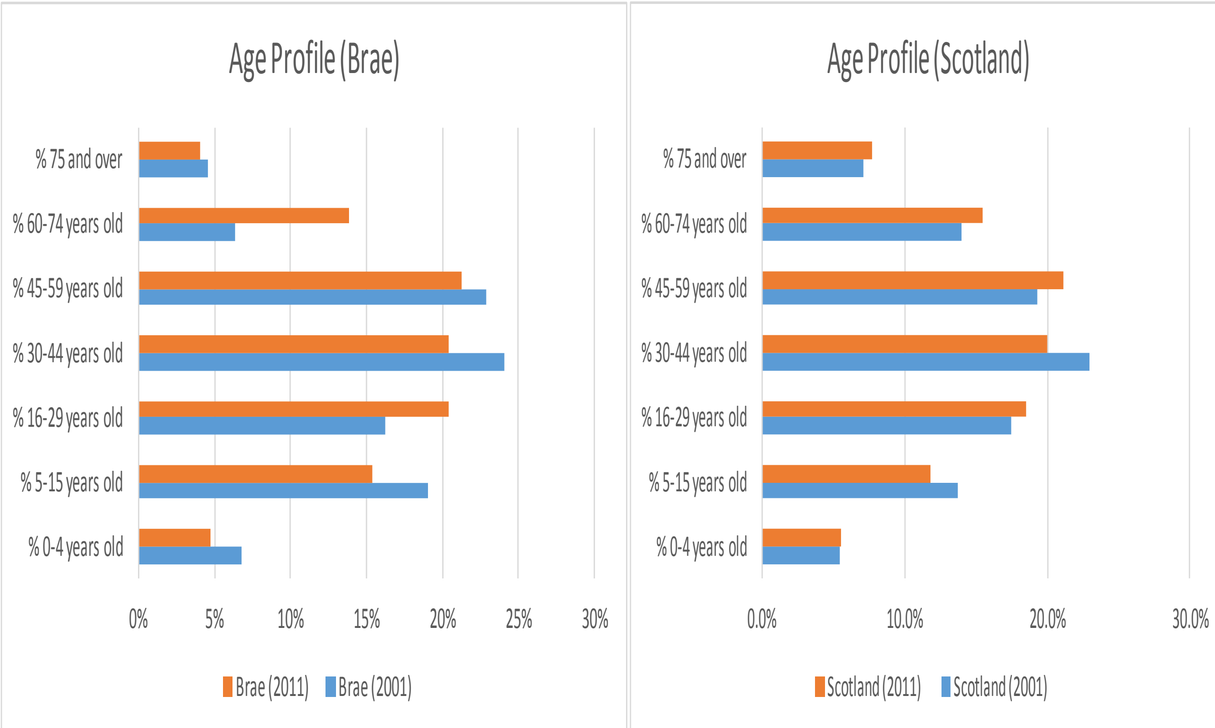
The population of Brae, based on Census figures from 2011, is 716; an increase of 8% since 2001. A summary of the population by ages is shown in Figure 2.

Figure 2 Population of Brae (breakdown by age)



The change in demographics between 2001 and 2011, and a comparison with Scotland's population as a whole is shown here.

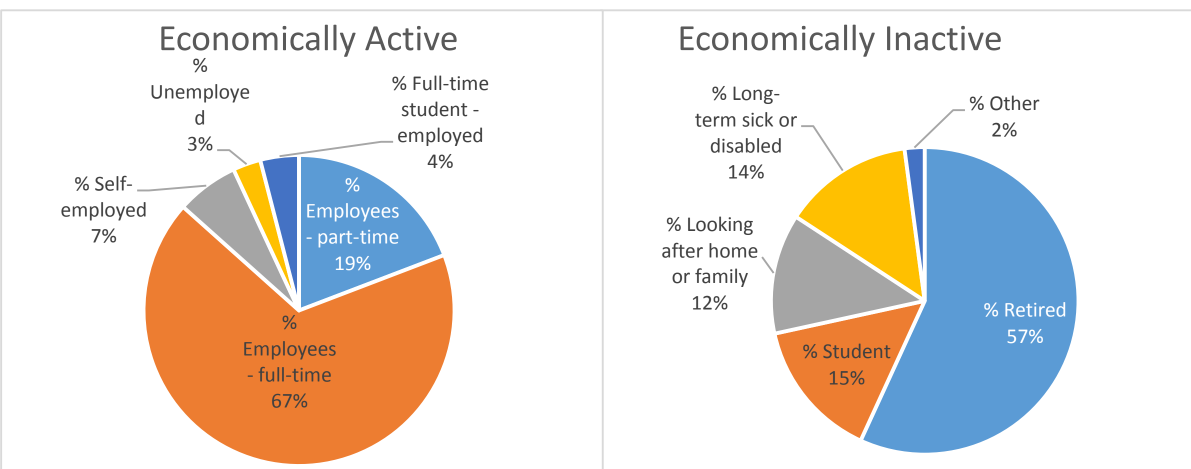
Figure 3 Demographic Profile (Brae)



3.2 Employment and journey to work

In terms of employment, 83% of the population are economically active, with 67% in full time employment.

Figure 4 Economically active and inactive (breakdown for Brae)



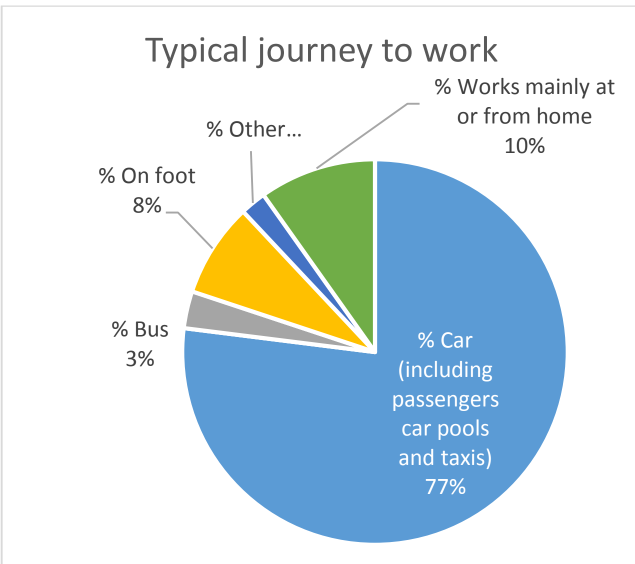
In terms of employment sectors the five most common, comprising approximately two thirds of total employment are summarised in Table 1.

Table 1 Largest five employment sectors (Brae)

Employment sector	% of local workforce
Transport and storage	16.4%
Construction	14.8%
Human health and social work activities	11.4%
Education	11.1%
Wholesale and retail trade; repair of motor vehicles and motorcycles	9.7%

In terms of those that are economically active, a typical journey to work is predominantly made by car.

Figure 5 Typical journey to work (Brae)



3.3 Residential

Residential Property - summary

- Over half of domestic properties in Brae are privately owned (59%)
- 65% of all dwellings are of timber frame construction; 75% built between 1950 – 1983
- Electric heating is used by 67% of dwellings in Brae; oil heating makes up a further 20%
- Average fuel poverty rates are estimated at 58%

Data available from the Energy Saving Trust Home Analytics database outlines there are 379 residential properties in Brae.

A short summary is provided here. Further details can be found in Appendix B, Section B1.

3.3.1 Residential Property Overview

Table 2 Residential Property – Overview of characteristics

Characteristic	Details
Archetype and size	Pre-dominant dwelling types are detached and semi-detached (around 75% of total dwellings) Typically these properties have 4 or 5 habitable rooms
Tenure	Over half of domestic properties in Brae are privately owned (59%) and almost one quarter of properties are Shetland Islands Council properties (22%).
Construction Type	The most common wall construction type is timber frame (ca. 65% of all dwellings)
Primary Heating Fuel	Electric heating is used by 67% of dwellings in Brae; oil heating makes up a further 20%
Estimated Energy Efficiency	The predominant EPC rating of dwellings is D (55%). 88% of dwellings are rated D - G

3.3.2 Estimate of fuel poverty levels from Scottish Government statistics

The North Mainland (Brae) has an average fuel poverty rate[2] at 58**%** (SIC, 2016). Brae has a particularly acute problem in that many of its homes are early timber framed constructions, which are near impossible to retrofit at a reasonable cost for insulation. The table here shows a breakdown of the probability of fuel poverty in Brae as estimated from details within the Home Analytics database.

Table 3 Estimate of fuel poverty (Brae)

Probability of fuel poverty (fuel bill >10% of income)	Number of houses
Less than 40%	38
40-49%	27
50-59%	102
60-69%	97
70-79%	73
80-89%	22
90-100%	2
Unknown	18

[2] Note that the Scottish Government has looked at an alternative definition of fuel poverty as recommended by a recent review panel http://www.gov.scot/Publications/2017/11/7715

In 2016, a Fuel Affordability Survey was undertaken by the Shetland Islands Council (SIC, 2016) which covered the whole of the Shetland Islands. 2,425 people responded to the survey and considering all owner occupiers who responded, 46% were in fuel poverty, and the social rented tenants who responded, 78% of SIC tenants and 73% of Hjatland Housing Association tenants were in fuel poverty.

The highest rate of fuel poverty was found in homes which were heated by solid fuel (59%) or by electricity (58%). Evidence shows fuel poverty higher in older properties with the highest number of households in fuel property living in properties built between 1965 and 1983. Evidence additionally shows that fuel poverty differs greatly depending on construction type: solid wall (62%), cavity wall (59%) and timber frame (34%).

Based on Energy Saving Trust data, 67% of domestic properties in Brae are heated by electricity, and 75% were built between 1950 and 1983.

The Fuel Affordability Survey Report, found approximately 550 respondents were paying between £601-£1,000 a year on electricity, with approximately 600 paying between £1,001-£1,500, nearly 300 paying between £2,001-£2,500 and over 100 paying up to £3,000.

Information received from a householder in Brae, while data gathering, demonstrated they were paying approximately £3,000 a year for their electricity and heating. They have an electric system and the property is timber framed, detached and was constructed in 1994. This aligns with the information received as part of the Fuel Affordability Survey Report.

Local information received from the Steering Group detailed that paying over £3,000 a year for electricity and heating was not uncommon.

3.4 Non-residential

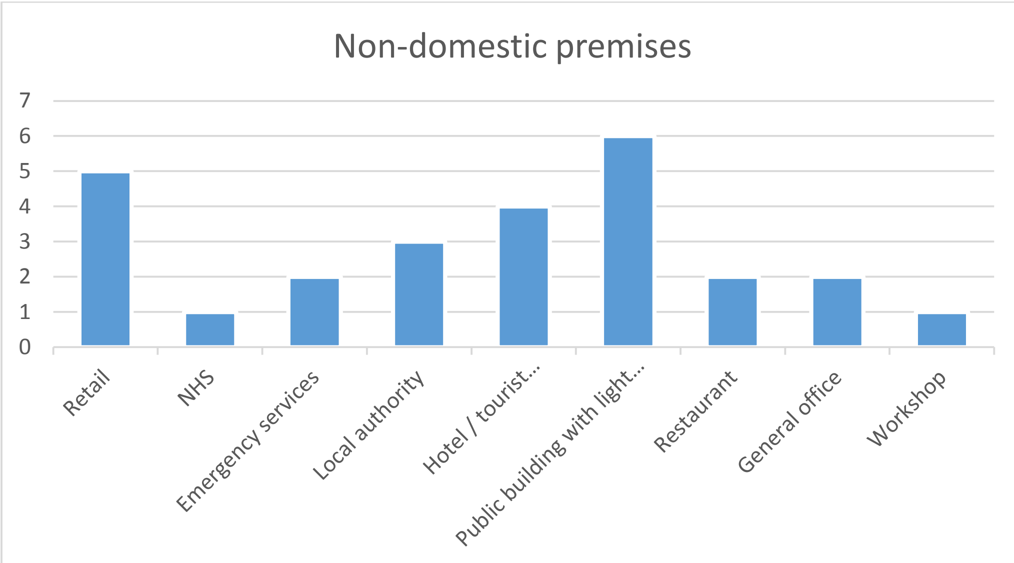
Non-Residential Property - summary

- Major non-residential energy users include the Primary and High Schools, North Haven Care Centre and North Mainland Leisure Centre.
- Electricity is the predominant source of energy demand

There are a number of non-domestic properties in Brae providing a wide range of services. There are the schools (Brae Primary and Brae High School) and the North Haven Care Centre which are operated by the Shetland Islands Council, the North Mainland Leisure Centre which is operated by the Shetland Recreational Trust and a number of community facilities including the Brae Community Hall, the Boating Club, and churches including the Gospel Hall and the Church of Scotland.

Brae has a NHS health centre, police station and a fire station. Other business premises include a number of general industrial properties, a branch of the Scottish Co-op and a number of small privately-owned shops, restaurants, hotels and B&Bs.

Figure 6 Non-domestic property in Brae (overview)



3.5 Transport

Transport - summary

- Over a third of residents in Brae have access to 2 or more cars/vans
- Current vehicles are predominantly diesel/petrol fuelled
- There is a single existing electric vehicle charging point in Brae
- Existing local bus services offer around 9 trips daily to Lerwick

3.5.1 Domestic Ownership

Domestic vehicle ownership in Shetland is one of the highest in the UK (ZetTrans, 2018). The estimated domestic vehicle ownership within Brae is 412[3]. The 2011 Census results for Brae show:

- 12.6% of households have no car or van
- 40.7% of households have access to 1 car or van
- 36.1% of households have access to 2 cars or vans
- 10.5% of households have access to 3 or more cars or vans

[3] Based on the following calculation using data from the 2011 Census: (No. of households with access to 1 car or van*1) + (No. of households with access to 2 cars or vans*2) + (No. of households with access to 3 or more cars or vans*3).

2011 Census data for Scotland as a whole shows that:

- 30.4% of households have no car or van
- 42.4% of households have access to 1 car or van
- 21.6% of households have access to 2 cars or vans
- 5.6% of households have access to 3 or more cars or vans

When compared to Scotland as a whole, 17.8% fewer households in Brae have no car or van. In addition to this, 14.5% more households have access to 2 cars or vans and 4.9% more households have access to 3 or more cars or vans in Brae.

Additionally, the assumed number of domestic vehicles by fuel type in Brae is shown in Table 5. The estimated annual domestic vehicle fuel type usage is therefore 157,109 litres of diesel and 315,607 litres of petrol based on calculations using data from the Scottish Transport Statistics (Transport Scotland, 2016) and fuel properties from the UK Government GHG Conversion Factors for Company Reporting (Department for Business, Energy & Industrial Strategy, 2017).

Table 4 Assumed fuel type of vehicles in Brae

Fuel type	Number of domestic vehicles
Diesel	190
Petrol	219
EV/Hybrid	3

3.5.2 Public Transport

Public transport across Shetland, including Brae, is managed and provided locally (ZetTrans, 2018). Despite the high domestic vehicle ownership, there are also local bus services. Services 21 and 23 stop in Brae and there are approximately nine trips a day to Lerwick.

3.5.3 Commercial Vehicles

There are a number of businesses within and around Brae which own and use different types of commercial vehicles. Table 6 gives an indication of the types of vehicles owned or used by different businesses or organisations.

Table 5 Commercial vehicle ownership and use in Brae

Business/organisation	Types of vehicles owned/used
Johnson Transport	Buses
Garrick Bros	LGVs, HGVs
Blueshell Mussels Ltd	HGVs
Co-op	HGVs
Hotels e.g. Moorfield Hotel	HGVs
Police Scotland	Police cars/vans
Scottish Fire & Rescue Service	Fire engines, fleet vehicles including cars and LGVs
Brae Medical Centre	NHS fleet vehicles e.g. cars and vans

3.5.4 Electric Vehicles

The total number of electric vehicles (either fully electric vehicles or plug-in hybrids) on the road in Scotland during 2017 was 5,521. Of these 36 licenced vehicles were registered by owners in the Shetland Islands (Q4 2017) with a total of 29 registered at the start of the year (Q1 2017)[4]. The detail of data available does not extend to the number of registered owners of electric vehicles within Brae itself.

At present there is one 43 kW electric car charging point located next to the Brae Health Centre.

3.6 Environment

Environment - summary

- There are a number of environmental and cultural heritage designations that would need to be taken into account in the design of any large scale local energy generation
- Wind resource in the LEP area can support medium and large scale wind projects
- Solar resource in the LEP area is moderate
- Hydro resource in the LEP area offers some potential for small-scale run-of-river hydro
- Geothermal heating shows some initial potential
- Marine energy opportunities are likely to be constrained by local environmental designations

Community scale energy generation will typically require planning consent prior to installation. An important factor in any planning consent is to take into account local environmental and cultural heritage designations.

In thinking about opportunities for local energy generation it is useful to consider what information is available regarding local renewable resources.

A summary of the key environmental designations and local renewable resources is outlined here.

Further details are provided in Appendix B, Section B2.

3.6.1 Summary of environmental designations and other relevant heritage items

Site of Special Scientific Interest (SSSI) - SSSIs are those areas of land and water that are considered to best represent our natural heritage in terms of their: flora – i.e. plants; fauna – i.e. animals; geology – i.e. rocks; geomorphology – i.e. landforms; or a mixture of these natural features. There are three SSSIs relevant to the LEP.

Special Area of Conservation (SAC) – A SAC protects one or more special habitats and/or species – terrestrial or marine – listed in the Habitats Directive. There is one SAC in close proximity to the north of the LEP area, which covers Sullom Voe. It is designated for its costal lagoon and reefs.

Environmentally Sensitive Areas (ESA) – the ESA aims to conserve specially designated areas of the countryside where the landscape, wildlife or historic interest is of particular importance and where

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[4] https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01 (Accessed April 2018)

these environmental features can be affected by farming operations. The whole area within the LEP area and surrounding are covered by this designation.

Shell Fish Growing Areas and Shellfish Water Protected Areas - The Shellfish Waters Directive (2006/113/EC) ('SWD') was introduced to protect designated waters from pollution in order to support shellfish life and growth. There is a designation that covers Busta Voe to the south of the LEP area.

Scheduled Monuments – There are 15 scheduled monuments within 3 km of the LEP area.

Listed buildings – there are five category B listed buildings within 3 km of the LEP area.

National Scenic Area (NSA) - The designation's purpose is both to identify our finest scenery and to ensure its protection from inappropriate development. There is one NSA within 2 km of the LEP area. Additionally, there is a local Landscape Area that follows the coast north of the NSA.

Further details are provided in Appendix B, Section 2.

3.6.2 Estimated solar resource

Shetland can have a solar irradiance of up to 737 W/m^2. The potential annual irradiation for the Brae LEP area, in terms of available resource, is a lot lower than other parts of the UK. Due to the lower annual irradiation of Brae and the Shetlands solar technology (solar photovoltaic and solar thermal) commercial viability will depend on the purchase cost of equipment. Over the last few years the system costs have dropped dramatically enabling their installation in areas where previously they were prohibitively expensive. Further detail is provided in Appendix B, Section 2.3.

3.6.3 Estimated wind resource

The wind resource in the area is very good with an available average wind speed of around 7 m/s at 10 m a.g.l. However, due to a number of constraints the potential opportunities for medium to larger scale wind appear to be limited. Key considerations can be summarised as:

- There could be implications for radar (clutter on radar), and low flying aircraft (collision risk) as they come in to land at Scatsta;
- Landscape has rolling hills therefore air flows likely to be less turbulent.

This means that medium or large scale wind development is unlikely to be feasible in or near the LEP area. Smaller wind turbines, below 30 m to tip, are more likely to be suitable.

Further details are provided in Appendix B, Section 2.4.

3.6.4 Estimated hydro resource

There are a number of watercourses, burns and rivers close to Brae. Details of these rivers can be found in the table here.

In terms of opportunities for micro / small hydro power the burn with some potential is Burn of Skelladale and Burravoe Burn due to its length, catchment and its height.

Further details are provided in Appendix B, Section 2.5.

Table 6 Rivers within 1 km of site area

Name of Burn / River	Length (m)	Height Max (m)	Height Min (m)
Burn of Brae	1,090	23	2
Burn of Foulawick	400	20	5
Burn of Wethersta	926	42	3
Skeotaing Burn	500	46	1
Burn of Skelladale and Burravoe Burn	2,734	111	2

3.6.5 Estimated biomass resource

Opportunities for biomass are limited due to the feedstock requiring importing to the islands.

3.6.6 Geothermal

A study into geothermal was undertaken in 2013 looking at the resource availability and location of geothermal within Shetland.

The study identified the Brae area as having potentially a commercially viable level of resource.

Further details are provided in Appendix B, Section 2.6.

3.6.7 Marine Renewables Resource

SIC have produced supplementary guidance for their marine spatial plan that outlines the potential constraints and opportunities for marine renewable energy[5].

A number of areas around the UK have been defined by the Crown Estate for their preferred locations for developments of offshore wind, wave and tidal energy generators.

These constraints maps show that there are many opportunities around Shetland for the deployment of marine renewables. However, they do indicate that there may be areas of high constraint within the Brae vicinity.

While wave and tidal resource appear to be relatively low based on these maps, these are regional investigations; a more local detailed study may indicate areas with some opportunity.

Further details are provided in Appendix B, Section 2.7.

4. Energy Baseline

4.1 Electricity

Data has been gathered to determine the estimated electricity demand baseline figure for Brae which includes domestic and non-domestic properties within the LEP area.

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[5] Source: http://www.nafc.uhi.ac.uk/research/marine-spatial-planning/shetland-islands-marine-spatial-plan-simsp/

4.1.1 Domestic Electricity

The domestic electricity demand figure was determined utilising the data within the Energy Saving Trust Home Analytics database. The database includes all the properties within the Brae LEP area. This database uses the UK Government approved Standard Assessment Protocol which is a recognised industry wide software approach.

The annual domestic electricity demand was determined to be 4.4 Gigawatt Hours (GWh).

4.1.2 Non-Domestic Electricity

The overall non-domestic electricity demand figure was determined by calculating the gross floor area of the non-domestic buildings in Brae and then estimating the electricity demand figure by using benchmarks from the Chartered Institution of Building Services Engineers (CIBSE, 2012) for that particular building type. This figure was added to the electricity demand data received from the Shetland Islands Council and the business who responded to the survey.

The estimated annual non-domestic electricity usage was determined to be 1.7 GWh.

4.2 Heat demand

4.2.1 Domestic Heat Demand

The domestic heat demand figure was determined utilising the data within the Energy Saving Trust Home Analytics database. The database includes all the properties within the Brae LEP area. This database uses the UK Government approved Standard Assessment Protocol which is a recognised industry wide software approach.

The annual domestic heat demand was determined to be 10.3 GWh.

4.2.2 Non Domestic Heat Demand

As detailed in Section 4.1.2, the non-domestic data was predominantly gathered by estimating the gross floor area of the non-domestic buildings in Brae and then estimating the heat demand figure using benchmarks from the Chartered Institution of Building Services Engineers for that building type. This figure was added to the heat demand data we received from the Shetland Islands Council and the business who responded to the survey.

The estimated annual non-domestic heat demand was determined to be 5.1 GWh.

4.3 Transport

Estimated annual fuel consumption and annual mileage was determined using data from the Scottish Transport Statistics (Transport Scotland, 2016) and fuel properties from the UK Government GHG Conversion Factors for Company Reporting (Department for Business, Energy & Industrial Strategy, 2017).

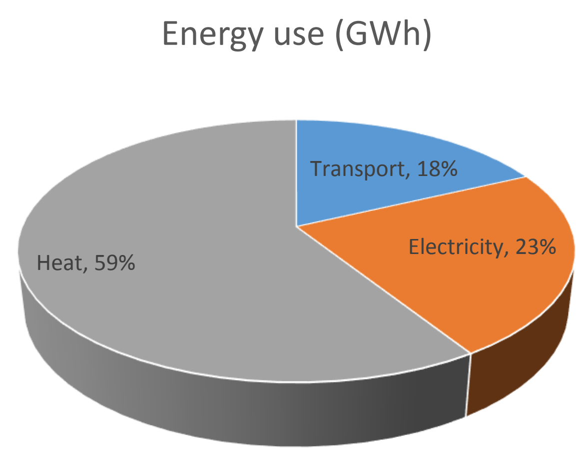
The estimated annual fuel consumption is 157,109 litres of diesel and 315,607 litres of petrol. The estimated total annual mileage is 21,343 miles (8,556 miles for diesel vehicles and 12,787 miles for petrol vehicles).

From liaison with the local ambassadors, it was identified that the public bus services were under used. This aligns with the 2011 Census data that shows that over three quarters of people in employment travel to work by car; whereas only 3% travel by bus.

4.4 Overall Energy Demand

The annual overall total energy demand, taking into account the domestic and non-domestic electricity and heating demand is shown here.

Figure 7 Overall Energy Demand



A breakdown of these three areas of energy use is provided in the Table here.

Table 7 Breakdown of energy use

Source	Annual Energy Use (GWh/yr)	Annual Carbon Emissions (tCO_{2e}/yr)
Domestic, *of which:*	14.7	5,221
Electricity	4.4	1,697
Heating	10.3	3,514
Transport	4.7	1,306
Non-Domestic, *of which:*	6.8	2,466
Electricity	1.7	526
Heating	5.1	1,940
Total (All Sources)	**26.2**	**8,993**

4.5 Future changes

As shown in Figure 26 there is some growth anticipated in Brae within the current Local Development Plan period. However, this is not expected to be significant therefore the estimated energy use of any properties is not anticipated to cause substantial change in the electricity and heating demand figures.

5. Options Appraisal

5.1 Scottish context

Scottish context - summary

- The Scottish Government sees local energy solutions as a vital element of the wider transition taking place across Scotland in the way our energy systems operate
- Encouraging a greater sense of ownership and control among all communities is seen as beneficial, not only in terms of security of supply but also in realising the wider benefits of sustainable, affordable energy among homes and businesses
- No access to feed-in tariffs from April 2019 means local electricity generating schemes need to look to use the energy in the local area in order to gain greatest economic benefit

Scotland's Energy Strategy was published in December 2017[6]. It provides a route map that outlines the vision that the Scottish Government has of what our future energy systems and needs might look like from now out to 2050.

The overall vision is set out in the introduction to the document:

Our Vision

A flourishing, competitive local and national energy sector, delivering secure, affordable, clean energy for Scotland's households, communities and businesses.

This vision is guided by three core principles:

A Whole-System Approach – Work to date has focused heavily on the production of electricity using low carbon sources and improvements to the efficiency with which we use our energy. The strategy recognises that these are important areas of action but need to be worked on alongside heat and transport. All of these elements influence each other in the energy systems that we need to create in future

An Inclusive Energy Transition – Changes to the whole energy system are driven by a need to decarbonise our energy use in line with targets set out within the Climate Change (Scotland) Act. While this will show Scotland's contribution to global action on climate change, this needs to be done in a manner that is fair to everyone. This means ensuring that inequality and poverty are addressed as well as promoting a fair and inclusive jobs market. Greater efficiency in energy use by businesses and householders offers the opportunity to reduce bills (and associated carbon emissions) leading to lower fuel poverty levels and enhanced competitiveness for business. As part of efforts to ensure that benefits from the low carbon energy transition are enjoyed by all, the Scottish Government intends to create a new energy company. This will be publicly owned and run on a not-for-profit basis.

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[6] http://www.gov.scot/Resource/0052/00529523.pdf

A Smarter Local Energy Model – Local energy economies are at the core of the transformation of Scotland's Energy Systems. Local solutions for local energy needs, linking local generation and use, provide a platform for vibrant local rural and urban communities. Local Heat & Energy Efficiency Strategies (LHEES) will provide prospectus for local area in terms of investment in energy efficiency, district heating and other heat decarbonisation opportunities.

Further details can be found in Appendix B, Section 3.

5.1.1 Financial support for renewables

For smaller scale renewable generation (of a size up to 5 MW) the UK Government has put in place two support schemes – the Feed in tariff (for electricity generation) and Renewable Heat Incentive (for heat generation). Eligible technologies in each case are able to receive a payment for each kWh of energy that they produce. These payments are received over the operational lifetime of the technology (typically 20 years).

In its Autumn Budget of 2017[7] the UK Government announced a review of the Levy Control Framework (LCF) that ultimately sets outs how much money is committed from UK Government funds to pay for feed-in tariffs, and schemes relevant for large scale generation (over 5 MW capacity), specifically Contracts for Difference and the Renewables Obligation. In the near term this means that no new carbon electricity levies will be put in place until 2025.

This means that there will not be access to feed-in tariffs for electricity generators until 2025. The scheme will effectively close to new generation in April 2019.

5.2 Local context

This section of the LEP provides an overview of the relevant local planning policy and guidance and provides a local level context in terms of any known changes to energy and transport networks.

Local context - summary

- Any community led energy projects will need to be developed in a manner that accounts for relevant existing planning policies and guidance documents
- The latest Shetland Transport Strategy includes proposed action around bus timetabling and promotion of car clubs and electric vehicles that support local interest in these
- Ongoing initiatives by SIC and other agencies are seeking to reduce overall fuel poverty levels and offer increasingly sustainable energy supply systems

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7 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/661480/autumn_budget_2017_web.pdf (Accessed April 2018)

5.2.1 Local Planning Policy and Guidance

Development Plan

The Development Plan for Brae, is the Shetland Local Development Plan, adopted in 2014. The Shetland Local Development Plan sets out the land use strategy for a period of 20 years. Work on the next Local Development Plan has already commenced. The Vision for Shetland as agreed by the Shetland Resolution in 2004 is:

"Work together for a future that is better and brighter. In particular, we aim to create a secure livelihood, look after our stunning environment and care well for our people and our culture."

The Shetland Local Development Plan identifies Proposed Development Sites and Areas of Best Fit and these are shown on the Figure below in Brae.

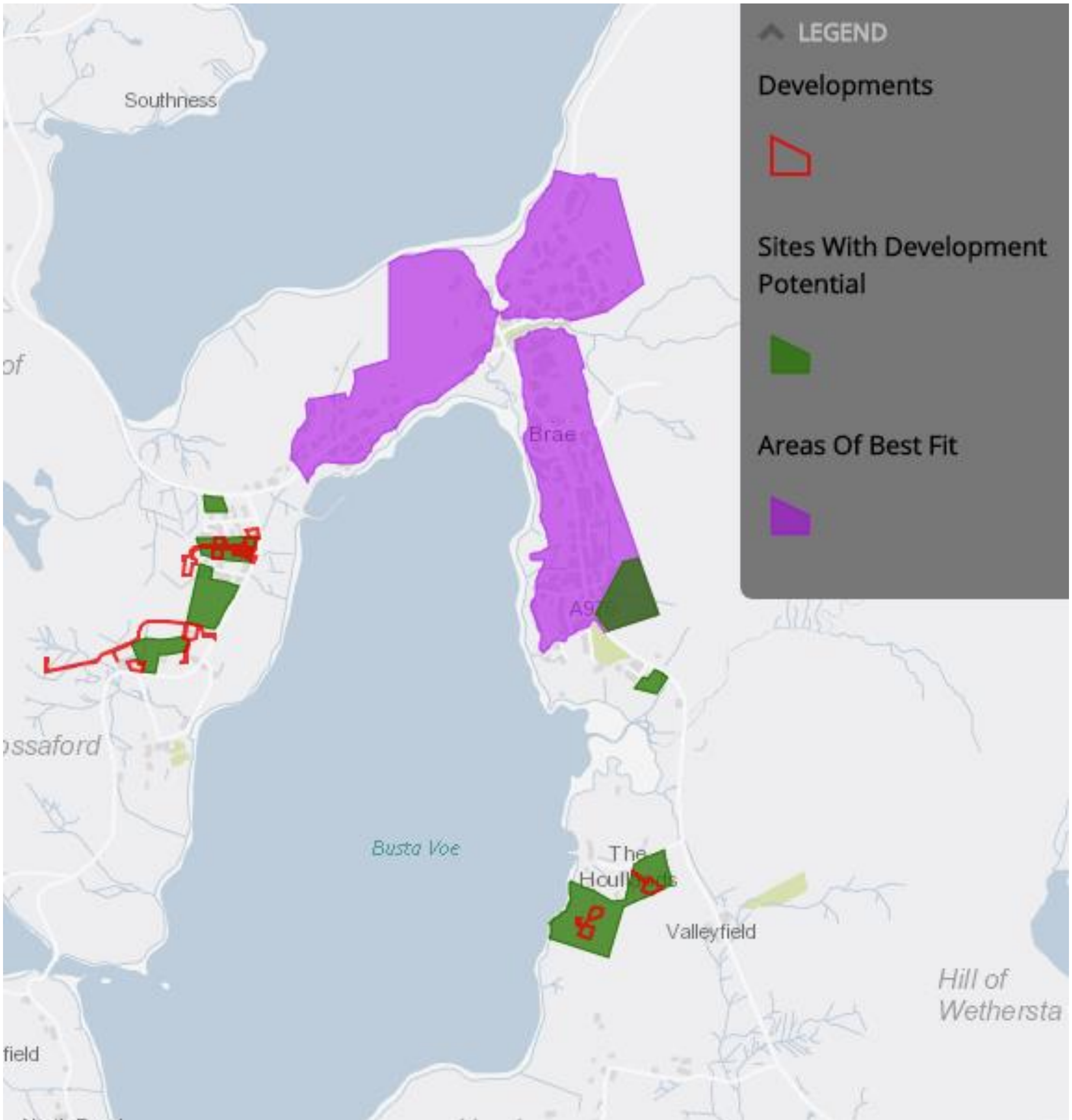
The Shetland Local Development Plan also identifies Areas of Best Fit in Brae. Policy H2 Areas of Best Fit outlines that the Areas of Best Fit have been identified as areas to *"provide a focus for growth within and adjacent to the largest community in each of the seven localities in Shetland."* They are identified for residential or residentially compatible development.

Any development in Brae will need to meet the requirements of Policies GP1 Sustainable Development, GP2 General Requirements for All Development and GP3 All Development: Layout and Design.

Policy RE1 Renewable Energy is supportive of renewable energy development "where it can be supported that there are no unacceptable impacts on people (benefits and disbenefits for communities and tourism and recreation interests) the natural and water environment, landscape, historic environment and the built environment and cultural heritage of Shetland."

Given the Special Area of Conservation directly to the north of the Local Energy Plan LEP area and the listed buildings within the LEP area, policies NH1 and HE2 will also need to be considered in relation to any development proposed.

Figure 8 Local Development Plan Proposed Development Sites and Areas of Best Fit



The sites in Brae which have been identified as Proposed Development Areas are:

- NM001, Houllands, Brae, allocated for housing with a timeframe of 1-5 years.
- NM002, Roebreck, Brae, allocated for housing with a timeframe of 1-5 years. An application for a hotel development was submitted in 2015 (Application Reference: 2015/195/PPF) however refused as the site is allocated for housing in the Local Development Plan.
- NM003, Burravoe, Brae, allocated for housing with a timeframe of 1-5 years. Some of this area is in the process of being developed for housing.

Adopted Supplementary Guidance Documents

Adopted Supplementary Guidance documents also form part of the Development Plan and are required to be considered in the assessment of development proposals.

Onshore Wind Energy Supplementary Guidance

The Onshore Wind Energy Supplementary Guidance provides further detail specific to wind.

In terms of large scale wind, the area around Brae is considered to be capable in principle of supporting large scale wind subject to meeting a number of requirements. Small and micro wind development could be acceptable within the Brae LEP area depending on local constraints and meeting planning policy.

Brae and the surrounding areas is within the Scatsta Safeguarding Region and consultation would be required with Scatsta airport in the early stages of feasibility.

It is also recommended the Landscape Sensitivity and Capacity Study for Wind Farm Developments is taken into account in the early stages of feasibility for wind turbine development.

5.2.2 Draft Supplementary Guidance

This section provides a brief summary of the draft Supplementary Guidance which is of relevance to the Brae LEP. The draft Supplementary Guidance would be a material consideration in any proposed development.

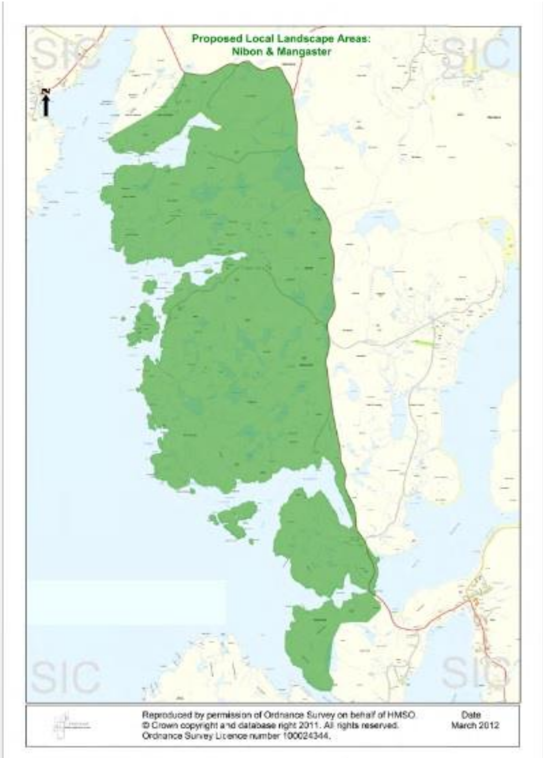
Supplementary Guidance Local Landscape Areas Consultation Draft 2014

Proposed Local Landscape Area 2: Nibon and Mangaster is situated approximately 1 km to the west at its closest point to Brae. The development guidelines state:

- Seek to retain undeveloped wildness character: any development should be at the smallest scale, and should be very sensitively sited and designed.
- Encourage sustainable and responsible recreational access into this landscape, to allow greater appreciation.
- Maintain the wider setting of the NSA through control of development within this area.

Figure 9 shows the proposed Local Landscape Area. The figure is from the Supplementary Guidance Local Landscape Areas Consultation Draft.

Figure 9 Proposed Local Landscape Areas



5.2.3 Other Applicable Documents

This section provides an overview of other applicable local policy and guidance in relation to energy and transport.

Transport Strategy and Transport Strategy Refresh

The Shetland Transport Strategy, prepared by ZetTrans: Zetland Transport Partnership, was approved in July 2008 and a consultative draft Shetland Transport Strategy has been prepared in 2018.

The consultative draft Transport Strategy Refresh recognises as outlined above in Section 3.4 that car ownership in Shetland is one of the highest in the UK.

The consultative draft Transport Strategy Refresh sets out a number of proposed Interventions to address the Strategic Objectives. Key ones in relation to the issues raised in the Steering Group meetings and from the local community are:

- Bus Network Review which is underway and due to be completed by December 2017. Through discussions with ZetTRANS it is understood this is underway.
- Care Share Promotion which is at concept/scoping stage and plan due to be completed by December 2019.
- Car Club Development which is at the feasibility stage and feasibility due to be completed by June 2018. Through discussions with ZetTRANS it is understood this is on schedule.
- Area Transport Forums which is currently dormant however initial meetings are due to be held by September 2018.

- Area Transport Plans which is currently at concept/seeking approval stage and plans are due to be completed by September 2019.

It is recommended the Steering Group liaise with Zetland Transport Partnership to get an understanding of progress on these proposed Interventions. In particular, around potential opportunities around the Car Club Development.

Shetland Place Standard

The Shetland Islands Council undertook a public consultation exercise between June and July 2016 which gave the public an opportunity to assess the place they live against 14 different themes. In terms of the North Mainland locality, which included Delting, Nesting and Lunnasting and Northmavine 12% of the population responded. The Final Report was published in March 2017. The top 3 priorities for the North Mainland were Public Transport, Housing & Community and Work & Local Economy.

A Community Forum was held in November 2016 which raised key issues and the ones relevant to the LEP are detailed below:

- Bus timetables should be considered to reduce the number of empty buses around.
- Transport issues considered more prevalent in the north mainland than in other areas due to reliance and lack of other options and costs involved.
- Potential economic opportunities need to be considered.

It is understood the findings will be used to inform key policies and strategies which will include:

- Local Outcomes Improvement Plan
- Local Development Plan
- Shetland Local Housing Strategy
- Shetland Transport Strategy
- Shetland Islands Health and Social Care Partnership: Joint Strategic Commission Plan

Some of the issues raised are also relevant to the LEP including housing improvement and transport.

Local Outcomes Improvement Plan

The Shetland Local Outcomes Improvement Plan was published in June 2016 by the Shetland Partnership Performance Group. Five outcomes have been established as a result of a number of workshops carried out by the Shetland Partnership Performance Group. Two of these are directly relevant to the LEP:

- Outcome D: Priority: Make the best use of existing assets, infrastructure and human capital for sustainable economic development
    - This outcome recognises that living costs including energy are significantly higher in Shetland than England
- Outcome E: Priority: To protect and enhance our natural environment and promote the benefit to society (including health) that it provides

The Shetland Local Outcomes Improvement Plan includes a number of actions relating to the outcomes. Applicable actions to the LEP include:

- Raise awareness of climate change through engagement with communities in Shetland to inform a Local Action Plan
- Consider approaches to development a Sustainable Energy Action Plan for Shetland

Fuel Affordability Report 2015/16

Shetland Islands Council distributed a Domestic Fuel Affordability Survey to all Shetland homes (10,800) in November 2015 and 2,425 were sent back. The Fuel Affordability Report details the findings of the survey. The survey results outlined that the fuel poverty in Shetland in 2015/16 was 53% which is an increase of 10% since 2010. The fuel poverty level for the North Mainland which includes Brae was 58%.

5.3 Community commentary on areas of action

This section of the LEP provides an overview of the community engagement undertaken as part of the preparation of the draft Local Energy Plan. One of the key aims of the preparation and subsequent ongoing management of the LEP is to have effective community engagement and to understand what the community's needs and aspirations are for Brae in relation to energy.

Community commentary - summary

- The views of the community in developing the LEP have been sought via a combination of work with the local steering group, workshop sessions with volunteer local ambassadors and via an online survey
- The community is keen that the LEP supports wider aims of economic resilience, education, good health and wellbeing
- In terms of energy the community is keen to raise awareness of source of support for energy efficiency in homes and businesses
- There is an interest in using local renewable resources (where practical) to generate local energy needs
- In terms of transport there is interest in alternative fuelled vehicles (both cars and larger vehicles)

5.3.1 Community Workshops

A total of three community workshops have been undertaken. They have been attended by local ambassadors who are members of the community from Brae. The workshops helped to understand what the local community want and aspire to have in terms of a LEP.

Feedback from Workshop 1

Seven ambassadors attended Workshop 1. The ambassadors were asked for their ideas and thoughts regarding the LEP.

- Must be cost effective and efficient
- The Local Energy Plan must support wider aims of economic resilience, education, good health and wellbeing
- In relation to transport:

- There needs to be an accurate reflection of issues
- More charging points for electric vehicles which could be powered by renewables

- In relation to energy:
  - Raising awareness of energy saving measures
  - Tidal generation
  - Efficiency of a seawater heat pump for Brae located in the North Sea

The ambassadors were asked what energy solutions they would like to see in the community and noted the following:

- Two were interested in Solar PV
- Five were interested in Wind
- Four were interested in District Heating
- One was interested in Biomass
- Four were interested in Hydropower

Feedback from Workshop 2

Two ambassadors attended the second workshop. A summary of their feedback on potential projects to consider for the LEP is provided in Table 8.

Table 8 Ambassador Feedback on project ideas (Workshop 2)

Energy Generation	**Energy Consumption**	**Transport**	**Balancing supply and demand**
Wind Turbine	Promoting Home Energy Scotland	Electric Vehicle charging points	Smart Meters
Solar PV	Battery Storage	Community electric or hybrid minibus for schools	Install energy efficiency measures in households
Air/water source heat pump		Community bookable bus	
District heating		Electric hybrid car club	
		Develop algae based fuel	

Online questionnaire

An online questionnaire was also distributed within the local community by the ambassadors and advertised in the local press. 64 respondents completed the questionnaire. The full responses are detailed in Appendix A and a summary is provided below.

The respondents were asked what was important to them in terms of energy. A summary of the feedback is detailed in the table below.

Table 9 Online questionnaire feedback (Brae community)

Topic	Feedback
Reduce business energy costs so they are competitive in a post oil economy	44% of respondents thought this was very important
Raising awareness to help people save money for heating their homes	75% of respondents thought this was very important
Understanding funding available to install energy saving ideas	79% of respondents thought this was very important
Energy projects that help people live in comfortable warm homes and cut fuel poverty	81% of respondents thought this was very important
To generate new business, such as tourism from being a low carbon area	44% of respondents thought this was very important
Would you consider using a smart meter to help you understand your energy spend?	60% of respondents said yes
Would you consider receiving tips and advice on how to reduce energy?	69% of respondents said yes
Would you consider switching to LED lighting?	87% of respondents said yes
Would you consider improving insulation and draft proofing to keep your home warm and bills down?	87% of respondents said yes

The survey also asked what kind of renewable energy the respondents were interested in for Brae. The options were hydropower, wind power, geothermal energy, solar power, sea water heat pumps and biomass.

The table below outlines the feedback received in terms of each option.

Wind power was the most popular with 66% stating yes they were interested in it for Brae. Sea water heat pumps and solar power were the next most popular options with 62% and 60% respectively stating they were interested in them for Brae. Hydropower, Biomass and Geothermal energy respectively had 49%, 35% and 32% stating yes it was of interest to them for Brae.

Table 10 Questionnaire feedback on renewable energy options

Renewable Option	Yes	Maybe/It Depends	No
Hydropower	49%	35%	16%
Wind power	66%	19%	15%
Geothermal energy	32%	50%	18%
Solar power	60%	31%	9%
Sea water heat pumps	62%	29%	9%
Biomass	35%	49%	16%

It is understood where people answered maybe/it depends then the option could be acceptable however it depends on what the local requirements are, the feasibility of the option and whether it would help to meet the aims of the LEP.

In terms of transport, the survey asked the respondents what travel and transport options interested them. The table here provides the results.

Table 11 Online questionnaire (transport feedback)

Transport Option	Yes	Maybe/It Depends	No
Electric buses	35%	38%	27%
Electric cars	38%	43%	19%
Alternative fuelled transport	47%	44%	9%

Alternative fuelled transport was the most popular option with 47% stating yes they were interested in it for Brae. Again, it is understood where people answered maybe/it depends means this option could be acceptable depending on the circumstances, such as funding for electric cars and appropriate infrastructure being in place to facilitate electric buses and cars.

5.4 High level technology review

High level technology review - summary

- Wind resource is an important local asset
- A mix of solar PV, heat pumps (particularly for new build properties), medium wind and small scale hydro generation is likely to offer a beneficial mix for Brae
- Large scale district heating is unlikely to be economic given existing larger heat generating assets and the overall scale of demand
- Any heating solutions involving supply of hot water for space heating will involve expensive retrofit for the majority of properties that use electric heating (dry system)
- Household scale battery storage is unlikely to offer substantial benefit given current tariffs (higher rates in daylight hours)

There a number of technologies that could be considered for use within the Brae area. The following section provides an overview of the major technologies and an overall suitability rating in the context of energy needs in Brae.

Further details in relation to each technology can be found in Appendix B, Section 3.3.

A simple Red/Amber/Green qualitative scoring system is used. Red means that the technology is not well suited to Brae's needs; Green means that it is well suited to Brae's needs.

Table 12 Technology overview (Brae)

Overall Technology suitability for Brae	Technology	Commentary
HIGH	Wind	Wind resource is good in the LEP area. Opportunities for medium and small scale turbines are likely to exist
MEDIUM	Heat Pumps	Air-source heat pumps offer potential alternative to electric heating. Ground source and water source heat pumps are more expensive options (more civil works are required during their installation). Fitting to existing properties needs to be linked with building fabric improvements.
	Hydro	There are a number of local water courses offering potential for small scale hydro schemes.
	Biomass	Potential cost effective alternative to oil fired systems. Not a direct alternative for electrically heated properties (requires wet heating system)
	Solar PV	Rooftop solar PV offers potential for householders. There is limited immediate land area available within the LEP for larger ground-based systems
	Geothermal	An initial pre-feasibility study suggests geothermal resource. Any system would be expensive to install (deep boreholes and associated civil works) and require the ability to supply all heat users via hot water. Those with electrical heating at present don't have the necessary plumbing in place
	Energy storage	Household scale storage systems (often linked to solar PV) are expensive. The benefit of individual storage would be limited for THTC users given a lower tariff for electricity overnight. Multi-property storage systems could be viable.
	Fuel Cells	Some limited potential use in the LEP area if able to supply larger non-domestic building
	District Heating	The size and distribution of heat demand in the LEP area is not well suited to a district heating scheme. Small scale clusters of housing served by a communal system may be viable.
	Electrolysers	Given potential wind output available due to constrained export capacity community-scale electrolyser systems could be viable. These would provide a means of producing hydrogen that could be used as a transport fuel.

Overall Technology suitability for Brae	Technology	Commentary
LOW	Gas CHP	No mains gas supply to the LEP area makes this option expensive. Alternative gas supplies would need to be imported and processed prior to use in any system
	Solar Thermal	Given local solar resource there will be limited benefit from solar water heating for the majority of households and businesses. A supplementary heating system would need to also be in place.
	Energy from waste	The main potential route would be anaerobic digestion. Costs are likely to be prohibitive since there are no existing food waste collections in place for households. Scale of generation would be low.
	Biomass CHP	This is an expensive option and could not operate effectively at the scale of heat demand within the LEP area
	Tidal	The scale of system is likely to be larger than the demand for electricity in Brae. This will be constrained by present grid capacity and make the scheme unviable
	Wave	The scale of system is likely to be larger than the demand for electricity in Brae. This will be constrained by present grid capacity and make the scheme unviable

6. Review of local options

The earlier sections of the LEP outline the baseline situation in Brae and the aspirations of the local community and Steering Group for the outcomes for it.

A key theme as part of the data gathering and the consultation was to raise awareness of energy saving measures and to provide an education framework on energy. This links into reducing energy bills and will support the wider aims of economic resilience, education, good health and well-being and also potentially improving the economic profile of Brae.

6.1 Energy Saving Measures and Educational Framework

6.1.1 Energy Efficiency Awareness and Support

Support is already available to the community of Brae via a number of agencies including Shetland Islands Council, Home Energy Scotland, Resource Efficient Scotland and Energy Saving Trust.

- Shetland Islands Council has grant funding (which is from the Scottish Government Home Energy Efficiency Programmes Scotland – Area Based Scheme) available to install energy efficient measures in Shetland Households within Council Tax bands A-D. Properties owned by the

Shetland Islands Council and Hjatland Housing Association are required to meet national targets within the Energy Efficiency Standard for Social Housing (EESSH) to ensure their properties achieve a minimum standard of efficiency.

- Home Energy Scotland (HES) – provide clear and impartial advice on saving energy at home, including travel. HES Specialists have developed a wealth of knowledge about domestic energy efficiency and heating. Over the last nine years, the team have visited almost 6,000 households across the Highlands and Islands and heard the concerns of many householders, including many struggling to heat their home. They are fully trained and know what advice to provide and understand the barriers that can stop people taking action. There remains opportunity to take advantage of their in-depth knowledge when developing potential community projects on domestic energy efficiency. HES help people access Government-funded energy efficiency schemes and support from local service providers. Their advice covers the actions that can be taken and support available to help save money on energy bills and transport costs. They provide information on home energy efficiency schemes and financial support available including:
    - Warmer Homes Scotland
    - Area-based scheme (see above)
    - Home Heating Cost Reduction Scheme
    - Scottish Government interest free loans and cash back
    - Renewable heat incentives and feed-in-tariffs
    - Other local and national schemes as they become available.

Home Energy Scotland is funded by the Scottish Government and managed by Energy Saving Trust.

- Resource Efficient Scotland – provide energy efficiency support to businesses. They can work with the local community and the steering group to raise awareness within the business community in Brae on what is available to them. They can:
    - Work with local business facing organisations and advisors to disseminate information on the support available including grant and loan funding
    - Provide stakeholder packs with promotional text and relevant case studies/testimonials for newsletters, emails, social media feeds, etc. to assist with local engagement efforts

The programme is delivered by Zero Waste Scotland and funded by Scottish Government and the European Regional Development Fund.

- Energy Saving Trust – provide clear and impartial advice on energy saving. This includes support in accessing funding through grant and loan schemes. Energy Saving Trust's work in Scotland is funded by the Scottish Government, and transport advice is funded by Transport Scotland, the Scottish Government's national transport agency.

These agencies will continue to offer useful advice in relation to energy efficiency and energy saving measures that will be available to the community of Brae.

Proposed Action Point #1

Deliver community energy awareness event, showcasing the emerging Local Energy Plan and the work of the above agencies in supporting ongoing efforts to use energy efficiently and further develop renewable energy opportunities. This could include trial opportunities to use electric vehicles and/or electric bikes. The Come to Brae Days (June 30th / July 1st) would offer one potential forum.

6.1.2 Energy tariffs and market switching

The cost of electricity in Shetland is high and it is well documented that there is a high level of fuel poverty. The consultation with the community felt raising awareness was key and this needs to include information and education to the community and businesses on the different tariffs available. It is understood a large proportion of householders use the Total Heat Total Control (THTC) tariff and awareness needs to be provided to show there could be the potential to switch to a more competitive tariff which could reduce household energy bills.

Proposed Action Point #2

Community Council to work with SIC and Citizens Advice Scotland, along with other agencies, to promote awareness of potential alternative electricity tariffs which residents can explore. Seek means of support to be provided in switching account details and subsequent follow up to avoid return to standard tariffs (where short term tariffs are available).

For properties heated by oil there is an opportunity to set up a heating oil club in Brae. There are a number of others in operation on Shetland, such as in Sandwick and Lodgemoor for example. The basic premise of a heating oil club is the ability to achieve a bulk discount price by co-ordinating a single purchase for all members, rather than negotiating separately with suppliers. It also potentially smooths out short term supply availability issues given a larger single order.

Proposed Action Point #3

Post local notice to residents using heating oil to explore interest in setting up a heating oil club. Make contact with other existing heating oil clubs on the islands to learn from their experiences and determine best way to proceed.

6.1.3 Promotion of energy efficiency

There is an opportunity to provide educational information to Brae High School so the younger generation can benefit from the advice from the agencies listed above. Flyers and posters could be distributed in the local area.

6.2 Energy efficiency measures

The direct impact of any measures to improve energy efficiency will depend on the individual properties. However, the Home Analytics database dataset provides a means of estimating the impact of a range of energy efficiency interventions across the residential stock in Brae. This therefore offers an indication of the scale of impact that this can provide (see Table below).

While delivery of these measures are best delivered in conjunction with SIC and other agencies, it is useful to consider the relative impact of these individual measures. A summary is provided here.

The larger and more disruptive works would be the delivery of hybrid wall insulation and replacement of existing electric heaters with high efficiency storage heaters.

Alongside the existing funding schemes and programmes described in Section 6.1 the Scottish Government is currently developing its EES (Energy Efficient Scotland Programme) to be delivered from 2020. This will encourage investment programmes of works that combine action in social housing and owner occupied dwellings in order to target a small geographical location.

Proposed Action Point #4

Continue to work with SIC, Hjaltland Housing Association and Home Energy Scotland to seek support, advice and funding (where available) for ongoing improvement works to insulation and building fabric in residential properties. Support householders in accessing advice and participating in co-ordinated programmes of works.

Table 13 Insulation and energy efficiency measures (residential stock)

Measure	Estimated Capital Cost (£)	Estimated Energy Cost Saving (£/yr)	Estimated Energy Saving (kWh/yr)	Estimated Carbon Emission Saving (tCO_{2e}/yr)
Replacement of incandescent lightbulbs with LED equivalent	£5,954	£6,082	88,540	31
Loft insulation top-up	£32,783	£5,377	78,275	28
High efficiency storage heaters	£1,409,080	£37,342	543,598	193
Replacement of existing oil boilers	£269,047	£19,187	279,307	99
Hybrid wall insulation	£2,018,660	£56,854	827,645	294
Underfloor insulation works	£467,699	£43,154	628,199	223
Replace entry doors with modern equivalent	£226,384	£8,903	129,600	46
Install A-rated windows (uPVC frames)	£1,140,834	£21,025	306,063	109
Installation of Solar PV	£779,640	£11,199	163,027	58

6.3 Small Scale Renewable Generation

At present in Brae, there are already some householders who have their own micro-generation renewables to allow them to reduce reliance on the constrained grid, reduce energy costs and reduce carbon emissions.

Small scale micro-generation is not constrained by the grid and can also benefit from permitted development rights, which means planning permission may not be required.

6.3.1 Small scale wind

There are a number of properties identified with sufficient land area to erect small 6 kW turbines that would produce electricity that could be used locally without extensive export to the grid. These would particularly suit householders with electric heating.

The total potential capacity is summarised here.

Proposed Action Point #5

Explore community opportunity for collective install of turbines in Brae area.

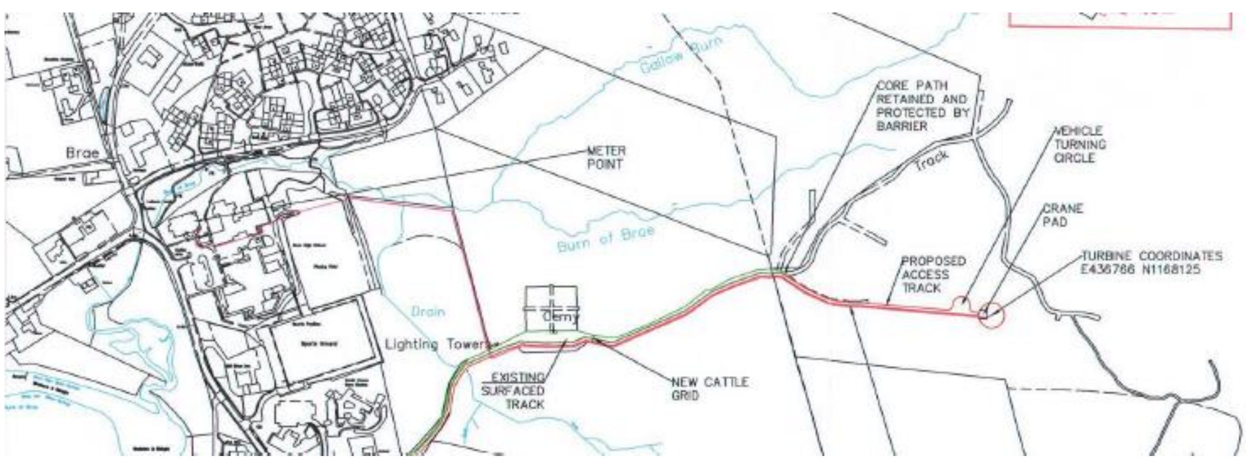
Table 14 Insulation and energy efficiency measures (residential stock)

Measure	Estimated Capital Cost (£)	Estimated Energy Cost Saving (£/yr)	Estimated Energy Saving (kWh/yr)	Estimated Carbon Emission Saving (tCO_{2e}/yr)
Small scale wind turbines	£655,400	£24,495	168,264	67

6.3.2 Wind Turbine to East of Brae

There is existing planning permission in place for a 100 kW turbine to be located to the East of Brae as shown here.

Figure 10 Proposed wind turbine (100 kW)



Given its location there is potential to use the supply from the wind turbine to feed local buildings. Presently it is proposed to install a feed to the High School. It would also be possible to supply power to the Care Home.

In order to maximise the benefit of the output from the turbine installation of a battery storage solution is a potential solution. This would facilitate storage of output that wasn't consumed during peak generation periods and discharge at other times of the day or night when generation from the turbine was lower.

In the medium term the use of battery storage would assist the development of a local smart grid.

Proposed Action Point #6

Explore opportunity for community to become involved in proposed scheme – either as purchaser of energy or as co-investor in development. Discuss potential to supply School and Care Home with output power from the turbine with the developer.

6.3.3 Small scale hydro

The initial resource assessment suggests that there may be potential for a small hydro scheme within the Burn of Skelladale and Burravoe Burn. The scale of development is likely to be no larger than 25 kW, with an annual energy output in the region of 100,000 kWh/year.

A feasibility study would need to be carried out in order to better understand the flow regime in the water course and enable a better understanding of the potential energy generation achievable.

Given the removal of FiT from April 2019 there would need to be a physical connection to supply local buildings in order to make best use of the electricity generated.

Proposed Action Point #7

Carry out feasibility study to assess scope for micro hydro scheme in local area.

6.3.4 Heat Pumps

Both air source and ground source heat pumps could be a potential source of space heating for individual buildings. Ground source heat pumps need more physical space around the property to enable installation of a borehole or horizontal trench.

The heat output from these systems is lower than a conventional radiator (or storage heater) so they are best suited for use with underfloor heating in order to provide a larger surface area for heat emitting. The alternative is a larger radiator. This makes them difficult to use as a retrofit installation method, particularly if replacing electric heaters. It also means lower cost savings for properties where there has not been considerable work to improve overall insulation and reduce heat demand.

It is possible to develop small scale supply networks to buildings, where hot water is fed from a ground source heat pump system to provide space heating and domestic hot water. Cold water shared loop systems can be used, which reduce the civil works costs for a cluster of adjacent properties. This approach also ensures that the system is eligible for the Renewable Heat Incentive (RHI). These would be most suited to new build developments, given the need for a whole new distribution system in the case of fitting in existing properties with electric heating.

Proposed Action Point #8

Seek designs for new build dwellings that use heat pumps where appropriate as the primary heat source alongside high levels of insulation and fabric. Encourage consideration of air/ground source heat pumps for use in extensive retrofit refurbishment work in place of electric storage heaters.

6.3.5 Solar Thermal

Solar hot water systems will provide a proportion of domestic hot water requirements in each house. Given the solar radiation available on Shetland this is not going to be more than around 50% or so of these hot water needs. In terms of individual systems there would also need to be space in the house to locate a water storage tank fed from the solar thermal system.

In most instances installation of the solar water system would mean available roof space for solar PV would be taken up. The net benefit of the Solar PV system is greater in terms of the total electricity output that can be used.

It is not recommended that the community looks for widespread use of these systems.

6.4 Larger Scale Generation

Given existing grid capacity constraints any larger scale generation must look to deliver its energy output to end users. It is not presently possible to export large amounts of power into the grid network.

6.4.1 Large scale wind

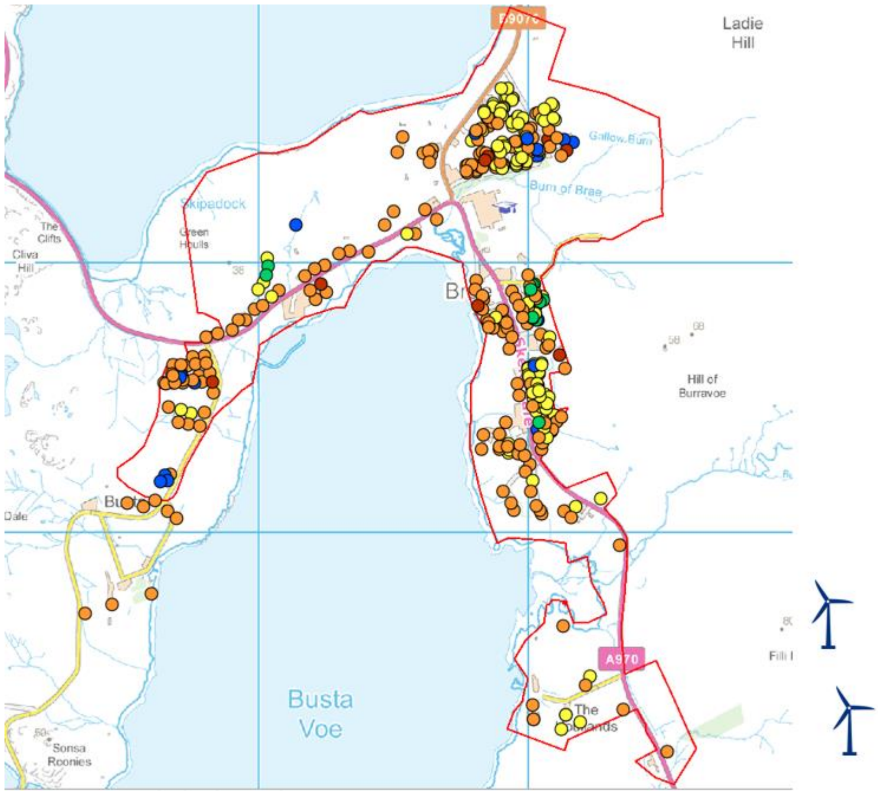
There is an initial feasibility study into the potential for 2 x 2.2 MW wind turbines to be installed at a site to the South of Brae (at Hill of Wethersta adjacent to Valleyfield Guest House). This is at an early stage of investigation by a private developer. At a simple level this would only be feasible in the event of development of an interconnector with mainland Scotland.

A more complex solution would be a battery storage system, where output from the turbines could be stored and supplied to other consumers at a different moment in time. This would still need a physical private wire connection to local consumers in order to maximise the system benefit.

Another alternative is to look to develop a hydrogen production facility alongside the turbine. This would require an electrolyser to generate the hydrogen using the electricity from the turbines. A compressor and pressurisation system would also be installed to enable storage of the output hydrogen.

The hydrogen can be used either to generate electricity at a later point in time or as a vehicle fuel for either cars or buses. If used to regenerate electricity, then there would need to be a fuel cell installed. This would be best placed within Brae in order to benefit from the local electricity production.

Figure 11 Proposed location of large wind turbines



Proposed Action Point #13

Discuss proposal with local developer. Explore how local energy demand might be met by turbines reducing constrained output. This could include either use of electrical battery storage or production of hydrogen for use as a vehicle or heating fuel.

6.4.2 Solar Array

An alternative to a wind turbine development would be to develop a large-scale solar PV array on an area of land within close proximity to Brae. As a rule of thumb each Ha of land can accommodate around 1.5 MW of solar PV capacity.

Similar development issues would arise as with any larger generation capacity in terms of how to use the energy generation in a cost-effective way.

Given the local wind resource, there is a lower energy potential available via a large-scale solar array. For this reason it is not recommended to pursue this option.

6.4.3 Biomass heating

The existing biomass systems supply the Leisure Centre and associated buildings around the all-weather pitches.

The existing system is designed to meet the needs of these buildings and therefore does not have any significant capacity to supply heat to neighbouring buildings. To extend the existing scheme would therefore need a new boiler to be installed with associated space within the existing (or a new) boiler house.

The nearest dwellings are to the north of the pitches across Moorfield Ring Road. The majority of these properties are electrically heated.

To develop any district heating network therefore would require installation of flow and return pipework from the biomass boiler at the Leisure Centre beneath the road and into the dwellings. There would also need to be entirely new radiator and hot water systems fitted within each dwelling. This is prohibitively expensive.

Individual boilers fitted for use by single dwellings are similarly expensive for electrically heated homes (around two thirds of Brae residents). There would be potential to explore replacement of oil boilers with biomass equivalent for relevant households.

All fuel needs to be imported from outside the islands.

6.4.4 Tidal power

Tidal power schemes are a developing technology. For this reason there are no standard scheme designs and each system is effectively designed bespoke for the local conditions. Given the early phase of commercial development these schemes tend to be large in generation scale (1 MW and above) and require extensive design and planning consultation.

The immediate coastal area around Brae includes shellfishing waters and is subject to wider marine development planning. It is unlikely that the tidal resource in this area would offer a viable scheme. It is more likely that any scheme would look to use Roe Sound and the channel that this offers.

Given grid capacity constraints and the scale of energy output, which would likely exceed daily electricity demand, this is not a viable option unless grid constraints are relieved.

An initial feasibility study would be required to look at the specific local tidal resource available and identify the best locations for installation of any scheme.

6.4.5 Geothermal

Previous initial assessments have suggested that there is a suitable geothermal resource close to Brae to offer a potential source of district heating.

There is only one existing commercially operated geothermal plant in the UK in Southampton. There have been a number of studies looking into potential schemes, and active pursuit of a large scale scheme in Cheshire.

The proposed scheme uses a so called 'hot rocks' method where latent heat within the geology is used to heat a borehole water loop that then feeds into a wider heating system.

Given the low level of distributed hot water heating systems in the area there would need to be a large amount of supply system works to make this feasible.

Depending upon the amount of heat that could be generated, then it might be possible to develop a steam supply system for a turbine that could generate electricity. It is likely that this might need additional heat input in order to ensure a reliable supply of steam at sufficient temperature and pressure for a turbine.

A detailed feasibility study would be required in order to understand the capacity that any system would provide.

Proposed Action Point #9

Seek to undertake a feasibility study to look in more detail at the potential resource and system design that would be feasible for Brae.

6.4.6 Sea water heat pump

It is possible to use sea water as a source of heat for a heat pump system that could supply hot water for a district heating scheme. There are a few examples of such schemes in operation, including one in Drammen (Norway) that provides heat for a district heating system that feeds a number of buildings in the town (population of around 60,000). This scale of system would be larger than the heating needs for Brae. Smaller scale systems don't afford significant scale savings due to the infrastructure required in putting in the heating coils and associated equipment to operate the scheme.

The output from a sea water heat pump scheme would be hot water that could be supplied as a means of space heating and domestic hot water. However, the majority of properties in Brae do not use a wet space heating system given the use of electricity as the primary fuel. There would therefore need to be a significant amount of additional supply system works to put in place the plumbing required to use the hot water supply from the heat pump. This would add considerable expensive to the cost of the scheme and would be complex to deliver. It is possible to configure the heat pump system to supply warm air heating into properties. However, this is less efficient from an energy perspective (in comparison to a hot water system) and would still require significant modifications to individual properties.

In terms of siting any heat pump system there would need to be care not to disturb any shellfish areas and in ensuring minimal impact in the local marine environment during any installation works.

For these reasons it is not recommended that this option is taken forward for further feasibility work.

6.5 Transport

The baseline data has demonstrated in Brae that car usage is high with public transport utilisation low. Feedback from the consultation undertaken has shown there is an interest in car club schemes, electric or alternative fuel vehicles and a community bus scheme.

6.5.1 Car Club Development

It is understood from the consultative draft Transport Strategy Refresh that a Car Club Development for Shetland Islands Council is at the feasibility stage. Given Brae is a key settlement in Shetland, and the interest in a car club scheme, (identified during the data gathering stage of the LEP) it is recommended to have discussions with ZetTRANS and Shetland Islands Council to understand if Brae could incorporate car club spaces. This could be an opportunity for the NHS to be involved in using vehicles for home visits, etc.

Existing electronic applications are available that assist in enabling booking and tracking of car club vehicles in order to ensure users have a practical and useful system.

Proposed Action Point #10

Seek opportunity to develop ULEV car club. In first instance this may be part of wider Shetland Islands Council scheme.

6.5.2 Hydrogen fuel vehicles

Trials of hydrogen fuelled buses elsewhere, such as in Aberdeen, have shown the potential for these vehicles to be used more widely. Each vehicle is powered using an on-board fuel cell that uses hydrogen to generate electricity to power the bus. A similar model of operation would be true for cars and light vans.

The proposed wind turbines discussed earlier offer a potential source of hydrogen to fuel these vehicles. A hydrogen fuelling station to supply car club vehicles would be one option to explore further.

Fuel supply to local buses, and more broadly, to ferry services could also be a potential application.

Proposed Action Point #11

Explore potential for local hydrogen supply produced via wind turbine fed electricity to provide fuel for hydrogen vehicles (e.g. via Hill of Wethersta proposed wind turbine development).

6.5.3 Electric vehicles

In contrast to the fuel cell operated vehicles, a battery only model would simply require a source of electricity for recharging.

There is an existing electric vehicle charging point in Brae which has the potential to be expanded if the number of electric vehicles increases. This is one of 12 in total across the Shetland Islands; data shows that at least 7 of these were used at least once in the past year with an average energy use of 6 – 8 kWh per charge.

There are grants and loans available from the Energy Saving Trust to help householders and businesses make the switch to electric vehicles. The price difference between internal combustion engine (ICE) vehicles and electric vehicles is steadily narrowing. In terms of range, the electric vehicles on the market are well capable of travelling distances across the Islands.

Local generation in the form of the proposed wind turbine, solar PV on local buildings or a solar canopy created as part of an enhanced electric vehicle charging station could all supply the needs of charging points.

Proposed Action Point #12

Explore local opportunities to extend charging point network via local generation. Potential community investment in vehicles (private cars, community mini bus, light goods vehicles).

6.6 Smart Grid System and smart meters

The value of an electrical grid system is the ability to balance the supply of electricity with the demand (loads) placed upon the system. At sufficient scale this ensures that voltage and current levels remain within required limits for the safe operation of appliances and equipment.

At present this load balancing operation is carried out at an Islands wide level by the DNO.

Trials, such as those on Mull and in Fintry, have looked at the potential to use a similar approach but at a more local scale. In the case of Mull, for example, a local hydro scheme output was matched to charging requirements for electric heaters in individual homes. The system was able to prioritise the heaters in order of those that needed to be charged most urgently.

These more localised systems offer the potential to enable more efficient use of local energy generation by avoiding periods where electricity is either purely exported to the wider grid or is curtailed due to lack of capacity on the grid.

To enable this system to operate the first step is to have smart meters installed in individual homes and at sites with electricity generation. These meters need to be capable of two-way communication so that demand can be signalled by individual buildings and these requests can be processed by the supplying assets. There are also some issues that would need to be explored in terms of the ability of the local grid to cope with the anticipated power flows.

In a fully operational smart grid, local energy generation from wind turbines, solar PV and any other significant sources, as well as potential battery storage could be linked together to deliver electricity requirements in the local Brae area.

While there is an ongoing roll out of smart meters across the UK, led by the larger electricity suppliers, there is no standard design for all providers. This means that a dialogue with the local DNO would be required to understand the capacity of any smart meters presently being offered to householders to support any future smart grid.

Otherwise the benefit of the smart meters is limited to householders and businesses being able to see in real time how their energy consumption changes.

Proposed Action Point #14

Seek understanding of potential development of localised grid management system. Initial exploratory talks with SSEN regarding appropriate smart meter designs to be rolled out

7. Summary of prioritised actions

A summary of the opportunities reviewed in the previous section is provided here.

Table 15 Description of measures summary

#	Measure	Description of measure
1	Replacement of incandescent lightbulbs with LED equivalent	Carry out programme of replacement of incandescent bulbs with LED equivalent within households
2	Loft insulation top-up	Programme of loft insulation upgrades to ensure minimum 250 mm thickness in relevant households
3	High efficiency storage heaters	Programme of replacement of storage heaters with modern equivalent in relevant households
4	Replacement of existing oil boilers	Programme of replacement of existing boilers in households with oil use as primary heating fuel
5	Hybrid Wall Insulation	Programme of Hybrid Wall Insulation (external and internal) wall insulation work on relevant households
6	Underfloor insulation works	Programme of insulation work to be installed beneath wooden floors in identified households
7	Replace entry doors with modern equivalent	Programme of replacement of main entry doors to households with modern insulated equivalent
8	Install A-rated windows (uPVC frames)	Programme of replacement glazing for relevant households
9	Installation of Solar PV	Programme of installation of domestic scale Solar PV on appropriate housing. Potential to develop community body to co-ordinate installation
10	Solar thermal (roof mounted)	Programme of installation of domestic scale solar hot water on appropriate housing. Potential to develop community body to co-ordinate installation
11	Wind (small scale domestic)	Explore feasibility of programme of installation of 6 kW scale domestic turbines in properties with sufficient land area. Potential to develop community body to co-ordinate installation
12	100 kW wind turbine	Explore potential for community involvement in taking forward consented wind turbine development to east of Brae. This to include feasibility of supply to High School and Care Home. Consider battery storage to maximise use of energy output from turbine.
13	Ground source heat pump	Look to use ground source heat pumps as part of heating solution for new build properties. Potentially share a ground loop between properties to assist in installation cost reduction
14	Air source heat pump	Look to use air source heat pumps as part of heating solution for new build properties alongside high levels of building fabric and insulation.
15	Wind turbine (4 MW)	Explore potential for community to support proposed wind turbine development at Hill of Gremista. Includes potential for direct supply to households, battery storage and/or hydrogen production for use as fuel for energy or transport

#	Measure	Description of measure
16	Solar array	Development of a ground mounted solar array to generate electricity for use within Brae
17	Biomass heating	Use of biomass as a primary fuel in replacing oil boilers within relevant households
18	Tidal barrage	Development of a tidal barrage offshore to generate electricity supplied into Brae
19	Tidal array	Development of a tidal array offshore to generate electricity supplied into Brae
20	Geothermal heating supply	Use of a deep geothermal well to provide a source of heat to enable a hot water supply for heating homes and businesses in Brae
21	Sea water heat pump	Use of a sea water heat pump to provide a source of heat to enable a hot water supply for heating homes and businesses in Brae
22	Hydrogen vehicles	Use of wind turbine capacity developed in the area to provide a fuel source for hydrogen production to be used as vehicle fuel
23	Electric vehicle car club	Development of car club with electric vehicles available for use to local agencies
24	Smart meters	Installation of smart meters in homes and businesses to begin process of enabling smart grid for local electricity grid management

Table 16 List of options and initial overall assessment rating

#	Measure	Total Rating
1	Replacement of incandescent lightbulbs with LED equivalent	HIGH
2	Loft insulation top-up	HIGH
3	High efficiency storage heaters	HIGH
4	Replacement of existing oil boilers	LOW
5	Hybrid (external and internal) wall insulation	HIGH
6	Underfloor insulation works	HIGH
7	Replace entry doors with modern equivalent	LOW
8	Install A-rated windows (uPVC frames)	MEDIUM
9	Installation of Solar PV	HIGH
10	Solar thermal (roof mounted)	LOW
11	Wind (small scale domestic)	HIGH
12	100 kW wind turbine	HIGH
13	Ground source heat pump	LOW
14	Air source heat pump	MEDIUM
15	Wind turbine (4 MW)	MEDIUM
16	Solar array	LOW
17	Biomass heating	LOW
18	Tidal barrage	LOW
19	Tidal array	LOW
20	Geothermal heating supply	MEDIUM
21	Sea water heat pump	LOW
22	Hydrogen vehicles	MEDIUM
23	Electric vehicle car club	HIGH
24	Smart Meters	HIGH

This overall rating is a combination of the weightings and the technology fit as described in more detail in Appendix B, Section 3.4.

A summary of proposed actions is provided here.

Table 17 Summary of action points

#	Action	Description	Relevant parties to be consulted	Timeframe (Short / Medium / Long)
1	Promote energy efficiency and opportunities for support in demand management and resource efficiency	Raise awareness among community in Brae of existing support services available to homes and businesses Potentially use 'Come to Brae Days' as a forum for this	Local Energy Scotland Home Energy Scotland Resource Efficient Scotland Energy Saving Trust	Short
2	Provide support and advice around tariff switching	Offer support and advice to households and businesses regarding electricity tariff switching and maintaining awareness of changes to tariffs in the market	Citizens Advice Scotland Shetland Islands Council Hjaltland HA	Short
3	Heating oil club	Promote idea of heating oil club within Brae	Delting Community Council	Short
4	Continue programmes of fabric improvements and insulation within residential property	Seek funding for ongoing improvement works to insulation and building fabric	Shetland Islands Council Hjaltland HA Home Energy Scotland Warmworks Scotland	Medium
5	Small scale wind development	Explore community opportunity for collective install of turbines in Brae area	Delting Community Council Shetland Islands Council Local Energy Scotland	Medium
6	100 kW wind turbine East of Brae	Explore opportunity for community to become involved in proposed scheme – either as purchaser of energy or as co-investor in development. Discuss potential to supply School and Care Home with output power from the turbine with the developer	Delting Community Council Local Energy Scotland	Short / Medium
7	Small scale hydro scheme	Carry out feasibility study to assess scope for micro hydro scheme in local area	Delting Community Council	Short / Medium

#	Action	Description	Relevant parties to be consulted	Timeframe (Short / Medium / Long)
8	Seek to use heat pumps as primary heat source (new build)	Seek designs for new build dwellings that use heat pumps as the primary heat source alongside high levels of insulation and fabric. Encourage consideration of air/ground source heat pumps for use in extensive retrofit refurbishment work in place of electric storage heaters	Shetland Islands Council Hjaltland HA Private Developers	Short / Medium
9	Geothermal heating system	Seek to undertake a feasibility study to look in more detail at the potential resource and system design that would be feasible	Delting Community Council Shetland Islands Council	Medium
10	Car Club development	Seek opportunity to develop ULEV car club. In first instance this may be part of wider Shetland Islands Council scheme	Shetland Islands Council Energy Saving Trust	Short / Medium
11	Hydrogen vehicle development	Explore potential for local hydrogen supply produced via wind turbine fed electricity to provide fuel for hydrogen vehicles	Shetland Islands Council Delting Community Council Energy Saving Trust	Short / Medium
12	Electric vehicle development	Explore local opportunities to extend charging point network via local generation. Potential community investment in vehicles (private cars, community mini bus, light goods vehicles)	Delting Community Council Energy Saving Trust	Medium
13	Hill of Westersta (proposed wind turbines)	Discuss proposal with local developer. Explore how local demand might be met by turbines reducing constrained output	Private Developer Delting Community Council	Short
14	Smart grid development	Seek understanding of potential development of localised grid management system. Initial exploratory talks with SSEN regarding appropriate smart meter designs to be rolled out	SSEN Delting Community Council Shetland Islands Council Hjaltland HA	Medium

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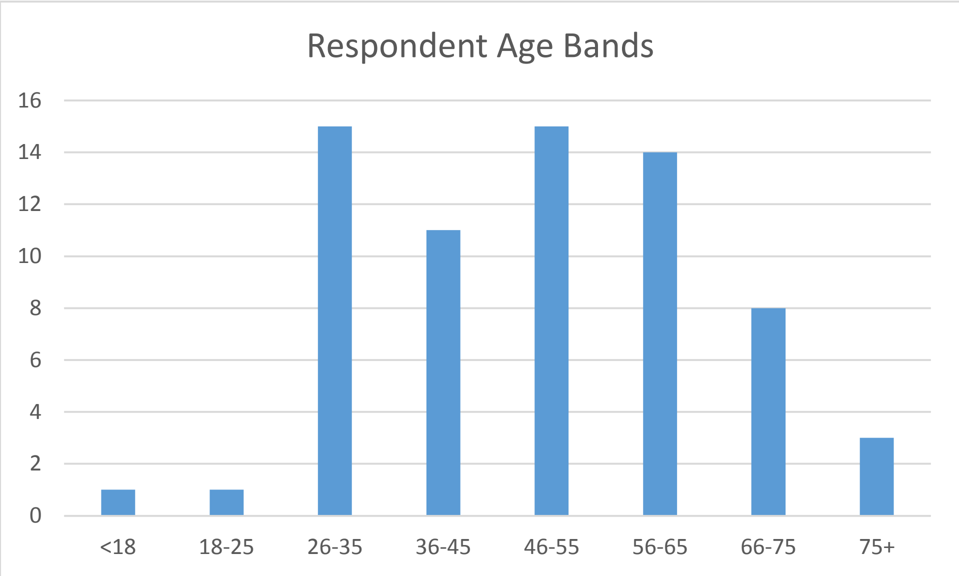
Appendix A Community Consultation Survey Data

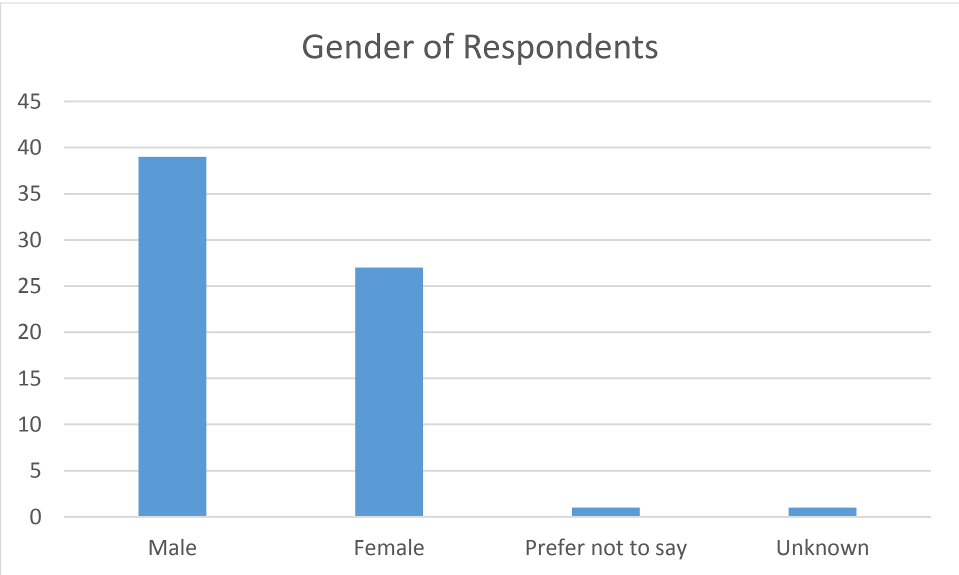
Respondents

The community survey was completed by a total of 68 respondents.

The age range of respondents is shown below.

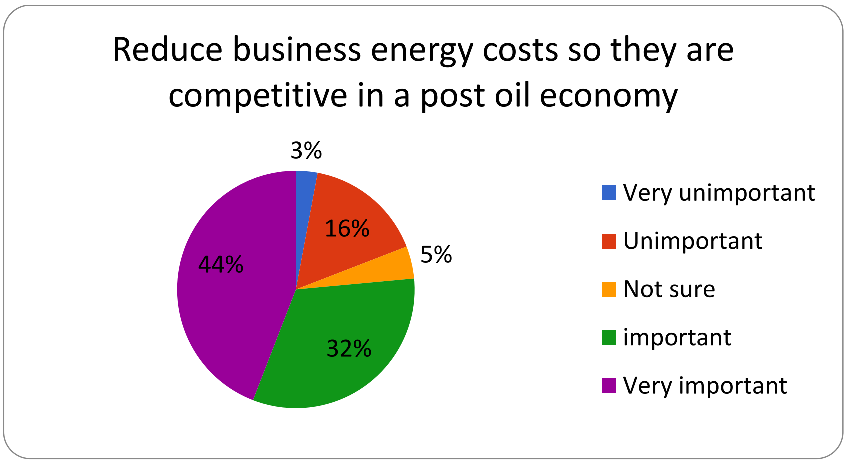


The gender of respondents is shown below.

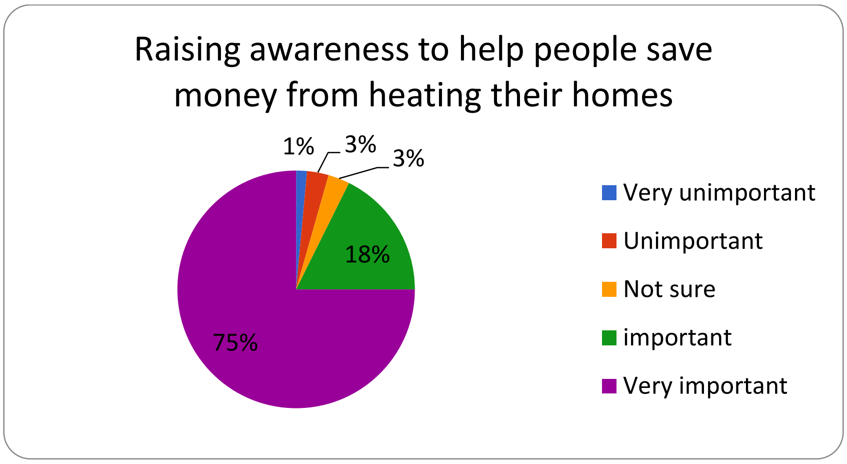


Survey Questions & Responses

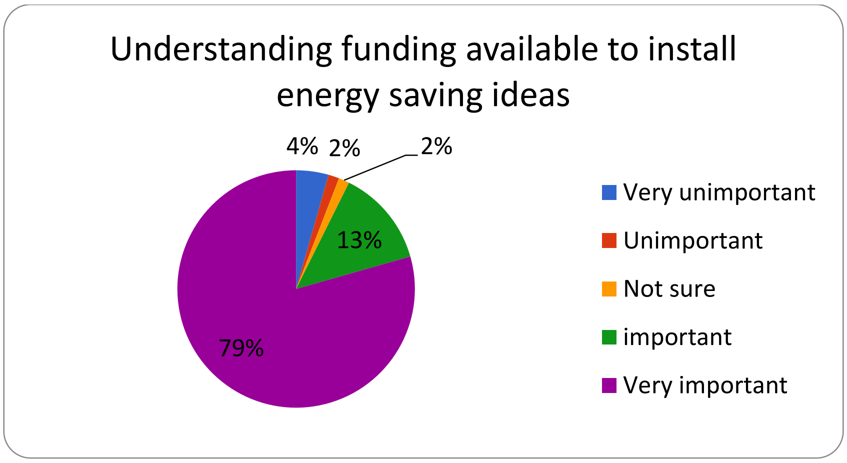
1. How important to you is each statement to meet Brae's future energy needs? [Reduce business energy costs so they are competitive in a post oil economy]



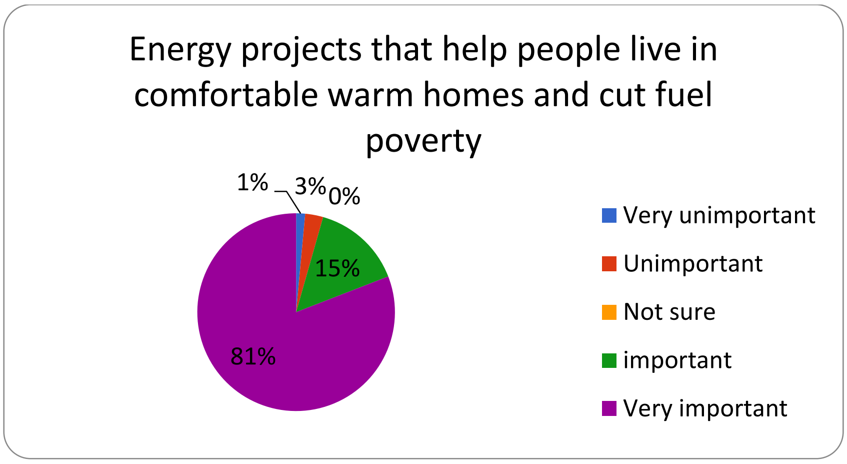
2. How important to you is each statement to meet Brae's future energy needs? [Raising Awareness to help people save money from heating their homes]



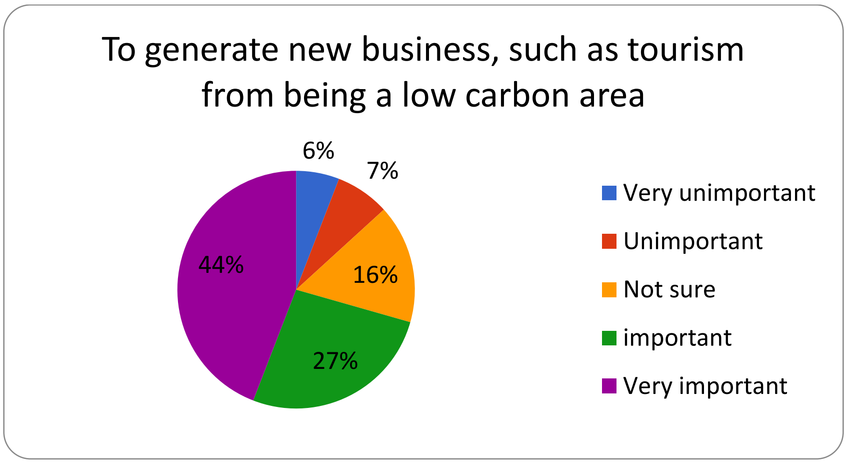
3. How important to you is each statement to meet Brae's future energy needs? [Understanding funding available to install energy saving ideas]



4. How important to you is each statement to meet Brae's future energy needs? [Energy projects that help people live in comfortable warm homes and cut fuel poverty]



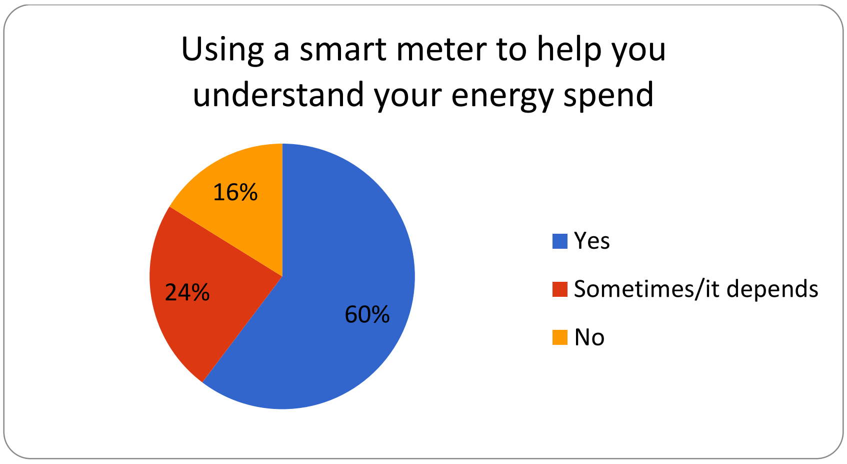
5. How important to you is each statement to meet Brae's future energy needs? [To generate new business, such as tourism from being a low carbon area]



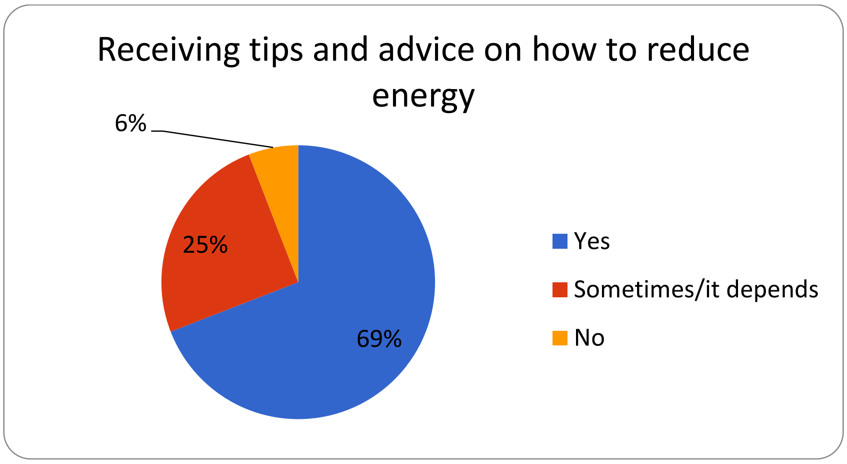
6. Any other matters that are important to you?

- Saving on heating at home and building my own windmill to produce energy for my household.
- Saving money.
- Community energy schemes - maybe 6-20 houses per scheme.
- Better information about insulation grants.
- Community owned power generation e.g. sea pumps etc.
- Focus on people in their homes not businesses.
- Public buildings in the area heating costs could reduce too.

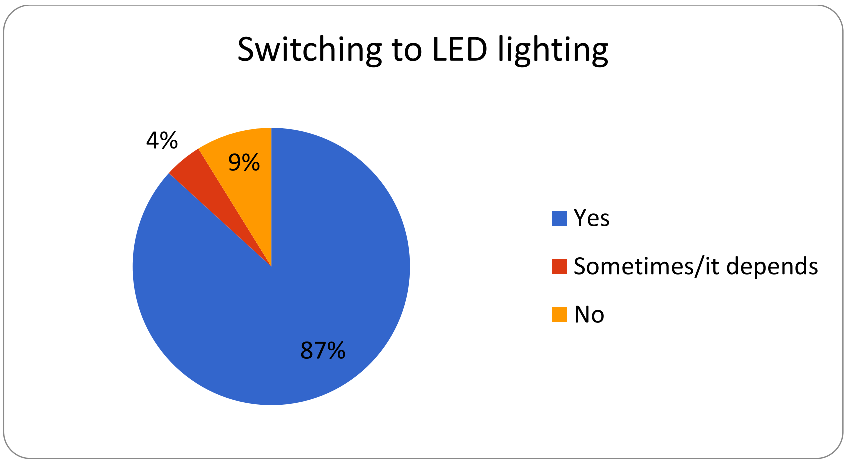
7. Would you consider any of the ideas listed below? [Using a smart meter to help you understand your energy spend]



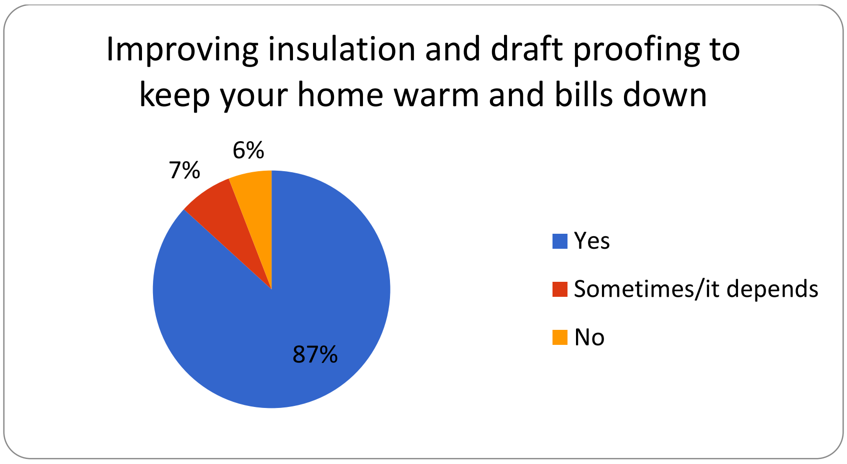
8. Would you consider any of the ideas listed below? [Receiving tips and advice on how to reduce energy]



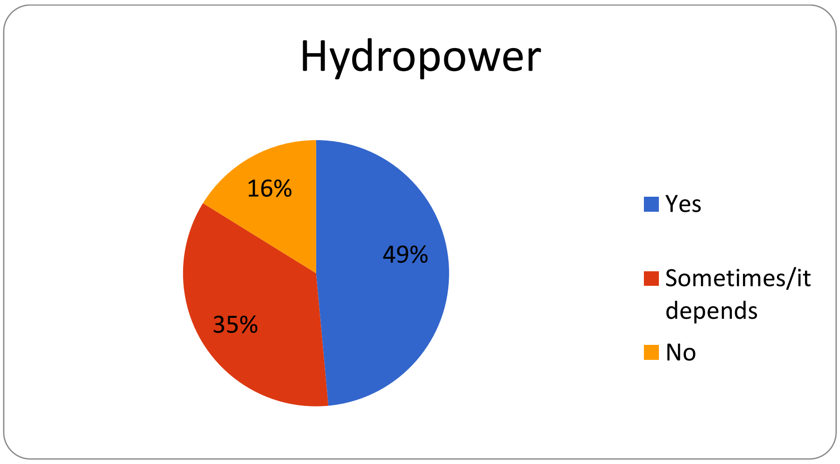
9. Would you consider any of the ideas listed below? [Switching to LED lighting]



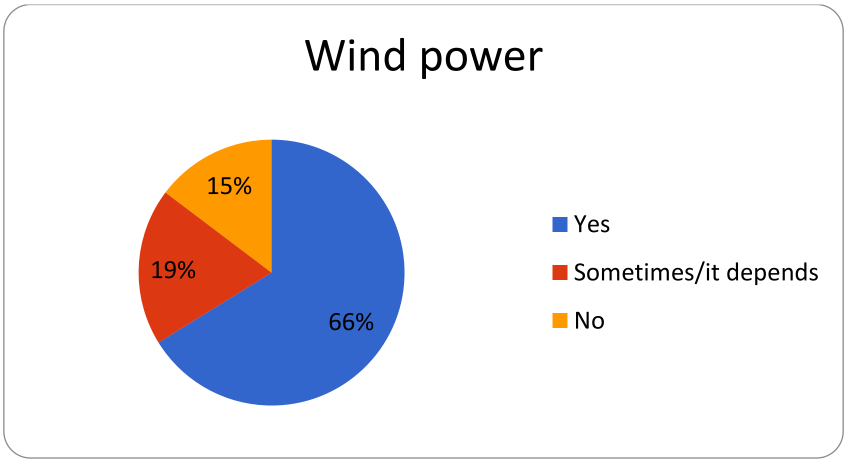
10. Would you consider any of the ideas listed below? [Improving insulation and draft proofing to keep your home warm and bills down]



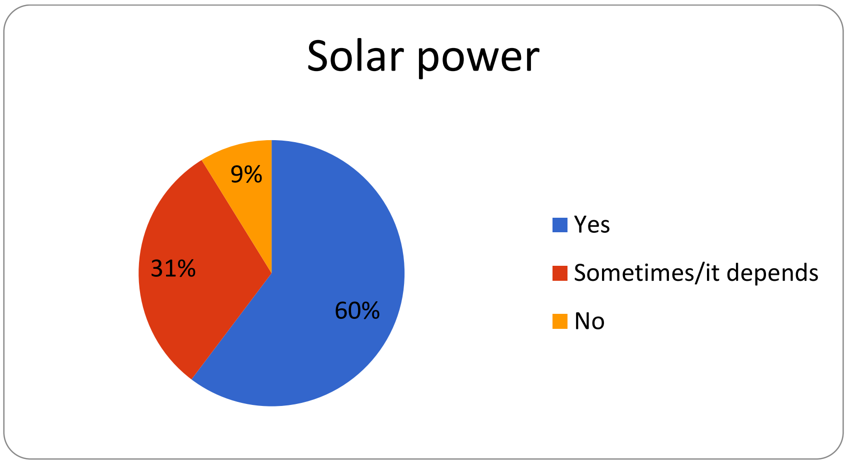
11. What kind of renewable energy are you interested in for Brae? [Hydropower]



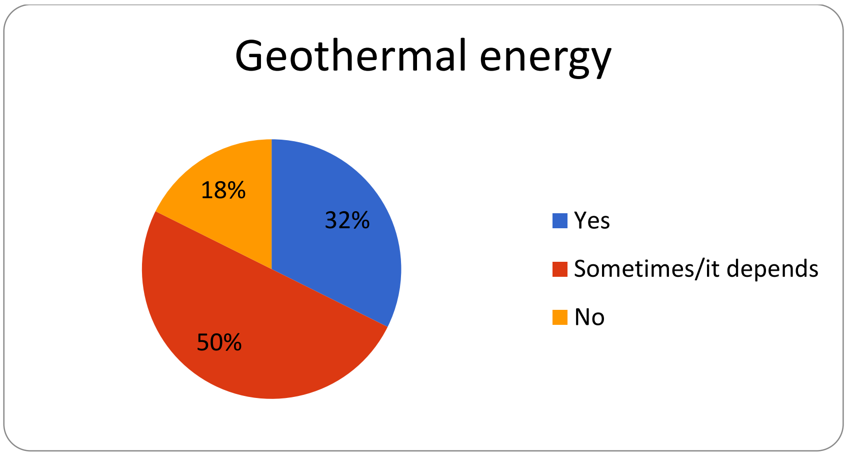
12. What kind of renewable energy are you interested in for Brae? [wind energy]



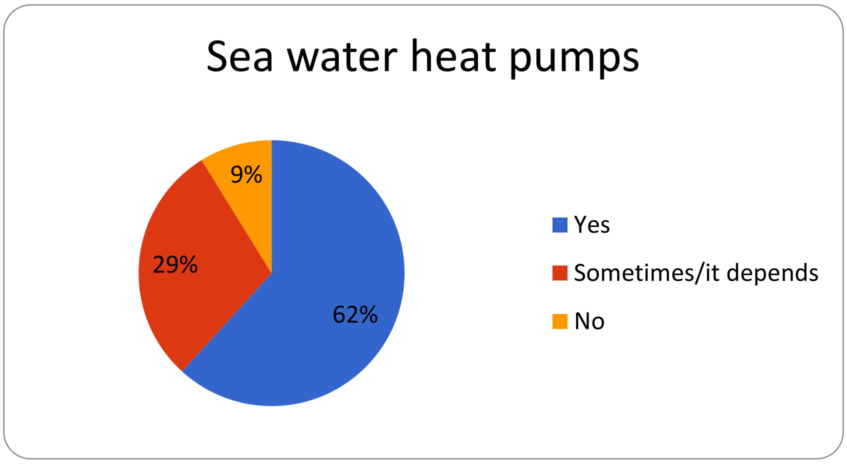
13. What kind of renewable energy are you interested in for Brae? [solar energy]



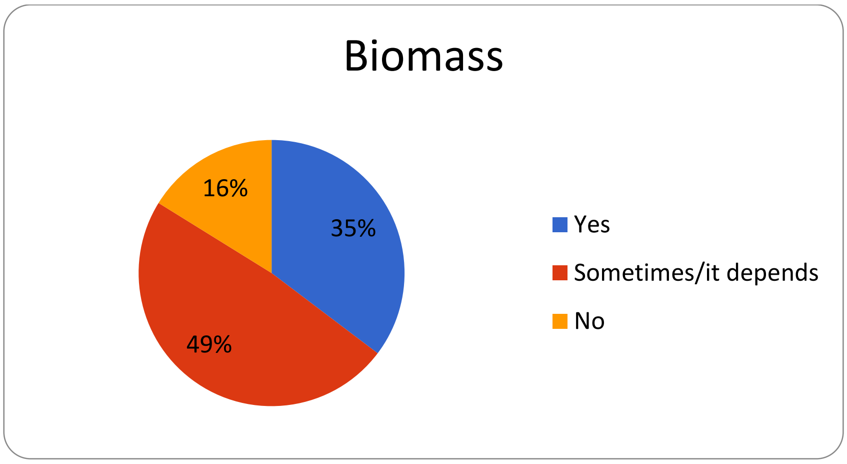
14. What kind of renewable energy are you interested in for Brae? [geothermal energy]



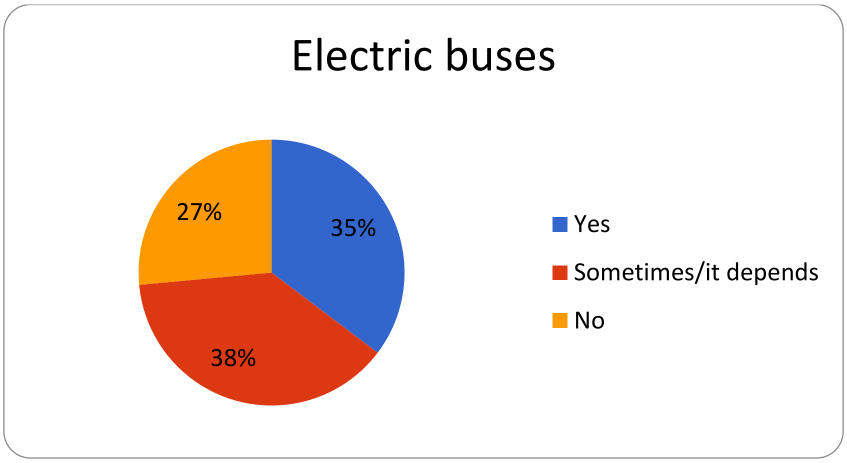
15. What kind of renewable energy are you interested in for Brae? [sea water heat pumps]



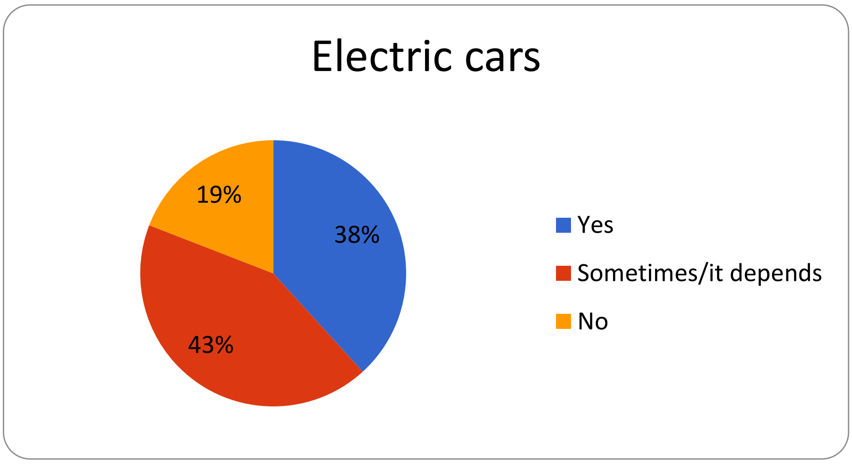
16. What kind of renewable energy are you interested in for Brae? [biomass energy]



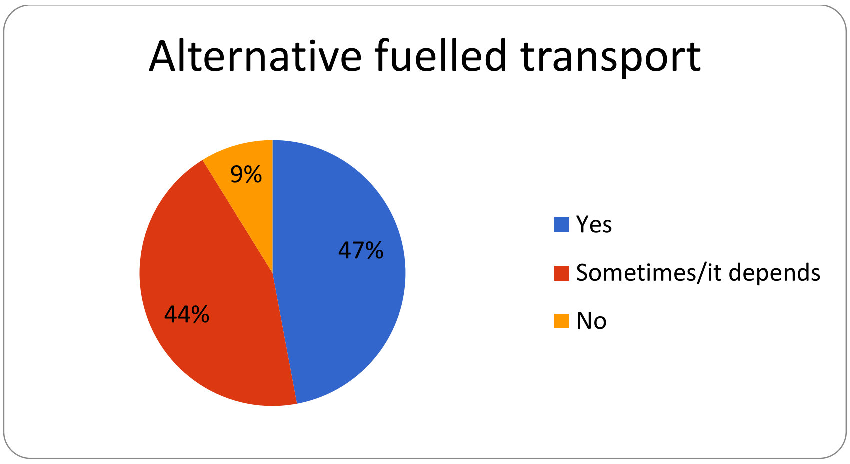
17. What travel and transport options interest you? [Are you interested in electric buses for Brae?]



18. What travel and transport options interest you? [Are you interested in electric cars for Brae?]



19. What travel and transport options interest you? [Are you interested in alternative fuelled transport for Brae?]



Additional Comments

- If there would be an option to join existing wind electric grid it would be fantastic.
- My landlord refuses to make my house more draught proof claiming that the gap along the roof is supposed to be there. There are vents there to let in air! The wind blowing through my house lifts laminate flooring and blows out through sockets and light fittings. More pressure needs to be put on landlords to solve draught problems.
- How about Hydrogen Powered Vehicles?
- Since privatisation energy costs have made some people very wealthy - unfortunately they were already very wealthy. If nationalisation in the future seems unlikely then local initiatives like these might help. I can imagine the EC being sympathetic but not the current Westminster govt.
- We recently moved from Fintry, Stirlingshire, which has implemented many of the proposed measures for Brae.

Appendix B Supporting Information

B.1 Residential

Data available from the Energy Saving Trust Home Analytics database outlines there are 379 residential properties in Brae. The sections below provide information on archetype and size, the tenure and construction type of domestic properties as well as fuel poverty indicators and energy efficiency.

B.1.1 Archetype and size

A large proportion of domestic properties in Brae are detached properties (208); of these approximately half have five habitable rooms (105). The next most common archetype is semi-detached houses (85), primarily with four (34) or five habitable (31) rooms. The remaining are a mixture of end (30) and mid-terraced houses (16), dwellings within small blocks of flats (22) and a small number of properties where the archetype and size are unknown (18).

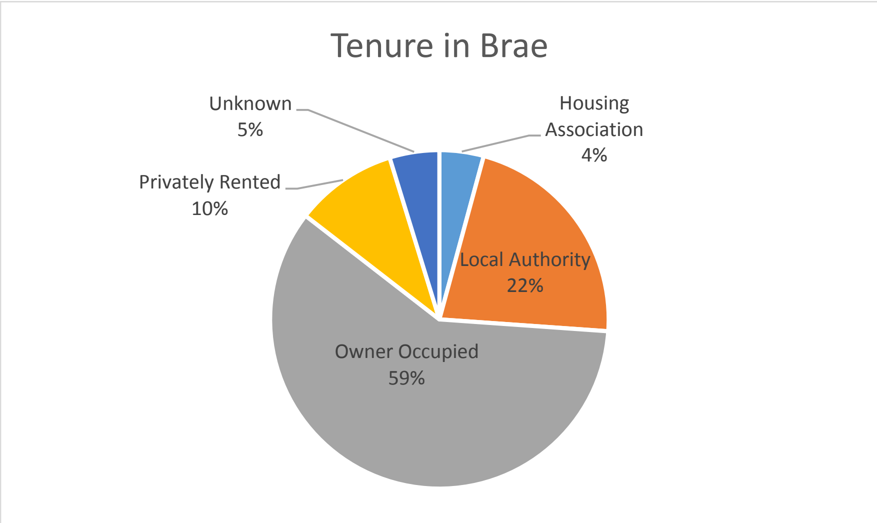
Table B.1 Domestic archetypes and size (number of habitable rooms)

	Number of habitable rooms								
	Less than three	Three	Four	Five	Six	Seven/ eight	Nine or more	Unknown	Total
Detached House	4	7	16	105	17	56	3		208
Semi-detached house	6	6	34	31		8			85
End-terraced house		2	10	13		5			30
Mid-terraced house		1	7	6		2			16
Small block of flats (2 dwellings in building)	2	2	2	7		8	1		22
Unknown								18	18

B.1.2 Tenure

Over half of domestic properties in Brae are privately owned (59%) and almost one quarter of properties are Shetland Island's Council properties (22%). The remainder are privately rented (10%), social rented by Hjatland Housing Association (4%), or the tenure is unknown (5%).

Figure B.1 Residential property (breakdown by tenure)



B.1.3 Construction type

Domestic properties in Brae are a mixture of cavity construction, solid wall, timber frame, system built and a small percentage which are unknown. Table B.2 shows the most common type is timber frame, with 255 constructed in this method.

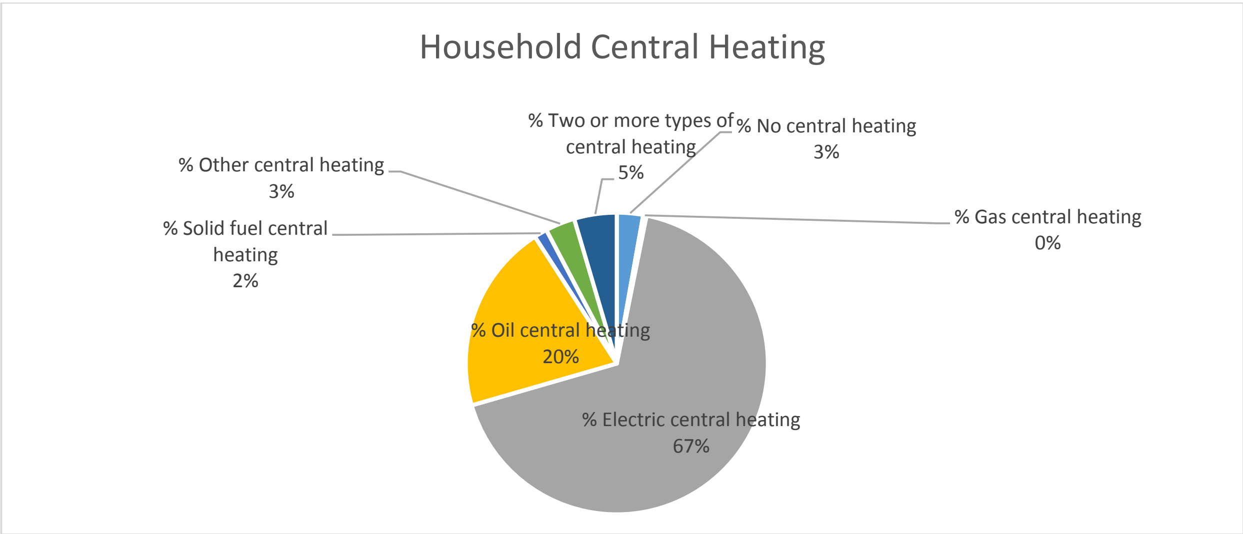
Table B.2 Residential property by construction type (Brae)

Wall Construction Type	Number of Properties
Cavity	42
Solid Wall	50
Timber Frame	255
System Built	14
Unknown	18

B.1.4 Domestic Heating

Electric heating forms the predominant source of primary heating in residential dwellings in Brae. Figure B.2 outlines the central heating composition for domestic properties in Brae.

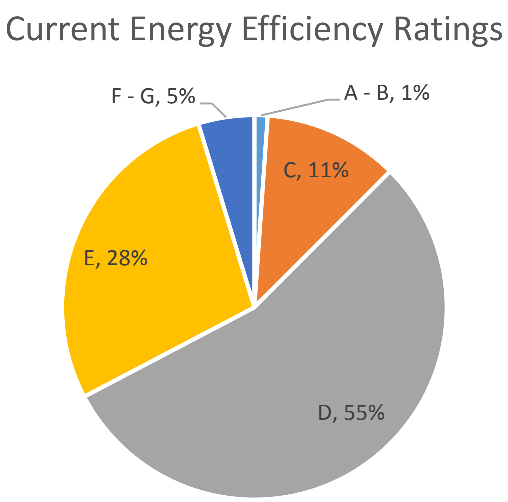
Figure B.2 Household central heating by primary fuel type (Brae)



B.1.5 Estimate of existing energy efficiency

The energy efficiency of a property depends on its physical characteristics. Factors such as the age of construction, the dwelling type, the heating and hot water systems in use and the extent to which the building fabric is insulated, all affect energy efficiency. Data from Energy Saving Trust Home Analytics database shows that housing in Brae is of poor energy efficiency levels with 88% of homes with EPC ratings D-G.

Figure B.3 Current Energy Efficiency Ratings



B.2 Environment

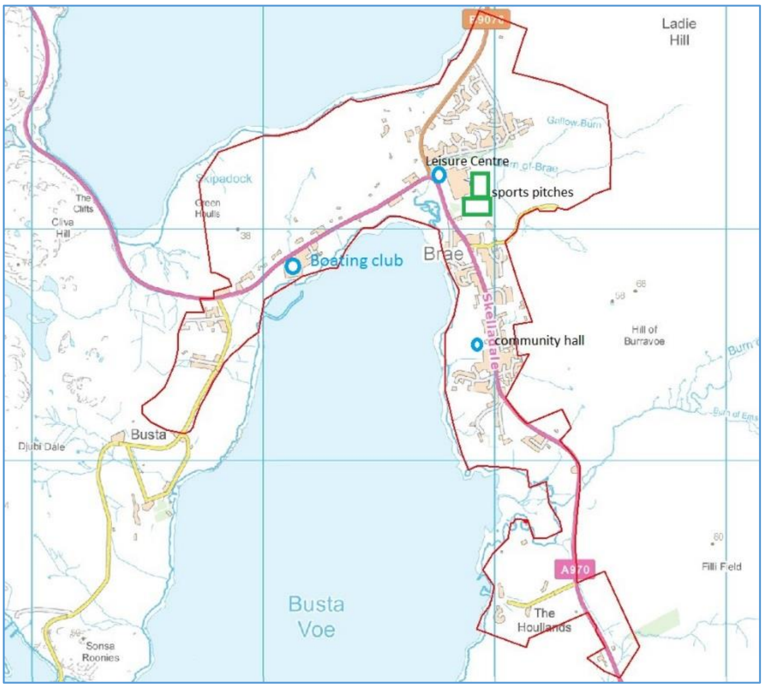
Community scale energy generation will typically require planning consent prior to installation. An important factor in any planning consent is to take into account local environmental and cultural heritage designations.

In thinking about opportunities for local energy generation it is useful to consider what information is available regarding local renewable resources.

A summary of the key environmental designations and local renewable resources is outlined here.

B.2.1 Areas of recreational use, open land, etc. within LEP area

Figure B.4 Areas of recreational use



B.2.2 Summary of environmental designations and other relevant heritage items

Site of Special Scientific Interest (SSSI) - SSSIs are those areas of land and water that are considered best represent our natural heritage in terms of their: flora – i.e. plants; fauna – i.e. animals; geology – i.e. rocks; geomorphology – i.e. landforms. There are three SSSI relevant to the LEP:

- Muckle Roe Meadows to the south of the LEP area and is designated for its vegetation, particularly four hawkweed species.
- Voxter Voe and Valayre Quarry located to the north of the LEP area and is designated for its geological interest, in particular for the rock known as Valayre gneiss which marks the base of a ‘boundary zone’.
- Burn of Valayre located to the north of the LEP area and is designated due it containing some of the last remnants of Shetland’s native tree and shrub cover.

Special Area of Conservation (SAC) – A SAC protects one or more special habitats and/or species – terrestrial or marine – listed in the Habitats Directive. There is one SAC in close proximity to the north of the LEP area, which covers Sullom Voe. It is designated for its costal lagoon and reefs.

Environmentally Sensitive Areas (ESA) – the ESA aims to conserve specially designated areas of the countryside where the landscape, wildlife or historic interest is of particular importance and where these environmental features can be affected by farming operations. The whole area within the LEP area and surrounding are covered by this designation.

Shell Fish Growing Areas and Shellfish Water Protected Areas - The Shellfish Waters Directive (2006/113/EC) ('SWD') was introduced to protect designated waters from pollution in order to support shellfish life and growth. There is a designation that covers Busta Voe to the south of the LEP area.

Figure B.5 Brae Environmental Designations

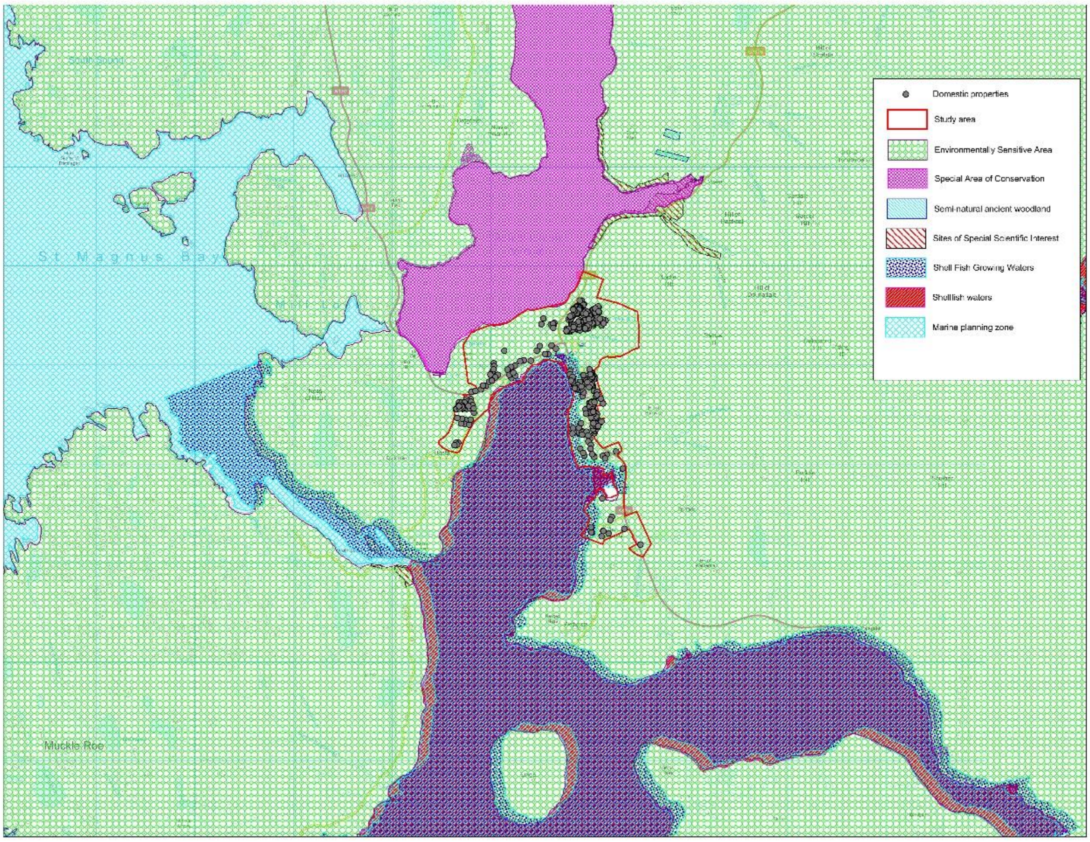
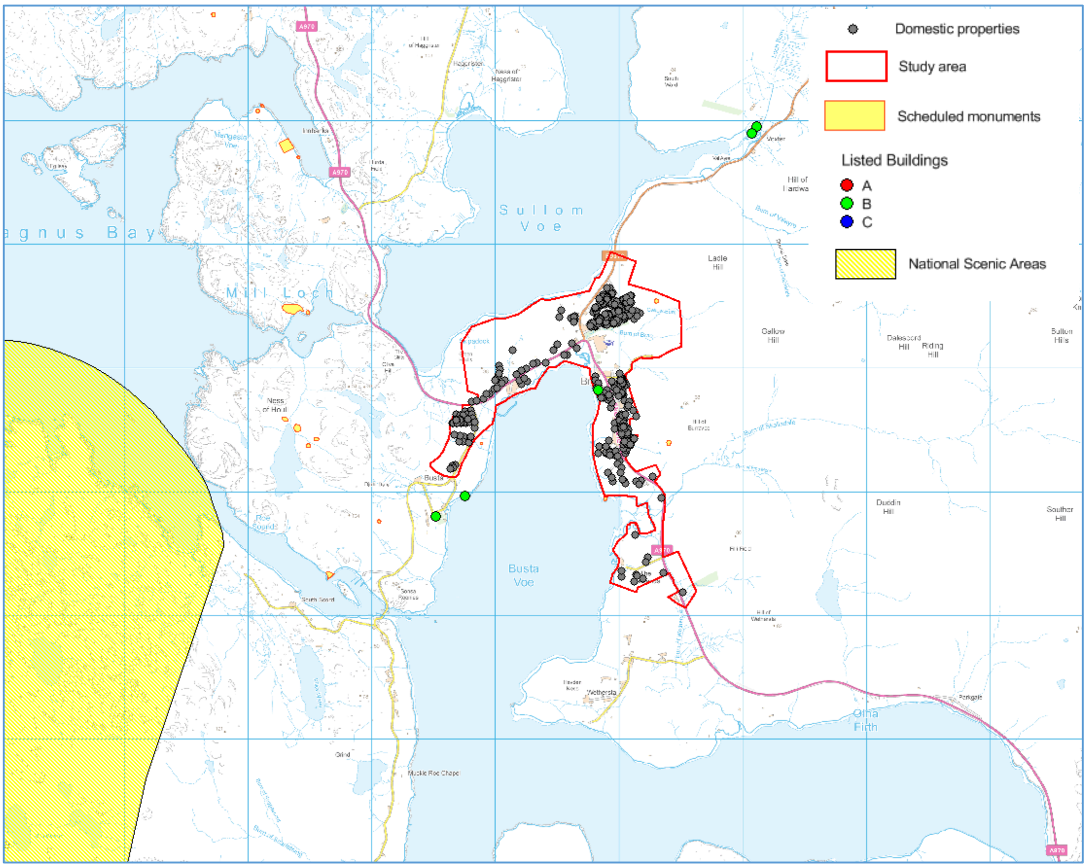


Figure B.6 Brae Cultural Heritage Designations



Scheduled Monuments – There are 15 scheduled monuments within 3 km of the LEP area.

- Culsetter, house 100 m WSW of
- Burravoe, chambered cairn & cairn 470m NE of, Brae
- Burravoe, broch on NW promontory, Brae
- Houll, house 90 m SW of Roe Sound
- Skeo of Gossaford, cairn 400 m W of Busta
- Culsetter, chambered cairn 180 m SSW of
- Busta, standing stone 100 m E of Staneside
- Islesburgh, prehistoric houses 560 m and 685 m NNW of
- Isleburgh, chambered cairn 745 m SSW of
- Mangaster Voe, prehistoric house 610 m NW of Innbanks
- Mangaster Voe, prehistoric house 630 m NW of Innbanks
- Isleburgh, prehistoric house and enclosures 760 m SSW of
- Culsetter, prehistoric house 250 m W of
- Culsetter, prehistoric house 130 m S of
- Ladie Hill, cairn 325 m E of 1 Gossaford

Listed buildings – there are five category B listed buildings within 3 km of the LEP area:

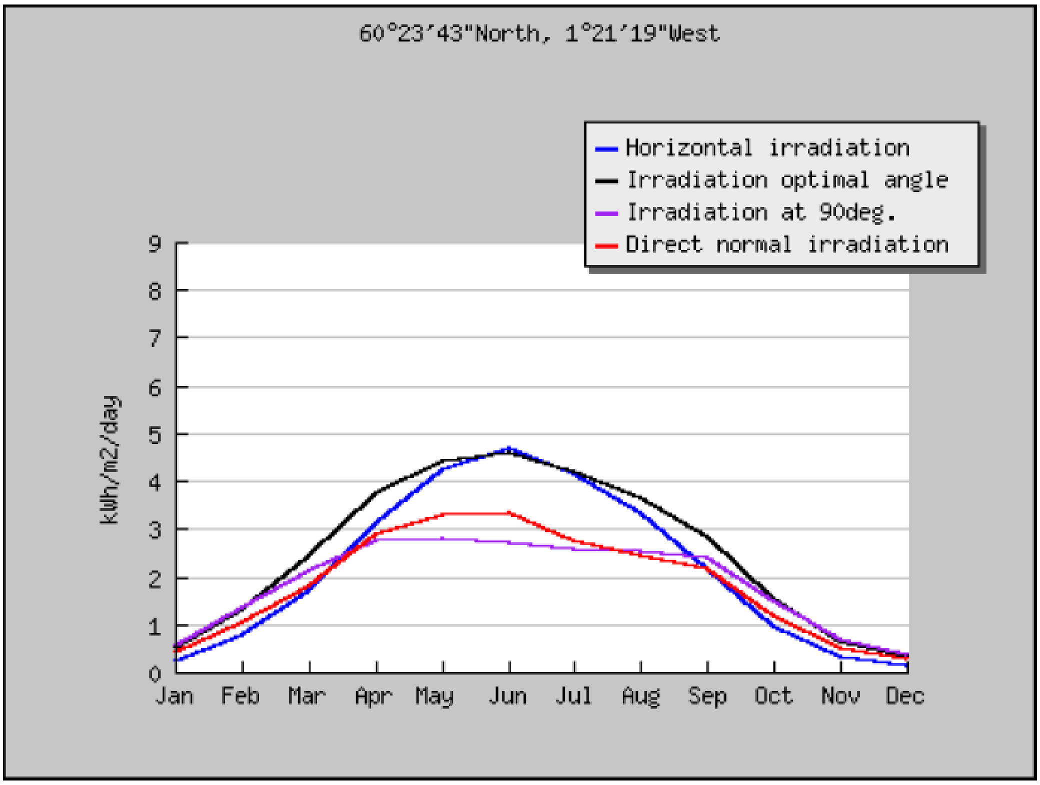
- Brae, Voxter House
- Brae, Voxter House & Walled Garden
- Brae, Busta House Hotel, Dovecot
- Brae, Brae House
- Brae, Busta House Hotel

National Scenic Area (NSA) - The designation's purpose is both to identify our finest scenery and to ensure its protection from inappropriate development. There is one NSA within 2 km of the LEP area. Additionally, there is a local Landscape Area that follows the coast north of the NSA.

B.2.3 Estimated solar resource

Shetland can have a solar irradiance of up to 737 W/m^2. The potential annual irradiation for the Brae LEP area is shown here. In terms of available resource, it is a lot lower than other parts of the UK.

Figure B.7 Estimated annual solar irradiation



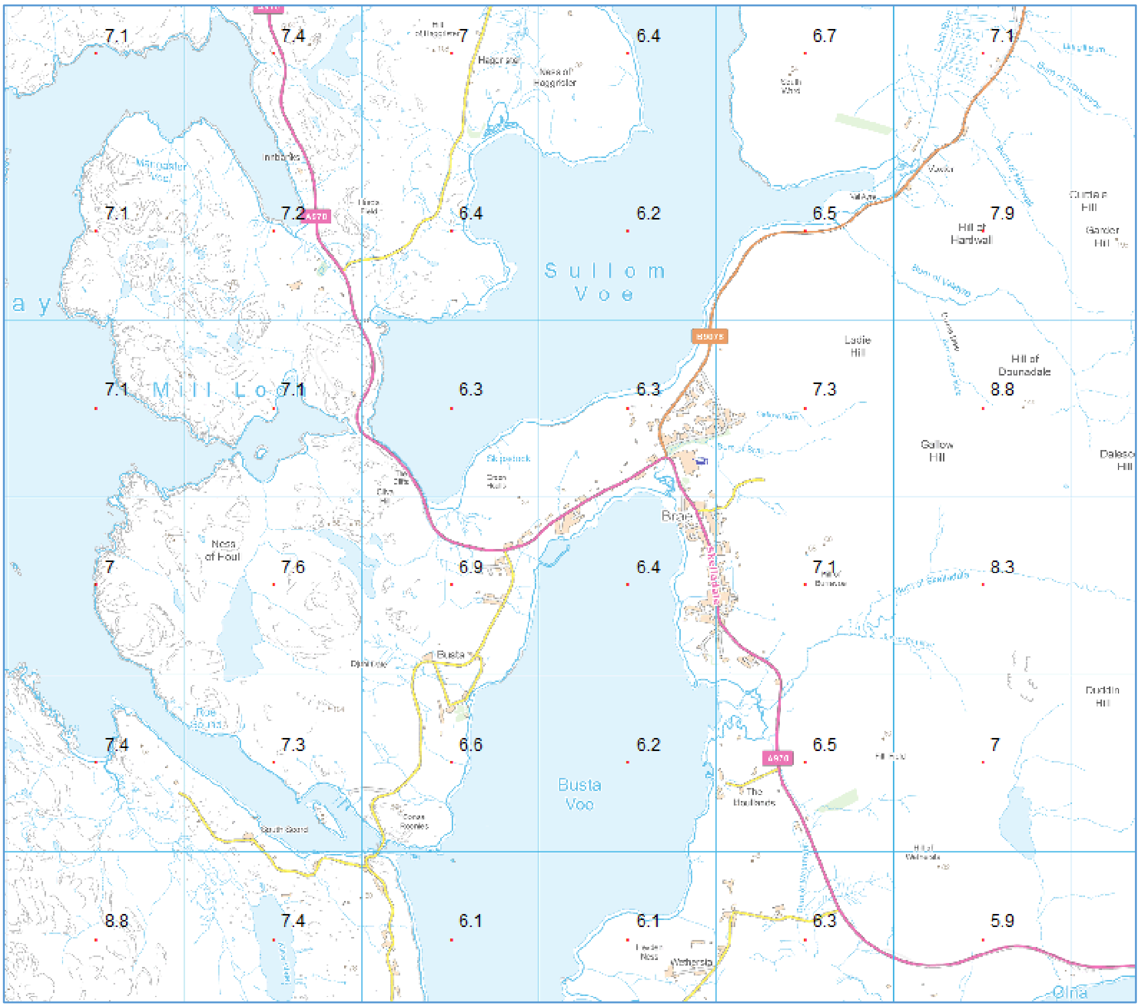
B.2.4 Estimated wind resource

The wind resource in the area is very good with an available average wind speed of around 7 m/s at 10 m a.g.l. However, due to a number of constraints the potential opportunities for medium to larger scale wind appear to be limited, see Figure B.9. Key considerations can be summarised as:

- There could be implications for radar (clutter on radar), and low flying aircraft (collision risk) as they come in to land at Scatsta;
- Landscape has rolling hills therefore air flows likely to be less turbulent.

This means that medium or large scale wind development is unlikely to be feasible in or near the LEP area. Smaller wind turbines, below 30 m to tip, are more likely to be suitable.

Figure B.8 NOABL[8] Wind Speed at 10 m above ground level



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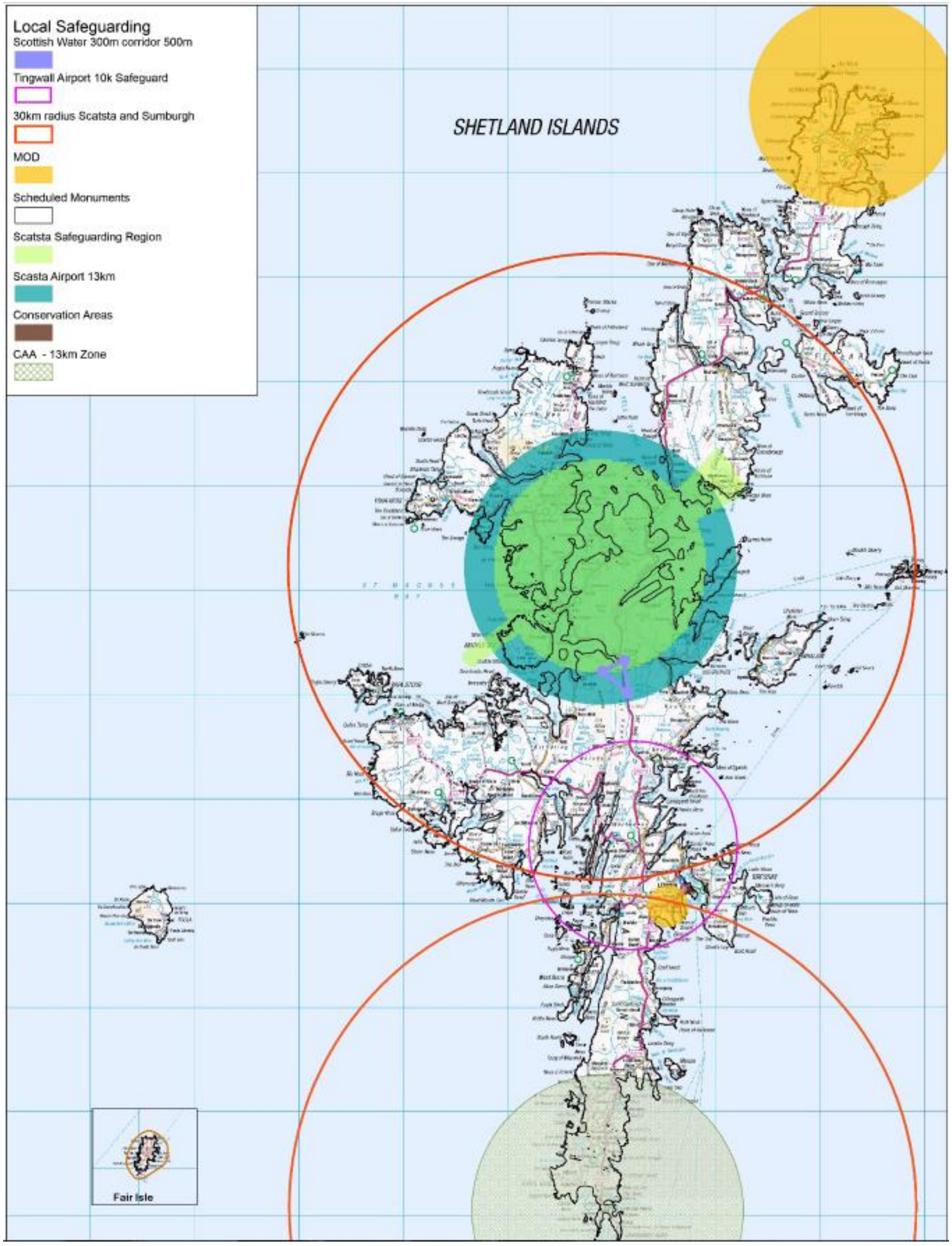
[8] Source: http://webarchive.nationalarchives.gov.uk/20121217154048/http://www.decc.gov.uk/en/content/cms/meeting_energy/wind/onshore/deploy_data/windsp_databas/windsp_databas.aspx

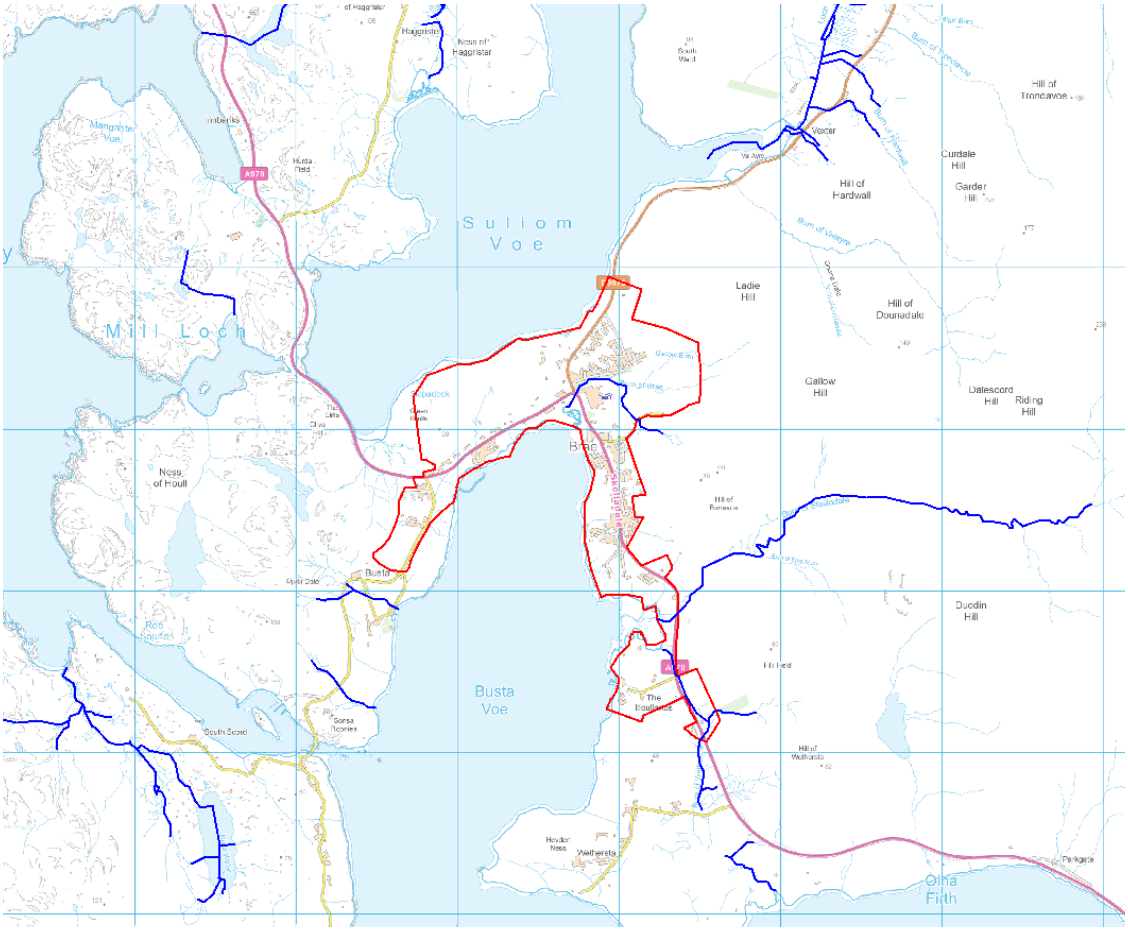
Figure B.9 Shetland Local Development Plan – Onshore Wind Local Safeguarding Map



B.2.5 Estimated hydro resource

There are a number of watercourses, burns and rivers close to Brae, as shown here.

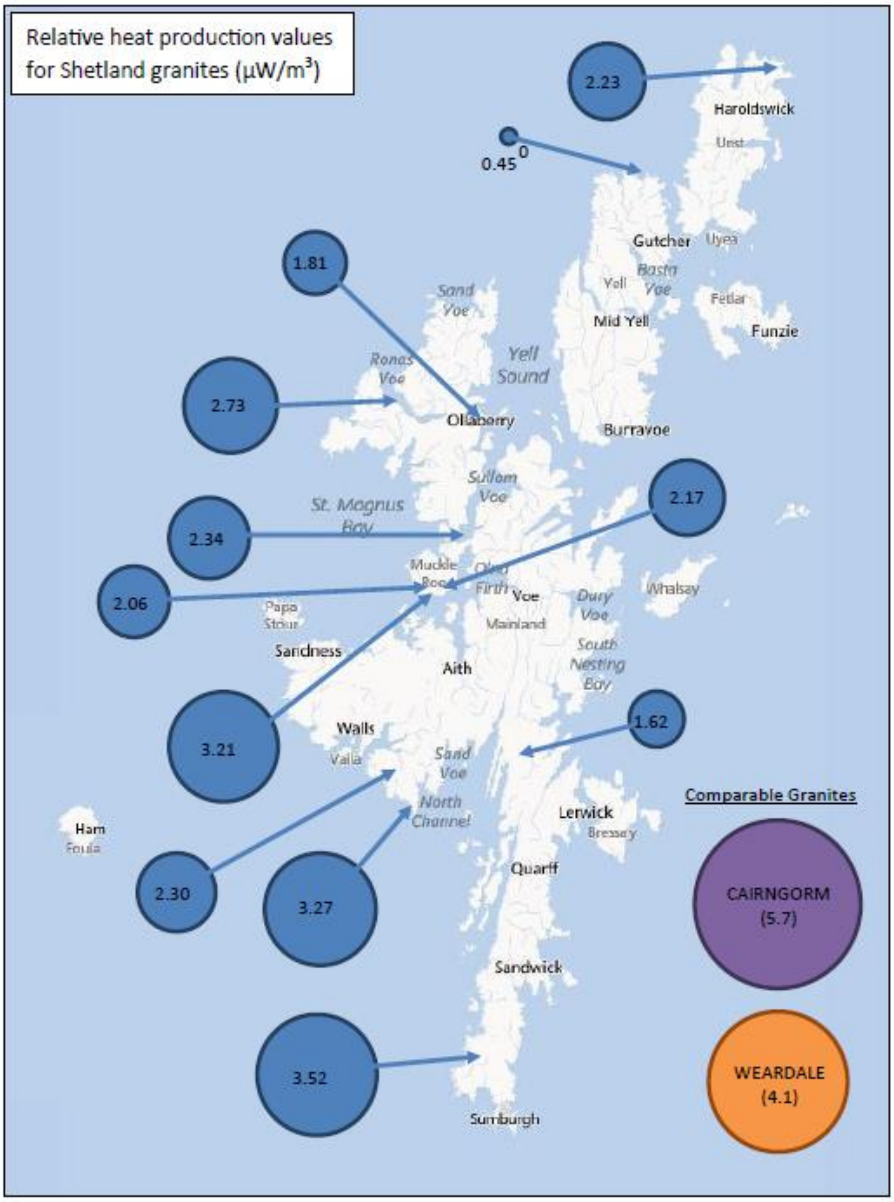
Figure B.10 Key Rivers and Burns within close proximity of Brae



B.2.6 Geothermal

A study into geothermal was undertaken in 2013 looking at the resource availability and location of geothermal within Shetland. Figure 18 indicates areas that were identified that had suitable geology with their correspondent relative level of heat production.

Figure B.11 Location of Shetland granitic intrusions with relative heat production[9]



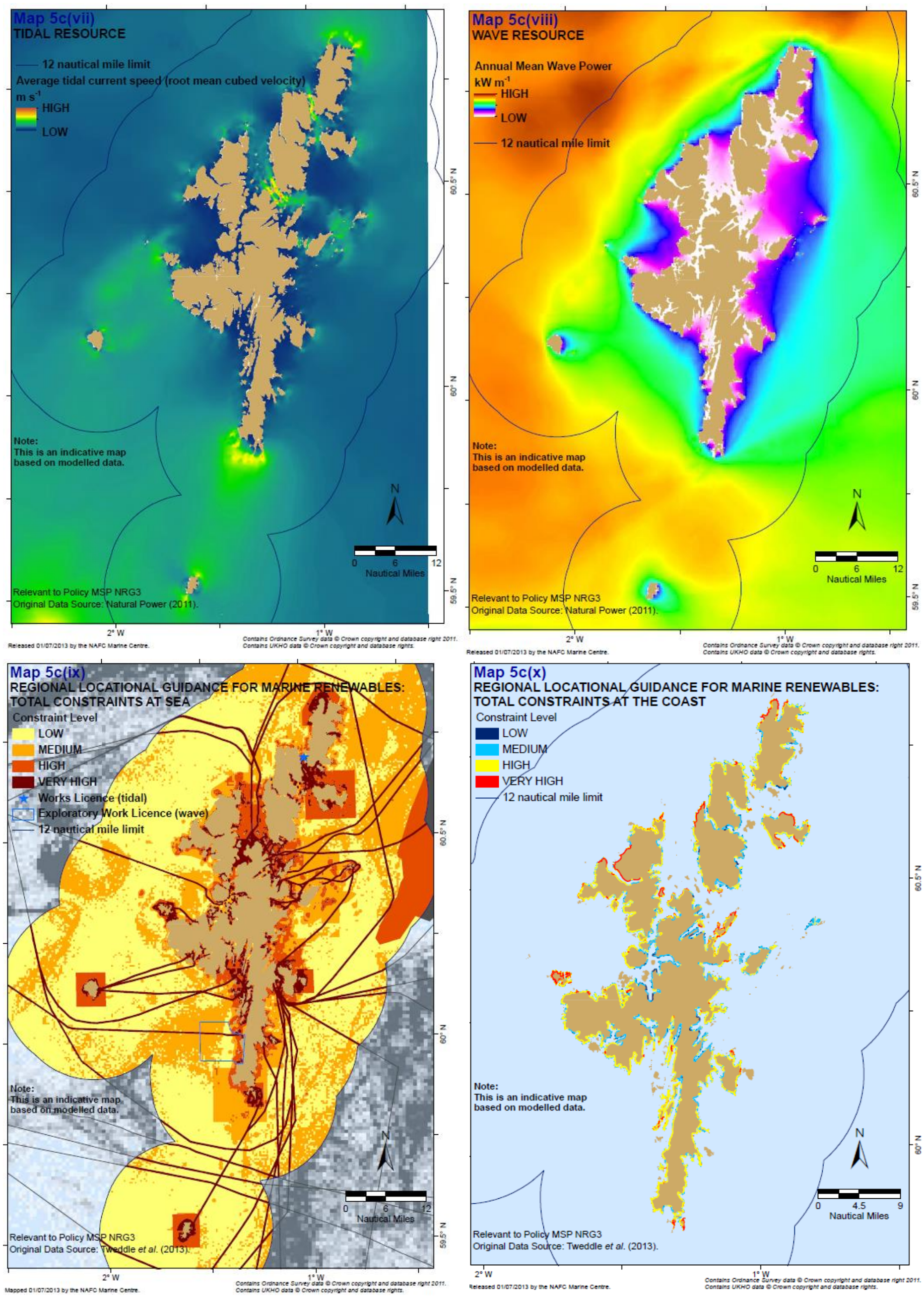
The study identified the Brae area as having potentially a commercially viable level of resource.

[9] Deep Geothermal Energy in the Shetland Isles, Cluff Geothermal Limited, September 2013

B.2.7 Marine Renewables Resource

Shetland Islands Council have produced supplementary guidance for their marine spatial plan that outlines the potential constraints and opportunities for marine renewable energy[10].

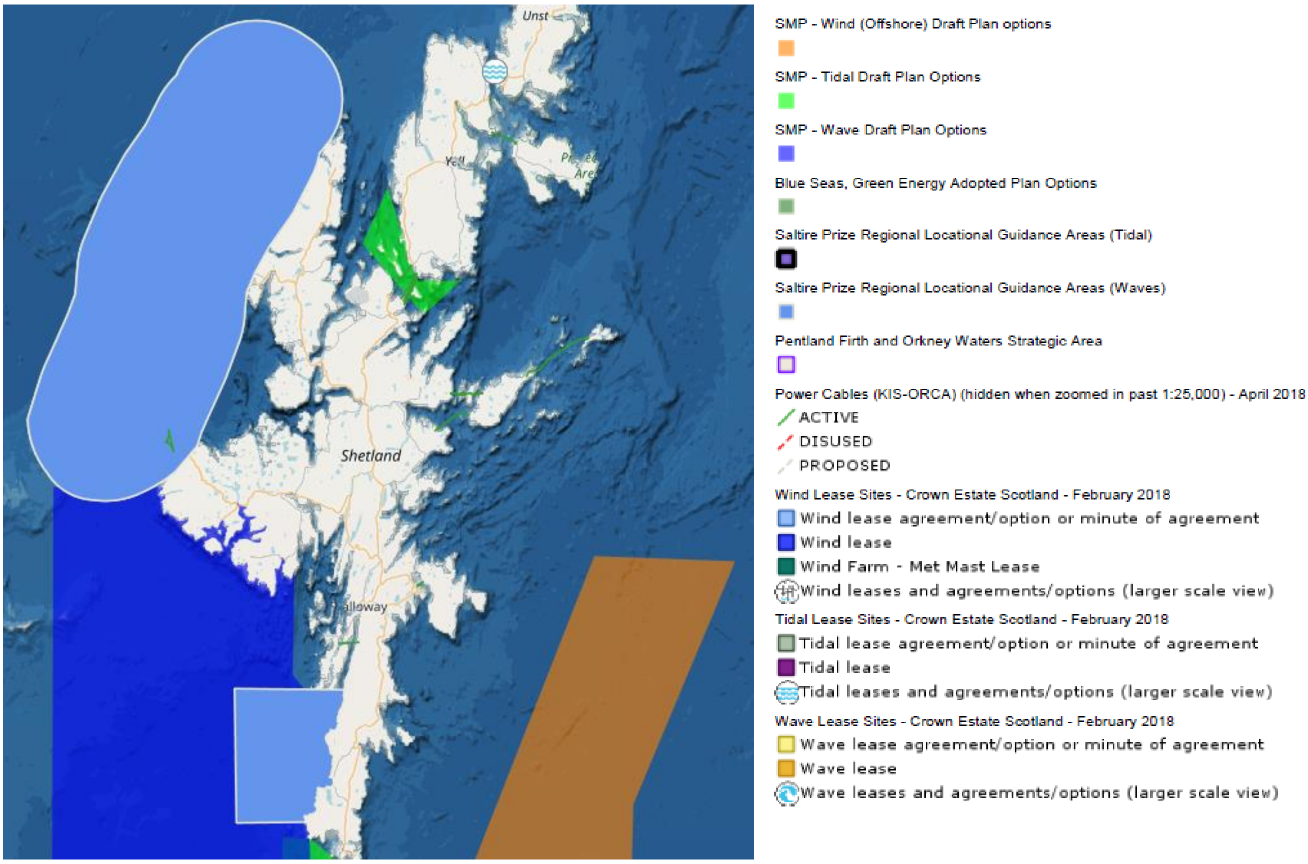
Figure B.12 Marine renewables opportunities across Shetland



A number of areas around the UK have been defined by the Crown Estate for their preferred locations for developments of offshore wind, wave and tidal energy generators. Figure B.14 shows the defined areas around Shetland.

[10] Source: http://www.nafc.uhi.ac.uk/research/marine-spatial-planning/shetland-islands-marine-spatial-plan-simsp/

Figure B.13 Map of Offshore Renewable Energy Locations and Lease Sites[11]



These constraints maps show that there are many opportunities around Shetland for the deployment of marine renewables. However, they do indicate that there may be areas of high constraint within the Brae vicinity.

Also, the wave and tidal resource appear to be relatively low based on these maps. However, as these are regional investigations a more local detailed study may indicate areas that may have some opportunity.

B.3 Options Appraisal

B.3.1 Scottish context

Scotland's Energy Strategy was published in December 2017[12]. It provides a route map that outlines the vision that the Scottish Government has of what our future energy systems and needs might look like from now out to 2050.

The overall vision is set out in the introduction to the document:

[11] Source: https://marinescotland.atkinsgeospatial.com/nmpi/
[12] http://www.gov.scot/Resource/0052/00529523.pdf

This vision is guided by three core principles:

A Whole-System Approach – Work to date has focused heavily on the production of electricity using low carbon sources and improvements to the efficiency with which we use our energy. The strategy recognises that these are important areas of action but need to be worked on alongside heat and transport. All of these elements influence each other in the energy systems that we need to create in future

An Inclusive Energy Transition – Changes to the whole energy system are driven by a need to decarbonise our energy use in line with targets set out within the Climate Change (Scotland) Act. While this will show Scotland's contribution to global action on climate change, this needs to be done in a manner that is fair to everyone. This means ensuring that inequality and poverty are addressed as well as promoting a fair and inclusive jobs market. Greater efficiency in energy use by businesses and householders offers the opportunity to reduce bills (and associated carbon emissions) leading to lower fuel poverty levels and enhanced competitiveness for business. As part of efforts to ensure that benefits from the low carbon energy transition are enjoyed by all, the Scottish Government intends to create a new energy company. This will be publicly owned and run on a not-for-profit basis.

A Smarter Local Energy Model – Local energy economies are at the core of the transformation of Scotland's Energy Systems. Local solutions for local energy needs, linking local generation and use, provide a platform for vibrant local rural and urban communities. Local Heat & Energy Efficiency Strategies (LHEES) will provide prospectus for local area in terms of investment in energy efficiency, district heating and other heat decarbonisation opportunities.

These in turn are built on six priorities:

Scotland's Energy Priorities		
Consumer engagement and protection We will work hard to protect consumers from excessive or avoidable costs, and promote the benefits of smarter domestic energy applications and systems	**Energy efficiency** We will continue to take direct and supporting actions to improve the use and management of energy in Scotland's homes, buildings, industrial processes and manufacturing	**System security and flexibility** Scotland should have the capacity, the connections, the flexibility and resilience necessary to maintain secure and reliable supplies of energy to all of our homes and businesses as our energy transition takes place.
Innovative local energy Systems We will empower our communities by supporting the development of innovative and integrated local energy systems and networks	**Renewable and low carbon Solutions** We will continue to champion and explore the potential of Scotland's huge renewable energy resource, and its ability to meet our local and national heat, transport and electricity needs – helping to achieve our ambitious emissions reduction targets	**Oil and gas industry strengths** We will support investment, innovation and diversification across our oil and gas sector, working with industry to advance key priorities such as maximising the recovery of remaining resources, subsea engineering, decommissioning and carbon capture and storage – collaboratively addressing the challenges of today and preparing the sector and its workforce for a positive role in Scotland's future energy system

In Scotland at present 51% of the energy we consume is used to heat homes and businesses; around 79% of homes use natural gas as their heating fuel. Transport energy use accounts for another 25%, predominantly via road vehicles. The final 24% is electricity use. While just over 75% of electricity generation in Scotland came from low/zero carbon sources in 2015, there is work needed in the areas of heat and transport in order to deliver sufficient carbon emissions reduction to meet Scotland's climate change targets.

There is no single vision for the long term changes we will see in the generation, supply and use of electricity, heat and transport systems.

There is potential for greater use of electricity in heating homes and businesses as well as powering electric vehicles. However, this also requires changes to the way in which we manage demand for electricity and the control systems we use to match supply and demand.

In an electricity led world:

- Heat pumps and smart storage heaters are used to heat homes and businesses
- Demand management and smart meters enable an efficient electricity supply network
- Cars and vans are electrically powered and a national network of public charging points operate alongside those in our homes
- HGVs and ferries are operated using hydrogen fuel (or as electric/hydrogen hybrids)
- There is limited use of bioenergy and natural gas by businesses
- UK wide management of electricity transmission networks includes interconnectors with Europe and a smart grid approach is required to manage the demands in distribution

An alternative approach is to use greater amounts of low carbon gas – sources can include biogas (from anaerobic digestion) and hydrogen (potentially produced from electrolysis or via steam methane reforming in combination with carbon capture storage).

In a hydrogen led world:

- Hydrogen boilers and fuel cells replace natural gas and fossil fuel boilers in heating within homes
- Hydrogen fuel and fuel cell technology is used in cars, vans, and larger vehicles. Fuel cells have helped shift freight from road to rail and ferries are also predominantly hydrogen fuelled
- Hydrogen replaces natural gas in commercial use and off grid businesses use heat pumps and district heating systems
- Gas demand is met from a variety of sources; this includes import of natural gas from Europe and globally
- Carbon capture storage is used at large industrial facilities

In reality it is likely that elements of both these scenarios will be implemented depending upon local needs. What these scenarios show is that there will be significant change in the way our energy systems work and extensive investment required to enable these changes.

An important aspect of these changes is the role of local energy solutions, as the increase in low/zero carbon energy generation means more distribution of generation away from traditional large scale power stations. The benefits of local solutions, particularly in areas where access to national infrastructure is limited, can be multiple in terms of consumers and local economies.

Local Heat and Energy Efficiency Strategies (LHEES) will be a mandatory requirement of local authorities. Led by local authorities, working with communities, these will set out long term priorities (15 – 20 years) within an area in terms of energy efficiency, decarbonisation of heat and district heating opportunities.

Communities will be empowered wherever possible to develop and commission local energy system plans where they are the full or part owners of the final scheme. Local projects will seek, as far as possible, to use existing energy infrastructure before seeking new transmission or distribution requirements. This aims to make best use of available investment and ultimately maintain affordable energy costs for end users.

At the heart of this process is the 'whole system' approach and inclusivity:

- Systems designed and developed in line with local need;
- Active, energy efficient consumers (both residential and non-residential);
- Lower annual energy bills; and
- Opportunities for local supply chains and investment in local businesses.

Support for local energy systems will continue via Scottish Government investment streams such as Community and Renewable Energy Scotland (CARES), the Low Carbon Infrastructure Transition Programme (LCITP) and the Energy Investment Fund (EIF).

Community-owned renewables projects generate income, which communities can reinvest. This has the potential to create jobs, deliver local services and increase population as a result. Increasing the level of shared ownership of energy projects can play a big role in this process.

In summary, the Scottish Government sees local energy solutions as a vital element of the wider transition taking place across Scotland in the way our energy systems operate. Encouraging a greater sense of ownership and control among all communities is seen as beneficial, not only in terms of security of supply but also in realising the wider benefits of sustainable, affordable energy among homes and businesses.

B.3.2 Local context

This section of the Local Energy Plan provides an overview of the relevant local planning policy and guidance and provides a local level context in terms of any known changes to energy and transport networks.

B.3.2.1 Local Planning Policy and Guidance

Development Plan

The Development Plan for Brae, is the Shetland Local Development Plan, adopted in 2014. The Shetland Local Development Plan sets out the land use strategy for a period of 20 years. Work on the next Local Development Plan has already commenced. The Vision for Shetland as agreed by the Shetland Resolution in 2004 is:

"Work together for a future that is better and brighter. In particular, we aim to create a secure livelihood, look after our stunning environment and care well for our people and our culture."

Adopted Supplementary Guidance Documents

Adopted Supplementary Guidance documents also form part of the Development Plan and are required to be considered in the assessment of development proposals.

Onshore Wind Energy Supplementary Guidance

The Onshore Wind Energy Supplementary Guidance categorises wind energy development into the following:

- Very Large – 50 MW or more.
- Large

  - 8 or more turbines and/or
  - Turbines larger than 50 metres to hub and/or 80 metres to tip and/or
  - Total capacity between 20MW and 50MW
- Medium
  - 4 to 7 turbines with a hub height of 50 metres or less and/or
  - Total capacity over 5MW and up to 20MW
- Small
  - Up to three turbines with hub height 15 to 50 metres or less and/or
  - Total capacity greater than 50kW and up to 5 MW
- Micro Generation
  - up to three turbines with hub height 15 metres or less, rotor diameter 10.5 metres or less and total capacity of 50kW or less.

In accordance with Scottish Planning Policy, The Onshore Wind Energy Supplementary Guidance outlines the following:

- Group 1: Areas where wind farms will not be acceptable which are within National Parks and National Scenic Areas. Map 1 of the Supplementary Guidance identifies the National Scenic Area designation for Shetland.
- Group 2: Areas of significant protection – These are areas which have a recognised sensitivity to large scale wind energy developments and are therefore given significant protection due to their national or international heritage value. Wind developments may be permitted in Areas of Significant Protection where it can be demonstrated that any significant effects on these areas can be substantially overcome. Wind developments proposed in these areas must show they can meet the development criteria outlined in the Supplementary Guidance. Map 2 identifies the Areas of significant protection.
- Group 3: Areas outwith groups 1 and 2 – These are areas which are considered to be capable, in principle, of supporting large scale wind energy developments within Shetland. These areas are shown on Map 3.

B.3.2.2 Other Applicable Documents

This section provides an overview of other applicable local policy and guidance in relation to energy and transport.

Shetland Place Standard

The Shetland Islands Council undertook a public consultation exercise between June and July 2016 which gave the public an opportunity to assess the place they live against 14 different themes. 939 people responded and made 4,840 individual comments. In terms of the North Mainland locality, which included Delting, Nesting and Lunnasting and Northmavine 12% of the population responded. The Final Report was published in March 2017. The top three priorities for the North Mainland were Public Transport, Housing & Community and Work & Local Economy. The Final Report summaries the key points that were raised during the public consultation period. The ones most relevant to the draft Local Energy Plan are detailed here:

- Some concerns regarding the availability and condition of social housing Enforcement of Allocation Policy and tenancy conditions.
- The good facilities in the area are underused and would be used more if transport links were improved.
- High cost of external transport.

- Transport is essential to access local amenities and a marked difference in bus provision depending on where you live in Shetland.
- Speed of traffic is a concerns and pavements/roadside verges need improved.

A Community Forum was held in November 2016 which raised key issues and the ones relevant to the draft Local Energy Plan are detailed below:

- Bus timetables should be considered to reduce the number of empty buses around.
- Transport issues considered more prevalent in the north mainland than in other areas due to reliance and lack of other options and costs involved.
- Potential economic opportunities need to be considered.

It is understood the findings will be used to inform key policies and strategies which will include:

- Local Outcomes Improvement Plan
- Local Development Plan
- Shetland Local Housing Strategy
- Shetland Transport Strategy
- Shetland Islands Health and Social Care Partnership: Joint Strategic Commission Plan

Some of the issues raised are also relevant to the Local Energy Plan including housing improvement and transport.

Fuel Affordability Report 2015/16

Shetland Islands Council distributed a Domestic Fuel Affordability Survey to all Shetland homes (10,800) in November 2015 and 2425 were sent back. The Fuel Affordability Report details the findings of the survey. The survey results outlined that the fuel poverty in Shetland in 2015/16 was 53% which is an increase of 10% since 2010. The fuel poverty level for the North Mainland which includes Brae was 58%.

The survey results demonstrated that:

- 30% of households do not feel their home is adequately heated
- The highest fuel poverty levels were in social rented homes
- Respondents living in homes heated by electric boiler/panel heaters or electric storage heaters have the highest levels of fuel poverty. Of those not adequately heating their home, most had electric storage heaters (60%).
- The highest fuel poverty was found to be in older, solid wall constructed properties.
- Properties with low insulation levels showed the highest fuel poverty.
- Single person households living in their own homes, over the age of 65 were most likely to be in fuel poverty.
- Scottish Hydro (SSE) was the energy supplier for 93% of respondents.

B.3.3 High level technology review

There a number of technologies that could be considered for use within the Brae area. The following section provides a brief overview of the major technologies that could be considered and some details regarding how they work and an overall suitability rating in the context of energy needs in Brae.

A simple Red/Amber/Green qualitative scoring system is used. Red means that the technology is not well suited to Brae’s needs; Green means that it is well suited to Brae’s needs.

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
Gas Fired Combined Heat and Power	A gas fired gas turbine (engine) where electricity is generated and heat is recovered for use from engine cooling systems and exhaust.	Output is available at all times.	CHP and other LZC technologies have to complement rather than clash.	Not eligible for RHI or FiT Unlikely to attract grant Good quality CHP can lead to reduction in Climate Change Levy paid on gas via CHPQA scheme.	Low risk – Gas Fired CHP is a mature technology, well understood and reliable when maintained.	No mains gas supply, and no other local sources of gas (e.g. landfill gas) nearby so not a viable option. Many providers of technology mean that it is competitively priced. Maintenance contracts are typically carried out under contract by the supplier.	Expect ROI to range from 10-15% with a payback of 6-8 years.	**LOW**
Wind	The wind blows and rotates the blades of the wind turbine which then transforms the kinetic power of the wind into electricity.	Wind is an intermittent source of energy and output can vary from full rated output of the turbines to zero.	A wind turbine will require a backup via grid or energy storage system to meet the demand. However, a wind turbine can be coupled with other systems (which are not wind dependent) to	Unlikely to receive any grant funding or incentives via FiT or CFD	Wind energy is a mature renewable energy system but the numerous planning issues make it a medium to high risk technology for development. Large scale development	Well established technology with range of turbines to suit client requirements. Many providers of technology mean that it is competitively priced. Maintenance contracts are	Average project cost for a turbine ranges between £1,000 to £6,000 per kW installed depending on the scale. ROI can range from 5% to 10% depending on funding mechanisms.	**HIGH**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
			cover the user needs e.g. solar PV.		constrained by grid capacity. Smaller domestic scale turbines viable.	typically carried out under contract by the manufacturer.		
Solar PV	Solar Photovoltaic (PV) technology works on the principle that energy from the sun is converted to electricity.	Hours of daylight only without storage with reduced output over winter	Building specific or would need to be considered part of overall baseload of electricity supply technologies to avoid grid export and increase ROI.	Feed in Tariff available at a rate per kWh produced depending on the size of the installation (up to 5 MW). Note that this will not be available from April 2019.	Solar PV technology is well established and would be considered as relatively low risk. Relatively low solar resource in comparison to other regions of UK	Supply chain and after sales are well established with competitive market space.	Typical cost is £1,000 per installed kWp. Typical ROI is less than 8% with simple paybacks over ten years.	**MEDIUM**
Solar Thermal	Solar thermal systems absorb and use the sun radiation to heat up water or other mediums. This thermal energy can then be used to provide hot water, contribute to the heating (solar heating) or cooling (solar cooling) of a building or even generate electric power (Concentrated Solar Thermal).	Output is available during the hours of daylight only although it can be stored. Typically best installed at close to the point of use.	It is typical for a solar thermal installation to operate in conjunction with a conventional means of raising thermal energy such as a gas boiler. Solar thermal can also be combined with other	It is possible that solar thermal will be removed from the list of eligible technologies that qualify for RHI support. Unlikely to attract any grant funding. Enhanced capital allowances can be	Solar thermal technology is mature and would be considered as relatively low risk.	There are many providers of technology which means that it is competitively priced. Maintenance contracts can be placed with either equipment suppliers or	The technology would displace around 500 kWh of heating per m^2 per annum worth around £10 per annum without RHI. A 100 m^2 system would cost around £70,000 and would save around £1,000 per annum without RHI. It cannot be considered an attractive	**LOW**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
			renewable energy systems. i.e. Heat pumps for COP improvement.	claimed for eligible products.		specialist contractors.	investment with an ROI of less than 2%. RHI is available for systems below 200 kWth and this would improve ROI to 6% to 8%. RHI eligibility is periodically reviewed.	
Fuel Cells	A fuel cell is a device that converts the chemical energy from a fuel into electricity due to a chemical reaction (no combustion).	Available at all times as long as there is fuel. Due to the cost of the installation, the use of the fuel cells will have to be maximised to justify this type of investment. A significant potential issue is that the nature of the process means that there would be little use for the lower grade heat that is available from a fuel cell installation.	Potential to be combined with CHP systems and other renewable technologies. Potential key role in enabling use of hydrogen as source of electricity production and in operating ULEV vehicles.	Large fuel cells do not currently attract FiT or RHI. It is possible that the innovative use of the technology could attract grant funding.	Technology does not have extensive track record in the UK and would carry a medium to high risk. Most likely to be used in transport rather than as a stationary source of heat and power.	Emerging technology with and aftersales support would be subject to a maintenance contract with the supplier.	Use in a combined heat and power configuration has significantly higher costs per kW than conventional CHP and would have an ROI of ~ 8% (less if lower grade heat cannot be recovered).	**MEDIUM**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
Energy from Waste – Gasifier or Anaerobic Digestion	Energy from waste systems convert the fuel source into useable energy. This can include electricity, heat and transport fuel. Waste streams are typically converted into energy by combustion, gasification or anaerobic digestion.	Available at all times as long as there is fuel (waste). Backup system required during maintenance periods.	Energy from waste systems would require sizing so as not to clash with other LZC technologies. For example, if a biomass direct firing system has been sized for heat baseload, an energy from waste system would need to ensure that heat is not rejected to atmosphere.	Depending on the system, Feed in Tariff could be available for electricity generated and RHI for heat.	Relatively mature technology with a number of potential planning issues which make it a technology involving moderate risks. Main issue is delivery of feedstock. Given no immediate waste collection sources and competition from the existing Energy Recovery Plant in Lerwick there would not be enough feedstock to make this a viable option.	Well established technology which remains relatively expensive.	The costs of AD systems will depend on whether the system is heat only or combined heat power. The scale of the installation will also be a factor. Costs for a heat only system range from £1,500 to £2,000 per kW thermal output. On £ per kWe basis, AD CHP systems range from £2,500 to £5,000 per kW electrical output. ROI will depend on a number of factors including capital costs, financial incentives, value of waste streams and how much energy could be used on site. Typical ROIs can range from 8% to 12% with simple paybacks ranging from 8-10 years.	**LOW**
Energy Storage	Energy storage systems are devices which capture the energy produced, usually	Energy is available on demand as long as the battery is charged. An example	Battery type energy storage systems can easily be integrated	Energy storage does not qualify for FiT or RHI but could	The technology is still developing. Commercial	There is only a limited number of commercially viable	Battery energy storage systems are a relatively new product for the commercial market.	

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
	using a renewable source, to use it at a later time. Energy storage systems can be used to assure an efficient use of the electricity produced by renewable systems such as wind and solar PV which are not always available to meet the user demand.	could be that wind turbine electricity is used to charge a battery during periods when wind generation occurs. The system would then supply a site during periods of higher electricity charges. The system could also mitigate the electricity supply outages and disruptions that may occur.	with renewable and non-renewable electricity production systems.	potentially attract grant funding as part of an innovative installation.	applications and risks are relatively high. There is limited evidence base of operational systems that have been installed for an extended period of time.	electricity storage systems but ongoing maintenance is understood to be minimal. Difficult to develop revenue stream given isolation from UK grid balancing mechanisms	Whilst costs are expected to fall as the manufacturing base increases, current costs range from £750 to £2,000 per installed kWh of storage capacity depending on scale. A domestic battery system linked to a Solar PV array in Brae might provide an ROI of 2% to 5% and typically an 8-10 year simple payback. This relies on use of electricity to displace grid demand at peak prices.	**MEDIUM**
Biomass Boiler	Biomass systems generate energy using biological material. There are a number of different types of energy conversion methods such as biomass direct firing.	Output is typically available at all times as long as there is fuel. Biomass is also typically sized not to be the sole means of energy generation so backup systems such as gas fired boilers/burners will be required to cover	An additional capacity direct fired biomass system would require sizing so as not to clash with other LZC technologies. For example, if a gas turbine CHP has been sized for electrical baseload,	RHI eligible.	Biomass direct firing is considered to be low risk. Technology is well established. Expensive system to retrofit for	Many providers of technology mean that a scheme can be competitively tendered. Maintenance contracts can be carried out under contract by the supplier. It is essential that	Project economics will be sensitive to: 1. sourcing biomass fuel at a competitive price. 2. Access to RHI for the new installation	**MEDIUM**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
		energy demands during maintenance periods and in the case of an interruption to biomass fuel supplies.	it is imperative that the exhaust heat can be used within the process. This means that the scope for increased direct firing capacity would need to be considered in the context of any other LZC technologies selected for further analysis.		electrically heated homes given requirement for new hot water supply pipework. Could work well for new development	maintenance is carried out in accordance with manufacturer's guidance. Fuel supply will be imported from off the island.	ROI would be expected to be 8% to 10%.	
Biomass CHP	This technology is based on the combustion of biomass to create steam. The steam is then supplied to a steam turbine generator. This generates electricity which is typically used on site to reduce the import of grid electricity. This would typically be a back pressure steam turbine so that exhaust steam can be used with a process.	Output is typically available at all times as long as there is fuel. Biomass CHP is also typically sized not to be the sole means of energy generation so backup systems such as grid electricity will be required to cover energy demands during maintenance periods and unplanned outages.	A biomass CHP system would require sizing so as not to clash with other LZC technologies. For example, if a biomass CHP has been sized for electrical baseload, then it may limit the opportunity for installing additional electricity generation such as wind turbines or	RHI eligible - There is a dedicated Biomass CHP tariff. This applies to qualifying heat produced from the turbine and used within a process rather than condensed.	There are few examples of biomass CHP systems and this technology would be considered medium risk. For maximum efficiency this would need to be several MW in size. This would make use of the heat output difficult to match with Brae residents' needs.	Many providers of technology mean that a scheme can be competitively tendered. It may be logical to procure on a turnkey basis for the two main elements of the project; the biomass boiler and the steam turbine. Maintenance contracts can be carried out under contract by the	The nature of this LZC technology means that reference pricing is more difficult than other technologies such as wind and solar PV. 5 MWe biomass CHP package with grate boiler and steam turbine is likely to cost £15M to £20M dependent on technology used. Project economics will be sensitive to:	**LOW**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
			solar PV. This means that the scope for biomass CHP would need to be considered in the context of any other LZC technologies selected for further analysis.		The electrical output would likely be constrained by local grid capacity	suppliers of boiler and turbine. It is essential that day to day maintenance is carried out in accordance with manufacturer's guidance. Fuel would need to be imported on to the island.	1. Being able to source biomass fuel at a competitive price 2. Access to Contract for Difference for electrical output The ROI could be 3% to 6%. However, these figures should be treated with caution given the uncertainties detailed above and that further investigation is required.	
Heat Pumps	A heat pump is a device which transfers energy from a source to another via a refrigerant. Heat pumps can be used in cooling or heating mode depending on the requirements. Heat pumps can use heat sources from air land or water (including the sea).	Output is available at all times only the efficiency (COP) of the heat pump will vary depending on the source temperatures.	It would be unusual for a large heat pump to operate in conjunction with a CHP or biomass heat scheme given that both depend on a heat sink to operate efficiently. The heat pump compressor can be run with a renewable electricity production system	RHI range per kWh generated depending on the type of heat pump (air, water, ground source) with no limit in capacity. Very unlikely that a heat pump based heating system would be considered innovative so unlikely to qualify for any grant funding.	Heat pumps are a mature technology with relatively low risk. There are some risks in sizing which can be mitigated by using reputable suppliers. Ground or air source heat pumps may offer opportunity to use in serving	Many providers of technology mean that it is competitively priced. Maintenance contracts are typically carried out by a specialist refrigeration contractor.	Costs increase significantly with ground and water source systems due to the need for civils. Typical costs for larger systems are in the region of £500 per kW heat output so a 1MW heat output system would be £500k compared a 1 MW heating gas boiler at £30k. With RHI and typical energy prices, the ROI	**MEDIUM (although at small scale)**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
			to cover its electricity needs.		needs of a small number of dwellings via a communal system. Not well suited to properties with low fabric insulation given lower heat output		would be expected to be 8% to 10% and is very much dependent on RHI income. Simple payback is likely to be more than ten years.	
Geothermal Energy	Geothermal energy is a thermal energy derived from the heat generated and stored in the earth. Geothermal energy systems harness the heat from the earth to produce heat and or electricity. Installations typically have a heat pump as a means of energy transfer.	Available at all times when installed at a location that is suitable.	Consideration would have to be given to ensure that output energy does not clash with other LZC technologies such as heat pumps, CHP or biomass	RHI available for deep geothermal.	Still considered as an emerging technology in the UK and would be considered as high risk. Viability would be extremely sensitive to local geology and system design. Initial pre-feasibility study suggests potential resource within Brae. Difficult to retrofit for electrically heated dwellings given	The geothermal energy industry is not well established and there are few companies supplying this technology. The same can be said of after sales support although many of the components are similar to what would be used in a large heat pump scheme.	The developing nature of this technology in the UK means that it is not possible to provide estimated costs or ROI. Information from the Scottish Government would suggest that a cost of £1M to £2M per installed MW output has been achieved for some schemes overseas.	**MEDIUM**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
					need for hot water distribution pipework and larger heat emitters within the dwellings			
District Heating	District heating, also known as communal heating, is considered to be a secondary LZC technology in that it does not generate renewable energy but can provide a means of delivering both conventional and renewable heat energy to a group of end users.	Output is available at all times so long as there is a source of thermal energy supplying the system. In most DH schemes, the end user is supplied via a heat interface unit (HIU). The HIU normally features a heat exchanger and a heat meter for measuring energy supplied and to bill the end user.	Would need to be considered with other technologies. District heating could be supplied by a number of LZC technologies.	Would not currently attract FiT or RHI as DH is not in itself a renewable technology. May attract grant funding as part of a LZC scheme supplied by an innovative technology such a large scale heat pump.	Medium risk – Reasonably established technology with many successful commercial applications in Scotland although there have been examples of poor design that have led to the DH scheme being oversized and operating at a loss. Difficult to retrofit for electrically heated dwellings given need for hot water distribution pipework and larger heat	There are a number of companies who operate in the domestic district heating space, given favourable economics.	Costs of a DH scheme are difficult to estimate at this point due to the fluidity in relation to chosen generation technology and end users. ROI again depends on chosen generation technology and end users. But based on previous schemes, we would suggest that ROI is likely to be less than 5%. DH schemes normally work on a project lifecycle basis of 40 years.	**MEDIUM (small scale for new build)**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
					emitters within the dwellings			
Hydro	Run-of-river schemes rely on the difference in height (head) between the input and output to a turbine. The other key factor in the power output achievable is the water resource (flow rate) passing through the turbine. An alternative design uses a dam to create a reservoir of water with a regulated flow then run through a turbine to generate electricity. The reservoir is topped up by pumping water back up from the discharge point	Run-of-river schemes offer electricity output all year round. The output will vary with the flow rate of water.	Hydro schemes tend to be remote in location and so the energy output is typically not used alongside other LZC technologies	Hydro run-of-river schemes are presently eligible for FiT funding (at a scale below 5 MW). This will be removed in April 2019.	The technology is well established and there are a number of different turbine designs that can be selected based on head and flow conditions. There are a few burns in the area that may be suitable for a small hydro scheme. Larger schemes would be constrained by present grid capacity	There are multiple suppliers and design consultants operating in this area with experience of installing community scale projects	Capital costs for a run-of-river scheme are around £5,000 - £7,000 per kW of capacity. Lifecycle operating basis is 25 years. ROI typically in the range 3-8%	**MEDIUM**
Tidal	One device design is an underwater capture device (similar to a wind turbine). An alternative option is to use a barrage to capture tidal differences in order to generate electricity	Tidal schemes will generate electricity all year round. Output will vary with peak tides	Tidal schemes typically operate independently of other technologies	No direct eligibility for FiT or grant funding	There are a limited range of technologies in the market at early stages of maturity.	The supply chain is small	Schemes are typically several MW in scale and so costly to install. ROI is typically low	**LOW**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
					The scale of system is likely to be larger than the demand for electricity in Brae. This will be constrained by present grid capacity and make the scheme unviable			
Wave	Wave energy converting devices capture energy from waves and convert it into electricity	Electricity output from these devices is available all year round.	Generally little interaction with other technologies	No direct eligibility for FiT or grant funding	The technologies are not fully mature and there are limited options to select from. The scale of system is likely to be larger than the demand for electricity in Brae. This will be constrained by present grid capacity and make the scheme unviable	The supply chain is limited and typically bespoke for an individual project's needs	Wave energy schemes are costly to install and offer low ROI	**LOW**

Technology	Description	When is energy available?	Interaction with other technologies	Incentives Available	Technology maturity/risk	Supply chain maturity and after sales	High Level Costs and Typical ROI	Overall Technology suitability for Brae
Electrolyser	An electrolyser uses electricity to split water into hydrogen and oxygen gases. These gases can be sold to third parties. Hydrogen can be used as a vehicle fuel or storage fuel that can be converted back into electricity.	The electrolyser can operate at any point when it is supplied with electricity	Using renewable energy from devices such as wind turbines that are constrained by grid connections means that more locally generated energy can be stored as hydrogen and used either to generate electricity (using a fuel cell) or as a fuel for a boiler of vehicle	There are no incentive schemes for use of electrolysers	The technology is mature, though a number of more recent designs are emerging This would be most suited for use with a wind generator that is curtailed in order to maximise use of the energy generated. Would need market for output hydrogen.	The supply chain is limited	Prices range from £2,000 - £3,000 / kW of capacity.	**MEDIUM**

B.3.4 Review of local options

In thinking at a high level about the different options open to the community it is helpful to consider a number of impact factors as summarised here.

B.3.4.1 Impact Factors

In assessing the potential overall benefits of each option the following factors have been considered:

Electrical Grid Capacity – the influence of local grid network capacity on the viability of proposed supply schemes. Where large schemes are proposed these might need reinforcement works to be carried out in order to enable export of electricity into the wider grid network. For a smaller scheme it may not be possible to export all of the available energy from the system therefore reducing the value of this output to the local community.

Environmental designations – the influence that any proposed action might have in terms of designated areas such as Site of Special Scientific Interest (SSSI) and Special Areas of Conservation (SAC). This is both in terms of preventing use of land areas for energy development to avoid disturbing such sites and also landscape and visual impacts of any energy supply schemes.

Cultural heritage designations - the influence that any proposed action might have in terms of designations such as ancient monuments, burial grounds or archaeologically significant sites. This is both in terms of preventing use of land areas for energy development to avoid disturbing such sites and also landscape and visual impacts of any energy supply schemes.

Supply chain – The relative size of the supply chain for the technology and availability of relevant equipment. This includes consideration of whether required equipment is readily available at different scales or whether orders are bespoke to local requirements.

Technological maturity – Assessment of how well developed any technology is, and where there is risk associated with its operation. This includes how easily the technology could be used within the local area without need for significant modification.

Community ownership – The scope for community ownership and potential investment in the proposed solution.

Scale of development cost – Assessment of the relative scale of development costs involved in the proposed solution, capital cost requirements and initial view of investment return rates.

Lower energy costs – Estimate of impact on energy costs to end users

Local economic benefit – Assessment of potential local economic benefit. This is both in terms of whether any additional employment may arise from the proposed solution as well as additional benefit arising from the likes of lower fuel costs, enhanced community income via revenue generated from community owned assets

Carbon impacts – Estimate of impact of solutions in terms of net carbon emissions associated with energy supply and use.

Human health impacts – Any impacts of measures on local environment in terms of air quality and any other benefits from a change in energy supply or transport. This is predominantly focussed on reduced pollutants (e.g. particulates and oxides of nitrogen/sulphur from existing transport)

Increased mobility for vulnerable groups – Specifically for transport related projects, an assessment of whether the proposed solution will provide benefit for local mobility

Note:

Each impact factor is rated according to the following scale of impact:

Negative impacts, costs, constraints			No impact	Positive impacts, cost savings, revenues		
"-3"	"-2"	"-1"	"0"	"1"	"2"	"3"
high negative	medium negative	low negative	no impact/ neutral	low positive	medium positive	high positive

Each factor is also given a relative weighting in combining the scores. A summary of the scale of impact and relative weightings is provided here.

Table B.3 Summary of impact factors and relative weighting

Impact Factor	Negative impact	Positive impact	Weighting %
Electrical Grid Capacity	Grid capacity constraint limits or prevents full use of output electricity	Present grid capacity is enhanced by proposed scheme	10%
Environmental designations	Opportunity is limited or impossible to take forward due to impact on local environmental designations	Opportunity provides enhancement of local environment	10%
Cultural heritage designations	Opportunity is limited or impossible to take forward due to impact on cultural heritage designations	Opportunity provides indirect benefits to cultural heritage sites (e.g. sustainable power, alternative transport)	10%
Supply chain	Opportunity requires bespoke solution only available via a restricted number of suppliers/installers with a long lead time	Opportunity can be readily delivered via wide supply chain and installer base	3%
Technological maturity	Opportunity is an emerging technology with likelihood of high ongoing maintenance and insurance costs	Opportunity is well established with no significant difficulties to address in installation and well understood ongoing maintenance requirements	2%

Impact Factor	Negative impact	Positive impact	Weighting %
Community ownership	Opportunity is entirely reliant on a private developer and would not offer direct community benefit	Opportunity offers a number of routes where the community could be involved as a developer/owner and deliver ongoing benefit	10%
Scale of development costs	Opportunity requires large capital investment which is difficult to obtain	Opportunity is deliverable with a moderate capital requirement that may be met in part via funding/loan schemes	15%
Lower energy costs	Opportunity will not offer cheaper energy costs or potentially result in increased costs in order to achieve a cost-effective supply	Opportunity offers significant energy cost savings for end users	15%
Local economic benefit	Opportunity offers no additional local economic benefits	Opportunity offers additional local economic benefit in terms of lower fuel costs, enhanced community income, potential employment	5%
Carbon impacts	Opportunity offers no carbon reduction emissions benefit or potentially increases net emissions associated with energy use	Opportunity offers significant reduction in carbon emissions associated with energy use	10%
Human health impacts	Opportunity offers no benefit to local environment	Opportunity provides support for better health outcomes in terms of better heating in homes or improved air quality	5%
Increased mobility for vulnerable groups	Opportunity does not improve access to transport for the community	Opportunity offers more flexible transport that more closely meets needs of vulnerable groups	5%

The overall rating (combining the individual factors) then provides a HIGH/MEDIUM/LOW prioritisation score for taking forward the proposed theme. This is a combination of the weightings and the technology fit.

Evaluation Example

Measure 7 – Replace entry doors with modern equivalent

Electrical Grid Capacity – There is no impact from the local grid on this measure so the score in this category is 0

Environmental designations – There is no impact on this measure from local environmental designations so the score in this category is 0

Cultural heritage designations - There is no impact on this measure from cultural heritage designations so the score in this category is 0

Supply chain – The supply of entry doors is achievable via the local supply chain relying on sourcing from the wider Scottish market so the score in this category is 0

Technological maturity – Suitable door designs are available without extensive modification so this category score is +3

Community ownership – Door replacement will not be something that directly benefits a community trust or similar so the score in the category is 0

Scale of development costs – The costs of installing this programme to all relevant properties is very high and would require significant capital investment so the score in this category is -2

Lower energy costs – The benefit of the door replacement will mean reduced heating energy use and so a moderate reduction in associated heating energy bills so the score in this category is +1

Local economic benefit – There may be a small level of additional local employment associated with the replacement programme so the score in this category is +1

Carbon impacts – The improved insulation properties of the doors will reduce heating energy requirements and therefore offer a similar moderate scale of reduction in the related carbon emissions so the score in this category is +1

Human health impacts – Reduced heat losses from the property will offer a moderate improvement in the capacity to heat houses to a comfortable standard. It therefore offers a moderate potential to reduce under-heating of homes and associated issues of damp offering small positive health benefits. The category score is therefore +1

Increased mobility for vulnerable groups – The measure is not related to transport so does not have any impact in this area so the category score is 0

Table B.4 List of options and estimated scale of potential impacts

#	Measure	Electrical Grid Capacity	Environmental designations	Cultural heritage designations	Supply chain	Technological maturity	Community ownership	Scale of development cost	Lower energy costs	Local economic benefit	Carbon impacts	Human health impacts	Increased mobility for vulnerable groups	**Total Rating**
1	Replacement of incandescent lightbulbs with LED equivalent	0	0	0	1	3	0	1	1	1	1	0	0	HIGH
2	Loft insulation top-up	0	0	0	1	3	0	1	1	1	1	0	0	HIGH
3	High efficiency storage heaters	0	0	0	1	3	0	-1	2	1	2	1	0	HIGH
4	Replacement of existing oil boilers	0	0	0	1	3	0	-1	1	1	1	1	0	LOW
5	Hybrid wall insulation	0	0	0	1	3	0	-3	3	1	3	1	0	HIGH
6	Underfloor insulation works	0	0	0	1	3	0	-1	1	1	1	1	0	HIGH
7	Replace entry doors with modern equivalent	0	0	0	0	3	0	-2	1	1	1	1	0	LOW
8	Install A-rated windows (uPVC frames)	0	0	0	0	3	0	-2	2	1	2	1	0	MEDIUM
9	Installation of Solar PV	0	0	0	1	3	0	-1	2	1	2	1	0	HIGH
10	Solar thermal (roof mounted)	0	0	0	1	3	0	-2	1	0	1	1	0	LOW

#	Measure	Electrical Grid Capacity	Environmental designations	Cultural heritage designations	Supply chain	Technological maturity	Community ownership	Scale of development cost	Lower energy costs	Local economic benefit	Carbon impacts	Human health impacts	Increased mobility for vulnerable groups	**Total Rating**
11	Wind (small scale domestic)	0	-1	0	0	3	0	-1	2	1	2	1	0	HIGH
12	100 kW wind turbine	0	0	0	0	3	1	-1	2	1	2	0	0	HIGH
13	Ground source heat pump	0	0	0	1	3	1	-2	2	1	2	1	0	LOW
14	Air source heat pump	0	0	0	1	3	1	-1	2	1	2	1	0	MEDIUM
15	Wind turbine (4 MW)	-1	0	0	3	3	2	-2	2	2	3	1	0	MEDIUM
16	Solar array	-1	0	0	3	3	2	-2	2	2	3	1	0	LOW
17	Biomass heating	0	0	0	0	3	-3	-1	2	1	2	0	0	LOW
18	Tidal barrage	-3	-2	0	1	-1	-3	-3	3	2	3	0	0	LOW
19	Tidal array	-3	-2	0	1	-1	-3	-3	3	2	3	0	0	LOW
20	Geothermal heating supply	0	-1	0	-3	-3	-3	-3	3	1	3	1	0	MEDIUM
21	Sea water heat pump	0	-1	0	-3	-1	1	-3	1	0	2	0	0	LOW
22	Hydrogen vehicles	1	0	0	-1	1	1	-2	1	1	2	1	0	MEDIUM
23	Electric vehicle car club	1	0	0	-1	1	1	-1	2	1	1	2	2	HIGH
24	Smart meters	0	0	0	0	2	-3	3	0	0	0	0	0	HIGH