



## **Net Zero Living Pathfinder Places Shetland Rural Energy Hub**

**Report to Innovate UK**

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# 1 INTRODUCTION

The Shetland Rural Energy Hubs (SREH) project, a collaboration between Shetland Islands Council (SIC), Aquatera Ltd and Community Energy Scotland (CES) funded by the Net Zero Living: Pathfinder Places (NZLPP) programme from Innovate UK, aims to address the non-technical systemic barriers to decarbonisation in Shetland, by creating a network of rural energy hubs in Shetland.

Energy hubs that could incorporate elements such as electric vehicle (EV) charge points, on-site community renewable energy generation and storage, fleet vehicles, information, training and recycling facilities provide an opportunity to co-ordinate decarbonisation efforts within a whole systems approach. However, such hubs which have worked well in urban environments could be more challenging to implement in areas such as Shetland due to low population density, remote settlements, grid constraints and lack of skills capacity.

The study will utilise previous and ongoing SIC work to determine achievable pathways for decarbonising key sectors and reaching net zero through an integrated energy hub network. It seeks to address the following barriers which have been encountered so far: regulation, grid capacity, resource (skills/capacity), behavioural change and lack of data.

## 1.1 PROJECT PARTNERS AND COLLABORATIVE PROJECTS

### 1.1.1 Shetland Islands Council (SIC)

**Project lead.** SIC is the lead on this project and the study will utilise previous and ongoing SIC work to determine achievable pathways for decarbonising key sectors and reaching net zero through an integrated energy hub. SIC has provided resource in kind from the Climate Change Programme as necessary to enhance the outputs of this project. The Climate Change Programme's purpose is fully aligned to the objectives of this project.

### 1.1.2 Aquatera Ltd (AQT)

**Energy technology and Resource Mapping, systems analysis and Heat expertise.** Aquatera is an environmental consultancy which was established in Orkney in 2000 and provides operational support and environmental expertise for offshore, coastal and land-based activities. Aquatera employs over 40 people and have worked in over 40 countries with staff located worldwide. Thinking locally and operating globally Aquatera uses its experience and expertise to help overcome some of the major environmental and energy challenges of the time.

### 1.1.3 Community Energy Scotland (CES)

**In-community innovation, demonstration and adoption activity mapping, project and tool developers and managers, and community outreach, analysis and enablement specialists.** A National charity and member-based social enterprise, CES has two decades of experience working with communities in the Scottish islands: supporting them to organise themselves, adopt clean technologies, implement behaviour change and "own" solutions to decarbonise inclusively and equitably whilst still thriving.

### 1.1.4 Current Collaborations

All three partners in the Shetland Rural Energy Hubs project are also collaborating as partners on two other projects in the years ahead, providing opportunity for shared learning and potential long-term delivery beyond October 2025.



The Carbon Neutral Islands (CNI) project started in 2021 and is a Scottish programme for government commitment aimed at supporting six islands to become carbon neutral by 2040 – including Yell in Shetland, and Hoy in Orkney as well as Barra in the Outer Hebrides, Great Cumbrae in the Clyde, Islay in the Inner Hebrides and Raasay near Skye.

The Island Centre for Net Zero (ICNZ) project is a new 10-year programme that began summer 2023. The UK and Scottish Government Islands deal has provided the initial capital investment for ICNZ to build a pan-islands innovation centre and wider catalyst for societal change that will support Shetland, Orkney and the Outer Hebrides to achieve a rapid but just and inclusive transition across their regions and become "lighthouse communities" for wider energy transition.

Aquatera and CES are also partners in the Pathfinder Places Orkney project and the bids for the Shetland and Orkney projects were linked in Phase 1 to highlight the shared partnerships, learning and projects.

CES is a partner in the Net Zero Living: Fast Followers project in the Outer Hebrides.

## 1.2 PROJECT AND POLICY BACKGROUND

This feasibility study builds on the existing delivery of net zero plans within Shetland, with the Net Zero Route Maps (NZRM) having been accepted by Council in November 2022. These maps set out pathways for emissions reduction for SIC and Shetland as a whole. The NZRMs are split into six categories, most of which make up the work packages of this study:

- Transport
- Energy use
- Reuse, recycling and waste
- Business and industry
- Buildings (heat and electricity demand)
- Agriculture and land use (not directly addressed in the study but acknowledged)

This project also builds on and complements other strands of work and ongoing SIC projects, including the Local Heat and Energy Efficiency Strategy (LHEES), Regional Transport Strategy, EV Charging Infrastructure Expansion Strategy, Active Travel Strategy, the Climate Change Strategy and the Energy Strategy. The project ties into the long-term ambition of the Islands Centre for Net Zero, which will put Shetland at the heart of net zero innovation, along with Orkney and the Western Isles. A key component of this ambition is leveraging available funding, such as the Pathfinder Places.

SIC's 'Our Ambition 2021-26' provides strategic political direction to help SIC focus on the things that can help to create opportunities and achieve long-term sustainability for Shetland. 'Our Ambition 2021-26' is based on a vision of working together to create a positive, confident and sustainable future for Shetland. A Shetland where the community's opportunities attract people of all ages to live, work, study and invest in our islands. The plan states that SIC will:

*"Support the creation of community energy networks across Shetland that link in with a green and strengthened Shetland Electricity Grid and complement/enable local energy efficiency, recycling and carbon capture initiatives;"*

And



*"continue to support delivery of an affordable and sustainable system of public transport services to meet the needs of Shetland. SIC will support the development of alternative solutions such as active travel and mobility as a service that encourages positive travel choices. These will evolve with the availability of alternative fuels and technologies and will complement other transport modes to form part of an integrated transport network. The network will support SIC's community outcomes of achieving climate change targets, reducing inequality, improving public health and enabling access to essential goods and services, employment, education and health care, as well as other opportunities to ensure inclusive economic growth and healthy communities."*

This project directly aligns with these ambitions and will contribute to achieving them within the 5-year aim.

SIC acknowledged the climate emergency in 2020 and formed the Climate Change Programme in response. The Climate Change Programme commits to a proactive approach to tackling climate change in Shetland and proposes a range of immediate actions and priority areas. It emphasises that it is essential to act in partnership with agencies, industries and communities to be successful.

### **1.3 REFLEX PROJECT BACKGROUND**

As is set out in this report, the Shetland Rural Energy Hubs draw on learning from the ReFLEX Orkney project and, if funded for Phase 2 of the Pathfinder Places programme, the Shetland Rural Energy Hubs will seek to establish ReFLEX Shetland as part of the project. The ReFLEX Orkney project ran from April 2019 to March 2023 and aimed to pioneer an integrated, affordable, low-carbon smart local energy system by interlinking electricity, transport and heat networks into one controllable system, digitally connecting distributed and variable renewable generation to flexible demand.

Funded by UKRI the ReFLEX Orkney project was led by the European Marine Energy Centre (EMEC) with partners including Aquatera, CES, SMS Plc, Heriot-Watt University (HWU) and Orkney Islands Council (OIC). The Pathfinder Places Orkney project, which is linked to the Shetland Rural Energy Hubs project and with whom we will potentially submit a joint bid together for Phase 2, includes partners Aquatera, CES, EMEC and OIC.

ReFLEX was designed as an ambitious project that built on multiple previous projects and brought together a range of expertise. It began in 2019 and it has successfully delivered several key objectives – it has also identified and evidenced key challenges and barriers to progression of localised decarbonisation initiatives.

Non-technical barriers encountered include regulation not designed for innovative decarbonisation technology, financial challenges ranging from investors being risk averse with new technology to private individuals concerned about the costs of changing to low carbon technologies, and understanding the need to assure, enable, and involve all of society when needing to deliver effective behavioural change. The ReFLEX project has taken place alongside other innovative projects in Orkney including Heat Smart Orkney and SMILE creating and mobilising smart and integrated local community energy systems and developing hydrogen as a fuel for maritime and aviation and these learnings will be brought into the Shetland project in Phase 2.

While ReFLEX came up against significant non-technical and technical barriers, it has demonstrated the value and need for locally based energy management and support services. It has delivered some of its key aims, including the establishment of ReFLEX Orkney Ltd (ROL), the special purpose vehicle that is taking forward the aims of ReFLEX beyond March 2023. ROL will be a potential delivery channel for NZLPP and ICNZ. ReFLEX Orkney Ltd and its customer engagement team based in Kirkwall combine with the skills and capabilities of the project partners, and other existing local actors, to provide a powerful, enhanced, model for community and customer engagement that incentivises and



encourages behavioural change and adoption of new technologies – a principle that will be built on with the Shetland Rural Energy Hubs.

## **1.4 PHASE 2 POTENTIAL COLLABORATION**

Given the multiple projects and opportunities for shared and complementary learning to accelerate decarbonisation in Shetland and Orkney, the teams for the Pathfinder Places Shetland and Orkney projects are exploring the potential of submitting a joint bid for Phase 2. This opportunity will be explored in full in the bid for Phase 2. This feasibility study is focused on the learning from Phase 1 that can be taken forward in Phase 2 and long-term, regardless of whether or not a joint bid is submitted.

Please note that this study has been prepared by the three project partner organisations and the headings for each of the deliverables set out which partner authored that deliverable. Where the subsections under a deliverable have different authors, that has been stated in the subsection headings. The sections that have no note of author have been authored by Aquatera.



## 2 METHODOLOGY

The feasibility study was split into seven stages:

- **Literature review:** review of previous work by SIC and other agencies within Shetland relevant for rural energy hub creation;
- **Consultation:** to obtain ideas, options, and community buy in to the overall concept;
- **Long-list of options:** to consider products and services for inclusion within the hub along with their advantages and challenges;
- **Short-listing:** workshop with SIC team and relevant stakeholders to distil the longer list into short list of options;
- **Site identification:** identify an appropriate site for a pilot hub, as well as reviewing what a network of hubs could offer and where would they be sited;
- **Detailed option analysis:** fully develop the short-listed options to understand how barriers or challenges can be mitigated; and
- **Final report:** highlight findings of the study as well as analysis of a preferred site and options for inclusion in a rural energy hub.



### 3 WORK PACKAGE 1: TRANSPORT

Work Package 1 examines the potential transportation elements for the rural energy hubs, including the wider knowledge and lessons learned within both Shetland and elsewhere and the key factors that could determine the potential location of the hubs for transport needs.

The deliverables in Work Package 1 will:

- Deliverable 1: identify locations for rural energy hubs and the best location for pilot for phase 2;
  - Analysis of grid requirements;
  - Analysis of green fuelling
  - Review how to incorporate all transport elements
  - Review how locations facilitate engagement; and
- Deliverable 2: identify data gaps, active travel
  - Gather existing data from council telematics and existing reports/studies
  - Examine how to incorporate active travel routes and car club into hubs
- Deliverable 3: engaging community.
  - Examine routes to drive behavioural change for engaging community to use hubs



### 3.1 DELIVERABLE 1 - IDENTIFY LOCATIONS FOR RURAL ENERGY HUBS

**Identify locations for Shetland Rural Energy Hubs and best location for pilot for phase 2, including: analysis of grid requirements; green fuelling; review how to incorporate all transport elements; how locations facilitate engagement.**

**Non-technical barriers addressed:** Regulation, Grid capacity, Resource, Behavioural change and Lack of Data for Rural Communities.

**Authors:** Aquatera and CES, with support from SIC

Deliverable 1 aims to identify the non-technical barriers to decarbonisation in Shetland and use this information to help assess the best locations for the rural energy hubs to help overcome these barriers.

This work is explored through four distinct elements:

- **Literature review** examining the non-technical barriers that challenge the path to decarbonisation in Shetland. Since declaring the climate emergency in 2020 SIC has undertaken significant engagement with the community and used that research to publish strategies and policies seeking to address this. The literature review examines the reports from the community engagement, the policies published since then as well as reviewing older reports and policies analysing energy needs and challenges in Shetland;
- **Grid requirements study** aims is to understand where the grid could reasonably accommodate new demand infrastructure such as electric vehicle (EV) chargers for energy hubs without significant upgrade;
- **Development of Shetland’s electric vehicle charger network; and**
- **RADMApp spatial analysis of potential locations for hubs.** Aquatera’s RADMAPP tool is a raster-based GIS framework for data analysis which can be applied to many different scenarios. It has been used to map a range of technical and socio-economic factors to determine where the rural energy hubs could be located in Shetland.



### 3.1.1 Literature Review – Aquatera

#### 3.1.2 Introduction

This literature review focuses on the non-technical barriers that challenge the path to decarbonisation in Shetland, more specifically on “Regulation”, “Grid capacity”, “Resource”, “Behavioural change” and “Lack of Data for Rural Communities”, classified as main themes of the review. The report highlights:

The main barriers and concerns expressed by Shetland’s community;

- The key challenges and obstacles faced by the community members and potential solutions; and
- Case studies that reflected specific aims related to the community.

The selection of sources included in the literature review include an ‘Internal Materials Review’, of which the use of these are confidential or sensitive and therefore limited and rationalised for inclusion, and an ‘External Materials Review’ that included academic papers, Government Publications, Local Authority Publications and Publications from Government commissioned third parties. Notes from sources pre-reviewed by SIC have also been reviewed as part of the literature review process. Sensitive and confidential reports have been marked and will not be cited as part of the reference list.

**The full Literature Review report can be read in Appendix A, with the conclusions below.**

#### 3.1.3 Conclusions

This section presents the summaries and conclusions of the literature review per theme.

##### Regulation

Several regulatory improvements or gaps were identified in the literature review. Regulatory support is needed to help maximize renewable energy generation including regulation of export techniques and management methods related to grid connection coordination.

Shetland communities insisted on the importance of community ownership of the energy transition. The communities need to clarify their expected role in the transition and define areas of priority for the islands and set key principles to reach net zero objectives.

Defined pathways and net zero targets are also requested for Shetland industries to become decarbonized locally. Industries such as transport, active travel and tourism already have strategies in place, renewed every couple of years, but a lack of regulatory structure to help advance decarbonisation has been noticed.

To this end, a sector-by-sector consultation has been suggested as an approach by the communities to establish the priorities for businesses. Fostering network links and mutual learning between communities has also been mentioned. With regard to energy supply and generation, specific policy gaps are also needed to regulate the financial support required to implement energy efficiency measures. Shetland generation energy tariffs are also needed to be re-evaluated unless this has been revisited since 2015 after the Ofgem’s presumed revision.

##### Grid capacity

The current energy system in Shetland is isolated with no electricity grid connection with the rest of the mainland and no large-scale gas transmission network. 90% of the electricity is supplied by Lerwick Power Station and 100MW power station Sullom Voe Terminal, the remainder provided by local wind generators. The existing electricity system is managed by an Active Network Management (ANM) system but faces rising constraints with the increasing addition of more



renewable generation in the Shetland's energy system. A new high voltage direct current (HVDC) interconnector to mainland Scotland is currently being constructed and is due to be connected to the grid by 2024. This will make a significant change to the current energy system. The grid issues are explained in detail in the Grid Requirements Study on Pages 28.

Full electrification requires a detailed net zero implementation plan with a sector-by-sector approach. As part of this plan, the reinforcement of the grid connection with the mainland is critical. This also includes the consideration of additional network constraints from the electrification of heating from heating oil systems at care homes or transport hub locations.

Shetland's communities miss clear information on the potential changes for Shetland's energy system and more precisely the impacts of full electrification for the industries, public services and households. Concerns are raised about the possibility for area-wide emissions in Shetland to become net zero by 2045, suggesting a systemic overhaul of the economy, land use, consumer habits and social engagement. The energy price rates are already high and are concerning the communities, requesting more financial support, subsidising these costs.

The current grid capacity in Shetland only relies on existing grid connections. With more requirements to add more renewable energy generation into Shetland's energy mix, the new interconnector is critically needed.

## Resource

Efficient use of Shetland resources is mentioned throughout the literature review. With regard to the procurement of materials and equipment, the frequency of shipments is too low, generating delays and increasing shipping costs, affecting the rate of the energy transition.

The energy transition also severely impacts local businesses and low-income families highly reliant on fossil fuel sources and needing financial support. Fuel grants are temporary and insufficient to meet industries and households' energy needs. These major energy opportunities and challenges of all Shetland communities emphasise the need to develop small-scale energy projects.

With regard to transport resourcing, several needs have been identified including the growth of Shetland's demand in recent years. External ferries face capacity challenges to meet current demand whilst the vessel size of the new fleet is restricted to accommodate the current infrastructure at Aberdeen harbour. Inter-island ferries face vessel replacements, approaches for crew retention competing with other sectors or vehicles, people capacity challenges as well as deadweight crane capacity for small island ferries. The inter-island air network has also been restricted with no services offered for Papa Stour and Skerries due to lack of rescue and firefighting services at Skerries. Bus services are impacted by staff ageing and the subsequent lack of bus drivers with the associated lack of testing facilities.

ZetTrans aims to develop walking and cycling journeys, routes and measures across Shetland to increase active travel options.

With regard to the implementation of energy transition for the workforce, upskilling including energy efficiency skills and setting up support to acknowledge competences among the communities are seen as critical. Knowledge sharing, involvement of the local industries and long-term job opportunities are necessary to retain local wealth. Current training options are often too long. The upskilling of the workforce and creation of net-zero compatible jobs may not offset the job loss from fossil fuel consuming activities (i.e Oil and Gas) or be sufficient to cover the unemployment rate in Shetland.



## Behavioural change

The results of the literary review have shown that many residents in Shetland wish to change their behaviours to reduce carbon emissions, however they are restricted by current infrastructure and financial barriers. Main areas of change lie in transportation and energy use where many wish to utilise alternative modes of transport such as public transport, active travel methods and communal car use (car clubs and car shares). For energy use, there is a desire to explore alternative heating solutions and increase energy efficiency within their homes along with exploiting renewable energy developments to increase benefits to communities living near renewable development areas. Micro renewables are also a popular change albeit out of reach financially for many who wish to install them.

Where support may be available to enable changes to be made, access to these support services is unclear and difficult to navigate for most residents; this puts them off pursuing the options. Where the support was accessed, many were excluded due to criteria needing to be met.

Infrastructure is a significant issue in Shetland where transportation is concerned which is hindering the change to more sustainable transport options and a reduced reliance on personal car use. Active travel is moderately considered as an alternative due to the lack of safe walking and cycling infrastructure on the narrow Shetland roads, this makes people feel unsafe walking or cycling. Public transport is limited in routes and in departure/arrival times and does not tie in with critical services such as school and ferry timetables. This, along with routes not being serviced or times being highly limited makes them unsuitable for many residents to use. Distance and remote locations of these transport locations is also reported by the communities. Weather conditions are also reported as a main barrier for active travel in Shetland.

The conclusions are that there is a willingness to change in carbon use behaviours, but the lack of support to organise and act via financial and advisory services is a significant roadblock to making these changes.

## Lack of Data for rural communities

Much of the data gathered was over the years of 2019-2022 which were impacted by the Covid 19 pandemic and therefore had significant data gaps and had to adjust to a 'new normal' following the reduced restrictions and restarting of activities.

For surveys, there was a lack of awareness and understanding from many participants which may have skewed the data retrieved. Many stated that they felt there was not enough information readily available to educate on the importance of net zero and how to facilitate this transition. This was the most common theme through the reports reviewed: the lack of data and information available to individuals.

Many commercial companies do not share data which could be an issue for fully understanding transition pathways and impacts on communities. Where data may be available (local/community sites) this data is unverified and not subject to quality control out with the owners of the website so may not be reliable.

### Challenges

The key challenges to communities and stakeholders around the challenges facing a transition to Net Zero are around transportation, education, technologies, housing conditions and land use. The biggest barriers to addressing these are finance, access to information and support, skilled trades and regulation.

Transportation is going to be a major factor in decarbonisation effort with 9 in 10 people relying on private cars and ferry transport to move around the islands and further afield. The lack of public transport that is useful to the residents is a huge issue and active travel is not a viable option for many.



Housing is not only a net zero transition issue to increase the use of renewable energy and reduce emissions through energy efficiency; it is also a health issue with many living in damp drafty old houses that are not easily retrofitted and are the most expensive to heat. The owners are often elderly and less financially stable which further compounds the issue. This is a serious concern for many residents and stakeholders and a priority action in climate action plans. Increased funding, support and clearer advisory services is needed to initially help the housing problem as many find seeking help difficult and confusing.

The lack of skilled tradespeople to install and maintain renewable technologies is a challenge to rural and island communities and many cannot take advantage of offers on microgeneration due to lack of installers or geographical restrictions on the offer. The lack of education and information is not only restricted to employment and skilled trades, but there is also a lack of general education and awareness around decarbonisation and what that means to the individual as well as how they can access information and guidance on how to contribute to the Net Zero effort.

Food and energy insecurity is another big challenge due to the adverse and increasingly unpredictable weather conditions. Island residents rely on ferry transport to deliver food from mainland Scotland to the shops and those on the outer Shetland islands have to rely on additional ferry services to bring food and goods from the main Shetland island. This is significantly disrupted in adverse weather as it is not safe to sail. This is also a high carbon cost for food. Energy production and disruption is similarly impacted by adverse weather conditions with frequent power cuts and damage to infrastructure.

## Solutions

The potential solutions to the above challenges have been explored by Shetland communities and stakeholders with significant community buy-in. Many would welcome the opportunity to grow their own food to combat food insecurity, high prices and create a sustainable circular economy. Solutions suggested are community allotments and polytunnels so residents can grow and harvest food locally in their immediate communities. This expands into further land use and land maintenance with many wishing to be more involved in restoring vulnerable habitats such as peatland.

For transport decarbonisation, suggestions to reduce reliance on private car ownership focus on better public transport services and increased active travel links. Car sharing and car clubs are popular options, as well as more facilities to store bikes and charge e-bikes at public transport hubs to encourage active travel to wider public services. While the adverse climate will always be a challenge to encourage active travel, many would increase the use of walking, cycling and e-bikes if the infrastructure was improved to increase safety on the narrow roads and provide easier access ways.

Energy use and development using renewable and low carbon alternatives is a key factor in the transition to net zero and is a large industry on the islands, with many commercial, private and community renewable energy developments in operation and under development. Lack of information and funding hinders many from installing private microgeneration and there is a history of misinformation and distrust with commercial developers within communities. Better information and education on renewables would be a great benefit to communities as well as increased skills in trades for installing and maintaining technologies within the communities to increase uptake of technologies. Regulation should be revised to keep pace with the innovation and technological advances to increase the renewable technology options available to the market. Technologies such as anaerobic digestors which are a good way to tackle waste and provide sustainable energy are not dependant on weather conditions and many can be used off grid to avoid the issue of grid capacity for new technology connections. However, regulation and investment into such technologies is hindering the deployment and excluding this option from being developed.

Housing and energy efficiency solutions hinge on significant investment and better information, support and advisory services. Increasing insulation and the installation of micro renewables with education on better energy use is a key aspect of reducing domestic emissions while tackling health and fuel poverty concerns. New build properties are well



insulated and large housing developers are installing roof mounted solar as standard in many areas. However, older housing stock is still behind and are often inhabited by the more vulnerable in the community. With better access to support and advice, more residents could access the grants and funding available to make essential upgrades to their homes and install more energy efficient heating solutions. This, along with an increase in skilled installers, would significantly reduce the high energy and emission costs currently faced by Island and rural communities.

### 3.1.4 Literature Review Challenges

With all literature reviews, there is a limit on the volume of sources that can be reviewed and reported. While the team have taken every effort to select quality information that is relevant and specific to the Shetland Rural Energy Hubs project, not all topics, opinions, results and views have been recorded. To do a full in-depth review on all literature available on the transition to Net Zero would be a significant stand-alone project so this has been an exercise in reviewing island specific, recent reports based on community participation and local stakeholder insight.

Where selected materials are confidential, the project team have committed to relaying and reviewing the pertinent information while retaining the anonymity and confidentiality of the reports and as such are not referenced. Many of these reports are connected to in progress development projects or internal reviews.

Assessment and summary conclusions derived from the reports and publications requires a degree of personal insight and understanding of the topics, with multiple reviewers providing input into the literary review process. This may result in some inconsistencies in highlighted aspects selected from the reports and writing styles. While this does not detract from the quality or factual accuracy of the literary review, there may be some contextual variation.

### 3.1.5 Literature Review Gaps

Topics not covered in this report are Regulation and Planning policy. This is a key aspect of the transition to net zero as many of the challenges and solutions involve a revision of the regulatory and planning systems. Funding is another significant aspect which has been raised throughout this report from individual residents to large developers. Further investigation into the funding context would benefit this project at a different stage or as a standalone project as it is critical in a successful transition to net zero.

Many of the reports selected were community driven, and while this is important, a more well-rounded review may have been possible if more information from other external sources such as individuals, developers and suppliers (trades, grid infrastructure, DNO and advisory services) had been included.

### 3.1.6 Overall Conclusions

The results of this literature review show that Shetland communities are enthusiastic to be involved in the Shetland Islands transition to net zero and see many benefits to them as individuals and as a wider community with many solutions being carbon neutral, financially sustainable and personally beneficial on many levels. There is a solid link between a net zero way of living and increased health benefits such as reducing fuel poverty, improving housing stock and increasing active travel and social interactions through car shares and access to communal resources. Creating a circular economy is important to the community to tackle food and energy insecurity with more ownership on food production locally and microgeneration with skilled trades and workers to facilitate these actions. Along with this, there is a distinct need for clarity and easier access to information and advisory services in all matters relating to decarbonisation, energy efficiency and energy production.

Public transportation is a service lacking in many rural and island areas and is a significant concern to many residents. In order to address transportation decarbonisation, more investment and flexibility is needed in all areas of transportation



with a financial challenge to overcome as well as weather conditions and service stability for land and sea-based transport.

The community's involvement in the energy transition is essential and clearly defined priorities, principles and sector-by-sector consultations are needed to help progress with the decarbonisation of the sectors.

Upskilling the workforce and evaluating long-term employment and training options are critical in the delivery of the energy transition as well as enabling on-time delivery of materials and equipment, faced with scarce shipments currently. Ensuring local wealth from the transition is retained is critical.

Grid capacity challenges are also affecting the development of new renewable energy projects in Shetland. Streamlining regulatory processes for new grid connection is highly advised.

### 3.1.7 Case studies

This section showcases selected case studies from the research phase as innovative examples to inform the options for the creation of rural energy hubs in Shetland.

#### Canolfan y Fron Community Centre

##### *Description*

Canolfan y Fron is a community centre that was founded by local individuals with the aim of transforming the closed Ysgol village school in July 2015 into a vibrant hub. Through the efforts of local residents, a long-term lease for the building was obtained from Gwynedd County Council, and funding from the Big Lottery and Welsh Government was secured to renovate it. In the autumn of 2018, the building was transformed into a community centre, which has been greatly appreciated by the entire community.

During the renovation process, the community made an effort to preserve the building's original features, such as the pitch pine architraves, tongue and groove panels, and a slate mullioned window. Additionally, sustainability was prioritized, incorporating environmentally friendly elements like air source heat pumps, underfloor heating, optimal insulation, solar PV panels, and electric car charging points (Canolfan y Fron, 2023).

##### *Challenges*

Despite initial success, disagreements arose among community members regarding the centre's management, resulting in the resignation of directors and the formation of a group seeking changes to the Board. A new Board was set up to take over the centre's management which worked for a while. However, the centre faced further challenges during the pandemic, including boycotts due to the new board's decisions, anonymous memos, and vandalized signs.

During the pandemic, members of the board held a zoom meeting in an attempt to reduce conflict, faced with a group calling themselves 'Concerned Members of Canolfan y Fron'. The meeting ended with the failure to find a "unifying force in the community" (Canolfan y Fron, 2021).

##### *Lessons learned*

From the forementioned context, divisions within the community can be quite common in villages. In the Canolfan case, there is willingness to find compromises after the bitterness of some divisions in the community. Following the conflict period, two actions were taken: the extension of the membership base to 130 people, and the election of a new board of up to 12 people (maximum authorised under the Articles). With these actions, Canolfan community centre hopes to broaden the decisions range and support required by the community but with the integration of compromises in them (Canolfan y Fron, 2021).



## The Strathdearn – Tomatin Community Hub

### Description

After several consultations and studies, it was agreed that Strathdearn was badly in need of a new community hub as a focus for the community's activities and life. As investment in Inverness and the surrounding area rose it had a dramatic effect on rural communities such as Strathdearn and most of the facilities have closed or shut down due to lack of vision, investment, and available business strategy.

The Strathdearn is a newly built hub based in Tomatin in the Scottish Highlands between Inverness and Aviemore. Previously the hub was part of a shop/cafe building alongside an older sports hall and tennis court with the previous sports being the village hall from 2000 – 2019. It was planned by the Starthdearn Community Developments Company Ltd which aims to advance community development and assist in providing recreational facilities. The hub has a multifunctional use within the community with both fit-for-purpose rooms and multipurpose rooms for hire and was designed to be both inclusive and last 'for 100 years'. The decision to build a new hub was driven by factors such as the small and deteriorating condition of the existing hall, the need for improved public toilets, increased flexibility, inefficient use of car parking, and difficulties in clearing snow in winter. The project involves the demolition of the existing hall built in 1961 and the conversion of the Millennium Hall. This large project became the new Community Hub, acting as a community space which houses the shop, and welcoming cafe, a large community hall to hold all the current users.

One of facilities included in this hub are the multi-functional meeting rooms. These rooms range in sizes and can be used for meetings, training courses, conferences, lectures, presentations, informal gatherings and intimate weddings. Each meeting room contains kitchen facilities and an IT integrated system for both visual and audio needs. Another facility within the hub is the purpose-built large auditorium with a viewing balcony that is used for parties, dances, music events, sports, weddings and exhibitions. This auditorium also contains an IT integrated system, audio equipment and a stage to accommodate for all functions held. Smaller spaces within the facility include offices that provides workspaces for hot desking for small businesses with a meeting booth and some IT equipment, a shop that sells local produce and items, a café and a commercial kitchen that can cater up to 150 people and communal areas both inside and outside to encourage socialisation.

Outside of the facility, there is a versatile covered sports area with showers and changing rooms that is big enough for five-a-side football, tennis, etc. An extension is planned for additional storage space. Donated gym equipment has prompted a potential gym at the centre, as revealed in a community survey (The Strathdearn Tomatin, 2022). Quarterly updates are provided to inform the community about ongoing developments within the hub. Electric bike hire was introduced in 2021, with some delays due to storage shed supplier issues. The centre hosted over 400 community events and 80 corporate events in 2022.

Collaborative relationships are being established with Highlands and Islands Police and NHS. Efforts are being made to enhance the hub's environmental sustainability by exploring grants and funding for solar panels and a storage battery. A community resilience/emergency plan is being developed to implement interim measures in case of power outages.

The decision to build a new hub was driven by factors such as the small and deteriorating condition of the existing hall, the need for improved public toilets, increased flexibility, inefficient use of car parking, and difficulties in clearing snow in winter. The replacing of infrastructure was, seen as vital for the future of the area and the retention of population as well as the attraction of new residents moving into the area. The project involves the demolition of the existing hall built in 1961 and the conversion of the Millennium Hall.

There is a demand from local residents, visitors of Tomatin Distillery, and tourists engaging in recreational activities in the area. The community desired an active role in the hub's development. The community did not support a self-service



petrol station due to its higher cost compared to supermarket prices but supported the establishment of a new hub and café. The new community hub aims to provide resilience facilities and off-grid resources for both residents and visitors (The Strathdearn Tomatin, 2023).

### **Challenges**

There were several challenges highlighted in the quarterly reports from the Strathdearn Community Developments Company Ltd. More specifically, the centre faced issues with drainage due to blockages and extensive choking of the existing soakaway. Power upgrades were required to accommodate car charging points. The facility needed a name, and it was decided that the use of the facility would come with a charge.

During the initial opening, both staff and user groups faced a steep learning curve, and the acoustics within the facility were not optimal. Weather conditions caused delays in concrete placement during construction. The changing VAT regulations necessitated a quick rewriting of the financial model to ensure that the hub could receive 100% VAT back on the construction costs.

The COVID-19 pandemic also posed challenges to the project. In 2017, the community hub failed to secure a grant from the Big Lottery. Prior to the hub's construction, challenges in the community included the absence of a large meeting place for community events, limited transportation services, the absence of a railway station, and the need for improved medical services (The Strathdearn Tomatin, 2022).

### **Lessons learned**

The following lessons learned have been gathered from running the new hub. The new community centre underwent a soft opening to facilitate a smooth transition from the old hall to the new facility, while certain works were still ongoing. To assist with resolving the facility's name, a marketing consultant was hired.

Additionally, discounted rates were offered to individuals residing within a specific postcode area. A new surface water drainage system was developed for the sports facility to address drainage needs. Utilizing the SCDC's charitable status and seeking guidance from a consultant, a new financial model was established in 2019 to support the construction of the hub.

Following the COVID-19 pandemic, the hub reopened in November 2020 with necessary procedures in place. Funding of £500,000 was secured from the Scottish Government's Regeneration Capital Growth Fund, and an upfront payment was received from wind companies operating in the region to support the construction of the hub (The Strathdearn Tomatin, 2022).

## **Case Study: Tayside Upcycling and Craft Centre**

### **Description**

The Tayside Upcycling & Craft Centre (TUCC), located in Carse of Gowrie, on the A90 Perth to Dundee Road, is a Community Interest Company focused on promoting the environmental benefits of upcycling. The centre features the work of local upcyclers and craftspeople, including furniture upcyclers and artisans working with various materials such as metal, wood, and fabrics. The artisans bring additional value to discarded items through their imaginative designs and transformations. The centre showcases various themes such as retro furniture and wooden bowls, all exemplifying the concept of upcycling. The centre offers paint, brushes, and workshops for individuals to revamp their own furniture.

The centre is open seven days a week and allows visitors to explore the creative possibilities of upcycling through showcased items. Additionally, the centre offers advice and materials to the general public for their own upcycling projects. They aim to reduce the amount of furniture and fabrics ending up in landfills each year (Perthshire Chamber of Commerce, 2023).



In addition to retailing finished products, the centre accepts commissions from customers who want to upcycle their own furniture and welcomes donations of furniture that can be reimagined rather than discarded. The centre also provides volunteering opportunities for individuals who may face challenges in learning new skills, employment challenges, or finding suitable placements (The Tayside Upcycling and Craft Centre, 2023).

### Challenges

There is no official disclose of the current challenges faced by the Tayside Upcycling & Craft Centre. However, the following challenges have been assumed:

- Reliance on public donations to supply in materials and furniture;
- Only focus on upcycling and craft activities which implies engagement to a limited number of locals and visitors. Expansion to repairing activities or inclusion of a café or other low-carbon activities could increase the community's engagement.
- Fixed costs of running the community centre likely to be reliant on public scheme grants, threatening the longevity of the centre

### Lessons learned

There is no direct feedback from the key lessons learned from the development of the Tayside Upcycling & Craft Centre. However, the key success indicator, the TUCC measures is the quantification of the volume of various materials the centre manages to divert from landfill.

As assumptions, the free advice and materials offered by the TUCC enables a higher level of engagement by the public, that views upcycling as an imaginative and creative outlet whilst reusing or repairing used materials or pieces of furniture. This could likely increase behavioural change in locals and visitors opened to these subjects. Efforts on community engagement include the run of several workshops during the year.

### 3.1.8 Grid Requirements Study - CES

Many potential hub locations across Shetland, whether new or an existing building, would require new electrical loads added to it to enable the desired services. Part of the initial investigation into which are the preferable locations for hubs is to understand the current grid status and existing connections, and begin to estimate the reinforcement works which would be required.

As with multiple aspects of this report, investigations are focusing on Brae, Scalloway and Yell as the most likely locations for the initial hub proposal, due to the quantity of existing data. It is because of this focus that this investigation in grid reinforcement requirements is on these three locations.

Furthermore, the principal goal of the following assessments is to understand where the grid could reasonably accommodate new demand infrastructure such as EV chargers for energy hubs without significant upgrade. Reinforcement of the network could be required at any voltage level and due to a number of reasons including thermal, voltage, and fault level. This analysis is constrained to the potential thermal constraints spanning Low Voltage (LV) to primary substation. This is because a full and accurate load flow model would be required to undertake assessment of potential voltage and fault level constraints. It is estimated that the peak demand in Shetland will reach 80MW by 2030 compared to 43.5MW at present.<sup>1</sup> The new high voltage direct current (HVDC) interconnector due to be connected to the grid by 2024 will be 600MW. However, power will need to be supplied to predicted increased demand in the scenario that the interconnector fails. An 8MW/6MWh Lithium-ion battery is being connected at Lerwick Power Station that will support the security of supply. However flexible demand connections may become more common. A back-up solution is also being developed at the new Grid Supply Point, providing grid inertia and stability when the interconnector is down, giving time for the Lerwick Power Station to start up.



The new HVDC link connecting Shetland to Caithness is already over subscribed for generation. Therefore, the addition of further new generation not already contracted that could require export outside of the local Shetland grid will be challenging. Small scale projects less than 50kW might be allowed to connect by Scottish and Southern Energy Networks (SSEN) (as in the rest of their network where generation constraints exist) however it is expected that projects that can demonstrate connecting additional demand at the same time as generation are more likely to be provided with a grid connection.

From April 2023, the access rules surrounding the reinforcement costs that can be charged directly to a Demand customer on the Distribution network have been changed. This change removes the upfront cost of the reinforcement up to a high-cost cap (HCC) which means if the total reinforcement costs are above £1,720/kVA, all of the reinforcement costs above the HCC would be passed to the demand customer as a connection fee. The rest of the cost of the reinforcement is then socialised through Distribution Use of System charges which all demand customers on the distribution system pay. The cost of any extension assets e.g., those that are for the sole use of the demand customer, will be charged for as usual. This means that the cost of reinforcement may be reduced financially but could increase on a time basis due to possibly more reinforcement work being required to accommodate high volumes of new demand connections (e.g. heat pumps and EVs).

### Primary substation analysis

The Scottish Hydro Electric Power Distribution PLC (SHEPD) Network Headroom 2022 report forecasts that constraints will be in place at Scalloway during winter periods from 2023 onwards in summer periods from 2035 and in spring/autumn periods from 2027 for firm capacity. Constraints are forecast at Brae during winter and spring/autumn periods from 2032 and in summer periods from 2035 for firm capacity. While Mid Yell is not forecast to contain demand constraints before 2050. Upstream constraints have been identified for all primary substations in Shetland. These are not laid out in SHEPD's report, but it is likely due to forecasts of more demand across Shetland than is currently covered by a firm connection.

Data from SSEN Open Data Portal ([ssen.co.uk](https://network-maps.ssen.co.uk/opedataportal))<sup>1</sup> indicates that all primary substations have some level of thermal headroom. This data is displayed below in Figure 3.1. This indicates that the primary substations would be able to accommodate additional demand associated with Rapid EV chargers without the need for thermal reinforcement at the primary substation or a flexible connection. However, it is likely that other constraints such as voltage or fault levels are considered in the first report and therefore some reinforcement would be needed at Scalloway now and some may be needed at Brae in future years.

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<sup>1</sup> <https://network-maps.ssen.co.uk/opedataportal>



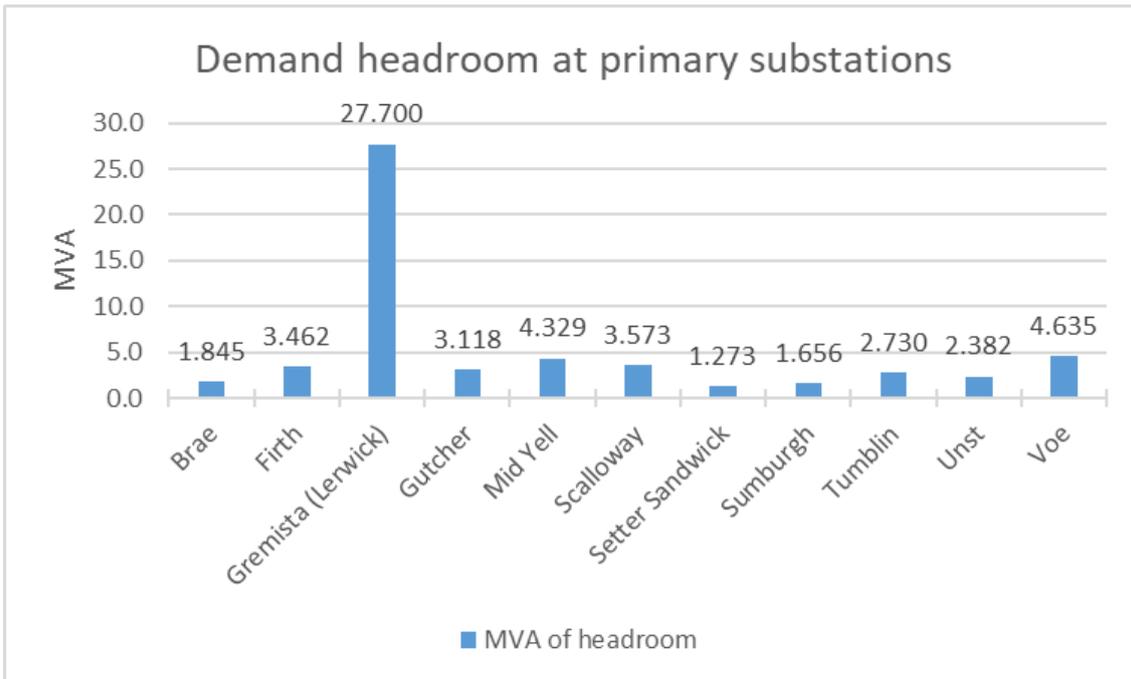


Figure 3.1 Thermal capacity of primary substations derived from SSEN Open Data Portal

Table 3.1 Summary of transformer rating and number of customers per primary substation

Islands	Primary substation	Transformer rating (MVA)	Number of customers supplied by primary substation
Yell	Mid Yell	5	417
	Gutcher	4	250
Brae	Brae	5	995
Scalloway	Scalloway	8	1662

### Secondary substation analysis

Secondary substations connecting existing community buildings or schools have been identified in each of the three areas. The assessment does not make comment on whether the specific locations identified are a good location for an energy hub as many factors will be important in choosing an appropriate energy hub beyond the existing grid infrastructure. However, it is important to understand the constraints that grid poses to future developments. Locations have been identified on the islands and the corresponding secondary substations identified on the SSEN 11kV single line drawings.

The SSEN GIS system was used to identify the existing LV network in each area including conductor type, phase and secondary substation transformer capacity. The accuracy is entirely dependent on SSEN records. Older networks are more likely to be mapped incorrectly. It is important to identify whether the network is single, split, or three-phase, as a standard 22kW charger and a standard 50kW Rapid EV charger will require a three-phase connection. SSEN Customer Rating and Load Data has also been used to determine the existing number of customers and previous known demand load on related secondary substations. Unfortunately, the previous demand load for secondary substations is generally not known and therefore the headroom at the secondary substations has not been able to be determined.



The locations investigated, the 11kV network, customer loading data, and GIS of SSEN assets have been compiled for each island.

Most of the locations identified are supplied by ground mounted transformers with the final demand connection being either single or three-phase. Pole mounted transformers supply most of the connections in Mid Yell due to how spread out customers in the area are. It is likely that all the locations identified will be able to accommodate a 7kW charger.

A 15kW single phase supply would allow a dual post charger to provide 7kW of charge to a single vehicle or to two vehicles simultaneously up to 7kW. However, a 7kW single phase supply would be able to provide 7kW of charge to a single vehicle or charge two vehicles simultaneously up to 3.68kW.

As previously mentioned, chargers rated at 22kW and above need a three-phase supply. If a building already has a three-phase supply, then utilising the existing meter along with any potential renewables should be considered. A new cut out may be required depending on the site's overall power demand. In locations with a single-phase supply where a 22kW charger, and above, is desired, a new supply connection should be considered. This is partly due to the potential for disruption to the existing building as upgrading a supply from single or split phase to three phase will require a new meter and distribution board (also known as a consumer unit). To reduce disruption would require SSEN, the meter operator (which is assigned by the existing supplier), and an electrician to collaborate to reduce the length of time the building is without power. However, if there is a desire for the building and the EV charger to be supplied using either existing renewables connected behind-the-meter or new renewable generation then sharing a single supply point would be required.

Only Grindwell road secondary substation (which supplies the Brae Hall) has previous load data from a number of years ago which suggests that up to 63kVA of headroom is available. This suggests that a Rapid 50kW EV charger could be installed at the hall with limited reinforcement required. This is of significance to the project as the hall has been identified as a potential location for the pilot hub to be set up in Phase 2.

**See Appendix C for Brae Grid Assessment.**

### 3.1.9 Development of Shetland's EV charger network - Aquatera

#### Background

Terrestrial transport represents a significant contributor to Shetland's carbon emissions and the adoption of EVs therefore provides an excellent opportunity to decarbonise this sector. However, supporting infrastructure is required to encourage adoption, placing further demands and the need for reinforcements on the local grid. However, at the same time, the low usage of cars, typically no more than 3 to 5% of the time, means the batteries in EVs offers a potentially very flexible load to assist with managing operation of the local grid and help match the intermittency of local renewable energy generation.

In the last quarter of 2022, the UK had around 600,000 electric vehicles registered on the roads, equivalent to an average of 1 EV for every 110 people. In Shetland, of the approx. 11,600 cars on the road, there are only around 140 EVs (1.2%), or 1 for every 162 people, indicating a lower uptake rate than the UK average. This contrasts sharply with Orkney where it is estimated there is approximately 1 EV for every 37 people.

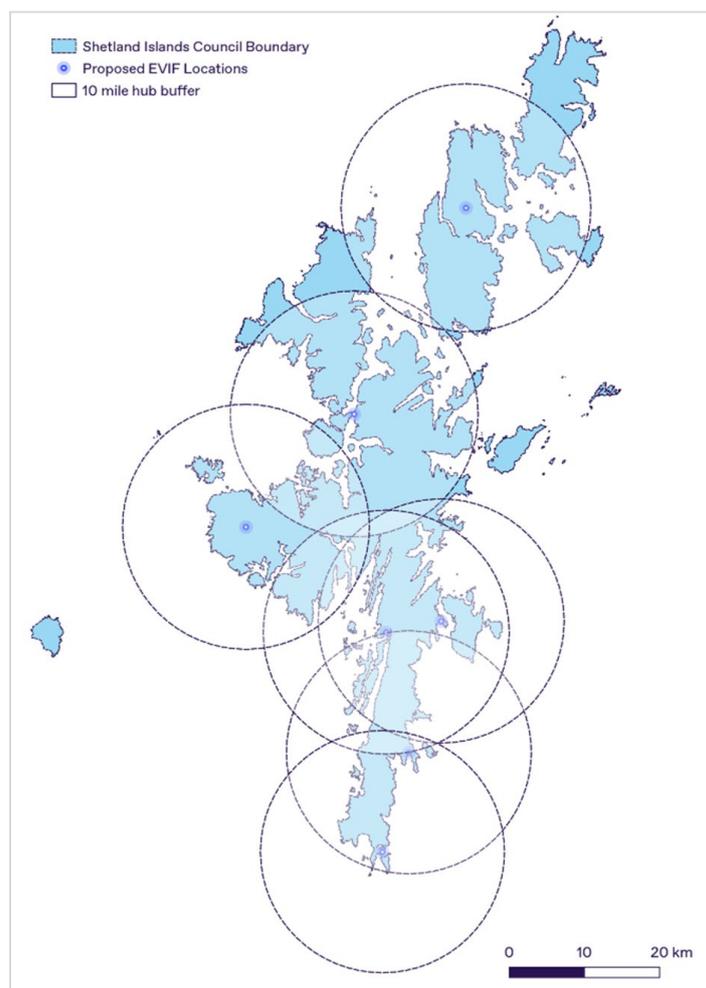
At a UK level, EV sales are predicted to see 300% growth by 2030, which means if Shetland was to follow a similar growth rate, then there can be expected to be at least 560 EVs on the roads in the next 7 years. This would represent over 5% of the total number of cars.



In terms of public charging provision, at a UK level, at the end of 2022 there were 37,055 chargers installed or one for every 1820 people. In Shetland the comparable figures are 24 chargers, or one for every 950 people. This might suggest that lack of charging infrastructure may not be a reason for the lower EV uptake than the UK average.

However, the literature review and community engagement in Deliverable 3, shows that lack of rapid chargers and the subsequent range anxiety is a major reason Shetlanders cite for not having an electric vehicle. So, improving the charger network, particularly rapid charger provision, to remove these barriers to behavioural change is essential to decarbonising transport in Shetland.

Some of the chargers in Shetland are coming towards the end of their working life. This coupled with a continued growth in EVs is expected to create demand for further public (and private) EV chargers. SIC have started to evaluate locations for new charging infrastructure, based on a maximum distance to travel from homes of 20 miles and a maximum distance between rapid charging points also of 20 miles, as illustrated in Figure 3.2 below.



**Figure 3.2 Potential EV charger locations identified by SIC**

In 2022, the UK stopped grants on new EVs, announcing its intention to switch resources to supporting the rollout of EV chargers, in recognition of the current shortage relative to demand. Although the Scottish Government has established the ChargePlace Scotland scheme, this is now operated by a private organisation with the objective to bring further private finance into the sector.

SIC's strategy for EV charger expansion is to see a network of small to medium sized EV charger hubs, with both fast and rapid charging provision, throughout the Shetland Islands, supporting both residents and visitors to Shetland. The development of these hubs fits in with the plans for the Shetland Rural Energy Hubs, supporting the principles of a 20-minute neighbourhood. The geographic nature of the Shetlands islands also poses a significant challenge regarding maintenance. While units may be purchased with warranty or have maintenance contracts the units are likely to be down for a significant time if a problem occurs. To minimise unit downtime in the event of maintenance problems, SIC are keen for local contractors to be involved in the maintenance contracts.

Charger utilisation is a key factor in financing new charging infrastructure and will have a significant bearing on future growth rates. Utilisation of publicly available EV chargers depends on a range of factors, the main ones being:

- EV sales growth rates relative to EV charger installation rates – if the former is higher, then this will tend to drive higher utilisation rates with demand higher than supply.
- EV charger costs relative to private (e.g., home) charger costs; cost per kWh is important but also there's a convenience factor linked to availability of chargers and speed of charging.
- Type of users in area, for example EV drivers passing through an area who do not have access to a home charger are more likely to use a public charger than a driver who lives locally.
- Location – workplace charging, where vehicles may be left on a charger all day, or chargers in more popular areas, close to other facilities and amenities, tend to have higher utilisation rates. Similarly, these are often easier to maintain, and repair compared with more remote, smaller island chargers.

Utilisation data of existing (public) chargers in Shetland has been considered, and summarised for a range of locations as follows (Table 3.2).

**Table 3.2 Utilisation rates for sample of public chargers in Shetland**

Charger Location (and type)	Utilisation % (2022)
Gilberston Park, Lerwick (50kW rapid)	8.92%
Cullivoe Pier, Yell (22kW fast)	2.24%
Clickimin Leisure Centre, Lerwick (22kW fast)	6.28%
Brae Health Centre, Grindahoul, Brae (22kW fast)	5.65%
Bixter Car Park, Bixter (50kW rapid)	2.24%
Pitt Lane Car Park, Lerwick (50kW rapid)	9.33%
Sumburgh Airport (50kW rapid)	1.38%
Ulstá Shetland Ferry Terminal, Yell (43kW rapid)	0.44%
Scalloway Primary School, Scalloway (22kW fast)	6.81%

*Note: Utilisation calculated as: kWh/(charger capacity in KW x 8760 hours per year)%*

There are two clear observations from this data. Firstly, there is a very wide range, from 0.44% to 9.33%, a difference factor of over 20 between the least and most used, in terms of kWh delivered per kW of installed capacity. Secondly, the chargers with the higher utilisation tend to be in the areas of higher population density, such as Lerwick, or were provided as part of a workplace charging facility such as Scalloway Primary School. Based on this cross-section of existing chargers the utilisation in 2022 averaged just under 5%.



SIC’s strategy is to see an approximate 7-fold increase in fast chargers by 2030/31, and around a 5-fold increase in rapid chargers. Forecasting future utilisation is very difficult, with a number of variables as outlined above. However, conservatively assuming something similar to existing utilisation (an average of 5%), and combining this with likely growth rates in the roll-out of chargers, preliminary central, upper and lower forecasts for deployment and energy usage per charger over the next 7 years have been generated, as set out in the tables below:

**Table 3.3 EV Chargers – Low growth / utilisation scenario**

Low Growth / Utilisation Scenario									
No & kWh/charger	2022	2023	2024	2025	2026	2027	2028	2029	2030
7kW	5	6	7	9	11	14	17	20	25
	3066	3001	2938	2876	2815	2756	2698	2641	2585
22kW	12	15	18	22	27	32	40	48	59
	9636	9433	9233	9038	8848	8661	8478	8299	8124
50kW	7	8	10	11	13	16	19	22	26
	21900	21438	20985	20542	20108	19684	19268	18861	18463

**Table 3.4 EV Chargers – Central growth / utilisation scenario**

Central Growth / Utilisation Scenario									
No & kWh/charger	2022	2023	2024	2025	2026	2027	2028	2029	2030
7kW	5	6	8	10	13	17	22	27	35
	3066	3066	3066	3066	3066	3066	3066	3066	3066
22kW	12	15	20	25	32	41	52	66	84
	9636	9636	9636	9636	9636	9636	9636	9636	9636
50kW	7	9	10	13	16	19	23	29	35
	21900	21900	21900	21900	21900	21900	21900	21900	21900

**Table 3.5 EV Chargers – High growth / utilisation scenario**

High Growth / Utilisation Scenario									
No & kWh/charger	2022	2023	2024	2025	2026	2027	2028	2029	2030
7kW	5	7	9	12	16	21	28	37	49
	3066	3304	3559	3835	4132	4452	4797	5169	5569
22kW	12	16	21	28	38	50	67	89	118
	9636	10382	11187	12053	12987	13993	15077	16245	17503
50kW	7	9	11	14	18	23	29	37	47
	21900	23596	25424	27394	29516	31802	34266	36920	39780

The “low” scenario assumes EV charger growth runs ahead of EV growth, such that utilisation is expected to fall over time. The “central” scenario assumes growth rates are the same, so the utilisation remains constant. The “high” scenario assumes EV growth runs ahead of EV charger growth, such that utilisation is expected to increase over time.

At this stage these forecasts should be treated with some caution as future roll-out will depend on a wide range of factors, a key one being the growth in EVs deployed in Shetland. However, the forecasts should provide a guide to likely energy usage over time for the proposed energy hubs, assuming a number of chargers are integrated into the design of these hubs.

EV chargers are a key consideration in choosing locations for the proposed hubs and therefore a key input into the mapping work for the project being brought together under the Aquatera RADMapp system.



### 3.1.10 RADMApp Model – Aquatera

#### RADMApp Analysis of potential hub locations

##### Introduction

Selecting potential sites for the Shetland Rural Energy Hubs required taking into account a wide range of factors and Aquatera's in-house **R**esource **A**nalysis and **D**igital **M**apping **A**pplication (RADMApp) tool was adopted to identify the suitability of areas around Shetland for the potential development of such community hubs. For this purpose, they were envisaged to be locations for electric vehicle charging, centres for technology and information, self-sustaining in terms of energy production, and be easily accessible for the general public, be that by private vehicle or public transport.

**The full RADMApp analysis report detailing the site selection process can be read in Appendix B.**

##### Methodology

Aquatera worked in collaboration with Shetland Islands Council (SIC) to identify criteria necessary for the site selection process. The initial approach consisted of a series of workshops to agree on the requirements of the hubs, the desired data that would allow spatial mapping of these requirements, and whether the data would be available from either one of the project partners, or from a third party.

Discussions in the workshop determined that the requirements of the hub were as follows:

- Essential
  - Proximity to a population centre
  - On an existing bus route
  - Suitable surrounding land for renewable energy installations
  - Proximity to 3-phase grid supply
- Desired
  - Existing SIC asset for use as a hub
  - Suitable land for hydrogen storage
  - Use as a recycling centre.

As well as the above factors, additional constraints were also considered in terms of planning suitability. These considered negative impacts on nearby residents, ecological impacts on habitat types and designated sites. Avoidance of impact on scheduled monuments.

Once all the required data sets were identified, data was sourced directly from SIC, where data was already available, Ordnance Survey, and various other third parties. The data was then processed for use within the RADMApp model.

##### RADMApp Model

The RADMApp model is a raster-based model that utilises spatial data to support spatial planning questions. The raster-based model for this project consisted of a uniform grid of 10 m by 10 m cells (100 m<sup>2</sup>) that covered the entirety of the Shetland islands, utilising the British Grid system (OSGB1936). Each dataset identified for use in the model was processed, where necessary, into a raster format of 10 m x 10 m in the British Grid co-ordinate system. At this stage, each cell of each dataset was scored in terms of suitability using a scoring system agreed upon during a second workshop with the project partners. Additional weights were also assigned to each of the datasets during this workshop, to



determine if some criteria were more important than others. This was done using a weighted linear combination incorporating pairwise comparison. The combination of all the scored layers provided an overall suitability score for each individual grid cell in the raster. The results allow for comparison of each 10 m x 10 m grid cell within the model to determine areas of potential suitability.

### Analysis

This section summarises the key data, criteria and scores for the suitability analysis. Several data sources were identified and sourced based on criteria agreed with the project partners.

**Table 3.6 Data sets used in the RADMApp model**

Dataset	Source
Proximity to bus routes	Shetland Islands Council
Proximity to A-roads	Derived from Ordnance Survey data
Proximity to B-roads	Derived from Ordnance Survey data
Proximity to minor roads	Derived from Ordnance Survey data
Proximity to existing grid infrastructure	Scottish Power
Proximity to offsite hydrogen production	N/A
Proximity to ferry terminals	Derived from Shetland Islands Council data
Proximity to airport	N/A
Proximity to population	Derived from Ordnance Survey Data
Land gradient	Derived from Aerial Photography for Great Britain data
Proximity amenity (Bring) site	Derived from Shetland Islands Council data
Proximity to residences	Derived from Ordnance Survey Data
Topography	Ordnance Survey Data
Wind Capacity Factor	Global Wind Atlas
Proximity to Community Halls	Derived from Shetland Islands Council data
Proximity to Council Assets	Derived from Shetland Islands Council data
Proximity to Listed Buildings	Derived from Historic Environment Scotland data
National Nature Reserves	Nature Scot
Ramsar Site	Joint Nature Conservation Committee
Special Areas of Conservation	Joint Nature Conservation Committee
Proximity to Scheduled Monuments	Derived from Historic Environment Scotland data
Proximity to locations with 3-Phase supply	Derived from Shetland Islands Council data

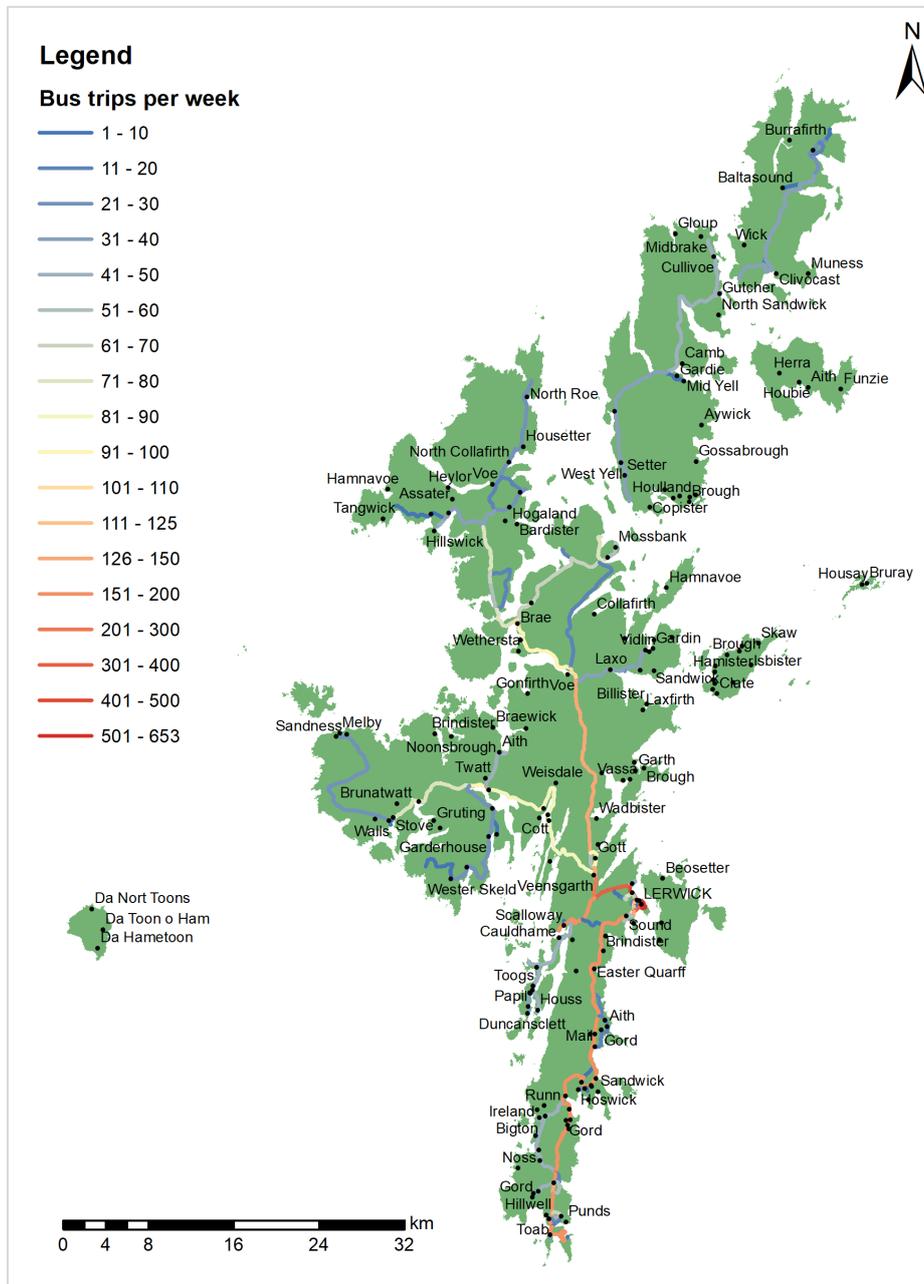
### Factors

The following section expands on the data sets considered as factors in the above table and their use in the model. Factors are considered as layers that determine the overall level of suitability of the final model, but do not constrain the areas in any way. A factor with a very low suitability level will drive the overall suitability for an area down but will not remove it as a possible area for development.



**Example: Bus routes**

One of the key aspects of the siting of a hub was that it be accessible via public transport. To determine this, each individual bus route was digitised and assigned a value relating to the number of trips that the bus took in one week. Each bus route was then added together to give an overall value of number of bus trips passing through each 100 m<sup>2</sup> cell per week.



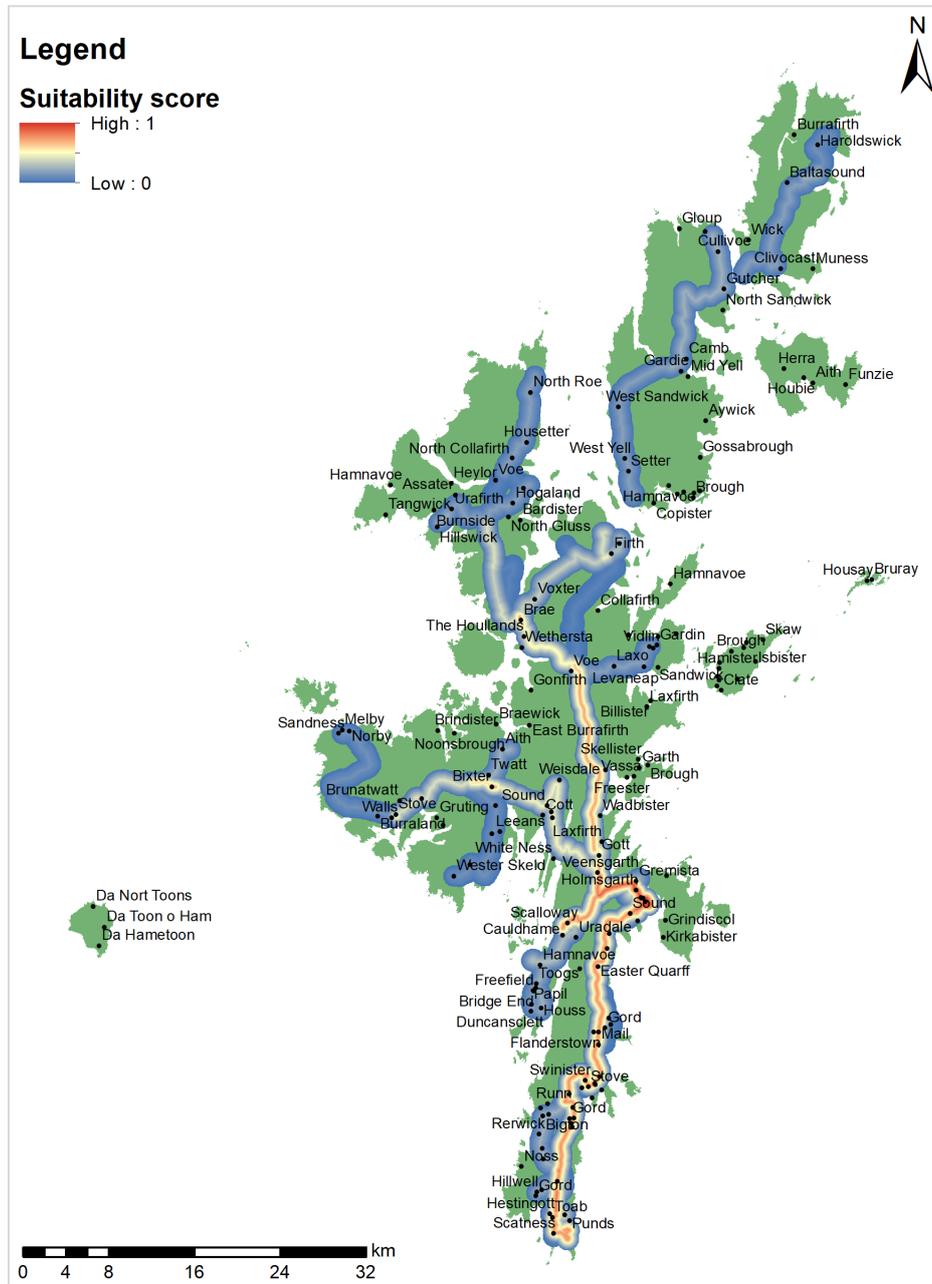
**Figure 3.3 Weekly frequency of scheduled bus trips around Shetland**

Based on the 100 m<sup>2</sup> resolution of the model, the bus routes would only take up a 10 m wide cell in the model. In reality a suitable hub location would not be expected to be located within 10 m of the road. For each grouped section of bus routes (as shown in the legend in Figure 3.3), a distance calculation was run out to 1 km.



**Proximity to bus routes**

It was determined that the hub would need to be sited within 1 km of a scheduled bus route, as it would be preferred that the hubs ideally are at bus stops or very close to them, in order to encourage use of public transport. Cells that are closest to the road were scored as most suitable, with suitability scores decreasing with linear distance from the road. The total number of weekly journeys also played a role, with the most travelled routes receiving the highest suitability scores.



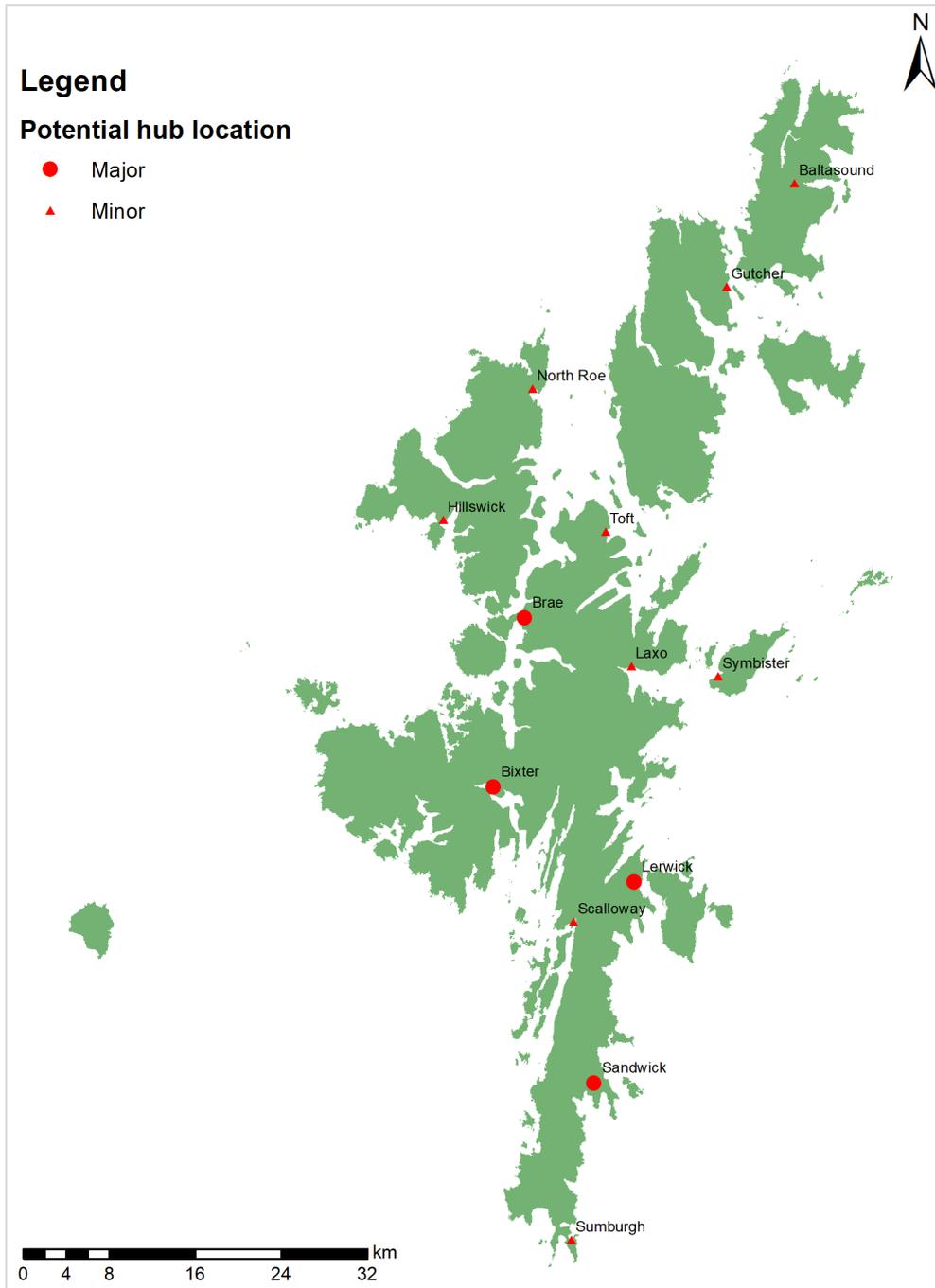
**Figure 3.4 Suitability based on bus routes and frequency**

**Results**

Once all the data had been processed, scored, and weighted, the model was run to provide an output of comparative suitability. The results were presented at a workshop with the project partners. Individual areas of suitability were analysed in more detail and based on the knowledge of Shetland residents 13 sites were selected for taking forward as



potential hub sites. These sites were chosen based on both their overall levels of suitability, but also their proximity to one another. Spacing between the proposed sites allowed for the adoption of a network of hubs throughout Shetland.

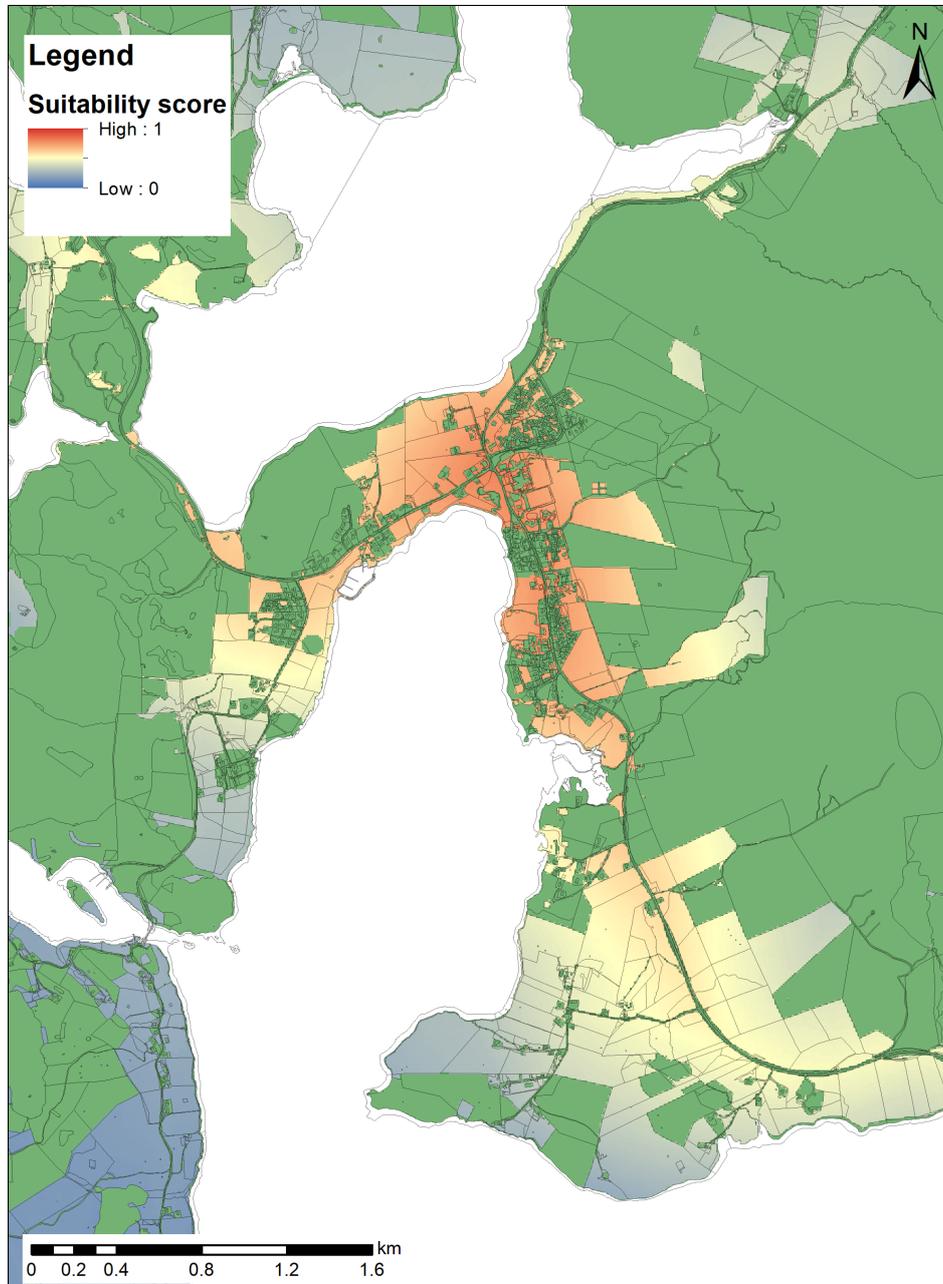


**Figure 3.5 Potential hub network throughout Shetland**

Depending on the overall suitability of the location, the local community and nearby facilities, and therefore the scale of services that might be needed in a hub each of the proposed hub locations was classified as either minor or major.

**Brae**

After Lerwick, Brae shows the highest levels of suitability for a site in Shetland. The large population size and connectivity make this an ideal location for a major hub serving the north of mainland Shetland. Brae has been selected as the location of the pilot hub to be set up if the bid for Phase 2 is successful. Brae is also the closest town to Mossbank, which is the most deprived area in Shetland, and if a link to the Brae hub from Mossbank could be established this would give access to the services of the hub to this community, addressing Just Transition aims.



**Figure 3.6 Overall suitability levels at Brae**

### 3.1.11 Deliverable 1 Conclusion

The four sections of Deliverable 1 and Appendix A and B, setting out the full detail of the literature review and RADMApp analysis, have provided varied and detailed evidence for the selection of the pilot hub location in Brae and for the proposed 12 other locations for hubs. There are maps setting out each potential hub locations as well as other special detail in Appendix B. In Phase 2 the project would do public consultation of the 12 additional locations, to ensure community input into their selection.

As well as identifying Brae as the pilot location further work by the project team has identified the community hall as the potential site. This locations scores highly in the RADMApp analysis and also in the Grid Requirements Study which notes it as a suitable location for rapid charging.

SIC have met with the Brae Hall Committee, who were positive about exploring Brae Hall as the location for the Brae hub, and further engagement with them will be undertaken prior to submitting the bid for Phase 2 in September.



### 3.2 DELIVERABLE 2 - DATA GAPS, ACTIVE TRAVEL

**Identify data gaps – gather existing data from council telematics and existing reports/studies. Examine how to incorporate active travel routes and car club into hubs**

**Non-technical barriers addressed:** behavioural change, financial barriers

**Authors:** Aquatera and CES with support from SIC

This deliverable set out to examine how to incorporate active travel and car club facilities into the rural energy hubs, and to identify any gaps in data that might hinder this analysis.

#### 3.2.1 Data gaps - Aquatera

It was anticipated that there might be gaps in data related to active travel and car club that would adversely affect the ability of the project team to analyse what would be required to incorporate active travel into the energy hubs. However, that has not been a significant challenge in practice.

While there was a lack of GIS data for mapping existing active travel routes in Shetland, the literature review shows there are a series of reports and community engagement workshops that have provided useful information for this study. The only data gaps related to this area identified in the literature review were:

##### *Shetland Community Energy Strategy Conversations Survey*

Main changes identified by participants in the study are (Shetland Islands Council, 2023):

- Lack of resources to empower change;
- Lack of information and advice.

##### *Nort Natters Community Engagement Workshops*

Main challenges identified by participants in the study are (Shetland Islands Council, 2023):

- Perceived lack of communication between travel organisations and the public.

##### *Shetland Regional Transport Strategy*

The issue of carpooling sites being informal, unmanaged, and unrecorded is a gap in data sources (ZetTrans, 2022).

#### 3.2.2 Analysis of How to incorporate Active Travel Routes and Car Club into Hubs - Aquatera

The COVID-19 pandemic has had a big impact on working and travel habits with only half of respondents to a survey undertaken for a SIC report on “Active Travel Strategy” expected to go back to their previous working arrangement. As part of the wider engagement process, respondents indicated a willingness to walk and cycle more but they often felt unsafe due to traffic speeds and volume and lack of dedicated space for people walking and cycling. They also expressed a clear support for investment in walking and cycling, even when it means less space for other traffic.

Some of the challenges highlighted which need to be considered further included:

- Awareness of travel options;
- Cost of travel and affordability;



- Fuel / power issues;
- Integration of travel between modes (e.g., bus to ferry);
- Journey information, including for protected groups who may find accessing information particularly difficult;
- Journey quality;
- Journey times;
- Personal security (fear of crime);
- Personal Accessibility – being able to access transport networks and services specifically including people with disabilities or other protected characteristics which affect accessibility;
- Reliability of journey times (including public transport service punctuality);
- Safety (transport); and
- Travel emissions.

In addition, a number of surveys/engagement activities, including one by NHS Shetland, have identified 4 main barriers to active travel (in order) as: bus routes and times, weather conditions, distance and remote location, and a lack of safe routes. Incorporating a car club (and possibly the hire of e-bikes, or maybe covered electric scooters) into a hub would certainly help in addressing the first 3 of these 4 barriers, by allowing people to reserve an EV (or an e-bike/scooter) in the event that their travel plans do not time with available bus times/routes or during inclement weather.

Creating a ‘critical mass’ of services and facilities at the hubs should also encourage active travel. For example:

- having bus stops in the same/similar location;
- provision of an indoor dry/warm area;
- provision of hot and cold drinks and food;
- a lockable bike shelter (with charging points for e-bikes);
- sources of information on other local services (businesses and tourism);
- technology demonstrators and targeted briefing sessions;
- EV, e-bike/scooter test driving days;
- community drop-in sessions;
- other community events/social gatherings; and
- bike/e-bike recovery/breakdown service (possibly combined with geo-location devices so users feel safer venturing out into more remote areas).

Longer term, the hubs themselves might well support the development of active travel routes with walks and bike trails starting and finishing at them.

### 3.2.3 Orkney Car Club Learnings - CES

#### Introduction

As previously noted, the ReFLEX project ran between 2019 and 2023 in Orkney. One of the multiple aspects of the project was the growth of a 100% electric car club. The following takes data and learnings from the operation of this car club for the purposes of supporting the development of a car club as part of rural energy hubs in Shetland. The current plans by SIC to create a car club in Shetland are set out in the next section 3.6.4.



### 3.2.4 Car clubs

#### How they work

Car clubs offer a convenient way for people to access vehicles and decrease the need for car ownership. They operate through a membership-based system, where individuals can book and use vehicles for a specified duration, typically by the hour or day. Members can book a vehicle through an online platform or mobile app. Typical car club services follow a back-to-base model where the cars are picked up and returned in designated locations within the service area (Halden, 2016).

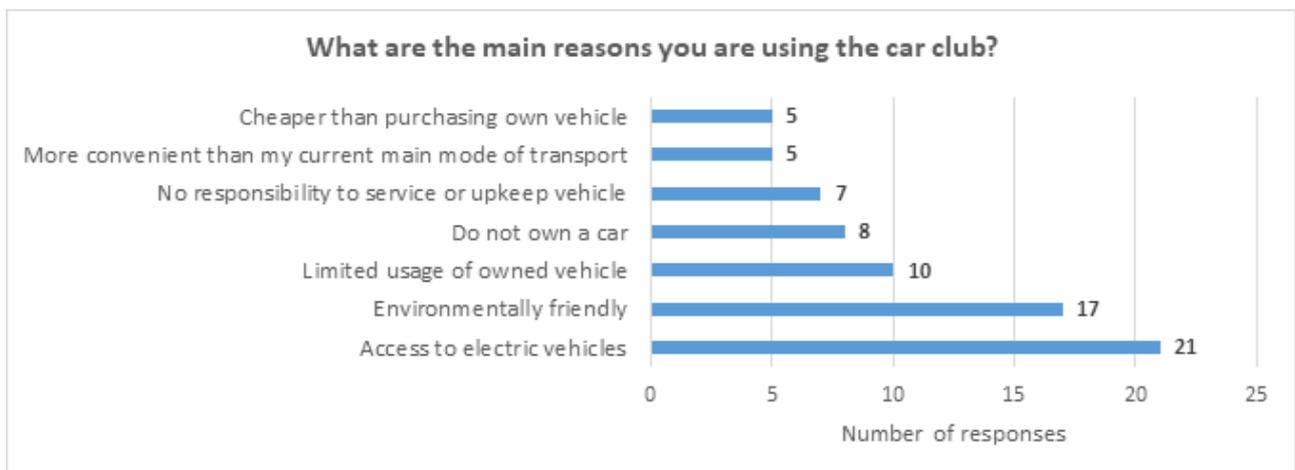
#### Cost effective

In terms of cost-effectiveness, car clubs can be a more economical option compared to owning a private car, depending on the recurrence of the usage. Members pay for their usage (based on booking time and distance travelled), including fuel and insurance costs in the booking price. This eliminates the need for individual expenses such as vehicle purchase, maintenance, insurance, road tax and parking fees. For occasional drivers or those living in areas with limited parking availability, a car club can provide substantial savings (LCA, 2022).

#### Decarbonisation

Car clubs contribute to transport decarbonisation. Indeed, providers typically offer low emissions recently manufactured vehicles, the average age of car club fleet vehicles being 1.6 years compared to eight years for privately owned cars (LCA, 2022) or EVs. The Orkney car club only uses electric vehicles. Contributing to the reduction of carbon footprints also leads to improved air quality in the service areas.

In addition, car clubs decrease carbon emissions by reducing private vehicle usage and promoting active and public transportation. Users of car clubs reported reduced mileage in their own vehicles, especially for those who own multiple cars, as car club membership eliminates the need for additional vehicles (Department for Transport, 2022). Based on an Orkney car club usage survey conducted by CES in 2022, it was found that most service users joined to access EVs and have an environmentally friendly transport solution.



**Figure 3.7 Orkney car club users survey response for service usage motivations (31 respondents, multiple choice)**

#### Use Cases and Car ownership

Car clubs are especially useful when there is no suitable other mode of transport to meet their specific requirement, or if there is no recurrent service. Car clubs can be an opportunity enabler, indeed, 27% of car club members across



Scotland use such services for journeys that they would not have been able to without it (CoMoUK, 2023). In cases where the user is travelling with children or heavy items, car clubs are considered more convenient, comfortable and private compared to public transportation or even taxi services (Department of Transport, 2019).

There is evidence that Car clubs can lead to reduction in car ownership, with 20% of car club users across the UK having sold a personal vehicle following joining a car club. Such behaviour seems to be driven by the cost effectiveness perceived by the service users, indeed, 78% of car club users that have reduced car ownership believed that using car clubs was cheaper for their usage. (CoMoUK, 2023).

**Overview of the Orkney car club**

The service described here as the Orkney Car Club was initiated in 2020, by Co Wheels and OHAL, and was then expanded with the support of the ReFLEX project to two further locations and for further promotion of the usage of EVs and to reduce people’s reliance on car ownership. It was launched only two weeks before the second COVID lock down and uptake of the service was heavily impacted by COVID during the first two years, however it has improved in the past year as the pandemic subsides.

The service currently offers three cars: two in located in Kirkwall (Kirkwall Pier and Kirkwall Centre); and one in Stromness (Orkney Research and Innovation Centre campus). The Stromness car is mainly used by students and local residents and is operated between EMEC and Co Wheels. The Kirkwall Pier EV is predominantly used by residents from the northern isles arriving by ferry and leaving their cars at home, or by tourists and Orkney Mainland residents and is owned/leased on a cost and revenue sharing agreement between CES and Co Wheels.

As presented previously, the service has three electric vehicles to hire:

- one award-winning MG4 family hatchback available in Kirkwall Pier, and one in Stromness
- one spacious-sized SUV MG ZS EVs available in Kirkwall Sommerville Square.



**Figure 3.8 MG4 Orkney Car Club vehicle available to use from the Kirkwall Pier location**

CES ran a survey in 2022 to gain some feedback on the service and results showed at least 4 recurrent Northern isles users no longer bringing their vehicles to the Orkney mainland. Case studies have been conducted and extensive positive feedback was presented by students of the Heriot-Watt MSc.

### **Pricing**

The current car club vehicles can be rented for the price of £5.95 per hour or £47.6 per day for the MG4 vehicles and £6.70 per hour or £53.60 per day for the MGZS EV. There is an additional cost of 12 pence per mile driven also charged to the user. (Co-wheels, n.d.)

## **3.2.5 Orkney car club targets and barriers**

### **The identified target population for the Car Club usage**

The target population for the service is wide, indeed, as many members of the public as possible should be reached for the service to be financially viable.

One of the primary target audiences of the car club are the **residents of the isles** that come to the mainland by either ferry or plane. The aim is for them to access a reliable EV and reduce the need for bringing over their vehicle by ferry or own a second vehicle on the Orkney mainland to get around. With sufficient vehicles to offer, this could result in lower personal vehicle ownership and the shift to sustainable transport options.

More widely, **residents who do not own or only need to use a vehicle occasionally** would benefit from the car club service continuing to develop in Orkney. In 2022, 73% of CoMoUK survey respondents said that they joined the car club because they do not often need a car (CoMoUK, 2023).

**Electric vehicles enthusiasts** would benefit from the service as it gives them access to recent different models of EVs that they can drive without requiring to purchase one.

Another important target group are **students that need** vehicle access occasionally. In the case of Orkney, at the Orkney Research and Innovation Campus (ORIC) in Stromness for example, there is a mix of international and non-local students that do not own a personal vehicle. Having the car club next to the campus has been useful to them and some have been using it regularly.

A focus should be made on **local businesses and organisations** willing to lower their carbon footprint for work trips. Engagement with businesses could help car clubs see a higher usage rate.

Orkney islands have few options with regards to car hire and those can be expensive as is the case across the UK. Therefore, **tourists** that would like to hire a private car to explore the Orkney mainland are a good target for the car club also. The vehicles, therefore, need to be accessible by the main entry points of the island (airports, ferry terminals).

### **Identified barriers to the development of a larger-scale car club across Orkney**

#### **Car clubs typical barrier**

Car clubs can be **perceived as an expensive option** to travel since they require paying for the duration of the booking as well as the distance travelled. This is especially true for people that have already invested large sums of money in a vehicle; the marginal cost of driving their own vehicle is likely less than hiring a car club vehicle.



**The unfamiliarity with EVs** can result in a negative perception or an apprehension of using an EV including range anxiety. Driving an EV is also not intuitive for those used to petrol/diesel manual vehicles.

The **unfamiliarity with Car Clubs** can result in a negative perception of the service or an apprehension of using a Car Club. In a rural place like Orkney this is not something common like in big cities, so the service should be demonstrated. The **existing dependence on a private vehicle** can make the switch to a shared vehicle more challenging. For people that have a strong dependence on a vehicle for everyday survival, the impact of a vehicle not being available when needed is much larger than that of someone who has different travel options (such as walking, use of public transport, and lifts from others) or more flexibility in when they need a vehicle to undertake a journey.

### Orkney wide barriers

**Lower population density** in rural environments makes it harder to achieve the critical mass of varied users needed to make an EV Car Club economically viable. Due to the limited population density, multiple vehicles per location could be hard to justify, a **limited number of vehicles** are available in the Orkney Car Club. This can lead to the unavailability of vehicles for users when they want to use it which could lead members to lose trust in the service reliability.

The fact that the **vehicles can only be dropped back at the same pick-up location** also reduces the options for people to use the service as sometimes the vehicle could be needed to go from a point A to a point B without the need to get back to A so it becomes non-practical to use the service in that use case.

As Orkney is a **rural location**, not all residents are able to easily access the car club at the three locations. Residents living outside of the main settlements would struggle to access the car club vehicles without using another means of transport to reach the current locations. There is an opportunity here for some to cycle or get the bus to get to the service, but this may not always be practical in all cases (due to distance, weather conditions or existing bus routes).

The **visibility, awareness, and trust** of the service is key for the residents to be able to join and use the car club. At the moment, the ORIC and Kirkwall Pier locations are not necessarily directly visible to every Orkney resident which limits the service uptake. There also needs to be trust that the service will continue.

**COVID-19** was also a barrier to the use of the service. The vehicles were kept available throughout the pandemic with a strict cleaning regime, but many people did not want to risk it at the height of the pandemic.

### Survey evidence

A survey to gain feedback on the Car Club service was created in April 2022 and sent to the car club members and ReFLEX members interested in the service. The survey had a total of 46 respondents among them 35 were car club members.

Among the 46 respondents, 18 had never used the service (even if members). The main reasons stated why they had not used the car club seemed to be the reduced convenience compared to using their personal vehicle (with 13 of 15 respondents selecting this answer) as well as the accessibility of the locations (6 of 15 respondents selecting this answer) which reflects the challenges cited above.

### Understand the opportunity

As part of the Orkney Car Club Usage survey presented in the previous section, feedback received from respondents showed that additional locations at the mainland ferry terminals servicing the isles, the Hatston ferry terminal, Kirkwall Airport, as well as other locations around the mainland were desirable. Additional vehicles at existing locations were also suggested in order to ensure vehicle availability when booking. Even though the number of respondents was low, the



engagement rate of car club members was more than 10% so this is an encouraging sign that there is demand for a wider car club in Orkney. Of the 944 member of ReFLEX Orkney 318 expressed an interest in using the car club in their membership application form.

This section will therefore focus on assessing the viability of such expansion using the recorded car club usage figures as well as the ferries and Kirkwall Airport utilisation statistics.

## Car Club historical usage and revenue analysis

### Financial feasibility

The car club in Orkney has benefitted from grant funding from Energy Savings Trust, Innovate UK and Paths4all to trial different models of the car club and to encourage more sustainable travel choices. However, to reach financial self-sustainability a certain level of use of the car club is required. A ten-year cashflow forecast has been used to identify the number of bookings and type of bookings needed for a car club to be self-sustaining. For this assessment the car club is considered self-sustaining if the Net Present Value (NPV) is positive (using a 2% discount rate). For simplicity, utilisation rates have been increased by whole percentage points<sup>1</sup>. Higher utilisation rates improve the NPV in every scenario investigated below.

It is assumed that a car is not purchased but leased by the club operator. Costs in the first year have been estimated at ~£15,000 and this includes installing a domestic style charger (£1,200 where network reinforcement is not needed); staff costs; lease of vehicle and service provision; and a nominal lease on a car parking space. It is assumed staff costs in the first year are twice that of the subsequent years due to additional effort to set the car club up including negotiating contracts and advertising the car club. There will also be annual electricity costs associated with the charger and public charging. It is assumed this will cost 30p/kWh and the vehicle will have an efficiency of 4 miles/kWh. The Co Wheels car club pricing has been used in this assessment. A standard vehicle costs £5.95/hour to book but if the vehicle is booked for more than 8 hours in any given 24-hour period, the cost is capped at 8 hours. Effectively a 24-hour booking costs £1.98/ hour. Mileage is charged at 12p/mile. Two estimates for number of miles driven have been used: the first assumes that each booking will result in 37 miles driven. In reality, there is a correlation between length of booking and number of miles driven. 01.53miles/hour booked was also used. Both are derived from the same data in 2021 and 2022 and skews the results differently for short and long bookings. Multi-day bookings often have lower mileage / hour booked due to overnight stays. It is assumed that the number of bookings, utilisation, and miles driven are the same from year 1 to simplify the analysis. In reality, it will take a few years to reach financial self-sustainability.

Results tables for varying booking length to achieve financial sustainability.

**Table 3.7 Miles driven per booking**

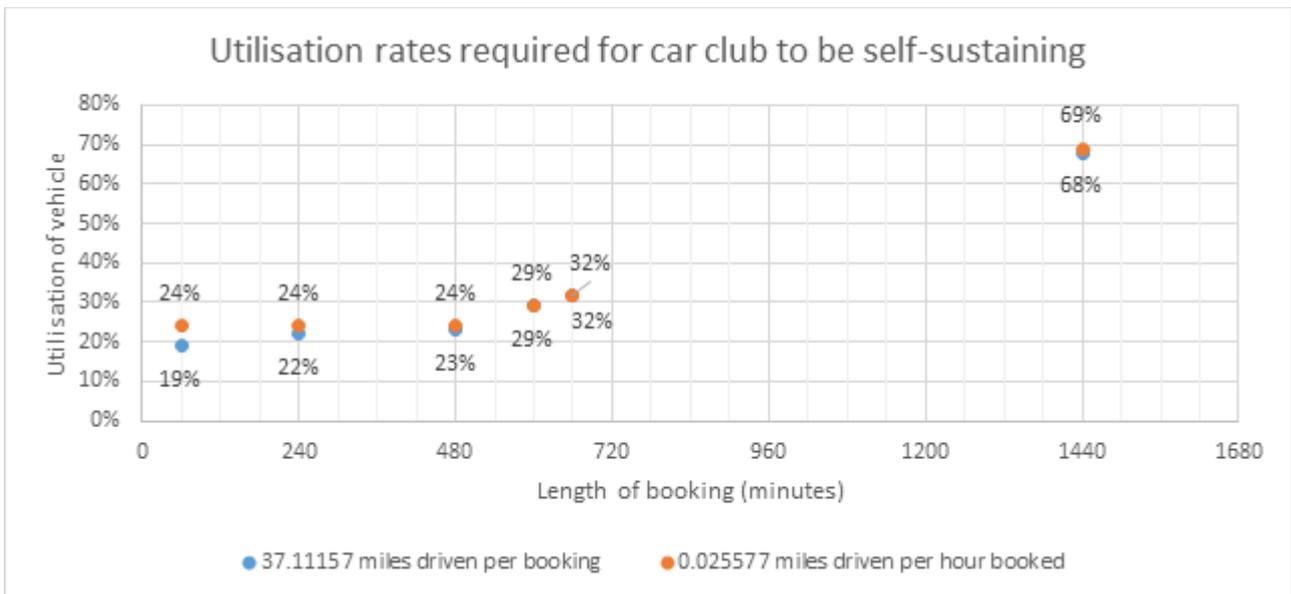
	37.11157 miles driven per booking					
Average booking length (min)	60	240	480	600	660	1440
Miles driven	61,768	17,880	9,347	9,428	9,457	9,211
Number of bookings	1664	482	252	254	255	248
Utilisation rate	19%	22%	23%	29%	32%	68%
Internal Rate of Return	41%	7%	13%	19%	21%	2%
Net Present Value	£5,397	£640	£1,518	£2,417	£2,743	£21



**Table 3.8 Miles driven per hours booked**

	1.53 miles driven per hour booked					
Average booking length (min)	60	240	480	600	660	1440
Miles driven	3,226	3,226	3,226	4,033	4,302	9,276
Number of bookings	2102	526	263	263	255	252
Utilisation rate	24%	24%	24%	30%	32%	69%
Internal Rate of Return	26%	26%	26%	3%	7%	13%
Net Present Value	£3,372	£3,372	£3,372	£182	£659	£1,490

If all bookings are 24-hour bookings, then a utilisation of 68-69% is needed for financial sustainability. If bookings are only ever up to 8 hours, then a utilisation of 23-24% is needed for financial sustainability. If the average booking is one hour, then 19-24% utilisation is needed for financial sustainability. In 2022, the average length of bookings was 651 minutes (between 10 and 11 hours) suggesting a utilisation of 30-32% is required for the car club to be self-sustaining or more than 250 bookings per year. However, some multiple day bookings skew this average booking length and a utilisation of between 20 and 30% is likely required with more intraday bookings.



**Figure 3.9 Sustainable utilisation rate**

### Orkney Car Club Kirkwall Pier usage

One of the locations presented in the previous section was already host for one of the Orkney Car Club EVs. Indeed, the Kirkwall Pier weigh bridge building is one of the car club locations operational since 202

The usage recorded for that car club location can help estimate how potential additional locations would perform if the car club was to expand. It should be noted that the Kirkwall Pier has not yet reached financial self-sustainability.

As mentioned before, the Car Club was launched during the COVID pandemic which had an impact on the people’s willingness to use the service. On top of that, it took time for the service to gain visibility and the vehicle’s usage increase.



The Orkney Car Club usage survey conducted highlighted that the Kirkwall EV was practical for the Northern Isles residents (5 out of the 5 survey respondents living on the Isles have used the vehicle). Three of those users also suggested making an additional vehicle available in the future to ensure the availability of the car in peak season.

**Kirkwall Pier EV statistics**

The car club Kirkwall Pier vehicle has showed the best results over the year 2022. Indeed, in terms of its utilisation rate, which represents the share of time the vehicle was booked for, it reached a higher figure in **2022 with 16% of utilisation across the whole year** compared to 13% in 2021 (see Figure 3.10 and Figure 3.11 present the monthly miles driven and number of bookings of the Kirkwall Pier Car Club vehicle in 2021 and 2022. Those statistics show that the miles driven vary significantly throughout the year with, for 2021, as little as 64 miles driven in January 2021 for two bookings and, for 2022, 95 miles driven for 5 bookings in November 2022.

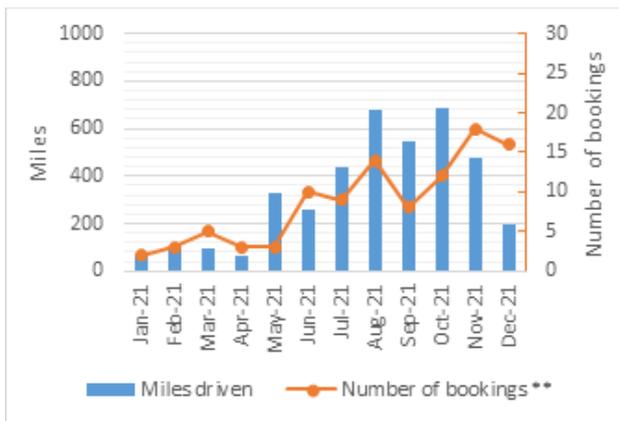


Figure 3.10 Kirkwall Pier Car Club statistics for 2021

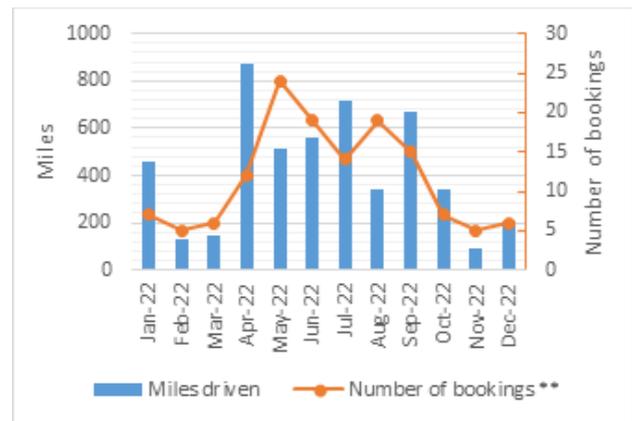
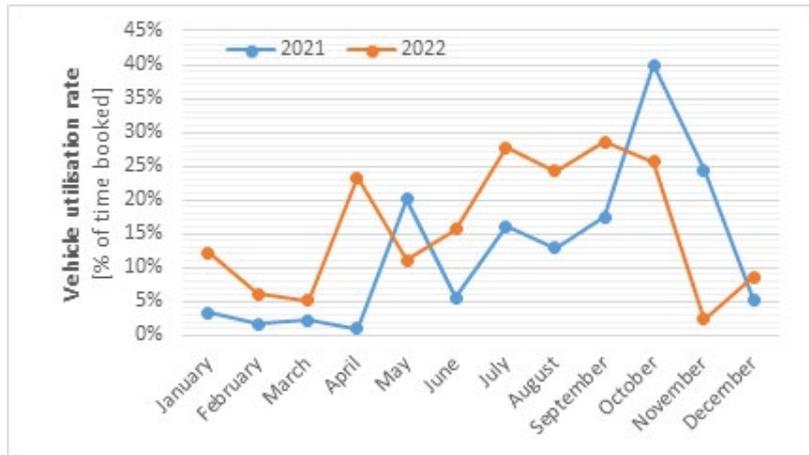


Figure 3.11 Kirkwall Pier Car Club statistics for 2022

In terms of number of bookings, the graphs show that there is a big disparity from one month to another, with a **slight correlation to the season**, with higher usage in the summer. Across the two years period of data, the car has known 11 months with 10 bookings or more per month which is promising. On the other hand, the car club struggles to reach those figures consistently with few bookings in the January to April 2021, February to March 2022 and the October to December 2022 periods. **The winter only does not explain this low usage** as the November 2021 to December 2021 showed higher car club usage with above 15 bookings those months, which suggests **other factors had an influence on the number of bookings**.

There is a slight correlation between the number of bookings and miles driven with typically more mileage for more bookings, but no linear relation between the two. Indeed, months with lower number of bookings than others can result in higher mileage and vice-versa (comparing April and May 2022 for example) which suggest **a high variability in the users distance driven per booking**. Each booking can vary in length.

The utilisation rate (UR) of the car club vehicle is the best indicator of the potential financial sustainability of the service. Indeed, the service being paid by period of time (daily or hourly), the higher the utilisation rate the more revenue to the car club.



**Figure 3.12 Utilisation rate of the Kirkwall Pier vehicle for 2021 and 2022**

As a rule of thumb, a figure of 25% of utilisation rate is the threshold for a financially viable service (which is aligned with the figures obtained in the previous section). Looking at the UR for 2021 and 2022, only 7-months have showed URs above 20% and only two of those months in the May to August period.

Some positive high utilisation rates occurred for the months of October 2021 and 2022 and high usage for November 2021 too.

### Driving Behavioural Change to expand the car club

There is evidence that the car club service provides some of Orkney residents and visitors’ needs. Indeed, the service has shown rising usage figures since its launch in 2021 as presented in the previous section. On top of that, Orkney has a need for easy to access and affordable "hire" vehicles, since few options exist at the minute. A number of Orkney visitors have raised the issue of the lack of options for car hire in Orkney and have shown interest in the Car Club vehicles (ReFLEX customer team got contacted multiple times for Car Club queries).

However, the service so far offers limited vehicles and has not met financial self-sustainability which could be a sign that more efforts need to be deployed to promote the service. The following sections highlight the need for the service to mature and potentially expand.

### Ensuring a reliable service

One of the first points is for the service to give **access to reliable electric vehicles**. Vehicles that are relatively new and less likely to have faults need to be prioritised. Higher ranged vehicles offer the possibility for users to travel longer distances and reduces the potential for the vehicle to be at low charge with successive bookings. As part of the car club survey deployed in 2022, range anxiety was mentioned as an issue for a few people using the service.

Car club users need to make sure they can book a vehicle when needed. For that, the booking system needs to be functioning well and indicating clearly to the user the times when the car is available and provide customer support in case of booking issues. Multiple vehicles available in one location would help improve the availability of the service however lower population densities / potential users prove a challenge as the previous sections demonstrates. The usage of the service needs to be significantly higher to justify multiple vehicles in a financial self-sustainable model.



## Education and community engagement

A key learning for the Shetland car club is that **Education** is vital for people to adopt the car club. People need to understand how the service works and the advantages it has compared to car ownership. Potential use cases of the service in the Shetland context need to be presented to the public.

In addition to the previous points, **guideline materials** need to be placed in vehicles, to provide more information about the EV driving and charging as well as the car club service to support users.

In conjunction with the SIC and the local development trusts, key stakeholders should be identified per area and engagement events should be organised to identify local need, build trust with the local communities, manage their expectations, and answer queries when needed. Communications supported by evidence and previous user's experiences could be used to help with the engagement (Department for Transport, 2022).

Car club and EV **familiarisation events** are necessary for the service development, with **booking system, vehicle usage and charging demonstrations**. This would decrease anxiety associated with service and EV unfamiliarity. Such community engagement could happen during the Shetland agricultural shows happening in the summer, where a large volume of residents would be in attendance and would definitely be a great opportunity to showcase the car club on top of targeted events to the different isles in collaboration with the Development Trusts and community groups.

## Promotion

Raising awareness of the car club existence is key to increase the service uptake. To do so, efforts need to be made to promote the service.

**Blog posts and case studies** on the car club could provide feedback of the service from users and then increase the profile of the car club for Shetland residents and improve the trust they have in it. Different groups around the islands using the vehicles could be interviewed (NGOs, charity group, students) to demonstrate to Shetland residents the different usage possibilities of the car club.

Increasing **the visibility of the car club online** would also definitely be helpful. This could be done through actions such as:

- Adding Google Maps pins for vehicle locations around Shetland if possible, to increase visibility of the service by people in Shetland;
- Exploring the possibility to link the car club supplier to search engine searches including "Shetland Car Hire/Rental";
- Ferries/Loganair/tourist/accommodations provider websites: approach those websites to promote the car club, to increase awareness of the service in tourist visiting Shetland and struggling to find affordable car hire (Car Club is a cheaper option);
- Supplier/ReFLEX Shetland/SIC/CES websites and social media posts: Post latest updates and Car Club content on websites and social media.

To reach the isles communities, **information leaflets** would need to be distributed in Shetland Ferries and Ferry Terminals. The information should promote the usage of the car club as a sustainable travel choice reducing the carbon footprint from fewer vehicles on the ferry, the short walk to the EV and the use of a new zero-emission vehicle when on Shetland mainland.

On a similar note, flyers could be distributed in Shetland Airports to promote the accessibility of the car club vehicles. This could increase usage of the existing car club locations.



Local media such as Radio Shetland and The Shetland Times could be used as platforms to raise the service’s visibility and understanding.

### Incentives

Incentives could be a really good way to build the interest in the Shetland Car Club. Those incentives could take the form of free membership, free driving credits or discounted rates for the car club utilisation.

Such incentives should be applied at the beginning of new deployments to ensure raising the interest in the service and give the opportunity for people to try the service without a financial barrier and decide from there how much this service satisfies their need. These should apply for a long enough period to ensure achieving a sufficient mass of users for the different car club locations.

These incentives would reduce the income from the developments in the first place but are key to ensure higher usage of the service in the first place and retain car club users.

### Additional recommendations

Engagement with businesses could help car clubs see a higher usage rate and could be beneficial both for the general public and businesses. This could be a good opportunity for businesses not benefitting from a fleet of vehicles to access one, reduce their carbon footprint using EVs and could cut on business travel costs.

Businesses and general public uses would have different usage patterns and use the vehicles at different times, maximising the car club usage potential (LCA, 2022). A location with mixed office space and residential properties are likely to benefit from this dual usage so engagement locally should be undertaken.

An additional scope for the car club would be to include other models of vehicles other than 5-seater cars; minibuses or vans for examples. Recent engagement with the Brae Hall and the Delting Football Club highlighted that a hireable electric minibus would be a helpful asset to the community. Currently, volunteer car drivers are relied upon for driving sports teams to games across Shetland. An available minibus would be able to reduce the dependency of these volunteers and reduce the driven miles by their cars. Prior to 2012, the Community Planning and Development department at the SIC operated a hireable minibus. This popular service was unfortunately removed due to budget cuts in 2012 but highlights a demand with the current business case.

There are multiple ways the council could support the development of the car club, set out in the next section. Examples of council support from previous locations include (LGA, 2022):

- EV charging infrastructure development;
- Parking provision and permits;
- Funding seeking;
- Marketing the car club and raise public awareness; and
- Stakeholder engagement.

### 3.2.6 Shetland Islands Council Car Club project - SIC

The Shetland Islands Council has recently commissioned a project to trial a car club implementation to speed up fleet decarbonisation, make more efficient use of the existing fleet and overcome barriers to efficient Service delivery where the local authority must work more collaboratively with partner organisations. Additionally, although not one of the primary objectives, the local authority wishes to make the authority supplied car club vehicles available to the public



when not required for business use. The initial trial is intended to be 10 vehicles spread across key locations, including outside Lerwick. The Car Club project has identified many of the same locations identified in the Shetland Rural Energy Hubs project to locate EVs and the associated infrastructure for similar reasons including proximity to population centres, community hub hotspots and 3 phase power availability. While the Car Club Project was commissioned by SIC prior to the energy hubs project, there are useful learning from this Phase 1 Report and SIC will seek to integrate the car club with Phase 2 activity where possible.

## Barriers

The local authority faces similar barriers to a community car club implementation – set out in the previous sections - in that the existing council fleet vehicles are often underutilised and therefore transferring their operation to a car club does not make sense from a purely financial standpoint. The changing face of service delivery, especially in the care sector where there is an increased focus on community care at home, often with the aid of health professionals and 3<sup>rd</sup> sector volunteers, means the traditional model where the fleet is owned and insured in-house is no longer meeting the needs of this Service sector. At present only Council personnel undertaking Council business are able to drive the vehicles. Moving to the car club model would facilitate a much greater level of flexibility and the potential for additional community benefit.

## The opportunity

There is potential to trial an amalgamated (community and local authority) car club model whereby vehicles are housed at, or near, existing authority buildings and are block booked for periods required to deliver Council Services. Vehicles would then be made available for the community to book out with these times, which may make the car club sustainable even in rural areas where this would normally be unachievable without subsidy. Should this trial be successful, SIC would aim to decrease the number of vehicles it owns and increase the number of car club vehicles it uses across the Islands. This aligns well with the aims of the Shetland Rural Energy Hubs and provides a clear opportunity to overcome one of the main non-technical barriers to car club operations in rural areas.

### 3.2.7 Deliverable 2 Conclusion

Some of the barriers to active travel can be reduced by the development of local energy hubs. The provision of an EV based car club would be a key component of this, helping to address both local emissions, and mobility accessibility and affordability. As is often the case in sparsely populated rural communities demand volume is relatively low and therefore it is important to look at spreading fixed costs, such as facilities and supporting infrastructure across a number of services. Asset utilisation is also important to help keep down user costs. The energy hubs can provide a focal point for a number of initiatives and help create a 'critical mass'. They can also be used for promotional, awareness raising and educational activities to widen their impact in delivering local decarbonisation.

Early demonstration of the hub concept is an important next step for achieving net zero in Shetland. The development of the hub can build on the work of the ReFLEX project in Orkney, including the roll-out of the car club and provision of new and second hand EVs, and support tailored to the requirements of an island community.



### 3.3 DELIVERABLE 3 - ENGAGING COMMUNITY

**Examine routes to drive behavioural change for engaging community to use hubs.**

**Non-technical barriers addressed:** behavioural change.

**Author:** CES with support from SIC

For this deliverable, led by Community Energy Scotland, CES organised a series of community engagement events and did a public survey completed by almost 400 people, with the aim of gathering feedback on what the public would find useful in the energy hubs. In preparation for this engagement work, they undertook a literature review, additional to the main project review in D1, that focused on the specific areas they planned to engage with the public on.

#### 3.3.1 Stakeholder Engagement Plan

While the current literature, on the previously mentioned studies, offers insights into the transport, heat, power and facilities priorities of Shetland residents, there were some data gaps that needed to be addressed. Further research was needed to understand the specifics on behavioural changes to implementing net-zero transport and energy solutions in the area. Furthermore, there is a need for comprehensive data on the level of bicycle ownership, barriers to active travel, and the availability of safe routes in Shetland.

To fill these data gaps, a stakeholder engagement plan for the Shetland Rural Energy Hubs combined quantitative data from the county-wide survey and qualitative insights gathered through community drop-in sessions and one-to-one interviews. The following provides more detail on the design and results of these.

This comprehensive approach ensures that stakeholder input is considered, addressing specific requirements and fostering collaboration. The plan recognises the importance of ongoing stakeholder engagement to create opportunities for dialogue, address concerns, and maximize community engagement and commercial interests. Through this approach, the plan aims to successfully implement the energy transport hubs in Shetland.

#### Online Survey

The purpose of the survey, built on Survey Monkey, was to gather feedback and opinions from the community regarding the potential services and priorities for the Shetland Rural Energy Hubs. This survey built on previous community engagement events already undertaken throughout Shetland around the topics of decarbonisation and sustainable living, such as the Nort Natters events, Climate Conversation Workshops, and the Brae Energy Review. It is vital to understand what services would be most valued by local communities to aid them in decarbonising.

These services could include EV charging, a community car club, e-bike rental, secure cycle storage, EV transition support, district heating, community waste management facilities, office workspace, and opportunities to explore renewable and energy-efficient technologies. The survey sought to gauge interest in these potential services and gather suggestions for additional services or highlight their barriers. The survey aimed to gather information on residents' perspectives and priorities regarding heat and power, transport options, and other facilities like waste management. The survey had 46 questions and a total of 393 responses were collected, with a range of participants from various age groups. 97% of results were completed by individuals and 4% was completed by organisations. The survey was completed by residents from all regions of Shetland, the region with the most responses was Yell with 21% responses. Mid Yell Development Company (MYDC) were subcontracted to engage with the community to get more surveys



completed; this resulted in approx. 50 surveys being completed and the resulting high percentage of representation. It was not possible to secure the subcontracting arrangements with other community organisations.

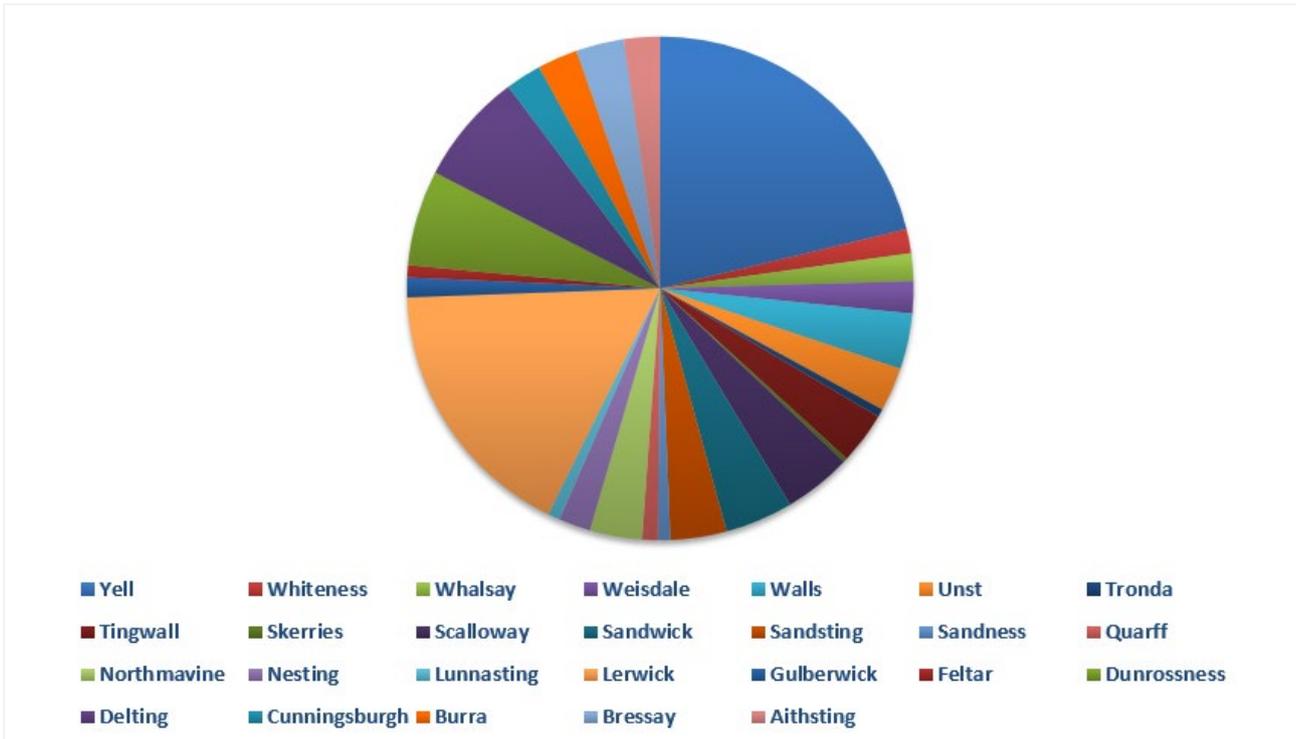


Figure 3.13 Survey responses by Shetland Parish's

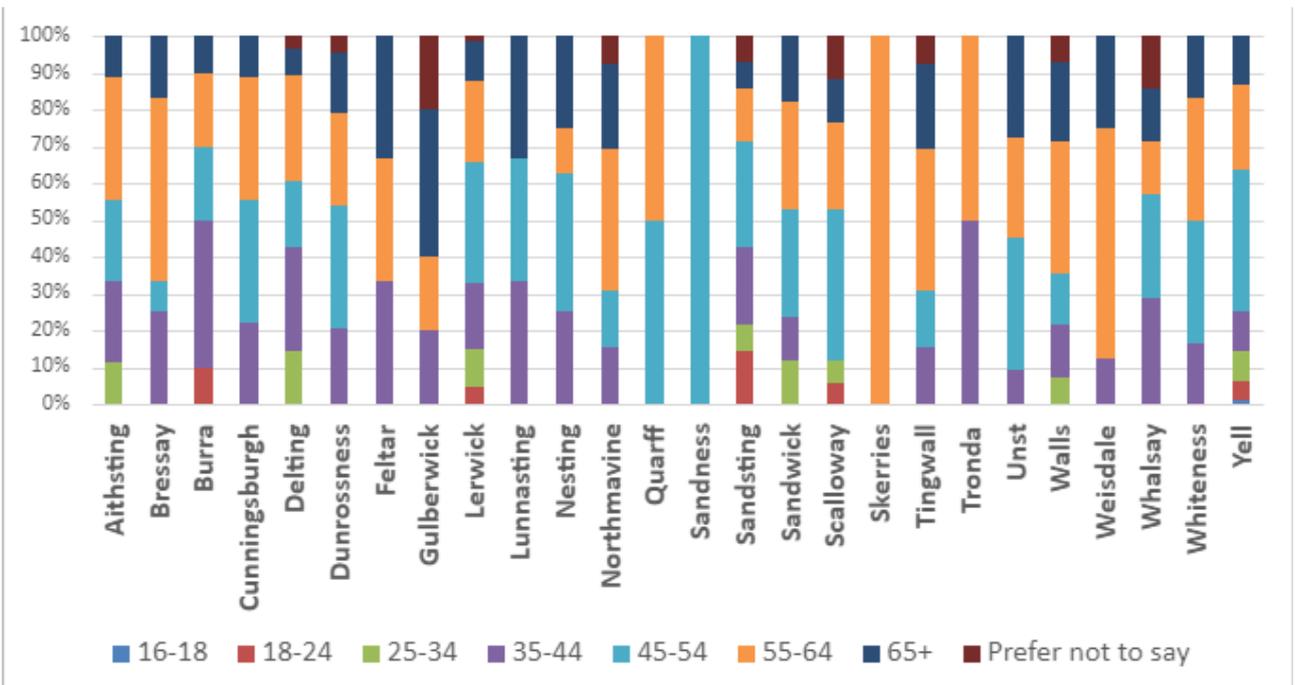


Figure 3.14 Parish and Age Demographic

### Community Drop-in Sessions

As there are multiple aspect of this report’s investigations, time and energy were focused on Brae, Scalloway and Yell for the in-person community drop-in sessions. These sessions were designed to allow the community in those areas to inform the project which services were desired, practical and feasible in those locations; building upon the acknowledgement that services within the hubs will vary from location to location.

Printed material was produced to ensure attendees could read up on the concept of rural energy hubs, while also seeing examples of other transport hubs in Scotland. The principal methods of getting information from the attendees was: paper headed with the service in question for attendees to leave comments with post-its or written notes, and a map of Shetland and the local area for additional locally specific data to be provided.



**Figure 3.15 Community Drop-in Session Set-up**

The scheduling of the drop-in sessions was to allow for enough responses from the online survey as well as internal development by the project partners. These took place on three consecutive days during the 8<sup>th</sup> week of the project (out of 13 weeks):

- Tuesday 22 May: Brae Community Hall
- Wednesday 23 May: Scalloway Community Hall
- Thursday 24 May: Mid-Yell Community Hall

Unfortunately, attendance to the drop-in sessions was particularly low, with only a total of ten attendees across the three events, in contrast to the 393 online responses. It is believed that one of the main contributions to the low attendance was the tight timescale available to allow the literature review to inform the stakeholder engagement plan, to then design and advertise the events. For the stakeholder engagement for Phase 2, it is hoped that having buy-in from the community at an early stage would have much greater effectiveness in gaining greater engagement. The relationships established within Phase 1 will significantly contribute towards this.

The other factor which is believed to have contributed to the low attendance, is the possibility of too much surveying. A number of the community expressed that they do not believe there is enough action being taken from previous

stakeholder engagement, and they feel there is a higher importance of implementation rather than further engagement, this was often cited as 'survey fatigue'. This was acknowledged by project partners all the way through the stakeholder engagement planning but felt the REH concept was breaking new ground and just couldn't logically proceed without engaging the community. However, this should be taken into consideration during the Phase 2 planning, with initial plans available in Section 7.3 (Phase 2 Planning).

From those who attended there was expressed interest in the prospect of a rural energy and transport hub in each of the areas and feedback on how these could benefit the local residents in terms of both infrastructure and transportation.

There were calls for an integrated skip system in Mid Yell. This is not a unique situation to Yell as the rural skip service was scrapped by the Shetland Islands Council back in 2012 due to a lack of funding. This has resulted in expensive trips to Lerwick to dispose of rubbish, and a significant increase in fly tipping across the isles.

One commented on how a car club and e-bike hire/storage/charging station could be of real benefit to Yell. They stated that if there were a car club available on the isle, they could potentially look at reducing the number of cars in the household from 2 to 1. They would also be able to use their e-bike more often if there were storage facilities at ferry terminals. A final comment was that the potential for people to try e-bikes before they consider buying one would increase usage in e-bikes across the isles.

There wasn't much comment on the potential for hot desks or rural office facilities, however there was more interest in the potential for a café/self-service/meeting up areas. One suggested using the struggling local Leisure Centres as facilities other than for 'sporting activities' and expand these into potential rural hubs for things such as cafes and non-sport facilities. These leisure centres could also be used for EV charging points, E-bike charging points, and hubs such as car clubs due to their central locations across the isles, and the significant car parking space outside each centre.

Another person commented around the expansion of dial-a-ride services across Shetland, or the potential for each local community to have an electric minibus and spoke of the huge success in community electric vehicles in Northmavine and Fetlar.

Another commented on the significant lack of EV charging points across Shetland and if the islands are to meet government targets of stopping diesel and petrol vehicle sales by 2030, a significant and rapid expansion of EV charging points across Shetland is absolutely necessary to facilitate this and make sure Shetland doesn't fall behind. They stated that rural energy and transport hubs across Shetland "would go some way to facilitate this".

The Northmavine Scrapstore was mentioned a few times during the drop-in sessions, and there were comments on how other local communities in Shetland, including in Lerwick and Nesting, have developed their own recycling centres and upcycle centres for community benefit. These sorts of ideas would have a positive impact on local communities and cut back on 'unnecessary travel'.

Finally, the team also heard from one individual who thought that the idea of rural transport and energy hubs overlapped significantly with other projects happening in Yell, namely the Carbon Neutral Islands project, and suggested that any funding available could coincide with that project.

The drop-in sessions were low attended but the feedback from those who did attend was generally positive and they saw the prospect of rural energy and transport hubs in their localities as exciting and in some cases, necessary to meet government targets going forward.



## Stakeholder Interviews

In-person events and one-to-one interviews were conducted to engage stakeholders, including:

- transportation companies;
- environmental organisations;
- local businesses;
- community anchor organisations;
- heating contractors; and
- skills development organisations.

These one-to-one interviews facilitated qualitative discussions and gathered insights to inform the decision-making process, specifically for businesses. Please reference Section 6.1.4 (Deliverable 8) and Deliverable 11 for this information and findings. By integrating the survey data and workshop insights, the stakeholder engagement plan aims to understand the diverse needs and perspectives of stakeholders.

## Climate Festival

Both CES and Aquatera attended Shetland’s first climate festival on the 9<sup>th</sup> and 10<sup>th</sup> of June. The attendance was designed in the stakeholder engagement plan to further raise awareness and discuss the project with the community, seek feedback on some of the proposed conclusions being made by the project partners, and as a final opportunity to feed information into the feasibility stage of this project.



**Figure 3.16 Shetland Climate Festival**

The added benefit of attending this event was the collection of over 35 Shetland-based organisations in a single location; some of which it had not been possible to secure an interview from previously. Furthermore, the morning of the Friday was focussed on school groups attending the Climate Festival. This presented the project team a chance to get the perspective from young people and their thoughts on the priorities in the community.

### 3.3.2 Hub Service Findings

The following sections go into greater details across transport, power, heat and services; with relevant material from the literature review, gaps in the literature and relevant survey results presented.

#### Transport

##### *Transport Literature Review*

According to the Yell Climate Action Plan, transport received the most unanimous consensus from residents, with the implementation of fixed transport links such as bridges and tunnels being a priority. Regular island bus services aligned with ferry transport and better off-island bus services were also desired. The irregularity and inflexibility of public transport links were identified as major reasons for underutilization. Private car ownership in Shetland is one of the highest in the UK, indicating a lack of trust in the current local infrastructure.

Residents expressed a desire for fast chargers for electric vehicles in public buildings to alleviate range anxiety. The implementation of rural energy hubs with charging facilities for electric vehicles and public buses, along with transport links for buses and car sharing facilities, could address these concerns and encourage a shift towards sustainable transportation methods.

In addition to addressing range anxiety and promoting sustainable transportation methods, it is crucial to acknowledge the specific needs and challenges of the community. For instance, in Yell it has the lowest utilised rapid charger in the area, namely the Ulsta Shetland Ferry Terminal with a 43 kW rapid charger, which is currently being utilised at a rate of only 0.44%. Exploring the reasons behind this underutilisation and identifying the barriers, including behavioural factors, can provide valuable insights into improving the effectiveness and uptake of electric vehicle charging infrastructure. Understanding the low usage of the Ulsta Shetland Ferry Terminal rapid charger requires a deeper investigation into various aspects. One possible area to explore is the current level of awareness among residents regarding the availability and benefits of electric vehicle charging facilities. It is essential to educate the community about the advantages of electric vehicles, the convenience of fast chargers, and how they can contribute to reducing carbon emissions.

##### *Transport Survey Results*

The survey aimed to understand residents' perspectives on car clubs, dial-a-ride services, cycle networks, and electric vehicles (EVs). Regarding car clubs, residents exhibited varying levels of interest. Of the respondents, 11.64% stated that they would be very likely to use a car club service if it were available near their home or workplace, while 7.16% expressed a likelihood of using it. Similarly, 11.94% were somewhat likely to use such a service, and 9.55% were neutral about it. On the other hand, 12.54% were somewhat unlikely to use car clubs, 20.60% were unlikely, and 26.57% considered themselves very unlikely to utilise these services.

Regarding the reduction of cars at home if car club cars were made available, opinions varied. While 7.81% of respondents strongly agreed and 12.01% agreed to reduce the number of cars, 23.72% remained neutral, 17.42% disagreed, and 24.02% strongly disagreed with the notion. A significant portion, 15.02%, indicated that the question was not applicable to them.

Interest in EVs was significant among respondents, with 49.40% stating that they had considered purchasing or leasing an EV. The main barriers identified by respondents regarding EV adoption were cost (79.09%), charging time (49.09%), range anxiety (48.48%), and lack of dealer network (25.76%).



Respondents' knowledge and confidence levels varied regarding purchasing or leasing an EV and finding information/services on financing an EV. While a portion of respondents agreed or strongly agreed, others remained neutral or disagreed with their knowledge and confidence levels.

A lack of available public charging facilities close to home or work was considered a barrier to EV ownership by a significant portion of respondents. 33.74% strongly agreed, 33.74% agreed, 16.41% remained neutral, 10.64% disagreed, and 5.47% strongly disagreed.

In the case of dial-a-ride services, opinions on potential conflicts with existing businesses were divided. Only 4.56% considered it very likely, 11.55% likely, and 20.67% very unlikely for a dial-a-ride service connected to the hubs to conflict with existing businesses. The majority of respondents, 30.70%, expressed a neutral stance on this matter, and 32.52% found it unlikely.

The survey showed that there were varying responses regarding the likelihood of using the energy hub if it were located near cycle routes. While 10.30% of respondents considered it very likely and 20.30% found it likely, 25.15% remained neutral, 18.18% considered it unlikely, and 26.06% found it very unlikely. Similarly, when asked about the likelihood of using the hub with shower facilities as part of their active travel route, only 7.27% found it very likely, 15.45% found it likely, 23.33% remained neutral, 25.45% found it unlikely, and 28.48% found it very unlikely.

The survey also highlighted significant interest in bike rental services, particularly e-bikes. Among the respondents, 45.18% preferred e-bikes, while only 3.31% preferred regular bikes. Furthermore, 15.66% expressed a preference for both options, and 35.84% preferred neither.

Respondents' opinions varied regarding the impact of secure bike storage and e-bike charging facilities on cycling likelihood. While 9.06% found it very likely and 26.28% found it likely to cycle to the energy hub with these facilities, 19.94% remained neutral, 11.18% found it unlikely, and 22.96% found it very unlikely. Additionally, 10.57% indicated that the question was not applicable to them.

### **Transport Parish Survey results**

Looking at the parish specific results for whether residents would consider purchasing an EV. All responses in Skerries were 'don't know', whereas in Aithsting the majority responded that they would consider purchasing an EV with over 80% responses. Delting, Dunrossness, Fetlar, Lunnasting, Quarff, Sandsting, and Scalloway had over 50% of respondents in these regions voting that they would consider an EV. However, in other regions there was a majority that wouldn't consider like in Gulberwick, Nesting, Northmavine, Whalsay, Sandness and Yell. Please see graph below.

The main barriers for purchasing an EV were similar in all areas, with the majority of residents answering cost was the main barrier, followed by range anxiety then charging time. Please see the graph in appendix.





**Figure 3.17 Considering EV purchase survey results**

The implementation of a car club, the survey results revealed a range of responses. While 26% of respondents indicated that they would be "very unlikely" to use such a service if it were available near their home or workplace, it is important to note that this represents one perspective. In contrast, 11% of respondents expressed a strong likelihood of using a car club. Residents were asked to select their top 5 choices for services they would like to see at the Rural Energy Hub, the car club was identified as the third most requested service for a hub, indicating interest from a portion of the respondents.

Overall, many parishes responded that they would use e-bikes if a bike rental service offered. The majority of respondents from Lunnasting, Skerries, Trondra and Quarff would rent an E-bike.



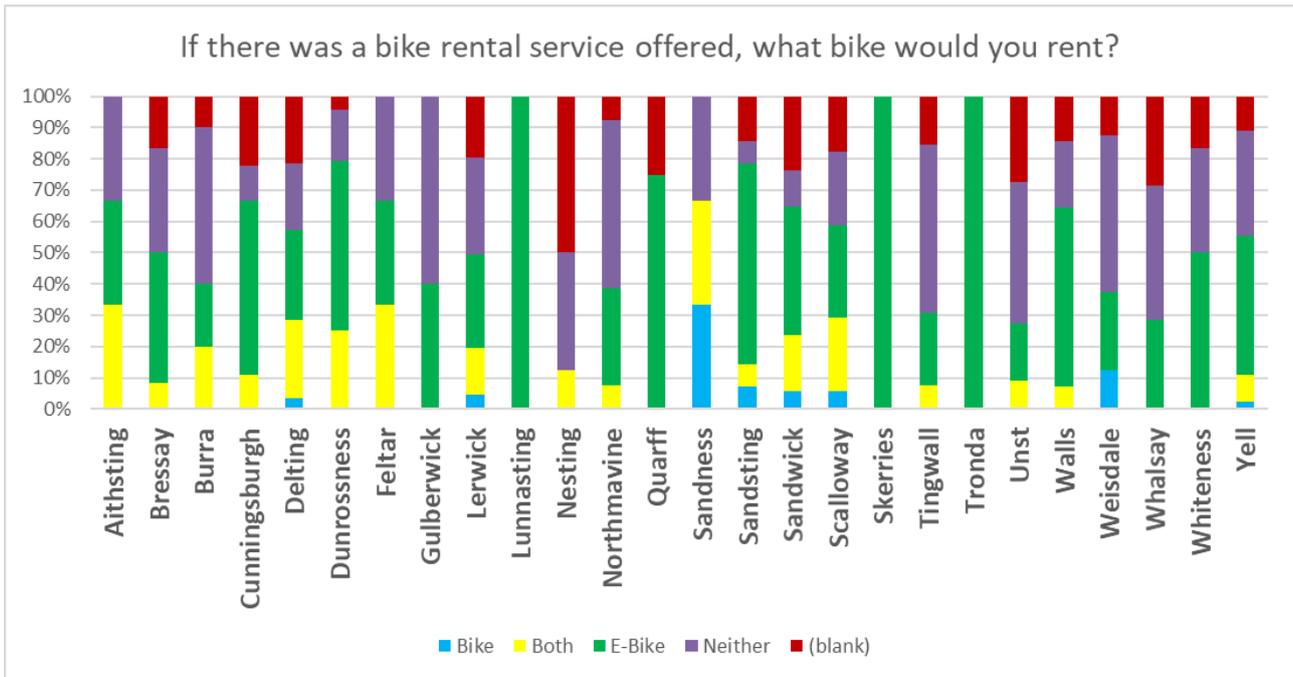


Figure 3.18 Bike rental service proposal survey results

### Transport Conclusions

The survey results provided valuable insights into residents' perspectives on various transportation options. Concerning car clubs, two-thirds of respondents expressed they were unlikely to use such services. Half of these expressed that the fact they already had a vehicle was the main reason for not using a car club. This is a major barrier for this service as car ownership rates are very high in Shetland, as is the case for many rural areas. But promoting the car club usage, addressing concerns related to limitations and hygiene issues is crucial, and highlighting the benefits, such as cost savings, and partnering with car club providers for more options and flexible plans can increase adoption by giving people confidence that personal car ownership isn't the only option for moving around Shetland. It is felt that many of the perceived limitation expressed by respondents can be addressed through better familiarisation.

To promote car club usage and address concerns, it is crucial to acknowledge the preference for personal vehicle ownership expressed by respondents. By focusing on behavioural change and highlighting the benefits of car clubs, such as cost savings, convenience, and reduced environmental impact, residents can be encouraged to consider alternative transportation options.

For dial-a-ride services, a comprehensive assessment should be conducted to minimise any potential negative impact and maximise benefits and improvements to existing transportation services while emphasising the advantages of improved accessibility, economic benefits and reduced reliance on personal vehicles.

Improving cycling infrastructure, including dedicated and safer routes, would encourage more residents to choose cycling as a mode of transportation. Establishing bike rental services, especially e-bikes, and providing secure storage and charging facilities at the energy hubs can further support cycling initiatives.

Improving cycling infrastructure, including dedicated and safer routes, was identified as a potential way to encourage more residents to choose cycling as a mode of transportation. The survey results indicated an interest in bike rental services, particularly e-bikes. Establishing secure storage and charging facilities at the energy hubs can further support cycling initiatives and provide the necessary infrastructure for residents to engage in active and sustainable travel.



The survey also revealed a considerable interest in electric vehicles (EVs), with cost, charging time, and range anxiety identified as the main barriers. Providing comprehensive information on financing options, conducting awareness campaigns highlighting the benefits of EVs, and addressing specific concerns in each region are crucial to promote EV adoption. Initiatives such as test drive events and incentives can be tailored to regions where there is a higher openness to EV adoption, helping to overcome barriers and drive behavioural change.

The survey revealed a considerable interest in electric vehicles (EVs), with cost, charging time, and range anxiety being the main barriers. Offering comprehensive information on financing options and conducting awareness campaigns about the benefits of EVs are essential. Targeted initiatives, such as test drive events and incentives, can be tailored to regions with a higher openness to EV adoption, addressing specific concerns in each area.

## Heat and Power

### *Heat and Power Literature Review*

The implementation of rural energy hubs can address concerns related to heat and energy supply in Shetland. Residents expressed a desire for connection points to local renewable energy installations to maintain a continuous electricity supply during power cuts. Small-scale renewable energy devices like solar PV, micro wind turbines, and solar hot water devices were also prioritised.

Reliability and sustainability in electricity supply were major concerns, particularly due to increased fuel poverty resulting from the ongoing cost of living crisis. Addressing fuel poverty and providing information on available support services should be integral to the rural energy hub project.

When residents in Yell were asked to highlight their priorities for heating, they included lower electricity costs, district heating schemes and local job creation.

When asked whether they would use the hub during power cuts if the facility could provide them with heating and hot water, a large majority (60%) replied they would. During the Yell Climate Action Plan survey, residents expressed a desire for small scale renewable energy devices which could provide the island with a continuous supply of electricity during the power cuts that have occurred relatively frequently in past winters. With extreme weather events expected to increase in frequency as the effects of climate change continue to progress, the need for facilities that can facilitate reliable electricity connection or even a heated building will become more valuable.

Whether this desire for a continuous supply of electricity in resident's homes would also apply to using a rural energy hub during the same events is not a concept that has been brought into conversation in community engagement events. A desire for a centralised location that could be used to disseminate information regarding extreme weather events has been mentioned as a priority, however. As power cuts often occur as a result of such events, so this may imply a degree of overlap in this potential service.

### *Power Survey Results*

In the survey a question looked into power, specifically demand side management considered an electric vehicle charging service that offers cheaper rates during periods of excess renewable energy generation. Survey results on willingness to use an electric vehicle charging service aligned with excess renewable energy generation:

- 36% of respondents agree with using the service, recognising the benefits of sustainable energy alignment and cost savings;

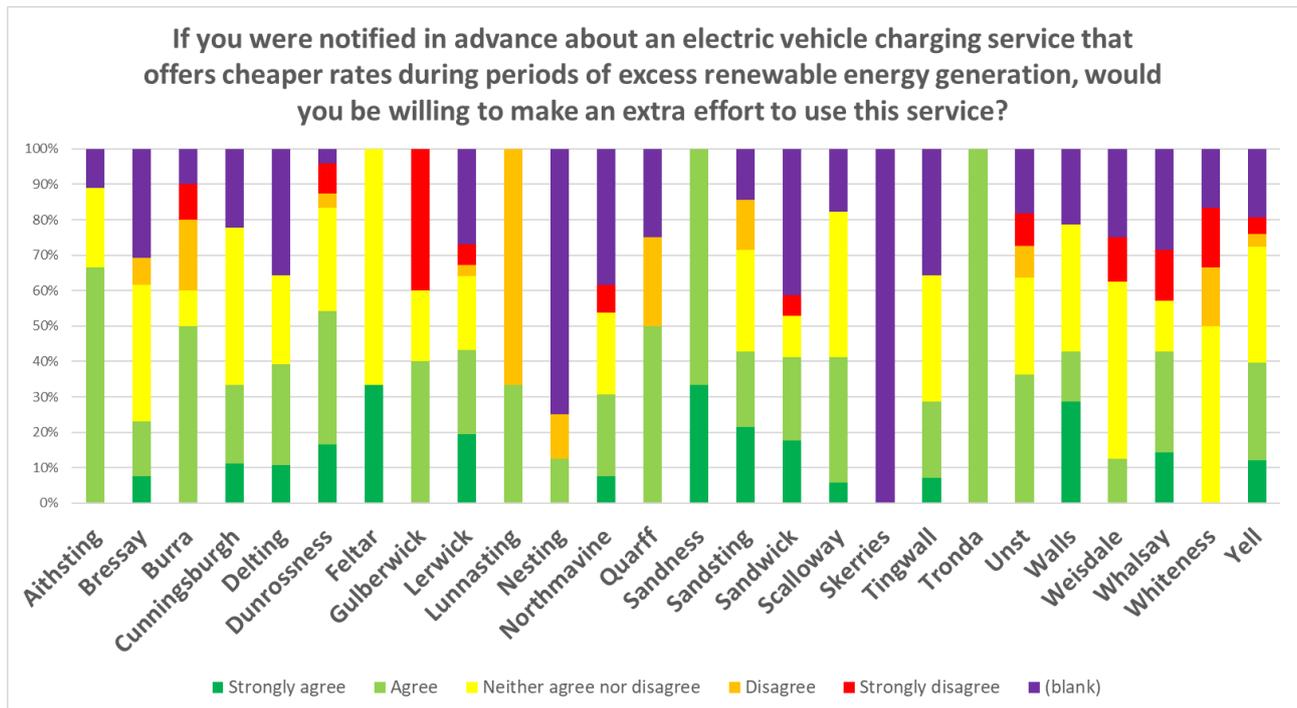


- 35% neither agree nor disagree, indicating a need for more information and addressing potential concerns or barriers; and
- 16% strongly agree, displaying a strong commitment to sustainability and a desire to actively reduce carbon emissions.

Participants were asked whether they would be interested in using electric vehicle chargers that could provide cheaper rates for charging during periods of curtailment, if they could be provided with advanced notice. 52% of respondents replied positively to this proposition and would therefore make an extra effort to use this service in exchange for cheaper EV charging.

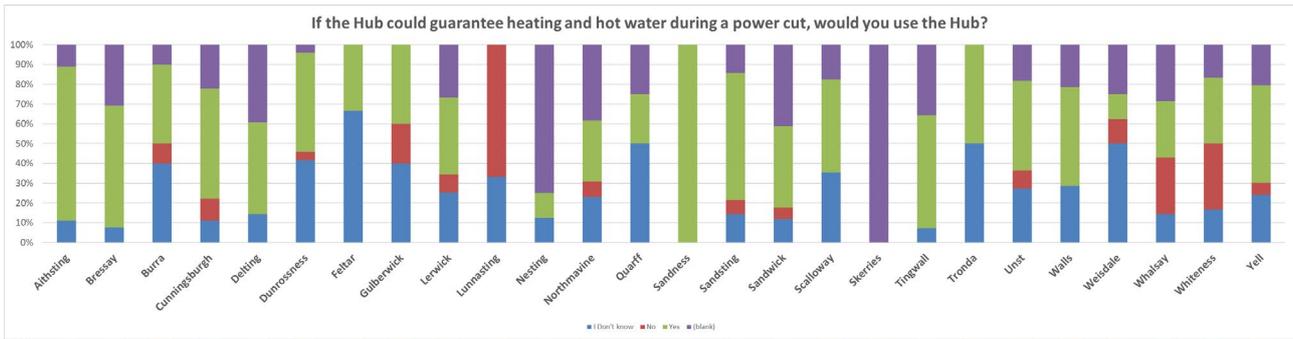
The survey results indicate that parish-specific data aligns with the overall trend of willingness to use an electric vehicle charging service that offers cheaper rates during periods of excess renewable energy generation.

Many of the Parish’s would use the hub if it could guarantee heating and hot water during a power cut, within Aithsting, Bressay, Cunningsburgh, Tingwall, Sandness and Sandsting majority said that they would use the hub in this scenario.



**Figure 3.19 Reduced EV rates promoting behavioural change survey results**





**Figure 3.20 Community reliance centre survey results**

### 3.3.3 Heat Survey results

The survey asked various question surrounding the practical barriers surrounding the decarbonisation of heating, relating to both insulation measures, heat pumps, and providing support services relating to these facilities.

In general, the main barrier cited to the decarbonisation of heating related to cost (75%), with the availability of heating engineers (32%), information (27%), choice (27%), and expectations on alternative technologies (23%) being cited as lesser barriers.

The main barriers to further increasing the insulation were similarly distributed across the barriers of cost (67%), disruption (27%), knowledge of businesses (22%), information (20%), and space requirements (20%).

Many of these barriers have been discussed in community engagement events by Shetland Islands Council and various Community Development Groups throughout the islands. A major issue, as represented in the survey results is the availability of advice services relating to energy efficiency measures, and the availability of engineers for installation. When asked whether a hub which had information and physical examples of insulation measures would be of value to their homes or industries, 57% agreed or strongly agreed with this inclusion.

In the Carbon Neutral Islands Yell energy and transport survey, information relating to draft-proofing was a key priority for residents. During the Climate Conversation community events the lack of available engineers for the installation, repair and maintenance of renewable heating devices was seen as being a major barrier to their adoption.

When asked whether a rural energy hub that provided support and services relating to heat pumps would increase their interest in heat pumps, 43% either agreed or strongly agreed with this statement. This demonstrates a clear consensus between the survey and community engagement events from a wide variety of locations throughout Shetland.

A part of the Carbon Neutral Islands Yell project, a survey was conducted relating to the use of energy and transport across the island to gain a better understanding of the priorities of residents in relation to these two key areas. Respondents were asked to prioritise which options they felt were of the greatest importance to them, and in relation to heating the establishment of a district heating network on the island was ranked among the top priorities.

This desire was reflected in the survey results, when asked whether Shetland Islands Council should conduct a feasibility study into the viability of district heating scheme in their area 45% said yes.

When asked whether the inclusion of information and support for domestic renewable energy technologies would increase interest in installing them in their homes, an overwhelming majority agreed or strongly agreed with this statement (38% and 29% respectively).



Respondents were also asked if renewables at the hub could include a visualisation of the operational data, would this give them more confidence in these technologies. A majority agreed or strongly agreed that data visualisation would increase their confidence in such technologies (39% and 17% respectively).

When asked what information and signposting participants would like to see in a rural energy hub, several options were given for consideration:

- Funding (72%)
- Energy advice and information on energy efficiency (69%)
- Demonstrations/ advice on renewable energy technology (58%)
- Live data demonstrating the effectiveness of low carbon technologies (I.e. wind turbines, solar, electric vehicles etc.) (51%)
- Live data on the effectiveness of heat pumps (41%)

### **Heat and Power conclusion**

The survey results obtained from residents in Shetland reveal a strong interest in finding solutions to their heat and power supply challenges. To address these concerns, the implementation of rural energy hubs that incorporate local renewable energy. This approach aims to ensure a continuous electricity supply during power cuts and promote reliability and sustainability in energy provision.

One of the major concerns expressed by residents is the increased fuel poverty resulting from the ongoing cost of living crisis. Therefore, it is crucial for the rural energy hub project to address fuel poverty and provide information on available support services. Lowering electricity costs, implementing district heating schemes, and creating local job opportunities are also prioritised by residents.

The survey results also indicate a positive attitude towards utilising an electric vehicle charging service that offers cheaper rates during periods of excess renewable energy generation. A significant percentage of respondents recognize the benefits of sustainable energy alignment and cost savings, displaying a strong commitment to sustainability and a desire to actively reduce carbon emissions.

Barriers to the decarbonisation of heating, such as cost, availability of heating engineers, and lack of information, have been identified. Residents have highlighted the importance of advice services, physical examples of insulation measures, and support for heat pumps in addressing these barriers.

Additionally, the desire to conduct a feasibility study for a district heating network has been expressed by residents in various areas of Shetland. Feasibility studies and providing information and support for domestic renewable energy technologies are considered crucial in increasing adoption.

Overall, the survey results indicate a high level of interest among Shetland residents in implementing rural energy hubs that prioritise renewable energy, address fuel poverty, provide support services, and offer cost-effective and sustainable solutions to their heat and power.

## **Other facilities**

### **Other Facilities Literature Review**

Residents of North Shetland expressed a desire for more cafes and social spaces, providing opportunities for socialising and working away from home. The implementation of community gardens or similar facilities for growing and sharing



food was also suggested. A scrapstore, where unwanted but still useful appliances or materials can be redistributed, was another proposed facility for improving sustainability.

In terms of energy facilities, residents in Yell expressed a desire to have connection points to local renewable energy installations to maintain a continuous supply of electricity during power cuts. Small-scale renewable energy devices such as solar PV, micro wind turbines, and solar hot water devices were seen as a priority. Local hubs for food, warmth, and information related to extreme weather events were also considered important.

The desire for increased reliability and sustainability in electricity supply reflects concerns raised in various engagement events. Fuel poverty was identified as a significant issue, with a majority of respondents potentially qualifying as living in fuel poverty. Providing information related to fuel poverty and focusing on issues that residents prioritize within rural energy hubs could positively impact community engagement.

The topic of growing more food locally, especially in more remote areas of Shetland that are prone to weather related supply chain issues has been expressed before, as well as a desire for more community growing spaces. A centrally located community garden or allotment would aid in removing the barrier of transport to this service, allowing it to be accessible to a wide a larger portion of the community.

### **Other Facilities Survey Results**

Regarding additional facilities at the Rural Energy Hub, respondents expressed preferences for amenities in the waiting room such as informational displays on bus schedules (79%) and free Wi-Fi access (79%). Other suggestions included charging stations for mobile devices (68%), weatherproof bus stops with comfortable seating, and services like a microwave, coffee machine, maps of bus services and local facilities, food bank/community fridge, book swapping, water bottle filling stations, and a community tool share.

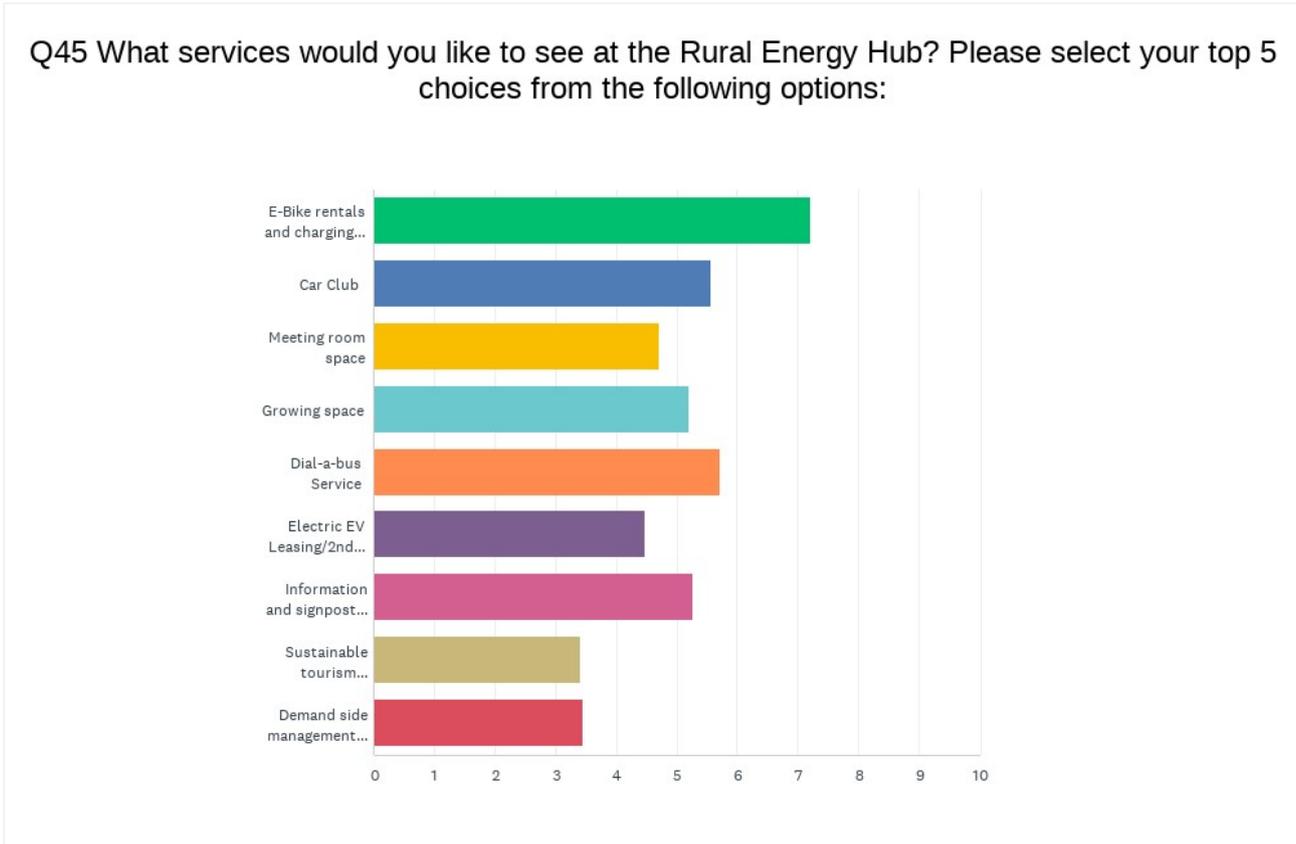
When asked whether the inclusion of a café would bring good value to the rural energy hub, a majority of 58% agreed that this would be the case.

The survey looked to understand if increasing ease of movement around Shetland could also mean easier access to growing spaces at or near a REH, and whether this would be of interest. When asked whether this would increase their interest in growing food, the largest firm response agreed (26%) that it would, with 36% neither agreeing nor disagreeing with the question.

The survey results regarding desired services at the Hub were asked to be ranked and are as follows:

- E-Bike rentals and charging/Bike storage facilities received a high score of 7.2, indicating strong interest in these amenities. This suggests a demand for convenient and sustainable transportation options within the community;
- Dial-a-bus service received a score of 5.71, indicating a strong interest in a flexible and accessible transportation service that can cater to specific travel needs within the rural area;
- The Car Club option scored 5.56, demonstrating interest in a car-sharing program. This indicates a desire for flexible access to vehicles without the need for individual ownership;
- Growing space, with a score of 5.21, highlights the interest in having an area for community gardening or agriculture. This reflects a desire for self-sufficiency and sustainable food production; and
- The Meeting room space option received a score of 4.71, suggesting a need for a dedicated space where community members can gather, collaborate, and hold meetings.





**Figure 3.21 Proposed REH services prioritisation**

Several specific suggestions were made regarding the additional services that Shetland Rural Energy Hub could offer including:

- **Childcare facilities:** Some participants mentioned the need for child-friendly services or facilities, such as a youth club or a space for families with young children;
- **Information and support for energy-efficient practices:** Several respondents expressed an interest in receiving advice on energy-efficient measures, such as solar panels, insulation, and understanding energy bills;
- **Community resources and support:** Some participants suggested utilising existing community resources, such as public halls, for the rural energy hubs and supporting their maintenance and use. Others mentioned the importance of not compromising the viability of local businesses and community resources;
- **Mobility services:** A few respondents mentioned the potential for mobility services, such as mobility scooter hire or a dial-a-ride service for vulnerable individuals who have difficulty accessing transportation;
- **Information and signposting:** Some participants emphasized the need for information and signposting related to various topics, including climate change mitigation, car club/transport options, and local services; and
- **Growing space and composting:** A couple of respondents suggested incorporating growing spaces and community composting facilities into the rural energy hubs.

**Other Services Conclusion**

Respondents to the survey appeared to prefer services which could make waiting for public transport more comfortable, or to give them easy access to bikes. When asked to prioritise the preferred services in the REH, the three highest ranked services were those connected to transport: ebike rental, car club and dial-a-ride services. This would support



an argument that the community are interested in support addressing barriers they have in ease of movement around Shetland.

## **Waste Management**

### ***Waste management Literature Review***

During the CNI Yell survey there was also concern surrounding the environmental impact of recycled waste once it had left the island, and that more information on this issue would be beneficial in increasing community confidence and subsequent engagement in recycling. This view was represented in the CNI Yell survey, in which increased frequency of recycling and other waste collection was cited as a major priority for islanders.

### ***Waste Management Survey Results***

Relating to issues surrounding sustainable waste management, the survey asked questions relating to their current services and potential services that could be included in a rural energy hub. The first of these asked whether there were currently sufficient facilities for disposing of waste in their area, which more respondents either disagreeing or strongly disagreeing (29% and 20%) than agreeing or strongly agreeing.

As 21% of all the total responses to this survey were received from the island of Yell, the largest rate of participation from any of Shetland's parishes, this may explain the wide spread of results on this topic and convey a greater level of dissatisfaction with the current state of waste collection in rural and remote island parishes.

Similar positive feedback was given when residents were asked whether having a drop-off point closer to them would increase the amount they recycle, 36% agreeing and 18% strongly agreeing. During the CNI Yell survey there was also concern surrounding the environmental impact of recycled waste once it had left the island, and that more information on this issue would be beneficial in increasing community confidence and subsequent engagement in recycling.

### ***Waste Conclusion***

While recycling alone is not going to "turn the dial" on climate change, as one resident was quoted, many have expressed feelings that it is an ideal topic to begin having conversations surrounding net-zero and sustainability (Ricardo, 2022a). The engagement with the public has shown a general want to recycle and for it to be easier for them. It design of the Hub(s) in phase 2 will be tasked with investigating if it is feasible to achieve this in rural energy hubs.

## **Remote Working**

### ***Remote working Literature Review***

While previous community engagement events focused on the north mainland suggested that more community spaces such as cafes and places to work remotely would be a welcome addition to their communities, these were only suggested as a priority in these locations. Rural areas that lack such facilities would naturally wish for more of these facilities, while less rural locations already have existing businesses and services that provide these amenities.

### ***Remote working Survey Results***

On the question on the likelihood of renting office space in a REH, 32% stated that deemed this question not applicable, while 6.6% would be very likely and 9% would be likely to rent. There was a strong inclination to not rent an office space; 17% and 19% respectively. and a further 17% stated they were neither likely nor unlikely. But it should be noted that the majority of respondents represented the public where office space is likely to be less useful.



In contrast, when asked on the desirability of hot desk facilities, there was a relatively close response across the board. Most respondents were inclined towards not making use of hot desk facilities (29.5%), while 26.9% answered favourably to this proposed service. Additionally, 13.3% felt neither likely or unlikely. While 30.2% felt it wasn't applicable to them.

In terms of facilitating office space outside of Lerwick for the benefit of businesses, of those that deemed this question applicable to them (49%) a majority of 22% either agreed or strongly agreed this would benefit their business. A further 17% neither agreed nor disagreed with this proposition, implying the potential for increased public engagement in the future should this be included for consideration.

On asking whether a hub that provided a meeting room facility if it was located near the respondents 26% either agreed or strongly agreed this would be of use to them. This was however not a clear consensus, as 23% disagreed with this statement to some degree.

## **Sustainable Tourism**

### ***Sustainable Tourism Literature Review***

The Nort Natters series of engagement events demonstrated residents understand tourism is vital to the economic prosperity of Shetland, but also expressed dissatisfaction with the perceived prioritisation of tourists by the council.

### ***Sustainable Tourism Survey Results***

The inclusion of power and waste management facilities for campervans and campers was met with an overwhelmingly positive response, 74% agreed these facilities should be included in a rural energy hub.

When asked to choose between various amenities or services to support the sustainable tourism industry in Shetland respondents most positively reacted to bike/ E-bike hire (74%), with the following all receiving 70% approval

- facilities/ power/ waste management for campsite and campervans;
- Walking trails and drop-off points: establishing walking trails and using the centre as a drop-off point for visitors to explore the surrounding area by foot; and
- Public transport links to tourist sites.

Eco-tours and a means to facilitate car club sign up for tourists were met with far less enthusiasm, with 44% and 35% support respectively.

### ***Sustainable Tourism Conclusion***

The survey results indicate there is a high level of interest in the services proposed for the Rural Energy Hub, and that facilitating working spaces within the hub could prove to be a valuable method of reducing travel across the islands. The inclusion of a growing space for use by the community was also a valued proposition, with supply chain issues and concerns around Shetland's food security already being a topic of local discussion.

The responses relating to sustainable tourism also indicate a high level of understanding from the local community about the value tourism in general has to their economy, and that reservations towards the tourism industry are it an opinion all islanders share. Decarbonising the tourism sector would also have additional benefits for islanders such as reducing the number of cars via E-bike rentals and increasing the use of public transport.



### 3.3.4 Deliverable 3 Conclusion

#### Overarching Summary

In conclusion, the survey results looking at services and facilities has provided valuable insights into the current practices and resident perspectives. Moving forward into phase 2, it is crucial to prioritise customer engagement and ensure continued involvement in shaping and improving the rural energy hubs. The findings from this report will serve as a foundation for developing comprehensive strategies that align with the evolving needs of residents and contribute to a more efficient and sustainable waste management system.

A lot was achieved and learnt in the tight timescale of this Phase 1 feasibility study. New relationships within the community were fostered, to supplement existing relationships from previous community and stakeholder engagement, which will significantly support Phase 2 activities; the project teams were able to make notable progress towards understanding the suitable and desirable REH services in many of the potential parishes; and understand the barriers by many Shetlanders in decarbonising their energy consumption. However, the lessons learnt focused on the most effective ways to engage with the community and how changes in the stakeholder engagement plan could have possibly resulted in greater feed-in. These lessons will all contribute towards the planning of Phase 2 stakeholder engagement.

Based on the findings from the literature review and survey results, several recommendations can be made for the next steps of the project for phase 2.

#### Transport

**Enhance transportation infrastructure:** Improve the transportation system by incorporating initiatives like E-bike rentals, bike storage facilities, and dial-a-bus services. These options will provide convenient and sustainable transportation alternatives for residents, reducing the reliance on individual car ownership.

It is important to address concerns related to car clubs, such as limitations and hygiene issues, to promote their usage. Highlighting the benefits, partnering with car club providers for more options and flexible plans, and addressing the preference for personal vehicle ownership can increase adoption.

**Install electric vehicle charging infrastructure:** Increase the number of fast or rapid chargers in public buildings and establish charging stations within the Rural Energy Hub. This will encourage the adoption of electric vehicles and address "range anxiety" concerns, promoting the transition to cleaner transportation. Create targeted initiatives, such as test drive events and incentives, can increase adoption, particularly in regions where residents show a higher openness to EVs.

#### Heat and Power

**Focus on reliable power supply:** Develop a system within the Rural Energy Hub to provide a continuous supply of electricity during power cuts. This can include backup power generators or integrating renewable energy.

**Implement energy-efficient heating solutions:** Introduce sustainable heating options such as heat pumps or solar thermal systems within the Rural Energy Hub. Residents have identified barriers to decarbonising heating, such as cost, availability of heating engineers, and lack of information. Addressing these barriers through advice services, physical examples of insulation measures, and support for heat pumps is important.



**Offer energy advice and support:** Provide information and resources to the community on energy-efficient practices, including guidance on insulation, heat pumps, and understanding energy bills. This will empower residents to make informed decisions and contribute to reducing energy consumption.

**Foster community engagement in sustainable energy:** Promote community involvement in energy-related initiatives by organising workshops, events, and educational programs. Encourage participation in local renewable energy installations, energy-saving practices, and support networks for fuel poverty and energy-related concerns.

Conducting feasibility studies for district heating networks is crucial in order to assess the viability and potential benefits of implementing such systems within communities.

## Other Facilities

Based on the survey results, desired amenities at the Rural Energy Hub include informational displays on bus schedules, free Wi-Fi access, charging stations for mobile devices, weatherproof bus stops with comfortable seating, services like a microwave and coffee machine, maps of bus services and local facilities, food bank/community fridge, book swapping, water bottle filling stations, and a community tool share.

Considering the specific suggestions made by participants, additional services such as childcare facilities, information and support for energy-efficient practices, and utilising existing community resources should be considered.

**Establish cafes and social spaces:** Respond to the community's desire for more socialising and working spaces by creating cafes and social areas within the Rural Energy Hub. The cafe can serve as gathering spots for both cyclists and visitors to the hub, offering a welcoming and comfortable environment. It will also provide an opportunity for EV drivers to conveniently charge their vehicles while using the café.

**Implement community gardens:** Address the need for sustainable practices by incorporating facilities for growing and sharing food.

**Provide information on fuel poverty:** Raise awareness about fuel poverty and offer resources and support related to energy-efficient practices, such as advice on solar panels, insulation, and understanding energy bills.

## Waste Management

**Improve waste disposal facilities:** Address the community's dissatisfaction with waste collection by enhancing existing waste management services and increasing the frequency of recycling and waste collection.

**Increase community engagement in recycling:** Provide more information on the environmental impact of recycled waste to build community confidence and encourage greater engagement in recycling efforts.

## Remote Working

**Create a multi-purpose community space:** Establish a dedicated meeting room within the Rural Energy Hub where community members can gather, collaborate, and hold meetings.

**Consider additional amenities:** Install amenities like a café, hot desk facilities, and office spaces outside of Lerwick to cater to the needs of remote workers and businesses.



## Sustainable Tourism

**Incorporate power and waste management facilities for campervans:** Include facilities in the Rural Energy Hub to support sustainable tourism, such as power and waste management services for campervans and campers.

**Establish walking trails and drop-off points:** Develop walking trails and use the hub as a drop-off point for visitors to explore the surrounding area by foot, promoting eco-friendly tourism.

**Promote sustainable transportation for tourists:** Focus on initiatives like bike/E-bike hire, public transport links to tourist sites, and facilitating car club sign-ups to reduce car usage and encourage sustainable travel options.

Overall, the recommendations for the next steps involve creating a diverse range of facilities and services within the Rural Energy Hub to meet the community's needs and promote sustainability. These initiatives will support social interaction, address energy concerns, enhance waste management practices, facilitate remote working, and promote sustainable tourism in Shetland.



## 4 WORK PACKAGE 2: ENERGY

Work Package 2 consists of the energy use and possible on-site generation and storage at hubs, to work around grid restrictions, exploring grid connections for small scale renewable energy generation as the priority energy source and demonstration products and information for heat and microgeneration technologies.

The deliverables in Work Package 2 will:

- Deliverable 4: large mobility options; and
  - Create an options analysis for fuel for large mobility vehicles
- Deliverable 5: demand side management
  - Create an options analysis of demand side management for having generation at the hubs and providing storage 24/7 supply to charging infrastructure



## 4.1 DELIVERABLE 4 - LARGE MOBILITY OPTIONS

**Options analysis for fuel for large mobility – buses, trucks, ferries - hydrogen vs electric – and storage.**

**Non-technical barriers addressed:** behaviour change, regulation, finance.

**Author:** Aquatera with support from SIC

Deliverable 4 examines options for to decarbonise large vehicles such as buses, trucks, and council vehicles like rubbish trucks, comparing options for electrification and hydrogen fuel. Hydrogen is being considered as an option for the rural energy hubs, despite its multiple challenges highlighted in this chapter, because part of Shetland’s wider plans for decarbonisation includes shifting some of the oil infrastructure and workforce to the generation of green hydrogen for export and for use locally. While there are multiple trials around the UK and internationally using both electric and hydrogen fuelling options for larger vehicles, the market has not yet landed on definite preferred solutions compared to the smaller vehicle market where electric cars and vans are now widely available and being rapidly adopted. This study examines the current energy demand of Shetland’s large vehicles, explores options for decarbonisation and also looks at storage options.

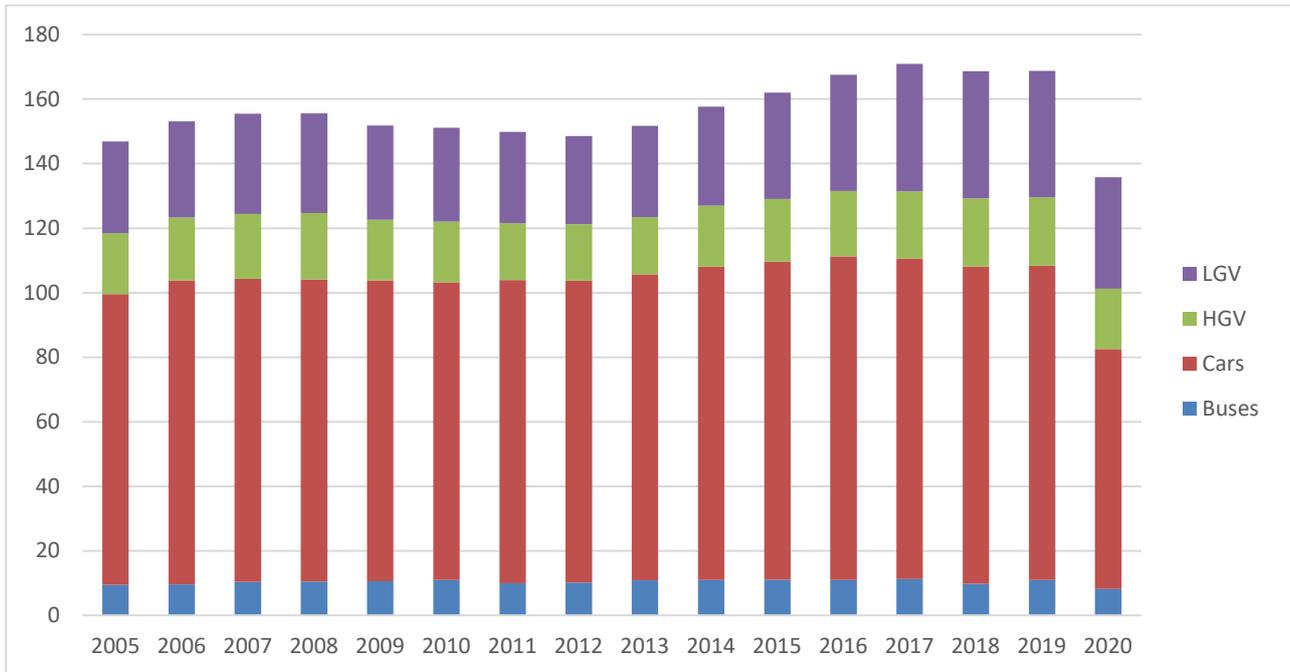
Shetland has already gained considerable local expertise in hydrogen developments, including promoting itself through the ORION Clean Energy Project since 2020, a collaboration to create an industrial green hydrogen export business. Further details on this are provided in section 6.2.3.

The end of the chapter provides a case study on the Tees Valley Hydrogen Transport Hub that is currently in development. While much of this analysis is consideration of the technologies, understanding the technical challenges and opportunities is necessary to be able to address the non-technical barriers to decarbonisation of large mobility in Shetland and the role that rural energy hubs could play in refuelling those vehicles and therefore accelerating their adoption and use in Shetland.

### 4.1.1 Current Energy Demand

The UK government Department for Energy Security and Net Zero (previously the Department for Business, Energy, and Industrial Strategy) produces every year a retrospective account of energy usage across local authorities. The following chart is extracted from that report and features the primary energy demand for road transport in Shetland. Maritime transport fuel usage was extensively covered as part of the Neptune project and will thus not be covered in this study of future large mobility energy demand. As can be seen below, there was a significant drop in energy demand in 2020 compared to 2019. As a result, the year 2019 was used as the baseline for future low carbon demand estimates.





**Figure 4.1 Evolution of Road Transport Energy Demand for Shetland, this dataset is due to be updated over the summer (BEIS, 2022). HGV: Heavy Goods Vehicles, LGV: Light Goods Vehicles**

#### 4.1.2 Future Energy Demand

##### Methodology

The zero-emission energy forecasting tool provided by the Scottish Government was used as the basis for future hydrogen usage up to 2045 for Road Transport. It was extracted from a report commissioned by Transport Scotland and delivered by Jacobs (Jacobs, 2022). Based on a variety of tools, they estimated future energy demand for modes of transportation considering:

- Future transport usage estimates, which are based on behaviour change, technological, and demographic projections from the TMfS:18 model by the Department for Transport. This model forecasts vehicle kilometres for cars, LGVs, HGVs and buses for 2019 up until 2045. This model was supplemented with vehicle number statistics available on the DfT website. In particular, some of the key considerations:
  - Lowered personal vehicle use in favour of public transport
- Fleet replacement rates, with an increasing proportion of battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV) as technology, policy, markets, and behaviour evolve.
- Data projections from the Committee for Climate Change’s 2020 report by Elements Energy (Committee for Climate Change, 2020) and their report to Transport for Scotland in 2021, highlighting an ambitious policy scenario to keep within climate change targets. That policy scenario describes:
  - Rapid uptake of zero emission technology
  - Reduced passenger and freight kilometres
- Efficiency improvements as technology improves

The tool provides a comprehensive look at six scenarios forecasting different integrations of hydrogen and battery-based transport technologies using the above parameters. The modelling estimates future energy needs from electricity and



hydrogen (in kWh and kg) for the different modes of transportation considered. In those scenarios, the hydrogen is considered to be used directly in a variety of technologies.

- For heavy duty vehicles, buses, and coaches:
  - Fuel cell powered electric power trains
  - Fuel Cell Range extended battery electric vehicles
  - Battery Electric Vehicles
- For cars and Light Goods Vehicles (Vans) :
  - Fuel Cell Electric Vehicles, modelled based on the Toyota Mirai
  - Battery electric and some Plug in Hybrid vehicles as a transition vehicle

The transition scenarios are titled as follows:

- Low Transition to Electric, High Transition to Hydrogen
- Medium Electric, Low Hydrogen
- Medium Electric, High Hydrogen
- High Electric, Low Hydrogen
- High Electric and High Hydrogen
- Medium Electric and Medium Hydrogen

The transition trajectories are based on a combination of the policy and technology work that has been mentioned previously.

One of the key benefits of the study is that it considers future hydrogen and electricity demand within the confines of renewable capacity and electrolyser capacity targets from the Scottish Government.

The breakdown of future transport demand for road transport in Shetland was based on the sub national road consumption dataset from BEIS (see above). As stated previously, the reference year that was used primarily was 2019, as there was a significant drop in overall transport energy usage in 2020, making that year an outlier. There were several options to break down the market to the local authority level, including vehicle numbers from the Department for Transport, but it was assumed that the current spread of fuel usage for road transport is representative of the future distribution of transport needs. It was also assumed that the progress in low carbon vehicle deployment would happen at the same rate as it is modelled in Scotland. In reality, given that the purpose of this report is to accelerate the development of low carbon initiatives locally in Shetland, the target should be to aim for the 2045 energy demand as early as possible in selected areas as demonstrators of sustainable leadership.

Within the six scenarios, it is suggested that high battery and low hydrogen uptake is the most likely for vans and cars. This is on par with the observed market, with the automobile industry offering a variety of models, and available funding for vans (UK Government, 2023) and charging infrastructure. Hydrogen still suffers from slow development and is more likely be taken up by professional vehicle users that need to cover long distances with constrained refuelling times.

This is where the study suggests that a likely scenario for HGV's, buses, and coaches is medium electric and medium hydrogen uptake. Based on the learnings from a previous study for ReFLEX, this scenario is likely to unfold as a number of large vehicles will be covering low enough distances through the year Battery Electric Vehicles will be viable and more cost effective. Where daily distances are high and charging/refuelling time is limited (e.g.: regular main bus routes), hydrogen will prove a more appropriate option.



### SIC Fleet analysis

Data provided for the SIC fleet was used to estimate future demand by SIC operated vehicles, with the assumption that a larger cluster of demand by SIC will influence the location of a hub.

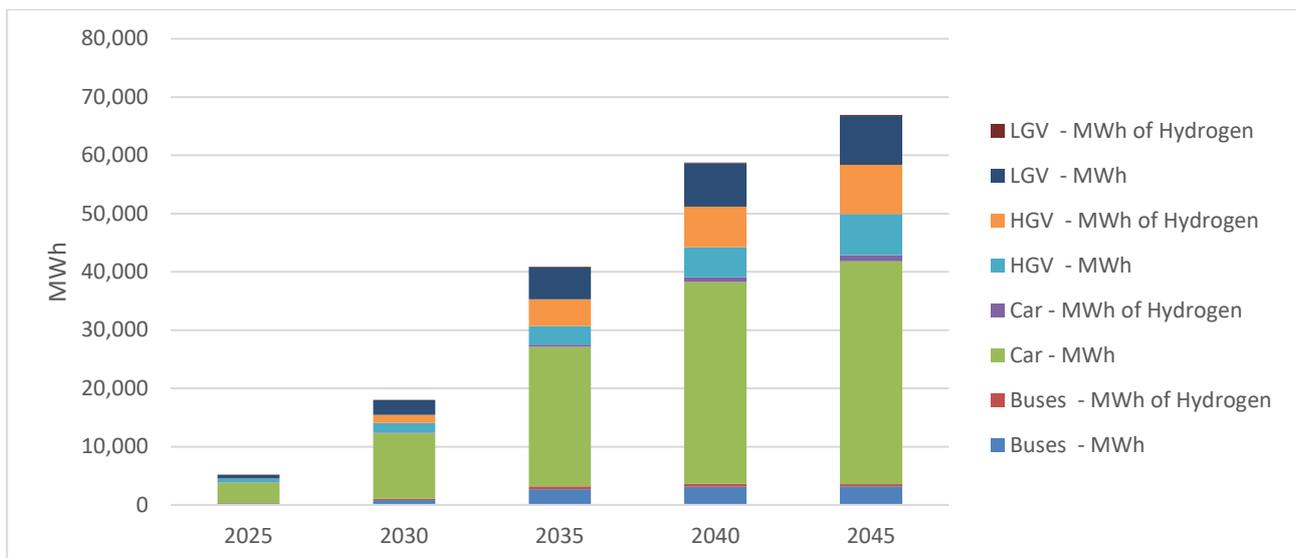
This was achieved based on the annual fuel consumption for the different vehicles operated by the authority, which were then categorized as either HGV, bus, LGV, or cars as follows.

Quantity	Vehicle Type	Vehicle Category	Energy MWh (Gross)
69	Medium van	LGV	915.39
78	Small van	LGV	602.49
32	4wd/pick-up	LGV	417.13
2	Large van	LGV	46.63
8	Refuse collector	HGV	887.88
9	Trucks	HGV	791.29
1	Road sweeper	HGV	82.4
1	Liftec	HGV	19.91
1	Tractor 4x4	HGV	0.09
6	Car	Cars	62.12
11	Mpv	Cars	53.59
8	Mini-bus	Buses	290.53

The annual energy demand was then used to estimate the proportion of total Shetland demand represented by the SIC fleet.

### Projections

#### Shetland as a whole

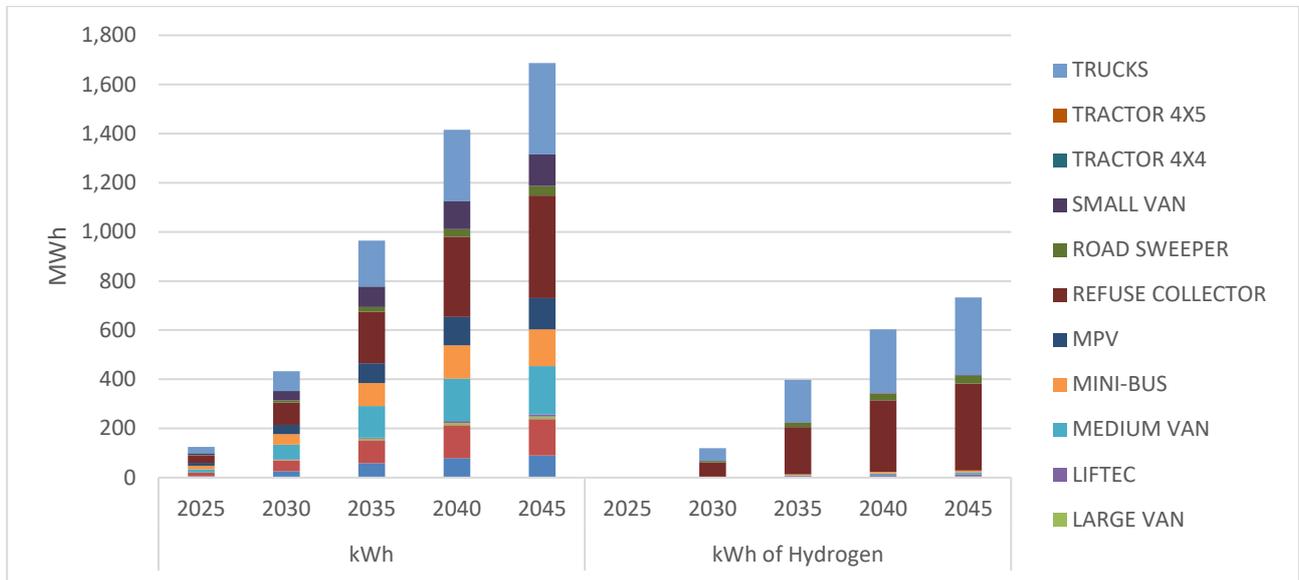


**Figure 4.2 Primary energy (expressed as energy “in the tank”) demand projections for transport in Shetland based on the most likely scenario**



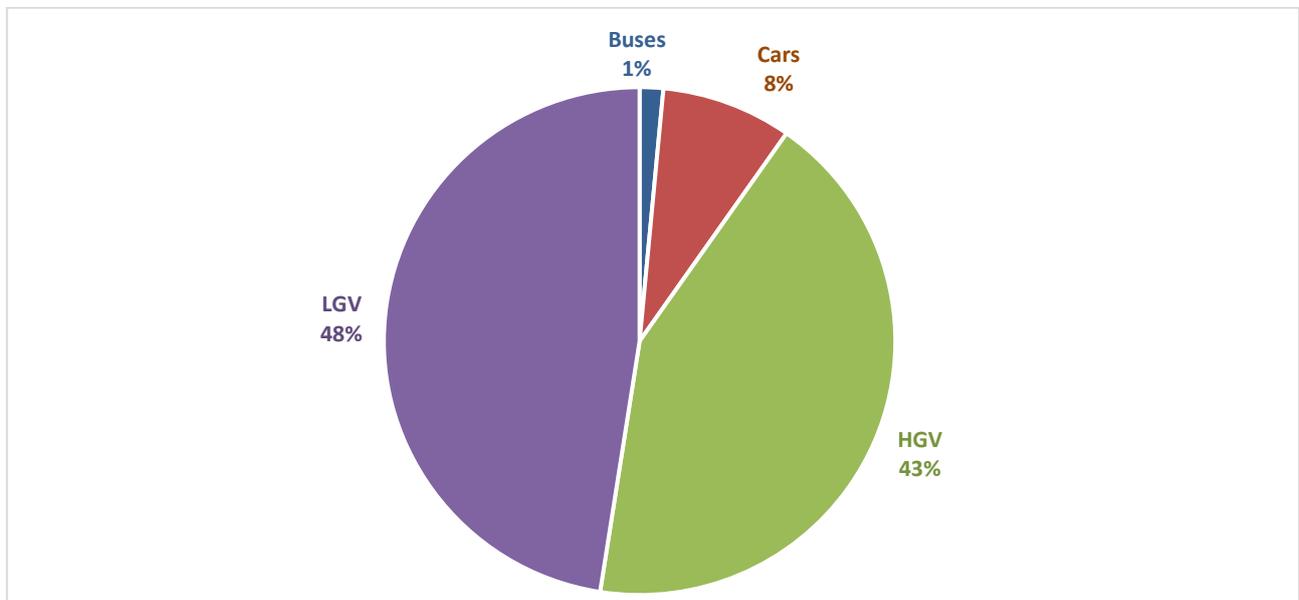
It can be observed that future primary energy demand is lower than the current 2019 total (168 GWh vs 67 GWh). This is in part due to some of the demand that can't be decarbonised not being accounted for in the above chart, but mostly because from a tank to wheels perspective, electric powered drive trains (battery or fuel cell) are more efficient than internal combustion ones. As explained above this also accounts for changes in behaviour, ie more efficient fleet management and use of public transport, and technological improvements in efficiency having been built into the modelling tool used.

**SIC Fleet**



**Figure 4.3 Projection of primary energy demand for the SIC fleet up to 2045 based on the current fleet composition**

As can be seen above, most of the fleet demand will likely be based on battery EV's. This is because LGV's and cars represent the majority of the fleet demand (56%), as well as having shorter replacement cycles.



**Figure 4.4 Breakdown of current energy demand by the SIC fleet by vehicle category**



For the implementation of hubs to be successful, the regulatory framework needs to enable vehicles and fuels, in particular hydrogen, to be stored and handled where the energy is needed. The following section reviews the rules currently in place around storage and transport of hydrogen. Aside from grid applications and potential island grid constraints, charging infrastructure does not suffer from similar barriers, as a technology that has been available at the consumer level for much longer than consumer facing hydrogen.

### 4.1.3 Regulatory Framework

Presently, there is a lack of a comprehensive regulatory framework governing the production, transportation, and storage of hydrogen. Those involved in hydrogen projects in the UK encounter a challenging situation due to the existence of fragmented legislation and regulations. This is because the current rules and policies were established prior to the recognition of hydrogen as a viable and practical fuel source.

Therefore, the following regulations related to the health and safety, environmental and planning, technical standards, transport, energy and storage are seen as applicable to hydrogen.

#### Health and Safety

Hydrogen depots are subject to various health and safety regulations to ensure the safe handling, storage, and distribution of hydrogen. These regulations aim to prevent accidents, mitigate risks, and protect both workers and the general public. The Health and Safety Executive (HSE) in the UK is responsible for enforcing these regulations and providing guidelines for safe hydrogen operations.

Compliance with the following regulations is required by the Health and Safety Executive (HSE):

- **Gas Safety (Management) Regulations 1996:** These regulations pertain to the transportation of gas through the network. Gas transporters must develop and submit a safety case to the HSE, outlining the identification and control of hazards and risks, as well as the system in place to ensure proper application of controls. Compliance with the safety case is audited by the HSE.
- **Pipeline Safety Regulations (1996):** These regulations focus on maintaining pipeline integrity. They specify requirements for pipeline design, construction, installation, operation, maintenance, and decommissioning. For instance, pipelines should be equipped with emergency shut-down valves, and their design should account for maintenance access needs.
- **Storage of Hydrogen:** The storage of hydrogen is regulated by either The Planning (Hazardous Substances) Regulations 2015 or the Control of Major Accident Hazards Regulations 2015 (COMAH), depending on the quantities involved. COMAH sets high standards, requiring operators to take all necessary measures to prevent major accidents and mitigate their consequences for human health and the environment. Operators must have safety plans, emergency plans, and a Major Accident Prevention Policy in place.
- **Hazardous Substances Regulations:** Consent is necessary for storing two or more tonnes of hydrogen, and additional consent is required when storing five or more tonnes of hydrogen. These regulations govern the storage of hazardous substances, including hydrogen.
- **Dangerous Substances and Explosive Atmosphere Regulations 2002:** These regulations establish requirements for the use of equipment and protective systems in potentially hazardous environments where hydrogen is produced or stored.



## Planning and environmental

The establishment and operation of hydrogen depots requires compliance with planning and environmental regulations. At present, there is no specific planning framework exclusively designed for hydrogen projects. However, according to the UK hydrogen strategy, the government intends to establish planning and permitting regimes specifically tailored for hydrogen projects by the year 2024 (Nardell, et al., 2023). This means that while the needs of hydrogen infrastructure and delivery have been considered in the selection of the location of hubs (as shown in the RADMApp analysis), it is not anticipated that Phase 2 will include hydrogen facilities in the pilot hub.

### Planning

Major hydrogen projects that are deemed nationally significant infrastructure projects typically necessitate a development consent order under the Planning Act 2008. However, for smaller projects or pipelines, such consents may be regulated through the Town and Country Planning Act 1990 (Nardell, et al., 2023).

Securing land rights is crucial for these projects, similar to other infrastructure endeavours. Access rights must be obtained from production and storage facilities to ensure their suitability for large-scale industrial transportation. These access rights can be established through private contracts or by utilising compulsory acquisition powers when necessary. In cases where existing infrastructure is repurposed for hydrogen projects, modifications to existing rights are likely required to accommodate necessary technological upgrades and address regulatory concerns.

Regarding hydrogen storage, an Environmental Impact Assessment (EIA) may be necessary if on-site hydrogen storage is involved or if pipelines are used for hydrogen transportation, as per the Town and Country Planning (Environmental Impact Assessment) Regulations 2017.

### Environmental

As part of the hydrogen production, related environmental standards are applied to producers. Hydrogen depots may be required to develop the following in case of hydrogen emissions or leakages as detailed in the "Low Carbon Hydrogen Standard: emissions reporting and sustainability criteria" (UK Department for Energy Security and Net Zero, 2023) :

Risk Reduction Plan: Produce a plan demonstrating how fugitive hydrogen emissions at the production plant shall be minimised.

Risk Plan: Provide estimates of expected rates of remaining fugitive hydrogen emissions by the plant. (Noting that these are not accounted for in the GHG emissions calculation above).

Risk Monitoring: Prepare a monitoring methodology for fugitive hydrogen.

## Technical Standards

Hydrogen depots must adhere to specific technical standards to ensure the safe storage, handling, and distribution of hydrogen.

In this case, the technical standards for fuel infrastructure for hydrogen are:

- EN6196-2(Type 2) et EN62196-3(CCS) for electric vehicles recharging point socket outlets and vehicle connectors
- ISO 17268 for hydrogen refuelling point connectors
- IEC/ISO/IEEE 80005-1 for shore-side electricity supply installations

## Transport

When hydrogen is transported to or from a depot via road, rail, or waterways, additional regulations governing the transport of dangerous goods may apply.



### **Transportation by road**

Specific designs for tanks, cylinders and tubes are required to transport hydrogen under the Pressure Equipment (Safety) Regulations 2016 (SI 2016/1105). Existing standards need to be revised to allow higher vessel capacities, both in terms of volume and pressure. Hydrogen transport is prohibited through ten road tunnels in the UK based on its classification under the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR).

The transportation of hydrogen, classified as a dangerous good under Annex 5 of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), is governed by the ADR regulations. As per its ADR classification, hydrogen transport is prohibited through ten tunnels in the UK.

To ensure safe transportation, drivers handling hydrogen must receive adequate training, and vehicles used for transporting hydrogen must comply with the specified requirements for hazardous cargoes.

Furthermore, the design and production of tanks employed for hydrogen transport are subject to the Pressure Equipment (Safety) Regulations. These regulations establish guidelines for the safe construction and manufacturing of hydrogen transport tanks.

### **Transport licences**

A licence issued by Ofgem under the Gas Act 1986 is required to ship, transport or supply hydrogen. Conducting any of these activities without a licence, or an applicable exemption, is a criminal offence (section 5, Gas Act 1986). No licence is needed purely to produce hydrogen, but production must be "unbundled" from transport and supply (section 7(3A), Gas Act 1986) (Nardell, et al., 2023).

A licence (where required) includes provisions relating to the safe operation of the network and price controls. To obtain a licence, an entity must:

Demonstrate a credible plan on how it will undertake the licensed activities.

Allow Ofgem to carry out a risk assessment. (the Gas (Applications for Licences, Modifications of an Area and Extensions and Restrictions of Licences) Regulations 2019 (SI 2019/1024)).

## **Energy**

### **Compliance with Gas regulations**

Hydrogen falls within the definition of "gas" according to the Gas Act 1986, making it subject to regulation within the gas network (CMS Tax Law Future, 2023). The Gas and Electricity Markets Authority, operating through the Office of Gas and Electricity Markets (Ofgem), regulates the UK gas market. Entities involved in gas supply, gas shipping, gas transportation, operation of gas interconnectors, or providing smart metering for gas are required to hold a license under the Gas Act. These licenses incorporate measures to ensure the safe operation of the gas network and include provisions regarding price controls.

To transport hydrogen or engage in other activities regulated by the Gas Act through gas pipelines, obtaining a license is necessary. As part of the licensing process, the entity must present a credible plan for commencing licensed activities and undergo a risk assessment conducted by Ofgem.

Furthermore, gas licensees are required to adhere to various industry codes, including:

- **Uniform Network Code:** This code establishes common rules governing the gas transportation arrangements between licensed gas transporters and shippers. Each licensed gas transporter must have its own network code,



which incorporates the Uniform Network Code and governs the terms of gas transportation. It includes documents such as the Transportation Principal Document, outlining arrangements between gas shippers and transporters, and the Offtake Arrangements Document, specifying arrangements among different transporters.

- Independent Gas Transporter Uniform Network Code: This code applies to independent gas transporters, aiming to standardize network code arrangements for those operating extensions to the gas network, such as those serving new housing developments.
- Supply Point Administration Agreement: This multi-party agreement must be complied with by all gas transporters and suppliers. It facilitates the administration of supply points, including the process of changing gas suppliers.
- Retail Energy Code: This code enables end consumers to switch energy suppliers, empowering them in the retail energy market.
- Blending hydrogen into the existing gas networks, known as injection into the gas grid, is subject to the Gas Safety (Management) Regulations 1996. Currently, the regulations permit a maximum concentration of 0.1% hydrogen to be injected onto the UK gas network. However, ongoing testing is being conducted to assess the feasibility of increasing the hydrogen blend to up to 20%. If the tests prove successful, the regulations will require amendment to accommodate this higher blend.

These regulations may include energy efficiency standards, renewable energy requirements, and grid connection requirements. The specific energy-related regulations applicable to hydrogen depots may vary depending on their size, location, and energy usage.

### **Compliance with EU regulations**

The EU sets out rules and requirements for the production of renewable liquid and gaseous transport fuels of non-biological origin including hydrogen, supplementing Directive (EU) 2018/2001 (European Commission, 2023).

“practical feasibility to consider a time period of up to 36 months when determining if an installation generating renewable electricity has come into operation after, or at the same time as, the installation producing renewable liquid and gaseous transport fuel of non-biological origin”

Renewable energy can be labelled on electricity if the “renewable liquid and gaseous transport fuel of non-biological origin is located in a bidding zone where the emission intensity of electricity is lower than 18 gCO<sub>2</sub>eq/MJ”

### **Storage**

A consent is required under the Planning (Hazardous Substances) Regulations 2015 (SI 2015/627) to store two tonnes or more of hydrogen (Nardell, et al., 2023).

There is a duty to implement safety plans, emergency plans and a Major Accident Prevention Policy under the Control of Major Accident Hazards Regulations 2015 (SI 2015/483) where the amount of hydrogen present on site is over the lower threshold (five tonnes).

Where between five tonnes and 50 tonnes of hydrogen are to be stored, the lower-tier duties apply. If the amount of hydrogen exceeds 50 tonnes, the upper-tier duties apply. For more information, see Practice note, Control of major accident hazards (COMAH) regime: Lower tier and upper tier establishments. These rules are also likely to apply to hydrogen production and dispensing sites, not just dedicated storage facilities.

There are other rules, derived from EU law and policed by Ofgem, on ownership of and access to commercial gas storage facilities.



As is set out in detail in Deliverable 5, both CES and EMEC, a project partner in the Pathfinder Places Orkney project, have experience in developing and delivering transport regimes for hydrogen on roads and ferries in an islands context, from multiple projects in Orkney where hydrogen has been produced on the outer isle of Eday and used on mainland Orkney. If the project is successful in bidding for Phase 2 then their expertise would be drawn on to develop further plans for the long term aims of incorporating hydrogen into the rural energy hubs both as fuel for large mobility and as storage for renewable generation on-site.

#### 4.1.4 Case Study: Tees Valley Hydrogen Transport Hub

##### *Description*

The [Tees Valley hydrogen transport hub](#) will be operational starting 2025 and it will be the first of its kind in the UK, benefitting from a £3 million investment from the UK government. This initiative aims to accelerate the adoption of hydrogen-powered transportation, bolstering the government's commitment to achieve net-zero carbon emissions by 2050. The hub will act as a central hub with pop-up trials integrating local shops, supermarkets, online retailers, warehouse operators and delivery companies using hydrogen-transport services with refuelling stations, and help the deployment of hydrogen-powered buses, trains, and cars. The development work will be supported by Teesside University, forming an innovation campus with leading research and testing of new hydrogen transport technologies, including for cars, buses, trains, lorries, boats and planes.

Tees Valley region has been strategically chosen for its existing industrial clusters and hydrogen infrastructure. The region produces 50% of the UK's hydrogen and encompasses existing transportation networks, ideal to pilot small-scale production, distribution and usage of hydrogen and scaling-up possibilities. This hub will deliver "emission-free hydrogen passenger services, such as on-demand regional buses or zero-emission refuse vehicles" (UKRI, 2022).

Vital infrastructure to be developed include components, such as hydrogen production facilities and refuelling stations. These will enable the widespread adoption of hydrogen-powered vehicles across the region. Funding will also cover the deployment of hydrogen-powered buses, trains, and cars within the Tees Valley area. This initiative aims to create a comprehensive ecosystem for hydrogen transport, demonstrating the viability and benefits of this technology.

This hydrogen transport hub will serve as a "living lab and a blueprint" of the infrastructure needed to deliver the net zero vision and will help create up to 5,000 new long-term jobs in the north-east of the region as part of the net zero workforce transitioning skills (Tees Valley, 2022).

##### *Challenges*

The development of this hydrogen transport hub will tackle several challenges. The hub is focused on the development of large-scale production of low-carbon hydrogen, aiming to contribute to the energy transition. This includes facilitating refuelling on a large scale, specifically targeting the usage of hydrogen in buses, coaches, and other public transport vehicles. The integration of hydrogen-fuelled HGVs into the supply chain is also considered, with the aim of creating ripple effects throughout the transportation sector.

Additionally, the hub is committed to supporting the upskilling of the local workforce and fostering the development of a specialized skills base in the Tees Valley region. By doing so, they aim to contribute to the growth of the UK hydrogen economy and support the overall energy transition efforts.

##### *Lessons learned*

The first phase of the development of this Tees Valley hydrogen transport hub was the pilot trial at Teesside airport with the deployment of commercial and support vehicles fitted with 100% hydrogen zero emission engines. These vehicles included a ground support tug and a forklift truck with hydrogen provided by ULEMCo and global car manufacturer Toyota



supplying two Mirai hydrogen fuel cell vehicles (Teesside International Airport, 2021). Additionally, delivery vans were used in the demonstration operating in collaboration with “a leading supermarket chain, running between 19 superstores and their main distribution centre” with a 643km range (Teesside International Airport, 2021).

#### 4.1.5 Deliverable 4 Conclusion

The next year will see a strong shift in the energy sources for transport as more and more vehicles need renewed. In a rural island context light goods vehicles and cars are the majority of energy demand. With the maturity of the EV market for both vehicle types, there is an opportunity for supporting the shift to battery vehicles. This will come from available charging space at key hotspots of vehicle traffic (ie, the hubs), removing the potential reservations of users.

As seen in the scenario modelling larger mobility decarbonisation will rely on several levers:

- Campaign for regulatory sandboxes for grid applications for high-capacity fast charging and hydrogen as a mobility energy vector in the marine environment.
- Enabling the reduction of freight kilometres through more efficient route planning, route sharing and multimodal hubs (ferries, road freight). This is especially important as the current regulatory framework does not easily allow onboarding of hydrogen powered vehicles. Therefore, while it is key that hydrogen is allowed to be used and/or transported onboard ferries, setting up hubs that allow road freight to offload cargo onto ferries so that it can be picked up on the other side is a key part of rapid downshift in energy demand and would enable hydrogen powered vehicles to be used either side of ferry routes.
- SIC, as a demand cluster in terms of vehicles, has the potential to lead by example and behave as a first mover and provide early use cases for energy hubs, especially for mobility applications that require high daily mileage. SIC are also part of Net Zero Technology Centre’s Net Zero Technology Transition Programme, a Scottish Government funded study investigating the future hydrogen economy in Scotland, including production, storage, transportation, demand, regulations and safety. Phase 1 has just been completed with phase 2 beginning in Q3 2023, trying to identify potential pilot project locations.

Based on Ricardo’s maritime decarbonisation timelines and scenarios, ships will require a combination of hydrogen, ammonia, and biofuel storage and refuelling infrastructure by 2040. Whether this can be included in a multipurpose hub will be highly dependent on the safety regulation framework. Orkney has experience in the generation, transport and use of hydrogen, the learning from which could be used to accelerate developments in Shetland. Some relevant case studies are included in the next section on Demand Side Management.



## 4.2 DELIVERABLE 5 - DEMAND SIDE MANAGEMENT

**Options analysis of demand side management for having generation at the hubs – for both grid connected and off grid options - and for providing storage to ensure 24/7 supply to charging infrastructure.**

**Non-technical barriers addressed:** behaviour change, resilience, weather.

**Author:** CES with support from SIC

Grid connections are not guaranteed to operate without fail; likely this will occur, and it comes down to the purposes of the loads on the connection point and how critical they are to then dictate what efforts should be taken to ensure a secure import or export of energy. In the case of the Shetland Rural Energy Hubs, renewable generation is prioritised in the design, so being able to export power to self-consume is a large potential for the hubs. But in order to make full use of the generation potential of wind turbines or solar panels typically an installation will need additional components and/or management systems to maximise self-consumption or to allow for self-consumption during power cuts. The over-arching mechanism for doing so is 'Demand Side Management' (DSM).

The following will look into some of the main options for DSM technologies, including design considerations to ensure hubs can operate during power cuts. Some real-world examples have been included to demonstrate the potential of DSM.

As with Deliverable 4, while demand side management is a technical solution, it is explored to provide solutions to overcoming non-technical barriers. These include ensuring hubs have enough power to supply the varied power and charging needs to encourage use of EVs and ebikes; power electric buses and secure energy supply during power outages from extreme weather. These issues were raised repeatedly in the community engagement work cited in Deliverable 3, with Shetlanders saying that they would be more likely to get an EV or ebike if they could charge at the hubs and they would use the hubs during power outages a key aim identified in SIC resilience planning as well.

### 4.2.1 DSM Options Analysis

As mentioned, having a renewable energy source at the Hub is a priority in the design; this will both help ensure low carbon energy for the hub, while also helping to stabilise/reduce the cost of energy for the services provided to the community. The energy generated from the wind turbines and/or solar panels should be consumed in the hub as much as possible. It is significantly more cost effective to use the power generated, rather than exporting when power isn't needed and then importing from the grid when it is.

DSM is the management of energy demand to match the supply of energy as much as possible. This can be achieved either by intelligent timing of consumption or smart storage and communication systems that allow controllable separation of energy input and output for utilisation by a consumer. The term "flexibility" has recently been more commonly adopted to describe this process in both energy demand and generation activities. Generation Side Management has fundamentally underpinned the operation of the UK grid system for a considerable time, but this study will focus mostly on the more recent focus on demand side activities. There is little control how much the wind will blow or the sun will shine, so the resources available for this type of renewable generation is a fluctuating commodity; with some predictability and seasonality. Along with existing measures for generation management, such as overbuilding, turn up and down and pumped storage, DSM systems are increasingly being adopted to help reduce balancing costs and ensure generated power has somewhere to be consumed or stored locally, rather than being exported to the distribution grid. The following will take a look at the main options of achieving such systems in the hubs.



## Hot Water

The hubs will require hot water. Excluding properties on the Shetland Heat Energy and Power (SHEAP) district heating system in Lerwick, most properties will have a hot water cylinder. In domestic settings these would typically range from 100L to 300L. In business properties the range can be greater, from small under counter storage to 1,000s litre tanks.

Smart timer switches and power diverters are a simple mature technology which are simple to install and cost effective; depending on the installer it could cost between £700-£1,200 to have the unit installed. A smart timer switch linked to energy efficient thermal storage can allow for splitting of energy input from heat output allowing import to suit on-site or external generation surpluses whilst the heat output still delivers at the times and levels required by the user of the system. The basic principle behind power diverters being that they can monitor if the property is exporting power to the grid via a CT-clamp (current transport) clipped around a power cable in the distribution board. If power is being exported then this means there is less demand for power than is generated from wind turbines or solar panels. The power diverter then simply turns on the standard immersion element within the hot water cylinder, proportional to the volume of real-time power being exported. Even though the immersion element would typically be rated at 3kW, it will only be instructed to come on to meet the quantity of export. Typically, a domestic hot water (DHW) cylinder will be sized for user demand, and not oversized in order to maximise storage capacity. In this situation an oversized cylinder would risk a low refresh rate of water, and a risk of legionella. However most modern systems, esp. linked to heat pumps, are now designed to protect against this eventuality with fortnightly disinfection cycles. If the hubs typically require hot water for sinks in kitchens and bathrooms, it will normally size a cylinder below 150L. By oversizing this type of cylinder to 300L or larger more than 10kWh of DSM storage can be created daily from DHW systems alone.

Alternatively, where the property also has a wet space heating system, large hot water storage can be placed between the heat source (e.g., heat pump, etc.) and the space heating delivery system. In this situation an even larger accumulator tank could be installed to act as energy storage until the space heating in the property was required.

If the property utilises a heat pump, it is harder to pair the system with the variable nature of renewables, as heat pumps have a 10–15-minute start-up phase to get to peak efficiency and are not designed to stay within a certain power to meet real-time exports. However, if a tariff included off-peak rates, with enough storage capacity, then whole day's heating requirements could be generated and stored during these times.

### Case Study: Abernethy Trust and CES Hydro 2 Heat

The Abernethy Trust is a non-profit organisation which owns and operates four outdoor centres and one bunkhouse in Scotland, providing instruction in outdoor activities with on-site residential facilities. The trust also operates the Abernethy Trust Hydro Scheme, on their Ardgour Centre site and consists of a 89kW run-of-river hydro project which was first conceived in 2008 and began operation in 2010. This device was installed to generate electricity to be sold to the national grid and to raise money for the trust.

In 2015 Abernethy Trust completed a project which aimed to utilise more of the electricity generated from their on-site hydro device to provide electric heating within the main administrative and residential building of their Ardgour Centre, Ardgour House. Prior to this project 10% of generation was used by the centre, with the remaining 90% being exported to the grid. The Abernethy Trust aimed to use more of this on-site generation to reduce their heating oil consumption and reduce the amount of electricity imported from the grid by replacing their current space and water heating systems.

In the consultation phase of the project CES supported the Trust in designing a DSM system, conducted an assessment of the current domestic hot water system within Ardgour House and found the building to be generally poorly insulated, owing to an aging heating system. It was also determined there was a serious risk of Legionella bacteria within the current hot water system, with the greatest risk coming from water spray from showers and taps.



CES and their contractors determined that a new boiler house should be built, and that mains water supply be redirected into this facility which would include a 2,000 L thermal store with immersion heaters, integrated with a 420 L of domestic hot water storage. This 2,000 L thermal store would allow 35 kWh of heat to be stored at a maximum temperature of 85°C and would contain 6 x 9 kW immersion heaters.

This system was connected and integrated with an EMMA system, a device that monitors and controls the incoming supply of electricity into the system and directs it to the thermal store after which any surplus electricity is exported to the grid. The space and hot water systems within the building were also modified to include more modern and efficient systems within the main building.

### **Dump Load Heaters**

A very mature mechanism for maximising self-consumption is to have a resistive heating system operate as a dump load; any excess energy is “dumped” into the heater. A very similar technology to hot water power diverters, dump load heaters can often be seen paired with domestic wind turbines, which are harder to stop generating when there is no demand for the electricity.

The key benefits of dump load heaters is that they are cheap to install and maintain. The heater itself has no moving parts and will have a long operational life. The response times of the heater is close to instantaneous. However, if the heater is place incorrectly and the control is not optimal, the occupant of the property may be forced to have heating supplied at an undesirable time such as on a windy hot summer day. The technology can be very basic with control systems very rudimentary.

Dump load heaters are a cheaper accessible technology that can contribute towards maximised self-consumption. However, it should not be prioritised over most of the other DSM methods, as it is closer to forcing consumption on the occupants, rather than storing energy until it is required/desired.

### **Case Study: Heat Smart Orkney**

Orkney suffers high levels of fuel poverty, and lost generation and revenue due to grid curtailment, while having some of the highest wind generation capacity. For the islands of Rousay and Eday, an average of >45 % of production (nearly £500k lost revenue combined per annum) when curtailment first started to impede generation. The Heat Smart Orkney (HSO) project (funded by the Scottish Government’s Local Energy Challenge Fund) provided a smart solution by connecting the community owned wind turbines to the heating of local homes.

Rousay, Egilsay and Wyre Development Trust led HSO, with delivery support from Community Energy Scotland. A technology partner developed an aggregator platform to monitor signals from the distribution system operator’s (DSO’s) Active Management System to the turbine and control the demand-side management (DSM) load (264kW of hot water cylinders and storage heaters) to the benefit of the turbine. This required the DSM loads to react fast enough to be relevant to the project’s goals.

The funded project was completed in 2019 however the community continued to fund the project until this year and it consistently showed live matching as a business-as-usual activity, although the further investment needed to take it forward as a standalone enterprise is currently paused until regulation and market issues are further resolved. However, it has already fed learnings into a number of multi-million-pound projects in Orkney, including both SMILE and ReFLEX and supported other UKRI initiatives such as PITCHES, ECAS and TradER and resulted in significant implications for the rest of the UK.



Over 70 local properties benefited from the project. Energy fuels across project properties saw a total drop, due to displacement or efficiency measures, of 4,700 litres of oil; 8,000kg of coal and wood; and 20.4MWh of electricity. However, the benefits went beyond being able to reduce fuel costs and increase generation, including: energy advice; increased sense of ownership of local energy; increased revenue for community projects; employment for 3 isle residents.

A key aim of HSO was to reduce fuel poverty. A rebate compensated homeowners for the additional power used in their home at a higher cost than the alternative provision of heat (oil, coal, etc). Due to its success, the rebate rate was doubled to promote further incentive.

### **Case Study: H2020 Smart Islands Energy Systems (SMILE) Orkney Demonstrator**

The Smart Islands Energy System (SMILE) project was a collaboration of nineteen partners from various European countries. The project looked to demonstrate nine different smart grid technologies on three different islands. The main end goal of the project was to foster the market introduction of these nine technologies. CES was work package lead for the Orkney demonstrator. In Orkney, SMILE built on the previous work undertaken by CES and across Scotland, primarily to continue to try to combat curtailment for local generators, but partly to also try to develop and demonstrate DSM systems with more modern and future proof power and heating technologies. This involved developing and adapting the smart DSM communication and control systems implemented in the HSO project and applying them to heat pump, electrical battery storage, phase change heat batteries, 2 types of EV charger and potential hydrogen generation technologies.

The project implemented more than 100 installations across these different system types in households and non-residential properties in Orkney and ran from 2016 to 2022. Although hampered by the pandemic during its main delivery phase, key learnings and achievements resulting from the project were development of robust household energy system use monitoring and how this could support users to better optimise their properties and reduce use and costs, the challenges of working with and integrating technologies at lower Technology Readiness Levels into working households and properties, effective methods of integrating DSM controls with a range of Heat Pump, heat storage electrical battery, and EV charging technologies and the value of enablement and appropriate involvement of users into effective system and behaviour change.

### **Battery Storage**

Battery storage in this context refers to stationary electrochemical battery banks installed within the property. These have seen a national surge in interest in the last 12-months as unit costs continue to drop and the cost of energy in the UK continues to increase. Batteries allow for those with wind turbines or solar panels to ensure a maximised self-consumption of energy, which in theory results in much cheaper energy costs.

Investments in batteries as a result of the EV market has seen significant growth over the last decade. Unit costs have decreased almost 90% to roughly \$100/kWh, while battery densities continue to increase which allow for the same sized car to continue to have higher and higher range capabilities. Furthermore, investigations into different battery chemistries to lithium-ion based batteries is also in a high rate of investment. In the medium to long-term timescale, it is very likely that the main battery chemistry will be very different from today's.

The principal benefits of lithium-ion batteries is that they are very simple to operate; battery management systems take away all risk of over or under charging the battery banks. Battery banks are available 24-hours a day, as long as they aren't fully charged when energy storage is required. Battery banks are usually modular in design, and depending on the system design the appropriate number of batteries can be connected in series to meet this demand. Or if the demand of the property changes over time, more batteries can be added later. Charge and discharging of the batteries can



happen almost instantaneously. For this reason, they pair very well with nearly all technologies. For example, heat pumps do not like to be ramped up or down, so batteries can help accommodate for any fluctuations with zero sacrifice in performance or efficiency of the heat pump.

A downside of battery energy storage to meet DSM mechanisms is the cost to meet large storage requirements. Meeting multi-day storage capacities would likely be prohibitive and too difficult to finance.

### Electric Vehicle Charging

If you consider that an electric vehicle is a battery on wheels, it makes sense to maximise the use of that battery to enable increased self-consumption of generated power. Since 2019, to get grant support for an EV charger, the unit had to be classed as a smart charger. This typically meant having functionality to control the supply or rate of power to the EV. Many chargers on the market now can take external commands to control the supply of power to the car; be this from simply monitoring when the property is exporting power to the grid and turning on to limit this export, or taking signals via API (Application Programming Interface) from a central Integrated Energy System (IES), like the FlexiGrid platform trialled in the ReFLEX Orkney project which is proposed to be further developed in Phase 2.

EV chargers can commonly be equipped with the ability to reduce power supplied to the car if it is at risk of exceeding the property's maximum current rating; sometimes referred to as load balancing. For example, domestic properties are typically limited to 100A. The EV charger could monitor this with a simple CT-clamp around a power cable in the distribution board, and ramp power down when this limit is close to being reached.

Load balancing EV chargers are well suited in the domestic setting, as typically the charge rates are not critical. Cars are usually plugged in from 6pm until 8am, which is more than enough in most personal and/or professional lifestyles to charge the car to the required mileage. Additionally, there is typically zero competition for access to the charger, so no need to charge and unplug as soon as possible. The other setting where DSM controlled chargers could work well, is to charge cars operating as part of a car club. Often a car can be sitting for prolonged periods of time, and charging could be drawn out over a longer period of time to accommodate the generation from wind turbines or solar panels. Additionally, it is possible to forecast when the car will be needed due to the booking system of the car club. Conversely, the charger must also have the capacity to charge at full rate power when it is known the car is needed in the near future.

Other variations in Load Balancing can be found in public charging or office charging infrastructure. Typically, in these settings there are multiple sockets to charge from, usually a mixture of chargers with 2-sockets, or a series of chargers across multiple parking spaces. Load Balancing can either be enabled on a single charger with 2-sockets, or across multiple chargers. This effectively means sharing the maximum grid connection across the number of cars plugged in. For example, on a 7kW charger, one car charging might get 7kW, while two cars charging may get 3.5kW each. This mechanism can be scaled up depending on the grid connection available at that location, the capacity of the charger model, and the charging rate for the car.

Vehicle to Grid (V2G) is an advancement on the smart charger, as it can charge the car and take energy from the car to supply a property. These chargers are still very uncommon in the UK and are typically designed to connect to a 3-phase supply. They are significantly more expensive and there isn't a market incentive to push for further deployment at present. It is expected though that as markets advance, tariffs will come into place that will make V2G chargers more attractive.



## Hydrogen

Hydrogen holds immense potential as an energy storage medium. It's an amazingly abundant element, very energy dense, and in certain areas of the hydrogen sector the technologies involved in the generation, transportation and consumption are mature. However, there are also many aspects which require a lot of development to make the use of hydrogen reliable, accessible, abundant and cheaper – as was set out in Deliverable 4.

In islands settings, the main potentials for hydrogen are the use on lifeline ferries and planes, once the technologies and regulations for use of hydrogen ion vehicles matures. The other potential is the creation of jobs and revenue in the production of utility-scale hydrogen produced from renewable energy, with the hydrogen then exported to national and international markets.

In the context of this particular investigation, hydrogen would be a storage medium for matching renewable energy generation at the hub and then later energy consumption at the hub. If the design was to produce hydrogen from electricity, then convert back to electricity from the stored hydrogen, both an electrolyser and a fuel cell would be needed to be located at the hubs. With both processes being approximately 50% efficient, and not taking storage efficiency into account, 75% of the initial energy generated from the Hub's wind turbines or solar panels is lost as heat. The case study of the Surf 'n' Turf Project both highlights the potentials of hydrogen, but also the attempt to capture some of the waste heat by-product of the fuel cell and divert it into a nearby building. As much as possible, heat should be recovered from these processes, as in all likelihood, if hydrogen was to be used in a hub setting, it would be to power heating systems. It should be noted though that generating hydrogen on site to store and then convert back to electricity on the same site is a very inefficient process and should only be considered under specific circumstances. In most cases, battery energy storage is the much more viable alternative.

The other means of making use of hydrogen in a hub setting to help manage the power generation for wind turbines or solar panels, is to produce hydrogen to limit the export of energy to the grid, and then use the hydrogen directly in a hydrogen boiler for the purpose of generating heat in the building. This is a more preferable alternative approach to turning the hydrogen back into electricity for use; using hydrogen as a fuel is better value for money than converting back to electricity to use as a fuel.

It should also be noted that the current mature electrolyser technologies are not well suit to be paired with the variable nature of renewable generation. Electrolysers, as well as fuel cells, operate optimally when being supplied with a steady power. In reality, a battery bank is required to level off power being used by the electrolyser stacks. Arguably, the battery bank should just be used directly to balance the generation and consumption of electricity if this is the end goal.

In the short-term, hydrogen would not make a good medium to support DSM activities. The complexity and cost, especially in an island community make the technology difficult to cost for and to maintain. Then at the end, the unit cost of hydrogen is debilitating expensive. However, in the medium to long-term timescale, with the hydrogen sector in Shetland becoming significant in scale, the unit cost of hydrogen and the cost to install and maintain may make hydrogen a more attractive option.

### Case Study: Surf 'n' Turf

The Surf 'N' Turf project was developed by CES and the European Marine Energy Centre (EMEC), with funding from Local Energy Scotland and the Scottish Government's Local Energy Challenge Fund (LECF). The aim was to reduce the level of curtailment on the community-owned 900 kW wind turbine on the island of Eday and tidal turbines at EMEC's test site, and to show the viability of developing a supply chain for the production and distribution of renewably generated hydrogen across rural areas of Scotland.



The grid in Orkney was (and is) operating close to full capacity, and as a result renewable generators at key pinch points are either turned off or have their generation severely reduced.

This project aimed to tackle the issue of curtailment by using electricity generated at the Eday turbine during periods of high curtailment to create hydrogen on the island. Hydrogen was generated via a 0.5 MW Proton Exchange Membrane (PEM) electrolyser unit, with the highly pressurised gas being stored within mobile storage units (MSU) tube trailer where it was then transported to Kirkwall, Orkney’s main town. The hydrogen fuel was then transported to the 75 kW hydrogen fuel cell in Kirkwall harbour, where it was used to provide auxiliary power to ships as they dock at night.

The process of turning hydrogen back into electricity and water at the 75 kW fuel cell is only a 50% efficient process. For every unit of electricity produced, there is also a unit of heat produced. Typically, this heat is usually vented into the atmosphere. But the Surf ‘n’ Turf project was designed to try and limit unnecessary inefficiencies where possible. In this case the cooling circuit for the three heat pump stakes extended to three heat exchanges installed in the adjoining storage sheds for the local authority's marine services.

The Surf ‘n’ Turf project was able to demonstrate the potential of hydrogen as a mechanism to keep renewable generation assets operating, to bypass pinch points in the distribution grid, and to allow for a flexible zero carbon auxiliary power source for large power loads (I.e., berthed ferries).

**Summary**

**Table 4.1 DSM Mechanism Advantages and Disadvantages**

DSM Mechanism	Advantages	Disadvantages
Hot Water (DHW)	<ul style="list-style-type: none"> <li>• Easy to install</li> <li>• Cheap</li> <li>• Simple technology</li> <li>• Can be retrofitted to nearly all existing cylinders</li> </ul>	<ul style="list-style-type: none"> <li>• Can have limited energy potential if the hubs water requirements is low</li> </ul>
Hot Water (Space Heating)	<ul style="list-style-type: none"> <li>• Significantly larger capacities</li> <li>• Can make heat pumps operate more efficiently</li> <li>• Can shift heating costs to excess and off-peak times</li> </ul>	<ul style="list-style-type: none"> <li>• The space requirements for tanks can be significant</li> </ul>
Dump Load Heaters	<ul style="list-style-type: none"> <li>• Cheap technology</li> <li>• Easy to install</li> <li>• Quick response time</li> </ul>	<ul style="list-style-type: none"> <li>• In the wrong circumstance it could negatively interact with a heat pump based heating system</li> </ul>
Battery Storage	<ul style="list-style-type: none"> <li>• Batteries can be available 24-hours a day</li> <li>• Response times of batteries is instantaneous</li> <li>• Batteries pair very well with heat pumps</li> <li>• Development in battery technologies is accelerating due to the popularity of EVs</li> </ul>	<ul style="list-style-type: none"> <li>• Multi-day battery energy storage is very expensive</li> <li>• Battery banks may be expected to last only 10-years before needing to be replaced</li> </ul>
EV Charging	<ul style="list-style-type: none"> <li>• Very cost effective</li> <li>• Easy to install</li> <li>• Can be easily retrofitted</li> </ul>	<ul style="list-style-type: none"> <li>• Not suitable where charge rates need to be as high as possible</li> <li>• Cars need to be plugged in to benefit</li> </ul>



DSM Mechanism	Advantages	Disadvantages
	<ul style="list-style-type: none"> <li>• Could potentially make charge rates cheaper if self-consumption is maximised</li> <li>• Could pair well with car club cars</li> </ul>	<ul style="list-style-type: none"> <li>• Could potentially result in annoyed EV owners due to reduced charger speeds</li> </ul>
EV Charging (V2G)	<ul style="list-style-type: none"> <li>• Could potentially reduce the need for the hub to have stationary batteries as well</li> <li>• V2G chargers could significantly benefit hubs during power cuts</li> </ul>	<ul style="list-style-type: none"> <li>• Market is not yet incentivising V2G chargers</li> <li>• Significantly more expensive than one-way chargers</li> <li>• Has the potential to result in unwanted discharging of EV batteries</li> </ul>
Hydrogen	<ul style="list-style-type: none"> <li>• High energy density</li> <li>• Could benefit from the planned H2 economy in Shetland</li> <li>• Could help enable H2 vehicles in Shetland</li> </ul>	<ul style="list-style-type: none"> <li>• Very expensive</li> <li>• Track record of being unreliable</li> <li>• Safety considerations</li> </ul>

The above has all considered DSM mechanisms when the power supply to the property is operating correctly. But the following looks at the consideration in place for when power is lost during power cuts, and how to ensure energy availability for the community.

#### 4.2.2 Resiliency Centres Design and Consideration



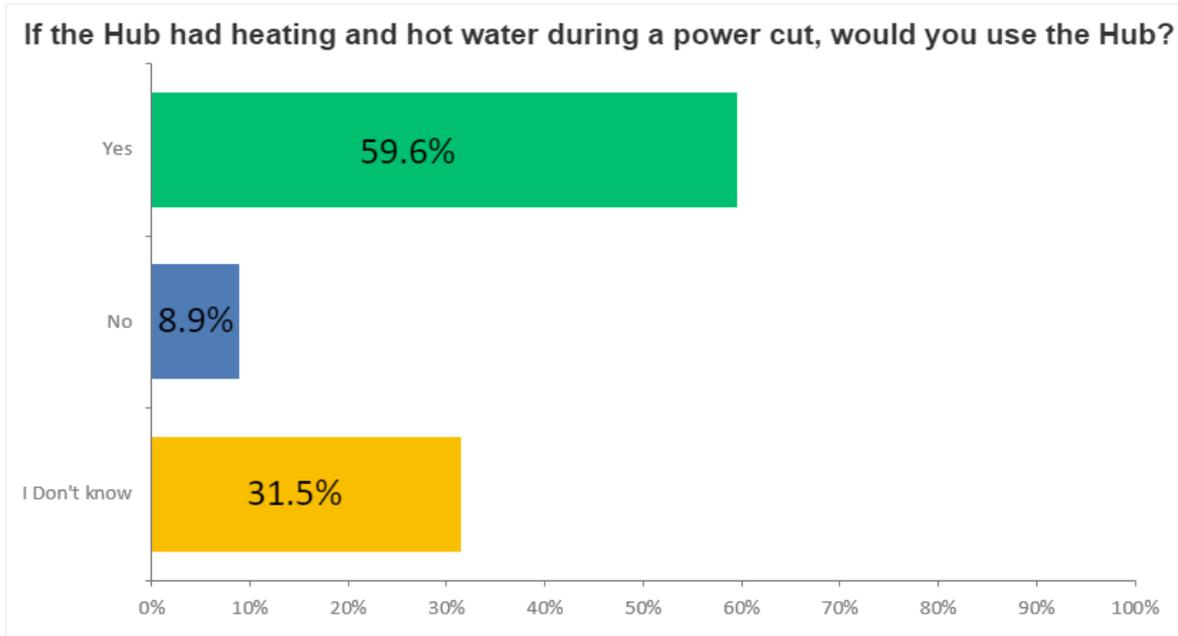
**Figure 4.5 Failed Distribution Power Lines (Picture Credit: Shetland Times)**

The following section looks at the high-level design and considerations of the work involved in providing resilience to two community halls; one at Mid Yell and the other at Brae in Shetland. These locations have been used as examples only of the design process. Both halls are normally provided with electricity from the Shetland AC grid network currently supplied from SSENs power station in Lerwick with contributions from the oil terminal at Sullom Voe and several large wind turbines around Lerwick and in Yell. From 2024, the primary supply to the Shetland grid will come instead from the Viking wind farm. When output from the wind farm and other renewables in Shetland are insufficient to meet Shetland’s

demand load then power will be drawn from the HVDC (High Voltage Direct Current) cable normally used to export surplus electricity.

During the winter in December 2022, large areas of Shetland experienced almost a week without electricity after severe freezing conditions made multiple lengths of the overhead distribution line snap and break under the weight of ice on the lines.

When surveyed, almost 60% of respondents answered positively towards the concept of resiliency centres among the community; a building where people travel to, if asked to do so, to access heating and hot water during a power outage.



**What Is Resilience?**

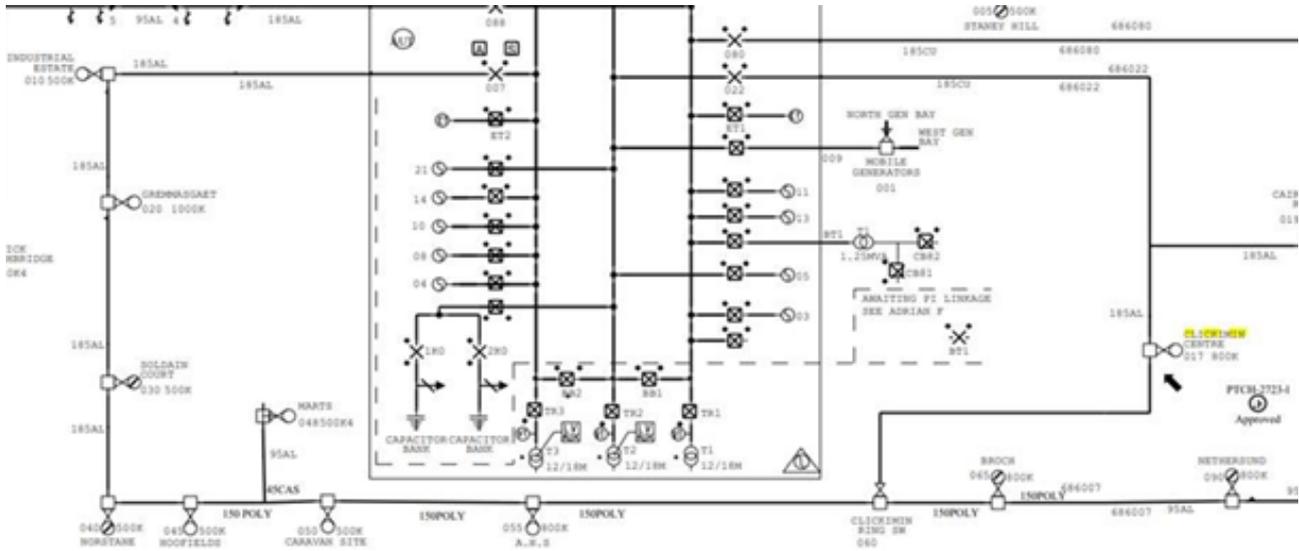
Resilience in this context is the ability to continue operating essential electrical loads at the premises during a failure of the normal main electricity supply. This could be because of a local fault or because of a fault affecting a wider area for which the community halls could be used as hubs to support people not able to provide meals at home for example. Energy may also be needed at these hubs to keep them warm, to charge peoples’ personal electronic equipment and possibly to charge EVs.

Traditionally resilience could be provided by installing a diesel-powered generator sized to meet the essential loads to allow the building to meet the requirements of a community hub. This means providing both heating, lighting, and cooking facilities with the latter being pushed to the limits to provide sufficient meals for people in need in the area.

As Shetlanders decarbonise their energy supply system, the use of diesel generators to provide this functionality will become less attractive over time and has been excluded from this study. However, it may be expected that for the next 10-years or so that portable diesel generation supplied by SSEN could be used to extend the period of resilience for as long as necessary should it not be possible to restore normal supplies within 24-hours.

Resilience can also be provided by having more than one electricity supply which is fed via a different route and for which there is no single point of failure. Electricity supplies in some parts of Lerwick already meet this requirement except for the final Low Voltage network and connection into the property. However other electricity supplies in Lerwick

such as that to the Clickimin Centre have a single point of failure in the 11,000/400 V transformer at the substation providing its supply but it is resilient for faults on the 11,000-volt network as there are two cables providing alternative supplies to the substation. The enclosed drawing Figure 4.6 shows the alternative circuits available to the Clickimin Centre sub-station.



**Figure 4.6 SSEN diagram showing alternative 11kV supplies to the Clickimin Centre**

Both Brae and Mid Yell have many potential single points of failure on 33,000 V, 11,000 V networks and at 33,000 /11,000 transformers. In addition, Mid Yell has the potential to be off supply for longer if there are issues with the Mainland to Yell ferry crossing or if there are faults on cables. It is believed that there are two submarine cables to Yell so that resilience is provided in case one fails but given the time taken to repair submarine cables the resilience will be depleted for some time.

**Required Power Capacity and Energy Storage Capacity**

The required power capacity will be shown as a maximum kW for the site and an after-diversity kW capacity for the site showing the expected maximum load in kW. Note that diversity tackles the issue of what is being used at one time and the after-diversity total sets the size of storage in terms of its kW rating. However, due to potential unbalance between the loads on three-phase systems the total rating will need to be higher than the after-diversity figure and may be higher than the maximum kW required capacity.

For a smaller location with only a single phase supply the required power capacity could be sized at the first available size above the after-diversity power capacity in kW. This is not the case at Brae or Mid Yell community halls.

Where loads have poor power factors then additional allowances need to be designed for. It is not thought that the loads involved in the community halls have poor power factors and this has been ignored at this point but would need to be checked as part of any detailed design work prior to specifying an energy storage system.

Energy storage capacity will be shown as kWh required for the first phase of 6-hours, and the second phase of 24-hours. This is calculated in the Mid Yell and Brae sections of the report using estimates of load factor, this is the ratio of the actual load expected in a period in kWh to the potential maximum load in the same period if the load was operating 100% of the time, this is used to calculate the number of kWh of storage required to be provided by the system to the



load. Load factors vary depending on the type of load. Without more detailed information quite high load factors have been assumed to ensure that the design is adequate. This may mean that as currently presented the design is over specified. With the more traditional diesel generator, over design of energy storage capacity has never been an issue as the equivalent is the size of the fuel tank required. Moving from a 500 litre to a 1,000-litre tank is not that expensive adding probably less than 10% to the cost. Moving from a 500kWh to a 1,000kWh battery for example would increase the total cost of an installation by perhaps 80%.

### How Long Does a Community Hub Need Resilience For?

There is no simple answer to this question, given enough time to produce one meal is better than nothing but as an emergency goes on the value of hot meals and drinks increases. It is further into an emergency that the value of a community resilience hub increases as people's homes become colder and personal portable devices start to run out of power. Therefore, there will be a requirement to provide warm rooms for people to shelter in and to provide power to recharge personal electronic equipment. But this must be balanced against the cost of the battery storage to cover prolonged durations of power provision.

For the purposes of the following modelling, estimates of the provision duration must be made. For this, a figure of 6-hours is used to represent the first phase; a period of time between the loss of grid power and when the hub is expected to begin providing services to the community. During this time the only loads required will be the buildings standing load of background heating and operation of fridges and freezers. If the hub is opened earlier the next phase will start earlier.

The second phase is opening the hub, providing meals and warm refuge for people, 24-hours has been used for this phase. The aim though is to make sure that it can operate until normal supplies of electricity can be restored, or for emergency generation to be brought in to restore supplies. SSEN would normally be able to do this within 18 to 24 hours if transport is available, though weather conditions may on some occasions mean that transport is not available.

During this phase the building will require the heating system to run at a high rate both to warm up the building and to cater for the heat losses caused by repeated entry and exit from the building. For the purposes of the modelling a load factor of 0.6 for the space and water heating systems, and as the cooking facilities will be used extensively, a load factor of 0.3 has been used.

With no power at home, people will want to charge portable devices at the community hub, phones, tablets, and laptops. Given the number of people who could be accommodated or feed them plus those who may need to stay to keep warm then charging portable devices has the potential to create a significant load which needs to be catered for. It is assumed that charging of personal devices will peak at 2kW with a load factor of 0.5 during the second phase when the resilience hub is open. In practice the loads may be lower, and the hub may be able to continue to operate for a longer period.

The timings given assume that no local generation sources are available, and even if installed they may not be available for several different reasons. If local renewable generation is available, then a method has been identified so that either wind or PV power can be used to supplement supplies and extend the resilience period of the community hub.

It should be noted that under normal and G98 connection methodologies renewables would not be able to provide supplies to isolated systems. However, the same generation could be connected under G99 with the agreement of SSEN in such a way that they could contribute to the supply of an isolated system.



## EV Charging Provision

At first glance the provision of EV charging might seem a luxury for a community resilience hub. However as there become fewer petrol and diesel cars on the roads then it may become vital. An option to provide emergency charging of EVs has been provided based on there being two 7kW AC charge points which during an emergency are cut off unless authorised by the manager of the resilience hub. With a load factor of 0.75 for charging, this will use 252kWh in 24 hours and give about 750 miles of driving which may be required to bring people into the resilience hubs and take out hot food and drinks. EV charging could be regarded as a future upgrade which is not required in 2023 but which will be required by 2030. It would make sense to provide sufficient space for this type of expansion if any building work must be done to provide resilience now and in terms of the power capacity available. With most energy storage systems, the amount of energy stored is not directly linked to capacity and can be expanded in the future.

## Scope For the Integration of Renewable Energy at Community Resilience Hubs and Potential for Renewable Energy to Provide Increased Resilience Hours

Both solar PV and small-scale wind power could be integrated with the community halls. At Mid Yell there already is a 5kW wind turbine, at both sites the total renewable generation could be expanded up to 11kW.

For regular use, but not used during a power cut, SSEN would allow the connection of up to 11kW of generation split across the three phases of the supply under the connect and notify processes set down in G98. Currently SSEN are not allowing larger amounts of generation to be connected in Shetland unless the generation is connected to the Shetland generation management system. This is an expensive option and would potentially result in a lot of curtailment of generation until the new interconnector is operational.

Connection under G98 would require the renewable generation to disconnect and remain disconnected during any power cut so would not be able to contribute to extending the resilience period. This could be any mix of solar PV panels and small-scale wind turbines the limit is based on the size of the inverters providing AC connection to the Grid.

In Shetland a 5kW wind turbine is likely to have a high load factor of at least 0.3 but quite possibly 0.4 or 0.5 while a PV system will have a low load factor of perhaps only 0.1. In addition, the wind turbine will operate far more in winter than the PV and its output could be used to keep the hall warm rather than exported to the grid. A PV system produces peak output during long summer days when there may be no need for heating and so the output would be exported to the grid at a low price; circa 5p per kWh.

The same basic generation could be connected in such a way that it can operate in parallel with the grid while the grid is working and then when the grid goes down it could disconnect from the grid and start to feed into the energy storage system on site. This is relatively easy if the storage system is batteries but may be harder if other storage technologies are used. This could only be connected under the G99 rules and would have to be approved by SSEN prior to installation. Given that this system is not in common use in the UK yet, it would be recommended to allow a lead time of at least one year, preferably longer, to be allowed to design a system and get agreement with SSEN before seeking to purchase and install the system.

If a small-scale wind system were installed then in winter it could provide in windy conditions up to around 120kWh per day for each 5kW turbine, so two turbines could provide up to 240kWh on one windy day. This would extend the halls resilience period to around 2-days and significantly longer if loads could be reduced. However, it would not work if there was a calm period.



## Outline system to provide resilience

The aim of this section is to design an outline system to provide resilience in electricity supply so that the community halls at Brae and Mid Yell could act as community resilience hubs for a minimum period of 24-hours from opening even if they are not opened until 6-hours after the start of an electricity supply interruption. The actual storage mechanism may be batteries, but other forms of storing energy produced from renewables could be used and may be cheaper. No attempt has been made to cost any solution or to find the optimum mix of storage solutions as part of this project. This is an area for future work.

An indication of where integration of existing and potential renewable systems could extend the resilience period for longer than 24-hours has been provided. This is restricted to small scale wind and solar PV for this project and is not specific to either Community centre.

The following goes into some detail on the design consideration for the Brae Community Hall and the Mid Yell Community Hall. These buildings have principally been selected for this exercise as they were used for the community drop-in sessions, as discussed in Deliverable 3. The project team were able to perform an assessment of the buildings and gather details relevant for the modelling including: power grid connection, heating and hot water systems, other electrical loads, renewable power generation, building lay-out, etc. These assessments are primarily process examples, which could be used on any possible hub location which was considered for providing energy resilience in the community.

### Brae

The Brae Community Hall is located to the south of the town of Brae next to the main access road. It is primarily heated through a series of heat pumps. The kitchen uses a mixture of electricity and gas. The car park has approximately 30 spaces.



**Figure 4.7 Brae Community Hall**

The existing information available suggests that the building has the heating and cooking facilities as outlined in the table below. Lighting has not been assessed so an assumption has been made. Other power uses such as mobile phone and laptop charging have been assumed as have the optional extra figures for emergency EV charging. A more detailed load assessment and analysis may result in the required storage figures being lower. Based on the figures shown it would be recommended that a storage system with a power capacity of 60kW three-phase and an energy storage capacity of 500kWh would be adequate. The power capacity is higher than the maximum load because it is highly likely

that the loads are not evenly balanced across the three phases of the electricity supply. Testing may show that some rebalancing is required to keep the load per phase within the capacity of the emergency supply.

An expansion of storage capacity to around 750kWh would be needed to support emergency EV charging.

Due to the design of the Brae Community Hall, PV panels could be mounted on the east and west facing roofs of the main hall. It does not appear that there is sufficient south facing roof to install a PV system. The requirement to balance the output across the three-phases to keep the per phase connection under 16A will require purchase of more expensive three-phase inverters than would be used on a smaller domestic property.

From information available it appears that there is land to the east of the community hall where a 5kW wind turbine could be installed. Current guidance from the manufacturer of one 5kW wind turbine suggests that it should be located at least 120 metres away from any building where people live.

**Table 4.2 Brae Community centre load assessment**

Brae Community Hall	Max Load (kW)	After Diversity Load (kW)	Load Factor (6-hour 1st Period)	Load Factor (24-hour 2nd Period)	Energy Requirement (6-hour 1st Period) (kWh)	Energy Requirement (24-hour 2nd Period) (kWh)
<b>Load Description</b>						
Lighting (estimate)	2.0	2.0	0.1	1.0	1.2	48.0
Space Heating	14.0	11.2	0.5	0.6	42.0	201.6
Water Heating	3.0	3.0	0.2	0.6	3.6	43.2
Cooking	20.3	12.2	0.0	0.3	2.4	146.2
Charging personal devices	2.0	2.0	0.0	0.5	0.0	24.0
<b>Total (Hall Load Only)</b>	<b>41.3</b>	<b>30.4</b>			<b>49.2</b>	<b>463.0</b>
EV Charging (2x 7kW)	14.0	14.0	0.0	0.8	0.0	252.0
<b>Total (Hall and EV Charging)</b>	<b>55.3</b>	<b>44.4</b>			<b>49.2</b>	<b>715.0</b>



### Mid Yell

The Mid Yell Community Hall is a modern facility in very good condition. Heating is based on a series of heat pumps, with air-to-air appearing to be the sole method of heating the space. The kitchen uses a mixture of gas and electricity. The hall itself does not appear to have a lot of designated parking, but an area across the road is used for both the hall and the bus stop.



**Figure 4.8 Mid Yell Community Hall (Picture Credit: Google Maps)**

The existing information available suggests that the building has the heating as outlined in the table below. The kitchen is assumed to have a mix of gas and electric appliances. Lighting has not been assessed so an assumption has been made. Other power uses such as mobile phone and laptop charging have been assumed as have the optional extra figures for emergency EV charging. A more detailed load assessment and analysis may result in the required storage figures being lower. The figures presented here can be considered as a maximum creditable figure, though it would be possible to exhaust the storage in under 24-hours if the pressure on the system was higher than in this assessment.

Based on the figures shown it would be recommended that a storage system with a power capacity of 60kW three phase and an energy storage capacity of 500kWh would be adequate. The power capacity is higher than the maximum load because it is highly likely that the loads are not evenly balanced across the three phases of the electricity supply. Testing may show that some rebalancing is required to keep the load per phase within the capacity of the emergency supply.

An expansion of storage capacity to around 680kWh would be needed to support emergency EV charging.

**Table 4.3 Mid Yell Community centre load assessment**

Mid Yell Community Hall	Max Load (kW)	After Diversity Load (kW)	Load Factor (6-hour 1st Period)	Load Factor (24-hour 2nd Period)	Energy Requirement (6-hour 1st Period) (kWh)	Energy Requirement (24-hour 2nd Period) (kWh)
<b>Load Description</b>						
Lighting (estimate)	2.0	2.0	0.1	1.0	1.2	48.0
Space Heating	16.0	12.8	0.5	0.6	48.0	203.4
Water Heating	3.0	3.0	0.2	0.6	3.6	43.2
Cooking	8.0	4.8	0.02	0.3	1.0	57.6
Charging personal devices	2.0	2.0	0.0	0.5	0.0	24.0
<b>Total (Hall Load Only)</b>	<b>31.0</b>	<b>24.6</b>			<b>53.8</b>	<b>403.2</b>
EV Charging (2x 7kW)	14.0	14.0	0.0	0.8	0.0	252.0
<b>Total (Hall and EV Charging)</b>	<b>45.0</b>	<b>38.6</b>			<b>53.8</b>	<b>655.2</b>

### 4.2.3 Deliverable 5 Conclusion

Energy storage and DSM systems hold great potential for multiple reasons, the above has discussed many of the benefits of energy storage and its ability to enable DSM functionalities. For the low carbon transition energy storage is the key enabler to this. The hubs are working on a micro-scale in relation to the globe transition, but the same is still just as true. With energy storage the hub will be able to take advantage of exporting electricity at high prices, when available, and then buying back at lower prices (when available).

The network of hubs has a very real opportunity to demonstrate to the community what can be enabled when on-site power generation is managed to its full capacity; from potentially cheaper services to the ability to supply a heated facility with hot water to the community during any power cuts.

The above has investigated the operations for DSM design. Phase 2 would look to actually produce a high-level design suitable for the pilot hub in Brae. As well as the services that hub will offer, the technical design can be conducted, based upon a cost benefit analysis of the options outlined above.

Longer-term, the hub would represent a test bed for the other hubs for DSM functionality which pays back to the community once the energy markets begin to truly recognise and incentivise the use of distributed energy storage (and flexible loads) as a grid balancing mechanism.



## 5 WORK PACKAGE 3: REUSE, RECYCLING AND WASTE

For Work Package 3, it looked at how hubs could be drop off/collection points for recycling, reuse and waste food outside of Lerwick.

The deliverables in Work Package 3 will:

- Deliverable 6: waste management.
  - Examine ways hub model could enhance waste management in Shetland
  - To drive behavioural change
  - To locate a possible site for an anaerobic digester for composting



## 5.1 DELIVERABLE 6 - WASTE MANAGEMENT

**Feasibility to examine ways hub model could enhance waste management in Shetland, drive behavioural change, and possible location for anaerobic digester for composting.**

**Non-technical barriers addressed:** behavioural change

**Author:** SIC with support from CES

### 5.1.1 Literature review

Based on assessment from Shetland Islands Council waste management experts, a number of theoretical opportunities were identified for waste management at a Rural Energy Hub model. If the hubs sell items which can be returned under the Deposit Return Scheme (DRS), they would then also be collection points for these items. Turning to composting, the hubs could become centres for composting information and equipment, bridging the gap between rural Shetlanders and the main facilities in Lerwick. Similarly, the hubs, with convenient locations and multi-purpose space, could provide workshops, classes, or educational material on recycling, repairing and up-cycling to encourage and enable behaviour change. Many Shetlanders already use scrap stores and swaps, so Hubs could become formal locations for circular economy activities. This would address some of the main points identified in community engagement, which found that Shetlanders –particularly those in rural areas- would find it useful to have recycling and composting equipment closer to them. This would enable them to do these activities more frequently and reduce the carbon cost associated with travel to these facilities. Information at the hubs would also answer many residents’ concerns about how waste is managed both in Shetland and once it departs.

However, significant challenges and risks were identified to using rural energy hubs as waste management facilities. The hubs would require sufficient resource for waste processing and storage, including space, equipment, and labour. These resources may include a reverse vending machine, recycling sorting facilities, compost storage, and space for large items set to be repaired. Any waste held onsite would need to be stored in compliance with health and safety regulations (SEPA, 2016). There would also be the added expense of transporting all this waste; though the hub would make delivery of this service more cost-effective than household collection or residents’ trips to Lerwick, it would still be an additional service that the Council does not already provide. There are also substantial regulatory barriers to providing any of the above services. The hubs would need licensing and permission to be classed as waste transfer stations and any products distributed to the community, including compost or upcycled items, would need to meet quality and safety standards such as PAS1000. The Council could also be locked into a substantial provision of labour resource dedicated to onsite waste management to safely store, sort, and distribute materials.

Lastly, practically speaking, the review suggests that a rural energy hub would likely have limited use for anaerobic digestion as a method of low-carbon heat production. Shetland already has an Energy Recovery Plant (ERP), which handles the majority of Shetland’s waste and is expected to have a substantial lifespan. Diverting waste from the ERP would significantly reduce its efficiency and require further import of waste from other regions- Shetland already imports waste from Orkney to maximise the ERP’s efficiency and changes to this operation would pose risks (Reynolds et al, 2022). As a rural authority, Shetland is also exempt from separate food waste collection so there would need to be a wider change to existing operations to enable the operation of an anaerobic digestion plant, including the installation of permanent resource to manage the plant (Ibid.). A case study from Orkney, a region facing similar geographic and regulatory difficulties, determined that a plant would also be financially unsustainable and may only be able to operate intermittently, as food waste is subject to seasonality (Ibid.). Ultimately, a specific feasibility study would be needed to



fully understand if an anaerobic digestion plant could be viable for Shetland, whether standalone or as part of a rural energy hub.

### 5.1.2 Community and Stakeholder Engagement

Section 6.6 (Deliverable 3) of this report provides detailed insights and analysis based on the survey responses received from the community. But in summary, the large numbers of the respondents wished to have more assistance and accessibility to recycling and waste management.

### 5.1.3 Case Study: Northmavine Community Development Company, Sensible Community Recycling at Northmavine Service

#### *Description*

The Northmavine Community Development Company (NCD) is a community led organisation based at the Hillswick/Ollaberry Junction on the A970 in Shetland. A significant presence in the community, NCD offer a variety of services including e-bike rental, property development, local growing areas, recycling centres and even own the local shop.

During the Shetland Islands Council cost saving measures in 2012/2013, community skips were withdrawn from across Shetland due to costs and health and safety implications around what was being dumped including potentially hazardous items.

There was a concern across Shetland about the potential for an increase in fly tipping, particularly in Northmavine where the local community group, Northmavine Community Development Company (NCD) decided to set up their own community skip service. Eventually, similar skip services showed up across the isles from various other community development companies including the Unst Partnership, with Northmavine pioneering a way around council cutbacks while continuing to provide a service to the local community.

Due to the significant interest in the community skip scheme, combined with the number of items being disposed of which could be repaired and recycled, Bruckland SCRAN (Sensible Community Recycling at Northmavine) was born.

The Bruckland skip service still exists for those who would like to dispose of bulky items, a service which is only available to those who reside in the Northmavine area and can either be used through an annual membership of £60 per annum, or a one off £10 fee per use.

The Bruckland Recycling Centre is open and accessible to the whole of Shetland both in terms of custom and disposal of items that can be recycled.

#### *Challenges*

While no significant challenges were highlighted during the meetings, there was mention of a lack of available volunteers required to be able to work with waste on a more regular basis. There is hope to expand the services required including a repair shop soon, but this will depend on funding, and availability of suitably qualified individuals.

#### *Lessons learned*

There have been no quantifiable lessons learned outlined from the stakeholder engagement with NCD regarding their SCRAN recycling centre and waste services. Starting small, and growing into the well-established facility covering the whole area of Northmavine, they see themselves as continuing to grow and becoming a well-established, permanent and much needed facility within the community.



#### 5.1.4 Deliverable 6 Conclusion

There are some opportunities for the Shetland Rural Energy Hubs to become dispersed centres to assist waste management, particularly as information and education centres for encouraging behavioural change. When supported by the appropriate space, the hubs could distribute information and equipment, including through tool shares and scrap stores, which would make circular economy activities more accessible to Shetlanders near a hub. However, the contextual risks of onsite waste management and the necessary provision of new services mean that rural energy hubs are unlikely to be an efficient delivery mechanism for more operational changes to waste management. The regulatory and practical concerns of waste storage and the efficacy of the already-extant Energy Recovery Plant mean that there would be limited utility in carrying forward this deliverable without being supported by bespoke research that finds these amenities suitable for the hubs. However, community engagement found substantial interest in localised and accessible waste management opportunities and there is a proven instance of community waste management, so there should a concerted effort made to facilitate some of these facilities in the hubs.



## 5.2 DELIVERABLE 7 - PROJECT MANAGEMENT

.Non-technical barriers addressed:

.Author: SIC

### 5.2.1 Introduction

Deliverable 7 simply notes the project management methodology and is included purely as a tool to compensate for a typographic error in the original Phase 1 application whereby Deliverable 7 was missed. It was decided that rather than renumber the deliverables the project should retain continuity and use Deliverable 7 to outline the approach to the feasibility study based project.

This project methodology and approach followed for the project adhered to the Prince2 principles. The project involves multi-disciplinary teams from different organisations, requiring effective collaboration and coordination. Furthermore, the project was managed using the principle of management by exception to ensure efficient decision-making and control.

### 5.2.2 Methodology and implementation

As set out this project aligns with the Prince2 principles with a particular focus on the following:

- **Defined Roles and Responsibilities:** Clear roles and responsibilities were key to successful implementation because of the multi-organisational make-up of the project. Deliverable and sub deliverable owners and sub teams were assigned with clear responsibilities defined.
- **Learn from Experience:** Lessons learned from previous projects and relevant industry practices was documented and applied to enhance project performance.
- **Manage by Exception:** Management by exception practice was employed to promote efficient working practices by ensuring that day-to-day management is delegated to appropriate levels within the multi-disciplinary teams. The project manager only intervened if asked to or if task completion timescales were introducing project risks.

### 5.2.3 Implementation - Day to day management

- Weekly internal organisational team meetings held to discuss issues and drive development for the coming week.
- Weekly multi-organisational meetings to review project deliverables and sub tasks using an action tracker, which also was used to raise issues with the project manager.
- Monthly check-in meetings with Innovate UK monitoring officer which provided opportunity to seek guidance if required and to demonstrate progress.
- Various other meetings/workshops organised on specific topics or themes involving personnel from each organisation as required.

### 5.2.4 Deliverable 7 Conclusion

The phase two application will not make reference to deliverable 7 from phase 1 nor will it be carried forward into the phase 2 application.



## 6 WORK PACKAGE 4: BUSINESS AND INDUSTRY

The literature review in Deliverable 1 and the survey responses from the community engagement in Deliverable 3 highlight that businesses face a range of key non-technical barriers when considering how to decarbonise.

The deliverables in Work Package 4 will:

- Deliverable 8: supporting businesses to decarbonise;
  - Examine barriers to decarbonisation for businesses and recommend how rural energy hubs could support businesses to decarbonise
  - Examine how hubs can be used by or be useful for commercial operators
  - Examine how the hub could be used by people while charging
- Deliverable 9: district heating;
  - Provide an options appraisal for heating properties through a district scheme linked to the energy hubs, including considering hydrogen
  - Scope out technologies to demonstrate at ReFLEX Shetland office in the hub, examine how ReFLEX team can aggregate and coordinate interest from customers.



## 6.1 DELIVERABLE 8 - SUPPORTING BUSINESSES TO DECARBONISE

**Feasibility will examine barriers to decarbonisation for businesses and recommend how rural energy hub could support businesses to decarbonise. How can hubs be used by/useful for commercial operators – rapid charging to support business uptake of EVs, business activity at the Hub - things for people to do while charging, Wi-Fi access, tie into remote workplaces, remote access to healthcare, community engagement.**

**Non-technical barriers addressed:** finance, business models that can support behavioural change.

**Author:** Aquatera with support from CES and SIC

### 6.1.1 Key barriers to decarbonisation for businesses

As part of the stakeholder engagement CES held meetings with businesses and organisations in Shetland regarding the barriers to businesses decarbonising in the isles.

The main issues highlighted (but not exclusive) were:

- Finance
- Lack of information
- Lack of clarity
- Lack of tradesmen / companies who can undertake the work.

One of the main barriers was the cost of undertaking the work. Some organisations have invested significantly in wind turbines, additional insulation, solar panels and air-to-air heat pumps. The feedback from these types of organisations was that it was a convoluted process, with an extreme amount of repetition, forms to be completed, and clarity around what they should be doing and when was not easily accessible.

A lack of finance for other organisations means they cannot undertake the work they would necessarily like to, or the lack of information and signposting around what access to grants and loans is available is a barrier for them to be able to undertake the work.

Other companies who have looked into what options are available to them say the system is convoluted, and the vast majority of options available to others, isn't available to them in Shetland, or some of the more remote islands due to a lack of tradesmen.

Speaking to the Mid Yell Development Company, they have noticed that a lot of businesses in Yell are talking about decarbonisation and are very positive about the benefits of doing so. Some have installed wind turbines, solar panels, and heat pumps but the issue around a lack of businesses prepared to travel to the outer isles in Shetland for installation and maintenance is significant problem.

Other barriers include the significant waiting lists involved, again due to a lack of tradesmen, to even get a response to a query. The waiting times for materials and products post Brexit/Covid can be months if not years and the prices are now often more than 300% more expensive than just a couple of years ago.



When businesses approach HIE or the Shetland Islands Council, they tend to flag them to Business Energy Scotland who then do an assessment with the business owners in Shetland and offer them suggestions or assistance regarding potential action or any potential support for action.

HIE tends to be the starting point to see what products and services are available, but again even for HIE, signposting is an issue and there is a lot of duplication between organisations nationally.

HIE state that businesses complain about the length of time it gets to get from initial enquiry to final result; and the amount of time things take, and duplication of work is a huge disincentive for companies. It is a long journey to get any available grant funding for heat pumps. The Energy Savings Trust also help, but again the duplication is a struggle for businesses, and it is of the opinion of the representative from HIE that integration between some national organisations is inefficient, if it is in place in the first place.

It has been difficult to get feedback in any detail from businesses that don't have decarbonisation as a priority, or view it as not relevant to their business. Information provided from HIE states that around 13% of businesses think that decarbonisation is too challenging for them and that 23% state that decarbonisation is simply not a priority for them, stating reasons such as cost, energy costs, and ongoing economic uncertainty as reasons.

### 6.1.2 Stakeholder Survey Results

While the majority of respondents to the Shetland Rural Energy Hub survey were from individuals, respondents were also given the opportunity to answer on behalf of an organisation they work for or represent. These organisations ranged from private sector businesses such as transport operators to community development organisations.

Throughout the survey respondents were asked questions surrounding the non-technical barriers they face to decarbonising their lives or businesses, and which services would aid them in doing so. The first series of questions relevant to decarbonising businesses related to transport, respondents were asked whether they would be interested in using a car club service as well as several questions relating to the purchasing and use of electric vehicles.

The interest in a using a car club service should one become available was mixed, 54% of respondents claimed they were interested in such a service of which the majority said they were very likely to use. Evidence from previously conducted community engagement events demonstrates that while formally operated car clubs are not available on Shetland, residents make use of informal car sharing agreements to facilitate travel between islands and rural locations for a variety of purposes (Ricardo, 2022).

When asked what the main barriers to the purchase of electric vehicles were, the unanimous consensus was that range anxiety was the largest factor, although this question was skipped by 54% of respondents. This view is consistent with the perceived lack of available public chargers, as when asked if this was a barrier to the adoption of electric vehicles 77% either agreed or strongly agreed with this assessment.

A further question which aimed to determine whether test driving an electric vehicle would give more confidence in adopting one into their business operations was met with largely indifferent responses, with 54% neither agreeing nor disagreeing with this proposal. 30% did however agree with this statement, with the majority strongly agreeing.

The subject of decarbonising domestic and business heating was also a key area for the survey, when asked what the main barriers to achieving this for businesses 100% of responses reported it was due to cost. To support the adoption of renewable energy technologies to aid in the reduction of costs associated with decarbonising heating and power, the survey asked businesses if information and support in this area would be beneficial to them. This was met with strong



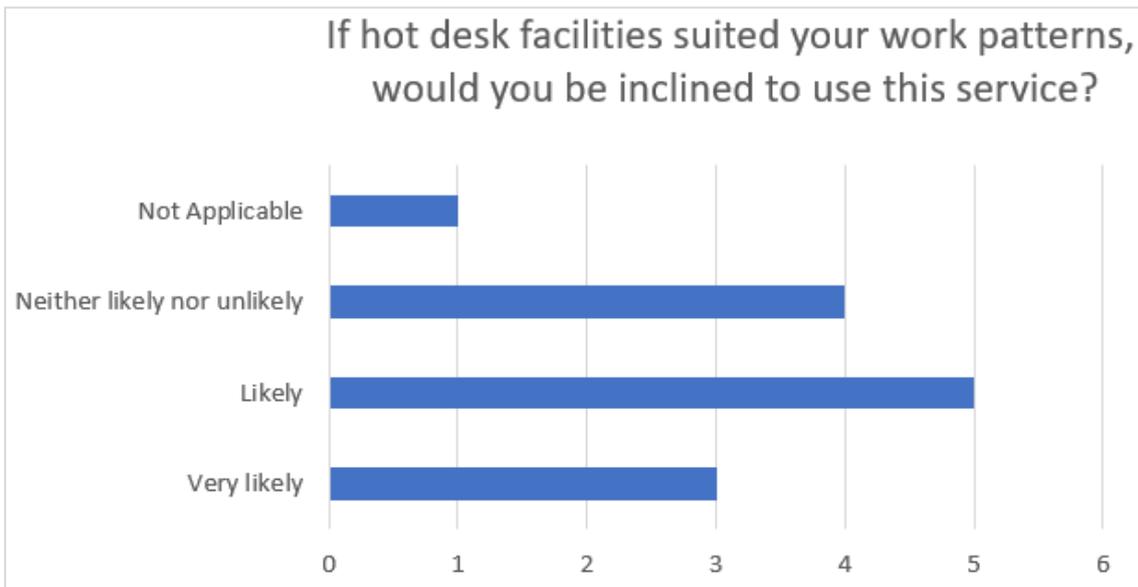
agreement, with 62% of respondents agreeing more information and support would benefit them and no disagreements regarding this service.

This demonstrates there is a desire to further decarbonise the variety of businesses and organisations represented in this survey, but more support is needed to facilitate changes in attitudes and to build trust in these technologies.

Further supporting this idea when the survey asked what kind of information and signposting they would like to see in a rural energy hub, of the respondents that did reply (46%) there was a unanimous consensus that live data demonstrating the effectiveness of low carbon technologies would be of most value to businesses.

Further questions which relate to business decarbonisation surrounded the possibility of including other services into a rural energy hub, relating to remote or cooperative working facilities. Specifically, businesses were asked how likely they would be to lease office space, make use of hot desk facilities, and whether they would make use of a meeting room should one be provided in a rural energy hub.

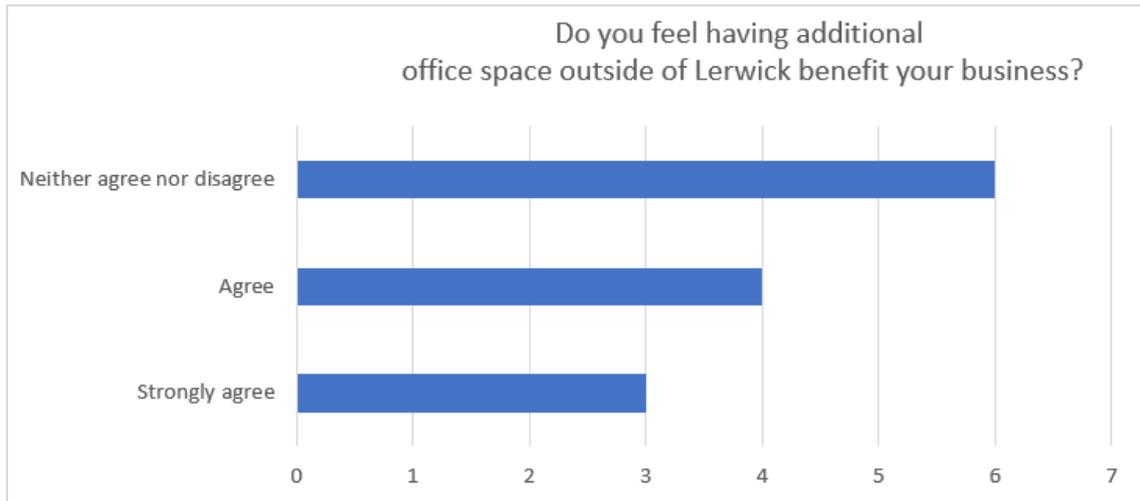
Each of these potential services was met with generally positive responses, with 46% of businesses stating they would be likely or very likely to lease office space, and 31% state they did not know if this would be of use to them. Regarding hot desk facilities, in which a single working space can be booked daily 62% of those representing businesses claimed they would make use of this facility, with the remainder neither agreeing nor disagreeing with this proposed service.



**Figure 6.1** Survey question on hot desking

Similarly, 62% of businesses responded that they would make use of a meeting room if one was provided. Overall, 54% of businesses responded that having more office space available to them outside of Lerwick would be beneficial to their business, with the remainder of the respondents neither agreeing nor disagreeing with the question.





**Figure 6.2 Survey question on office space**

The relative lack of firm negative responses to the questions relating to the business services indicated there is value in including them in a rural energy hub, and that businesses who currently do not have access to these facilities may not see the value in them before it has been demonstrated to them.

### 6.1.3 How Rural Energy Hubs can support decarbonisation for businesses in Phase 2

The ways in which the hubs could support businesses to address the issues highlighted above in the survey and decarbonise in different vectors include:

#### Transport – Phase 2 Implementation

Reliable rapid charging at the hubs would support businesses and organisations that require travel around Shetland as part of their work to have the confidence to switch to electric vehicles, knowing that they could recharge quickly en-route. This could apply to businesses and organisations ranging from delivery companies to healthcare visitors.

Provision of hot-desking and meeting space, café and wifi would further support the shift to EVs, as it would mean the time stopped to charge could be productive.

A multimodal transport hub on the bus route and A roads with options for public transport and private vehicle use and ebikes would give businesses more choices for how their staff travel and interact with clients and business contacts.

There is further detail on the ReFLEX elements in the hub in Deliverable 10, but the decarbonisation products and services, demonstration of technologies and expert advice from the ReFLEX Shetland customer team at the hub would help businesses with:

Transport and finance options, including advice on telematics for fleets;

- Installing workplace charging options, funding advice and support with applications;
- Support for businesses to set up and run EV salary sacrifice scheme; and
- Provision of demo vehicles for test driving would enable businesses to try before they buy.

**For example:** ReFLEX Orkney’s demo insurance supports extended test drives and a delivery company used the demo van for a week under these terms, to test if the range worked for their routes. This company then leased, first, one van and then another about 6 months later, because they were so pleased with the first one.

The main elements of the hub – charging, EVs, hot desking, meeting rooms, café, public transport links - would aim to be up and running in the pilot hub in Brae during Phase 2 of the project, while some would be developed in phase 2 for full roll out longer term – such as some of the services from ReFLEX Shetland.

#### **Heating – Phase 2 development / long term implementation**

In Phase 2 the pilot hub could provide businesses with information on funding and technology options for heating their premises, with potentially some demonstration technology – highlighted as useful in the survey.

Longer term the hubs, through ReFLEX Shetland could offer information and installation coordination service to support businesses to decarbonise their heating system and improve insulation in their business premises, providing information and guidance on grants and affordable finance. This programme would be based on the Building Renovation Passport model being developed by ReFLEX Orkney Ltd in Phase 2 of the Orkney branch of the project. It could then be rolled out longer term by ReFLEX Shetland building on the learning from Orkney.

#### **Power – Phase 2 development / long term implementation**

In Phase 2 the pilot hub could provide businesses with information on funding and technology options for powering their premises.

Longer term the hubs could provide information and installation coordination service to support businesses to decarbonise through using solar, micro wind and batteries, providing information and guidance on grants and affordable finance. This programme would follow the finance model being developed by ReFLEX Orkney Ltd and would be rolled out to the Shetland Hubs once fully developed through the Orkney branch of this project.

#### **Training and development for businesses**

Meeting space in the hubs could provide a venue for training. See Deliverable 11 Skills Shortages for a detailed review of how hubs could help to address the shortage of skilled installers for insulation, heat pumps, batteries and solar.

### **6.1.4 Deliverable 8 Conclusion**

The literature review identified a number of key concerns and asks from businesses in Shetland during the Climate Conversations including calls for a sector-by-sector consultation to establish what the net zero transition entails for businesses and what businesses need to help achieve this. (RICARDO, 2022). However, separate to this SIC has also received feedback from the community that there has been a lot of engagement already and they are keen to see action rather than more engagement.

Along with those differing pieces of feedback, the project partners are all also partners in the Carbon Neutral Islands project, which includes Yell. This project is currently doing a very detailed survey of businesses exploring these issues.

Phase 2 will draw on learning from this research as well as the climate conversations feedback and learning from ReFLEX Orkney to develop services in the hubs to support businesses as outlined above, with further sector-based engagement where needed.



## 6.2 DELIVERABLE 9 - DISTRICT HEATING

**Options appraisal for heating properties through a district scheme linked to the energy hub, including considering hydrogen – regulatory review.**

**Non-technical barriers addressed:** finance, regulation, skills and resources.

**Author:** Aquatera with support from SIC

Shetland has a district heating system, and this experience means the potential of developing further schemes is of strong interest in the community. It also has the potential to tie in with the ORION project and production of green hydrogen in Shetland. Like Deliverables 4 and 5 this section looks heavily at the technology involved, but the technologies provide potential routes to overcoming non-technical barriers to decarbonisation of heating as well as the significant skills development required to support that change.

This deliverable explores the potential for incorporating them into some of the hubs and provides:

- Background on the existing scheme;
- Discussion of potential future schemes;
- Examination of the potential role of hydrogen in future schemes; and
- Skills development needed to support the development of green in Shetland.

### 6.2.1 Literature Review

The district heating scheme in Shetland is in Lerwick, the county's main town, and is powered by an Energy Recovery Plant (ERP). This facility makes use of municipal and clinical waste from Shetland, the neighbouring island group of Orkney and previously waste from offshore oil rigs in the North Sea, burning this waste in an on-site incinerator to heat water for distribution to around 6000 people per day (SHEAP, 2023). The network supplies not only homes but also a hospital, council offices, schools, a swimming pool, and a cinema.

The flue gases from this primary incineration stage are treated prior to their discharge into the atmosphere through several stages to ensure minimal impact on air quality and public health (Martin and Spence, 2010). The first stage is a controlled secondary combustion, then dry electrostatic precipitation in which the pollutants are moved via electrical forces through an exhaust stream into a particulate control device where harmful compounds are aggregated onto collector plates.

The exhaust gases then undergo a process of wet scrubbing, in which these gases are decontaminated and deacidified by mixing them with water before being dried and passing through a bag filtration system. This process is highly effective at limiting the amount of nitrogen oxides, carbon monoxide, sulphur dioxide, hydrochloric acid, total organic carbon, and dust released into the atmosphere.

The 2020 Energy Recovery Plant Annual Report, published by Shetland Islands Council Environmental Services reported that none of these pollutants exceeded their daily, monthly or 30-minute maximum allowed levels over the course of the year. The water discharge pH also remained within the acceptable limit between acidity and alkalinity ranging from a monthly average between monthly averages of 7.78 and 8.05.



A major objection to facilities such as Lerwick's ERP is the release of dioxins into the atmosphere, these highly toxic environmental pollutants are classed as persistent organic pollutants (POPs) as they take a long time to break down in the environment and are known to cause cancer, damage the immune system, interfere with hormones, and cause developmental and reproductive problems (Martin & Spence, 2010).

Monitoring for dioxins takes place twice yearly from the stack, and as demonstrated by a report published in 2010 the dioxin levels released by the ERP stand at just 0.0053 ng/m<sup>3</sup> with the limit being 0.1ng/m<sup>3</sup> as directed by the European Parliament's waste incineration directive (2000). This level is a fraction of 1% of total emissions compared to the 15% that are emitted from domestic coal burning (Porteous, 1996), which the district heating scheme has largely replaced in its operational area.

The site is managed by Shetland Heat Energy and Power Ltd (SHEAP) and is based on the Danish model, in which heat that would otherwise be wasted during the burning of fossil fuels or waste is used to supply electricity or hot water to local communities.

The heat is provided by a network of pre-insulated pipes consisting of a steel pipe, with a layer of polyurethane foam secured to the pipes and protected by a high-density polyethylene (HDPE) outer covering. The pipe network is constructed with tungsten inert gas welding, a technique used to join thin materials with each joint being covered with specialised fitting to maintain their structural integrity. This network of pipes stretches approximately 40km throughout Lerwick.

The network utilises two sets of pipes, one is the supply pipe which provides water to homes at 93C and the other is the return pipe which takes cooled water back to the ERP for reheating. District heating works at its most efficient when the return temperature is as low as possible, with the current return temperature of Lerwick's network being around 55C in the winter and 60C in the summer. The pressure difference between the supply and return pipes is a minimum of 0.5 bar at the outermost edge of the network.

In addition to the ERP, the Lerwick district heating scheme utilises an oil-fired Peak Load Boiler Station to aid in meeting demand at peak times which typically occur in the mornings and evenings. This Peak Load Boiler Station also allows the system to continue the supply during periods of servicing and maintenance at the ERP, which is limited to 40 days per year spread across two main periods in the spring and autumn. Such planning helps reduce the need for expensive oil alternatives during the more intensive winter period.

This district heating scheme has had several additions throughout its 25 years in operation, in 2006 a hot water storage tank was installed which stores excess heat during off-peak periods for supply during periods of peak demand. This allowed for an additional 500 homes to be connected to the network without the need for additional energy generation. In 2008 a similar 6.5 MW boiler was installed to give a total back up capacity of 14.5 MW at the Peak Load Boiler System (SHEAP, 2023).

During the 2007/2008 period a radio transmitting system was installed to allow customer meter readings to be transmitted directly to the on-site office on demand, where previously customers were sent cards to be filled out and returned.

The waste that is burned at the ERP is mostly municipal in origin, with a restricted amount of non-hazardous clinical waste being approved for incineration during the COVID-19 pandemic under an agreed 'temporary enforcement position' lasting for two years (Shetland Islands Council, 2022). This required the implementation of new infrastructure to safely handle this waste, mainly a front-end hoist lift which was eventually replaced with an automated bin loading system which prevented unnecessary handling or mixing of this material.



The addition of this clinical waste was not expected to increase site emissions, or the amount of waste produced.

The municipal waste that makes up most of the ERP's input, which in the latest available Energy Recovery Plant Environmental report published in 2020 by Shetland Islands Council Environmental Services was 22,575,720kg of a total 22,786,020kg (99.08%). The second largest source of waste was clinical waste, of which 107,460kg was incinerated (0.47%) followed by waste from the fish processing industry at 102,840kg (0.45%).

The public perception of the Lerwick District Heating Network is overwhelmingly positive, having undergone multiple expansions over its operational lifespan such as the Quoys housing estate with the possibility of further expansion being assessed on a regular basis. The cost for membership in the Lerwick District heating scheme is a £160 annual standing charge and a connection fee which is assessed upon application and will vary based on the location and type of home being connected.

Shetland Heat Energy and Power accept three different methods of payment, a quarterly direct debit/ invoicing, a monthly standing order/ direct debit, and via card meter. The basic charge is 6.9p/ kWh or 8.9p/ kWh for customers that use a card meter, the increased cost including elements for standing charges and other costs.

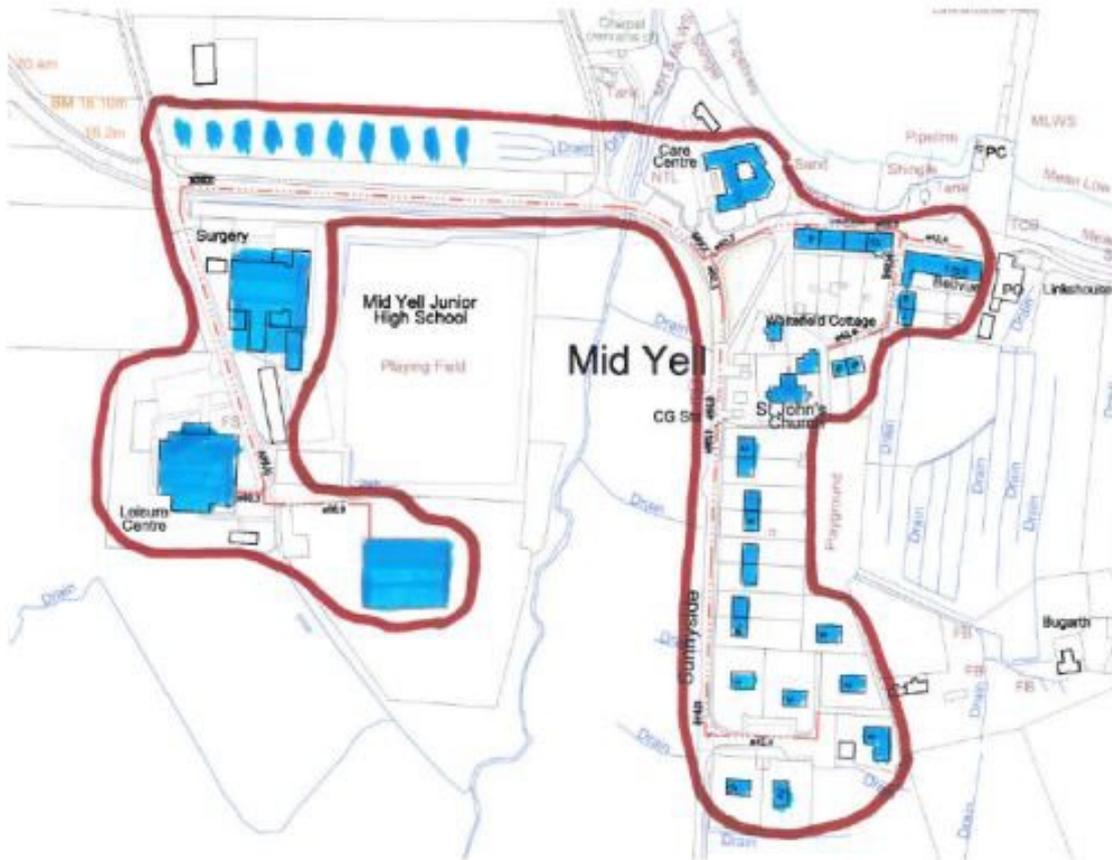
The cost of 6.9p/ 8.9p per kWh offers a clear financial incentive to join when compared to the costs of other sources of heating, especially considering Shetland's subarctic climate. According to EDF Energy the average cost of other heat sources as of October 2022 are 9.2p/ kWh for heating oil, gas 10.3p/ kWh, liquid petroleum gas 12.1p/ kWh, and electricity at a standard-rate of 34p/ kWh (EDF Energy, n.d.).

### **6.2.2 Future District Heating Schemes in Shetland**

The Scottish Government has released The Heat Networks Scotland Act 2021, which sets out Scotland's ambition to increase the amount of heat networks. Currently, around 1.5% of Scotland's heat is supplied from heat networks. The Government's target is to increase this to 8% by 2030 which is equivalent to around 650,000 additional homes. There is £300m available through the Heat Network Fund, announced as part of The Act. Due to the lack of gas grid in Shetland, further district heating schemes should be considered, contributing to this national policy.

Between 2007 and 2009, Danish consultants COWI completed a number of assessments to determine whether other locations within Shetland, out with Lerwick, would be suitable for a district heating scheme. These reports have been difficult to track down, with only the report on Mid Yell being available, but it is understood a study was also done on Brae and Scalloway. The study in Mid Yell was based on a potential new school, existing leisure centre, existing and prospective new care centre, local shop, as well as 38 houses in the nearby area, as shown in Figure 6.3.





**Figure 6.3 Drawing showing the area in Mid Yell identified as potential location for district heating**

The following supply side alternatives were assessed:

- Alternative 1 - Diesel based CHP plant;
  - Alternative 1a - Diesel based CHP but only supplying the leisure centre, the new school and a prospective new care centre.
- Alternative 2 - Wind based CHP plant with electrical boiler;
- Alternative 3 - A combination of the alternatives 1a and 2; and
- Alternative 4 - Wind to Heat plant.

The analysis showed that alternative 1 (the diesel CHP) is not economically viable with the present assumptions. The analysis showed that alternative 2 (the Wind turbine CHP) is economically viable. The smaller CHP-engine supplying the New School and the Leisure Centre also seems a feasible solution. However, it is not as "green" a solution as the wind alternative.

COWI recommend SIC to carry on with more detailed investigations of these solutions by investigating in further detail the possibility of obtaining grants for a detailed project as well as the investment and ROC's. Due to the report being done 15 years ago many of the assumptions may now have changed.

During discussions with SHEAP, they highlight Brae as having the most potential to host a district heating scheme out with Lerwick. Brae has a leisure centre with swimming pool, care home, health centre, primary and secondary school, large shop and industrial units, and these are spread out over a relatively small area. There are housing schemes nearby, with some likely due for refurbishment in the near future. Much of the required pipelines are likely to go through non-

paved areas, cutting capital costs. SIC are currently looking at building a new school in the area, replacing the existing separate primary and secondary schools. A new plant room for the new school could be designed to supply other buildings in the area, including domestic properties. Currently, the SIC owned buildings are heated by oil boilers. The care centre has a heat requirement of 403,790kWh annually, and the school has an annual heating requirement of 814,424kWh. A significant amount of savings can be made, both carbon and financial, if these buildings were connected to a low carbon district heating scheme. The supply of any new district heating scheme would need to be carefully analysed, with biomass and ground source both having benefits.

SHEAP have stated how any potential new scheme will require an assessment of what the changes could be over the next decade or two in terms of house refurbishments, boiler replacements etc, with a cost analysis of whether it would be cheaper to put in a centralised unit fuelled by biomass, heat pumps and/or wind/solar.

Symbister, on the island of Whalsay, Sandwick, in the South Mainland, and Aith in the Westside have also been cited as potential locations for a district heating scheme but again would require further analysis. These locations tie in with favourable locations for transport hubs, so a holistic view must be taken when designing the hubs to ensure an opportunity isn't missed to facilitate a district heating scheme that could benefit the wider region.

SIC/SHEAP are investigating utilising waste heat from a hydrogen electrolyser to supply district heating, but this would be in Lerwick. This could allow more properties to connect to the existing scheme, which is currently nearing capacity.

Orkney Islands Council have also assessed district heating scheme viability for Kirkwall, with the work done by Ramboll. A number of viable options were detailed but as yet no further work has been done. A joint approach could benefit both islands in the development of further schemes.

### 6.2.3 Hydrogen Supply Chain in Shetland

The hydrogen economy in Shetland is very much in its infancy, with no hydrogen currently produced on the island. There is significant local expertise with The PURE Energy Centre, based in Unst, working on hydrogen projects across the world as a consultant and as an electrolyser provider.

Shetland has been promoting itself as a future clean energy hub through the ORION Clean Energy Project since 2020. This is a collaboration between Shetland Islands Council, Highlands and Islands Enterprise, Lerwick Port Authority, Net Zero Technology Centre and University of Strathclyde. One of the project's main aims is to transform Shetland's current dependency on fossil fuels to affordable renewable energy and to create an industrial green hydrogen export business. The promotion aspect of the project has been a success, with many large-scale developers now interested in producing hydrogen in Shetland. The developers involved in the 2.8GW offshore wind site to the East of Shetland have also announced that hydrogen production will be the route to market for their green electricity.

SIC are also having extensive discussions with other areas in Scotland that are further ahead with their hydrogen roll-out, such as Aberdeen, to learn best practices. Figure 6.4 shows the expected hydrogen road map, with pilot projects starting in the next few years, before production is ramped up utilising offshore wind.



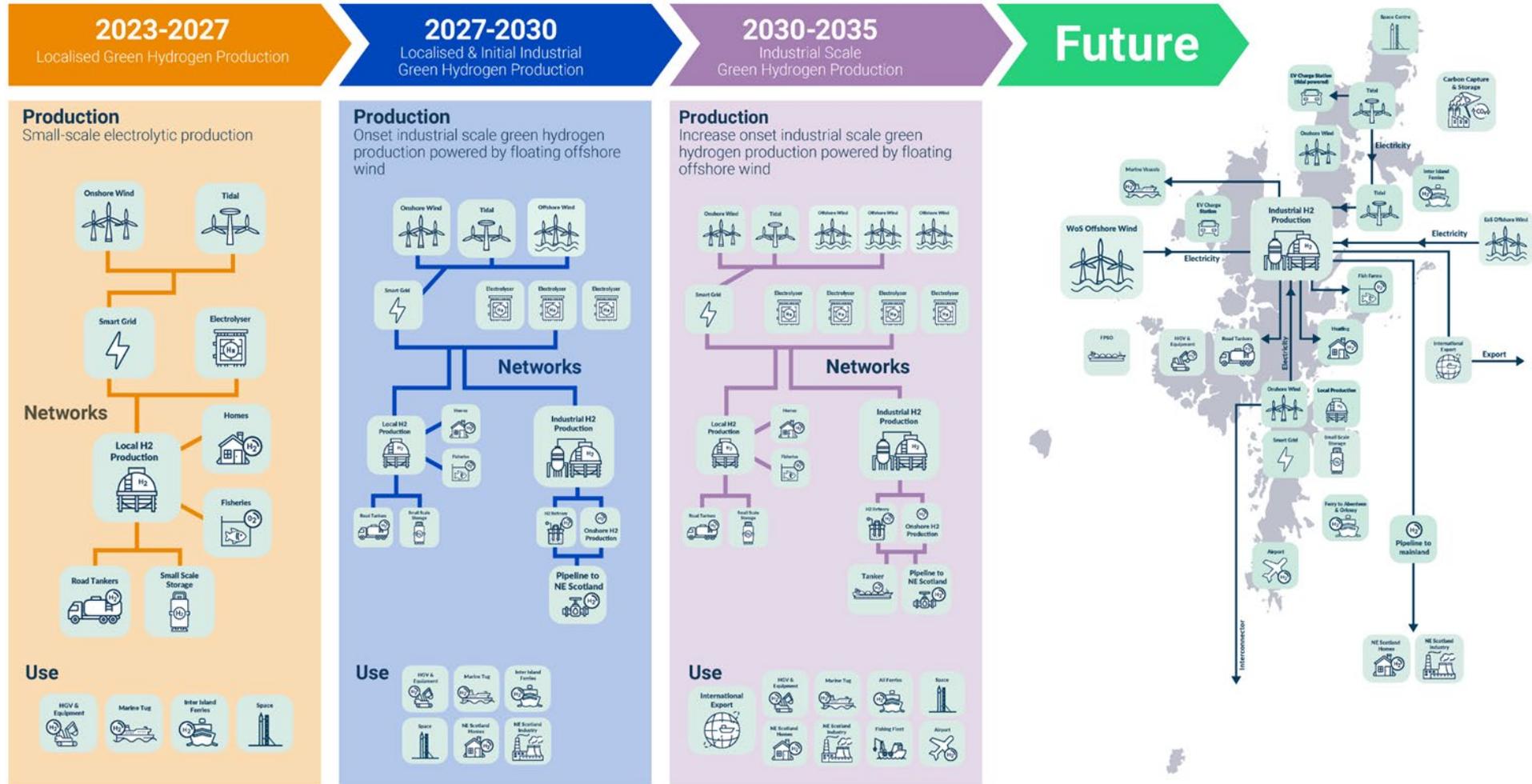


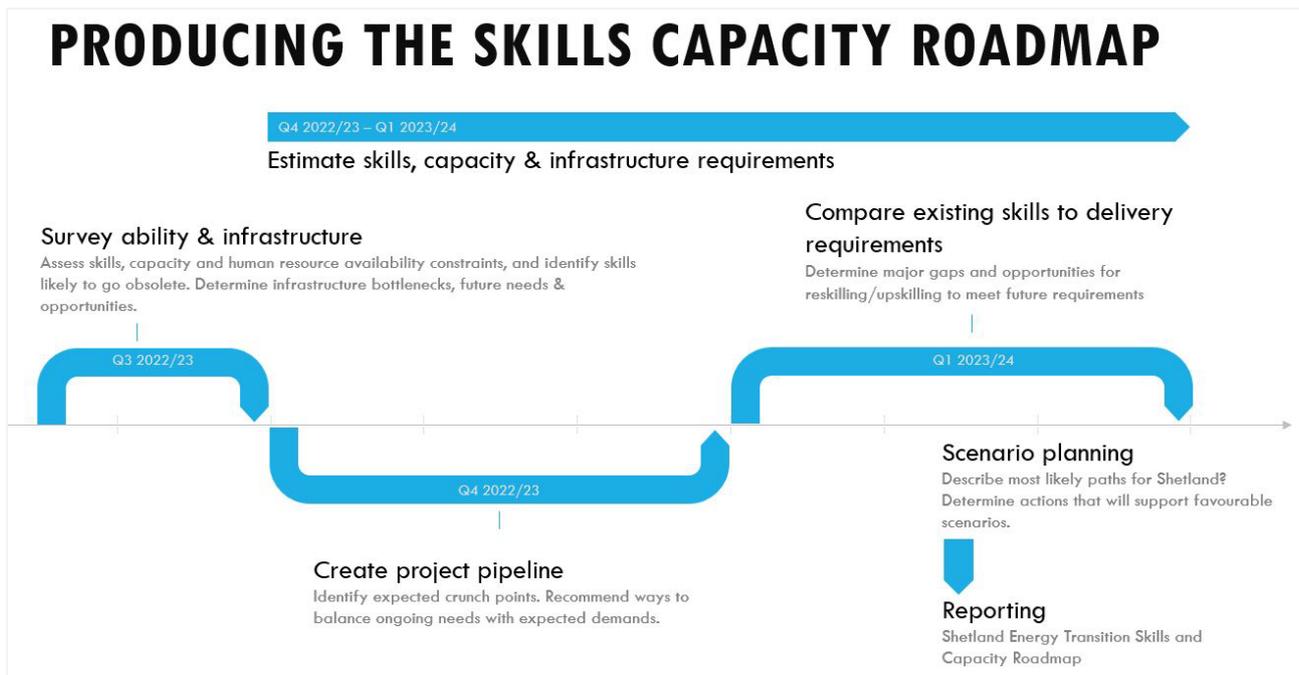
Figure 6.4 Hydrogen Roadmap for Shetland



Due to the expected developments, the Shetland Energy Skills Transition Group (SESTG) was formed, involving University of the Highlands and Islands, SIC, HIE and Skills Development Scotland. The aim of the group is to:

- Ensure that skills issues across Shetland, and wider, energy sector are well understood;
- Ensure a skilled workforce is in place to address challenges and capitalise on opportunities;
- Ensure a coordinated and partnership approach to help address Shetland’s skills & training requirements; and
- Inform and influence Shetland’s education and skills provision.

The group is currently developing a skills capacity roadmap to support organisations and the Shetland workforce to respond to emerging opportunities in Shetland’s energy transition. The process for this is shown in Figure 6.5.



**Figure 6.5 Skills Capacity Roadmap**

This partnership approach involves working closely with industry and will put in place measures required to ensure Shetland will be equipped to serve any emerging industry, such as hydrogen, that will form in the coming years. Shetland already has a highly experienced engineering supply chain built up through decades of experience working on oil and gas projects, and there are many existing companies that are well positioned to take advantage of new emerging industries.

ClimateXChange have recently released a report *Mapping the hydrogen skills landscape* (climatexchange.org.uk) which sets out the current key findings forecasting the hydrogen skills landscape in Scotland:

- Scotland is in a strong position to develop its hydrogen economy, initially by using transferable skills from the oil and gas and process industries and, in the longer term, adapting the existing skills provision so that it can support the hydrogen sector as it grows;
- The hydrogen sector is currently emerging, with a focus on project development, feasibility studies and pre-FEED studies. These activities are being delivered by actors with in-depth experience in the oil and gas, utilities and process industry sectors; and



- Achieving the ambition of 5GW of hydrogen production capacity by 2030 requires the delivery of hands-on hydrogen skills to be fully established in the next two to three years. Central to this is development of knowledge and capabilities within educators / skills providers, which has been identified as a key short-term priority.

A number of recommendations are made based on the findings in this study, including:

- Skills development provision is available at a regional level to support the expected development of several regional hydrogen hubs;
- An initiative to design and specify relevant hydrogen-specific course content is established. This should include representatives from industry, education and the public sector that are committed to delivering the changes to skills provision that will be needed by the sector. It should set out a series of short (1-2 years) and medium-term (2-5 years) actions to do so;
- The concept of 'skills passports', which OPITO is pursuing in the energy sector, is considered in other sectors relevant to hydrogen, such as the chemical and process industries;
- Strategies to promote the hydrogen sector and attract new entrants are developed and implemented. These should highlight the net zero and sustainability credentials of the hydrogen sector and be designed for primary, secondary, further and higher education students, as well as individuals already in the workforce. These should clearly illustrate the potential career pathways for individuals, recognising that younger generations, in particular, are far more mobile in the workforce; and
- More research is carried out to understand the demand and provision of skilled STEM workers across future energy, transport and industry sectors.

These will be followed and incorporated into the current workstreams underway in Shetland. There is a wider analysis of skills shortages and development needed to accelerate decarbonisation in Shetland in Deliverable 11.

#### 6.2.4 Deliverable 9 Conclusion

The review of the successfully run existing scheme, and initial study work into potential new scheme locations, show there is a credible opportunity to develop a new district heating scheme in Shetland. There is funding available, it meets national policy, and it could contribute to decarbonising Shetland's heating requirements while reducing the current fuel poverty crisis. During phase 2, a feasibility study should be conducted, building on from previous studies investigating a district heating scheme in Brae, and how a hub can help facilitate this.

Shetland is currently making significant strides to create a hydrogen production business on island, with local use and export routes both viable options at different stages of development. If hydrogen is to be required at the hubs, it is likely that on-island production will only commence in 2026. The Shetland Clean Energy Project, part of the Islands Growth Deal, is also looking at the transportation and demand for Hydrogen on Shetland. The money allocated for the Shetland Clean Energy Project could be used in conjunction with funding from Phase 2. Shetland is proactively addressing potential skills shortages, but a closer link with other schemes that are investigating future hydrogen jobs requirements, such as ClimateXChange, as well as the locally based SESTG is essential. The skills capacity roadmap currently being developed by SESTG can feed directly into Phase 2 work.



## 6.3 DELIVERABLE 10 - REFLEX CONTRIBUTION TO HUB

**Feasibility will scope out technologies to demonstrate at ReFLEX Shetland office in the Hub, examine how ReFLEX team can aggregate and coordinate interest from customers.**

**Non-technical barriers addressed:** behavioural change.

**Author:** Aquatera with support from CES

The role of ReFLEX in the Shetland Rural Energy Hubs will be based on learning from the ReFLEX Orkney Project and ReFLEX Orkney Ltd. The technologies and services recommended for the hubs are partly based on the learning and offers from ReFLEX Orkney that have helped to achieve behavioural change and adoption of decarbonisation technologies.

Structurally there are two aspects to ReFLEX Orkney – the project and the company. The ReFLEX Orkney Project ran from April 2019 to March 2023. ReFLEX Orkney Ltd was set up as a Special Project Vehicle to deliver the commercial offering, information service and customer engagement during the project, from the commercial launch of ReFLEX Orkney Ltd in December 2020 to March 2023, and then long-term taking forward the project aims into the future. ReFLEX Orkney Project partner Aquatera Ltd was responsible for the set-up of ReFLEX Orkney Ltd and the company is now part of the Aquatera Group of companies. Funded by UKRI through the Industrial Strategy Challenge Fund, the project was led by the European Marine Energy Centre (EMEC) with cross-sector partners including Aquatera, SMS, Community Energy Scotland, Heriot-Watt University and Orkney Islands Council.

In the same way that the ReFLEX Orkney Project led to the set-up of ReFLEX Orkney limited, Phase 2 of the Shetland Rural Energy Hubs project will examine the best business model to set up and take forward the development of hubs long term. While it is envisioned that this will involve establishing ReFLEX Shetland it is also key to make sure how they are delivered and managed locally. Two key deliverables recommended for Phase 2 will be a feasibility study to determine the best business model to deliver the hubs long term and a roll out plan for the hubs beyond Phase 2.

### 6.3.1 ReFLEX Orkney customer offering

**The set up.** When ReFLEX Orkney launched the customer offering in December 2020 the staffing and office set up included:

- 3 customer engagement officers all experienced in customer facing retail and a team manager;
- An office where customers could come in person to make enquiries, take test drives, and get support from the team;
- A fleet of five electric demo vehicles of varying range and size so people could come and test drive; and
- A workshop where new vehicles could be prepared and handed over to customers.

In February 2022 the team moved into the ReFLEX Orkney Experience Centre in Hatston, Kirkwall, with a team of 2 customer engagement officers and a team manager. This unit brings together the office and workshop facilities in an ideal location for Orcadians to stop by for test drives, for information and support and to collect new vehicles. It can also support the roll-out of other decarbonisation technologies in future including demonstrations and exhibitions for customers.



**Membership.** The model for the services offered were and still are based around a free membership. The original purpose of the membership was to provide a method to verify every customer was a resident of Orkney (a requirement of the UKRI funding) and to have them sign a data sharing agreement to enable the research aims of the project. Only signed-up Members (including local businesses) could receive support available from the UKRI funding opportunities such as discounted EV leases. But the membership was and is also about people feeling that they are joining ReFLEX as an initiative to decarbonise their own lives and the wider Orkney community. Membership also provides a mechanism for ReFLEX to engage on an ongoing basis with their community of customers and the newsletter provides up-to-date information about the latest service offers as well as topical information about new technologies, approaches and top tips for increasing energy efficiency and affordability. Since the launch ReFLEX Orkney has built up a community of 944 members – approximately 5% of the Orkney adult population and 10% of Orkney households.

**Affordability** is a key aspect of ReFLEX Orkney and so the services are all based on finance models that help people and businesses access decarbonisation technology more affordably – since cost is one of the biggest non-technical barriers to adoption. These models include leasing new technology, buying used technology and access to grant funding and interest free loans through organisations including the Energy Savings Trust.

**Phased launch.** The commercial launch of ReFLEX Orkney was delayed from April to December 2020 due to the first COVID-19 lockdown. This had a huge impact on the development and roll out of the customer offering, as further lock downs ensued, and not all the envisioned services were ready at launch. However, given the complexity of launching a business providing multiple products and services, this phased approach in retrospect was sensitive and is recommended for future locations such as Shetland.

**ReFLEX Orkney services.** Most of the services that ReFLEX Orkney offered at launch or that were rolled out later are still available and include:

- **Lease new Electric vehicles:** to increase the use of electric vehicles, the ReFLEX leasing model offers a wide range of market leading EVs. For the initial roll-out ReFLEX Orkney provided a discount of up to £4500 (spread across monthly lease payments) funded by the UKRI grant, to provide a strong financial incentive for early adoption. The vehicles are supplied through the UK's leading EV leasing business, DriveElectric, and customers can lease any vehicle on DriveElectric's website. The selection of demo vehicles in Orkney means customers can test drive before they commit to a lease. UKRI funding rules required the discount offered to be reduced over time and this had some impact on continued roll-out particularly as the cost of living crisis post Covid started to come into play. However, the discounted offer was well received by Orcadians and led to the uptake of over 180 new EVs in a little over 12 months.
- **Buy used electric vehicles:** this bespoke model offers a buying-to-order service from trade vehicle auctions, then delivering direct to the customer for a fixed fee. This service has been running since 2013 and was brought into ReFLEX Orkney when it acquired the Eco-cars brand. It has helped put thousands of drivers behind the wheel of their own electric vehicle including customers in Shetland.
- **EV Support Package:** Designed to work alongside the lease, this package offers benefits tailored to the needs of Orcadians and using an EV in an island community, such as use of a longer-range vehicle for trips off Orkney and courtesy car and support with ferry costs if their vehicle needs to go to a mainland dealer for warranty work. This was a key learning point for ReFLEX and very valid for the roll-out and use of other decarbonisation technologies in future. Similar initiatives would be highly relevant to Shetland.
- **Electric vehicle chargers for off-street parking:** The ReFLEX team works with a local installer to provide a service to help customers get an EV charger installed, and the customer team supports them through the journey of installation and applying for grants to cover most of the cost of a new charger and installation, and support grid



and planning permission applications. These home car chargers enable faster charging and charge scheduling to help manage energy use.

- **Fully electric pay-as-you-go car club:** In addition to the individual car leasing options ReFLEX teamed up with UK wide car club Co-wheels to introduce new EVs into the local car club. Operating in more than 60 locations UK-wide the car club offers Orcadians use of vehicles in Orkney and in all Co-wheels locations – including Aberdeen where there are car club vehicles at the ferry terminal. When signing up to Co-wheels, a discount code gives Orcadians access to a start-up credit and discounted car club use.
- **Carbon calculator:** Aquatera developed an Orkney specific carbon calculator that is embedded in its website for domestic users. The calculator was developed using industry standard data from local Orkney, Scottish and UK government backed sources, and takes into account carbon use specific to island life such as ferry journeys and inter-islands flights. This tool enables Orcadians to calculate their carbon footprint more accurately. An aim for Phase 2 of the Orkney Pathfinder Project will be to further develop this tool into a tracker, so it saves the data each time a person uses the calculator and they can track changes to their carbon footprint as they change their lifestyle and homes.
- **100% renewable electricity tariff and smart meter – no longer available:** ReFLEX at launch aimed to help customers access the most appropriate electricity supply tariff for their needs and get smart meters – which were not available in Orkney at that time. Supplied by Shell Energy Retail, the residents of Orkney were offered the ReFLEX Orkney tariff, a flat, low-rate tariff of 14 pence per unit. The tariff came with smart meter installation – helping people to track energy consumption and reduce energy waste. Unfortunately, the energy crisis that kicked in summer 2021, leading to the bankruptcy of many energy suppliers, meant Shell decided to close the ReFLEX tariff to new customers from the end of August 2021. But 115 customers signed up between Dec 2020 and August 2021, receiving a low-cost fixed rate for their electricity. Long term it is the aim of ReFLEX to explore partnering with a tariff supplier again, or even to become a licence exempt or 'licence lite' supplier itself, to help Orcadians – and populations in replication locations like Shetland – to have lower cost 100% renewable electricity, ideally from local generation.

**Facilitating behavioural change.** There are key learnings from the ReFLEX Orkney offering relevant to deciding what services the Shetland Rural Energy Hubs will offer to help drive behavioural change.

The combination of affordable finance, demo cars and test drives are significant drivers of change. When leasing an electric vehicle most of the ReFLEX customers were undertaking two forms of behavioural change: leasing for the first time and driving an EV for the first time. Many customers came to test drive because of the discount offers and the fact they could try out an EV locally with no obligation. None of the car dealers in Orkney had electric vehicles to test drive, so this was a new opportunity in Orkney. It was common experience for the customer team doing test drives to encounter a sceptical potential customer, who said they were not keen on an EV but had seen the great deal and had driven past the office, seen the demo fleet and decided to come try one anyway. Usually within 5 minutes of driving the vehicle the team would see the customer 'get it.' The EVs were actually great to drive – people expected them not to be – and by the end of the test drive they were keen. ReFLEX Orkney have consistently had a conversion rate from test drive to lease of more than 50% since launch. Also, most of the models leased are models ReFLEX have had available for test drive in Orkney, for many people trying the vehicle they will get is essential.

The EV support package also helped overcome fears about range anxiety – by providing low-cost access to longer range vehicles – and about the potential hassle if there were any warranty issues. Interestingly, while knowing that they will have access to a longer-range vehicle has helped many customers go ahead with leasing an EV through ReFLEX Orkney, relatively few actually have gone on to book the long-range vehicles. This suggests that once people actually have their EV they overcome range anxiety.



Having an in-person service where people can come see the technology first hand and get information and help face-to-face through often complex customer journeys has been very valuable to customers, and essential for vulnerable and less tech-savvy customers.

**Service not launched.** ReFLEX Orkney also set out to provide a battery and solar offering, that would be financed by a tariff to avoid up front cost to the customer, and a heat offering funded by grants helping people access affordable upgrades to their heating systems. These offers came up against significant non-technical barriers, including regulatory and financial issues, and were not launched during the lifetime of the ReFLEX Project. However, the Pathfinder Places Orkney project is developing new models to launch these services through ReFLEX Orkney Ltd in Phase 2, and it is envisioned that these services would then be offered through the Shetland Rural Energy Hubs as well once demonstrated in Orkney.

### 6.3.2 Lessons Learned from ReFLEX Orkney

The ReFLEX Orkney Project – like the Shetland Rural Energy Hubs Project – was a highly ambitious innovation project aiming to achieve major behavioural (and technological) change. That alone would bring non-technical challenges. But the project was developed, launched and run through COVID-19, Brexit was 3 weeks after the commercial launch, the energy crisis, war in Ukraine and cost of living crisis all occurred since the 2020 launch and have had major impacts on everything from daily operations, to supply chain and customer demand. This means the ReFLEX Orkney customer offering and the methods of delivering services to members has been thoroughly tested.

The following excerpts from the Draft ReFLEX Orkney Lessons Learned Report 2023 set out key aims and learnings from the project that are relevant to developing public facing services in the rural energy hubs that will enable individuals and businesses in Shetland to decarbonise:

*“ReFLEX Orkney set out to pioneer an integrated, affordable, low-carbon energy system. The project aimed to create a smart local energy system (SLES) in Orkney, Scotland, interlinking local electricity, transport and heat networks into one controllable, overarching system, digitally connecting distributed and variable renewable generation to flexible storage and demand. At the heart of the project is the demonstration of flexibility (the ability to modify electricity generation and consumption patterns in response to variability) using technologies like battery storage, electric vehicles, smart chargers and smart meters.”*

#### **Top three barriers identified to implementing SLES**

**Regulations.** Existing regulations limit the ability of SLES to deliver benefit to customers in generation constrained areas like Orkney where, during periods of curtailment, consumers do not have a right to supply their own demand from renewable generation behind their own meter.

**ReFLEX outcome:** Through discussion with Ofgem and the DNO this issue is now clearly defined and identified as a major barrier to the delivery of SLES in generation-constrained areas. This leads to exclusion of disadvantaged consumers from the potential benefits of SLES.”

**Multi-partner structures and consumer regulations.** Bilateral arrangements between consumers and the multiple organisations involved in delivery of technologies and services limit the ability to develop a simple customer journey for participants.

**ReFLEX outcome:** Original plans for a one-stop shop model had to be adapted to the project providing customers support in engaging with suppliers rather than acting as a single point of contact for all services.



**Consumer debt risk.** Long payback periods of 15 years or more combined with significant debt risk for investors affected the financial viability of the 'no-upfront-cost model' for domestic PV and battery systems.

**ReFLEX outcome:** Delivery of domestic PV and battery systems were descope but ReFLEX delivered a clear understanding of the factors affecting financial and regulatory viability of future projects."

### *The ReFLEX experience: from one-stop-shop aspiration to local energy services hub*

"ReFLEX Orkney aimed to establish a one-stop-shop for energy services. We set up the ReFLEX Experience Centre in Kirkwall co-locating the customer team's office and a workshop for prepping vehicles. This enabled customers to come in to speak to staff, take test drives, and collect their new vehicles.

The aim was for the customer team to provide a central contact point for services that are delivered through multiple businesses. Each of the services offered aimed to join up commercial products with grant funding or affordable finance, which meant that ReFLEX Orkney worked with external suppliers for each of our service offerings.

For example:

- For electric cars the leasing is brokered with DriveElectric and the finance with either Arval or Lex Auto, and we helped customers access grant funding from the UKRI funding to ReFLEX, Energy Savings Trust (EST) and the Office for Zero Emissions Vehicles (OZEV).
- For the car club we work with Co Wheels.
- For the chargers we work with RS Merriman as the installer and MyEnergi as the supplier of the Zappi smart charger.

However, if there's a problem with a vehicle, it has to be reported by the customer to the leasing finance company as they own the vehicle and hold the warranty. Likewise, if there is an issue with a car charger, customers need to report directly to MyEnergi (the manufacturer of the Zappi charger supplied by ReFLEX) due to how the warranty works.

The ReFLEX customer team's role in this is to handle all initial enquiries, track where in the journey a customer is, help customers to understand the process they need to follow and be a point of contact for help through-out that journey. We also act as administrative support for the suppliers and gathered data for the research aspect of the project.

This multi-partner approach allows the project to partner with well-established businesses and give customers the best products and financial help.

However it creates a challenge to having a one-stop-shop from a customer service point of view. Data protection law, warranty T&Cs, and FCA regulations mean that customers still have to interact directly with multiple organisations – ReFLEX staff can't provide the single point of contact we initially hoped to. If someone leases a car and gets a charger that's six or seven organisations they may have to engage with. So we are more of a hub, coordinating service for people to get multiple products (electric vehicles and chargers) in one place and guiding them through sometimes complex customer journeys.

The ReFLEX team can help people navigate a process they would otherwise have to do all themselves, but it creates false expectations with customers to call it a one stop shop so we've had to change our approach along the way.

As a demonstration project trying to develop a model that shows how to bring together multiple products, services and funding to make it easier for people to decarbonise affordably, these complex relationships are a challenge and an area of ongoing learning for team.



We get a lot of feedback from customers thanking the customer team for our help in navigating a process that they would have had to figure out on their own – like getting a charger and applying for the grants at the right time. But we also get feedback from customers where there have been challenges due to the number of organisations involved, breakdowns in communication, etc. Throughout the project we are constantly looking at how we can refine and improve working between the organisations involved, to make it easier for customers.

We have managed to instigate some changes in the system to improve the customer journey. For example, following feedback from customers about the EV charger process, we worked with MyEnergi to improve the process enabling RS Merriman to liaise with MyEnergi on the customer’s behalf once the initial case number is received (customers still need to make the initial report themselves due to the warranty).

The UKRI grant funding provided to set up the ReFLEX Orkney project and demonstrate a smart local energy system came to an end in March 2023, however ReFLEX Orkney Ltd, Orkney's local energy services business set up during the project, is here to stay. ReFLEX Orkney continues to offer electric cars to lease or buy, can support you in getting an EV charger installed and we are working on some exciting new offers, coming soon.”

### 6.3.3 Applying learning from ReFLEX Orkney to Shetland rural energy hubs business model

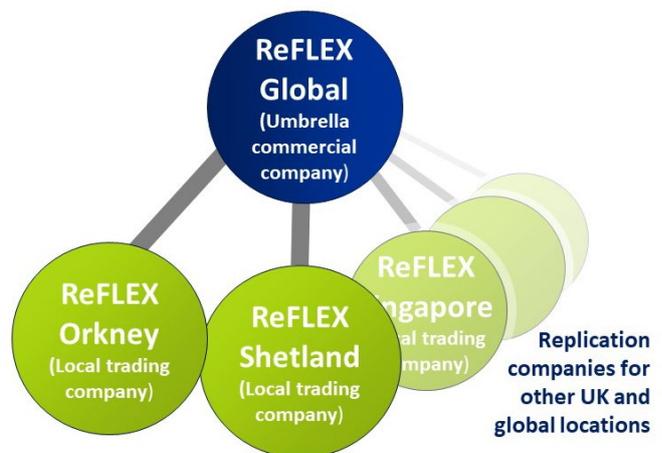
#### Learning from ReFLEX Orkney

While the feasibility study in Phase 2 will ultimately determine the best business model to take forward the Shetland Rural Energy Hubs, it is anticipated that this will involve the establishment of ReFLEX Shetland - offering a similar range of products and services as ReFLEX Orkney based on local need – which will draw heavily on the learning from the ReFLEX Orkney Project and business model for ReFLEX Orkney Ltd.

Aquatera Ltd determined during the development stage of the ReFLEX Project that ReFLEX Orkney Ltd should be set up initially as a limited company because this business structure was the quickest to set up and offered the most flexibility during the funded project. Given the highly innovative and changeable nature of the REFLEX Project, and the range of commercial retail elements to the business the flexibility of a limited company was deemed important. However, the intention has always been that the business would ultimately have a structure that is more firmly ‘rooted’ in the community which it serves and it is the intention of Aquatera to explore changing ReFLEX Orkney Ltd to a Community Interest Company (or similar structure) over the next year (through the Orkney element of the Phase 2 project).

It is also envisioned that Aquatera will establish a company, ReFLEX Global, and that each location of ReFLEX – be it Orkney, Shetland or Singapore (where ReFLEX has replication interest) – will sit under (or have some contractual relationship such as licencing with) ReFLEX Global. Each of the replication companies may be structured differently depending on the needs and legal context of the location, but always with the aim of the local community benefiting from income generated.

The ReFLEX Orkney Experience Centre at Hatston in Kirkwall is the office and workshop for ReFLEX Orkney Ltd and functions as a physical hub for the range of services that ReFLEX Orkney Ltd provides. It does not provide all of the elements envisioned for the Rural Energy Hubs in Shetland, but it is a useful model and practical experience of bringing together for multiple activities under one roof to make it easier for individuals and businesses to decarbonise.



### **ReFLEX Shetland**

Based on the learning from ReFLEX Orkney Ltd a likely approach would be to set up ReFLEX Shetland as the Special Project Vehicle for the Rural Energy Hubs Shetland project and to set that up as a Community Interest Company from the start, thus enshrining local benefit and providing a structure that can receive full grant funding in future. Given that the hubs are likely to include elements that are income generating and other elements that will require funding, this model should support these dual aims. But the feasibility will examine the best model and make recommendations.

### **Phase 2 Governance**

As was the case in ReFLEX Orkney Project, delivery of the planning and development of the pilot hub in Brae will need to be done in parallel with the feasibility exploring the best financial model for the hubs. This means that services and assets will need to be procured by project partners that will later be handed over by the end of the funded project, to the organisations /businesses that have been identified as delivering the hubs long term – such as ReFLEX Shetland.

ReFLEX Orkney Ltd will be able to provide ReFLEX services to the Brae hub by having staff travel to Shetland regularly to deliver activities such as test driving, providing services and support online and over the phone, and training to ReFLEX Shetland staff once it has been set up.

This approach will ensure that a rigorous process is undertaken to determine the best model/s for the Shetland Rural Energy Hubs are undertaken in Phase 2, without delaying the set up and running of the pilot hub in Brae during Phase 2.

### **Engagement**

Development of the business model/s will require engagement with organisations with assets that could be included in the hub (such as using existing community buildings as premises) and those activities could be based in the halls. This would include community groups and development companies, the NHS Resilience team, Voluntary Action Shetland and others.

### **Subcontractors**

The study will engage financial and legal expertise to provide knowledgeable analysis and advice on the best business model/s. A learning from ReFLEX Orkney is that in a public facing hub that aims to comprehensively engage with individuals and business on decarbonisation across multiple areas – such as heat, power and transport - this work naturally includes elements that are income generating and others that are not. In the case of ReFLEX Orkney Ltd the income comes from retail of decarbonisation products like electric vehicles and chargers, and non-income generating activities include supporting customers through the often complex process of securing affordable finance and grants so they can afford to decarbonise.

For a hub to effectively drive behavioural change – a major non-technical barrier to decarbonisation – they need to combine this income generating and non-income generating activities to be able to support individuals and businesses to decarbonise. Only providing the income generating service would not accelerate behavioural change, as it leaves out the elements that often provide affordable funding and these elements are complex for people and businesses to access on their own.

This mix of functions in turn creates a non-technical barrier in terms of creating business models for a hub service that is financially flexible and sustainable. This including expert financial and legal advice will support the development of a viable, replicable business model for rural energy hubs that support decarbonisation – not just in Shetland but across the UK.



### Feasibility study questions

The study will examine questions including:

- Will there be one business model for all of the hubs, or a model for the major hubs and a model for the minor hubs, or individuals models for each location?
- How will local community groups and development companies and their buildings and assets be involved in the hubs?
- How will NHS Resilience hubs be incorporated into the hubs?
- What role will the Pathfinder Places Project partners SIC, CES and Aquatera have in the hubs long term?
- For example would SIC or CES base any staff in the hubs part time?
- What will the role of the Islands Centre for Net Zero be longer term, especially in helping to secure grant funding beyond October 2025? (ICNZ is a 10 year project 2023-2033. It has a remit and responsibility to catalyse change, but currently has mainly initial capital support to “build” the facility and capabilities going forward)
- What model/s will provide the best solutions to create sustainable hubs that will support Shetland’s people and businesses to overcome non-technical barriers to decarbonisation and drive behavioural change.
- Identify funding and finance sources to fund the pilot hub in Brae long term and for the set up and running of all of the other hubs
- Timeline and order for the roll out programme of Rural Energy Hubs across Shetland

#### 6.3.4 Deliverable 10 Conclusion

The model developed by ReFLEX Orkney provides a strong example to draw on in setting up the Shetland Rural Energy Hubs and a feasibility study to examine the business model/s for the energy hubs, including establishing ReFLEX Shetland will be an aspect of Phase 2, if the bid is successful.

Learning from ReFLEX Orkney is that forming multi-partner structures requires time and expert advice and so this will create new deliverables in Phase 2 including:

- The feasibility study on business models for the hub.
- Planning and delivery of the customer offering for the Brae hub during Phase 1.
- The set up of the model to deliver the pilot hub in Brae and handover of assets and contracts from the project to the business by the close of Phase 2.
- A timeline and plan for the long-term development of hubs across Shetland beyond the Phase 2 finding, including the role of projects such as ICNZ and CNI in the hubs’ development.



## 6.4 DELIVERABLE 11 - SKILLS SHORTAGE

**Develop proposal for how Hub can help address shortage of skilled installers for insulation, heat pumps, batteries and solar.**

**Non-technical barriers addressed:** skills shortage, behaviour change.

**Author:** CES with support from Aquatera

### 6.4.1 Shetland Construction Industry Background

The construction market in Shetland is very similar to Orkney in terms of having a small number of large (by isles standards) contractors and lots of smaller specialised contractors covering things like heating, renewables installations and the like. The market in Shetland is currently very skewed by the development of the Viking windfarm with a significant proportion of the construction workforce being utilised in its development. This leaves other projects and clients with limited or no access to contractors or access to available plant hire. Housing development is one area that is suffering and the lack of housing completions is having knock-on effects. Energy efficiency retrofit is an area that is not seen as a priority for many contractors with more pressing needs around the Viking Windfarm and new build developments. Part of the reason for this may well be the certification that is required for insulation measures. While contractors have the skills, the need to develop back-office functions and train staff further for work that can be quite complicated and varied, is often not seen as a lucrative option when compared with other things. PAS 2030 is the requirement that is currently in place and it is outlined further below.

### 6.4.2 PAS 2030 and 2035 Background

The British Assessment Bureau describe PAS (Publicly Available Specification) 2030 as 'a standard with the primary objective to provide a robust, uniformly applicable specification that will assist installers to demonstrate that their installation of energy efficiency improvement measures have met specification and customer requirements.'

PAS 2030 is a specification and guidance that firms need to follow to install energy efficiency measures with a retrofit approach to dwellings specifically relating to undertaking Green Deal and ECO (Energy Company Obligation) installations. It covers three primary types of installations:

- Building Fabric Measures (BFM) which include insulation, glazing, and doors;
- Building Services Mechanical (BSM) which include boilers and heating systems;
- Building Services Electrical (BSE) which includes lighting and lighting controls.

PAS 2035 has recently been introduced and is a specification for what is called 'whole-house' or 'whole building' retrofit. This is an approach to the installation of energy efficiency measures which takes into account the requirement of the entire building, both from a technical standpoint and considering factors like occupancy comfort.

PAS 2035 is concerned with assessing domestic dwellings for energy retrofit. This involves identifying areas where improvements can be made and specifying and designing the relevant improvement measures. It is also concerned with the monitoring of domestic retrofit projects.

PAS 2035 is to be used in conjunction with PAS 2030: 2019, which sets out the standards required for installing energy efficiency measures and while the elements introduced through PAS 2035 correct some issues that were missed through PAS 2030 the requirements placed on contractors, surveyors, etc. by PAS 2035 are significant and make it difficult for



contractors based in Scotland’s islands, particularly small contractors, to be able to undertake the process required for certification. The quality of the product being delivered is often not the issue, the main barrier is often the back-office requirements that contractors need to have in place.

PAS 2035 also brings the requirement for a Retrofit Assessor and a Retrofit Coordinator, two roles that are brand new (although qualified Energy Assessors can quite quickly become accredited as Retrofit Assessors). There is expected to be a shortage of Retrofit Coordinators over the next few years.

Lack of contractors certified to PAS 2030 has been a key issue in all three of Scotland’s island authorities. The Managing Agent approach to the Energy Efficient Scotland: Area Based Schemes (EES: ABS) can help tackle the problem as it draws in a larger qualified managing agent who then helps some of the local supply chain attain the required certification. This approach is probably going to be even more useful when PAS 2035 comes into full effect.

At the moment, two of the four main funding schemes for energy efficiency retrofit require PAS 2035 compliance. These are Energy Company Obligation (ECO) funding and the new Energy Efficient Scotland: Warmer Homes Scotland (EES: WHS) contract that has just been awarded to Warmworks (who are also the Managing Agent for Orkney’s EES: ABS programme). EES: ABS and the Energy Saving Trust administered loan and cashback programme both require PAS 2030 accredited installers for insulation works. All funding streams generally require Microgeneration Certification Scheme (MCS) for heating and renewable generation and battery storage installations.

MCS is similar to PAS but is aimed at low carbon energy technologies like solar panels, heat pumps, small scale wind turbines and battery storage. MCS has been around for longer than PAS and because its introduction coincided with the ramp-up in installations of solar PV, heat pumps and micro-wind there are various contractors in Shetland. It is very possible that for domestic and non-domestic buildings installations of energy efficiency and renewable heating, generation or storage will require measures to be installed under both PAS and MCS certifications. It is unlikely that a single contractor in Shetland (or Orkney) will have both PAS 2030/2035 and MCS certification as companies are generally more specialised in role.

### 6.4.3 Stakeholder Engagement

There are numerous barriers within Shetland in terms of heat pump installation and recruitment of heat pump engineers and plumbers. To make sure the project team understood the reasons for the problems in Shetland, they tried to get as much input as possible from businesses and stakeholders on the isles as possible. While the response was relatively limited most likely due to the short timeframes involved, the team managed to speak to:

- Foreman at E&H Heating & Ventilation Services Ltd
- Vocational Training Coordinator for Shetland, in charge of apprenticeships in Shetland through the UHI,
- Director of SSD Group who offer a variety of services to Shetland including environmental management and sound and airtightness testing on new builds.
- Northmavine Community Development Company (NCDC) Chairperson and Director who offer a variety of services to the community of Northmavine including Bruckland SCRAN (Sensible Community Recycling at Northmavine) recycling centre.

What has been highlighted after discussions with these stakeholders is the numerous barriers to recruitment and apprenticeships in Shetland. There isn’t enough skilled workforce to cope with demand for either installing new heat pumps for residents, maintaining the heat pumps themselves once they have been installed, or any sort of required signposting or information necessary to make sure potential customers have access to the right sort of information around the heat pumps themselves, or where to find national financial assistance.



Most larger companies in Shetland will maintain and fix heat pumps they have installed over the years, but the team have heard from individuals and organisations who have struggled to get quotations or companies in Shetland to even respond to initial enquiries.

The issue with apprenticeships isn't a lack of interest or applications in the industry, but a lack of placement opportunities within Shetland.

There are four organisations or companies within Shetland large enough to be able to deal with the financial pressure of taking on apprentices annually:

- Shetland Islands Council
- E&H Heating & Ventilation Services
- Ness Engineering Ltd
- AJ Pottinger Ltd

These organisations take on roughly 3-4 apprentices within Shetland per year.

There are several very small companies with only one or two members of staff who offer heat pump installation and maintenance services. However, according to UHI "99% of these cannot take on an apprentice due to the huge financial outlay involved. They will have to pay their wages, spend valuable time with the apprentice and see no benefit for at least 3-years."

UHI Shetland regularly takes calls from small businesses in this sector looking for grants or financial assistance to take on apprenticeships however there is simply no government assistance in place. Previously there was a £2,000 grant for any business willing to take on an apprentice, however that disappeared during the COVID-19 lockdown in 2020 and has yet to be return or be replaced.

This remains the most significant barrier to small businesses taking on apprenticeships and looking to expand their operation. It's not just the wages the companies spend on apprentices, however. When they're being supervised on site the organisations themselves are missing out on valuable worktime. The business is also expected to pay the apprentice for their considerable time spent at college.

There is also then the risk that after four-years, the now fully qualified apprentice goes self-employed or joins a rival company therefore the financial outlay in terms of the business itself was unworthwhile. This is prominent in Shetland, there is a culture of self-employment within these isles so that risk is quite high.

Finally in terms of apprentices, UHI Shetland have been hit with significant reductions in their government grants which could have a significant adverse impact on the apprenticeships going forward. A 13% reduction in the overall budget combined with a 30% reduction in their travel and accommodation budget will have a significant impact on potential apprentices given the cost of travel between Shetland and the Mainland of Scotland.

To summarise, there isn't any issue with a lack of interest in the sector in Shetland, but the significant outlay involved remains a high risk for the vast number of small companies in Shetland.

### **Heat Pump Installation**

As per the survey, the biggest single issue or barrier faced by someone wanting to purchase a heat pump is cost. There are other issues including a lack of installation engineers, a lack of information about heat pumps, faith in the technology, familiarity and waiting times.



What the Foreman from E&H has noticed as a significant barrier when talking to customers is the fear of the unknown. There is little or no information within the isles and that information can be varied or false. There is a concern that people have invested in heat pumps only to see no substantial difference in their electricity consumption, or in fact some claim to have had prices increase due to a lack of proper insulation within the property, or inadequate windows.

The vast majority of those who have enquired about getting a heat pump installed have done most of the research themselves prior to contacting businesses. There is little or no advertising of the services as most of the work obtained by companies in Shetland is "reputation based and word of mouth."

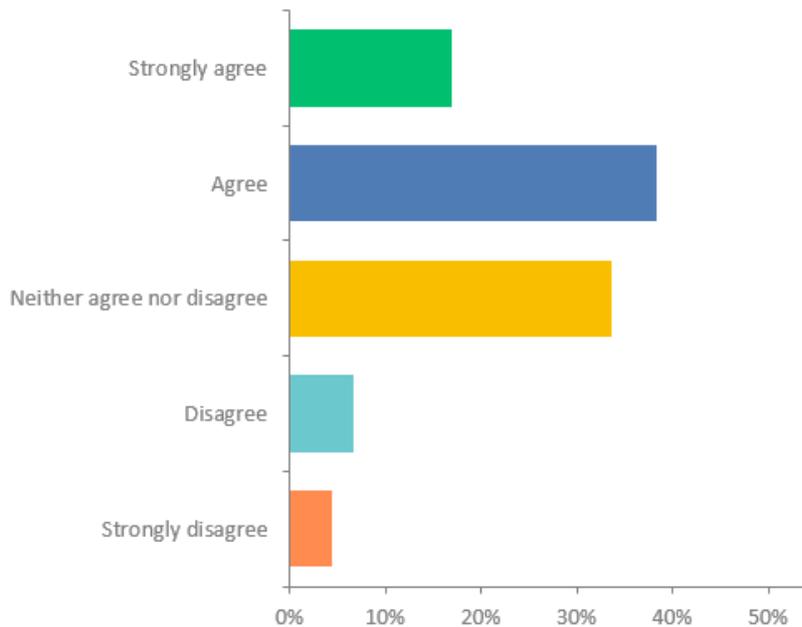
When heat pumps have been installed, there is very little ongoing maintenance or teaching of how the system works. At most it's around one or two, maximum two visits after initial installation, "nearly always because the customer has further queries after it has been installed." Annual service is required to maintain warranties so there is a high uptake on this service.

There has long been talk of a heat pump-based district heating system in Shetland. However, the consensus appears to be this would be unrealistic in the current economic climate.

In terms of businesses looking at the potential for a heat pump, the survey suggests that there could be potential interest in having support and services based at the rural energy hubs. It is clear there is a lack of information, advertising and faith in the technology and hubs could help overcome a significant barrier in terms of a lack of information and understanding of the technology.

Again, when asked during the survey if renewables at the hubs also included visualisation of the data, most answered positively that this would give confidence in the technology.

### Would visualisation of the data give you confidence in renewables?



#### 6.4.4 Proposal for Hub

##### Contractors

The sections above have outlined the skills shortages and the pressures on the Shetland construction industry, including skills and labour shortages and the need for compliance with what can be quite costly and time-consuming requirements like PAS 2030/2035. They have also outlined the concerns that households can have around the costs or effectiveness of renewable or retrofit measures.

In terms of assisting contractors gain accreditation for PAS 2030/2035 hubs are probably best placed to provide information on the requirements for the accreditation and direct contractors into a Shetland wide or even Orkney and Shetland wide training programme to help contractors gain the necessary accreditations. Hubs themselves could be used as locations for contractors to undertake online elements of training, but it is probably more likely that training would be better delivered in one central location to ensure economies of scale.

##### Households

The hubs can offer a significant resource to help household and potentially business and community group behaviour change and renewable and retrofit decision making. As outlined in the heat pump section above a key barrier to the uptake in heat pumps is the fear of the unknown. Hubs can provide perfect locations for displays of live, anonymous energy monitoring from several different households and property types in Shetland. Some could be heated by electric storage heaters, while others could be heated by a heat pump. The ability to display generation data of properties that have solar PV, a wind turbine or battery storage and/or EV and charger, as well as energy usage from properties with insulation upgrades and those without will help households understand the benefits of energy efficiency and renewables installations.

The ability to show what is being generated, stored and used in a property in real time, as well as comparisons (where possible) to the same property's energy usage prior to the upgrades, would help households considering changing their heating type or installing renewable generation make informed, locally valid cost benefit calculations. Comparing the energy usage of similar sized properties that have and don't have energy efficiency upgrades or renewable generation will also help show the potential benefits and that systems like solar PV do work in places like Shetland and can provide a return on investment and energy savings.

The partners in this study, esp. Community Energy Scotland and their linked community organisations, already have a number of "live" activities gathering and analysing property and household data to support the householders and users with energy management and novel technology implementation. If a number of different property types can be monitored across Orkney and Shetland it would allow an energy advisor or community organisation representative within the hub (or the household themselves if supported by the former and/or the system was set up in an easy to use interactive way) to be able to select a property comparison that was close to the build and heating type of their own property to see the potential benefits that installing particular measures might have. This level of interaction would require the development of a user interface linked to live household energy monitoring feeds coming via the Island Centre for Net Zero (ICNZ) data exchange and the householder and associated community support resource to provide value to individuals from this information. Stage 2 Net Zero Living Fund funding could be utilised to help develop this user interface and support linked to the ICNZ data exchange and Islands Community Action Network (iCAN) activities and to purchase further household energy monitors that could be installed across Shetland (and Orkney).

Tied to this activity, hubs would give an ideal location to display and demonstrate the potential of energy monitoring and lifestyle change, as well as renewables and energy efficiency measures to help households make positive decisions to improve the energy efficiency of their properties and move to carbon neutral heating and generation options.



As well as providing households with information on the potential impact of different renewable energy measures hubs could also be locations where Home Energy Scotland's Home Energy Specialist or Shetland's EES: ABS managing agent/contractor could hold drop-in session to provide information and advice to households.

### **Businesses and Community Groups**

Hubs also offer the potential to provide information and advice to businesses and community groups considering energy efficiency improvements and renewables upgrades to their buildings. As well as having displays showing live energy data for a couple of different household types there could also be a display showing the live data for the hub's energy generation, consumption and storage. The data for the hub itself would be more relevant to community buildings and business premises than household data and should a district heating scheme or the like be feeding the hub there would be the potential to show the usage and cost for a building like the hub.

As with households above, live monitoring and supported analysis of non-residential properties, tied into ICNZ, ReFLEX Shetland and wider local support work could also be strongly enhanced through use of the ICNZ data exchange and the iCAN activities when combined with an increased level of in-property energy monitoring and linking to other sites and similar organisations.

### **6.4.5 Deliverable 11 Conclusion**

Hubs provide a great opportunity to inform and educate households, businesses and community groups about energy efficiency and renewable energy generation and heating options, overcoming key non-technical barriers. Due to the scale of the training requirements for things like MCS and PAS 2030/2035 it is unlikely that hubs will be able to play a significant role beyond early information provision for contractors looking to upskill their workforce. However, there is significant potential for hubs to provide information and live energy generation and usage data to help inform and ease concerns households might have about taking on renewable or energy efficiency measures.

There is significant potential alongside ReFLEX Orkney and the ICNZ to explore the development of a user interface and associated support and active networking to help households compare a property like their own with another that has had energy efficiency and renewable generation measures installed to show what savings etc might be possible if they undertook upgrades. The purchase of a number of energy monitors that could be distributed to some households and with the household's permission the data collected and utilised anonymously, as well as others installed in community buildings, businesses and the Hubs themselves are also potential options for spend in a Phase 2 proposal.



## 7 PHASE 2 DELIVERY

### 7.1 INTRODUCTION

As is set out throughout this report, the vision for establishing a network of Shetland Rural Energy Hubs is a long-term programme with the aim of creating a replicable model for rural energy hubs that can support decarbonisation in rural areas across the UK and overcome non-technical barriers to this goal. The aim for Phase 2 will be to prepare and establish the pilot hub in Brae, and do further feasibility building on the work of Phase 1 and preparation for the roll out of the rest of the Shetland hub network as well as replication elsewhere.

### 7.2 PHASE 2 DELIVERY TIMELINE

Phase 2 will be delivered in overlapping stages, with an agile project management approach, aiming to implement activity as soon as possible given the short timeframe of this project.

The stages will include:

1. Development – February to July 2024
2. Preparation – May 2024 to January 2025
3. Implementation – October to July 2025
4. Operation and transition – May to October 2025

**Development** will involve follow on stages of research relationship building, and scoping; required to establish what will be included in the pilot hub and what will be required for the set up. It will also include delivery of activities that can be identified quickly, such as submitting a planning application for charger installation, and a public consultation on the locations of the future hubs.

**Preparation** will be taking the scope and plans identified in development and doing the set up to work towards opening the pilot hub in Brae in Feb 2025. Although we have given indicative timelines we will be considering a phased approach with possibility of some elements of the hubs being up and running before Feb 2025.

**Implementation** will begin with the phased launch of the different elements of the pilot hub to the public, and involve getting the hub operating procedures including governance, and then refining and further developing the hub as learning from operations impacts how it works in practice. If the pilot hub is set up at Brae community hall there may be some aspects of hub services that could begin before the official launch of the hub.

**Operation and Transition** will be the last six months of the funded stage of the project, where the pilot hub will continue to operate and preparations for the transition from the hub being funded by the project to the implementation of the longer term funding model (identified during the project) is put into effect.

### 7.3 PHASE 2 RESOURCE PLANNING

The development and delivery of phase 2 will require a variety of different resources and organisations including:

- Project partners - the three original partners, SIC, CES and Aquatera will all continue in Phase 2 and if a joint bid is submitted with Orkney, then EMEC and OIC would also be partners on the project.
- Brae Hall Committee – Engagement with the hall committee in Phase 1 indicated willingness to potentially use the hall as the base of the pilot hub. Further discussion needs to be undertaken on the wider governance, but if this



goes ahead then the volunteer committee that run the call will become a key relationship for the project development and deliver.

- NHS Resilience team - Engagement with the team manager in Phase 1 indicated a strong interest in locating resilience hubs that they are developing across Shetland, in the community energy hubs.
- Voluntary Action Shetland (VAS) - VAS support volunteer-led committees and organisations across Shetland that have community hall facilities to improve their governance and manage the halls. During Phase 1 VAS staff said they would be keen to work with the hubs project to and to help us identify already existing hall facilities that could be potential locations for future hubs across Shetland.
- Highlands and Islands Enterprise (HIE) – the hubs align with multiple aims of HIE and the project team would seek to involve them in the feasibility study on the business model, to examine ways HIE could support with expert guidance and potential long term funding across business and community development, as well as skills and training.
- There will also be a need for subcontractors for a range of services including:
  - Providing legal and financial advice on the business model/s for the hubs (as set out in Deliverable 10).
  - Installations of infrastructure at the hubs such as chargers, building retrofit and a range of other services.
- Suppliers for services within the hubs, such as the café, hotdesking and meeting spaces, cleaning, IT support.

## 7.4 PHASE 2 DELIVERY AND FINANCIAL PLAN

Table 7.1 sets out the activities expected to be undertaken during Phase 2 and the resources to be delivered, setting out whether or not these would be capital or revenue and whether they would only be costs in Phase 2 or if they will need long term funding beyond the life of the project.

The ultimate aim for this Hub and others is to become fully sustainable. The Phase 2 funding will be used to lick start the first hub, For the activities that would require long term finance beyond Phase 2, this would be included in the further analysis that will examine and recommend the most appropriate business model/s and governance for the hubs (detailed in Deliverable 10). This analysis would be undertaken in the first year of the project and then implemented so that the business model, governance and funding streams were established by the time the funded project completes in October 2025. The analysis will identify the routes to funding, but is anticipated that they would include a combination of:

- Revenue from the income generating activities in the hub;
- Grant funding supporting non-income generating activities;
- Funding from sources such as the NHS for delivery of statutory activities, such as the resilience hubs.

The Shetland Rural Energy Hubs will by their nature be collaborative centres hosting multiple activities delivered by different organisations. So creating long term sustainable funding will be about bringing together multiple types and routes of income and funds including:

- Income generation from services at the hub including rent from others using the hub such as the café, EV sales via ReFLEX Shetland, income from use of the EV chargers at the hub;
- ReFLEX Orkney could fund some staffing through sharing resources and training of hub staff and ReFLEX Shetland staff;
- The hubs may also attract other businesses to relocate to the Hub to make use of the combined services
- If NHS resilience hubs are based in the hubs there could be payments to the hub for hosting them (The current pilot resilience hubs being developed in Yell are funded through the carbon Neutral Islands Project);



- The Island Centre for Net Zero could facilitate match funding and possibly some capital funding for capital assets for the hubs after Phase 2;
- SIC could potentially allocate resources to the hubs if they were delivering statutory duties and/or providing efficiency savings elsewhere.
- Grant funds aligned to the purpose of the hubs include:
  - HIE have multiple funding streams aligned to the roles of the hubs including business development, community development, skills development that could all be sources of funding for elements of the hub services;
  - Skills development Scotland for training budget
  - SIC Business Development Fund;
  - Shetland Community Benefit Fund – will allocate grants from profits from the Viking wind farm, currently under construction in Shetland, and aims to use its £2,214,500 a year to fund initiatives that see all the local communities to benefit from commercial renewable energy developments in the islands;
  - Shetland Charitable Trust is both a Scottish charity and a trust set up to benefit the people of Shetland from income generated by the oil industry in Shetland.

#### 7.4.1 Case study

There is useful learning on creating a sustainable financial model for hubs, from the wider movement around the development of community hubs in some of Scotland’s islands and rural areas, including Orkney and Shetland. The hubs developed through the Shetland Rural Energy Hubs Phase 2 project could take on some of the elements that are being explore elsewhere to add to the long-term viability of the hub and the services that could be delivered from the hub.

The North Ronaldsay Trust on island of North Ronaldsay in Orkney is developing a community hub project which will include a community gym and wellbeing centre, garage facilities for the Scottish Fire and Rescue Service’s fire tender, a meeting space, hot desking, small kitchen area, flat and the potential for additional housing on site and a wool mill and meat larder. There will be renewable energy generation (PV and hopefully turbine), battery storage and EV charger on site as well and the community are looking to investigate developing a neighbouring building as additional hot desk space and a community laundry.

With onsite renewable generation the community are also looking to utilise the facility for enhancing resilience against longer-term power cuts and other emergency requirements. The aim is to also look to provide some additional resilience for internet connectivity to help an island that is mostly connected by microwave internet which is less reliable than mainstream broadband provision. A back-up connection via either satellite or 4G will mean that should the main microwave fail islanders and visitors would have access to a back-up connection via wifi at the hub.

The hope is that visiting services will utilise the space and that visitors, digital nomads and tourists can use the hot desking space should they require it. This will bring a rental income to help sustain the hub for community use. The Shetland Rural Energy Hubs pilot hub in Brae in Phase 2 could look to create income by filling other similar needs that the community, to enhance the 20 minute community proposals coming from the Scottish Government.



**Table 7.1 Activities and resources proposed to be delivered and funded in Phase 2**

Activities and resources proposed to be delivered and funded in Phase 2	Cost type	Cost timeframe
<b>Set up and OPS for Brae pilot hub</b>		
<b>Establish governance procedure and agreements for Phase 2</b>		
Develop governance plan with partners and key stakeholders for the delivery of Phase 2 (since this will take place before the business model and structure for long-term running of hubs has been developed)	Revenue	Phase 2 only
Produce MOU /contracts as needed to enable governance	Revenue	Phase 2 only
Engage legal advice as needed to produce necessary agreements/contracts	Revenue	Phase 2 only
<b>Hub building set up and operations</b>		
Finalise options and plan set up	Revenue	Phase 2 only
Hall retrofit or purchase of business hub portable buildings	Capital	Phase 2 only
Furniture and decoration - including for co-working area (phone booth), meeting and training space	Capital	Phase 2 only
Computers, printer, phone etc, including screens for co-working desks, AV equipment for meeting space	Capital	Phase 2 only
Maintenance and subscriptions	Revenue	Phase 2 and long term
Utilities	Revenue	Phase 2 and long term
Rent if using community hall		
Insurance	Revenue	Phase 2 and long term
<b>Renewable generation</b>		
Finalise technology options	Revenue	Phase 2 only
Equipment & installation	Capital	Phase 2 only
Maintenance	Revenue	Phase 2 and long term
Replacement / decommissioning	Capital	Long term
<b>Charging infrastructure</b>		
Finalise technology options	Revenue	Phase 2 only
Equipment and installation (including for car club vehicle)	Capital	Phase 2 only
Maintenance	Revenue	Phase 2 and long term
Replacement / decommissioning	Capital	Long term
<b>Car club</b>		



Activities and resources proposed to be delivered and funded in Phase 2	Cost type	Cost timeframe
Set up and planning of car club element in Hub	Revenue	Phase 2 and long term
Installation of infrastructure if separate from other charging infrastructure	Capital	Phase 2 only
Car club vehicle to be based in Brae	Capital	Phase 2 and long term
Maintenance of infrastructure and vehicle	Revenue	Phase 2 and long term
<b>Ebikes + bike storage</b>		
Finalise technology options	Revenue	Phase 2 only
Equipment & installation	Capital	Phase 2 only
Maintenance	Revenue	Phase 2 and long term
Replacement /decommissioning	Capital	Long term
<b>Planning application for Hub</b>		
Preplanning	Revenue	Phase 2 only
Planning application prep	Revenue	Phase 2 only
Planning submission fees	Revenue	Phase 2 only
<b>Information centre - in person &amp; online</b>		
Finalise options and types of info	Revenue	Phase 2 only
Ongoing staffing to handle enquiries	Revenue	Phase 2 and long term
Display materials, library and handouts	Capital	Phase 2 and long term
<b>ReFLEX Shetland</b>		
Set up and planning for ReFLEX Shetland	Revenue	Phase 2 only
Ongoing staffing	Revenue	Phase 2 and long term
Display materials and handouts	Capital	Phase 2 and long term
Demo vehicles leased from DriveElectric	Capital	Phase 2 and long term
Other demo technology	Capital	Phase 2 and long term
<b>Co-working space</b>		
Finalise options and set up	Revenue	Phase 2 only
Manage bookings of desks and phone booth	Revenue	Phase 2 and long term
(capital costs for furniture and IT noted under Hub set up)		
<b>Meeting and training space</b>		



Activities and resources proposed to be delivered and funded in Phase 2	Cost type	Cost timeframe
Finalise options and set up	Revenue	Phase 2 only
Liaise with voluntary organisations, manage bookings of desks and phone booth	Revenue	Phase 2 and long term
(capital costs noted under Hub set up)		
<b>Cafe</b>		
Finalise options and procure franchise to run cafe from the Hub	Revenue	Phase 2 only
Kitchen equipment for cafe	Capital	Phase 2 only
Furniture and decoration	Capital	Phase 2 only
Utilities other operational costs	Both	Phase 2 and long term
<b>NHS Resilience hub / room</b>		
Finalise options and set up	Revenue	Phase 2 only
Coordinate with NHS on bookings /usage	Revenue	Phase 2 and long term
Fit out /installation	Capital	Phase 2 only
Equipment (and ongoing provision)	Capital	Phase 2 and long term
Staffing of resilience hub	Revenue	Phase 2 and long term
<b>Active travel elements</b>		
Examine active travel options linked with Brae	Revenue	Phase 2 only
Create resources to promote these options	Revenue	Phase 2 and long term
<b>Marketing and communication</b>		
Website creation	Capital	Phase 2 only
Website updating, hosting and maintenance	Revenue	Phase 2 and long term
Social media accounts set up and running	Revenue	Phase 2 and long term
Logo and design assets creation	Capital	Phase 2 only
<b>Feasibility study to develop business and governance model for the hubs</b>		
Develop draft business and governance model for hubs	Revenue	
Stakeholder engagement on draft model	Revenue	
Financial & legal advice on business model	Revenue	
Finalise business model	Revenue	



Activities and resources proposed to be delivered and funded in Phase 2	Cost type	Cost timeframe
Preparation and delivery of the business model, so long term funding is in place for end of October 2025	Revenue	
<b>Feasibility study for district heating in Brae</b>		
Consultancy for early design concept from the consultant who has already worked on options for district heating in Shetland	Revenue	
Staff time from project partners to develop plan	Revenue	
Possible public consultation on plan (if required)	Revenue	
Preparation of planning application	Revenue	
Procurement of technology (if possible in the project timeframe)	Revenue	
<b>Preparation for future hubs</b>		
Framework for replication of rural energy hubs – to act as guidance for Shetland roll out and as replication guide UK-wide	Revenue	
Public consultation on future hub locations (we told people during Phase 1 stakeholder engagement we would consult on this)	Revenue	
Feasibility study for establishment of Hub in Sandwick	Revenue	
Feasibility study for establishment of Hub in Yell	Revenue	
Feasibility for establishment of other main hubs	Revenue	
Feasibility for establishment of minor hubs	Revenue	
Preparation of planning applications	Revenue	
Feasibility of hydrogen provision at hubs	Revenue	

## 7.5 PHASE 2 STAKEHOLDER ENGAGEMENT APPROACH

Phase 2 will involve multiple forms of stakeholder engagement – building on the engagement already undertaken in Phase 1. Given the 3 month time frame of Phase 1, and the need to consult on some elements once further details of planning and scoping have been undertaken, additional stakeholder engagement is required. This will include:

- Further development of relationships with organisations key to the development and delivery of the hubs including establishing working agreements with partners, community groups, subcontractors and suppliers;
- Public engagement through formal consultation on the future locations of the hubs as promised in the Phase 1 community engagement to ensure community input into the majority of locations;
- Public engagement with the community in and around Brae that would be the users of the hub to ensure the facilities meet the needs and are attractive to the community;
- Public engagement through marketing and communications activity throughout the project, which will be essential to building community buy-in and support for the hubs so the pilot hub is used and future locations welcome the roll out;



- Dissemination of the findings and outcomes of Phase 1 and Phase 2 of the development of the hubs to promote replication.

## 7.6 REPLICABILITY

One of the deliverables for Aquatera on the ReFLEX Orkney project was to seek out opportunities to replicate the project and develop a replication guide. Aquatera has developed a highly detailed replication guide with a step-by-step process for identifying and developing the ReFLEX replication opportunities in different locations. This work has and is leading to replication opportunities in multiple UK locations (Wales) and also international opportunities (Singapore) and the learnings and tools developed from this work provide a strong foundation to then build the replication approach and guidance for the Shetland Rural Energy Hubs.

## 7.7 PHASE 2 COLLABORATION BETWEEN SHETLAND AND ORKNEY

With significant collaborative working and shared learning opportunities between Orkney and Shetland on overcoming non-technical barriers to decarbonisation, the teams for the Pathfinder Places Shetland and Orkney projects are exploring the potential of submitting a joint bid for Phase 2. As noted in the introduction, this feasibility study is focused on the learning from Phase 1 that can be taken forward in Phase 2 and long-term, regardless of whether or not a joint bid is submitted.

An example of where this collaboration would be beneficial for the delivery of the Shetland Rural Energy Hubs is on Hydrogen:

- EMEC has built and runs a hydrogen electrolyser on the Orkney island of Eday and has – in partnership with CES, OIC and others, has pioneered a whole ecosystem of use of hydrogen in Orkney. If there is a joint bid then EMEC will be a project partner and that will be able to bring their considerable practical experience with hydrogen to the work related to incorporating hydrogen into the Shetland hub network..

## 7.8 PHASE 2 NET ZERO TOOLS

The project partners have a range of tools for evaluating the project activity and delivery against the aims of overcoming non-technical barriers to decarbonisation to work towards net zero.

### 7.8.1 RADMAPP

As was set out in detail in Appendix B Aquatera's RADMAPP package provides a GIS based framework for data analysis which is used as a powerful site selection tool. This was used in Phase 1 to do identification of potential hub locations throughout Shetland and to identify Brae as the pilot hub location. It is expected that the RADMApp tool will be used extensively in Phase 2 as well for site identification, feasibility assessments and other GIS survey needs. Key areas will be to identify in further detail future hub locations, potential district heating options, private wire assessments based on usage heatmaps, blue economy issues as well as to aid in development plan production for prime development areas.

### 7.8.2 Shetland and Shetland Islands Council Net Zero Route Map Tool

During development of the Shetland Net Zero Route Map for SIC, future GHG pathways were modelled using the Ricardo Net Zero Projections (NZP) tool, which enables users to model the impact of implementing mitigation measures on a Local Authority's GHG emissions over time. The tool is essentially a 'What if?' calculator tool that relies on external



validation of inputs, assumptions, and outputs to ensure its projections are sensible. At its core, the tool is an accounting system that calculates the change in energy use and fuel mix as a result of series of mitigation measures.

The tool is designed to enable the development of scenarios for reaching net zero by any given target year and allows the users to define mitigation measures for each line in the energy and emissions inventory. These scenarios can be used to build a baseline projection, assess the likely impact of planned measures, and model the impact of alternative strategies to reaching net zero. The scenarios can also be used to undertake sensitivity testing around the impact of changes in assumptions.

It is important to understand that this modelling is based on assumptions about the magnitude of energy or emissions reduction that is technically achievable within each sector. However, it makes no assumptions about the types of policies that would be needed to achieve this. To give an example, the NZP tool can estimate the change in emissions that would result from a 10% reduction in miles travelled by private car, but it cannot assess the impact of specific policy measures, such as 'Introduce a workplace parking levy to discourage people from commuting in private cars' unless the user inputs an assumption about the quantitative impact this would have. That type of information must be established via separate modelling, research, case study evidence or expert judgment.

### 7.8.3 Carbon Emissions baseline tool

This tool is an excel based tool which uses the open-source Welsh Government carbon reporting database with an Aquatera added graphical model option to clearly illustrate where the carbon emissions are highest. Current usage is recorded in the database then a graphical output is created to illustrate the baseline to allow target reduction strategies. Below is an example output produced for a previous project.

This will be used as part of building renovation passports being developed by ReFLEX Orkney in Phase 2, for roll out in Shetland long term. The tool will create a baseline for the passport and provide direction on potential solutions. This tool can be used for domestic and commercial premises, the example below was for a commercial operation. Due to its flexibility, this tool will be instrumental in Phase 2 to target emission sources across multiple users and further develop the Islands decarbonisation plan.

### 7.8.4 Net Zero Pathway Tool

Aquatera developed a carbon emission pathway to Net Zero tool to model a range of potential options and how those options would impact a pathway to Net Zero. The parameters are energy use, transport, heating, renewable energy installations and behaviour. As project teams present different options for the parameters, the pathway model is altered by their choices to show a short-term, medium-term and long-term emission reduction. There is also a high levels costs analysis tool embedded which provides an estimation on costs and savings based on the pathway. The tool is built within Excel so is accessible to all users without the need for any expensive additional software platforms. Below is an example output for a net zero pathway from a previous project.

This can be used in Phase 2 once the baseline assessment/audits have been done to produce a proposed pathway based on the operators accepted solutions and priorities. It is possible for this tool to be adjusted to provide a net zero pathway for domestic users as well as commercial operators so could be used to aid in the building passports as well as a range of other Phase 2 deliverables and activities.

### 7.8.5 Land Carbon Storage Tool

Aquatera developed a high-level land carbon storage tool to allow for land use and land management strategy purposes to guide the user in the ability for a range of land types to store, sequester and emit carbon. This is an important tool



for agriculture and council development where guidance is needed on how best to manage parcels of land and potentially change land use from, i.e. arable to woodland wetland or grassland. The tool allows a clear carbon emission graph to be produced based on the amount of land held, type of land and how carbon storage would be impacted if a land type was reduced, increased, changed etc. Carbon flux is where seasonal or anthropogenic based changes in the land condition can reduce sequestration efficacy and lead to carbon being emitted or lost through erosion desiccation or irrigation. Below is an example of the tool, the future use bar will move depending on the area of land inputted to compare against the baseline.

This tool will be useful in the creation of development, sustainability and environmental plans linked with the Phase 2 actions, in particular in relation to peatland degradation, a significant challenge to decarbonisation in Shetland.

### 7.8.6 Carbon calculator

As part of ReFLEX, Aquatera developed an Orkney specific carbon calculator that is embedded in its website for domestic users. The calculator was developed using industry standard data from local Orkney, Scottish and UK government backed sources. Given some of the particular challenges of island life carbon calculators based on UK or Scottish data only, could not give Orcadians an accurate measure. These differences include things like use of ferries or flights for inter-island and off island travel, higher use of heating due to higher wind and colder weather, and the fact that all of the electricity used in Orkney comes from renewable sources. Since it was launched in January 2021 the ReFLEX Carbon Calculator has been used by 360 people.

As noted in Deliverable 10, in Phase 2 one of the learnings from ReFLEX that this project will implement will be to further develop the carbon calculator for both Orkney and Shetland. The current tool gives Orcadians the ability to measure their carbon calculator at the specific moment in time. The further development will allow people to save the result each time they use the tool so they can track changes to their carbon calculator over time. Beyond Phase 2 this tool can be replicated for different locations, such as Shetland, where local data can be used to adapt it to provide a locally relevant carbon calculator tool.

A carbon calculator tool that tracks change will be an invaluable tool for helping to drive behavioral change. The success of products such as fitness trackers like FitBit, show that being able to measure and track the impact of changes in behavior over time helps to motivate people and keep them motivated over time.

### 7.8.7 Inclusivity tool developed for ReFLEX Orkney – CES

The Social Inclusivity Tool (SIT) was initially developed by CES for the ReFLEX Orkney project and was inspired by Energy Systems Catapult's 'Let's Beta Fuel Poverty' tool. The ReFLEX tool was used for the ReFLEX project to make sure social inclusivity was prioritised in collaborative projects where technical, logistical and business complexities tend to take the focus. The SIT was developed to monitor the inclusivity of the customer offerings and services. This provides structured support to score a project's customer offerings against consistent inclusivity metrics and highlight areas of the project that need more attention or have the potential to be more socially inclusive. The SIT is designed to be adapted to the scope and requirements of individual projects, ensuring it is both relevant and fit for purpose. While ensuring fair and inclusive behaviour. The periodic review process promotes discussion and development through all stages of project development and implementation; allow for small changes to make big changes.



## 7.10 PHASE 2 OPEN SOURCE DATA PLANS

The SREH project will use the IsleDex data exchange for managing open source data. IsleDex is a Scottish Islands data exchange whose purpose is to increase data accessibility. An early form of it was created by the ReFLEX Orkney project and it is currently being further developed by partners in order to be utilised for the Islands Centre for Net Zero (ICNZ) as it is seen as central to the initiative objectives of helping to accelerate decarbonisation and deliver smart local and affordable energy systems. Governance processes for managing the exchange of data and ensuring protection of personal data (e.g. GDPR) are in place. In addition to providing a platform for the exchange of data between participating members it also provides a visualisation tool for public dissemination of selected datasets.



## 8 LONG TERM PLANNING

### 8.1 INTRODUCTION

The aim of this wider initiative is to ensure that the rural hubs that are developed within Phase 2 become sustainable and a long term asset to the host community but also the wider aspirations for the Shetland islands . It also important to show that this model can be rolled out to other rural communities across the UK and potentially internationally.

### 8.2 SUTSAINABILITY

During phase 2 of this project the team intends to develop and demonstrate governance and finance structures that will sustain the rural hub at Brae over a longer term. The work in phase 2 at Brae will also provide learning and options for the wider hub network to ensure they can be developed and run efficiently. There will be a training programme and learnings that will be documented to support the development of rural energy hubs beyond Shetland.

### 8.3 COMMUNITY INVOLVEMENT

It is fully understood by the project team that the only way the proposed hubs are to be a success is to fully involve each host community at every stage. This is to be a community asset and should be a real opportunity for the communities to embrace the changes that are coming and lead others to overcome the barriers to reduced carbon dependance. Building a network of hubs over the longer term has the potential to create a movement that can become self-perpetuating. On a Shetland wide basis, the hub network should allow for efficiencies across the public and private sectors and enhance a place-based approach to island wide challenges.

### 8.4 REPLICATION

Throughout the completion of phase 2 the team will be developing lessons learned and options into a replication and training handbook or roadmap. The purpose of which will be to support other communities to follow the Shetland and Orkney lead. The hubs by their nature will be driven by the host communities but the handbook can support them on the journey given that these two island communities are already recognised as leading in this area.

The ReFLEX team and Aquatera have already been talking to a number of similar rural communities and have developed a replication plan for ReFLEX for this purpose which can form part of the rural hub process and the overall replication tool. Some of the tools highlighted in section 7.8 can also be utilised and will provide further support to new communities.



## 9 CONCLUSION

In conclusion for this study the team have set out how the report addresses each of the elements required to overcome the non-technical barriers to decarbonisation.

### 9.1 ALIGNMENT TO EXISTING ACTIVITIES

Shetland has already developed and completed a number of studies and plans to support the journey to reduced emissions as listed in the literature review in Appendix A. The work proposed through these studies collates this previous work and supports the development of rural energy hubs as a credible solution to taking rural areas forward on a decarbonisation pathway.

### 9.2 PLAN FOR UNLOCKING SYSTEMIC BARRIERS

The rural energy hubs will allow for communities to tackle the challenges highlighted within the literature review. They will increase awareness of the opportunities, demonstrate how to change behaviour utilising previous experience and learning as well as technology options that support these changes to behaviour. The best way to help people to understand what they need to do is through demonstration "seeing is believing". The hubs developed in a local environment can support the community to embrace behavioural change by giving them the confidence that the technology and systems work. The plan for the initial hub in Brae is outlined, but also the wider development of a network of hubs across Shetland as well as how these might be rolled out across other rural areas across the UK.

### 9.3 HOW YOU WOULD DEMONSTRATE REMOVAL OF THESE BARRIERS IN A POTENTIAL FOLLOW-ON PHASE

The key component of the next phase of the project would be to plan, develop and set up the first rural energy hub in Brae. Although not fully formed at this stage it is outlined throughout the report, the options to be included in each of the deliverables and the further work needed to get into the detail of implementation as well as operational procedures and governance structure. There will also need to be at each stage further consultation with the communities as well as the potential service users of the hubs. To monitor the outputs will require on going consultation to understand if and how these identified barriers have been removed or reduced. This would feedback into the lessons learned reports and also into ongoing training and road mapping for the wider hub network.

### 9.4 SYSTEMS APPROACH DEMONSTRATED

The approach that has been taken is to develop the evidence that the location is correct and also understand what the communities themselves would like to see and more importantly what they would use within a hub. The details of the hub are set out in table 7.1. Each of the elements will be developed further in Phase 2 but more importantly the integration of them into a cohesive hub and potentially a wider hub network will form part of the Phase 2 plan.

### 9.5 LONG TERM PLAN (BEYOND LIFE OF FUNDING)

The long-term plans for the wider project are set out in section 8 and will be more fully developed through Phase 2.



## 9.6 SCALABILITY AND REPLICABILITY ACROSS UK

During Phase 2 a full replication pack will be developed, building on the replication work in ReFLEX Orkney, as highlighted in sections 7 and 8. This will allow other communities to develop rural hubs by learning from the work done in Shetland and Orkney. There is also the real possibility for developing a country wide network of hubs.

## 9.7 EXPECTED OUTCOMES

The main outcome of the project will be to deliver and demonstrate the first rural energy hub at Brae. The other outcomes will be:

- Complete the design of other major and minor hubs across Shetland;
- Develop an operational system for the individual hubs and possible integrated network;
- Develop a governance structure for the hubs;
- An option analysis of potential funding sources for hubs both for development and longer-term sustainability;
- Development of a replication handbook or roadmap to support early-stage development of other rural hubs.



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# 11 APPENDICES



## APPENDIX A LITERATURE REVIEW - AQUATERA

### A.1 AIMS

This literature review focuses on the non-technical barriers that challenge the path to decarbonisation in Shetland, more specifically on "Regulation", "Grid capacity", "Resource", "Behavioural change" and "Lack of Data for Rural Communities", classified as main themes of the review.

As part of the main themes review, this report will highlight the main barriers and concerns expressed by Shetland's community. This report also aims to capture the key challenges and obstacles faced by the community members. Through the review process, various challenges were identified, and potential solutions were explored to address them effectively.

Additionally, the report focuses on selected case studies that exemplified specific aims related to the community. These case studies provided valuable insights into both the potential issues and successes encountered in their respective contexts. Subsequently, a comprehensive understanding of the challenges and lessons learned from these case studies will be developed, enabling informed decision-making and fostering community development.

### A.2 SELECTION OF SOURCES

#### A.2.1 Internal materials review

Material sources are in Final version format to ensure the information was verified and the content complete. The use of confidential or sensitive documentation was limited and rationalised for inclusion.

#### A.2.2 External Materials Review

For external materials, documents are limited to academic papers, Government Publications, Local Authority Publications and Publications from Government commissioned third parties such as the Energy Saving Trust, Community Energy Scotland (CES) and other high-quality resources. External materials reviewed as part of this literature review are exclusively provided from SIC and CES sources. Notes from sources pre-reviewed by SIC have also been reviewed as part of the literature review process. Sensitive and confidential reports have been marked and will not be cited as part of the reference list.

#### A.2.3 Priority Classification

As part of the review process, a classification of priority to review the sources has been established by SIC. This classification ranges between "1", estimated at the highest priority to "3" estimated at the lowest priority to be reviewed. This classification guided the review of the sources, with a primary focus on the sources estimated as "1", followed by sources classified as "2" and "3" according to their relevance to the specific aims of the literature review.

### A.3 RECORDING THE INFORMATION

The Sources that are selected and reviewed are recorded on a Data Framework excel database. This database holds the key relevant information from the sources reviewed, organised in columns with the following headings:

- Publication Title
- Publishing Authority
- Location
- Date
- Study aims
- Main themes ("Regulation", "Grid capacity", "Resource", "Behavioural", "Lack of data")



- Additional themes supporting the Main themes categories (such as “Engagement”)
- Key Takeaways summarised in (“Challenges” and “Solutions”)
- Source link

These headings were chosen to allow for quick referencing to the most important aspects of the documentation as well as allowing direct access to the source materials. The documents were then reviewed in order to ascertain how the materials may be interlinked/common themes of support and to identify if there are key publications that are referenced or widely used in the production of other plans and policies and to illustrate how plans and policies are intended to be used in conjunction. The main themes covered in the Data Framework refer to the proposal’s non-technical barriers categories. A note on the confidential or sensitive nature of the content reviewed has been added in the “References” column.

The study aims and key takeaways are intended to highlight the main focus of the materials and how they specifically relate to the Shetland Rural Energy Hubs (SREH) project. This will allow users to identify which document/plan/policy may be of most benefit to the information they seek.

## **A.4 REVIEW PROCESS**

The actual publications review process should involve reading the full report or relevant sections as most appropriate and highlighting specific areas where the information was relevant to the SREH project aims and ambitions. Notes have been taken from this review and results are documented in the appropriate report section.

## **A.5 CASE STUDIES**

As part of the options considerations for the development of rural community hubs, several case studies are researched, selected and developed to support the decision-making.

### **A.5.1 Case studies research**

Data collection of case study examples was conducted using searches with specific keywords and Boolean format in search engines (i.e Google search). Boolean searches format includes the use of keywords and Boolean operators such as “AND”, “OR” and “NOT” to include, broaden or exclude results.

The use of Key Phrases or Key words has been determined prior searches. These Key Phrases/words directly relate to the content aims, be concise and targeted to increase the return of relevant search options. This method reduces the time spent searching and increases the quality of the sources returned as well as ensuring where there are multiple people working on the literary review, that they are consistent in their approach and the aims of content clear.

### **A.5.2 Case studies selection**

Case studies collected were then selected to be integrated in this report following these criteria:

- Scale of development of the hubs depending on their location;
- Technologies involved;
- Longevity of the hubs.

Case studies are reported on with a brief description, and lessons learned where information is available.



## A.6 RESULTS ON NON-TECHNICAL BARRIERS

As Shetland faces decarbonisation of its isolated energy system, existing non-technical barriers are still unresolved and new challenges have emerged. Despite previous works, non-technical barriers related to community concerns are still very present. These community challenges have been classified into "Regulations", "Grid Capacity", "Resource", "Behavioural" and "Lack of data for rural communities". Key information from other categories revolving around these main themes are included in the results.

## A.7 REGULATION

### A.7.1 Internal reports

#### Confidential internal report – A review of Shetland's current onshore energy system

This confidential report aimed to characterise the current onshore energy capabilities of Shetland for generation, electricity networks. It also identifies several regulatory gaps related to energy efficiency and energy system management more precisely on:

- existing and future generation from renewable energy sources, to improve a well-established coordination and maximise generation.
- Shetland's renewable energy potential has not been fully utilised yet, needing specific regulations on integration/export techniques and management methods (Confidential source).

#### SIC – Shetland Community Energy Strategy Conversations Survey

This report draws upon the Shetland community's expertise and initiatives on energy usage through an engagement survey and discussions from different locations across Shetland. 40% of the 182 responses obtained strongly support Shetland as a key leader in the energy transition in Scotland with 35% viewing this energy transition as beneficial for Shetland. Most respondents (50%) find it is necessary that the energy transition should be affordable, clean, and secure.

In relation to regulatory issues, the communities support that the council should ensure the community ownership of the transition and that no hidden profits are taken from it. There's a clear need for defined ambitions and targeted priorities set locally. The development of a set of principles by SIC to reach net zero objectives locally has been suggested (Shetland Islands Council, 2023).

### A.7.2 External reports

#### ZetTrans - Shetland Regional Transport Strategy and Shetland Active Travel Strategy 2021-2026

The Shetland Regional Transport Strategy provides the strategic framework for the development of transport, both within Shetland and to / from the Scottish mainland up to 2040 including transport issues within Shetland and how ZetTrans intends to respond to them.

The Shetland Active Travel Strategy sets out the ambition, objectives and actions for the next five years to achieve an increase of walking and cycling journeys.

Regulations addressing pathways to decarbonisation and more largely climate change targets and challenges were mentioned as part of several reports. Most of these regulations have been developed at a national level apart from a few exceptions such as local development plans for Shetland, strategies with regards to specific industries (e.g tourism and road transport & safety) and the Islands Growth Deal (ZetTrans, 2022) (ZetTrans, 2021). Key local and emerging policies and ambitions for Shetland include:

- Shetland Islands Council 'Our Ambition 2021-26'



- Shetland Partnership – the Local Outcomes Improvement Plan for the Shetland Islands (LOIP), 2018-2028
- Local Development Plan II

Other national strategies are mentioned in the report either related to transport such as the “National Transport Strategy II” or more general planning frameworks. Local strategy for Shetland has also been continued with the Shetland Transport Strategy Refresh 2018- 2028”. There are mentions of tourism and active travel strategies including cycling and walking in Scotland.

### **RICARDO - Shetland Community Conversations on Climate Change Workshop Report**

This report intends to provide communities an opportunity to raise feedback related to climate resilience and low carbon places and include these in the development of the net zero map for Shetland. The previous findings are consistent with the regulatory concerns raised by the Shetland’s communities. More precisely, a “need for clarity on priority areas for the net zero transition” and the “expected role from communities” is stated (RICARDO, 2022). Steering on local actions is needed to accelerate the net zero living targets set nationally.

Alongside this need for clarity, a sector-by-sector consultation approach is suggested by the communities to establish what the net zero transition entails for businesses and understand their impacts. Learning and mutual support are critical in reaching these targets and a defined need to foster networks and links between communities is also raised (RICARDO, 2022).

In addition, specific gaps in regulations and missing guidelines have also been noticed with regards to:

- the increase of energy ratings and the required capital to implement these energy efficiency measures (e.g draft, exclusion, airtightness and insulation) (RICARDO, 2022).

### **Tnei – Demand Side Management Report**

This report aims to detail how network constraints could be alleviated by both ANM and demand side management techniques.

In this report, Shetland is presented as an isolated energy system, with no connection with the power grid on the Scottish mainland. As such, local suppliers operate with no access to the mainland generation market. However, there are high operating costs from local facilities. This implies that generation prices charged on the Shetland islands are 3 to 4 times higher than the average generation prices on the mainland.

In 2015, at publication date, there was a clear need for Shetland generation energy tariffs to be re-evaluated, also called “uplift arrangement” and covering the additional costs of procuring generation in Shetland for generators and demand side management sites. At the time Ofgem was revising them under the Scottish Hydro Electric Power Distribution (SHEPD) license scheme (Tnei, 2015).

**Author’s note:** It is important to note that in July 2020 - after this report was published - the UK energy regulator OFGEM approved the construction of a subsea interconnector cable linking Shetland to the national power grid. Scottish and Southern Electricity Networks (SSEN) aims to build the 600MW electricity transmission link by 2024, connecting Kergord in Shetland to Noss Head on the Scottish mainland.



## A.8 GRID CAPACITY

### A.8.1 Internal reports

#### **Confidential internal report – A review of Shetland’s current onshore energy system**

The current energy system in Shetland is mainly based on electricity with no large-scale gas transmission network on the Shetland islands. As an isolated island power system, energy generation is produced by both synchronous generation stations and renewable sources must be consumed locally by domestic, commercial, and industrial users. An existing Active Network Management (ANM) system is used on Shetland, where source management and load response are co-ordinated. The construction of an interconnector will change this system in Shetland. The intention of using an ANM is to increase renewable generation output and reduce reliance on fossil fuels.

### A.8.2 External reports

#### **RICARDO - Shetland Community Conversations on Climate Change Workshop Report**

The report also presents the communities’ views on the grid capacity of Shetland. More clarity is needed on the effects and consequences of the full electrification of Shetland’s energy system, in particular related to the cost of electricity, already at higher prices. To this regard, financial support is needed for subsidising the costs (RICARDO, 2022).

#### **PURE Energy – Shetland Energy Source Analysis**

This report aims to investigate Shetland energy sources, its environmental CO2 impacts and its associated energy costs in the local economy. Since late 2009, renewable generation connections in Shetland have been limited to 16A (3.68kW) per phase. In 2013-2014, applications were opened for the management of the Shetland connections as part of the Scottish and Southern Energy (SSE) North Isles New Energy Solutions (NINES) project. However, due to oversubscriptions to the scheme applications for further managed renewable generation connections are currently closed.

In this context, this situation has a stringent impact on renewable energy generation expansion. Currently, new renewable energy projects only rely on existing grid connections, with new connection permission for potential projects with short-medium term developments being severely restricted. A maximum grid connected renewable generation capacity of 11kW is allowed currently in a three phase connections configuration. A single-phase connection is limited to a 3.68kW maximum. Due to these generating connection constraints, further significant renewable energy contribution is unlikely to be accommodated in the short term (PURE Energy, 2020).

The construction of the subsea interconnector will open up options for renewable generation in future.

#### **Tnei – Demand Side Management Report**

In Shetland, 90% of the electricity is supplied by Lerwick Power Station and the 100MW power station at Sullom Voe Terminal, with the remainder provided by local wind generators. The distribution system license is held by Scottish Hydro-Electric Power Distribution (SHEPD), responsible for maintenance and provision of suitable connection for the existing network.

The report also details heating oil requirements at care homes or sites near potential transport hub locations. According to these heating oil requirements, additional network constraints could be applied to the current system if the heating system was completely supplied by electricity (Tnei, 2015).

#### **RICARDO Energy and Environment – Shetland Islands Net Zero Routemap (NZSR)**

This report develops a strategic route map on the suitable route and mitigations measures for Shetland in achieving net zero emissions. This includes a more detailed implementation plan (RICARDO Energy and Environment, 2022).



Sectors targeted by the net zero implementation plan include buildings and transport requiring electrification. Reinforcement of the grid through the planned interconnector to mainland is a critical step. The carbon emissions from fossil fuels activities in Shetland could feasibly be reduced to net zero by 2045 if all fossil fuels are replaced with zero-emission alternatives, such as decarbonised grid electricity or green hydrogen.

However, a significant portion of Shetland’s sectors that require decarbonisation are difficult to electrify (e.g. aviation, marine vessels, etc.) The report highlights the uncertainty on the presence of technologies available by 2045 that can mitigate these sources of emissions.

The report states the difficulty and even impossibility for area-wide emissions in Shetland to reach net zero by 2045 base on the current available technologies or mitigation methods, barring a systemic overhaul of the economy, land uses, consumer habits and social engagement (RICARDO Energy and Environment, 2022).

## A.9 RESOURCE

### A.9.1 Internal Reports

#### **Fuel Poverty Advisory Services Project - SIC, Shetland Housing Association, Home Energy Scotland and the Citizens Advice Bureau**

This report was the result of a workshop and community engagement events that ran from March through April in 2022 (Shetland Islands Council, Shetland Housing Association, Home Energy Scotland, Citizens Advice Bureau, 2022).

The report strongly emphasizes the critical importance of upskilling the workforce and setting up support and ways to share knowledge and competences among the communities.

### A.9.2 External Reports

#### **RICARDO - Shetland Community Conversations on Climate Change Workshop Report**

The report was commissioned by the Shetland Island Council to investigate the communities’ views on the development of the net zero route map for Shetland and raise community-level issues. Shetland’s communities highlight in the report specific resource needs to be addressed (RICARDO, 2022):

- Lack of funding for up-front costs to implement energy efficiency measures within public and private buildings;
- Lack of local skills to implement energy efficiency measures e.g installing PV or air/ground source pumps;
- Current training options available for renewable sector are often too long;
- Creation of net-zero compatible activities jobs may not offset jobs loss from all targeted sectors i.e oil and gas or cover the unemployment rate in Shetland;
- Lack of material/equipment due to scarce shipments;
- Financial support to low-income families reliant on oil and gas industry;
- Fuel grants often temporary and not sufficient to meet households needs and limitation of number of fuel vouchers available.

#### **ZetTrans - Shetland Regional Transport Strategy**

As part of the development of the strategic framework for transport by 2040 in and out of Shetland, specific issues with regards to resourcing have been raised in the report (ZetTrans, 2022):

- External ferries with the size of vessel as the constraining factor in the design of the current Northern Isles Ferry Services (NIFS) fleet to be accommodated within the current infrastructure at Aberdeen Harbour. Capacity



challenges were clearly identified in the 2016 NIFS Scottish Transport Appraisal Guidance (STAG) and will have worsened over time given the general growth in demand (particularly freight demand) pre-pandemic.

- Inter-island ferries with the increasingly urgent need for a funded vessel replacement programme or alternative solution. Challenges of crew retention is also raised, due to competition from other sectors for example, from oil and gas, NIFS services, and the aquaculture industry. Each of the high-volume Shetland Roll-on-Roll-off routes suffers from vehicle capacity challenges at certain points of the day (weekday commutes and weekends).
- 'Small island' ferries with limitations in terms of passenger numbers, deadweight, and crane capacity limit the number of people and the volume and size of goods that can be carried.
- Aircraft to the islands of Papa Stour and Skerries were previously part of the inter-island air network but were withdrawn in 2020 due to lack of appropriate Rescue and Firefighting Services (RFFS) at Skerries.
- Buses face challenges with the workforce rapidly ageing and the recruitment of new bus drivers becoming an increasing issue, hastened by the COVID-19 pandemic and the consequent lack of testing facilities for public service vehicle (PSV) and HGV drivers. Added to this, reduced patronage post-COVID and an aging population means that a higher proportion of concessionary passengers will continue to put pressure on bus service finances.

### ZetTrans - Shetland Active Travel Strategy 2021-2026

This report aimed to set out the ZetTrans vision, objectives, and the actions to increase active travel options across Shetland with the uptake of walking and cycling journeys and routes. As part of the actions taken, ZetTrans will allocate dedicated staff time, in agreement with Sustrans to deliver walking and cycling measures identified in the action plan. ZetTrans will also continue to chair the Active Travel Group, which will be formalised with regular meetings (ZetTrans, 2021).

### Shetland Islands Council – Shetland Community Energy Strategy Conversations Survey

The report sets out islander's knowledge and initiatives for energy usage in the communities as part of the 182 responses from the survey. Critical needs have been identified and include (Shetland Islands Council, 2023):

- Develop local small-scale energy provision;
- Prioritise development and share of energy transition knowledge, skills and capacity with involvement of local businesses and communities through training and not just outsourcing from outside workers;
- Diversify and broaden economic opportunities of local supply chain whilst protecting current existing industries;
- Create long-term local jobs to retain local wealth and content, with the distinction between short and steady stream of contractors;
- Provide financial relief from cost of living and financial assistance with energy transition.

## A.10 BEHAVIOURAL CHANGE

### A.10.1 Internal Reports

#### Confidential internal report – A review of Shetland's current onshore energy system

As this is a confidential internal SIC report, only the relevant findings are being included here and there will be no citing or referencing of the report. The main aim of the report was characterising the current capabilities of Shetland's onshore energy system including generation, electricity networks, and current load centres.

With regards to the energy networks and loads where it is relevant to behaviour, assessment of the Active Network Management (ANM) is required. For households to take part in the ANM scheme they must provide consent i.e. opt-in to the scheme. It is likely that because social housing typically has a higher occupancy turnover than non-social housing,



the original occupants that provided consent no longer live in these houses and have not provided consent for their new address. Therefore, it is probable that many, if not all, of the occupants of the social housing neighbourhoods on Shetland are no longer taking part in the ANM scheme. This means that the space heaters and hot water tanks that were part of the scheme are no longer being managed by the ANM system.

Communication and maintaining contact with participants in energy survey schemes such as the ANM is critical to allow for ongoing energy stability, use and capacity assessment projects which are needed for the transition journey.

### **Confidential report - Net Zero Living Data – Barriers to Active Travel**

Additional unpublished information has been reported with regard to potential barriers to active travel in Shetland communities. In 2021, the average car ownership was 1 per household based on licenced car vehicles and number of households in Shetland. The highest ratio was found in Shetland South with 1.16 per household, followed by: Whalsay & Skerries with 1.11; Shetland Central with 1.06; Shetland West with 1.00; Shetland North with 0.97; Yell, Unst & Fetlar with 0.84 and the lowest ratio in Lerwick & Bressay with 0.77. However, these measures combine different datasets and it is understood that there are households with multiple cars and households without any cars.

19.2% of respondents from the NHS Shetland Population Health Survey in 2021 reported there were no barriers to them increasing their use of active travel. Moreover, 45% of Shetland South respondents were interested in increasing their use of active travel; followed by 44% in Lerwick & Bressay; 43% in Shetland West; 41% in Shetland North; 40% in Yell, Unst & Fetlar; 38% in Shetland Central and 33% in Whalsay & Skerries.

However, the main barriers identified by the communities to active travel were in order:

- Bus routes/times not suitable with the highest percentage of respondents from Shetland West with 54%. This was followed by Shetland Central and Shetland South, with 32%, then 30% in Shetland North, 24% in Yell, Unst & Fetlar, 19% in Lerwick & Bressay and 17% in Whalsay & Skerries.
- Weather conditions with the highest percentage of respondents from Yell, Unst & Fetlar, followed by Lerwick & Bressay, with 20.9%; 18.2% in Shetland North; 17.5% in Shetland Central; 13.8% in Shetland South; 8.9% in Shetland West and 8.3% in Whalsay & Skerries.
- Distance/remote location with the highest percentage of respondents from Yell, Unst & Fetlar with 31.6%; followed by Shetland South with 20.8%; Shetland North with 19.7%; Shetland West with 19.6%; Shetland Central with 18.6%; Whalsay & Skerries with 12.5% and Lerwick & Bressay with 3.4%. Only Whalsay & Skerries and Lerwick & Bressay had a lower percentage of respondents choosing this than the Shetland average with 15.3%.
- Lack of safe routes with the highest percentage of respondents from Shetland Central with 16.5%, followed by 12.5% in Whalsay & Skerries and Shetland West; 12.4% in Lerwick & Bressay; 12.3% in Shetland South; and 2.6% in Yell, Unst & Fetlar.

## **A.10.2 External Reports**

### **Shetland Community Conversations on Climate Change Workshop report – Ricardo**

Ricardo was commissioned by SIC to undertake a series of 15 workshops within the Shetland community to discuss the main priorities and concerns around climate change, the transition to becoming a climate resilient and low carbon place to live and work, as well as to discuss the opportunities for individuals and communities to feed into the development of the net zero route map for Shetland (RICARDO, 2022). The below key topics were the focus of the workshop:

- Impacts of climate change on Shetland and needed adaptations
- Emission reduction strategies for net zero including just transition and fuel poverty
- Communities' role in the transition.



Behaviour has a large part to play in a Net Zero transition; the following behaviour challenges and adaptations were raised in the report:

- Communities want tried and tested technologies, rather than anything too innovative – acceptance of new technologies is an issue.
- Activities that don't work often last long in the memory – several examples were given, such as installing a wind turbine on a community hall that did not deliver the expected benefits, and the Fetlar Developments Ltd electric minibus that is now not running due to difficulty and cost of maintenance. Another example was the Powerdown Project that supplied electric scooters. Once these broke down, there was a lack of spare parts to repair them. This lack of faith in technologies causes resistance in uptake for renewable technologies.
- Lack of maintenance on a community-owned wind farm due to the fact that the turbines are from Germany and a lack of local expertise meant that ongoing maintenance was challenging.
- Lack of skills and the support needed to maintain technologies, lack of resources and information on technologies
- Young people, in particular, mentioned reducing energy use. This is a behaviour change all can participate in, however it can be more challenging in remote areas and harsh climates. Currently the most accepted and actioned behaviour change.
- Shifting from private car use to public transport may be more challenging than elsewhere. Rural transport networks can be restrictive and unreliable but there are some adaptations that are being made to make more use of this alternative.
- Action being taken on active travel, despite adverse weather conditions. Rural and Island communities do have more enthusiasm for active travel when weather allows and options are available. - This will not be as popular (as with public transport) as it is in urban mainland areas where there are more options.
- Car sharing is quite common, especially for taking the ferry. – Island communities have a strong community bond and resource sharing is common and a behavioural benefit towards net zero.
- Clothing and toy swaps in an effort to save money and/or to access a greater variety of goods than is available in local shops, while also reducing their carbon footprint. – As above, resource sharing is popular and common in rural and island communities which is a beneficial behaviour adaptation towards net zero
- Need for clarity on what the priorities are for the transition to net zero – many require more information and education on carbon reduction and how behaviour can drive this for a transition.

### **Nort Natters – SIC and partners**

This report was the result of the SIC and partners engaging with over 500 members of North Shetland mainland. The project aimed to gain insight into the community needs and feedback on services, specifically relating to transport, wellbeing, education, housing, energy and net zero transitioning.

The participants ranged in age from young school aged people to the more mature residents with good participation. Relevant to the Shetland Rural Energy Hubs feasibility were opinions on transport, energy and net zero transitioning with many raising issues around lack of public transportation, lack of active travel options and networks as well as concern over road safety for active travel (Shetland Islands Council, 2023). Should improvements be made to these transport issues, more would support alternative low carbon options such as e-bikes, public transport, car sharing, walking and cycling. Currently having a car is the most realistic option with few seeing alternatives in the current transportation climate.



With regards to energy, many worried about energy efficiency, with housing stock - both private and social housing - being mostly old and in poor condition with little insulation and drafty. Access to support for improvements in energy efficiency is viewed as limited with typical barriers being cost, material availability and waiting lists for works to be done (especially in social housing). While residents are willing to change behaviour and improve energy efficiency, this is not often possible.

Renewables are seen as a positive thing for Shetland although many do not see any benefit from them which reduced community buy-in to more renewable projects. This links into the net zero transition where participants felt that although they wanted to do more to reduce carbon emissions and saw the transition positively, there is not enough support for the individual to contribute (Shetland Islands Council, 2023).

### Yell Climate Action Plan Priorities

As part of the Carbon Neutral Islands (CNI) project, Yell was elected to participate along with five other Island communities. The aim is to understand how the net zero transition could benefit or impact the community and where the communities focus was on climate change action. The report produced from the CNI Action plan (Carbon Neutral Islands, 2023) showed that the key areas of interest for the communities in regard to how they could change behaviours to facilitate the transition were primarily around transport links, energy efficiency, better tie-ins to large commercial and community renewable energy developments and access to micro renewables.

Infrastructure was highlighted such as alternatives to ferry travel to reach outer Islands (tunnels or bridges), EV chargers installed in more community access areas, safe bike storage and e-bike charging areas at ferry terminals. The use of commercial and community renewable developments to power charging hubs. Should infrastructure be improved, the sustainable behaviour changes would be easier to action and would encourage many to review how they move around the island, power their homes and use energy.

Waste management and a circular economy were mentioned with participants stating the willingness to recycle/upcycle and re-use more goods within the immediate community should facilities be made available. This is similar for land use and other aspects of circular economies with many wanting to utilise local produce from farms, aquaculture and supply chains to reduce import carbon footprints and increase local community sustainability (CNI Yell, Unknown).

### NHS Shetland Population Health Survey

There is a tangible link between health and well-being and a transition to net zero, with more sustainable energy use increasing home health and sustainable transport encouraging active travel, car sharing increasing community bonding and more accessible transport options reducing isolation and promoting mental health. The report produced by the NHS (NHS Shetland, 2022) repeated what many other reports found, with the desire of the community to engage in more active travel, increase home energy efficiency and seek out alternatives to fossil fuel heating systems. The same non-technical barriers were identified such as safe active travel routes, public transport links, lack of financial and advisory support, in home energy efficiency and limited options to action desired changes (NHS Shetland, 2022).

## A.11 LACK OF DATA FOR RURAL COMMUNITIES

### Shetland Community Conversations on Climate Change Workshop report – Ricardo

Ricardo was commissioned by SIC to undertake a series of 15 workshops within the Shetland community to discuss the main priorities and concerns around climate change, the transition to becoming a climate resilient and low carbon place to live and work, as well as to discuss the opportunities for individuals and communities to feed into the development of the net zero route map for Shetland (RICARDO, 2022). The below key topics were the focus of the workshop:

- Impacts of climate change on Shetland and needed adaptations;



- Emission reduction strategies for net zero including just transition and fuel poverty;
- Communities role in the transition.

Key gaps in information are identified as the following:

- Lack of awareness linking more frequent severe winds and high wind chill to climate change causing damage to buildings and infrastructure;
- Lack of awareness on overview of current carbon emission sources by sectors and their factors, e.g land use not understood as a major emissions source, e.g consideration of livestock emissions or not;
- Lack of awareness of the Citizens Advice Bureau services to support with fuel grants and stigma associated with it;
- Lack of understanding of net zero impacts on specific vulnerable sectors (e.g fishing, fuel pumps), creating competitive disadvantage between small and large companies;
- Lack of understanding of long-lasting effects of COVID on net zero targets, how COVID helped demonstrate the potential for net zero measures.

### **Shetland Community Energy Strategy Conversations Survey**

Main changes identified by participants in the study are (Shetland Islands Council, 2023):

- Lack of resources to empower change;
- Lack of information and advice.

### **Nort Natters Community Engagement Workshops**

Main challenges identified by participants in the study are (Shetland Islands Council, 2023):

- Perceived lack of communication between travel organisations and the public;
- Lack of information about decarbonisation of households, such as insulation and heating.

### **Shetland Regional Transport Strategy**

Most of the challenges have been addressed in other surveys and there are common themes apparent within the communities surveyed. The addition of carpooling sites being informal, unmanaged, and unrecorded has not been addressed in other reports and is a gap in data sources (ZetTrans, 2022).

## **A.12 CHALLENGES**

### **RICARDO - Shetland Community Conversations on Climate Change Workshop report**

The main challenges that were raised during this study were how to encourage a shift from private to public transport use and promote the increase of walking and cycling given the barriers expressed by the participants such as adverse weather being common and off putting for active travel as well as limitations with public transport. Other challenges to a sustainable transition to net zero are the costs to procuring low carbon technologies and energy efficiency measures making them out of reach for many. Instability of the power grid in adverse weather events such as power cuts, and storms that make solid fuel back up heating sources essential as low carbon/electric back-up systems are costly and may not be compatible with the building heating system. Adverse weather is also a factor in the ability to have locally or privately grown food produce, meaning the communities are reliant on imported foods (RICARDO, 2022).

Support and advisory services are often difficult to navigate and access to many people and most support has criteria that need to be met which excludes a significant number of people wishing to transition to a net zero way of living. There is a general feeling that many people struggle to understand how they can facilitate a net zero transition and are confused by what that means and the impacts it may have on them personally and in Shetland as a whole (public services and



infrastructure). Confidence that it could be a positive change is currently uncertain among the majority (RICARDO, 2022).

### Confidential internal project report

A confidential energy report done by SIC concluded that a number of challenges were apparent in a net zero transition. Much of the challenge around Shetland's energy production and use is the restrictions on grid export and connection capacity, with many of the renewable developments needing to be curtailed on productive days wasting potential energy generation.

Keeping the overall cost down is important and challenging with new decarbonisation targets and objectives such as replacement of conventional fossil fuel, network management, demand control etc., requiring significant changes and therefore implementation costs. Finding funding and investment for these objectives is competitive and difficult to access.

### Shetland Regional Transport Strategy

Transport is a key issue for residents of rural and islands communities and is a top priority for behaviour change as emissions from transport are significant and it is an area where technological advances are progressing quickly.

Ferry transportation is unavoidable for many and not only are there challenges in ferry emissions, but also in personal travel to and from the ferries. Many have stated that the current public transport links do not match up with or support ferry transport and if this was resolved they may consider using public transport as costs for taking a car on a ferry are high and unsustainable for frequent ferry users (ZetTrans, 2022).

Going forward, there are a range of issues which will put pressure on bus services finances and the cost of delivering our bus network, including:

- Difficulties retaining and recruiting drivers;
- Increased concessionary travel costs associated with the under-22 scheme;
- A forecast aging population, meaning more concessions.

At a private level, the awareness of alternative options can be a challenge to those not digitally connected or internet savvy. While many state that the main challenge to accessing low carbon transport alternatives is the cost and concern over range of electric vehicles.

Public transport has issues around accessibility to remote residents, frequency of service, reliability of service, comfort, access for vulnerable and less able-bodied users. Some have mentioned a wariness of using public transport that may be available due to fears of safety (vulnerable people not feeling safe). These issues make giving up a personal car unlikely (ZetTrans, 2022).

### Shetland Active Travel Strategy 2021-2026

The transport sector is the largest contributor to Scotland's emissions (37% in 2017), and the only one where emissions have increased over the past few years. Furthermore, road transport makes up over two-thirds (69%) of transport emissions.

Challenges to active travel in rural remote and island communities are commonly the lack of safe walking and cycle paths along the roadside. This leads to a feeling of not being safe when walking or cycling on the roads as traffic can pass at speed. In Shetland, the climate is challenging and often restricts outdoor activities (ZetTrans, 2021).

### Shetland Community Energy Strategy Conversations Survey



Several challenges came out of the Community Energy Strategy with the key challenges being how to reduce the level of fuel poverty and increase home energy efficiency and increase electricity resilience. Additionally, ensuring that progress does not exploit the natural environment is a key factor in community support for renewable developments. Environmental resilience is also a key factor in the reduction of reliance on fossil fuels which is a key industry still in Shetland (oil and gas industry). Increasing renewable technologies while addressing the fossil fuel reliance challenge has some resistance within the community due to external corporate ownership and the perception of exploiting the local residents and environment for little gain. There is a need for increased local community ownership and clear community benefits as well as upskilling opportunities for young people, those transitioning from fossil fuel industries and women (Shetland Islands Council, 2023).

### **RICARDO - Shetland Islands Net Zero Routemap (NZSR)**

In Shetland some of the largest sources of emissions are from land use, energy industries, and agriculture. This is due to the rural setting and geography, nature of Shetland's economy and the underlying geology and soil condition (RICARDO Energy and Environment, 2022).

### **Nort Natters Community Engagement Workshops**

Connectivity is a key challenge for residents on the outer islands of Shetland. The rugged and unpredictable weather conditions of Shetland makes improving availability of ferry services during extreme weather events difficult, however the cost of replacing ferry services with fixed links such as a tunnel or bridge may be prohibitive.

As for renewable development and technologies and community buy-in to such developments, there is a lack of sufficient knowledge/ skills required for the installation and maintenance to support the increased demand for renewable energy/ heating solutions along with supply chain issues relating to accessibility to parts and equipment (Shetland Islands Council, 2023).

### **Yell Climate Action Plan Priorities**

Challenges on Yell, a northern island in the Shetland archipelago relate mainly to supply chain and transport. All of Shetland experiences these issues but they are compounded on Yell due to the more isolated location and reliance on ferry transportation, which is impacted by the unpredictable and volatile weather conditions. There is a concern that the increased chance of climate related extreme weather events such as flooding, storms and blizzards will further impact on the essential ferry service and power cuts.

Generally, there is a feeling that there is a lack of clarity and access to support and advisory services to those wishing to better understand decarbonisation and transitioning to net zero. This is specifically apparent when it comes to home energy efficiency and improvements. Shetland has a lot of older housing stock with poor energy efficiency. The main challenge to the residents is access to support, financial aid and contractors to increase energy efficiency and install low carbon technologies (CNI Yell, Unknown).

### **NHS Shetland Population Health Survey**

Challenges relating to fuel poverty include the lack of available knowledge/ skills available to residents within Shetland which can cause anxiety and depression along with other physical issues that result from cold, damp and poorly heated homes.

Active travel is limited in Shetland due to the climate and an ageing population which impacts on the promotion of active travel with 77.5% of 40-44 year old respondents not supporting active travel in any strong way and majority of over 65+ being less inclined to participate in active travel (NHS Shetland, 2022).



## A.13 SOLUTIONS

While the challenges and non-technical barriers to a transition to net zero are significant, there are a range of potential solutions to aid in the transition and allow more awareness around decarbonisation. The below results from the literary review highlight the findings from the selected source material.

### Shetland Community Conversations on Climate Change Workshop report – Ricardo

The results of the survey gave several potential solutions that were of interest to the community:

Climate resilience (RICARDO, 2022):

- Carpooling schemes formal and informal (already in place) – Transport is a key concern in rural and remote communities with limited options aside from private car ownership. There is significant support for car share schemes, car clubs and alternative active transport options (e-bikes) once infrastructure to support more electric vehicles are in place as well as better public transport links;
- Building standards – Increasing the quality of the housing stock through retrofitting insulation, doors and windows to increase energy efficiency and new build properties to higher standards (renewable energy options and well insulated);
- Sharing schemes, community swaps for commodities (already in place) – circular economy practices such as bring and buy stores/stalls, local products and produce being sold locally and communal equipment/goods depots for resources sharing;
- Local food production to reduce vulnerability from mainland supply chains – community allotments/polytunnel sites where locals can grow and pick their own food to reduce pressures on store supplies in times of adverse weather and contributing to a low carbon circular economy;
- Land management – increased/improved land drainage to combat flooding events, better use and maintenance of green spaces, better soil and peat management, native woodland/hedgerow reinstatements.

Net zero:

- Tried and tested technologies – Increase deployment of well-established renewable technologies and micro generation technologies while ensuring local expertise for the install and maintenance of the developments;
- Increased education, training and apprenticeship options in renewable technologies for young people;
- Inter-island travel options - Retrofitting ferries, replacement of old ferry stock with new low carbon fuel alternatives, fixed links (tunnels/bridges) to allow more stable access during adverse weather;
- Better quality of housing with more options for low carbon heating – increased microgeneration, solar/battery installs and heat pumps. energy efficient homes;
- Increased education and training in decarbonisation skills and awareness throughout demographics and work programmes.

### Confidential internal project report

Shetland's significant renewable energy potential can be greatly utilised for consumers/clients of Shetland (and GB, when the Shetland interconnector is commissioned, and even other European areas, when more international HVDC links are commissioned).

New and innovative technologies can be applied and Shetland will become a world-leading energy hub regarding clean energy generation, transmission, and utilisation. Maintaining the security and reliability of the Shetland power system, keeping with the latest cost effective technologies and innovations being implemented in the path toward decarbonisation



Practical and effective approaches can be implemented to reduce the environmental impacts during construction and engineering, improvement of electrical infrastructures with novel equipment (such as switchgears).

### Shetland Regional Transport Strategy

Transport is a key issue for rural and remote residents and many of the reports have raised the desire to have an improved public transportation service and more options for alternative travel. To encourage low carbon transportation and active travel the following suggestions were made as a result of the Shetland Regional Transport Strategy (ZetTrans, 2022):

- Integration of active travel and public transport connections, including through the delivery of mobility hubs where appropriate and within new developments (residential and leisure etc);
- The bus network should be developed in a more coherent, recognisable, and integrated way for regular, occasional and new users of the network, including visitors with better facilities to wait for the service. More connectivity with community services (school times) and locations through demand responsive transport (DRT). This should support the reduction of isolation in non car users (elderly, young people and disabled) and decrease reliance on private car ownership.
- A minimum level of facilities should be provided at bus station and stops, ferry terminals, and airfields and airports with safe storage for bikes and chargers available for e-bikes;
- Commit to contributing to the sustainability of island communities by reducing or removing the cost, capacity and connectivity barriers to personal and business travel, the delivery of public services and the movement of goods between our islands;
- Support measures which facilitate the decarbonisation of the vehicle fleet in Shetland and between Shetland and the Scottish mainland, including cars, buses, commercial vehicles, aircraft and ferries. Increase EV charging infrastructure.

### Shetland Active Travel Strategy 2021-2026

Active travel is difficult in Shetland due to weather and terrain as well as the lack of safe infrastructure to encourage active travel. Part of the solutions identified through the Active Travel Strategy are to increase the facilities at bus stops to make them more accessible and attractive to users (safe bike storage etc), increase the integration of walking and cycle routes and conduct further study via audits of current active travel routes and seek input from residents on how to enhance these and increase the interconnectivity (ZetTrans, 2021).

### Shetland Community Energy Strategy Conversations Survey

Shetland produces a significant amount of energy from renewable energy developments and there is potential to increase the use of this energy within the Shetland industries, both established and new. The energy transition measures that stand out the most were:

- Use energy more efficiently e.g car sharing, district heating schemes and insulation installation;
- Small to large scale renewable energy generation e.g solar panels, large offshore wind farms.

Financial energy transition costs are a significant issue with end users and producers with many believing the renewable energy industry is causing the increase in bills when those living near developments feel they should be getting reduced bills. More information and education on this would aid in reducing energy development resentment and allow for a more open dialogue on community benefits from energy production (Shetland Islands Council, 2023).

### Shetland Islands Net Zero Routemap (NZSR)

To facilitate the transition to Net Zero, the Shetland roadmap to Net Zero has identified the following potential solutions to some of the challenges faced (RICARDO Energy and Environment, 2022):



- Peatland restoration and land management – this is the single most impactful mitigation measure for Shetland in relation to land use, this can also include sustainable agricultural practices and paludiculture;
- Improving standards of living and lowering fuel bills by retrofitting buildings and ensuring that everyone has access to affordable, low carbon heating and energy and increased insulation;
- Contributing towards the decarbonisation of the wider UK energy system via large-scale renewable energy technologies and storage systems to include Carbon Capture and Storage to become a Hub of decarbonisation innovation. This could be achieved easier in Shetland than the rest of the UK because:
  - Its North Sea location is in proximity to suitable storage geologies;
  - There is an opportunity to reuse existing gas and oil infrastructure both on and offshore;
  - There is likely to be a large amount of renewable electricity generation in and around Shetland, and therefore a source of renewable power for CCS facilities;
  - Innovation for technologies such as green hydrogen, CCS and tidal power, which could include a micro-CCS pilot project at the Lerwick ERP.

### **Nort Natters Community Engagement Workshops**

Potential solutions that came from the Nort Natters workshops focused around increasing the skill level in local communities for low carbon and renewable energy technologies installations and maintenance through education and job training to increase services available to facilitate decarbonisation. Information and advisory support and increased engagement was also a key solution raised to allow residents to better understand alternative transport and travel options (Shetland Islands Council, 2023).

### **Yell Climate Action Plan Priorities**

Improving the climate resilience of northern Shetland communities through increasing renewable energy on a domestic and commercial level is a priority from the CNI action plan community outreach along with clarity and more input from the community on the use of renewable development benefits paid to the communities to allow for more focused and responsive projects (CNI Yell, Unknown).

There is a requirement to improve transport links to the Scottish mainland and better communication on the impacts of weather on travel options throughout the islands. Improving transport links throughout the islands would facilitate the behavioural change towards public transport, reducing car dependency.

Improving the availability of information and skilled workers to improve insulation and advise residents on how to make best use of resources and services. This education and training would also relate to domestic renewable energy and would increase likelihood of residents installing these technologies in their homes should more skilled trades and advisors be available to the community.

There is a call to allow communities to increase food security through possibly subsidising the production of locally produced food and reduce the impact of increasing frequency of climate related supply issues. Increasing availability of local food would encourage residents to purchase them, reducing reliance on imported food and lowering the carbon footprint as well as increasing community relationships and increasing social activities.

### **NHS Shetland Population Health Survey**

Much of the health-related benefits to decarbonisation are centred around housing improvements and transportation. Solutions from the Shetland NHS survey echo many of the other community driven surveys and strategies around improving housing quality through insulation, energy efficiency and renewable heating options to tackle fuel poverty.



In addition to these actions, increasing the level of knowledge by both professional stakeholders and the public at large, increasing building standards and using policy to mandate that homes can get assistance for insulation/ heating solutions would facilitate these changes.

Reducing the need for car-dependency on the islands via increased public transport and alternative options throughout the island, with special attention to mitigating the effects of wind and rain on Active Travel users is also a priority seen in multiple reports (NHS Shetland, 2022).

## A.14 CONCLUSIONS

This section presents the summaries and conclusions of the literature review per theme.

### A.14.1 Regulation

Several regulatory improvements or gaps were identified in the literature review. Regulatory support is needed to help maximize renewable energy generation including regulation of export techniques and management methods related to grid connection coordination.

Shetland communities insisted on the importance of community ownership of the energy transition. The communities need to clarify their expected role in the transition and define areas of priority for the islands and set key principles to reach net zero objectives.

Defined pathways and net zero targets are also requested for Shetland industries to become decarbonized locally. Industries such as transport, active travel and tourism already have strategies in place, renewed every couple of years, but a lack of regulatory structure to help advance decarbonisation has been noticed.

To this end, a sector-by-sector consultation has been suggested as an approach by the communities to establish the priorities for businesses. Fostering network links and mutual learning between communities has also been mentioned. With regard to energy supply and generation, specific policy gaps are also needed to regulate the financial support required to implement energy efficiency measures. Shetland generation energy tariffs are also needed to be re-evaluated unless this has been revisited since 2015 after the Ofgem's presumed revision.

### A.14.2 Grid capacity

The current energy system in Shetland is isolated with no electricity grid connection with the rest of the mainland and no large-scale gas transmission network. 90% of the electricity is supplied by Lerwick Power Station and 100MW power station Sullom Voe Terminal, the remainder provided by local wind generators. The existing electricity system is managed by an Active Network Management (ANM) system but faces rising constraints with the increasing addition of more renewable generation in the Shetland's energy system. An new high voltage direct current (HVDC) interconnector to mainland Scotland is currently being constructed and is due to be connected to the grid by 2024. This will make a significant change the current energy system. The grid issues are explained in detail in the Grid Requirements Study on Pages 28.

Full electrification requires a detailed net zero implementation plan with a sector-by-sector approach. As part of this plan, the reinforcement of the grid connection with the mainland is critical. This also includes the consideration of additional network constraints from the electrification of heating from heating oil systems at care homes or transport hub locations.

Shetland's communities miss clear information on the potential changes for Shetland's energy system and more precisely the impacts of full electrification for the industries, public services and households. Concerns are raised about the



possibility for area-wide emissions in Shetland to become net zero by 2045, suggesting a systemic overhaul of the economy, land use, consumer habits and social engagement. The energy price rates are already high and are concerning the communities, requesting more financial support, subsidising these costs.

The current grid capacity in Shetland only relies on existing grid connections. With more requirements to add more renewable energy generation into Shetland's energy mix, the new interconnector is critically needed.

### **A.14.3 Resource**

Efficient use of Shetland resources is mentioned throughout the literature review. With regard to the procurement of materials and equipment, the frequency of shipments is too low, generating delays and increasing shipping costs, affecting the rate of the energy transition.

The energy transition also severely impacts local businesses and low-income families highly reliant on fossil fuel sources and needing financial support. Fuel grants are temporary and insufficient to meet industries and households' energy needs. These major energy opportunities and challenges of all Shetland communities emphasise the need to develop small-scale energy projects.

With regard to transport resourcing, several needs have been identified including the growth of Shetland's demand in recent years. External ferries face capacity challenges to meet current demand whilst the vessel size of the new fleet is restricted to accommodate the current infrastructure at Aberdeen harbour. Inter-island ferries face vessel replacements, approaches for crew retention competing with other sectors or vehicles, people capacity challenges as well as deadweight crane capacity for small island ferries. The inter-island air network has also been restricted with no services offered for Papa Stour and Skerries due to lack of rescue and firefighting services at Skerries. Bus services are impacted by staff ageing and the subsequent lack of bus drivers with the associated lack of testing facilities.

ZetTrans aims to develop walking and cycling journeys, routes and measures across Shetland to increase active travel options.

With regard to the implementation of energy transition for the workforce, upskilling including energy efficiency skills and setting up support to acknowledge competences among the communities are seen as critical. Knowledge sharing, involvement of the local industries and long-term job opportunities are necessary to retain local wealth. Current training options are often too long. The upskilling of the workforce and creation of net-zero compatible jobs may not offset the job loss from fossil fuel consuming activities (i.e Oil and Gas) or be sufficient to cover the unemployment rate in Shetland.

### **A.14.4 Behavioural change**

The results of the literary review have shown that many residents in Shetland wish to change their behaviours to reduce carbon emissions, however they are restricted by current infrastructure and financial barriers. Main areas of change lie in transportation and energy use where many wish to utilise alternative modes of transport such as public transport, active travel methods and communal car use (car clubs and car shares). For energy use, there is a desire to explore alternative heating solutions and increase energy efficiency within their homes along with exploiting renewable energy developments to increase benefits to communities living near renewable development areas. Micro renewables are also a popular change albeit out of reach financially for many who wish to install them.

Where support may be available to enable changes to be made, access to these support services is unclear and difficult to navigate for most residents; this puts them off pursuing the options. Where the support was accessed, many were excluded due to criteria needing to be met.



Infrastructure is a significant issue in Shetland where transportation is concerned which is hindering the change to more sustainable transport options and a reduced reliance on personal car use. Active travel is moderately considered as an alternative due to the lack of safe walking and cycling infrastructure on the narrow Shetland roads, this makes people feel unsafe walking or cycling. Public transport is limited in routes and in departure/arrival times and does not tie in with critical services such as school and ferry timetables. This, along with routes not being serviced or times being highly limited makes them unsuitable for many residents to use. Distance and remote locations of these transport locations is also reported by the communities. Weather conditions are also reported as a main barrier for active travel in Shetland.

The conclusions are that there is a willingness to change in carbon use behaviours, but the lack of support to organise and act via financial and advisory services is a significant roadblock to making these changes.

#### **A.14.5 Lack of Data for rural communities**

Much of the data gathered was over the years of 2019-2022 which were impacted by the Covid 19 pandemic and therefore had significant data gaps and had to adjust to a 'new normal' following the reduced restrictions and restarting of activities.

For surveys, there was a lack of awareness and understanding from many participants which may have skewed the data retrieved. Many stated that they felt there was not enough information readily available to educate on the importance of net zero and how to facilitate this transition. This was the most common theme through the reports reviewed: the lack of data and information available to individuals.

Many commercial companies do not share data which could be an issue for fully understanding transition pathways and impacts on communities. Where data may be available (local/community sites) this data is unverified and not subject to quality control out with the owners of the website so may not be reliable.

#### **A.14.6 Challenges**

The key challenges to communities and stakeholders around the challenges facing a transition to Net Zero are around transportation, education, technologies, housing conditions and land use. The biggest barriers to addressing these are finance, access to information and support, skilled trades and regulation.

Transportation is going to be a major factor in decarbonisation effort with 9 in 10 people relying on private cars and ferry transport to move around the islands and further afield. The lack of public transport that is useful to the residents is a huge issue and active travel is not a viable option for many.

Housing is not only a net zero transition issue to increase the use of renewable energy and reduce emissions through energy efficiency; it is also a health issue with many living in damp drafty old houses that are not easily retrofitted and are the most expensive to heat. The owners are often elderly and less financially stable which further compounds the issue. This is a serious concern for many residents and stakeholders and a priority action in climate action plans. Increased funding, support and clearer advisory services is needed to initially help the housing problem as many find seeking help difficult and confusing.

The lack of skilled tradespeople to install and maintain renewable technologies is a challenge to rural and island communities and many cannot take advantage of offers on microgeneration due to lack of installers or geographical restrictions on the offer. The lack of education and information is not only restricted to employment and skilled trades, but there is also a lack of general education and awareness around decarbonisation and what that means to the individual as well as how they can access information and guidance on how to contribute to the Net Zero effort.



Food and energy insecurity is another big challenge due to the adverse and increasingly unpredictable weather conditions. Island residents rely on ferry transport to deliver food from mainland Scotland to the shops and those on the outer Shetland islands have to rely on additional ferry services to bring food and goods from the main Shetland island. This is significantly disrupted in adverse weather as it is not safe to sail. This is also a high carbon cost for food. Energy production and disruption is similarly impacted by adverse weather conditions with frequent power cuts and damage to infrastructure.

#### **A.14.7 Solutions**

The potential solutions to the above challenges have been explored by Shetland communities and stakeholders with significant community buy-in. Many would welcome the opportunity to grow their own food to combat food insecurity, high prices and create a sustainable circular economy. Solutions suggested are community allotments and polytunnels so residents can grow and harvest food locally in their immediate communities. This expands into further land use and land maintenance with many wishing to be more involved in restoring vulnerable habitats such as peatland.

For transport decarbonisation, suggestions to reduce reliance on private car ownership focus on better public transport services and increased active travel links. Car sharing and car clubs are popular options, as well as more facilities to store bikes and charge e-bikes at public transport hubs to encourage active travel to wider public services. While the adverse climate will always be a challenge to encourage active travel, many would increase the use of walking, cycling and e-bikes if the infrastructure was improved to increase safety on the narrow roads and provide easier access ways.

Energy use and development using renewable and low carbon alternatives is a key factor in the transition to net zero and is a large industry on the islands, with many commercial, private and community renewable energy developments in operation and under development. Lack of information and funding hinders many from installing private microgeneration and there is a history of misinformation and distrust with commercial developers within communities. Better information and education on renewables would be a great benefit to communities as well as increased skills in trades for installing and maintaining technologies within the communities to increase uptake of technologies. Regulation should be revised to keep pace with the innovation and technological advances to increase the renewable technology options available to the market. Technologies such as anaerobic digestors which are a good way to tackle waste and provide sustainable energy are not dependant on weather conditions and many can be used off grid to avoid the issue of grid capacity for new technology connections. However, regulation and investment into such technologies is hindering the deployment and excluding this option from being developed.

Housing and energy efficiency solutions hinge on significant investment and better information, support and advisory services. Increasing insulation and the installation of micro renewables with education on better energy use is a key aspect of reducing domestic emissions while tackling health and fuel poverty concerns. New build properties are well insulated and large housing developers are installing roof mounted solar as standard in many areas. However, older housing stock is still behind and are often inhabited by the more vulnerable in the community. With better access to support and advice, more residents could access the grants and funding available to make essential upgrades to their homes and install more energy efficient heating solutions. This, along with an increase in skilled installers, would significantly reduce the high energy and emission costs currently faced by Island and rural communities.

### **A.15 LITERATURE REVIEW CHALLENGES**

With all literature reviews, there is a limit on the volume of sources that can be reviewed and reported. While the team have taken every effort to select quality information that is relevant and specific to the Shetland Rural Energy Hubs project, not all topics, opinions, results and views have been recorded. To do a full in-depth review on all literature available on the transition to Net Zero would be a significant stand-alone project so this has been an exercise in reviewing island specific, recent reports based on community participation and local stakeholder insight.



Where selected materials are confidential, the project team have committed to relaying and reviewing the pertinent information while retaining the anonymity and confidentiality of the reports and as such are not referenced. Many of these reports are connected to in progress development projects or internal reviews.

Assessment and summary conclusions derived from the reports and publications requires a degree of personal insight and understanding of the topics, with multiple reviewers providing input into the literary review process. This may result in some inconsistencies in highlighted aspects selected from the reports and writing styles. While this does not detract from the quality or factual accuracy of the literary review, there may be some contextual variation.

## **A.16 LITERATURE REVIEW GAPS**

Topics not covered in this report are Regulation and Planning policy. This is a key aspect of the transition to net zero as many of the challenges and solutions involve a revision of the regulatory and planning systems. Funding is another significant aspect which has been raised throughout this report from individual residents to large developers. Further investigation into the funding context would benefit this project at a different stage or as a standalone project as it is critical in a successful transition to net zero.

Many of the reports selected were community driven, and while this is important, a more well-rounded review may have been possible if more information from other external sources such as individuals, developers and suppliers (trades, grid infrastructure, DNO and advisory services) had been included.

## **A.17 OVERALL CONCLUSIONS**

The results of this literature review show that Shetland communities are enthusiastic to be involved in the Shetland Islands transition to net zero and see many benefits to them as individuals and as a wider community with many solutions being carbon neutral, financially sustainable and personally beneficial on many levels. There is a solid link between a net zero way of living and increased health benefits such as reducing fuel poverty, improving housing stock and increasing active travel and social interactions through car shares and access to communal resources. Creating a circular economy is important to the community to tackle food and energy insecurity with more ownership on food production locally and microgeneration with skilled trades and workers to facilitate these actions. Along with this, there is a distinct need for clarity and easier access to information and advisory services in all matters relating to decarbonisation, energy efficiency and energy production.

Public transportation is a service lacking in many rural and island areas and is a significant concern to many residents. In order to address transportation decarbonisation, more investment and flexibility is needed in all areas of transportation with a financial challenge to overcome as well as weather conditions and service stability for land and sea-based transport.

The community's involvement in the energy transition is essential and clearly defined priorities, principles and sector-by-sector consultations are needed to help progress with the decarbonisation of the sectors.

Upskilling the workforce and evaluating long-term employment and training options are critical in the delivery of the energy transition as well as enabling on-time delivery of materials and equipment, faced with scarce shipments currently. Ensuring local wealth from the transition is retained is critical.

Grid capacity challenges are also affecting the development of new renewable energy projects in Shetland. Streamlining regulatory processes for new grid connection is highly advised.



## APPENDIX B RADMAPP ANALYSIS OF POTENTIAL HUB LOCATIONS

### B.1 INTRODUCTION

The Shetland Rural Energy Hubs were envisaged to be locations for electric vehicle charging, centres for technology and information, self-sustaining in terms of energy production, and be easily accessible for the general public, be that by private vehicle or public transport. Aquatera's in-house **Resource Analysis and Digital Mapping Application** (RADMApp) was adopted to identify the suitability of areas around Shetland for the potential development of such community hubs. This section provides an overview of the different methods and data used in this research as well as providing a summary of the results.

### B.2 METHODOLOGY

Aquatera worked in collaboration with Shetland Islands Council (SIC) to identify criteria necessary for the site selection process. The initial approach consisted of a series of workshops to agree on the requirements of the hubs, the desired data that would allow spatial mapping of these requirements, and whether the data would be available from either one of the project partners, or from a third party.

Discussions in the workshop determined that the requirements of the hub were as follows:

- Essential
  - Proximity to a population centre
  - On an existing bus route
  - Suitable surrounding land for renewable energy installations
  - Proximity to 3-phase grid supply
- Desired
  - Existing SIC asset for use as a hub
  - Suitable land for hydrogen storage
  - Use as a recycling centre

As well as the above factors, additional constraints were also considered in terms of planning suitability. These considered negative impacts on nearby residents, ecological impacts on habitat types and designated sites. Avoidance of impact on scheduled monuments.

Once all the required data sets were identified, data was sourced directly from SIC, where data was already available, Ordnance Survey, and various other third parties. The data was then processed for use within the RADMApp model.

#### B.2.1 RADMApp Model

The RADMApp model is a raster-based model that utilises spatial data to support spatial planning questions. The raster-based model for this project consisted of a uniform grid of 10 m by 10 m cells (100 m<sup>2</sup>) that covered the entirety of the Shetland islands, utilising the British Grid system (OSGB1936). Each dataset identified for use in the model was processed, where necessary, into a raster format of 10 m x 10 m in the British Grid co-ordinate system. At this stage, each cell of each dataset was scored in terms of suitability using a scoring system agreed upon during a second workshop with the project partners. Additional weights were also assigned to each of the datasets during this workshop, to determine if some criteria were more important than others. This was done using a weighted linear combination



incorporating pairwise comparison. The combination of all the scored layers provided an overall suitability score for each individual grid cell in the raster. The results allow for comparison of each 10 m x 10 m grid cell within the model to determine areas of potential suitability.

### B.2.2 Scoresheets

Scoresheets were developed to provide the RADMApp model with a set of instructions of how to deal with each of the criteria. The data values in each layer were converted to a common range lying somewhere between 0 and 1 depending on the level of suitability. The RADMApp model uses a multiplicative combination approach, meaning that areas which are considered a development constraint are assigned a score of 0 and are removed from the analysis. Conversely, scores of 1 are applied where there will be no alteration to the overall suitability score. Soft constraints, also described as factors, are then applied to datasets which are neither completely suitable or completely unsuitable. These assigned scores range between 0 and 1, with scores becoming more suitable as they approach 1 and less suitable as they approach 0. In some cases, these may be based on pre-defined technical requirements of developers, whilst in other cases the scoring can be more subjective and based on previous experience.

### B.2.3 Pairwise Comparison

The RADMApp model also incorporated additional analysis through a weighted linear combination based on a pairwise comparison developed by Saaty (1997). This decision-making process is known as the Analytical Hierarchy Process (AHP) and is used to calculate the relative importance weight of each criterion in the suitability analysis. Ratings were provided on a 9-point continuous scale. For example, if it were felt that proximity to a bus route was very strongly more important than proximity to a ferry port, you would enter a 7 on this scale. If the inverse were true (bus route strongly less important than ferry port), you would enter 1/7. When developing the weights, every possible pairing was compared, and the weightings entered into a pairwise comparison matrix. Below is an example of what each of the scores represents on the scale.

**Appendix table B.1** Pairwise comparison scale

1/9	1/7	1/5	1/3	1	3	5	7	9
extremely	very strongly	strongly	moderately	equally	moderately	strongly	very strongly	extremely
Less Important					More Important			

As mentioned earlier, a series of workshops were held with the project partners. It was during these workshops that the suitability scoring and weighting of each factor was discussed and agreed upon.

## B.3 ANALYSIS

This section summarises the key data, criteria and scores for the suitability analysis. Several data sources were identified and sourced based on criteria agreed with the project partners.

**Appendix table B.2** Data sets used in the RADMApp model

Dataset	Source
Proximity to bus routes	Shetland Islands Council
Proximity to A-roads	Derived from Ordnance Survey data
Proximity to B-roads	Derived from Ordnance Survey data
Proximity to minor roads	Derived from Ordnance Survey data
Proximity to existing grid infrastructure	Scottish Power
Proximity to offsite hydrogen production	N/A



Dataset	Source
Proximity to ferry terminals	Derived from Shetland Islands Council data
Proximity to airport	N/A
Proximity to population	Derived from Ordnance Survey Data
Land gradient	Derived from Aerial Photography for Great Britain data
Proximity amenity (Bring) site	Derived from Shetland Islands Council data
Proximity to residences	Derived from Ordnance Survey Data
Topography	Ordnance Survey Data
Wind Capacity Factor	Global Wind Atlas
Proximity to Community Halls	Derived from Shetland Islands Council data
Proximity to Council Assets	Derived from Shetland Islands Council data
Proximity to Listed Buildings	Derived from Historic Environment Scotland data
National Nature Reserves	Nature Scot
Ramsar Site	Joint Nature Conservation Committee
Special Areas of Conservation	Joint Nature Conservation Committee
Proximity to Scheduled Monuments	Derived from Historic Environment Scotland data
Proximity to locations with 3-Phase supply	Derived from Shetland Islands Council data

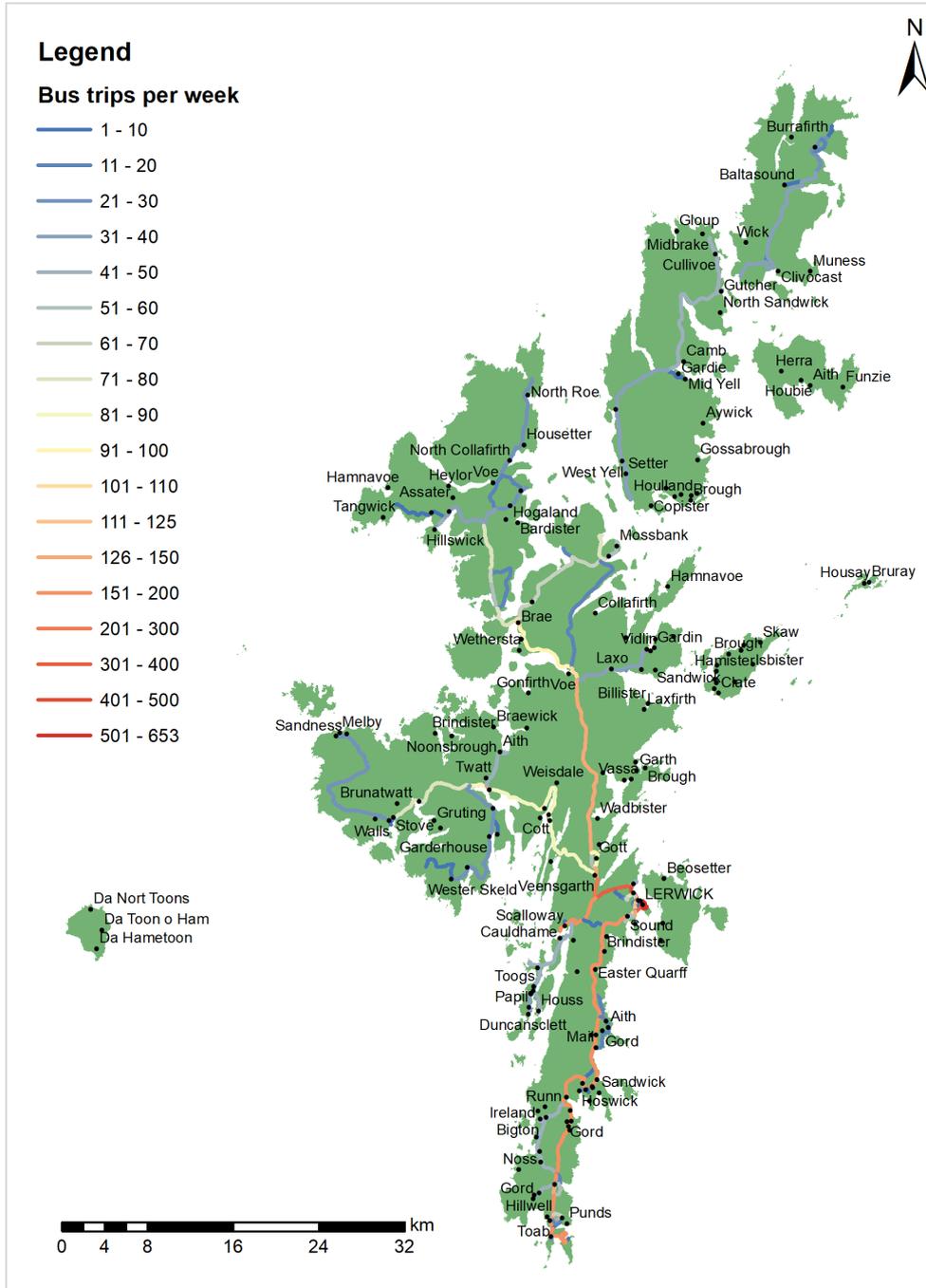
### B.3.1 Factors

The following section expands on the data sets considered as factors in the above table and their use in the model. Factors are considered as layers that determine the overall level of suitability of the final model, but do not constrain the areas in any way. A factor with a very low suitability level will drive the overall suitability for an area down, but will not remove it as a possible area for development.

#### Bus routes

One of the key aspects of the siting of a hub was that it be accessible via public transport. To determine this, each individual bus route was digitised and assigned a value relating to the number of trips that the bus took in one week. Each bus route was then added together to give an overall value of number of bus trips passing through each 100 m<sup>2</sup> cell per week.





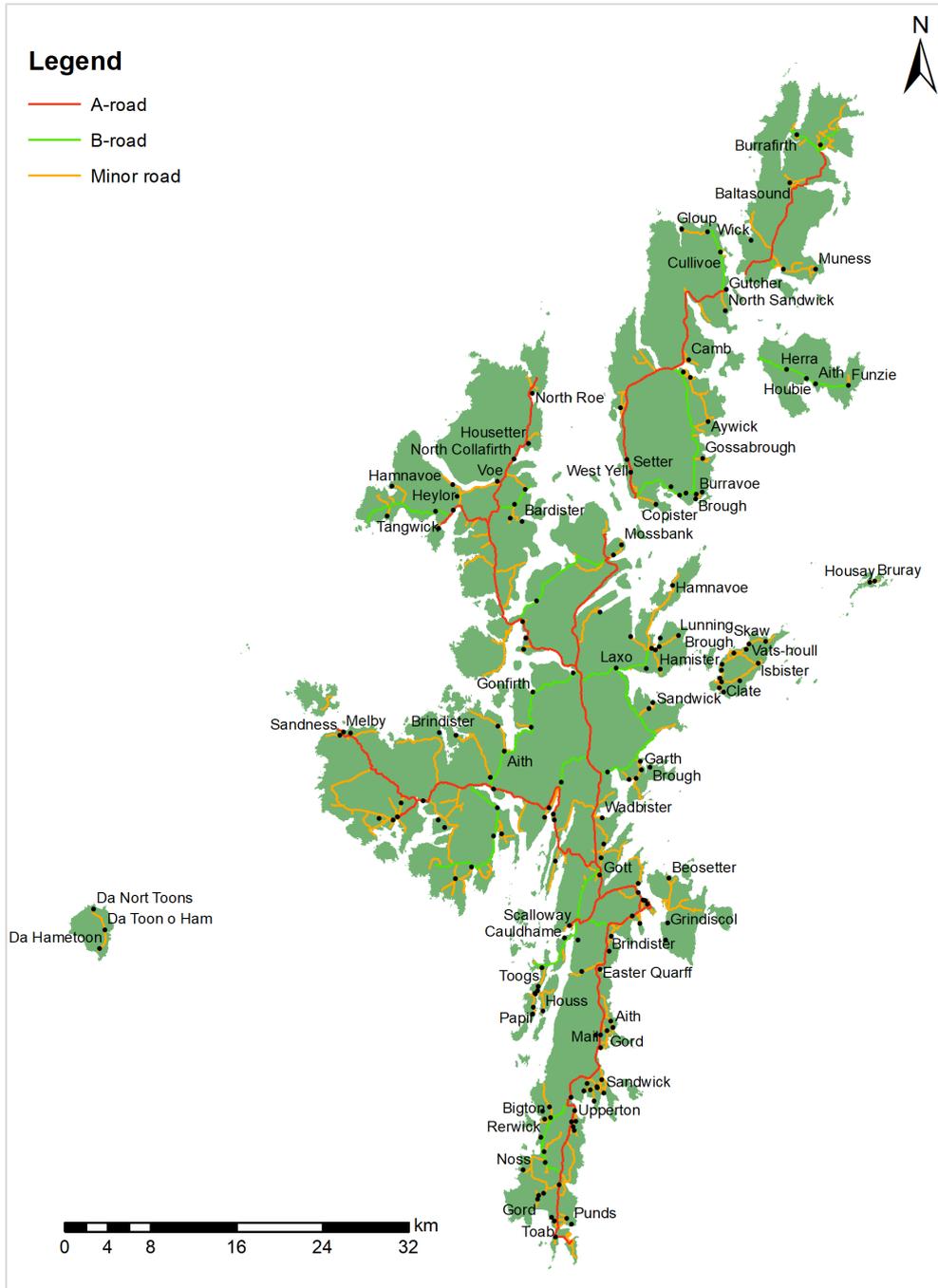
**Appendix figure B.1 Weekly frequency of scheduled bus trips around Shetland**

Based on the 100 m<sup>2</sup> resolution of the model, the bus routes would only take up a 10 m wide cell in the model. In reality a suitable hub location would not be expected to be located within 10 m of the road. For each grouped section of bus routes (as shown in the legend in Appendix figure B.1 **Figure 3.3**), a distance calculation was run out to 1 km.



**Proximity to roads**

As well as accessibility from public transport, the hubs need to be accessed by private vehicles. A distance calculation was run separately from A-roads, B-roads, and minor roads out to 1 km.

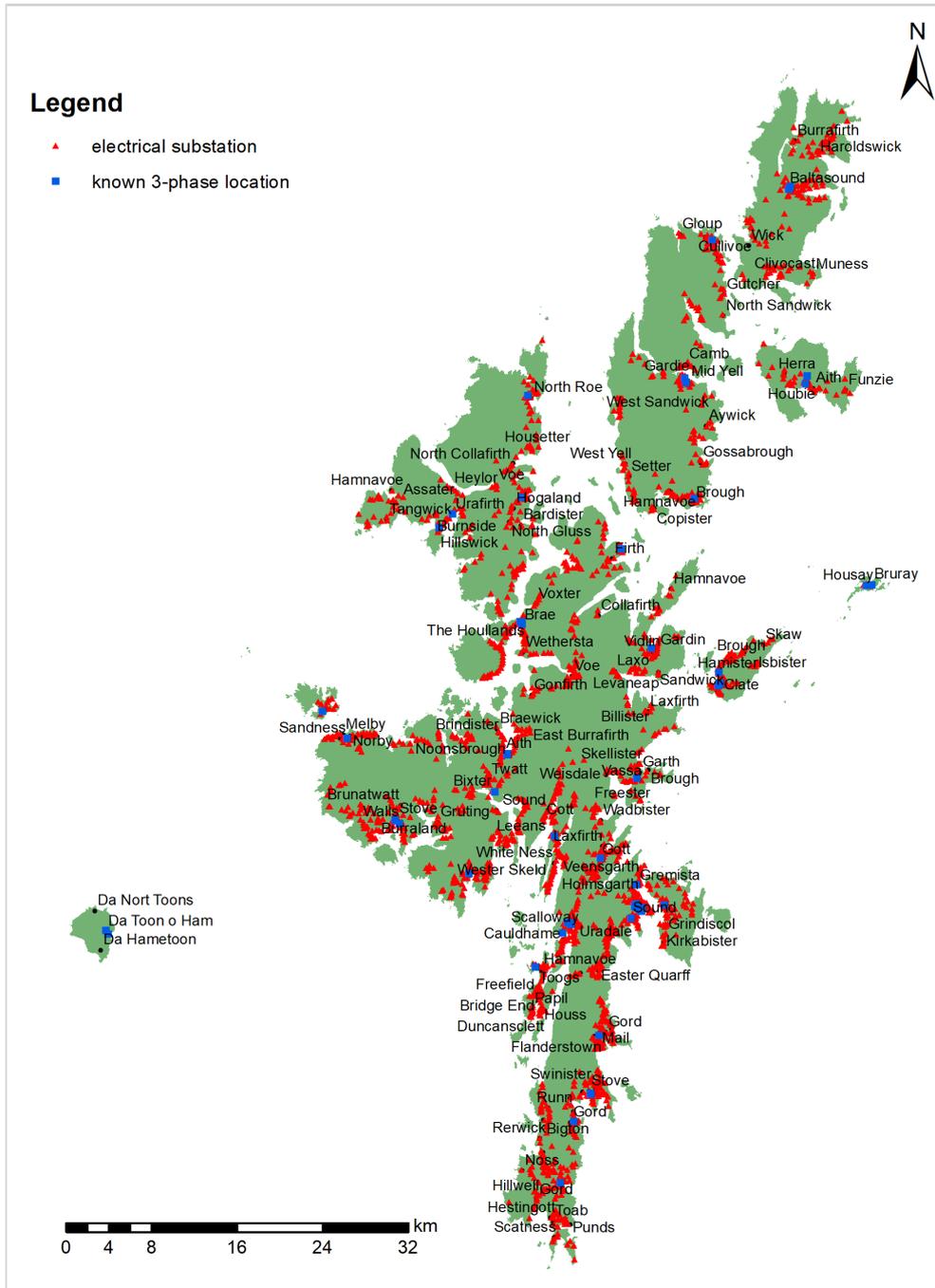


**Appendix figure B.2 Shetland road network**



**Grid infrastructure**

The hubs will be required to have a source of electricity for vehicle charging. As noted earlier in the Deliverable 1 Grid Requirements study and EV charging section, a 3-phase supply will be required for the purposes of most fast chargers, and all rapid chargers. For the purpose of this investigation, only 3-phase supplies are considered. Fast chargers on a 3-phase supply will be much more effective to the community due to quicker charging times and reduced impact of charging multiple cars at the same time. The model looked at a combination of grid infrastructure and locations of known 3-phase supply, such as care homes, and leisure centres. As detailed data 3-phase supply was unknown, proximity to existing grid and 3-phase supplies was used as a proxy.

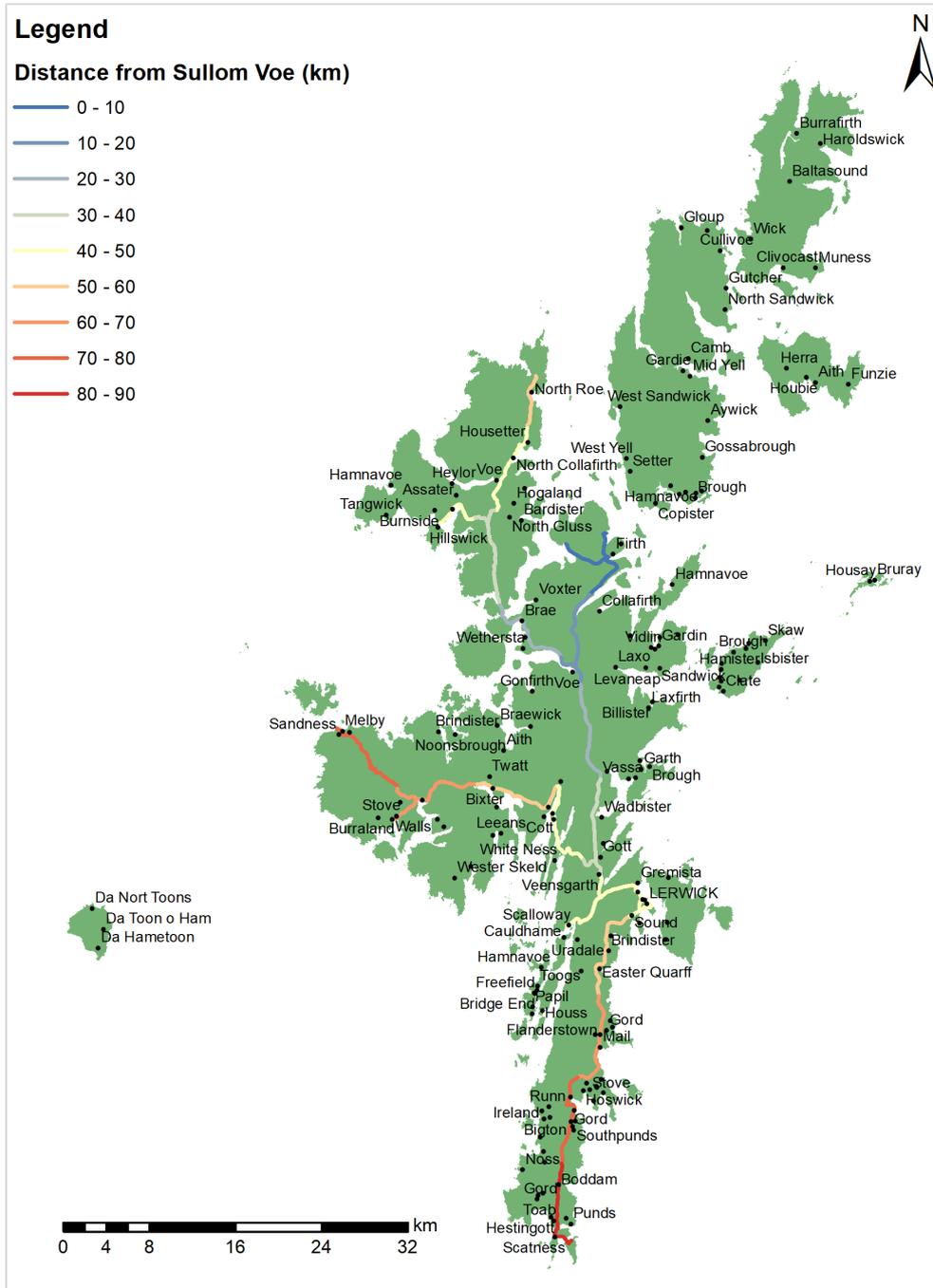


**Appendix figure B.3 Electrical grid infrastructure**



### Hydrogen production

Some of the hubs may include hydrogen storage and hydrogen refuelling stations. As such, travel distance from a potential hydrogen depot at Sullom Voe, via A-roads was calculated and fed into the model.

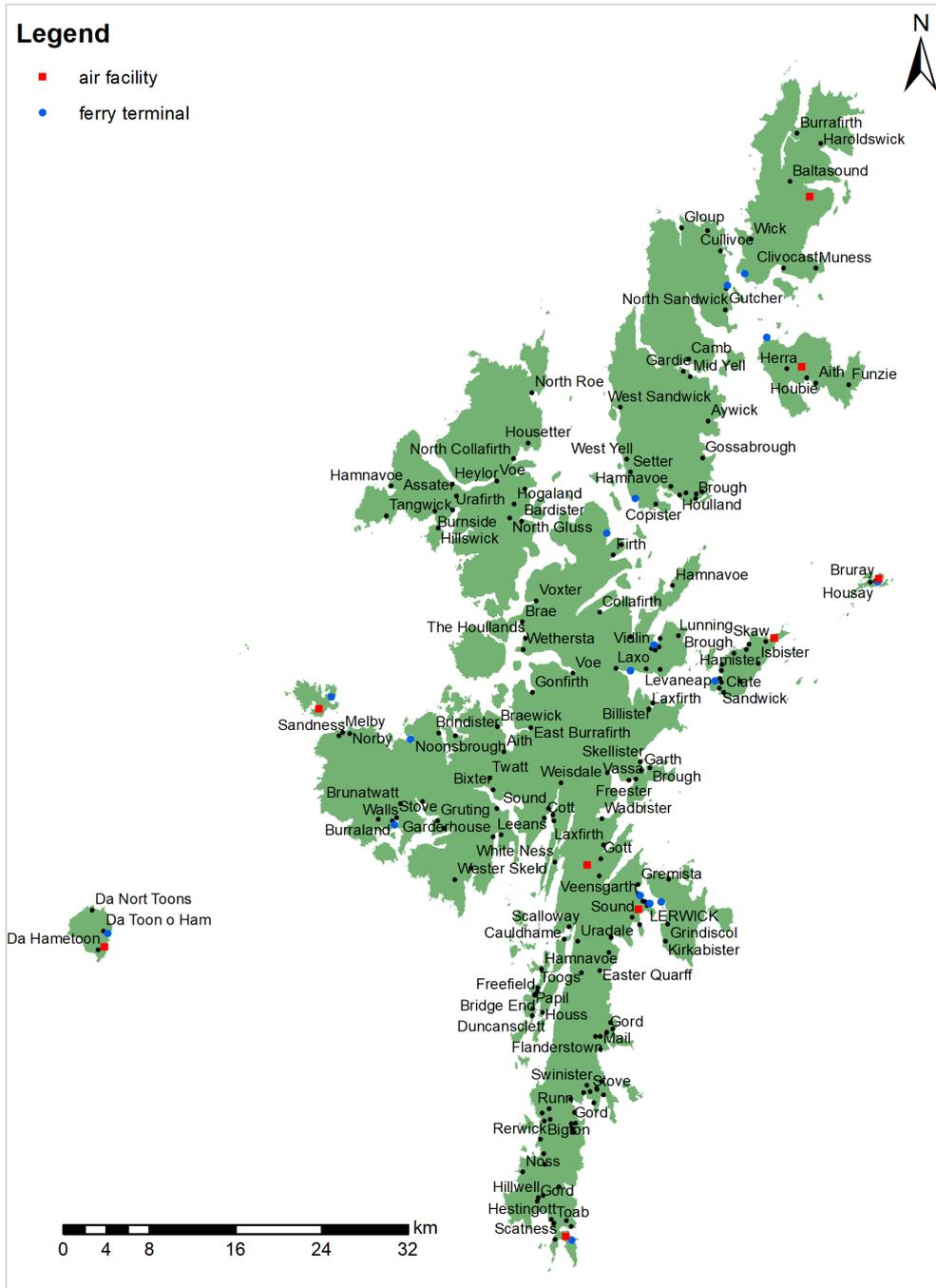


Appendix figure B.4 Distance from Sullom Voe via A-roads



### Ferries and airports

One of the options for the hubs was as a car club location, where locals on the islands could make use of a vehicle when travelling to the mainland, or tourists could look to hire a vehicle when arriving in Shetland either by sea or air. In this case, areas close to ferry terminals and airports would be looked on favourably. Highlands and Islands Airport Ltd (HIAL) who operate Sumburgh Airport, are actively looking at decarbonising both ground and air operations. Locating a hub near the airport could align with HIAL’s future plans and save infrastructure costs, and a discussion with them in Phase 2 could initiate co-operation. Sumburgh Airport is also located near Grutness ferry terminal, where the Fair Isle ferry docks when it comes to mainland Shetland. There is an ongoing project to replace the Fair Isle ferry, and this could include alternative propulsion measures such as electric or clean fuel. This provides another opportunity to co-ordinate decarbonisation measures across a range of travel sectors.



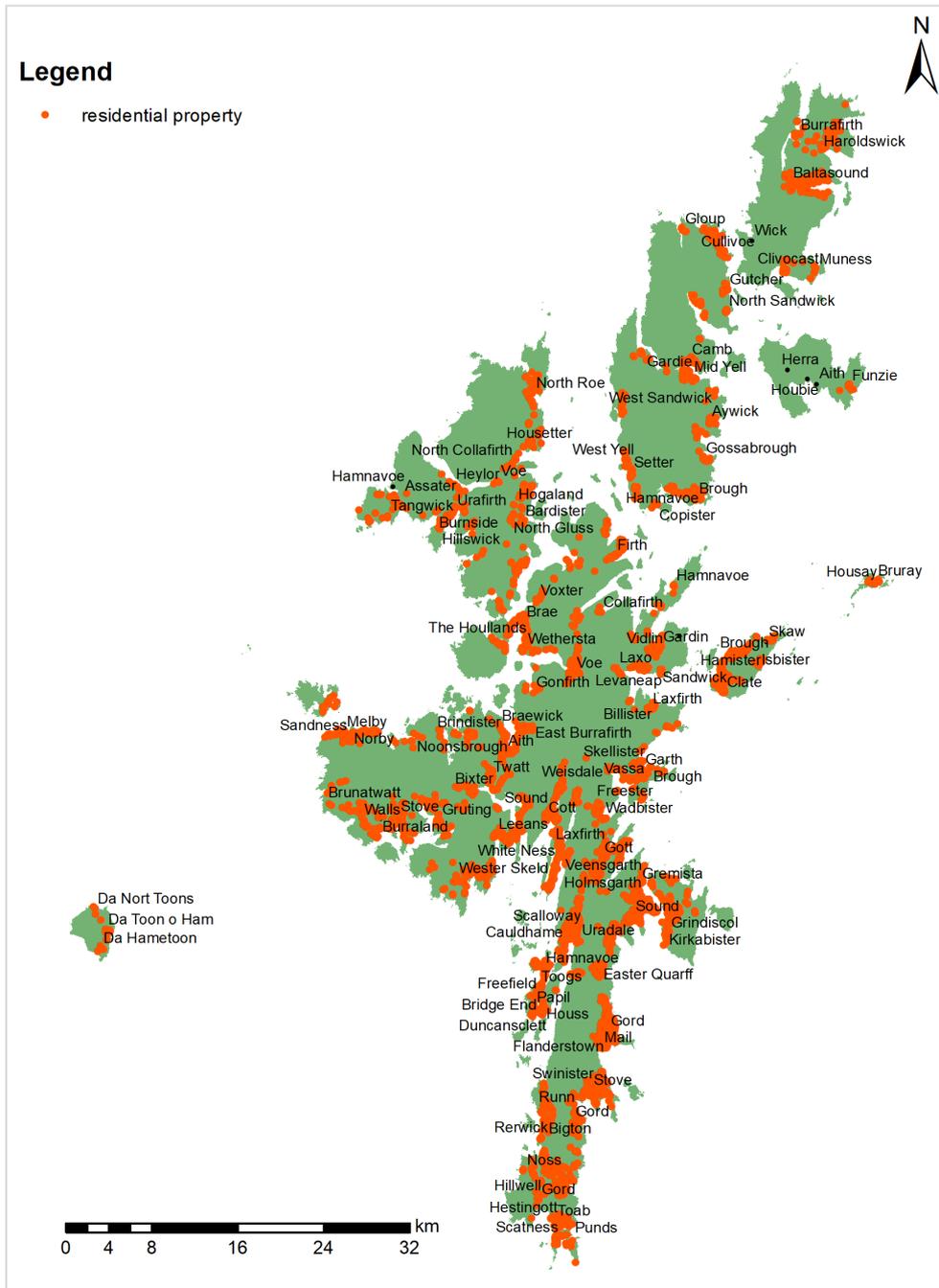
Appendix figure B.5 Airports and ferry terminals



**Populations and residences**

The hub is designed to be a community asset and therefore it is key that the hubs location is within an accessible distance of local populations. There are residential communities spread throughout Shetland of varying population sizes. For the purposes of the model, being close to a large community will be seen as beneficial to being remote or only of use to a small community or scattered dwellings. To determine the community size, the number of contiguous dwellings was calculated for each community and distances from each calculated.

At the same time, there will be elements of the hub that could cause a disturbance for near neighbours. In this case, the proximity to individual properties was accounted for to minimise the potential for a development to take place adjacent to a private property.

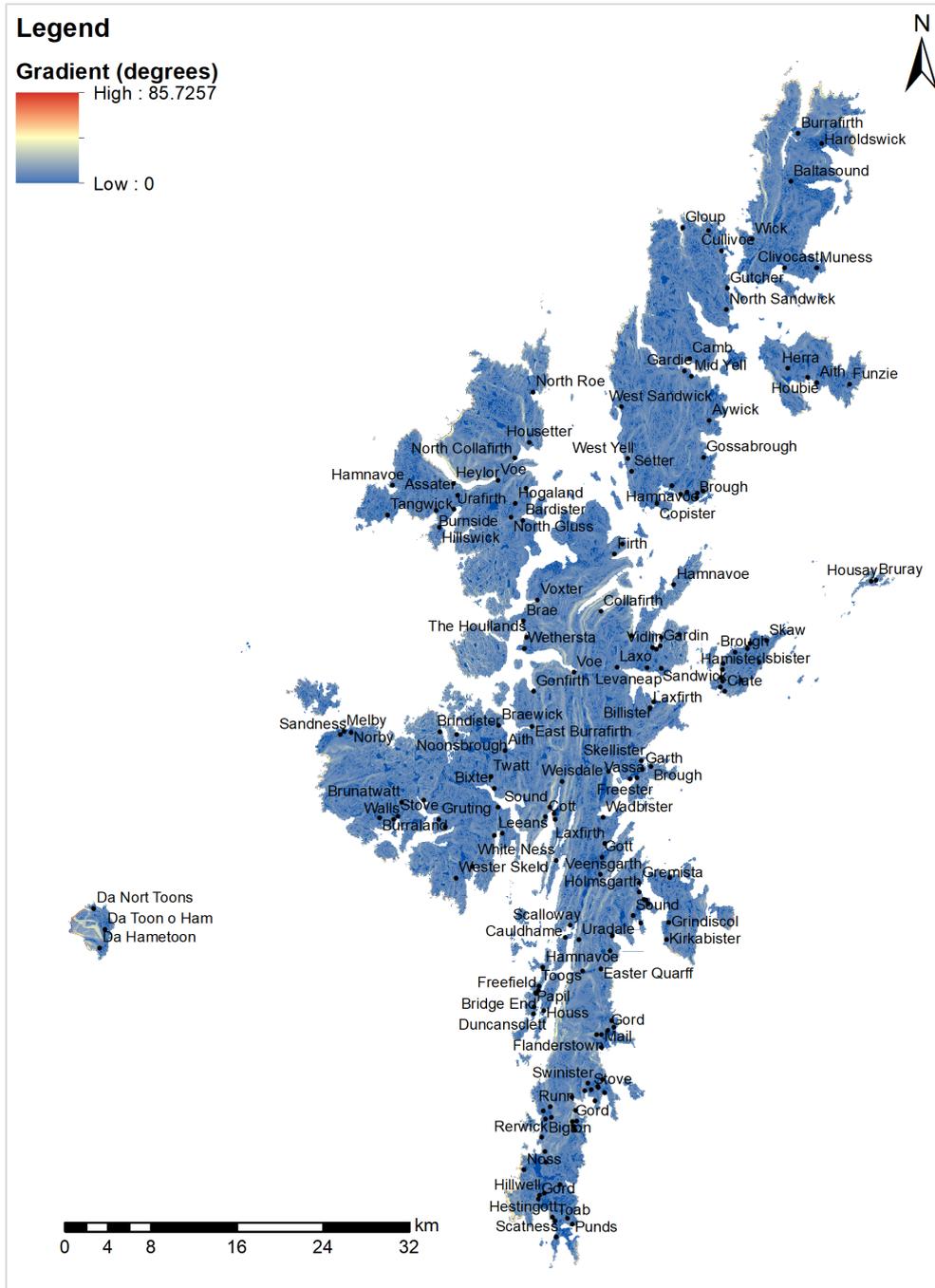


**Appendix figure B.6 Residential property locations**



### Land gradient

The purpose of this data layer is simply to drive new developments towards level ground, avoiding steeper slopes. The land gradient was calculated from a 5 m resolution digital terrain model.



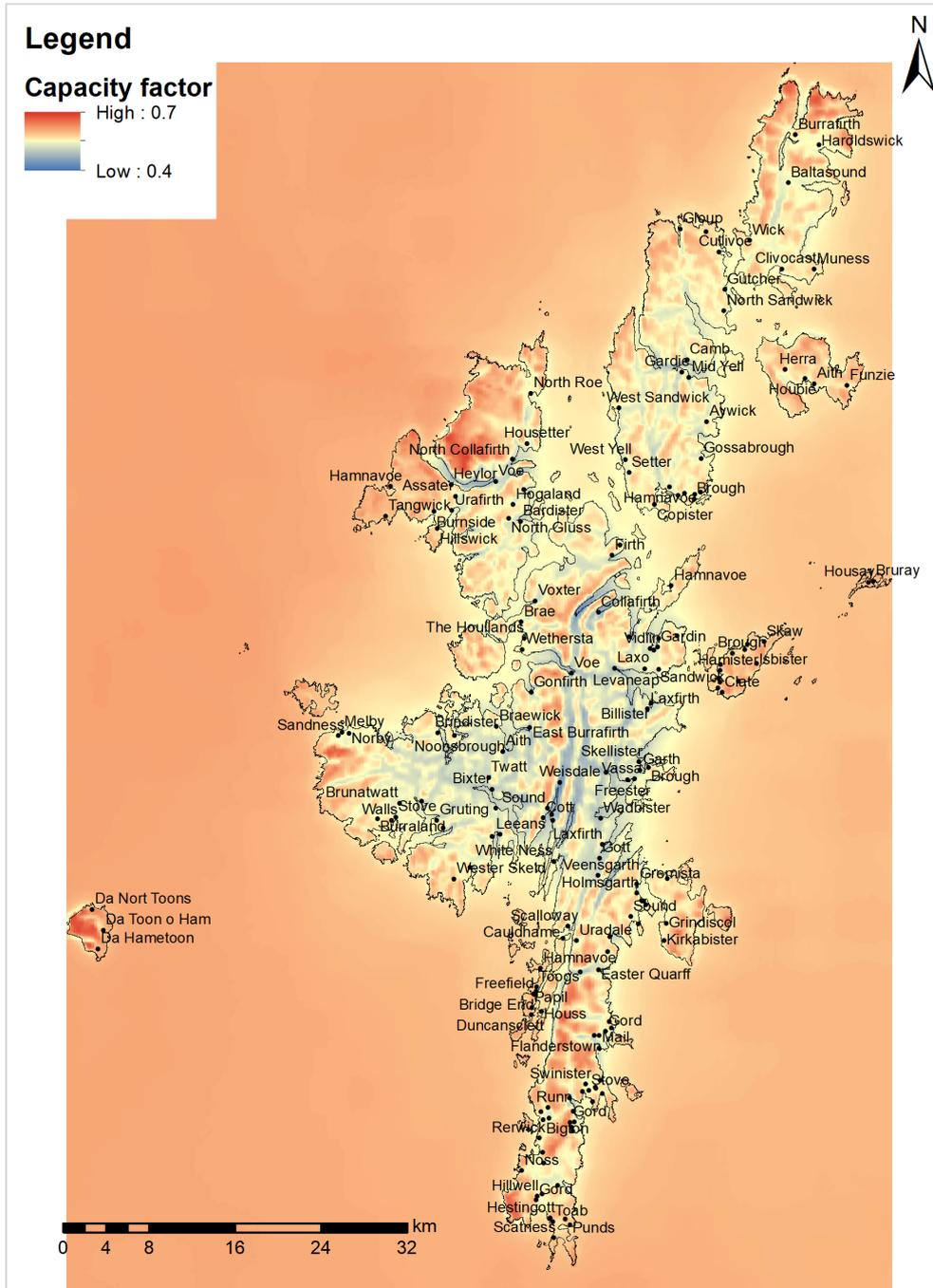
Appendix figure B.7 Gradient





### Wind capacity

There is a requirement for the hub site to be able to generate its own electricity, be that from solar panels, wind turbines, or a combination of both. Solar resource will vary minimally throughout Shetland, and therefore wasn't considered in the site selection process. Wind resource can, however, vary throughout the islands, with open expanses and hilltops experiencing the better resource and valleys and voes being more sheltered from development. Capacity factor data were used to determine areas of best resource throughout the islands.

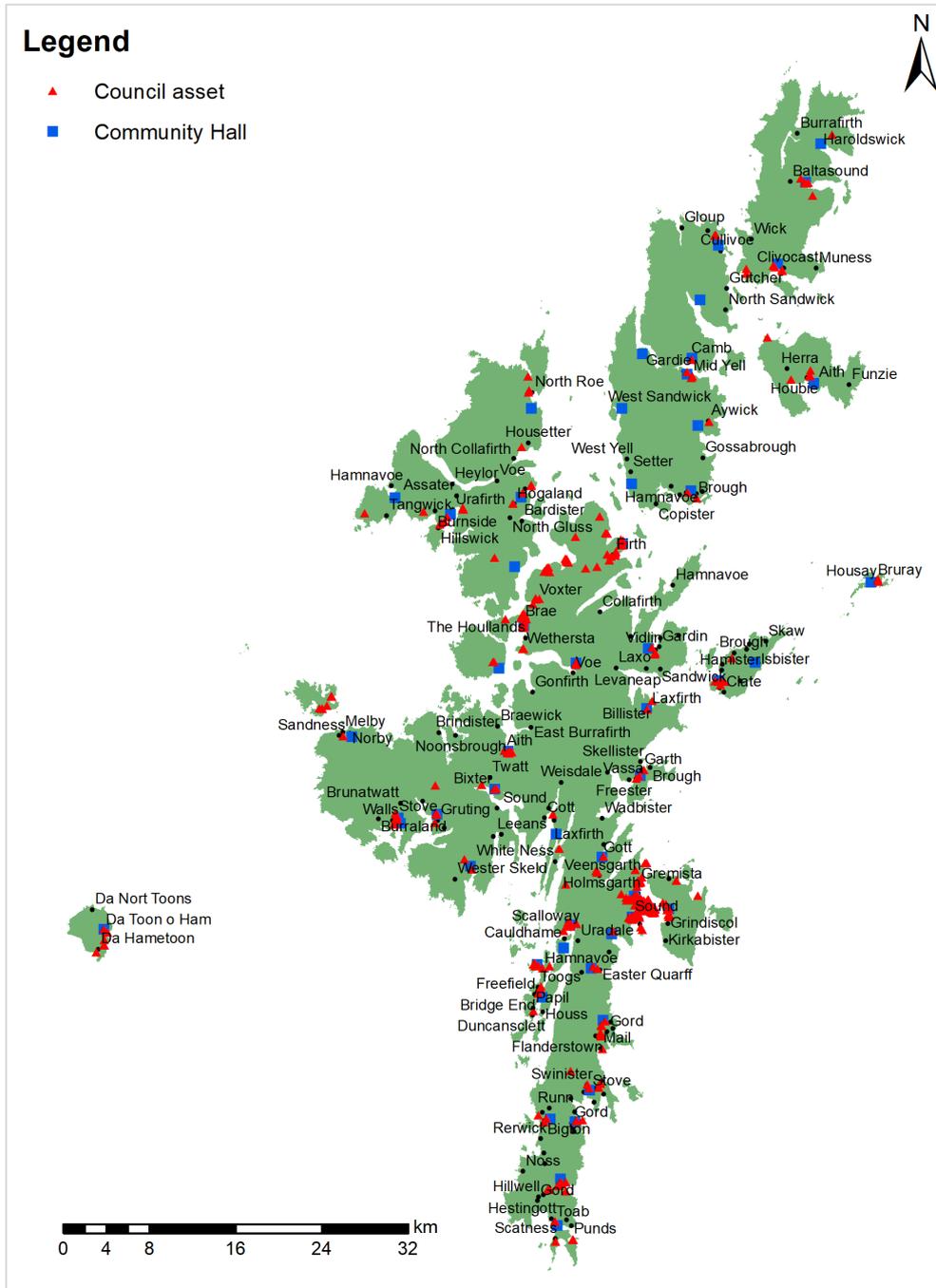


Appendix figure B.9 Wind turbine capacity factor



### Community Halls and Council Assets

A potential hub does not necessarily need to require the building of a purpose built structure. Community engagement work in Deliverable 3 found that Shetland has a high number of community owned buildings that are underutilised, and it could be beneficial to the hubs project and to community groups to use existing facilities where possible. It was determined that community halls and council owned properties would offer an option for potential conversion of an existing asset. Locations were provided by SIC.



Appendix figure B.10 Community Halls and Council Assets



### B.3.2 Constraints

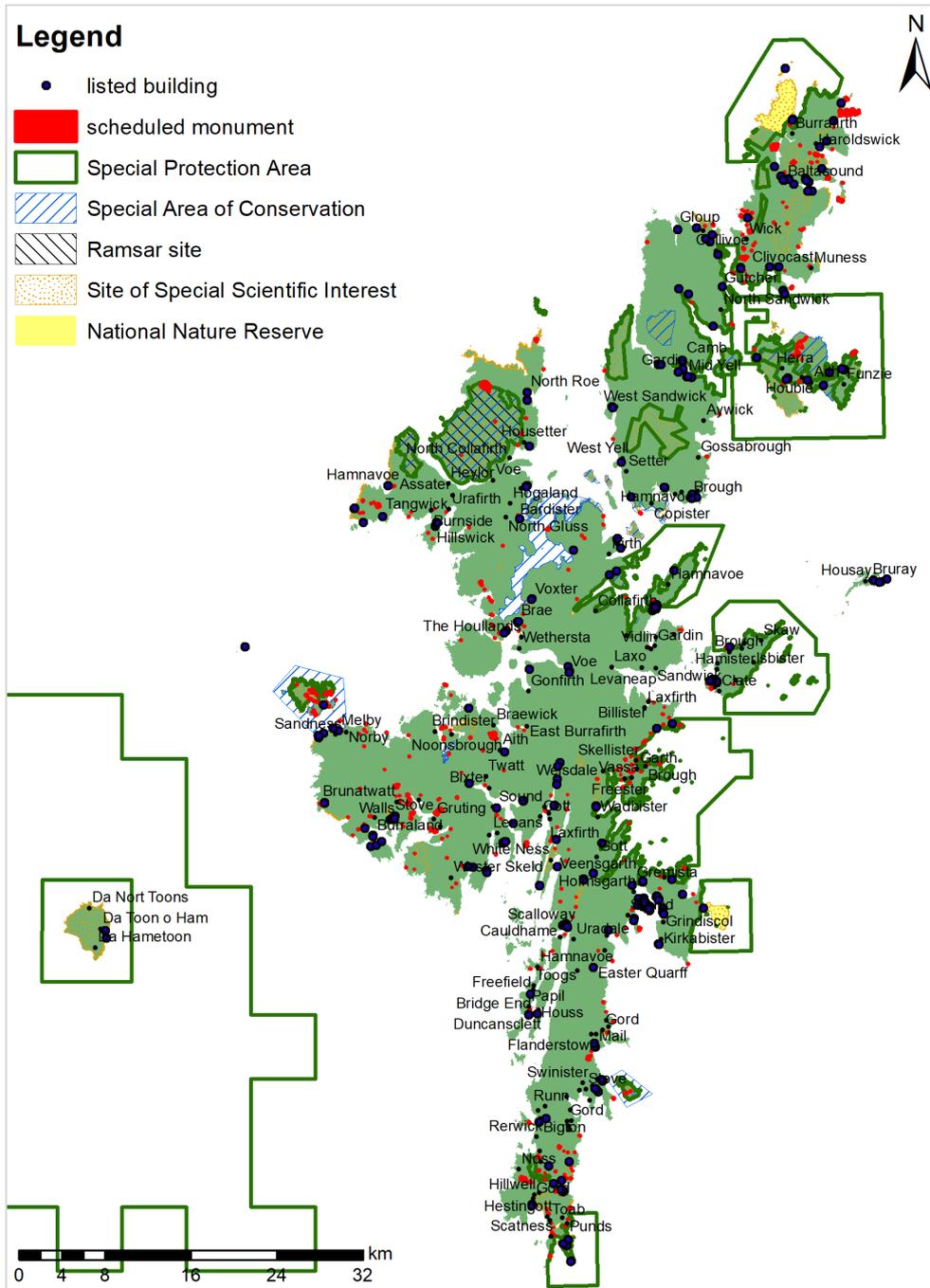
As well as the factors described above, it was decided that there were a number of constraining factors that restricted the potential development areas. Some of the factors can also be considered as constraints at certain levels. For example, the suitability for a development increases the further you move away from an individual property. However, at the closest points to a property, a score of 0 is assigned to prevent developments being built too close. The list of factors that have also been counted as constraints at their most impacting, are as follows:

- Proximity to residences – areas immediately adjacent prohibited
- Topography – land use types of heather moorland and blanket bog prohibited from development
- Distance from roads – areas greater than 1 km from a road are prohibited from development

As well as these factors/constraints, there are also a number of data sets that are used as constraints only. These can be thought of as binary, i.e., they are either suitable or not suitable. These are as follows:

- Listed buildings
- National Nature Reserves
- Ramsar sites
- Special Areas of Conservation
- Special Protection Areas
- Sites of Special Scientific Interest
- Scheduled Monuments





Appendix figure B.11 Constraints

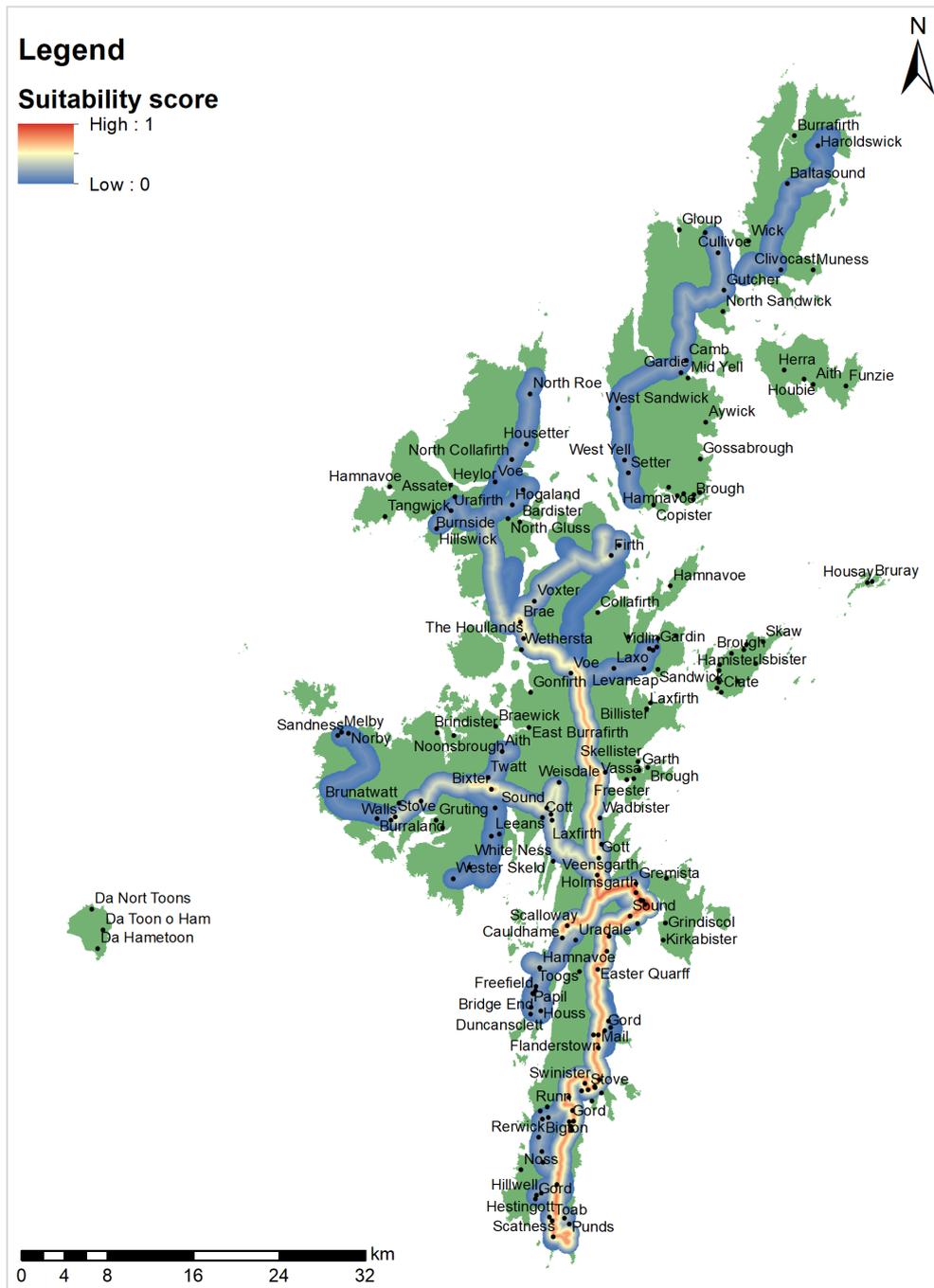
### B.3.3 Scoring

A full breakdown of the suitability scoresheet (developed in agreement with the project partners) has been provided in the appendices. This section describes these scores and explains why each of the scores have been selected for each of the model parameters.



**Proximity to bus routes**

It was determined that the hub would need to be sited within 1 km of a scheduled bus route, as it would be preferred that the hubs ideally are at bus stops or very close to them, in order to encourage use of public transport. Cells that are closest to the road were scored as most suitable, with suitability scores decreasing with linear distance from the road. The total number of weekly journeys also played a role, with the most travelled routes receiving the highest suitability scores.



**Appendix figure B.12 Suitability based on bus routes and frequency**



**Proximity to roads**

Similarly to bus routes, the hub was scored to favour areas within 1 km of a road. A-roads were scored more favourably than B-roads, which in turn were scored more than minor roads.

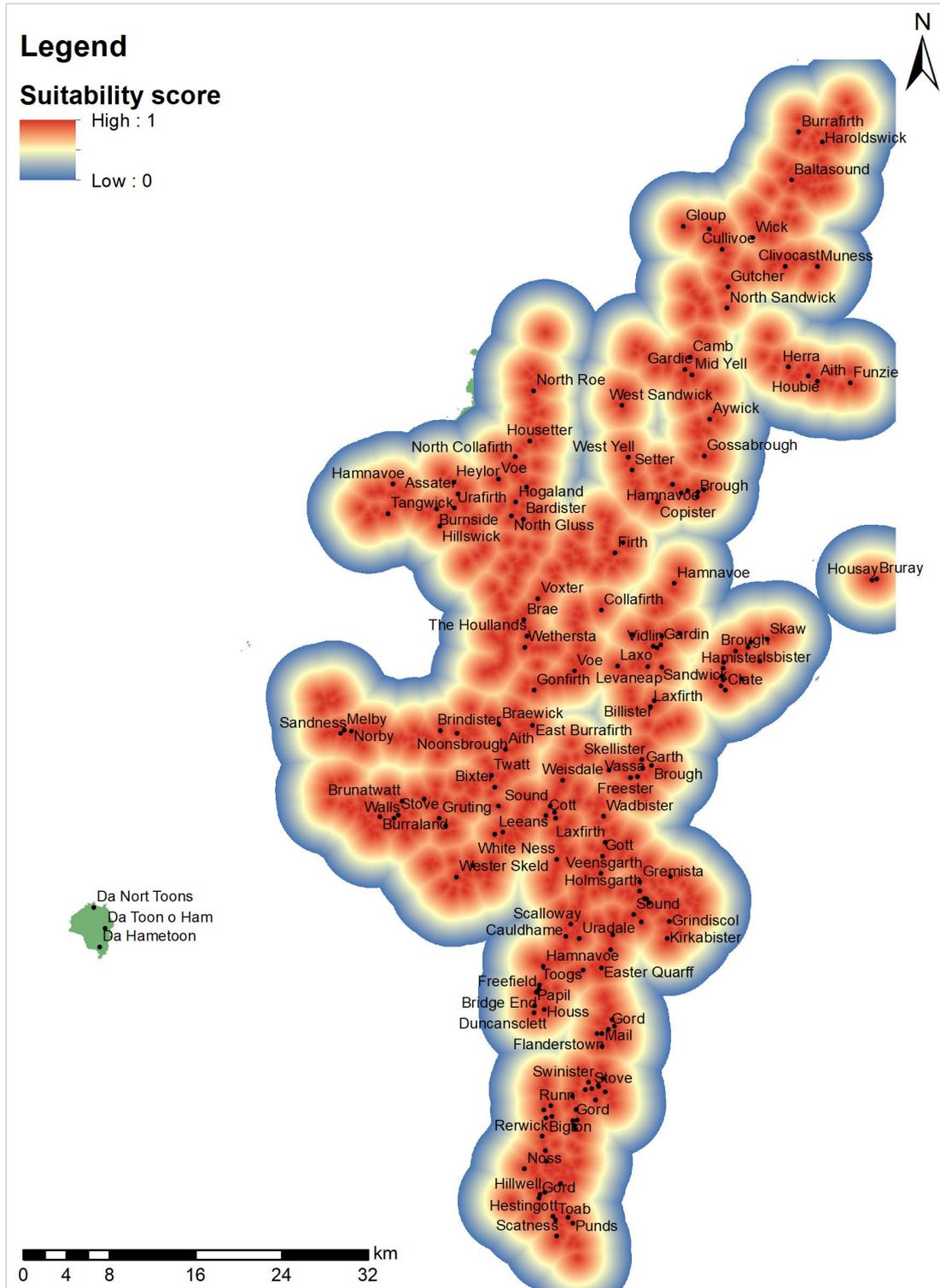


**Appendix figure B.13 Suitability based on road network**



**Proximity to grid infrastructure**

This layer was simply rescored, with the most suitable areas directly adjacent to the existing grid network, and suitability decreasing with distance from the grid.

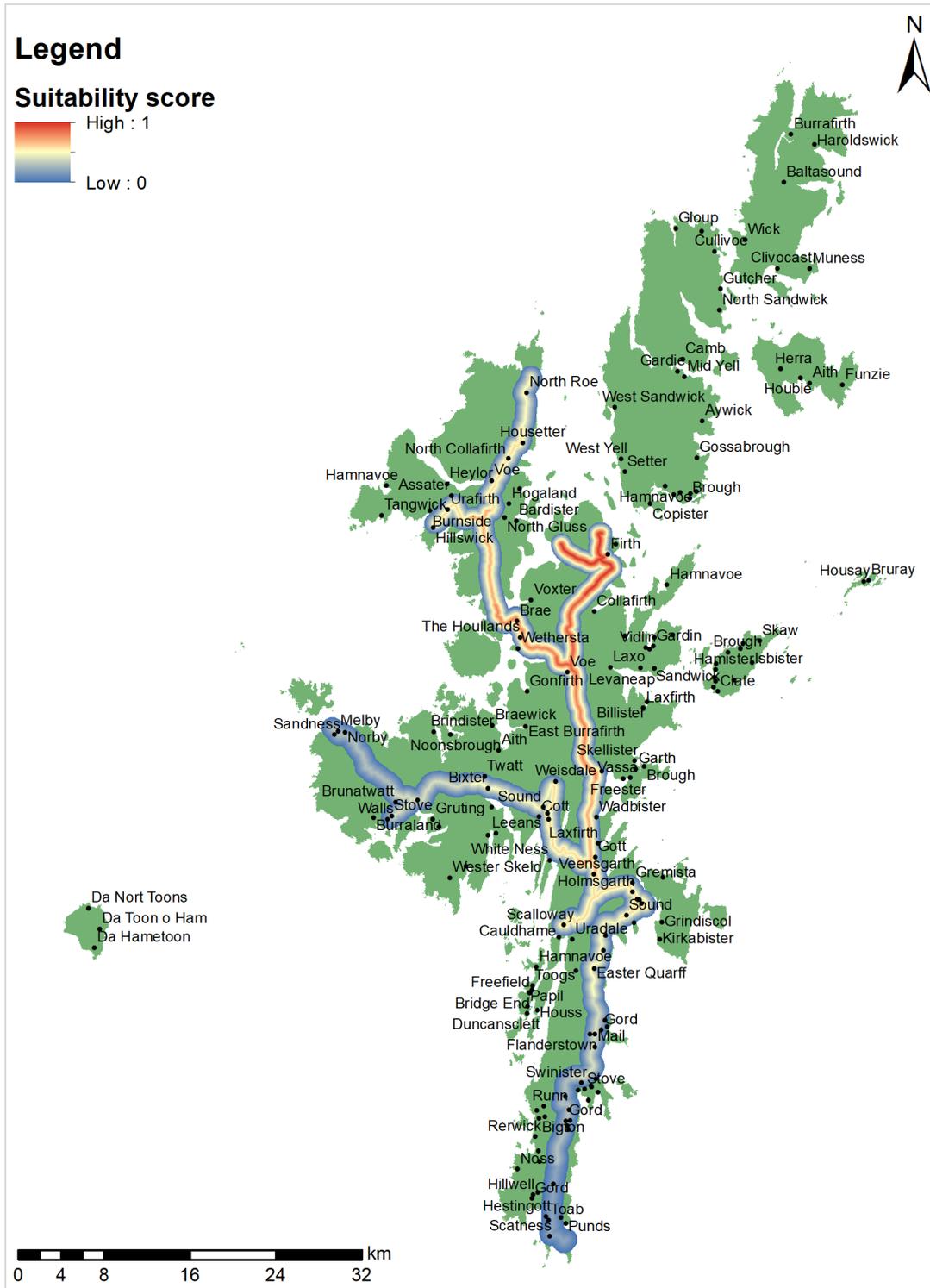


**Appendix figure B.14 Suitability based on substation proximity**



**Proximity to offsite hydrogen production**

With Sullom Voe projected to be a centre for hydrogen production in the future, suitability levels were calculated based on proximity to Sullom Voe. Infrastructure such as pipelines for moving hydrogen on were discounted, so distance along roads was considered. Due to the size and weight of vehicles required to transport hydrogen, only A-roads were considered.

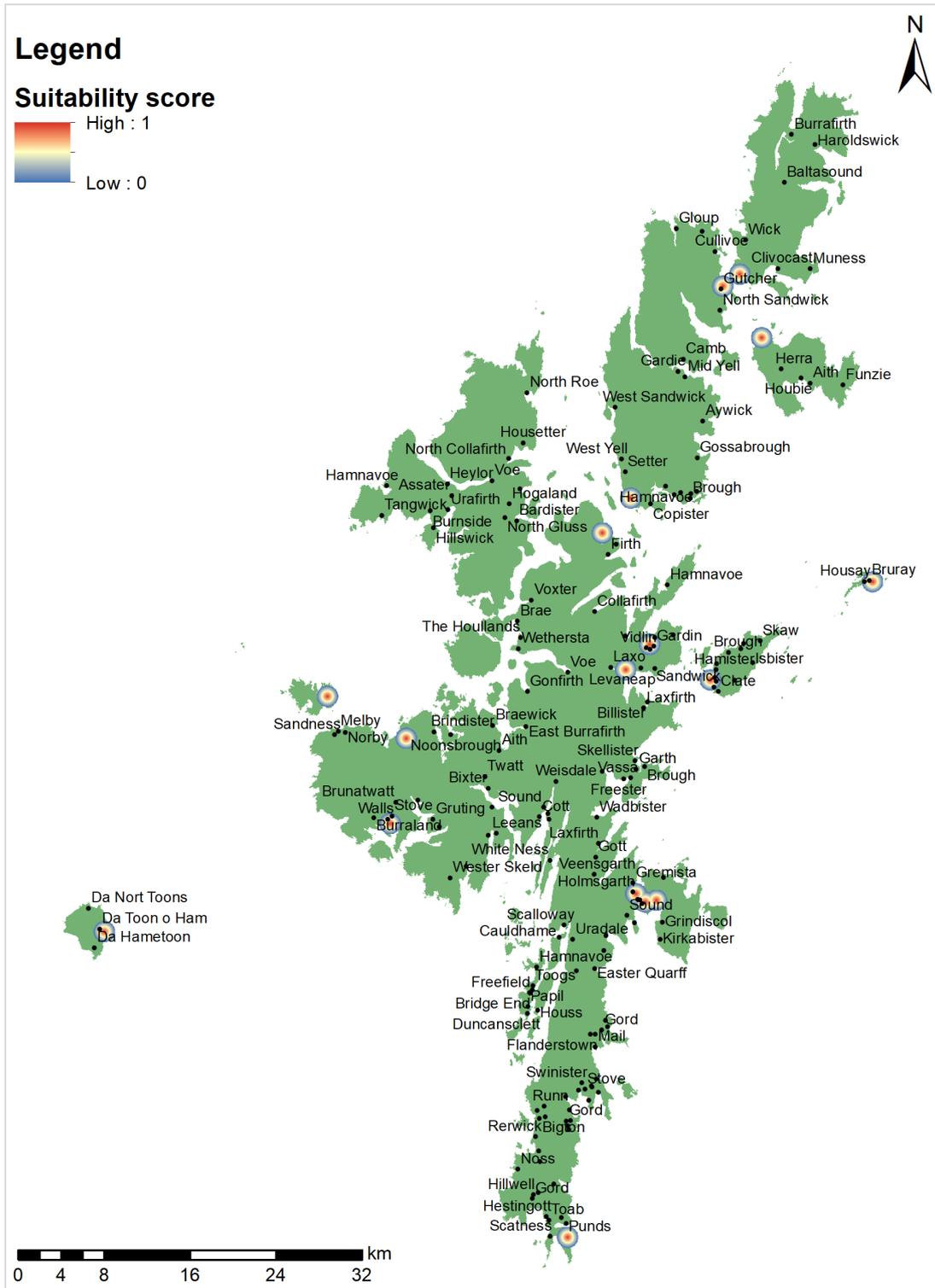


**Appendix figure B.15 Suitability for hydrogen transportation**



**Proximity to ferry terminals**

Scores were assigned based on their proximity to a ferry terminal.

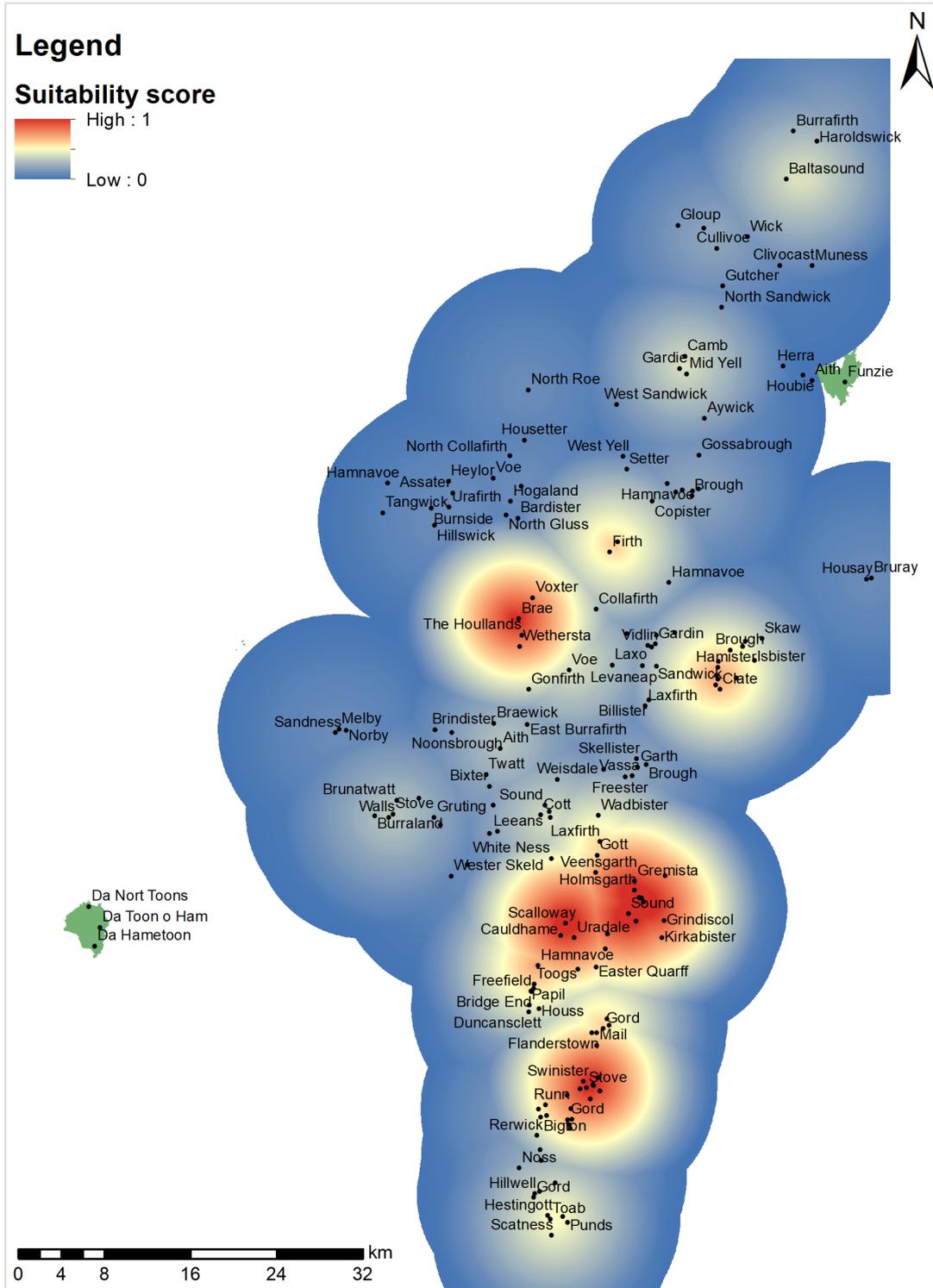


**Appendix figure B.16 Suitability based on proximity to a ferry terminal**



**Proximity to population centres**

Scores were assigned based on a combination of population size and proximity to that population. Scores were deemed more suitable close to population centres, and larger population centres were deemed more suitable than smaller population centres.

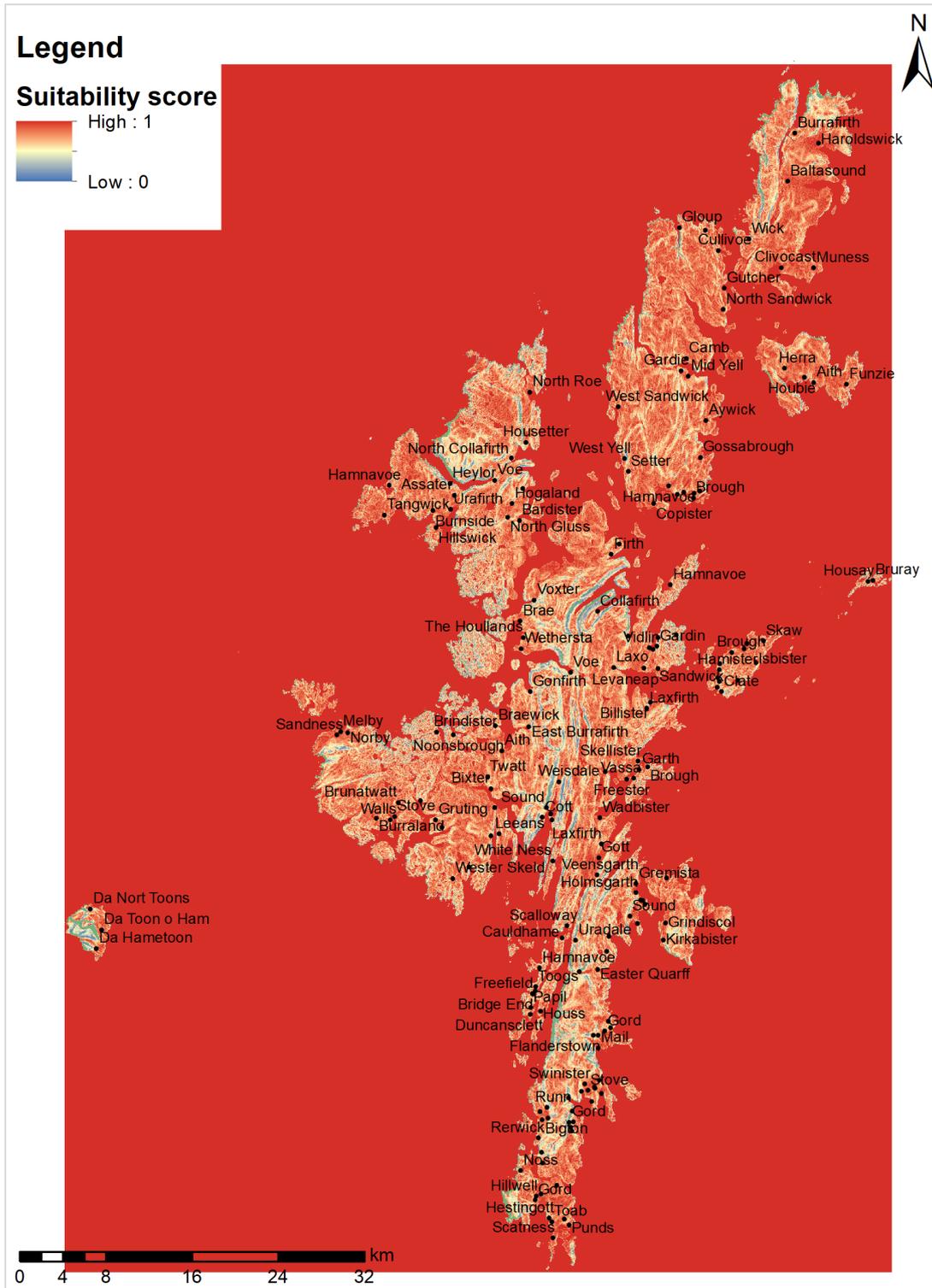


**Appendix figure B.17 Suitability based on proximity to population centres**



**Gradient**

Land gradient values were scored most suitable on level ground with a linear scaling to 0 at 25° of slope.



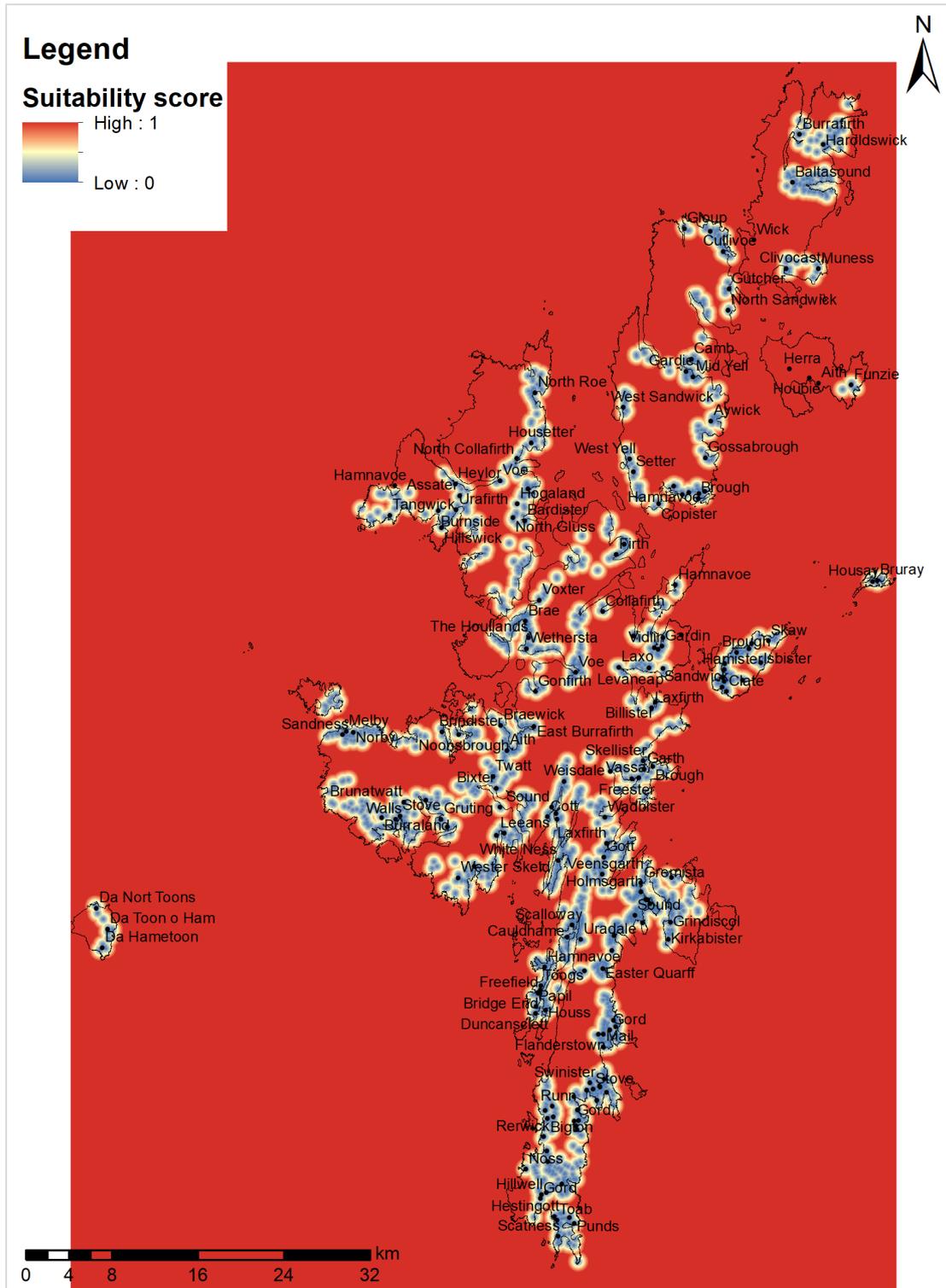
**Appendix figure B.18 Suitability based on land gradient**





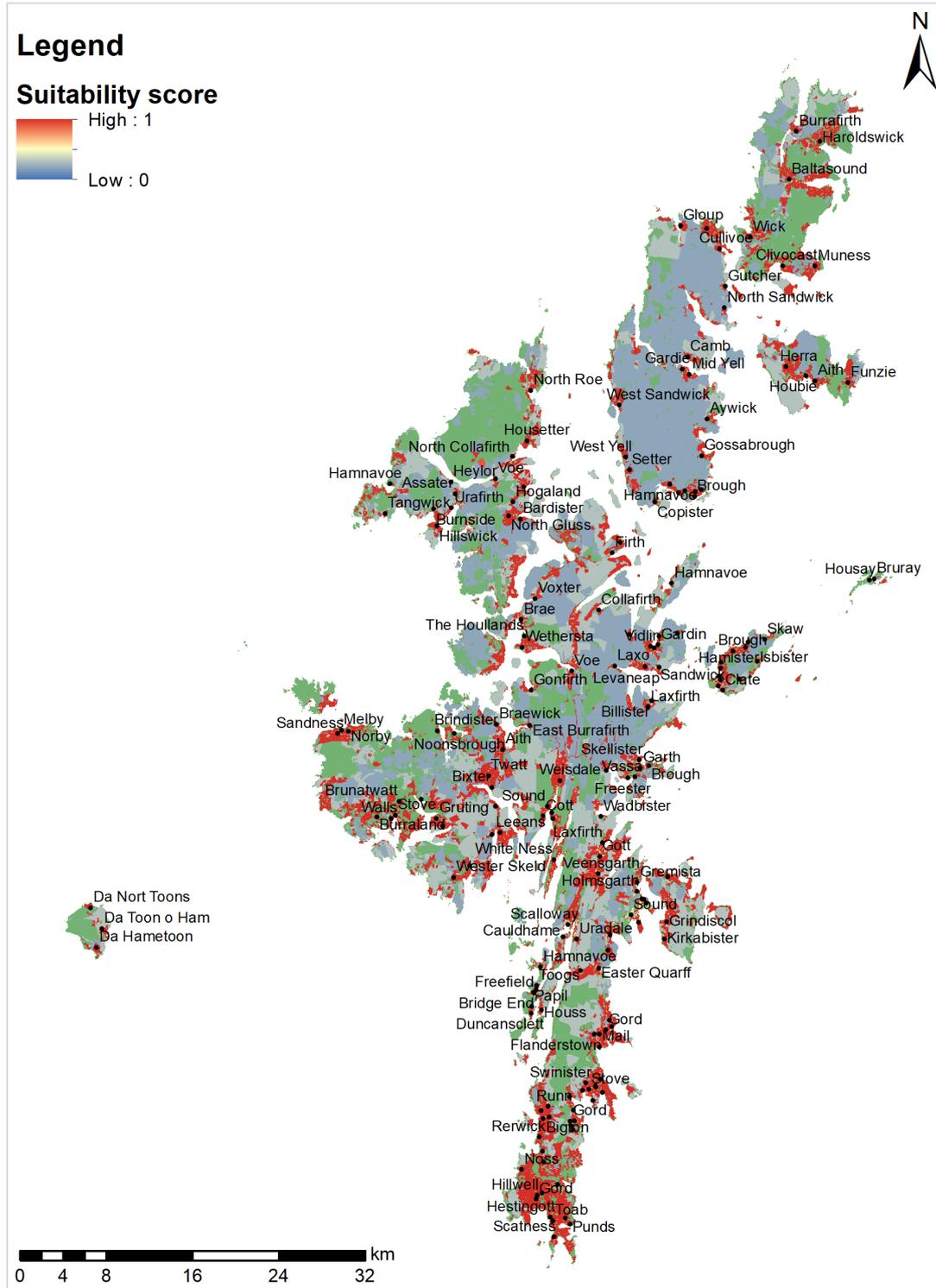
**Proximity to individual residences**

To avoid disturbance, areas immediately adjacent to properties were scored at 0, with suitability increasing to 1 at 1 km.



### Topography

Scoring was assigned based on the land use type. Undeveloped areas environmentally sensitive areas and water bodies were scored at 0, with areas of rough grassland and agricultural land scored at 1. Other land types were allocated a score between 1 and 0. The full scoresheet provides details on the scoring assigned.

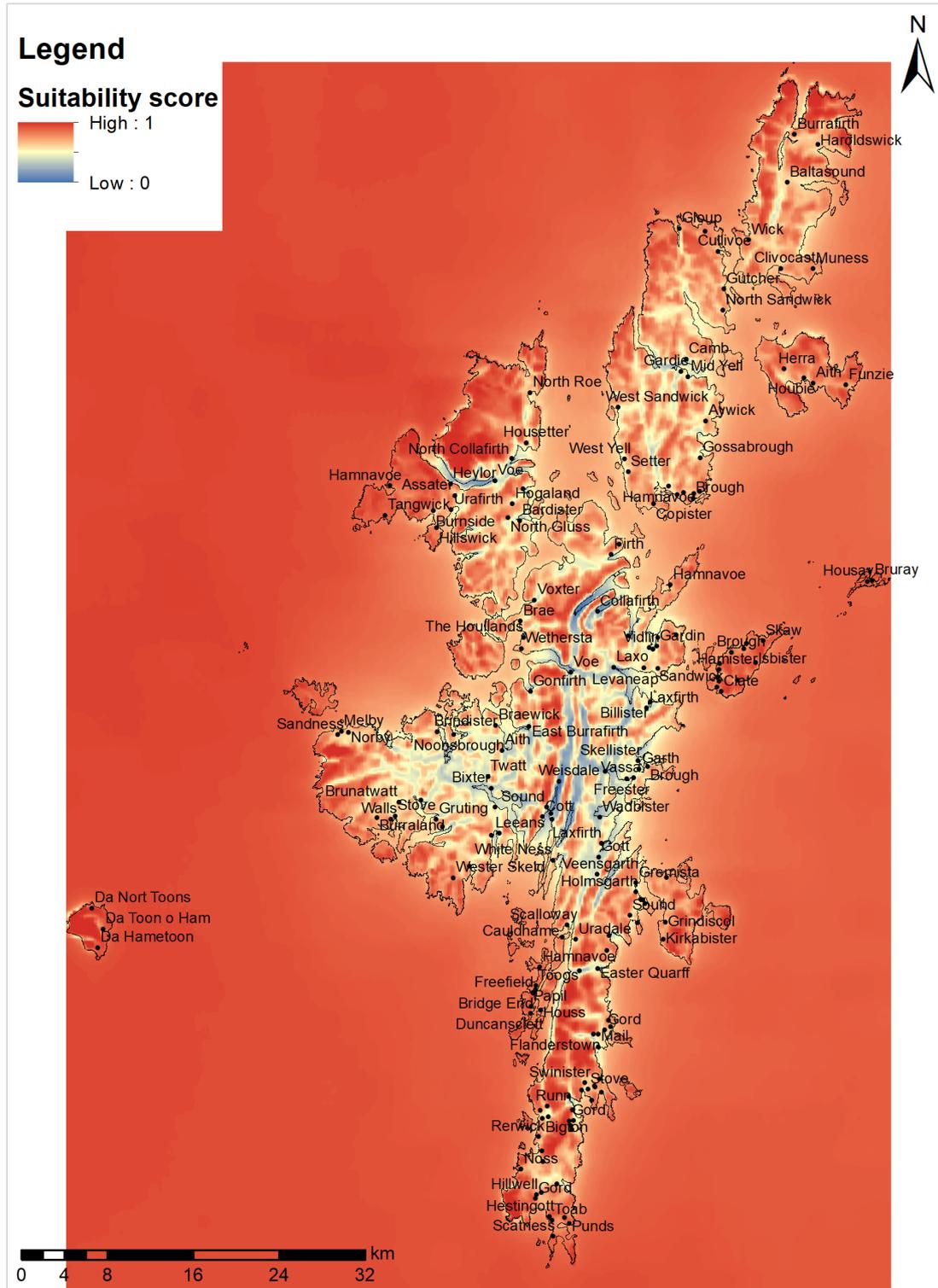


Appendix figure B.21 Suitability based on topography (land use type)



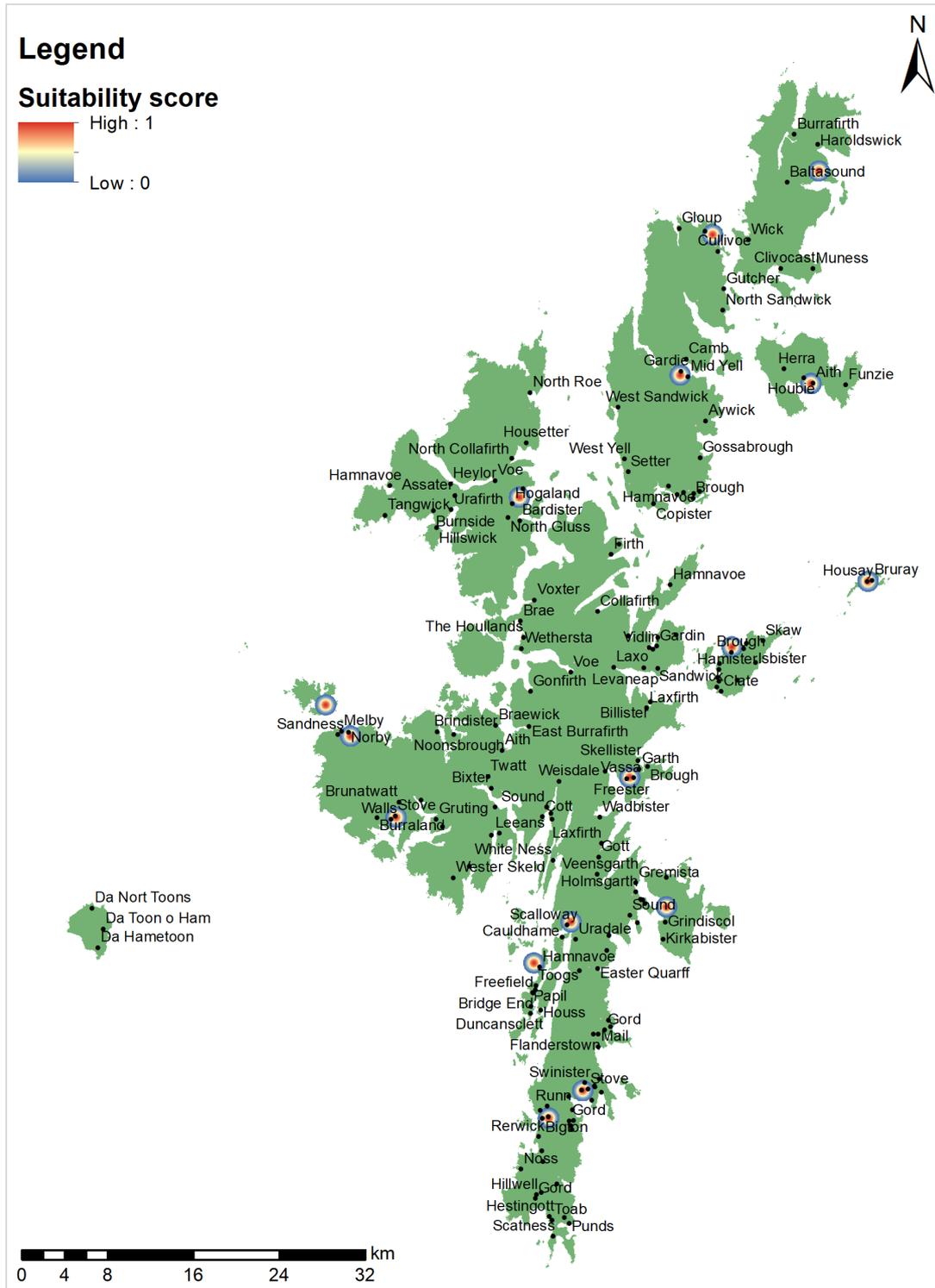
**Wind resource**

The capacity factor values for wind turbines were assigned suitability scores, with the highest capacity factors receiving a score of 1.



### Community Halls and Community Centres

With community halls offering the opportunity to make use of existing buildings for the hub, halls and the land immediately surrounding them were assigned a suitability score of 1. Community centres, where activities are already taking place to look into community energy and renewables, were assigned a score of 1 out to a distance of 1 km, where scores reached 0.

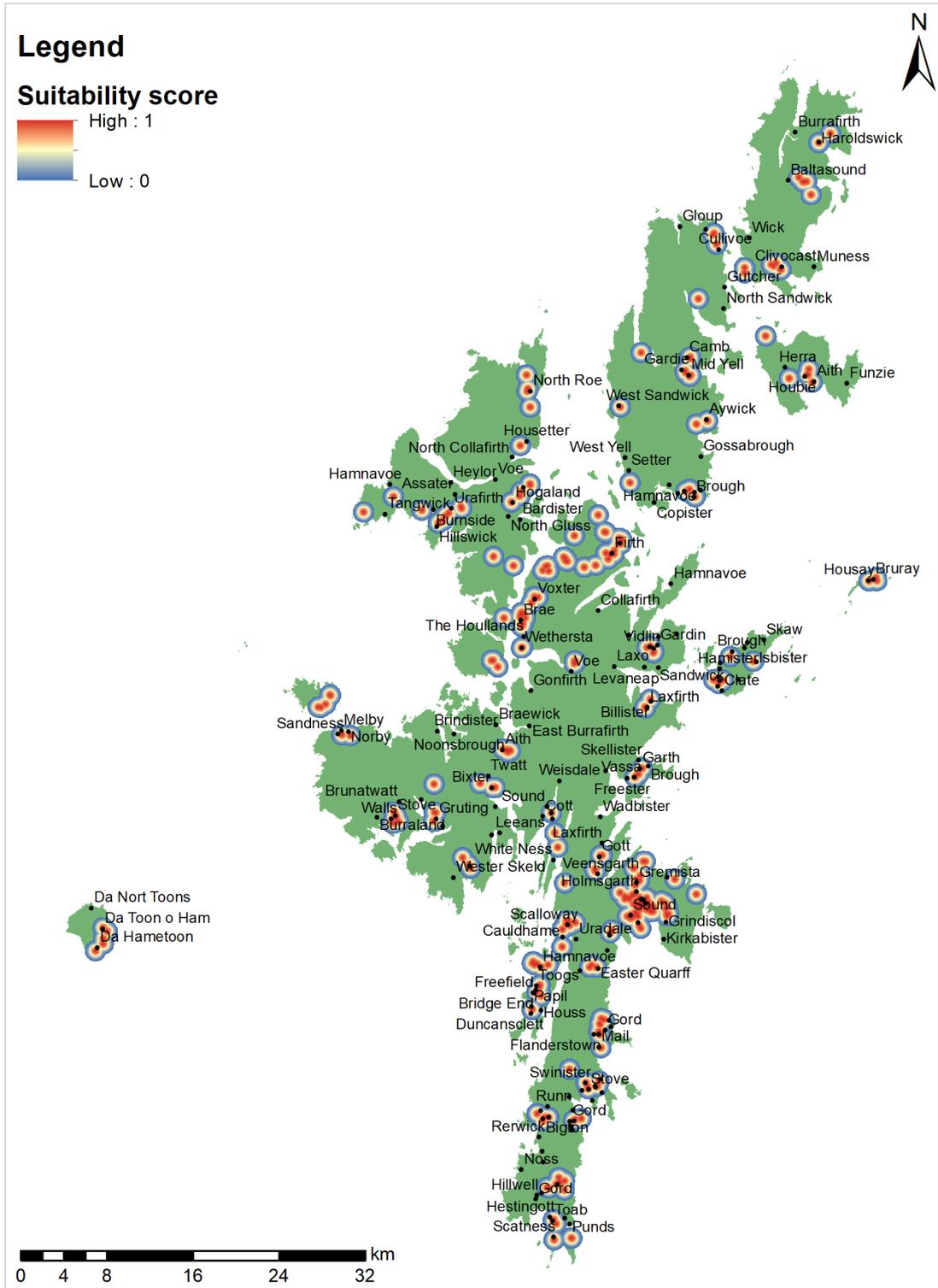


Appendix figure B.23 Suitability based on proximity to community halls and community centres



**Council Assets**

Similarly, to community halls, council assets offer the opportunity of converting an existing building into a hub, rather than a new build development. Scores were assigned based on proximity, with scores of 1 at the site of the asset, out to 0 at a distance of 1 km.

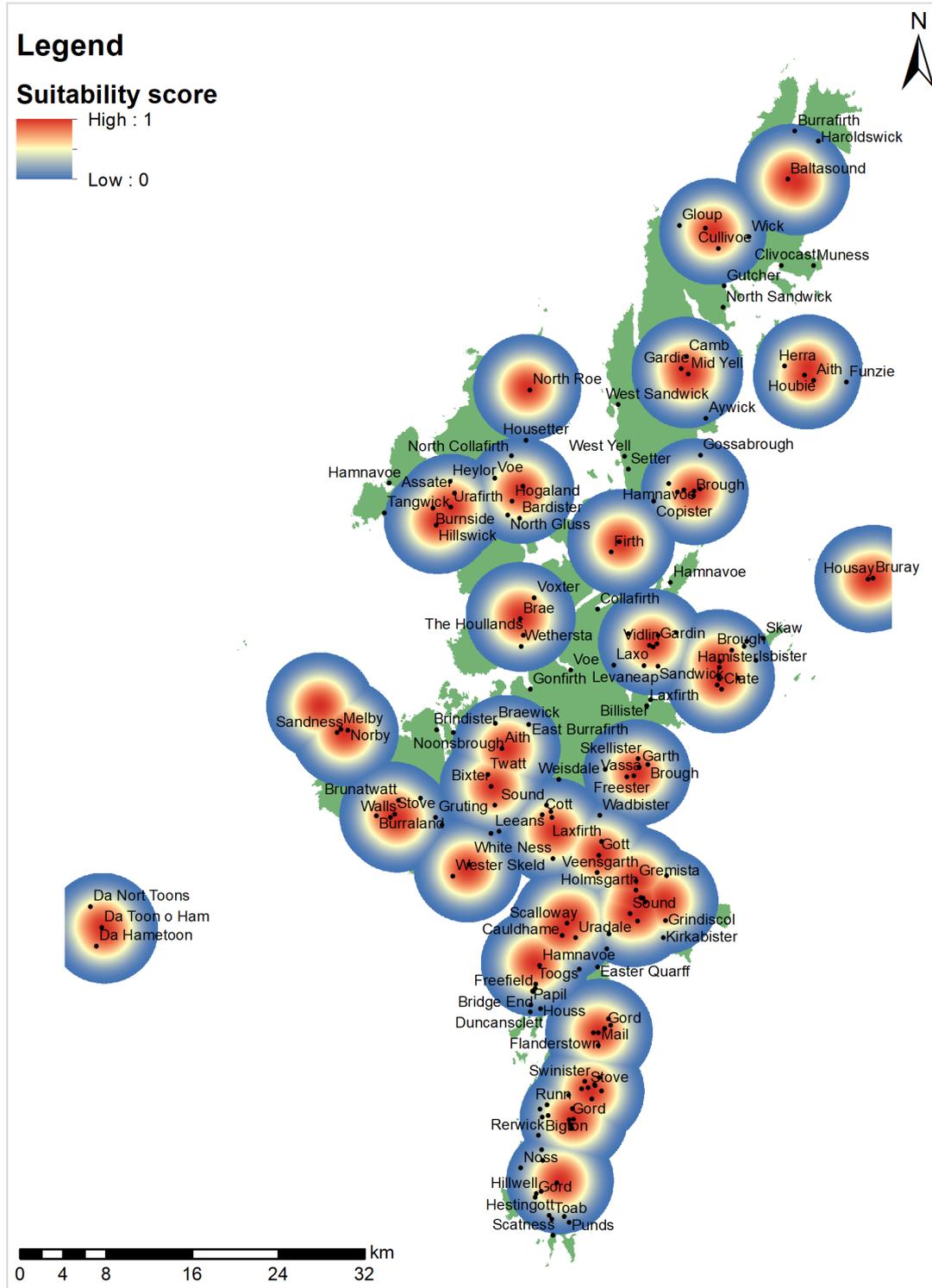


**Appendix figure B.24 Suitability based on proximity to council assets**



**Proximity to existing 3-phase supply**

As data on the distribution of electrical infrastructure supporting 3-phase supply was not known, locations with known 3-phase supplies were used as a surrogate. Scores were assigned based on proximity, with the most suitable scores being closest, scaling down to 0 at a distance of 10 km.



**Appendix figure B.25 Suitability based on proximity to existing 3-phase supply**



### **B.3.4 Weighting**

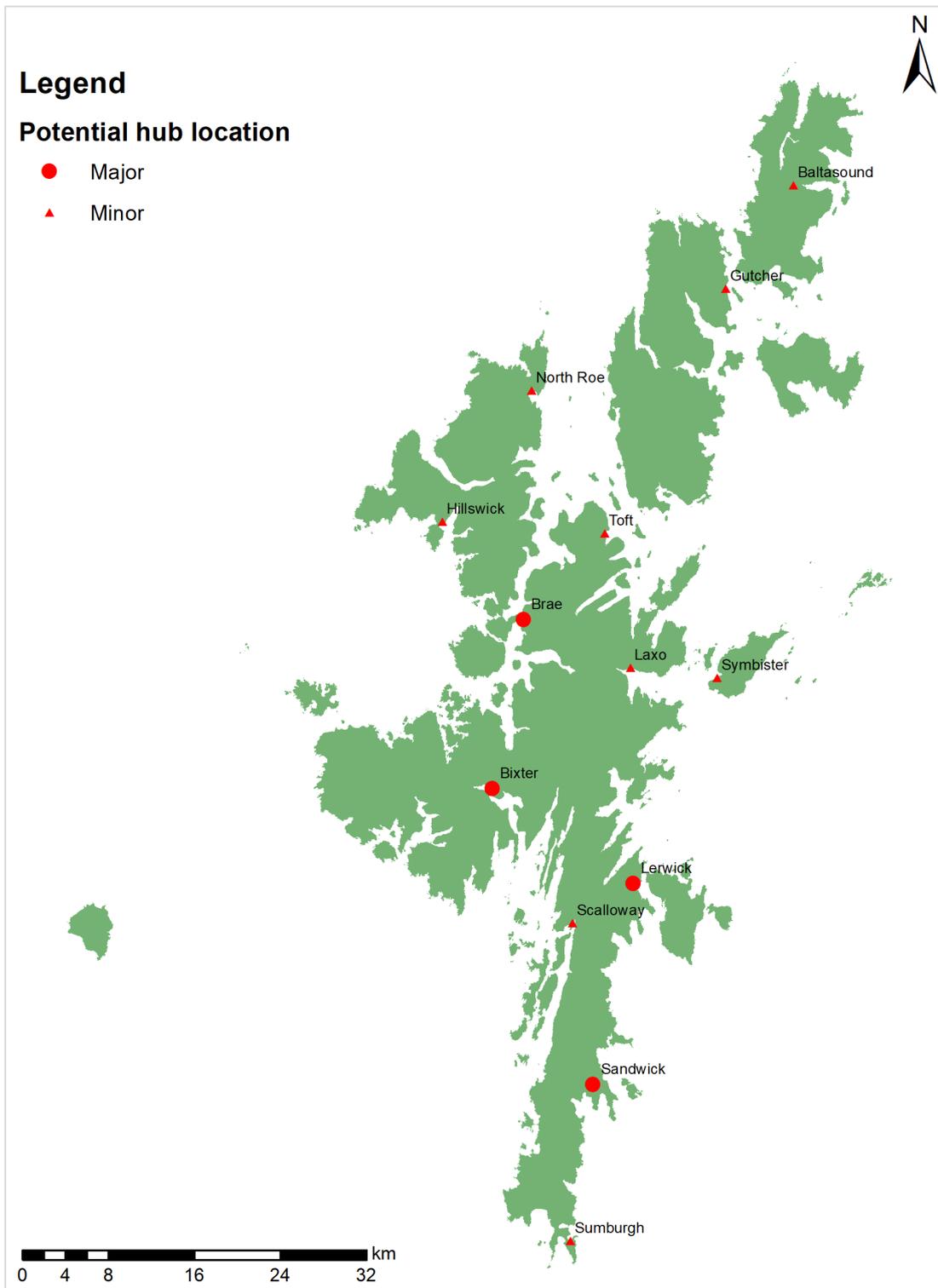
While individual scores were applied to each layer on a scale of 0 to 1, each of these layers were then compared in terms of relative importance to each other. The weighting matrix can be found in the appendices. Values which represent an integer are more important than those that represent a fraction, and the value represents the degree to which it is more important. Only one half of the matrix is completed to prevent repeat comparisons. Weights of 1 represent factors that are equally as important.

## **B.4 RESULTS**

Once all the data had been processed, scored, and weighted, the model was run to provide an output of comparative suitability. The results can be seen in Appendix figure B.26 below.





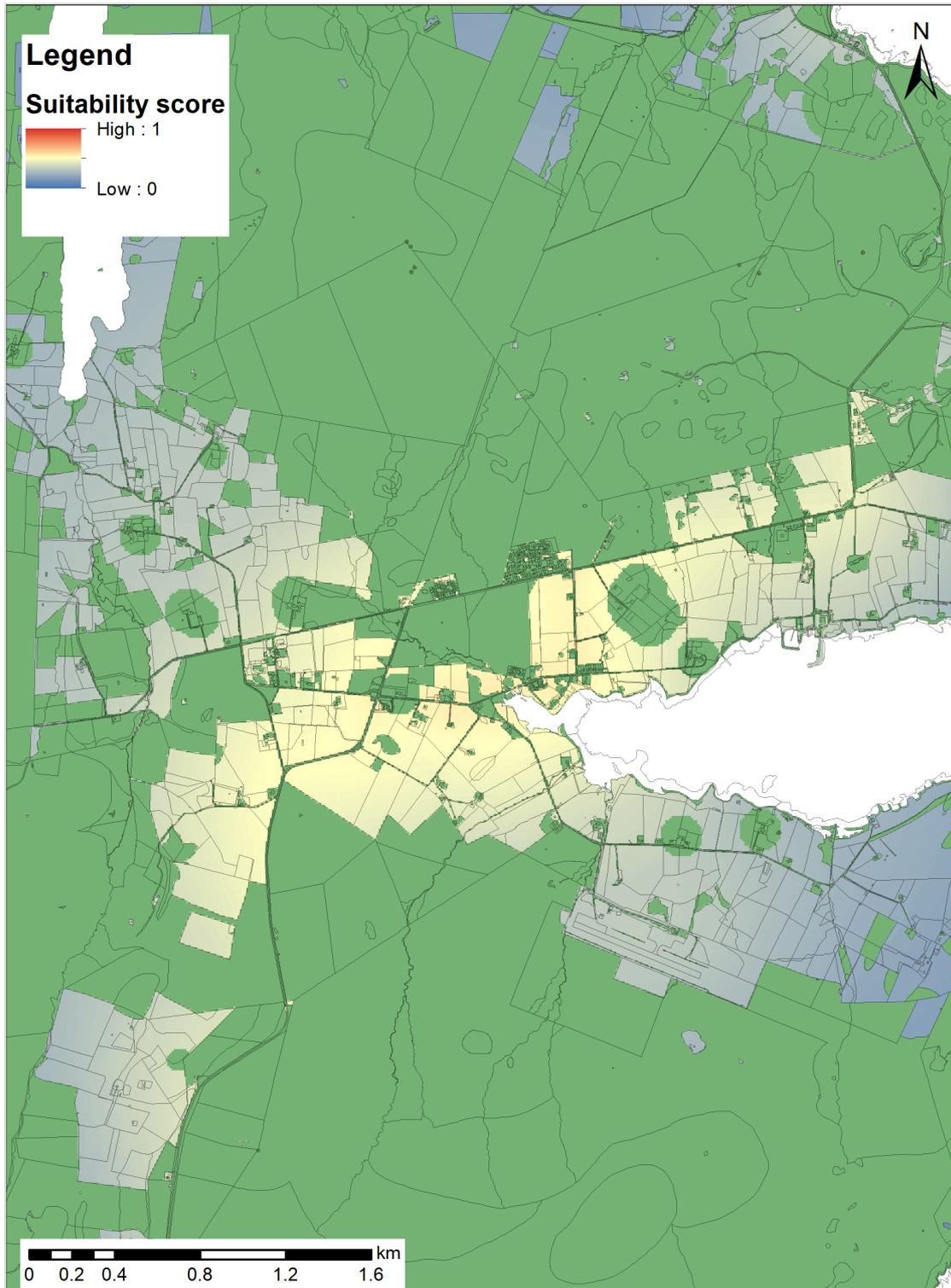


**Appendix figure B.27 Potential hub network throughout Shetland**

Depending on the overall suitability of the location, the local community and nearby facilities, and therefore the scale of services that might be needed in a hub each of the proposed hub locations was classified as either minor or major.

### Baltasound

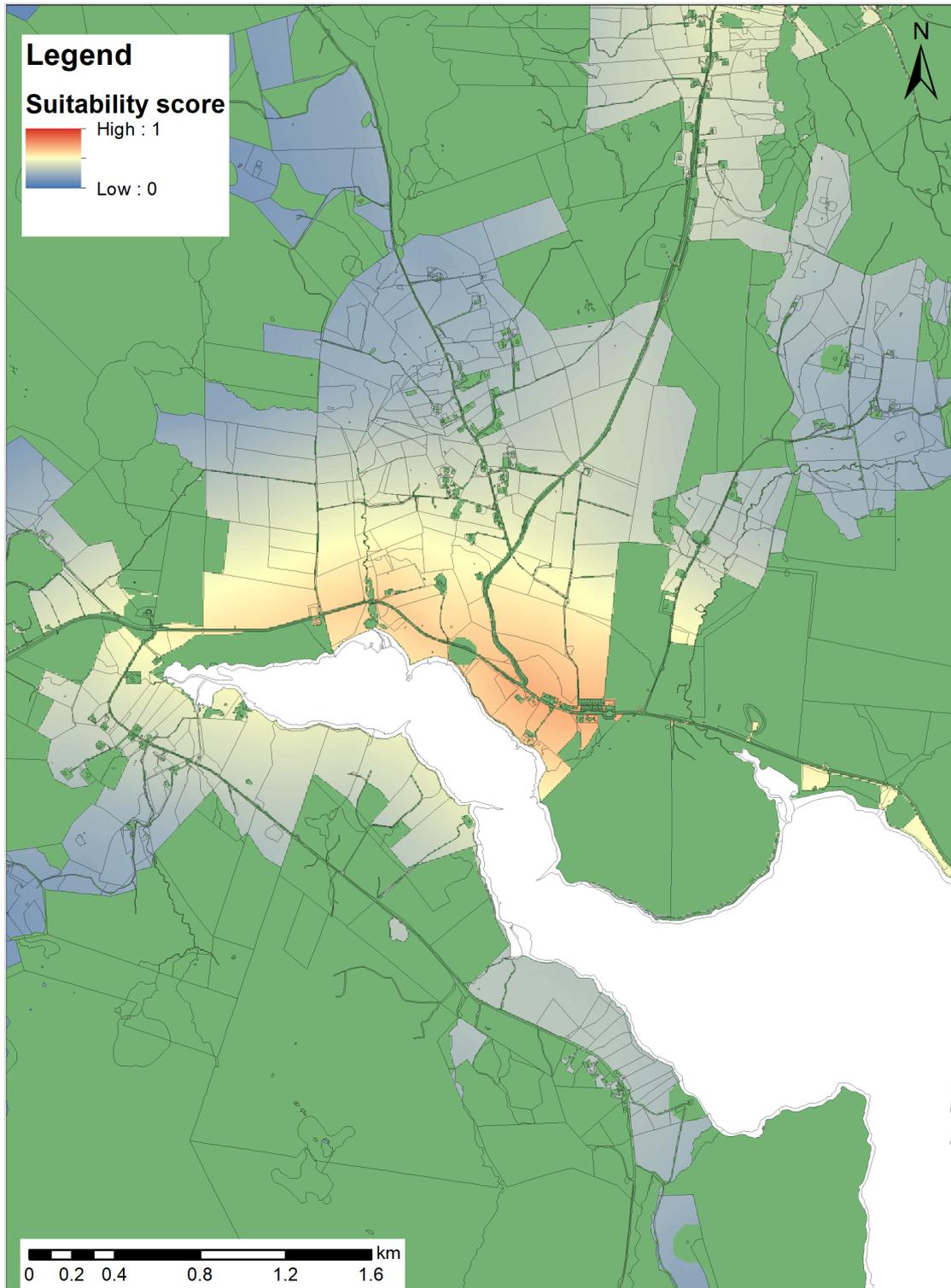
A hub at Baltasound would serve the community on Unst. The population is quite small and therefore there would only be the need for a small-scale hub.



Appendix figure B.28 Overall suitability levels at Baltasound

### Bixter

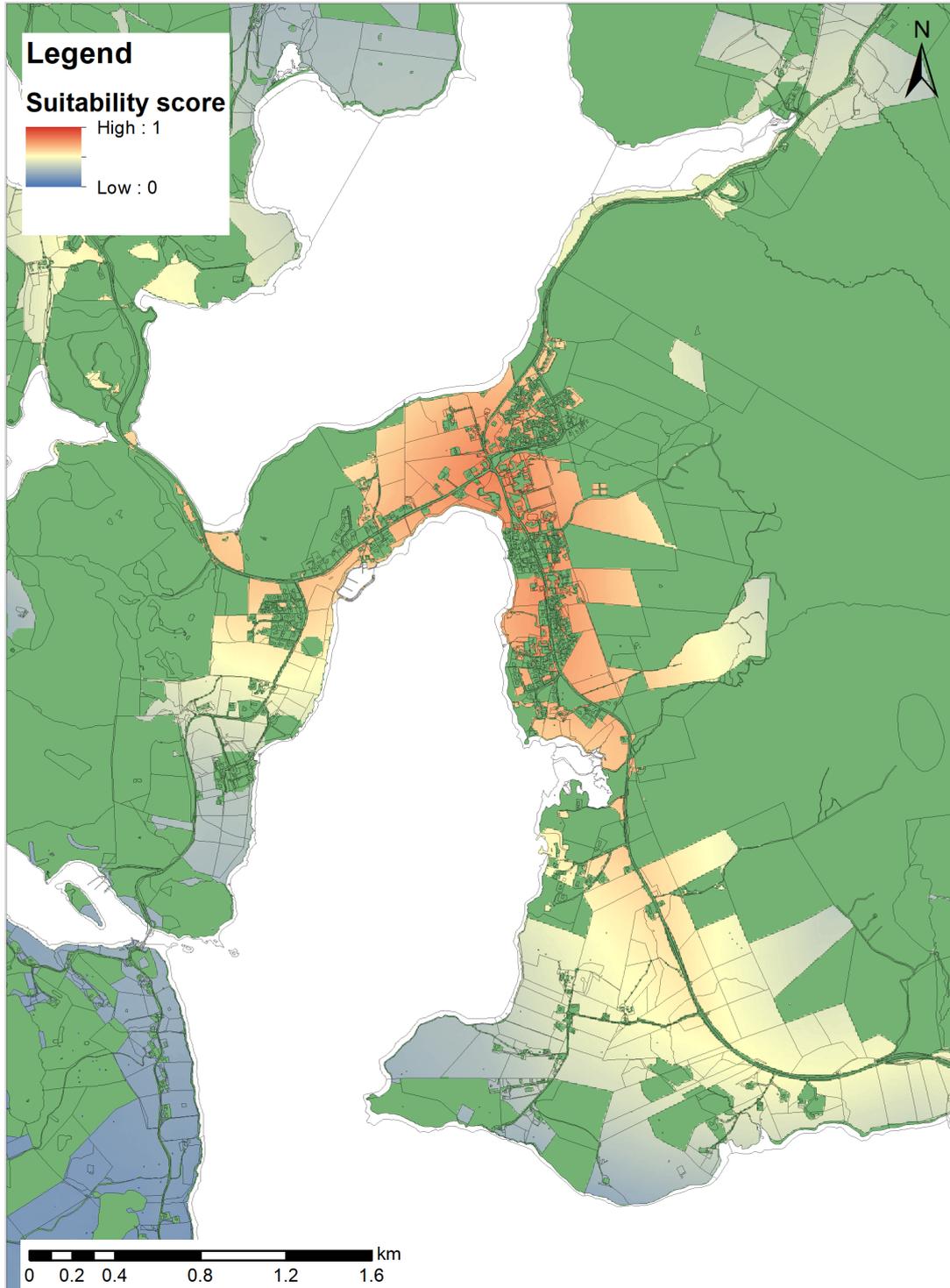
Although there is only a small population at Bixter itself, the road connectivity and frequent bus services make this location a prime site for a major hub serving a large expanse of the west Shetland mainland.



Appendix figure B.29 Overall suitability levels at Bixter

**Brae**

After Lerwick, Brae shows the highest levels of suitability for a site in Shetland. The large population size and connectivity make this an ideal location for a major hub serving the north of mainland Shetland. Brae has been selected as the location of the pilot hub to be set up if the bid for Phase 2 is successful. Brae is also the closest town to Mossbank, which is the most deprived area in Shetland, and if a link to the Brae hub from Mossbank could be established this would give access to the services of the hub to this community, addressing Just Transition aims.

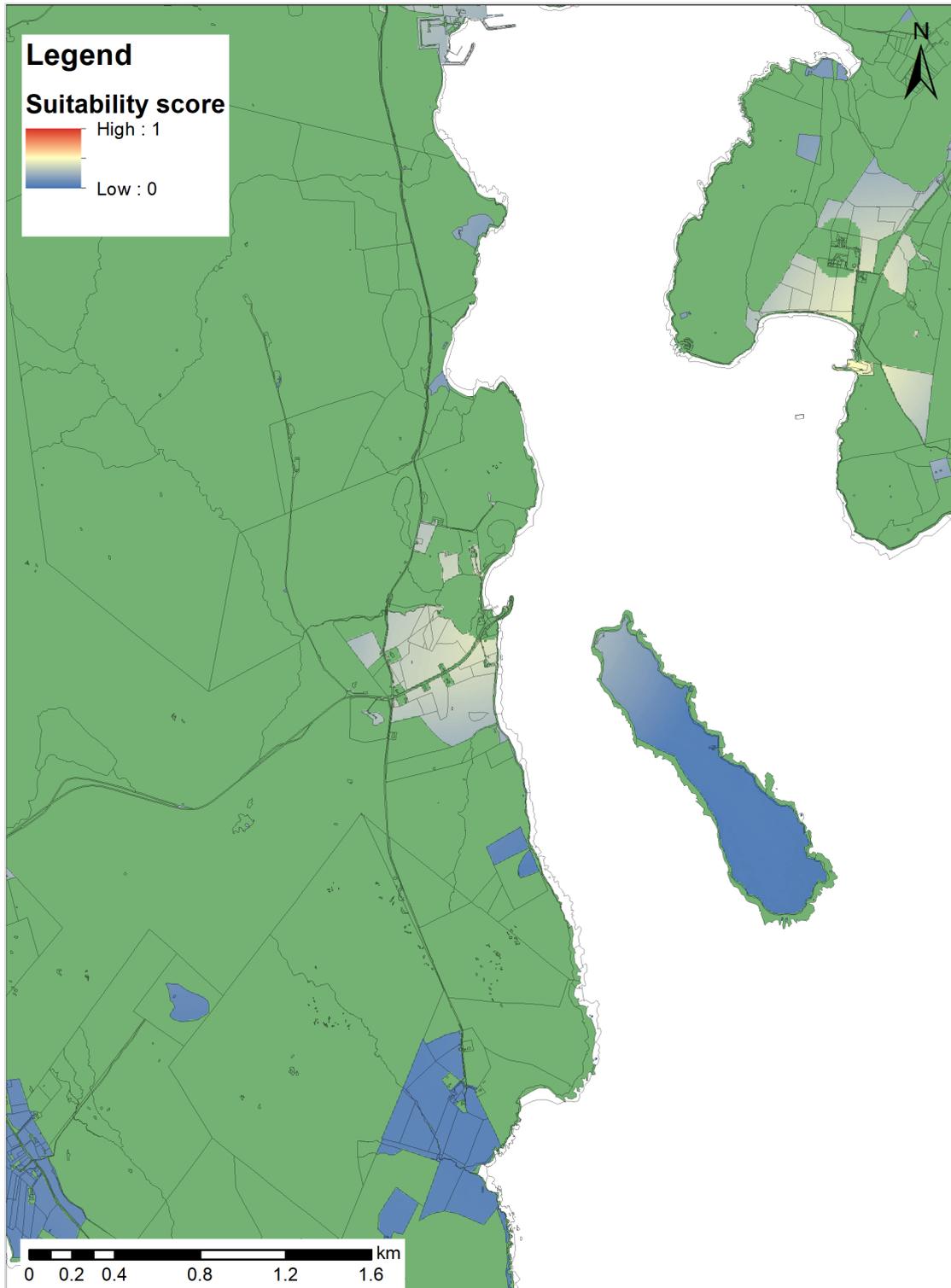


**Appendix figure B.30 Overall suitability levels at Brae**



**Gutcher**

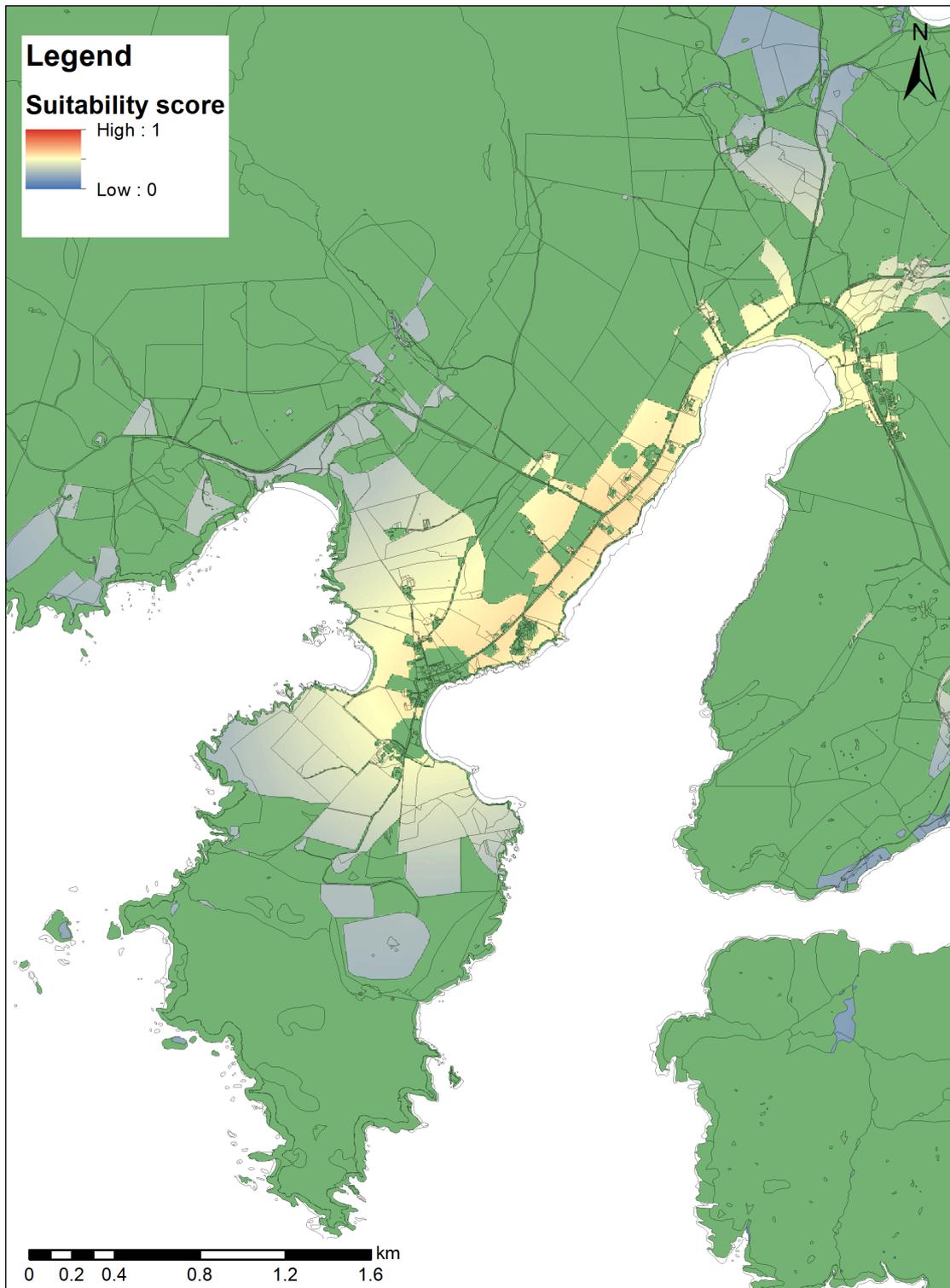
A hub at Gutcher would serve the communities on Yell. It would only serve as a minor hub, but its proximity to the ferry across to Unst makes this a potential site for car and electric bike hire and charging.



**Appendix figure B.31 Overall suitability levels at Gutcher**

### Hillswick

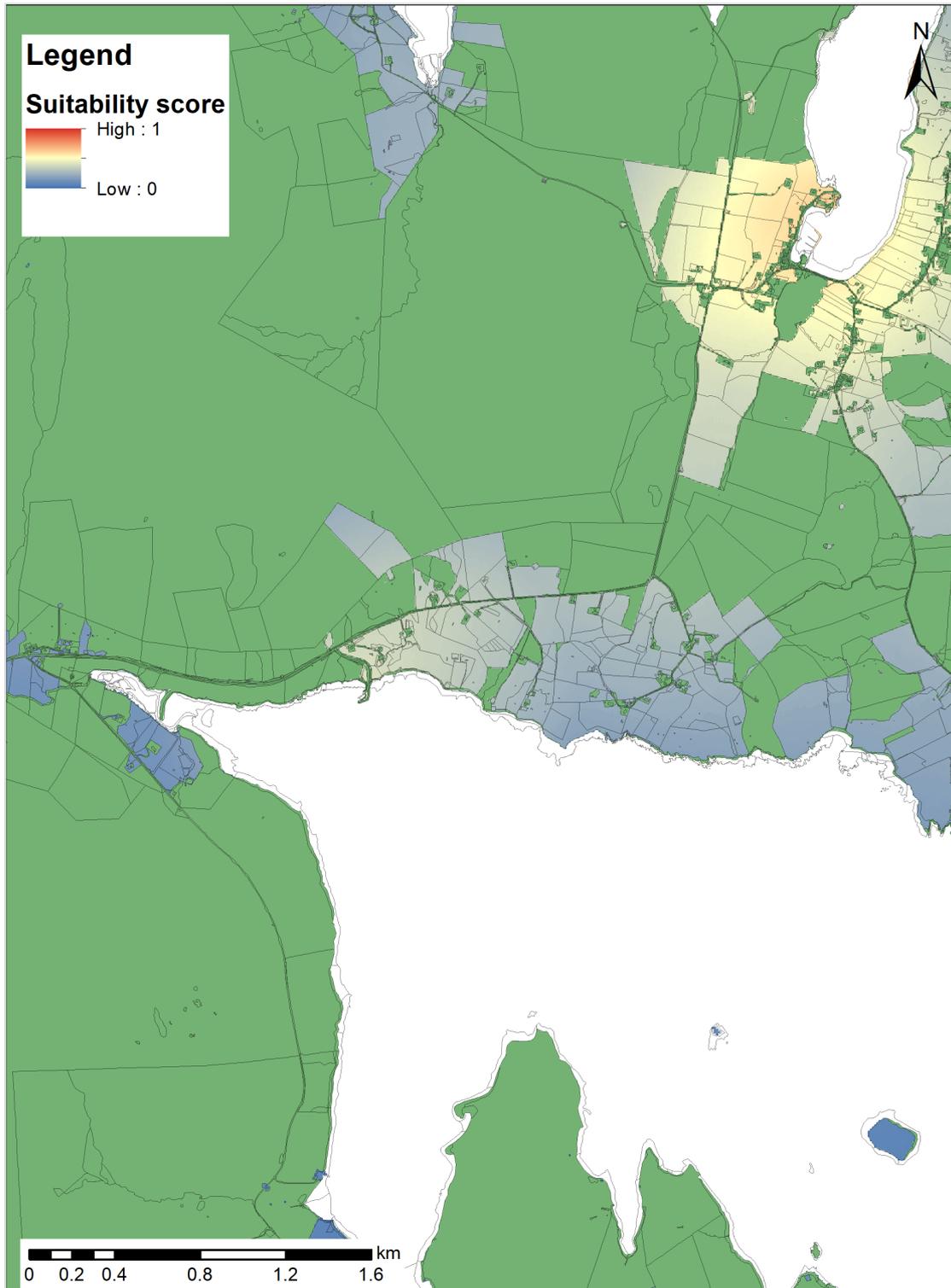
Hillswick is proposed as a minor hub serving the community of Hillswick and nearby residents.



**Appendix figure B.32 Overall suitability levels at Hillswick**

**Laxo**

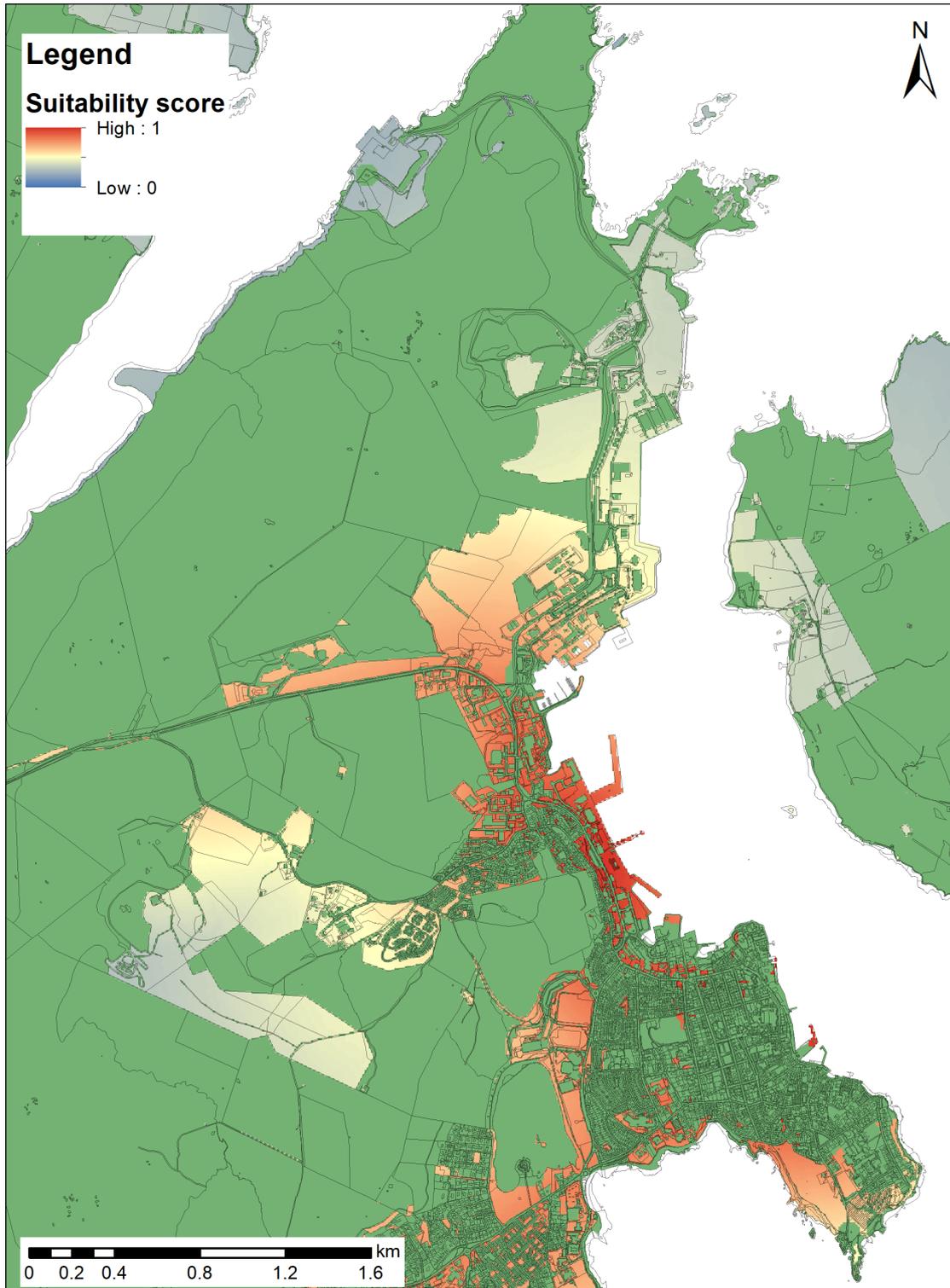
Laxo is the main ferry departure for Whalsay, although this does alternate with Vidlin nearby. Again, with the proximity to the ferry, this would serve as an ideal location for vehicle and bike charging/hire.



**Appendix figure B.33 Overall suitability levels at Laxo**

### Lerwick

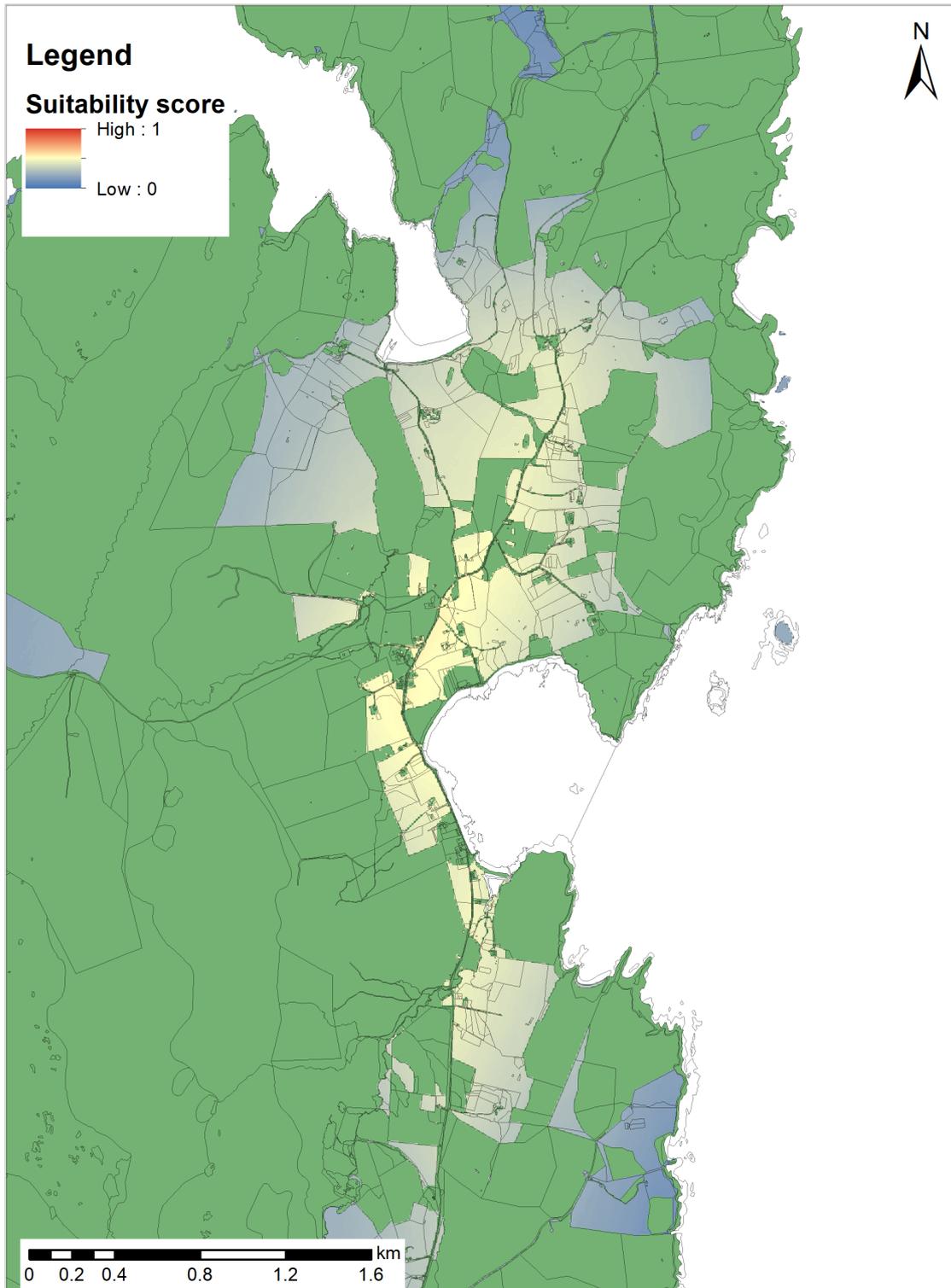
Lerwick would likely host a major hub to the north of the town in the industrial estate. It is likely that a hub here would host all features and be central to the other hubs in Shetland.



Appendix figure B.34 Overall suitability levels at Lerwick

### North Roe

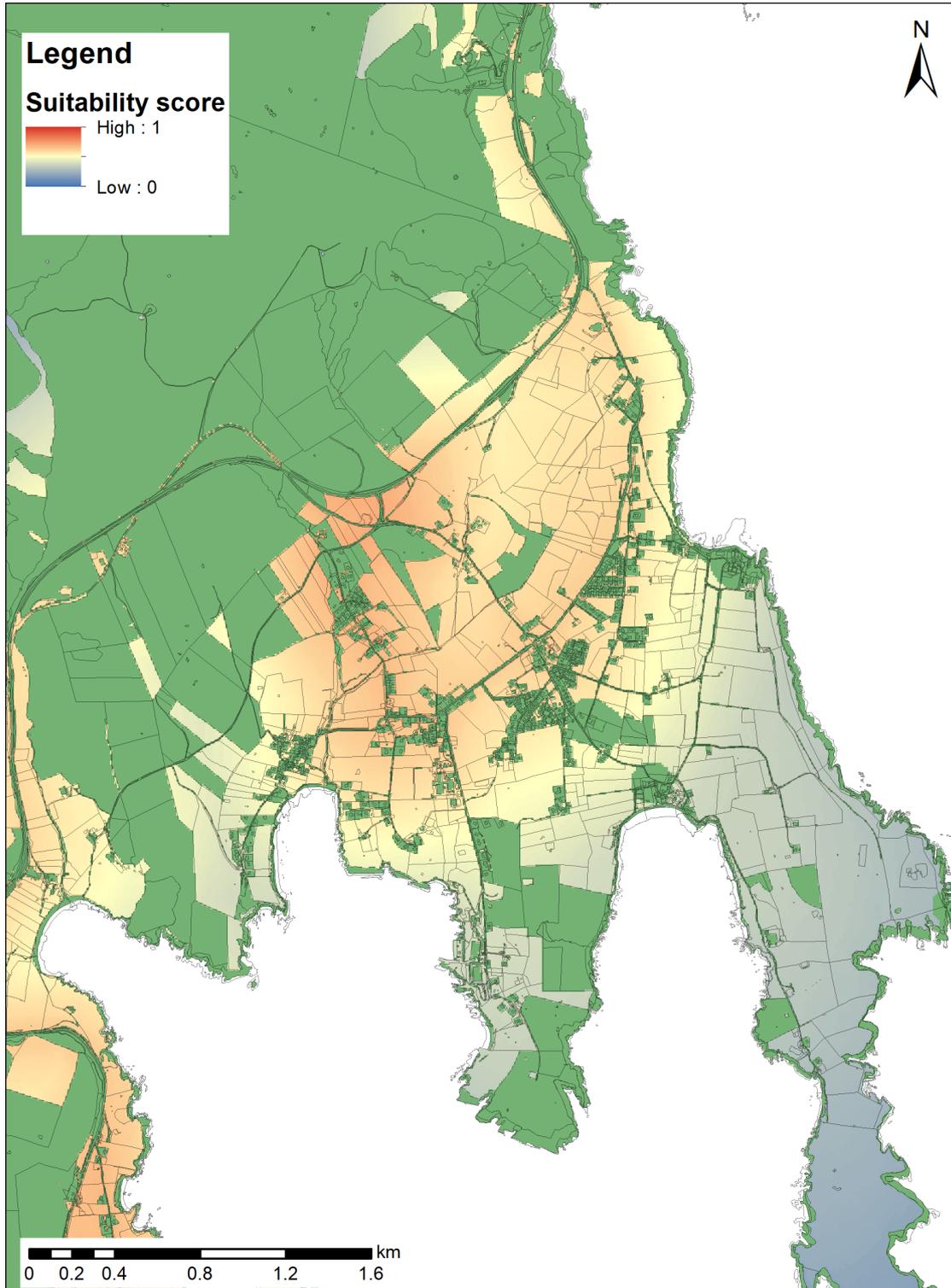
North Roe is a small settlement and it expected that a minor hub with minimal facilities would be based here.



**Appendix figure B.35 Overall suitability levels at North Roe**

### Sandwick

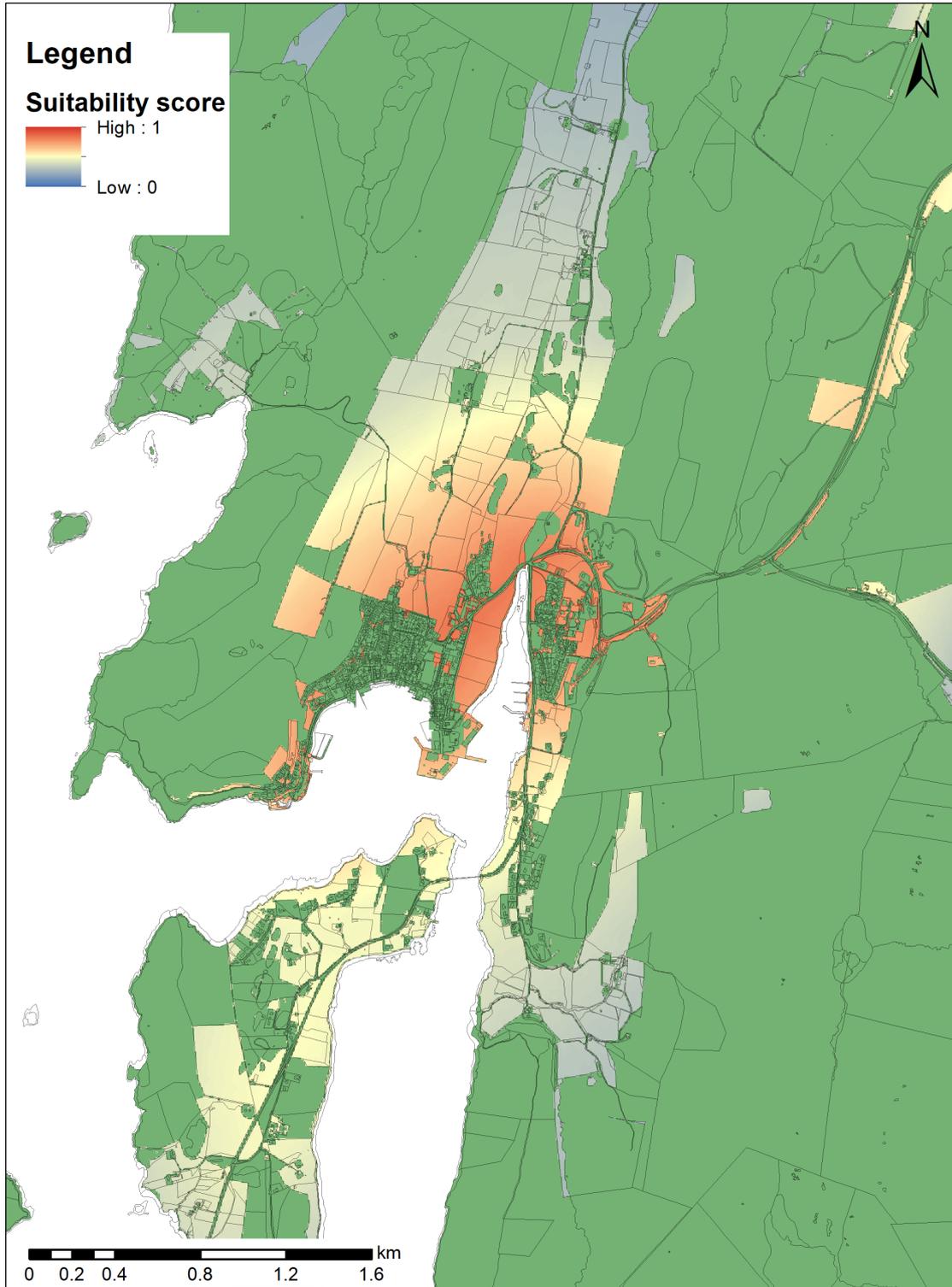
It is proposed that Sandwick would host a major hub serving the south of Shetland. The location is roughly halfway between Lerwick and Sumburgh at the southern tip, and lies adjacent to the main road connecting the south of Shetland to the rest of the islands.



Appendix figure B.36 Overall suitability levels at Sandwick

### Scalloway

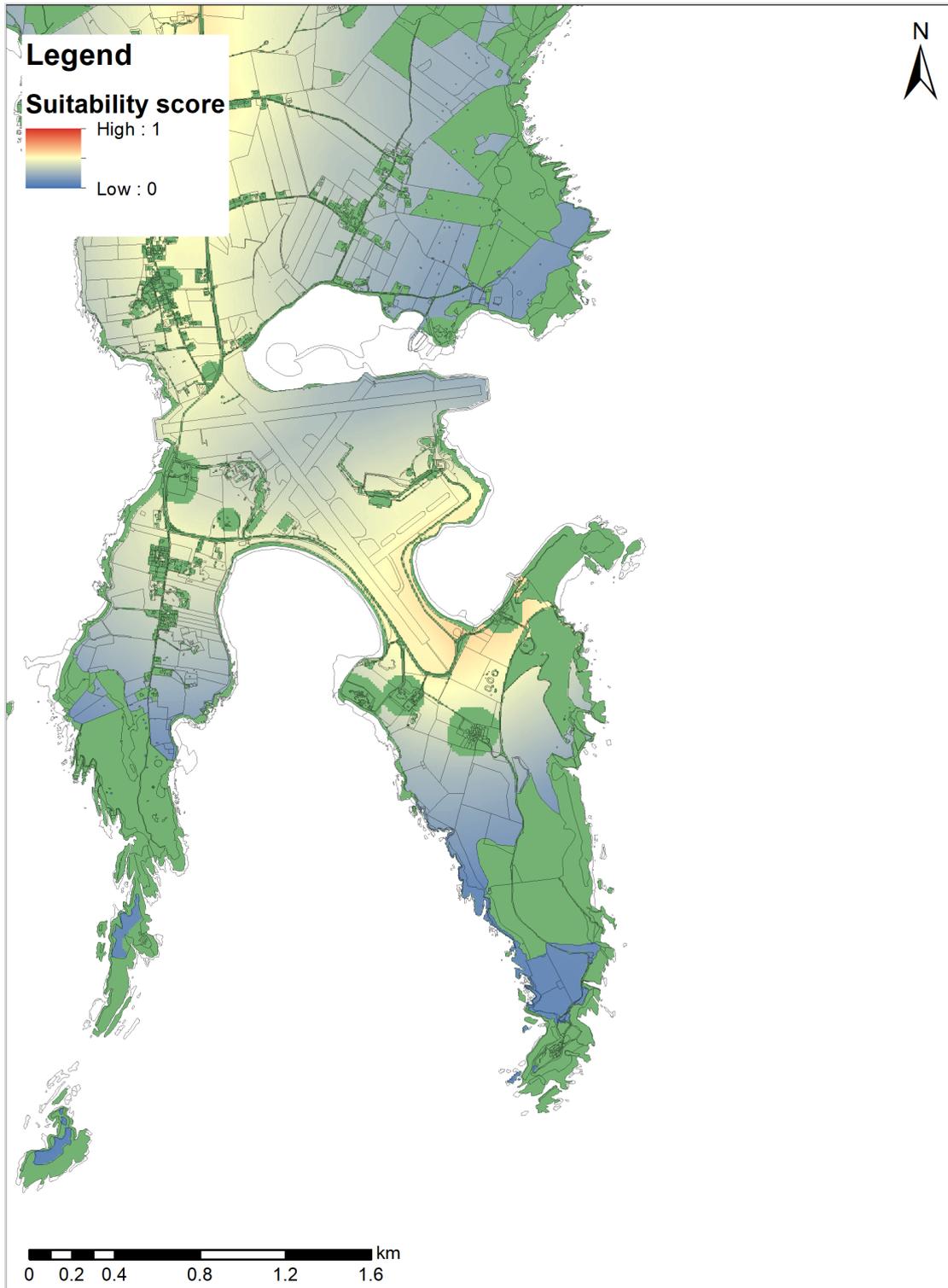
Although relatively close to Lerwick, it is envisaged that a minor hub would be located around Scalloway. There is the opportunity for this to be transport hub linking some of the smaller communities in the vicinity of Scalloway to the major hub in Lerwick.



Appendix figure B.37 Overall suitability levels at Baltasound

### Sumburgh

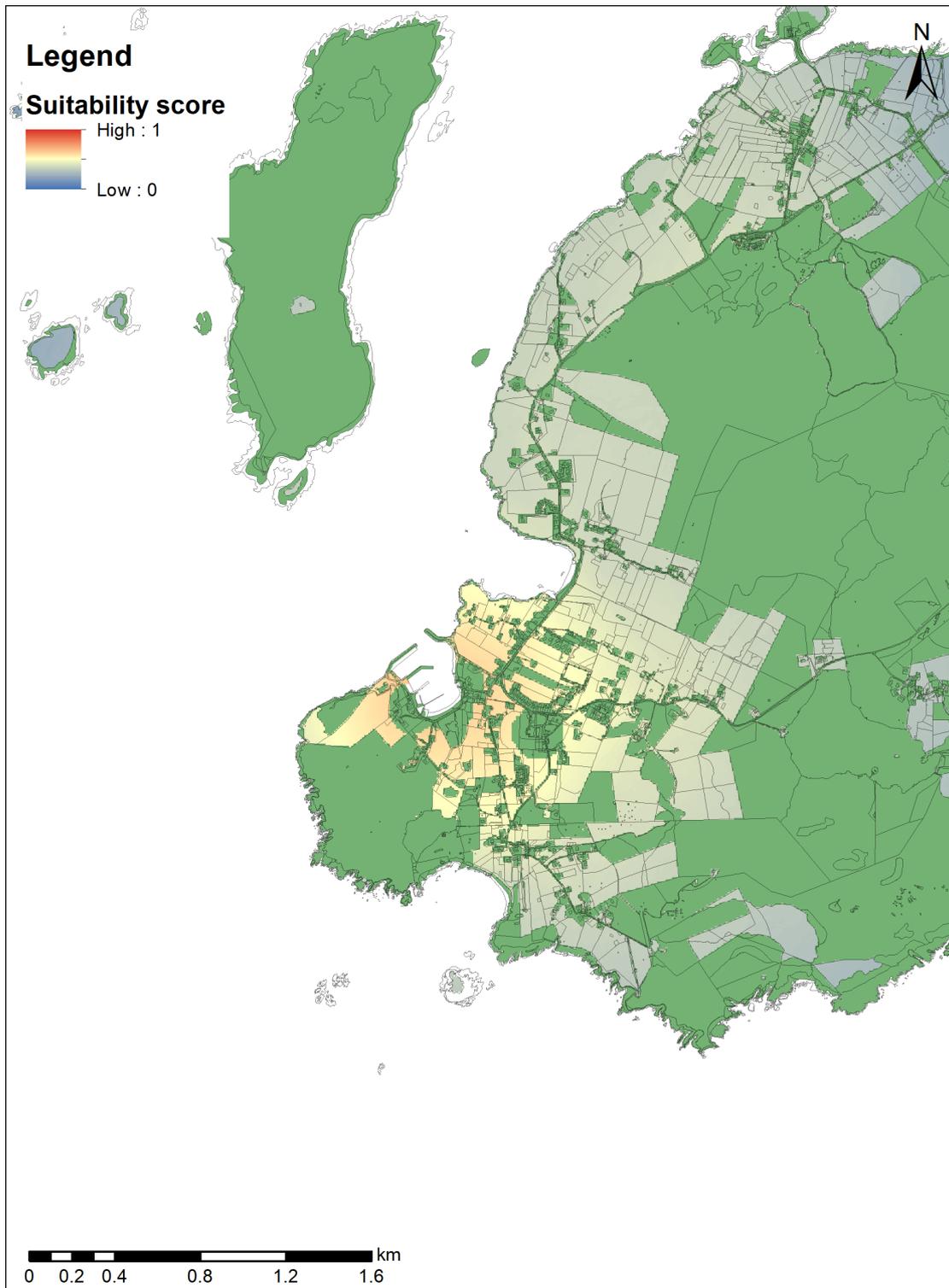
Sumburgh offers the opportunity for a minor hub serving the airport and south of the island. With non island residents arriving at the airport there is an opportunity for electrical vehicle hire here.



Appendix figure B.38 Overall suitability levels at Sumburgh

### Symbister

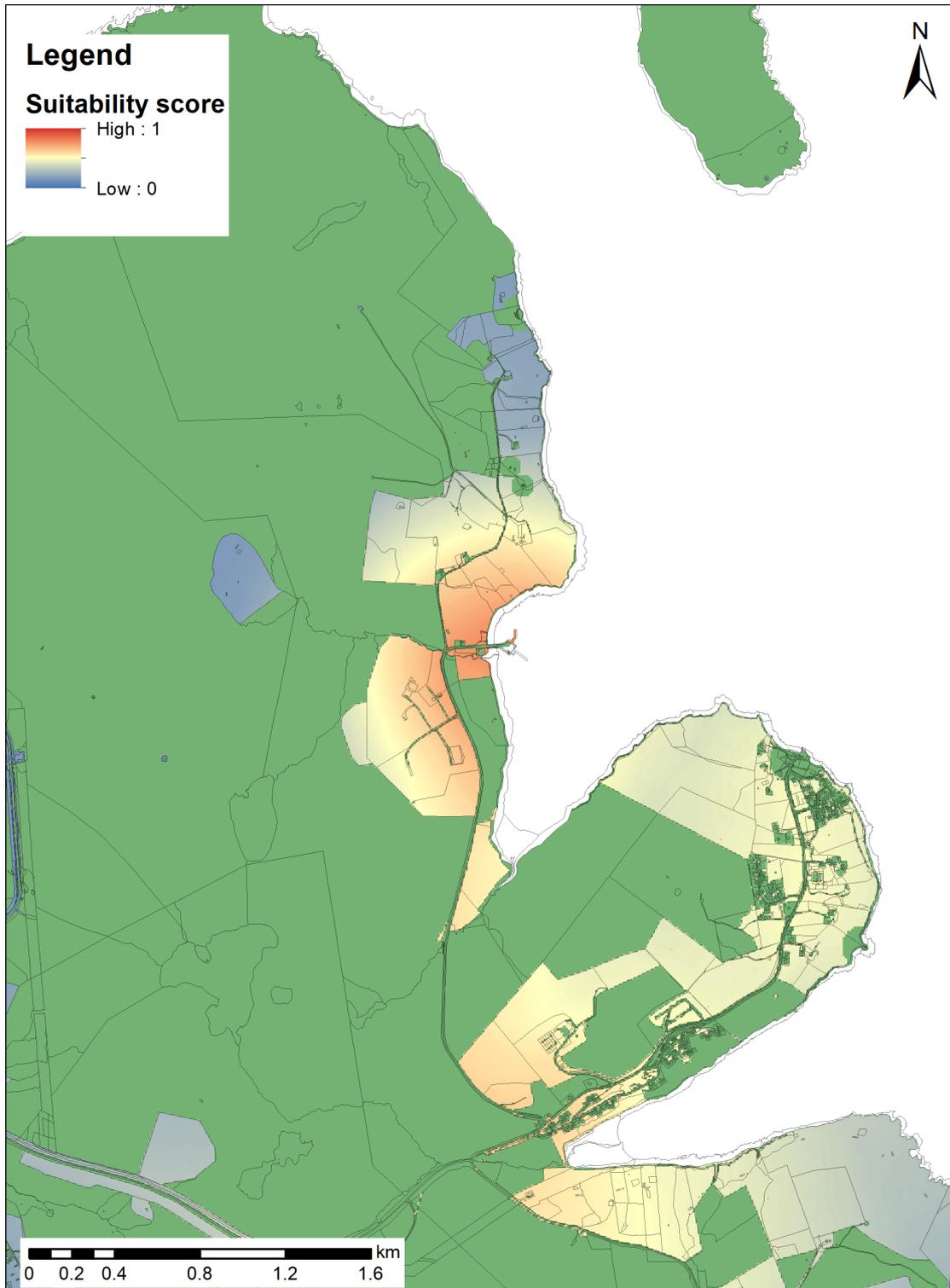
Symbister is the main community on the island of Whalsay and home to an extensive fishing fleet. The hub would serve as centre of the local community and also for visitors to the island.



Appendix figure B.39 Overall suitability levels at Symbister

**Toft**

A hub at toft would be located near to the ferry terminal operating regular ferries across to Yell. A hub here would offer the chance for a car club for residents of Yell and Unst visiting the mainland, meaning that they don't have to bring their cars onto the island. Conversely, visitors to Yell and Unst could opt to hire electric cars or bikes to explore the islands from here.

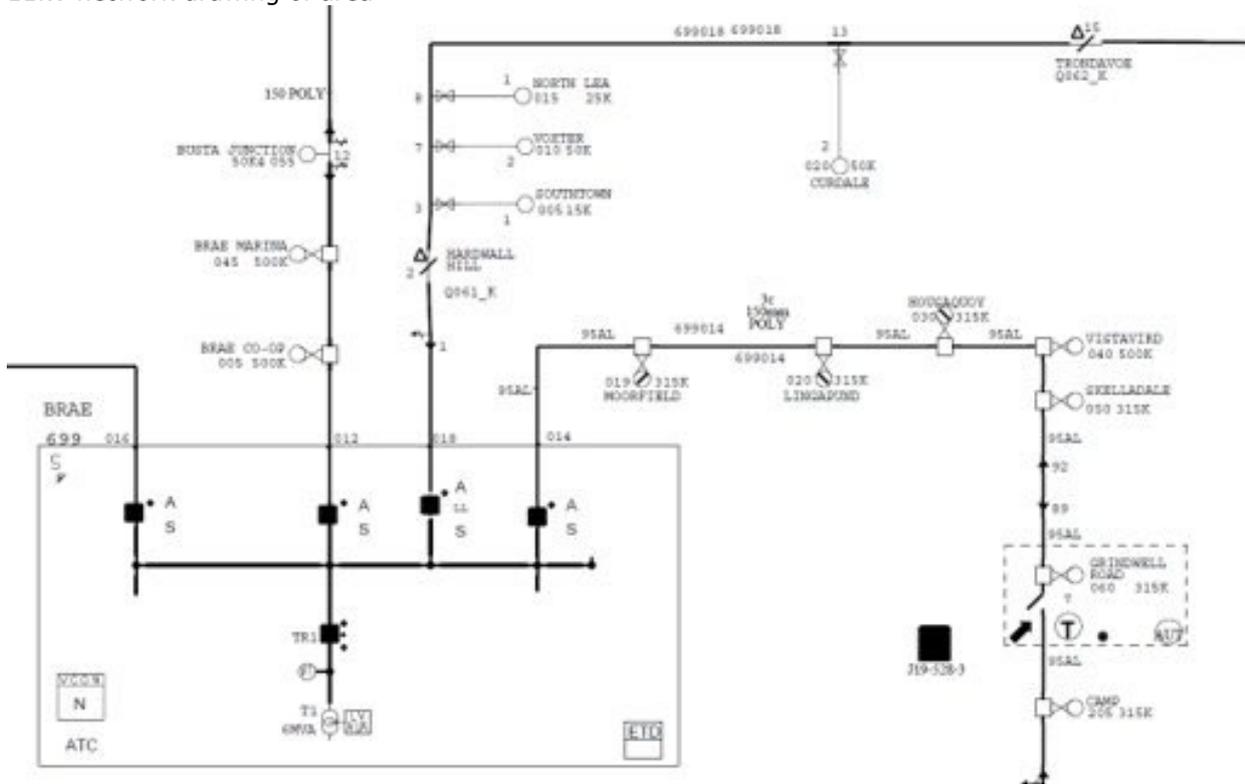


**Appendix figure B.40 Overall suitability levels at Toft**



## APPENDIX C BRAE GRID ASSESSMENT

11kV network drawing of area



### Customer Load

NRN	Primary (Source) Substation	Customers	Rating (MVA)	Demand (MVA)	Fault Level (kA)
699	BRAE	995	#N/A	#N/A	#N/A

NRN	HV Feeder	Customers	Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
014	MOORFIELD	289	Unknown	Unknown	Unknown	Unknown

Previous year				
Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)	
Unknown	Unknown	Unknown	Unknown	

NRN	Distribution Transformer	Customers	Rating (kVA)	Demand (kVA)	Demand (Yr - 1)	Demand (Yr - 2)
060	Grindwell Road	46	315	Unknown	252	Unknown

#### Brea Hall:

- 3-phase LV supply
- 315kVA secondary substation Grindwell road ground mounted
- Existing cable in area is 4c 95mm Al
- Either
- a new supply point required with new meter
- Tap off existing building supply and add new dummy meter

#### Brae High School and Leisure Centre

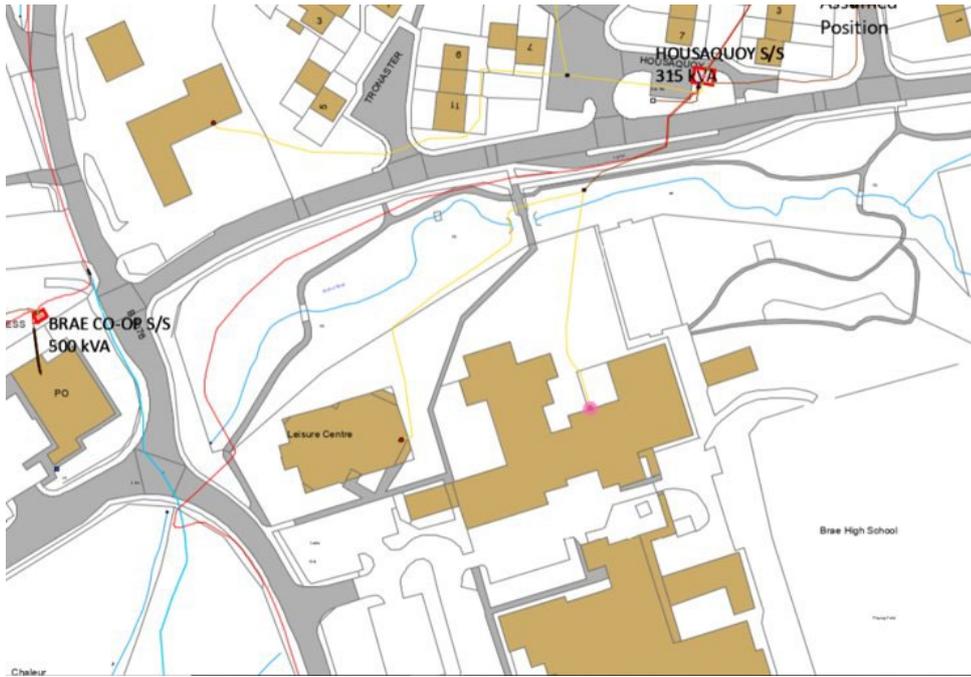
- Single phase LV supply
- 315kVA secondary substation Housaquooy
- Existing cable in area is single phase
- Either
- a new supply point required with new meter
- Tap off existing building supply and add new dummy meter



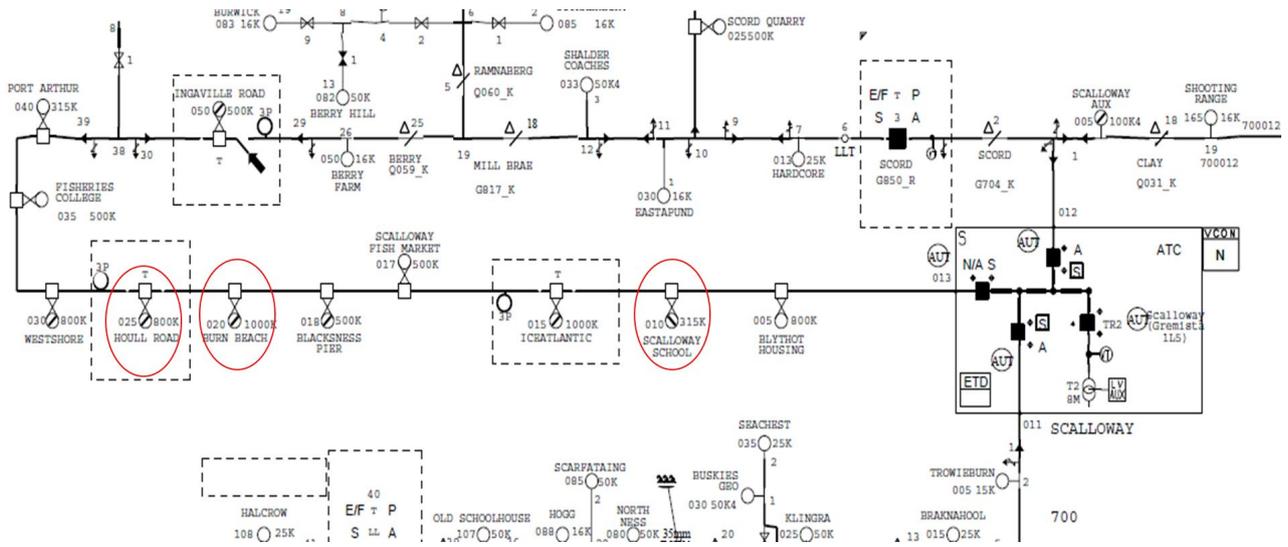
SSEN GIS – Brae Community Hall



SSEN GIS: Brae High School and Leisure Centre



# APPENDIX D SCALLOWAY GRID ASSESSMENT

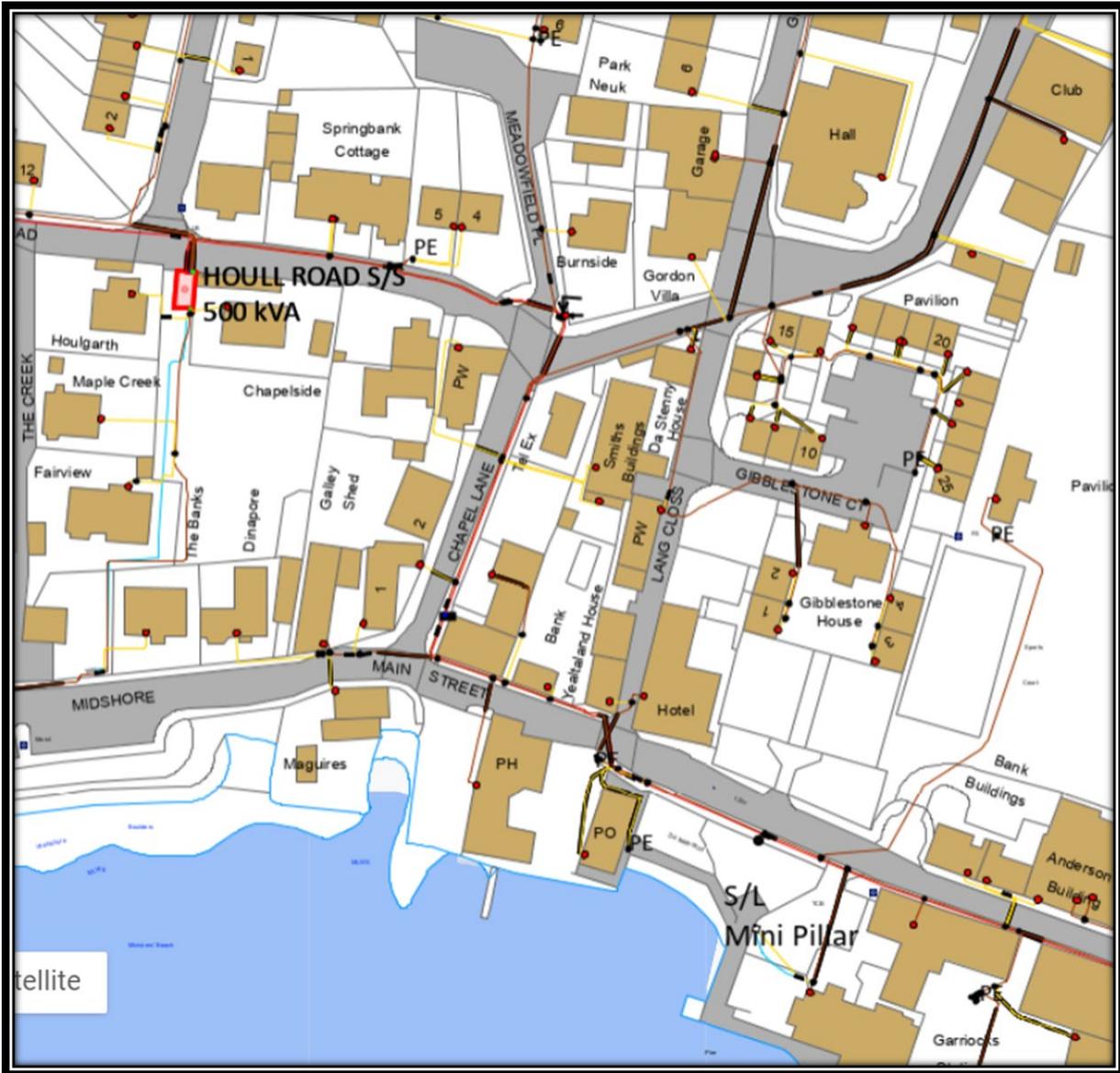


<b>NRN</b>	<b>Primary (Source) Substation</b>	<b>Customers</b>	<b>Rating (MVA)</b>	<b>Demand (MVA)</b>	<b>Fault Level (kA)</b>	
700	SCALLOWAY	1,662	#N/A	#N/A	#N/A	
<b>NRN</b>	<b>HV Feeder</b>	<b>Customers</b>	<b>Summer (Amps)</b>	<b>Autumn (Amps)</b>	<b>Winter (Amps)</b>	<b>Spring (Amps)</b>
013	BLYTHOT HOUSING	657	86	111	113	100
<b>Previous year</b>						
	<b>Summer (Amps)</b>	<b>Autumn (Amps)</b>	<b>Winter (Amps)</b>	<b>Spring (Amps)</b>		
	97	83	113	122		
<b>NRN</b>	<b>Distribution Transformer</b>	<b>Customers</b>	<b>Rating (kVA)</b>	<b>Demand (kVA)</b>	<b>Demand (Yr - 1)</b>	<b>Demand (Yr - 2)</b>
025	HOULL ROAD	195	800	Unknown	Unknown	Unknown

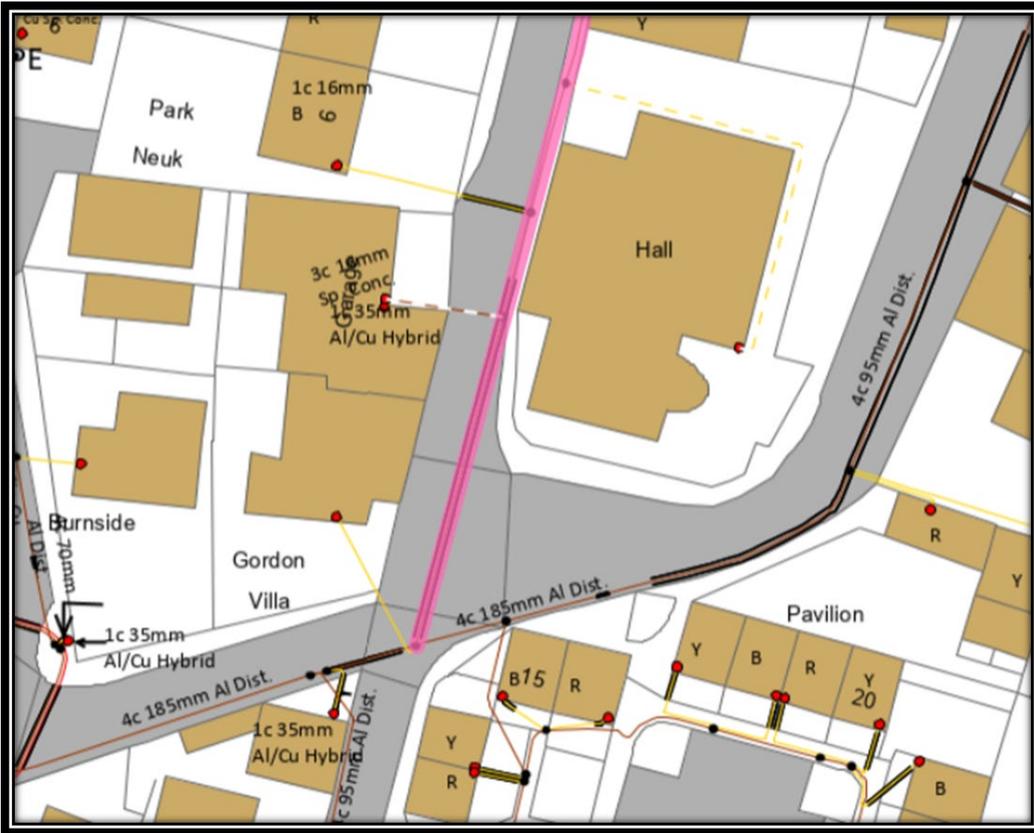
<p>Scalloway Community Hall</p> <ul style="list-style-type: none"> <li>•single phase LV supply</li> <li>•Suspect 500kVA or 800kVA secondary substation Houll Road ground mounted – area is fairly meshed</li> <li>•Existing cable in area is 185_Al_Districable_4c (final supply is not)</li> </ul>	<p>Scalloway Youth Centre</p> <ul style="list-style-type: none"> <li>•3phase LV supply</li> <li>•Suspect 1000kVA secondary substation Burn Beach ground mounted – area is fairly meshed</li> <li>•Existing cable in area is 4c 35mm Al</li> </ul>	<p>School, Pool and Health Centre</p> <ul style="list-style-type: none"> <li>•3phase LV supply at pool</li> <li>•315kVA secondary substation ground mounted - Scalloway School</li> <li>•Existing cable in area is 4c 95mm Al</li> <li>•Exact supply point is not clear – possible that school and health centre are effectively on a private wire network</li> </ul>
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SSEN GIS: Scalloway

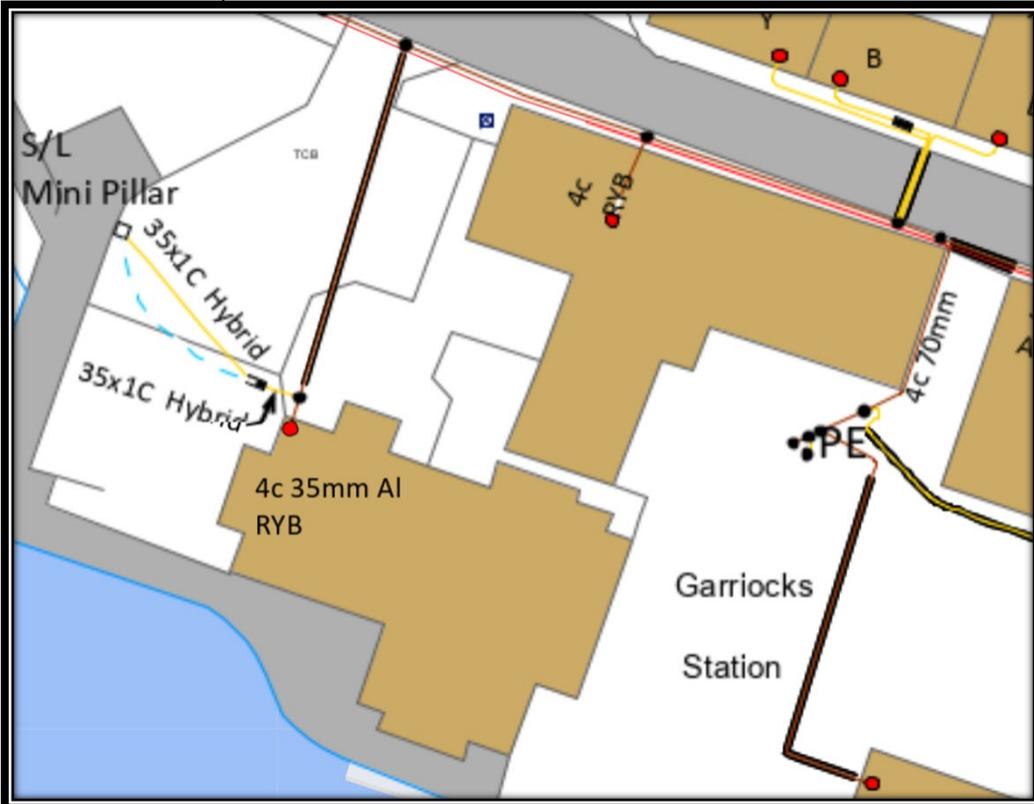




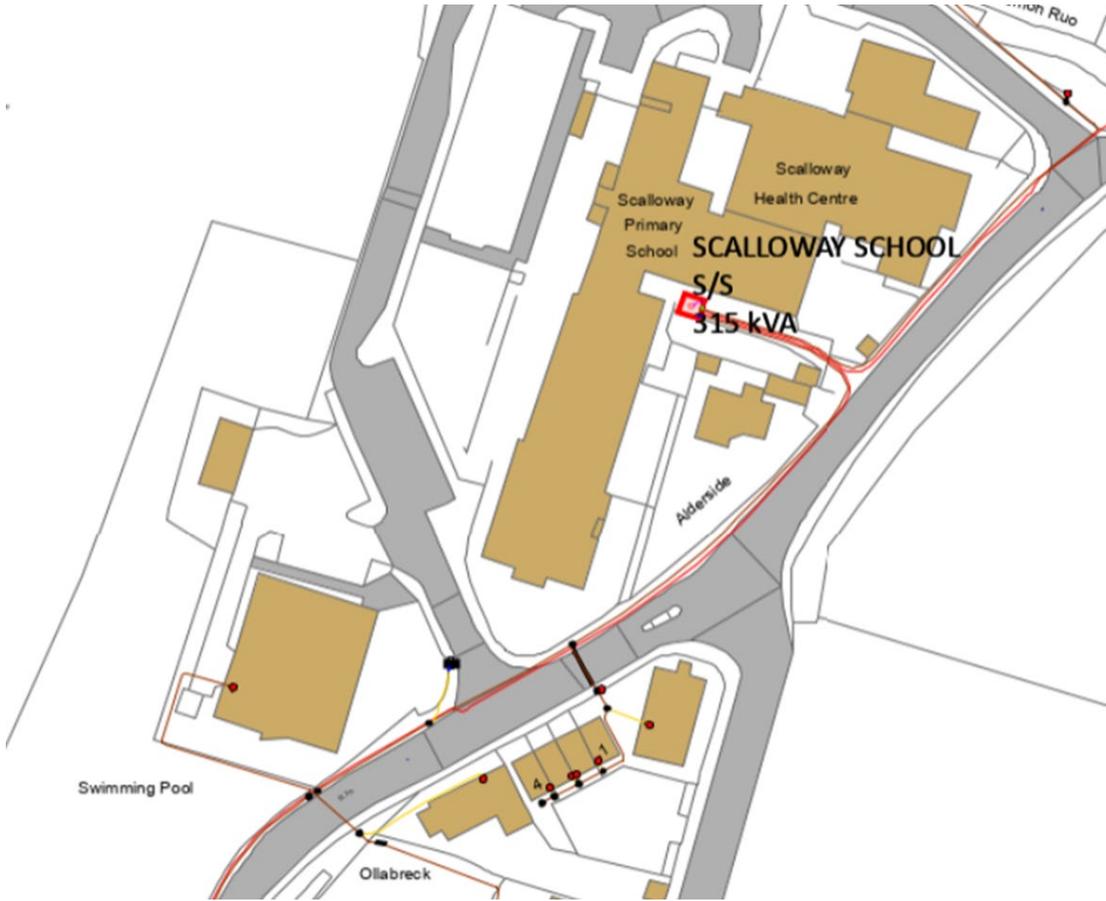
SSEN GIS: Scalloway Community Hall



SSEN GIS: Scalloway Youth Centre

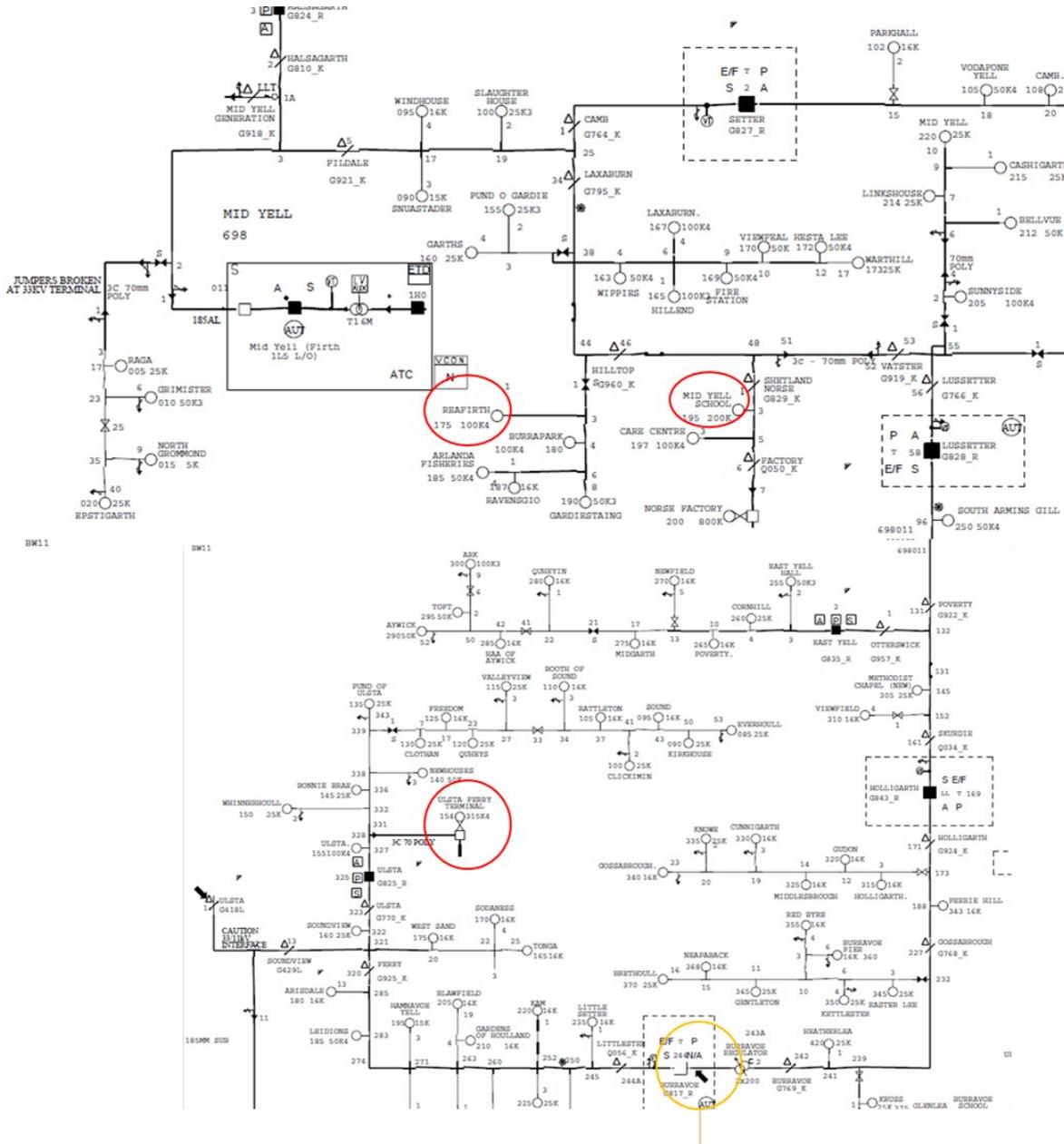


SSEN GIS: Scalloway School Pool and Health Centre



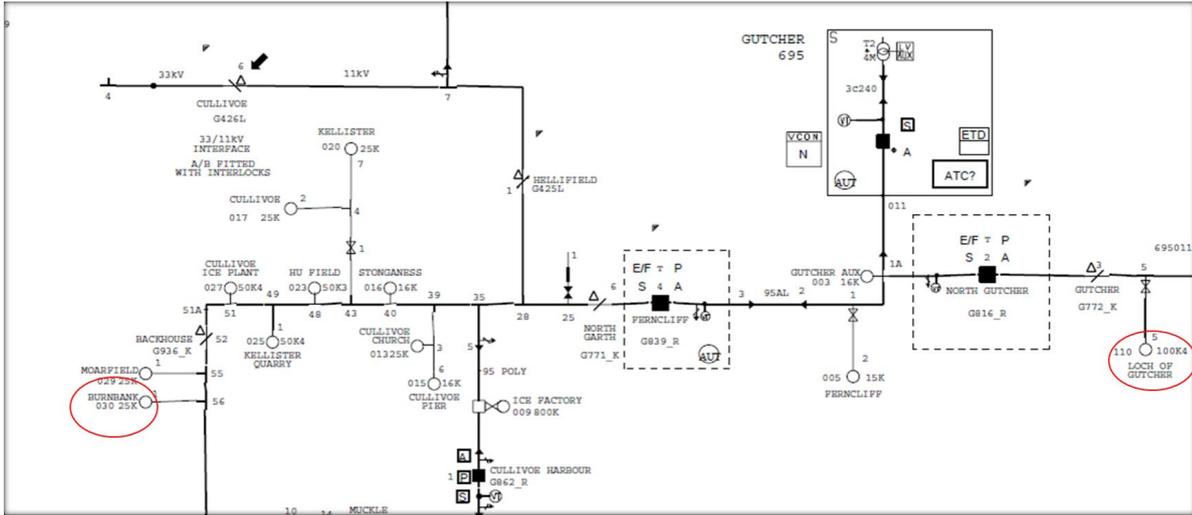
# APPENDIX E YELL GRID ASSESSMENT

## Yell 11kV Network



Gutcher, Yell 11kV Network





Customer Load: Mid Yell

NRN	Primary (Source) Substation	Customers	Rating (MVA)	Demand (MVA)	Fault Level (kA)
698	MID YELL	417	#N/A	#N/A	#N/A

NRN	HV Feeder	Customers	Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
011	FILDALE	417	34	45	46	38

Previous year			
Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
31	25	107	38

NRN	Distribution Transformer	Customers	Rating (kVA)	Demand (kVA)	Demand (Yr - 1)	Demand (Yr - 2)
195	MID YELL SCHOOL	5	200	Unknown	Unknown	Unknown
175	REAFIRTH	16	100	Unknown	Unknown	Unknown

Customer Load: Firth

NRN	Primary (Source) Substation	Customers	Rating (MVA)	Demand (MVA)	Fault Level (kA)
692	FIRTH	386	#N/A	#N/A	#N/A

NRN	HV Feeder	Customers	Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
053	FIRTH CAMP	325	Unknown	Unknown	Unknown	Unknown

Previous year			
Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
Unknown	Unknown	Unknown	Unknown

NRN	Distribution Transformer	Customers	Rating (kVA)	Demand (kVA)	Demand (Yr - 1)	Demand (Yr - 2)
154	ulista ferry terminal	2	315	Unknown	Unknown	Unknown

Customer Load: Gutcher

NRN	Primary (Source) Substation	Customers	Rating (MVA)	Demand (MVA)	Fault Level (kA)
695	GUTCHER	250	#N/A	#N/A	#N/A

NRN	HV Feeder	Customers	Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
011	NORTH GARTH	250	65	100	45	85

Previous year			
Summer (Amps)	Autumn (Amps)	Winter (Amps)	Spring (Amps)
65	54	48	55

NRN	Distribution Transformer	Customers	Rating (kVA)	Demand (kVA)	Demand (Yr - 1)	Demand (Yr - 2)
030	BURNBANK	3	25	Unknown	Unknown	Unknown
110	LOCH OF GUTCHER	6	50	Unknown	Unknown	Unknown

<p>North Yell Dev Centre</p> <ul style="list-style-type: none"> <li>•Single phase LV supply</li> <li>•25kVA secondary substation pole mounted (Burnbank)</li> <li>•Existing cable in area is 35 x1C Al/Cu</li> </ul>	<p>Yell Leisure Centre &amp; Mid Yell Junior High School</p> <ul style="list-style-type: none"> <li>•3phase LV supply</li> <li>•200kVA secondary substation pole mounted (Mid Yell School)</li> </ul>	<p>Mid Yell Community Hall</p> <ul style="list-style-type: none"> <li>•single phase LV supply</li> <li>•100kVA secondary substation Reafirth pole mounted</li> <li>•Existing cable in area appears to be 4c 70mm so</li> </ul>	
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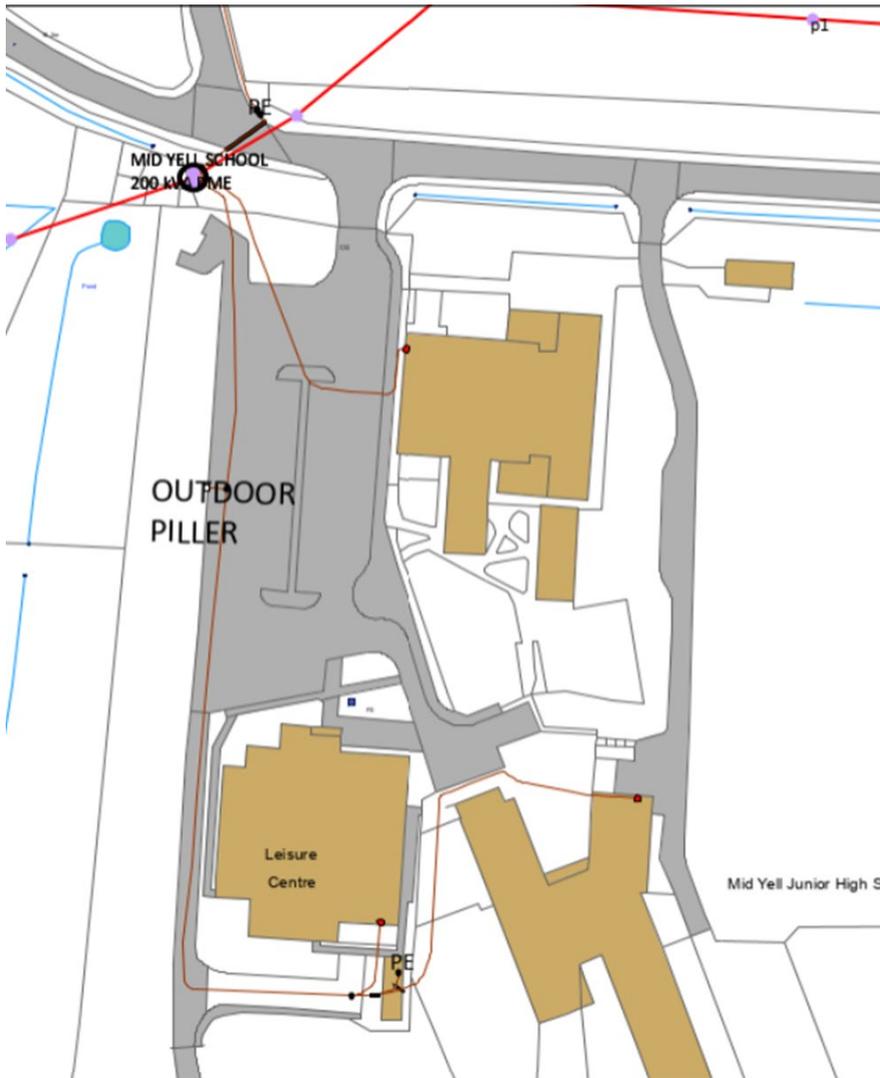


	<ul style="list-style-type: none"> <li>Existing cable in area is 4 core</li> </ul>	<p>may be possible of 3 phase - unknown if transformer is 3ph</p>	
<p>Gutcher Ferry Terminal – North Yell</p> <ul style="list-style-type: none"> <li>Lack of information</li> <li>50kVA or 100kVA secondary substation Loch of Gutcher (GIS and 11kV schematic show different capacity)</li> <li>Existing OHL in area is 3 phase</li> </ul>		<p>Ulta Ferry Terminal – South Yell</p> <ul style="list-style-type: none"> <li>Single phase LV supply in building to South.</li> <li>Expect harbour has its own network.</li> <li>315kVA secondary substation Ulsta Ferry Terminal – expect 3ph</li> <li>Fed from Firth Primary Substation (based on normal open points)</li> <li>Existing cable in area is 4c and 3c</li> </ul>	

SSEN GIS: Morth Yell Development Centre



SSEN GIS: Yell Leisure Centre & Mid Yell Junior High School



SSEN GIS: Mis Yell Community Hall



SSEN GIS: Gutcher Ferry Terminal





SSEN GIS: Ulsta ferry Terminal

