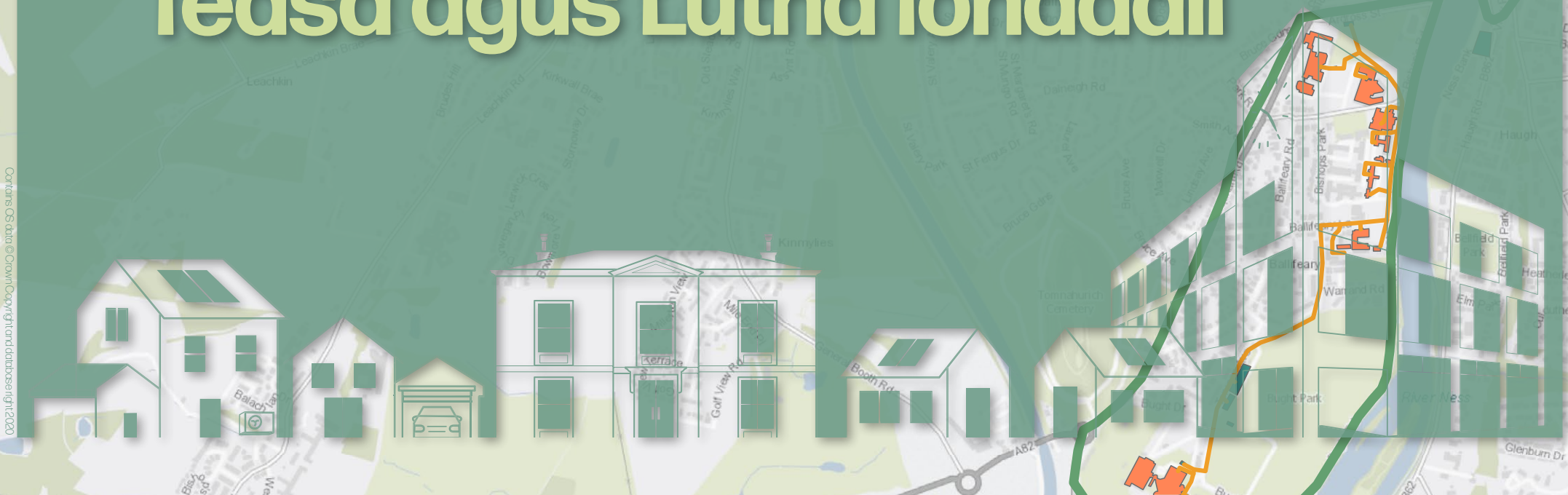
The Highland Council
Comhairle na Gàidhealtachd

Local Heat & Energy Efficiency Strategy

Ro-innleachd Èifeachdas Teasa agus Lùtha Ionadail



Foreword
Facal-toisich

The Highland Council is delighted to introduce the first iteration of the Local Heat and Energy Efficiency Strategy (LHEES). This Strategy underpins the Highland-based approach to improving energy efficiency and achieving heat decarbonisation across domestic and non-domestic buildings in the region.

The Strategy identifies area-based solutions and actions by setting out how these works could be coordinated and undertaken to help achieve Scotland's legally binding Net Zero commitments. It provides a strategic framework to attract investment and target existing and future funding.

Communities are already experiencing the impacts of climate change in the Highlands. The Council declared a climate and ecological emergency in 2019 and has adopted the Scottish Government's target to achieve Net Zero by 2045 at the latest, in order to become a greener and more sustainable local authority area. It enables us to build on the progress we have made to date and continue our journey to becoming a resilient and sustainable Council.

The Strategy is a long-term plan for decarbonising heat and improving energy efficiency for all buildings across the Highland Council area and the Delivery Plan sets out how the Council and its stakeholders propose to support implementation of its first LHEES. By working collaboratively with the Highland-wide stakeholders to deliver the Strategy and Delivery Plan, LHEES is a step in the right direction to help improve the energy efficiency of Highland's buildings and become a Net Zero region.

Karl Rosie
Chair of Climate Change Committee

Derek Brown
Chief Executive

Raymond Bremner
The Leader of The Highland Council

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1 Introduction
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The Local Heat and Energy Efficiency Strategy (LHEES) is at the heart of a place based, locally led and tailored approach to the heat transition. The Strategy underpins an area-based approach to heat and energy efficiency planning and delivery. It sets out the long-term plan for decarbonising heat in buildings and improving their energy efficiency across an entire local authority area.

The LHEES sits below Scotland's national Heat in Buildings Strategy which sets out a national vision that by 2045 our homes and buildings will be cleaner, greener, and easier to heat whilst no longer contributing to climate change. The Strategy supports economic investment and supply chain development and introduces LHEES to support the coordination of activities at the local level to help meet targets relating to energy efficiency and heat.

Key targets outlined in national plans and strategies:

For the Highland Council, the development and implementation of the Strategy will help influence a regional approach for heat decarbonisation in both public and private buildings. Tackling climate change, decarbonising heat, improving the energy efficiency of buildings, reducing fuel poverty, supporting supply chain and skills retention and local development and community wealth building are key local priorities.

The LHEES is a step in the right direction to help the Council align their own individual targets and priorities to the wider target of achieving Net Zero.

- **Net Zero emissions by 2045 and 75% reduction in emissions by 2030**
- **by 2030 emissions from buildings must be 68% lower than 2020 levels, which requires zero emissions heating in:**
  - **the vast majority of 170,000 off-gas heated homes**
  - **at least 1 million on-gas homes**
  - **50,000 non-domestic buildings**
- **by the end of 2032 all social housing is to have an Energy Performance Certificate (EPC) of B or above**
- **by 2033 all homes in Scotland are to meet the equivalent of EPC C or above**
- **by 2038 all publicly owned buildings are to meet the Net Zero emission heating requirement**
- **by 2040 no more than 5% of households in fuel poverty and no more than 1% of households in extreme fuel poverty**
- **by 2045 all homes and buildings are no longer contributing to climate change.**

1.1 Strategy Layout

This section summarises the structure and layout of the Strategy.

- **Background Information – introduces LHEES, its structure, function, local priorities, and approach.**
- **Local Authority Progress – summarises the LHEES Considerations, the Heat in Buildings Strategy, Heat Networks (Scotland) Act 2021, and Fuel Poverty (Scotland) Act 2019 and addresses the Highland Council progress towards heat decarbonisation, energy efficiency, fuel poverty (with focus on energy efficiency as a driver), heat networks, technologies and measures including renewable energy technologies, support for energy efficiency, and heating upgrades for the community.**
- **Policy and Strategy Context – sets out national, regional, and local heat and energy efficiency policy landscape, including a review of Scottish, UK and local policies and drivers relevant to LHEES.**
- **Baselining – overview of how the Highland Council baseline is performing including building characteristics, energy efficiency performance, fuel type, tenure, and historic buildings.**
- **Generation of Strategic Zones & Pathways, including Potential Zones [1] for Heat Networks – presents the Council Strategic Zones for the LHEES Considerations and sets out what needs to be done to change buildings and relevant local infrastructure over the next 15-20 years to fulfil the Scottish Government's objectives and local priorities relating to heat and energy efficiency in buildings.**
- **Summary of Strategy Findings and Next Steps – includes the main findings set out in the Strategy.**
- **Delivery Plan – includes a summary of high-level actions to take forward in the first LHEES Delivery Plan.**
- **Appendices – summarises the models, tools, templates used and additional information to complete the Strategy.**

1.2 Strategy Scope and Limitations

The scope of the Council LHEES is to:

- **focus on energy efficiency and heat decarbonisation to identify opportunities to target the domestic and non-domestic stock**
- **set out how each segment of a building needs to change to meet local and national objectives including Net Zero and energy efficiency to reduce fuel poverty**
- **identify potential heat decarbonisation zones**
- **identify key areas for the first iteration of LHEES to deliver against local and national priorities**
- **act as a prospectus for where government funding and private investment for heat decarbonisation and energy efficiency should be targeted.**

Accompanying the Strategy, the Council has developed the Delivery Plan in partnership with key stakeholders to identify short-term actions streaming from the LHEES. This provides a prospectus for local communities, government, investors, developers and wider stakeholders, pinpointing areas for targeted intervention and early, low-regret actions.

There are limitations to the LHEES methodology [2] in terms of the scope, data and the tools developed, and these can be found in the LHEES methodology (v4) guidance Section 2.7 'Limitations to the methodology'.[3]

During the development of the Council-wide LHEES, several limitations and mitigation measures were identified, these are listed in **Appendix A.**

[1] The analysis carried out for strategic zoning and pathways for the heat networks. Consideration is to identify potential zones.

[2] The LHEES methodology is a more detailed, step-by-step approach, which includes models, tools, and templates, and represents best practice in how to produce an LHEES in accordance with the requirements set out in the LHEES Order and Guidance.

[3] LHEES methodology V4.pdf

2 Background Information
Cùl-fhiosrachadh

2.1 LHEES Structure

As established in the Local Heat and Energy Efficiency Strategies (Scotland) Order 2022, LHEES has a two-part structure.

1. **Strategy which underpins an area-based approach to heat and energy efficiency planning and delivery and sets out the long-term plan for decarbonising heat in buildings and improving their energy efficiency across an entire local authority area.**
2. **Delivery Plan which sets out how a local authority proposes to support implementation of the Strategy.**

There are 8 LHEES Stages proposed in the LHEES methodology. Stages 1-4 feed into the Strategy and Stages 5-7 feed into the Delivery Plan.

2.2 Function of LHEES

LHEES sets out a long-term plan for decarbonising heat in buildings and improving their energy efficiency across an entire local authority (LA) area, framed around the LHEES Considerations set out in **Table 1**. A full description of them can be found in **Appendix B**.

Table 1 – **Summary of the LHEES considerations**

	No.	LHEES Considerations	Description
Heat decarbonisation	1	Off-gas grid buildings	Transitioning from fossil fuel heating such as oil and Liquefied Petroleum Gas (LPG) in off-gas areas
	2	On-gas grid buildings	On-gas grid heat decarbonisation
	3	Heat networks	Decarbonisation with heat networks
Energy efficiency and other outcomes	4	Poor building energy efficiency	Poor building energy efficiency
	5	Poor building energy efficiency as a driver for fuel poverty	Poor building energy efficiency as a driver for fuel poverty
	6	Mixed-tenure, mixed-use and historic buildings	Mixed-tenure, mixed-use buildings, listed buildings, and buildings in conservation areas

2.3 Local Priorities

The Council-wide LHEES takes the LHEES Considerations into account and ensures that they are set out against our own local priorities and drivers listed in **Figure 1.**

Figure 1 - Local priorities and drivers

Decarbonisation

- 35% of domestic properties in the area are on-gas, which is significantly less than the average for Scotland (83%).
- 61% of domestic dwellings are beyond the reach of the gas grid network.
- Electricity is the main fuel type across the non-domestic stock.
- the non-domestic stock accounts for the total heat demand of 947,753 (MWh/yr).

Fuel poverty

- 33% of households are experiencing fuel poverty in the Highlands, compared to the national average of 24%.
- 22% of all households are facing extreme fuel poverty, which is nearly double the national average, at 12%.

Energy efficiency, mixed-tenure, mixed use, and historic buildings

- Historic Environment Scotland estimates that there may be around 450,000 traditional buildings in Scotland.
- There are 8 conservation areas within Caithness, Sutherland and East Ross, 11 within Ross, Skye and Lochaber, and 11 within Inverness, Nairn, Badenoch and Strathspey.
- There are 127,066 domestic properties on the Energy Saving Trust's Home Analytics database in the Highlands.
- It is estimated that there are approximately 16,086 registered private sector landlord properties in the area.
- It is estimated that the Highland Council region has one of the highest proportions of second home ownerships in Scotland. In 2022, it was estimated to be around 3% of dwellings.[4]
- The Council manages around 14,800 social properties.
- The Highland Council owns and operates over 1,000 non-domestic sites with more than 2,300 associated individual utility supplies, including:
    - Over 200 primary and secondary educational sites.
    - 35 sport and leisure facilities, including swimming pools and sports centres.
    - 78 offices, 38 depots, 51 electric vehicle charging points.

The Council also owns many other facilities supporting the provision of services in relation to social care, community, infrastructure, economic development and the environment.

- 55% of Highland's population lives in remote small towns (17%) and remote rural areas (37.9%).
- There are 16,904 non-domestic buildings on the Energy Saving Trust's Non-Domestic Analytics (NDA) database.

Supply chain

- Approximately 80% of the Council's carbon footprint relates to Scope 3[5] emissions. A comprehensive analysis of supply chain emissions is underway, allowing the Council to work with suppliers and contractors to identify ongoing emissions reduction.

Skills retention

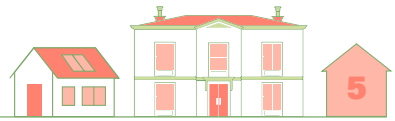
- Some sparsely populated areas are projected to lose more than 20% of their working age population from 2018 to 2043.
- Large proportion of young people want to leave the Highlands. Key drivers include higher education prospects and pay.[6]
- Population is projected to decline in Caithness (~21%) and Sutherland (~12%) by 2041.[7]
- Population is projected to increase in Ross and Cromarty (+9%), Skye and Lochalsh (+12%) but decrease in Lochaber (-6%) by 2041.
- Population is projected to increase in Inverness (+11%), Mid Ross (+12%, Nairn (+7%) but decline in East Ross (-14%) and Badenoch and Strathspey (-5%).
- Employment in construction by area:
    - 6.3% in Lochaber, Skye and West Ross.
    - 6.3% in Caithness and Sutherland.
    - 7.4% in Inner Moray Firth.

Skills development and upskilling

- Green Educational developments are currently being managed by the Highlands and Islands University Centre for Sustainable Communities. Smaller projects are looking to integrate circular economic learning into scientific, construction and engineering courses. Youth unemployment by area in 2020:
    - Caithness and Sutherland rose from 5.5% to 9.0%.
    - Lochaber, Skye and West Ross rose from 2.3% to 7.6%.
    - Inner Moray Firth rose from 3.5% to 8.1%.
    - National rate is 8.3%.

Local development

- The Council is currently developing a new Highland-wide Local Development Plan (HLDP).
- The Scottish Government has introduced Local Place Plans for communities to have a more direct role in the decisions that influence their local community. Community-led groups will be invited to create and submit their local Place Plans by end-January 2024. The Council will keep a register of Local Place Plans and once registered, it has a legal responsibility to take Local Place Plans into account while preparing the Local Development Plan.
- The Caithness Place-Based Demonstrator aims to learn about how organisations, services and communities can work together in new ways to improve local outcomes in Caithness to make communities more resilient and sustainable. The project is supported by Hub North Scotland Limited and Scottish Futures Trust (SFT) and partner organisations such as Caithness Voluntary Group, NHS Highland, Highlands and Islands Enterprise (HIE), University of the Highlands and Islands (UHI) to allow share lessons leaned and develop new Place Based Reviews to support the Council and our communities.



- The Highland Council has developed the Indicative Regional Spatial Strategy that by 2050, the Highland will be an exemplar carbon action region by optimising its unique, rich, and diverse assets to lead national emissions reduction targets. It will help attract new and emerging sectors and diversify jobs and skills.
- The Council supports sustainable rural developments to encourage thriving business and communities.

Resilience and adaptation

- Climate change is affecting the region's built environment and we are experiencing extreme weather events such as storms, higher temperatures, wildfires, and excess rainfall causing flooding and landslips.
- Resilience is at risk in the Highlands.

Net Zero Strategy and local energy policies

- The Council declared a climate emergency on 9th May 2019. It has developed strategic delivery plans to achieve the legally binding targets to Net Zero by reducing emissions relating to fleet, waste, and energy use across our estate.
- The Council's energy use across our built estate (consumption of electricity, gas, oil, in LPG and biomass) accounts for 76% of our corporate emissions.
- For financial year 2021-22, carbon emissions from the Council's built estate amounted to 25,582 tCO2e.
- Inflation impact on capital investment (cost increase of around 30% seen so far).

Community wealth building

- The Council will develop a Community Wealth Building Strategy and Action Plan for consideration in March 2024. It aims to create new employment opportunities, help sustainable businesses and provide more economic assets to the local community.
- There are over 8,000 voluntary community groups in the Highlands and Islands delivering focused services to meet local needs.
- The Highlands and Islands region has 99% of Scotland's community-owned land and 59% of community-owned assets.

Building repairs

- Unsuitable repairs may damage the fabric of the building. Careful consideration and advice need to be sought before commencing any energy efficiency works.
- Engagement with the services of a skilled tradesperson to make repairs to any buildings and traditional buildings is generally recommended.[8]

2.4 LHEES Approach

This section sets out the approach undertaken by the Council to deliver the analysis required to develop the Strategy.

Pilot programme

The Council has participated in the LHEES pilot programme from September 2017 to March 2019 to gain a better understanding of what an LHEES involves and has tested and developed methods for creating a LHEES.

Stages 1-4 analysis

The Highland Council has appointed Changeworks as their consultant to produce outputs for Stages 1-4 that feed into the Strategy. A summary of Stages and their outcomes are presented in **Table 2** below.

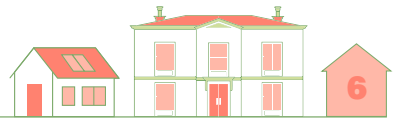


Table 2 – **Summary of the LHEES Considerations**

LHEES Stage	LHEES Stage Description	Outcomes
Stage 1	• Sets out national and local policies relevant to LHEES and provides an opportunity to consider how the national landscape could be linked to local drivers. • For each priority, it sets out Indicators and Weighting that underpin analysis across the other stages. • It enables the mapping of key internal and external stakeholders and funding opportunities to support the Delivery Plan actions.	• A summary of national and local policies, strategies and legislation, funding sources, stakeholders, Indicators, and Weighting.
Stage 2	• Identifies the most appropriate data and information needed to support analysis of the LHEES Stages. • The library captures data requirements for the priorities, acting as a record of data sets and provides associated detail on ownership, data sharing, and key contacts.	• Data and tools library spreadsheet capturing all relevant information as listed in Stage 2 description (Appendix C).
Stage 3	• Offers an assessment of the current energy efficiency and heat decarbonisation performance of the building stock at a local authority level against the indicators from Stage 1-2.	• Baseline Tool, summary table at Data Zone[9] level, top priority Data Zones per Category, 21 PDF maps, ArcGIS[10] shapefiles, Geographic Information System (GIS) data guide.
Stage 4	Uses GIS techniques to generate initial delivery areas[11] for each of the priorities.	• Heat Network output table, All Buildings template, Off-gas Domestic template, On-gas Domestic Template, non-domestic stock template and GIS files.

Workshops

As part of the approach undertaken by the Council to carry out the analysis required to complete the LHEES, we ran several internal workshops.

LHEES Working Group

A LHEES Working Group was established and meets frequently to assist in the development of the Strategy and Delivery Plan.

The Working Group consists of Property Management, Housing, Development Planning and Climate Change and Energy colleagues.

The remit of the group is to review the Stage 1-4 results and assign responsibility and accountability for the final LHEES, Stages 5-8 steps.

Secondly, the LHEES Working Group supported the creation of an engagement plan for the external stakeholders to be involved in the finalisation of the Delivery Zones and Areas, and those that will shape the direction of the Delivery Plan.

Engagement and consultation

During the development of the Highland Council LHEES, robust internal and external stakeholder engagement took place. Key stakeholder engagement activities included:

- Internal engagement to determine the scope of the LHEES prior to the pilot programme.
- Internal engagement with Housing, Property, Planning, Climate Change and Energy Colleagues.
- Ongoing engagement with strategic partners such as Zero Waste Scotland (ZWS), SFT, Heat Network Support Unit (HNSU), Scottish Government and Hub North Scotland Limited.
- Ongoing engagement with other LAs through the Local Authority Forum and LHEES Governance & Oversight Group.
- Engagement with social landlords and other relevant parties.
- Engagement with the Highland Council area's public and private stakeholders through consultation on the LHEES and Delivery Plan.

2.5 Local Authority Formalities

The Council has considered several impact assessments to support the development of the Strategy and Delivery Plan, and these are summarised in **Table 3**.

Table 3 – Summary of Impact Assessments

Impact assessment
Climate Change Impact Assessment
Child Rights and Wellbeing Impact Assessment
Island Communities Impact Assessment
Equality Impact Assessment
Rural Impact Assessment
Poverty Impact Assessment
Data Protection Impact Assessment
Strategic Environmental Assessment (SEA)

The identification of Strategic Zones and Delivery Areas through the Strategy and Delivery Plan are indicative only. Any potential site-specific impacts are assessed at the subsequent detailed planning and implementation stage, where required, before any proposals are finalised.

The strategic designation and review of Heat Network Zones will be subject to appropriate levels of assessment, against the requirements of the Environmental Assessment (Scotland) Act 2005 and as required under separate duties in the Heat Network (Scotland) Act 2021.

The Council LHEES is subject to oversight and scrutiny by the Climate Change Committee which provides advice and guidance on the climate, ecological and environmental sustainability agenda. The Committee has received regular updates throughout the development of LHEES. The Strategy and Delivery Plan will be presented to the full Council on the 14th of December 2023.

[4] www.spice-spotlight.scot/2022/09/07/second-homes-in-scotland-facts-figures-and-policy (SPICe Spotlight)

[5] Note: Scope 3 (indirect other) emissions occur from assets not owned by the Council such as commuting, purchase of goods and services.

[6] Note: Between 2021 and 2022, the Highlands and Islands University (UHI) and Skills Development Scotland conducted a research survey (Women into STEM (science, technology, engineering and mathematics) – Rural) and found that 35% of women are wanting to leave and 38% apathetic to staying in the Highlands.

[7] Note: Highlands and Islands Area Profiles 2020 can be found at: www.bit.ly/HIE-area-profiles-2020

[8] Note: According to Historic Environment Scotland, these are the buildings constructed before 1919 - www.bit.ly/HES-traditionalbuildings-history

[9] Note: Data zones are groups' output areas which have populations of around 500 to 1,000 residents.

[10] Note: ArcGIS is geospatial software to view, edit, manage and analyse geographic data.

[11] Note: Delivery areas are at a higher granularity than Strategic Zones. These spatial zones should set out clusters of buildings within a Strategic Zone or across the whole local authority that identify potential solution(s) at a delivery level.

3 Local Authority Progress
Adhartas Ùghdarrais Ionadail

This section presents national context and local progress towards:

- **heat decarbonisation**
- **energy efficiency**
- **fuel poverty (with focus on energy efficiency as a driver)**
- **heat networks**
- **technologies and measures including renewable energy technologies (heat pumps, biomass), hydrogen, and insulation.**

3.1 Function of LHEES

The Scottish Government has published its updated Heat in Buildings Strategy[12] in October 2021, which sets out a vision for Scotland's homes and buildings to be greener and easy to heat by 2045. The Strategy focuses on energy demand for space and water heating in homes, workplaces and community buildings. It sets out the actions we need to take to reach legally binding climate change targets, maximises economic opportunities and aims to remove poor energy performance as a driver of fuel poverty. LHEES is part of delivering the Heat in Buildings Strategy and will support local planning, coordination, and delivery of the heat transition in Scotland.

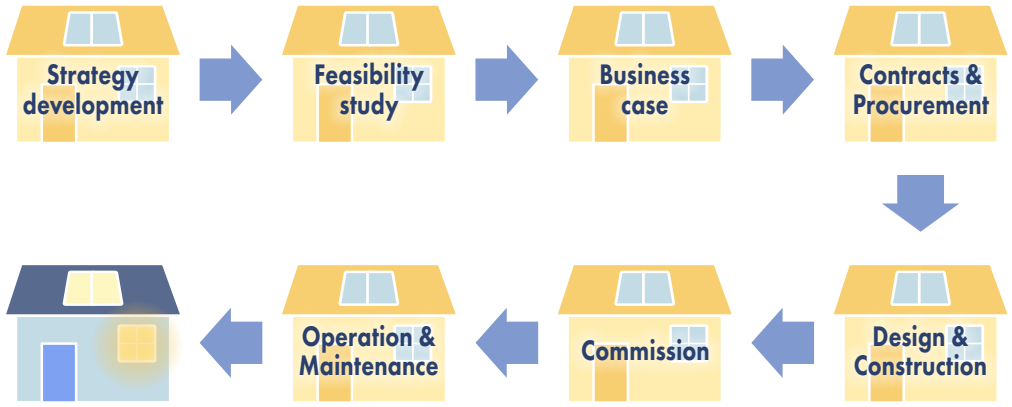
Heat decarbonisation requires a move away from fossil fuel towards low and zero emissions heating resources. Heat networks are a key strategic technology for reducing emissions from heating our homes and buildings in Scotland. The Heat Networks (Scotland) Act 2021 (the Act)[13] received Royal Assent in February 2021, which aims to accelerate the deployment of heat networks in Scotland through the introduction of a regulatory system aimed at boosting consumer confidence in the sector and providing greater certainty for investors. The Act contains a wide range of provisions that will allow Scottish Ministers to implement this new regulatory system, and these can be found in **Appendix D**.

The Scottish Government has published the Heat Networks Delivery Plan[14], which outlines how the provision of the Act, and other supporting policies contribute to increasing the use of heat networks in Scotland and meeting its statutory obligations.

The LHEES has a significant role to play in the deployment of heat networks by designing zones suitable for heat networks. The First National Assessment of Heat Network Zones in Scotland (FNA)[15] identifies potential Heat Network Zones across Scotland, where heat networks can be considered a suitable long-term solution.

Scotland's £300 million Heat Network Fund[16] enables and supports the development of new large-scale projects and the expansion of existing heat networks in Scotland. Grant funding for feasibility studies, Outline Business Cases (OBC) and technical, financial, and legal advisors are available through the Heat Network Support Unit[17].

Figure 2 – Heat network project journey[18]



Improving the energy efficiency in buildings is crucial to reduce energy demand and tackle fuel poverty. The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019 ('the Fuel Poverty Act') sets targets related to the eradication of fuel poverty with an overarching target that by 2040, as far as reasonably practical, no household is in fuel poverty. More information can be found in **Appendix D**.

The implementation of the Strategy and Delivery Plan explores better ways to heat and insulate houses at a transformational scale. It will significantly impact on fuel poverty in the Highlands, providing warmer and more affordable ways to heat buildings.

3.2 Local Authority Progress

To date, we have achieved a significant reduction in carbon emissions from our own estate, public and private buildings, replaced street lighting with Light Emitting Diode (LEDs), introduced electric vehicles into the Council fleet, and invested in various renewable energy projects, including the Hydro Ness.

The Council continues to support sustainable development across the Highland region, encouraging renewable energy generation such as hydrogen and supports energy efficiency and heat decarbonisation programmes.

3.3 Fuel Poverty and Energy Efficiency

It is estimated that in 2018 around 619,000 households in Scotland are in fuel poverty. The figure is likely to be higher now due to increased energy costs. Fuel poverty is a critical issue facing householders across the region. Scottish Government figures indicate that 33% of households in Highland are experiencing fuel poverty, compared to the national average of 24%. In addition, 22% of all households in Highland are facing extreme fuel poverty, which is nearly double the national average of 12%[19].

In 2019, the Council declared a climate and ecological emergency in recognition of the serious and accelerating effects caused by global climate change. Since then, the Council has been significantly impacted by the COVID-19 pandemic alongside rising energy prices and inflation.

Poor energy efficiency is one of the biggest contributors to fuel poverty in the area. The Council is committed to several programmes to help reduce fuel poverty and improve energy efficiency in the region, including:

Energy Efficiency Scotland Area Based Scheme (EES:ABS)

The Council has been delivering the Scottish Government's Energy Efficiency Scotland: Area Based Scheme (EES:ABS) for 11 consecutive years, which offers households the opportunity to benefit from grant-funded energy efficiency and innovative measures such as solar photovoltaic (PV). In some cases, an owner's contribution may be required to cover the remainder of the cost for installation[20].

Examples of energy efficiency measures:

- cavity wall insulation
- loft insulation
- external wall insulation
- air source heat pump
- solar PV and battery.

Under the 2022/23 EES:ABS programme, 87% of air source heat pump installations and 90% of solar PV with battery storage installations were to households which are classed under extreme fuel poverty.

The Energy Company Obligation (ECO)

The fourth iteration of the Energy Company Obligation (ECO4) runs from April 2022 – March 2026 and provides funding for domestic properties for various energy efficiency improvements for householders in fuel poverty, low income and vulnerable to cold temperatures. It aims to improve the efficiency of the least energy efficient homes which helps to meet the Scottish Government's fuel poverty and Net Zero commitments.

The Energy Company Obligation Flexible Eligibility (ECO4 Flex) and Great British Insulation Scheme Flex (GBIS Flex) provide funding for domestic properties towards energy efficiency upgrades for householders in fuel poverty and on low income and vulnerable to cold.

There are different criteria for owner-occupied, private rented, and social rented properties. For instance, the ECO4 scheme is also available for socially owned properties with an EPC[21] rating of E-G or D where innovation measures are included.

Warmer Homes Scotland (WHS)

Householders across Highland are already benefiting from the WHS scheme run by Warmworks, the Managing Agent of the Scottish Government, to make homes warmer and help save money on energy bills. The scheme was opened to applicants in September 2015 to spend at least £16 million plus VAT per year for up to seven years. Additional budget has been allocated to help those in fuel poverty. In October 2023, the scheme was relaunched with up to £728m available over the next 7 years.

In the Highlands, 2,095 of households were supported from 1st September 2015 to 31st March 2023, with a total of 11,619 energy efficiency measures installed. 513 of these households were supported in the last two years, with 2,730 energy saving measures implemented[22].

Private Sector Funding

The Council and SSE Renewables have joined forces, helping Highland households facing extreme fuel poverty make energy saving adaptations to their homes.

The EES:ABS programme has received vital grant support from SSE Renewables Highland Sustainable Development Fund to provide an additional £1 million of grant funding over 3 years to support households in extreme fuel poverty.

In August 2023, SSE Renewables permitted an extension to a grant funding to allow the Council to fund the battery installation alongside the solar PV installations which are funded under ECO4.

The Energy Efficient Standard for Social Housing 2 (EESSH2)

The Energy Efficiency Standard for Social Housing 2 (EESSH2) set a target that all social housing in Scotland would have an EPC rating of B by the end of 2032, or be as energy efficient as practically possible. It is currently under review by the Scottish Government and this may change some of the requirements.

The Highland Council has a stock of over 14,800 social properties now. When the energy analysis on EPC ratings and EESSH compliance was done, the Council had 14,483 properties. The average energy efficiency rating of EPC is D64. Many properties have a rating of EPC band C (4,918) or D (5,615). The remainder of the 2,883 properties remain in the lowest bands E or G. Currently, 1,067 properties of the housing stock meet the EESSH2 required energy rating of 81.

The average baseline of running costs across the stock is estimated to be £1,380 per property per year, considerably lower than the average of £1,825 per year for all housing stock in Scotland[23]. These figures are from 2019 (pre-energy crisis) and current costs and potential savings are likely to be higher.

If all eligible measures were installed, the average annual running costs per household would be £991. This would be the equivalent of a 28% reduction in running costs across the entire stock per year and would help tackle poor energy efficiency as a driver for fuel poverty and make properties more energy efficient and affordable to heat.

Ongoing engagement with the Registered Social Landlords is key. It is crucial to understand how their own stock is performing, funding they have available to deliver in the Highland- based properties over the next 5 years, and areas they are planning to target.

Photo by Ewen Weatherspoon

Changeworks

Changeworks supports the delivery of energy advice and support services such as Home Energy Scotland, Business Energy Scotland, and Local Energy Scotland in Scotland and the Highlands.

They have a long-standing track record of working in strategic partnership with the Highland Council on various energy efficiency programmes such as EES:ABS and EESSH2 analysis of the Council's housing stock.

Recently, Changeworks launched a new support service for Housing Associations (HA) such as Cairn Housing Association. This facilitates the provision of access to energy information, advice, and advocacy to HA tenants.

Support with energy bills

- The Highland Council has agreed a £3 million fund to support households living in fuel poverty, with a payment of £180 made available to 16,440 eligible householders in the Highlands.
- A Winter Fuel Payment is a one-off tax-free payment of between £100-300 in winter, eligible to households with someone over Pension Credit age, in order to assist with heating costs.[24] Households in the Highlands can also receive the Warm Homes Discount (WHD)[25] scheme payment of £150 to help reduce their electricity bills in winter.
- Child Winter Heating Assistance[26] is a payment for children and young people up to the age of 18. In 2022, the payment was £214.10 per eligible child.
- Low Income Winter Heating Assistance is a benefit of £50 to low-income households. The scheme replaces the UK Government's Cold Weather Payments.
- Some suppliers provide grants to householders experiencing financial difficulties such as fuel debt.[27]
- Inverness Winter Payment is a one-off payment from the Highland Council's City of Inverness Area Committee 2022/2023 winter payments scheme to help households with their winter fuel bills.

3.4 Technologies and Measures

To date, we have achieved a significant reduction in carbon emissions from our own estate, public and private buildings, replaced street lighting with LEDs, introduced electric vehicles into the Council fleet, and invested in various renewable energy projects, including the Hydro Ness.

The Council continues to support sustainable development across the Highland region, encouraging renewable energy generation such as hydrogen and supports energy efficiency and heat decarbonisation programmes.

Renewable Energy Projects

There are several existing and emerging innovative prospects in the pipeline to support the growth of renewable energy generation and consumption in the area. The Highlands is already seen as one of the major players in offshore wind and hydrogen, fostering innovation and the generation of employment opportunities.

In spring 2023, the Council's Redesign Board approved a motion towards more green investment in solar and battery storage projects which would help LAs tackle the climate emergency and reduce energy bills for commercial tenants.

The Council's Hydro Ness is an award-winning hydroelectric scheme, situated on the banks of the River Ness in Inverness. It is a £2.67 million self-financing project which is estimated to generate and supply up to 50% of the electricity demand to Inverness Leisure Centre.

Hydrogen

The opportunity for hydrogen has not been considered in the LHEES Stage 1-4 analysis. This is due to uncertainty surrounding when or where hydrogen might become available through the existing gas network. The potential for green hydrogen generation in the region has been recognised nationally and internationally, with delegates from Germany, Japan and the United States all commenting on the prospect of production within an area so rich in natural resources.

In 2022, H2 Green and the Highland Council agreed on a vision to create a regional network of green hydrogen hubs across the Highlands to accelerate decarbonisation of the area.

The agreement aims to:

- **Produce a regional plan to develop a network of green hydrogen hubs, with hydrogen production, storage and delivery infrastructure placed at optimal locations across the Scottish Highlands.**
- **Establish commercial agreements for green hydrogen offtake, underpinned by transport decarbonisation initiatives in the Highlands.**
- **Establish commercial agreements for consumption of by-products of hydrogen generation, including oxygen and zero-emission heat.**

The Council has already contributed £100,000 from an existing £2 million investment fund to support efforts to progress its Net Zero ambition, investing in green energy and providing long-lasting benefits to local communities.

The North of Scotland Hydrogen Programme[28], has identified the Cromarty Firth[29] as one of the locations for the green hydrogen hub to produce, store, and distribute to the region, Scotland, other parts of the United Kingdom (UK), and Europe.

The site has attracted interest due to its proximity to a large-scale renewable electricity supply and a high level of demand locally for green hydrogen, including distilleries, road, rail and aviation transport industries, and the domestic sector.

The project is privately funded by partners including Scottish Power, Glenmorangie, Whyte and Mackay, Diageo and Pale Blue Dot Energy.

Heat Networks

We can learn from several exemplars of successful heat networks in the area. Some of them are listed below:

- **District Heating Scheme in Wick**
- **Caol Community District Heating Scheme**
- **Glen Mhor Hotel District Heating Scheme**
- **The Aviemore Heating Project (Albyn Housing Society Ltd)**
- **The Milton Burn, Aviemore.**

Several projects are currently being developed or are at feasibility stage of investigating heat network potential. Some of them are listed below:

- **Inverness West Bank District Heating Network (led by the Highland Council).**
- **Ormlie District Heating Network (led by Caithness Voluntary Group).**
- **Inverness Castle District Heating Network (led by the Highland Council).**
- **Blar Mhor District Heating Network (led by the Highland Council in conjunction with NHS Highland and UHI).**
- **Power and Heat plan for the Longman Energy from Waste (led by the Highland Council).**

The Council has engaged and collaborated with the HNSU and SFT to receive support with the feasibility, business case and commercialisation stages of heat network projects.

Some local communities are working closely with the Scottish Government's Community and Renewable Energy Scheme (CARES) Community Heat Development Programme to investigate the potential for developing heat networks.

Some work has already been carried out across the region to identify Heat Network Zones and complete the Building Assessment Reports (BARs)[30]. This will boost confidence in data landscaping for public sector buildings. The LHEES will help the transition from the indicative zones to the designation of Heat Network Zones.

Hub North Scotland Limited

Hub North Scotland Limited play a crucial role in the Highlands. They offer support and continue to coordinate activities of the Council with NHS Highland, Blue Light Services and 3rd Sector.

They are currently supporting the Caithness District Heating Network project in Thurso with formalisation of technical, financial and management aspects. They are also supporting extension to existing network in Wick.

They have potential to support the LHEES activity in the region to:

- **share best practices, provide regional approach and linkages to Scottish Government, SFT and energy providers.**
- **support on procurement exercises through (but not limited to) its supply chain to assist in the implementation of LHEES and other projects.**
- **offer initial discussions around funding through the Hub Institutional Funding Model (provided there is an income stream).**
- **support on retrofit through Housing Associations' Charitable Trust and link to housing programmes in other Councils such as Argyll and Bute, Aberdeen City Council and Orkney Islands Council.**

Hub North Scotland Limited have linkages with Inverness and Cromarty Firth Green Freeport opportunities. They are currently exploring areas of mutual interest and community benefits.

3.5 Financial Support for Energy Efficiency and Heating Upgrades

The following table (**Table 4**) summarises financial support[31] available in the local authority area to help with energy efficiency improvements and heat decarbonisation. Detailed information with funding criteria and how to access funding is presented in **Appendix E.**

3.6 Summary of Ongoing Work by Local Authority

The Council and wider partners are already delivering several projects to achieve heat decarbonisation, energy efficiency improvements, and fuel poverty alleviation, in respect of climate change commitments and these are summarised in **Table 5** (list not exhaustive).

Table 4 – Summary of the financial support

Private Domestic Sector Housing	Social Sector Housing	Private Sector	Community Organisations and/or Public Sector	Other support
Energy Efficient Scotland Area Based Scheme (EES: ABS)[32]	The Energy Industry Voluntary Redress Scheme	Business Energy Scotland SME Loan and Cashback Scheme	Let's Do Net Zero Community Buildings Fund	Smart Export Guarantee (SEG)[33]
Warmer Homes Scotland (WHS)	Registered Social Landlord Loan	District Heating Loan Fund	Let's Do Net Zero: Off Electricity Grid Communities Fund	Power Purchase Agreement (PPA)[34]
Home Energy Scotland Grant and Loan	Social Housing Net Zero Heat Fund	Heat Network Fund	Community Heat Development Programme	Scottish Land Fund[35]
Energy Company Obligation (ECO) 4	District Heating Loan Fund	Green Heat Innovation Support Fund	The Energy Industry Voluntary Redress Scheme	Rural Housing Fund & Islands Housing Fund[36]
Great British Insulation Scheme	Energy Company Obligation (ECO) 4	Scottish National Investment Bank	Green Public Estate Decarbonisation Scheme	
Private Rented Sector Landlord Loan			Scottish Central Government Energy Efficiency Grant Scheme	
			Scottish and Southern Electricity Networks (SSEN) Resilient Communities Fund	
			Heat Network Support Unit	
			Heat Network Fund	
			District Heating Loan Fund	
			Salix Fund	
			Energy Investment Fund	
			Scottish National Investment Bank	
			Learning Estate Improvement Plan (LEIP)	

Table 5 – Summary of ongoing work in the Highland Council area

Adaptation of a fabric first approach in EESSH2 and EES:ABS to provide energy efficiency measures and reduce fuel poverty, whilst contributing towards carbon emission reduction targets.
Ongoing work towards compliance with the EESSH2 standard to improve social housing stock and its energy efficiency to achieve EPC band B by 2032. The scheme is currently under review by the Scottish Government.
Focus to ensure that new social housing is future-proof and climate resilient and that there is an up-to-date Business Continuity Plan for Social Housing and Housing Revenue Account (HRA).
Investigation of district heat network potential to identify future opportunities and consideration for future Heat Network Zone designation to support further LHEES work.
Development of low carbon behaviour change initiatives to inform staff and management training programmes, raise awareness of climate change issues, and promote climate action to mitigate against climate change.
The development and implementation of the LHEES Strategy and Delivery Plan to decarbonise and improve the energy efficiency of domestic and non-domestic stock.
Investigation of the potential to scale up investment opportunities and identify funding sources for various low carbon and energy efficiency projects.
Persuasion of/Commitment to a more collaborative approach to retrofitting across the housing sector in the Highlands by sharing innovation and jointly developing projects to secure procurement benefits.
The SALIX Recycling Fund to identify, develop and implement energy efficiency carbon reductions.
The development and implementation of the Net Zero Strategy and Action Plan to build resilience and ensure Business Continuity.
Housing Revenue Account Capital Plan to be submitted to the Council's Housing & Property Committee in 2024/25. This will provide a long-term costed analysis for housing investment in energy efficiency works.
The delivery of the EES:ABS and ECO Programmes to target fuel-poor householders, improve energy efficiency and heating and install innovative technologies.
Support Net Zero Fund investments to help communities deliver their Net Zero plans and projects.
Embed the zero carbon standard in both new build and retrofit initiatives.
The development of hydrogen hubs throughout the area to promote greener transport and move away from fossil fuels.
Partnership working with Citizens Advice Bureau (CAB), ZWS, NHS, (Registered Social Sector Landlords (RSLs), HNSU and community groups.
Partnership with SSE Renewables on the EES:ABS scheme.
Partnership working with commercial partners.
Support the development and implementation of the Local Place Plans to empower communities to prepare Local Place Plans that lead delivery of Net Zero and climate change objectives.
Benchmarking non-domestic estate to evaluate the energy efficiency of the current Council's stock.
The development of the new Highland Local Development Plan (when adopted, it will replace the Highland-wide Local Development Plan (HwLDP) and three individual 'area' Local Development Plans (LDPs).
The Council is adapting the internationally recognised Passive House standard and looking to build its new schools, nurseries and social housing accordingly.
Local Housing Strategy (2023-2028) approved by Committee to expand availability of good quality affordable housing to enable people to live, work and study more comfortably across the Highlands and support the local economy, connect communities, and re-populate rural areas.
Continuation of referrals to current funding streams.
Estate rationalisation to reduce property maintenance costs, risk and liabilities, and release property for potential re-use, transfer and redevelopment.
Development of shared co-location facilities for all community areas (e.g. business, volunteers, and leisure).
Community Development Groups such as the Cromarty Development Trust and Arisaig Community Trust support low carbon energy projects.
LHEES provides opportunities to inform and build on existing local activity and emerging projects in terms of heat decarbonisation and energy efficiency improvements.
The Healthy Homes for Skye and Lochalsh initiative investigates the conditions in people's homes in the Skye and Lochalsh region. This is a pilot that could foster a proper repair, renovation and retrofit service for the area.
The Carbon Neutral Islands project in islands, including Raasay, to demonstrate the climate-resilience and low carbon potential of islands.
Highlands and Islands Climate Hub supports sustainable community led climate projects in Highlands and Islands.[37]
The Scottish Fire and Rescue Services are running a pilot project to replace their old inefficient fire stations with newer buildings that have space for community activities.

3.7 Case Studies

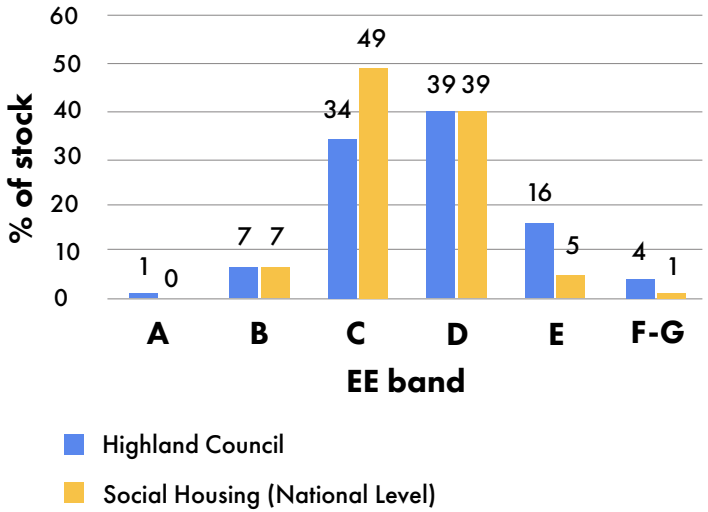
The case studies below highlight some works that are already happening in the Council area that have a strong link to the LHEES and its priorities.

Case study 1 – Meeting the EESSH2 standard

The Highland Council has a stock of over 14,800 social properties. Many of the properties are in the energy efficiency bands C (4,918 properties, 34%) and D (5,615 properties, 39%). 20% of properties (2,883) are in the lower bands of E to G. 7% of properties are in band B and only a small percentage of properties in band A.

Figure 3 summarises energy efficiency bands of the Council and Scotland's social housing stock.

Figure 3 – EE band of the Council and Scotland's social housing



The main aim of the EESSH2 standard is to improve the energy efficiency of housing in Scotland to help reduce energy consumption, fuel poverty and the emission of greenhouse gases. This means that by December 2032, social rented housing must meet an energy efficiency band of B, with a minimum energy efficiency rating of 81. The standard is currently under review.

The Council aims to adopt a fabric first approach (measures that improve thermal efficiency and reduce heat loss and incorporate any required ventilation) to housing to maximise the performance of the building fabric, followed by heating upgrades and solar measures.

It is estimated that £261m of investment is required to carry out all the technically feasible energy works throughout the Council stock. This equates to approximately £20,000 per property and does not include funding for other major component replacement investments such as kitchens, bathrooms, roofing, and rewiring.

The current HRA Capital Plan has budgeted £88.6m over the period 2022-2027, approximately £50.1m of this has been allocated to energy efficiency works. Housing Revenue Account Capital Plan to be submitted to the Council's Housing & Property Committee in 2024/25. This will provide a long-term costed analysis for housing investment in energy efficiency works.

As with other social landlords, there are concerns that the costs of improving the energy efficiency of our stock will continue to be met from our tenants. Extensive external funding will be required to drive our commitments towards Net Zero and improve the efficiency of the housing stock.

The LHEES acts as a planning mechanism for new funding and delivery programmes which could support the Council to decarbonise the heating and improve the energy efficiency of its buildings and social housing stock. This will act to both improve Council properties and also support compliance towards the EESSH2 programme.

Case study 2 – The Salix Recycling Fund

The current Salix Finance Recycling Fund provides a loan of £17 million to the Highland Council. The funding is matched by the Council's investment across a wide range of projects and together these funds create an energy efficiency fund known as 'the Local Fund'.

Your partner for a low carbon future

75% of the financial savings generated from all projects are paid back into the 'Local Fund' to finance further energy saving projects. Additionally, 25% of the financial savings can be accounted for as savings for the Council. This approach is crucial to help reduce the Council's energy consumption, reduce budget pressures and protect it from future energy increases.

The key benefits to date:

- **Estimated annual energy savings 4.4m kWh**
- **Estimated annual carbon savings 1,200 tCO2e**
- **Estimated annual savings £0.5m**
- **Lifetime savings of over £13.5m.**

Most of the funding has been invested within the school estate with the investments being data and business case driven.

Over £3 million of expenditure has been dedicated to lighting upgrades and all of that spend has directly benefited Highland-based contractors to support the local economy.

The fund has supported the Hydro Ness project to help the Council meet its ambitious climate and ecological emergency targets, generate and supply up to 50% of the electricity demand to Inverness Leisure Centre, protect the Council from future energy price increases and provide a hub for STEM[38] learning.

The fund has been established in conjunction with capital plans, as plans for heat solutions are often reliant on securing additional funding support. It is intended that this will empower the public sector to decarbonise and boost cleaner renewable energy with LHEES adding value in terms of investment prospectus.

Case study 3 – Net Zero Strategy and Action Plan

The Highland Council recognises their leadership role in addressing the climate and ecological emergency in the Highlands and has developed the Net Zero Strategy. The Strategy focuses on reducing emissions across Council operations and sets out a Route Map to Net Zero by 2045 with legally binding interim targets for building decarbonisation, alongside other sub-categories focusing on transport, waste and economy.

Accompanying the Net Zero Strategy is the detailed Action Plan, which enables the Council to work towards the delivery of changes identified in the Strategy.

The Highland Council Route Map to Net Zero can be found in **Appendix F.**

Case study 4 – ECO Funding for Council Properties - Caol Swedish Timber pilot

The Highland Council faces significant challenges in undertaking the required energy efficiency upgrades to Council houses to ensure compliance with EESSH2 and achieving Net Zero. Ongoing challenges include the scale of the work required and the significant capital investment, which exceeds the available budget within the HRA. To allow the Council to progress with required energy efficiency works, the Council must seek external investment and funding where possible to support delivery. One option to consider is ECO funding.

Union Technical Services Limited surveyed and produced concept design reports for the 5 Council-owned properties in Caol, Fort William. All properties have been surveyed to undertake a whole house retrofit, with a fabric first approach.

Table 6 – Summary of works

Desired outcomes:	Schedule of works:
• **EESSH2 2032 target – EPC band B or above** • **PAS2035: 2019 compliant retrofit design**	• External Wall Insulation (EWI) • Roofline extension or roof replacements • Solar PV • Battery storage • Air Source Heat Pump (ASHP) installation • Loft insulation (if required) • Ventilation upgrades • Retrofit assessment and co-ordination

There are numerous factors which can affect the level of ECO funding, such as property type, existing insulation, heating system and proposed energy efficiency upgrades.

ECO4 has a minimum requirement to improve the energy efficiency rating of band D and E homes to at least a band C, and band F and G homes to at least a band D. This increases the number of measures installed per property.

In most instances for privately owned and rented properties, ECO funding will cover the full installation costs (subject to eligibility). Socially owned properties can receive significant ECO funding to undertake energy efficiency upgrades (subject to eligibility) and will require a contribution from the housing provider.

For example, the Council is currently in discussion with a contractor to provide outline costings (costs are based on previous project costs) for a pilot project for Council-owned properties. Discussions are ongoing and updated project costs are still to be submitted to the Council. Based on initial costings, it is anticipated ECO funding will cover 50-70% of project costs.

The Climate Change and Energy Team, who have 11 years' experience of delivering multiple measures contracts for energy efficiency improvements in homes across the entire region, are collaborating with the Highland Council housing section to look at opportunities to align the EES:ABS programme and ECO funding with Housing Capital plans. This will allow the Climate Change and Energy Team to deliver collaborative area-based programmes across a range of tenures to achieve best value and tackle climate poverty. Furthermore, it will maximise funding opportunities for the Council by leveraging available government grants and investment from the private sector.

LHEES will set out the Council's approach for heat and energy efficiency planning and delivery which will support collaboration and future ways of working.

Case study 5 – Warmlie – A Community Heating Project

Warmlie
COSY COMMUNITY

Thurso's Ormlie area is mainly off the gas grid and has a high proportion of 1960's era social housing. With multiple deprivations in play and energy bills soaring, Caithness Poverty Action Group (CPAG) resolved to investigate ways of providing relief to residents struggling with high fuel bills.

After visiting the successful Wick Ignis District Heating plant (currently supplying reasonably priced heat to >120 homes as well as Caithness General Hospital and the local distillery), a plan was hatched to establish a similar scheme for Ormlie. Ormlie Community Association set up some low-key meetings with interested people and 'Warmlie – Cosy Community' was born, with the aim of 'improving the energy performance of homes and businesses in the area'. Our committee will remain small and simple until the time to build a suitable vehicle for the project arrives.

As the steering committee gained information and confidence it became apparent that a number of opportunities lay on Warmlie's doorstep; Thurso's Dunbar Hospital, the UHI Campus and Thurso High School are close by, each of which would make excellent anchor loads while making substantial energy (and carbon) savings through our proposed centralised heat system. Approaches to Highland Council, NHS Highland and UHI management were well received, and the coverage was developed to include these as well as the social and private homes close to or en-route to them. Other businesses in the nearby industrial estate were also enthusiastic about joining. Once the area of interest was settled the search for support began. An approach to Local Energy Scotland resulted in an initial review of the outline proposals being accepted and funding for a feasibility study granted. During the consultant's site visit it was suggested that a District Heat Network, with distributed heat sources using multiple technologies to take advantage of local fuel sources and existing biomass systems, would perhaps be preferrable to a single source. It was also pointed out that such a network was infinitely expandable and could, with time and investment, accommodate the entire town of Thurso. The committee decided to make the initial area 'phase 1' and build in expansion to the project plan from the off.

Photo by The Highland Council

Photo by The Highland Council

While the main selling point of Warmlie is 'cheaper heating', the carbon-reduction opportunities offered are becoming clear, grasped enthusiastically by many agencies and organisations operating in our area. Warmlie will play a big part in promoting and developing the Highland Council's Local Heat and Energy Efficiency Strategy (LHEES) as it moves forward. And with the Dunbar Hospital likely to be a major Warmlie user, system reliability becomes a major factor in selecting the technology and equipment to be used.

A key part of the feasibility study is the Community Survey (gathering information about homes, fuel types and energy spend) and its associated publicity: setting up warmlie.co.uk and various social media channels was easily managed, while providing newspaper and radio features to persuade our 'surveyed-out' community to complete the paper and online forms proved a bit of a challenge. A seemingly-endless process of 'door-chapping' round the various estates has seen a decent proportion of the ~625 homes and businesses covered responding. Developing a low-key energy advice service is another part of the plan, directing people to assistance in the here-and-now, while the big project is being developed.

During the survey phase other information-gathering has been carried out; finding local sources of biomass fuel, selecting suitable areas for ground-source heat pumps and identifying some means of using surplus wind turbine energy (of which Caithness has masses) via the national grid have all been pursued, throwing up interesting and viable (in the case of wind energy, novel) avenues. Fact-finding trips to Wick, Shetland and Denmark are being arranged, to ensure the most suitable and proven technologies are deployed for the benefit of our community. Links to local plumbing and heating companies have been formed and arrangements made to get their staff trained in the technologies involved.

There is a long way to go and much for us to learn on our journey. This will entail identifying and selecting technologies; managing large-scale projects; designing heating schemes; raising capital and establishing a community business. However, we have the people, the energy and the determination to see it through, given the right support and encouragement.

The Warmlie brand, simple as it is, seems to have caught imaginations, including of a number of our young folk already taking pride in 'their' big heating system. And those who really will see the benefits (older people and families on low incomes, who are currently spending a disproportionate amount of their already stretched incomes heating their homes) can't wait for the hot water to start flowing round our community. That is encouragement enough to keep us driving towards our goal.

[12] Heat in Buildings Strategy - achieving net zero emissions in Scotland's buildings - gov.scot: www.cek6.short.gy/SG-Heat-in-buildings-strategy

[13] Heat Networks (Scotland) Act 2021: www.cek6.short.gy/Gov-Legislation-Heat-Networks

[14] Heat networks delivery plan: www.cek6.short.gy/Gov-HeatNetwork-Delivery-Plan

[15] Potential heat network zones: first national assessment: www.cek6.short.gy/Gov-PotentialHeatNetworkZones

[16] Green Heat Network Fund (GHNF): www.cek6.short.gy/Gov-GHNF

[17] Heat Network Support Unit: www.heatnetworksupport.scot

[18] Note: Stage heading taken from HNSU website.

[19] www.cek6.short.gy/HC-HouseholdsLivingInFuelPoverty

[20] Note: This will be capped to £950 for fabric measures where possible.

[21] Note: The Standard Assessment Procedure (SAP) is the methodology used by the government to assess and compare the energy and environmental performance of dwellings. It is used to produce an EPC.

[22] Note: Local installation data has been received from Warmworks.

[23] Note: These costs are based on historical costs, which do not consider the recent fuel cost increases.

[24] Pension credit advice: www.cek6.short.gy/AgeUK-Pension-Credit

[25] Warm Home Discount Scheme: www.gov.uk/the-warm-home-discount-scheme

[26] Child Winter Heating Payment: www.mygov.scot/child-winter-heating-payment

[27] Note: Each energy supplier has its own eligibility.

[28] www.cek6.short.gy/All-Energy-PowerpointPresentation

[29] www.pocf.co.uk/hydrogen

[30] Note: BARs for buildings in the Highland Council area can be submitted by email to buildingassessmentreports@highland.gov.uk. Copies should also be emailed to the Scottish Government at heatnetworksBAR@gov.scot.

[31] Last updated in October 2023.

[32] Note: EES:ABS Loan is also available through the Home Energy Scotland loan scheme.

[33] Smart Export Guarantee (SEG): www.cek6.short.gy/OfGem-SEG

[34] www.solarenergyuk.org/resource/power-purchase-agreements

[35] www.gov.scot/policies/land-reform/scottish-land-fund

[36] Rural Housing Fund and Islands Housing Fund: www.gov.scot/publications/rural-housing-fund-guidance

[37] www.communityenergyscotland.org.uk/projects-innovations/carbon-neutral-islands

[38] Science, Technology, Engineering and Maths

4 Policy, Strategy, and Legislation Context
Co-theacsa Poileasaidh, Ro-innleachd, agus Reachdais

4.1 Function of LHEES

National policies, strategies and legislation play a vital role in defining Scotland's vision in terms of heat decarbonisation and energy efficiency.

Table 7 summarises national policy, strategy, and legislation that are linked to, impact, or could impact LHEES.

Table 7 – Summary of national policies, strategies, and legislation

National policies and strategies

- Energy Efficiency Standard for Social Housing post 2020 (EESSH2) - sets milestones for all social housing to meet EPC Band B, or be as energy efficient as practically possible by the end of December 2032. It is currently under review with a view to align it with Scotland's Net Zero targets.
- Heat in Buildings Strategy 2021 - sets out the steps required to reduce greenhouse gas emissions from Scotland's homes and non-domestic buildings to zero by 2045, and to eliminate poor energy efficiency as a driver of fuel poverty.
- Heat Networks Delivery Plan - sets out how the Heat Networks (Scotland) Act and supporting policies contribute to increasing heat networks use and sets statutory targets for heat to be supplied by heat networks, requiring the combined supply of thermal energy by heat networks to reach:
    - 2.6 TWh of output by 2027
    - 6 TWh of output by 2030.
- Heat Network Support Unit and Heat Network Fund - aims to support the growth of heat networks by working with the public sector to address key challenges and build capacity through advice, expertise, and financial support.
- Heat Policy Statement - sets out how low carbon heat can reach more householders, business and communities and a clear framework for investment in the future of heat in Scotland.
- Historic Environment Policy for Scotland (2019) – a non-statutory policy statement directing decision-making that should be considered whenever a decision will affect the historic environment.
- Housing to 2040 – sets out a vision for housing in Scotland to 2040 and a route map to get there.
- Hydrogen Policy Statement (2015) - sets out vision for Scotland to become a leading hydrogen nation in the production of reliable, competitive, sustainable hydrogen, securing Scotland's future as a centre of international excellence as we establish the innovation, skills and supply chain to underpin our energy transition. It aims to support the development of a low-cost hydrogen capability to meet an initial ambition of generating 5GW of renewable and low-carbon hydrogen by 2030. Further details are provided in the 2022 Hydrogen Action Plan.
- Local Energy Policy Statement - aims to promote access to useful resources and help inform decision-making, of all those participating in or developing local energy projects as Scotland's energy system transitions to a low carbon future.
- National Planning Framework - sets the context for development planning in Scotland and provides a framework for the spatial development of Scotland as a whole.
- National Planning Framework 4 - sets out Scotland's spatial principles, regional priorities, national developments, and national planning policy. It should be read as a whole and replaces NPF3 and Scottish Planning Policy.
- Place-Based Investment Programme – supports capital projects which deliver on place policy objectives such as 20 minute neighbourhoods, community-led regeneration, and community wealth building.
- Programme for Government – it is published every year at the beginning of September and includes the legislative programmes for a parliament to decarbonise our homes and buildings and improve the energy efficiency.
- Scotland's Sustainable Housing Strategy – sets out a vision for warm and affordable homes and a housing sector that contributes towards a low carbon economy across Scotland.

- Scottish Energy Strategy 2017 – sets out the 2050 vision for energy in Scotland to provide a 'flourishing, competitive local and national energy sector, delivering secure, affordable, clean energy for Scotland's households, communities and businesses.
- Tackling Child Poverty Delivery Plan 2022-2026 – sets out how Scotland will work together to deliver on its national mission to tackle child poverty. It acknowledges that fuel poverty is one of the contributors to poor energy efficiency and aims to make sure that children live in warm and efficient homes.
- The Energy Strategy and Just Transition Plan – refreshes and updates the 2017 Scottish Energy Strategy and provides the first sectoral Just Transition Plan. It is anticipated that by 2045, Scotland will need to deliver affordable and resilient energy supply to households, communities, and businesses.
- Update to the Climate Change Plan 2018-2032 - sets out the Scottish Government's pathway to its new and ambitious targets set by the Climate Change Act 2019. It is a key strategic document on the green recovery in the aftermath of COVID-19.

Photo by The Highland Council

Legislation

- Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 - targets to reduce Scotland's emissions of all greenhouse gases (GHGs) to Net Zero by 2045 with interim targets of:
  - 75% by 2030
  - 90% by 2040
- Fuel Poverty (Targets, Definition and Strategy) (Scotland) Bill - sets out a new target relating to the eradication of fuel poverty, as well as providing a revised definition of fuel poverty.
- Heat Network Regulations: The Heat Networks (Heat Network Zones and Building Assessment Reports) (Scotland) Regulations 2023 – introduces two new duties in relation to the Building Assessment Reports (BAR) and the Heat Network Zones (HNZ).
- Heat Networks (Scotland) Act – sets out provisions for regulating the supply of thermal energy by a heat network, the construction and operation of a heat network, the powers of a person holding a heat network licence, conferring rights in heat network assets where a person ceases operating a network, and plans relating to increased use of heat networks and for connected purposes.
- The Planning (Listed Building Consent and Conservation Area Consent Procedure) (Scotland) Regulations 2015 – sets out procedures for listed and conservation areas covering all aspects of building, engineering, design, and construction.
- Tenements (Scotland) Act 2004 - provides a structure for maintenance and management of tenements. It amends the Tenement Management Scheme (as outlined in Schedule 1 of the Tenements (Scotland) Act 2004, lists the 'scheme property' (explaining what parts for the tenement every flat owner should maintain) and explains how to come to arrangements about maintenance ('scheme decisions') and how costs are shared between owners) to log insulation installation as a maintenance measure rather than an 'improvement' so changes can be approved via a majority rather than unanimously.

4.2 Local Policy and Strategy Overview

This section identifies the existing local policies and strategies that are relevant and linked to LHEES. It sets out the relationships between the national and local policies, strategies and legislation.

A summary of the identified local policies, strategies and drivers are set out in **Table 8**.

Table 8 – Summary of local policies and strategies

Local policies, strategies, and drivers
Budget Strategy 2023-2024 – sets out a balanced approach to addressing the challenges faced, ensuring investment in priority activities is maintained.
Cairngorms National Park Local Development Plan 2021 – is the main document which influences the future of built environments in the National Park and focuses on the five-year period until 2025. It also includes development proposals for the 10-year period until 2030 and provides a general indication of the scale and location of development for 20 years into the future.
Caithness and Sutherland Local Development Plan - guides future development in Highland, specifically in the Caithness and Sutherland area. It focuses on what should and should not be built/developed in the area over the next 10-20 years.
Community Plan and Local Outcome Improvement Plan - establishes the vision, purpose and focus for the Highland Community Planning Partnership from 2017-2027 to reduce inequalities and support poverty reduction in the Highlands.
Corporate Plan - outlines the priorities for the organisation, the Council approach to resourcing and how these will be delivered. The Corporate Plan is designed to evidence delivery of the Council Programme, which is the lead document detailing this Administration's vision.
Development of Guidance – Coastal Development Strategy - outlines the Council's objectives for coastal planning and working with relevant sectors to make the most of the productive capacity of the coastal area, whilst safeguarding its unique environmental qualities through sustainable development.
Highland Historic Environment Scotland Strategy - is a Supplementary Guidance document to the Highland-wide Local Development Plan. The purpose of this strategy is to define the Highland Council's approach to the protection of the historic environment through the planning process. This document will, through the implementation of the strategic aims, ensure that there is a proactive and consistent approach to the protection of the historic environment.
Highland Indicative Regional Spatial Vision Strategy to 2050 - showcases the unique set of assets and resources that the Highlands will contribute to the national stage. It also outlines how the Council will collaborate with the Scottish Government and partner agencies at a national and local level to deliver on strategic national development priorities, national outcomes and delivery mechanisms to achieve a long-term sustainable vision for Highland in the period to 2050.
Highland-wide Local Development Plan (2012-2022) - sets out the overarching spatial planning policy for the whole of the Highland Council area, except the area covered by the Cairngorms National Park Local Plan.
Inner Moray Firth Local Development Plan - guides future development in Highland, especially in Inner Moray Firth area. It focuses on what should and should not occur in the area over the next 10-20 years.
Local Housing Strategy (2023-2028) - sets out the strategic direction, policies and plans that will enable Highland Council and partners to deliver high quality housing and housing services to meet the needs of local people across all housing tenures. It also sets out the important contribution that housing makes to improving health and wellbeing, creating connected and sustainable places, reducing climate change, supporting economic growth and reducing poverty across the Highlands.

New Local Development Plan - when adopted, it will replace the Highland-wide Local Development Plan and three individual 'area' LDPs.
Net Zero Strategy and Action Plan – sets out the approach the Council will take to reduce emissions and meet its climate change objectives.
Onshore Wind Energy Supplementary Guidance (2016) - sets out how the Council will manage onshore wind energy development proposals.
Sustainable Design Guide – Supplementary Guidance - intended to encourage the development of high quality and sustainably-designed buildings which will minimise impacts on the natural environment, help counter the effects of climate change and also promote greater use of local and renewable materials.
Tain Town and Centre Action Plan - highlights a range of proposals and opportunities identified by the community and stakeholders that can deliver regeneration in Tain town centre.
West Highland and Islands Local Development Plan - guides future development in Highland, specifically in West Highland and Islands area. It focuses on what should and should not occur in the area over the next 10-20 years.

A wide range of national and local strategies and policies highlight important drivers for the LHEES objectives. They create a better understanding between national and local priorities, objectives, and the communities' needs affected by the shifting political landscapes.

National and local policies identify the effects of climate change, raise the importance of heat decarbonisation, energy efficiency and fuel poverty whilst protecting the historic environment and environmental areas through sustainable development.

Photo by Eileen Ferguson

4.3 Wider Context

It is vital to consider the scope of LHEES in a wider context. **Figure 4** summarises other areas where LHEES could support its goals.

Figure 4 – LHEES in a wider context

Adaptation of existing building stock that could lead to a **reduction of materials and waste, the preservation of natural resources, improvements in energy use and reduced emissions**.

Development of policies to drive more **resource efficient construction and use of low-carbon materials**.

Support a 'whole system' approach **(heat electricity, energy efficiency and transport)** and recognise the effects that each element of the energy system has on others.

Increase citizens' awareness of **energy efficiency and heat decarbonisation** in their homes, community and business.

ParkPower programme and LHEES have a strong relationship as they will both **contribute to Local Energy Masterplans and help meet targets** in sustainability and climate change action plans.

Sustainable procurement to **maximise resources and environmental benefits**.

5 Baselining
A' Cleachdadh Bun-loidhne

This section provides information on the building stock's performance (baselining).[39] It gives an insight into the opportunities, challenges associated with buildings, their characteristics and the implications for this Strategy and its delivery.

5.1 Domestic Building Stock

The Highland Council serves a third of the land in Scotland, including the most remote and sparsely populated parts of the United Kingdom. The Scottish housing stock is diverse and varies across the country and between rural and urban areas with the stock in the Highlands being some of the most challenging across Scotland. The age of dwellings, the built form of a dwelling and also the heating fuel have consequences for running costs, energy performance and living conditions.

The Domestic Baseline Tool[40] is an Excel tool that uses input data to carry out the analysis of Stage 3. It provides tables and graph showing the characteristics of the baseline building stock within the Council area, including:

- **property characteristics such as buildings' age and type**
- **mixed-tenure, mixed-use and historic buildings**
- **energy efficiency and heat supply such as glazing, levels of insulation, EPC band and fuel type.**

The Council stock data was matched with the property data from the Energy Saving Trust's (EST) HA using the One Scotland Gazetteer (OSG) Unique Property Reference Number (UPRN) guide as property identification. Properties that were not matched with the Council-own data were kept as is in Home Analytics. Data on private rental tenure from the Scottish Landlord Registration database was utilised and matched using UPRN numbers to strengthen the analysis.

The overview of the domestic building stock performance[41] including building characteristics, energy efficiency, fuel type, tenure, conservation area and historic buildings are presented in **Figure 5**.[42]

Figure 5 – Summary of statistics of Highland homes

LA Summary Dashboard

Number of properties		
127,066		
	Heat demand per dwelling (kWh/dwelling/year)	15,969
	Energy demand per dwelling	29,168

	Percentage	Number of properties
EPC F-G	13.65%	17,345
EPC D-G	65.56%	83,304

	Percentage	Number of properties
Uninsulated walls	42.47%	53,965
Loft insulation <100mm	9.21%	11,703
Single glazed windows	6.51%	8,272

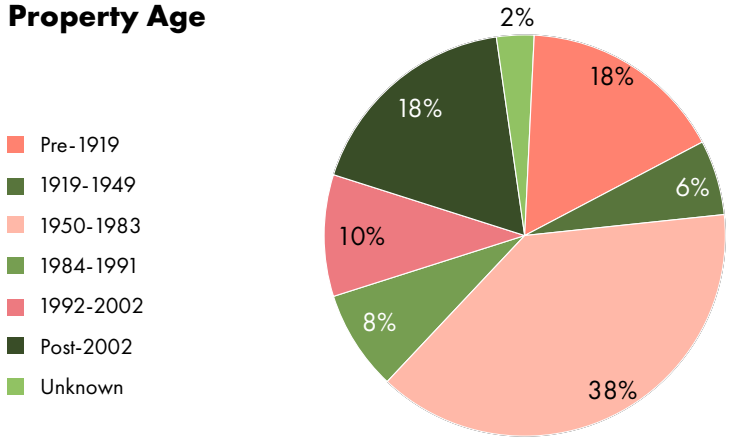
	Percentage	Number of properties
Estimate of households in fuel poverty (fuel bill>10% of income)	32.33%	41,080
Estimate of households in extreme fuel poverty (fuel bill>20% of income)	29.39%	37,345
Council Tax Band A-C	40.55%	51,525

5.2 Building Characteristics

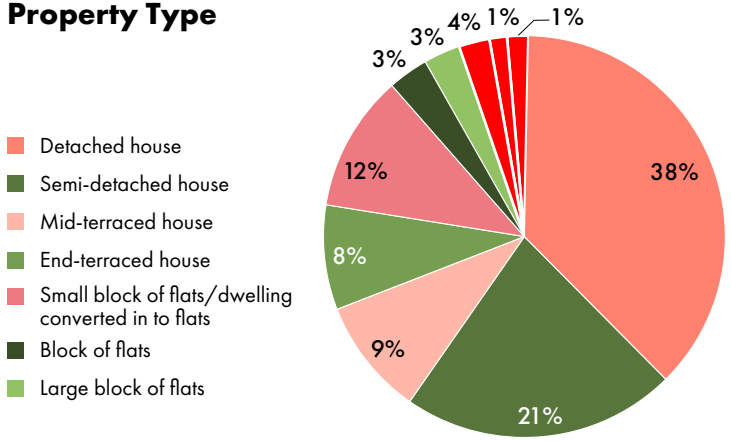
Building characteristics provide an overview of the current domestic building stock within the Highland Council area and insight into the opportunities and challenges associated with buildings and their characteristics.

Figure 6 – Summary of building characteristics

Property Age



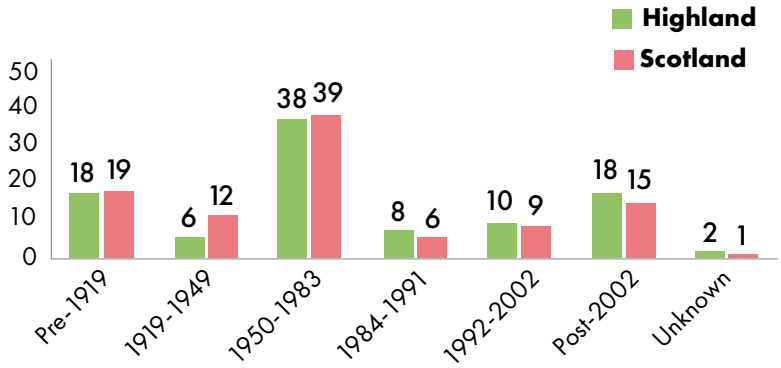
Property Type



Property age

Property ages in the Highlands are mixed. Most of the domestic properties were built in pre-1919 (18%), between 1950-1983 (38%), and post-2002 (18%). **Figure 7** compares local domestic stock with the national average, showing that the housing stock in the Highlands is very similar to national averages.

Figure 7 – Building age comparison



Property type

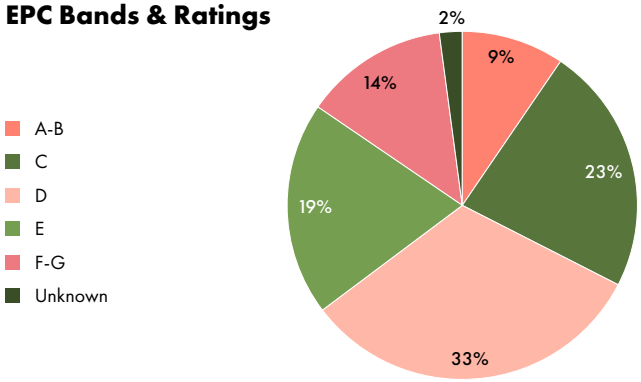
The region has a higher proportion of detached properties (38%) and semi-detached properties (21%). Only a small proportion of the housing stock represents small blocks of flats or dwellings converted into flats (12%), blocks of flats (3%) and large blocks of flats (3%)

5.3 Energy Efficiency and Heat Supply

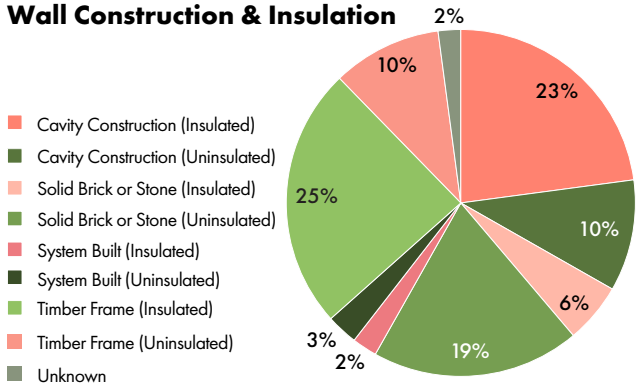
Energy efficiency and heat supply outputs provide insight into the energy efficiency standards and levels of fuel poverty within the Council area and therefore the extent of interventions required to support domestic building owners and to support compliance with existing regulation.

Figure 8 - Summary of heat efficiency and supply

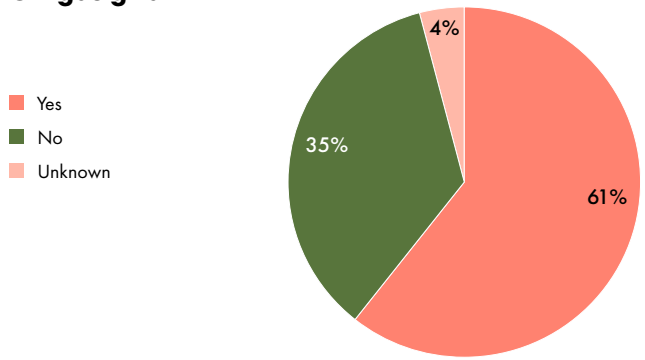
EPC Bands & Ratings



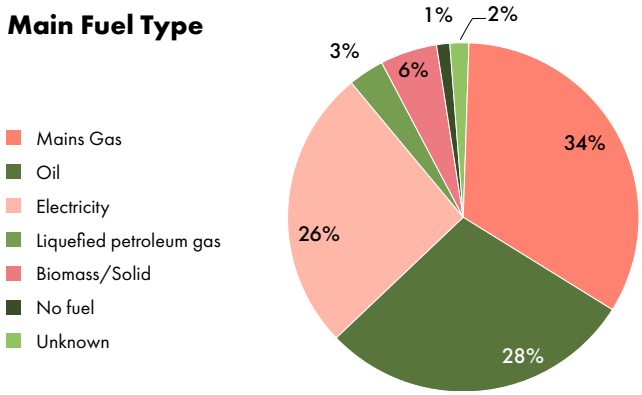
Wall Construction & Insulation



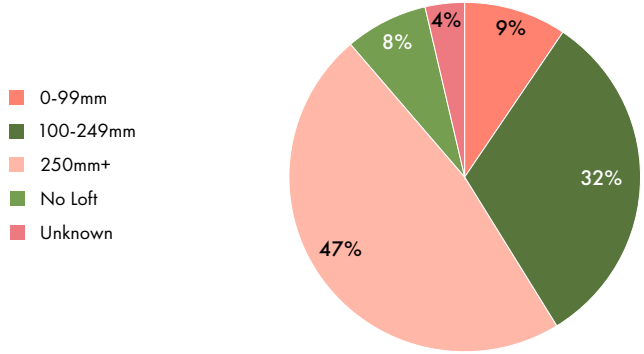
Off gas grid



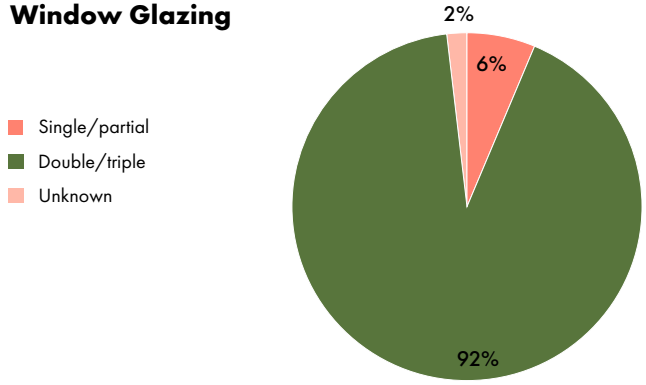
Main Fuel Type



Loft Insulation Level



Window Glazing



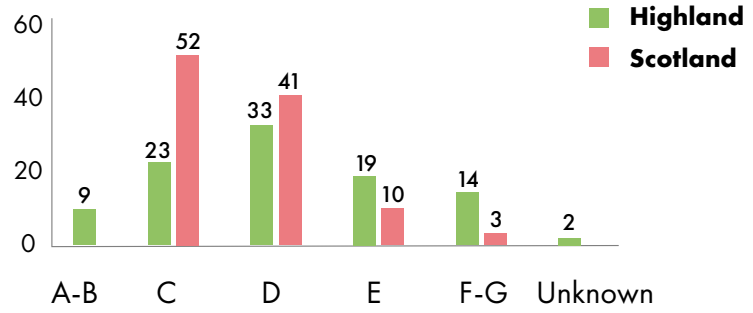
EPC bands and rating

Around 33% of properties are in an EPC band E-G, 33% band D, 32% band C and above and 2% unknown. According to the Scottish House Condition Survey (2021)[43], in 2021, 52% of Scottish Homes were rated as EPC C or better, 35% band D and the proportion of properties in the lowest EPC bands (E, F, and G) were 13%.

Most properties are below an EPC band C and are likely to require significant energy efficiency and heating upgrades to achieve a higher EPC rating. Renewable energy technologies could help increase the EPC rating further but a fabric first approach must be prioritised.

For instance, the EESSH2 standard requires properties to reach an EPC band of B, with minimum energy efficiency rating of EPC 81, pending review. The Council aims to prioritise a fabric first approach, followed by heating upgrades and solar measures.

Figure 9 – EPC band comparison



Wall construction and insulation

With buildings being a key contributor to greenhouse gas emissions, LHEES presents an opportunity to identify dwellings suitable for low carbon heating and promotes the importance of a fabric first approach to make buildings more energy efficient and warmer.

Detached and semi-detached properties have a large area of exposed walls that are likely to result in higher levels of heat loss than those that are shielded by adjacent properties. Due to locality, most properties are detached and terraced, with only a small number of them being flats.

- **Around 30% of domestic owner-occupier and around 5% of privately rented properties have uninsulated walls with most of them being solid brick and stone walls.**
- **Around 19% of solid walls, 10% of cavity, 3% of system built and 10% of timber framed walls are uninsulated.**
- **Around 42% of properties have uninsulated walls. Often it is not suitable or practical to insulate all of them.**

Loft insulation level

A quarter of heat loss is lost through the roof of an uninsulated dwelling. Insulating a loft, flat roof or attic is one of the most effective ways to improve the energy efficiency of a building. Loft insulation can significantly reduce heat loss and reduce heating bills. Although the analysis of domestic stock did not include the type of insulation, the recommended depth of mineral wool insulation is 270mm[44].

Nationally, in 2019, loft insulation with a thickness of 100 mm or more had been installed in 94% of dwellings and 27% of lofts were insulated to a higher standard of insulation (300 mm or more)[45].

Currently, almost half (47%) of the domestic dwellings in the Highlands had been insulated with 250 mm plus and 32% of them between 100-249 mm of insulation.

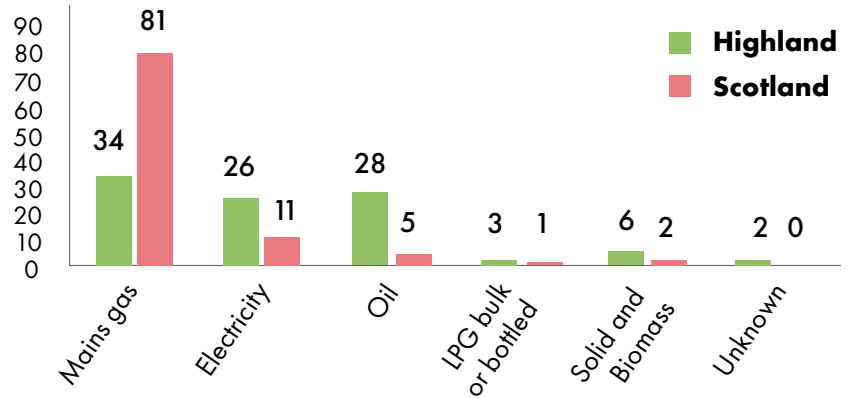
Loft insulation measures have been strongly targeted through programmes such as EES:ABS, EESSH and EESSH2 standards and the Home Energy Scotland schemes.

Off-gas grid and main fuel type

Primary heating fuel varies by geographic location. Heating fuel in the Council area looks very different from the rest of Scotland. Mains gas and electricity are the primary heating fuels in Scotland. In contrast, there are higher rates of oil and LPG fuels being used in the Highlands.

Around 17% of dwellings in Scotland are beyond the reach of the gas grid networks[46]. The total number of domestic properties in the Highlands is 127,066 with 77,648 (61%) of them being in an off-gas grid area. Heating for off-gas areas mainly relies on fossil fuels such as oil (28%) and LPG (3%) which have a higher carbon and financial cost and could put those in off-gas areas at a significant disadvantage.

Figure 10 – Heating fuel



Space heating (76%) is the largest component of the energy consumption which underpins the fuel poverty estimate. According to the Scottish House Condition Survey (2021)[47], rates of fuel poverty and extreme fuel poverty increased in remote rural areas such as the Highlands.

Window glazing

Energy efficient glazing reduces heat loss through two or more window panels in a sealed unit. Most domestic dwellings (92%) in the Highlands are already double or triple glazed. Only 6% are single, or 2% partially glazed windows and the remainder unknown.

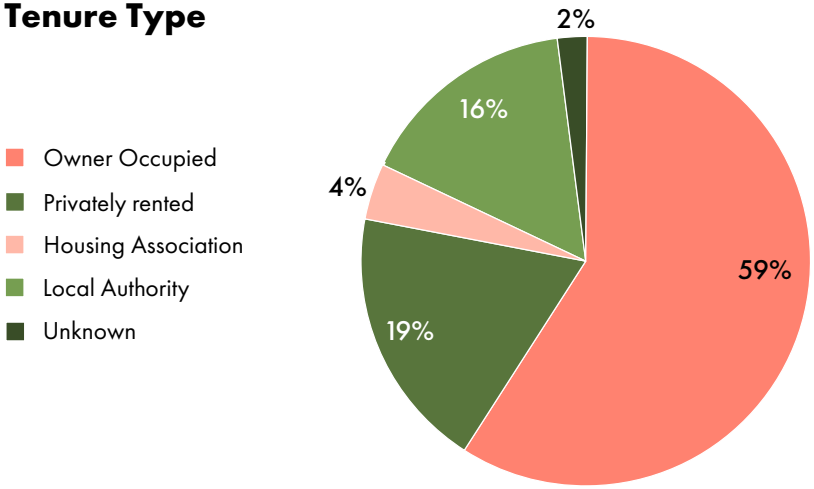
To meet the EESSH2 standard, the Council has identified a need to upgrade 8,006 (60%) properties with high efficiency glazing. Currently, domestic and privately owned properties with single glazed windows could upgrade them through various Home Energy Scotland programmes such as the WHS and Home Energy Scotland Grant and Loan.

5.4 Property Tenure and Historic Buildings

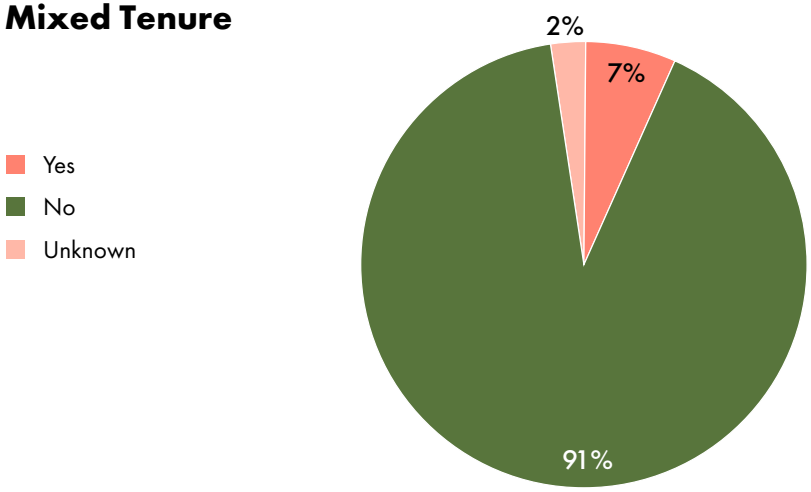
Property tenure and historic buildings present challenges and opportunities for interventions in properties. This is often the case with more than one dwelling in a building or mixed-tenure properties but it does provide insight into the number of listed buildings or buildings within a conservation area.

Figure 11 – Summary of property tenure and historic buildings

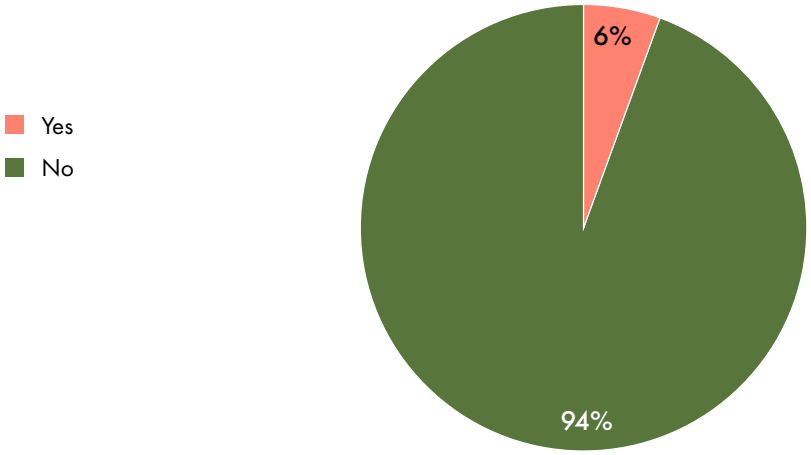
Tenure Type



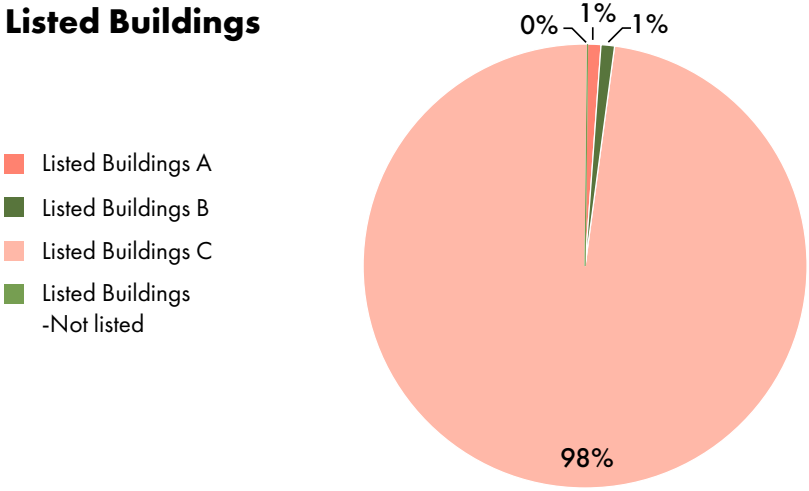
Mixed Tenure



Conservation Area



Listed Buildings



Tenure type

The majority of properties in the Council area are owner-occupied (59%), 19% privately rented, 16% owned by a LA and 4% by HA. Only 2% of the dwellings are of unknown ownership.

According to the National Records for Scotland[48], it is estimated that the Highland Council is one of the local authorities with the highest proportion of dwellings that are second homes - 3,800 (3.2%) dwellings.

Mixed-tenure

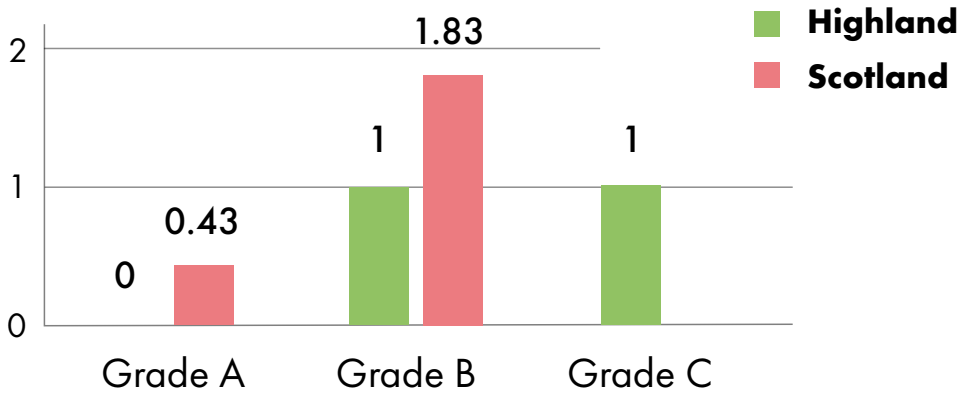
Local and national housing policies promote mixed-tenure developments to support sustainable mixed communities. It is estimated that only 7% of properties are of mixed tenure.

Photo by Ewen Weatherspoon

Conservation area and listed buildings

According to Historic Environment Scotland, there are around 47,000 listed buildings in Scotland[49]. Listing categories affect how the building is managed in the planning system. The majority of buildings in the Highlands are not listed (98%) with only 1% grade B[50] and 1% grade C[51] listed buildings. Around 7% of them are mixed-tenure properties and 6% in a Conservation Area.

Figure 12 – Listed building grade in percentages

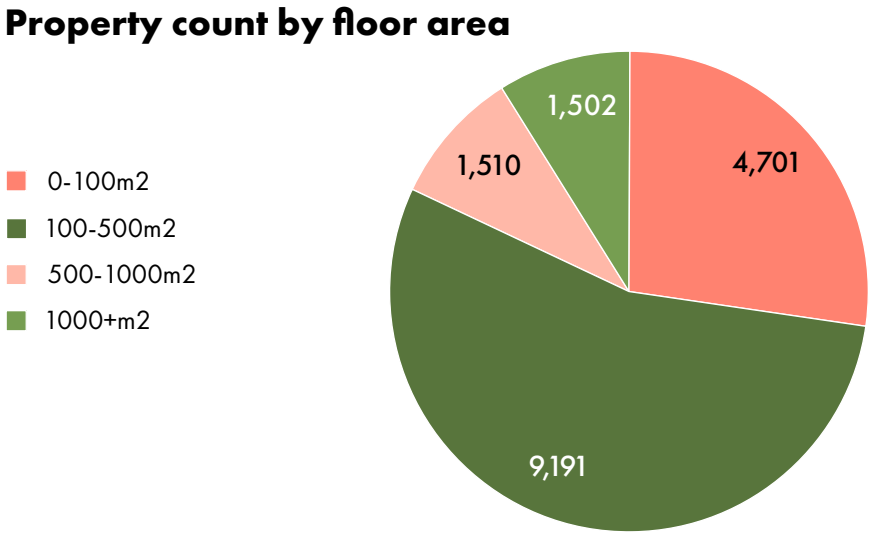


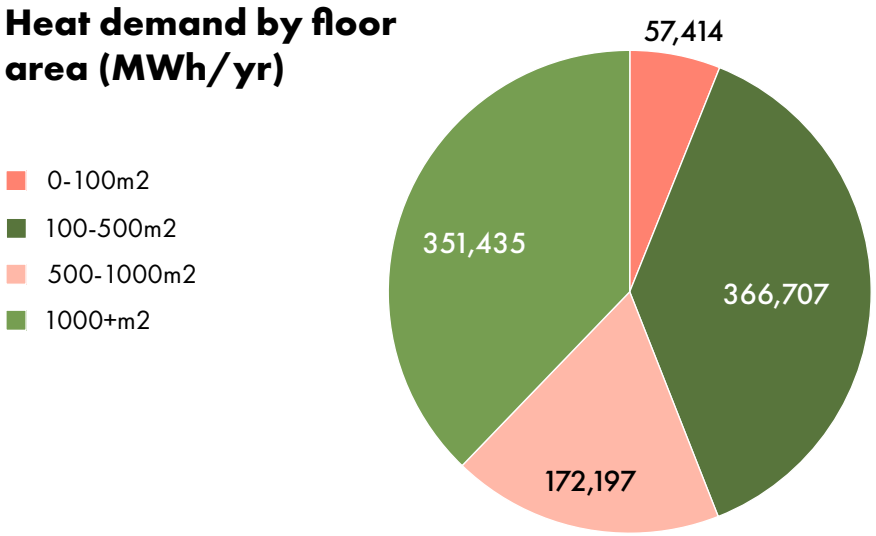
5.5 Non-Domestic Building Stock

There are currently 16,904 non-domestic properties in the Highlands on the EST's NDA. It provides information on property attributes and energy efficiency characteristics such as floor area, property age, main fuel type and heating demand.

Floor area

Figure 13 – Floor area summary





54% (9,191) of non-domestic buildings have a floor area between 100-500m2, 28% (4,701) between 0-100m2, 9% (1,510) between 500-1000m2 and 9% (1,502) 1000+m2.

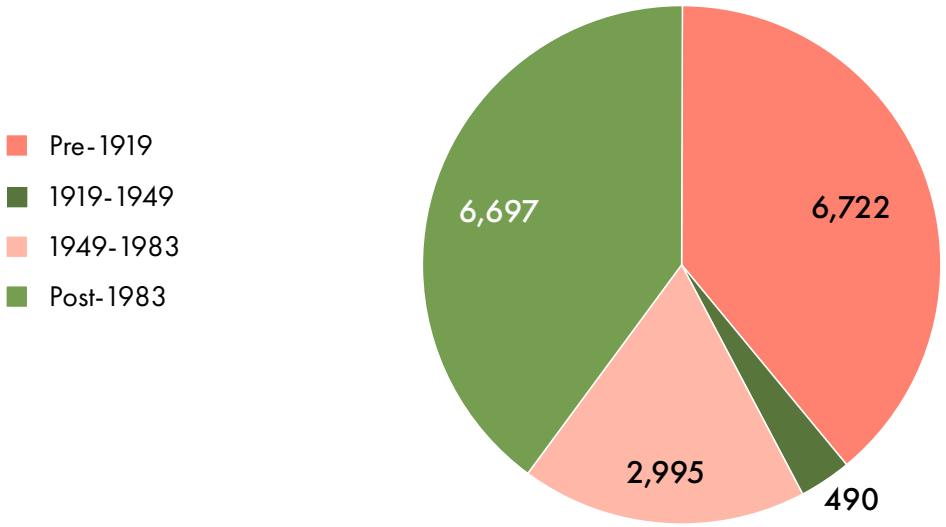
The highest heat demand by floor area belongs to buildings which have a floor area of 1000+ m2 (351,435 MWh/yr) and between 100-500m2 (366,707 MWh/yr).

The highest heat demand by typology split by floor area (MWh/yr) belong to residential, hotels, offices and retail.

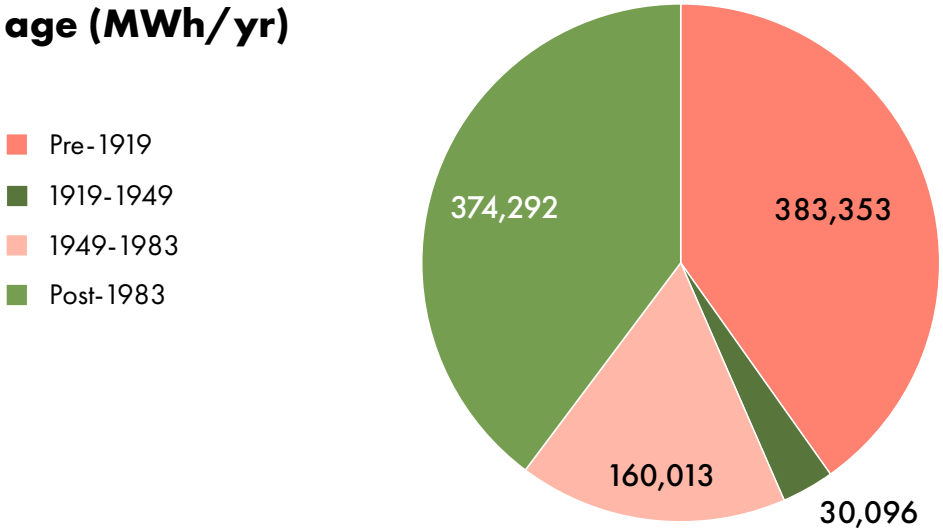
Property age

Figure 14 – Property age summary

Property count by property age



Heat demand by property age (MWh/yr)



6,697 (40%) of non-domestic buildings were built post-1983, 6,722 (40%) pre-1919 and 2,955 (18%) between 1949-1983. Only 490 (3%) of buildings were built between 1919-1949.

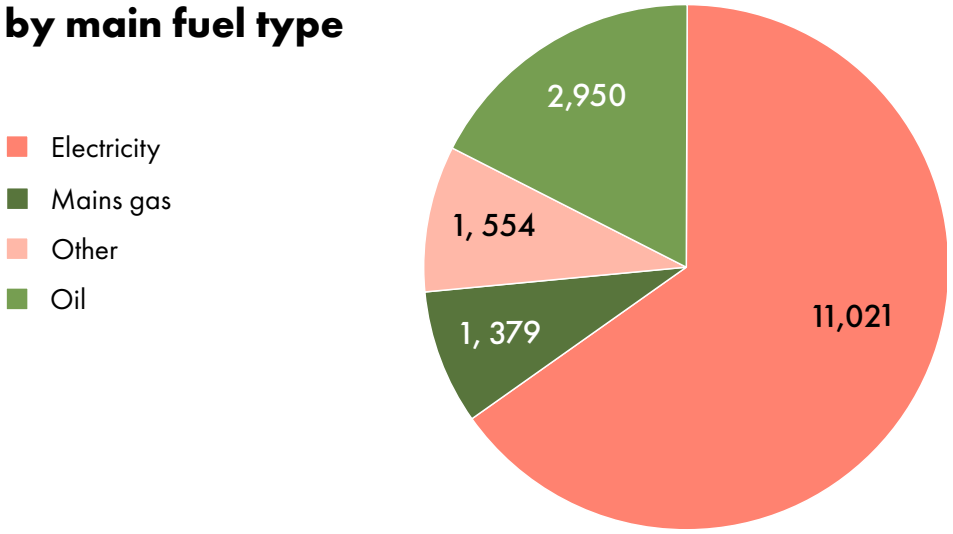
The highest heat demand buildings by property age are those built post-1983 (374,292 MWh/yr) and pre-1919 (383,353 MWh/yr).

The highest heat demand by property age (MWh/yr) belong to retail, residential, hotels and offices.

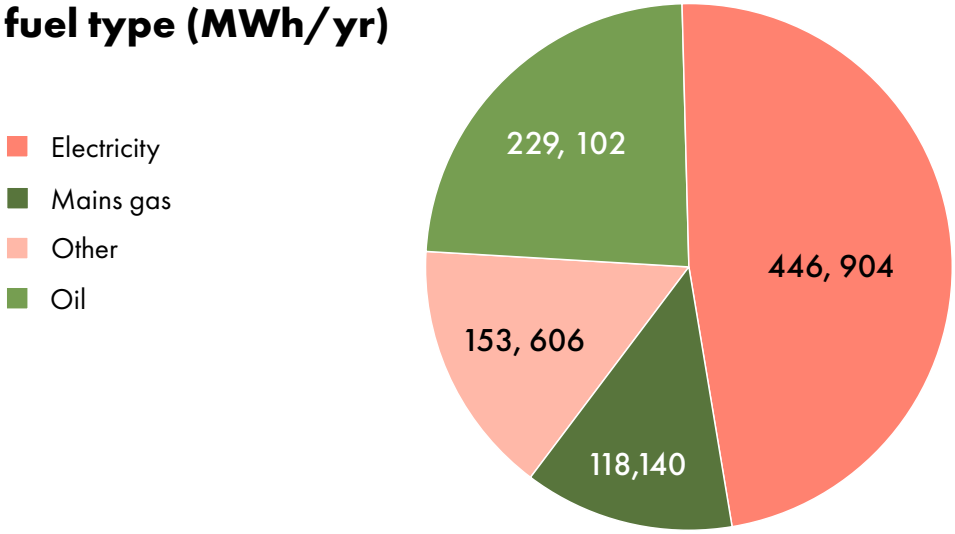
Main fuel

Figure 15 – Main fuel summary

Property count by main fuel type



Heat demand by main fuel type (MWh/yr)



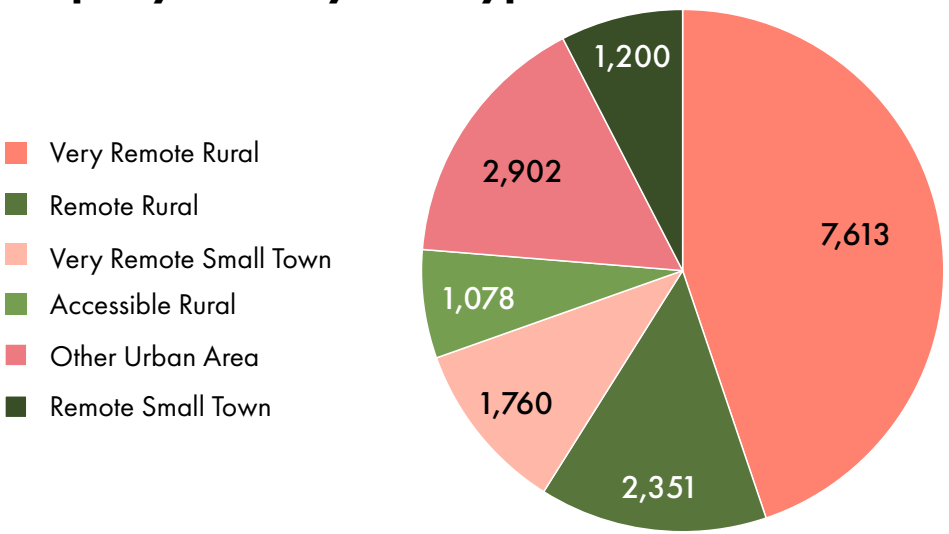
Electricity is the main fuel type across the non-domestic stock. 65% (11,021) of buildings are heated by electricity, followed by oil (2,950 / 17%), mains gas (1,379 / 8%) and other fuels (1,554 / 9%). The highest heat demand by main fuel type belongs to buildings that are heated by electricity (446,904 MWh/yr) and oil (229,102 MWh/yr).

The highest heat demand for typology split by fuel (MWh/yr) belong to residential, retail, offices, hotels, clubs and community centres.

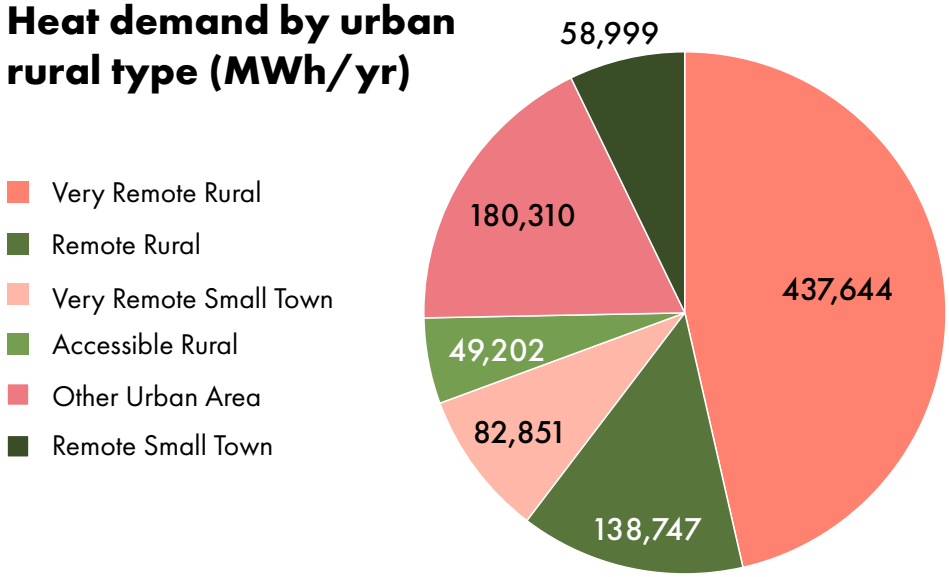
Urban rural 8-fold

Figure 16 – Urban rural 8-fold[52] category summary

Property count by rural type



Heat demand by urban rural type (MWh/yr)



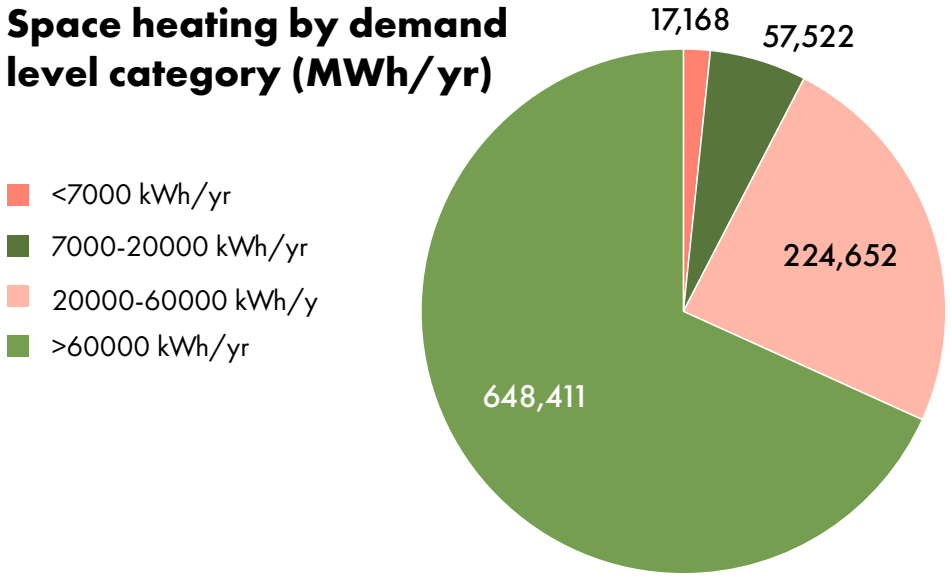
The non-domestic stock in the Highland Council areas are classed as very remote rural (7,613 / 45%), other urban areas (2,902 / 17%), remote rural (2,351 / 14%), very remote small town (1,760 / 10%), accessible rural (1,078 / 6%) and remote small town (1,200 / 7%).

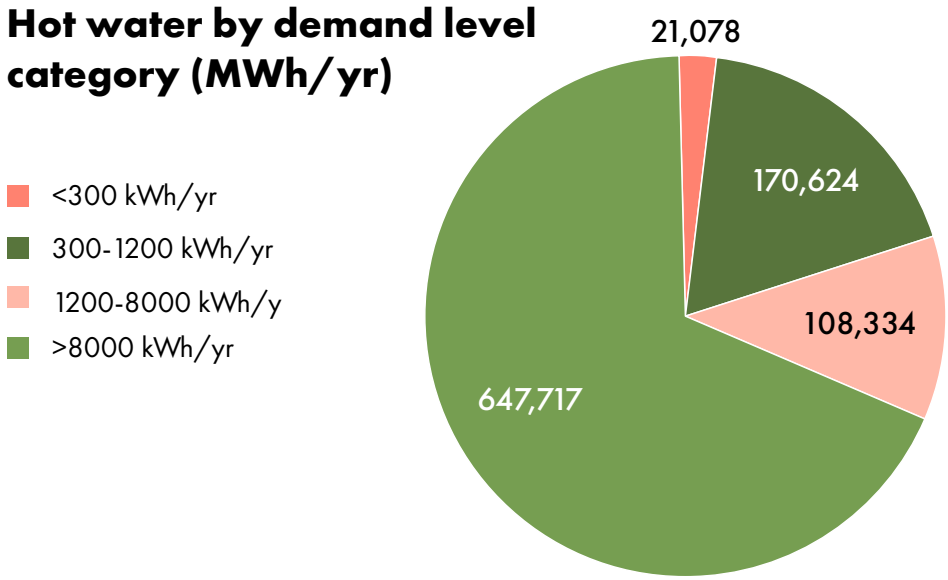
The highest heat demand by urban rural type can be found in very remote rural (437,644 MWh/yr). The smallest heat demand by urban rural type is in accessible rural (49,202 MWh/yr).

The highest heat demand for typology split by rural 8-fold type (MWh/yr) belongs to buildings such as residential, hotels and retail.

Space heating and hot water

Figure 17 – Space heating and hot water summary





Space heating and hot water account for a significant amount of energy use in buildings. The majority of space heating demand for typology split by space heating demand level (MWh/yr) belongs to residential, hotels, retail, offices, education, general sports and leisure, cafes, pubs, restaurants and takeaways.

Hot water demand for typology split by hot water demand level (MWh/yr) belongs to residential, hotels, education, general sports and leisure.

5.6 Key Conclusions

Reducing energy use and greenhouse gas emissions in domestic buildings through heat decarbonisation and energy efficiency improvements will contribute towards Net Zero targets and a just transition. To achieve this, there are various aspects that need to be taken into consideration, which are listed below but not limited to:

- **Upgrading insulation and the heating system are the two key factors in the thermal efficiency of the building. The energy efficiency rating in the Highlands falls beyond the average for Scotland, showing that domestic dwellings in the region are less efficient. This is often due to their age, heating fuel and levels of insulation.**
- **There are a significant number of ageing buildings in the region, which are more likely to have lower energy efficiency.**
- **The significant amount of non-domestic properties in the Highlands have a potential to decarbonise. Mains gas and oil heated buildings are more likely to be suitable for heat network connection as they will have wet heating distribution system. Retrofit for heat networks is likely to be less costly and complex compared to electricity heated buildings.**
- **A holistic approach needs to be taken into consideration, for instance ventilation, heating type and materials used to insulate older buildings.**
- **A significant number of domestic properties are detached, semi-detached and terraced properties. This could present an opportunity to install individual heat pump installations, replacing carbon intense fuels such as oil and LPG with cleaner and greener sources of energy.**
- **The Council area has a very small proportion of domestic flats which may be more suited to connect to a district's heating rather than to install individual heat pumps.**
- **Insulating solid stone and brick walls is more labour and resource intensive and requires a higher degree of skill to install compared to other insulation installations.**
- **Significant external funding will be required, as the HRA will not be sufficient to meet the funding needs to make domestic properties more energy efficiency and compliant with the EESSH2 standard.**
- **The Council has some influence over improvements to owner-occupier and privately rented sector properties.**
- **There is significant heat demand from hotels, offices and retail. Public buildings are required to submit BARS to inform suitability for connection to heat networks. This will help improve confidence in heat demand data.**
- **Retrofitting listed buildings or buildings in conservation areas requires careful consideration of planning permission and a good understanding of building characteristics and design restrictions to meet the standards for energy efficiency.**
- **Retrofitting buildings may identify additional repair works required.**
- **A small percentage of owner-occupied and privately owned properties are being identified as mixed-use. A collaborative approach to building level intervention will be needed.**

5.7 Indicators, Weightings and Criteria

Each LHEES priority, policy and strategy review sets out Indicators[53] and Weighting[54] that underpin analysis across the other LHEES stages. A full list of default Indicators, Criteria[55] and Weightings for the LHEES Considerations that are used in Stages 3 and 4 to complete a strategy level baselining exercise for the Council and to generate strategic zones are set out in Appendix G.

Each of the LHEES Priorities were discussed with internal stakeholders and this discussion influenced the Weighting used in Stages 3 and 4. Additional variables were added to make the results more relevant to the Council, including:

- **More focus on the wall fabric status in the energy efficiency Weighting. Additional energy efficiency maps for separate wall construction types were created (solid or brick, timber frame, cavity construction, or system build).**
- **Solar PV suitability for Category 1 buildings in the decarbonisation analyses (i.e. those ready for a heat pump, both on and off gas) was added.**
- **General solar PV opportunities with energy efficiency were added.**

The methodology[56] allowed adjustment of Weighting to consider the Council's priorities, so that the output can be more relevant and useful.

The below are the LHEES Considerations and that a full description is provided in **Appendix B**.

Energy Efficiency

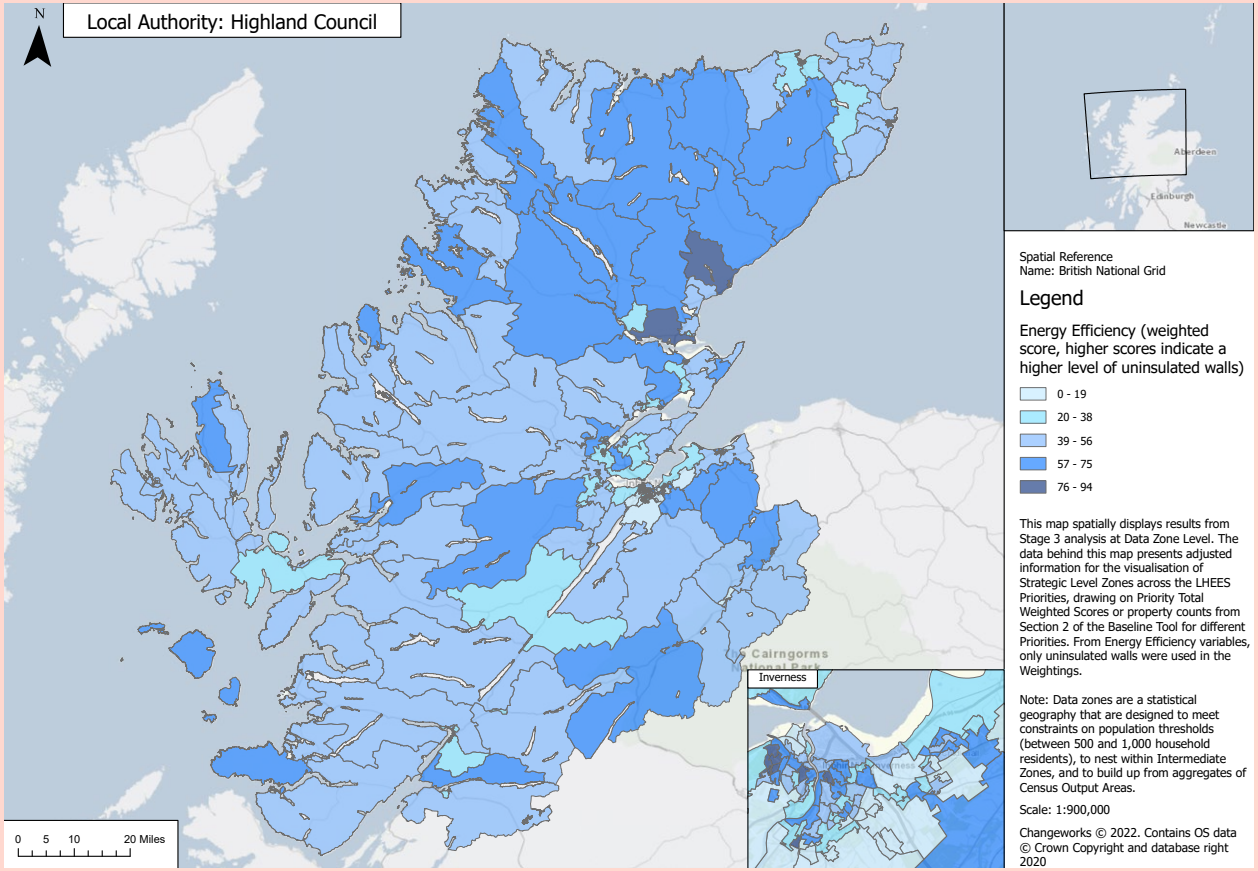
The proportion of properties with poor energy efficiency Indicators are summarised in **Table 9**.

Table 9 – Poor Energy Efficiency Indicators

Indicators	Total number of domestic properties	Weighting
Uninsulated walls (all types)	53,971	33
Single glazed windows	8,269	33
Loft insulation (0-99mm)	11,703	34

Photo by Ewen Weatherspoon

Map 1 – Poor Energy Efficiency – uninsulated walls



Key Summary:

- the proportion of loft insulation is 8% lower (87%) than nationally (95%)
- 7% of domestic properties have single glazed windows.
- the proportion of uninsulated walls is similar to the national average (42% and 41% nationally):
  - solid brick or stone – 19%
  - timber frame – 10%
  - cavity construction – 10%
  - system built - 3%
- most uninsulated wall properties are in domestic private sector (37,505 properties (30%))
- least uninsulated properties belong to housing associations (1,127 properties (1%)).

Poor energy efficiency as a driver of fuel poverty

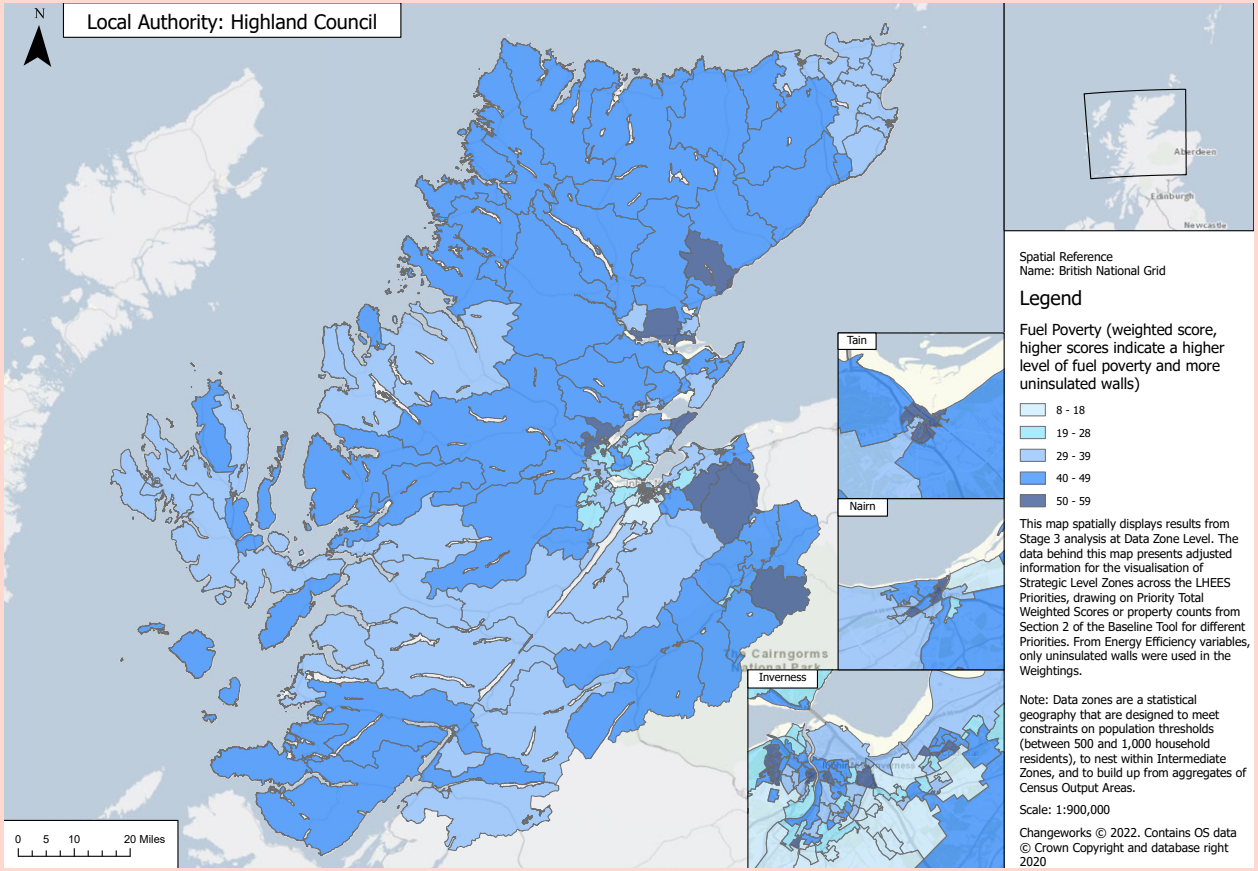
Poor energy efficiency is a driver for fuel poverty and Indicators are summarised in **Table 10**.

Table 10 – Poor energy efficiency as a driver for fuel poverty Indicators

Indicators	Total number of domestic properties	Weighting
0-99mm	11,703	17
Single glazed windows	8,269	17
Uninsulated (all construction types)	53,971	16

Households in fuel poverty (fuel bills >10% of income after housing), Weighting is 50.

Map 2 – Visualisation of Poor Energy Efficiency as a Driver of Fuel Poverty



Key Summary:

- Zones with highest total Weighted Score, where poor energy efficiency is likely to be acting as a driver for fuel poverty.
- The total number of uninsulated wall properties, where poor energy efficiency acts as a driver for fuel poverty, is 1,295.
- Mixed-tenure and mixed-use properties including listed buildings and buildings in conservation area.

At an Intermediate Zone (IZ)[58] level, this provides details of/ insight into the number of mixed-tenure, mixed use buildings within each IZ and ranks them depending on the total number of properties with dwellings > 1 or the total number of mixed tenure properties.

Table 11 – Indicators for mixed-tenure, mixed-use buildings

Indicators	Total number of domestic properties	Summary
Mixed-tenure in building	9,424	• Domestic properties in the Highlands consist of owner-occupied (59%), privately rented (19%), HA (4%), LA (16%) and around 2% unknown tenure.
Dwellings in building >1	23,998	

Listed Buildings and Conservation Areas

This provides at an IZ level the number of properties with a listed status of A-C, with a ranking for each IZ depending on the corresponding count of properties.

Table 12 – Indicators for listed buildings and buildings in conservation area

Indicators	Total number of domestic properties
Listed Buildings Grade A-C	2,865
In Conservation Area	7,360

Key summary:

- **The majority of buildings in the Highlands are not listed (98%), with only 1% listed as grade B and 1% grade C listed buildings.**
- **6% of domestic properties are in conservation areas.**

On-gas and off-gas domestic properties

The on-gas and off-gas domestic properties data analysis has provided the Council with an opportunity to explore property readiness for heat pump retrofit by grouping properties into categories[59]:

Category 0 - identifies properties that currently have a low or zero emissions heating system.

Category 1 – identifies properties highly suited for heat pump retrofit with good levels of insulation and a wet heating system, excluding any consideration of electricity network impacts or costs of any network upgrades.

Category 2 – identifies buildings with secondary potential for heat pump retrofit. They are properties in need of moderate fabric upgrades and/or wet distribution system to be heat pump ready.

Category 3 – identifies properties that have potential for heat pump retrofit but significant fabric improvements are required.

These categories do not imply prioritisation of one group over another one. It provides an opportunity to identify properties with similar characteristics that may require similar retrofit actions.

Table 13 – Categories for On-Gas Grid

Categories for On-Gas Grid	Total number of domestic properties
Category 1	23,613
Category 2	7,818
Category 3	12,924

Table 14 – Categories for Off-Gas Grid

Categories for Off-Gas Grid	Total number of domestic properties
Category 1	19,001
Category 2	27,333
Category 3	29,219

Key summary:

- **Around 53% of on-gas properties are considered to be Category 1 properties, meaning that they can be considered heat pump ready.**
- **Around 24% of properties in off-gas areas are considered Category 1 properties, meaning these properties would not need additional insulation measures before installing a heat pump and can be considered heat pump ready.**

5.8 Key Conclusions

The Highland Council and key stakeholders focus on improving energy efficiency in domestic and non-domestic properties to meet national and local targets such as the Heat in Buildings Strategy and EESSH2, to improve energy efficiency of building stock and decarbonise heat.

Some Indicators in geographical areas overlap. When considered together, they provide a holistic approach that may need to be taken forward to achieve heat decarbonisation and energy efficiency targets.

One of the Council's strategic actions focuses on helping fuel poor households to reduce their energy consumption by improving home energy and providing support on saving of energy costs. These actions support the Fuel Poverty (Targets, Definition and Strategy) (Scotland) Bill in terms of eradication of fuel poverty.

A significant number of on-gas and off-gas properties are classed as Category 1 properties meaning that they may be considered ready to be connected to a heat pump or heat network. This presents a key opportunity for heat decarbonisation

[39] Note: Baselining is the purpose of understanding at local authority or strategic level, the current status of the buildings against the LHEES Considerations, Targets and Indicators.

[40] Note: The Baseline Tool supports LHEES Stage 3 and enables the user to baseline the performance of domestic properties against the LHEES Priorities, providing summary statistics at local authority and intermediate zone level.

[41] Note: Data has been taken from the Domestic Baseline Tool.

[42] Note: At the time of the analysis, the data was analysed with the Baseline tool v3 and Home Analytics v3.7.2 and EESSH2 housing stock dataset from 2021 was used.

[43] Scottish House Condition Survey 2021: www.cek6.short.gy/Gov-housing-condition-survey-2021keyfindings

[44] Note: Other materials usually need different depths. For further information visit: www.energysavingtrust.org.uk/advice/roof-and-loft-insulation

[45] Scottish House Condition Survey 2021: www.cek6.short.gy/Gov-Scottish-housing-condition-survey-2021

[46] Scottish House Condition Survey 2019: www./cek6.short.gy/Gov-Scottish-housing-condition-survey-2019

[47] Scottish House Condition Survey 2021: www.cek6.short.gy/Gov-Scottish-housing-condition-survey-2021

[48] Household Estimates 2020: www.cek6.short.gy/NRS-householdestimates2020

[49] www.cek6.short.gy/HES-listedbuildings

[50] Note: Category B listed buildings have either regional or outside local importance.

[51] Note: Category C is buildings of local importance, but not necessarily a fine example of a certain period, building type or style.

[52] Note: An 8-fold version of the classification has been produced which includes two additional categories – very remote small towns and very remote rural.

[53] Note: For a given Consideration, the purpose of an Indicator is to act as a key information field to help characterise and baseline the local authority, support strategic zoning and generation of initial delivery areas, and if suitable, to act as a key information field to measure progress against Targets over the duration of the LHEES - set out in the LHEES Delivery Plan.

[54] Note: For some Considerations, one Target and Indicator may be sufficient, but for others a range of Indicators may be appropriate to contextualise and characterise performance against a Target and/or progress towards a Consideration. If multiple Indicators are used in strategic zoning or the identification of delivery areas, a Weighting can be applied based on the importance of each. The LHEES methodology sets out a core set of default Weightings for instances where multiple Indicators are suggested as a default setting. There is flexibility to update and augment these to support local needs or for more focused analysis linked to specific actions and project identification within the Delivery Plan.

[55] Note: Criteria are the settings applied to the Indicators for each Consideration to support Baselining, Strategic Zoning and the identification of Delivery Areas.

[56] Note: All terms and definitions used in this section have been taken from LHEES methodology document.

[57] Note: The local authority level statistics.

[58] Note: Intermediate zones are a statistical geography that are designed to meet constraints on population thresholds (2,500 - 6,000 household residents), to nest within local authorities, and to be built up from aggregates of data zones.

[59] Note: Definitions have been taken from the LHEES methodology document.

6 Generation of Strategic Zones & Pathways, including Potential Zones[60] for Heat Networks

Cruthachadh Shònaichean & Shlighean Ro-innleachdail, a' Gabhail a-steach Shònaichean san t-Sealladh airson Lìonraidhean Teasa

The Heat in Buildings Strategy introduces LHEES, to support the coordination of activities at the local level, to help meet targets concerning to energy efficiency and heat. It identifies heat pumps and heat networks as a near-term priority.

Heat networks play a key part in delivering on climate change objectives. They not only prove to be flexible for low carbon sources but centralised heat generation is likely to be cheaper than individual systems.

6.1 Heat Network Zoning

The first iteration of LHEES identifies indicative Heat Network Zones to understand the scale of potential and initial areas of focus.

The outputs of LHEES can be used to start work on the consideration of heat networks through follow-up work for Heat Network Zoning[61], as required by the Heat Networks (Scotland) Act.

6.2 Local Authority Overview

Heat networks play a crucial role in reducing the carbon intensity of heating and reducing fuel costs. We are already seeing these benefits in the Highlands with several existing heat networks or small-scale district heating schemes.

There is an opportunity for new developments or the expansion of existing heat networks to provide social, economic, and environmental benefits to the region through reducing carbon emissions, creating new jobs and tackling fuel poverty by providing heat at an affordable cost.

During the Stage 4 analysis, LHEES methodology has been followed and several potential Heat Network Zones were identified within the Highlands, and these include Inverness, Dingwall, Invergordon, and Fort William.[62]

While several potential Heat Network Zones were identified during the Stage 4 analysis, none have yet been designated. No opportunity category[63] has been assigned for the Potential Zones for Heat Networks. Existing infrastructure and constraints within indicative zones have been analysed, with strategic consideration given to how these zones could be further developed, considering heat source opportunities and proximity to existing networks.

The steps the Council took to identify those zones:

- **The GIS analysis was performed using the radii-buffering approach[64] which identifies clusters[65] of buildings where potential anchor loads[66] for a heat network are in proximity indicating a project opportunity.**
- **Anchor loads were identified by selecting buildings with a heat demand greater than 500 MWh/yr and a criterion on anchor load count was applied to filter clustered outputs with two or more anchor loads to identify potential Heat Network Priority Zones.**
- **A gridded heat density[67] layer was added to the identified priority clusters.**
- **Raster[68] units with a heat demand of 50 kWh/yr/m² were selected as a minimum threshold, so only those exceeding that were visible.**
- **Prioritised clusters_4000_2AL layer[69] was created.**
- **The GHiGS layer was added to explore if any nearby green spaces could support potential low carbon heat solutions for the identified priority clusters.**

6.3 Individual Heat Network Zones

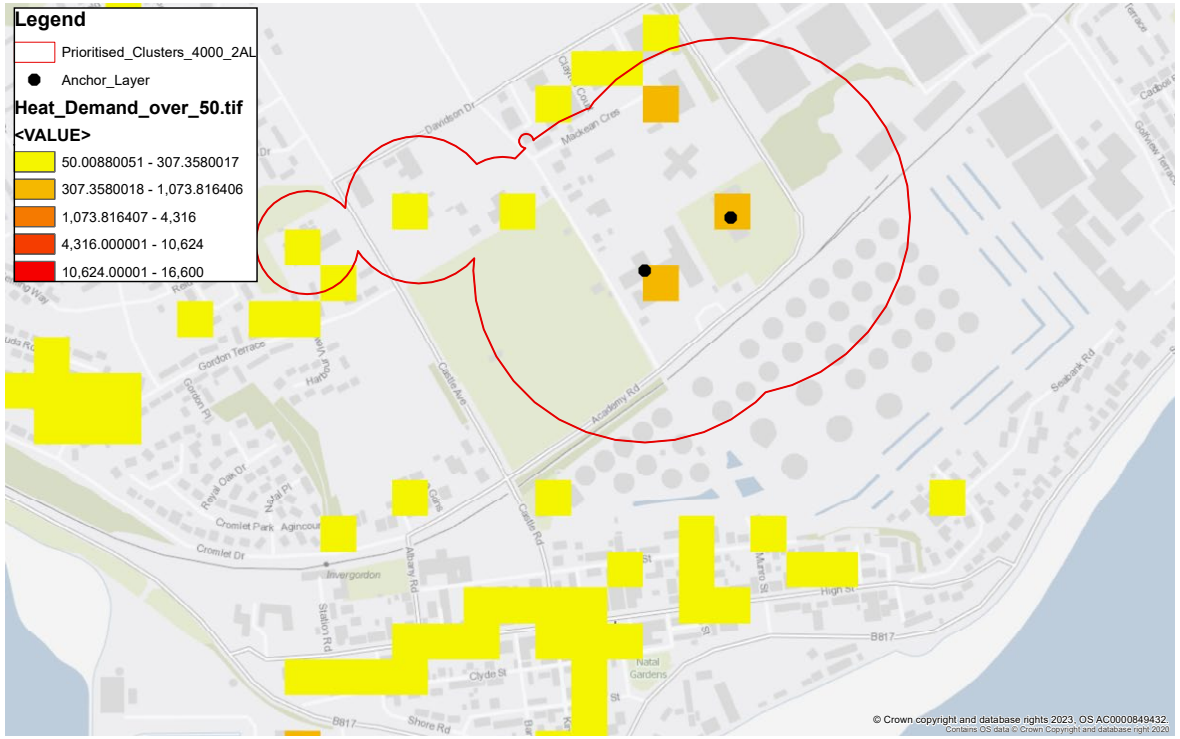
The potential zones present theoretical and technical potential only at a strategic level, prior to any site level feasibility study alongside funding availability to progress them.

Photo by The Highland Council

Figure 18 – Opportunity summary for Invergordon Potential Heat Network Zone

Opportunity summary:

- **Zone location: Invergordon Academy and Invergordon Sports Centre.**
- **2 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 2,391 MWh/yr.**
- **No existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis).
- **Constraints: no major roads** (minor constraint)**, no rivers but there is a railway cutting through south-east of the cluster** (minor constraint)**. It does not bisect groups of high heat demand buildings.**



GHiGS:

- **Number of green spaces: 15.**
- **Total area of green spaces (m2): 15,001.**

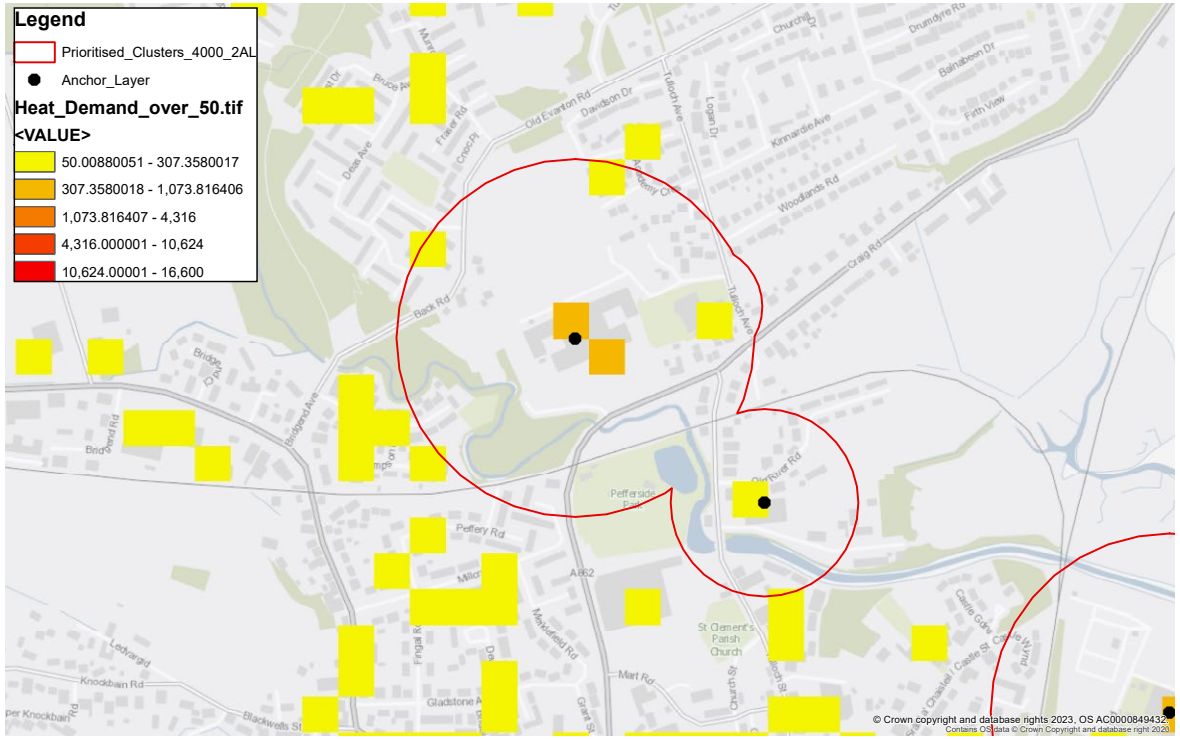
Resources:

- **High Heat Production (HHP) Granites: Area that may overlie buried HHP granite. It has potential for deep geothermal energy.**
- **Hot Sedimentary Aquifer: Moderately productive aquifer in which flow is virtually all through fractures and other discontinuities.**
- **National Atmospheric Emissions Inventory (NAEI) large emitters: Four sites within 300m from the cluster.**
- **Scottish Environment Protection Agency (SEPA) waste: One site within 500m from the cluster.**
- **Waterbodies: Not present.**

Figure 19 – Opportunity summary for Dingwall 1 Potential Heat Network Zone

Opportunity summary:

- **Zone location: Dingwall Academy and Highland Council Tecs Depot.**
- **2 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 2,678 MWh/yr.**
- **No existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis, as these were not shared with Changeworks at the time of the analysis).
- **Constraints: A862 bisects groups of buildings and anchor loads** (major constraint)**, river Peffery cuts through the cluster but it does not bisect groups of buildings or anchor loads (minor constraint). There is a railway that cuts through the cluster and bisects groups of buildings and anchor loads.**



GHiGS:

- **Number of green spaces: 16.**
- **Total area of green spaces (m2): 859.**

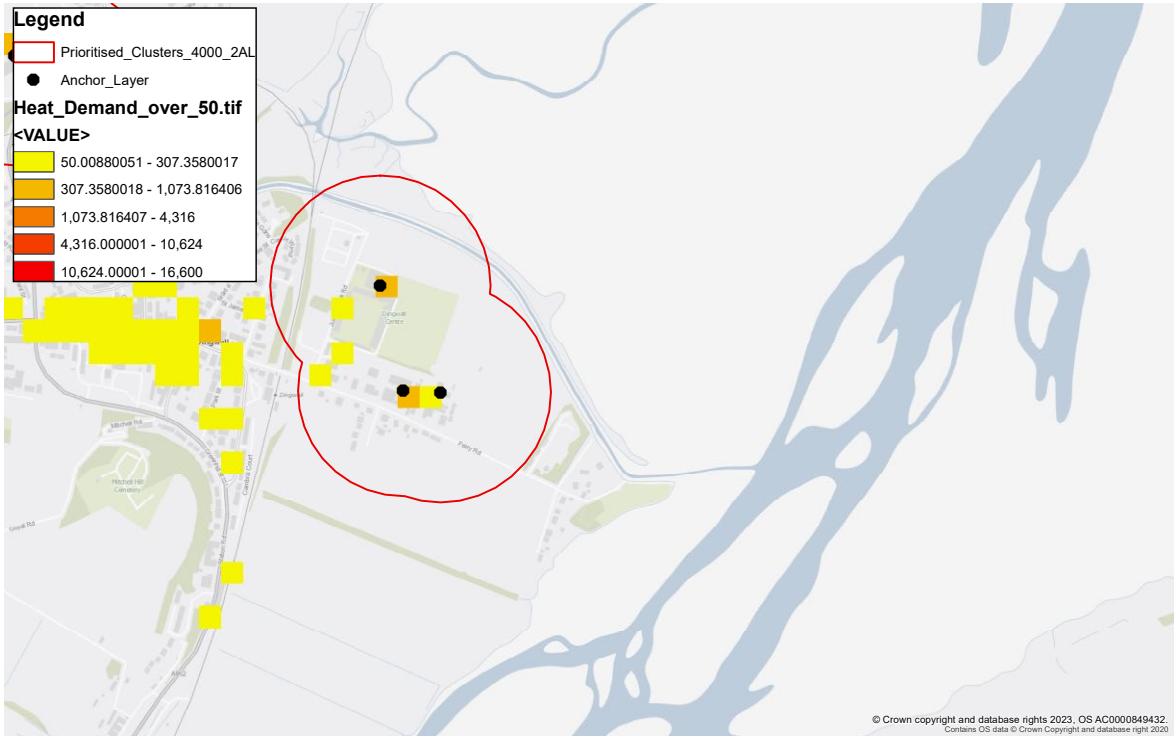
Resources:

- **HHP Granites: Area that may overlie buried HHP granite. It has potential for deep geothermal energy.**
- **Hot Sedimentary Aquifer: Moderately productive aquifer in which flow is virtually all through fractures and other discontinuities.**
- **NAEI large emitters: Not present.**
- **SEPA waste: Not present.**
- **Waterbodies: Not present.**

Figure 20 – Opportunity summary for Dingwall 2 Potential Heat Network Zone

Opportunity summary:

- **Zone location: Highland Football Academy, Ross Memorial Hospital and The Health Centre.**
- **3 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 4,830 MWh/yr.**
- **No existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis, as these were not shared with Changeworks at the time of the analysis).
- **Constraints: No major roads** (minor constraint), **river Peffery cuts through the cluster but it does not bisect groups of buildings or anchor loads. There is a railway that cuts through the cluster but does not bisect groups of buildings and anchor loads.**



GHiGS:

- Number of green spaces: 12.
- Total area of green spaces (m2): 13,427.

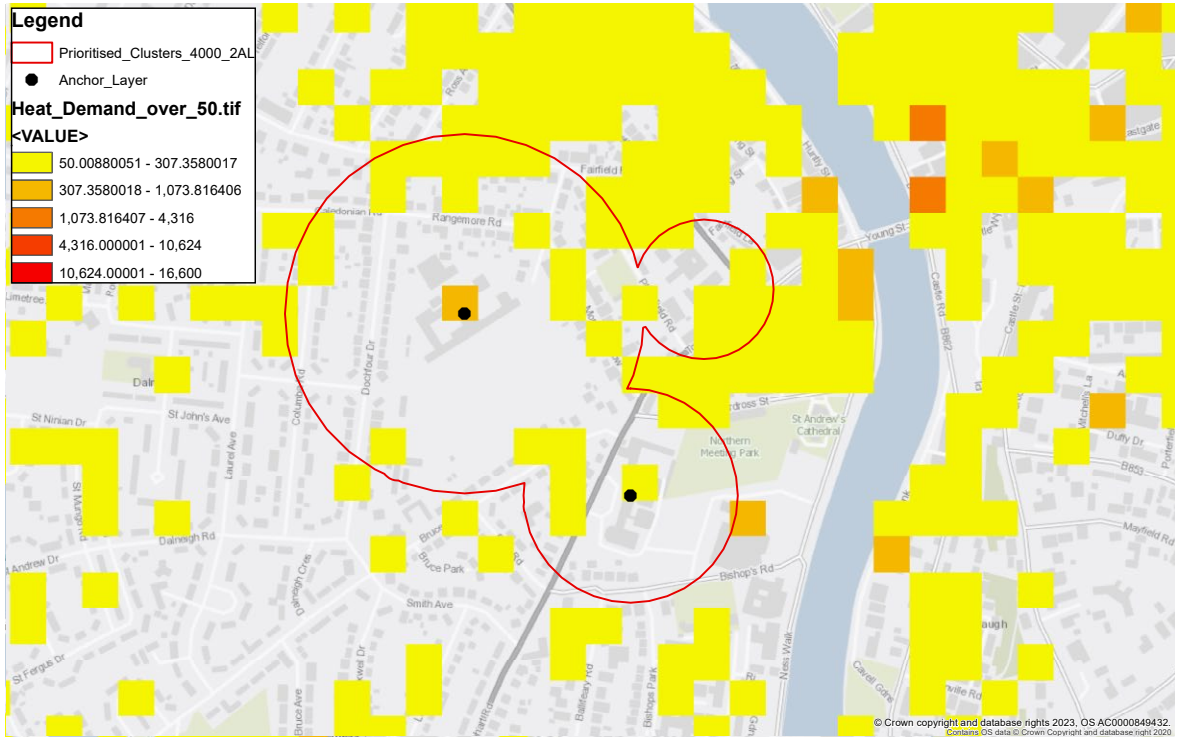
Resources:

- HHP Granites: Area that may overlie buried HHP granite. It has potential for deep geothermal energy.
- Hot Sedimentary Aquifer: Moderately productive aquifer in which flow is virtually all through fractures and other discontinuities.
- NAEI large emitters: Not present.
- SEPA waste: Not present.
- Waterbodies: Not present.

Figure 21 – Opportunity summary for Inverness 1 Potential Heat Network Zone

Opportunity summary:

- **Zone location: Inverness High School and the Highland Council Headquarters.**
- **2 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 1,645 MWh/yr.**
- **Interacts with 8 existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis, as these were not shared with Changeworks at the time of the analysis).
- **Constraints: A82 cuts through the cluster and bisects groups of buildings and anchor loads** (major constraint)**, no rivers or railways.**



GHiGS:

- Number of green spaces: 16.
- Total area of green spaces (m2): 2,752.

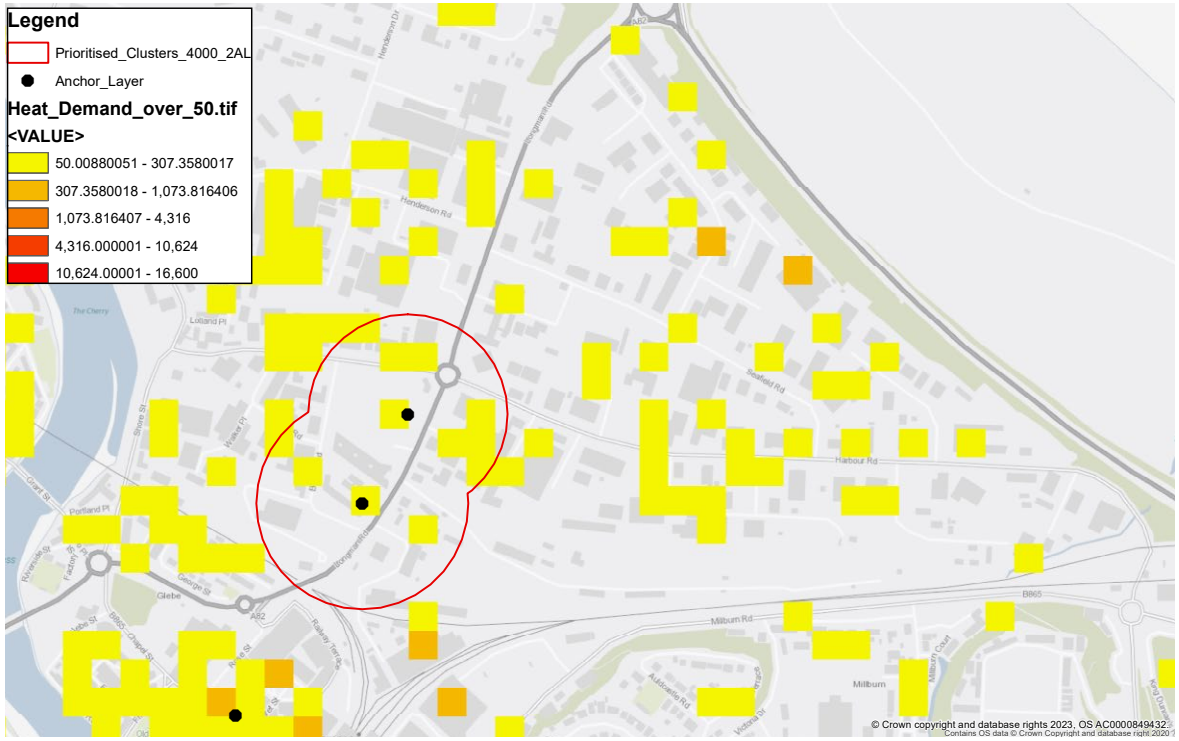
Resources:

- HHP Granites: Area that may overlie buried HHP granite. It has potential for deep geothermal energy.
- Hot Sedimentary Aquifer: Moderately productive aquifer in which flow is virtually all through fractures and other discontinuities.
- NAEI large emitters: Not present.
- SEPA waste: Not present.
- Waterbodies: Not present.

Figure 22 – Opportunity summary for Inverness 2 Potential Heat Network Zone

Opportunity summary:

- **Zone location: The Justice Centre and Police Scotland.**
- **2 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 1,431 MWh/yr.**
- **Interacts with 2 existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis, as these were not shared with Changeworks at the time of the analysis).
- **Constraints: A82 cuts through the cluster and bisects groups of buildings and anchor loads** (major constraint), **no rivers, railway intersects with the southern side of the cluster (minor constraint).**



GHiGS:

- Number of green spaces: 18.
- Total area of green spaces (m2): 4,729.

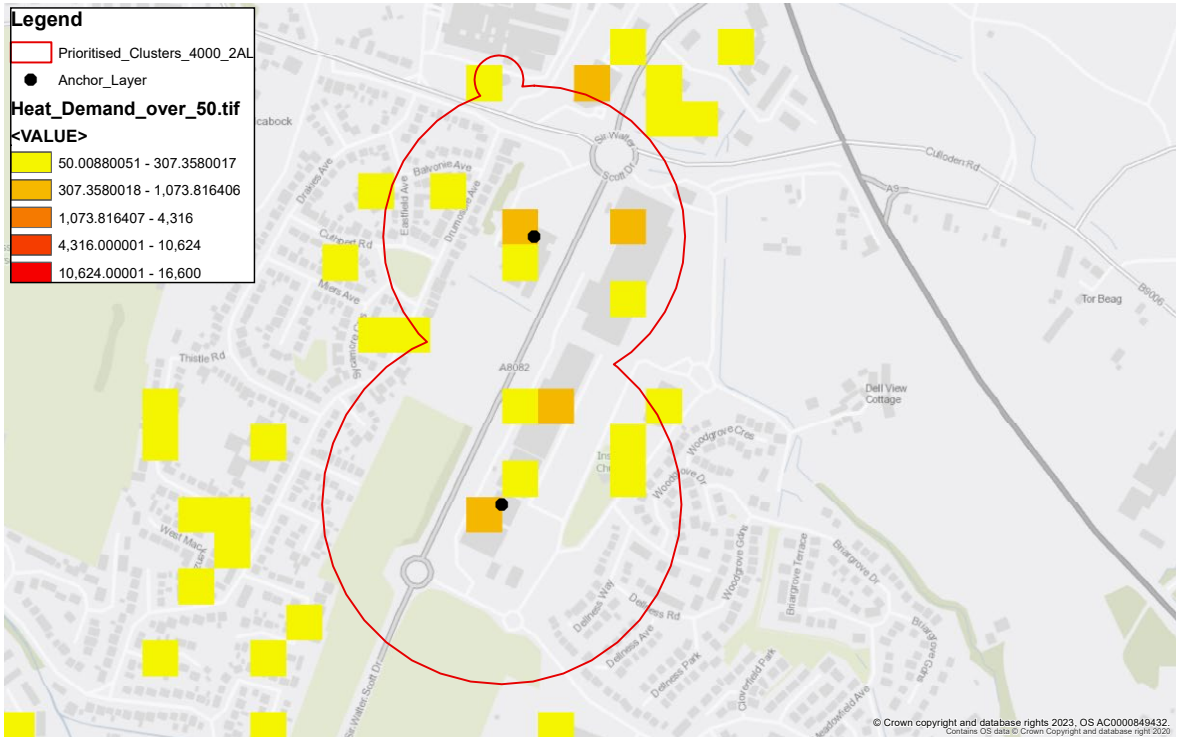
Resources:

- HHP Granites: Area that may overlie buried HHP granite. It has potential for deep geothermal energy.
- Hot Sedimentary Aquifer: Moderately productive aquifer in which flow is virtually all through fractures and other discontinuities.
- NAEI large emitters: One site within 200m from the cluster.
- SEPA waste: One site within the cluster.
- Waterbodies: Not present.

Figure 23 – Opportunity summary for Inverness 3 Potential Heat Network Zone

Opportunity summary:

- **Zone location: Police Headquarters and Bannatyne Health Clubs.**
- **2 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 1,956 MWh/yr.**
- **No existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis, as these were not shared with Changeworks at the time of the analysis).
- **Constraints: A80822 cuts through the cluster and bisects groups of buildings and anchor loads** (major constraint)**, no rivers or railways.**



GHiGS:

- Number of green spaces: 25.
- Total area of green spaces (m2): 259.

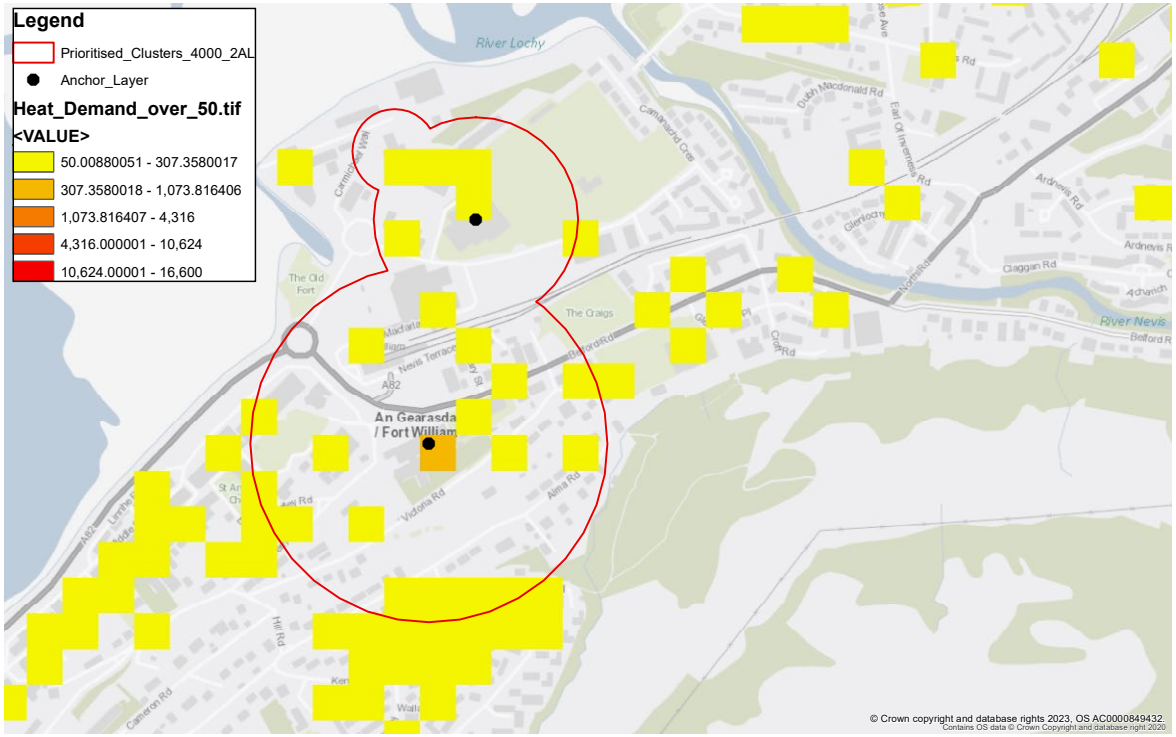
Resources:

- HHP Granites: Area that may overlie buried HHP granite. It has a potential for deep geothermal energy.
- Hot Sedimentary Aquifer: Moderately productive aquifer in which flow is virtually all through fractures and other discontinuities.
- NAEI large emitters: Two sites within the cluster.
- SEPA waste: Not present.
- Waterbodies: Not present.

Figure 24 – Opportunity summary for Fort William Potential Heat Network Zone

Opportunity summary:

- **Zone location: Bedford Hospital and The Nevis Centre.**
- **2 anchor loads identified in the 500 kWh/m/yr LHD zone.**
- **Combined heat demand is 1,866 MWh/yr.**
- **No existing heat networks.**
- **LDP sites: no relevant LDP sites in the area** (the only diversion from the Scottish Government's methodology was not adding LDP sites to the analysis, as these were not shared with Changeworks at the time of the analysis).
- **Constraints: A82 cuts through the cluster and bisects groups of buildings and anchor loads (major constraint), no rivers within the cluster and railways cut through the cluster and the main train station is in the middle of the cluster** (major constraint).



GHiGS:

- Number of green spaces: 25.
- Total area of green spaces (m2): 226.

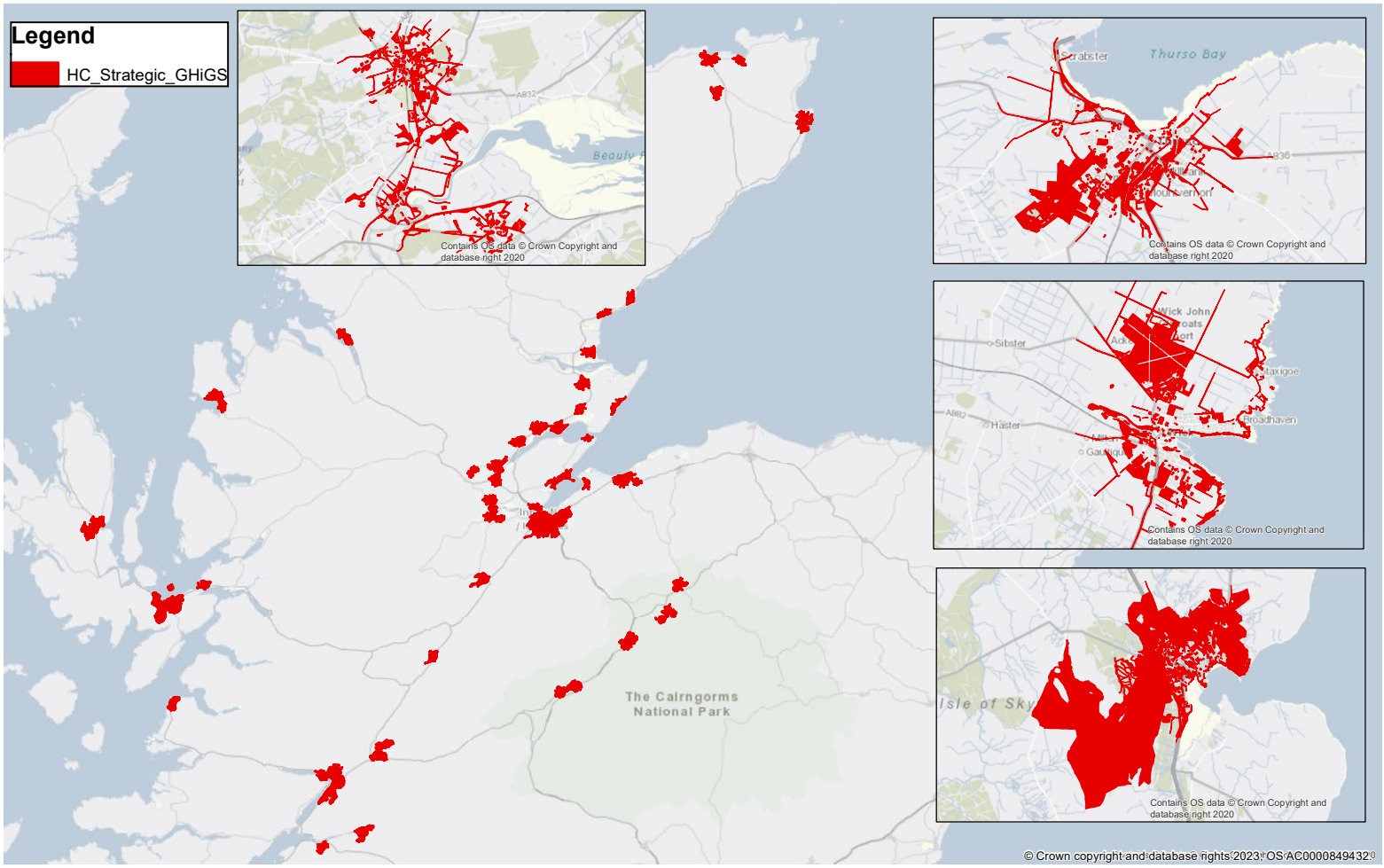
Resources:

- HHP Granites: Not present.
- Hot Sedimentary Aquifer: Low productivity aquifer in which flow is virtually all through fractures and other discontinuities.
- NAEI large emitters: One site within 50m from the cluster.
- SEPA waste: Not present.
- Waterbodies: Not present.

6.4 Small-Scale Heat Network Opportunities

When analysing the 'heat pump ready' property clusters in both the on and off-gas areas, over 1,550 green spaces in the off-gas areas are identified that show a high potential to be used for small-scale heat networks such as shared ground source heat pumps (GSHPs) for the nearby properties, and over 760 for the on-gas areas[70]. Some of the areas are Thurso, Wick, Skye, Beauly and Muir of Ord. **Figure 25** presents potential for small scale heat networks.

Figure 25 – Green Heat in Greenspaces Opportunities



Green Heat in Greenspaces (GHiGS)

1:900,000

N

The Highland Council
Comhairle na Gàidhealtachd

Further information can be found in **Appendix H.**

6.5 Key Challenges and Opportunities

Key challenges and opportunities are listed below but not limited to:

Scale of demand and expansion potential

- Sufficient demand assurance is required to assess the economic viability of potential projects. Investors need the prospect of long-term customers to invest in. Customers cannot legally commit in advance of the heat network being built.
- Council and public sector demands could act as a catalyst for development and present opportunities to establish heat networks within designated areas.
- The connection of publicly owned buildings presents a strategic opportunity for heat network planning. The existing data on public sector buildings such as Highland Council and NHS Scotland offers anchor loads, this would suggest an opportunity to target public sector demand clusters first before expanding into other sectors.

Procurement

- Heat network procurement needs to start as early as possible in the development pipeline. Early engagement with relevant stakeholders is required to take responsibility for meeting customer expectations over the long term.
- There is a need for wider recognition that anchor loads from the public sector would have to commit to connecting to a heat network as they expand.

New developments

- The presence of existing heat networks, or those in development within the areas of wider demand concentration, can present a strategically important opportunity. New developments are likely to offer the potential to investigate heat network viability on a site-by-site basis and help ensure that new sites are considered for future network expansion.

High upfront costs

- Heat network developers face uncertainty in achieving a return in investment. The development of heat networks requires high upfront capital costs and this may make it unattractive for some investors.
- May be a requirement for government subsidies in the early stages of delivering a network.

Low carbon supply

- Water, waste, air, ground, and hydrogen sources present a high potential in the Highlands. Further feasibility work will be required.

Operational and running costs

- Operational, maintenance, running costs and replacement costs need to be taken into consideration at an early stage.
- Electricity remains one of the highest cost fuels in Scotland. The government has consulted on the review of electricity market arrangements (REMA)[71] to identify reforms needed to transition to a decarbonised, cost effective and secure system and investment.

Network capacity

- It is crucial to consider geographical layout in terms of the distance between potential anchor loads.
- The Highland Council area is heavily constrained[72] and early engagement with District Heating Operator (DNO) is crucial. SSEN has published the 'Distribution Future Energy Scenarios 2022' results and methodology report[73] for the North of Scotland. The report provides high-granularity scenarios for the energy generation, demand and storage technologies connecting to the distribution network and shows how the demands on SSEN network will likely change over the next decade and beyond.

Supply chain and jobs creation

- The development of heat networks will create new demands on the supply chain needed to design, maintain, and operate a heat network. These include environmental consultants, building owners, planners, developers, Council officers and other parties.
- There is a gap in supply chain skills and capacity to deliver heat networks and meet the wider LHEES commitments.

Financial returns

- Establishing an adequate financial return and reducing risk levels to an acceptable level are challenges for heat network projects, notably in the early stages of development. Ascertaining these requirements is developed through technical, economic assessments and business plan development.

Building Status

- Some buildings might be within a conservation area and listed. It may not have a direct impact, but this is dependent on the alterations required (if any) to the buildings to accept the technology and the decisions around which technology is suitable.

Photo by Ewen Weatherspoon

6.6 Key Considerations

Heat networks present a good opportunity for heat decarbonisation in the area. During the targeted consultation with relevant stakeholders, the conclusion is that there is an appetite across the region for heat to be supplied by heat networks. Further engagement will become part of the Delivery Plan.

The Council has not designated any Heat Network Zones yet, and several key actions will need to be taken forward. These are listed below but not limited to:

- **Conduct feasibility studies and beyond to explore heat network delivery model options.**
- **Ensure that the new Local Development Plan is developed in conjunction with the LHEES heat network outputs.**
- **Support public sector organisations to discharge their duties to complete BARs.**
- **Continue to engage with a DNO and other relevant stakeholders regarding network capacity.**
- **Raise awareness of financial support available to explore further heating potential and assist with the development costs.**
- **Engage with planners and other relevant stakeholders to discuss heat network potential and share best practices for future network expansion.**
- **Engage with stakeholders to gather data and build information to investigate suitability for heat network connections and sources potential.**
- **Request fuel data to support prioritisation of low carbon technologies and heat network analysis for Delivery Areas.**
- **Continue to explore opportunities for heat network development.**

6.7 Building-Level Heat Decarbonisation

The section helps understand the scale of potential and initial areas of focus to support a strategic starting point to inform Delivery Areas and follow-on engagement.

6.8 Domestic Off-Gas Grid

The low-regret decarbonisation through heat pump deployment in off-gas areas presents a good opportunity for decarbonisation. At the local level, there are 77,648 properties in off-gas grid areas, with 6,428 already heated by a low or zero carbon heat (Category 0) and 29,219 (23%) with tertiary potential for heat pump retrofit. This means that a significant amount of fabric upgrades are required to the properties to be heat pump ready or those less suited to heat pump be electrified with storage or direct electric heaters or biomass.

Table 15 below summarises LA level statistics in terms of the categorisation of properties based on their suitability for heat pump retrofit.[74]

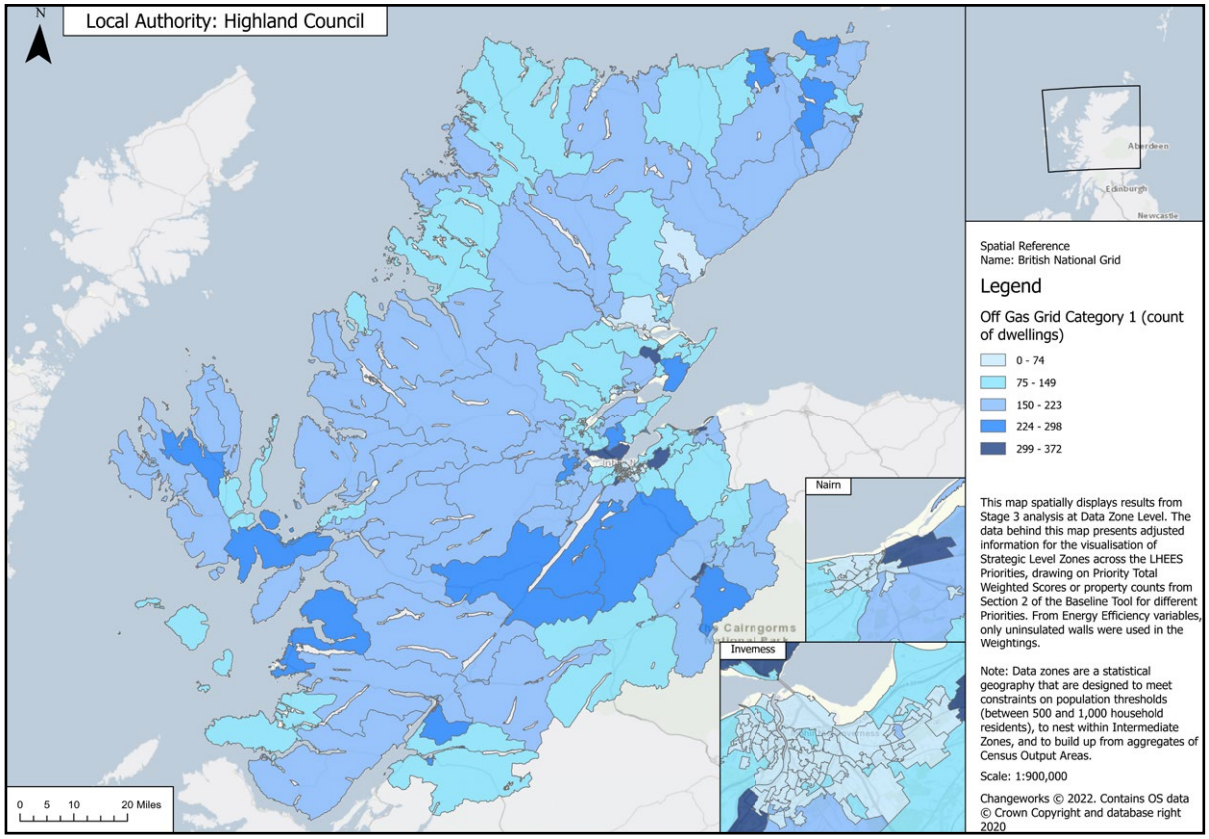
Table 15 – Summary of domestic properties in whole Local Authority, off-gas grid

	Count in Category	HA	LA	Owner occupied	Privately rented
Number of domestic properties in Category 1	19,001	187	2,319	13,793	1,495
Percentage of LA domestic properties	15%	0%	2%	11%	1%
Number of domestic properties in Category 2	27,333	1,820	6,091	13,624	2,340
Percentage of LA domestic properties	22%	1%	5%	11%	2%
Number of domestic properties in Category 3 [75]	29,219	377	1,278	20,075	4,101
Percentage of LA domestic properties	23%	0%	1%	16%	3%

There are 19,001 (15%) properties in Category 1 (Map 3) which can be considered highly suited to heat pump retrofit in off-gas areas. These properties have high levels of insulation with a wet heating system, excluding any consideration of electricity network impacts or costs of any network upgrades. Most of those properties (13,793 (11%)) are owner-occupied, Council-owned (2,319 (2%), privately rented (1,495 (1%)) and no Category 1 properties are owned by housing associations.

Photos by Ewen Weatherspoon

Map 3 – Off-gas grid (domestic) Category 1 map displays results from Stage 3 analysis at Data Zone Level



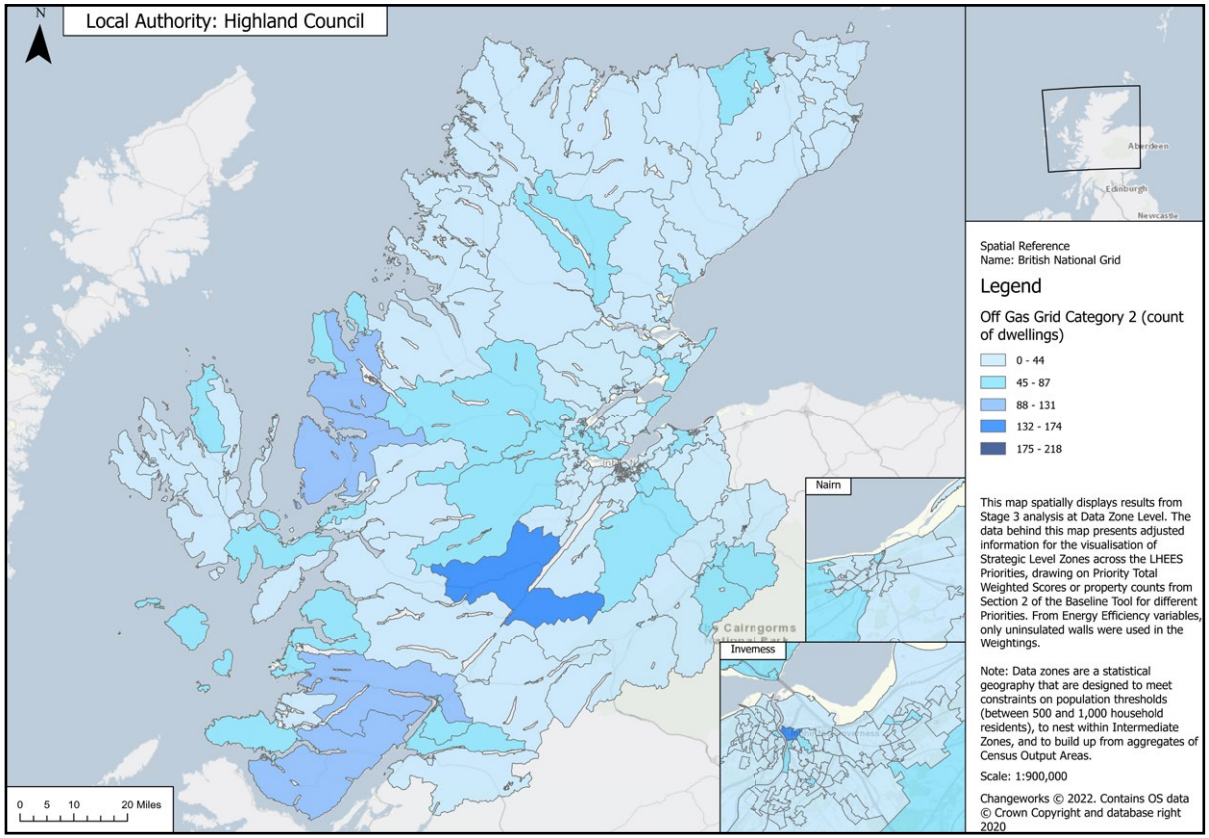
A significant number of properties could be ready for heat pump installations, presenting the Council, owner-occupied and privately rented sector with a primary opportunity to decarbonise domestic stock. This assumption will need to be assessed further at the project level.

Whilst Category 1 buildings indicate intermediate heat pump suitability, they can present challenges for improvement, as a result of the ownership. Whilst the Council has more control and influence over their own stock, owner-occupied and privately rented properties might bring additional challenges because the responsibility to make a change falls on the property owner and landlord. Some of these properties are likely to be in fuel poverty areas which will need to be considered before any actions are taken forward.

In most cases, the installation of a heat pump in domestic buildings is classed as 'permitted development', meaning that no planning permission is required, provided all the limits and conditions are met[76]. In cases where planning permission is not required, it saves time and money for those who are looking to install a heat pump and is more efficient for the registered installers to help them cope with installation demand.

With regard to Category 2 properties (Map 4), the Highland Council's own stock consists of 6,091 (5%), 13,621 (11%) are owner-occupied, 2,340 (2%) privately rented and 1,820 (1%) owned by housing associations. These properties have a secondary potential for heat pump retrofit as they require a moderate fabric upgrade and/or addition of wet distribution system to be heat pump ready.

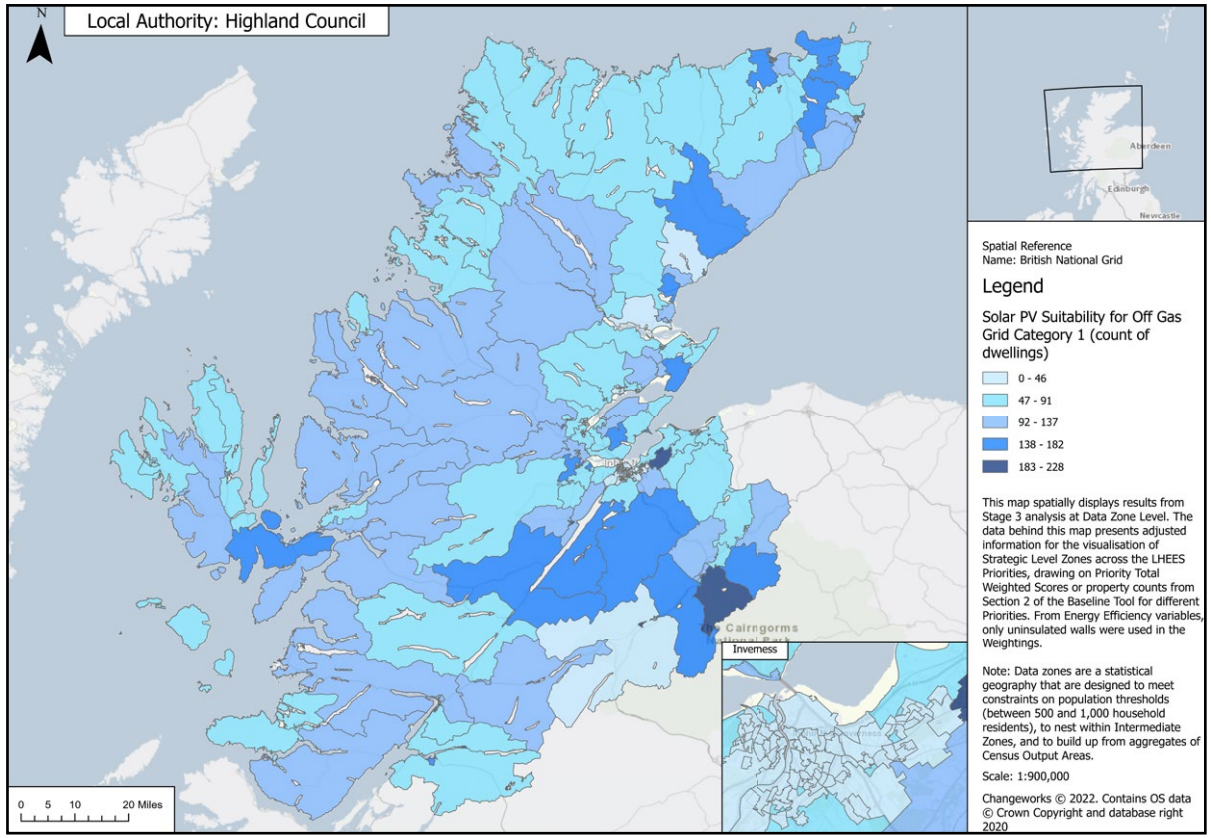
Map 4 – Off-gas grid Category 2 map displays results from Stage 3 analysis at Data Zone Level



Those owner-occupied and privately rented properties could be targeted through schemes such as the EES:ABS, WHS and Home Energy Scotland loans and grants. The LA and HAs have a greater level of control to target those properties via schemes available such as the Scottish Green Public Sector Estate Decarbonisation Scheme and Social Housing Net Zero Heat Fund. By doing so, it will help to upgrade properties to comply with the EESSH2 standard.

The data suggests that there are around 29,219 (23%) of properties in Category 3. Off-gas grid Category 3 map can be found in Appendix H. Regardless of ownership, these properties require a substantial amount of retrofitting work to be heat pump ready. This will involve a significant number of resources and it is unlikely that they will be targeted in the delivery of the first LHEES.

Map 5 – Solar PV suitability for off-gas grid category 1 properties



Given the relatively high proportion of houses compared to flats in the area (76% vs 64% nationally), there is potential for solar thermal and solar PV installations in the Council area. Renewables were not part of the LHEES methodology, although they provide an opportunity for the decarbonisation of heat in the short term, when combined with storage and electric heating.

Photo by Ewen Weatherspoon

6.9 Domestic On-Gas Grid

Around 19% of on-gas properties are in Category 1, meaning that they can be considered heat pump ready (**Map 6**).

Map 6 – On-gas grid (domestic) Category 1 map displays results from Stage 3 analysis at Data Zone Level

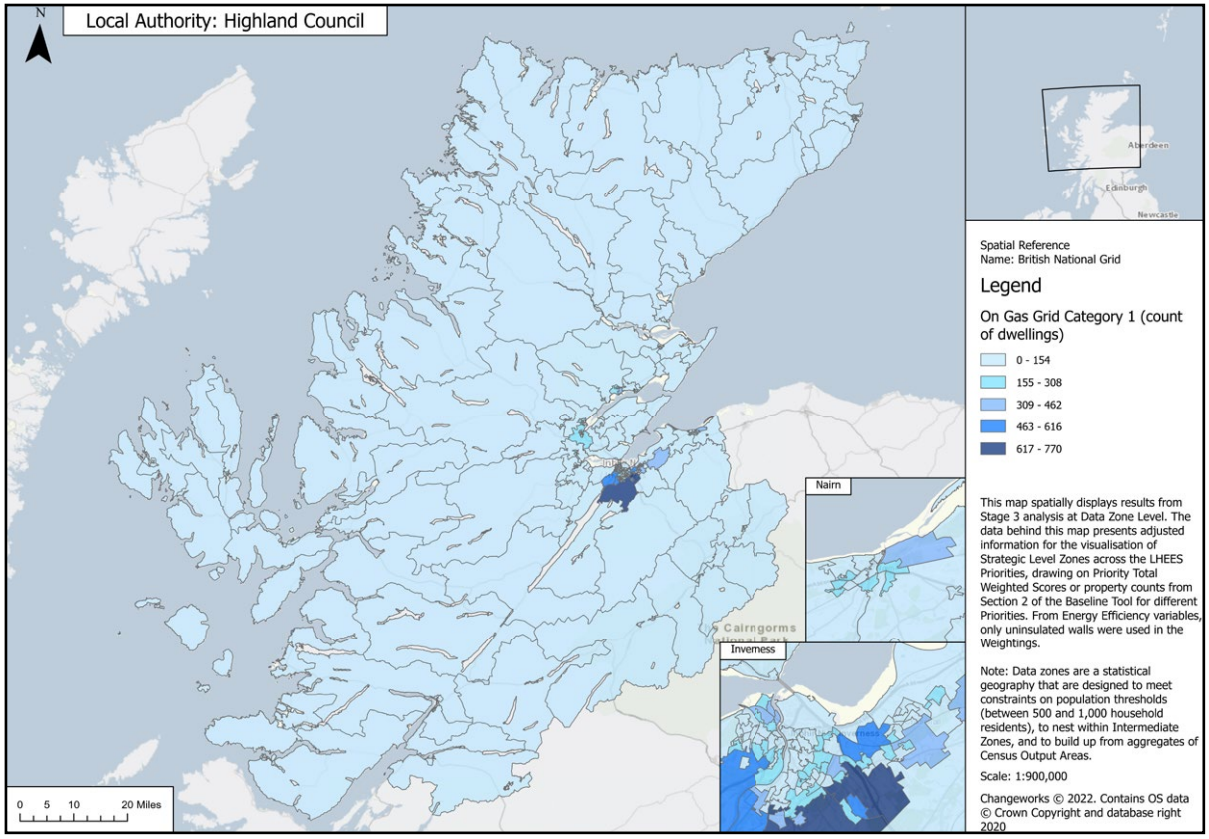


Table 16 presents core findings on outputs from LHEES Stage 3 on-gas properties by property tenure, based on their suitability for heat pump retrofit[77].

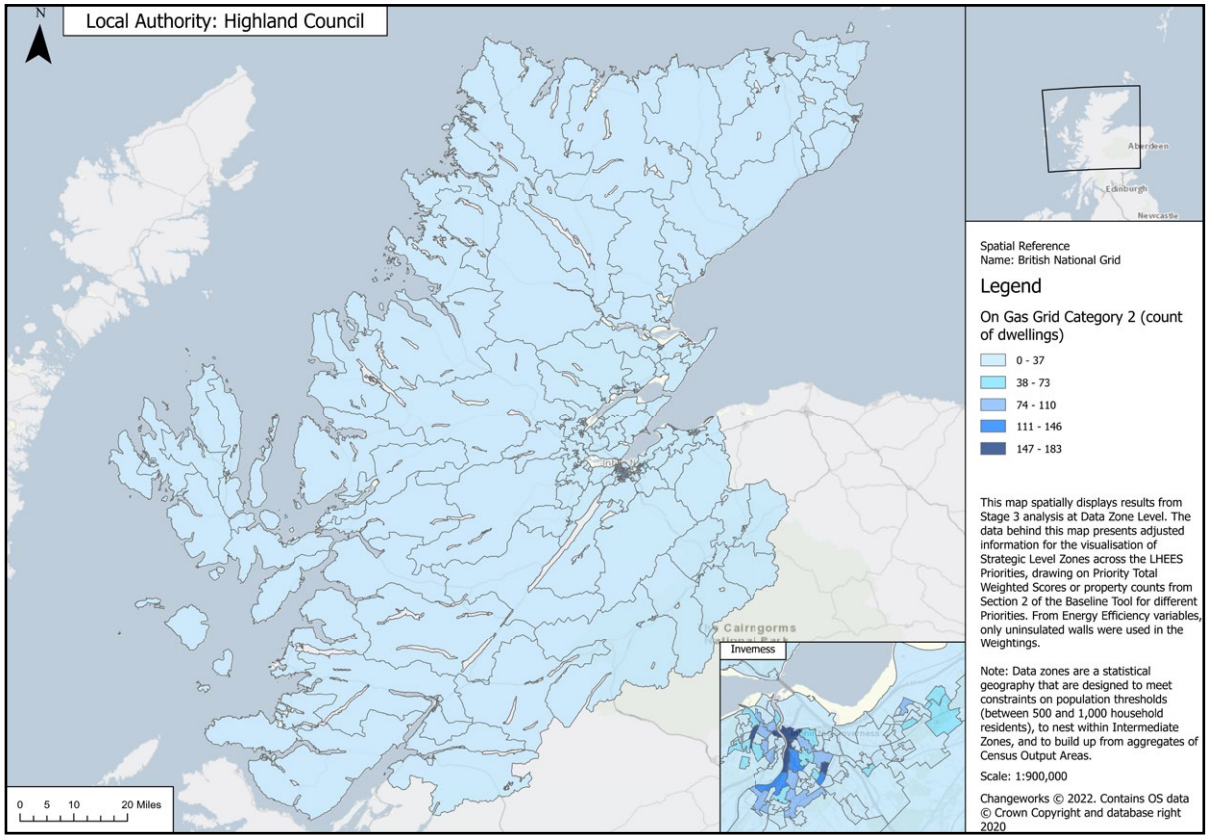
Table 16 – Summary of domestic properties in whole Local Authority, on-gas grid

	Count in Category	HA	LA	Owner occupied	Privately rented
Number of domestic properties in Category 1	23,613	1,502	7,637	13,518	6,617
Percentage of LA domestic properties	19%	1%	6%	11%	3%
Number of domestic properties in Category 2	7,818	217	460	3,535	1,122
Percentage of LA domestic properties	6%	0%	0%	3%	1%
Number of domestic properties in Category 3	12,924	332	952	8,831	2,769
Percentage of LA domestic properties	10%	0%	1%	7%	2%

In total, there are 44,492 of domestic properties in the Highlands which are on-gas grid including Category 0 properties. 23,613 domestic properties in Category 1. Most of them are owner-occupied (11%) and local authority-owned (6%). Around 4% in total are owned by housing associations or privately rented.

There are 7,818 properties which account for around 6% of domestic properties in Category 2 (**Map 7**). This means that they require moderate improvements to be made. Around 3% are owner-occupied and 1% privately rented.

Map 7 – On-gas grid Category 2 map displays results from Stage 3 analysis at Data Zone Level



Category 1 and Category 2 owner-occupied properties can be targeted through the same schemes as off-gas grid properties. The local authority has a better level of control to target their own stock for improvements, although this is dependent on funding availability. Where mixed-use or mixed-tenure properties overlap, a joint approach and scanning activity to identify available funding will be required.

There are 12,924 properties in Category 3 which account for around 10% of domestic housing stock. 7% are owner-occupied, 2% privately rented and 1% owned by the Council. To bring properties up to the energy efficiency standard requires significant capital investment.

Tackling fuel poverty is a key priority for the Council. Buildings where energy efficiency may be a driver of fuel poverty will require additional support. Actions where there will be no detrimental impact on fuel poverty may be taken forward but this will be decided at the project level rather than part of the LHEES Strategy.

Although domestic renewables were not part of the LHEES methodology, they provide an opportunity to meet the decarbonisation of heat in the short term, especially when combined with storage and electric heating. Map 8 presents solar opportunities in on-gas areas.

Map 8 – Solar PV suitability for on-gas grid category 1 properties

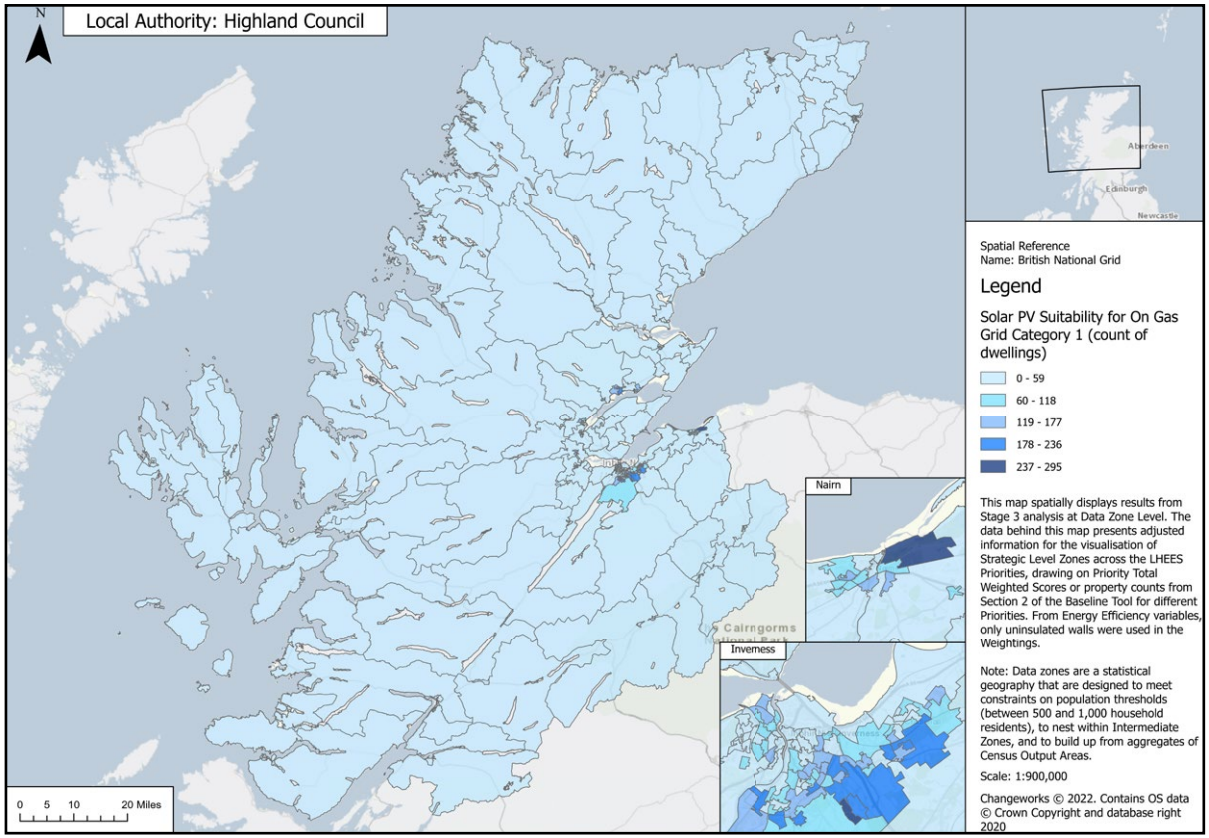


Photo by The Highland Council

Further information on Building-Level Heat Decarbonisation can be found in **Appendix I.**

6.10 Non-Domestic On-Gas Grid and Off-Gas Grid

The Highland Council area has 16,904 non-domestic buildings with the total heat demand of 947,753 (MWh/yr). Many non-domestic buildings are heated by oil and mains gas as their main fuel type. This could provide low regret opportunities for heat decarbonisation. **Figure 26** presents non-domestic buildings heat decarbonisation opportunities.

Figure 26 – The non-domestic stock summary from the Non-Domestic Baseline Tool, showing breakdown of properties by heating system fuel type

Main Typology	By heating system fuel type			
	Electricity	Mains Gas	Other	Oil
General sports & leisure	195	23	50	25
Clubs and community centres	428	47	41	87
Museums, art galleries, libraries, law courts	75	13	9	9
Large entertainment sites (e.g. theatres, cinemas, conference centres)	7	6	2	2
Places of worship	266	31	28	45
Education	209	25	27	39
Emergency services	85	7	9	22
Health	170	41	19	24
Hotels	509	131	144	228
Cafes, pubs, restaurants and takeaways	376	87	68	90
Light manufacturing / industry / workshop	392	68	50	161
Heavy manufacturing / industry	109	1	15	42
Offices	1,026	252	82	301
Retail	2,450	301	140	513
Storage/distribution	87	22	3	102
Residential	4,232	310	801	1,162
Military & prison	0	0	0	1
Other	280	8	48	69
Screened out	125	6	18	28
Total count	**11,021**	**1,379**	**1,554**	**2,950**

Further information on Building-Level Heat Decarbonisation can be found in **Appendix I**.

6.11 Building Level Challenges

Decarbonising heat and improving energy efficiency in private and public buildings comes with its own challenges. Some of the challenges from Section 6.5 also apply to building level decarbonisation. It is recognised that the following further challenges will need to be overcome:

- **If multiple domestic properties are targeted through, for instance the EES:ABS scheme in the same street, a DNO approval is required and that may take more time to acquire.**
- **Some individual installations will take longer incurring additional costs, particularly where distribution system and pipes need to be upgraded.**
- **Often, significant fabric upgrades and repairs will be required to allow a heat pump to run more efficiently.**

6.12 Key Considerations

The Highland Council area has many properties both on and off gas grid with potential for energy efficiency and low carbon heat improvements. This would contribute to Net Zero objectives at both local and national level.

Areas of focus:

- **Engagement with a DNO to understand impact of individual heat pump installations on local grid.**
- **Understand capacity for retrofit at scale.**
- **Identify opportunities for project development across the Council area.**
- **Continue to engage with housing associations and private sector stakeholders to increase uptake of heat decarbonisation works.**
- **Identify available funding opportunities at both national and local level for low carbon heating improvements.**
- **Raise awareness and knowledge of heat decarbonisation.**
- **Investigate solar suitability.**

6.13 Energy Efficiency and Other Outcomes

It is important to reduce energy use and heat demand, primary with building retrofitting measures. Generate renewable electricity to support the development of decarbonised heat and local energy security is critical in the successful delivery of the LHEES and Net Zero commitments.

6.14 Domestic Stock

A high-level overview of domestic building stock of poor energy efficiency is summarised in **Table 17.**

Table 17 – Summary of domestic properties in whole Local Authority, poor energy efficiency

		Number of properties	% of LA
Key indicators	Loft insulation 0-99mm	10,487	8%
	Single glazed windows	8,269	7%
	Uninsulated walls	53,720	42%
Uninsulated walls - construction type	Solid Brick or Stone	24,472	19%
	Timber Frame	12,694	10%
	Cavity Construction	13,294	10%
	System Built	3,260	3%
Uninsulated walls - tenure walls	HA	1,127	1%
	LA	2,302	2%
	Owner Occupied	37,505	30%
	Privately Rented	6,473	5%

Around 10,487 (8%) of properties have low levels of loft insulation (0-99mm), 8.269 (7%) are single glazed, 53,720 have uninsulated walls. The majority of properties have solid brick and stone walls (19%).

A great number of domestic properties with uninsulated walls belong to owner-occupiers 37,505 (30%), followed by 6,473 (5%) privately rented, 2,302 (2%) owned by the LA and 1,127 (1%) by HAs. The Council and Housing Associations covering the Highland region have increased control and influence over energy efficiency works to adopt a fabric first approach and upgrade windows.

There is a need for continuous commitment to working with partner organisations such as Home Energy Scotland to support the delivery of various energy efficiency programmes such as EES:ABS and WHS.

By analysing poor energy efficiency, it is possible to better understand how low energy efficiency can contribute to fuel poverty. **Table 18** provides a summary of poor energy efficiency as a driver for fuel poverty.

Table 18 – Summary of whole Local Authority, poor energy efficiency as a driver for fuel poverty

		Number of properties within specified fuel poverty rate %[78]	As a % of properties within specified fuel poverty rate	As a % of all properties in LA
Key indicators	Loft insulation 0-99mm	3,003	7%	2%
	Single glazed windows	3,106	8%	2%
	Uninsulated walls	16,799	41%	13%
Uninsulated walls - construction type	Solid Brick or Stone	6,875	17%	6%
	Timber Frame	4,093	10%	3%
	Cavity Construction	4,656	11%	4%
	System Built	1,175	3%	1%
Uninsulated walls - tenure walls	HA	1,314	3%	1%
	LA	3,748	9%	3%
	Owner Occupied	6,270	15%	5%
	Privately Rented	5,467	13%	4%

Table 19 – Summary for whole Local Authority, poor energy efficiency as a driver for extreme fuel poverty:

		Number of properties within specified fuel poverty rate %[80]	As a % of properties within specified fuel poverty rate	As a % of all properties in LA
Key indicators	Loft insulation 0-99mm	1,710	6%	1%
	Single glazed windows	1,969	7%	2%
	Uninsulated walls	10,330	38%	8%
Uninsulated walls - construction type	Solid Brick or Stone	3,804	14%	3%
	Timber Frame	2,655	10%	2%
	Cavity Construction	3,079	11%	2%
	System Built	792	3%	1%
Uninsulated walls - tenure walls	HA	1,209	4%	1%
	LA	3,269	12%	3%
	Owner Occupied	2,196	8%	2%
	Privately Rented	3,656	13%	3%

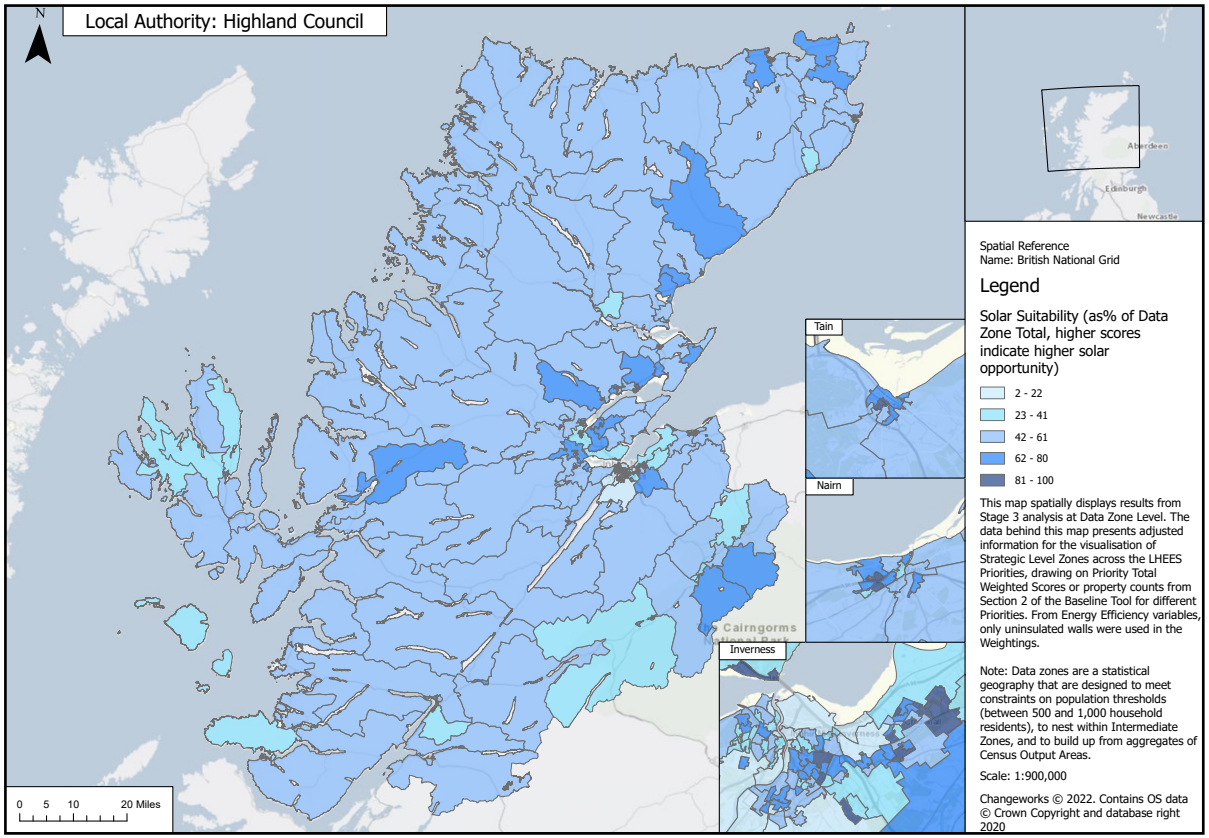
Most uninsulated wall properties in the poor energy efficiency sector that are known to drive fuel poverty are owner-occupied. In addition, other building types in the poor energy efficiency sector include those by HAs and LAs[79].

Table 19 shows that the majority of buildings with uninsulated walls that are in extreme fuel poverty areas are owner-occupied (6,270) and privately rented (5,467). A significant number of uninsulated walls are solid brick and stone walls that are usually more costly to insulate compared to other types of wall insulation.

Although domestic renewables were not part of the LHEES methodology, given the relatively high proportion of houses compared to flats (76% vs 64% nationally), there is potential for solar thermal and solar PV installations in the Council area (Map 9). A fabric first approach must be prioritised, where possible, to improve the thermal performance of the existing building by improving its fabric (roof, walls, floors, windows), airtightness[81], thermal bridging[82], service improvements (heating system and distribution), before considering the position and orientation of the building to determine its suitability for solar energy.[83]

Most properties are suitable for solar PV installations[84], and these are shown in **Map 9**.

Map 9 – Solar suitability from Stage 3 analysis at Data Zone Level



There are approximately 9,424 mixed-tenure properties and 23,998 with more than 1 dwelling in the building.

Further information on Energy Efficiency and Other Outcomes can be found in **Appendix J.**

6.15 Key Considerations

Energy efficiency retrofit works will be required to successfully achieve the Net Zero targets in domestic and non-domestic properties.

Areas of focus:

- **Understand capacity for retrofit at scale and costings of repair works.**
- **Identify building level delivery actions that will assist in a Just Transition.**
- **Identify opportunities for project development across the Council area.**
- **Ongoing engagement and collaboration with housing associations and private sector landlords to increase uptake of energy efficiency works.**
- **Engagement with the Federation of Small Business and Chamber of Commerce around decarbonisation of heat and energy efficiency within the business community.**
- **Engagement with relevant stakeholders to identify areas of collaboration across mixed tenure properties would provide an opportunity to improve energy efficiency at scale.**
- **Maximise existing funding opportunities at national and local level on available options for different types of housing stock.**
- **Explore solar potential further.**
- **Work with Historic Environment Scotland and Historic Environment Highland Team to develop a targeted approach for historic building interventions.**
- **Support identification of the skills and jobs required for energy efficiency, retrofit and heat decarbonisation works.**
- **Engage with SSEN to determine available grid capacity throughout the lifetime of the Strategy, whilst taking a holistic approach to the wider energy system.**

6.16 Portfolio Energy Analysis

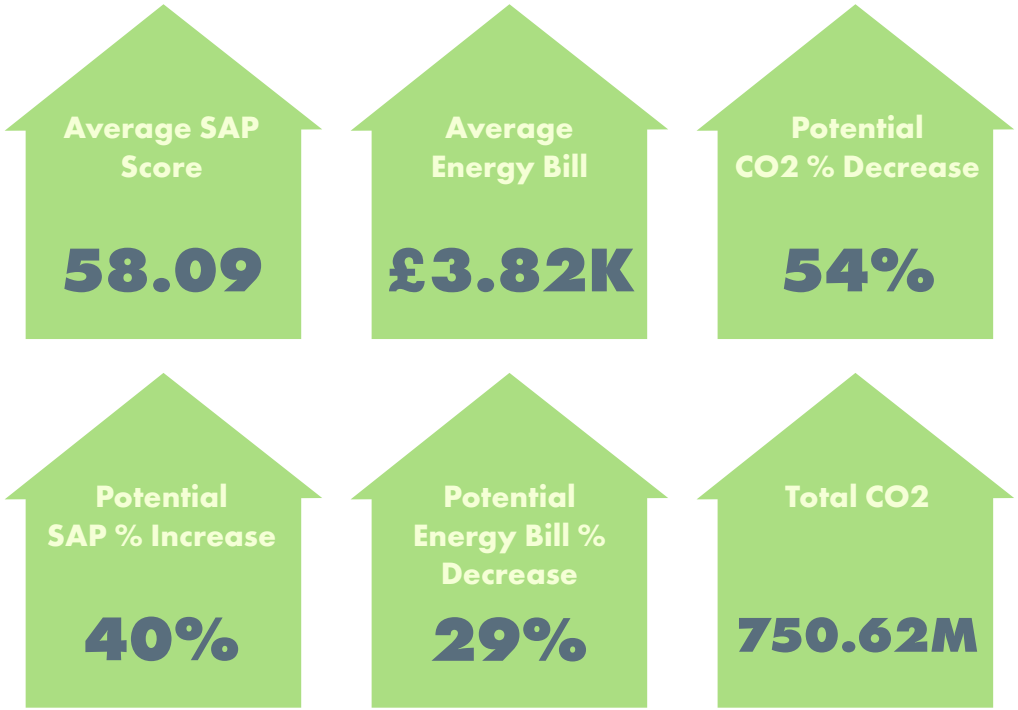
The Portfolio Energy Analysis (PEAT) allows to determine recommended energy efficiency improvements for each building, conduct what-if scenarios to assess the impact of installing various measures on key metrics such as EPC rating, CO2 emissions and risk of fuel poverty. The Council used the PEAT-OR tool to establish in more detail the type of intervention(s) required to improve energy efficiency and decarbonise heat. The high-level outputs for the Highland area are presented below. No Stage 4 GIS results are included in the table below because they will be taken into account at Stage 6 when finalising delivery areas.

Table 20 – PEAT-OR assessment outputs

Measures	Number of measures
Solar panels (PV)	55,400
UPVC windows	101,447
Air source heat pump	43,981
Ground source heat pump	14,188
Uninsulated walls	54,043
Uninsulated floor	89,482
Loft top up	32,082
Cavity wall insulation	12,150
Internal wall insulation	18,246
External wall insulation	15,728
Total number of measures	436,747
Total number of properties	116,610

If all measures were to be adopted:

Figure 27 – PEAT-OR assessment outputs



[60] Note: The analysis carried out for strategic zoning and pathways for the heat networks Consideration is to identify potential zones.

[61] Note: Heat Network Zoning involves assessing the combined heating needs of all the buildings in the area, identifying what sources of heat generation are available, and then identifying the subset of the demands.

[62] Note: The maps have been produced as part of Phase 3 Pilot Project.

[63] Opportunity category allows to provide an optional overall opportunity category for the Potential Zones for Heat Networks.

[64] Note: A radii-buffering approach drives the identification of clusters of buildings where potential anchor loads for heat networks are in close proximity, highlighting project opportunities.

[65] Note: Geospatial clustering is the method of grouping a set of spatial objects into groups.

[66] Note: Anchor loads are high heat demand buildings and key connections on a heat network that usually drive the economics of heat works.

[67] Note: The gridded approach displays heat demand density across all buildings, adding further context to support understanding of the clusters identifies in potential zones identification.

[68] Note: A matrix of squares, or grid, used as a method of data analysis in GIS. Each cell in the grid contains a value representing information on the cell's contents.

[69] Note: Layer presenting prioritised clusters with Linear Heat Density (LHD) benchmark of 4000 kWh/yr/m and a minimum 2 anchor loads.

[70] Note: This is a desktop-based analysis using the green spaces data from the Green Heat in Green Spaces dataset, which would still need to be researched beyond this analysis for feasibility and matters such as the landownership.

[71] Review of electricity market arrangements: www.gov.uk/government/consultations/review-of-electricity-market-arrangements

[72] www.network-maps.ssen.co.uk

[73] SSEN DFES 2022 North of Scotland report: www.cek6.short.gy/SSEN-DFES-2022

[74] Note: There are some addresses in Home Analytics where almost everything is "Unknown", including the absolute basics like tenure, property type, wall construction.

[75] Category 3 breakdown:

- Heat pump – 16,474 (13%).
- Biomass – 2,909 (2%).
- Electrification – 9,831 (8%).

[76] Note: Before installing a heat pump, it is crucial to check with the Council if planning permissions is required before proceeding. This is particularly the case if the property is a listed building or in a conservation area.

[77] Note: There are some addresses in Home Analytics where almost everything is "Unknown", including the absolute basics like tenure, property type, wall construction.

[78] Note: Local Authority specified fuel poverty rate is 33%.

[79] Note: In June 2022, the Highland Council completed the analysis on the Council's stock to determine compliance with the EESSH2 standard. It is estimated that in total 1,230 properties were identified as technically suitable for wall insulation measures. They have not been split in fuel poverty or extreme fuel poverty categories.

[80] Note: Local Authority specified extreme fuel poverty rate is 22%.

[81] Note: Airtightness aims to stop uncontrolled movement of air by closing the gaps and cracks on the external envelope of the building.

[82] Note: Thermal bridging is a weak point or area in the building envelope which allows heat to pass through more easily.

[83] Note: The Energy Saving Trust has developed a 'Guide to Energy Performance Certificates' to help understand the energy performance of the building and identify areas for improvement: www.energysavingtrust.org.uk/advice/guide-to-energy-performance-certificates-epcs

[84] Note: Often, flats are unlikely to be suitable for solar installations.

7 Summary of Strategy Findings and Next Steps
Geàrr-chunntas air Toraidhean na Ro-innleachd agus na h-Ath Cheumannan

The Highland Council recognises the critical strategic leadership role in tackling climate change and increasing resilience to the impacts of climate change across our built environment. Improving buildings is a core indicator of the energy transition to Net Zero and tackling challenges posed by climate change.

The Council-wide LHEES acknowledges that local strategies, priorities, plans, and targets are core in developing and implementing our LHEES. These include but are not limited to:

- **Local Housing Strategy (2023-2026)**
- **Existing and emerging Local Development Plans**
- **Net Zero Strategy and Action Plan**
- **Highland Outcome Improvement Plan and associated Locality Plans**
- **Our Future Highland Corporate Plan 2022-2027**
- **Carbon Management Plan**
- **Place-Based Investment Programme.**

Decarbonising our on-gas and off-gas grid buildings is central to addressing climate change and ensuring the long-term delivery of Scotland's Net Zero target by 2045. Through the development and delivery of LHEES, we have an opportunity to identify low regret off-gas and on-gas heat decarbonisation pathways and opportunities. Replacing fossil fuels with low carbon alternatives such as a heat pump or connecting buildings to a heat network is a future consideration.

Fuel poverty and extreme fuel poverty are prevalent across the Highlands due to the rural geography and lack of gas connections. Exploring ways to better heat and insulate buildings will play a significant role in tackling fuel poverty.

We recognise that it is important to improve mixed-tenure and mixed-use stock in the Highlands to ensure that we live and work in warm, energy efficient and affordable to heat homes and buildings.

The Scottish Highlands is home to several supply chain companies. Transitioning to a Net Zero society creates additional demand for the development of new skills and long-term employment prospects. Rising installation costs, lack of skills and shortage of local expertise in the installation of various energy efficiency measures and renewable energy technologies are posing significant risks in the delivery of various services and programmes across the Highlands, including LHEES. There is a need to help local supply chains lay the groundwork for a flexible skills and education system within the area to contribute towards Net Zero and address existing inequalities across supply chains.

Our LHEES acknowledges the importance of creating a reliable heating system that is future proofed against the impacts of climate change and is fuelled by an uninterrupted availability of energy sources at an affordable price.

Community wealth building helps create a resilient and inclusive economy for local people. Our local LHEES will support community renewable energy projects and provide a platform for local community engagement in the heat transition and climate action areas, creating opportunities for communities to help shape the Net Zero heat transition in Highland.

For the domestic housing stock, the main results from the data analysis in Stage 3 and Stage 4 are summarised in Appendix K.

We have 122,998 properties with a domestic Council tax band in the area, 128,215 properties on HA and 16,904 non-domestic buildings. Poorly heated and energy inefficient buildings have long been identified as a key problem in the Highlands. Retrofitting these buildings to improve air tightness and make them more sustainable and energy efficient is needed to meet our climate change and Net Zero commitments.

7.1 Supporting Delivery

The Next Steps for the Council are set out in the Delivery Plan. Alongside this, there are a range of ways the Scottish Government can further assist with the delivery of LHEES in order to maximise opportunities and help to deliver at the pace required to meet Net Zero targets. These are to ensure that:

- **There is certainty on the scale and continuity of resources.**
- **Funding streams are aligned with a 5-year Delivery Plan or other timescales are clearly demarcated.**
- **There is sufficient access to consultancy support. By tackling the shortage of technical and specialist consultancy; supporting and enabling LHEES stakeholders to access those services as and when required, the Scottish Government will address one of the major barriers impacting on the delivery of LHEES.**
- **Support and incorporated training, upskilling and support mechanisms are available to develop supply chains. This will support LHEES stakeholders with a pipeline of projects within given timescales.**
- **An alignment of policy to support with grid constraint challenges and help overcome barriers with a DNO.**
- **A data sharing platform is developed to allow organisations to tap into data consistently and be able to share it[85].**

On a local scale, due to increased need for electricity in rural communities and lack of infrastructure to meet the electricity demand, it is necessary to produce a Highland Local Energy Action Plan (LEAP). This will support an evidence-based approach to identify the best pathway for the Council to achieve Net Zero.

Ongoing public engagement is critical in the successful implementation of the LHEES. Engagement within specific areas will become part of the Delivery Plan.

[85] Note: Subject to data access and sharing permission.

8 Glossary
Clàr-mìneachaidh

AG	Address Gazetteer
ASHP	Air Source Heat Pump
BAR	Building Assessment Report
CAB	Citizens Advice Bureau
CAG	Corporate Address Gazetteer
CPAG	Caithness Poverty Action Group
CARES	Community and Renewable Energy Scheme
CO2	Carbon Dioxide
DNO	District Network Operator
ECO	Energy Company Obligation
EE	Energy Efficiency
EES:ABS	Energy Efficient Scotland: Area Based Scheme
EESSH	Energy Efficiency Standard for Social Housing
EPC	Energy Performance Certificate
EST	Energy Saving Trust
EWI	External Wall Insulation
FNA	First National Assessment
Flex	Flexible Eligibility
GBIS	Great British Insulation Scheme
GHGs	Greenhouse gases
GHiGS	Green Heat in Green Spaces

GIS	Geographic Information System
GSHP	Ground Source Heat Pump
HA	Housing Association
HHP Granites	High Heat Production Granites
HIE	Highlands and Islands Enterprise
HNSU	Heat Network Support Unit
HNZ	Heat Network Zone
HRA	Housing Revenue Account
HwLDP	Highland-wide Local Development Plan
IZ	Intermediate Zone
kWh/m/yr	Kilowatt-hours per metre per year
kWh/yr/m2	Kilowatt-hours in square metres per year
LA	Local Authority
LDP	Local Development Plan
LEAP	Local Energy Action Plan
LED	Light Emitting Diode
LEIP	Learning Estate Improvement Plan
LHD	Linear Heat Density
LHEES	Local Heat and Energy Efficiency Strategy
LPG	Liquefied Petroleum Gas
MEP	Monitoring and Evaluation Plan

MW/h/yr	Megawatt-hours per year
m2	The square metre
NAEI	National Atmospheric Emissions Inventory
NDA	Non-Domestic Analysis
NHS	National Health Service
NPF	National Planning Framework
OBC	Outline Business Case
OGG	On Gas Grid
OS	Ordnance Survey
OSG	One Scotland Gazetteer
PEAT	Portfolio Energy Analysis Tool
PPA	Power Purchase Agreement
REMA	Review of Electricity Market Arrangements
RSL	Registered Social Landlord
SAP	Standard Assessment Procedure
SEA	Strategic Environmental Assessment
SEEP	Scotland's Energy Efficiency Programme
SEG	Smart Export Guarantee
SEON	Scottish Energy Officers Network
SEPA	Scottish Environment Protection Agency
SHM	Scotland Heat Ma
SFT	Scottish Futures Trust
STEM	Science, Technology, Engineering, and Mathematics
Solar PV	Solar photovoltaic

SSE	Scottish and Southern Electricity
SSEN	Scottish and Southern Electricity Networks
TWh	Terawatt-hour
UHI	University of the Highlands and Islands
UK	United Kingdom
UPRN	Unique Property Reference Number
WHD	Warm Home Discount
WHS	Warmer Homes Scotland
ZWS	Zero Waste Scotland

9 Appendices
Eàrr-ràdhan

Appendix A - Limitations

Non-domestic sector limitations

LHEES aims to cover the full building stock within the local authority, including the domestic and non-domestic sectors. The LHEES methodology (v3) sets out approaches for each of the LHEES Stages for the domestic sector. However, there are some limitations for the non-domestic sector due to a lack of sufficient data. This is particularly noticeable for LHEES Stage 3 and Stage 4 data analysis in the creation of the Highland Council LHEES.

EST released an experimental dataset at the time of the analysis with property characteristics that cover all the non-domestic properties in a local authority. However, this dataset did not provide information regarding the fabric and potential energy efficiency upgrades. It contained information about the energy use such as heat demand and other energy use, energy efficiency scores, heating systems and dimensional information that can be used as a baseline.

Domestic sector limitations

The Highland Council completed Stage 1-4 analysis during the LHEES pilot programme. At the time of the analysis, the data was analysed with the Baseline tool v3 and Home Analytics v3.7.2 and the Council used an EESSH2 housing stock dataset from 2021.

Within the timescale for developing the first phase of LHEES an existing data set was utilised. Within the first five years of the Delivery Plan, the identified areas will be reviewed and updated.

Other limitations:

- Most of our local policies do not include any quantitative targets other than the national targets that the Scottish Government has already put in place.
- Data confidence: inconsistent EPC SAP rating and improvement recommendations pose challenges for energy modelling.
- Parts of the Baseline Tool had to be replicated to accommodate for extra Stage 4 analysis, as the tool did not allow for that.
- The Local Development Plan has not been included in Stage 4 analysis, which could have strengthened the analysis.
- When analysing the 'heat pump ready' property clusters in both the on and off-gas areas, Stage 4, Changeworks identified over 1,550 green spaces in the off-gas areas that show a high potential to be used for small-scale heat networks such as shared GSHPs for the nearby properties, and over 760 for the on-gas areas. It is crucial to note that this is a desktop-based analysis using the green spaces data from the Green Heat in Green Spaces dataset, which would still need to be researched beyond this analysis regarding feasibility and landownership.
- The potential Heat Network Zones were identified where heat networks presented a decarbonisation pathway that could be of strategic significance or warranted further investigation in terms of project opportunities. These potential zones present theoretical and technical potential only at a strategic level, prior to any site level feasibility study.

- An opportunity for hydrogen has not been considered in Stages 1-4 of the analysis because there was no clarity on when or where hydrogen might become available on the existing gas network, or how this could be used to inform the analysis in terms of identifying zones for LHEES. However, the Highland region is well-placed to consider hydrogen and this will be covered in Section 3 'Local Authority progress'.
- Limited resource dedicated to LHEES – one officer covering a third of the land area of Scotland.
- Currently there are no funding streams available that align with the five-year strategic plan to deliver LHEES.
- Regional skills shortage for delivering low carbon infrastructure projects.
- Lack of engagement from external stakeholders.

Mitigation:

- The Council has been working with the consultant Changeworks to fill in the gaps in non-domestic data. This will allow us to analyse non-domestic data in terms of energy efficiency measures and decarbonisation, so they can eventually be included in the LHEES.
- The Council understands its limitation in domestic data and has sense checked the outputs during the formal review of the LHEES Stages.
- The Council has developed a Council-wide Net Zero Strategy which sets out a Route Map to Net Zero by 2024. Legally binding interim targets are also included for building decarbonisation, alongside other sub-categories focusing on transport, people, economy, land use and the environment.
- Ongoing engagement with both internal and external stakeholders and strategic partners is critical in successful delivery of the LHEES.
- The Council has started engagement with with the EST's Supply Chain Team, UHI and Inverness Chamber of Commerce to identify opportunities to support supply chain.

Appendix B - A full description of the LHEES considerations

LHEES Considerations	Description
Off-gas Grid Buildings	In order to meet our interim climate targets and ensure long term delivery of our Net Zero objectives, by 2030 the vast majority of the 170,000 off-gas homes that currently use high emissions oil, LPG, and solid fuels must convert to zero emissions heating. LHEES will provide guidance for low risk investment into heat decarbonisation options.
On-Gas Grid Heat Decarbonisation	To meet Scotland's statutory targets for emissions reduction, we must reduce significantly – and eventually phase out entirely – our use of natural gas. By 2030, at least 1 million homes will need to switch to zero emissions heat, moving away from high carbon heating such as gas. LHEES should identify potential on-gas heat decarbonisation pathways and opportunities at a strategic and delivery level.
Heat Networks	LHEES should highlight zones within a local authority where heat networks present a potential decarbonisation option. Local authorities should consider heat demand density, the proximity of large heat demands that could form the basis of a network, and any opportunities or constraints relating to development potential e.g. proximity of identified zones to existing heat networks. Zoning that takes place within LHEES will serve as an initial analysis that will inform the designation of heat network zones. See Section 2 for more information on how LHEES interacts with local authorities' duties under the Heat Networks (Scotland) Act 2021.
Poor Building Energy Efficiency	LHEES should identify possible locations at a strategic and delivery level where poor building energy efficiency exists across the local authority. This could be low levels of wall insulation, loft insulation or glazing – or a combination of these measures.
Poor building energy efficiency as a driver of fuel poverty	Poor building energy efficiency is a recognised factor that can contribute to fuel poverty. LHEES should identify possible locations at a strategic and delivery level where poor building energy efficiency acts as a driver for fuel poverty. Within areas of high fuel poverty, this could be where low levels of wall insulation, loft insulation or glazing exist, potentially in combination. This should help to ensure that area-based energy efficiency and heat decarbonisation projects will be effective in reducing fuel poverty, as well as highlighting where extreme fuel poverty is prevalent and further measures and support may be needed.
Mixed-tenure, mixed-use and historic buildings	For mixed-tenure and mixed-use (including the non-domestic sector), building level intervention is likely to be the most effective way to reduce emissions caused by heating. For historic buildings (including those in listed buildings and conservation areas), these are categories that may require tailored approaches to the installation of zero emissions heat and energy efficiency solutions, or where specific advice and support might be available. Identifying such areas will enable the public sector to coordinate or regulate to achieve this outcome. LHEES should identify at a strategic and delivery level where there are buildings of mixed-tenure or mixed-use and also where there are historic buildings (covering listed buildings and conservation areas).

Appendix C - Summary of tools and data library

LHEES Data and Tools Library			
Row	**Data Resource or Tool**	**Description**	**Summary of Use Categorisation**
1	Scotland Heat Map (summer 2020)	Valuable spatial dataset with point-level heat demand data for all properties in Scotland / various other useful data fields and additional information layers. Updated approximately annually. Source data (including from public sector) requested at each update.	Heat demand estimates for all properties in Scotland are used primarily in the Heat Networks analysis. NOTE: cleansing was carried out to remove some heat demand records prior to completion of the national assessment activity for Heat Networks - see Stage 4 guidance for further details. Geographic boundaries used in analysis for all Priorities.
2	Ordnance Survey (OS) product data	Various mapping data, central to the development and use of Scotland's Heat Map and other GIS information sources.	OS product data and license are required to use SHM & other OS-derived datasets. Key to GIS analysis elements of LHEES.
3	Home Analytics v3.7 (Feb 2021)	Database covering all domestic properties in Scotland, built using information from the domestic EPC register and other sources; statistical models are used to provide estimates giving 100% property coverage.	Used extensively in the analysis stages across the LHEES Priorities. NOTE: ~6 month update cycle - changes to field names and addition of fields in future releases could impact on functionality of tools and templates used within the methodology.
4	Non-Domestic Buildings Energy Database	Database covering all non-domestic properties in Scotland, built using information from the domestic EPC register and other sources; statistical models are used to provide estimates giving 100% property coverage.	Likely to become a central data resource for LHEES non-domestic analysis when available.
5	Portfolio Energy Analysis Tool (PEAT)	Tool to accompany Home Analytics; can be used to investigate and cost intervention options for a portfolio of up to 500 properties; can be driven by a price cap or a target EPC score.	Tool to investigate cost interventions used for a number of LHEES Priorities in Stage 5.

6	One Scotland Gazetteer (OSG) - Address Gazetteer (AG)	Central database for all addresses within an authority.	Key to GIS elements of LHEES for identifying multi-tenure non-domestic properties.
7	Local Development Plan sites	Information, ideally in spatial format, on development sites in the LDP and LDP2. To include detail on development type and expected build-out where available.	Used in Heat Networks analysis to understand proximity of new development to existing networks or opportunity areas.
8	SEON Benchmarking or other LA energy data for buildings	Local data covering the energy performance of public sector building stock. SEON Benchmarking standardises format - the majority of Scottish local authorities took part in this work.	May be more accurate than Scotland Heat Map, could be used to update SHM prior to Heat Networks Analysis if preferred.
9	Cleansed version of Scotland Heat Map	Local data covering the energy performance of public sector building stock. SEON Benchmarking standardises format - the majority of Scottish local authorities took part in this work.	Could be used as an alternative to SHM, if cleansing work has been carried out. See note in Heat Networks detailed practitioner guidance regarding cleansing of data to remove erroneous records prior to national assessment work.
10	OS AddressBase Premium	Information about addresses, properties, and land areas.	An alternative to the Corporate Address Gazetteer (CAG), should it not be available. This is used in the GIS elements of LHEES for identifying both non-domestic multi-tenure properties and domestic multi-tenure properties with a parent UPRN.
11	Local authority or RSL property data	Local records of social housing estates / Local House Condition Survey.	Key information for LHEES should be reflected in Home Analytics but may be slightly out of sync with local records due to HA update frequency; local data may also contain supplementary detail not captured in HA.
12	Geographic boundary datasets	Shapefiles or feature classes with the geographic boundaries such as data zone, intermediate zone or postcode.	Offers additional geographic boundaries to those contained in SHM geodatabase.
13	Council-owned assets map	Information, ideally in spatial format, on Council-owned assets.	Could be used to inform low carbon heat resource potential or Heat Network Zoning.
14	Relevant strategy work / feasibility studies / reports not publicly available / LHEES pilot reports	Various studies for review to aid contextual understanding of local opportunities.	Supplementary information that could further inform Heat Network Zone finalisation.

15	Planning permission records	Approved planning permission information.	Supplementary information that could further inform Heat Network Zone finalisation.
16	EPC Register	Database of Energy Performance Certificates.	Could be used to provide additional information for non-domestic buildings, if records exist. Information will be captured in Non-Domestic Analytics in the fullness of time.
17	Electricity distribution network shapefile	Information on existing electricity network showing primary substation locations / constraints.	Supports understanding of Low Carbon Heat (LCH) supply options and constraints.
18	Gas distribution network shapefile	Information on existing gas distribution network - to inform understanding of off-grid properties. Xoserve Off Gas Postcodes data is an alternative.	On- or off-gas detail included in Home Analytics, expected to be included in Non-Domestic Analytics in fullness of time. May be useful in supporting Heat Network Zone finalisation or for considering non-domestic heat decarbonisation pathways.
19	Sewer network shapefile	Information on existing sewer network - to inform understanding of low carbon heat supply opportunities.	Shapefile and characterisation detail may be of value when considering LCH supply options.
20	National Atmospheric Emissions Inventory (NAEI)	Large emitters database to show potential sources of waste heat and likely large process heat demands.	Supports understanding of LCH supply options.
21	Waste sites capacity tool (SEPA)	SEPA waste heat data	Supports understanding of LCH supply options. Some waste sites could provide a potential heat resource – anaerobic digestion, incineration, co-incineration etc.
22	OS OpenMap Local	Rivers and waterbodies	Supports understanding of LCH supply options. Rivers and waterbodies can act as a heat source/sink.
23	British Geological Survey	Geology and hydrogeology	Supports understanding of LCH supply options. Hydrogeology base map for initial assessment of open or closed loop Ground Source Heat Pump systems.

24	Coal Authority and British Geological Survey	Interactive map showing where coal mines are and the extent to which temperatures increase with depth.	Supports understanding of Low Carbon Heat (LCH) supply options. Map for initial assessment of the potential for heat pumps, drawing heat from abandoned coal mines.
25	District Heating Scotland database	Database of operational and in-development heat networks.	Could be used to support the identification of existing heat networks or those in development.
26	Scotland Address Directory	Database of addresses and building use types.	Information regarding the use or function of buildings (e.g. business activity type).
27	Private landlord and owner-occupied installation measures	Database on recently installed measures e.g. installed through joint funding mechanisms such as Local Authority Flex, EES:ABS, Warmer Homes, Home Energy Scotland.	Could support Stage 6 - finalisation of zones and pathways.
28	Green Heat in Greenspaces	GHiGs investigated the suitability of many types of urban open space across Scotland for use as low carbon heat sources, heat storage sites and heat transmission corridors.	Supports understanding of Low Carbon Heat (LCH) supply options.

Appendix D - National Context

The Heat Networks (Scotland) Act 2021 (the Act)

The Act contains a wide range of provisions that will allow Scottish Ministers to implement this new regulatory system. These fall broadly into the following categories:

- Licensing (Part 1 of the Act): Anyone who wishes to run a heat network or network in Scotland needs to get a licence. This will help to maintain standards, improving user trust, and providing greater assurance to investors.
- Consents (Part 2 of the Act): Anyone who wishes to build and/or operate a heat network in Scotland needs to get consent for each network.
- Heat Network Zones (Part 3 of the Act): Scottish Government and local authorities will identify areas (Heat Network Zones) well-placed for the development of heat networks.
- Heat Network Permits (Part 4 of the Act): introduces a regulatory requirement for permits to be obtained in order to build and/or operate a heat network in a Heat Network Zone. It is likely that only one permit will be issued per zone, for a specified number of years.
- Building Assessment Reports (BAR) (Part 5 of the Act): Owners of non-domestic buildings (initially public sector) must prepare a Building Assessment Report for each of their buildings. This includes potential for connection to a heat network and considers the length and efficiency of the existing heat supply.

The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019 (the Fuel Poverty Act)

The Act establishes a new definition of fuel poverty:

> "A household is in fuel poverty if the household's fuel costs (necessary to meet the requisite temperature and amount of hours as well as other reasonable fuel needs) are more than 10% of the household's adjusted net income and after deducting these fuel costs, benefits received for a care need or disability, childcare costs, the household's remaining income is not enough to maintain an acceptable standard of living".

The Act states that by 2040, as far as reasonably possible, that:

- No more than 5% of households in Scotland are in fuel poverty.
- No more than 1% of households in Scotland are in extreme fuel poverty.
- The median fuel poverty gap[86] of households in Scotland is no more than £250, adjusted in accordance with section 5(5), to take into account changes in the value of currency.

It recognises that there are four main drivers of fuel poverty:

- energy prices
- income
- home energy efficiency
- home energy usage.

[86] Note: The fuel poverty gap is the additional income which would be needed to bring a household to the point of not being fuel poor.

Appendix E - Financial Support for Energy Efficiency and Heating Upgrades.

Programme	Funding Source	Eligibility Link and Information Pack
Private Sector Housing		
Energy Efficient Scotland Area Based Scheme (EES: ABS)[87]	Scottish Government	**www.cek6.short.gy/HC-EES-ABS**
Warmer Homes Scotland (WHS)	Scottish Government	**www.cf07.short.gy/Warmer-Homes-Scotland**
Home Energy Scotland Grant and Loan	Scottish Government	**www.cf07.short.gy/Home-Energy-Scotland-Grant**
Energy Company Obligation (ECO) 4	UK Government	**www.cf07.short.gy/Energy-Company-Obligation**
Great British Insulation Scheme	Scottish Government	**www.cf07.short.gy/Great-British-Insulation-Scheme**
Private Rented Sector Landlord Loan	Scottish Government	**www.cf07.short.gy/Home-Energy-Scotland-Private-Rented-Loan**
Social Sector Housing		
The Energy Industry Voluntary Redress Scheme	Ofgem	**www.cf07.short.gy/Energy-Saving-Trust-industry-voluntary-redress-scheme**
Registered Social Landlord Loan	Scottish Government	Closed to new applications
Social Housing Net Zero Heat Fund	Scottish Government	**www.cf07.short.gy/Social-Housing-Net-Zero-Heat-Fund**
District Heating Loan Fund	Scottish Government	**www.cf07.short.gy/District_Heating_Loan_Fund**
Energy Company Obligation (ECO) 4	UK Government	**www.cf07.short.gy/Energy-Company-Obligation**
Private Sector		
Business Energy Scotland SME Loan and Cashback Scheme	Scottish Government	**www.cf07.short.gy/Business_Energy_Scotland_SME_Loan**
District Heating Loan Fund	Scottish Government	**www.cf07.short.gy/District_Heating_Loan_Fund**
Heat Network Fund	Scottish Government	**www.cf07.short.gy/SG-Heat-Network-Fund**
Green Heat Innovation Support Fund	Scottish Government	**www.cf07.short.gy/Green_Heat_Innovation_Support_Fund**
Scottish National Investment Bank	Scottish Government	**www.cf07.short.gy/SG-Scottish-National-Investment-Bank-Funding**

[87] Note: EES:ABS Loan is also available through the Home Energy Scotland loan scheme.

Community Organisations and/or Public Sector		
Let's Do Net Zero Community Buildings Fund	Scottish Government	**www.cf07.short.gy/SG-Net-Zero-Community-Buildings-Fund**
Let's Do Net Zero: Off Electricity Grid Communities Fund	Scottish Government	**www.cf07.short.gy/SG-Net-Zero-Off-Electricity-Grid-Communities-Fund**
Community Heat Development Programme	Scottish Government	**www.cf07.short.gy/SG-Community-Heat-Development-Programme**
The Energy Industry Voluntary Redress Scheme	Ofgem	**www.cf07.short.gy/Energy-Saving-Trust-industry-voluntary-redress-scheme**
Green Public Estate Decarbonisation Scheme	Scottish Government	**www.cf07.short.gy/SG-Green-Public-Estate-Decarbonisation-Scheme**
Scottish Central Government Energy Efficiency Grant Scheme	Scottish Government	**www.cf07.short.gy/SG-Energy-Efficiency-Grant-Scheme**
Scottish and Southern Electricity Networks (SSEN) Resilient Communities Fund	SSEN Energy Networks	**www.cf07.short.gy/SSEN-Resilient-Communities-Fund**
Heat Network Support Unit	Scottish Government	**www.cf07.short.gy/Heat_Network_Support_Unit**
Heat Network Fund	Scottish Government	**www.cf07.short.gy/SG-Heat-Network-Fund**
District Heating Loan Fund	Scottish Government	**www.cf07.short.gy/District_Heating_Loan_Fund**
Salix Fund	UK Government	**www.cf07.short.gy/Salix-public-sector-funding-schemes**
Energy Investment Fund	Scottish Government and its enterprise agencies	**www.cf07.short.gy/Scottish-Enterprise-Energy-Investment-Fund**
Scottish National Investment Bank	Scottish Government	**www.cf07.short.gy/SG-Scottish-National-Investment-Bank-Funding**
Learning Estate Improvement Plan (LEIP)	Scottish Government	**www.cf07.short.gy/SG-Learning-Estate-Improvement-Plan**

Appendix F - The Highland Council Route Map to Net Zero

Route Map to Net Zero
Mapa Slighe

Highland-wide Targets

Scotland-wide Targets

- June 2023 – High Level Strategy and Route map signed off.
- December 2023 – Circular Economy and Community Wealth Building embedded into Procurement process.
- December 2023 – Detailed and costed Action Plan from each thematic group signed off.
- December 2023 – LHEES Strategy and 5-Year Delivery Plan signed off.
- All new homes consented from 2024 to use net zero emission heating.
- 18,000 hectares of woodlands to be created annually.

2025

- Phase out the need for new petrol and diesel light fleet vehicles.
- End landfilling of biodegradable municipal waste.
- Reduce the percentage of all waste sent to landfill to 5%.
- 70% of all waste to be recycled.
- 15% Reduction in total waste.
- Food waste reduced by 33%.

Scotland's combined supply of thermal energy by heat networks to reach 2.6 TWh of output by 2027.

2030

- Reduce emissions by at least 75%.
- Phase out the need for new petrol and diesel heavy fleet vehicles.
- Reduce car kilometres by 20%.
- 50% total energy to be generated by renewables.
- 250,000 hectares of peatland restored.
- Halt Biodiversity loss and become a Nature Positive Scotland.
- 30% of land to be Protected Areas.
- Every Local Authority to have a Nature Network.

Social Housing to achieve EPC B by 2032.

2035

- Scotland's rail service to be decarbonised.
- Low-carbon district heat networks in Scotland should provide a minimum of 22% of heat demand.

All publicly owned buildings to achieve zero direct emissions by 2038.

2040

- Reduce emissions by at least 90%.

2045

- Scotland is Net Zero.
- Scotland has restored and regenerated biodiversity across our land, freshwater and seas.

Appendix G - Indicators, Weighting and Criteria

LHEES Priority - Heat Networks

Theme	Indicator	Criteria	Weighting	Description	Data source (domestic & non-domestic), if known
Identification of Potential Zones	Heat demand (existing)	Definition of a Tier 1 anchor load as heat demand > 500,000 kWh/a.		Anchor loads are the basis for the identification of Potential Zones in Stage 4.	Scotland Heat Map
Identification of Potential Zones	Heat demand (existing)	Maximum radii distance for buffer is 250m.		Buffers around anchor loads are used to define boundaries for Potential Zones, this restriction is applied to prevent very large loads resulting in buffers over unrealistic connection distances.	Scotland Heat Map
Baseline assessment	Heat demand (existing)	Linear heat density (LHD) of 4,000 kWh/m/a to determine buffer radii for baseline assessment.		There is a lack of information on LHD thresholds that might indicate viability for low carbon heat supplied heat networks. Additionally, these thresholds will vary by supply technology and will be highly project-specific in nature. As such, for strategic assessment, a range of LHD values are used in the analysis, with 4,000 kWh/m/a being a typical lower threshold used in UK analysis.	Scotland Heat Map
Baseline assessment	Heat demand (existing)	Minimum number of anchor loads per Potential Zone = 2 for baseline assessment.		A minimum number of anchor loads within a Potential Zone is used to carry out an initial screening, dependent on local considerations.	Scotland Heat Map

Stringent assessment	Heat demand (existing)	Linear heat density (LHD) of 8,000 kWh/m/a to determine buffer radii for stringent assessment.		There is a lack of information on LHD thresholds that might indicate viability for low carbon heat supplied heat networks. Additionally, these thresholds will vary by supply technology and will be highly project-specific in nature. As such, for strategic assessment, a range of LHD values are used in the analysis, with 16,000 kWh/m/a being a threshold that was effective for highlighting the most promising zones in very heat dense regions when testing different thresholds during development of the methodology.	Scotland Heat Map
Stringent assessment	Heat demand (existing)	Minimum number of anchor loads per Potential Zone = 5 for stringent assessment.		A minimum number of anchor loads within a Potential Zone is used to carry out an initial screening dependent on local considerations.	Scotland Heat Map
Opportunity identification	Existing networks	Proximity to Potential Zones		The Stage 4 Heat Network methodology indicates if a Potential Zone is close to an existing network.	Scotland Heat Map
Opportunity identification	Local Development Plan (LDP) sites	Proximity to Potential Zones and / or existing networks		The Stage 4 Heat Network methodology indicates if a Potential Zone is close to a LDP site. Consideration could also be given to LDP sites in proximity to existing networks in identifying extension opportunities, and to LDP sites in isolation if they are of significant scale and density.	Locally held / Improvement Service data used for national assessment

LHEES Priority - Off-Gas Grid

Theme	Indicator	Criteria	Weighting	Description	Data source (domestic & non-domestic), if known
Select properties	Off-gas grid	Off-gas grid = Yes, OR off-gas grid = Unknown AND main fuel type is not mains gas	Filtering step	Property is not connected to gas grid.	Home Analytics
Category 0 already has a heat pump or biomass system installed or is connected to a heat network. Direct electric or storage are still considered for potential retrofit due to higher efficiencies from heat pumps and associated lower fuel costs. Category 0 properties require no further action.	Main heating system	Main heating system = Heat pump		Property already has a heat pump installed.	Home Analytics
	Main heating system	Main heating system = Communal		Property is already connected to communal heating.	Home Analytics

Category 1 required criteria for properties with immediate potential for heat pump retrofit (i.e. well insulated properties with a wet heating system, excluding any consideration of electricity network impacts or costs of any upgrades).	Category 0 property	Is a Category 0 property (No)		Excludes properties included in Category 0.	Home Analytics
	Listed property	Property is listed (No)		Listed buildings require additional considerations for retrofit such as planning permission/listed building consent.	Home Analytics
	Conservation area	Not within a conservation area		Buildings in conservation areas require additional considerations regarding some retrofit works.	Home Analytics
	Insulated walls	Walls insulated (Yes)		Required to have thermal efficiencies needed for heat pumps.	Home Analytics
	Double/triple glazed windows	Windows double or triple glazed (Yes)		Required to have thermal efficiencies needed for heat pumps.	Home Analytics
	Loft insulation 99mm+	Loft is insulated: 99mm+ (prediction)		Required to have thermal efficiencies needed for heat pumps.	Home Analytics
	Main heating LPG, Oil or Biomass/ Solid. As all systems except electric or no heating/hot water system.	Main heating fuel is: LPG, Oil or Biomass/ Solid		Already having a wet system in place is seen to significantly ease transition to heat pumps (replacing Biomass, Solid, LPG or Oil as the fuel source).	Home Analytics
Category 2 required criteria for properties with secondary potential for heat pump retrofit (i.e. properties in need of moderate fabric / heat distribution system upgrade to be heat pump ready).	Category 0 or 1 property	Is a Category 0 or 1 property (No)		Excludes properties included in Category 0 or 1.	Home Analytics
	Insulated walls	Not uninsulated solid wall or system built or timber frame (prediction)		Insulation of these wall types is considered beyond a moderate upgrade. This property type with suitable walls is captured in Category 1. More information is required to determine if necessary thermal efficiency could be achieved.	Home Analytics
	Risk of narrow uninsulated cavity.	Likely to have narrow uninsulated cavity (No)		These walls could require more than a moderate upgrade to meet the required thermal efficiency.	Home Analytics

Additional Category 2 Indicators, Criteria and Weightings to support Delivery Level Area identification (LHEES Stage 4 only).	Double/triple glazed windows	Windows double or triple glazed (Yes)	20%	Required to have thermal efficiencies needed for heat pumps – being in place reduces costs.	Home Analytics
	Wall insulation	Wall insulation prediction = Insulated	20%	Required to have thermal efficiencies needed for heat pumps – being in place reduces costs.	Home Analytics
	Loft insulation	Loft insulation prediction: 100-249mm, 250mm+ or No Loft	20%	Required to have thermal efficiencies needed for heat pumps – being in place reduces costs.	Home Analytics
	Property tenure	Property tenure = housing association or local authority	20%	Easier to install due to ownership levers.	Home Analytics
	Main fuel type	Main heating fuel is: Oil or LPG	20%	Existing wet systems with a high carbon saving from fuel change. Solid fuel is considered more suited to biomass, so not given additional weight.	Home Analytics
Category 3 required criteria for properties with tertiary potential for heat pump technology.	Category 0, 1 or 2 property	Property is considered as category 0, 1 or 2 property (No)		Property is not category 0, 1 or 2. Avoid double counting properties.	Home Analytics
	Main fuel type	Main heating fuel is: Oil or LPG		Existing wet systems with a high carbon saving from fuel change. Solid fuel is considered more suited to biomass, so not applicable in the required criteria.	Home Analytics

Category 3 Weighting to determine indicative decarbonisation pathway for those OGG properties which do not achieve the required heat pump criteria, for either an electric or biomass solution.	Main fuel type	Main fuel type = Electricity	100%	Buildings already fitted with electric heating systems should retain electric systems.	Home Analytics
	Main fuel type	Main fuel type = Biomass/Solid	100%	Buildings already fitted with biomass/ solid heating systems should retain biomass/solid systems.	Home Analytics
	Property type	Property type = Detached	20%	Increase biomass weighting 20%. Detached properties are more likely to have room for a biomass boiler and fuel deliveries.	Home Analytics
	Property type	Property type = Semi-detached	15%	Increase biomass weighting 15%. As with detached (but to a lesser extent), semi-detached properties are more likely to have room for a biomass boiler and fuel deliveries.	Home Analytics
	Wall type	Wall type = Solid brick or stone	15%	Increase biomass weighting 15%. Wall insulation is likely to have high cost.	Home Analytics
	Property type	Property type = Flat (Block of flats, Flat in mixed use building, large block of flats, Small block of flats).	20%	Increase electric heating weighting 20%. Flats unlikely to have space for biomass boiler and deliveries.	Home Analytics
	Urban classification	Urban classification = Large Urban Area, Other Urban Area or Accessible Small Town.	10%	Increase electric heating weighting 10%. Urban location less suitable for biomass due to space and potential air quality impact (particularly with the cumulative impact of multiple installations).	Home Analytics
	Wall insulation	Wall insulation prediction = Insulated	10%	Increase electric heating weighting 10%. Electric heating likely to have higher fuel tariffs, therefore aim to reduce fuel used as much as possible.	Home Analytics

	Glazing type	Glazing type is double/triple	10%	Increase electric heating weighting 10%. Electric heating likely to have higher fuel tariffs, therefore aim to reduce fuel used as much as possible.	Home Analytics

LHEES Priority - Poor building energy efficiency

Theme	Indicator	Criteria	Weighting	Description	Data source (domestic & non-domestic), if known
Building energy efficiency	Loft insulation	<100mm (prediction) (Yes)	33.33%	Binary identifier. Used to identify properties with a low energy efficiency, properties with no or minimal loft insulation.	Home Analytics
	Single glazed windows	Binary (Yes)	33.33%	Binary identifier. Used to identify properties with a low energy efficiency, properties with single glazed windows.	Home Analytics
	Wall insulation prediction (all construction types)	Binary (Uninsulated)	33.33%	Binary identifier. Used to identify properties with a low energy efficiency, properties with uninsulated walls.	Home Analytics
Additional example Indicators that could be used to support Delivery Level Area identification as part of LHEES Stage 4 and Delivery Plan.	Tenure type	User defined		Four types; housing association, owner/ occupier, privately rented, local authority. User can filter by interest.	Home Analytics
	Building age	User defined		Defined in six age brackets. User can filter by interest.	Home Analytics
	Non-traditional build design type.	Solid wall (binary)		User can filter by interest.	Home Analytics
	EPC Rating	E, F or G		User can filter by interest.	Home Analytics

LHEES Priority - Poor building energy efficiency as a driver of fuel poverty

Theme	Indicator	Criteria	Weighting	Description	Data source (domestic & non-domestic), if known
Indicators of fuel poverty	Probability of fuel poverty	% likelihood	50%	50% is default but set to 0% if extreme fuel poverty is to be analysed.	Home Analytics
	Probability of extreme fuel poverty	% likelihood	0%	0% is a default Weighting applied. User can adjust balance by selecting 0% or 50% to switch analysis focus between fuel poverty or extreme fuel poverty.	Home Analytics
Building energy efficiency	Loft insulation	<100mm (prediction) (Yes)	16.67%	Poor energy efficiency Indicators reach the sum of 50% of overall Weighting, each have an equal Weighting.	Home Analytics
	Single glazed windows	Binary (Yes)	16.67%		Home Analytics
	Wall insulation prediction (all construction types)	Binary (Uninsulated)	16.67%		Home Analytics
Additional example Indicators that could be used to support Delivery Level Area identification as part of LHEES Stage 4 and Delivery Plan.	Tenure type	User defined		Four types; housing association, owner/ occupier, privately rented, local authority. User can filter by interest.	Home Analytics
	Building age	User defined		Defined in six age brackets. User can filter by interest.	Home Analytics
	Non-traditional build design type	Solid wall (binary)		User can filter by interest.	Home Analytics
	EPC Rating	E, F or G		User can filter by interest.	Home Analytics

LHEES Priority - Mixed-tenure, mixed-use and historic buildings

Theme	Indicator	Criteria	Weighting	Description	Data source (domestic & non-domestic), if known
Mixed-tenure and mixed-use					
Identification of multiple properties in building	Dwellings in building	Dwellings in building >1		Domestic count for properties where there are multiple dwellings in a building.	Home Analytics
	Mixed tenure	Binary (Yes)		Domestic count for properties identified as being mixed tenure in building.	Home Analytics
	Parent and child UPRNs	Multiple dwellings in building when multiple child UPRNs to a single parent		To identify counts of non-domestic where there are multiple properties in a building, or where there are a mix of non-domestic and domestic properties in a single building.	One Scotland Gazeteer
Listed buildings					
Identification of listed buildings	Listed building grade	Listed A, B, or C		Domestic property is registered as a listed building. No data was available to identify listed non-domestic properties.	Home Analytics
Conservation areas					
Identification of properties in conservation areas.	Conservation area	Binary (Yes)		Domestic property within a conservation area.	Home Analytics
Identification of properties in conservation areas.	Conservation area	Within shapefile boundary		Provided as geographic boundary within Scotland Heat Map.	Scotland Heat Map

LHEES Priority - On-Gas Grid

Theme	Indicator	Criteria	Weighting	Description	Data source (domestic & non-domestic), if known
Select properties	On-gas grid	Off-gas grid = No, OR off-gas grid = Unknown AND main fuel type is mains gas	Filtering step	Property is connected to the gas grid.	Home Analytics
Category 0 already has a communal heating system installed.	Main heating system	Main heating system = Communal		Property is connected to a communal heating system. Properties in communal heating system are considered to be highly suited to a heat pump solution.	Home Analytics
Category 1 required criteria for properties with immediate potential for heat pump retrofit (for all categories, excluding any consideration of network upgrade or associated costs).	Category 0 property	Is a Category 0 property (No)		Excludes properties included in Category 0.	Home Analytics
	Listed property	Property is listed (No)		Listed buildings require additional considerations for retrofit such as planning permission/listed building consent.	Home Analytics
	Conservation area	Not within a conservation area		Buildings in conservation areas require additional considerations regarding some retrofit works.	Home Analytics
	Insulated walls	Walls insulated (Yes)		Required to have thermal efficiencies needed for heat pumps.	Home Analytics
	Double/triple glazed windows	Windows double or triple glazed (Yes)		Required to have thermal efficiencies needed for heat pumps.	Home Analytics
	Loft insulation 99mm+	Loft is insulated: 99mm+ (prediction)		Required to have thermal efficiencies needed for heat pumps.	Home Analytics

Category 2 required and weighting criteria for properties with secondary potential for heat pump retrofit (requiring fabric / heat distribution system upgrade).	Category 0 or 1 property	Is a Category 0 or 1 property (No)		Excludes properties included in Category 0 or 1.	Home Analytics
	Insulated walls	Not uninsulated solid wall or system built or timber frame (prediction).		Insulation of these wall types is considered beyond a moderate upgrade. This property type with suitable walls is captured in Category 1. More information is required to determine if the necessary thermal efficiency could be achieved.	Home Analytics
	Risk of narrow uninsulated cavity	Likely to have narrow uninsulated cavity (No)		These walls will be challenging to bring up to the required thermal efficiency.	Home Analytics
Additional Category 2 Indicators and Weightings to support Delivery Level Area identification (LHEES Stage 4 only).	Double/triple glazed windows	Windows double or triple glazed (Yes)	20%	Required to have thermal efficiencies needed for heat pumps – being in place reduces costs.	Home Analytics
	Wall insulation	Wall insulation prediction = Insulated	20%	Required to have thermal efficiencies needed for heat pumps – being in place reduces costs.	Home Analytics
	Loft insulation	Loft insulation prediction: 100-249mm, 250mm+ or No Loft	20%	Required to have thermal efficiencies needed for heat pumps – being in place reduces costs.	Home Analytics
	Property tenure	Property tenure = housing association or local authority	20%	Easier to install due to ownership levers.	Home Analytics
Category 3 properties are on gas properties not classified as either Category 0, 1 or 2.	Category 0, 1 or 2 property	Excess on-gas properties that do not fall within either Category 0, 1 or 2 Binary (No).		On-gas properties that may be challenging to transition to heat pumps.	Home Analytics

Appendix H - Heat Network Zoning

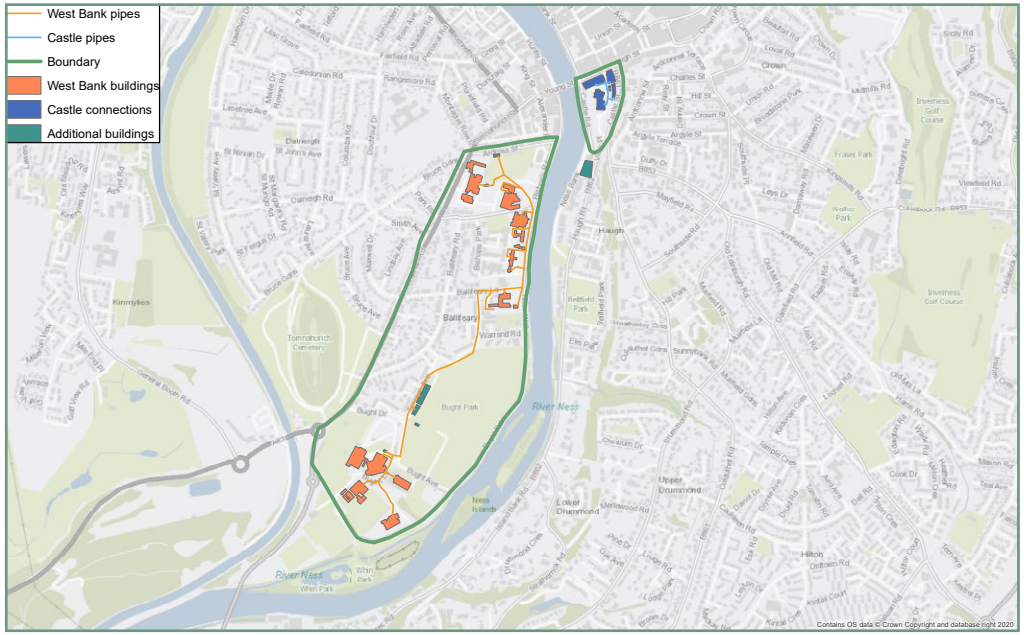
Although no opportunity category has been assigned for the Potential Zones for Heat Networks, the NDA heat network suitability analysis provides an opportunity to look at potential suitability (**Table 21**).

Table 21 – Heat network suitability summary

Heat Network Suitability		
Suitability categories	**Number of properties**	**Heat Demand (MWh/yr)**
''High Suitability'' properties	110	111,574
''Medium suitability'' properties	1,358	108,149
''Low Suitability'' properties	15,259	717,421
''Screened Out'' properties	177	10,610

The Highland Council, Buro Happold and Zero Waste Scotland have completed two heat network feasibility studies in Inverness. The feasibility studies have received grant funding from the HNSU. **Figure 28** displays the areas of interest.

Figure 28 – Inverness West Bank and Inverness Castle Heat Network Feasibility Studies Area



The purpose of the heat network feasibility studies is to inform the Highland Council of the opportunity for a heat network in the Inverness Castle and West Bank study areas. The feasibility reports can be accessed on the Council website.[88] **Table 22** summarises some findings.

[88] Item 7 - Inverness West Bank and Inverness Castle Heat Network Feasibility Studies: www.highland.gov.uk/meetings/meeting/4789/climate_change_committee

Table 22 – Summary of study findings

	Inverness West Bank	Inverness Castle
Buildings	Leisure Centre, Highland Council Headquarters, Botanic Gardens, Highland Archive and Registration Centre, Inverness Ice Centre, Highland Hospice, Eden Court, Cheshire House, University of Highlands and Islands, Royal Northern Infirmary Chapel, Ness Walk Hotel, the Edens Hotel, Ness Lodges, Northern Meeting Park Development, Bught Park Shinty, Bught Park Changing Rooms.	Inverness Castle, North Tower, Inverness Town House and new proposed development on the main street.
Annual heat demand (MWh/a)[89]	13,070	1,070
Peak demand (kW)	5,830	910
Proposed equipment	• Open loop ground source heat pumps fed via an alluvial aquifer, 2,100 kW. • Top-up electric boilers, 5,800 kW. • Thermal stores, 60 m3.	• ASHP, 451 kW. • Top up electric boiler, 480 kW. • Thermal stores, 12 m3.
Carbon savings[90]	91%	90%

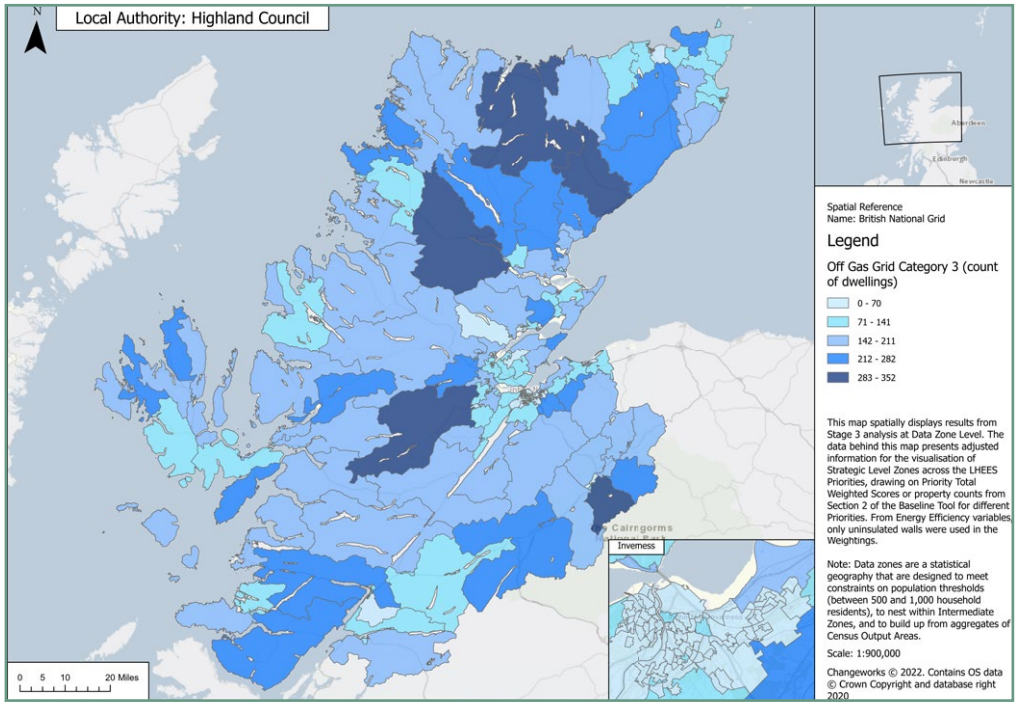
[89] Note: It is derived from combining metered data and industry standard benchmark data.

[90] Note: Carbon savings of 90% were estimated for the proposed heat network when compared to the business-as-usual scenario of each of the buildings continuing to use their current gas-fired boiler or gas-fired boiler/CHP unit (or proposed in the case of the future developments ASHP) heating technologies.

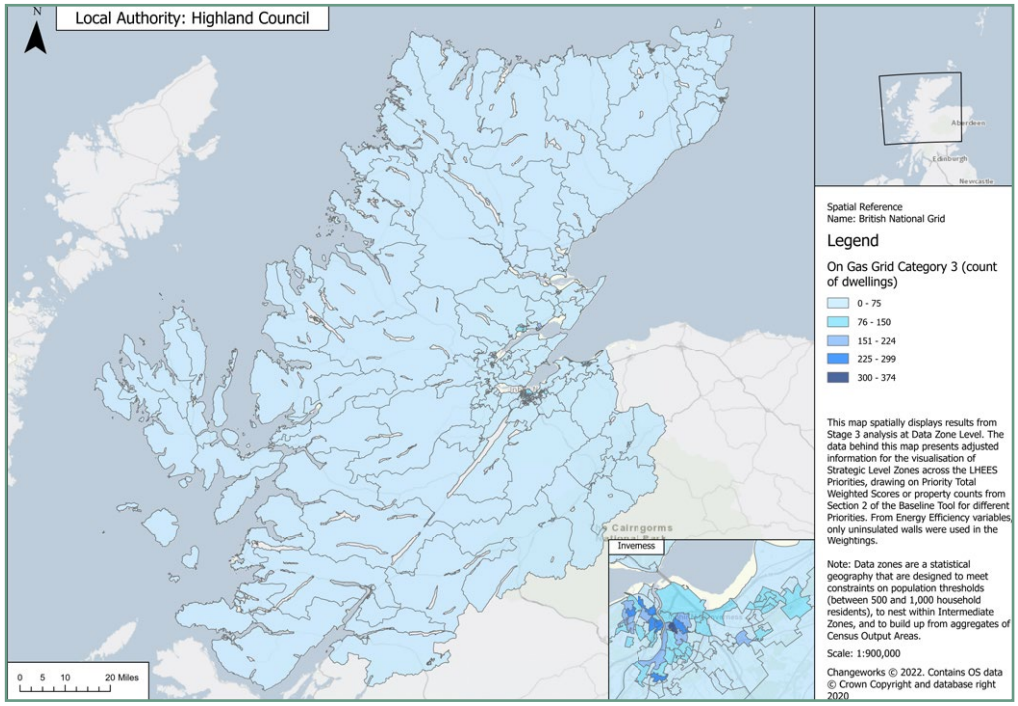
Appendix I - Building-Level Heat Decarbonisation

Domestic:

Map 10 – Off-gas grid Category 3 map displays results from Stage 3 analysis at Data Zone Level



Map 11 – On-gas grid Category 3 map displays results from Stage 3 analysis at Data Zone Level



Non-Domestic:

Figure 29 – Heat demand for typology split by floor area

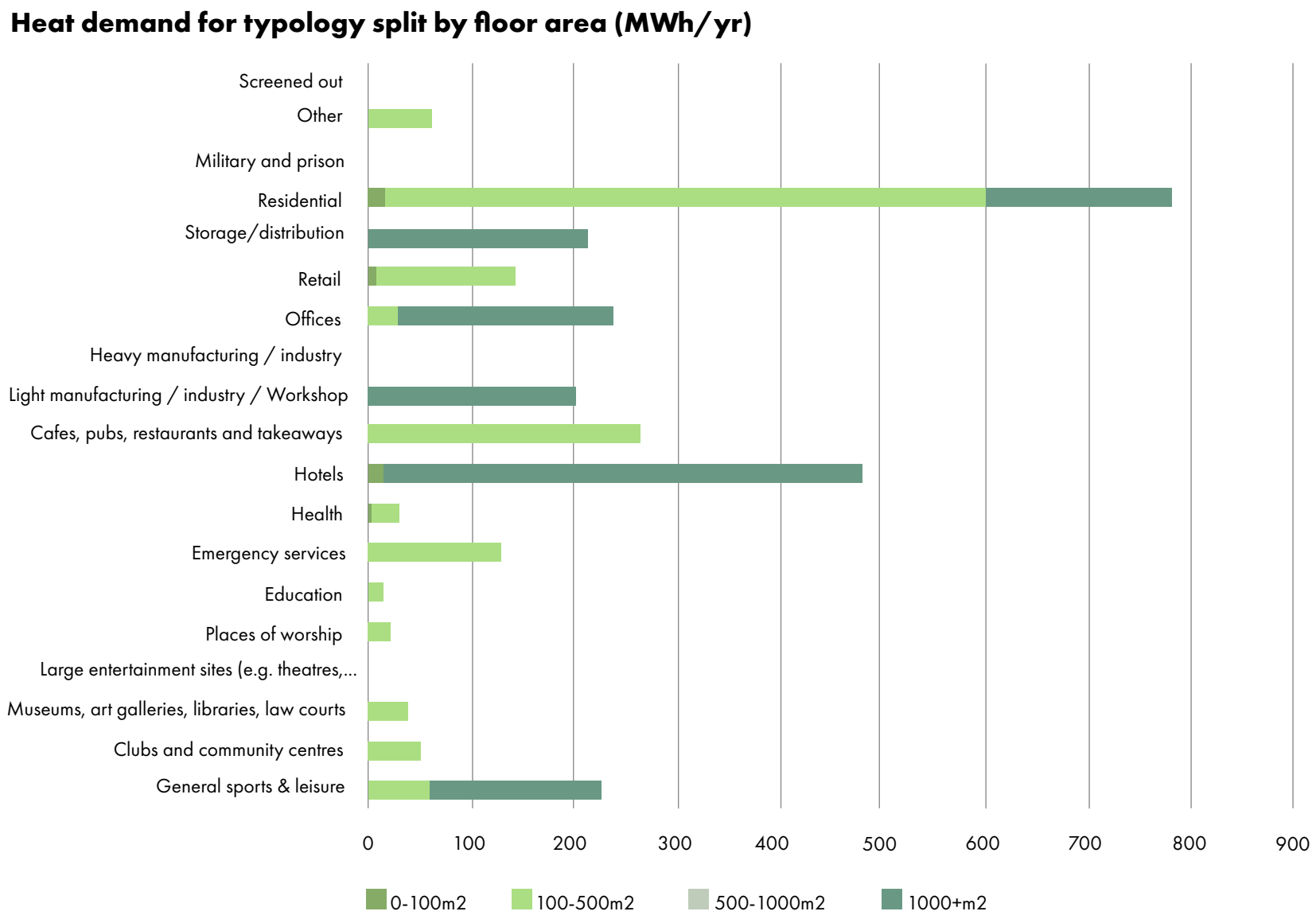


Figure 30 – Property count by typology split by age

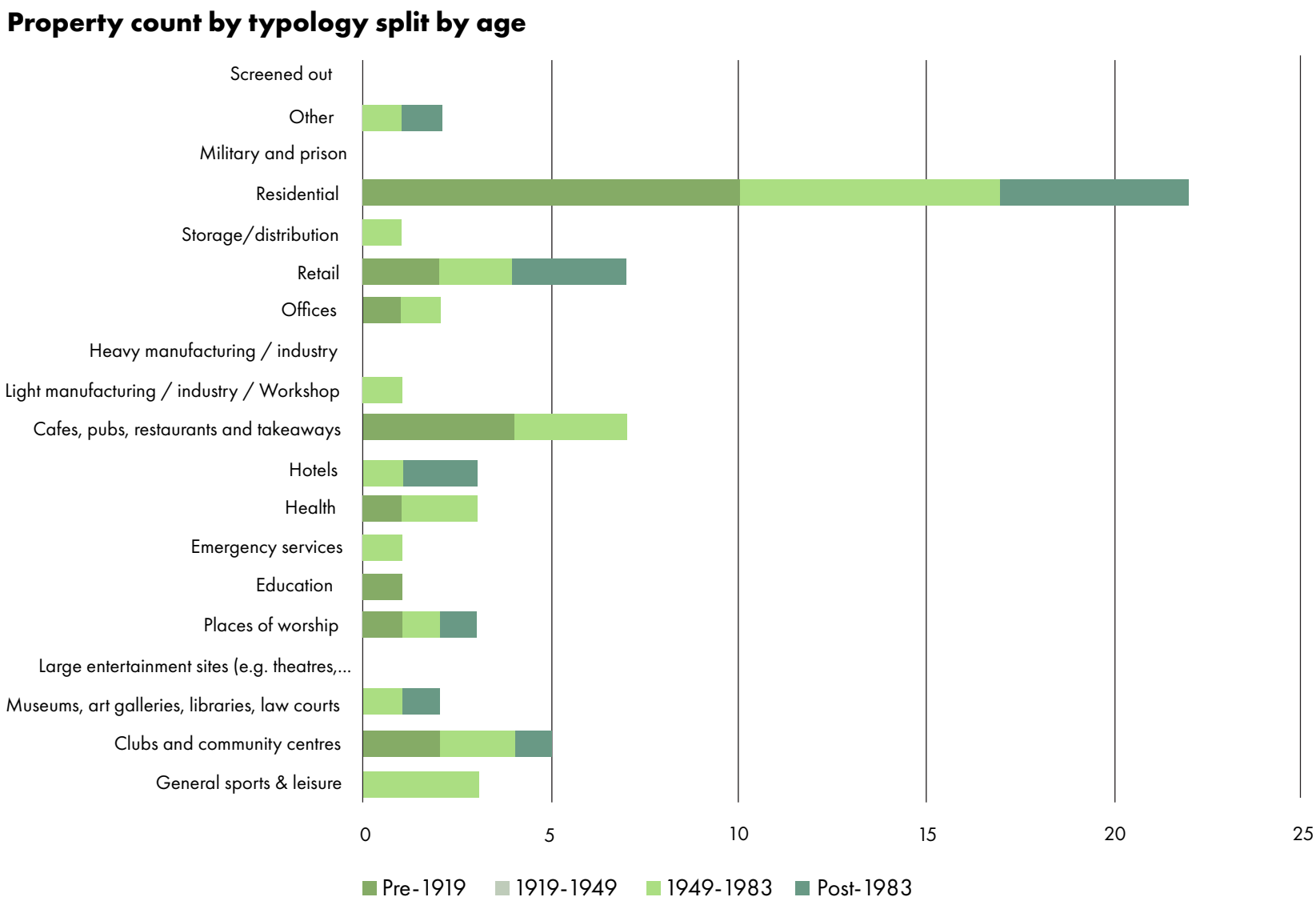


Figure 31 – Heat demand for typology split by age

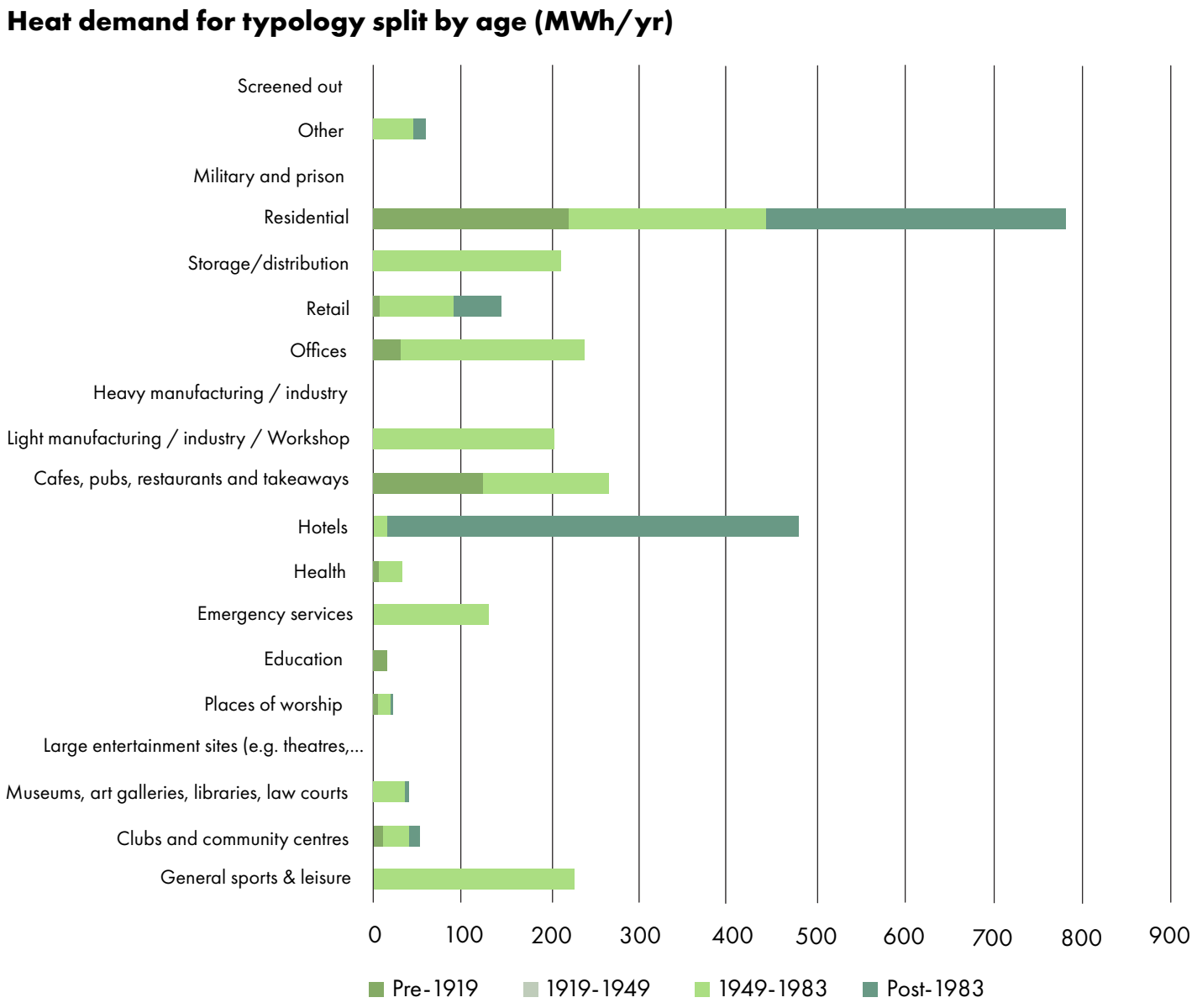


Figure 32 – Heat demand for typology split by fuel

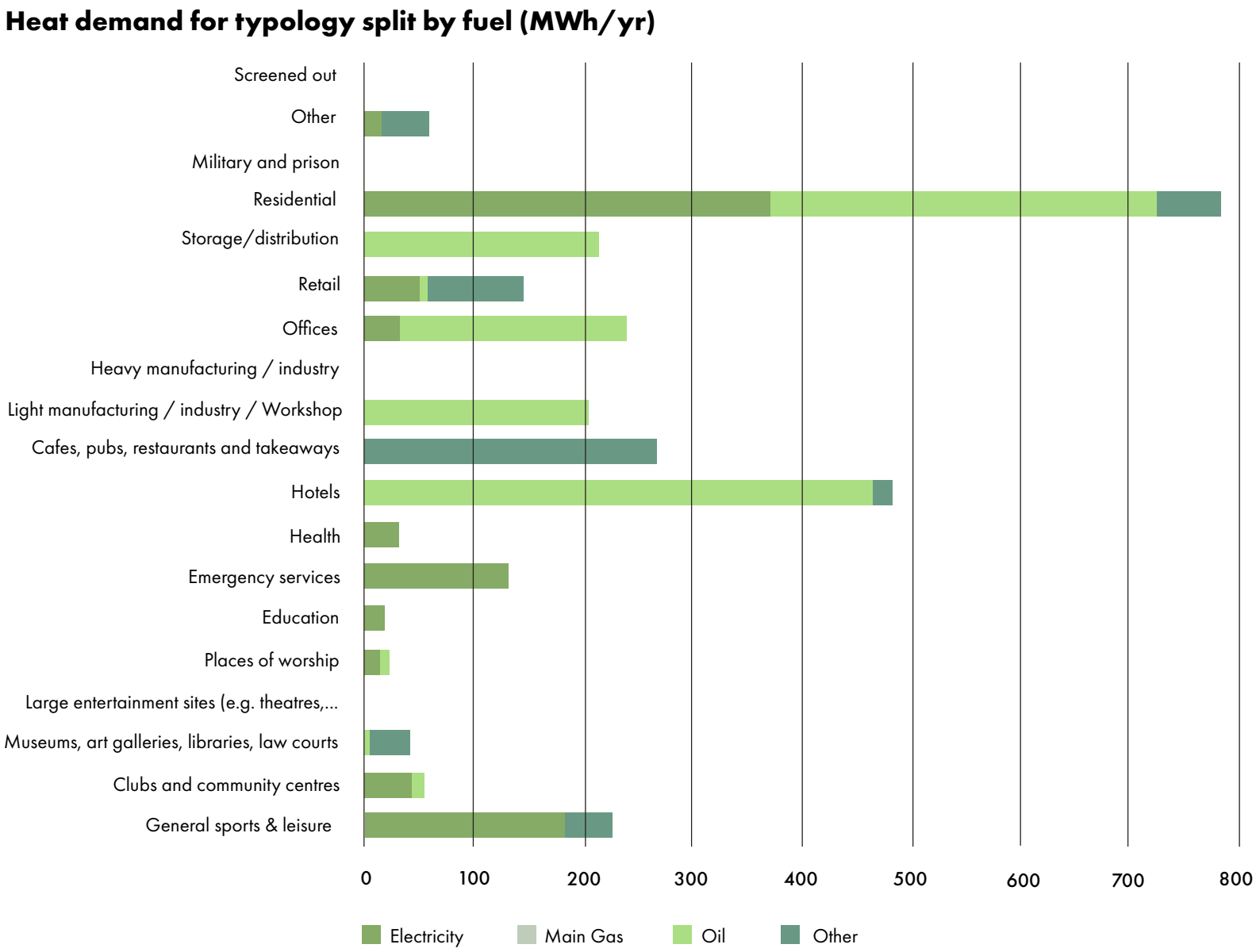
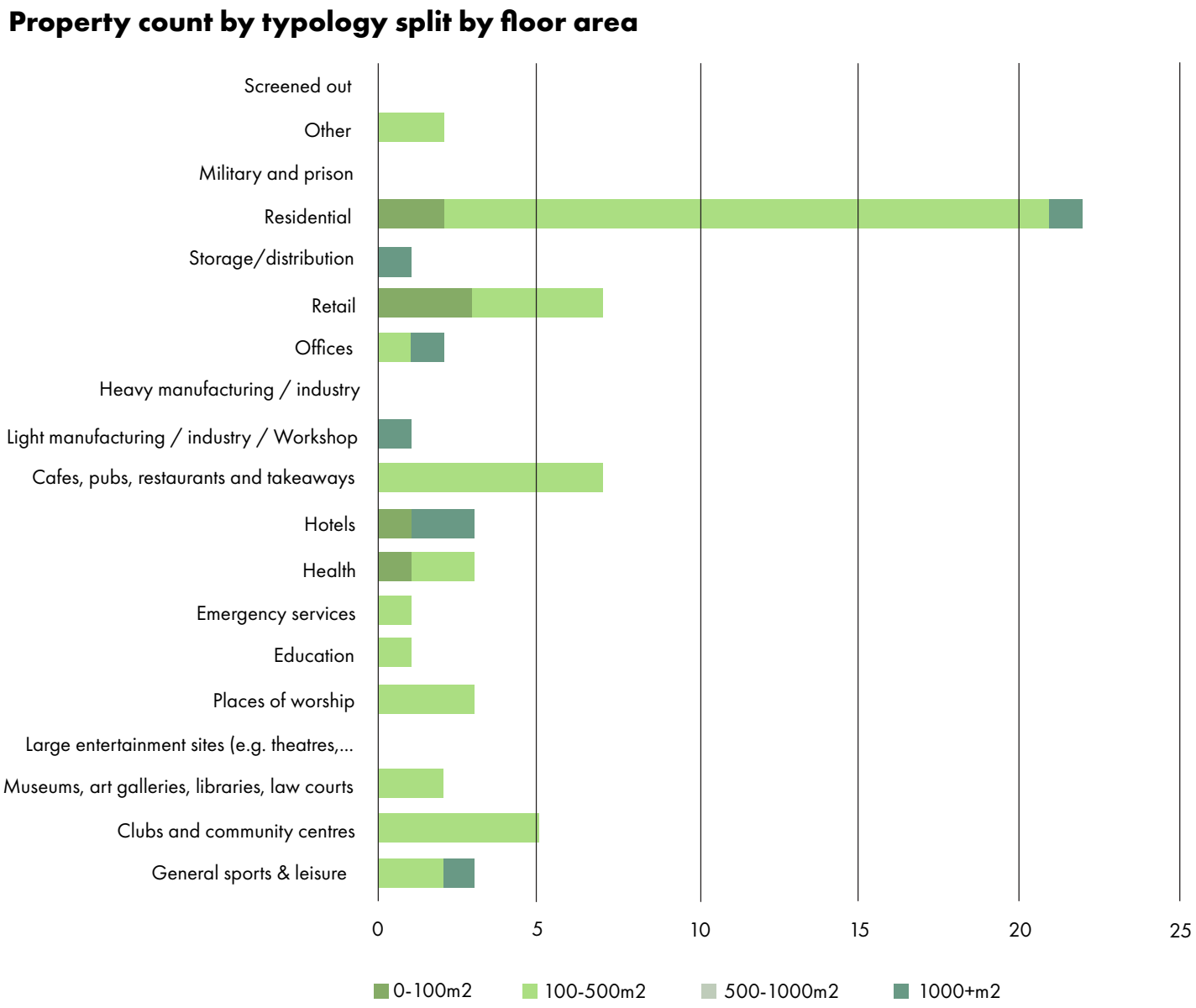
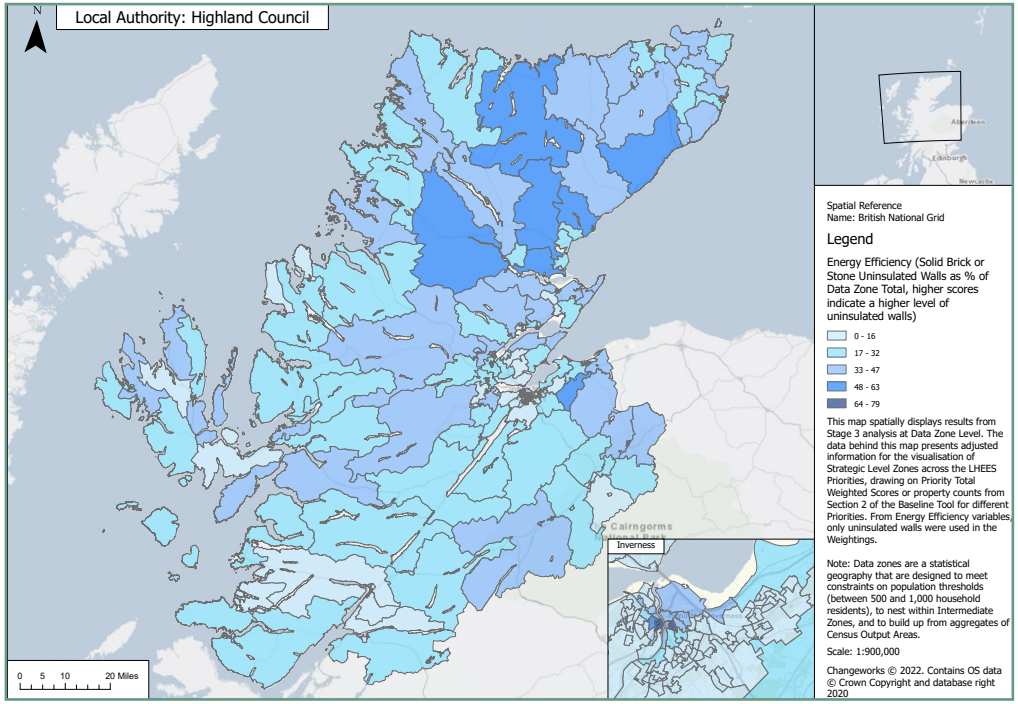


Figure 33 – Property Count by typology split by floor area

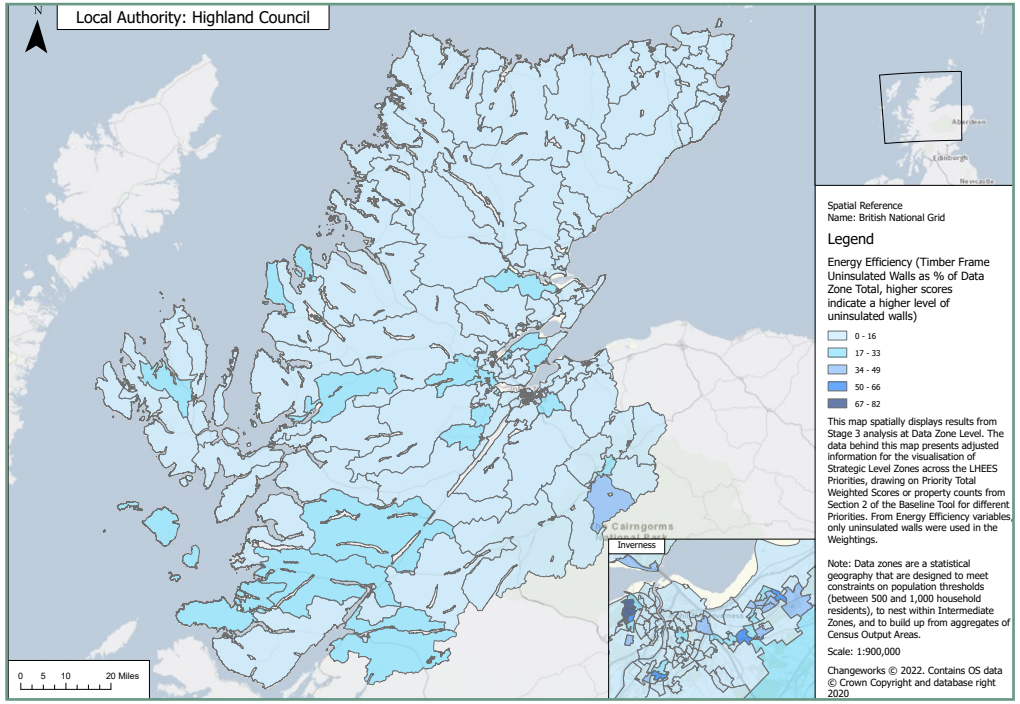


Appendix J - Energy Efficiency and Other Outcomes.

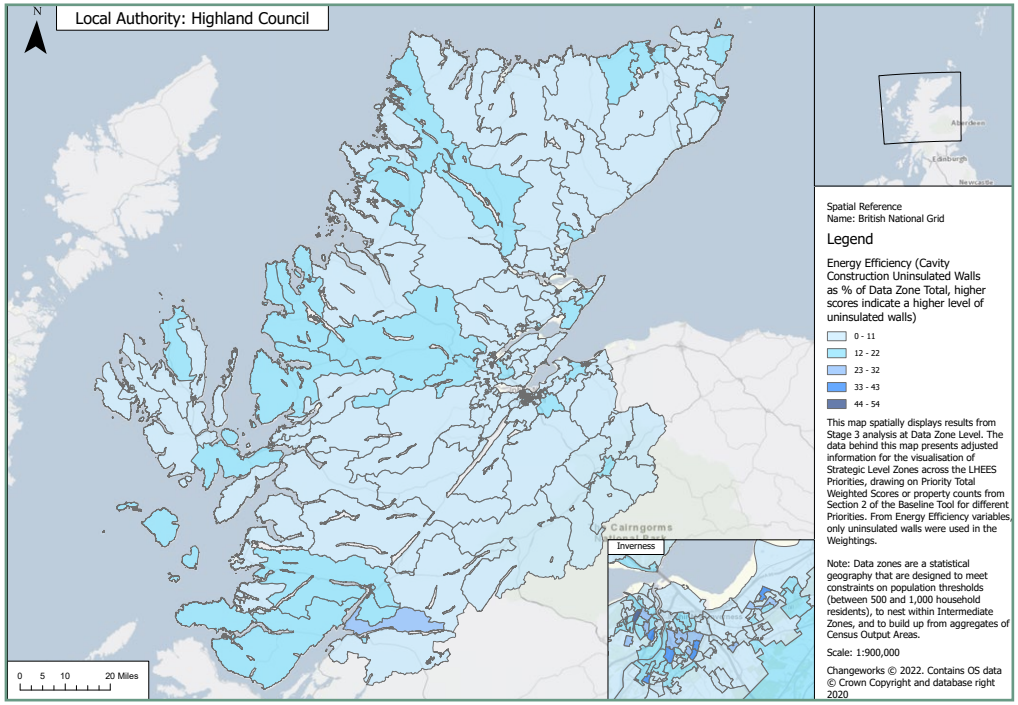
Map 12 – Energy efficiency and solid brick or stone uninsulated walls (domestic) map displays results from Stage 3 analysis at Data Zone Level



Map 13 – Energy efficiency and timber frame uninsulated walls (domestic) map displays results from Stage 3 analysis at Data Zone Level



Map 14 – Energy efficiency and cavity construction uninsulated walls (domestic) map displays results from Stage 3 analysis at Data Zone Level.



Map 15 – Energy efficiency and system build uninsulated walls (domestic) map displays results from Stage 3 analysis at Data Zone Level

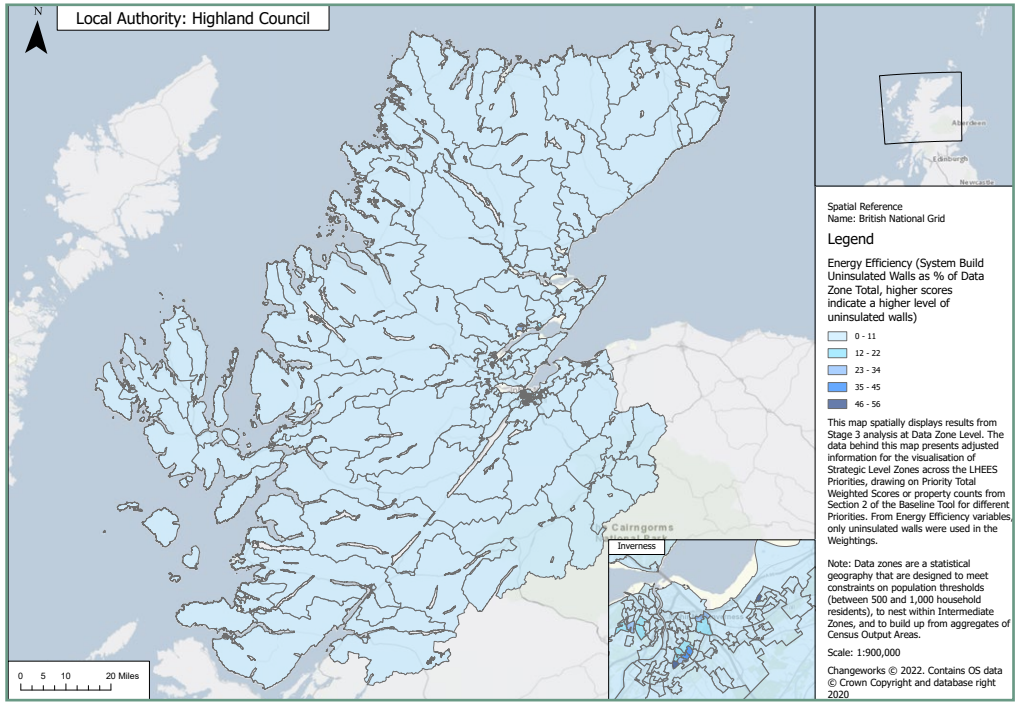


Table 23 – Summary of domestic properties, poor energy efficiency

	Single glazed windows	Uninsulated walls	Single glazed windows	Uninsulated walls
Loft insulation: 0-99mm	1,564	7,870	1%	6%
Uninsulated walls	5,986		5%	
All three key indicators		1,404		1%

Table 24 – Summary of domestic properties, poor energy efficiency as a driver for fuel poverty

	Single glazed windows	Uninsulated walls	Single glazed windows	Uninsulated walls
Loft insulation: 0-99mm	603	2,223	1%	5%
Uninsulated walls	2,071		5%	
All three key indicators		536		1%

Table 25 – Summary of domestic properties, poor energy efficiency as a driver for extreme fuel poverty

	Single glazed windows	Uninsulated walls	Single glazed windows	Uninsulated walls
Loft insulation: 0-99mm	392	1,193	1%	4%
Uninsulated walls	1,271		5%	
All three key indicators		343		1%

Table 26 – Summary for mixed-tenure and mixed-use properties

	Number of parent shell UPRNs	Number of child UPRNs
Domestic	5,086	117,228
Non-Domestic	820	10,767
Mixed	1,179	1,444
Total UPRNs	7,085	139,439

Appendix K- Summary of Indicative Zones per LHEES Priority

Table 27 – Summary of Indicative Zones per LHEES Priority

LHEES Priority	Description	Main Geographical Areas to Prioritise	Data Zone Codes
1. Heat networks	**Decarbonisation with heat networks**	Seven clusters were identified, of which the ones in Dingwall and Inverness show the most potential in terms of anchor loads and potential extensions to existing heat networks and local development sites.	No specific Data Zones
2. Off-gas grid buildings (cat 1 - heat pump ready)	**Transitioning mainly from heating oil and LPG in off-gas areas**	Off gas-grid heat-pump ready properties are in the following areas: Lochaber East and North, Badenoch and Strathspey	S01010527, S01010538, S01010568, S01010599.
		Central, Inverness East Rural and Inverness Lochardil and Holm Mains, Nairn Rural, Tain, Black Isle South and Loch Ness.	S01010549, S01010753, S01010725, S01010666.
3. Poor building energy efficiency	**Poor building energy efficiency**	Areas lacking in cavity wall insulation include Inverness Scorguie, Inverness Drakies, Inverness Lochardil and Holm Mains.	S01010648, S01010617, S01010602, S01010618.
		Areas without solid wall insulation are Inverness Crown and Haugh, Inverness Muirtown, Nairn East and Sutherland East.	S01010628, S01010640, S01010554, S01010769.
4. Poor building energy efficiency as a driver for fuel poverty	**Poor building energy efficiency as a driver for fuel poverty**	Areas with high levels of estimated fuel poverty and low levels of energy efficiency (particularly wall insulation) are: Inverness Scorguie, Nairn East, Inverness Kinmylies and South West, Tain and Inverness Crown and Haugh.	S01010647, S01010554, S01010653, S01010752, S01010628, S01010646
5. Mixed-tenure, mixed-use and historic buildings	**Covering mixed-tenure and mixed-use buildings, listed buildings and buildings in conservation areas.**	The areas with the highest levels of mixed-use and/or mixed tenure are in Inverness Merkinch, Inverness Central, Raigmore and Longman, Inverness Muirtown.	S01010641, S01010620, S01010639, S01010619.
		The areas with most properties in conservation areas or listed buildings are Inverness Central, Raigmore and Longman; Inverness Crown and Haugh, Nairn East.	S01010620, S01010628, S01010627, S01010554.
6. On-gas grid buildings (Category 1 – heat-pump ready)	**On-gas grid heat decarbonisation.**	Areas for on-gas grid are: Inverness Inshes, Inverness Slackbuie, Inverness Westhill, Inverness Kinmylies and South West, Inverness Lochardil and Holm Mains.	S01010593, S01010596, S01010582, S01010650, S01010591, S01010599, S01010598, S01010584.