Dumfries and Galloway Local Heat and Energy Efficiency Strategy (LHEES)

Strategy Report

Dumfries & Galloway COUNCIL

Contents

Executive Summary

1.1 Dumfries and Galloway Current Action

Dumfries and Galloway Council is a trailblazer in acknowledging the serious urgency of action required to tackle climate change. They declared a climate emergency in June 2019, and developed a 12-point action plan to accelerate activity by the Council, the wider local community, and local businesses to achieve net zero status by 2025. Dumfries and Galloway Council subsequently published a Carbon Neutral Strategic Plan in early 2021 which demonstrated some progress in reducing emissions, however, this highlighted the scale of the challenge remaining for the region to accelerate progress (Dumfries and Galloway Council, 2021a).

Dumfries and Galloway Council recognises that realisation of net zero ambitions cannot be delivered in isolation and requires close working with partner organisations, wider stakeholders and collaboration with the local people to deliver actions. Amongst several other programmes of decarbonisation work, the Council is co-working with South of Scotland Enterprise to support the implementation of their Net Zero Framework and with other neighbouring local authorities through the Borderland's Inclusive Growth Deal.

1.2 Overview of LHEES

Local Heat & Energy Efficiency Strategies (LHEES) are at the heart of a place based, locally-led and tailored approach to the heat transition. These local Strategies will underpin an area-based approach to heat and energy efficiency planning and delivery. They are driven by Scotland's statutory targets for greenhouse gas emissions and fuel poverty:

- Net zero emissions by 2045 and 75% reduction by 2030.
- In 2040, as far as reasonably possible, no household in Scotland is in fuel poverty.

Accompanying the Strategies are Delivery Plans, which will be developed in partnership with key stakeholders, and provide a strong basis for action for local communities, government, investors, developers and wider stakeholders, pinpointing areas for targeted intervention and early, low-regrets measures[1]. Engagement from the local people of Dumfries and Galloway will also be imperative to deliver these plans. Action from all individuals, including embracing new technologies, adapting to develop new behaviours where necessary and contributing to public engagement will be needed to achieve net zero and the decarbonisation of buildings.

It is important to note that all data presented in this Local Heat & Energy Efficiency Strategy and Delivery Plan has its limitations due to the availability of current and specific data which is used to produce examples of potential opportunities. This data will be verified prior to any planned activity.

1.3 Baseline Performance

Dumfries and Galloway region has just over 70,000 domestic properties and just over 11,000 non-domestic properties. Many buildings have solid wall types, which can have low thermal values and therefore difficult to treat. Roughly half of the buildings were constructed pre-1950, when living and building standards were lower than currently accepted and therefore used materials with lower thermal efficiency. The data also presents low levels of wall insulation across the area. This, paired with wider solutions to tackle issues such as damp and fabric deterioration, could improve overall energy efficiency. The lack of wall insulation appears to be the greatest retrofit challenge for Dumfries and Galloway, with low insulation for lofts and window glazing being far less of an issue.

[1] These are seen to be measures which are relatively low cost and are likely to provide at least reasonable benefit in the predicted future climate and technological scenarios.

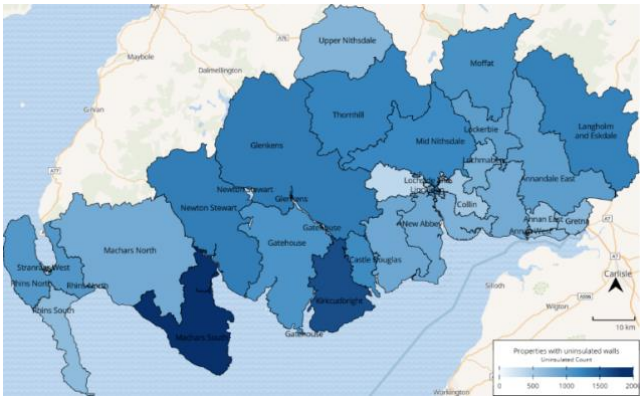

Figure 0-1: Buildings with Uninsulated Walls.

57% of properties are connected to the gas grid. 20% use oil boilers, 16% use electricity (split between heat pumps and direct electric heating) and the remaining are split between LPG, biomass boilers or have no available data. The area is diverse with a rural-urban split and has a need for accelerated action to remove dependency on highly polluting fuels (such as oil) for more remote properties.

The findings from the Baseline and Strategic Zoning were used to develop overarching themes across all the LHEES Considerations, which are reflected through the modelling or the subsequent actions in the Delivery Plan. These themes are as follows:

- Homes & Buildings Fit for the Future in Regeneration Areas: Integrating retrofit and decarbonisation measures into Place Plans and Regeneration Areas. This aims to highlight the need for support and improvement of existing buildings as well as delivering efficient new builds.
- Accelerating Decarbonisation of Buildings Requiring Minimal Standard Retrofit: Targeting the domestic and non-domestic buildings which have potential for no- or low- regrets building decarbonisation from less intrusive interventions with shorter pay back periods.
- Decarbonising Rural & Historic Dumfries and Galloway Buildings: Development of a robust plan, including identification of the funding gap, to understand the best decarbonisation pathway for the domestic and non-domestic properties which are Older Buildings or Unconventional Construction.
- Delivering Reliable Communal Heating Systems: Proposal of heat network zones across Dumfries and Galloway which focus on community-wide solutions and benefits. These zones present the highest opportunity for heat networks and therefore should be priority areas for analysis.
- Collaborative Working Across Local Programmes, Wider Stakeholders & Supporting a Local Supply Chain: Integration of wider planning and programmes across Dumfries and Galloway Council with the LHEES, with a key focus on the Borderlands Energy Masterplan, to share learnings and lean on the wealth of knowledge. This includes understanding the wider need to support local upskilling and retraining and targeting a local supply chain.
- Increasing Transparency & Accessibility Around the Delivery Pathway & Funding Mechanisms: Improving awareness and accessibility of funding mechanisms and increasing transparency of the delivery pathway to ensure decarbonisation is built on trusted advice and informed choices.

This report has provided evidence of areas which could be of strategic significance for the first four of these themes and could form the basis for priority targeting of buildings. It has also provided adequate data and justification for the local authority to continue to develop and select priority areas. This method, of providing both key zones and how to use the data to identify them, enables the local authority to continue to combine additional factors, programmes of work and developing priorities to strategically target buildings. All themes have been analysed to develop the accompanying LHEES Delivery Plan.

1.4 Regional Local Authority Findings

87% of domestic buildings in Dumfries and Galloway were found to achieve the future 2033 EPC target of a C through fabric retrofit, shown in Figure 0-2 and Table 0-1.

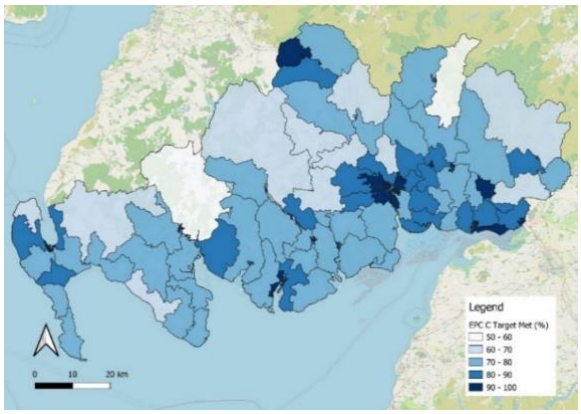

Figure 0-2: Domestic Properties Which Would Achieve and EPC Rating of C or Above, by Data Zone.

EPC Rating	Before Modelling	After Modelling
A	0%	18%
B	4%	35%
C	25%	33%
D	37%	10%
E	21%	2%
F	11%	0%
G	3%	0%

Table 0-1: Overview of EPC Score Improvement Across the Whole Building Stock from Fabric Retrofit Measures

Many buildings have been recommended measures which are considered as low-regrets, which removes barriers for building owners. These measures include 46% of properties suitable for loft or roof insulation, and 12% suitable for cavity wall insulation. 52% of properties are found to be suitable for heat pumps, based on high-level fabric measure analysis. Further work is required to understand the changes required to improve suitability of the remaining buildings, or to identify alternative solutions. Many of the 21% of properties which currently use oil as their main fuel could transition to a heat pump.

36% of properties were not recommended any form of low carbon heating through the modelling. This is due to limitations in the Portfolio Energy Analysis Tool (PEAT) used, which is high-level and will not recommend a heat pump where the modelling does not believe fabric interventions are suitable and therefore the energy efficiency is too low. This is limited both in terms of understanding the need for bespoke retrofit for many buildings across the local authority which are not suitable for standard measures, and assuming a high energy efficiency is required for a heat pump, which is not always the reality. These properties require more involved consideration and planning.

1.5 Focus on Minimal Standard Retrofit and Older Buildings & Unconventional Construction

Existing regeneration areas could be an opportunity to integrate retrofit needs. There are many modern or standard construction buildings which are already suitable for a heat pump or only require a small amount of retrofit. The uptake of low carbon heating systems could be integrated into the wider sustainability plans.

Dumfries and Galloway has a large number of listed buildings and conservation areas. The architectural character needs a robust, sustainable and realistic plan. Measures used should not jeopardise the fabric of the building in the long term and should minimise any detriment to historic or architectural interest.

Measurement of energy efficiency uses methods which are based on modern construction and airtightness which may not always be appropriate; based on that, the total cost to decarbonise buildings of historic or architectural character is generally higher per property.

1.6 Heat Networks

Dumfries and Galloway has significant opportunity for heat networks, particularly due to the presence of a large aquifer stretching across much of the area, which could offer an effective heat source. 14 potential heat network zones have been identified, with at least six showing considerable potential which would warrant further analysis. This includes two areas which currently have well-developed feasibility studies in Dumfries Town Centre and the Crichton Quarter.

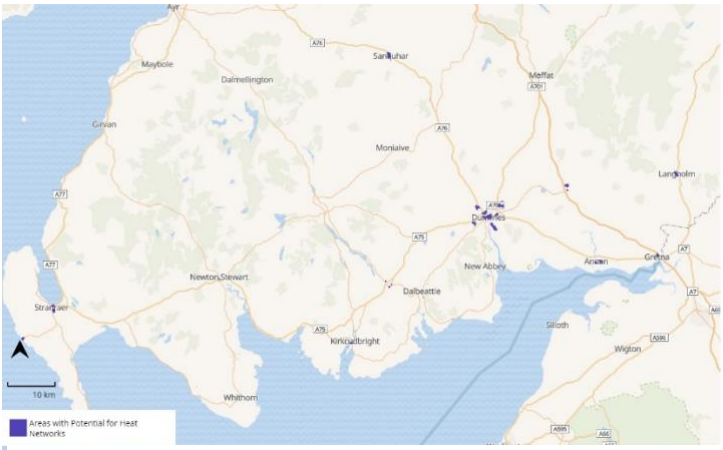

Figure 0-3: Overview of Heat Network Zones Across Dumfries and Galloway

1.7 Recommendations

Overall this data-driven analysis has led to several key findings which present the opportunities and challenges for Dumfries and Galloway that could be a focus in the initial stages of decarbonising the building stock. These outcomes have been the basis for the development of the Delivery Plan which captures a range of actions across various stakeholders.

Findings from this report include:

- Many buildings are suitable for low-regrets measures, which have fewer barriers to action.
- Many buildings have significant opportunity for fabric-based retrofit and suitability for heat pumps which could be integrated into existing regeneration area plans.
- Further analysis is required for buildings with more bespoke requirements where standard retrofit may not be a feasible or most effective option.
- There is significant funding available, which should be taken advantage of to help to accelerate building decarbonisation.
- Many buildings, both domestic and non-domestic, off the gas grid currently use oil or solid fuel and therefore should be prioritised for decarbonisation action.
- There are 14 potential heat network zones across the local authority, eight of which have medium or high opportunity of feasibility.

Actions from this LHEES intend to set a strong strategy for Dumfries and Galloway's decarbonisation. There has been significant input and engagement from key stakeholders and a plan for monitoring and evaluation to accelerate delivery, to continue the local authority's leading position in sustainability ambition and progress.

Glossary

Abbreviations

Acronym	Description
DNO	Distribution Network Operator
EESSH	Energy Efficiency Standard for Social Housing
EPC	Energy Performance Certificate
EST	The Energy Saving Trust
GDNO	Gas Distribution Network Operator
GIS	Geographic Information System
LDP2	Local Development Plan 2
LHEES	Local Heat & Energy Efficiency Strategy
LPG	Liquefied Petroleum Gas
PEAT	Portfolio Energy Analysis Tool
SAP	Standard Assessment Procedure
SGN	Scotland Gas Networks
SG	Supplementary Guidance (for Local Development Plan)

Terms

Term	Description
Anchor Load	Buildings with a large, reliable and long-term demand for heat, often with a stable and constant use profile, can act as anchors for a developing district heating network. These anchor loads allow district heat networks to operate efficiently and provide the potential to extend the network to smaller existing heat users in the area. For this analysis, this has been assumed as public buildings with a heat demand of greater than 500 MWh/year.
Baselining	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.
Building-level Pathway	As part of LHEES Stage 5, a building-level pathway is the outcome of the assessment undertaken using PEAT. It provides the likely energy efficiency retrofit technologies, as well as the low carbon heating system (where applicable) to support building level decarbonisation.
Criteria	Criteria are the settings applied to the Indicators for each Consideration to support Baselining, Strategic Zoning and the identification of Delivery Areas. An example of Criteria is a simple “no” applied to the Indicator of “wall insulation (Y/N)” to identify properties with uninsulated walls. Another example is the definition of an “anchor load” within the Heat Networks analysis, which applies a minimum threshold to the “heat demand” Indicator. The LHEES methodology provides a set of default Criteria that local authorities may wish to use, with 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.
Data - Alternative	Alternative data, can overwrite the Core data to improve accuracy (national to local level of detail, e.g. local housing data to overwrite fields in Home Analytics).
Data - Core	Core data is the data that is essential to complete the minimum requirements of the LHEES analysis. Core data will come from national datasets e.g. Home Analytics or the Scotland Heat Map.

Term	Description
Data - Supplementary	Supplementary data allows inclusion of additional Indicators to inform specific, local baselines and targets. Also, **Supplementary** data can be used in GIS investigation to complement the **Core** analysis carried out in any assessment. An example of **Supplementary** data would be the inclusion of a constraints appraisal as part of a district heating analysis.
Data Zone	Data zones are groups output areas which have populations of around 500 to 1,000 residents.
Delivery Area	Delivery areas are at a higher level of detail 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. They will be an important starting point for identifying a range of projects, regulation and actions that are within the competence of the Scottish Government, local authorities and wider partners (included as actions to be developed in the LHEES Delivery Plan).
Detailed practitioner approach	These Steps form part of the detailed practitioner approach in LHEES Stage 4, Generation of Initial Areas to set out particularly suitable heat network zones and to support project identification.
Indicator	For a given Consideration, the purpose of an Indicator is: 1. To act as a key information field to help characterise and baseline the local authority. 2. To act as a key information field to support strategic zoning and generation of initial delivery areas. 3. 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. For some Considerations, one Indicator may be sufficient, but for others a range may be appropriate.
Intermediate Zone	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.
LHEES Considerations	The LHEES Considerations are a list of technologies, building typologies and policy priorities used to identify and target interventions. They include: • Heat networks • Off-gas grid buildings • On-gas grid buildings • Poor building energy efficiency • Poor building energy efficiency as a driver for fuel poverty • Mixed-tenure, mixed-use and historic buildings
LHEES Delivery Plan	An LHEES Delivery Plan is a document setting out how a local authority proposes to support implementation of its local heat and energy efficiency strategy.
LHEES Guidance	The LHEES Guidance sets out the production and content requirements for a local authority to prepare a Strategy and Delivery Plan. Its purpose is to ensure that a Strategy and Delivery Plan contain outcomes and actions that are backed up by robust data and analysis, supported by stakeholder engagement, and that are linked to national and local priorities, plans and targets.
LHEES Methodology	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.
LHEES Stages	There are eight LHEES Stages proposed in this methodology. The purpose of the LHEES Methodology is to enable the local authority to complete LHEES Stages 1 to 6. The completion of these Stages will provide the local authority with the data analysis and

Term	Description
	evidence base to enable them to complete their LHEES Report and Delivery Plan documentation. There are two LHEES reporting templates included alongside this methodology– LHEES Report example template and LHEES Delivery Plan example template. The completion of these two templates will satisfy the completion of LHEES Stages 7 and 8. The 8 LHEES Stages proposed in this methodology are: 1. Policy & Strategy Review 2. Data & Tools Library 3. Strategic Zoning & Pathways 4. Generation of Initial Delivery Areas 5. Building-Level Pathway Assessment 6. Finalisation of Delivery Areas 7. LHEES Report 8. LHEES Delivery Plan
LHEES Report	An LHEES Report is a long-term strategic framework for: • The improvement of the energy efficiency of buildings in the local authority's area • The reduction of greenhouse gas emissions resulting from the heating of such buildings
Low-regrets Measures	Measures which are relatively low cost and therefore provide relatively high cost-benefits under the predicted future climate and technological scenarios.
Minimal Standard Retrofit	This description includes buildings whose fabric and build type is more commonly seen across Scotland and the UK, or buildings which need minimal retrofit to achieve a level of energy efficiency. The simplified and broad retrofit recommendations which are used by the modelling tools featuring in this LHEES analysis are therefore more applicable to buildings within this category and the modelling results are more accurate and reflective of the reality. These buildings may commonly be seen as the 'low-regrets' targets as they have a relatively low cost-benefit ratio, require less complex design or intervention methods which are likely to be the most appropriate solution regardless of future technological changes.
Mixed-tenure, mixed-use and historic buildings	Mixed-tenure and mixed-use buildings could include a mixture of owner occupied, private rented and social housing, and also non-domestic uses, or simply multiple ownership within the same tenure. Historic buildings include the buildings that are within conservation areas or those that are listed buildings. These categories may require established alternative approaches and regulation for the installation of low carbon heat and energy efficiency solutions and where specific advice and support might be available relating to the installation of these solutions.
No-regrets Measures	Measures which may provide a benefit immediately, in the future and potentially whether or not predicted future climate and technological changes become a reality.
Older Buildings and Unconventional Construction	Buildings within this category may require a more bespoke or unique retrofitting solution to achieve higher energy efficiency or decarbonisation and are likely to have limited or no low carbon heating, according to the available data. Buildings in this category tend to have a solid wall build construction, and may include historic buildings which are listed or within conservation areas, so to preserve their historical and architectural interest they may have additional non-standard retrofit requirements.

Term	Description
Potential Zones	The analysis carried out for strategic zoning and pathways for the heat networks Consideration is to identify potential zones rather than the otherwise used naming convention of Delivery Areas. The potential zones identified are to be included in the LHEES Report and should inform actions around further investigation / progression within the LHEES Delivery Plan. The heat networks Consideration analysis and activity carried out within LHEES is also anticipated to support activity related to formal zone designation as required by the Heat Networks (Scotland) Act 2021.
Raster	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.
Strategic Zone	Strategic Zones present a visualisation of the potential pathways to decarbonise the building stock at a local authority level. These could, for example, be split out by intermediate zone or data zone. They are useful to understand the baseline performance, the scale of potential and initial areas of focus, which could be used to inform Delivery Areas and follow on engagement.
Targets	Targets are the measurable aspect of the Consideration and are likely to be taken directly from national and/or local policy documentation, for example net-zero by 2045, or EPC C by 2040. Targets are likely to comprise of end-point targets and milestone targets and would sit along a timeline within (and beyond) the LHEES. This timeline would help to prioritise the types of projects undertaken within the LHEES over its duration.
Weighting	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.

2 Introduction

2.1 Overview of LHEES

Local Heat & Energy Efficiency Strategies (LHEES) are at the heart of a place based, locally-led and tailored approach to the heat transition. These local Strategies will underpin an area-based approach to heat and energy efficiency planning and delivery. LHEES will set out the long-term plan for decarbonising heat in buildings and improving their energy efficiency across an entire local authority area. They are driven by Scotland's statutory targets for greenhouse gas emissions and fuel poverty:

- Net zero emissions by 2045 and 75% reduction by 2030.
- In 2040, as far as reasonably possible, no household in Scotland is in fuel poverty.

For each local authority area, the Strategies should:

- Set out how each segment of the building stock needs to change to meet national and local objectives, including achieving zero greenhouse gas emissions in the building sector, and the removal of poor energy efficiency as a driver of fuel poverty.
- Identify strategic heat decarbonisation zones and set out the principal measures for reducing buildings emissions within each zone.
- Prioritise areas for delivery, against national and local priorities.

Accompanying the Strategies will be Delivery Plans, which will be developed in partnership with key stakeholders, and provide a strong basis for action for local communities, government, investors, developers and wider stakeholders, pinpointing areas for targeted intervention and early, low-regrets measures. These are seen to be measures which are relatively low cost and are likely to provide at least reasonable benefit in the predicted future climate and technological scenarios.

2.2 Strategy Scope & Limitations

2.2.1 Scope

The scope of the remainder of this strategy provides a more focused and technical view which is designed for Practitioners and will inform the next stages of wider engagement and planning in line with the requirements of the Local Heat and Energy Efficiency (Scotland) Order 2022.

This LHEES covers the Strategy around decarbonising Dumfries and Galloway's building stock. This includes consideration of energy efficiency schemes (namely fabric retrofitting), heat network zone development and decarbonising of individual building heating fuels, integrated with targeting the reduction in fuel poverty across the local authority. The LHEES process is complementary to wider strategies and programmes, such as local area energy planning however notedly does not cover wider energy system considerations such as industrial heating and power, transport, agriculture or renewables.

Due to the current uncertainty and reliance on wider UK Government decisions on the use of hydrogen for heating, hydrogen fuel is not considered within modelling for this LHEES. Viable alternatives are used instead, including air source heat pumps, ground source heat pumps, heat networks, biomass boilers and direct electric heating. However, it is noted that there is potential strategic importance of hydrogen for heating in future decarbonisation plans; the decision around hydrogen for heating (regardless of outcome) has and will have a large impact and influence on planning for local authorities; and Dumfries and Galloway specifically holds a crucial opportunity for generation of green hydrogen and has potential to have a lead role in hydrogen development across Scotland. Due to this, hydrogen has been considered in the wider engagement for this LHEES, including direct engagement with the Gas Distribution Network Operator (GDNO) for the area, Scotland Gas Networks (SGN).

2.2.2 Data Limitations

This LHEES is in line with the Scottish Government's guidance, covering extensive data analysis on domestic properties, with a more limited overview of non-domestic buildings, due to the limited data availability.

Data used in the Baselining and Strategic Zoning is based on the Energy Saving Trust's Home Analytics (domestic) and Non-Domestic Analytics (non-domestic). This data provides building fabric and energy demand indications, built from the EPC register and other sources. EST conduct statistical modelling to provide 100% coverage across the building stock. However, for this reason, the data is only indicative for some properties and therefore should be replaced with real or local data for future progression and more detailed work. The datasets are updated every six months.

Non-Domestic Analytics has been used to evaluate the baseline for non-domestic properties, however it should be noted there is a significant difference in the detail of non-domestic building fabric and energy performance compared to domestic data and therefore analysis is much more limited. It is accepted that currently non-domestic data is challenging to capture accurately due to the wide variation of building types and poor data coverage from sources such as EPC. The Non-Domestic Analytics dataset advises the use of local knowledge to critically evaluate it. For this reason, extensive investigation into the data has not been carried out for this LHEES.

The EST's tool, Portfolio Energy Analysis Tool (PEAT) has been used to analyse the retrofit potential, including cost and carbon saving, across the building stock. This tool provides valuable insights into the opportunity for retrofit measures. However it should be noted that the tool has limitations in applying potential measures to buildings needing more bespoke interventions or less standard fabric types. The data is based on high-level and broad assumptions around building fabrics and retrofit measures. Therefore the outputs are estimated and representative on a broad level but may not be suitable or applicable to some individual buildings.

Data used in the Heat Network Zoning is broadly based on the Scotland Heat Map. Data on heat sources has been provided from various datasets including Green Heat in Green Spaces and the National Atmospheric Emissions Inventory. The Scotland Heat Map data provides the heating demand of all domestic and non-domestic buildings across Scotland, built on a range of data from metered datasets to modelling. The data is updated on an annual basis and source data, including from local authorities, is requested for each update. As far as possible, the energy demands presented in the data have been sense checked. However, as some of the data is based on modelled values by the Scotland Heat Map team it should be replaced with real data when applied in future work.

3 Background Information

3.1 LHEES Structure, Function & Scope

3.1.1 LHEES Structure

As established in the LHEES (Scotland) Order 2022, LHEES should have a strategy report and a delivery plan.

A local heat and energy efficiency strategy is a long-term strategic framework for:

- The improvement of the energy efficiency of buildings in the local authority's area.
- The reduction of greenhouse gas emissions resulting from the heating of such buildings.

A LHEES Delivery Plan is a document setting out how a local authority proposes to support implementation of its LHEES.

3.1.2 First Iteration

The first iteration of the LHEES has a specific focus on giving an understanding, at local authority level and across the LHEES Considerations, of the scale of the challenge for heat decarbonisation and energy efficiency improvement, as well as identifying strategically a potential pathway to achieving this. A major outcome of this first LHEES will be the initial (five-year) actions required to support future engagement and delivery along this pathway. The first iteration specifically includes:

- National and local policy and strategy.
- Review of existing work within the local authority.
- The LHEES stakeholder engagement process.
- Baselining of current building energy performance.
- High level strategic zoning across the LHEES Considerations.
- Local authority wide review of scale of action needed.
- Review of overlap of buildings requiring 'Minimal Standard Retrofit' with respect to existing target Place Plans and Regeneration Areas.
- Detailed review of areas with 'Older Buildings and Unconventional Construction'.
- Proposals of potential heat network zones from high level analysis.

The aim of this structure is to create the foundation of the strategy with a focus on the near-term actions required to create sufficient support for a more detailed strategy in future iterations. This includes identifying the need for engagement and support networks, funding gaps and development of technical strategy around the more challenging building stock.

3.1.3 Building Analysis Scope

As stated in Section 3.1.2, this LHEES has a specific focus on the analysis of buildings requiring 'Minimal Standard Retrofit' and 'Older Buildings and Unconventional Construction'. These two terms have been used to summarise the buildings included in these analyses and are explained in more detail in this section. The selection of these buildings is based on the recommended LHEES methodology however it should be recognised as a simplification of how the building stock can be grouped. In reality, there is a broad variety of measures required for retrofitting a large number of buildings and these simplifications do not capture the unique design case which will be needed for some of the building stock.

Minimal Standard Retrofit

This description includes buildings whose fabric and build type is more commonly seen across the UK, or buildings which need minimal retrofit to achieve a level of energy efficiency. The simplified and broad retrofit recommendations which are used by the modelling tools featuring in this LHEES analysis (as described in Section 2.2.2) are therefore more applicable to buildings within this category and the modelling results are more accurate and reflective of the reality. These buildings may

commonly be seen as the 'low-regrets' targets as they have a relatively low cost-benefit ratio, require less complex design or intervention methods which are likely to be the most appropriate solution regardless of future technological changes.

Older Buildings and Unconventional Construction

Buildings within this category may require a more bespoke or unique retrofitting solution to achieve higher energy efficiency or decarbonisation and are likely to have limited or no low carbon heating, according to the available data. Due to their particular construction methods, these buildings are not represented as those that would benefit from the standard solutions suggested in the modelling. They will require more considered analysis, design and retrofit application. This includes recognising the differences between traditional and modern buildings and their respective appropriate retrofit solutions. For this reason, current models tend to suggest much higher costs for retrofit of older buildings, but this may not be an accurate or fair reflection.

Buildings in this category tend to have a solid wall build construction and may include historic buildings which are listed or within conservation areas, so to preserve their historical and architectural interest they may have additional non-standard retrofit requirements. Importantly, some of the traditional building materials commonly used are a range of local stone, with lime mortar pointing and sometimes with traditional lime harling. This requires more specialist traditional knowledge or specific treatment to avoid any retrofit measures from causing damage, performance issues or reducing longevity of the building.

These limitations to the data and modelling have been recognised as far as possible within this analysis and, in light of this, the results should be taken as indicative, to guide and support further work.

3.1.4 LHEES Approach

It should be considered that Dumfries and Galloway Council has an ambitious target of net zero by 2025, considerably earlier than the Scottish Government's national target and therefore this LHEES, and the subsequent update in five years' time, must be cognisant of the need for accelerated action.

As a result, the local authority has elected not to choose specific LHEES Considerations to be of priority, as all 'Considerations' will need immediate and fast action to meet the net zero target. Additionally, the local authority has a varied demographic of buildings with a relatively even split of on- and off- gas grid properties and diverse tenure types.

Dumfries and Galloway Council appointed City Science to conduct their LHEES analysis and produce this document and the Delivery Plan. The process has involved very close engagement of the main Council LHEES team, as well as wider stakeholders within the Council and some external parties with specific interest and influence on the actions. This is detailed in the subsequent sections.

3.1.5 Strategic Environmental Assessment

The LHEES Report and Delivery Plan has been reviewed with respect to the requirement for a Strategic Environmental Assessment (SEA). It has been decided by Scottish Governments SEA process that this strategy is unlikely to have significant environmental effects. Therefore this LHEES will not require a SEA.

However, this is only representative of the Strategy and the Delivery Plan documents and any subsequent projects or programmes which are developed out of the LHEES may require an SEA and should be reviewed independently.

It is important to recognise that the results of the LHEES SEA are outside of the effects which have already been identified through the SEA completed for the Scottish Government's Heat in Buildings Strategy.

3.2 Engagement & Consultation

A stakeholder engagement plan was developed at the inception of the project using the Policy & Strategy template to identify key stakeholders, both internal and external to the Council, to include in the process. Generally engagement was divided between data modelling and processing, and development of actions. This focused on an integrated stakeholder engagement plan with key sessions being held throughout the process. Table 3-1 details specific sessions carried out and a summary of attendees.

LHEES Stage	Session Details	Attendees
Introduction	Introduction to LHEES, wider stakeholder engagement. Introduced the concept of LHEES, the process and the scope.	• Core LHEES team • Strategic Housing • Development Planning • Procurement • Schools Manager - Property • Property Estates & Programmes
Stage 3	Review of Baseline Review outputs	• Core LHEES team
1:1 Insight Interviews	To introduce project to external stakeholders and identify any available and useful data or knowledge sharing	• SGN • Strategic housing • Schools Manager – Property • Built heritage policy • Existing heat networks • Social landlords
Stage 5	Selection of Delivery Areas	• Core LHEES team • Development Planning • Strategic housing
Stage 6	Review of Delivery Area outcomes	• Core LHEES team • Built heritage policy
Stage 8	Delivery Plan Workshop	• Core LHEES team • Strategic housing • Development Planning • Schools Manager – Property • Built heritage policy • Property Estates & Programmes • Existing heat networks
Stage 8	Delivery Plan Finalisation	• Core LHEES team • Property Estates & Programmes • Development Planning

Table 3-1: LHEES Stakeholder Engagement Activities

This report and the Delivery Plan have been subject to a thorough review by the Core LHEES team, as well as key individuals to review specific sections such as Historic Buildings or existing heat network plans.

4 Local Authority Progress

4.1 LHEES Content & Context

4.1.1 LHEES Considerations

The Scottish Government has prepared a guidance document (dated October 2022) on development of LHEES and delivery plans to support local authorities, like Dumfries and Galloway Council. A core element of the guidance covers 'LHEES Considerations' which constitutes a framework within which local authorities should set out their own local priorities and drivers for completing their LHEES. The LHEES Considerations are summarised in Table 4-1.

Area	No.	LHEES Considerations	Description
Heat decarbonisation	1	Off-gas grid buildings	Transitioning from heating oil and LPG in off-gas grid areas to zero carbon heat sources.
Heat decarbonisation	2	On-gas grid buildings	Switching on-gas grid heating to zero emissions heat sources.
Heat decarbonisation	3	Heat networks	Including highlighting zones where heat networks present a potential option.
Energy efficiency and other outcomes	4	Poor building energy efficiency	Identifying strategic opportunities where poor building efficiency exists around the local authority area (e.g. low levels of wall insulation).
Energy efficiency and other outcomes	5	Poor building energy efficiency as a driver for fuel poverty	Identifying areas of poor building energy efficiency as a driver for fuel poverty and strategic opportunities to address this.
Energy efficiency and other outcomes	6	Mixed tenure, mixed-use and historic buildings	Mixed-tenure, mixed-use buildings, listed buildings, and buildings in conservation areas where building-level solutions are likely to be the most appropriate.

Table 4-1: LHEES Considerations

Note that hydrogen for heating does not fall explicitly within the LHEES Considerations, primarily as it relies upon the UK Government making a strategic decision (scheduled 2026) on its future as a widescale heat source. The Guidance identifies that LHEES should only consider hydrogen for heating in a strategic context.

4.1.2 Key National Strategy & Legislative Context

The Scottish Government has passed legislation and produced accompanying strategy documents relevant to the implementation of the Dumfries and Galloway LHEES (see Section 6.2).

These include:

- **Heat in Buildings Strategy:** This sets out the vision for the future of heat in buildings and the actions to deliver upon obligations relating to decarbonisation and supporting tackling fuel poverty (The Scottish Government, 2021a).
- **Heat Networks (Scotland) Act:** This act regulates heat networks including the supply of energy and its ongoing operation and licencing arrangements and additionally sets targets for heat network delivery (6 terawatt hours of output by 2030) (The Scottish Government, 2021b).
- **Fuel Poverty (Targets, Definitions and Strategy) (Scotland) Act:** This act sets targets to eradicate fuel poverty by 2040 (including interim targets of no more than 15% in fuel poverty by 2030) and necessitates the future production of a fuel poverty strategy (The Scottish Government, 2019b).

4.1.3 Useful Resources for Private Building Owners

There are several resources available for building owners with more information on energy efficiency or replacing fossil-fuel based sources of heating with renewable heating sources. This includes:

- **Home Energy Scotland**: This service, which is funded by the Scottish Government and managed by the Energy Saving Trust, provides free and impartial advice to homeowners about energy efficiency, grants, incentives, and finance options (Energy Saving Trust, 2023a).
- **The Energy Saving Trust:** This UK-wide service provides further information on energy-saving measures and possible finance options, particularly for business owners (Energy Saving Trust, 2023b).
- **Warmworks:** Warmworks manages the Warmer Homes Scotland scheme, which is the Scottish Government's national fuel poverty scheme. It offers funding for eligible homeowners to improve energy efficiency (Warmworks, 2023).
- **Zero Waste Scotland:** Zero Waste Scotland offers support, funding and guidance for businesses looking to improve energy efficiency (Zero Waste Scotland, 2023).
- **Scottish Enterprise:** Provides funding opportunities and support for businesses, including those related to energy efficiency and sustainability (Scottish Enterprise, 2023).
- **Business Gateway:** Offers advice and resources for businesses in Scotland, including information on grants, funding, and support for energy efficiency initiatives (Business Gateway, 2023).
- **Citizens Advice:** Local Citizens Advice services, such as the Dumfries and Galloway Citizens Advice Service, may provide information on grants, incentives, and financing options available to homeowners for energy efficiency improvements (DAGCAS, 2023).
- **Energy Supplier:** Energy suppliers may offer energy efficiency programs, rebates, and financing options. Check with your local energy supplier for information.
- **Historic Environment Scotland:** Publications and guidance including Source advice on maintaining and making changes to traditional buildings, including how to make an older property more energy efficient (Historic Environment Scotland, 2023)
- **Historic England:** Free, independent, practical advice here on maintaining, repairing and improving homes which are listed, in a conservation area, or simply an older building (Historic England, 2023).
- **Society for Preservation of Ancient Buildings:** Advice on conserving, caring and campaigning for old buildings, all aspects of repair, maintenance and planning (Society for the Protection of Ancient Buildings, 2023).

4.2 Summary of Ongoing Work at Local Authority

Dumfries and Galloway Council is a trailblazer in acknowledging the serious urgency of action required to tackle climate change. They declared a climate emergency in June 2019, and developed a 12-point action plan to accelerate activity by the Council, the wider local community, and local businesses (Dumfries and Galloway Council, 2019a). Reflecting the urgency, a core element of this action plan would make significant strides toward achieving net zero status for the region, with an ambition to achieve this status by 2025.

Dumfries and Galloway Council subsequently published a Carbon Neutral Strategic Plan in early 2021, which incorporates potential future decarbonisation trajectories across emission sources such as agriculture, transport, and energy from both residential and commercial buildings (Dumfries and Galloway Council, 2021a). The decarbonisation trajectories were developed using 2018 raw baseline territorial emissions available from the Department of Business Energy & Industrial Strategy (BEIS), which was the most recent available at the time. A detailed and prioritised action plan is included in the Strategic Plan with clear ownership on delivery target years. Priority actions include:

- Mass installation of zero carbon heating systems such as heat pumps.
- A large-scale programme of building retrofitting to improve energy efficiency.
- Significant increases in renewable energy production.

Following the Strategic Plan, Dumfries and Galloway Council commissioned a short report in 2022, to update (re-baseline) the decarbonisation trajectory from 2018 to more recent 2019 BEIS data. This demonstrated some progress in reducing emissions, however, highlighted the scale of the challenge remaining for the region to accelerate progress.

Dumfries and Galloway Council recognises that realisation of net zero ambitions cannot be delivered in isolation and requires close partnership working with partner organisations and wider stakeholders to deliver actions. For example, the Council is co-working with South of Scotland Enterprise to support in implementation of their Net Zero Framework. Dumfries and Galloway Council is also working closely with other neighbouring local authorities through the Borderland's Inclusive Growth Deal (see Section 4.2.5). A summary of specific ongoing programmes of work being progressed by Dumfries and Galloway Council related to heating and energy efficiency is provided below.

Engagement from the local people of Dumfries and Galloway will also be imperative to deliver these plans. Action from all individuals, including embracing new technologies, adapting to develop new behaviours where necessary and contributing to public engagement will be needed to both achieve net zero and ensure a sustainable and equitable future.

4.2.1 Public Building Retrofits

Dumfries and Galloway Council has several live programmes making public buildings more energy efficient, including:

- **Dumfries and Galloway Learning Estate Strategy (2023):** This strategy aims to improve outcomes for all children and young people in the region. A key element of this strategy is ensuring schools are future-proofed by ensuring school buildings are 'sustainable, energy, waste and water efficient, with low carbon footprints.' There is an opportunity for the LHEES to build upon this ambition through incorporating measures targeted at retrofitting schools and introducing zero carbon heating systems.

4.2.2 Progress Towards EESSH & Energy Efficient Scotland

Dumfries and Galloway Council was awarded £2.4M of capital funding in 2023/24 from the Scottish Government as part of the area-based scheme. The focus of spending funding will be in areas with the highest levels of fuel poverty. This includes the following projects:

- **Project 1 – West Dumfries and Galloway:** Incorporating a project of targeted streets in Stranraer which are in the bottom 25% of the Scottish Index of Multiple Deprivation who have around a 60% probability of being in fuel poverty.
- **Project 2 – East Dumfries and Galloway:** targeting areas in the Lincluden area of Dumfries alongside areas in Thornhill and Eastriggs.

Within each targeted area, households will be allocated funding to install zero / low carbon measures.

4.2.3 Recent District Heating Projects

A summary of current projects progressing related to district heating is summarised below, with further information on heat network zoning provided in Section 8.1.

4.2.3.1 District Heating Network Area Studies

Dumfries and Galloway Council is intending on progressing feasibility studies to explore the possibility of developing district heating networks to mainly target high-density building areas, where heating demand is concentrated and where a district heating network is most appropriate. Some high-level assessments have already been completed to determine the heat density and key buildings which may be significant

to a future network. Furthermore, detailed feasibility studies will consider all relevant low carbon heat sources such as hot sedimentary aquifer, water source, sewer source and anaerobic digestion.

The studies completed at a high level and to be continued to feasibility stage are intended for the following urban areas initially:

- Dumfries Town Centre
- Crichton Quarter
- Midsteeple Quarter
- Stranraer
- Annan
- Kirkconnel & Sanquhar

A key focus across these areas is the potential around Dumfries, which is situated on the Dumfries Basin Aquifer. This could offer a low carbon and reliable heat source for a significant number of buildings across the area. Studies are currently underway into the potential of this heat source, as described below. There is particular interest into the opportunity to extract heat in more rural areas which may be more economical for the heat extraction equipment, such as around the Crichton Quarter. This could supply heat to the more dense heat demands in Dumfries Town Centre.

4.2.3.2 Dumfries Town Centre

Dumfries and Galloway Council recently commissioned a feasibility assessment of a heat network across Dumfries Town Centre, which had presented potential in a previous high-level study. The report includes a detailed building assessment, mapping and a technoeconomic assessment. The area presented high potential for a heat network due to the high heat density of the buildings and will be prioritised for further development.

The design included an energy centre at Dumfries Academy, with the suggestion to use the Dumfries Basin Aquifer as a heat source. Other notable buildings included in the proposed network are the Council Headquarters, Carruthers House, the DG1 Leisure Centre and Cairndale Hotel. The main recommendation from the report is based on the low efficiency of the network resulting in poor economics, this is due to the poor average building efficiency limiting the COP of the technologies. The recommendation would therefore be to address the fabric efficiency of the buildings to reduce the flow temperature required before feasibility is progressed further.

4.2.3.3 Crichton Campus, Dumfries

The Crichton Campus is a parkland estate run by the Crichton Trust at the southern edge of Dumfries which is home to over 100 local businesses and five academic partners. The Crichton Trust was awarded funding by the UK Government via the UK Community Renewal Fund in 2021 to assess the feasibility of a geothermal aquifer-based heat network for the campus (see Section 4.2.3.4).

Following a desk-based assessment in 2022, proof of concept work is currently ongoing through the drilling of boreholes to confirm the feasibility and potential future costs required to deliver any network. This study is currently a leading example of heat network feasibility assessment for the Dumfries and Galloway area, and the results from the aquifer assessment could unlock significant potential, opportunity and knowledge for other heat networks across Dumfries. In particular, due to the more rural nature of the Crichton Campus, there is interest in whether it could serve as an energy source for wider networks in the centre of Dumfries, where access to the aquifer would be considerably more expensive due to the dense infrastructure.

For this reason, there is a potential opportunity for the LHEES to build on local activity already commenced at the Crichton Campus and support a review of how it could be linked into the plans around Dumfries Town Centre, including the Midsteeple Quarter.

4.2.3.4 Midsteeple Quarter

Midsteeple Quarter is an independent community group set up and run by local people in Dumfries with an overarching aim to deliver positive change for Dumfries town centre. Dumfries and Galloway Council supports the ambitions of Midsteeple Quarter, including through adoption of the Midsteeple Quarter Masterplan (Dumfries and Galloway Council, 2019b) which forms Supplementary Guidance (SG) to the Dumfries and Galloway Local Development Plan 2 (LDP2) (Dumfries and Galloway Council, 2019c).

As highlighted in the Masterplan, there is an aspiration to deliver district heating for the Midsteeple Quarter's buildings within the town centre as part of a broader aspiration to deliver exemplar sustainable development. The concept would involve making use of the hot geothermal aquifer which could have the possibility of providing an energy source through a shallow open-loop borehole system.

It is understood that a live proof of concept study is ongoing into the technical feasibility of delivering this heat network. It should be noted that the study only covers buildings as part of the Midsteeple Quarter and therefore currently has a limited extent. The LHEES could support investigation into how this study could expand wider in the town centre, which would be part of a subsequent development phase.

4.2.3.5 Cargenbridge, Dumfries

Dumfries and Galloway Council commissioned a feasibility study exploring a potential biomass Combined Heat & Power District Heating Network in Cargenbridge which is located to the south west of Dumfries. The study (involving estimating potential heat demand, infrastructure design and scheme costs), concluded that this network would not be a viable option. This was due to potential future users of the network already having taken strategic investment decisions on alternative low carbon heating technologies.

4.2.4 Area Based Programmes

4.2.4.1 Local Place Plans

Local Place Plans offer communities the opportunity to produce a plan for their area, expressing their ambitions and aspirations for future changes. With support from the Council and its partners, they develop the community's proposals for the development and use of land through feeding into the planning system with ideas and proposals.

Dumfries and Galloway Council recently awarded funding to produce Local Place Plan for multiple areas across the region, including the town of Newton Stewart. No priorities and actions are currently known, however, there is an opportunity for the LHEES to embed anything relevant as it becomes available.

4.2.4.2 Place Plan for Stranraer

A Place Plan for Stranraer has been prepared by local people and businesses to set future ambitions for the town (Creating Stranraer, 2023). The Plan contains five key strands, including one dedicated to the environment and climate. This strand places an emphasis on renewable energy generation and ensuring local people have access to free or low-cost energy for the town. There is a potential opportunity for the LHEES to build upon this principle through considering measures that tackle fuel poverty and generate renewable heating sources for the town.

4.2.4.3 Kirkconnel & Kelloholm Place Plan

The Kirkconnel & Kelloholm Place Plan sets out the future ambitions for the town to 2033 (Dumfries and Galloway Council, 2023a). One of five strategic objectives is focused on creating 'A Sustainable Town', achieved through the following priorities:

- Delivery of a feasibility study which among other areas, will explore options for energy efficiency and renewable options as part of a large building retrofit programme.
- Delivery of a feasibility study examining the potential for establishing a new skills and innovation centre covering key areas such as insulation and ground/air source heat pump installation.

4.2.4.4 Chapelcross Strategic Development Framework

Partly funded by the Borderlands Inclusive Growth Deal, Dumfries and Galloway Council is in the process of preparing a Strategic Development Framework which will examine opportunities to redevelop the former nuclear power site at Chapelcross, located approximately 3km north of Annan.

The future vision for the site is centred on clean energy generation, storage, distribution, usage; with a particular focus on renewable hydrogen (green hydrogen potentially produced through curtailment of wind power). The ambition, which is also now reflected in the Scottish Government's Hydrogen Action Plan (2023), is for the site to become a regional hub for hydrogen development for the South of Scotland.

If this vision is realised and subject to the UK Government's strategic decision on hydrogen for heating due in 2026, there is a possibility that green hydrogen produced on site may provide a heating source for some buildings in the region. Note that in line with Scottish Government guidance, hydrogen for heating does not fall within the scope of a LHEES.

4.2.5 Borderlands Inclusive Growth Deal & Energy Masterplan

4.2.5.1 Borderlands Inclusive Growth Deal

Dumfries and Galloway Council will share in the benefits from £452 million of funding as part of the Borderlands Inclusive Growth Deal. The Growth Deal was signed in March 2021 by Ministers from the UK and Scottish Governments alongside the five councils which make up the Borderlands Partnership, including Dumfries and Galloway Council (Borderlands Growth, 2023).

A core element of the Borderlands Inclusive Growth Deal is energy investment to prioritise delivery of measures focused on clean growth and net zero targets. The Deal allocates £30 million to demonstrator, community and commercial energy projects which can deliver on this strategic aim.

4.2.5.2 Borderlands Low Carbon Energy Masterplan (Stage 1)

Supported by Dumfries and Galloway Council, the Borderlands Strategic Low Carbon Energy Masterplan was finalised in 2022 using £1.1m of allocated funding from the Inclusive Growth Deal (Borderlands, 2022). It provides a comprehensive evidence base to aid decision making and establish key priorities for low carbon energy investment opportunities.

The Masterplan incorporates energy demand modelling based on Future Energy Scenarios developed by the National Grid for the region across a balanced and hydrogen scenario. The balanced scenario identifies a significant projected increase in the uptake of air source heat pumps and ground source heat pumps by 2050 across the region.

A long list of 41 interventions were identified in the Masterplan which were subsequently shortlisted based on their ability to contribute to decarbonisation, economic activity and their relative regional geographical coverage. Of the 14 shortlisted interventions, the following are relevant to the LHEES:

- Non-Domestic Heat Electrification: mainly though heat pump technology.
- Domestic Heat Electrification: switching from fossil-fuel based heating systems to electric powered sources.
- Domestic Retrofit: considers deep and light retrofitting to improving building fabric and minimise energy consumption.
- Non-Domestic Energy Efficiency: see above.

There is a significant opportunity for the LHEES to develop and progress measures identified within the Borderlands Low Carbon Energy Masterplan which could unlock funding, including for actions, such as developing pilot projects like building retrofitting.

4.2.5.3 Borderlands Low Carbon Energy Investment Programme (Stage 2)

Development of the investment programme is underway, which, once complete, will constitute a funding strategy for delivery of the shortlisted interventions. This will include a focus on where existing funding already allocated within the Inclusive Growth Deal could be spent.

There is an opportunity for the LHEES to inform this ongoing programme and benefit from capital works funding for identified actions and interventions.

4.2.6 Dumfries and Galloway Local Development Plan (LDP)2

The most recent iteration of the LDP2 was adopted by Dumfries and Galloway Council in October 2019. LDP2 incorporates specific policies on supporting renewable sources of heating and building energy efficiency. This includes the following policies:

LDP2 Policy Name	Summary of LHEES Relevance
Policy IN1: Renewable Energy	• Dumfries and Galloway Council will support district heating systems. • Major planning applications required to include an energy statement which includes consideration of meeting heat demand through a district heating network or other alternatives. • All proposed developments located adjacent to significant heat sources or to existing / proposed heat networks required to be designed in a futureproof way to enable future connection, with any land required for such infrastructure safeguarded.
Policy IN5: Energy Recovery from Waste	• Any application for an energy recovery facility needs to consider potential ability to provide heat and power to the surrounding neighbourhood.
Policy OP1: Development Considerations	• Among other criteria, development is assessed against its ability to reduce carbon emissions through the introduction of energy efficiency measures, ensuring appropriate passive design of buildings (e.g. orientation) and through demonstrating all new buildings implement the emissions reduction standard set by Scottish Building Regulations (where relevant).

Table 4-2: Key LDP2 Policies

The existing policies in LDP2 present several opportunities for the LHEES. This includes:

- Integrating new buildings with pre-existing passive provision into future district heat networks (e.g. in Dumfries).
- Promoting new development to consider implementation of district heat networks, including for any future proposals for energy recovery facilities; particularly where there may be benefits to nearby existing buildings.
- Ensuring newly constructed buildings do not require future retrofitting.

4.2.6.1 LDP2 Sustainability – Reducing Carbon Emissions in Buildings Supplementary Guidance

Supplementary Guidance relating to reducing carbon emissions in buildings has been produced by Dumfries and Galloway Council in 2021, which provides further detail on how Policy OP1 and IN1 within LDP2 should be implemented.

The guidance goes beyond national policy by encouraging developers to aspire to match the Council's local authority-wide carbon neutral target of 2025.

There is a specific requirement for developers to produce Energy Statements for all new building applications, with a focus on implementing the energy hierarchy through measures such as implementing exemplary energy efficiency measures (e.g. to Passivhaus standards). The guidance

also reiterates the forthcoming policy changes from 2024 so that all new buildings must use a zero direct emission heating source.

4.2.7 Referrals to Home Energy Scotland, Warmer Homes Scotland & the Energy Efficiency Business Support

5,354 individual homes in Dumfries and Galloway benefited from advice from Home Energy Scotland between 2022 and 2023. A further 1,983 homes have benefited in just the first quarter of 2023. Home Energy Scotland offer advice around improving energy efficiency and can also provide grants to eligible building through Warmer Homes Scotland. 518 homes have been referred by Warmer Homes Scotland last year, with 107 referrals since the start of the 2023 financial year.

Business Energy Scotland, formerly the Energy Efficiency Business Support, offers support to small and medium sized businesses on saving money, energy and carbon. Data is not currently available on the use of this support across Dumfries and Galloway.

4.2.8 LHEES Pilot

Dumfries and Galloway Council was involved in an LHEES pilot in Phase 1 of the LHEES pilot scheme. In this phase, 12 local authorities around Scotland were awarded £50-70K to trial the development of an LHEES. The funding was used to provide resource in the form of staff time, to procure consultancy services to carry out aspects of the work, and to conduct stakeholder engagement. The pilots ran from September 2017 to March 2019. These pilots aimed to test and develop methods for the LHEES process.

For Dumfries and Galloway Council, this was the development of an LHEES in the small off-gas grid settlement of Glenluce and dispersed properties in the surrounding data zone area. Although a useful contribution to learnings around the LHEES methodology, the limitations of data accuracy used for this pilot restricted the benefits of the findings for the Council and therefore the Pilot data or outcomes have not been included in this LHEES.

4.2.9 Hydrogen for Heating

Hydrogen is not specifically covered within the scope of LHEES, however the potential for its use in heating should not be discounted, particularly in an area such as Dumfries and Galloway where hydrogen generation could be key. Therefore, it is recommended to continue to monitor policy around hydrogen for heat. SGN were engaged with during this LHEES to support this monitoring and consideration. SGN own and operate the gas distribution networks in Scotland and the South-East of England, supplying energy to 5.9 million homes and businesses through over 74,000km of pipeline infrastructure. The UK Government has legally committed to reducing greenhouse gas emissions to net zero by 2050, with the Scottish Government committing to the same reduction by 2045. As part of this transition to net zero, demand for unabated natural gas must be phased out and replaced by low carbon and ultimately renewable energy sources. This will require the transition of natural gas connections to low carbon alternatives.

SGN are working in collaboration with the other gas networks to provide evidentiary support for the UK Government's 2026 heat policy decision about hydrogen's future role in home heating to support Net Zero. SGN are undertaking an extensive programme of R&D, demonstration, and trial projects to prepare for and enable the system transition of the gas networks to 100% hydrogen. These projects include the Local Transmission System (LTS) Futures Programme and H100 Fife hydrogen neighbourhood. LTS Futures will research, develop, test and evidence the compatibility of LTS assets, pipelines, associated plant and ancillary fittings with hydrogen – this is important as the LTS consists of high-pressure pipelines that distribute gas directly to industry and feed the lower pressure gas networks that are used by homes and businesses. H100 is a world-first demonstration that will bring 100% green hydrogen gas to provide clean heat to around 300 homes in Buckhaven and Denbeath.

In addition, in preparation for the conversion of the gas networks in Scotland to 100% hydrogen, SGN has a number of system transformation projects which are developing the plans, roadmaps, and infrastructure requirements. In Dumfries and Galloway, SGN are investigating the potential for green hydrogen production from curtailed renewable generators and its implications for new hydrogen infrastructure and the repurposing of existing gas assets in the southwest of Scotland. In North East and Central Scotland SGN have a pre-FEED project, H2 Caledonia, which is designing and routing new hydrogen transmission pipelines to connect hydrogen production, storage and network injection locations. These new pipelines would form a hydrogen backbone, providing the hydrogen required to support the phased conversion of gas distribution networks which would ultimately allow for hydrogen use in a domestic setting (as seen in H100 Fife). H2 Caledonia's pre-FEED project and its future FEED phase, represent the technical and commercial development of SGN's hydrogen rollout strategy, which is aiming to demonstrate and ensure the timely delivery of the system transformation to hydrogen once the required policy decisions are made.

5 Policy & Strategy Context

5.1 Summary of Policy Landscape

There is a myriad of legislation and policies produced at a national, regional, and local level which have been considered in developing the LHEES for Dumfries and Galloway Council (see Figure 5-1).

At a national level, whilst climate and energy policy areas are largely devolved to the Scottish Government, the UK Government retains overall responsibility for energy security and regulation of the energy market in Scotland. This includes a recent Energy Security Plan which emphasises the role of using British generated electricity to heat our buildings rather than relying on imported gas (DESNZ, 2023b).

The Scottish Government has a well-developed legislative framework which underpins the decarbonisation of heating buildings including the Climate Change (Emissions Reduction Targets) (Scotland) Act (The Scottish Government, 2019a) and the Heat Networks Act (The Scottish Government, 2021b). These are supported by key policies such as the Heat in Buildings Strategy (The Scottish Government, 2021a).

Locally, Dumfries and Galloway Council declared a climate emergency in 2019 (Dumfries and Galloway Council, 2019a), and have developed a Carbon Neutral Strategic Plan for meeting net zero carbon emissions by 2025 (Dumfries and Galloway Council, 2021a). This leading decarbonisation agenda is a key theme in other key policies including the pan-regional Borderlands Energy Masterplan (Borderlands, 2022), the Dumfries and Galloway LDP2 (Dumfries and Galloway Council, 2019c), and the Strategic Housing Investment Plan (Dumfries and Galloway Council, 2022).

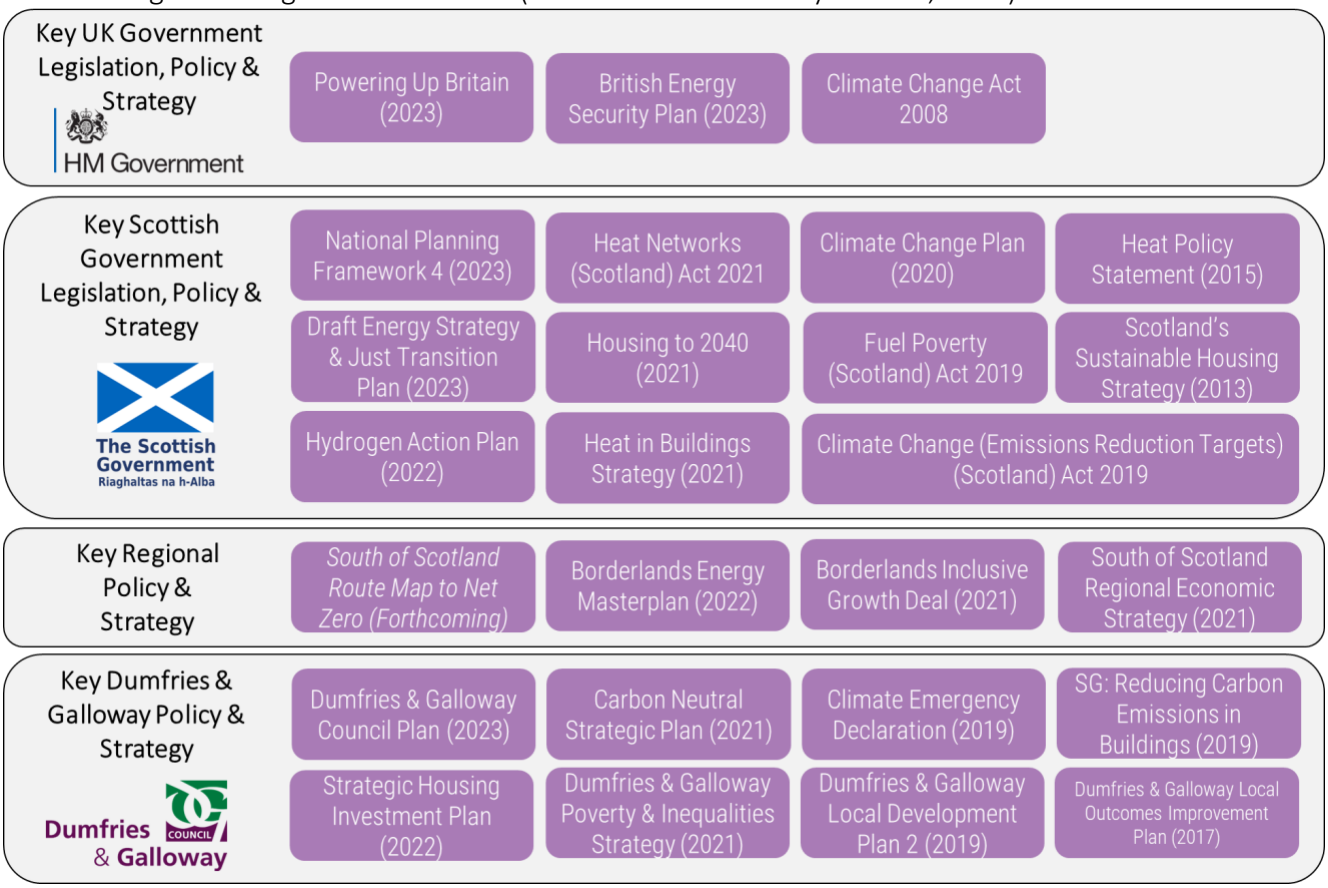

Figure 5-1: Summary of Policy Landscape Including Legislation, Strategy or Policy

A completed policy and strategy review template for Dumfries and Galloway Council is available which includes a comprehensive review of all policies, strategies and key legislation, with a brief summary provided in Section 5.2 to 5.3.

5.2 National Policy & Strategy

5.2.1 UK Government Legislation & Policy

Table 5-1 summarises the key UK Government legislation and policies relevant to the Dumfries and Galloway LHEES, mainly pertaining to energy security which is reserved to Westminster.

UK Legislation or Policy	Description	Key Relevant Priorities, Actions & Targets
Climate Change Act (UK Government, 2008)	This act contains a legally binding commitment which obligates the UK reaching net zero carbon emissions by 2050.	• Net Zero Carbon Emissions across the UK by 2050.
Powering Up Britain (DESNZ, 2023a)	This a plan relevant for the whole UK which sets out how the UK Government will improve energy security, take advantage of economic opportunities, and deliver a decarbonised energy system.	• Launch of the Great British Insulation Scheme to deliver £1 billion of additional investment by 2026 to retrofit around 300,000 of the least energy efficient homes. • Rebalancing of fuel prices so ensure green products (e.g. heat pumps) are more efficient and cheaper than gas by end of 2024. • Launch of Heat Pump Investment Accelerator to leverage investment in heat pump supply chain.
Powering up Britain: British Energy Security Plan (DESNZ, 2023b)	This plan provides a specific focus on ensuring the UK is energy independent and not subject to reliance on oversea imports of oil and gas	• Lowering our energy demand through increased focus on implementing energy efficiency measures. • Emphasis on using electricity for heating rather than imported gas to improve energy security.

Table 5-1: Key UK Government Legislation or Policies Relevant to the Dumfries and Galloway LHEES

5.2.2 Scottish Government Legislation & Policy

Table summarises the key Scottish Government legislation and policies relevant to this LHEES. Note that energy, heating and fuel poverty is largely a devolved area to the Scottish Government.

The key policy drivers at a national level relevant to the Dumfries and Galloway LHEES include:

- **Decarbonisation:** The need to deliver on climate commitments including the legal target to reach net zero carbon emissions in Scotland by 2045 (five years ahead of the UK Government target) (The Scottish Government, 2019d). This will require significant action to retrofit the country's building stock in terms of both energy efficiency measures and a switch to zero carbon heating sources.
- **Fuel Poverty:** The need to significantly reduce the relative costs of heating homes and near eradicate fuel poverty by 2045.

Scottish Legislation or Policy	Description	Key Relevant Priorities, Actions & Targets
Draft Energy Strategy & Just Transition Plan (The Scottish Government, 2023a)	This sets a vision for Scotland's energy system to 2045 and a route map of ambitions and actions to deliver a flourishing net zero energy system that supplies affordable, resilient and clean energy to all buildings	• By 2030 the majority of the 170,000 off-gas grid homes that currently use high emissions oil, LPG and solid fuels, as well as at least 1 million homes currently using mains gas, convert to zero emissions heating. • Invest over £1.8 billion in decarbonising homes and buildings through Heat and Energy Efficiency Scotland.

Scottish Legislation or Policy	Description	Key Relevant Priorities, Actions & Targets
National Planning Framework 4 (The Scottish Government, 2023b)	National Planning Framework 4 is the national spatial strategy for Scotland. It sets out spatial principles, regional priorities, national developments, and national planning policy for future development. This now forms part of the development plan, along with LDPs.	• Stranraer Gateway is highlighted as a key hub for delivering liveable places. • Chapelcross is a major redevelopment, with potential to help deliver net zero through renewable energy and heat generation. • Local Development Plans are linked into the six spatial principles to assist local authorities with the principles' development. Identifying heat networks is acknowledged and development is encouraged adjacent to these zones.
Heat in Buildings Strategy (The Scottish Government, 2021a)	This sets out a pathway to zero emissions buildings by 2045 and details a series of near-term and longer-term actions to achieving this.	• By 2030, over 1 million homes and 50,000 non-domestic buildings to be converted to using zero or low carbon emissions heating. • All homes to be a minimum of EPC rating C by 2033 with all private rented homes to meet this by 2028 and fuel poor homes to meet this by 2030. • At least 124,000 zero or low carbon emission heating systems to be installed per annum (2021-2026) and peak at 200,000 per year thereafter. • From 2024, all new buildings to use zero emission heating source to avoid future retrofitting.
Heat Networks (Scotland) Act (The Scottish Government, 2021b)	The aim of the Act is to encourage greater use of heat networks, through establishing a new regulatory framework.	• Scottish Ministers must ensure that the combined thermal energy from heat networks in Scotland reaches 2.6 terawatt hours by 2027 and 6 terawatt hours by 2030.
Housing to 2040 (The Scottish Government, 2021c)	This sets out a vision for housing in Scotland to 2040 and a route map. It aims to deliver an ambition for everyone to have a safe, good quality and affordable home that meets their needs.	• Ensure all homes by 2045 are warm and affordable to heat and reduce emissions. • All new homes delivered by Registered Social Landlords and local authorities required to be net zero emissions by 2026.
Climate Change Plan (The Scottish Government, 2020)	This sets out the Scottish Government's pathway to new and ambitious targets set by the Climate Change Act 2019 across all sectors of the Scottish economy, including energy and buildings.	• Emissions from buildings to fall by 68% by 2030 compared to 2020. • All new homes to have a zero-emission heating source by 2024. • By 2032, 35% of domestic buildings' heat and 70% of non-domestic buildings will be supplied by low carbon technologies. • 15% reduction in domestic heat demand and 20% reduction in in non-domestic heat demand by 2032 as a result of building fabric improvements.
Climate Change (Emissions Reductions Targets) (Scotland) Act (The	This sets out the Scottish Governments' future targets to reach net zero carbon emissions.	• Net zero carbon emissions to be achieved in Scotland by 2045. • Greenhouse gas reductions of 75% by 2030 and 90% by 2040.

Scottish Legislation or Policy	Description	Key Relevant Priorities, Actions & Targets
Scottish Government, 2019a)		
Fuel Poverty (Targets, Definitions and Strategy) (Scotland) Act (The Scottish Government, 2019b)	This defines the meaning of fuel poverty and sets legal targets relating to the eradication of fuel poverty	By 2040: • No more than 5% of households in Scotland are in fuel poverty and no more than 1% are in extreme fuel poverty. • The median fuel poverty gap of households in Scotland in fuel poverty is no more than £250.

Table 5-2: Key Scottish Government Legislation or Policies Relevant to the Dumfries and Galloway LHEES

5.3 Regional & Local Policy, Strategy & Linkages

5.3.1 Regional Policies & Strategies

At a regional level, Dumfries and Galloway Council will share in the benefits from £452 million of funding as part of the Borderlands Inclusive Growth Deal (see Section 4.2.5.1) which was signed in March 2021. A core element of the Borderlands Inclusive Growth Deal is the Low Carbon Energy Masterplan (see Section 4.2.5.2) which establishes key priorities for low carbon energy investment opportunities including domestic retrofit and heat electrification.

5.3.2 Local Policies & Strategies

Dumfries and Galloway Council was one of the first local authorities to declare a climate emergency in 2019 and have developed a Carbon Neutral Strategic Plan (2021) which sets out an ambition to meet net zero carbon emissions by 2025, which is well ahead of the national target. This trailblazing ambition to deliver decarbonisation as quickly as possible sets the agenda for this LHEES, which is also reflected in other key local policies including the Dumfries and Galloway LDP2 (2019) and the Strategic Housing Investment Plan (Dumfries and Galloway Council, 2022).

A further key priority for Dumfries and Galloway Council is empowering local people to lead independent, happy, and healthy lives, which is reflected in the Dumfries and Galloway Council Plan 2023 – 2028 (Dumfries and Galloway Council, 2023b), the Local Housing Strategy 2018 – 2023 (Dumfries and Galloway Council, 2018) and the Dumfries and Galloway Local Outcomes Improvement Plan and Locality Plan (Dumfries and Galloway Council, 2017). Critical to delivering upon this ambition is helping people tackle the causes and effects of poverty, inequality, and increased cost of living. Addressing fuel poverty and ensuring people can afford to hear their home is therefore a key policy driver of this LHEES.

A summary of the key local policies is provided in Table 5-3.

Local Policy	Description	Key Relevant Priorities, Actions & Targets
Dumfries and Galloway Council Plan 2023 - 2028 (Dumfries and Galloway Council, 2023b)	This sets out the vision and strategic outcomes that the Council wants to achieve over the next five years.	• Urgently transition to a carbon neutral region. Help is provided to tackle the causes and effects of poverty, inequality and increased cost of living.

Local Policy	Description	Key Relevant Priorities, Actions & Targets
Strategic Housing Investment Plan (Dumfries and Galloway Council, 2022)	This sets out the strategic investment priorities for affordable housing development over a 5-year period across Dumfries and Galloway.	• Iterates the strategic priority to construct affordable homes that meet high levels of energy efficiency, with preference given to sites which can achieve this.
Carbon Neutral Strategic Plan (Dumfries and Galloway Council, 2021a)	This provides a strategic action plan to provide a route map to achieving net zero carbon emissions across the council area.	• Significant improvements in energy efficiency in buildings. • Installing zero carbon heating systems such as heat pumps and biomass. • Replace gas or oil heated council buildings with renewable heating by 2024.
LDP2 SG – Reducing Carbon Emissions in Buildings (Dumfries and Galloway Council, 2021b)	This provides further detailed guidance beyond the main LDP2 related to achieving carbon reductions in new buildings	*See Section 4.2.6 for requirements beyond national policy.*
Dumfries and Galloway Poverty and Inequalities Strategy (Dumfries and Galloway Council, 2021c)	This sets out Dumfries and Galloway Community Planning Partnership's commitment and approach to tackling poverty and inequality across the region.	• The overarching ambition is for local action to drive poverty as low as possible and mitigate as far as possible the impact of poverty when experienced.
Climate Emergency Declaration (Dumfries and Galloway Council, 2019a)	This sets out Dumfries and Galloway Council's climate emergency declaration.	Implementation of a 12-point plan including commitment to a net zero carbon region by 2025.
Dumfries and Galloway LDP2 (Dumfries and Galloway Council, 2019c)	LDP2 sets out how and where land and property will be used in Dumfries and Galloway up to 2040. The written policies give guidance on all aspects of development.	*See Section 4.2.6 for key policies.*
Local Housing Strategy (Dumfries and Galloway Council, 2018)	Sets out the approach of the local authority and partners to deliver housing and related services across the region.	• **Strategic Objective 4:** "We will help everyone in our region to live in warm, affordable, energy efficient homes". • **Strategic Objective 3:** "We will ensure that households who live in the Private Rented Sector have a home that is safe, warm and achieves the required standards".

Table 5-3: Summary of Key Local Policies

5.4 LHEES Considerations, Targets & Indicators

Dumfries and Galloway Council has chosen not to prioritise specific LHEES Considerations but to analyse the challenges, potential solutions and actions required across all LHEES Considerations in

tandem. Further details, including indicators and assumptions around each of the LHEES Considerations and specific analysis undertaken for each of them are explained in this section. It should also be noted that due to the limited data around non-domestic buildings, these have not been included in the on- and off- gas grid LHEES Considerations, but have been included in the heat network analysis.

5.4.1 Off-Gas Grid Buildings

Off-gas grid domestic buildings are categorised with respect to suitability for heat decarbonisation measures and fabric retrofit requirements, in line with the LHEES building categories. This has been analysed spatially to determine:

- The extent of properties across the region which need different levels of intervention, presenting the scale of progress need for decarbonisation.
- Identification of key areas with groups of similar buildings to understand where area-based solutions could be applied, or tied in with other existing programmes.
- Category 3 buildings (see below) have been relabelled as Older Buildings or Unconventional Construction, and properties have been separated into three solution options: Significant retrofit and heat pump installation; direct electric heating (where a wet system does not exist for the property); biomass boilers.
- It was assumed that no further gas grid connections would be made and therefore hydrogen would not be a suitable solution for heat decarbonisation for off-gas grid properties.
- Heat networks may be a viable option for buildings within a potential heat network zone.

Buildings are separated into four different categories, with slightly different variations depending on if they are on or off the gas grid, primarily based on their suitability for heat pumps. Details on how the buildings are characterised for off-gas grid is given in Table 5-4. These categorisations have been developed through the LHEES process and are integrated in the EST's Home Analytics data.

They are used in this LHEES to group intervention pathways for buildings and provide a guide to strategically targeting and prioritising buildings, however are recognised to be a simplification. Categories can also be used to spatially analyse buildings with an area-based approach. The categories do not imply prioritisation of one building type over another. For the purposes of this LHEES the category definition has not been changed from the Scottish Government's LHEES guidance.

Category	Description
Category 0	Properties which currently have a low or zero emissions heating system including either heat pumps or connection to a heat network
Category 1	Those considered highly suited 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 network upgrades)
Category 2	Those with secondary potential for heat pump retrofit (i.e. properties in need of moderate fabric upgrade and / or addition of wet distribution system to be heat pump ready)
Category 3	Those with tertiary potential for heat pump retrofit (i.e. properties in need of significant fabric upgrade to be heat pump ready) or those less suited to heat pump technology, with electric (storage or direct) or biomass likely to be the most viable decarbonisation technology.

Table 5-4: Category Descriptions Used for Off-Gas Grid Properties

5.4.2 On-Gas Grid Buildings

Within the LHEES guidance, on-gas grid domestic buildings have been treated in the same way as off-gas grid properties, with a few exceptions.

- Older Buildings or Unconventional Construction which are not suitable for a heat pump even with significant retrofit have not been given a decarbonisation solution. This is due to two factors: direct electric heating is generally not suitable for houses which already have a wet heating system without extensive system retrofit; on-gas grid properties tend to be in more densely populated areas where biomass boilers are not suitable due to air pollution levels. These buildings will require a more comprehensive, individual assessment by a specialist.
- Hydrogen is a potential option for on-gas grid buildings, dependent on the UK Government's decision. Although not included in the LHEES scope, this is an option which may be contemplated by the Council.

The categories used for on-gas grid are largely the same as for off-gas grid, however there is no sub-categorisation of Category 3 properties as electric and biomass options are less likely to be suitable.

5.4.3 Heat Networks

Heat network analysis was conducted using a linear heat density approach across the local authority. Due to the rural nature of Dumfries and Galloway, and the early stage of consideration for heat network zones, the lowest suggested linear heat density value was used for this: 4,000 kWh/m/year.

Whilst having some higher density areas, much of Dumfries and Galloway is rural and therefore will have lower infrastructure costs associated with heat networks. Additionally, financial viability of heat networks is based on multiple factors which are difficult to quantify through a single metric. This initial stage of analysis is to identify potential zones, with subsequent stages reviewing the potential anchor loads, heat sources, physical infrastructure constraints and general appetite for heat networks. Therefore it was thought to be detrimental to the analysis to exclude areas without considering these wider and influential factors.

5.4.4 Poor Building Energy Efficiency

Poor building energy efficiency was analysed across the region and used to understand the major challenges for Dumfries and Galloway in terms of specific building fabric and required interventions. This LHEES Consideration was used to analyse the performance of properties, in combination with the analysis from the on- and off-gas grid 'Considerations' to categorise the building stock. The LHEES methodology suggests weightings for this analysis, and the standard, suggested assumptions were adopted for this LHEES.

5.4.5 Poor Building Energy Efficiency as a Driver for Fuel Poverty

The potential impact of poor building energy efficiency on fuel poverty was also analysed over the Strategic Zones, as an additional analysis layer to the on- and off-gas grid categorisation. This insight has been reported to aid Dumfries and Galloway Council in understanding which areas could be prioritised in the short term for energy efficiency interventions which could also reduce fuel poverty.

5.4.6 Mixed Tenure, Mixed-Use & Historic Buildings

Potential challenges to implementing energy efficiency measures and decarbonisation interventions were captured through mapping of buildings with mixed tenure, mixed-use or buildings with specific, non-standard needs (through Conservation Areas or being Listed Buildings). This gives indication of areas which may need more extensive and detailed review to determine solution pathways including more sensitive choices of materials and approaches to sustain the built fabric and ensure damage is not caused by retrofit. In particular, a focus was on listed buildings and buildings in conservation areas.

6 Baselining

6.1 Baseline Summary Across the Local Authority

The baseline performance of Dumfries and Galloway 's domestic and non-domestic building stock is captured below, in terms of building demographic, energy efficiency performance and fuels currently used. The domestic data used in LHEES, which is based on EST's Home Analytics, evaluates the standards of insulation across walls, windows, floor, loft and external doors.

The EST's Non-Domestic Analytics and the Scotland Heat Map were used to capture the non-domestic data, however it should be noted there is a significant difference in the detail of non-domestic building fabric and energy performance and therefore analysis is much more limited. These datasets were used to evaluate, on a high-level, the energy efficiency of buildings across the local authority and the applicability of standard retrofit measures.

This data has provided a high-level analysis, to broadly identify where retrofit is required and to what scale to reduce energy use, carbon emissions and ease fuel poverty. It should be recognised that standard forms of retrofit, such as internal or external wall insulation, are not the only solution for energy efficiency improvement and for individual projects, alternative solutions or pairs of solutions should be considered which offer co-benefits. For example, poor general fabric maintenance, poor material choice and reduced ventilation can be major issues affecting solid wall buildings, which are commonly seen in Dumfries and Galloway. These build types can also have specialist features which, if not preserved during further work, can have negative impacts and deterioration in the building fabric. This analysis should be seen as a guide and specific recommendations, particularly for buildings with traditional build types, will require specialist recommendations to conserve the character of buildings and ensure the longevity of the solutions.

6.1.1 Domestic Buildings

Dumfries and Galloway region has just over 70,000 domestic properties, with a wide variety of building types and mixed tenures. The area is a mix of urban and rural settlements with a relatively even split of on- and off- gas grid properties. Many buildings are historic and a proportion of them are either listed or in a conservation area. For this reason, having a diverse approach to decarbonisation is imperative for the local authority. The housing associations are run by housing providers and none are owned by the local authority.

The average EPC rating of the domestic buildings in Dumfries and Galloway is worse than the Scottish average (EPC rating C (The Scottish Government, 2019c)), with only 30% of buildings having an EPC of A-C.

28% of buildings have uninsulated solid brick or stone walls, which can yield poor thermal performance. Poor condition of walls, or using materials with poor thermal quality, can cause low building energy efficiency and therefore can be a method of identifying houses requiring interventions. Data sources used do not indicate the condition of the fabric, however it does supply detailed information on the wall build type and level of insulation. Wall build type can be significant due to the impact it has on retrofit intervention options, and relative cost.

47% of buildings have uninsulated walls, which is likely to be a major contributing factor to the low average EPC score. Although not a guaranteed reflection on energy performance, age of properties can provide insight into potential issues with energy efficiency, based on build styles and typical materials used at the time of building. Figure 6-1 shows that approximately 40% of buildings were built in an era which is unlikely to have cavity walls at all (pre-1950), and only 18% of buildings across the local authority were built post-1990, when cavity wall insulation became compulsory. Cavity wall insulation is one of the easiest and cheapest measures available. For buildings without cavity walls,

adding wall insulation will require either external cladding or internal insulation, and is likely to be expensive and disruptive.

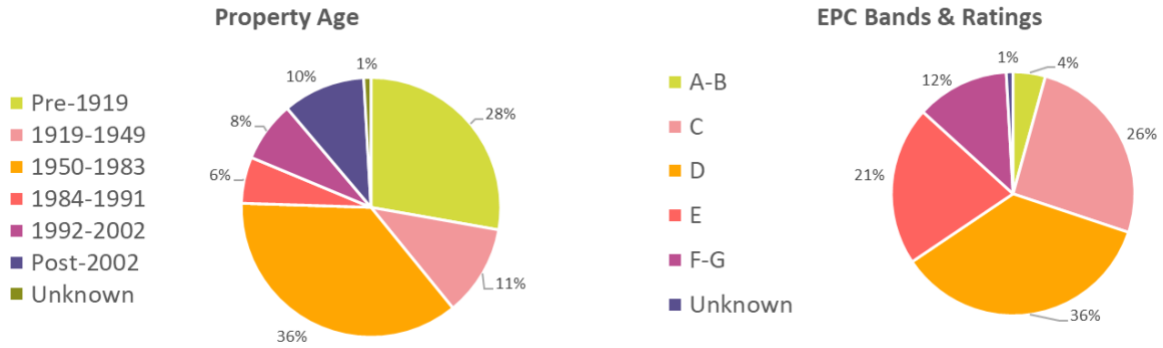

Figure 6-1: Domestic Baseline Tool, Local Authority Summary Statistics. Property Age & EPC Ratings

The number of homes with poor loft insulation or windows with single glazing or no secondary glazing is relatively low in comparison. 8% have single glazing, and 11% have only small amounts of loft insulation, suggesting that focusing on improving wall insulation will be key to tackling poor energy efficiency. Over 50% of properties already have deep loft insulation (≥250mm) and 92% have double or triple glazing. Only 1% of buildings have the worst reported level of insulation across all three fabric characteristics: Single Glazing; <100mm of loft insulation and uninsulated walls. A breakdown of these figures can be seen in Figure 6-2.

80% of properties are houses rather than flats. Flats offer a benefit of efficiency due to the density of properties in a single building, whereby one measure can improve many homes simultaneously or costs of interventions such as additional window glazing can be reduced from economies of scale for labour and programmes of work.

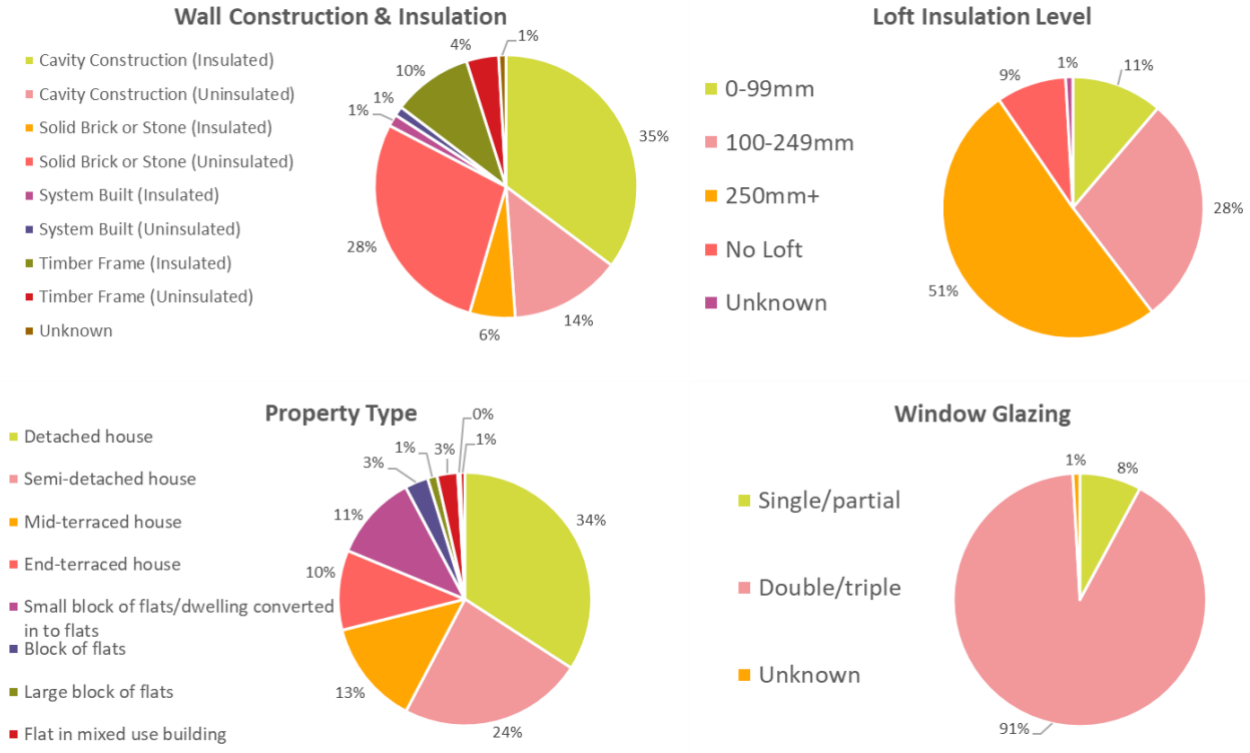

Figure 6-2: Domestic Baseline Tool, Local Authority Summary Statistics. Wall Construction; Loft Insulation Level; Property Type; Window Glazing Type

57% of buildings in Dumfries and Galloway are connected to the mains gas, with off-gas grid properties mainly being split between electricity (16%) and oil (20%) as their main fuel type, as shown in Figure 6-2. These two main alternative fuel sources offer slightly different challenges. Oil-based properties may be seen as a priority to decarbonise due to the high pollution rate – oil boilers can produce up to twice as much carbon as a gas boiler. <1% of homes already use heat pumps which are an effective low carbon option and therefore 15% use direct electric heating. However, electricity has a much higher unit price than gas and therefore can be expensive and risk increasing fuel poverty. Used efficiently and correctly, air source heat pumps can have an efficiency of 250-300%, whereas direct electric heating has a maximum efficiency of 100%, making it much more expensive than heat pumps and a significant risk for fuel poor homes, particularly if not correctly paired with storage heating.

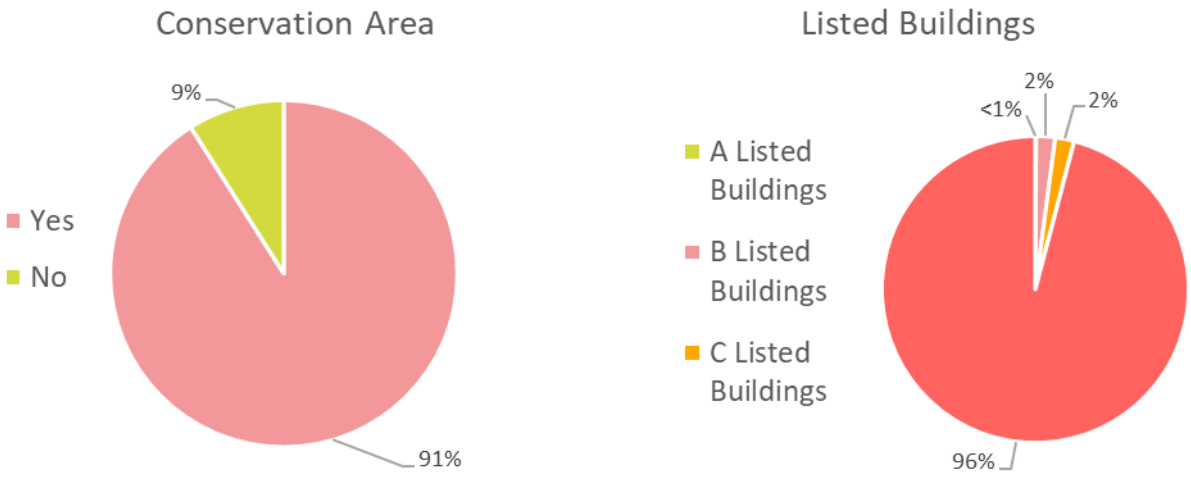

Figure 6-3: Domestic Baseline Tool, Local Authority Summary Statistics. Conservation Area; Listed Buildings

Buildings that are in conservation areas or are listed require more specialist interventions and more standard measures, such as internal or external wall insulation aren't always appropriate. Dumfries and Galloway has 9% of buildings in conservation areas, and 4% of buildings that are listed, as shown in the summary chart Figure 6-3. Figure 6-4 shows that there are three main zones where conservation zones could potentially challenge retrofit measures: Machars south; Langholm and Eskdale; and Kirkcudbright. In these areas it may only be possible to implement internal wall insulation (which is more disruptive to the occupier and results in a reduced building floor space) and/or insulation can be considerably more expensive. More appropriate, non-standard interventions for historic buildings are available and should be considered to reduce cost and may be more effective.

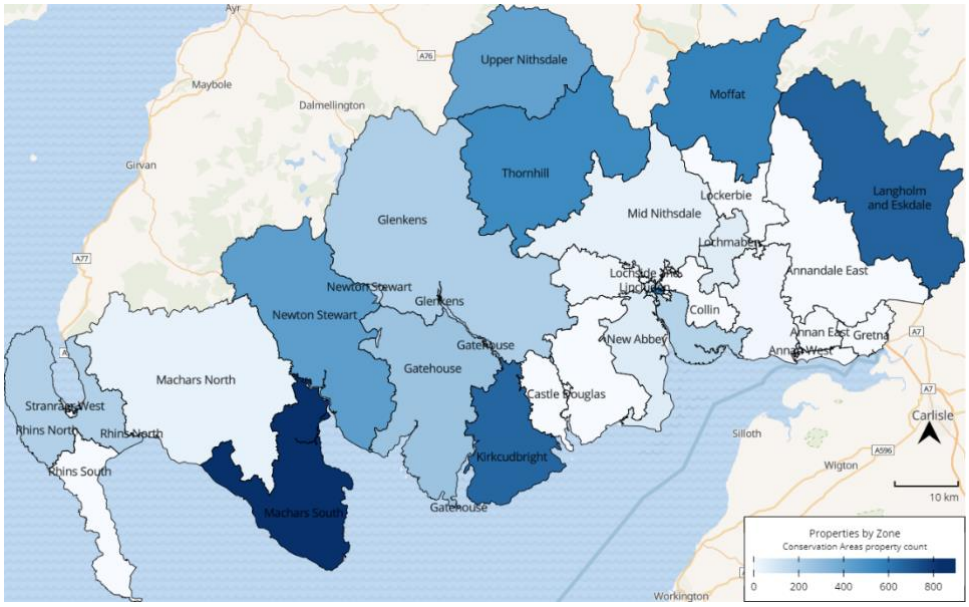

Figure 6-4: Properties in Conservation Area, by Intermediate Zone

6.1.2 Non-Domestic Buildings

There are over 11,000 non-domestic properties in the Dumfries and Galloway region. The building stock is old, with roughly 50% of buildings built before 1919, as show in Figure 6-5. The inefficiency of these older buildings is seen in the heat demand being greater than the 50% expected by building count. Based on the information from the domestic building stock, these older buildings are unlikely to have any wall insulation and minimal or no loft insulation. Cavity wall insulation may be present in the buildings built between 1949-83 (grey) and likely to be for buildings post-1983 (yellow).

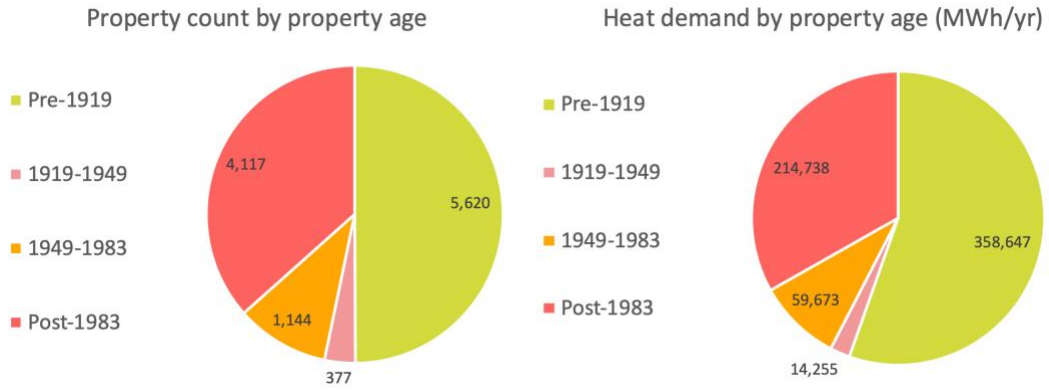

Figure 6-5: Non-domestic Baseline Tool, Summary Statistics Non-Domestic Property Age Summary

The non-domestic building stock is mainly heated by electricity (by count), shown in Figure 6-6. Electrified heating supports a fast decarbonisation due to the accelerated uptake in green generation by the National Grid. However, as the grid is set to be zero carbon by 2035, this will not meet Dumfries and Galloway Council's own target of 2025.

The next largest fuel type (by count) is mains gas. As discussed in Section 7.2, properties on the gas grid have the potential to transition to hydrogen heating systems, however the uncertainty around this and delay until the grid can provide 100% hydrogen makes this an unsuitable solution for this LHEES. To decarbonise by 2025, it will be necessary to target other decarbonisation pathways.

The remaining heat demand, which is still close to 50%, comes from oil and other sources. Oil will need to be replaced, either with heat pumps or biomass depending on the building suitability. 'Other fuels' could include biomass and solid fuels, the sustainability of which are unclear from the available data and therefore will have to be considered on an individual building level.

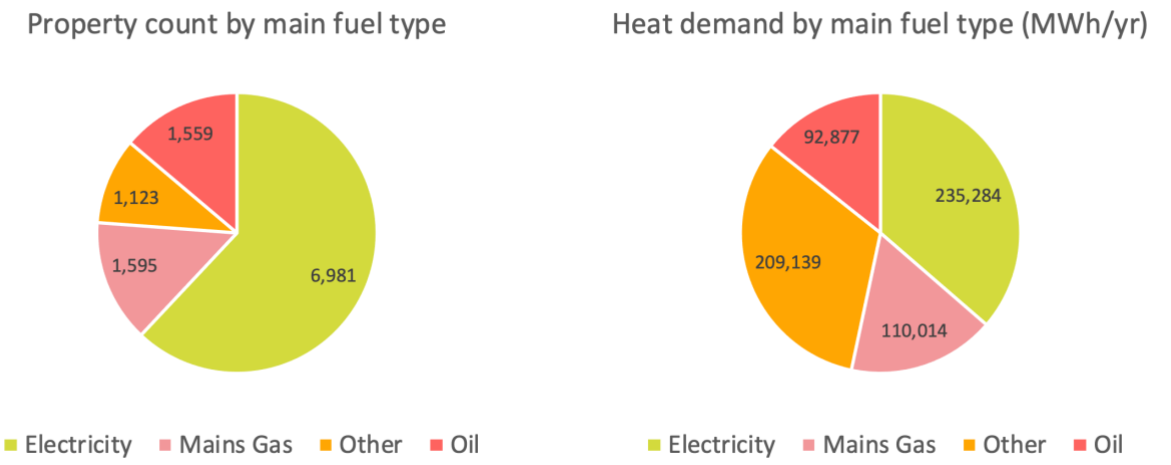

Figure 6-6: : Non-domestic Baseline Tool, Summary Statistics. Main Fuel Type for Non-Domestic Buildings

The properties that are connected to the mains gas network are only in a few zones in the local authority, shown in Figure 6-7. Those with a main fuel type of oil is shown in Figure 6-8. This shows that a relatively high proportion of properties that are not connected to the gas grid and using oil, and therefore a clear decarbonisation plan is needed for off-gas grid properties.

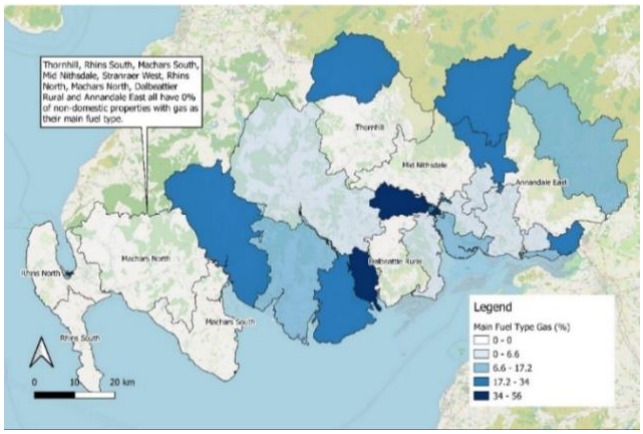

Figure 6-7: Non-Domestic Buildings Connected to the Mains Gas Network, by Intermediate Zone

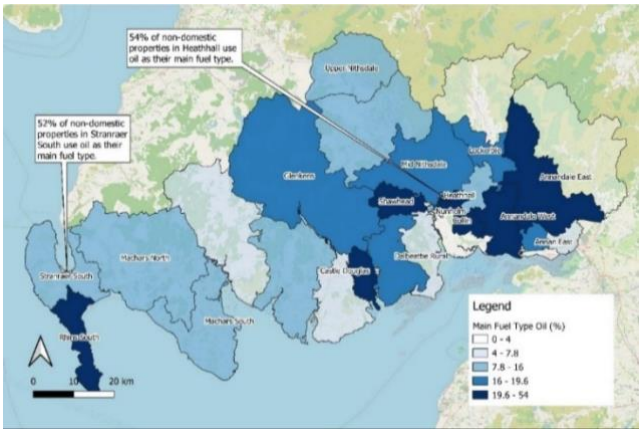

Figure 6-8: Non-Domestic Buildings with Oil as Main Fuel Type, by Intermediate Zone

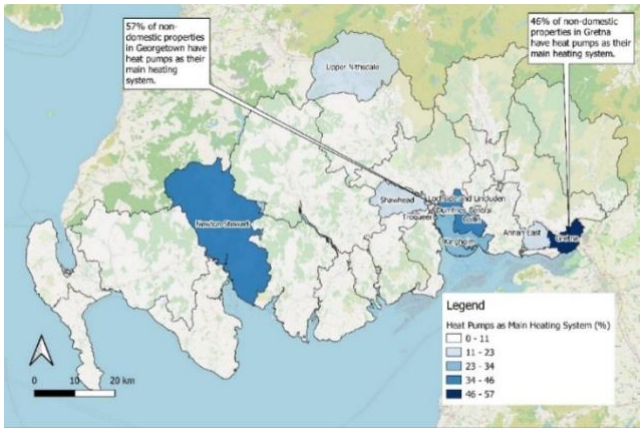

Figure 6-9: Non-Domestic Buildings with Heat Pumps, by Intermediate Zone

Figure 6-9 shows that some regions already have a high percentage of heat pumps as the main source of heat in the building, such as Gretna and Georgetown, although data does not indicate what type these are. Ensuring high performance of these heating systems could enable these buildings to be a strong evidence base and exemplar of decarbonisation and support further action.

Non-domestic buildings can be a key target for district heating networks, as the higher demands increase economic viability of the schemes. However, a low percentage of properties show a high heat network suitability, with the highest in Gatehouse of Fleet at 12% as shown in Figure 6-10. The next highest region is Kingholm Quay with a suitability of around 5%. More buildings, however, have

a medium suitability for heat networks as shown in Figure 6-11. This suitability is assessed based on the estimated building heat demand and usage type, at a high-level. A more comprehensive assessment has been undertaken and is reported in Section 8.4.

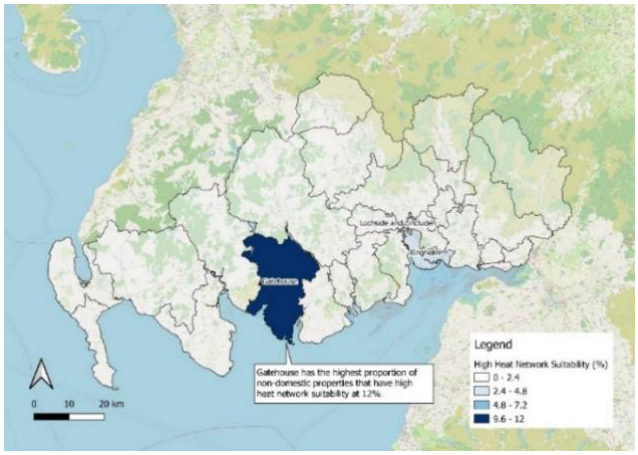

Figure 6-10: Non-Domestic Properties with High Heat Network Suitability, by Intermediate Zone

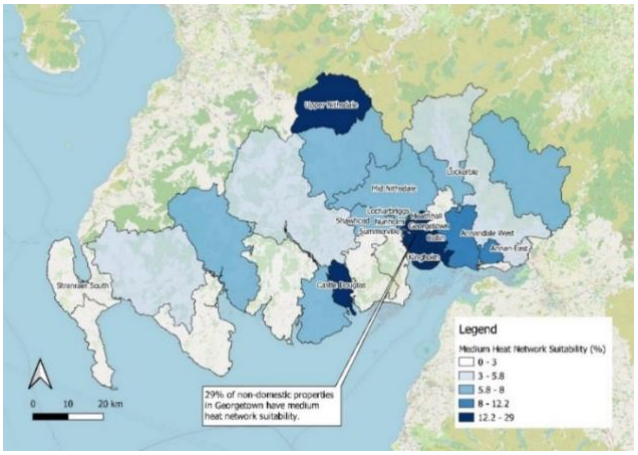

Figure 6-11: Non-domestic Properties with Medium Heat Network Suitability, by Intermediate Zone

7 Generation of Strategic Zones: Energy Efficiency & Building Decarbonisation

The LHEES analysis was based on data from Home Analytics, Non-domestic Analytics and the Scotland Heat Map. This data was analysed over all a mixture of intermediate zones to determine the current relative performance across each of the LHEES Considerations, highlighting areas which may need a higher level of intervention: Strategic Zones. This output gives an evidence-base for action needed by the local authority.

7.1 Off-Gas Grid Properties

For properties not connected to mains gas, around 9% are Category 0 or 1 properties, meaning they are either already on a low carbon heating source, or the property is ready to be swapped to a heat pump without any major changes. Therefore these properties could be a priority for 'quick wins' to accelerate decarbonisation, as shown in Figure 7-1.

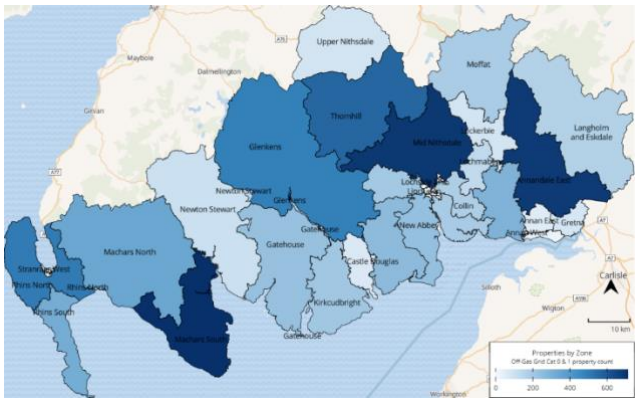

Figure 7-1: Off-Gas Grid Category 0 & 1 Properties, by Intermediate Zone

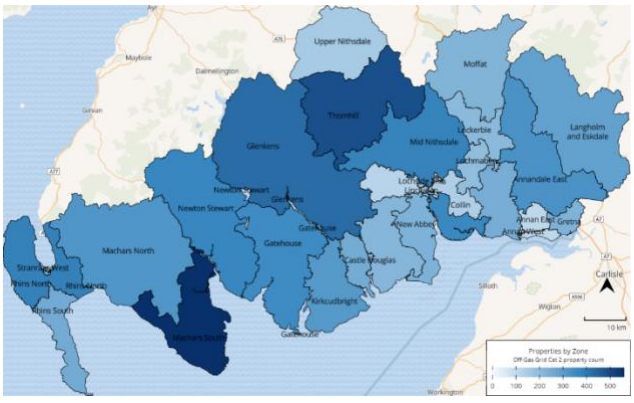

Figure 7-2: Off-Gas Grid Category 2 Properties, by Intermediate Zone

The remaining off-gas grid properties are all Category 2 and 3, which means they are not currently suitable for a heat pump. Category 2 buildings, shown in Figure 7-2, will only need a moderate amount of retrofitting to be efficient enough for a heat pump and therefore retrofitting and heat pump installation could be cost-effective.

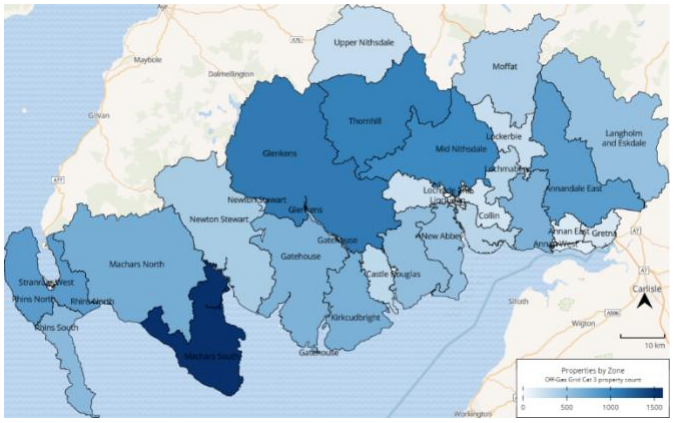

Figure 7-3: Off-gas Grid Category 3 Properties, by Intermediate Zone

Category 3 buildings may require considerable fabric retrofit to be suitable for a heat pump. These properties tend to be older or historic buildings with unconventional construction. For this reason, whilst being suitable for many retrofit measures, they often require more bespoke planning and complex interventions. Although heat pumps are proven to work effectively in a wide range of building types and ages, generally the lower temperature heat output requires a relatively higher fabric efficiency and upgraded radiators. As these Category 3 buildings are unsuitable for or will require significant investment to achieve this level of efficiency, a direct electric boiler or biomass boiler might be a preferable option. The zones with the most Category 3 properties are: Machars South; Glenkens; Thornhill; Mid Nithsdale and Rhins North, as shown in Figure 7-3. Recommendations for these properties are explored further in the subsequent section identifying Strategic Zones.

7.2 On-Gas Grid Properties

For properties connected to the mains gas network, only 105 currently fall under Category 0, meaning that they are suitable for a heat pump to be installed. The distribution of Category 0 and 1 properties is shown in Figure 7-4. Most of the on-gas grid properties (32,400) are Category 2, and 12,000 are Category 3. Therefore extensive work could be needed to improve the energy efficiency across the gas network.

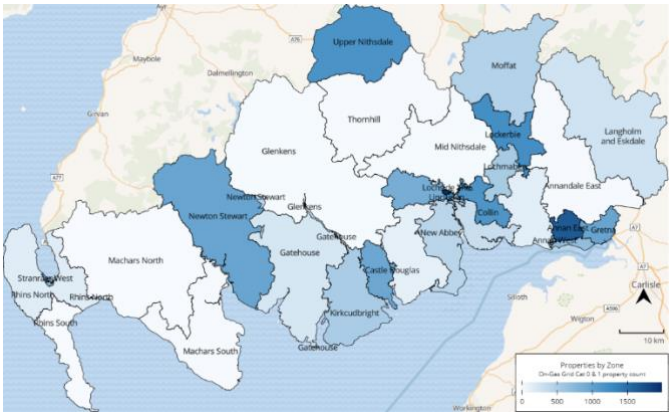

Figure 7-4: On-gas Grid Categories 0-1 Properties, by Intermediate Zone.

Switching to green hydrogen could be seen as an option for decarbonising on-gas grid properties, but retrofit measures will still be necessary to reduce the heat demand and limit the amount of fuel required. Evidently, this option is also reliant on a positive decision from the UK Government around the use of hydrogen for heating, due in 2026. Further to this, the gas network is unlikely to be ready to support a 100% hydrogen network until 2030, which would challenge Dumfries and Galloway Council's net zero target of 2025.

Finally, although hydrogen could be deemed a suitable option for decarbonisation of homes from a technical perspective, there are questions and critical uncertainties around the efficiency and cost associated. Costs of retrofitting homes for hydrogen are estimated to be high, while the cost of hydrogen as a fuel is highly uncertain. However, due to the extensive and inefficient generation process (electrolysis of water relying on significant energy from renewables) and high, competitive demand of hydrogen from hard to decarbonise industries and heavy transport, there is a strong chance of hydrogen having a high unit price and further increasing the risk to fuel poverty. For this reason, it is encouraged for Dumfries and Galloway Council to continue investigating alternative options for decarbonising its building stock and await further information on the realistic price of hydrogen for heat.

Depending on the strategic decision around hydrogen for heating, Category 1 on-gas grid properties could be prioritised for immediate decarbonisation action. Some Category 2 on-gas grid properties could also be considered as cost-effective to retrofit, and targeted alongside off-gas grid properties. Category 3 properties on the gas grid are slightly more challenging, this is explored further in subsequent sections.

7.3 Mixed Tenure, Mixed-Use & Fuel Poverty

Buildings which have mixed tenures or mixed-use were also analysed as these can prove particularly challenging for actioning retrofits. This is due to the difficulties of engaging multiple owners into retrofit plans, either where interventions will need to be agreed building-wide between multiple property owners (such as wall insulation) or across mixed-use buildings where intervention needs may slightly differ in different properties. There are 2,800 buildings with multiple domestic properties in, 500 with multiple non-domestic properties, and 230 with a combination of domestic and non-domestic properties. This must be considered in engagement actions and property owners may require further support and guidance.

7.4 Poor Building Energy Efficiency as a Driver of Fuel Poverty

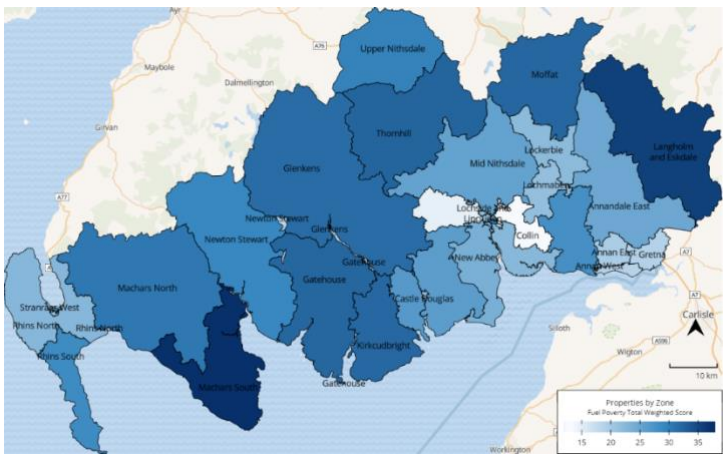

Figure 7-5: Properties in Fuel Poverty, by Intermediate Zone

29% of households in Dumfries and Galloway are in fuel poverty (fuel bill >10% of income), with 20% in extreme fuel poverty (>20% of income), see Figure 7-5. This presents the distribution of buildings in fuel poverty which also have poor levels of insulation. 18% of properties have an EPC rating of F-G, with the main driver of fuel poverty being uninsulated walls (47%), then loft insulation <100mm (11%) and single glazed windows (8%). Of the 47% uninsulated walls, 14% have a cavity wall

construction, which can be treated with cavity wall insulation, a relatively simple and cheap solution.

Nationally, levels of insulation (both loft and wall) are higher in the social sector than in the private sector (The Scottish Government, 2019c). Nationally, 55% of homes in the private sector have wall insulation compared to 70% in the social sector. In the private sector, 63% of lofts are insulated to 200 mm or more compared to 71% in the social sector. Nationally, in the social sector, around half (48%) of dwellings with solid and other wall types were estimated to have insulation in 2018 compared to in the private sector, only one tenth (13%) of solid and other wall dwellings were insulated. This highlights the importance in developing an effective plan to tackle privately owned buildings. It also demonstrates the benefit of the current and previous schemes to target and support social housing.

The Weighted Score scale in Figure 7-5 is an indication where poor energy efficiency is likely to be acting as a driver for fuel poverty. Comparing Figure 7-5 to Figure 6-4 shows that conservation zones correlate with poor energy efficiency which drives fuel poverty. This could be related to the older age of buildings within conservation areas and the restrictions around their fabric improvement. Therefore, developing a sustainable and effective action plan around this subset of buildings and how to improve their energy efficiency could have a positive effect on eradicating fuel poverty. Specifically, Machars South and Kirkcudbright have the most listed buildings in fuel poverty out of all the zones.

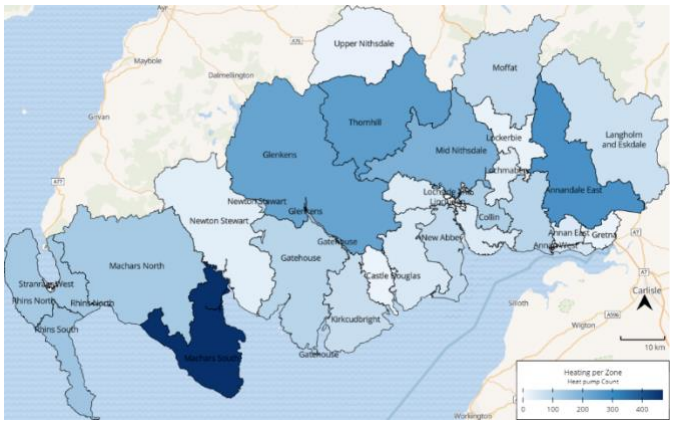

Figure 7-6: Properties with Heat Pumps, by Intermediate Zone

There is already a reasonably good uptake of heat pumps across the local authority, particularly in Machars South (16.4% uptake) but the percentage uptake is generally low (< 1%) in the more populous Intermediate zones. Glenkens and Thornhill have a lot of Category 3 properties, and both are sparsely populated. There is already a reasonable uptake of heat pumps in both these areas, as shown in Figure 7-6.

Figure 7-7 show the regions where the highest amounts of poor loft insulation are. Targeting these properties could be considered as a no-regrets solution due to the relatively low cost of loft insulation and unintrusive installation. It's generally considered to be an easy way of improving energy efficiency and reducing fuel poverty and therefore may be an effective means of meeting the Scottish Government's 2030 target of all buildings reaching EPC C.

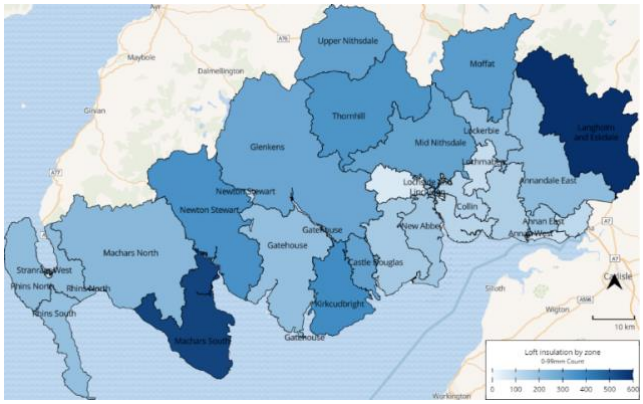

Figure 7-7: Indicator Visualisation of Loft Insulation showing the regions with the Lowest Loft Insulation

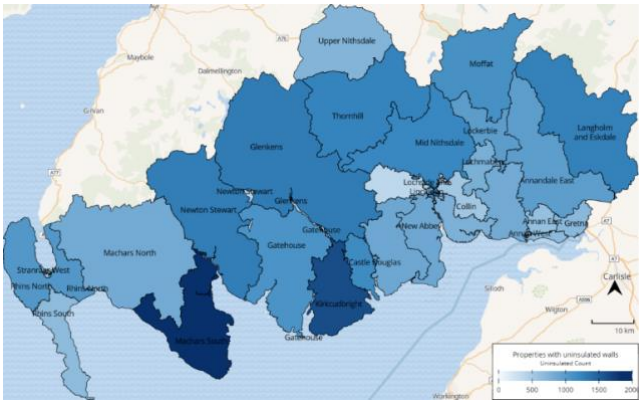

Figure 7-8: Indicator Visualisation of Wall Insulation showing the regions with the Most Uninsulated Walls

Figure 7-8 shows the regions with the largest amounts of properties without wall insulation. Wall insulation upgrades are likely to be both costly and disruptive for the residents of the property.

8 Building Level Decarbonisation

8.1 Strategic Zoning Themes

Extensive engagement was undertaken amongst Dumfries and Galloway Council to understand the greatest challenges and priorities around building decarbonisation. As previously mentioned, due to the ambitious nature of the Council's net zero target, and the urgency with which decarbonisation needs to happen, it was decided not to prioritise specific 'Considerations' in this LHEES. Instead, the findings from the Strategic Zones were used to develop overarching themes across all the 'Considerations', which are reflected through the modelling or the subsequent actions in the Delivery Plan. These themes are as follows:

- Homes & buildings Fit for the Future in Regeneration Areas: Integrating retrofit and decarbonisation measures into Place Plans and Regeneration Areas. This aims to highlight the need for support and improvement of existing buildings as well as delivering efficient new builds.
- Accelerating Decarbonisation of Buildings Requiring Minimal Standard Retrofit: Targeting the domestic and non-domestic buildings which have potential for low- or no-regrets building decarbonisation from less intrusive interventions with shorter pay back periods.
- Decarbonising Rural & Historic Dumfries and Galloway Buildings: Development of a robust plan, including identification of the funding gap, to understand the best decarbonisation pathway for the domestic and non-domestic properties which are Older Buildings or Unconventional Construction.
- Delivering Reliable Communal Heating Systems: Proposal of heat network zones across Dumfries and Galloway which focus on community-wide solutions and benefits. These zones present the highest opportunity for heat networks and therefore should be priority areas for analysis.
- Collaborative Working Across Local Programmes, Wider Stakeholders & Supporting A Local Supply Chain: Integration of wider planning and programmes across Dumfries and Galloway Council with the LHEES, with a key focus on the Borderlands Energy Masterplan, to share learnings and lean on the wealth of knowledge. This includes understanding the wider need for local upskilling and retraining and targeting a local supply chain.
- Increasing Transparency & Accessibility Around the Delivery Pathway & Funding Mechanisms: Improving awareness and accessibility of funding mechanisms and increasing transparency of the delivery pathway to ensure decarbonisation is built on trusted advice and informed choices.

The following describes the modelling undertaken to understand the potential interventions required to decarbonise Dumfries and Galloway's building stock. This modelling is not intended to specifically suggest areas where action should be carried out but presents how the data and findings can be interpreted to strategise the targeting of buildings to accelerate decarbonisation through the most impactful and cost-effective pathway. The modelling was split into four separate analyses:

- The whole local authority maximum decarbonisation potential.
- Consideration of how Strategic Zoning can progress identification of Delivery Areas.
- Heat network zoning.

8.2 Modelling Output Summary: Whole Local Authority

To understand the retrofit potential of domestic buildings across the whole local authority, the full Home Analytics address-level dataset for Dumfries and Galloway was run through the EST's Portfolio Energy Assessment Tool (PEAT). PEAT models individual building level retrofit potential and heat decarbonisation options based on Home Analytics data of building fabric. The model parameters had no limitations with respect to cost or intervention types and included all building types. The retrofit recommendations outputted from the tool for each property includes both fabric measures and heating system upgrades. SAP/EPC score increase from implementing the recommended measures are reported, along with total measure costs and carbon savings.

While PEAT is a valuable tool for high level analysis of building stock, it does have known limitations due to some of the broader assumptions on typical building performance or retrofit measures. For this reason, these outputs are indicative only, in particular with respect to historic buildings which tend to be less standard and therefore more poorly representative by typical modelling of building stock.

Additionally, any retrofit interventions should be installed by trained installers, with specialist skills where required. This includes awareness of proper installation to prevent future problems, including adequate ventilation and breathability for some solid wall type constructions, and accessibility to utilities under loft and roof insulation such as cables and pipes.

Although this analysis focuses on installation of retrofit measures, there are multiple less intrusive solutions to improving energy efficiency and performance which can be implemented immediately. This includes improving maintenance and repair, behaviour changes and draught exclusion. Simple solutions such as replacing sash cords, tightening pulleys on sliding sash and case windows or installing shutters in older properties can be effective. For historic buildings in particular, appropriate maintenance is essential, such as ensuring water is kept out from the top of buildings and the ground and that repairs are carried out properly and quickly. These buildings tend to be more sensitive to deterioration and therefore maintenance is an important factor in improving overall energy efficiency. Trusted support and advice for home owners can be found under the sources detailed in Section 7.

8.2.1 Analysis of EPC Results

The results of PEAT provide both the current and potential SAP score/EPC rating of each property based on the recommended measures. Table 8-1 shows the change in EPC rating for all properties in Dumfries and Galloway.

EPC Rating	Before	After	Properties Before	Properties After	Percentage Change
A	279	13,300	0%	18%	18%
B	2,590	26,000	4%	35%	32%
C	18,300	24,500	25%	33%	8%
D	26,900	7,680	37%	10%	-26%
E	15,200	1,640	21%	2%	-18%
F	7,900	352	11%	0%	-10%
G	2,280	9	3%	0%	-3%

Table 8-1: Impact of Suggested PEAT Retrofit Measures on Properties' EPC Rating

The greatest percentage increase is EPC B, increasing by 31%, from 2,590 properties to 26,000 or 35% of total properties. The proportion of properties at an EPC D or below would decrease from 71% to 13%, and the percentage of properties at a C or above would increase by 201% (by 42,600 properties).

All homes are required to meet an EPC C by 2033 in Scotland, according to the Scotland Heat in Buildings Strategy. Furthermore, no social housing shall be let that is below an EPC D by 2025, and it is expected that all social housing should be a B or above by 2033. The tool outputs indicate that 87%

of all properties in Dumfries and Galloway would meet the requirement to be an EPC C or above with all the recommended measures in place, as shown in Table 8-2.

EPC Rating D or below	Count of Properties	Percentage of Total Properties
EPC D or Below Before	52,300	71%
EPC D or Below After	9,680	13%
EPC A-C Before	21,200	29%
EPC A-C After	63,800	87%

Table 8-2: Properties Passing or Failing Future EPC Standards, Before and After PEAT Recommendations

It is recommended to investigate the 9,680 properties that would remain a D or below. These are likely properties that are not suitable for many of the standard retrofitting measures, which could be due to the age of the property, construction type, having listed building status or being in a conservation area.

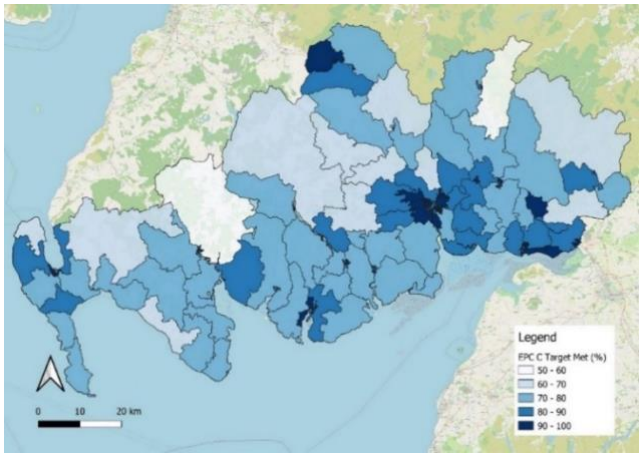

Figure 8-1: Percentage of Properties Meeting the 2033 EPC target of C

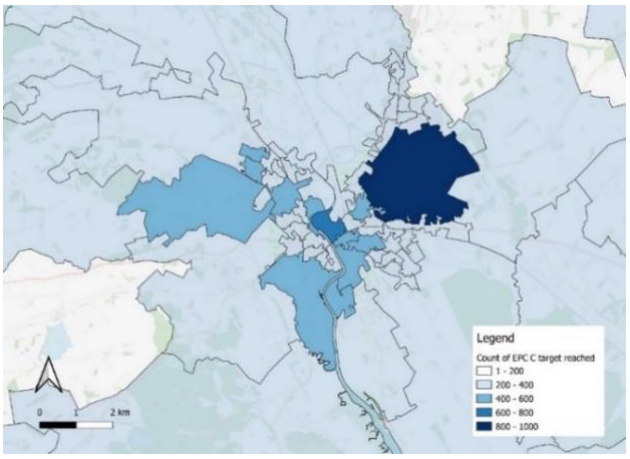

Figure 8-2: Properties Meeting the 2033 EPC C target in Dumfries

Figure 8-1 shows the proportion of all properties that would meet the EPC target of C by 2033, by data zone. This map shows some areas which would have less than 70% of properties meeting the EPC C target and therefore may require a more targeted and specific strategy to meet future standards.

Collin – 01 in Dumfries, shown as the darkest data zone in Figure 8-1, has the highest number of properties (99%, 903 properties) that would be an EPC C or above according to recommended measures. However, it must be considered that 91% of these properties were originally an EPC A, B or C and therefore only 63 properties increased from below to above a C. This level of analysis can be used to identify data zones of higher priority where actions can have more significant impacts.

To understand the properties which could be considered as low-regret targets strategically, buildings which could increase from below an EPC C to a C or above were analysed. Dumfries Town Centre has multiple data zones with high counts of properties reaching a C or above (see Figure 8-2). The five data zones in Dumfries and Galloway which show the highest potential to meet the future EPC C standards are shown in Table 8-3.

Data Zone Name	Count C or Above	Percentage C or Above
Collin – 01	903	99%
Dumfries Central – 04	654	83%
Dumfries Central – 03	566	93%
Upper Nithsdale – 06	487	98%
Kingholm - 04	533	88%

Table 8-3: Data Zones in Dumfries with Highest Potential to Meet 2033 EPC C Standards

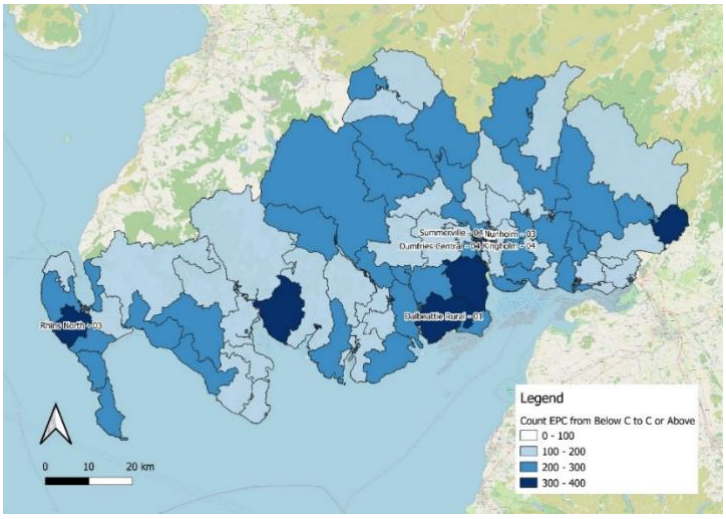

Figure 8-3: Count of Properties Increasing from an EPC Score below a C to a C or Above, by Data Zone

Figure 8-3 shows which data zones across Dumfries and Galloway have the highest number of properties with this low-regrets potential. A significant number of data zones (55%) in Dumfries and Galloway have over 200 properties that would increase from an EPC grade below a C to a C or above. Data zones which have the most properties with potential are labelled in Figure 8-3. Table 8-4 lists the top 10 low-regrets data zones based on this methodology, which could be prioritised for integration into retrofit or regeneration planning.

Data Zone Name	Count of Properties EPC C or Above	Percentage EPC C or Above
Dalbeattie Rural – 01	388	60%
Nunholm - 03	376	68%
Dumfries Central – 04	374	47%
Rhins North – 03	363	64%
Kingholm - 04	361	60%
Summerville - 04	358	79%
Gatehouse – 02	339	65%
Annan West – 03	334	65%
Castle Douglas – 03	333	71%
Newton Stewart - 08	322	64%

Table 8-4: Data Zones with the Most Buildings to Improve to EPC C or Above Through Retrofit Measures

Despite there being many data zones with a high number of properties reaching an EPC C or above, there remain some data zones with a particularly low proportion of properties that will reach an EPC C grade. Table 8-5 presents the data zones with the greatest number of properties that would fail to meet the EPC C requirement with all recommended measures in place.

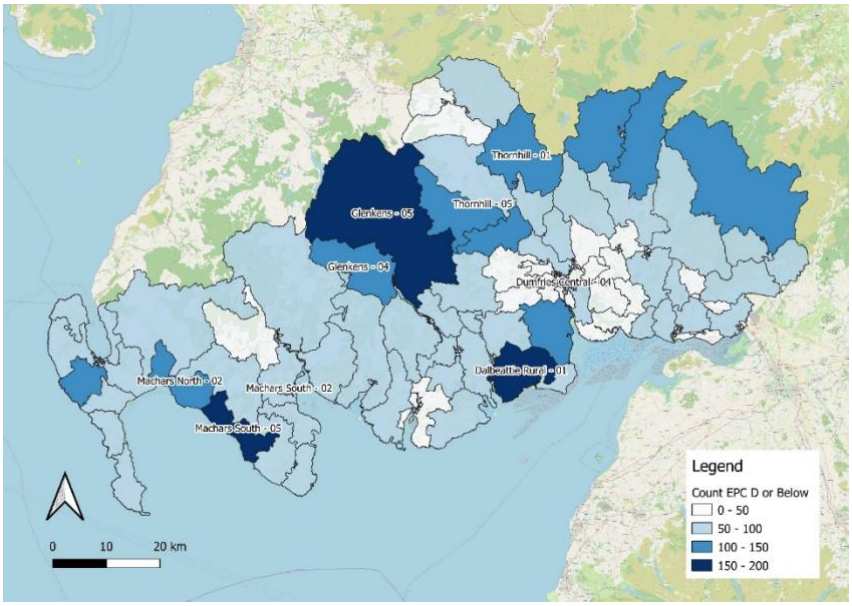

Figure 8-4: Count of Properties Failing to Meet an EPC of C or Above, per Data Zone

The data zone with the greatest number of properties that would not reach an EPC C or above is Dalbeattie Rural – 01 with 185 properties remaining below a C with all recommended retrofit measures in place. This is interesting to note as this data zone also had the highest number of properties that would increase from below a C to a C or above, presenting the diversity of its properties. Table 8-5 highlights the data zones with the most properties that will fail the standards.

Data Zone Name	Count D or Below	Percentage D or Below
Machars South – 05	174	37%
Glenkens – 05	168	29%
Dalbeattie Rural – 01	185	29%
Moffat – 05	102	42%
Mid Nithsdale - 01	117	36%

Table 8-5: Data Zones with the Most Properties Failing to Meet an EPC C or Above

These areas can be useful to identify to analyse alternative measures to improve energy efficiency. It is possible that the modelling used by PEAT is not suitable for these properties and that alternative, more bespoke interventions options are available which could support reaching EPC C.

8.2.2 Fabric Insulation Measures

One of the key outputs from PEAT is detailed recommendations of suitable fabric retrofit measures for each property, as shown in Table 8-6. All properties in Dumfries and Galloway are suitable for at least one type of fabric measure according to PEAT, however 5% of properties are only suitable for one measure. It should be noted that PEAT recommends a simplified list of common retrofit interventions which includes uPVC windows and doors. Dumfries and Galloway Council has an ambition to be a pioneer in sustainability, and aspires to have a zero waste policy prioritising repair and performance upgrade with secondary glazing and 1the use of carbon neutral materials such as timber which, with suitable treatment, can match the longevity and performance of uPVC.

Fabric Installation Measure	Properties	Percentage	Owner Occupied	Housing Association	Privately Rented
A-Rated uPVC Double Glazing from Older PVC Double	64,300	88%	41,500	12,100	10,600
A-Rated uPVC Double Glazing from Wood Framed Single	5,920	8%	3,710	281	1,930
Cavity Wall Insulation	8,910	12%	6,430	885	1,590
External Wall Insulation	5,140	7%	3,260	1,000	860
Insulation for Flat Roofing	658	1%	353	200	105
Internal Wall Insulation	18,500	25%	12,800	302	5,350
Loft Insulation	20,900	28%	13,600	3,000	4,280
New Insulated uPVC External Doors	66,200	90%	42,900	12,300	10,900
Room in Roof Walls and Sloping Parts	12,300	17%	9,330	266	2,690
Solid Floor Insulation	14,400	20%	10,300	1,600	2,500
Suspended Wooded Floor Insulation	40,800	56%	27,700	7,080	6,090

Table 8-6: Recommended Fabric Interventions for all Dumfries and Galloway

Table 8-7 shows the measures grouped by fabric type, including the percentage of properties that are suitable for that type of measure.

Installation Measure	Count of Properties	Percentage of Total Properties
Wall Insulation	32,600	44%
Floor Insulation	55,200	75%
Roof or loft Insulation	33,800	46%
A-Rated Double Glazing	70,300	96%

Table 8-7: Recommended Fabric Intervention for all Dumfries and Galloway, Grouped by Fabric Type

Although most properties already have double glazing, when grouped by fabric type A-rated double glazing is the most frequently recommended at 96%. This is because most (65,000 properties) are recommended an upgrade from older PVC double glazing, and 5,500 properties are recommended an upgrade from wooden framed single glazing. The lifespan of double glazing can be 15-20 years, and therefore it would be recommended to only replace double glazing with improved specifications when it is already at end of life. The PEAT modelling only considers double glazing, however secondary glazing can also be an effective and appropriate intervention.

46% of properties have been recommended roof or loft insulation, which includes loft insulation top-up, room in roof walls and sloping parts and flat roof insulation. Figure 8-5 shows the count of properties that are suitable for a loft insulation top-up or flat roof insulation by data zone.

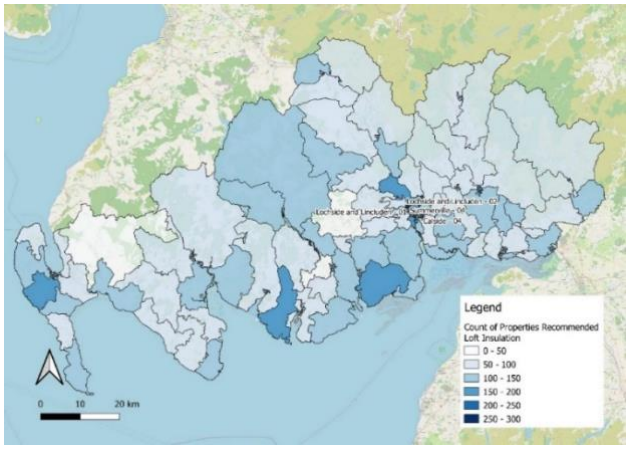

Figure 8-5: Properties Recommended Flat Roof Insulation or Loft Insulation Top-up, by Data Zone

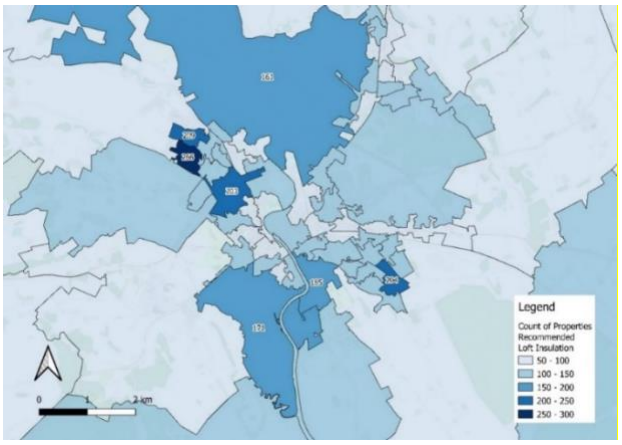

Figure 8-6: Properties Recommended Loft Insulation in Dumfries, by Data Zone

Loft insulation is an easy way of improving energy efficiency and reducing fuel poverty due to the relatively low cost and unintrusive nature of the installation process. Due to this, loft insulation is a recommended low-regrets measure and areas with a high number of properties that are suitable for loft insulation should be targeted. Labelled data zones have over 200 properties suitable for loft insulation top-up or flat roof insulation. Room in roof, walls and sloping parts insulation has been omitted from this map due to the relatively high cost and invasiveness of the installation process. Dumfries is a key area for targeting loft insulation, as can be seen in Figure 8-6. Lochside is an example of how an area could be selected for targeted interventions based off this data, with two data zones with over 200 properties recommended loft insulation.

Compared to roof and loft insulation, wall insulation measures typically involve higher costs and greater invasiveness. Cavity wall insulation, however, is a more cost-effective and minimally invasive measure in relation to solid wall insulation and therefore could be a low-regrets target. Figure 8-7, Figure 8-8 and Figure 8-9 show which data zones in Dumfries and Galloway have the highest proportion of properties that have been recommended the three types of wall insulation. Although cavity wall insulation is a low-regrets solution, for the other approaches to wall insulation, there may be alternative solutions which are more effective, but have not been modelled through this work. This includes consideration of the condition of the fabric (and subsequent repair and care plan) or revision of materials and methods used for building maintenance. This can be significant, in particular, for historic buildings or those with character which should be carefully preserved.

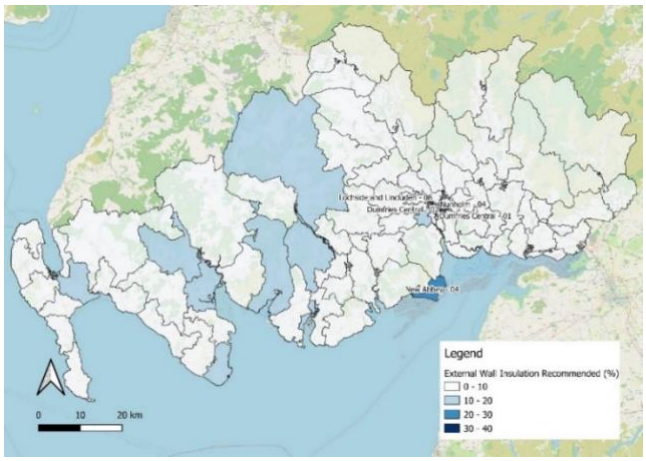

Figure 8-7: Properties Recommended External Wall Insulation, by Data Zone

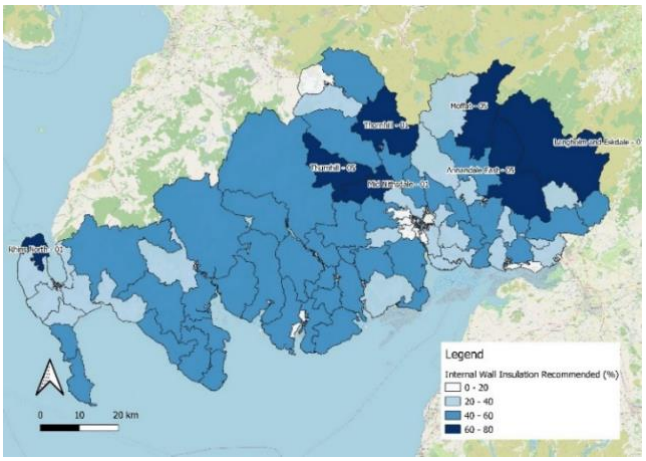

Figure 8-8: Properties Recommended Internal Wall Insulation, by Data Zone

The data zones in the highest band for percentage of properties suitable are labelled on each map. Internal wall insulation is most recommended, with seven data zones having over 60% of properties suitable. It should be noted that the recommendations from PEAT are at a high level and therefore this should only be seen as guidance. For many of these properties, more bespoke external wall insulation could be suitable, if examined at a building level.

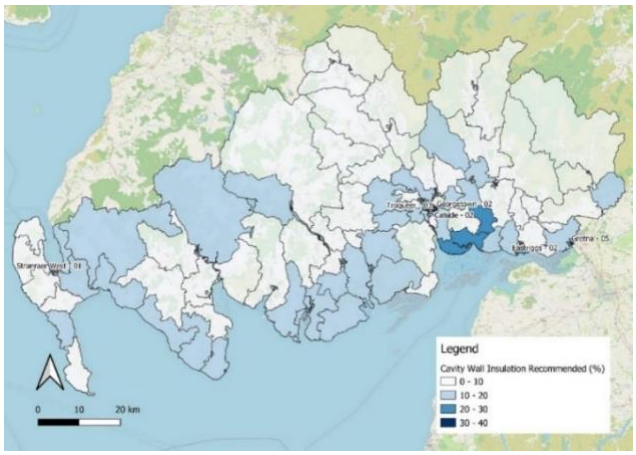

Figure 8-9: Properties Recommended Cavity Wall Insulation, by Data Zone

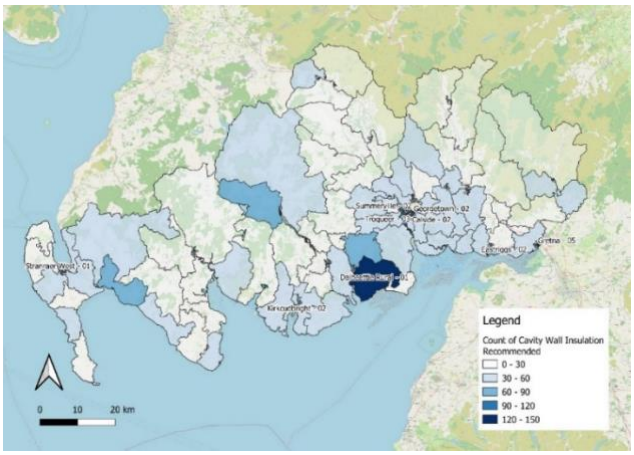

Figure 8-10: Count of Properties Recommended Cavity Wall Insulation, by Data Zone

The nine data zones that have the highest number of properties recommended cavity wall insulation are labelled in Figure 8-10. Stranraer West – 01 and Dalbeattie Rural – 01 are examples of data zones which could be targeted for this low-regrets intervention. Similarly to wall insulation, floor insulation (which includes solid floor insulation and suspended wooden floor insulation), can be a relatively costly and invasive process.

Figure 8-11 shows where in Dumfries and Galloway has the highest number of properties suitable for floor insulation.

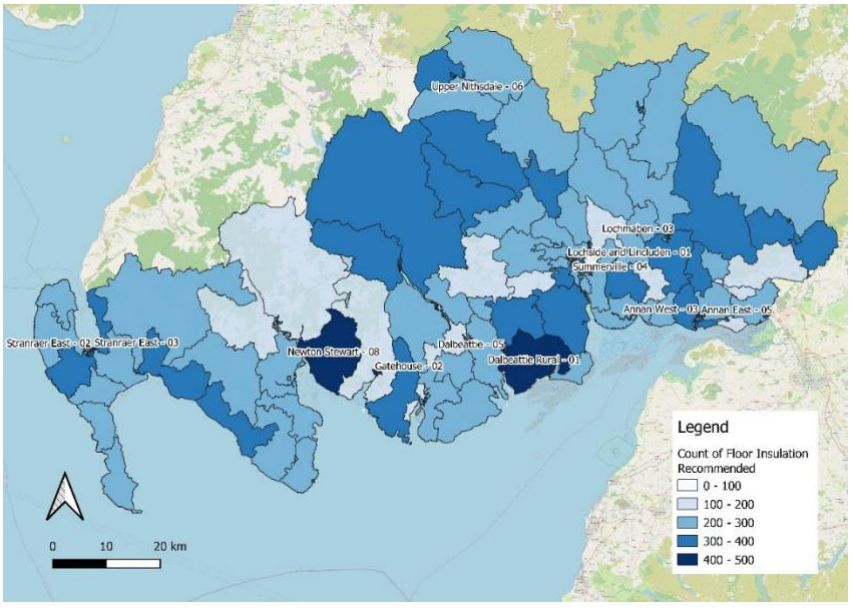

Figure 8-11: Properties Recommended Floor Insulation, by Data Zone

36% of data zones in Dumfries and Galloway have over 300 properties suitable for either solid floor or suspended wooden floor insulation. In Figure 8-11, the labelled data zones are those within the highest band of count of properties and are therefore key areas to target for floor insulation.

8.2.3 Heating System Recommendations

PEAT also recommends low carbon heating system upgrades, which includes air source heat pumps, ground source heat pumps, biomass boilers, pellet stoves, and high heat retention storage heaters (electric heaters). The data suggests over half of total properties in Dumfries and Galloway are suitable for a heat pump, with 43% suitable for air source and 9% suitable for ground source.

Out of the 35,000 properties which are unsuitable for a heat pump, 10% have been recommended high heat retention storage heaters, 2% have been recommended biomass boilers and 0.5% have been recommended a pellet stove. 30,700 properties (36%) have not been recommended an upgraded heating system. This is due to limitations in PEAT's modelling of more complex and challenging buildings which will require more unique interventions to be able to decarbonise. It will be important to focus on fabric retrofitting for these properties and examine their options on a case-by-case basis.

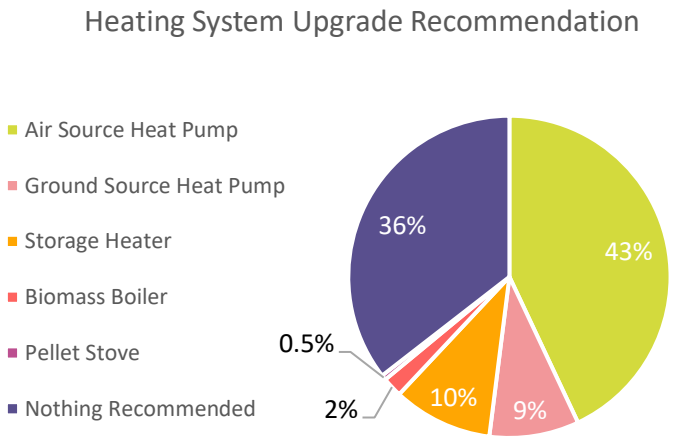

Figure 8-12: The Proportion of Properties that have been Recommended Each Heating System Upgrade.

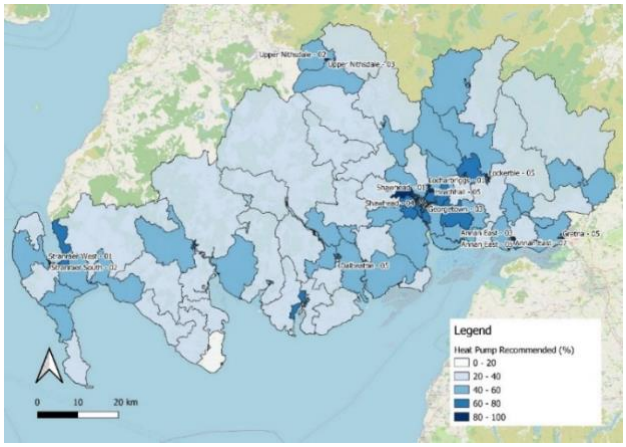

Figure 8-13: Properties Recommended a Heat Pump, by Data Zone

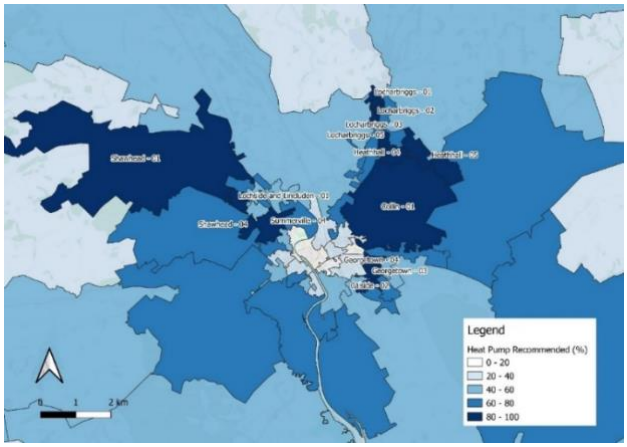

Figure 8-14: Properties Recommended a Heat Pump in Dumfries, by Data Zone

Figure 8-13 shows the proportion of properties that have been recommended a heat pump by data zone in Dumfries and Galloway. The labelled data zones indicate those that are in the highest band (>80% recommended) which includes 29 zones. Only six data zones have less than 20% of properties that are suitable for a heat pump. One of them is Machars South – 07, which is within the intermediate zone with the highest existing number of properties with heat pumps already installed.

14 data zones in and surrounding Dumfries have over 80% of properties with heat pumps recommended. These are shown in Figure 8-14. An example potential target area is Collin – 01 where 702 properties have been recommended an air source heat pump and 29 have been recommended ground source, totalling 80% of properties. This is the highest count of properties recommended a heat pump for any data zone in Dumfries and Galloway. Currently 91% of properties in Collin – 01 are an EPC A-C and therefore have sufficient energy efficiency to be suitable for a heat pump. For instance, 94% of properties are estimated to already have wall insulation and 88% of properties in

Collin – 01 are Category 1, which require the least retrofit. Thus, Collin – 01 could be targeted as a potential area within Dumfries for a large-scale air source heat pump installation scheme.

Many data zones in the centre of Dumfries have very few properties suitable for a heat pump, with less than 40% of properties. Dumfries Central – 04 only has 1% of properties recommended a heat pump out of 790 total, and Dumfries Central – 03 only has 7% of properties suitable for a heat pump out of 611. A large proportion of these properties are Category 3 and therefore may require extensive fabric improvements first. For these areas alternative decarbonisation options may be cheaper.

Figure 8-15 and Figure 8-16 present the spread of recommendations for biomass boiler and storage heaters, respectively. Biomass boilers tend to be recommended for more rural properties where air quality issues are less of a concern.

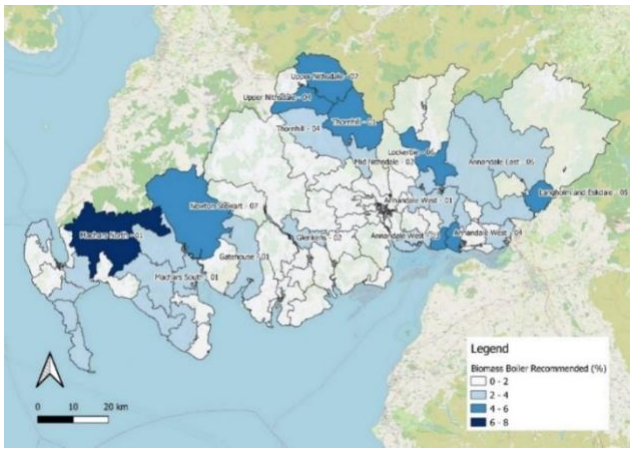

Figure 8-15: Properties Recommended a Biomass Boiler, by Data Zone

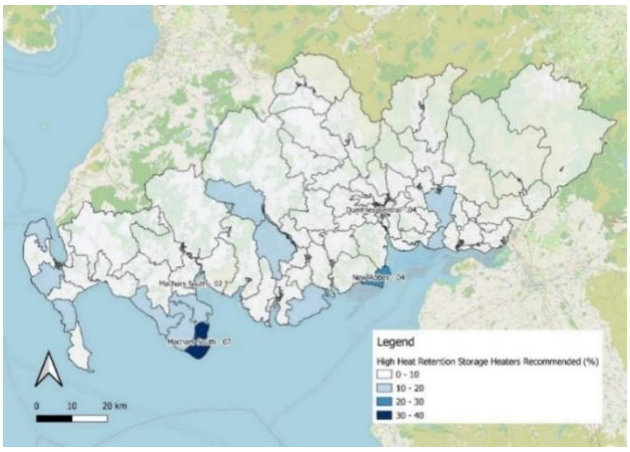

Figure 8-16: Properties Recommended High Heat Retention Storage Heaters, by Data Zone

In Dumfries and Galloway, 21% of all properties use oil as their main fuel and 2% use solid fuel. In comparison, 5% of properties in Scotland use oil as main fuel type and 1% use solid fuels, showing that Dumfries and Galloway has a proportionally high percentage of properties that use particularly unsustainable fuels (The Scottish Government, 2019c). Figure 8-17 shows which areas in Dumfries and Galloway have the greatest number of properties that are using oil and solid fuel that have been recommended an upgraded heating system.

These areas could be seen as priority to target in the near term, or no-regrets options, since they could offer significant decarbonisation and would have substantial EPC rating improvements.

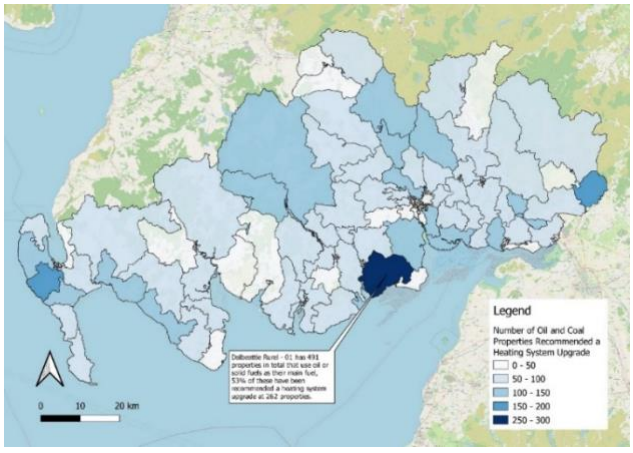

Figure 8-17: Properties Currently Using Oil or Solid Fuel Which Have Been Recommended a Heating System Upgrade, by Data Zone

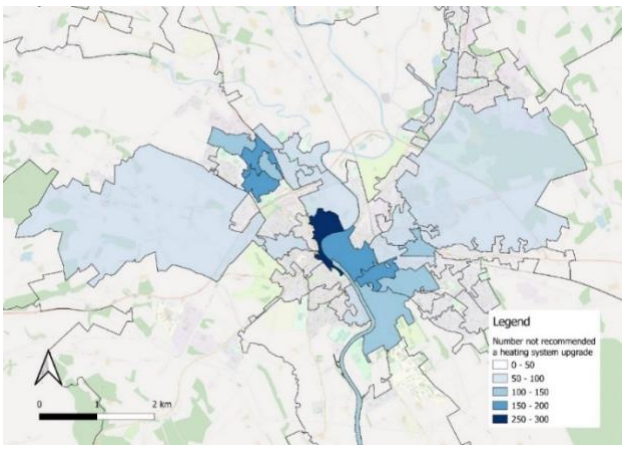

Figure 8-18: Properties Which Have Not Been Recommended a Heating System Upgrade in Dumfries, by Data Zone

Many central areas of Dumfries have properties with no heating system upgrade recommendations, particularly in comparison to the rest of the local authority. This can be seen in Figure 8-18. These data zones are also in line with those which are listed or in conservation zones and therefore may have restrictions on building level interventions.

Generally, PEAT will not recommend an upgrade for properties where the model does not believe fabric interventions are suitable and therefore the energy efficiency is too low for a heat pump or electric heating. Additionally, properties in more urban areas are not recommended biomass boilers due to the air quality impacts. These buildings will need to be considered on a case-by-case basis, with a more detailed analysis than is currently provided by PEAT, which is a first pass, high level tool.

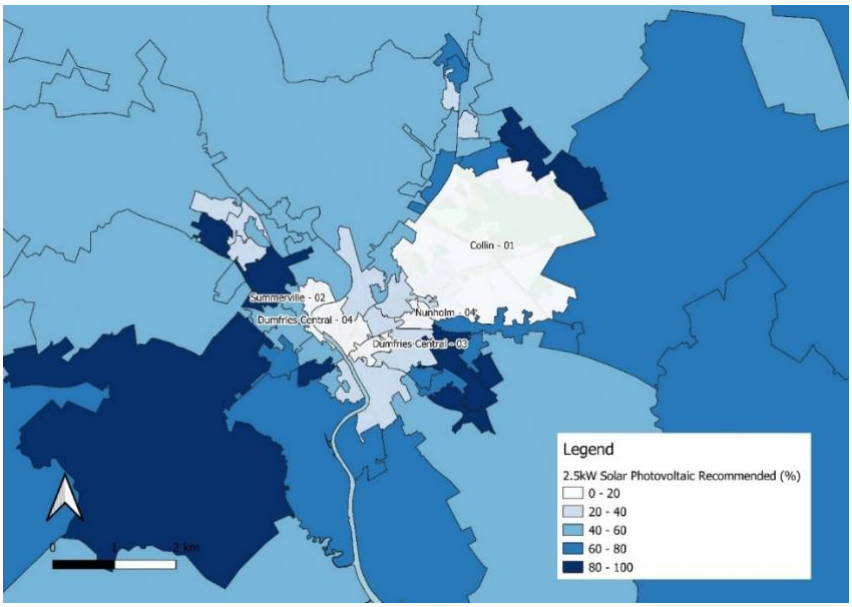

Figure 8-19: Properties Recommended Solar PV in Dumfries, by Data Zone

Although not specifically in scope for LHEES, the potential for Rooftop Solar PV has also been analysed through PEAT and is reported at a high level. Solar PV has been recommended to 53% of properties in Dumfries and Galloway.

Figure 8-19 shows that in Dumfries the central data zones have a low percentage of properties recommended solar photovoltaics in comparison to the surrounding areas. This is a similar pattern to the proportion of properties recommended heat pumps and may be aligned with the properties which are in a conservation area and therefore have limitations on their fabric improvements.

The labelled data zones in Figure 8-19 are those with less than 20% of properties suitable for solar PV. However, the surrounding data zones have a proportionally high percentage of properties suitable for solar PV, which is where the conservation area also ends. This pattern also aligns with achieved EPC rating, presenting how protected buildings need carefully considered solutions. The conservation area isn't necessarily completely restrictive of these measures being applied, however opportunities for each of the buildings will need to be considered individually with the Historic Buildings team.

8.2.4 Social Housing Analysis

Social housing in Dumfries and Galloway is managed by housing associations. Engaging with social landlords is typically easier than private landlords and owner-occupied residences and therefore more often results in accelerated action. It also covers building occupiers who are most at risk from fuel poverty. This section will explore the modelling results for housing association properties, identifying key areas to target for low-regrets retrofitting as well as areas that have particularly challenging social housing.

8.2.4.1 EPC Improvement

By 2033, it is expected that regulation will require all social housing properties in Scotland to achieve an EPC rating of B or higher. Figure 8-20 highlights the data zones in Dumfries and Galloway that would have the greatest proportion of social housing stock meeting this target with all the recommended fabric and heating system upgrade recommendations put in place.

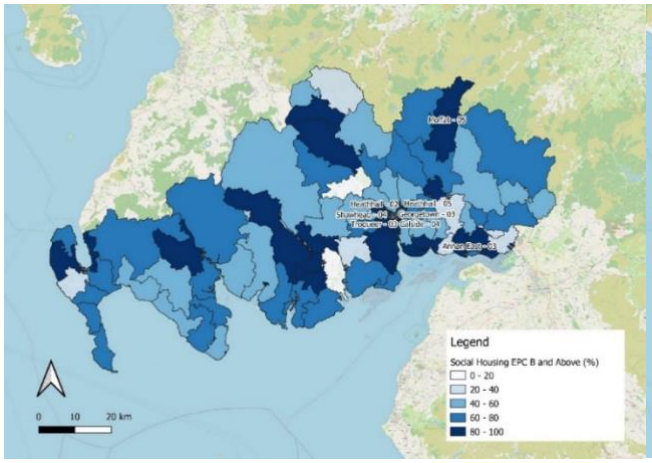

Figure 8-20: Social Housing Which Would Achieve an EPC Rating of B or Above, by Data Zone

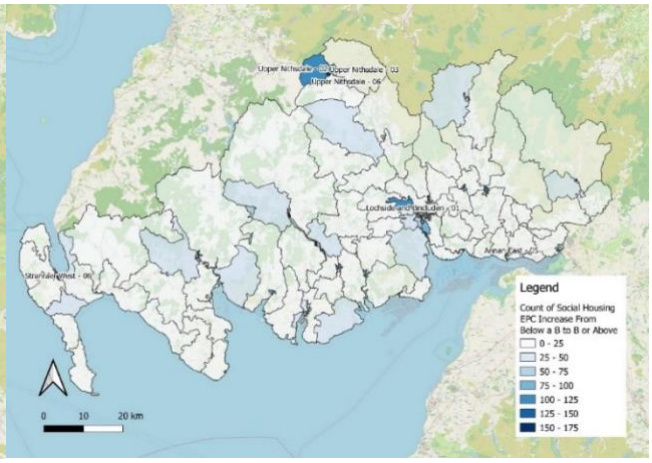

Figure 8-21: Social Housing Properties with the Most EPC Improvement, by Data Zone

Overall, most data zones (73%) in Dumfries and Galloway would have over 50% of properties reaching the future government regulation of EPC C. However, there would still be some areas where less than 20% of social housing would reach a B or above. To find the areas that are key to target, the number of social housing properties that would increase from below an EPC B to a B or above are mapped in Figure 8-21, with the highest values labelled. Appendix 12.1.1 gives some examples of how this data can be used to identify key areas to target for Social Housing interventions.

8.2.4.2 Decarbonised Heating System

Out of all social housing properties in Dumfries and Galloway, 57% have been recommended an upgraded heating system. 55% have been recommended a heat pump (1% ground source and 54% air source), 1% high heat retention storage heating, 0.15% biomass heaters and 0.04% pellet stoves. Figure 8-22 shows which areas in Dumfries and Galloway have the highest percentage of properties that have not been recommended an upgraded heating system, due to them being unsuitable for any of the above listed options provided by PEAT, with the labelled zones having more than 150 unsuitable properties.

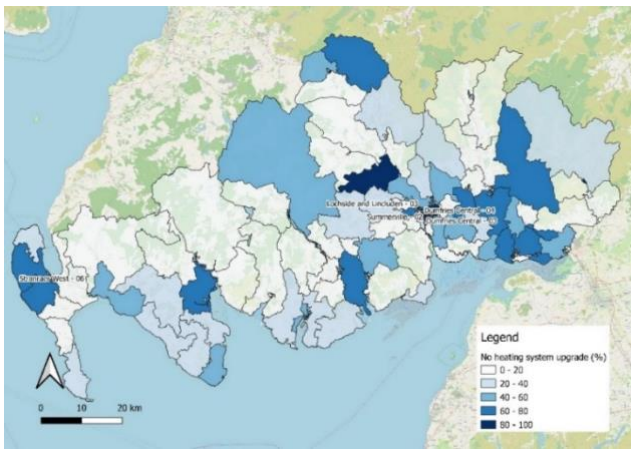

Figure 8-22: Social Housing Properties that Have Not Been Recommended a Heating System Upgrade, by Data Zone

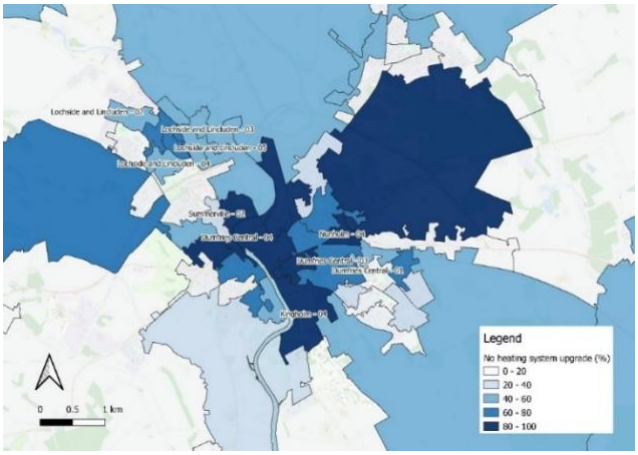

Figure 8-23: Social Housing Properties in Dumfries that Have Not Been Recommended a Heating System Upgrade, by Data Zone

Figure 8-23 zooms into Dumfries, with the labelled data zones those where over 100 properties have not been given an upgrade recommendation. Dumfries Central, with all four data zones grouped together, has 573 social housing properties (86%) that are not suitable for an upgrade according to PEAT. 259 of these are Category 3 and are therefore require the most retrofit to have good energy efficiency. Summerville – 02 has the highest number of unsuitable properties at 278, or 90% and therefore could be a target area for alternative measures.

8.3 Modelling Output Summary: Next Steps to Identify Delivery Areas

The next steps for the LHEES process will involve using the Strategic Zoning analysis to identify and progress Delivery Areas. These will be designated areas which show opportunity or potential for specifics actions around the identified themes. They will be much smaller and more specific than Strategic Zones, with a number of buildings or a few streets being targeted in a project.

This progression will be carried out by Dumfries and Galloway Council to prioritise Strategic Zones based on some of the previous analysis and techniques previously mentioned, as well as local priorities and funding opportunities. This could be carried out separately for each of the themes to determine the Strategic Zones with the most potential or strategic importance through techniques such as multi-criteria analysis. Some of the recommendations of how spatial analysis can be combined with wider engagement and considerations across two of the key themes are described in the following sections.

8.3.1 Accelerating Decarbonisation of Minimal Standard Retrofit Buildings

Category 1 and 2 properties have been considered as Minimal Standard Retrofit buildings since they are suitable for a heat pump with no need for additional retrofit, or only require a small number of retrofit measures which are standard or non-specialist. Spatial analysis of these buildings could be used to identify target areas and align with existing and future area plans.

For example, integrating the retrofitting of Minimal Standard Retrofit properties into wider community or sustainability programmes of specific areas could benefit from coordinated engagement, economies of scale and holistic development planning. As engagement with the general public and homeowners will be key to support the decarbonisation of building heating systems, working with existing plans could be essential to securing public buy-in and awareness of the benefits, co-benefits and funding options. This could include heat pump and retrofit awareness campaigns to improve local understanding of the benefits, and correct operation and use.

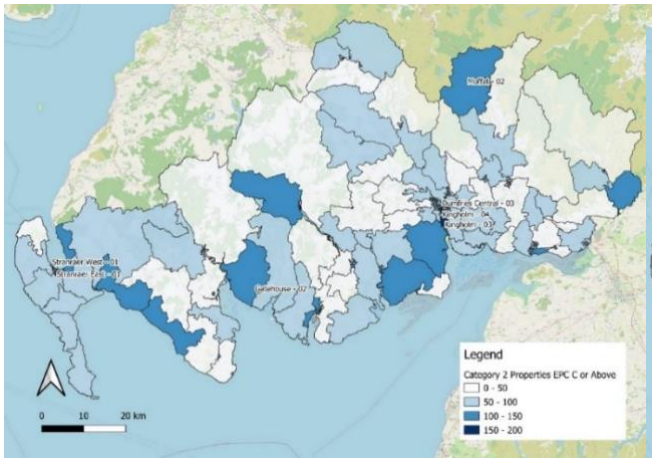

Figure 8-24: Category 2 Properties in Dumfries and Galloway with the Most EPC Improvements, by Data Zone

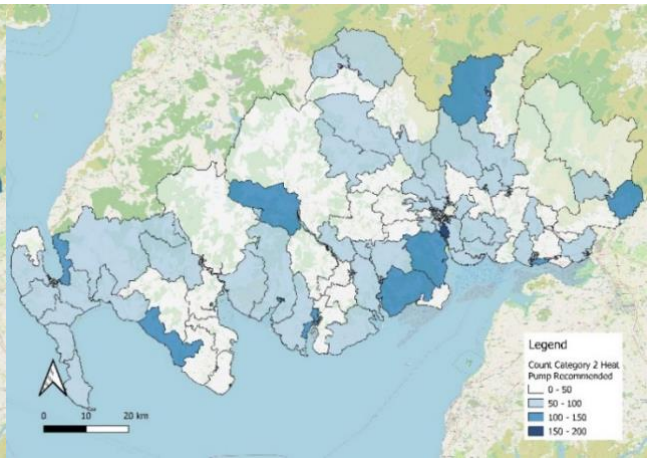

Figure 8-25: Category 2 Properties in Dumfries and Galloway with the Most Heat Pumps Recommended, by Data Zone

Figure 8-24 shows the areas where the most Category 2 properties would reach an EPC C or above when all recommended retrofit measures are in place. The two data zones in Kingholm Quay, shown in the map, have over 90% of Category 2 properties reaching an EPC C or above. Lochside and Lincluden – 01 would have 100% of all Category 2 properties reaching a C or above, 62% of these reaching an EPC A. Figure 8-25 shows which areas have the most Category 2 properties that are suitable for a heat pump with all recommended measures in place. These could be key areas to target for a low-regrets programme of retrofit and heat system decarbonisation, such as Stranraer West – 01, Kingholm – 03 and Gretna – 05.

Loft insulation top-up is a low-regrets fabric measure, with relatively low cost or invasiveness, therefore target areas have been identified as a relatively simple way to increase heat pump suitability. Figure 8-26 and Figure 8-27 show the areas in Dumfries and Galloway and Dumfries respectively with the highest number of properties that are suitable for loft insulation top-up. Particular zones of interest include Gretna, Summerville and Kingholm Quay.

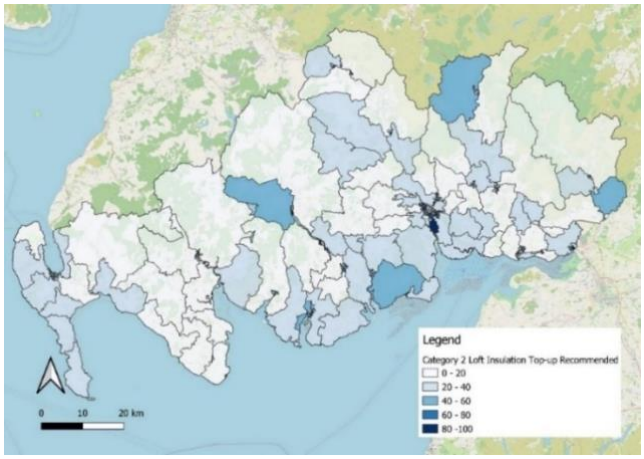

Figure 8-26: Category 2 Properties in Dumfries and Galloway with the Most Loft Insulation Recommended, by Data Zone

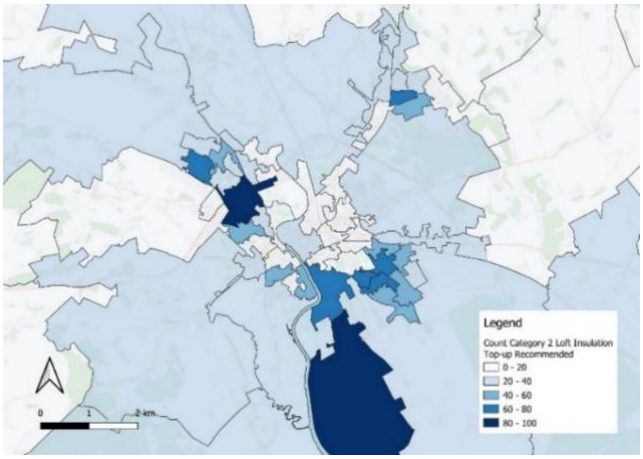

Figure 8-27: Category 2 Properties in Dumfries with the Most Loft Insulation Recommended, by Data Zone

Category 1 properties are those that are already suitable for a heat pump and can be used to determine priority areas for focused heat pump installation projects. There are 29,600 Category 1 properties in Dumfries and Galloway of which 25,400 (86%) have been recommended a heat pump through PEAT, these areas are shown in Figure 8-29.

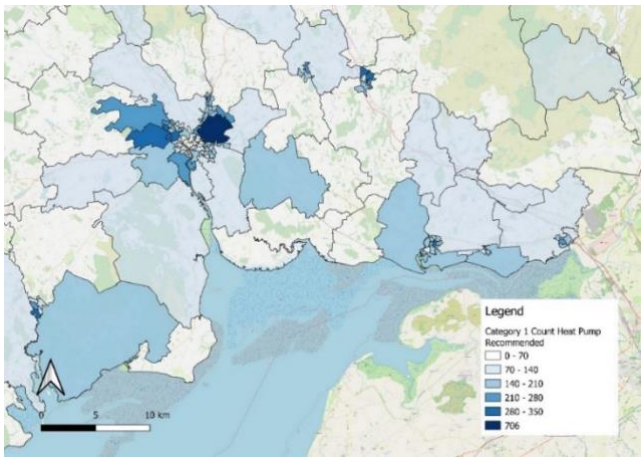

Figure 8-28: Category 1 Properties in the South East of Dumfries and Galloway with Heat Pumps Recommended, by Data Zone

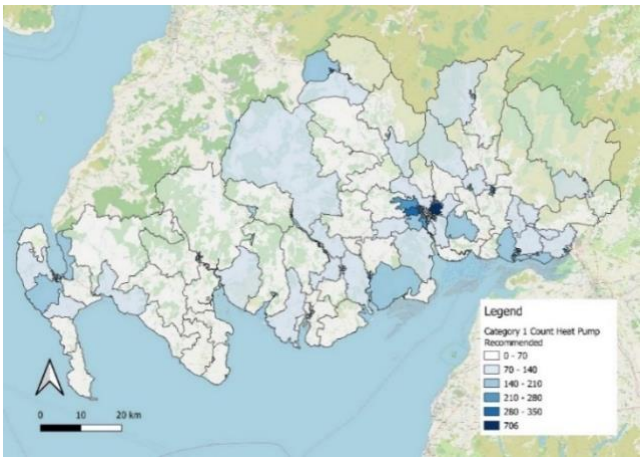

Figure 8-29: Category 1 Properties in Dumfries and Galloway with Heat Pumps Recommended, by Data Zone

Figure 8-28 shows the areas with the most potential across Dumfries and the south east. Specific data zones with high potential include Collin – 01, Shawhead – 04, and areas in Lockerbie, Annan, Stranraer and Dalbeattie, which all have data zones with over 300 Category 1 properties that are suitable for a heat pump.

8.3.2 Decarbonising Rural & Historic Dumfries and Galloway Buildings

Older Buildings and Unconventional Construction, or LHEES Category 3 properties, is a key theme across the local authority and could be identified for Delivery Areas. Many of these properties will have solid walls, are in conservation areas or are classed as listed buildings and therefore to preserve their building materials, historical and architectural interest may require more bespoke or unique retrofit solutions, or specialist advice for installation of decarbonised heating systems. Many can achieve high energy efficiency, but are not accurately represented by the standard retrofit modelling used by typical models.

Standard measures may not be appropriate or effective, or would risk causing damage to the building fabric and reducing the longevity of these buildings. More specialist models and historic building expertise, which will account for the differences between traditional and modern buildings, are needed to identify areas for action. Already, existing regulations around changes to listed buildings or buildings in conservation areas are being adapted to ease decarbonisation efforts without damaging the character. It is also recommended to consider these buildings in alignment with heat network zoning, as the high temperature heat available from networks can be well suited to historic buildings.

Spatial identification of areas with a higher density of this building type could enable an area-based programme and would benefit from the associated economies of scale and community or local engagement. Notedly, there are also multiple, easier actions which homeowners and building occupiers could take to improve the energy efficiency of their home before considering more intrusive retrofit. These include simple measures such as improved maintenance of sash windows to reduce draughts, or increased knowledge and understanding of effective maintenance of the traditional build materials which can in turn reduce building deterioration, such as from rainwater run-off. Building owners can refer to resources listed in Section 4.1.3 for further information.

8.4 Heat Network Zoning

The potential for heat networks has been explored across the whole of the Dumfries and Galloway region. The LHEES will support progressing the analysis of these suggested zones to confirm legally designated Heat Network Zones, as set out in the Heat Networks (Scotland) Act (The Scottish Government, 2021b).

This has included a review of available building heat demand data, including a cleansing process to correct erroneously high heat demand, to determine areas of higher heat demand density. Additional datasets have also been overlaid to further identify zones which could be of strategic importance for Dumfries and Galloway's decarbonisation pathway, including:

- Anchor loads: Buildings with a large, reliable and long-term demand for heat, often with a stable and constant use profile, can act as anchors for a developing district heating network. These anchor loads allow district heat networks to operate efficiently and provide the potential to extend the network to smaller existing heat users in the area. For this analysis, this has been assumed as public buildings with a heat demand of greater than 500 MWh/year.
- Industrial sites, which could offer opportunity for a waste heat source (NAEI, 2023).
- Green Heat in Green Spaces, which could offer potential for a ground source heat pump array.
- Future building development areas, in line with LDP2.
- Location of the Dumfries Basin Aquifer, running below Dumfries and Galloway, which could offer opportunity for a geothermal heat pump.
- Major constraints such as rivers, major roads or railway lines.
- Existing plans or studies for heat networks, potentially be expanded or connected to a new project.

Further detail has been given below on the zones which present high potential strategic importance. It should be noted that the following sections provide detail and data from the outcomes of the LHEES analysis and therefore do not represent any existing heat network studies which may be ongoing. However, where available, this LHEES analysis has been compared to the findings from independent feasibility studies to explore how LHEES could support progress or identify further opportunity.

As outlined in Section 2.2.2, the heat demand data used for this analysis was from the Scotland Heat Map. While the Scotland Heat Map team prioritise using real, metered data and request public data to be provided from local authorities for each update (every year), modelling is required for buildings where this is unavailable. Additionally, recent changes to buildings, such as changes in use type or demolition, or specific data around building typologies, is not always captured.

The data used in this analysis underwent data cleansing to remove largely anomalous values which could significantly impact the results. However, there is still uncertainty around some of the heat demand values used for some buildings, or the building use types. Where possible, these have been noted in the following sections and for further feasibility studies it would be necessary to supplement with local data or more extensive verification to improve the certainty of the heat network zones.

8.4.1 Local Authority Overview

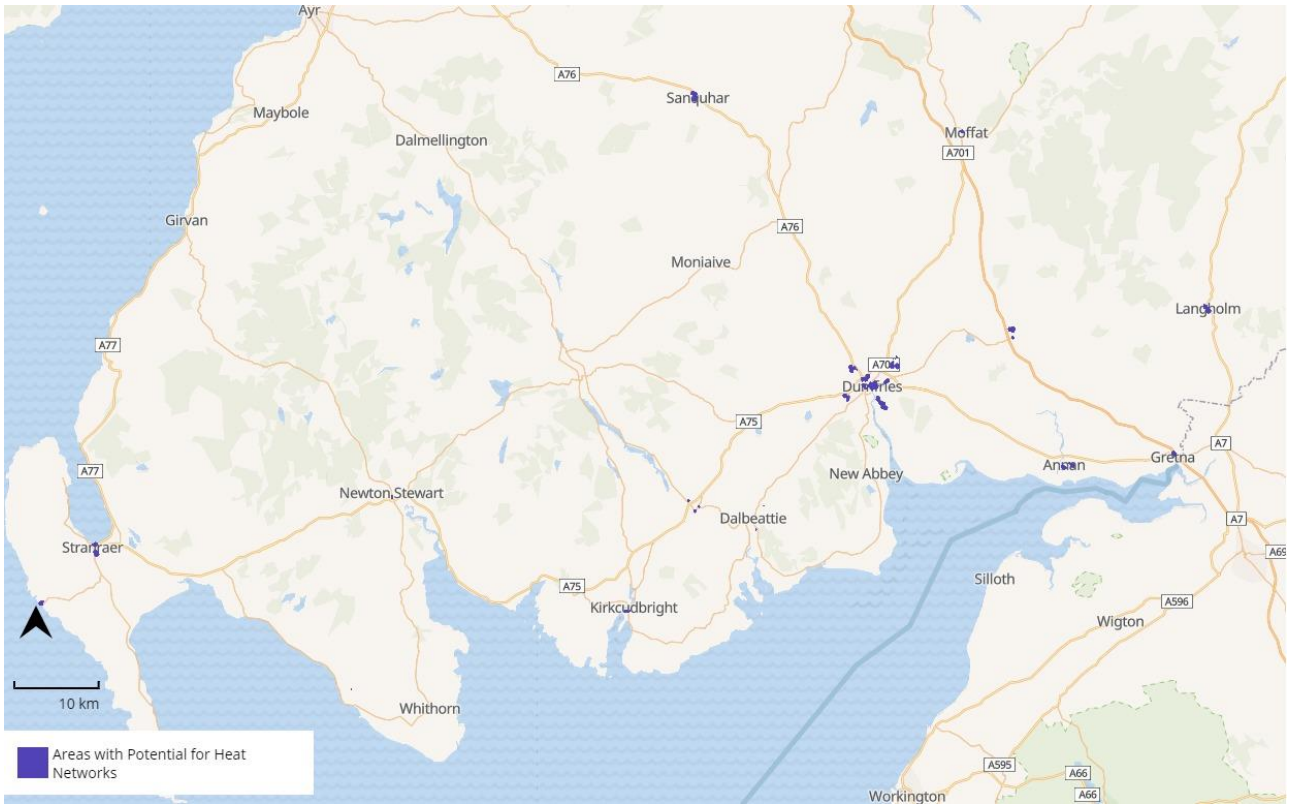

Figure 8-30: Identified Heat Network Opportunity Areas Across Dumfries and Galloway

Figure 8-30 presents an overview of the identified potential heat network zones across the local authority. Many of these overlap with previously identified opportunities through independent feasibility studies and reviews. The table below provides further detail on each potential zone, which have been named based on their location for reference.

Due to the mixed rural-urban nature of Dumfries and Galloway, potential for heat networks was based on a linear heat density of 4,000 kWh/m/year. Linear heat density is a commonly used metric to identify areas where heat demand could be sufficiently dense to support the high infrastructure costs of a heat network. The value used varies based on costs of network installation (generally ruled per metre of pipework needed, although at a high level this could also be assumed to cover costs of the energy centre ancillaries) and cost of the heat source. The higher these costs, the higher the linear heat density must be to suggest a financially viable network.

Rural areas tend to have lower costs of network installation due to the higher proportion of 'soft dig' areas (where trenching occurs in softer ground such as fields or verges) which tend to be much lower cost than installing pipework through cities or areas with busy and congested roads and underground networks. A relatively low linear heat density has been used to account for the high rural proportion of Dumfries and Galloway, and to provide the most ambitious potential for heat networks for the area. Due to the complexity of factors impacting heat network viability, it was deemed unsuitable to overly filter potential zones at this stage by using a more stringent value for this high-level metric. Instead, additional data has been included, such as types of buildings and potential heat sources, to understand zone significance and potential.

Dumfries and Galloway has numerous potential opportunities for heat networks in its more densely populated settlement areas. Heat networks may be particularly suitable for the area given the number of historic buildings, for which higher temperature, low carbon heat sources may be more appropriate than extensive fabric retrofit. This may make them more suitable for heat networks (which can run at higher temperatures or use technology to boost temperatures from the main

network) than heat pumps, which typically function more effectively with energy efficient buildings and lower flow temperatures.

There are 14 locations which have shown potential for a heat network zone. It should be noted that this analysis is high-level and based on limited data and a more comprehensive feasibility study should be conducted to understand the true potential or financial viability. Many factors can influence the viability of a heat network, including building owners, landowner and use type, underground infrastructure and constraints and future plans for building use and occupation which may influence the heating demand.

The identified potential zones have been categorised in terms of the opportunity they offer as Low, Medium or High. This is a qualitative assessment and is based on the total heat demand, the number of anchor loads (and those which are public buildings), the uncertainty of building demands or building use types and the physical constraints which could put network financial feasibility at risk. These categories are a guidance only and do not mean that a network is viable or not.

Where possible, any opportunity for heat sources have been reviewed for the heat network zones showing the most potential. It should be noted that the opportunity for the use of heat offtake from waste water was considered, however initial assessments from Scottish Water Horizons suggested there was no viability in the Dumfries and Galloway region.

8.4.2 Individual Heat Network Zones

Six of the key zones which show the highest potential and strategic significance have been explored in more detail in the following section. The remaining zones, which should also be considered, are captured in Appendix 12.1.2. Each individual review includes data on some of the key heating loads which were identified for each area. It should be noted this data is from the Scotland Heat Map which varies in accuracy depending on availability of data of each building. Although the highest and most apparently erroneous data has been reviewed and corrected, more detailed building data is required to ensure all values are accurate. For this reason, all heat demands should be reviewed and revised as necessary prior to further assessment of heat network feasibility.

It is recommended to carry all zones through to a further, more detailed review where this hasn't already been carried out. Following this, a detailed feasibility study in line with CIBSE Heat Network Code of Practice 1 is advised. It should be noted that heat networks aren't a suitable option in all areas due to their high capital cost and generally long payback periods. They should always be compared to alternative solutions to understand the most economical for both the project and the end customer. In some cases, a smaller geothermal array or individual building solutions may be more appropriate.

Dumfries town and its suburbs offer a substantial proportion of these potential zones. The high density of Dumfries, as well as the key retail areas, industrial areas and sites such as the Crichton Trust increase the strength of the opportunity. Three heat network studies are currently ongoing in the area, which could present key opportunities for collaboration and potentially expansion of the plans in future phases. These form a key evidence base for the potential and have been included in the below analysis.

Figure 8-31: Overview of Heat Network Opportunity Zones Across Dumfries

8.4.2.1 Dumfries Town Centre

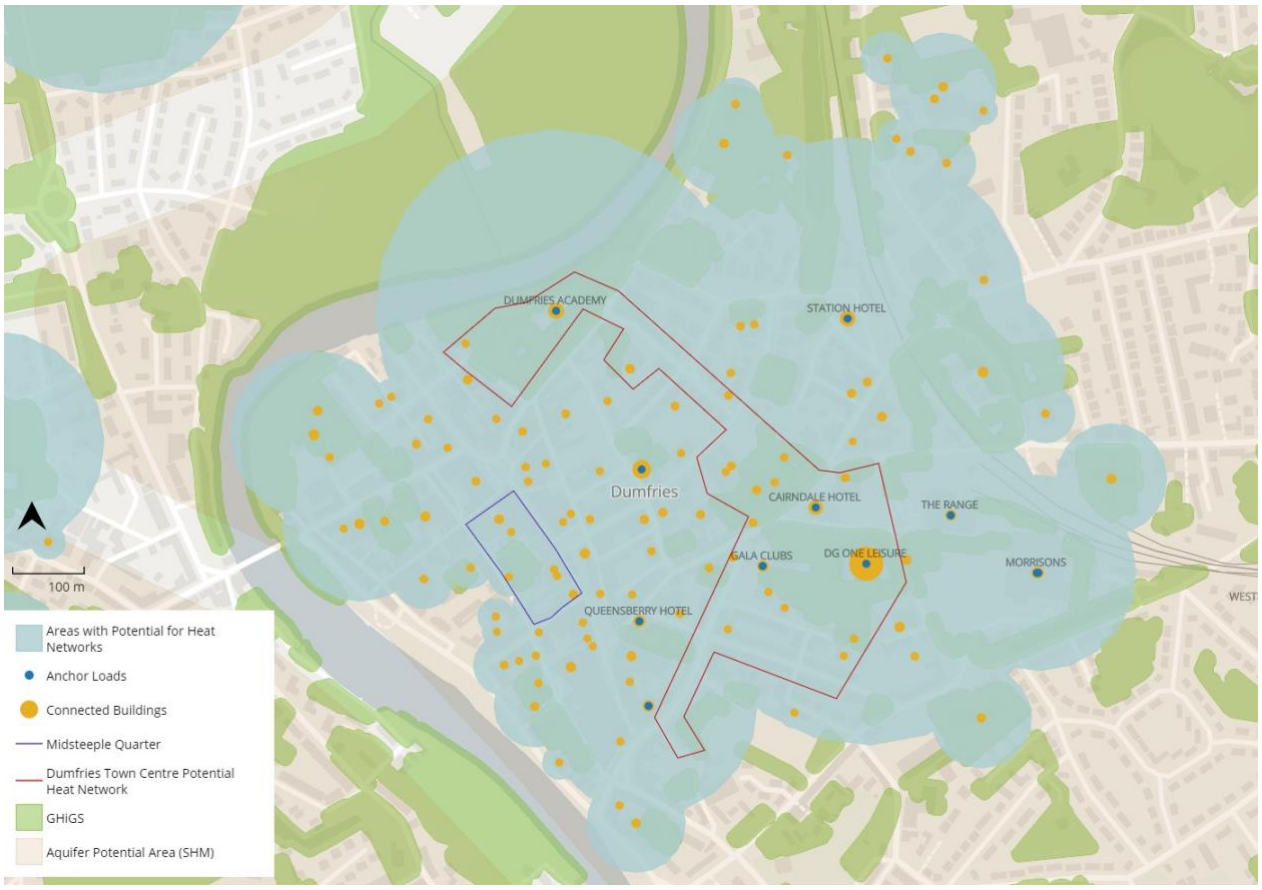

Figure 8-32: Potential Heat Network Zone, Dumfries Town Centre

Figure 8-32 presents the potential heat network zone covering the centre of Dumfries town. Due to the size and density of Dumfries Town Centre, this zone could be of high strategic importance for the decarbonisation of Dumfries and Galloway. The area has multiple potential key anchor loads including the DG One Leisure Centre, the Police HQ and Dumfries Academy. Other public buildings of note include the Dumfries and Galloway Council Offices which, when combined, could present a large heat load, the Court House and the Loreburne Shopping Centre. Multiple hotels offer additional, non-public high heat loads and several large-scale retail shops.

Aside from its high heat density, the area also sits on top of an aquifer which, following previous analysis carried out by Dumfries and Galloway Council, has indicated high potential for heat offtake. The town is part of a conservation area and has multiple listed buildings which can have higher temperature heat requirements and therefore be more suited to a heat network. This analysis could provide good examples of how to treat these older and more traditional buildings.

Zone ID: Dumfries Town Centre	Total heat demand: 31,000 MWh/year
Zone location: Centre of Dumfries Town	Public Anchor Loads: 4
Opportunity category: High	Number of Buildings: 120

Table 8-8: Opportunity summary for a Potential Zone, Dumfries Town Centre

The area has recently undergone a feasibility study exploring the opportunity for a heat network including the DG One Leisure Centre, Council offices and across to Dumfries Academy. This analysis did not identify as large a network as has been identified through LHEES however has included crucial, detailed data on individual buildings included to accurately assess viability.

The financial feasibility for this network was shown to be relatively high and therefore should be prioritised as a key opportunity. It was noted that with the buildings in their current state, the efficiency of the network would be relatively low due to the poor energy efficiency of the buildings within, requiring a high network flow temperature. The recommendations were to review the fabric retrofitting potential for the buildings to allow a lower temperature network which would have improved financial performance. The next stage of this assessment should be supported by LHEES, including evaluation of expansion to include more buildings within the Town Centre and detailed reporting of connection viability.

The potential for heat offtake from the Dumfries Basin Aquifer is presumed to be high and has been investigated through the Crichton Quarter Heat Network feasibility study, described in Section 8.4.2.2. Dumfries Academy was suggested as a suitable location for an energy centre in the existing study due to the space availability, however the costs of installing boreholes could still be considerable due to the dense infrastructure through the town centre. It is recommended to investigate the feasibility of connecting a Town Centre network to the Crichton Quarter, with the aquifer heat source based on the Crichton Trust land, where installation could be less expensive. This could feed both networks, as well as connecting other potential buildings on the route, around the outskirts of Dumfries Town Centre.

The Dumfries Town Centre zone also occupies the Midsteeple Quarter, which is currently undergoing feasibility studies for the opportunity to heat a selection of its buildings from an aquifer-fed borehole. If high heat capacity of the aquifer is found in the current studies, one option could be to expand the currently planned network to cover more of Dumfries Town Centre into a wider heat network. This could improve the financial viability of the currently planned network by introducing public buildings with large heat demands. Furthermore, these plans could be incorporated into other studies, joining all three proposed networks into a single, potentially more robust, network.

It is recommended to advance this assessment for Dumfries Town Centre by reviewing the heat demand of key loads identified within the area (which are not already included in the assessment) and engaging with the Crichton Trust and the Midsteeple Quarter to understand the opportunity for connection.

8.4.2.2 Crichton Quarter

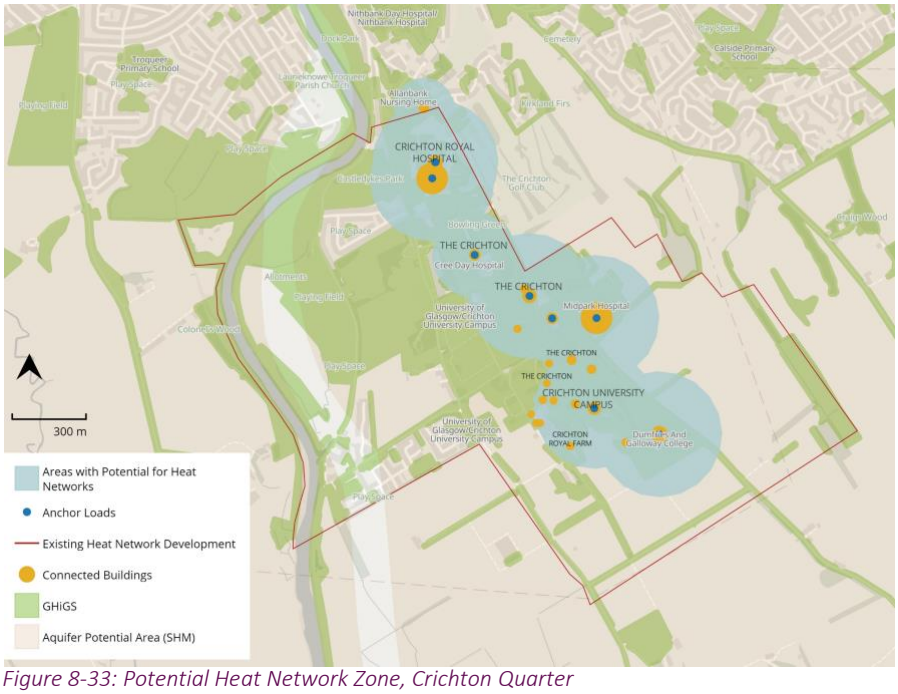

Figure 8-33: Potential Heat Network Zone, Crichton Quarter

Figure 8-33 presents the identified heat network zone, from the LHEES analysis, around the Crichton Quarter, which includes Mountainhall Treatment Centre, Crichton Hall and the Crichton Trust Estate.

Zone ID: Crichton Quarter	Total heat demand: 20,300 MWh/year
Zone location: Land Around the Crichton Estate	Public Anchor Loads: 9
Opportunity category: Medium	Number of Buildings: 25

Table 8-9: Opportunity summary for a Potential Zone, Crichton Quarter

There is already a proposed heat network covering the Crichton Quarter development, which is at an advanced stage including completed studies of aquifer heat potential. The proposed network is larger than that identified through the heat network analysis. It will connect the listed properties of the Crichton Trust as well as key public health buildings, a hotel and spa development and the Crichton Royal farm, with the potential to also extend to connect the neighbouring housing estate and future developments. This network has potential to be an exemplar to other areas of the opportunity heat networks offer to decarbonise listed buildings which have high heating bills and challenges around improving energy efficiency.

The study's investigation into the aquifer has opened a pathway for the whole town to access the heat supply by characterising the opportunity. There would be the potential to locate the energy centre in an area with less land constraint and deliver it to areas of high heat density. The study also has included extensive investigation into other potential heat sources, due to the high temperature demand of the buildings and importance of a reliable heat supply. This has included consideration of river source and sewer source heat pumps as well as biomass boilers.

There could be an opportunity to extend and connect the Crichton Quarter network to additional networks in the town centre, such as the Dumfries Town Centre zone or the Midsteeple Quarter. There are also multiple public buildings between the Crichton Estate and Dumfries town centre, such as St Michael's Primary School, St Joseph's College, St Andrew's RC Primary School and Nithbank Day Hospital, which would benefit from a connection if the networks were routed through that area. These could also offer greenspace to dig through which would reduce disruption and cost by routing along roads. This should be considered a good opportunity in further heat network assessment.

8.4.2.3 Dumfries – Outer Suburbs

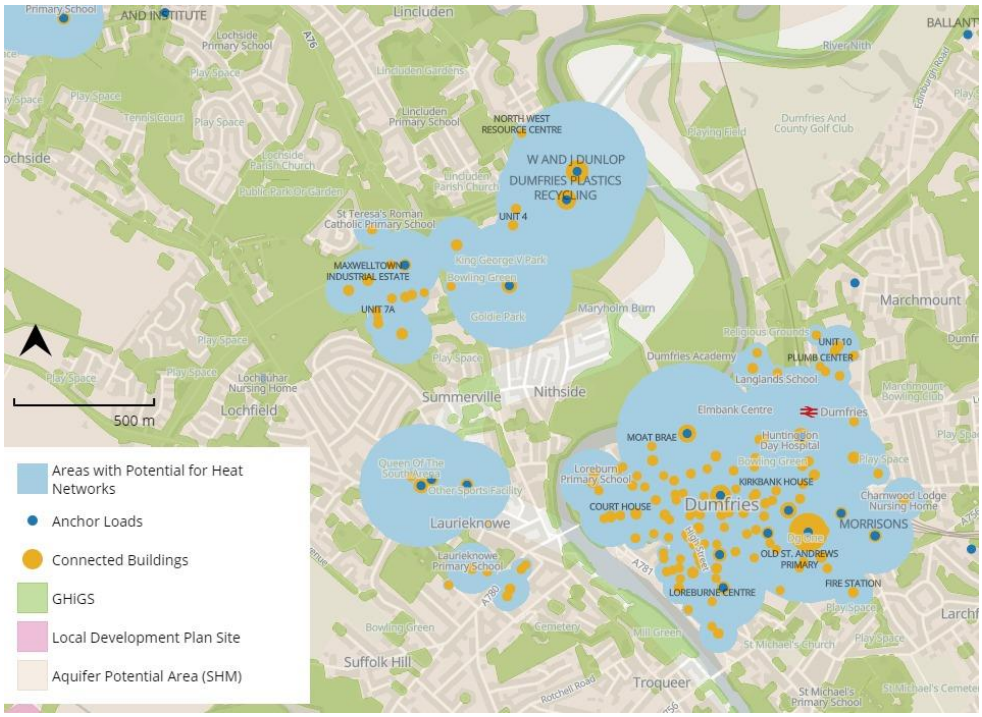

Figure 8-34: Potential Heat Network Zone, Dumfries Outer Suburb

There are three clusters in the outer suburbs of Dumfries, shown in Figure 8-34, which could offer an opportunity for an independent, or a joined heat network zone. Notably, these are also across the river from the larger Dumfries Town Centre zone and therefore it may also be worth considering joining the networks across the viaduct or bridge. The three clusters have been considered here as one opportunity and consist of an industrial park to the north (including a sports facility), the Ice Bowl and the smaller cluster with Laurieknowe Primary school.

Zone ID: Dumfries – Outer Suburbs	Total heat demand: 12,200 MWh/year
Zone location: West of Dumfries Centre	Public Anchor Loads: 1
Opportunity category: Medium	Number of Buildings: 34

Table 8-10: Opportunity summary for a Potential Zone, Dumfries Outer Suburbs

The largest heat demands in this zone are the industrial buildings in the larger cluster, however as always, these industrial loads should be reviewed and replaced with data from stakeholders where possible. It also includes The Bridge which is an educational facility near King George V Sports Complex. The Ice Bowl west of Dumfries centre holds a large opportunity and could be a reliable demand to connect. This could be considered to either connect north to the larger cluster, or across the bridge to any potential network within Dumfries Town Centre. However, the costs of developing a route across major infrastructure such as a bridge can be very high and therefore this would need to be analysed and costed to understand the economic benefit. The zone has multiple opportunities from Green Heat in Green Spaces to host ground source heat pumps, or a higher temperature source from the aquifer.

8.4.2.4 Stranraer – South

Figure 8-35: Potential Heat Network Zones Across Stranraer

Figure 8-36: Potential Heat Network Zone, Stranraer South

Stranraer has two potential heat network zones, as shown in Figure 8-35, however the southern-most zone, shown in Figure 8-36, offers slightly more potential due to the size and nature of the heat demands. This zone contains major industrial loads which could offer significant heat demands and potentially a heat source. The area is also situated next to several development areas. The potential northern zone is detailed in Appendix 12.1.2.

A recent study has been carried out on the heat network potential of Stranraer, which suggested viability of the northern and southern zones, as well as connecting to wider development areas. It should however be considered that buildings in development areas generally have lower heat demands due to stricter building standards and therefore the benefit of installing considerably more infrastructure should be analysed.

Zone ID: Stranraer - South	Total heat demand: 8,900 MWh/year
Zone location: Industrial Estate South of Stranraer town	Public Anchor Loads: 0
Opportunity category: Medium	Number of Buildings: 14

Table 8-81: Opportunity summary for a Potential Zone, Stranraer South

This zone supports the idea of a smaller industrial network between the key buildings: particularly those around the cheese industry or the neighbouring industry and shop outlets. It could potentially support a wider network across Stranraer, joining with the smaller northern cluster however the financial viability of

this would need to be assessed due to the relatively small heat loads compared with length of pipework which would be required. It is recommended to assess the potential for heat offtake from the aquifer which runs under Stranraer, the cheese factory as waste heat or from a ground source heat pump loop.

8.4.2.5 Annan

Figure 8-37 presents that Annan has two potential zones, each with significant anchor loads such as Annan Academy, Annan swimming pool and Annan hospital. If the clusters prove to be sufficiently heat dense, it could be beneficial to connect it into one larger, Annan-wide network. A recent heat network study has also been carried out on the area which includes similar buildings and suggests a network could be viable, although this does not include an assessment of economic viability or comparison to alternative heating systems.

Figure 8-37: Potential Heat Network Zone, Annan

Zone ID: Annan	Total heat demand: 8,500 MWh/year
Zone location: Central Annan (two clusters)	Public Anchor Loads: 2
Opportunity category: Medium	Number of Buildings: 32

Table 8-92: Opportunity summary for a Potential Zone, Annan

The proposed zone's largest load is from a previous fish factory, Pinney's of Scotland which is currently closed. There have been previous talks of reopening the site, if this happened it could be an opportunity to engage with the new operators to connect the building. Other large demands in this cluster include the Annan hospital and Lydiafield Residential Home which could be strong public anchor loads. The second cluster is close to the first and contains the Annan Academy and the Central Hotel (currently abandoned). Getting good stakeholder for the second could be vital in securing the network. This cluster could then support smaller public loads such as the primary school, swimming pool, Police Scotland and Council Offices. The area is on top of an aquifer zone which could be considered for heat offtake. There is also some potential from Green Heat in Green Spaces which could be considered for a ground source heat pump.

Table 8-10: Largest or Noted Potential Heat Demands for Annan

8.4.2.6 Dumfries – Lochside

Figure 8-38 presents the identified heat network zone in the Lochside area, north of Dumfries Town Centre. This area has been proposed to be a Transformational Regeneration Area, which will include affordable housing development, green infrastructure and improved active travel schemes. The consideration of a heat network could be complementary to these developments. The proposed heat network zone includes multiple industrial buildings and including storage units and warehouses.

Figure 8-38: Potential Heat Network Zone, Lochside

Zone ID: Dumfries - Lochside	Total heat demand: 6,400 MWh/year
Zone location: Lochside, North of Dumfries	Public Anchor Loads: 0
Opportunity category: High	Number of Buildings: 23

Table 8-13: Opportunity summary for a Potential Zone, Dumfries Lochside

As the largest demands in the zones are storage units or warehouses it is advised to review and revise these values as appropriate, as heating requirements of these types of storage buildings is highly variable and therefore, they are commonly overestimated. However, there are a large number of industrial units in the area which could support a potential network. This zone is of particular interest due to its proximity to the proposed regeneration zone, whereby the programmes of work could be integrated to form a large decarbonisation scheme. Consideration should also be given to the potential aquifer heat which should be reviewed as well as data from the Green Heat in Green Spaces. For this reason it is recommended to consider the financial viability of a heat network zone.

9 Summary of Strategy Findings & Next Steps

This LHEES Report has presented key analysis and findings around four of the identified themes for Dumfries and Galloway:

- Homes and buildings fit for the future in regeneration areas.
- Accelerating decarbonisation of Minimal Standard Retrofit buildings.
- Decarbonising rural and historic Dumfries and Galloway buildings.
- Delivering reliable communal heating systems.

These, and the remaining identified themes, have been analysed to develop the accompanying LHEES Delivery Plan.

This report has provided evidence of areas which could be of strategic significance for these themes, and has provided adequate data and justification for the local authority to continue to develop and select priority Delivery Areas. The strategic zones and accompanying granular data enable the local authority to continue to combine additional factors, programmes of work and developing priorities to strategically target buildings.

Overall, it is recommended to use the outcomes of this LHEES to determine:

- Opportunities to integrate the retrofitting and decarbonisation of existing buildings within wider, targeted regeneration areas.
- Low-regrets buildings or measures, which are considered to require standard or minimal retrofit and therefore support accelerated short-term decarbonisation with maximised impact per cost.
- Areas with Older Buildings and Unconventional Construction to support targeting the more accessible measures in the short term, as well as the development of more comprehensive modelling and solutions for the more bespoke and specialist solution in the long term.
- Potential heat network zones to carry forwards, in line with the Heat Networks (Scotland) Act (The Scottish Government, 2021b).

Although data on non-domestic buildings is limited and therefore analysis of decarbonisation has been restricted, the building stock has generally been found to be old, with a significant proportion still using oil as a fuel. The opportunity for heat networks has been analysed and it is highly recommended to pursue more detailed non-domestic retrofit plans.

87% of domestic buildings in Dumfries and Galloway were found to meet the future 2033 EPC target of a C through fabric retrofit, shown in Figure 9-1. Figure 9-2 presents the proportion of social housing estimated to meet the future EPC B targets. Table 9-1 gives a breakdown of estimated EPC scores achieved from retrofit measures.

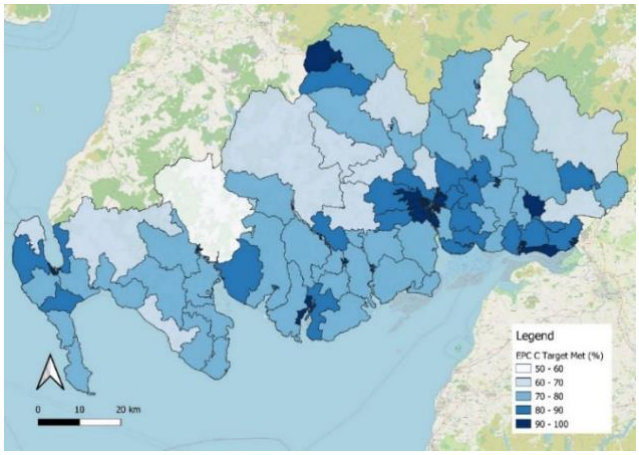

Figure 9-1: Domestic Properties Which Would Achieve and EPC Rating of C or Above, by Data Zone

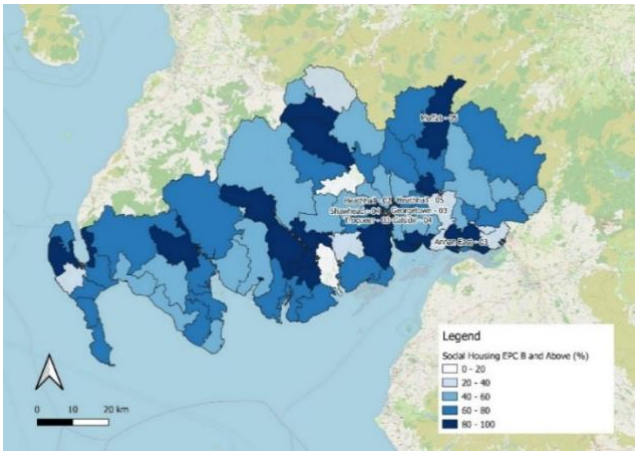

Figure 9-2: Social Housing Which Would Achieve an EPC Rating of B or Above, by Data Zone

EPC Rating	Percentage Properties Before	Percentage Properties After
A	0%	18%
B	4%	35%
C	25%	33%
D	37%	10%
E	21%	2%
F	11%	0%
G	3%	0%

Table 9-1: Overview of EPC Score Improvement Across the Whole Building Stock from Fabric Retrofit Measures

Many buildings require low-regrets measures which tend to have shorter payback periods and lower initial investment, which removes barriers to action for any building owner type. These measures, which include 46% of properties suitable for loft or roof insulation, and 12% suitable for cavity wall insulation could be a priority to target.

Fabric Installation Measure	Number of Properties	Percentage of Total Properties
Window glazing	70,220	96%
Cavity Wall Insulation	8,910	12%
External Wall Insulation	5,140	7%
Roof or Loft Insulation	33,900	46%
Internal Wall Insulation	18,500	25%

Table 9-2: Summary of Recommended Measures for Domestic Properties Across the Local Authority

Based on high-level fabric measure analysis, 52% of properties are found to be suitable for heat pumps. Extensive further work is required to understand the changes required to improve suitability of the remaining buildings, or to identify alternative solutions.

It is recommended to leverage existing regeneration areas to target buildings which are already suitable for a heat pump or only require a small amount of retrofit and therefore efforts to encourage uptake of low carbon heating systems could be integrated into the wider sustainability plans.

Dumfries and Galloway has distinct areas with a large number of listed buildings or conservation areas which need a robust, sustainable and realistic plan for decarbonisation. Suggestions around development of a retrofit plan are detailed in the Delivery Plan.

Dumfries and Galloway has significant opportunity for heat networks, particularly due to the presence of a large aquifer stretching across much of the area, which could offer an effective heat source. 14 potential heat network zones have been identified, with at least six showing considerable potential which would warrant further analysis.

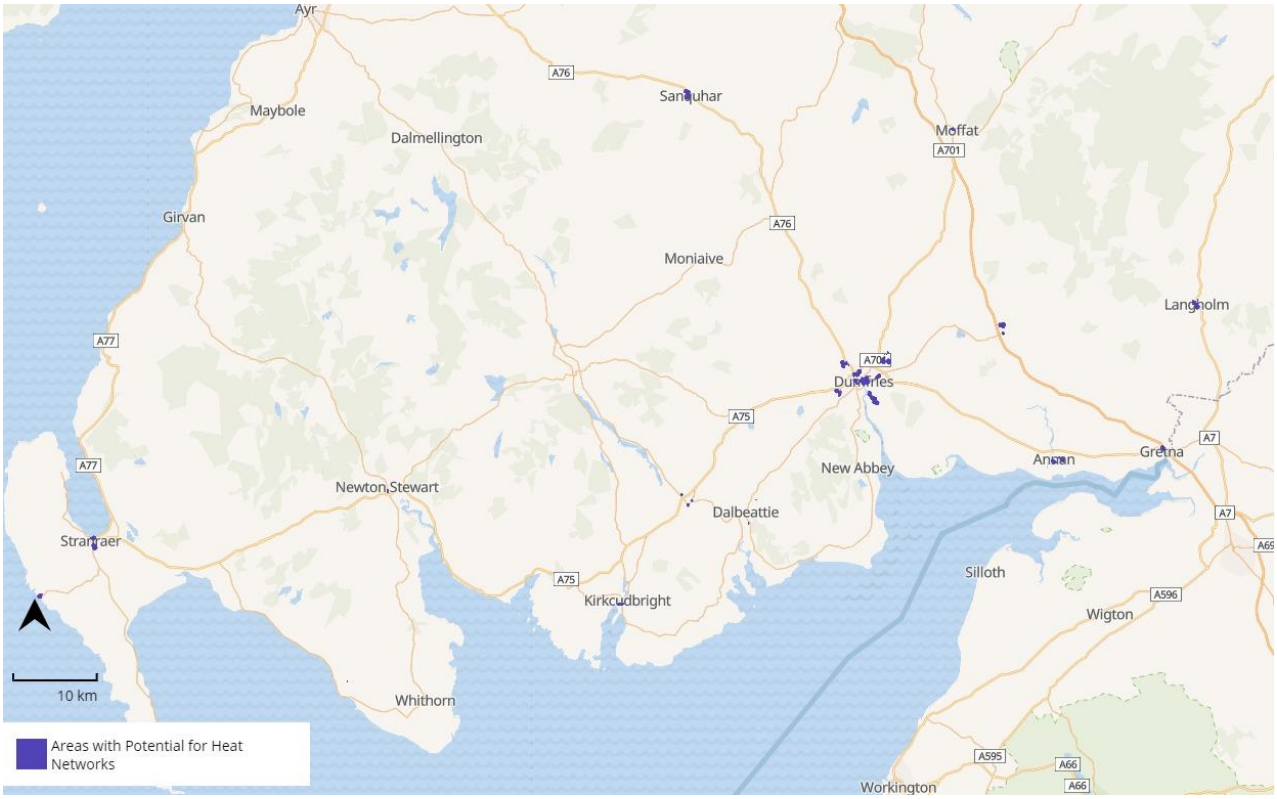

Figure 9-3: Overview of Heat Network Zones Across Dumfries and Galloway

Overall this data-driven analysis has led to several key findings highlighted by this strategy. These findings represent the main opportunities and challenges for Dumfries and Galloway's which are advised to be the Council's focus in the initial stages of decarbonising their building stock. These outcomes have been the basis for the development of the Delivery Plan which captures a range of actions across various stakeholders, to build the pathway to decarbonisation.

Findings from this report include:

- Many buildings require low-regrets measures which tend to have shorter payback periods and lower initial investment, which removes barriers to action for any building owner type.
- Many buildings have significant opportunity for fabric-based retrofit and suitability for heat pumps which could be integrated into existing regeneration area plans.
- A robust decarbonisation plan is required for the Older Buildings and Unconventional Construction, with specialist support and more specialist building modelling.
- Many buildings, both domestic and non-domestic, off the gas grid currently use oil or solid fuel and therefore should be prioritised for decarbonisation action.
- There are 14 potential heat network zones across the local authority, eight of which have medium or high opportunity of feasibility.

Actions from this LHEES intend to set a strong strategy for Dumfries and Galloway's decarbonisation. There has been significant input and engagement from key stakeholders and a plan for monitoring and evaluation to accelerate delivery, to continue the local authority's leading position in sustainability ambition and progress.

10 Data References

List of Figures	Data Sources
Executive Summary	© OpenMapTiles, OpenStreetMap contributors, Home Analytics, Scotland Heat Map
Baselining	© OpenMapTiles, OpenStreetMap contributors, Home Analytics
Generation of Strategic Zones	© OpenMapTiles, OpenStreetMap contributors, Home Analytics
Building Level Decarbonisation (sections 8.1 – 8.3)	© OpenMapTiles, OpenStreetMap contributors, Home Analytics, Portfolio Energy Analysis Tool
Building Level Decarbonisation (Sections 8.4)	© OS Data, Scotland Heat Map, Green Heat in Green Spaces, LDP

Table 10-1: Data Sources Used for the Figures and Maps

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12 Appendices

12.1 Appendix Strategic Zones & Pathways

12.1.1 Regional Local Authority Analysis: Social Housing

To find the areas that are key to target, the number of social housing properties that would increase from below an EPC B to a B or above are mapped in Figure 12-1, with the highest values labelled. This section gives some examples of how this data can be used to identify key areas to target for Social Housing interventions. Figure 12-2 shows areas in Upper Nithsdale, which contains the towns Sanquhar and Kelloholm, which have the highest number of social housing properties that would reach an EPC B or A.

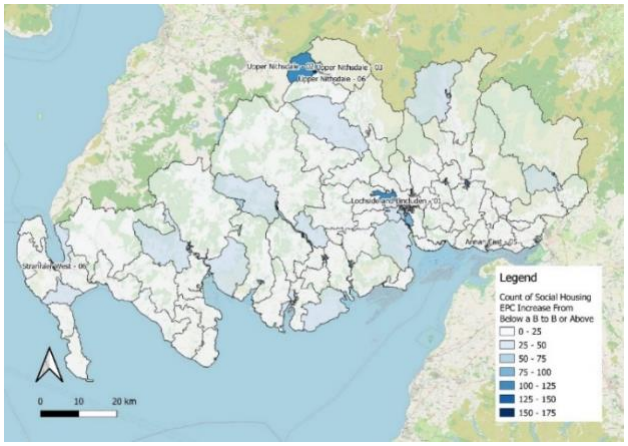


Figure 12-1: Social Housing Properties with the Most EPC Improvement

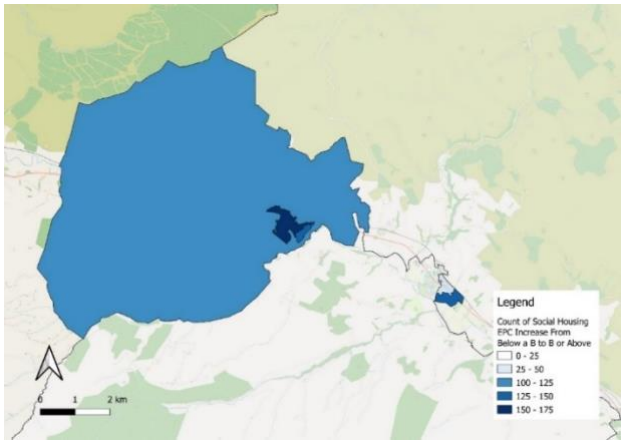


Figure 12-2: Social Housing Properties in Upper Nithsdale with the Most EPC Improvement

The data zone in the centre of Kelloholm (Upper Nithsdale – 02) has 160 properties (89%) and the centre of Sanquhar (Upper Nithsdale – 06) has 140 properties, that would increase from an EPC C or below to meet future EPC requirements. Kelloholm in total has 508 social housing properties, 80% of these would increase to a B or above with all recommended measures in place.

As well as Upper Nithsdale, Dumfries could be a priority area to target social housing properties. The data zones in Dumfries that would have the highest and lowest proportion of their social housing stock achieving an EPC B or above are shown in Figure 12-3.

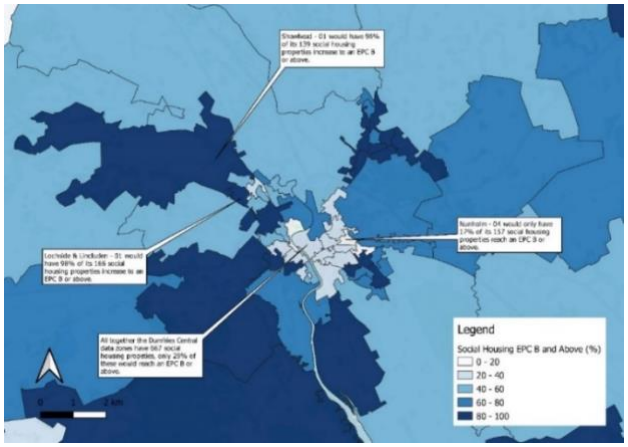


Figure 12-3: Social Housing Properties in Dumfries with the Most EPC Improvements, by Data Zone

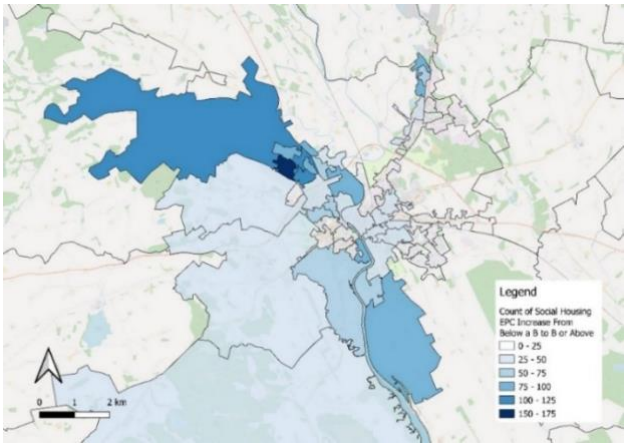


Figure 12-4: Social Housing Properties in Dumfries with the Most EPC Improvements, by Data Zone

Most data zones (447 out of 667) in the centre of Dumfries would have a low proportion of social housing reaching future EPC regulations. In comparison, many of the data zones surrounding Dumfries have a high proportion of properties that would reach a B or above. It is advisable to focus on the areas shown to have more than 80% of properties with high potential such as Lochside and Lincluden – 01 shown in Figure 12-4.

The south east of Dumfries and Galloway, and Stranraer also have areas with high potential impact. This is shown in Figure 12-5 and Figure 12-6. Annan, Gretna, Locherbie, Lochmaben and Stranraer have a relatively high count of social housing properties with potential. Therefore, these would be key areas to target for social housing retrofit.

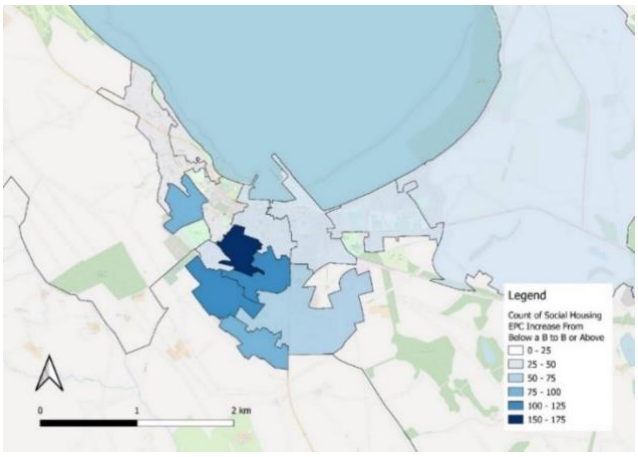


Figure 12-5: Social Housing Properties in Stranraer with the Most EPC Improvements, by Data Zone

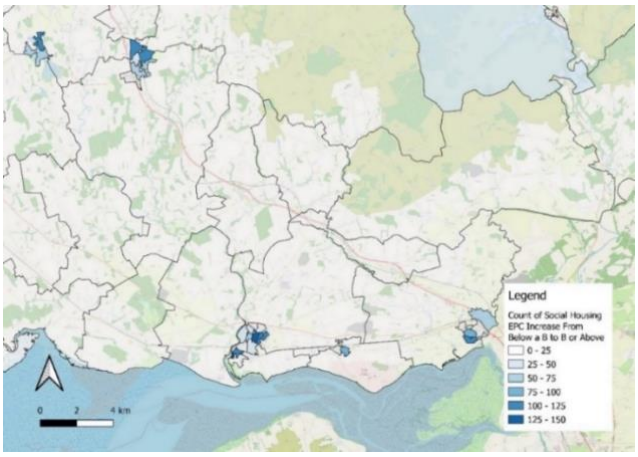


Figure 12-6: Social Housing Properties in the South East of Dumfries and Galloway with the Most EPC Improvements, by Data Zone

12.1.2 Heat Network Zones

12.1.2.1 Stranraer – North

Figure 12-7 presents the northern cluster in Stranraer. This potential zone offers fairly dense demand although the total heat is low and reliant on one major load from a hotel with no public anchor loads. Therefore the viability of a network would be uncertain as non-public buildings are more challenging to connect. If shown to be financially viable, it could be of interest to connect this zone to Stranraer South, however improved building data would be needed to understand the true opportunity.

Figure 12-7: Potential Heat Network Zone, Stranraer North

Zone ID: Stranraer - North	Total heat demand: 5,900 MWh/year
Zone location: Smaller, northern Cluster in Stranraer	Public Anchor Loads: 0
Opportunity category: Medium	Number of Buildings: 24

Table 12-1: Opportunity summary for a Potential Zone, Stranraer North

12.1.2.2 Sanquhar

Figure 12-8 presents a potential heat network zone in Sanquhar, which has a relatively good potential for viability. The zone could connect the FUN pool, Sanquhar Academy and a small industrial area which would give a reasonably sized network with public buildings. However, the total demand of the network is quite small and therefore the financial viability is uncertain due to the high capital costs and low payback rate. Recent studies have considered the potential of this network which have suggested a slightly larger network. This should be supported by a thorough economic analysis to understand if the demand could support the investment. It would be advised to target a smaller, localised network.

Figure 12-8: Potential Heat Network Zone, Sanquhar

Zone ID: Sanquhar	Total heat demand: 5,800 MWh/year
Zone location: Central Sanquhar	Public Anchor Loads: 2
Opportunity category: Medium	Number of Buildings: 8

Table 12-2: Opportunity summary for a Potential Zone, Sanquhar

12.1.2.3 Dumfries – Cargenbridge

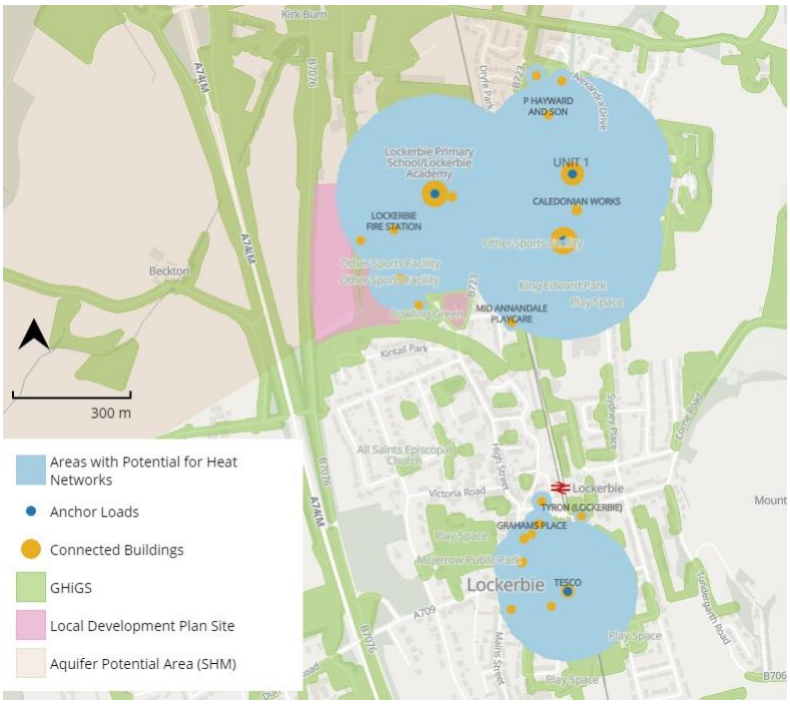
The Cargenbridge area on the outskirts of Dumfries has previously been considered for a heat network. Potential demands include the Dumfries and Galloway Royal Infirmary which could be a major public load, as well as some smaller industrial buildings. Previously it was suggested that waste heat could be used from the neighbouring plastics factory, however the study found that the heat demand was insufficient to support a network and therefore further studies were not carried out. As a result this is a low opportunity network, however it is advised to revise this in line with the planned development sites adjacent to the zone which could increase the total network demand.

Figure 12-9: Potential Heat Network Zone, Dumfries – Cargenbridge

Zone ID: Dumfries - Cargenbridge	Total heat demand: 20,500 MWh/year
Zone location: Outskirt of Dumfries	Public Anchor Loads: 2
Opportunity category: Low	Number of Buildings: 9

Table 12-3: Opportunity summary for a Potential Zone, Dumfries - Cargenbridge

12.1.2.4 Lockerbie



The potential zone in Lockerbie is split into one larger cluster north of the station and one small cluster south by the station. The connection of the two could be challenging due to the need to cross the railway which can result in significant costs. The northern cluster is also split by the railway, further weakening the opportunity. Building demands within the clusters are relatively large, including the Lockerbie Primary School, Industrial facilities and Tesco, however the infrastructure constraints could prevent the network from being financially viable.

Figure 12-10: Potential Heat Network Zone, Lockerbie

Zone ID: Lockerbie	Total heat demand: 10,300 MWh/year
Zone location: North of station	Public Anchor Loads: 1
Opportunity category: Low	Number of Buildings: 9

Table 12-4: Opportunity summary for a Potential Zone, Lockerbie

12.1.2.5 Langholm

Figure 12-11 presents the potential heat network for Langholm, which extends across the old mill and industrial area. Langholm Academy is a potential anchor load on the edge of the cluster. Many of these buildings, such as the Waterside Mill, Waverley Mills and Woollen Mill, have since been repurposed into small commercial units and therefore an accurate heat demand of these, and the longevity of their use, would need to be assessed before confirming viability of connection. As these make up most of the total heat demand, if they have been overestimated due to the change in use type it could result in the cluster no longer being suggested as a zone. The cluster is also split across the River Esk which could add additional costs to route the network across the bridge. However, this could also offer the opportunity of a water source heat pump to provide energy to the network.

Figure 12-11: Potential Heat Network Zone, Langholm

Zone ID: Langholm	Total heat demand: 9,800 MWh/year
Zone location: Across the old industrial area	Public Anchor Loads: 1
Opportunity category: Low	Number of Buildings: 28

Table 12-5: Opportunity summary for a Potential Zone, Langholm

12.1.2.6 Dumfries – Industrial Area

Figure 12-12 presents a potential heat network zone across the Dumfries Industrial Estate. This area may have potential for a zone due to the large heat demand of individual buildings, however the cluster is spatially scattered and therefore the quantity of heat required would need to be accurately analysed compared to the length of network to assess the financial viability of connecting the buildings. The main heat loads include buildings across the Heathhall Industrial Estate and storage type buildings, the heat demand of which tend to vary widely from typically used benchmarks and therefore should be replaced with real data for further assessment. The adjacent development area could further support a network if new buildings could be connected.

Figure 12-12: Potential Heat Network Zone, Dumfries Industrial Area

Zone ID: Dumfries – Industrial Area	Total heat demand: 7,200 MWh/year
Zone location: East of Dumfries	Public Anchor Loads: 0
Opportunity category: Low	Number of Buildings: 19

Table 12-6: Opportunity summary for a Potential Zone, Dumfries Industrial Area

12.1.2.7 Gretna

The heat network zone proposed in Gretna, shown in Figure 12-13, is one of the smallest found. It could however offer a good opportunity for a small, localised network, or a geothermal array, between select buildings which make a dense demand for heat. This includes a manufacturing site and Caledonia Park. Most of the total demand is from the Engineering site and therefore the viability of the full network is likely reliant on this heat demand remaining high. This therefore makes the zone slightly higher risk.

Figure 12-13: Potential Heat Network Zone, Gretna

Zone ID: Gretna	Total heat demand: 2,200 MWh/year
Zone location: Adjacent to the train station	Public Anchor Loads: 0
Opportunity category: Low	Number of Buildings: 5

Table 12-7: Opportunity summary for a Potential Zone, Gretna

12.1.2.8 Moffat

Figure 12-14: Potential Heat Network Zone, Moffat

The potential zone in Moffat, shown in Figure 12-14, is the smallest of all zones found across the local authority. The main heat load comes from hotels which are more challenging and high risk stakeholders than public buildings. Combined with the small demand, this reduces the viability of this network, however it could suit a private, local array.

Zone ID: Moffat	Total heat demand: 2,100 MWh/year
Zone location: Central Moffat	Public Anchor Loads: 0
Opportunity category: Low	Number of Buildings: 9

Table 12-8: Opportunity summary for a Potential Zone, Moffat