Calderdale Local Area Energy Plan (LAEP) Report

17/09/2024

Contents

1. Executive Summary

1.1 Introducing the Calderdale Local Area Energy Plan

Calderdale is leading the way in its efforts to tackle the climate emergency, with the development of a Local Area Energy Plan (LAEP) and digital twin model - a data-driven tool that provides a framework for selecting projects that will make the biggest difference across the borough.

This is an innovative and ambitious detailed plan that sets out key local priorities that are needed to reach local net zero targets by 2038. It identifies where changes can be made to decarbonise local heat and transport, to improve the energy efficiency of buildings, and to generate renewable energy.

The LAEP shows a range of options including focus zones, quick wins, low regrets, demonstrator projects, enabling actions, and key decision points. It is a key document that underpins the local response to the climate emergency.

Robust technical data has been used to create a dynamic model using IES' digital twin technology, that plots every building in Calderdale and visualises the information on a 3D digital map to show:

- Energy usage e.g., gas, electricity
- Building stock characteristics e.g., built form, EPC rating, age-band, property tenure, etc.
- Building fabric e.g., property wall construction, insulation, roofs, walls, floors etc.
- Heating information e.g., primary fuel type

Calderdale's digital twin has been used to model and identify suitable decarbonisation options, such as the potential for building energy efficiency (building fabric upgrades), heating improvements e.g., switch to air source heat pumps, and renewables e.g., the potential for roof top solar PV.

Extensive stakeholder engagement work has been undertaken within the local and regional community to provide an understanding of the strengths and weaknesses of different options, to ensure that the plan can be seen as an informed and legitimate representation of local intent in relation to energy system decarbonisation.

Socio-economic analysis and sensitivity analysis has been used to ensure that the priorities in the LAEP consider wider social impact and social value as part of understanding and ensuring a just transition - including fuel costs, fuel poverty, and air quality.

The LAEP identifies the most technically suitable and cost-effective pathway to reach net zero, identifying short and long-term actions, and priority projects.

It is also beneficial for colleagues at the West Yorkshire Combined Authority (Combined Authority), supporting ongoing work in the areas of (among other things) electric vehicle infrastructure, the Better Homes Hub and One Stop Shop which aims to improve retrofit access and mitigate fuel poverty.

As the frontrunner district in West Yorkshire for LAEP development, the Calderdale project represents a dependable steer that can be applied to the other four Districts in the region.

1.2 Key Actions Required to Reach Net Zero Targets

Transitioning to a net zero energy system is essential to achieving Calderdale's target of 'Net Zero by 2038' and will need to occur faster than the current Climate Change Committee and Distribution Future Energy Scenario (2023) projections. It will also need a higher level of initial investment than the current national plans suggest.

This section outlines the key actions in the scope of the LAEP required to reach Calderdale's net zero target in areas such as building energy efficiency, the decarbonisation of heat supply, installation of renewables, and potential electricity grid infrastructure upgrades.

1.2.1 Building Energy Efficiency

Improving energy efficiency by upgrading the fabric of existing buildings plays a significant role in reaching net zero. In Calderdale:

- Almost 40% of homes were built before 1920.
- 40% of properties are terraced houses.
- 38% of properties have solid brick or stone walls.
- 98% of homes use natural gas for heating.

Analysis of the data in the LAEP shows that over 75,000 homes in Calderdale will require some form of building fabric upgrade to enable local net zero targets to be met.

Cumulatively, Calderdale's housing stock will need investment of around £300 million. This investment would unlock financial savings of more than £50 million a year (359 GWh of energy per year) meaning that thousands of people would be able to live in warmer, healthier, more affordable homes.

Table 1 below, shows the total number of properties in Calderdale where the building fabric (roof, walls, floors) could be improved so that heat losses are reduced, split into light and deep retrofit categories. Note that there is some overlap between these categories as many homes in the borough require both light and deep works.

Table 1. Potential Number of Properties Due for Building Fabric Improvements

	Total Number of Properties	Total Investment Cost (£)	Annual Energy Savings (GWh)	Annual Carbon Savings ($ktCO_2e$)
Light retrofit	70,590	£174,283,750	79 GWh	24 $ktCO_2e$
Deep retrofit*	34,231	£116,783,045	281 GWh	60 $ktCO_2e$
All measures**	76,866	£291,066,795	359 GWh	84 $ktCO_2e$

**Deep retrofit – figures represent building fabric upgrades needed for properties to reach EPC rating C. Upgrading buildings to a higher EPC rating is possible but has not been quantified within this study.*

***All measures – figures are not a sum of Light plus Deep retrofit due to some properties requiring Deep retrofit also requiring Light retrofit as well.*

Relatively affordable 'light retrofit' upgrades (such as cavity wall and loft insulation) need to be implemented very widely - in more than 70,000 properties, which is equal to 73% of all houses in the Borough. Light retrofit upgrades offer a relatively attractive payback period of 5 to 10 years; projects that deliver light retrofit upgrades are considered a quick win for decarbonisation and should be prioritised.

Solid wall buildings can often be poorly insulated, losing heat quicker than in an insulated property, requiring more energy and emitting more carbon. Deep retrofit upgrades, such as solid wall insulation (SWI) and room-in-roof (RIR) insulation are more disruptive to install and more expensive. However, they are also needed in large numbers (more than 34,000 which is 36% of all homes in Calderdale) to unlock significant carbon savings.

Due to the relatively high costs of deep retrofit upgrades, longer payback periods of 15 years or longer are typically expected. Some form of investment support (whether subsidy, grant funding or private investment) is likely to be needed to make this a reality. Deep retrofit fabric upgrades will also help many homes switch to low carbon heating systems such as a heat pumps by reducing the costs needed to run them.

Work to understand which homes are eligible for deep retrofit funding and demonstrator projects (such as the WYCA funded whole street demonstrator project the Council's Healthy Homes is leading in 2024) should be undertaken to enable local action on deep retrofit. The Council's Innovate UK Retrofit Calderdale project, which aims to improve the customer journey in solid wall retrofit, will also offer important learning.

1.2.2 Heat Decarbonisation

Heat decarbonisation presents the biggest challenge that Calderdale faces to reaching its net zero target by 2038. To achieve this, almost 100,000 domestic and non-domestic properties will need to replace their fossil fuel heating systems with low carbon alternatives.

An investment of approximately £1.34 billion across these properties will be required to deliver heating system upgrades, resulting in an estimated annual carbon saving of 250 ktCO_2e. Table 2 below, shows this broken down for domestic properties only due to the higher confidence in the base figures (see Section 3.2.1 for more details) and the level of uncertainty regarding non-domestic use of hydrogen and/or district heating networks.

Table 2. Potential for Low Carbon Heating Improvements in Domestic Properties

Domestic Heating System	Total Number of Properties	Total Investment Cost (£)	Annual Carbon Savings (ktCO_2e)
Heat pumps	68,437	£718,587,450	170 ktCO_2e
Other electric heating	12,077	£57,366,450	21 ktCO_2e
All measures	80,514	£775,953,900	191 ktCO_2e

Heat pumps are expected to be the most popular technology to decarbonise heating systems due to their efficiency, these were assumed to be primarily air source heat pumps in the modelling, but some homes and businesses may be suitable for ground source heat pumps or communal heat pump schemes. Direct electric heating systems or electrical storage heating can help space-constrained homes that aren't suitable for heat pumps.

Many homes will need fabric retrofit improvements before they can cost-effectively run a heat pump unless there are significant changes to the market. At current energy prices, changing from a gas boiler to a heat pump will increase fuel costs for most homes in the borough. This is because the ratio of electricity costs to gas are 'unbalanced' meaning that it currently costs more to heat a home with electricity than it would to heat it with gas.

It is vital that the UK Government takes action to re-balance energy prices to an electricity to gas ratio of at least 3.4:1. As heat pump technology improves and installation costs fall, heat pumps will become more accessible and cost effective, allowing for increased uptake across Calderdale.

Heat pumps are, however, more cost effective than solid fuel or oil heating systems – so installing heat pumps in off-gas-grid properties is considered a quick win.

Social housing providers that can pair heat pumps with insulation upgrades, and manage procurement and installation effectively, are another area where heat pumps can be installed as a quick win.

There is a great deal of uncertainty around hydrogen and whether it should be used as a fuel for heating buildings. Even if there is a positive policy decision from the UK Government in 2026 confirming hydrogen fuel as a priority for domestic heating, it is unlikely to reach Calderdale by 2038.

There are other technologies which can help Calderdale reach net zero and reduce fuel poverty. district heat networks, industrial hydrogen clusters, and shared open-loop ground source heat pumps were all investigated as part of the LAEP and indicative zones for each of these technologies have been identified. Further work is needed as an enabling action to develop these ideas to help understand if they could be cost effective and support complex to decarbonise areas.

1.2.3 Renewables

To reach net zero, Calderdale will need much more electricity to power all the new electric vehicles and low carbon heating systems. Electricity demand in Calderdale is expected to double, from just less then 800GWh per year to over 1600GWh per year. It is important that as much of this electricity as possible is locally generated by renewables. Local renewable installations can often represent the most affordable energy source and help to reduce grid electricity transmission and distribution losses.

An increase in renewable generation is required at all levels - from small scale rooftop solar on homes and business right up to large scale generation developments on suitable areas of land. The most affordable and easily deployed renewable generation technology in Calderdale is currently solar PV panels.

Table 3. Potential for Rooftop Solar PV on Domestic Properties

Suitability for Solar PV	Number of Properties	Total Investment (£)	Annual Renewable Energy Generation (GWh)
Very suitable	26,829	£187,803,000	52 GWh
Moderately suitable	42,241	£295,687,000	77 GWh
Potentially suitable	25,644	n/a	n/a
Total All	94,714	£483,490,000	129 GWh

Current analysis shows that solar panels don't offer a fast payback for many households, with many having estimated paybacks of over 20 years. More affluent households and social housing providers (who can bulk-buy and bulk-install) are the most likely to buy and install solar panels in the short term and this is a quick win. As prices for solar technology continue to drop, it’s expected that in the coming years that solar PV panels will be more affordable and will be installed on more houses.

Onshore wind also offers significant potential for renewable generation in Calderdale, if this is permitted via the planning system. It is recommended that a forum is established to consider land use and how renewable energy can be accommodated in the landscape alongside biodiversity, protecting our communities from flood risk and other local needs.

Community owned renewable energy schemes can enable people to take a stake in the energy system via shared ownership of renewable energy technology. Innovative projects are also looking at smart local micro-grids e.g., with battery storage, EV charging and electrified heat. A smart grid is one in which there is live electronic monitoring and communication so that different parts of the energy system balance the electricity supply and demand. Smart grids can offer cost savings for local people and also reduce the need for major grid infrastructure upgrades in an area.

Further feasibility work on community ownership and smart local microgrids is needed as an enabling action and could lead to engaging and successful projects in Calderdale.

1.2.4 Electric Vehicles (EV)

Carbon emissions from vehicles make up a significant proportion of Calderdale’s total carbon footprint representing one of the largest sources of fossil fuel used in the Borough. The UK Government currently plan to ban the sale of new combustion engine vehicles by 2035. This legislation alone will likely not be enough to support Calderdale to reach net-zero transport emissions by 2038. Action must be taken locally to accelerate the uptake of electric vehicles and reduce the demand for fossil fuels.

To understand where large increases in electricity demand (from EV charging) is expected and to identify where there may be any gaps or issues, modelling from Transport for the North (TfN) and the West Yorkshire Electric Vehicle Charging Infrastructure Study (June 21) produced by Arcadis have been reviewed.

Analysis shows that Elland is predicted to have one of the largest public charging point requirements of all zones in the borough, but there are currently no plans to have public charge points installed in this area.

It is recommended that Elland should be one of the high priority areas for future electric vehicle charge point installations for the Borough.

Additionally, zones with predominantly narrow terraced streets, such as King Cross and Pellon East, may not have room to house the required infrastructure for public charging points. It is important that the local authority works closely with the planning department, West Yorkshire Combined Authority and Northern Powergrid to identify suitable potential alternative solutions for these areas. The West Yorkshire Electric Vehicle Infrastructure Strategy (currently out for consultation) and Local Electric Vehicle Infrastructure (LEVI) programme should be referred to for further clarifications in this area.

1.2.5 Network Infrastructure and Flexibility

There will be significant additional electricity demand created in Calderdale resulting from the electrification of most heat and transport. A combination of projected electrical demand increases (estimated using the digital twin model) plus current substation electricity load data from Northern Powergrid, was used to determine which postcodes will likely require some form of network upgrade to reach net zero.

Upgrades will be required at all levels of the network, including upgrading existing grid supply points, constructing new primary and secondary substations, and re-laying / resizing some wires and cables.

Demand side flexibility (smart tariffs that encourage people to use electricity outside of peak times) may be able to reduce the extent of the required grid upgrades that are needed in some areas. It is important that the local authority work closely with Northern Powergrid to ensure that the electricity network is ready to take on these additional electricity demands and to ensure that upgrades are applied at the right time in the right place.

1.2.6 Short term Priority Actions

Figure 1 below represents the key actions which are required to occur in the short term for Calderdale to meet its net zero target.

Figure 1. Key Actions in the LAEP to 2028

1.3 Green Economy, Investment and Jobs

Calderdale's net zero transition requires a collective investment of over £2bn across its buildings and energy systems. Figure 2 below shows the breakdown of investment required in different intervention areas:

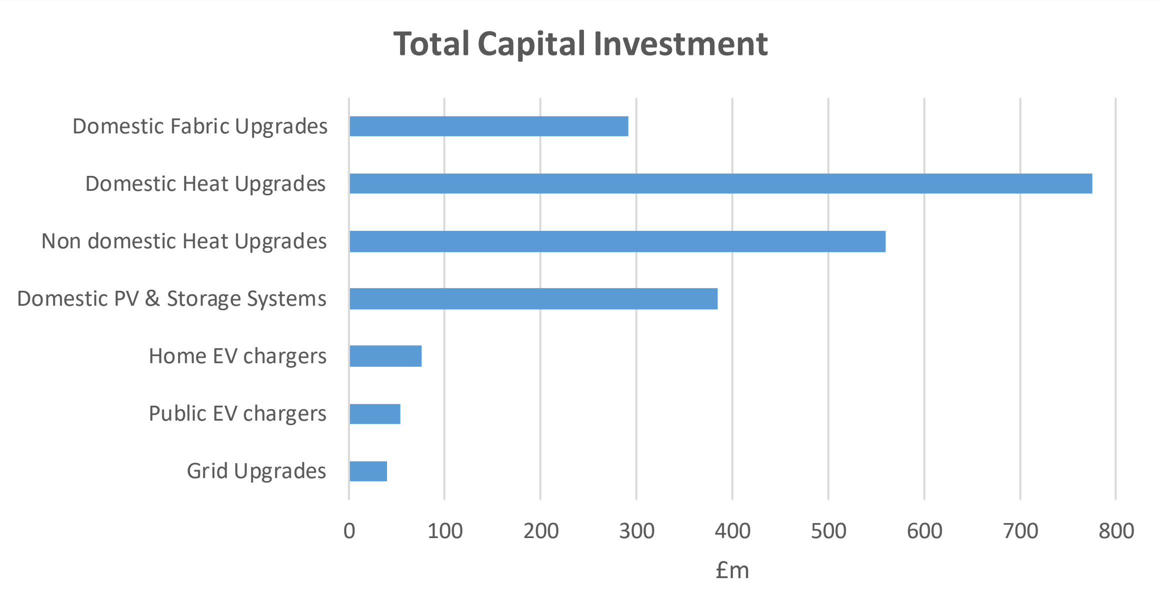

Figure 2. Investment Required in Different Intervention Areas

This investment will support over 3,000 jobs in roles delivering building fabric retrofit upgrades to houses, switching properties away from gas heating to heat pumps and other low carbon heat sources, and installing solar PV. Further work is needed to determine how to support and encourage the local supply chain.

There are huge potential economic and social benefits to growing the green economy and local supply chain. The West Yorkshire Mayor's green jobs taskforce and ambitions on green jobs provide strong strategic links.

Investment and growth can support local ambition for an inclusive economy and a 'just transition' which ensures that the substantial benefits of net zero investment are shared amongst all.

2. Background and Introduction

Calderdale Council declared a Climate Emergency in 2019 recognising the threat and challenge that climate change presents to the Borough. Since then, major progress has been made. Calderdale met its historic target to reduce CO_2 emissions by 40% by 2020 and has committed to reaching net zero by 2038, with significant progress by 2030.

In 2023, the Calderdale Climate Action Partnership published a three-year Climate Action Plan. This sets out actions needed to set Calderdale on the path to net zero. One of the key actions in the Climate Action Plan was to create a Local Area Energy Plan (LAEP) for Calderdale.

The LAEP explores how energy efficiency measures and renewable energy generation will enable Calderdale to achieve its target, and how the transition to net zero can benefit local people.

2.1 What is a LAEP?

The Calderdale Local Area Energy Plan (LAEP) follows a 7-stage methodology set out in national guidance produced by Energy Systems Catapult[1] (ESC). It delivers clear insights into the Borough's current energy landscape and plans out the next steps in local energy decarbonisation.

Potential pathways have been explored within the LAEP considering a range of low carbon technologies and scenarios to identify the most cost-effective 'preferred' pathway including:

- A sequenced plan of proposed actions, setting out costs and changes in energy use and emissions over incremental time periods.
- Both early actions and long-term scale-up activities needed to reach the Calderdale net zero target.
- Key enabling actions and decision points to help Calderdale to stay on track and to navigate future uncertainty.
- Energy use and supply for buildings in both domestic and non-domestic sectors.

The projected electricity demand expected from heat pumps and electric vehicle take up is also included which helps electricity distribution system operators (DSO) to see and plan for future demand.

Excluded from the study were the following sources of emissions:

Table 4. Emissions Excluded from the LAEP

Source of Emissions	Scope
Land-use, land-use change, and forestry (LULUCF)	Considered out of scope
Waste management	Considered out of scope
Road transport	Overall emissions from transport, at a detailed road level, were not included. Proposed electric vehicle (EV) charging locations and infrastructure impacts were included in the modelling, in line with existing EV strategies from the region.
Industrial Activities	Data was not available for accurate, detailed estimates of emissions from industrial activity in the area.

1 https://es.catapult.org.uk/guide/guidance-on-creating-a-local-area-energy-plan/

Agriculture	For emissions from agriculture, a Natural England study external to the LAEP is currently being conducting in partnership with local partners (including CMBC) covering the Calderdale area. Findings from this study will be shared with the Calderdale Climate Partnership and promoted via the Calderdale Climate Action Newsletter when available.

In terms of energy interventions considered, the LAEP has looked at building fabric retrofit, heat pumps and electric heating. District heating and potential areas with buildings that might be suitable for hydrogen were also assessed at a high level, as were solar PV (rooftop and land), wind, and hydro power.

The LAEP covers the Calderdale Council Boundary (see map below) and has been split into different primary zones known as Middle Super Output Areas (MSOAs). This is the UK Government's geographical classification for the reporting of 'small area' statistics and is the lowest geographical area where there is sufficient Government energy usage data (gas and electricity) for comparison.

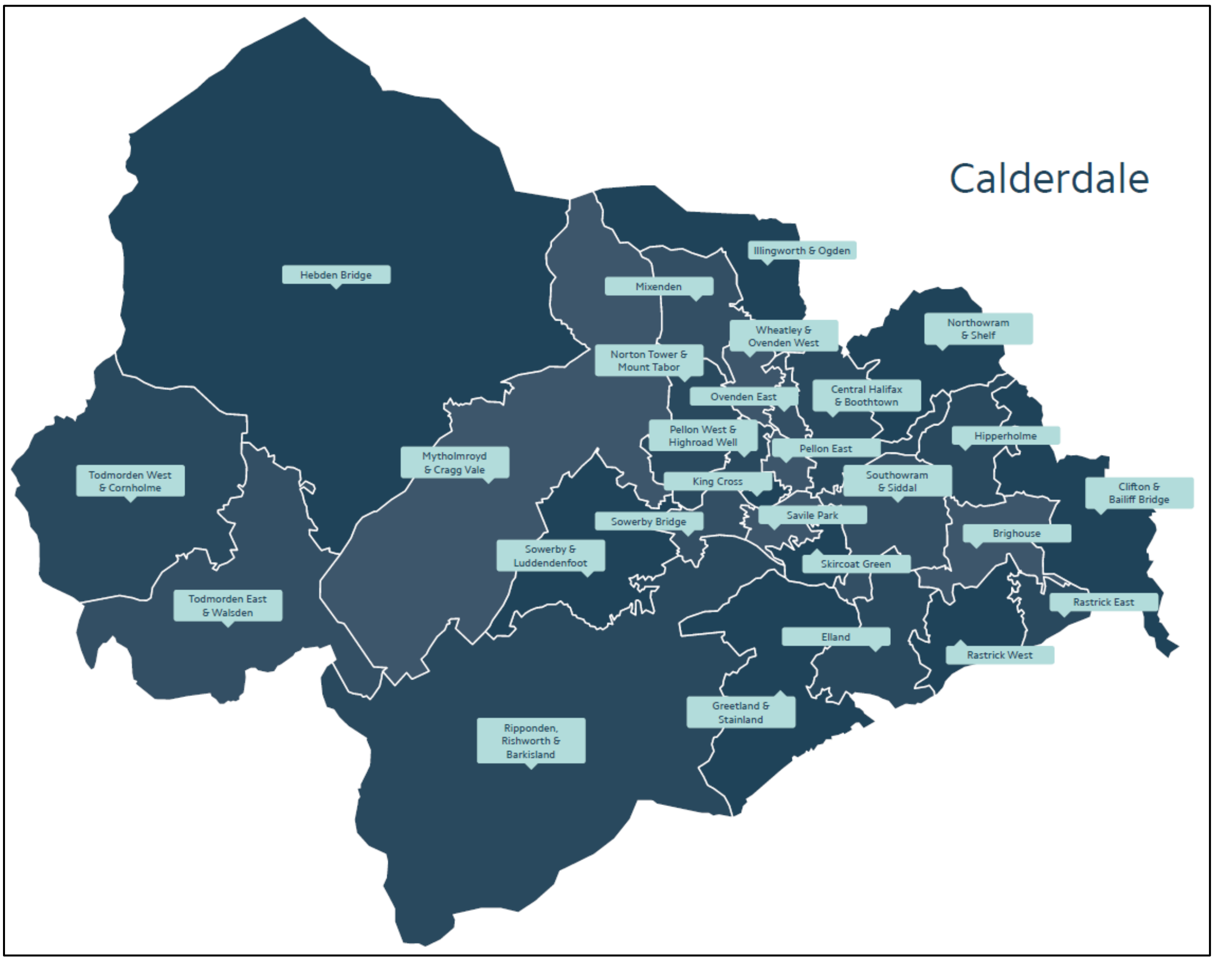

Figure 3. Geographical Boundary of the LAEP and Primary Zones

2.2 Summary of Stakeholders Involved

The LAEP was developed in close collaboration with key stakeholders, including businesses and community organisations. Primary stakeholders involved were from relevant Council service areas and teams (housing, planning, climate and environment, business intelligence), Northern Powergrid, Northern Gas Networks, Together Housing and West Yorkshire Combined Authority (WYCA). These stakeholders were engaged in-depth to build upon existing knowledge, data and plans.

Wider stakeholder engagement was conducted through themed workshops involving the domestic sector, public sector, third sector, private sector, utilities, councillors, and large energy users.

Workshops helped to capture sector-specific views on achieving net zero including barriers, drivers, and priorities. Feedback received was used to shape the LAEP's different areas of focus and recommendations for implementation. Individual engagement was also undertaken for large energy users. Overall, more than 100 organisations have helped to shape the Calderdale LAEP.

Stakeholder engagement ensures that the needs and concerns of all are considered in decision-making processes within the LAEP, enabling buy in, transparency and accountability.

2.3 Policy Context

Key policies and strategies relevant to the Calderdale LAEP were reviewed at national, regional, and local levels. The aim of the review was to show areas of policy that could impact on the LAEP, and areas where the LAEP could have influence. Analysis also highlighted where there could be conflict with the LAEP that should be considered.

2.3.1. Regulations, Policies, and Strategies Used to Inform the LAEP

Existing local, regional, and national net zero targets informed the modelling in the LAEP. At a national level, the Climate Change Act and associated 6^{th} Carbon Budget with its 'Net Zero by 2050' target and 'Balanced Pathway Scenario' were referenced. These documents have a legal standing at a national level.

The strategies listed below all use the same net zero by 2050 'Balanced Pathway Scenario' assumptions to model their own respective pathways to 2050. These were reviewed to ensure alignment:

- Government Net Zero Strategy: Build Back Greener (updated April 2022)
- West Yorkshire Climate and Environment Plan (2021-24)
- Calderdale Emission Reduction Pathway (ERP) Element Energy (2021)
- Calderdale Climate Action Plan (2022)
- Future Energy Scenarios (FES) National Grid (2021)
- Distribution Future Energy Scenarios (DFES) Northern Powergrid (2023)

Each of the above have their own modelled scenarios which reach net zero sooner than 2050. However, none have set out a full pathway for how to reach net zero by 2038.

Other regulations, such as the Future Homes Standard and Minimum Energy Efficiency Standard (MEES), were adhered to in the modelling. Similarly, for planning regulations and policies, the following were adhered to in the modelling of the Calderdale LAEP:

- The National Planning Policy Framework
- National Policy Statement for Renewable Energy Infrastructure
- Planning practice guidance for renewable and low carbon energy, and
- The Calderdale Local Plan

2.3.2 Regulations, Policies, and Strategies the LAEP Should Support

There are a variety of socio-economic strategies which had links with, supported, and positively contributed to the LAEP. These can be considered as the policies and strategies regarding economic growth, health and well-being, and culture. The most important of these are focussed on a local level, and will therefore receive the most benefit from the LAEP's implementation:

- Inclusive Economy Strategy for Calderdale (2018-2024)
- Calderdale Anti-Poverty Action Plan (2022/23)
- Calderdale Health and Wellbeing Strategy (2022-2027)
- Where Creativity Flows: A Cultural Strategy for Calderdale (2022-2032)

2.4 Current Emissions and Profile of Energy Use

Historical greenhouse gas emissions in Calderdale from UK Government data are shown in the graph below (see Figure 4). The overall emissions trajectory is on a steady downward trend, but there are still significant contributions from domestic buildings, transport and industry which will be challenging to decarbonise.

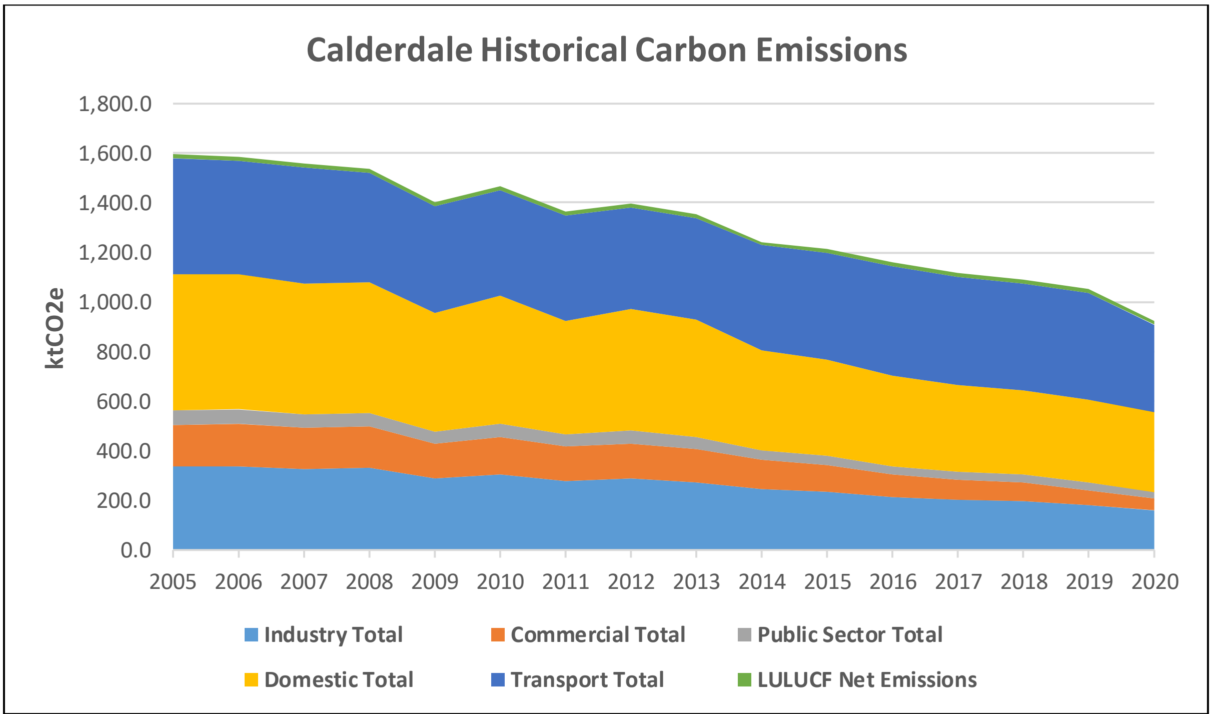

Figure 4. Calderdale's Historic Carbon Emissions

Emissions shown in the form of land use, land-use change and forestry (LULUCF) have not been covered within the scope of the Calderdale LAEP.

Direct modelling for addressing transport emissions has not been completed as part of the LAEP, but projections and results from transport modelling completed by Arcadis and Transport for the North have been presented.

Detailed data for the source of emissions from industrial processes was difficult to obtain. Future work will be required to gather more information so that appropriate industrial measures can be targeted.

The primary focus of the modelling included in the LAEP process was on the emissions from domestic, commercial, and public sector buildings out of the categories in the graph above (see Figure 3).

At a high level, the overall current emissions breakdown for Calderdale by sector is also available from UK Government. Data is shown below (see Figure 5):

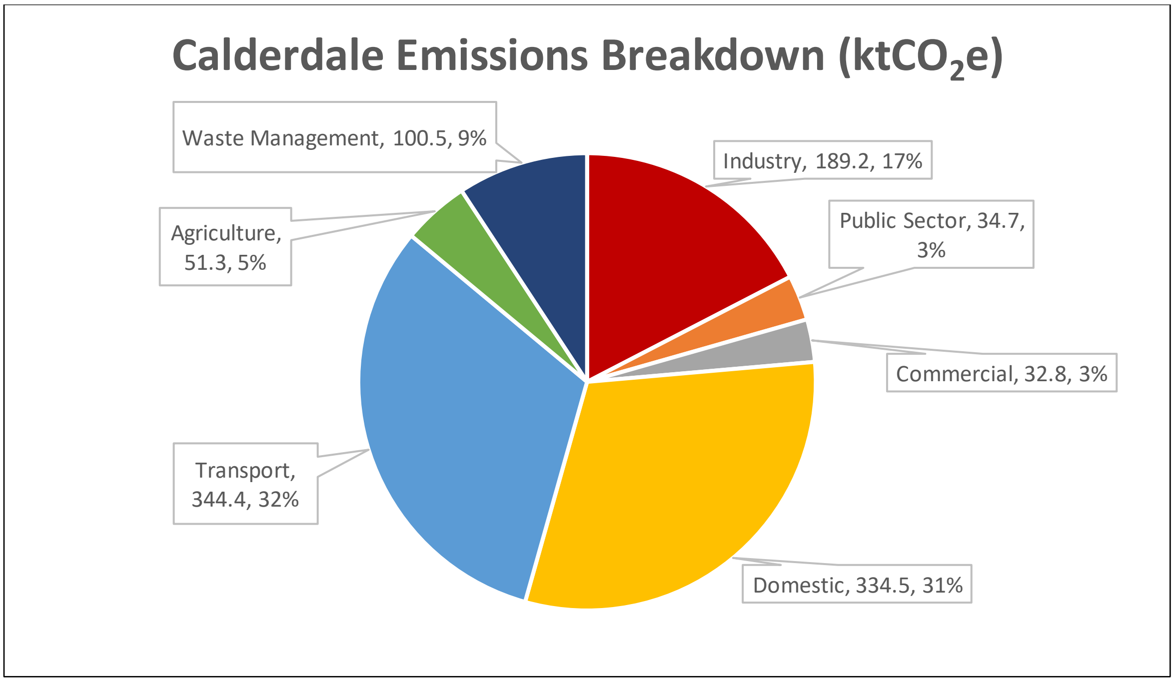

Figure 5. Calderdale's Current Carbon Emissions by Sector

Current energy use of buildings across the borough is shown below (see Figure 6) which emphasises the importance of effective decarbonisation for space heating and domestic hot water (DHW):

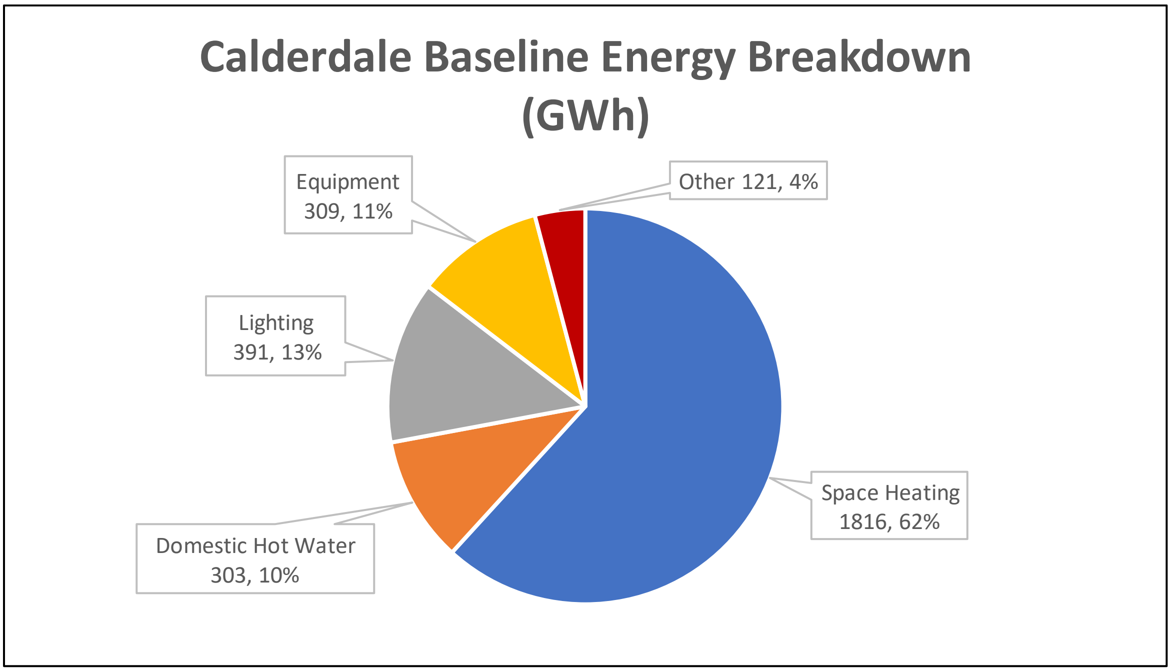

Figure 6. Calderdale's Use of Energy in Buildings

Existing energy flows in the area can be seen in the Sankey diagram below (see Figure 7). Again, the significant amount of fossil fuels used for space heating in the Borough is apparent.

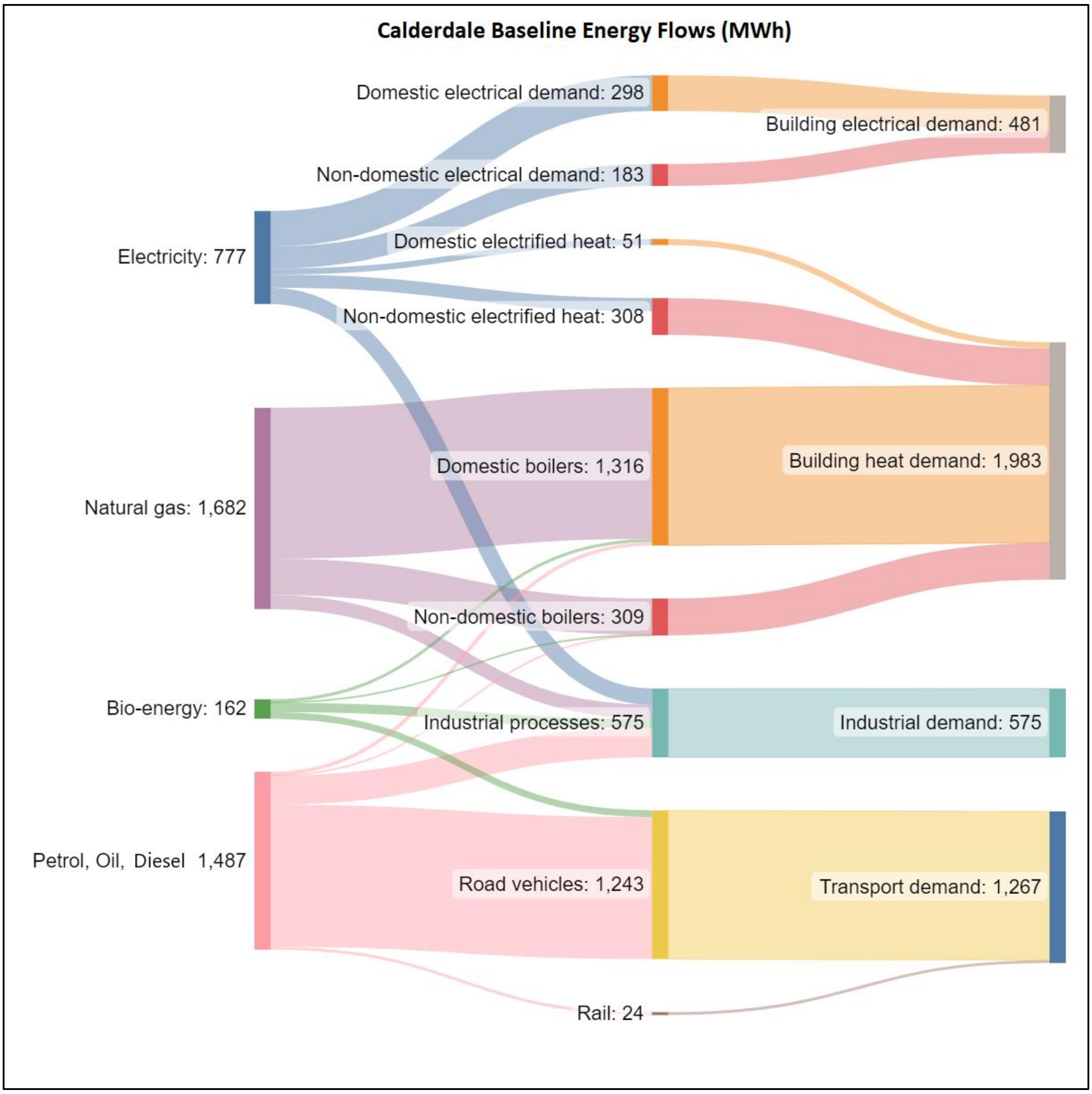

Figure 7. Sankey Diagram of Calderdale's Energy Flows

2.5 Validation

For domestic energy consumption, the detailed energy baseline model for Calderdale was validated by comparing results with available UK Government data held at MSOA level. This was further validated using a sample of buildings for which energy consumption data was available.

Non-domestic energy consumption data was compared to available UK Government data held at Calderdale local authority level. The public sector energy baseline was further validated using consumption data from a sample of buildings.

3. Intervention Areas

3.1 Domestic Building Energy Efficiency

3.1.1 Overview and Pathway to Net Zero

The pathway diagram below (see Figure 8) shows the key actions that are needed for Calderdale to improve the energy efficiency of its buildings to reach net zero.

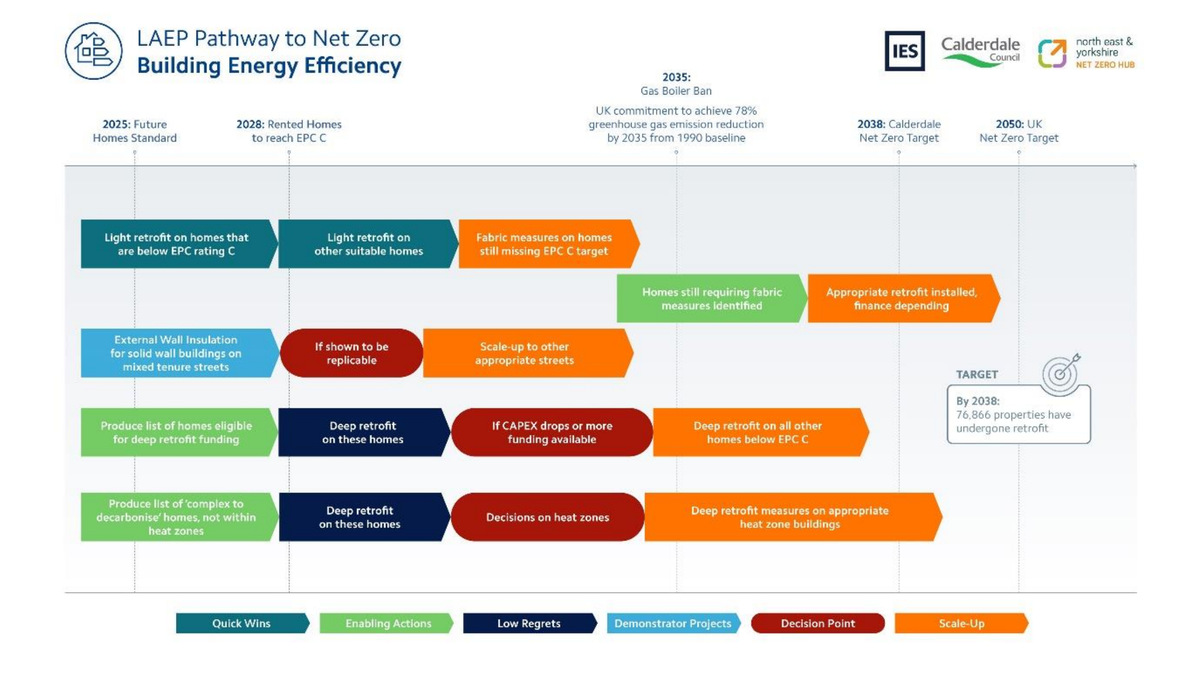

Figure 8. Building Energy Efficiency LAEP Pathway to Net Zero

Approximately 75% of homes in Calderdale will have to undergo some form of fabric retrofit upgrade work. The specific building fabric upgrades that were modelled in the LAEP were split into two categories: light or deep fabric retrofit, as shown in the table below (note that for both light and deep retrofits ventilation works may also need to be carried out).

Table 5. Definition of Light and Deep Fabric Retrofit Measures

Light Fabric Retrofit Measures	Deep Fabric Retrofit Measures
Cavity Wall Insulation	Solid Wall Insulation (Internal or External)
Loft Insulation (full or top-up)	Glazing replacements
Suspended-floor insulation	Room-in-Roof Insulation

The maps below (see Figure 9, and Figure 10) show how these measures are distributed across the primary zones in Calderdale.

Many of the zones contain a significant number of older solid brick or stone properties. These properties will likely require deeper retrofit to fully decarbonise, particularly before installing heating technologies such as air or ground source heat pumps.

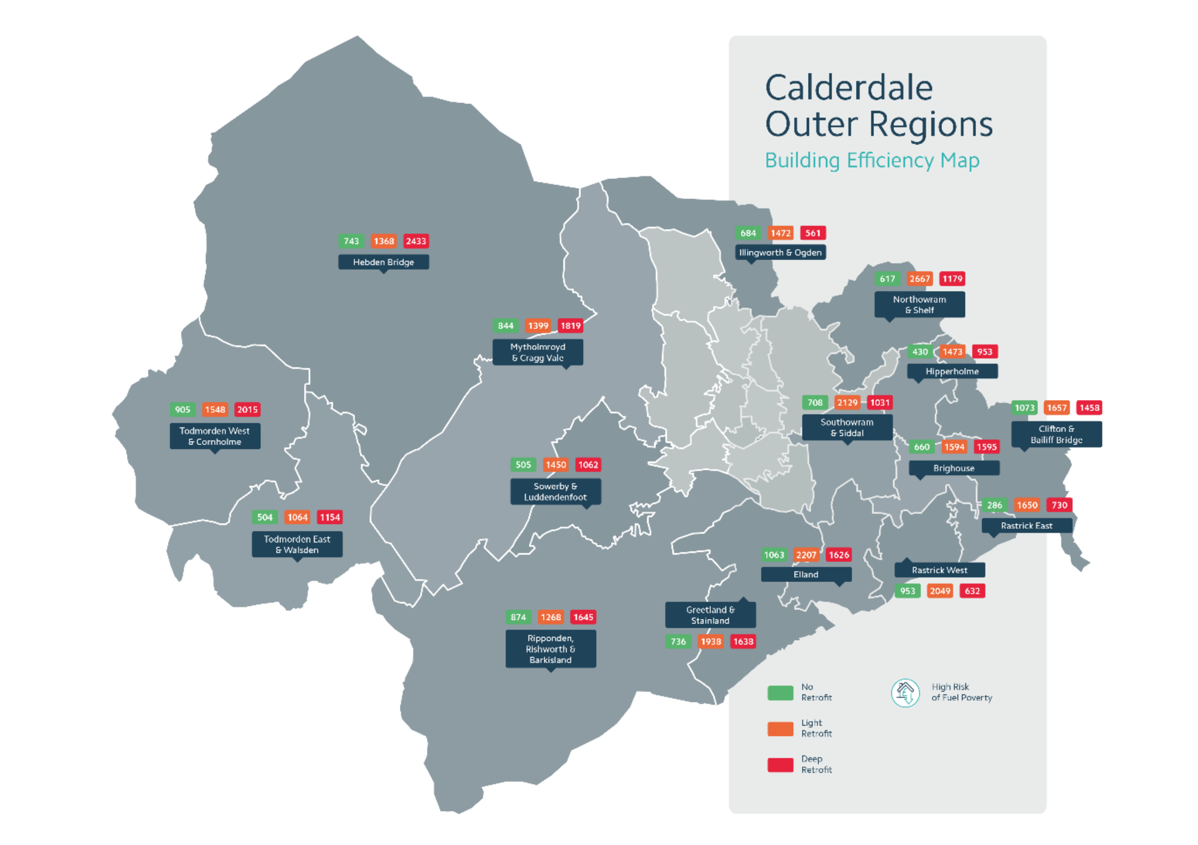

Figure 9. Potential for Building Energy Efficiency Measures for Calderdale's Outer Regions

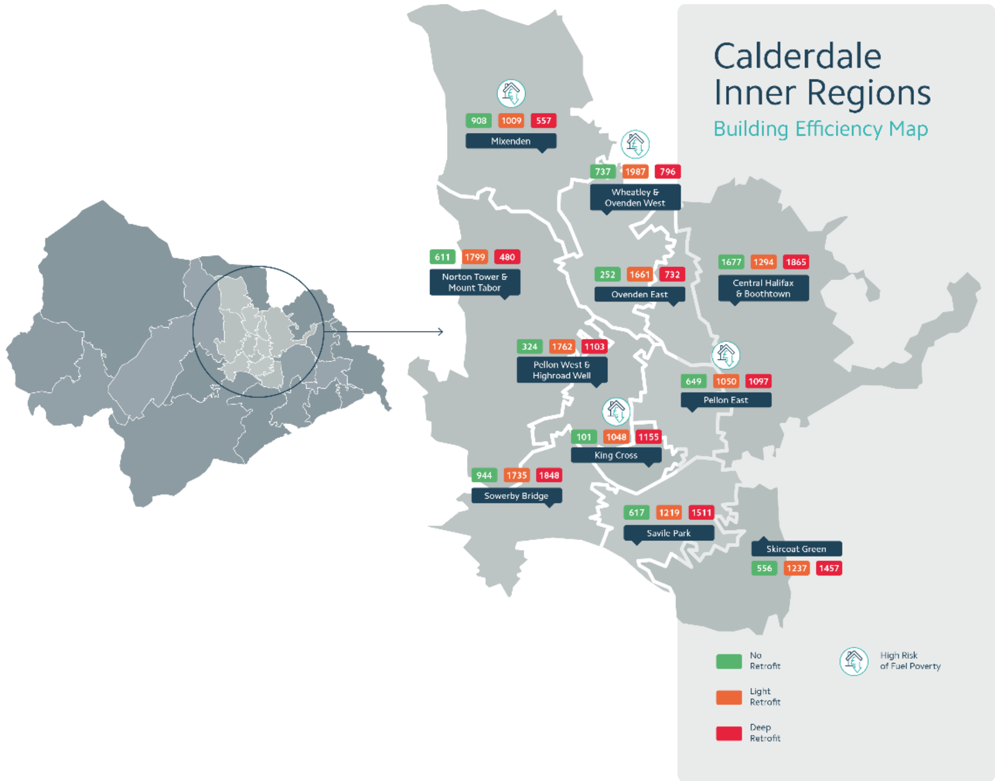

Figure 10. Potential for Building Energy Efficiency Measures for Calderdale's Inner Regions

The areas with the highest proportion of homes requiring fabric retrofit upgrades tend to be the densely populated urban areas in the west of Halifax. These zones also typically have the highest rates of fuel poverty and high percentages of homes usually eligible for the Energy Company Obligation (ECO) and other UK Government funding for insulation and energy efficiency works, when it is available.

The larger, more rural zones, such as Hebden Bridge, Todmorden, and Ripponden have the highest total number of properties requiring fabric retrofit upgrades.

The table below outlines the total number of homes that require fabric retrofit, the estimated capital investment and annual energy savings that could be made from improvements.

Using the digital twin model simulations were created for each fabric measure. The graph below (see Figure 11) shows the number of building fabric upgrades required for domestic buildings in each primary zone categorised into 'light', 'deep' or 'no' fabric upgrade works needed.

Most of the primary zones have relatively similar percentages of homes requiring light and deep retrofit measures, with some notable exceptions such as almost every home in King Cross requiring some form of fabric retrofit upgrade. Central Halifax and Boothtown has a proportionally higher percentage of homes requiring 'no retrofit' compared to the other zones due to its relatively high number of more modern domestic properties.

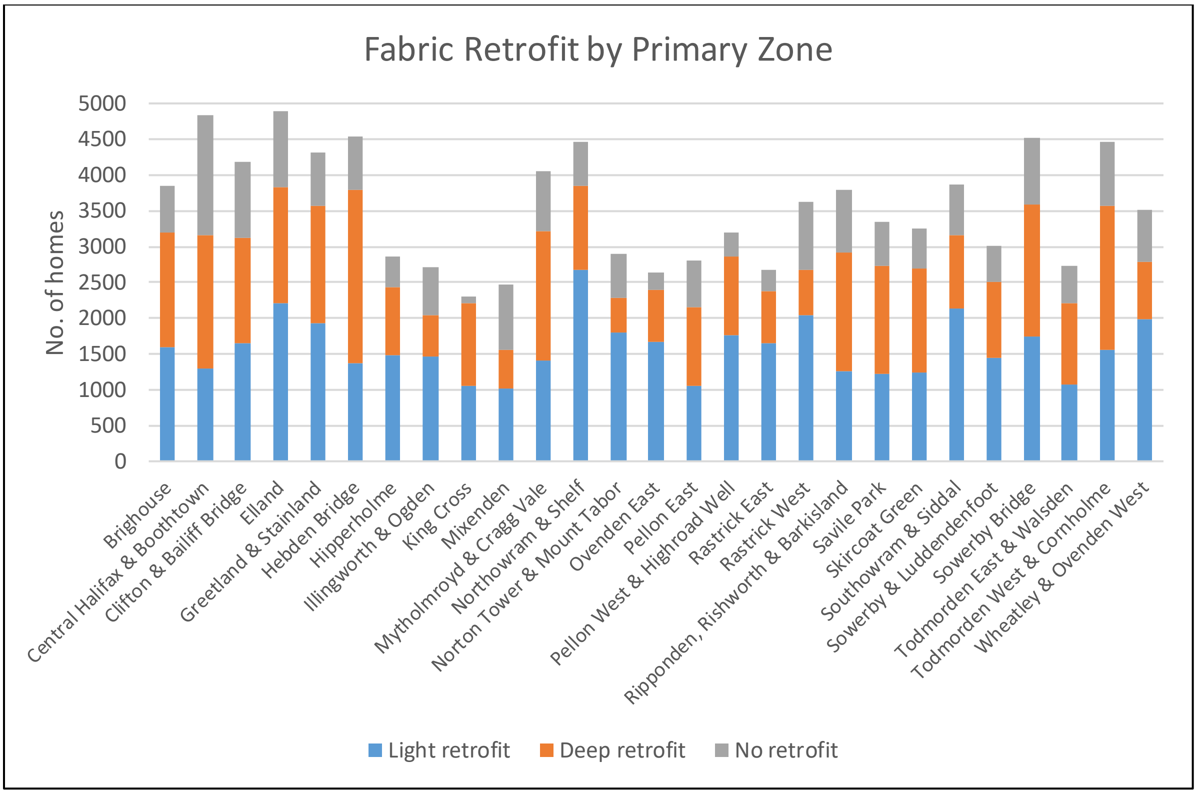

Figure 11. Potential for Fabric Retrofit Measures by Primary Zone

Affordably heating, insulating, and ventilating homes can provide a wide array of benefits aside from reducing fuel bills and carbon emissions, including improvements to residents' health, reducing the risks of condensation, damp, and mould, and improving internal and external air quality.

The technoeconomic and sensitivity analysis that was undertaken to develop the LAEP indicated that both light and deep retrofit measures are cost effective methods to decarbonise the built environment. Both groups of measures gave a positive net present value (indicating that investment would be profitable) when considering energy bill savings as well as the monetary benefits of wider social improvements such as carbon emission reductions and air quality improvements.

When looking at average payback periods across the housing stock in Calderdale, light retrofit measures typically paid back within only a few years; however, for some deep retrofit measures the payback periods could be over 20 years. Most households will require affordable funding in the form of subsidy incentives and low-cost repayment loans to be able to implement deep retrofit measures.

The benefits of fabric improvements stayed constant under all scenarios (Do Nothing, Net Zero by 2050 and Net Zero by 2038) and under future uncertainties i.e. changes to capital expenditure, fuel costs, and the electricity grid carbon-factor.

Fabric retrofit works have been classified as a 'low regret' option for the Calderdale pathway, with the caveat that households often may only be able to afford deep fabric retrofit works where additional affordable funding streams and subsidies are available.

The most common deep retrofit measure required across the borough is solid wall insulation, which can be delivered as either external wall insulation (EWI) or internal wall insulation (IWI). Both of these can have significant barriers to installation, including high installation costs. EWI can have barriers due to planning policy and is more expensive but is typically less disruptive to install. IWI can require homes to be redecorated with all walls and floors stripped, which is highly disruptive. IWI will typically have shorter payback periods but can require kitchens and bathrooms to be re-fitted which can increase costs.

The homes that will benefit most from deep retrofit measures are typically those at high risk of fuel poverty; however, these householders are least likely to be able to afford it. Deep retrofit measures should therefore be targeted in the short-term for homes that are eligible for UK Government funding to help with the costs of installation, within areas at high risk of fuel poverty. This approach will reduce financial and health inequality in the short term and provide households with a greater level of improved thermal comfort during the colder winter months. However, households in extreme fuel poverty are likely to be underheating; carrying out retrofit works may lead to increased levels of energy consumption and carbon emissions in the short term, with long term carbon savings spread over the lifetime of the works (30-40 years for insulation).

3.1.2 Primary Zone Visualisations

Significant numbers of fabric retrofit upgrades are required to reach net zero across all of Calderdale's primary zones studied in the LAEP, with 81% of homes being suitable for some form of fabric improvement and 75% of homes currently rated below EPC rating C. To achieve this, targeted support and awareness raising will be required borough wide.

Fabric retrofit focus zones can be prioritised by comparing key metrics that determine where the benefits of building fabric improvements will have the biggest impact. The figures below show the primary zones ranked by several key metrics for fabric upgrades: risk of fuel poverty, number of homes below EPC rating C, and percentage of homes eligible for funding (via the ECO, HUG, and LAD schemes). It should be noted that as LAD funding has now ended, and HUG funding is due to end March 2025, it is important that replacement national funding schemes are implemented by the UK Government to encourage the required uptake of energy efficiency improvements to reach net-zero.

3.1.2.1 Fuel Poverty

Improving building fabric represents an opportunity to both decarbonise and reduce fuel poverty. Fuel bill reductions and health improvements will deliver larger impacts in areas of higher fuel poverty; this is why it is important to prioritise these areas.

There are currently less incentives for private landlords to upgrade their properties, therefore additional targeting may be required in areas of high fuel poverty that have a large proportion of privately rented homes.

The map below (see Figure 12) shows that the primary zones with the highest average risk of fuel poverty are King Cross and Pellon East.

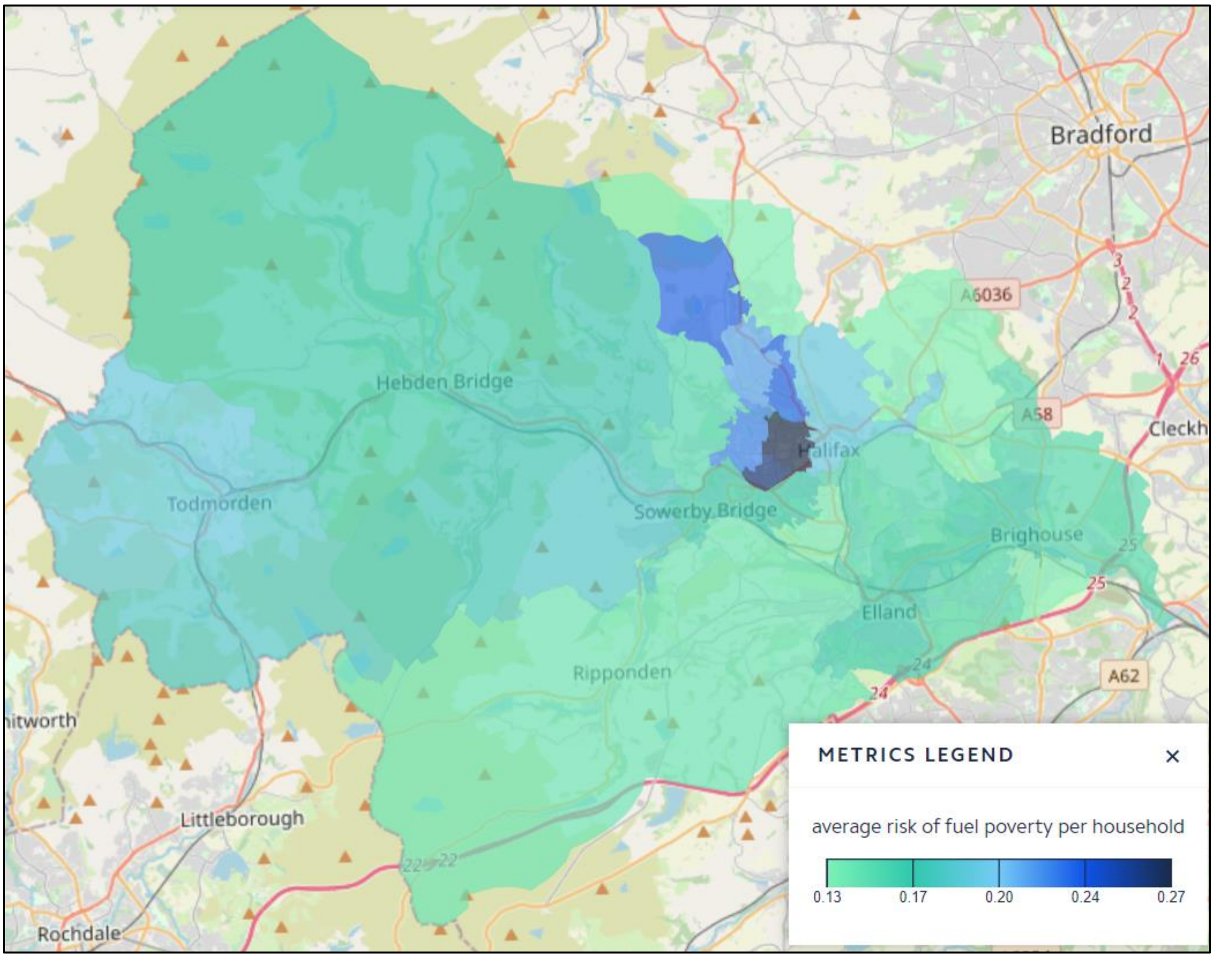

Figure 12. Primary Zone Risk of Fuel Poverty

3.1.2.2 EPC Ratings

The UK Government has set a target for all homes to be EPC rating C by 2033. Around half of all homes in Calderdale that are below EPC rating C will require 'deep retrofit' measures. It is important that funding is appropriately targeted, and that awareness is raised on appropriate measures that should be taken e.g., available financial investment, funding, and support.

The map below (see Figure 13) shows that most zones in Calderdale have a high number of properties below EPC rating C, highlighting the importance of raising awareness and signposting appropriate support across the entire borough.

The King Cross area in Halifax, has the highest percentage of homes below EPC rating C. The areas with the highest total number of homes below EPC rating C are shown below:

- Hebden Bridge
- Todmorden West and Cornholme
- Elland
- Northowram and Shelf

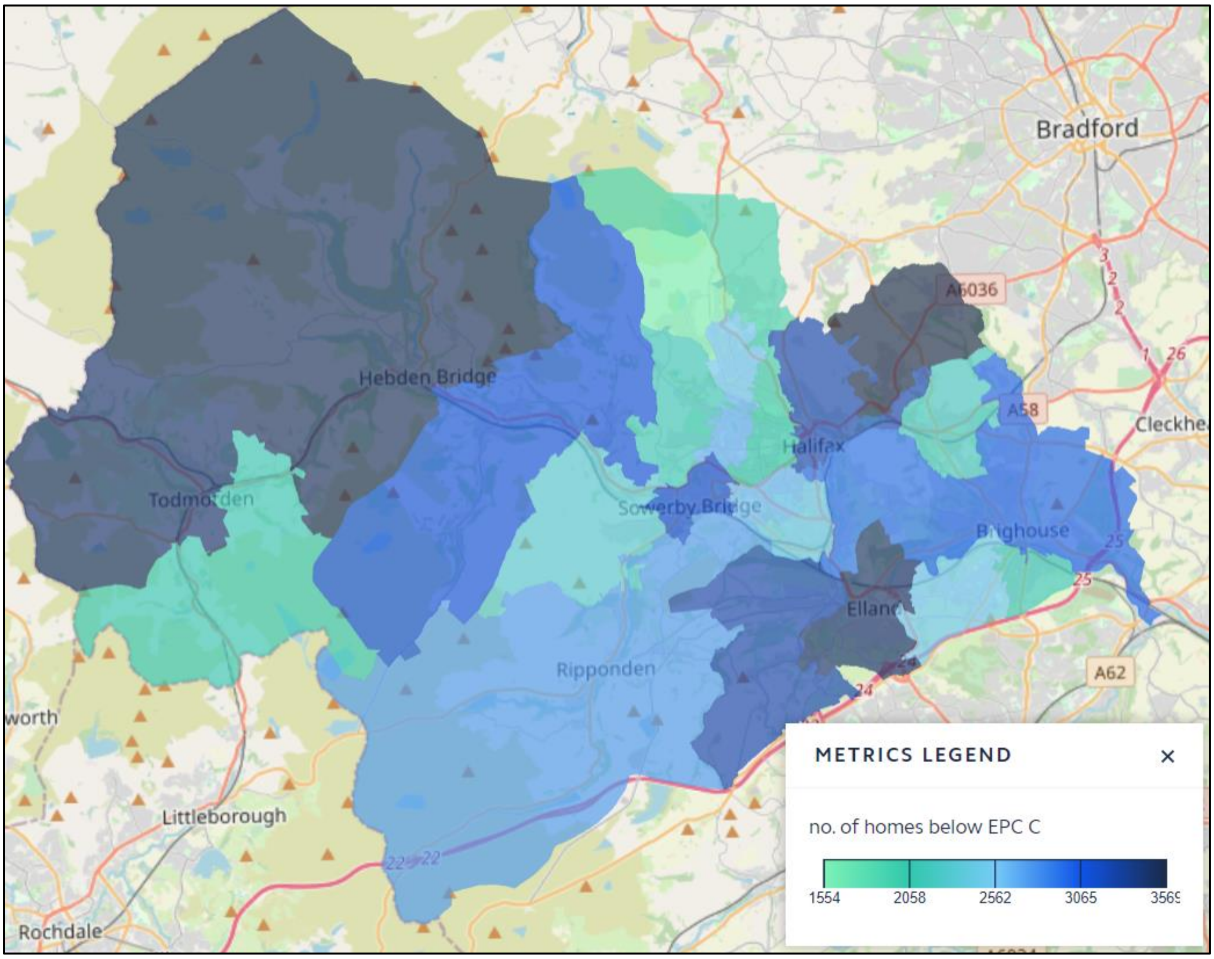

Figure 13. Primary Zone Number of Homes Below EPC Rating C

3.1.2.3 Funding Eligibility

King Cross has the highest percentage of homes eligible for funding, with the nearby zones of Pellon East, and Pellon West and Highroad Well also having a significant proportion of properties eligible. Mixenden is the zone with the second highest percentage of homes eligible.

Light retrofit measures typically payback within approximately five years so are more likely to be affordable for homeowners and landlords without requiring external funding. However, deep retrofit measures will typically require external funding to be implemented, particularly in areas of high fuel poverty.

Various UK Government funding streams that cover deep retrofit measures are available, but only certain households are eligible, based on a range of criteria.

Further funding schemes will be required to reach the number of fabric retrofit measures needed across the borough. The map below (see Figure 14) shows the percentage of homes in each zone that are eligible for either the ECO, LAD or HUG funding schemes.

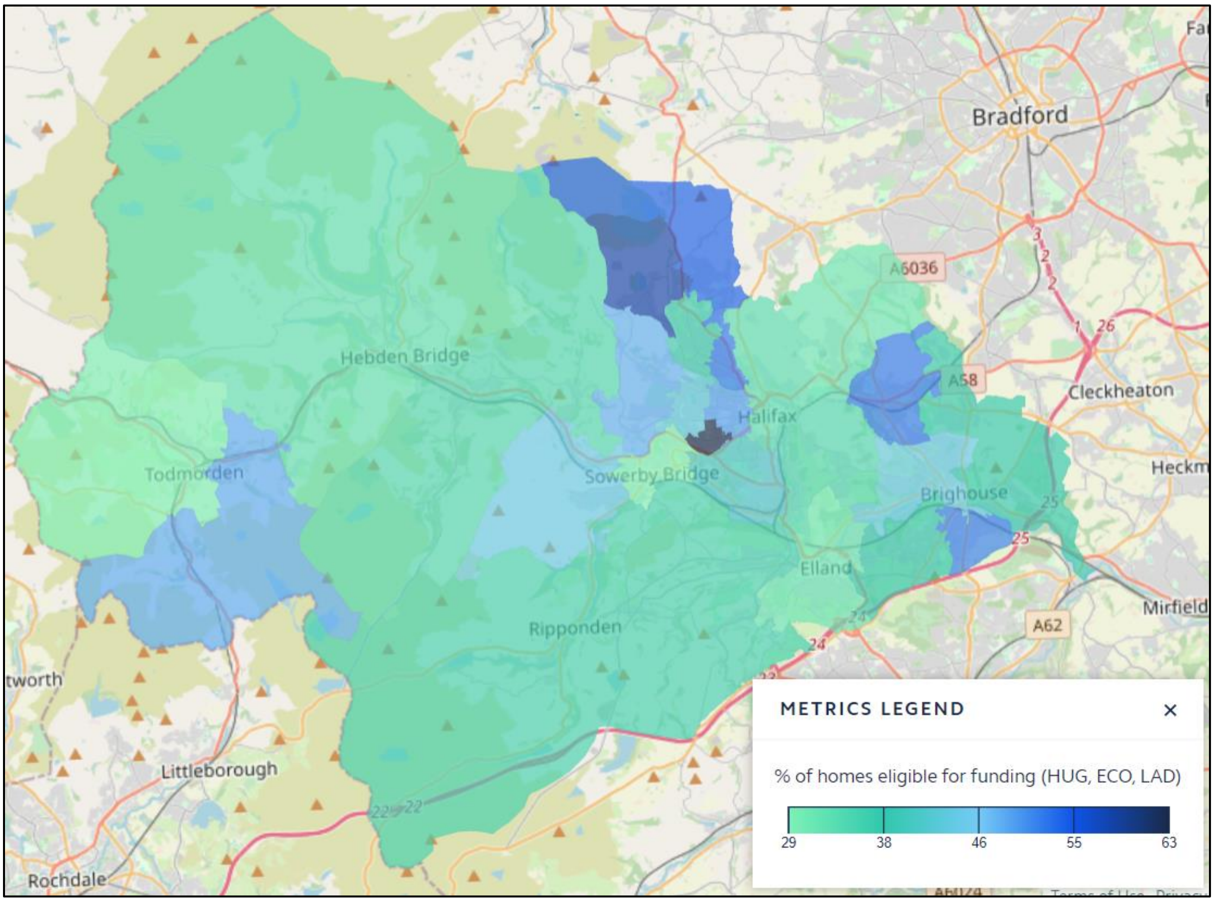

Figure 14. Primary Zone Percentage of Homes Eligible for Funding

3.1.3 Focus Zones for Priority Projects

The two zones selected as a high priority for fabric measures were King Cross, and Todmorden West and Cornholme. The number of homes and percentages for the three key factors visualised in the previous subsection are shown for these two zones below.

Table 6. Socio-Economic Criteria and Statistics for Chosen Focus Zones

Primary Zone (MSOA)	No. of Domestic Properties	Properties Below EPC C	% of Properties Below EPC C	Ave. Risk of Fuel Poverty Per Household	Homes Eligible for Funding	% of Homes Eligible for Funding
King Cross	2304	2065	89.6%	26%	1452	63
Todmorden West & Cornholme	4468	3459	77.4%	19%	1307	29.3

3.1.3.1 King Cross and Surrounding Areas

The area around King Cross in western Halifax is highlighted as a priority zone for fabric retrofit upgrades as it has the highest fuel poverty rates of any zone in the local authority area, the highest percentage of homes with an EPC rating below C, and the highest number of homes that are eligible for funding – as can be seen in the previous tables and figures. Most homes in this area are pre 1920s solid wall properties, many of which will require some form of solid wall insulation. Further work will be required to understand if external or internal wall insulation will be most suitable across the area, based on cost and planning implications. The area shown in the map below (see Figure 15) shows the domestic properties in the King Cross zone colour coded based on EPC rating.

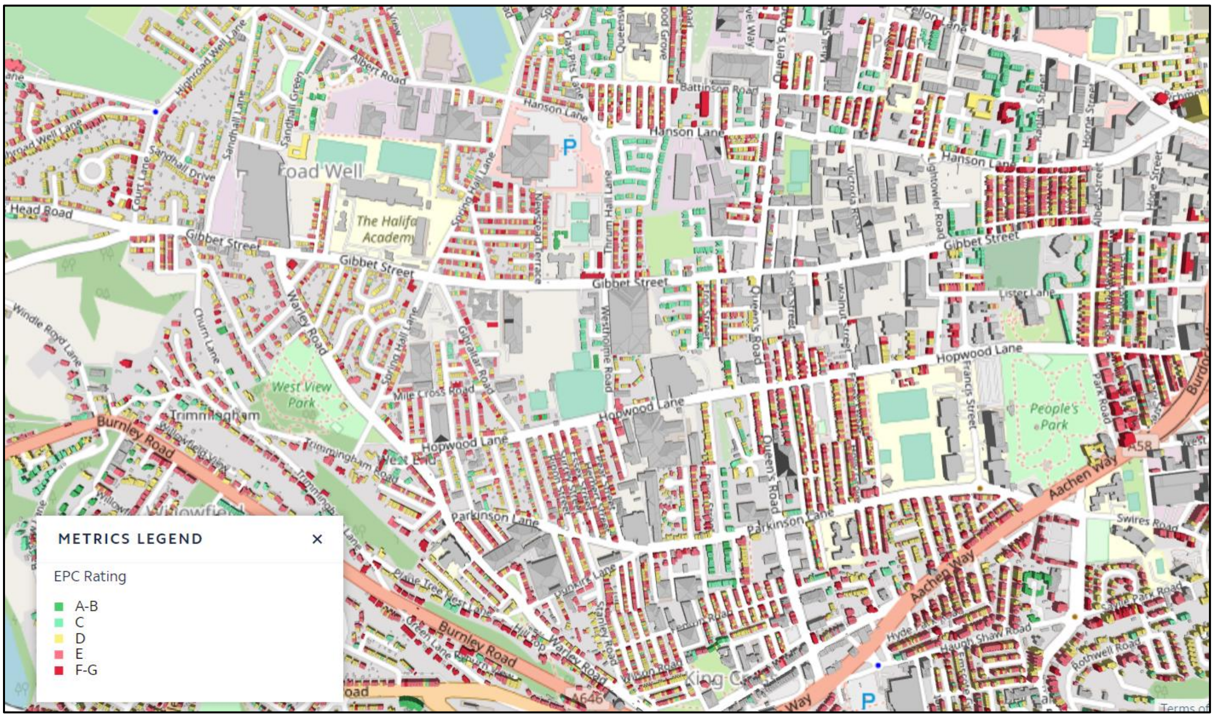

Figure 15. EPC Ratings of Domestic Properties in the King Cross Zone

Included in the map are parts of Pellon East, and Pellon West and Highroad Well zones, which also have relatively high rates of fuel poverty, a high number of homes that are below EPC rating C and a high number of homes eligible for funding – as highlighted in the previous zonal diagrams.

These areas should be targeted for fabric retrofit measures to help meet local and national decarbonisation targets and to provide wider benefits to householders in the local community e.g., reduced energy bills, improved thermal comfort.

The homes in this area mainly require deep retrofit measures, which will likely require external funding, however there are also many homes which only require light retrofit measures to reach EPC rating C, for which external funding is also available but may also be affordable without funding for some local homeowners and landlords.

3.1.3.2 Todmorden West and Cornholme

The second priority zone for fabric retrofit measures is Todmorden West and Cornholme. The properties in the most densely populated part of this zone can be seen below (see Figure 16), colour coded by EPC rating.

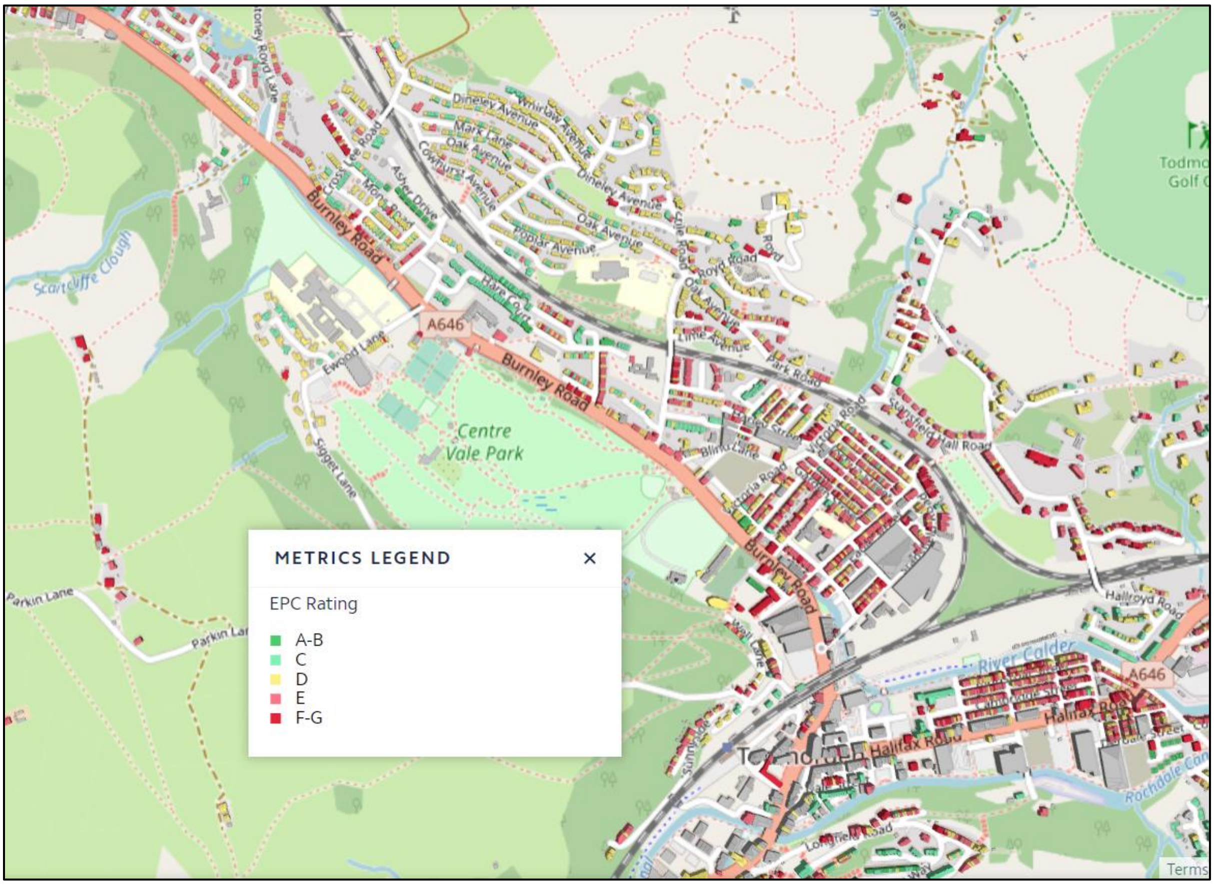

Figure 16. EPC Ratings of Domestic Properties in Todmorden West and Cornholme Zone

This zone has been selected as a priority as it has a relatively high number of homes below EPC rating C, and high number of homes at risk of fuel poverty, as can be seen on the previous images. This zone has a lower percentage of homes suitable for funding measures compared to King Cross.

The Todmorden West and Cornholme zone is not located near a potential heat network or hydrogen cluster zone, therefore it is likely that most homes in this area will need to decarbonise via heat pumps.

With current technology, heat pumps operate less efficiently in homes with high heat losses and can struggle to maintain thermal comfort in cold weather conditions, so it is important that areas such as this undertake fabric retrofit improvements as soon as possible. Hence why this zone has been selected as a priority for fabric retrofit measures.

There are other primary zones with similar (or higher) rankings as Todmorden West and Cornholme for these metrics, however these areas are in zones that are designated as having the potential for district heating or for an industrial cluster for hydrogen (see heat decarbonisation section).

Some homes in these zones may be able to cost effectively decarbonise their heat and energy use without significant fabric retrofit upgrades if a heat network or hydrogen cluster is developed in the area (depending on various factors around the feasibility of the network at the particular site).

3.2 Low Carbon Heating

3.2.1 Overview and Pathway to Net Zero

3.2.1.1 Domestic Heating

The pathway diagram below (see Figure 17) shows the key actions that are needed to decarbonise heat in Calderdale.

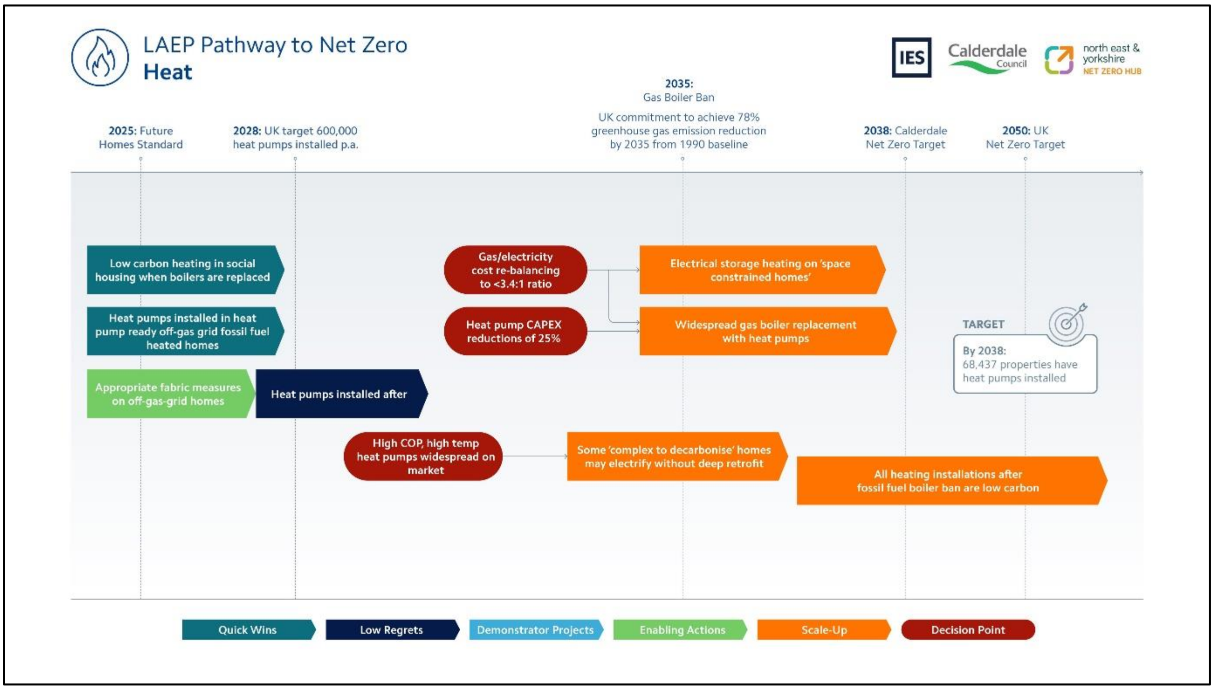

Figure 17 Low Carbon Heating LAEP Pathway to Net Zero

Reducing energy used for heating domestic properties is a key challenge for the borough, with 89% of homes in Calderdale currently using natural gas. To reach net zero by 2038 all homes (or as many as technically feasible) will need to convert to a low carbon heat source. This will likely cost around £776 million and save around 191ktCO_2e per year.

Table 7. Number of Dwellings Requiring Heating System Change with Investment Costs and Carbon Saving

Number of Dwellings Requiring Heating System Change	Total Investment Required for Domestic Heating Upgrades	Potential Annual Carbon Emissions Saved
86,968	£775,953,900	191ktCO_2e

It has been assumed for the Calderdale LAEP that most homes and businesses will need to electrify their heating systems, primarily via the use of heat pumps.

It is considered that space constrained homes, those with a habitable room space smaller than 16m^2, would unlikely be suitable for a heat pump, even after fabric improvements, due to there being limited space for required hot water cylinder[2]. Borough wide, roughly 15% of domestic properties can be considered as space constrained.

2 The UK Government definition for space constrained homes has been used, indicating a home as being space constrained if it has less than 16m^2 per habitable room.

Space constrained homes that are not in a district heat network zone, or shared open-loop ground source heat pump zone, will likely require an alternative form of electrified heat, such as a modern efficient electrical storage heater. While these are not as efficient as heat pumps, they can still represent an economical way to decarbonise heat when combined with appropriate tariffs and potentially solar PV and battery storage.

The graph below (see Figure 18) shows the heating system upgrades that will likely be required in each zone. Homes that currently use biomass or an electrical heating system are classed as low carbon. Properties marked for a heat pump upgrade may choose to replace their boiler with an alternative low carbon heat source such as electrical storage heating, or even bioenergy (fuel from wood, biogas or bio-oil) if a sustainable source is available.

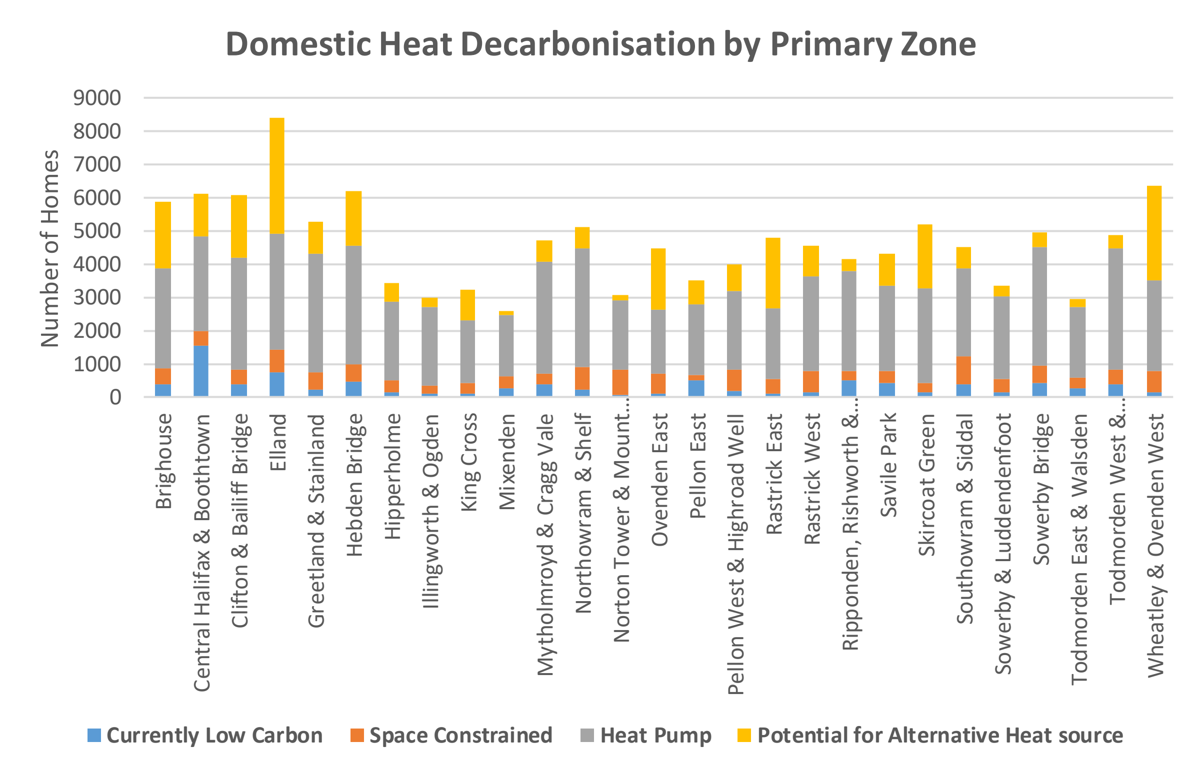

Figure 18. Domestic Heat Decarbonisation by Primary Zone

The homes under 'potential for alternative heat source' shown above includes the properties within indicative zones for district heating or a hydrogen cluster, as well as homes that may be suitable for a shared open-loop ground source heat pump. These alternative sources are discussed later in this section.

Whether alternative heat sources are delivered will depend on more technical feasibility studies being completed. If these alternative sources are not viable, then properties in this category will need to transition to heat pumps or another low carbon heating system instead.

There is currently a large degree of uncertainty around the future use of hydrogen as a fuel for space heating and hot water in both domestic and non-domestic buildings. The UK Government is set to make a policy decision in 2026 on whether (or not) hydrogen is a priority for domestic properties. Even in the case of a positive decision around hydrogen use being made, it is unlikely that a large enough supply will have reached Calderdale to fuel homes and businesses by 2038.

The West Yorkshire Combined Authority (WYCA) has produced a Hydrogen Roadmap for the region, which shows planned new hydrogen pipelines and larger volumes of hydrogen supply are unlikely to reach Calderdale before its 2038 net zero target.

Some potential hydrogen zones have been identified, located around areas with significant industrial activity, where the technology is not currently available to electrify their high temperature processes.

The maps below (see Figure 19 and Figure 20) show the maximum number of domestic heat pump installations per zone, the number of space constrained homes per zone, as well as icons for zones that include:

- Potential district heat networks,
- Potential industrial hydrogen clusters, and
- A significant proportion of homes suitable for shared open-loop ground source heat pumps.

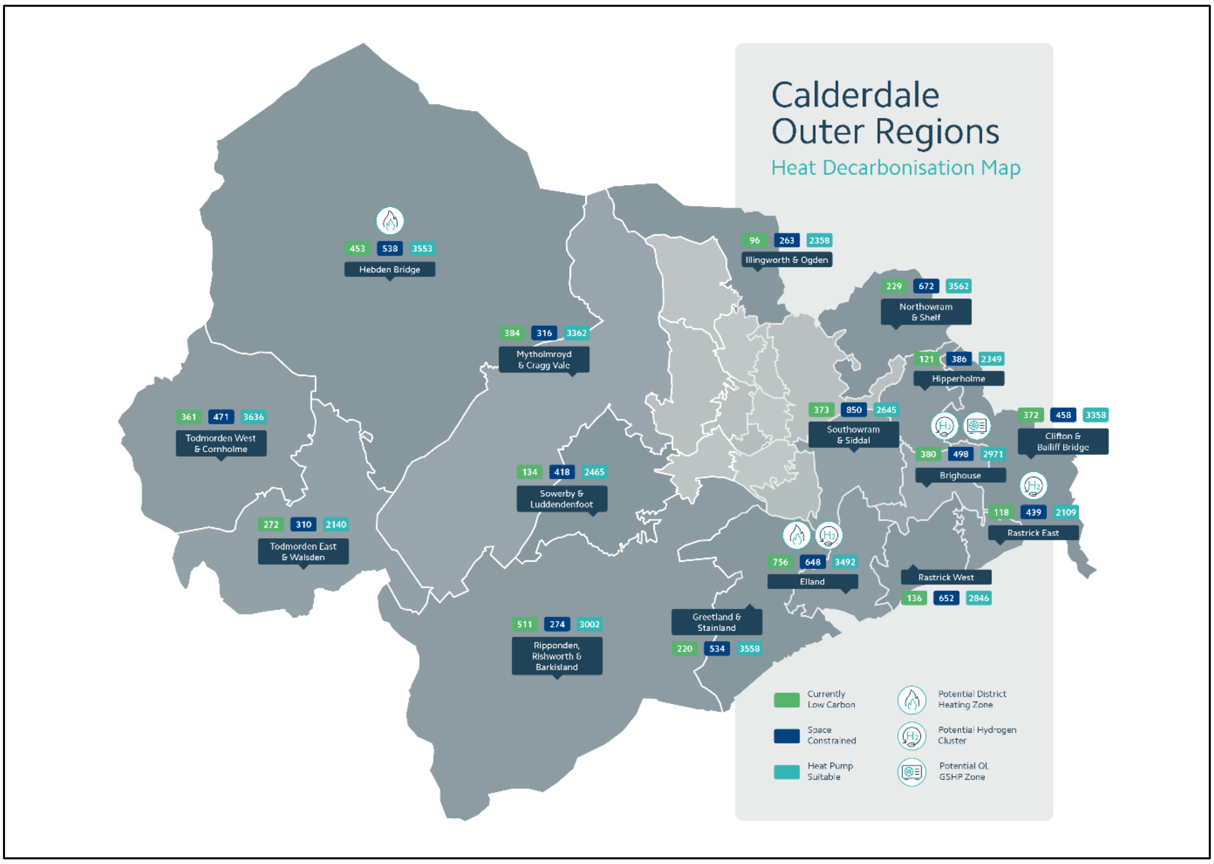

Figure 19. Heat Decarbonisation for Calderdale's Outer Region

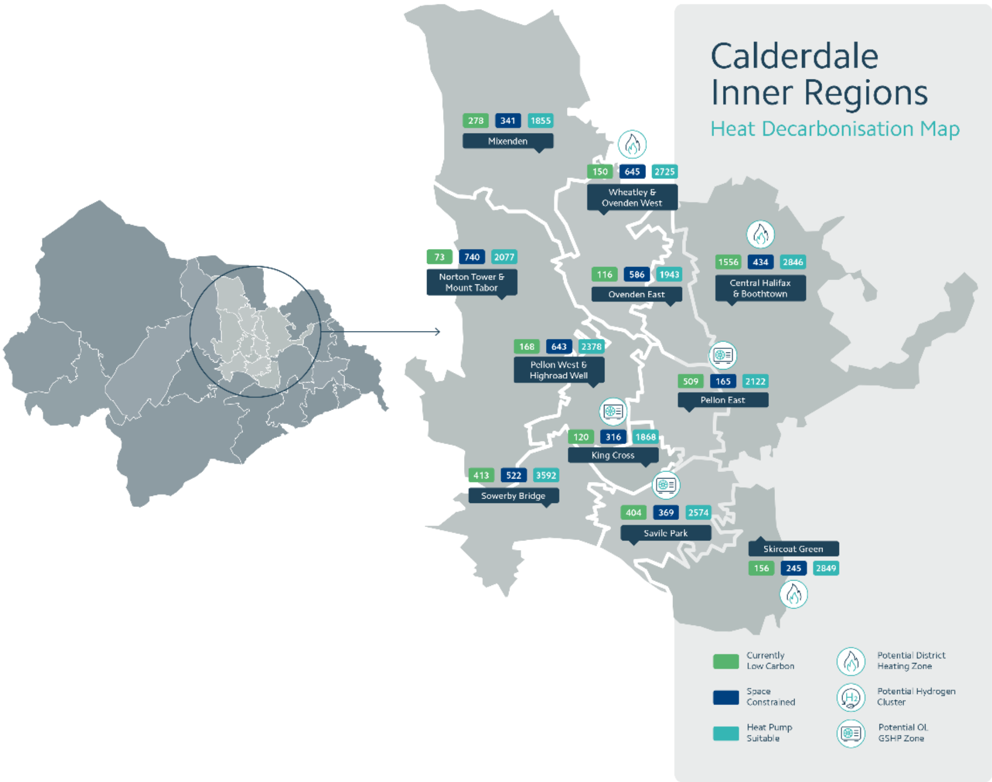

Figure 20. Heat Decarbonisation for Calderdale's Inner Region

The techno-economic analysis for decarbonisation of heat indicated that installing a heat pump will increase fuel costs for most homes in the borough currently using a gas boiler, unless an annual average coefficient of performance (COP) of above 3 can be achieved. While the widespread rollout of heat pumps across domestic properties represents the biggest opportunity to save carbon across the borough, it is important that fuel poverty is not exacerbated.

Sensitivity analysis indicated that when one (or more) of the following conditions are met, it is likely that heat pumps can be rolled out across most homes in the borough without increasing energy bills and the risk of fuel poverty:

- The cost ratio of electricity to gas reduces to 3.4:1 or lower - currently it is around 3.74:1. The advisory body NESTA3 has recommended a ratio of 2.5:1 is adopted by the UK Government to encourage widespread heat pump adoption and ensure decarbonisation targets are met.
- Heat pumps with an average coefficient of performance (COP) of 3.2 or higher at high supply temperatures become widespread on the UK market - due to the UK's cold wet climate, heat pumps (designed for warmer climates) often operate at lower efficiency than their rated conditions. Technological advancements in heat pumps can now provide high temperature hot water to radiators without compromising on efficiency, meaning that more householders should be able to install heat pumps in the UK without needing extensive retrofit or increasing their fuel bills.

3 NESTA are a registered charity and advisory body to the UK Government, aiming to increase "social good" through innovation.

- The capital cost of heat pumps reduces by around 25% - when the cost falls to this level, it will be cost competitive with gas boilers across their lifespan, including running costs, even without external funding.

3.2.1.2 Non-domestic Heating

Brighouse, Elland, Hebden Bridge, Wheatley and Ovenden West were the zones with the highest percentage of non-domestic buildings potentially suitable for alternative heat sources.

Many non-domestic buildings within Calderdale will have to stop using fossil fuels for heating if the borough is to reach its targets of net zero by 2038. A much higher percentage of non-domestic buildings are currently using a low carbon heat source (predominantly electric), compared to domestic buildings (see Figure 21).

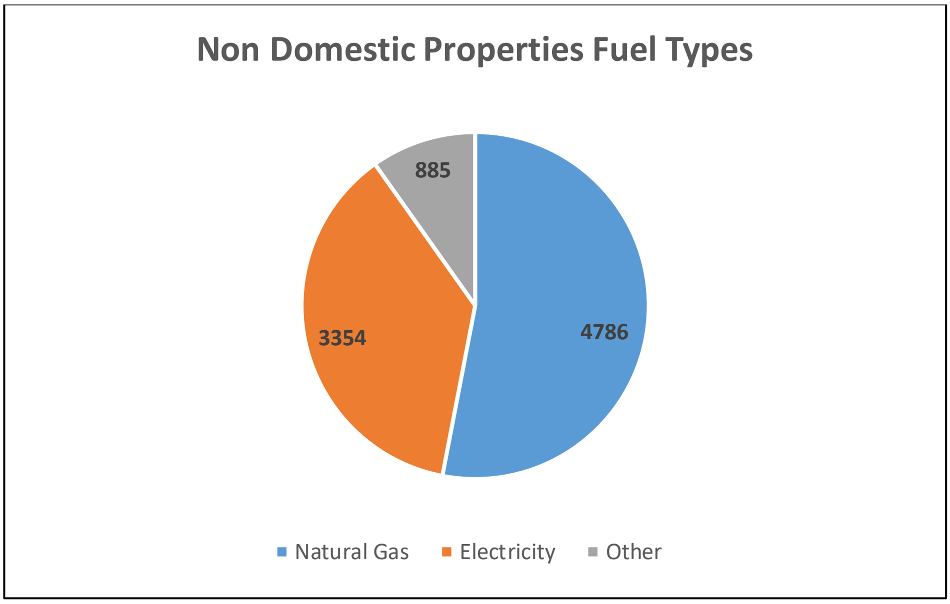

Figure 21. Fuel Types Used in Non-domestic Properties

The chart below (see Figure 22) outlines the number and type of new heating installations that will likely be required across non-domestic buildings per zone. Detailed data was not available on the heating systems across non-domestic buildings, so all properties not in a potential district heat network or hydrogen cluster zone were marked as requiring a heat pump – those buildings which are already using an older less efficient electric heating system will likely require upgrading before 2038.

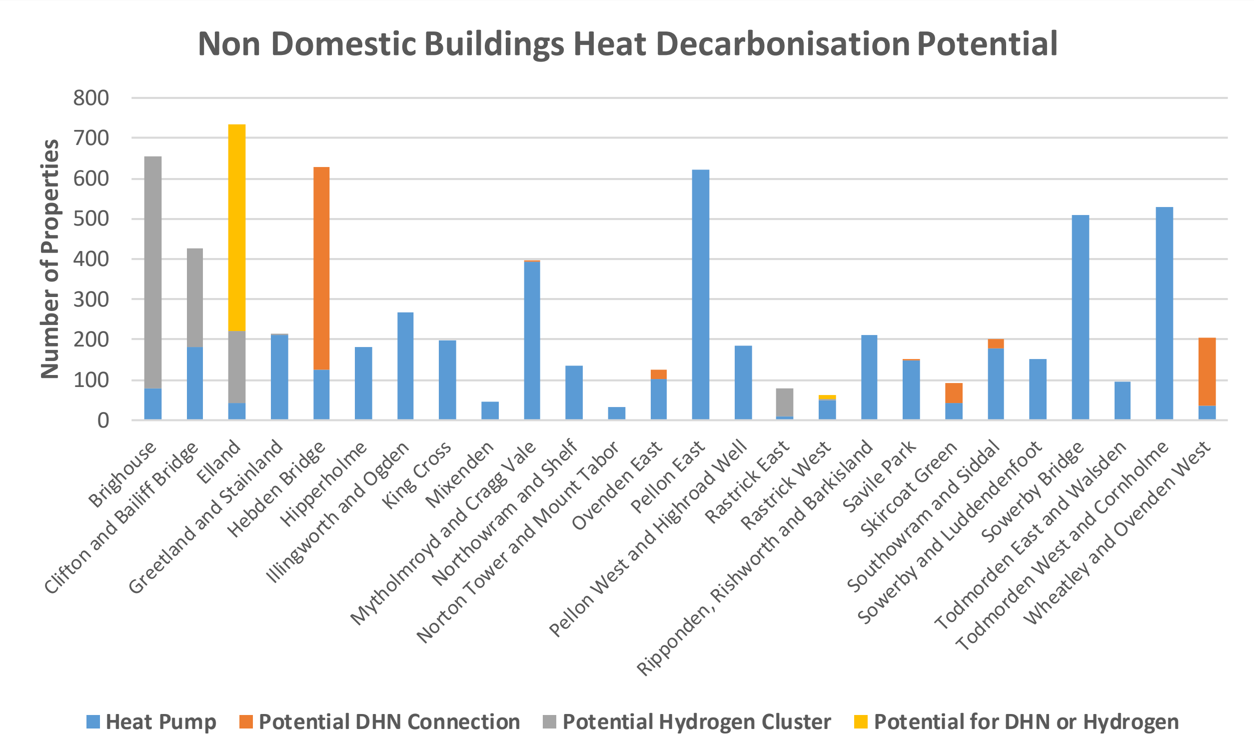

Figure 22. Non-domestic Buildings Heat Decarbonisation Potential

**Note: The 'Central Halifax and Boothtown' zone has been excluded from the graph above due to its significant amount of non-domestic properties putting the y axis scale out of sync. This zone has ~800 non-domestic properties that will likely require a heat pump, and ~1000 that may be suitable for a district heating connection.*

3.2.1.3 District Heat Networks and Indicative Hydrogen Zones

The pathway diagram below (see Figure 23) shows the key actions required for heat networks in Calderdale to reach net zero.

Figure 23. Heat Networks LAEP Pathway to Net Zero

The map below highlights the areas in Calderdale that have been identified as having the potential for either a district heat network or having hydrogen for heating supplied via an industrial cluster. It is unlikely that any hydrogen pipelines will be installed in Calderdale by the 2038 target, this would likely have to be tankered in via road or generated via small scale production on site. In 2037, there is a possibility that the extension of the hydrogen distribution pipelines further into West Yorkshire, may enter south-east Calderdale, where the bulk of the borough's industrial demand is located. More detailed assessments are required to understand the technical and commercial viability of these schemes, and which hydrogen transportation method will be the most viable for transporting hydrogen to these sites.

Of the zones below (see Figure 24), Holywell green is likely the most technically feasible site for an industrial hydrogen cluster, and Skircoat Green is likely the most technically feasible site for a district heat network – see section 4.2.3 for further details.

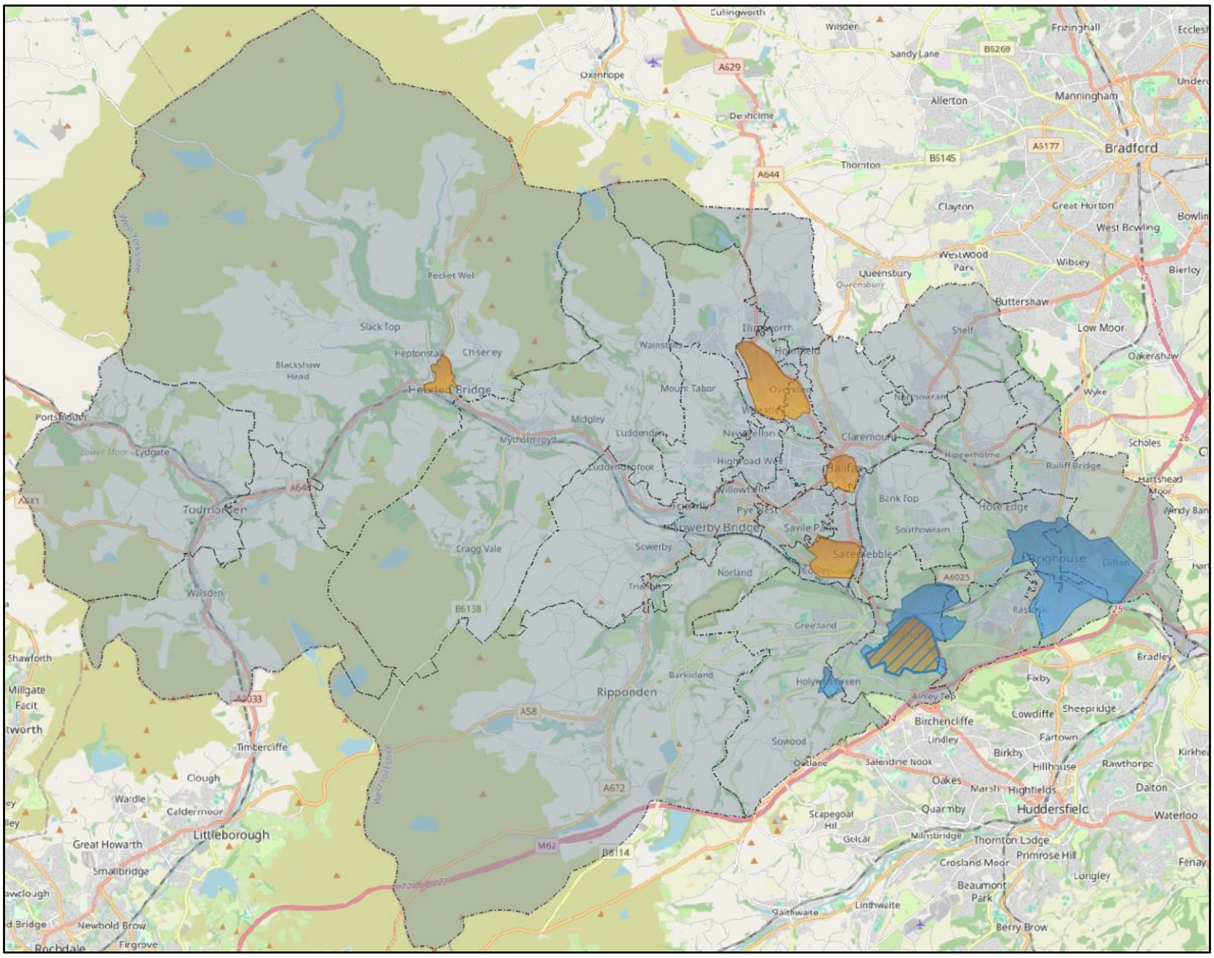

Figure 24. Calderdale Potential for District Heating or Hydrogen Clusters

Hydrogen zones were mainly identified through looking at areas with a high prevalence of industrial buildings. The smaller zone in Holywell Green was identified through stakeholder engagement.

One of the industrial buildings in the area highlighted that they have very high temperature processes operating 24/7, which currently requires natural gas and will likely need hydrogen to decarbonise. This area has a high prevalence of older, solid stone, potentially hard to treat homes so if hydrogen is being produced at (or supplied to) a nearby manufacturing site at some point in the future, having local homes and businesses use this hydrogen may prove more cost effective than retrofitting and installing heat pumps on each property.

A key next step for the LAEP will be to identify and map other industrial premises that have high temperature process loads in Calderdale and use this information to refine the existing hydrogen cluster zones, and potentially define new ones as well.

District heating zones highlighted on this map have been generated by using the digital twin model to identify areas where there is a heat demand density. Mapping also considers factors such as number and size of potential anchor loads, any nearby low carbon heat sources (such as waste heat or rivers and canals), or the potential to reduce fuel poverty. These zones are indicative only; further development will require more detailed feasibility studies to be carried out.

The UK Government recently announced new regulatory measures to encourage the uptake of heat networks across England. The zones in the LAEP represent a good starting point to begin this official zoning process from, but do not meet the statutory requirements for development of a heat network as set out in the legislation. For that, a more detailed linear heat demand density analysis will be needed. Funding and support are available from the UK Government to help develop district heat networks through the Heat Network Delivery Unit and the Green Heat Network Fund[4].

The table below outlines the justification for each indicative heat network zone highlighted in the map above (see Figure 24).

Table 8. Justification for Indicative Heat Network Zones

Heat Network Location	Justification
Hebden Bridge	Two possible low carbon heat sources (the Rochdale Canal and the river Hebden Water); there are several non-domestic buildings which could represent an anchor load (a regular, consistent heat demand is required for a heat network to be cost-effective) when combined; has many old stone buildings which may be complex to decarbonise.
Ovenden	Domestic building stock in this area has higher heating demands than the typical Calderdale average home; high rates of fuel poverty, maximising the potential social benefit of low-cost heat that could be provided from a heat network.
Central Halifax	High concentration of heat demand in a relatively small geographical area; several possible anchor loads; there is already a small scale open-loop ground source heat pump installed serving a large commercial building which could potentially be a starting point for any new heat network development.
Skircoat Green	Calderdale Royal Infirmary could be an excellent anchor load; waste heat may be available from the nearby wastewater treatment plant; includes many properties in a conservation area which may be complex to decarbonise with potential planning issues regarding the external parts of a heat pump.
Elland	River Calder is a potential low carbon heat source; many industrial buildings are located in this zone which could act both as potential anchor loads or as a source of waste heat; high proportion of solid stone properties which may be complex to decarbonise.

4 Further information: https://www.gov.uk/government/collections/heat-networks

3.2.2 Primary Zone Visualisations

3.2.2.1 Off-gas Grid Fossil Fuel Heated Homes

In the short term, homes most suitable for immediate adoption of heat pumps, without requiring extensive fabric retrofit works, are those currently using LPG or oil boilers which have cavity walls (rather than solid brick or solid stone walls). These homes should be able to install a heat pump without seeing an increase in household energy bills.

Older, solid wall homes in off-gas grid areas will likely need deep retrofit works before low carbon heating is installed.

The map below (see Figure 25) shows that Hebden Bridge has the highest number of off-gas grid fossil fuel heated homes, with nearly 400. The homes in more rural areas which are not pre-1920s solid stone should be targeted first for heat pump adoption before more widespread rollout can occur. Ripponden, Rishworth and Barkisland are the zones with the second highest number of off-gas grid, fossil fuel heated homes, with around 300 properties.

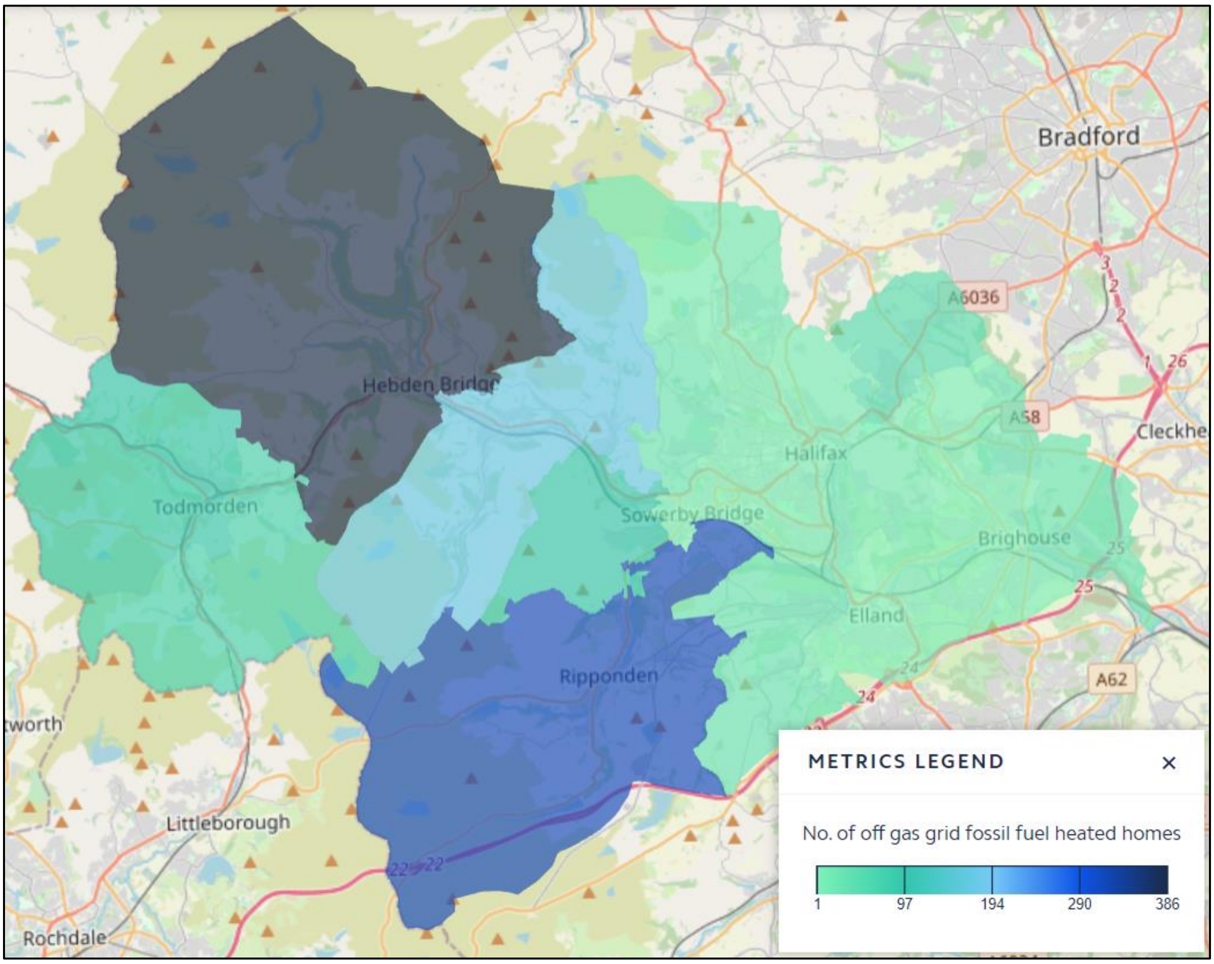

Figure 25. Number of Off-gas Grid Fossil Fuel Heated Homes

3.2.2.2 Potential for Shared Open-Loop Ground Source Heat Pumps

King Cross is the zone with the highest percentage of homes suitable for shared open-loop ground source heat pumps on terraced streets. Pellon East, Saville Park, Skircoat Green and Brighouse also have high percentages of suitable homes.

In addition to the larger potential district heating and hydrogen cluster zones previously described, there is also scope for smaller scale shared heat networks at street level. These would entail rows of terraced properties sharing a high capacity open-loop ground source heat pump, which could provide heat to the whole street.

Implementing this type of project would require more detailed feasibility studies and a potential demonstrator innovator project, as well as buy-in from key stakeholders such as all homeowners, landlords and Northern Powergrid.

Shared open-loop -heat pumps could potentially provide the most benefits for solid brick or solid stone terraces that would otherwise be complex to decarbonise. The zones have been visualised in terms of the percentage of homes suitable for this technology as shown below (see Figure 26). An individual property was deemed suitable for this technology if it was on a solid wall terraced street constructed before 1950.

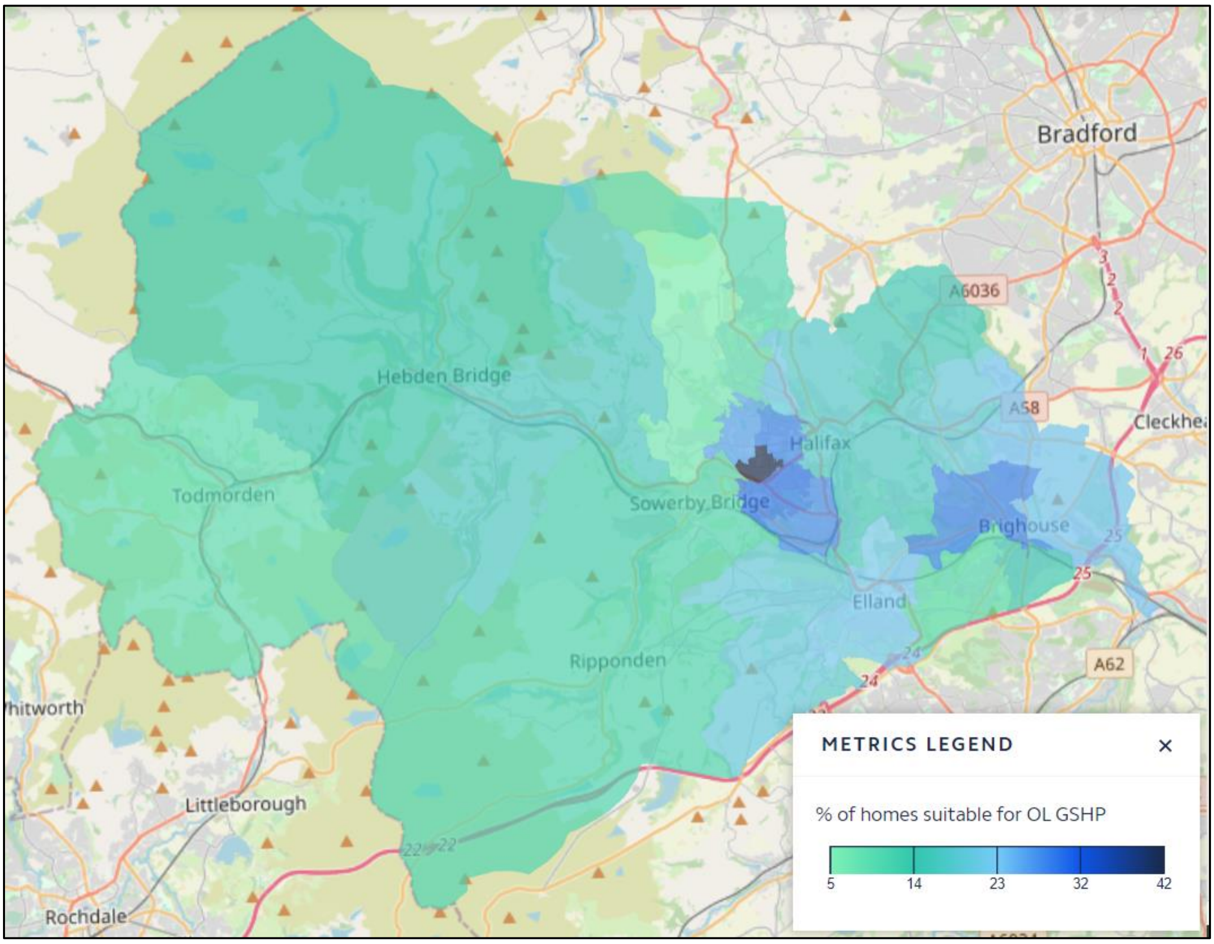

Figure 26. Homes Suitable for Open Loop Ground Source Heat Pumps

3.2.3 Focus Zones for Priority Projects

3.2.3.1 King Cross – Shared Open-Loop Ground Source Heat Pumps

King Cross has the highest percentage of homes suitable for shared open-loop ground source heat pumps of all primary zones, at 42%. The area has high levels of fuel poverty, so the benefits of less expensive, low carbon heat could provide greater social value here.

Secondary substations in the area tend to be less constrained than in other zones, meaning significant energy network upgrades are less likely to be needed to meet the high electrical demands of heat pumps. Further feasibility work will be needed to explore and model this in more detail.

The image below (see Figure 27) shows the digital twin filtered to show all domestic properties potentially suitable for shared open-loop ground source heat pumps highlighted in red. The entire King Cross zone is shown in the bottom of the image, with Pellon East to the east of the screen, and Pellon West and Highroad Well to the west. Both zones contain properties that would also be suitable for shared open-loop ground source heat pumps.

A specific street to progress for a demonstrator innovator project could be selected from the King Cross zone following consultation with key stakeholders.

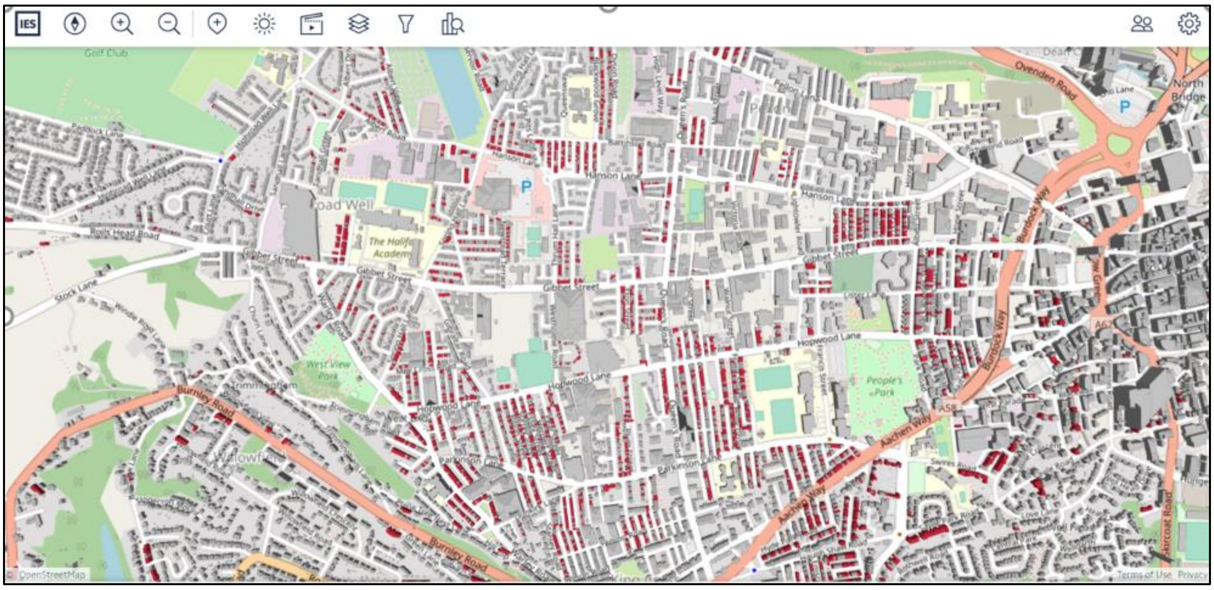

Figure 27. Domestic Properties Potentially Suitable for Shared Open-Loop Ground Source Heat Pumps

3.3 Renewable Generation

3.3.1 Overview and Pathway to Net Zero

The pathway diagram below (see Figure 30) shows the key actions needed for renewable generation in Calderdale.

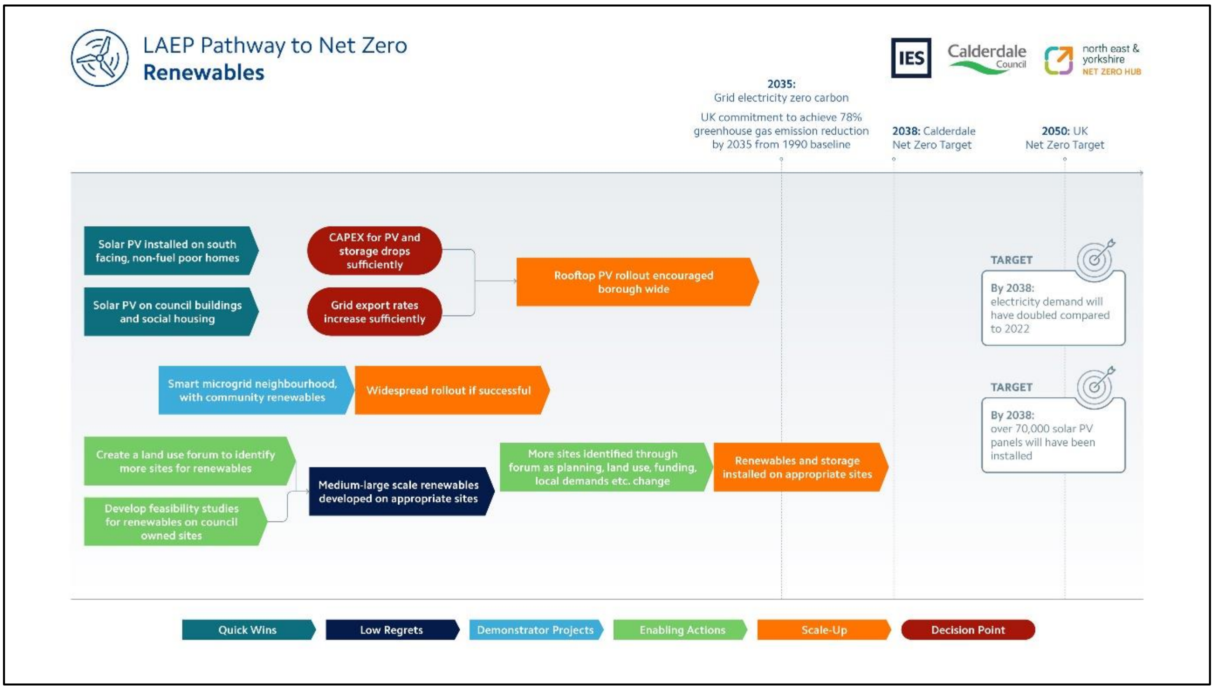

Figure 28 Renewables LAEP Pathway to Net zero.

Calderdale's electricity usage is projected to double from circa 800GWh per year to over 1600GWh per year to reach net-zero, predominantly from the electrification of heat and transport. It is important that as much of this increased electrical demand as possible can be met by locally generated clean electricity, to reduce costs for the end user and prevent emissions for electricity increasing.

The most viable renewable technology for the borough is currently solar PV panels, based on current planning policy and technology costs. However, as planning restrictions regarding onshore wind change in the future then there could be potential for wind generation as well. Calderdale's Planning Service is currently considering the preparation of a new planning document on energy and related matters in order to help the Council to achieve its net zero ambitions.

Battery Energy Storage Systems (BESS) will also play a key role in the decarbonisation of Calderdale's energy systems, from small scale domestic batteries up to large capacity energy storage sites used for grid balancing. The techno-economic analysis indicated that battery storage systems will typically increase the expected payback period of a solar PV array for the average Calderdale household. However, it is expected that as local smart grids and demand side response systems become more common, domestic battery storage will become more cost-effective.

There have been some planning applications put forward for large scale battery energy storage systems in Calderdale which, if developed, would contribute towards the grid being ready for wide spread electrification of heat and transport.

There may also be scope for micro-hydro developments at various locations throughout the borough; however, these would be dependent upon further feasibility work to assess financial viability, which is more likely to be positive if there are high electricity demands located near to the site.

An increase in renewable generation is required from small scale rooftop solar PV on homes and business, right up to large scale renewable generation development on suitable areas of land.

3.3.2 Suitability of Domestic Buildings for Solar PV

Greetland and Stainland, and Sowerby Bridge are the two zones with the highest number of homes that are 'very suitable' or 'moderately suitable' for rooftop solar PV panels (77% and 81% respectively). A suitability assessment was undertaken using the calculated areas of rooftop space available and orientation of each building. The number of homes suitable for solar PV in each primary zone is shown in the graph below (see Figure 31).

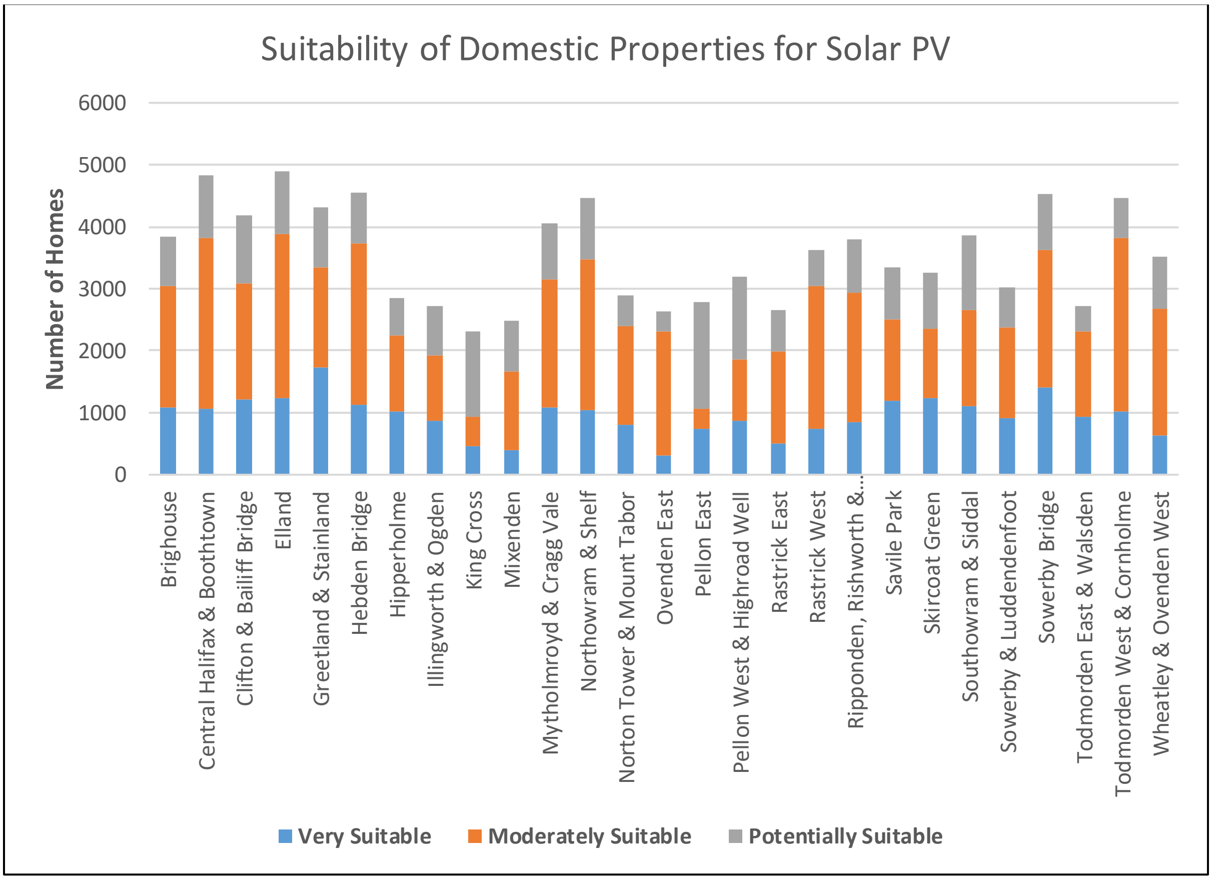

Figure 29. Suitability of Domestic Properties for Solar PV

The most suitable homes for roof top solar PV are typically those with larger south-west facing roofs through to south-east. Homes categorised as 'potentially suitable' in the graph above (see Figure 31) are typically facing east or west.

The proportion of homes suitable for rooftop solar PV in each category is broadly similar across each zone. King Cross, Mixenden and Ovenden East have the least number of suitable homes due to the high proportion of homes in streets that run from north to south (with east and west facing rooftops). Homes in these zones also typically have a smaller roof area.

There is currently no funding available from the UK Government for domestic solar panels, meaning that homes at risk of fuel poverty may not be able to afford the up-front costs.

Sensitivity analysis indicated that if the price of solar PV panels and battery storage continues to drop at the current rate, then solar PV will likely become cost-effective for most households within the next 5-7 years. The increase in tariffs from energy suppliers offering generous rates for exported electricity, and for supply / demand balancing through a household battery, will also help to make solar PV panels more affordable for most households.

It is recommended that in the short term, solar PV is predominantly installed on socially rented houses, with landlords and homeowners that can currently afford to do so installing it if they wish – with a widespread rollout encouraged once the capital costs have dropped by around 20-25%.

There is scope to encourage more widespread adoption of solar PV in the short term through community-owned renewable schemes. In a scheme like this, a group of homeowners and landlords could communally purchase solar PV panels for their street or neighbourhood together, reducing costs through economies of scale. This has the potential to save residents energy bills with the potential to connect renewable energy into a local smart micro-grid with battery storage, electric vehicle charge points and potentially electrified heat all communicating with each other to balance electricity supply and demand. Such a scheme could also potentially reduce the need for grid upgrades in the area and provide consistent income, through export-tariffs and grid balancing, if the battery energy storage system was sufficiently large enough. Further feasibility work would be needed to explore this concept, and a community energy group would need technical experts and project management capacity in order to deliver a scheme such as this.

3.3.3 Zone Overview Solar PV Generation

One of the key opportunities and priorities, identified by several businesses during the stakeholder engagement sessions held during the development of the LAEP, is the potential for solar PV to reduce energy costs while also decarbonising energy use.

The primary zones in Calderdale have been ranked based on the total potential for rooftop solar PV generation on domestic and non-domestic buildings respectively. Elland is the highest-ranking priority zone for Calderdale, due to its high number of larger non-domestic buildings, such as warehouses, industrial sites and larger retail properties, which have significant roof areas that may be suitable for solar PV.

The map below (see Figure 34) shows that rural areas have a higher potential for total domestic rooftop solar PV generation. For commercial and industrial buildings (see Figure 35), the two zones with the highest potential are Elland and Central Halifax and Boothtown. Central Halifax and Boothtown has more than twice the number of non-domestic buildings of any other zone, hence the high generation potential here.

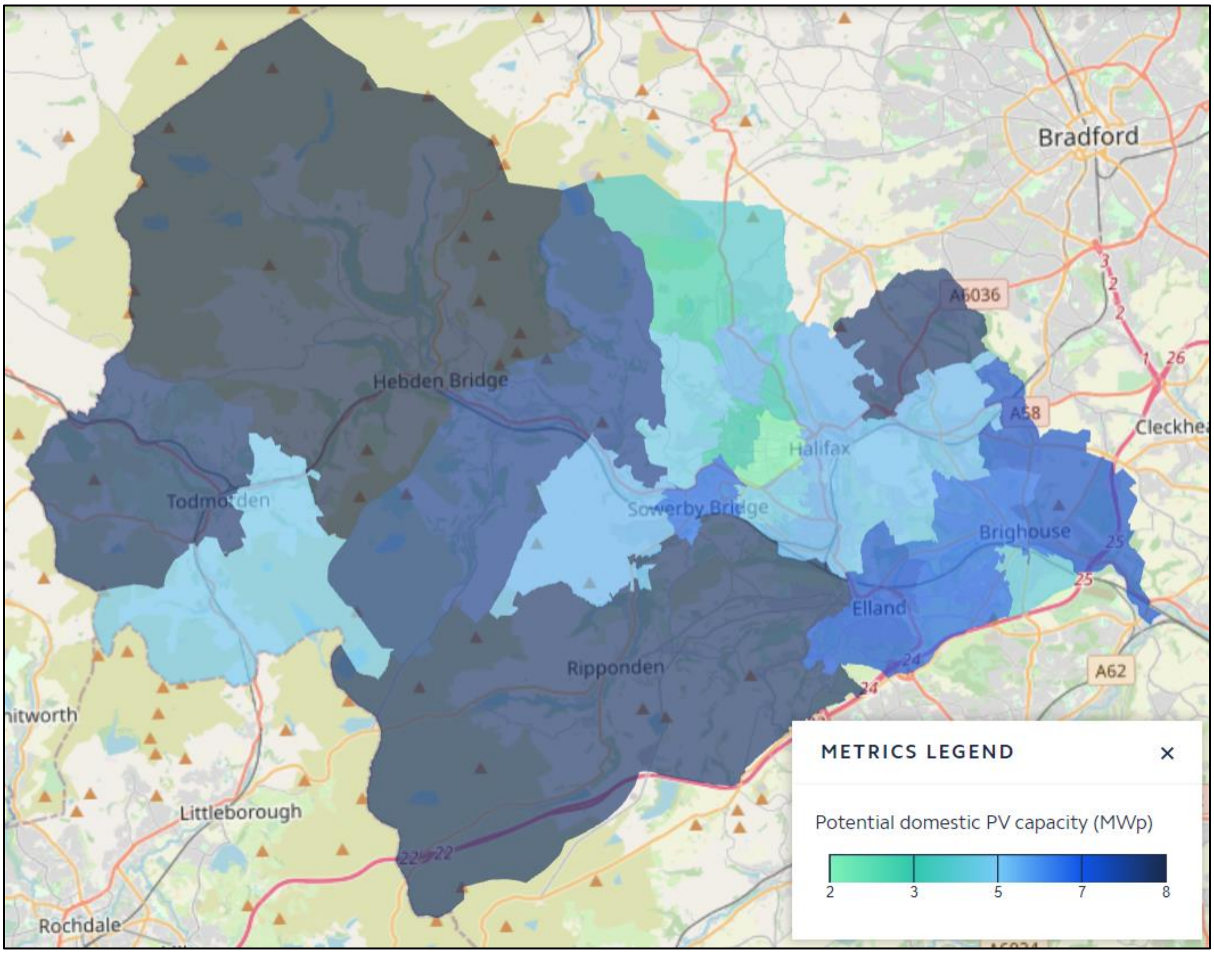

Figure 30. Potential for Domestic Solar PV Generation

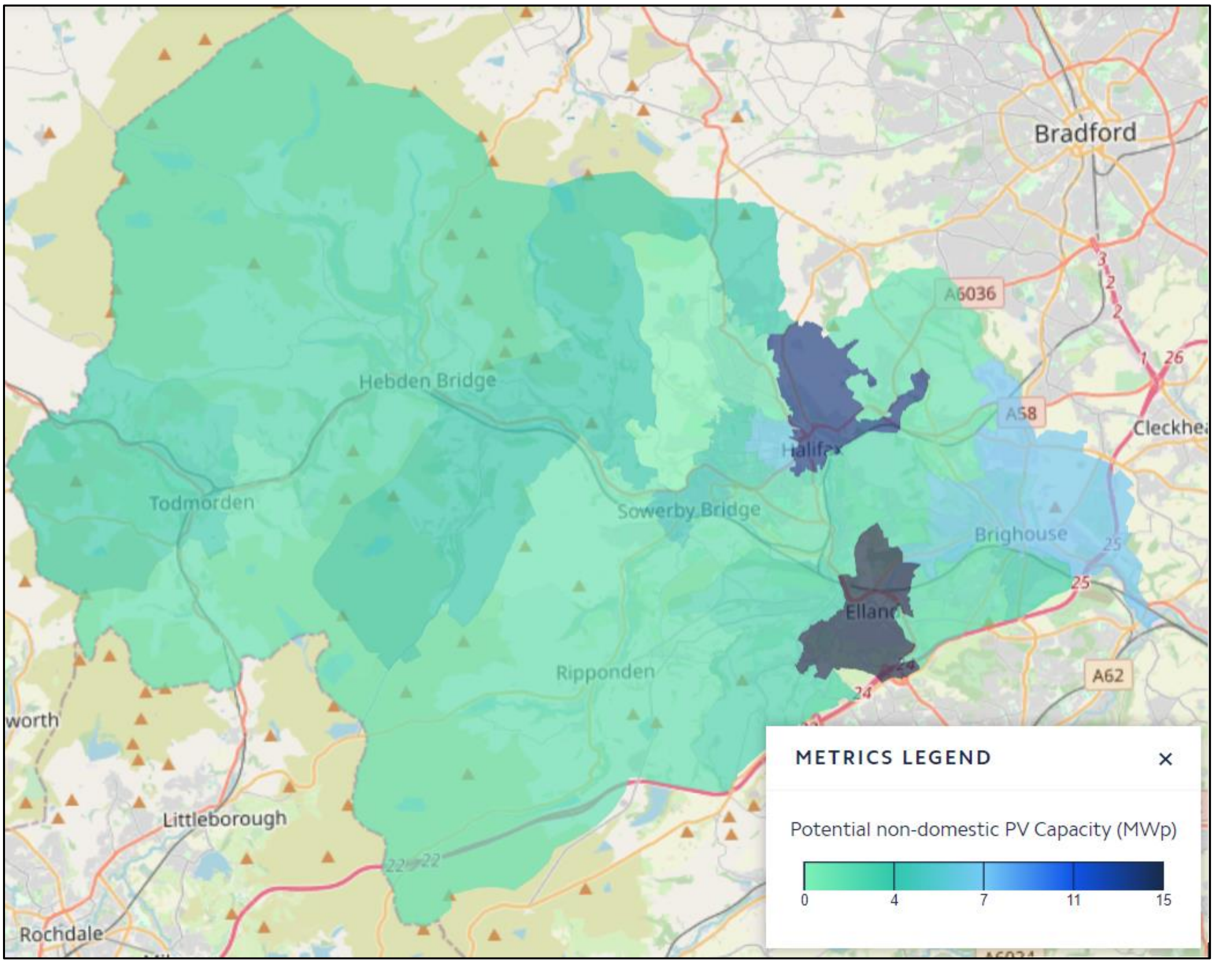

Figure 31. Potential for Non-domestic Solar PV Generation

3.4 Electric Vehicle Charging Infrastructure

3.4.1 Overview and Pathway to Net Zero

The pathway diagram below (see Figure 37) shows the key actions required for EV charging for Calderdale to reach net zero.

Figure 32. Transport EV Charging LAEP Pathway to Net Zero.

Emissions from transport make up a significant proportion of Calderdale's carbon footprint, around 38%, and represents one of the largest sources of fossil fuel consumption.

The UK Government currently plans to ban the sale of new combustion engine vehicles in 2035. Further national policy will be needed to drive transportation decarbonisation to enable the borough to meet its 2038 target, with additional action required locally.

Projects to install on-street electric vehicle (EV) charging infrastructure across the borough are now being delivered, funded through the UK Government's Local Electric Vehicle Infrastructure (LEVI) scheme and managed by the West Yorkshire Combined Authority (WYCA) in partnership the West Yorkshire districts.

A key component when planning required infrastructure for the coming uptake of EVs and electrification of transport, is determining which areas will require public charging points. Areas with a large proportion of homes with off-street parking (typically detached and semi-detached houses) will likely require less public charging points, as they have off-street parking and could install a charge point at home.

The tables below order the primary zones by the estimated percentage of homes unlikely to have off street parking available.

Table 9. Primary Zones by the Estimated Percentage of Homes Unlikely to Have Off-street Parking Available

Zone	No. of homes unlikely to have off street parking	% of homes unlikely to have off street parking
King Cross	1,329	58%
Pellon East	1,539	55%
Pellon West & Highroad Well	1,672	52%
Ovenden East	1,294	49%
Todmorden West & Cornholme	2,139	48%
Central Halifax & Boothtown	2,289	47%
Savile Park	1,508	45%
Sowerby Bridge	2,035	45%
Todmorden East & Walsden	1,164	43%
Elland	2,073	42%
Hebden Bridge	1,878	41%
Mixenden	1,021	41%
Skircoat Green	1,280	39%
Brighouse	1,482	38%
Southowram & Siddal	1,482	38%
Mytholmroyd & Cragg Vale	1,517	37%
Clifton & Bailiff Bridge	1,493	36%
Greetland & Stainland	1,525	35%
Wheatley & Ovenden West	1,236	35%
Sowerby & Luddendenfoot	1,044	35%
Ripponden, Rishworth & Barkisland	1,258	33%
Illingworth & Ogden	866	32%
Hipperholme	895	31%
Norton Tower & Mount Tabor	897	31%
Rastrick East	823	31%
Rastrick West	1,103	30%
Northowram & Shelf	1,332	30%

Transport for the North (TfN) have modelled the expected public charging provision that will be required in each zone in more detail, and the full results of this can be viewed on their interactive tool[5]. Some key visualisations and metrics from the TfN modelling work has been presented later in this section of the report. Data used highlights areas where large increases in electrical demand from EV charging is expected so that the local authority and Northern Powergrid can plan accordingly.

The graphic below (see Figure 38) represents a heat map using data from Northern Powergrid's net zero compliant Distribution Future Energy Scenarios (DFES), highlighting the areas (in darker red) where the biggest increase in EV charging demand is expected. Unsurprisingly, the more densely populated areas have a higher expected increase in EV charging demand. It is important the projections from Northern Powergrid and TfN are used when developing plans for charging infrastructure.

5 https://evcivisualiser.z33.web.core.windows.net/

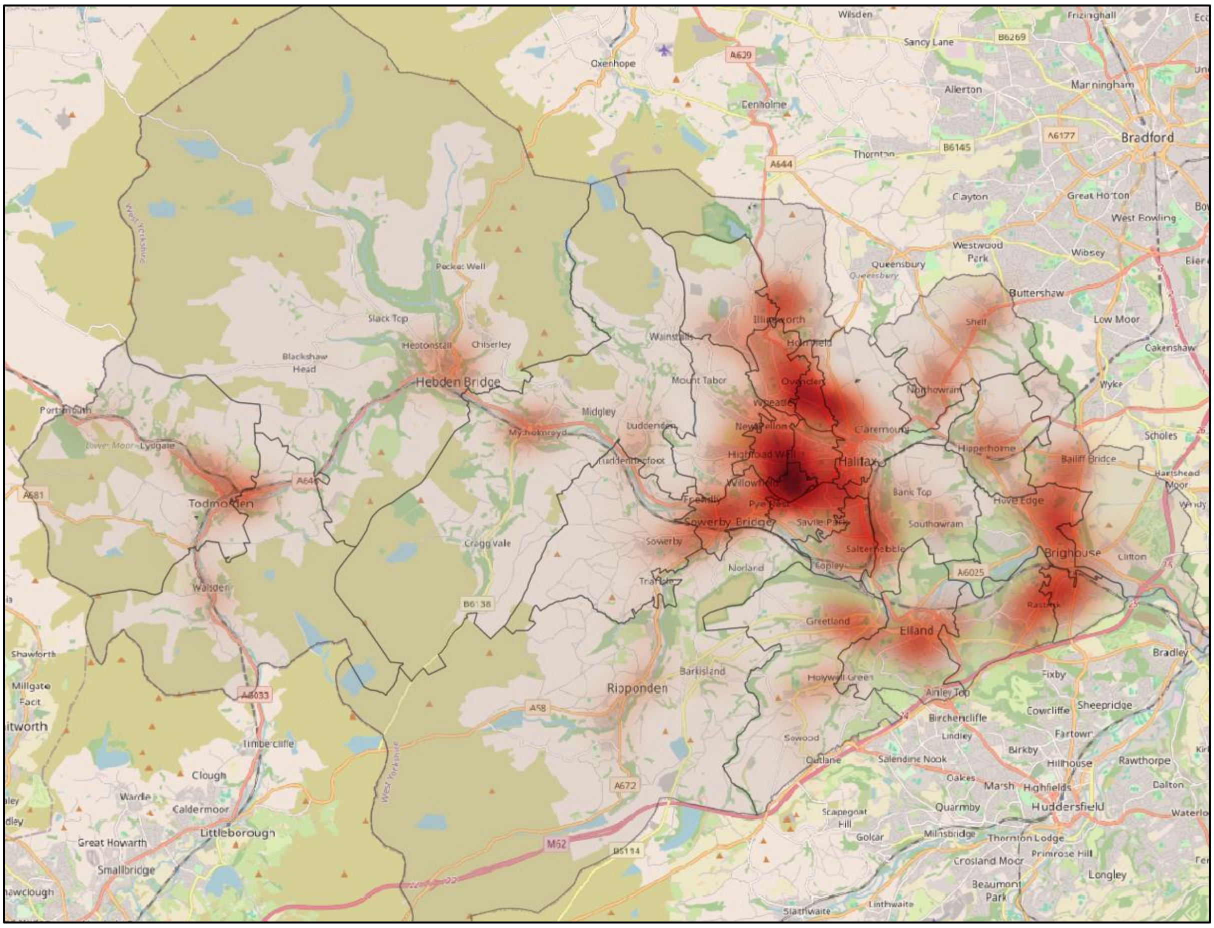

Figure 33. Heat Map for Locations of Largest Expected Increase in Electric Vehicle Charging Demand

3.4.2 Zone Visualisations from Transport for the North

3.4.2.1 Public Electric Vehicle Charge Points

TfN estimate that over 2100 public EV charge points will be needed across Calderdale. These installations should be phased based on expected electricity demand increases and supply side network constraints on the grid, as well as ensuring equitable coverage for all. It is important to work with Northern Powergrid to ensure that the local network is ready to incorporate this extra demand.

The map below from Transport for the North (see Figure 39), highlights the expected number of public EV charging points required per zone in Calderdale by 2040.

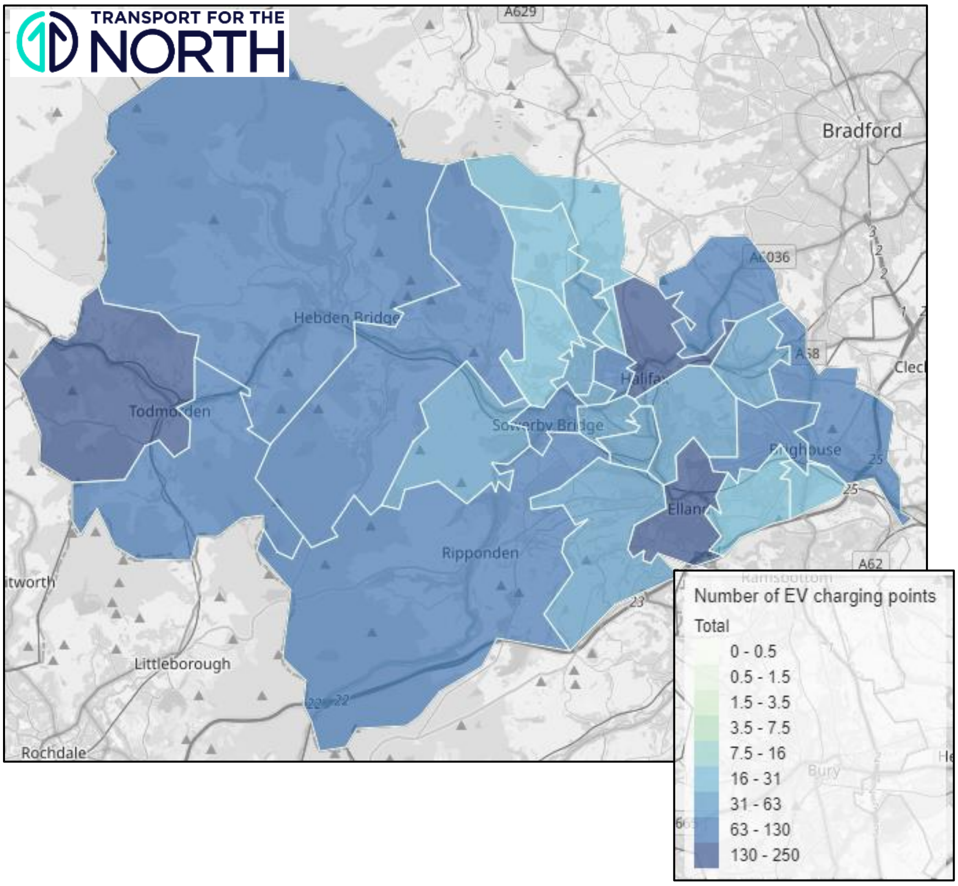

Figure 34. First Round of Public Charging Installations

Homes most likely to install a home charging point in the short term are those with off street parking in non-fuel poor areas. Homes that are most likely to require communal or public charging points are mainly terraced housing and flats.

The maps below outline the projected public residential charging demand (See Figure 40) and home charging demand (see Figure 41) per zone by 2040.

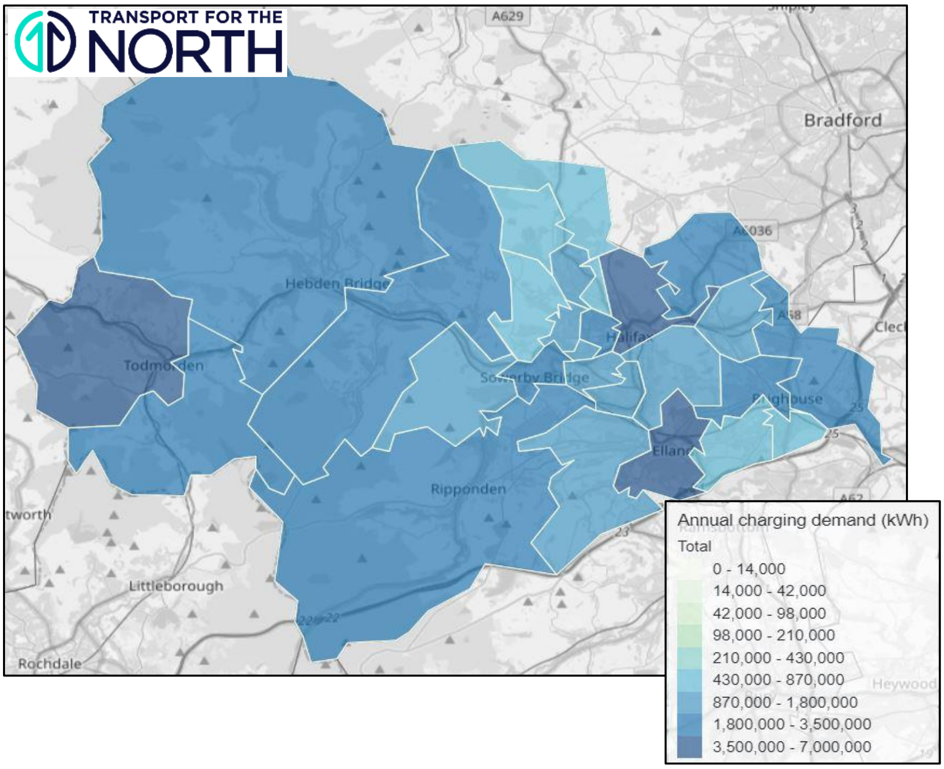

Figure 35. Estimated Public Annual Electric Vehicle Charging Demand 2040

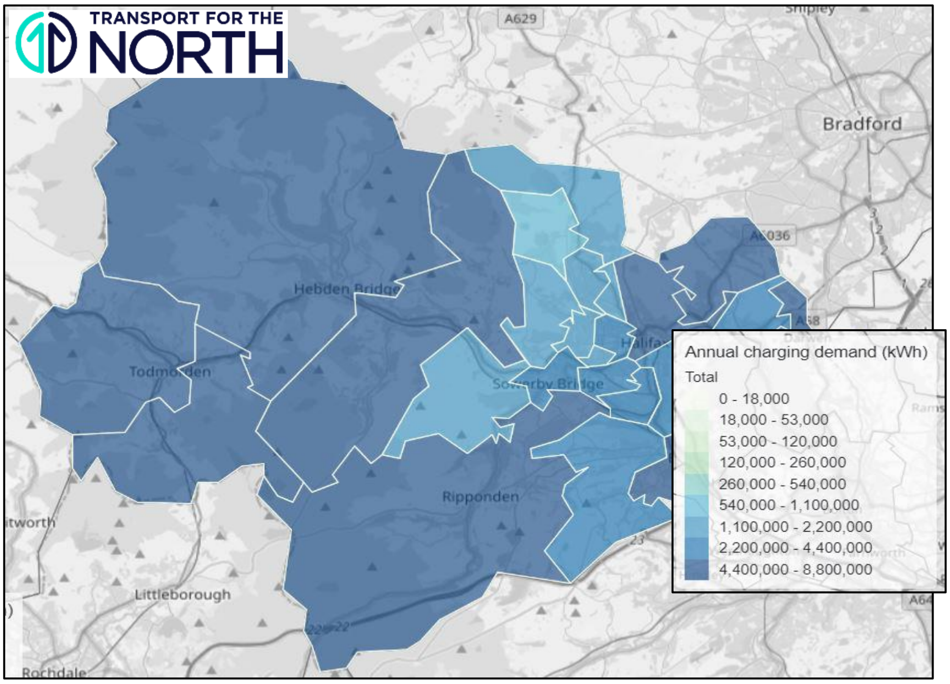

Figure 36. Estimated Home Annual EV Charging Demand in 2040

The estimated annual home charging demand (kWh) highlighted in shades of blue on the map (see Figure 41) shows a significant amount of additional electricity will be required for public EV charging across nearly all of Calderdale's zones in the coming years. For densely populated areas where there are space constraints this may represent a challenge.

Zones with predominantly narrow terraced streets, such as those in King Cross and Pellon East, may struggle to have enough space for the required public EV chargers needed.

It is important that the council works closely with the planning team and Northern Powergrid to identify suitable potential alternative solutions. The West Yorkshire Electric Vehicle Infrastructure Strategy and Local Electric Vehicle Infrastructure (LEVI) programme should be referred to for further clarifications in this area.

3.4.2.2 Focus Zones for Priority Projects

Elland is projected to have one of the largest public charge point requirements of all zones and has been identified (using Northern Powergrid's data) as a high-priority area for future EV charging infrastructure.

A report by consultant Arcadis has outlined the first locations where public EV chargers should be installed in Calderdale based on projected demand (see Figure 39). These charge point locations are shown below (see Figure 42), represented by the red dots.

Once these charge points have been installed, future charging locations should be determined in collaboration with Transport for the North (TfN). The TfN project data is extremely useful for determining where charging infrastructure gaps might be.

Most of the zones (identified by TfN) showing a high demand for public charging infrastructure in the future, have some EV charge point provision identified in the Arcadis report and its recommendations; with the exception of Elland which is projected to have one of the largest public charge point requirements of all zones.

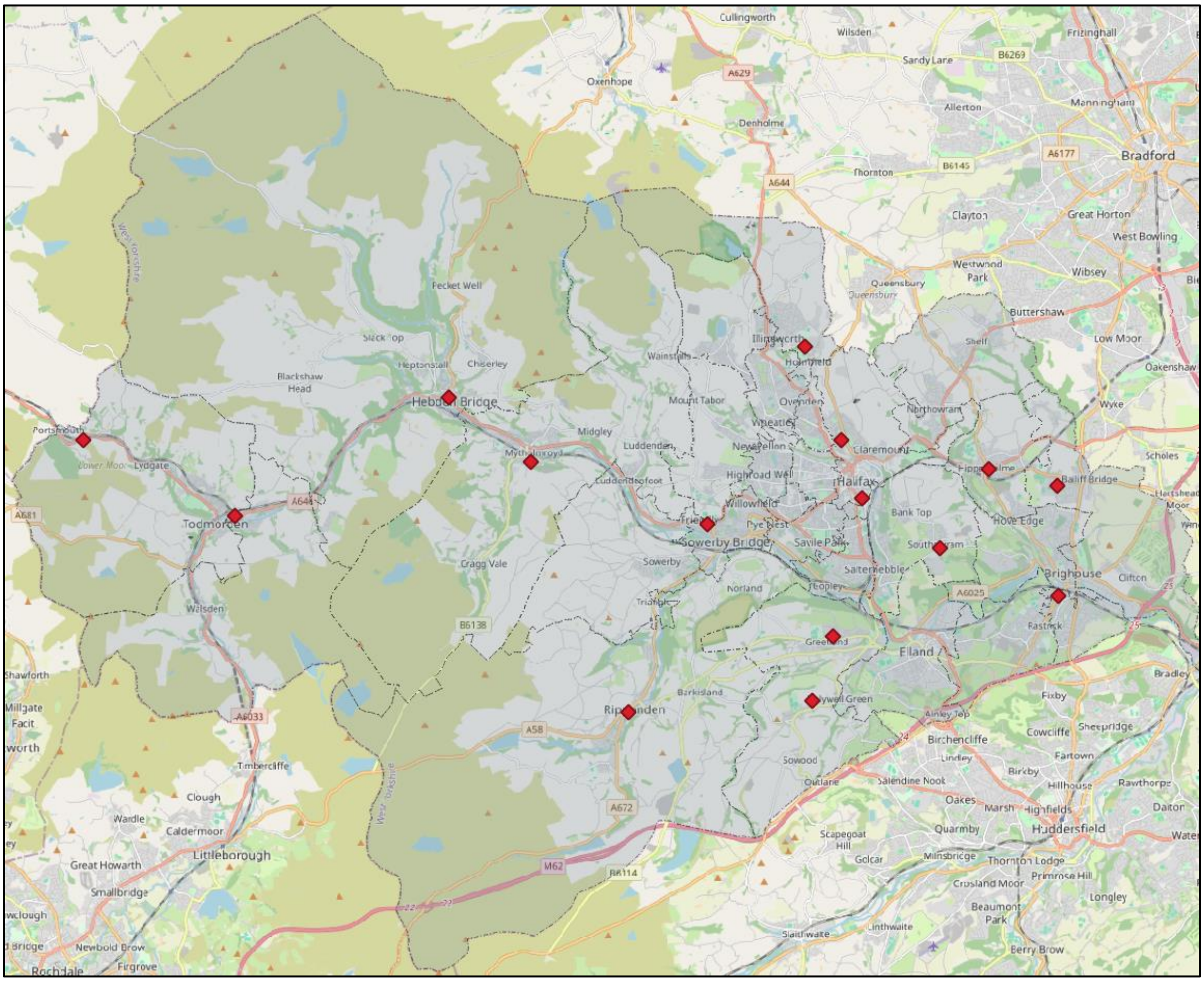

Figure 37. Locations for Public EV Charger Installation in Calderdale

3.5 Networks and Flexibility

3.5.1 Overview

To reach net zero by 2038, electricity demand in Calderdale will likely double. It is important that the council works closely with Northern Powergrid to ensure the electricity network is ready to take on the additional demand, with infrastructure upgrades being applied at the right time in the right place.

Flexibility schemes may be able to reduce the extent of the required grid infrastructure upgrades needed in some areas; upgrades will be required at all levels of the network, including upgrading existing grid supply points, constructing new primary and secondary substations, and re-laying wires and cables. The costs of these upgrades are estimated to be around £40 million[6].

The red dots on the map below (see Figure 44) show postcode areas that will definitely require some form of network upgrade to accommodate the electrification required to reach net zero.

A combination of projected electrical demand increases from the digital twin model, and current substation loading data from Northern Powergrid was used to estimate this, and it should be used as a high-level initial assessment only. More detailed network upgrade planning will be required as more energy demands start to electrify.

[6] This figure is a high-level estimation provided by Northern Powergrid based on the projected electrical demand increases from modelling undertaken with the digital twin

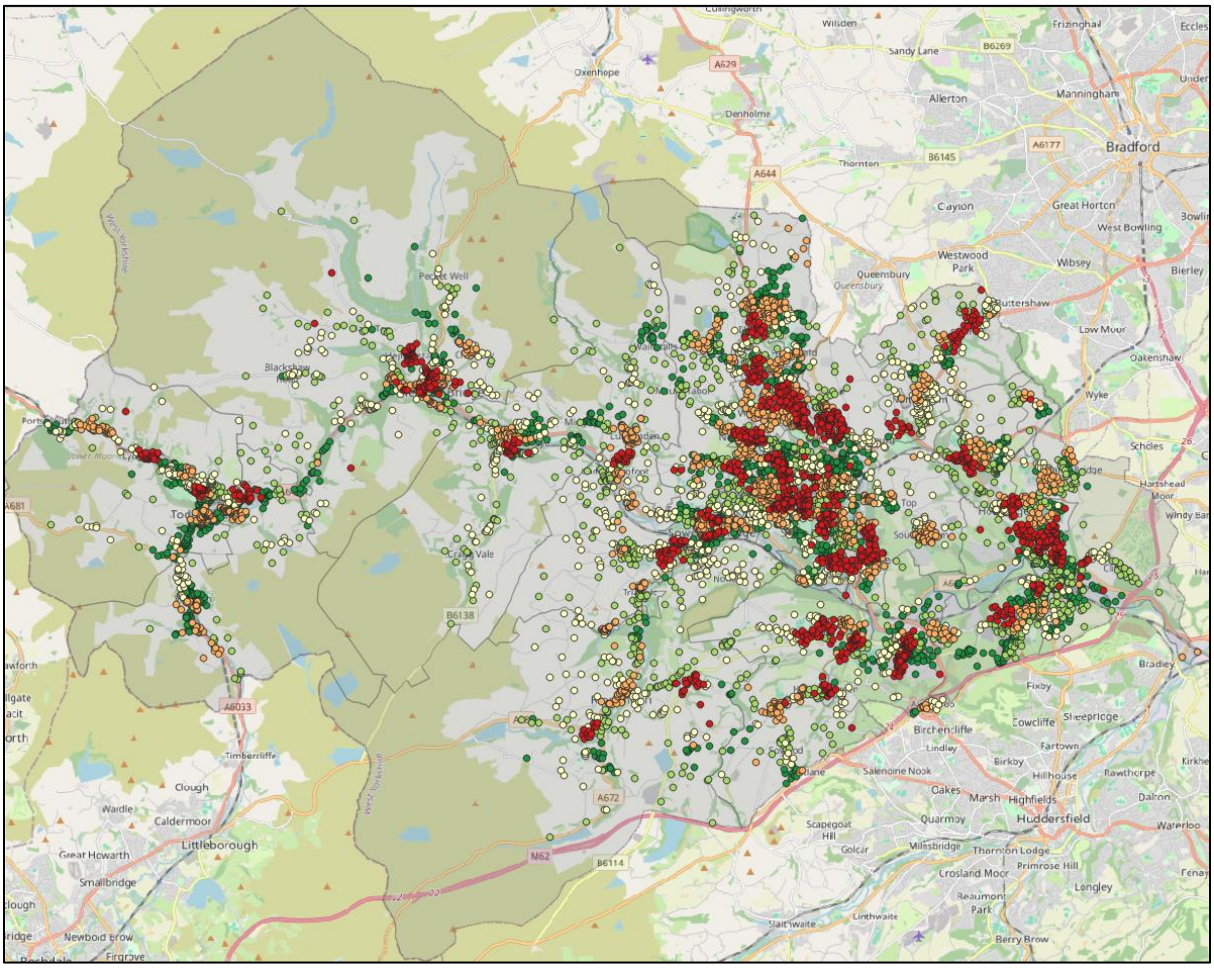

Figure 38. Areas that Require Electricity Network Upgrades to Reach Net Zero

Note: The red dots represent postcodes where network upgrades will definitely be needed, orange represents those that probably will be needed, yellow possibly, light green probably not, and dark green definitely not.

3.5.2 Zone Breakdown

The percentage utilisation of secondary substations that each home is connected to, has been split into four bands in the chart below (see Figure 44), across each primary zone. This shows that for nearly every zone the most common loading percentage is 25-49%; which means that there are locations in most zones that can proceed with heat and transport electrification without overloading the grid.

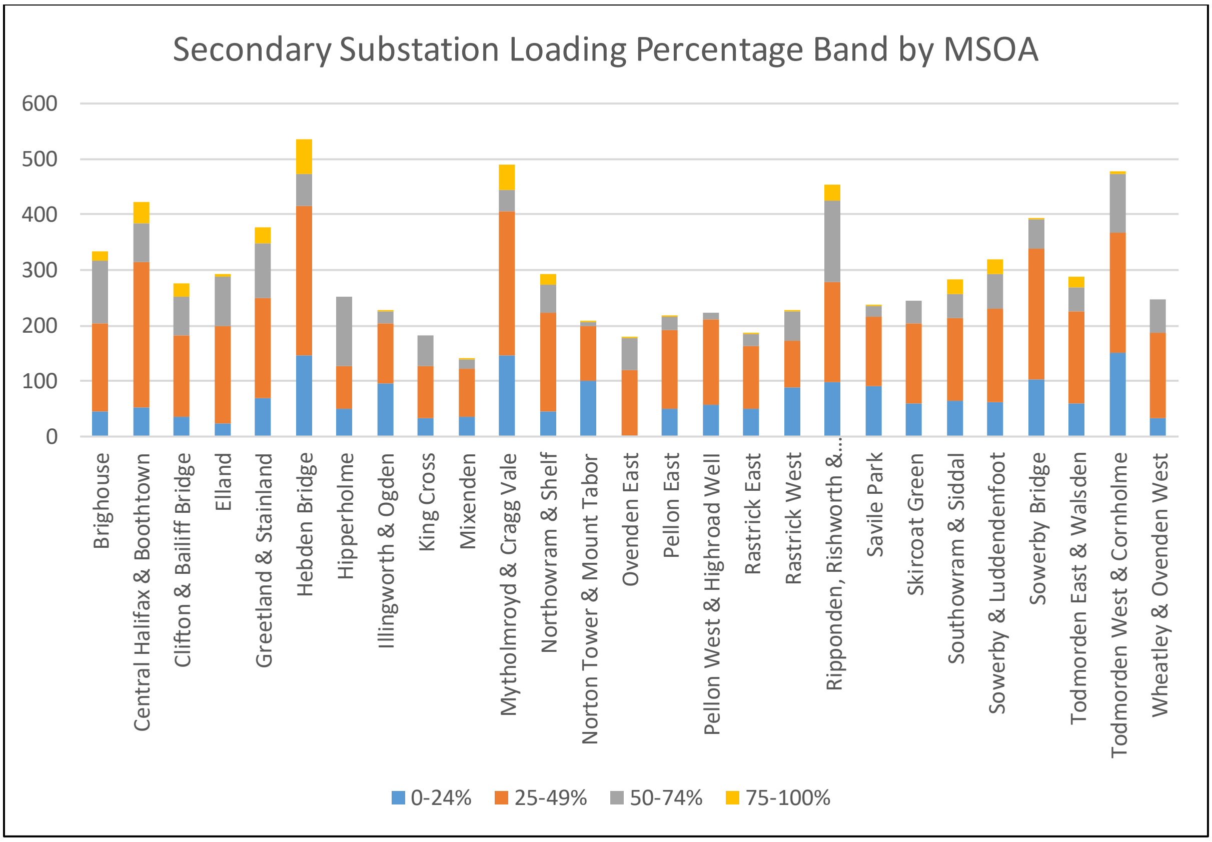

Figure 39. Secondary Substation Loading by MSOA

There are no primary zones identified that have an average utilisation value of over 50% which supports the notion that most zones can proceed with electrification in the short term. However, it is important to note that this is an average across each primary zone; each zone includes several secondary substations (and cabling etc.). While a zone may have lots of free capacity on average, there may still be some substations that are constrained and will require upgrading before heating demands are electrified.

The map below (see Figure 45) shows the average secondary substation utilisation percentage for each primary zone. Norton Tower and Mount Tabor have on average, the most available electricity capacity on the network for additional electrical demands. Ovenden East and, Clifton and Bailiff Bridge are the two primary zones with the lowest percentage of available electricity capacity, which means that these zones may require network infrastructure upgrades sooner than the other zones.

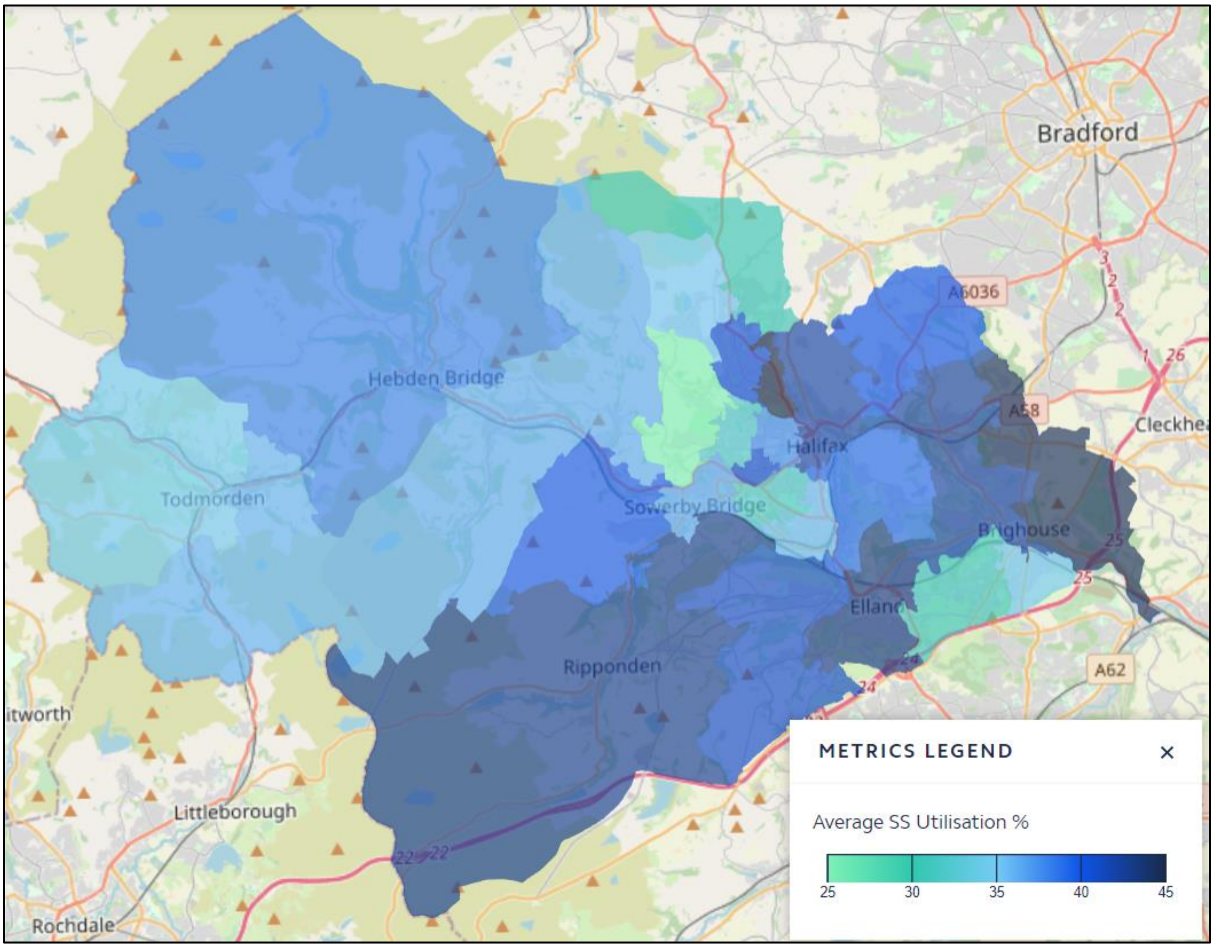

Figure 40. Average Substation Utilisation

3.5.3 Focus Zone for Priority Projects

A suggested location for a pilot project for aggregated demand side flexibility has been identified in Brighouse using the digital twin model.

Details were provided regarding an upcoming demonstrator scheme on network flexibility involving discounted energy bills for residents within a local area if they shifted their use of high consuming appliances out of peak time periods.

The digital twin was filtered to find homes at moderate to high risk of fuel poverty (that would benefit most from reduced bills), and that were also in a relatively constrained part of the grid, so that any benefits from demand-side management could be monitored.

A project such as this could both generate savings for residents and provide the council and distribution system operator (DSO) with valuable data on how aggregated demand side flexibility could help with grid balancing, and potentially reduce the need for expensive network upgrades.

Waring Green has been suggested as an initial indicative zone for this scheme. This will need to be refined in the future before any flexibility scheme is implemented, where the local authority will work with the national grid to determine a suitable location based on additional suitability criteria.

4. Next Steps

The Calderdale LAEP shows an optimal route to achieve net zero target. It also highlights initial projects for consideration. A 5-stage approach is suggested to take the LAEP and priority projects forward, to embed these within the region, attract investment and enable the LAEP to be monitored and updated over time.

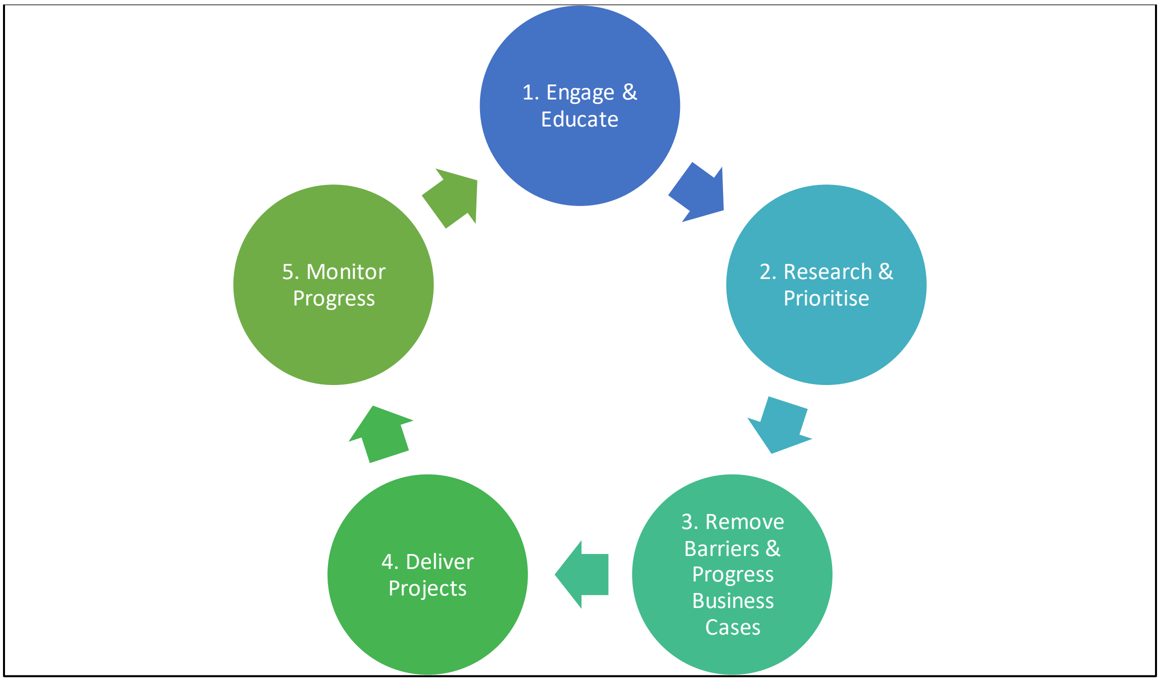

Figure 41. High Level Process for LAEP Implementation, Monitoring and Evaluation

Next steps are shown as a circular diagram as delivery of net zero is a long-term, iterative process. As projects progress this will trigger further work in an ongoing cycle.

1. Engage & Educate

The LAEP is an important document. The findings and analysis contained in this report will need to be communicated to a wide range of stakeholders. The following actions are recommended.

a) Launch the LAEP findings at an event for key energy system stakeholders and local decision makers – as this is the first LAEP in West Yorkshire, and the first time a digital twin has been used for data modelling at this scale in England, the Calderdale project has interesting learning to share and very visual engagement tools.
b) Creation of a separate dissemination plan to map out key audiences and opportunities for engagement – meetings where data could be presented by the project team. Many of the priority projects highlighted in the LAEP would require high levels of stakeholder engagement to deliver (from retrofit of private sector homes to businesses who could connect to heat networks). Early engagement to assess interest and appetite is important.
c) Consider whether the Calderdale Climate Partnership and Calderdale Council could be asked to endorse the LAEP. These groups could offer their support to embed LAEP findings in further connected strategies (e.g. Planning, Transport and Regeneration) and support delivery.

The Calderdale LAEP should also to continue to engage with the West Yorkshire Local Area Energy plans which are being created at present to ensure Calderdale's needs are represented and visible.

As projects move forward and modelling is updated, there will be a continuous need to update stakeholders to support Calderdale's net zero journey.

2. Research & Prioritise

This stage reflects the need for further work on the projects proposed within the LAEP report. Further technical and commercial viability and business case development is needed for each priority project – and once priority projects are delivered, further phases of work will be needed to support the whole Borough to transition to net zero. The Council will need to assess its appetite for involvement and risk within potential projects, the market's appetite to deliver these, and the roles other local stakeholders can play.

There are many lenses which could be chosen for prioritisation (carbon saving, social benefit, ability to attract private sector investment). An initial matrix to support discussions and aid decision making is outlined below, along with an explanation of the logic used for the scoring of each of the criteria.

Table 10. Matrix to Aid Project Priority Ranking

Project and Zone	No. of Homes Effected	Annual Carbon Savings (tCO_2e)	Investment Costs	Technical Complexity	Govt. Funding Scheme Available	Innovation Funding Suitability	Private Sector Finance Suitability	Confidence In Data
King Cross fabric upgrades	2065	1536	£9,455,645[7]	Low (medium for some solid wall homes)	Yes - ECO, HUG, LAD[8]	None	None	High
Todmorden West and Cornholme fabric upgrades	3459	4342	£13,036,430[4]	Low (medium for some solid wall homes)	Yes - ECO, HUG, LAD[7]	None	None	High
King Cross shared OL GSHP	up to 959	Up to 3464	Technical feasibility study required	Medium	No	High	Low	Medium
Skirtcoat Green District Heat Network	Up to 1600	Up to 7500	Technical feasibility study required	High	Yes - Green Network Heat Fund, Heat Network Delivery Unit	Low	Medium	Medium
Holywell Green Hydrogen	Up to 470	Up to 2761	Technical feasibility study required	High	No	High	Low	Medium

7 Including solid wall insulation

8 Some of these schemes may expire in 2025, when the UK Government's Local Authority Retrofit Scheme will start.

Industrial Cluster								
Ovenden East Community Renewables	Up to 2079	Up to 1350	Up to £6,750,000	Medium	No	Low	High	Low
Waring Green, Brighouse, demand side flexibility	Up to 600	n/a	Zero	Low	No	Low	None	Low

Table 10.1 Further Detail on Retrofit Costs

Zone	Average Cost per Household Light Retrofit	Average Cost per Household Deep Retrofit
King Cross	£2,308	£4,712
Todmorden West & Cornholme	£1,884	£3,802

With regards to the costs quoted, these are high level estimations calculated using UK Government costing data sets on typical costs for fabric improvements on different built forms. The digital twin data was used to determine the number of each type of built form, requiring each type of fabric improvement, and from this the overall costs per zone could be estimated

Delivery costs for a public sector led scheme are typically higher due to several factors, including:

- rooms such as bathrooms and kitchens often need to be removed and reinstated as a part of delivering internal wall insulation, and other rooms require redecoration
- planning permission requirements for external wall insulation
- inclusion of supplier guarantees / warranties
- costs for project management, resident engagement and scheme overheads

Figures quoted in this report help Calderdale to understand the quantum of investment needed across the Borough – however further work is needed to scope out and cost schemes ahead of these being investment ready.

Table 11. Logic for Criteria Scoring for Ranking Priority Projects

Factor	No Criteria	Low Criteria	Medium Criteria	High Criteria
Technical Complexity	n/a	Technology is well understood and widespread, although there may still be barriers and constraints to implementation in some cases	Technology is generally well understood, but there may be fewer examples of implementation nationwide compared to "low" criteria	Technology is either quite new with large uncertainties regarding the specifics of implementation, or has several significant technical barriers that will need to be overcome
Govt. funding	No standard funding scheme	n/a	n/a	Yes = there is currently a scheme available from the UK Government to

scheme available	available for the technology			fund the installation of the technology
Innovation Funding Suitability	Technology is considered standard and had widespread use	Same as none criteria, but could have small possibility of innovation funding depending on the specifics of implementation	Technology is less novel than "high" but could still potentially be considered for funding	Technology and/or implementation strategy is highly novel and there is a possibility of replication nationwide if successful.
Private Sector Finance Suitability	There are no options for private sector investment in this solution.	Private sector investment may be possible, but it is unlikely.	Private funding may be available, depending on technical feasibility and ownership structure	Private sector investment models are common for this technology
Confidence in data	n/a	Assumptions and high level estimations made to determine possible carbon emissions, not much relevant data in digital twin model	Some relevant data is included in the digital twin model	Relevant data is included in the digital twin model and have a high degree of confidence in the projected savings

3. Remove Barriers & Progress Business Cases

Any priority project chosen is likely to face barriers – as no project presented in the LAEP is already underway at the scale or extent proposed. Understanding stakeholders' roles, assembling project teams and feasibility budgets, assembling investment cases, constructing procurement strategies, meeting Planning requirements – these are all future steps to be taken and each will involve project team(s) overcoming barriers to progress projects to a delivery stage.

Further technical design and project work will need to be undertaken to create a clear technical specification, clarify environmental impacts and benefits, refine scope, and to explore delivery models. This will involve the following:

- Progress stakeholder engagement and soft market testing to refine plans and manage risk.
- Create strategies for scheme management, funding, procurement, and project resource.
- Gain investment from public or private funds if project is viable.
- Implement projects, creating governance and risk management processes as needed.

Learning from other projects and engaging with funding providers ((e.g., WYCA's Net Zero Region Accelerator or DESNZ' Heat Network Delivery Unit) are likely to be key in working efficiently and accessing expertise and funding to move forward. Early project successes should be highlighted to create confidence with communities and investors.

Engagement should also occur at this stage with local/national policy makers when it has been identified that policy hinders delivery of Calderdale's net zero targets. The Calderdale Climate Partnership's Influencing Strategy is an example of how local needs can be fed back to national government for discussing how specific changes could be made. The LAEP offers a powerful evidence base to support the Climate Action Partnership's Influencing work.

4. Deliver Projects

This stage concerns projects which have been progressed via business case development to investment stage. Each project will need a delivery team – whether at CMBC, staffed by an external partner, or who sit within a newly created special purpose vehicle which has been created as a new governance structure.

Delivery of most of the projects highlighted in this LAEP will involve multi-year construction phases. Inward investment will create new job opportunities and can link to wider neighbourhood renewal.

Project construction and delivery will be an intense and busy time. The project lead organisation will need to make sure teams have the skills and track record needed, and that there is adequate resourcing for engagement with key stakeholders to answer their questions about construction and educate about new technologies.

5. Monitor Progress

Monitoring progress towards net zero is important. The LAEP should not be a one-time exercise, but an ongoing, dynamic plan which is updated and changed as necessary. The Council in dialogue with West Yorkshire Combined Authority and Network Operators will need to discuss how often the plan can be reviewed. The digital twin could be updated as new information becomes available so that tracking progress towards the net zero goal can occur in real time.

Work is also underway to ensure that key monitoring indicators and data on Calderdale's net zero transition are presented via annual review of the Calderdale Climate Action Plan and an online performance dashboard.

We also note that there may be new technological developments that have not been modelled in this LAEP. As new technology becomes market ready, further investigation and scenario testing should be conducted to understand how this can help Calderdale to reach net zero and if any of the proposed pathway should be updated or changed. Examples of technologies which are anticipated include:

- Highly efficient thermal energy storage. This could allow space constrained homes to deploy a heat pump.
- Ultra-thin insulating wallpaper. This would allow for internal wall insulation to be completed with minimal disruption compared to current methods.
- Rooftop micro-wind. Efficiency improvements could mean that this becomes an efficient investment. Micro wind could offer additional options for some households and businesses and offer an option for buildings unable to install solar panels.
- More efficient solar panels could mean that buildings with a wider variety of roof orientations are able to affordably invest and see rooftop energy generation.

Appendix – Screen Reader Text Descriptions

Figure 1

Short term priority actions within the local area energy plan required to reach net zero by 2038.

Building Energy Efficiency

Action	Key
Light retrofit on homes that are below EPC rating C	Quick Win
External Wall Insulation for solid wall buildings on mixed tenure streets	Demonstrator Project
Produce list of homes eligible for deep retrofit funding	Enabling Action
Begin deep retrofit on these homes	Low Regrets
Produce list of 'complex to decarbonise' homes, not within heat zones	Enabling Action

Heat

Action	Key
Low carbon heating in social housing when boilers are replaced	Quick Win
Heat pumps installed in heat pump ready off-gas grid fossil fuel heated homes	Quick Win
Appropriate fabric measures on off-gas grid homes	Enabling Action

Heat Networks

Action	Key
Refine district heat network zones	Enabling Action
Compile a full list of businesses that have high temperature processes	Enabling Action
Refine site selection for shared open-loop ground source heat pumps	Enabling Action

Renewables

Action	Key
Solar PV installed on south facing, non-fuel poor homes	Quick Win
Solar PV on council buildings and social housing	Quick Win
Create a land use forum to identify more sites for renewables	Enabling Action
Develop feasibility studies for renewables on council owned sites	Enabling Action

Transport

Action	Key
Public charging points from Arcadis report installed	Quick Win
Assess suitability of public sites for EV charging – identified by Transport for the North	Enabling Action
Private chargers at non-fuel poor homes with off-street parking	Quick Win
Smart microgrid neighbourhood (with interconnected chargers)	Demonstrator Project

Figure 2

Total capital investment required in different intervention areas.

Intervention	Cost (£M)
Domestic Fabric Upgrades	291
Domestic Heat Upgrades	776
Non-domestic Heat Upgrades	560
Domestic PV & Storage Systems	385
Home EV Chargers	76
Public EV Chargers	54
Grid Upgrades	40

Figure 3

A map displaying the geographical boundary of the local area energy plan and the primary zones

Figure 4

Calderdale's historic carbon emissions from 2005 – 2020. It displays six key categories: industry total, commercial total, public sector total, domestic total, transport total, and Land use, Land-use Change and Forestry (LULUCF) Net emissions. The domestic total and transport total are the largest emitters, and LULUCF net emissions and public sector total have the least emissions. The overall trend shows a reduction in emissions from 1,600 ktCO_2e to around 900 ktCO_2e, with some fluctuations between 2008 and 2014.

Figure 5

A pie chart displaying Calderdale's current carbon emissions by sector. Waste management is responsible for 9% of Calderdale's emissions (100.5 ktCO_2e), Industry is responsible for 17% (189.2 ktCO_2e), the public sector is responsible for 3% (34.7 ktCO_2e), commercial is responsible for 3% (32.8 ktCO_2e), the domestic sector is responsible for 31% (334.5 ktCO_2e), transport is responsible for 32% (344.4 ktCO_2e), and agriculture is responsible for 5% (51.3 ktCO_2e).

Figure 6

A pie chart displaying Calderdale's use of energy in buildings. Space heating is responsible for 62% of Calderdale's building energy use (1816 GWh), domestic hot water is responsible for 10% (303GWh), lighting is responsible for 13% (391 GWh), equipment is responsible for 11% (309GWh), and 'other' is responsible for 4% (121 GWh).

Figure 7

Sankey diagram describing how energy from different sources supports different sections of the economy in Calderdale. Fossil fuels (oil, petrol, diesel and natural gas) represent our biggest energy sources at present. These predominantly supply transport and building heat. Transport is particularly dependant on fossil fuel at present.

Figure 8

Building energy efficiency pathway to net zero.

Light Retrofit

Action	Theme	Complete By
Light retrofit on homes that are below EPC rating C	Quick Win	2028
Light retrofit on other suitable homes	Quick Win	2035
Fabric measures on homes still missing EPC C target	Scale Up	2035

External Wall Insulation

Action	Theme	Complete By
External wall insulation for solid wall buildings on mixed tenure streets	Demonstrator Project	2028
If shown to be replicable	Decision Point	2028
Scale up to other appropriate streets	Scale Up	2035

Light Retrofit Next Steps

Action	Theme	Complete By
Homes still requiring fabric measures identified	Enabling Action	2038
Appropriate retrofit installed, finances depending	Scale Up	2050

Deep retrofit

Action	Theme	Complete By
Produce list of homes eligible for deep retrofit funding	Enabling Actions	2028
Deep retrofit these homes	Low Regret	2035
If CAPEX drops or more funding is available	Decision Point	2035
Deep retrofit on all other homes below EPC C	Scale Up	2038

Heat Zones

Action	Theme	Complete By

Produce a list of 'complex to decarbonise' homes, not within heat zones	Enabling Action	2028
Deep retrofit on these homes	Low Regret	2035
Decision on heat zones	Decision Point	2035
Deep retrofit measures on appropriate heat zone buildings	Scale Up	2050

Figure 9

A map with the potential for building energy efficiency measures for Calderdale's Outer Regions.

Figure 10

A map with the potential for building energy efficiency measures for Calderdale's Inner Regions.

Figure 11

Number of buildings and their level of required fabric retrofit by primary zone (MSOA).

	Light Retrofit	Deep Retrofit	No Retrofit
Brighouse	1594	1595	660
Central Halifax & Boothtown	1294	1865	1677
Clifton & Bailiff Bridge	1657	1458	1073
Elland	2207	1626	1063
Greetland & Stainland	1938	1638	736
Hebden Bridge	1368	2433	743
Hipperholme	1473	953	430
Illingworth & Ogden	1472	561	684
King Cross	1048	1155	101
Mixenden	1009	557	908
Mytholmroyd & Cragg Vale	1399	1819	844
Northowram & Shelf	2667	1179	617

Norton Tower & Mount Tabor	1799	480	611
Ovenden East	1661	732	252
Pellon East	1050	1097	649
Pellon West & Highroad Well	1762	1103	324
Rastrick East	1650	730	286
Rastrick West	2049	632	953
Ripponden, Rishworth & Barkisland	1268	1645	874
Savile Park	1219	1511	617
Skircoat Green	1237	1457	556
Southowram & Siddal	2129	1031	708
Sowerby & Luddendenfoot	1450	1062	505
Sowerby Bridge	1735	1848	944
Todmorden East & Walsden	1064	1154	504
Todmorden West & Cornholme	1548	2015	905
Wheatley & Ovenden West	1987	796	737

Figure 12

A map displaying the average risk of fuel poverty per household across each primary zone in Calderdale.

Figure 13

A map displaying the number of homes below EPC rating C across each primary zones.

Figure 14

A map displaying the percentage of homes eligible for funding across all primary zones.

Figure 15

A map displaying the EPC ratings of domestic properties in the Kings Cross zone at an individual building level.

Figure 16

A map displaying the EPC ratings of domestic properties in the Todmorden West and Cornholme Zone

Figure 17

Heat pathway to net zero.

Social Housing

Action	Theme	Complete By
Low carbon heating in social housing when boilers are replaced	Quick Win	2028

Heat Pumps

Action	Theme	Complete By
Heat pumps installed in heat pump ready off-gas grid fossil fuel heated homes	Quick Win	2028
Appropriate fabric measures on off-gas grid homes	Enabling Action	2028
Heat pumps installed after	Low Regret	2035
High coefficient of performance, high temperature heat pumps widespread on the market	Decision Point	2035
Some complex to decarbonise homes may electrify without deep retrofit	Scale Up	2038
All heating installations after fossil fuel boiler ban are low carbon	Scale Up	Ongoing

Affordability

Action	Theme	Complete By
Gas-electricity cost re-balancing to <3.4:1 ratio	Decision Point	2035
Heat pump CAPEX reductions of 25%	Decision Point	2035

Electrical storage heating on space constrained homes	Scale Up	2038
Widespread gas boiler replacement with heat pumps	Scale Up	2038

Figure 18

Domestic heat decarbonisation metrics per primary zone – this includes number of homes that are: currently low carbon, space constrained, heat pump, and potential for alternative heat source.

	Currently Low Carbon	Space Constrained	Heat Pump	Potential for Alternative Heat Source
Brighouse	380	498	2971	2012
Central Halifax & Boothtown	1556	434	2846	1290
Clifton & Bailiff Bridge	372	458	3358	1878
Elland	756	648	3492	3501
Greetland & Stainland	220	534	3558	952
Hebden Bridge	453	538	3553	1654
Hipperholme	121	386	2349	564
Illingworth & Ogden	96	263	2358	256
King Cross	120	316	1868	912
Mixenden	278	341	1855	101
Mytholmroyd & Cragg Vale	384	316	3362	634
Northowram & Shelf	229	672	3562	667
Norton Tower & Mount Tabor	73	740	2077	173
Ovenden East	116	586	1943	1808
Pellon East	509	165	2122	723
Pellon West & Highroad Well	168	643	2378	791
Rastrick East	118	439	2109	2133
Rastrick West	136	652	2846	923

Ripponden, Rishworth & Barkisland	511	274	3002	356
Savile Park	404	369	2574	969
Skircoat Green	156	245	2849	1942
Southowram & Siddal	373	850	2645	649
Sowerby & Luddendenfoot	134	418	2465	346
Sowerby Bridge	413	522	3592	421
Todmorden East & Walsden	272	310	2140	234
Todmorden West & Cornholme	361	471	3636	390
Wheatley & Ovenden West	150	645	2725	2819

Figure 19

Heat decarbonisation map for Calderdale's Outer Regions.

Figure 20

Heat decarbonisation map for Calderdale's Inner Regions.

Figure 21

A pie chart displaying non-domestic properties fuel types. 4,786 properties currently use natural gas, 3,354 properties currently use electricity, and 885 properties currently use 'other'.

Figure 22

The number of non-domestic buildings heat decarbonisation potential per primary zone (MSOA).

	Heat Pump	Potential District Heat Network Connection	Potential Hydrogen Cluster	Potential for District Heat Network or Hydrogen
Brighouse	79	0	576	0
Clifton & Bailiff Bridge	181	0	246	0
Elland	43	0	178	513
Greetland & Stainland	213	0	2	0
Hebden Bridge	124	506	0	0

Hipperholme	182	0	0	0
Illingworth & Ogden	268	0	0	0
King Cross	199	0	0	0
Mixenden	47	0	0	0
Mytholmroyd & Cragg Vale	395	1	0	0
Northowram & Shelf	135	0	0	0
Norton Tower & Mount Tabor	32	0	0	0
Ovenden East	101	24	0	0
Pellon East	622	0	0	0
Pellon West & Highroad Well	185	0	0	0
Rastrick East	9	0	69	0
Rastrick West	48	0	4	48
Ripponden, Rishworth & Barkisland	211	0	0	0
Savile Park	149	1	0	0
Skircoat Green	42	51	0	0
Southowram & Siddal	177	23	0	0
Sowerby & Luddendenfoot	152	0	0	0
Sowerby Bridge	509	0	0	0
Todmorden East & Walsden	95	0	0	0
Todmorden West & Cornholme	528	0	0	0
Wheatley & Ovenden West	35	171	0	0

Figure 23

Heat networks pathway to net zero.

District Heat Network

Action	Theme	Complete By
Refine district heat network zones	Enabling Action	2028

Feasibility studies, business cases	Enabling Action	2028
If any sites are financially viable	Decision Point	2035
Funding or policy changes	Decision Point	2035
Revisit feasibility studies	Enabling Action	2035
District heat network rollout: construction, commissioning, etcetera.	Scale Up	2035

Hydrogen Zones

Action	Theme	Complete By
Compile a full list of businesses that have high temperature processes	Enabling Action	2028
Re-assess hydrogen zones	Enabling Action	2028
Project to assess economic feasibility of small scale industrial hydrogen clusters	Demonstrator Project	2035
2026 hydrogen policy decision	Decision Point	2026
If positive, assess likely dates and pipe routes with Northern Gas Network, potential new zones	Enabling Action	2035
Encourage hydrogen boiler installation in suitable zones	Scale Up	2035
If negative, proceed with widespread electrification	Scale Up	2035

If heat electrification uptake too slow for 2038 target	Decision Point	2038
Further hydrogen zones assessment and roll out	Scale Up	2050

Shared Open Loop Ground Source Heat Pumps

Action	Theme	Complete By
Site refinement based on zones	Enabling Action	2028
Refine site selection for shared open loop ground source heat pumps	Demonstrator Project	2035
If cost effective, roll-out at scale	Scale Up	2035

Figure 24

A map displaying Calderdale's potential for district heating or hydrogen clusters.

Figure 25

A map displaying the number of off-gas grid fossil fuel heated homes per primary zone.

Figure 26

A map displaying the percentage of homes suitable for open-loop ground source heat pumps per primary zone.

Figure 27

A map displaying the domestic properties [potentially suitable for shared open loop ground source heat pumps.

Figure 28

Renewables pathway to net zero.

Solar PV

Action	Theme	Complete By
Solar PV installed on south facing non-fuel poor homes	Quick Win	2035
Solar PV on council buildings and social housing	Quick Win	2035

CAPEX for PV and storage drops sufficiently	Decision Point	2035
Grid export rates increase sufficiently	Decision Point	2035
Rooftop PV rollout encouraged borough wide	Scale Up	2035

Smart Microgrid

Action	Theme	Complete By
Smart microgrid neighbourhood with community renewables	Demonstrator Project	2035
Widespread rollout if successful	Scale Up	2035

Land Use Forum

Action	Theme	Complete By
Create a land use forum to identify more sites for renewables	Enabling Actions	2035
Develop feasibility studies for renewables on council owned sites	Enabling Action	2035
Medium to large scale renewables developed on appropriate sites	Low regrets	2035
More sites identified through forum as planning, land use, funding, local demands, etcetera change	Enabling Action	2035
Renewables and storage installed on appropriate sites	Scale Up	2035

Figure 29

Suitability of domestic properties for solar PV per primary zone. Metrics include number of homes and their suitability i.e.: very suitable, moderately suitable, and potentially suitable.

Figure 30

A map displaying the potential domestic solar PV generation capacity (Megawatt peak) per primary zone.

Figure 31

A map displaying the potential for non-domestic solar PV generation capacity (megawatt peak) per primary zone.

Figure 32

Transport electric vehicle charging pathway to net zero.

Public Electric Vehicle Charging

Action	Theme	Complete By
Public charging points from the Arcadis report installed	Quick Win	2035
Assess suitability of public sites for electric vehicle charging identified by Transport for the North	Enabling Action	2035
Public chargers installed at suitable locations	Low regret	2035
Reassessment of public charger and kerbside charging sites	Enabling Action	2035
Installation of new suitable sites	Scale Up	2050

Private Electric Vehicle Charging

Action	Theme	Complete By
Private chargers at non-fuel poor homes with off street parking	Quick Win	2035
Homes with off street parking install chargers as	Scale Up	2035

electric vehicles are purchased		

Smart Microgrid

Action	Theme	Complete By
Smart microgrid neighbourhood with interconnected chargers	Demonstrator Project	2035
Widespread rollout if successful	Scale Up	2035

Figure 33

Heat map displaying the locations of largest expected increase in electric vehicle charging demand.

Figure 34

A map displaying the expected number of electric vehicle charging installations per primary zone by 2040.

Figure 35

A map displaying the estimated public annual electric vehicle charging demand per primary zone by 2040.

Figure 36

A map displaying the estimated home annual electric vehicle charging demand per primary zone by 2040.

Figure 37

A map displaying the locations for public EV charger installations in Calderdale.

Figure 38

A map displaying the areas that require electricity network upgrades to reach net zero.

Figure 39

A bar chart displaying the secondary substation loading percentage by the number of homes per primary zone (MSOA).

	0-24%	25-49%	50-74%	75-100%
Brighouse	44	159	113	18
Central Halifax & Boothtown	52	263	70	37
Clifton & Bailiff Bridge	35	146	70	26
Elland	24	175	88	5
Greetland & Stainland	69	180	100	29
Hebden Bridge	147	269	58	62

Hipperholme	50	77	124	0
Illingworth & Ogden	96	109	21	2
King Cross	34	93	56	0
Mixenden	35	87	17	2
Mytholmroyd & Cragg Vale	145	261	38	46
Northowram & Shelf	44	179	51	19
Norton Tower & Mount Tabor	100	100	6	1
Ovenden East	3	117	57	1
Pellon East	50	141	25	1
Pellon West & Highroad Well	58	154	12	0
Rastrick East	50	113	21	3
Rastrick West	89	83	53	2
Ripponden, Rishworth & Barkisland	99	180	145	30
Savile Park	92	124	18	3
Skircoat Green	59	146	40	0
Southowram & Siddal	65	148	43	28
Sowerby & Luddendenfoot	61	169	62	28
Sowerby Bridge	103	235	54	1
Todmorden East & Walsden	59	167	43	18
Todmorden West & Cornholme	151	217	105	4
Wheatley & Ovenden West	32	156	60	0

Figure 40

A map displaying the average substation utilisation percentage per primary zone.

Figure 41

A flow diagram explaining the high level process for local area energy plan implementation, monitoring and evaluation. Step one is to engage and educate, step two is to research and prioritise, step three is to remove barriers & progress business cases, step four is to delivery projects, step 5 is to monitor progress. Step five flows back into step one.