GREATER MANCHESTER
LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Local Area Energy Plan

Rochdale, Greater Manchester

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0. EXECUTIVE SUMMARY

Context

Greater Manchester (GM) is committed to achieving carbon neutrality by 2038. To support this, it has a vision of each of its boroughs transforming their infrastructure, homes and buildings to be part of a smarter local energy system. Recognising the climate emergency, national Net Zero* commitments and the need to translate the strategic vision to an implementable plan of action, Greater Manchester is supporting each borough in the development of a Local Area Energy Plan (LAEP).

This LAEP aims to define the extent of the transformation needed across each borough (including a focus on identifying first steps to progress), and provide a robust evidence base and plan to help engage businesses and citizens in accelerating towards the carbon neutral goal.

Local Area Energy Planning

Energy Systems Catapult (ESC) developed the concept of Local Area Energy Planning (LAEP) as a mechanism of applying a whole system approach to the planning and design of Net Zero Local Energy Systems. The technologies and future trends considered and assessed for meeting Greater Manchester's carbon neutrality targets include: thermal insulation, heat pumps, district heating, electric resistive heating, hydrogen boilers, solar photovoltaics (PV), wind turbines, hydropower, electric vehicles (EVs), demand flexibility and energy storage.

Scenarios for achieving Carbon Neutrality in Rochdale

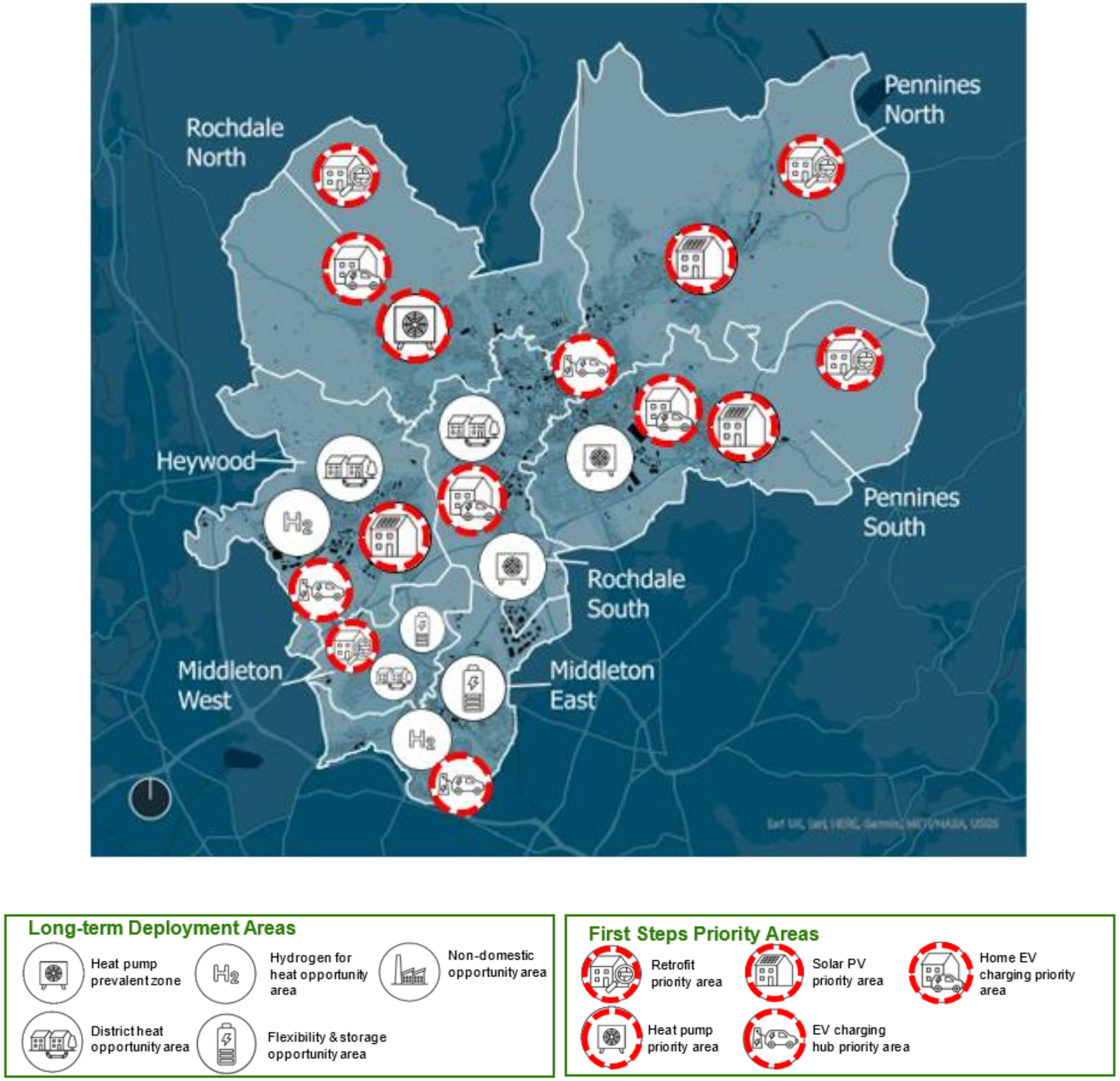
The two scenarios which have been more deeply analysed to inform this LAEP are:

- **Primary Scenario – GM Leading the Way:** this scenario focuses on meeting the carbon budget and carbon neutrality target by making use of **measures within Rochdale's local control** where at all possible.
- **Secondary – An Alternative Future Local Energy Scenario:** this scenario assumes hydrogen for residential heating and non-domestic buildings becomes available in Rochdale from 2030 onwards (aligned to HyNet Phase 3†), considering where it could be cost-effective to use hydrogen alongside the measures / technologies considered in the primary scenario. The quantity of hydrogen expected to be available under the HyNet plans would not be sufficient to allow all GM boroughs to pursue this option; therefore focus has been centred on prioritising where to target the use of hydrogen‡.

* Climate Change Act 2008 (2050 Target Amendment) Order 2019

† HyNet North West is being delivered by a consortium of partners, each of which will lead a different part of the project. Progressive Energy is leading the development of the low carbon hydrogen production plant and the CO2 pipeline, while Cadent is leading development of the hydrogen pipeline

‡ Cadent's Greater Manchester decarbonisation pathway report anticipates a proportion of homes being met by electric heat pumps out to 2038.



Local Priorities and Measures

Rochdale has been geographically sub-divided into 7 zones for the purposes of assessment and to understand what is needed for decarbonisation at a more local level. The zones have been made along the 33-11kV substation boundaries, with each zone containing roughly equal numbers of dwellings.

This map shows the 'First Steps Priority Areas' and 'Long Term Deployment Areas' that have been identified for different areas within Rochdale. This is based on a synthesis of the results from the two scenarios alongside other considerations such as network constraints.

1. INTRODUCTION

Context

Greater Manchester is committed to achieving carbon neutrality by 2038. To support this, it has a vision of each of its borough transforming their infrastructure, homes and buildings to be part of a smarter local energy system. Recognising the climate emergency, national Net Zero* commitments and the need to translate the strategic vision to an implementable plan of action, Greater Manchester is supporting each borough in the development of a Local Area Energy Plan. This aims to define the extent of the transformation needed across each borough (including a focus on identifying first steps to progress), provide a robust evidence-based plan to help engage businesses and citizens in accelerating towards the carbon neutral goal.

Energy Systems Catapult developed the concept of Local Area Energy Planning (LAEP) as a mechanism of applying a whole system approach to the planning and design of Net Zero Local Energy Systems. Bury was one of the first Local Authorities in the country to work with Energy Systems Catapult, Electricity North West (ENWL) and Cadent in piloting a data-driven whole system approach in 2018. Since this initial pilot, Greater Manchester has launched its Five-Year Environment Plan, which includes a commitment to be carbon neutral† by 2038, and an accompanying science-based carbon budget. Alongside this, there have been significant updates to the supporting whole system modelling approach, including the latest technology attributes and costs, updated building data and network data, changes in EV uptake projections and more detail in options for decarbonising non-domestic buildings. The most significant update has been the addition of hydrogen in line with HyNet‡ projections, as an option that in certain scenarios can be used to decarbonise heat demand in domestic and non-domestic buildings. This is key as achieving carbon neutrality will require the transition of Rochdale's heating systems from natural gas fired boilers to electrified heating systems, district heating networks or converting the gas network to hydrogen.

Modelling Approach

We have used the ESC-developed EnergyPath Networks tool to produce a series of future local energy scenarios for Rochdale (these are discussed in the Technical Annex). This tool seeks to develop a full range of decarbonisation options for the local area and then use an optimisation approach to identify the combination that best meets the carbon ambitions in a cost-effective way across the whole system.

* Climate Change Act 2008 (2050 Target Amendment) Order 2019

† Carbon neutrality is defined by the Tyndall Institute's study for GM as below 0.6 Mt CO2/year across GM

‡ HyNet North West is being delivered by a consortium of partners, each of which will lead a different part of the project. Progressive Energy is leading the development of the low carbon hydrogen production plant and the CO2 pipeline, while Cadent is leading development of the hydrogen pipeline

For the impact of the energy system outside of the boundaries of Rochdale, the national Energy System Modelling Environment (ESME) – an internationally peer-reviewed national whole energy system model – has been used to identify the lowest-cost decarbonisation scenarios for the UK energy system to then feed into the local modelling.

These national scenarios have been used to inform the development of a primary and secondary local scenario that illustrate two potential, but quite different, routes to achieve Greater Manchester's ambitions for carbon neutrality in Rochdale. These explore the actions and investment needed in different areas of Rochdale between now and 2038 to reduce its emissions. The scope of emissions in this plan covers those resulting from domestic, industrial and commercial consumption of electricity, gas and other fuels; home charging of personal electric cars; and process emissions from large industrial installations. Out-of-scope are emissions from agriculture, all usage of liquid fuels for transportation, and electricity use for vehicles other than personal cars.

It should be noted that techno-economic optimisations (i.e. the scenarios that have been considered and modelled) are imperfect. Many low carbon solutions have benefits and drawbacks that cannot be easily represented in modelling approaches. This appreciation has been used to shape the LAEP; however, as the LAEP is taken forward, new significant insight may result in a requirement to update this LAEP. For example, the process has highlighted the potential use of a highly ambitious quantity of solar PV, based on availability of roof space and land; latter sections of this LAEP discuss whether this would be an effective approach when accounting for its potential wider system implications.

Scenarios for achieving Carbon Neutrality in Rochdale

A core aspect of the analysis has been the consideration of resulting emissions from the gas and electricity required to serve domestic, commercial, industrial and public sector energy demands, including the impacts heating system and building fabric changes within the modelled scenarios, and how these relate to the GM carbon budget. This has strongly influenced the creation of this LAEP, recognising the need to cut emissions rapidly.

The two scenarios which have been more deeply analysed to inform this LAEP are:

- **Primary Scenario – GM Leading the Way:** this scenario focuses on meeting the carbon budget and carbon neutrality target by making use of **measures within Rochdale's local control** where at all possible.
- **Secondary – An Alternative Future Local Energy Scenario:** this scenario assumes hydrogen for residential heating and non-domestic buildings becomes available in Rochdale from 2030 onwards (aligned to HyNet Phase 3*), considering where it could be cost-effective to use hydrogen alongside the measures / technologies considered in the primary scenario. The quantity of hydrogen expected to be available under the HyNet plans would not be sufficient to allow all GM

* HyNet North West is being delivered by a consortium of partners, each of which will lead a different part of the project. Progressive Energy is leading the development of the low carbon hydrogen production plant and the CO2 pipeline, while Cadent is leading development of the hydrogen pipeline

boroughs to pursue this option; therefore focus has been centred on prioritising where to target the use of hydrogen*.

Once plans for all local authorities are complete, then total remaining emissions can be compared against the carbon neutrality target at a GM level; subsequent consideration will be required to determine how these remaining emissions are decarbonised. Of note, the scope of modelling completed does not include all the transport emissions included within the scope of the GM carbon budget, but these will be considered when the plans for all ten local authorities are analysed centrally at a GM level.

The modelled scenarios explore uncertainties, considering implications of different choices and behaviours by policy makers, businesses and individuals, the development and take up of technologies and the balance between different options, where they exist. Within the scenarios, the key technologies that are likely to be important in cost effective local system designs have been considered, as well as some that are more expensive but may have popular support. Technologies that consistently appear regardless of scenario and warrant prioritisation in preparing for transition; this approach has led to the identification of the priority areas within this LAEP.

Conclusions from the scenario analysis have been used to develop this LAEP. This represents a point-in-time plan of intent, as the basis for Rochdale taking important implementation steps over the next 5 years to engage industry and businesses, build momentum around a shared plan and support the identification and creation of opportunities for smarter local energy systems. Progressing this LAEP can help to realise the potential of a local energy market for GM and support meaningful action and progress on reducing emissions.

Both the primary and secondary scenarios make assumptions around changes to behaviour, advances in technology and innovation whilst recognising uncertainty in key areas such as the potential use of hydrogen for transport and heating in homes and buildings, as well as advances in energy storage and controls. While it is not a prescriptive plan to be followed exactly, it does provide a detailed spatial evidence base and supporting data that can be used to inform the planning and coordination of activity in Rochdale over the coming years. Where hydrogen for building heating does become available (as per the secondary scenario), it is expected that all the components within the primary scenario (heat pumps, district heating, solar PV, EV charging, building fabric retrofit and flexibility and storage systems) will still be needed to decarbonise Rochdale; any uncertainty is generally around the scale of deployment. Therefore, it is deemed low risk to demonstrate how to deploy these components and prepare for significant scale-up whilst assessing whether HyNet will be able to cost-effectively provide zero carbon hydrogen, across GM in-line with projections.

In addition, as the secondary scenario has significantly lower modelled cost (£6.3 bn compared to £7.3bn for the primary scenario), there is a need to make major decisions that consider the many associated advantages and disadvantages of each option; however, waiting until there is certainty would be too risky, reinforcing the need to commence demonstration in the identified priority areas. Furthermore, there may be a need to prioritise hydrogen supply in the region, therefore regional energy planning will

* Cadent's Greater Manchester decarbonisation pathway report anticipates a proportion of homes being met by electric heat pumps out to 2038.

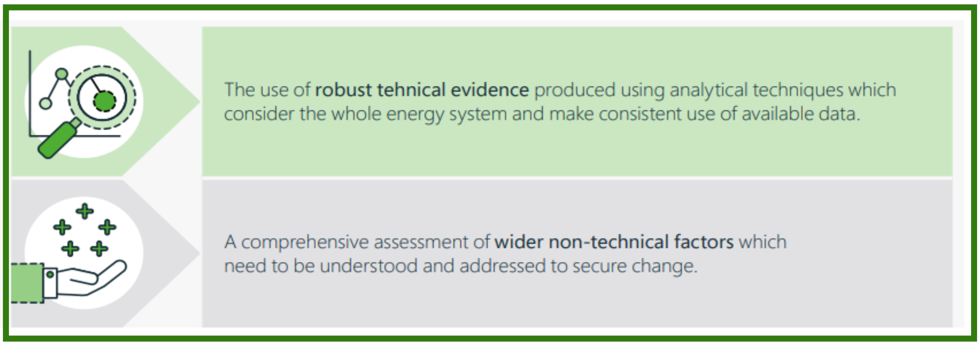
be needed once the picture becomes clearer and all LAEPs for each GM borough are in place.

In summary, the scenarios have been developed in response to the science-based carbon budget for GM: defining a credible plan for Rochdale, based on currently deployable technologies, to support an understanding of the actions, pace and scale of change as well as the investment needed. Insights from the scenarios that consider the role of hydrogen (in decarbonising domestic and non-domestic buildings), including aligning with the timeline for phase 3 of the HyNet project (which envisages low carbon hydrogen becoming available at scale from the early 2030s), have been used to set out heat decarbonisation priority areas. The scenarios also seek to understand the costs, benefits, uncertainties, opportunities and risks to decarbonisation by 2038 that a hydrogen-based approach would bring. Combining the insight from these scenarios informs the plan for Rochdale.

This LAEP has also considered previous studies including the Decarbonisation Pathway for Greater Manchester study completed in 2020 by Navigant on behalf of Cadent Gas and Electricity North West* and is generally aligned to the latest guidance on Local Area Energy Planning developed with Ofgem, the ambitions of Greater Manchester and wider UK Net Zero commitments.

In accordance with the Ofgem LAEP Method†, which provides guidance and framework for LAEP done well, this plan has been developed through the use of robust technical evidence which considers the whole energy system for Rochdale and consistent use of available data and assumptions.

It has also sought to consider wider non-technical factors which influence the deliverability, pace and scale of change required for decarbonisation.



The next steps of the development of the plan are expected to comprise wider stakeholder and public consultation on the plan to inform its further development, as well as the approach of both Greater Manchester and Rochdale in its ongoing governance and delivery.

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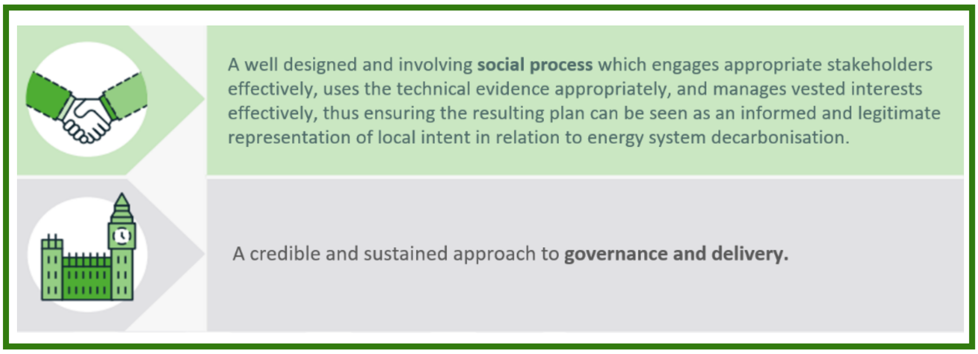
* Decarbonisation Pathway for Greater Manchester, Reaching carbon-neutrality in a balanced scenario by 2038, Navigant, July 2020

† From LAEP: The method https://es.catapult.org.uk/reports/local-area-energy-planning-the-method/



The approach differs from the Ofgem methodology where it has taken advantage of the data and engagement available at the Greater Manchester Combined Authority level, streamlining the approach and reducing the need for separate processes with each local authority.

Report Structure

The report is set out in the following structure. It summarises the key aspects of the plan and its supporting modelling and analysis and is presented in nine chapters, supported by an accompanying technical annex.

Chapter 1: (this chapter) sets out the context and the approach taken to modelling, developing the scenarios and supporting technical evidence and associated assumptions and limitations and relevant supporting information

Chapter 2: sets out the vision and primary scenario to carbon neutrality for Rochdale, informed by the scenario analysis. The primary scenario demonstrates how Rochdale could meet Greater Manchester's decarbonisation ambitions across each of its key areas by 2038 in a practical way. A series of first steps is also presented that focus on demonstration and scale-up of some of the key components that will be needed to decarbonise Rochdale.

Chapters 3-7: set out some of the key aspects of the primary scenario and what this means in relation to implementation for Rochdale including Fabric Retrofit (Chapter 3), Heating System Zones (Chapter 4), EV charging and infrastructure (Chapter 5), Local Energy Generation and Storage (Chapter 6), and Energy Networks including electricity, gas and heat (Chapter 7). They also consider key uncertainties and dependencies informed by the wider scenario analysis and specific areas of investigation

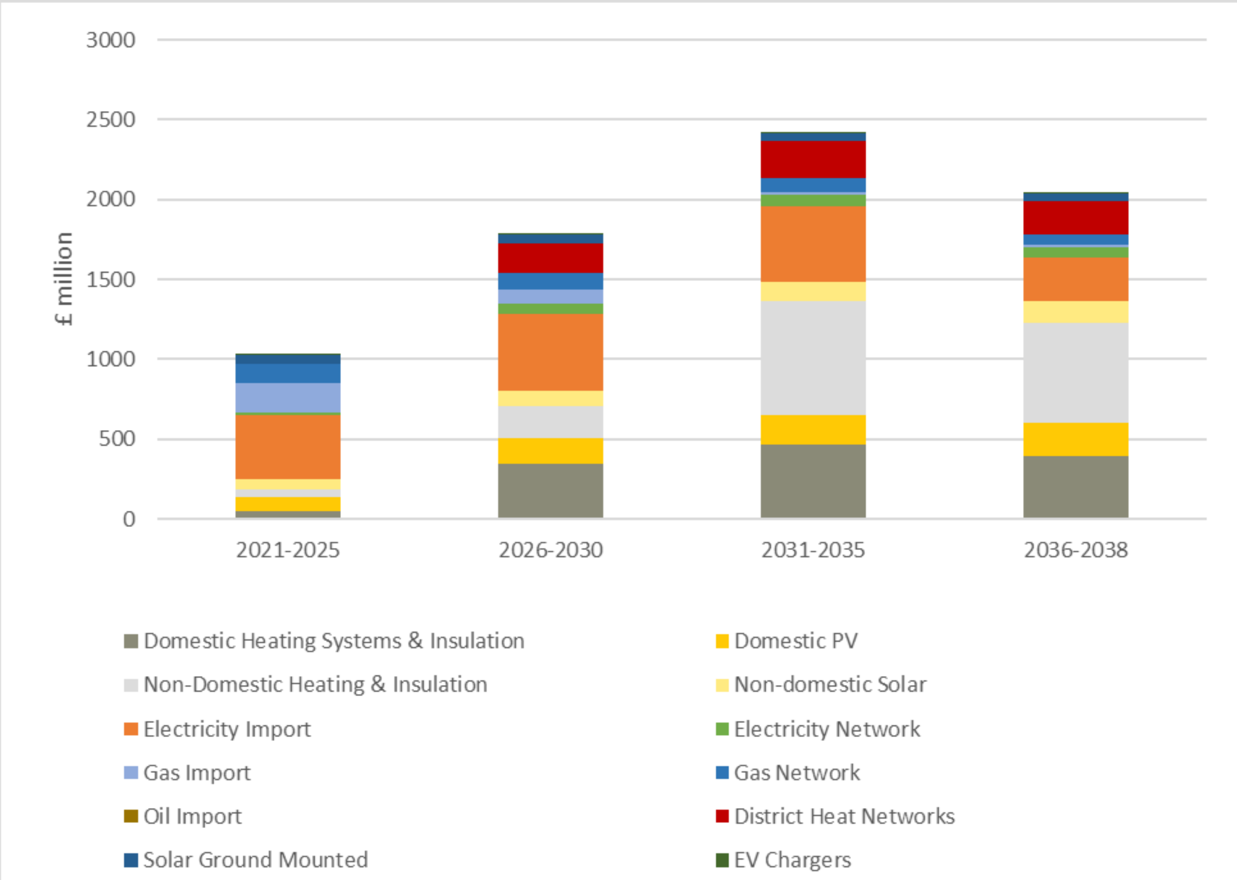
Chapter 8: sets out the estimated system costs and investment needed for implementation of the primary scenario. This includes definition of the total system costs between now and 2038 across different areas of Rochdale, the capital investment at key time steps in infrastructure and key technologies within the scope of the analysis.

Chapter 9: summarises the key findings and recommended actions to support implementation and ongoing review and monitoring in the context of national and regional energy strategy, carbon budgets and associated policy and regulation.

This Local Area Energy Plan (LAEP) aims to support Rochdale to transition to an affordable and decarbonised energy system and to support the delivery of Greater Manchester's (GM) commitment to carbon neutrality by 2038.

Decarbonising Rochdale local energy system by 2038 is achievable and expected to require capital investment of between £4.4 bn (secondary) and £5.3 bn (primary). Total energy costs including capital investments, operations and energy consumed is between £6.3 bn (secondary) and £7.3 bn (primary) to 2038; the upper chart illustrates the breakdown of this expenditure over time for different components (for the primary scenario). The lower chart shows how implementing the transition reduces carbon emissions*.

CapEx and Energy Costs Over Time

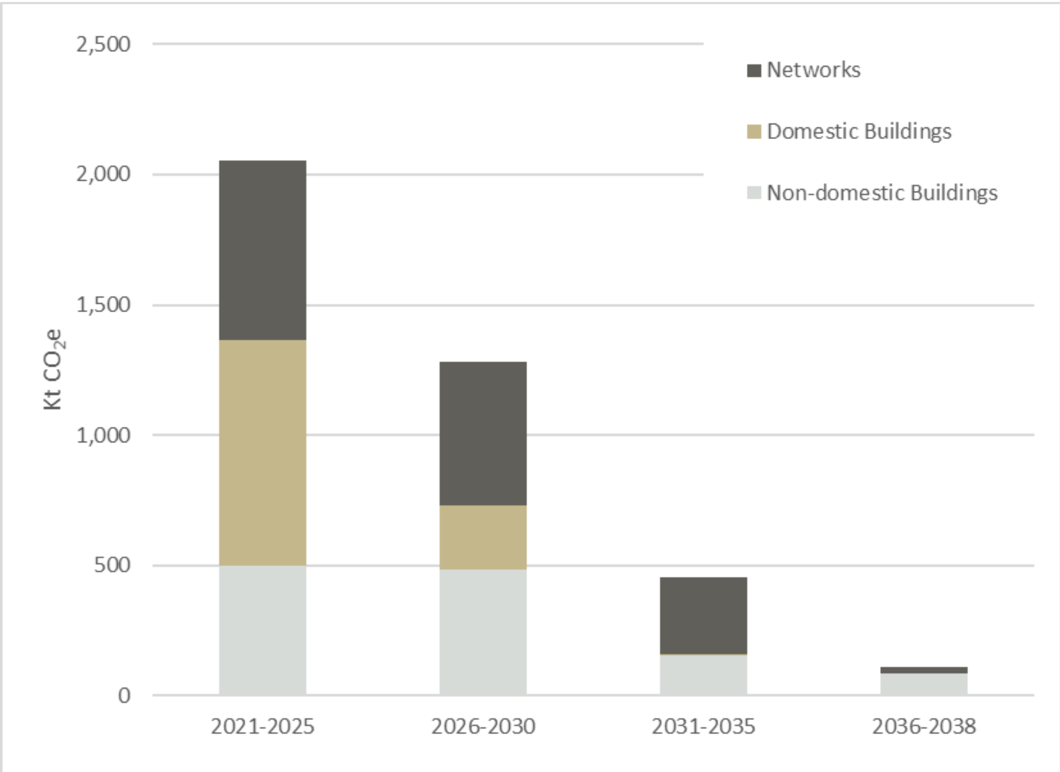


With such a variation (£1.0.bn) in total projected system cost between the two scenarios, progress on wider national energy planning and policy decisions would be needed, recognising the current uncertainty (regarding the UK's heat decarbonisation strategy) associated with selecting a preference on decarbonising heat in buildings (e.g. either through electrification, district heating or hydrogen). In addition, regional (Greater Manchester) collaboration, should be pursued to consider an across GM borough

* In-scope emissions are those resulting from domestic, industrial, and commercial consumption of electricity, gas & other fuels, electric vehicle charging and process emissions from large industrial installations. Out-of-scope are emissions from agriculture and existing liquid fuels for transportation.

approach, recognising that major decisions do not stop at a local authority boundary, for example, it may be preferential to prioritise the use of hydrogen in targeted areas of GM; noting that the proposed HyNet route would be coming along Manchester Ship Canal in from the southwest to Manchester City Centre, therefore an understanding of plans to supply Rochdale to the northeast side of GM would be needed. Regional collaboration also provides the opportunity to ensure a complete LAEP process is undertaken, where key regional stakeholders (including Cadent and Electricity North West) should support the evaluation and decision making process.

CO2 Emissions Over Time



The cumulative emissions over the period 2021-2038 in the primary scenario are 3.9 Mt of CO_2e (from a range of 3.7 to 4.0 Mt across the scenarios assessed), of which 1.6 Mt is due to grid electricity consumption*.

How to Interpret this Vision

This transition will involve the greatest infrastructure change across Rochdale and Greater Manchester for decades; key sections of this LAEP illustrate the scale of change and investment needed, based on a primary scenario. An alternative scenario (secondary), incorporating the use of hydrogen for heat, is also presented on page 19 (along with other variations within the appendix), where the supporting analysis indicates that hydrogen could have an important role in decarbonising Rochdale. Unless explicitly stated otherwise, quoted values in this report will refer to the primary scenario. Given the

* Based on current forecasts for electricity grid decarbonisation. If the rate of grid decarbonisation accelerates in line with the UK's recent commitment in the Net Zero Strategy to reduce emissions by 80-85% by 2035, grid intensity could reach nearly zero emissions by 2035, eliminating most of the remaining emissions in this plan.

significance of backing one view of the future (or scenario) now, the LAEP promotes a demonstration and scale-up approach over the coming years to 2025, before moving to full scale implementation. Therefore, this LAEP identifies several ‘priority areas’ to build capacity and test approaches, across different components, for working with Rochdale’s citizens and stakeholders. Insights from the alternative scenarios have been used to produce these priority areas. It is expected that this LAEP may need to be updated as lessons are learnt and uncertainties (such as UK policy regarding the decarbonisation of heat) become clearer.

Fabric Retrofit

As much as **72% of Rochdale’s dwellings receive insulation retrofit** in the plan: around **75,400** in the primary scenario, or 75,600 in the hydrogen focused secondary scenario. A greater number of these retrofits are deep retrofits in the secondary scenario (around 5% more of Rochdale’s homes) to enable the earlier decarbonisation required to meet carbon budgets due to the later availability of low carbon hydrogen in 2030 relative to these targets. Fabric retrofit and solar PV are low regret measures to progress in the short-term.

Heat Decarbonisation

Three heating options are explored to decarbonise buildings: electric heating (primarily heat pumps), hydrogen to replace natural gas, and district heat networks. For hydrogen to play a significant heat decarbonisation role, certainty would be required that hydrogen will be available to supply Rochdale in a timeframe that supports the delivery of the GM carbon budget; this key decision point will need to be made c.2025, primarily based on the role hydrogen will play in providing heat to buildings. Alternatively, almost 78,000 heat pumps are deployed for most dwellings, except in areas where district heat supplies a large share of buildings in part due to the higher density of buildings and presence of public buildings which could provide anchor loads as well as being buildings within the local authority’s control. Where district heat network opportunities have been identified, analysis of the cost and carbon benefit has identified that there is a marginal case[*] for using district heating over individual building heat pump based systems, therefore further consideration is required.

The combined cost of fabric retrofit and heating system replacement is £1.3 bn for homes, and £1.6 bn for non-domestic buildings. The delivery of any option presents comparable challenges and risks, resulting in the need to focus on the demonstration and scale-up approach advocated.

Energy Generation & Networks

To reduce emissions in line with the GM carbon budget, local energy generation would need to increase significantly, consisting predominantly of the installation of solar PV on much of the available roof space across all parts of Rochdale (under all scenarios considered), providing up to 912 MWp of installed capacity, at a cost of £1 bn. Rochdale has a significant amount of non-domestic roof space which could potentially site rooftop solar PV, having 9,000,000m^2 of non-domestic roof space compared to other boroughs

[*] For example, there is a significant associated cost for providing a relatively small carbon benefit over individual building systems; driven by the need to reduce carbon aligned to the carbon target and budget.

which typically have around 3,000,000m^{2}[*]. Further work is required to understand how achievable and effective this substantial provision of electricity through rooftop solar PV is when taking into account wider system implications (p.68 providing some associated considerations).

Land in the area has been identified for opportunities to deploy 483 MW ground mount solar PV for further CO_2 reduction. Deploying such large volumes of local generation would be very challenging and is highly ambitious. These solar farms will likely be connected into the transmission network; how this deployment of PV will impact the need for electricity network reinforcement will need to be explored as the modelling in this report is focussed on the effects of demand and generation change within the local distribution network.

Under the primary scenario, the electricity network would require capacity reinforcements of substations and underground feeders to accommodate electrification, at an estimated cost of £214m. A significant proportion of this is attributed to the peak demands of the large numbers of proposed heat pumps. Further work would be required, under this high electrification scenario, to determine the most cost-effective, approach for providing this additional capacity.

EV Infrastructure

The transition to electric vehicles, with uptake increasing from around 3,800 plug-in vehicles today to almost 88,000 by 2038, drives a demand for EV chargers to be installed across all areas. Around 40,700† domestic chargers would need to be installed (one for every home with potential for off-street parking) at a cost of £23m, along with multiple public charging stations (or hubs); areas where fewer car owning households have potential for off-street parking rely more on public charging hubs.

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[*] The only exception to this being the borough of Manchester itself which has a proportionally higher annual electricity demand

† Based on ESC in-house analysis of EV uptake. Quantities will need to be aligned with local planning policies as it relates to provision of chargers in new developments and existing dwellings.

Consumer Uptake

By the early 2030s all new cars and vans, and all boiler replacements in dwellings and other buildings in Rochdale are low carbon*; the vast majority of heating systems are either electrified or use hydrogen. Between 23,000 and 78,000 of Rochdale's dwellings are fitted with a form of heat pump, and up to 76,000 boilers could be running from 100% hydrogen. By 2038, nearly 85% of cars are electric vehicles or plug-in hybrids, requiring the provision of ~40,700 electric vehicle charging points for homes with potential for off-street parking, as well as electric vehicle charging hubs for areas of terraced homes and destinations such as offices and shopping centres. By 2035 commercial and industrial activities in Rochdale largely shift to using renewable or zero carbon electricity (either locally generated or grid supplied), district heating or hydrogen instead of fossil fuels; carbon capture may be required to reduce remaining emissions.

Low-carbon energy supplied to and generated in Rochdale

The emissions intensity of UK electricity production is expected to fall by at least 65% from today's levels by 2035†. By then, offshore wind would contribute a significant source of renewable electricity generation nationally. Renewable electricity production in Rochdale increases to contribute to the GM carbon budget, predominantly in the form of up to 912 MWp of rooftop solar PV, with opportunity for a further 483 MWp ground mounted solar PV across Rochdale. Renewable generation (if the ground mounted PV potential is maximised), provides up to 1,596 GWh annually (76%), with 512 GWh (24%) of electricity supplied from the grid. This scale of solar PV is a highly ambitious aspiration and requires further detailed consideration; for example, from a network capacity perspective it may not be the optimal place to locate generation. However, with the 2038 target and GM carbon budget influence, solar PV could provide low carbon electricity earlier than the grid is expected to.

The low carbon electricity is used in heating, industry and vehicle charging, more than doubling electricity demand over the next 15 years. Total electricity consumption is expected to increase by 87% by 2038 in the primary scenario and by 59% by 2038 in the secondary scenario.

Low-carbon hydrogen is likely to be prioritised nationally for the hardest-to-decarbonise sectors such as shipping, heavy transport fuel and energy intensive industry, and therefore the quantity that will be available for building heating is uncertain. However, HyNet is a project which aims to pioneer low carbon hydrogen production, potentially making it available to buildings in the region by 2030. Greater Manchester

* This LAEP considers the energy and emissions associated with current and projected personal car use and ownership only; providing an important understanding of the impact on Rochdale's future energy system from electrified cars. This LAEP does not provide a fully integrated energy and transport plan where it is recognised that further work will be required to consider and integrate broader transport decarbonisation and net zero plans. This LAEP does not also account for aspects such as modal shift or behaviour change, acknowledging that other measures such as these will be needed to achieve net zero.

† Based on current forecasts for electricity grid decarbonisation. If the rate of grid decarbonisation accelerates in line with the UK's recent commitment to reduce emissions by 78% by 2035, grid intensity could reach nearly zero emissions by 2035, eliminating most of the remaining emissions in this plan.

has a carbon budget that requires immediate action to stay within, and so any delay to HyNet could make it too late to keep within the carbon budget. However, hydrogen may have a significant role to play in combination with other technologies. This has been explored in some of the further scenarios. The similarities across scenarios point to low regret opportunities for heating system options in each area of Rochdale and areas where hydrogen deployment would be cost effective in comparison to other areas (zones).

Reducing demand for carbon-intensive fuels

Buildings will lose less energy thanks to a series of targeted fabric retrofit programmes, improving insulation and efficiency across Rochdale. Fabric retrofit will prepare buildings for low carbon heating, whilst also making a notable contribution to staying within the carbon budget. By 2038, over 75,000 of Rochdale's 106,000 dwellings are retrofitted in the plan (circa 71%), split fairly evenly between basic and deep fabric retrofit packages. The option of deeper fabric retrofit has the potential to increase headroom in the carbon budget to give some flexibility for deferring decisions on heating systems.

Energy Networks

The creation of district heating networks in targeted areas could see up to 22,000 homes connected to a heat network in 2038. These connections are concentrated in Rochdale South, Heywood and Middleton West, where there are opportunities to explore if heat networks would be a cost effective solution to reduce carbon aligned to the carbon target and budget. Energy centres predominantly use large-scale heat pump systems to produce heat[*], though local opportunities for other forms of heat supply such as waste heat should be considered, where available. Rochdale South, with its wastewater treatment works and hospital provides additional potential. However, the case for district heating of is finely balanced compared to other options and requires further detailed consideration.

Annual electricity demand is forecasted to increase from 1,126 GWh to 2,108 GWh by 2038, due to electrified heat and electric vehicle charging. This requires an increase in electricity network capacity, with the greatest network reinforcement requirement in Pennines South, Rochdale North and Middleton East, though opportunities to consider using flexibility, storage (or other alternative measures) in place of grid reinforcements are highlighted in the provided opportunity areas (see map on p.24).

Depending on the conversion and roll-out of hydrogen for heat, gas networks remain in place in some areas to support some hard-to-decarbonise non-domestic buildings that may not be of the scale to have a dedicated hydrogen connection. However, should HyNet phase 3 be available, up to 76,000 homes could be supplied by hydrogen by 2038, at a 13% lower overall total system (CapEx and Opex inc. energy costs) cost[†] and very similar levels of emissions.

[*] However, a heat network is technology agnostic and heat could be generated through another source such as hydrogen or heat generated through the production of hydrogen

[†] Based on the Hynet projections

Investment

Rochdale's transition requires a total energy system and building level investment of £5.3 bn (excluding energy costs). This unprecedented level of investment provides a once in a lifetime opportunity for Rochdale. Urgent focus will be needed to determine how to maximise the local benefit from this opportunity, considering how to develop the local supply chains and skills needed to enable the transition and provide new, green, local jobs.

Local Opportunities

This LAEP provides a vision for a carbon neutral Rochdale. How it is delivered will influence the local benefit, in addition to job creation. For example, there will be opportunities for local/community initiatives to provide components of the future energy system.

Smart local energy systems could be used to provide EV charging hubs, renewable energy generation, communal or locally owned heat networks, energy storage systems, smart/flexible energy systems to avoid electricity network reinforcement or any combination of these or other measures. Greater Manchester is working with partners in developing a Local Energy Market to support the implementation of such solutions through new business models, customer propositions and a trading platform.

Local Impact and Risks

Without changes to national policy, wider energy market reforms or the introduction of new support mechanisms, household energy bills are forecasted to increase, predominantly as heating homes through electricity is more expensive than using gas. However, the proposed investments in building works will help to mitigate this and consideration will be needed to target measures at homes with the most need. Consideration is also needed to determine how to fund an average household investment of £18,220 (CapEX) for the associated measures.

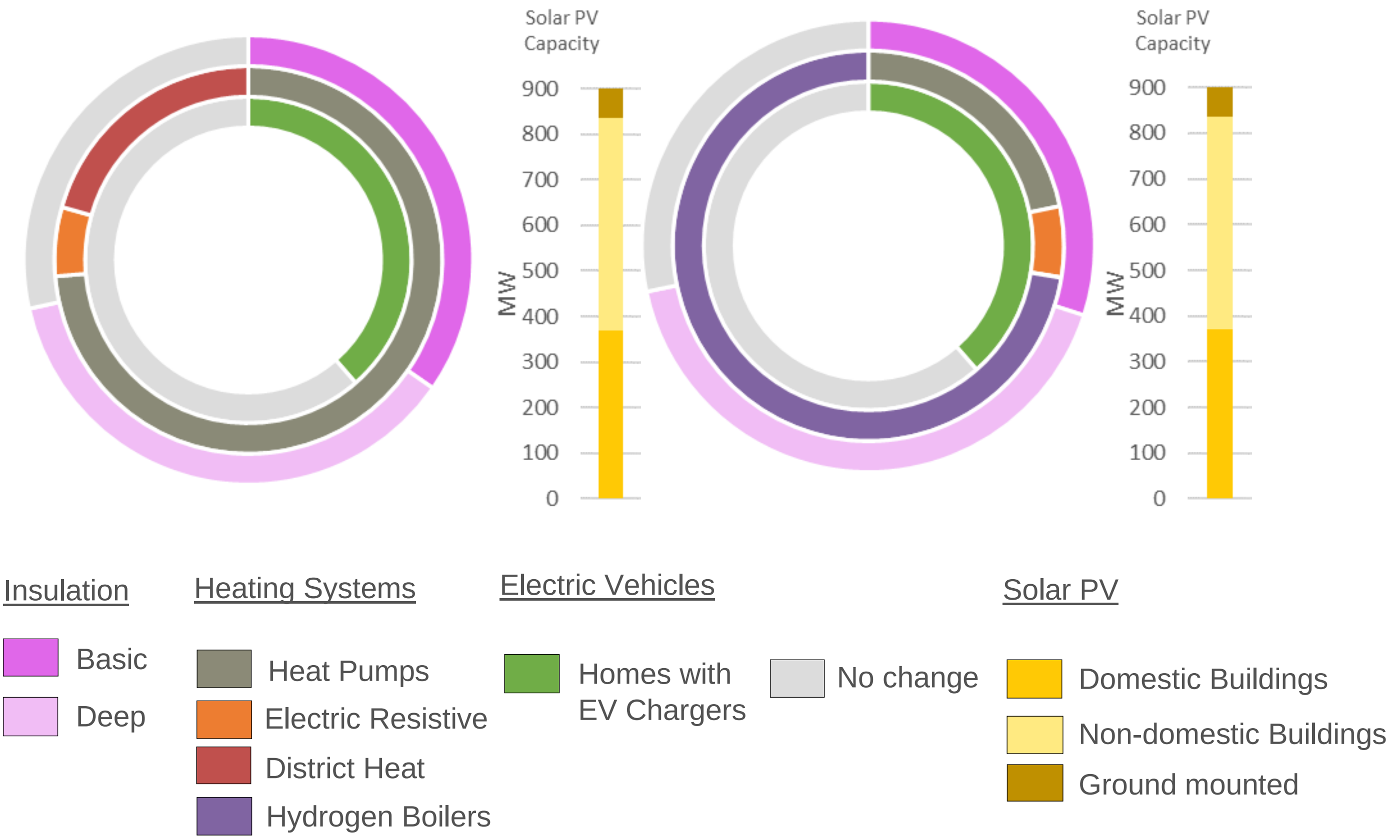
An electric or heat network focused heat transition, involving changes to building fabric and internal heating systems (e.g., changes to doors, windows, larger radiators, and improved controls) could be more disruptive to residents and it is not clear how this might compare with disruption associated with using hydrogen for home heating[*], where extensive fabric retrofit would also be required to provide emissions reductions aligned to the carbon budget. In either case, compelling consumer propositions would be needed to facilitate it. With extremely challenging rates of deployment, there is an urgent need to scale up and develop skills and supply chains. Moving to an electrified heating future also presents a risk of backing a technology 'winner' before national decisions are made on heat strategy. Targeting specific areas and housing types most likely to be suited to electric heating and demonstrating effectively clustered transitions in Rochdale and GM more widely can build knowledge and evidence for policy decisions as well as industry supply chains, making meaningful progress on emissions reduction. Finally, there is a risk that the economic and social benefit may not be captured locally, therefore consideration of how to maximise the opportunity is essential.

[*] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760508/hydrogen-logistics.pdf

What Rochdale's transition to carbon neutral could look like

The charts below illustrate the scale of change needed to decarbonise Rochdale in each scenario; the coloured portion of the rings indicating the proportion of homes that receive measures (the grey parts representing homes with no change). This is intended to illustrate the scale of measures and investment needed to the stakeholders who will support and deliver Rochdale's transition.

System Changes by 2038 in Primary Scenario (left) and Secondary Scenario (right)



The primary scenario to 2038 is most suitable if uncertainty remains around converting the gas grid to zero carbon hydrogen (at an acceptable cost) by the mid to late 2020s. It is around this time that it would be deemed too late to rely on hydrogen for heat to meet the Greater Manchester science-based carbon budget, recognising the timescales needed to carry out widescale infrastructure and building investment and adaptation.

This secondary scenario illustrates an alternative future where hydrogen becomes widely available for heating and hot water in buildings from 2030, in accordance with the aspirations of HyNet phase 3. These graphs show some of the key differences in investment and installation between the primary and secondary scenarios. Total costs vary within 13% between the two scenarios – see section 8 for full cost details.

The availability of hydrogen for home heating in the secondary scenario avoids much of the investment in both electricity and heat networks, although investment for repurposing the gas network to distribute hydrogen is needed instead. The need to invest in building retrofit is similar to the primary scenario, as both scenarios require large quantities of fabric retrofit measures to meet the carbon budget. Most of the cost savings are due to less expensive heating systems installed in buildings (hydrogen boilers rather than heat pumps), and lower energy costs[*] compared to electricity. This energy cost saving is very sensitive to actual hydrogen price, which is highly uncertain at this stage.

While the secondary scenario is found to cost less overall, the focus throughout this report is on the primary scenario. The understanding of the HyNet plans is that insufficient volumes of hydrogen would be produced in the timescale required for all of Greater Manchester to follow a hydrogen based decarbonisation pathway, so this LAEP assumes that available hydrogen is likely to be prioritised for boroughs with substantial industrial requirements[†]. This assumption would need to be considered further with relevant stakeholders such as GMCA and Cadent. The secondary pathway is included for illustration of a future where progress on hydrogen occurs faster than expected, for example due to strong backing from national energy policy. Priority areas for hydrogen use within Rochdale are also presented to give options for limited supply or later decisions in these areas. Further work with Cadent to understand realistic availability and timescales can help inform the scenario focus as this plan is updated going forward.

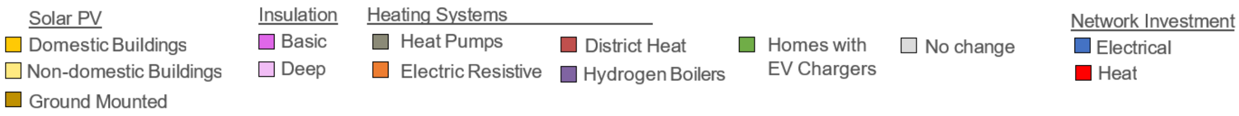
Both scenarios include a similar amount of roof and ground mounted solar PV, required in both cases to provide early emissions reduction to support the carbon budget. EV related aspects are consistent across both scenarios.

The primary scenario is broken down by zone on the following pages to give a detailed impression of the distribution of works and investment geographically.

[*] Based on Hynet projections

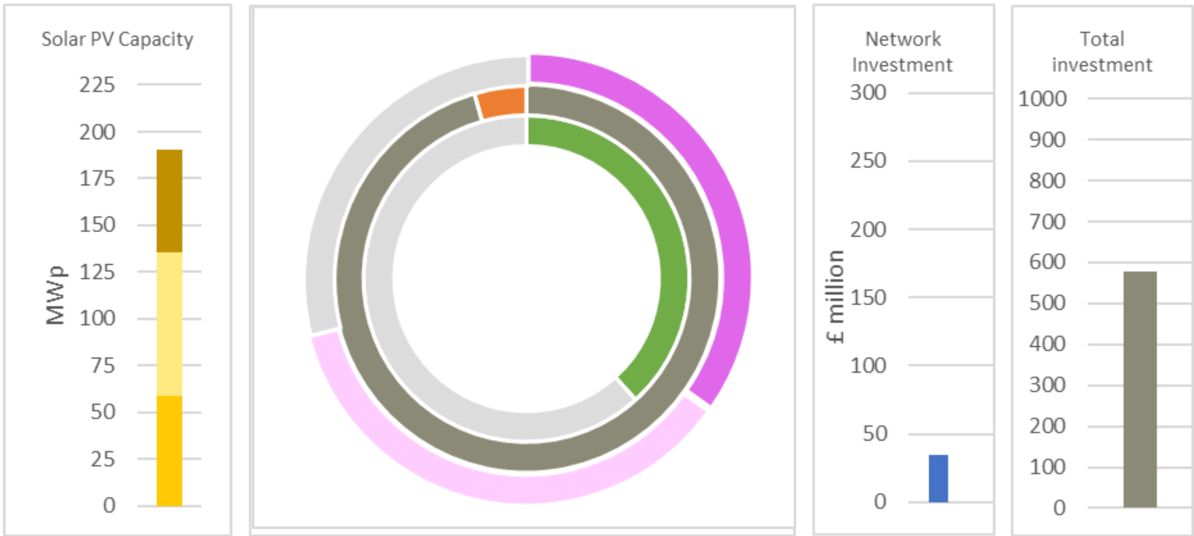
[†] Cadent's Greater Manchester decarbonisation pathway report anticipates a proportion of homes being met by electric heat pumps out to 2038 as well as a cluster-based approach of converting discrete sections of the gas network to 100% hydrogen starting with sections of the gas grid heavily relied on by industry.

2. THE VISION – BREAKDOWN OF PRIMARY SCENARIO BY ZONE

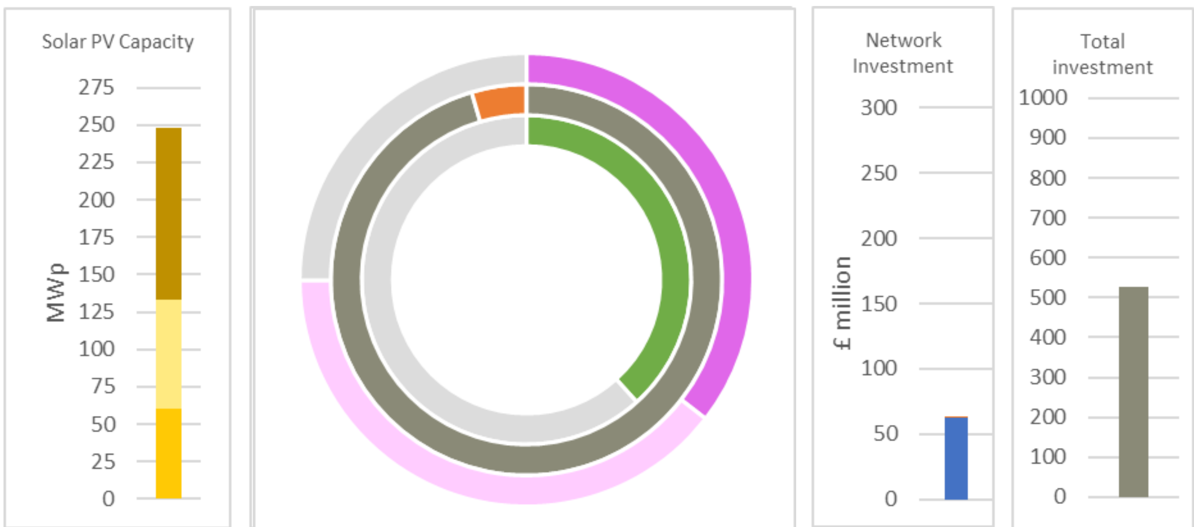


The coloured portion of the rings indicates the proportion of homes that receive measures by 2038 (the grey parts representing homes with no change).

Pennines North



Pennines South



Solar PV
Domestic Buildings
Non-domestic Buildings
Ground Mounted

Insulation
Basic
Deep

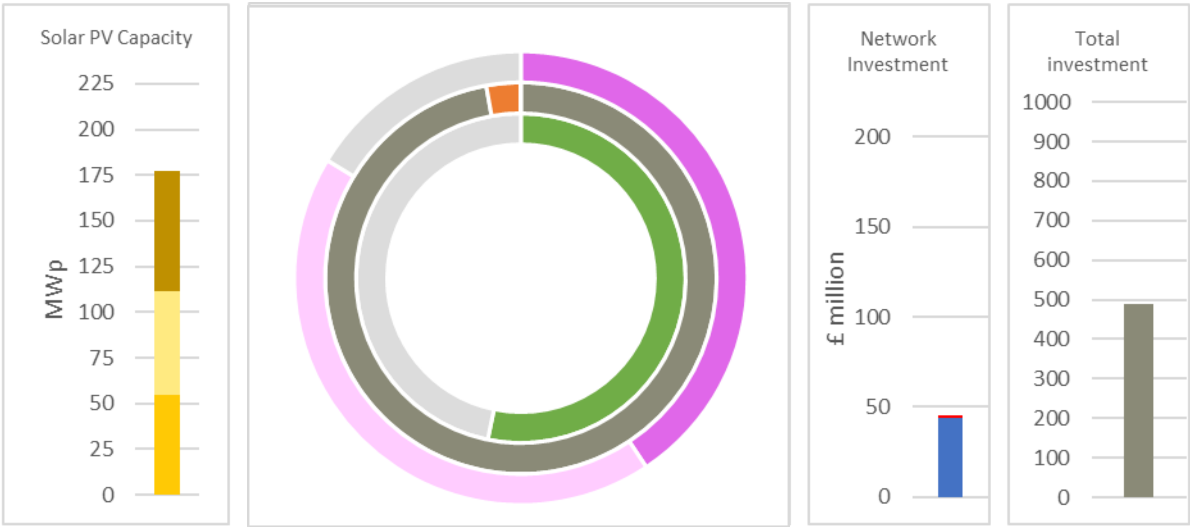
Heating Systems
Heat Pumps
Electric Resistive
District Heat
Hydrogen Boilers

Homes with EV Chargers

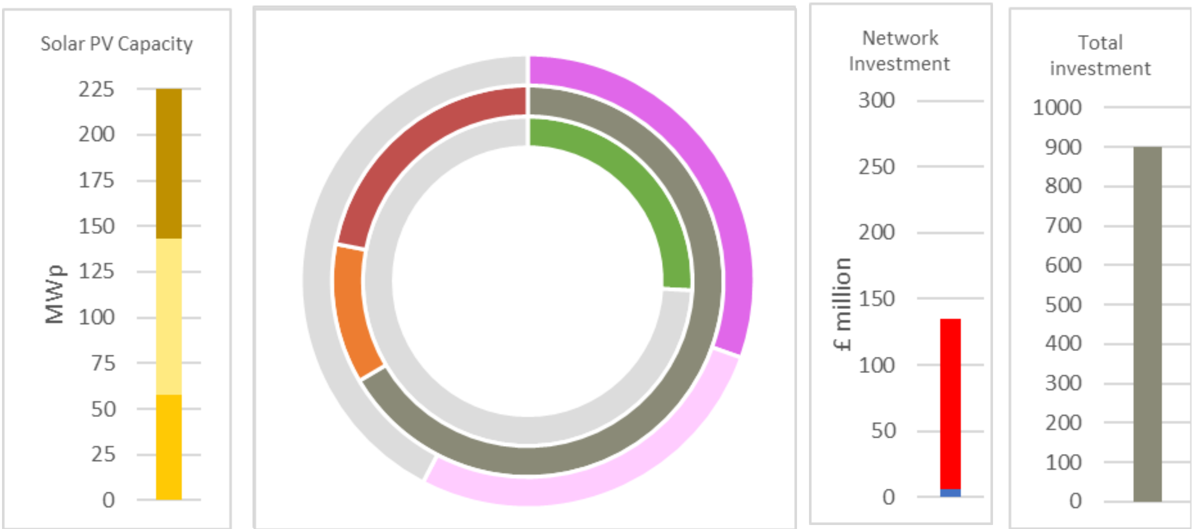
No change

Network Investment
Electrical
Heat

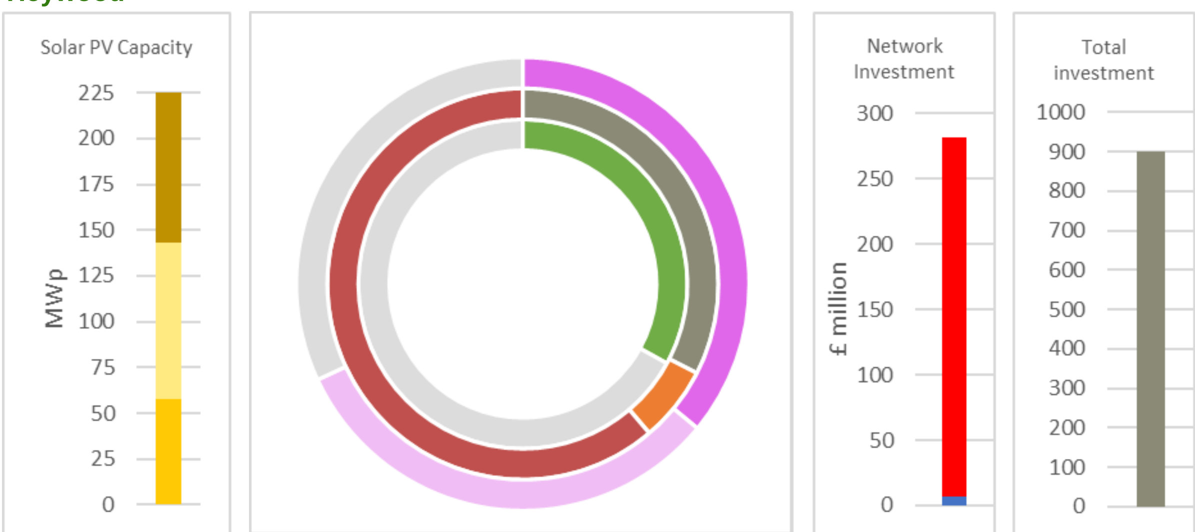
Rochdale North

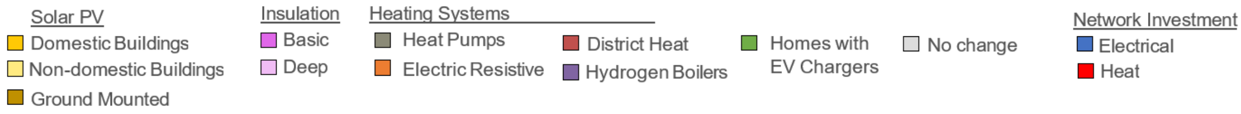


Rochdale South

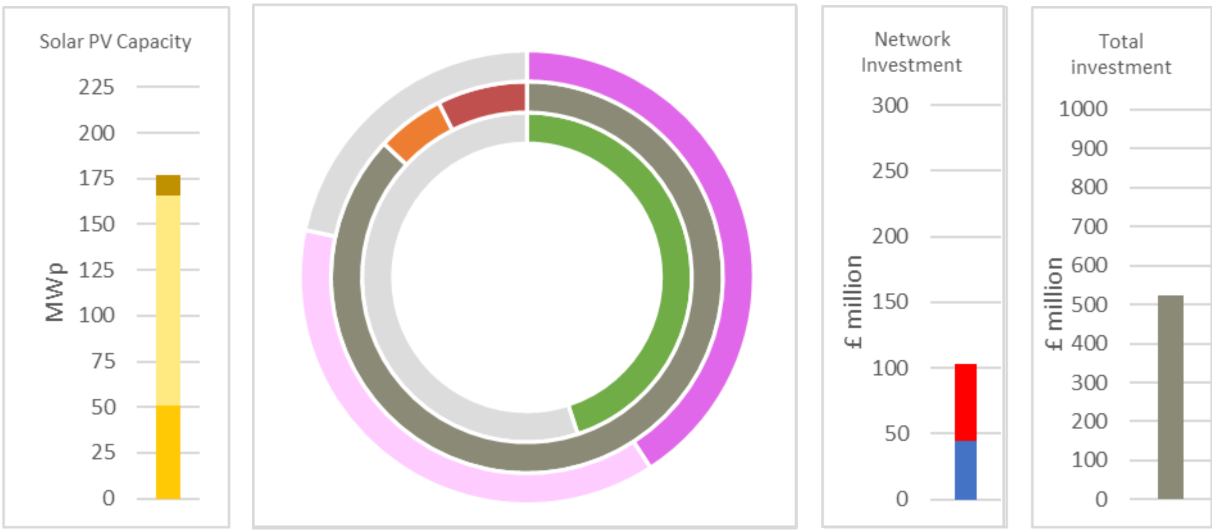


Heywood

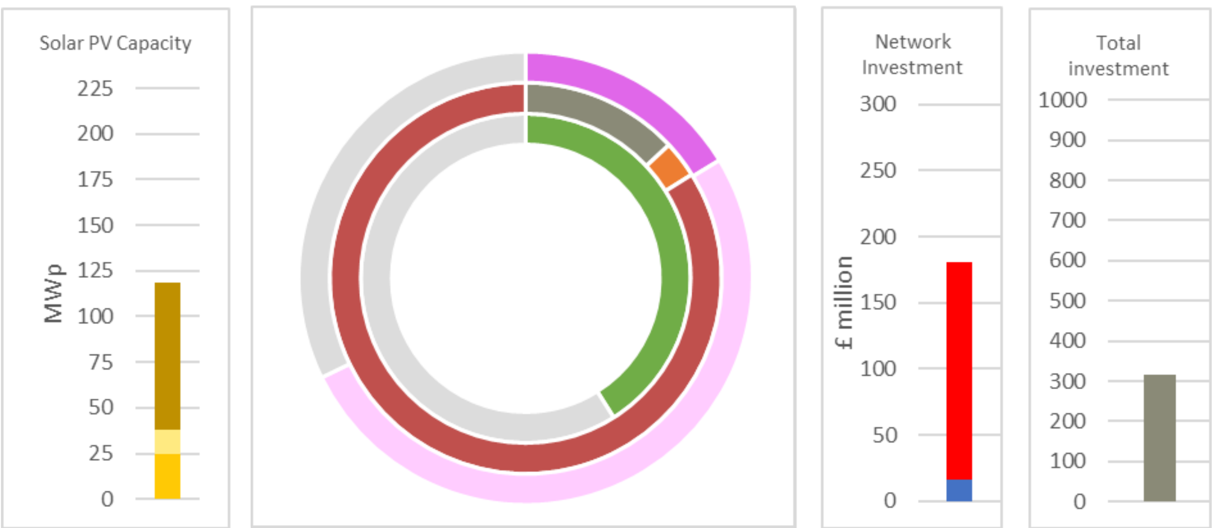




Middleton East



Middleton West



How to use this LAEP

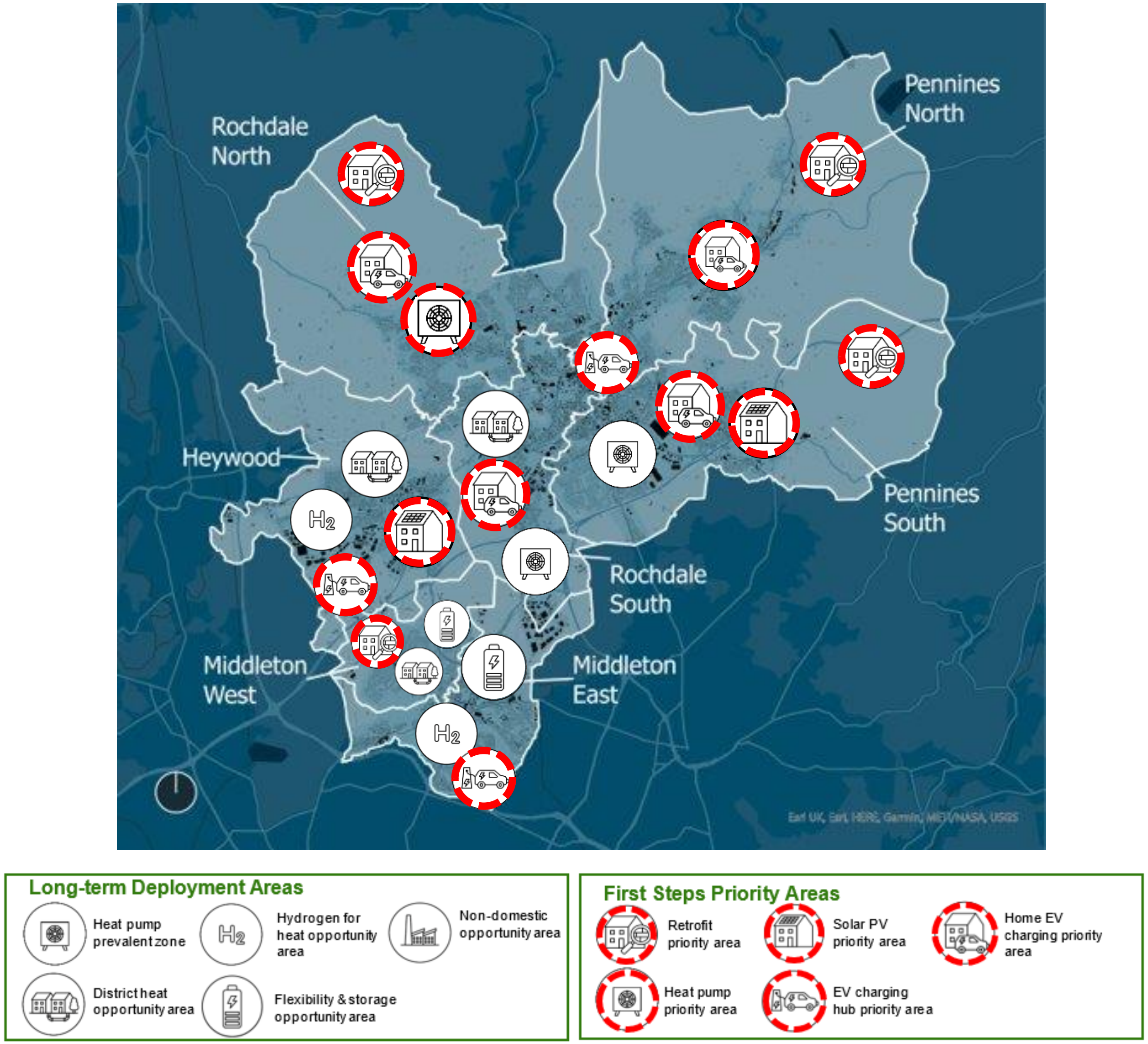
Rochdale has been geographically sub-divided into 7 zones for the purposes of assessment and to understand what is needed for decarbonisation at a more local level. The zones have been made along the 33-11kV substation boundaries, with each zone containing roughly equal numbers of dwellings.

The plan below illustrates the proposed activities to progress this LAEP in the near-term, based on a demonstration and scale-up approach, as well as focus areas for changes in the longer term. The red rings highlight priorities to test how to roll out Rochdale's transition to carbon neutral and work with Rochdale's citizens. It is recommended that the impact of these early activities be evaluated by the district, for example to demonstrate where proposed components of the LAEP are still the cost-effective option, before moving to widescale rollout. For example:

- How to roll out heating system and fabric retrofit change alongside renewable energy generation and EV charging infrastructure. Testing how best to combine these components and understand where a whole house retrofit approach may be beneficial
- How should additional electricity demand be provided in an area e.g. through network reinforcement or through providing alternative strategies
- How to engage with stakeholders and provide appealing customer propositions. Should activities be deployed at a neighbourhood level or dispersed across a wider area
- Taking account of evolving UK energy and heat policy

It is expected that Rochdale Council will work with other key stakeholders, including GMCA, Cadent, ENWL and delivery partners to develop a detailed demonstration and delivery programme.

Demonstration and scale-up priority areas



The following priority areas highlight suggested places to test specific components of this LAEP as demonstrators of possible solutions:

- Existing spare electrical network demand capacity in Pennines South, Rochdale North and Rochdale South along with significant roll out of heat pumps in the primary scenario is conducive to making early progress for heat pump deployment in these zones. This electrical capacity also allows for early deployment of home EV chargers.

- In the other zones, heat pumps would also be a low-regrets option for areas of housing that are far from any industrial areas (which might be served by hydrogen) or potential heat network coverage. Modelling has also shown that ground source heat pumps could be cost-effective in detached homes, regardless of presence of low carbon hydrogen in the network.

- Rochdale North in particular has a significant number of detached homes and has therefore been identified as an area of low-regrets to make early heat pump progress.

- Pennines North, Pennines South, Rochdale North, Middleton East are prioritised for fabric retrofit deployment, predominantly due to high proportions of older detached and semis that would benefit from thermal improvement. These zones differ in the types of homes which are most prominent, allowing archetypal approaches to be pioneered and developed, e.g. for rows of terraces.

- Rochdale South, and Heywood and Middleton West have been identified as district heating opportunity areas since they see significant uptake of this solution in the primary scenario alongside lower priority of hydrogen uptake. However, the economic case for district heating over individual systems such as heat pumps is finely balanced in these areas, based on the assumption that heat networks can be built to provide energy more efficiently (and hence lower carbon) than individual systems[*]. Further work is required to determine the most appropriate solutions

- Rochdale South and Heywood are prioritised for the demonstration of solutions for Rochdale's non-domestic buildings; with the potential development of district heating in areas of Rochdale South and potential for hydrogen serving industrial needs in Rochdale Heywood

- Rooftop solar PV can be developed early in areas with spare generation capacity in the electricity network, such as Pennines South, Pennines North and Rochdale North. Public EV charging is prioritised in Pennines North, Heywood and Middleton East where demand is expected to be highest and existing car parks, public land and unoccupied buildings could be repurposed to provide EV charging hubs

Long term Deployment

- Flexibility and storage (combined with other components including heat pumps, solar PV and EV charge points) can be tested in Middleton West and Middleton

[*] The cost of carbon reduction is also very high; further work may determine there are more cost-effective means of reducing carbon

East, including a focus on evaluating whether alternative approaches to electricity network reinforcement provide benefit

- If hydrogen became widely available, Heywood and Middleton East could benefit from low carbon hydrogen to support industry and heat buildings. Additionally, domestic dwellings located near these industrial could also benefit as initial areas to target for cost effective connection to low carbon hydrogen supplies built to serve industry

2. THE VISION – KEY CONSIDERATIONS

To summarise, aspects of this LAEP present a vision (from many possible options), rather than a design, of how Rochdale could move towards carbon neutrality by 2038. This is not meant to provide a forecast or recommendation on what Rochdale's actual decarbonisation will be, where it is accepted that technologies, policy and expectations will evolve over the period of this vision.

The following themes set out both the rationale for how this vision has been produced, identifying several key considerations that will need to be thought about and integrated, alongside demonstration and scale-up activities, as plans to take this LAEP forward are developed. It is expected that insights from the demonstration activity and considerations of these themes will influence Rochdale's actual transition.

Modelling Approach and GM Carbon Budget

The GM carbon budget and the modelling approach to develop this LAEP are the primary drivers for setting out this vision. The GM carbon budget requires an approximate 15% year-on-year emissions reduction. This stringent target drives the need for early decisions and significant action in early years rather than adoption of a 'wait and see' approach with more change in later years. Therefore, the cost-optimised modelling approach used has to identify measures from a wide range of options to provide the required short term carbon savings. This results in the identification of measures such as local generation and deep fabric retrofit, which can provide early emission savings. If there wasn't a carbon budget, or there were a later carbon neutrality target, different options would be identified, some of which may have provided a more cost effective (from a whole system perspective) transition or one that would be easier to roll out and less disruptive to building occupants.

There are risks and benefits associated with each of the options discussed and either of the scenarios presented. Because of these, Rochdale's actual transition may result in a combination of the primary and secondary scenario. Before making any widescale and significant commitment to one option or technology over another, evaluation of multiple factors will be needed.

Evaluation

Demonstration of low-regrets and priority actions in the short term (3-5 years) feeds into key decisions in the plan. These decisions also require further evaluation of the following aspects, so that trade-offs between different options and their impacts on consumers are taken into account before moving from demonstration to large scale implementation, considering associated risks and benefits.

- Local generation is most effective at reducing carbon in the earlier years of the plan, while grid emissions are higher. This contributes to the near-term carbon budget, but is less critical for reaching long term targets as grid emissions fall. The large quantity of ground-mounted PV suggested in this plan will require assessment around feasibility, whole energy system integration and public acceptability.

- The timing (regarding the delivery) of HyNet compared to the rate of electricity grid decarbonisation

- The ability to scale-up and install options rapidly aligned to the carbon budget

- The practicality and cost of installing measures in dwellings and non-domestic buildings, for instance air source heat pumps in existing flats, or fabric retrofit of terrace houses

- The disruption associated with options – both within homes and at community level (e.g. traffic disruption from street works)

- Maintaining the gas network to supply sites (e.g. industrial) in areas that are expected to be heat pump or district heat prevalent

- How an electrified heat future would be paid for, recognising the greater in building investment required to move off-gas

- Coordination with other Greater Manchester local authorities in relation to energy network options

- Social and community benefits

- How to fund options and the preferences of investors

Consultation

Further consultation will be needed with key stakeholders, including GMCA, Cadent, ENWL and delivery partners to consider these considerations when developing demonstration and scale-up activity.

In addition, consultation with Rochdale’s citizens is essential to help understand attitudes towards Rochdale’s carbon neutrality transition; whilst also forming part of the evaluation process. This will help Rochdale communicate with its citizens so that they both understand the transition and can help to inform plans to take forward this LAEP.

Citizen consultation will help to:

- communicate Rochdale’s intentions
- understand what people want and which options they are supportive of
- identify areas to focus demonstration and then wider roll-out activity
- provide confidence to the organisations that will be involved in the delivery of Rochdale’s transition that there is a demand for solutions, products and services.

Vision to 2038

A significant portion of existing homes and buildings in Rochdale will require retrofit, carrying out insulation in **at least 72% of dwellings** (around 75,000). This is true for both scenarios, whether electrification or hydrogen forms the bulk of the heating solution, so early focus and investment in fabric retrofit is a low regret step. **More dwellings receive deep retrofits in the secondary (HyNet) scenario** (over 44,000, compared to circa 39,000 in the primary scenario). Evidently, the reduction in energy usage through deep retrofit is prioritised to lower carbon emissions in the short term while waiting for hydrogen to come in. However, a lot more basic insulation is proposed in the primary scenario (circa 39,000 vs 32,000)

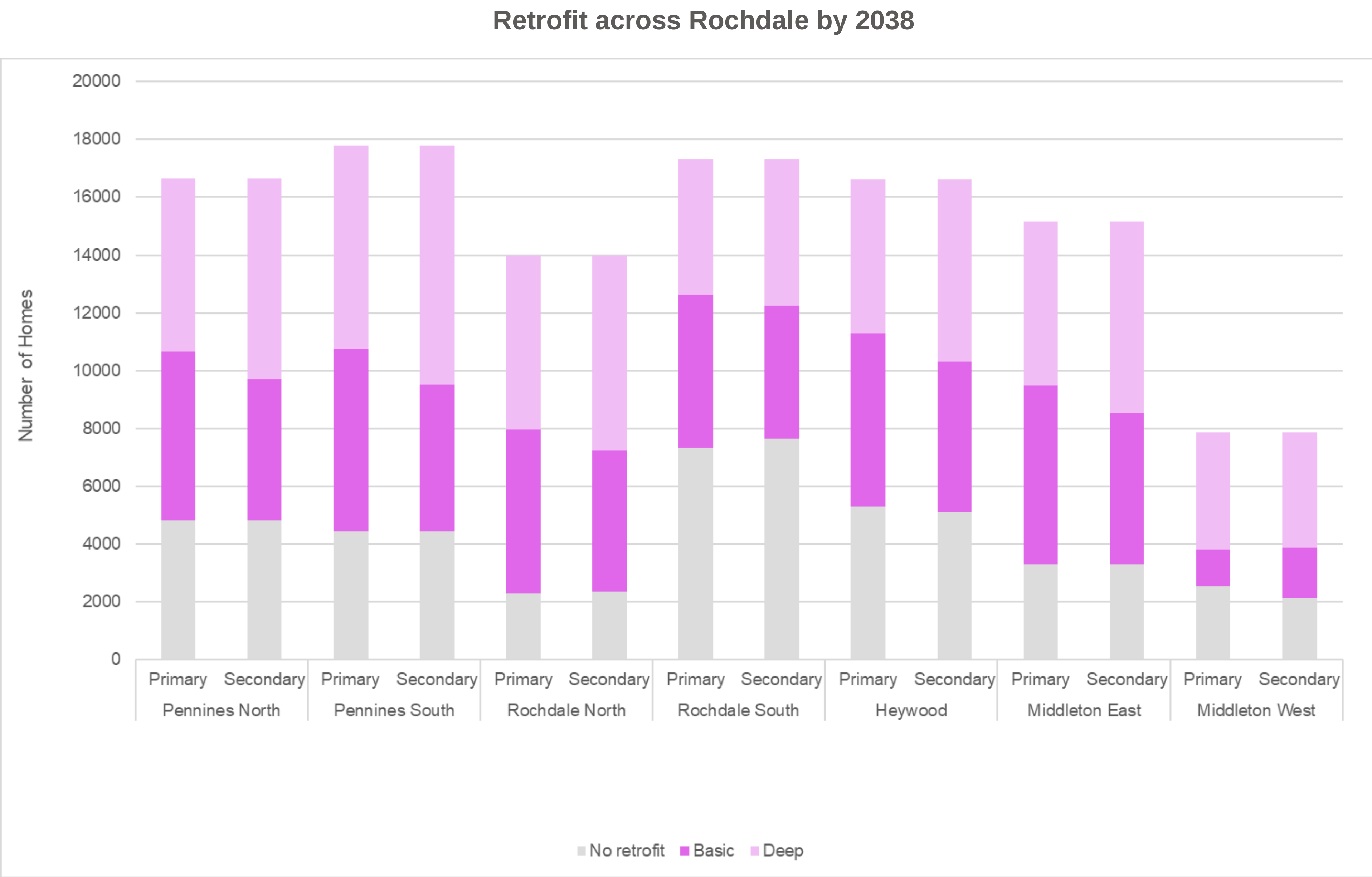
However, regardless of the heating system used, additional level of fabric retrofit may be needed to address affordability issues; for example, the cost of hydrogen is expected to be higher compared to gas*. In the second scenario, a higher proportion of dwellings undergo deep retrofit (circa 6,000).

Fabric retrofit could be combined with other measures such as heating system replacement, PV installation and EV chargers to minimise number of visits required to homes, as in the “cost effective retrofit” option on page 39.

Flats, which tend to have lower heat loss, show lower benefits from fabric retrofit, so are less of a focus area. However, further specific consideration will be needed at a building level to determine buildings that would benefit. For example, if a block of flats were to pursue a communal heating system, then the optimum balance between fabric improvement (to reduce heat loss and demand) and internal heating distribution systems would need to be specified, dependent on the heating system design strategy, recognising that a whole energy system approach will always be needed at a building level. Newer houses often already have better standards of insulation and fabric energy efficiency, but many will still need some treatment, unless built to the most recent building standards.

Overall, similar quantities of both basic and deep fabric retrofit have been selected in each zone for both the primary and secondary scenarios, as highlighted in the chart below, with only minor variation.

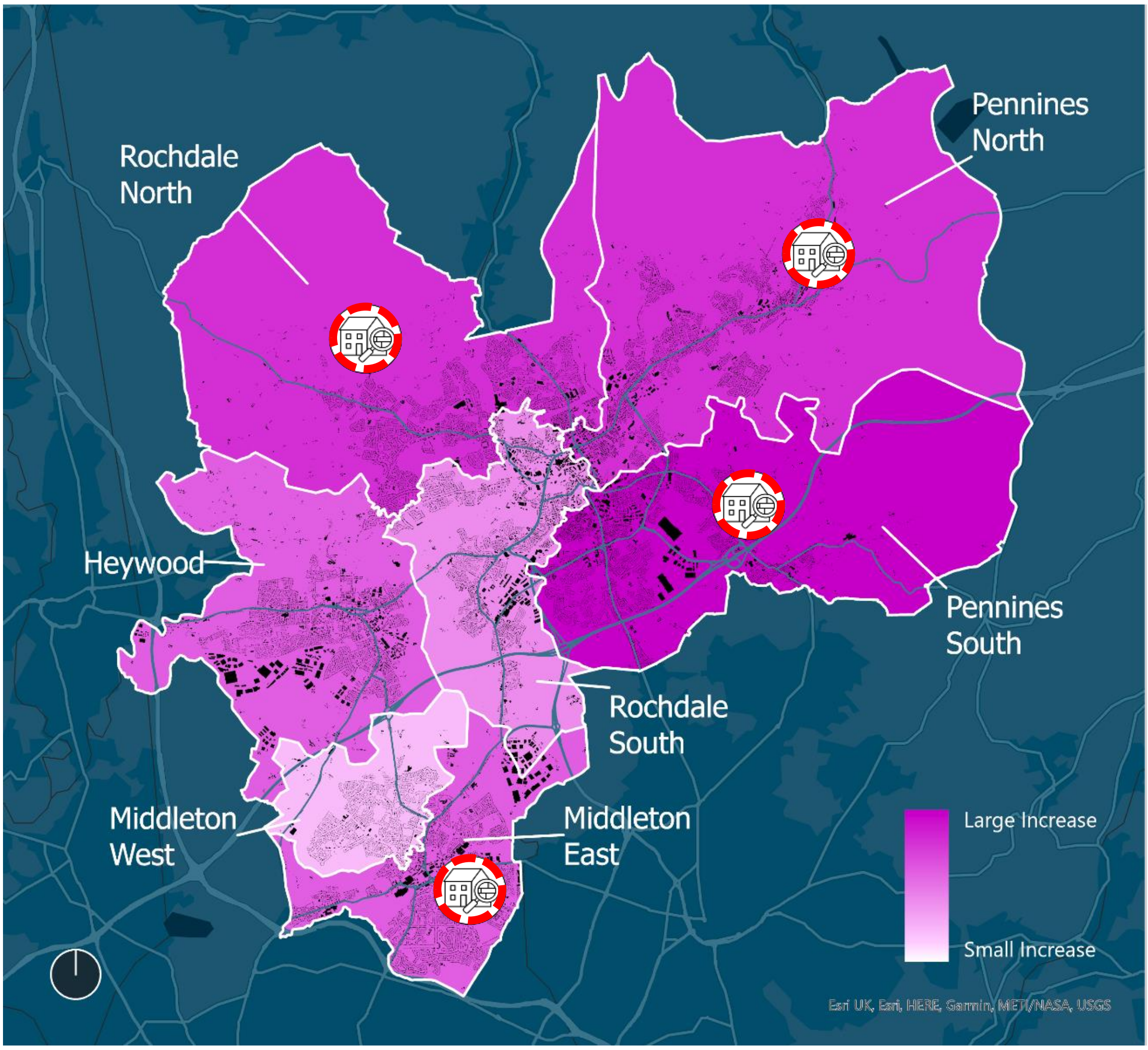
* Estimates vary - see for example projections for initial HyNet cost of hydrogen at around 150% uplift over natural gas https://HyNet.co.uk/wp-content/uploads/2021/06/14368_CADENT_PROJECT_REPORT_AMENDED_v22105.pdf [page 15]


Retrofit across Rochdale by 2038
Number of Homes
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Primary
Secondary
Pennines North
Pennines South
Rochdale North
Rochdale South
Heywood
Middleton East
Middleton West
No retrofit
Basic
Deep

First Steps – Priority Areas

Whilst large numbers of dwellings will need to be retrofitted to improve energy efficiency across all areas of Rochdale, several retrofit priority zones have been identified. The purpose of providing these priority zones is to highlight areas where demonstration and scale-up could be prioritised over the near-term (<5 years) *. The areas have been selected as they are regarded as low regret, are considered to be cost effective to receive fabric retrofit measures, regardless of the type of heating system (e.g. hydrogen or a heat pump) that is used to replace natural gas boilers.

Four priority retrofit zones have been highlighted for Rochdale:



* Fabric retrofit measures have been identified following a whole energy system approach, considering the cost-effectiveness of fabric retrofit measures alongside other options to achieve carbon neutrality in Rochdale. This does not mean that individual dwellings or buildings would not benefit from additional retrofit measures when considered on a case-by-case basis, particularly as part of a package of wider measures that could include heating system change and PV installation. During the development of any activity or plans to progress this LAEP, consideration will be needed to determine the optimum approach for deployment, when appraised alongside the approach for taking forward any of the other components of this LAEP. For example, in some cases a whole house retrofit may be beneficial, taking account of other GMCA activity, such as the Pathways to Healthy Net Zero Housing for Greater Manchester report and recommendations: https://democracy.greatermanchester-ca.gov.uk/documents/s13523/07%20Pathways%20to%20Healthy%20Net%20Zero%20Housing%20GM_Report.pdf

Pennines North, Pennines South, Rochdale North, Middleton East

These are areas in which a high proportion of homes (between 70 and 80%) receive insulation measures, with these zones also containing a large absolute number of properties to be retrofitted, so the opportunity in these zones is significant.

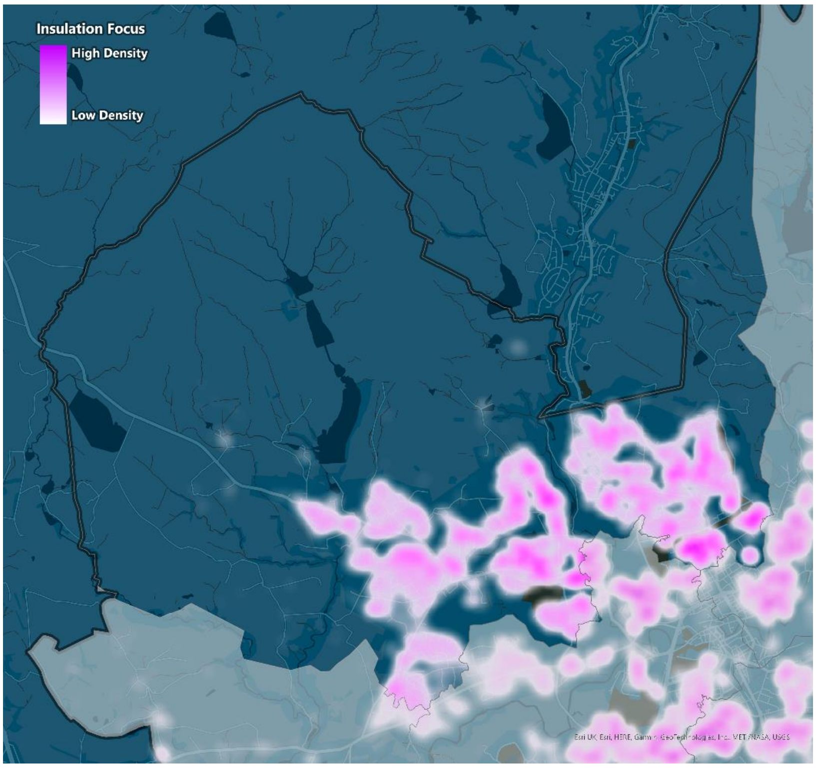
However, all other areas also see high levels of retrofit, with the lowest levels in Rochdale South still being around 55%. Greater proportions of flats, newbuilds or pre-1914 properties which are less economic to apply insulation to lead to lower insulation levels in these zones.

Whether or not a priority area based retrofit approach is pursued, it is essential that any delivery programme considers how to best integrate implementation with other dwelling related components to consider where a whole house retrofit approach would be required.

Fabric Retrofit Zones in Rochdale by 2038

Rochdale North is dominated by semi-detached and detached homes, most of which (93% - circa 9000) receive fabric retrofit. This is split half-and-half between basic and deep fabric retrofit packages in the semi-detached homes and detached homes. Around 84% of the 3,450 terraced homes in this area receive retrofit, with approximately an even split between basic and deep. The predominant age groups of homes in this area are 1914-1944 (around 3,500 homes) and 1965-1979 (around 3,400 homes). Retrofit is spread evenly and extensively (nearly all buildings) across all age groups, except pre-1914 homes which receive upgrades to approximately half of the buildings. In the secondary scenario, where hydrogen heating is dominant, overall retrofit numbers are nearly identical, but with more of the semis and terraced homes receiving deep rather than basic retrofit.

Fabric Retrofit Opportunity in Rochdale North

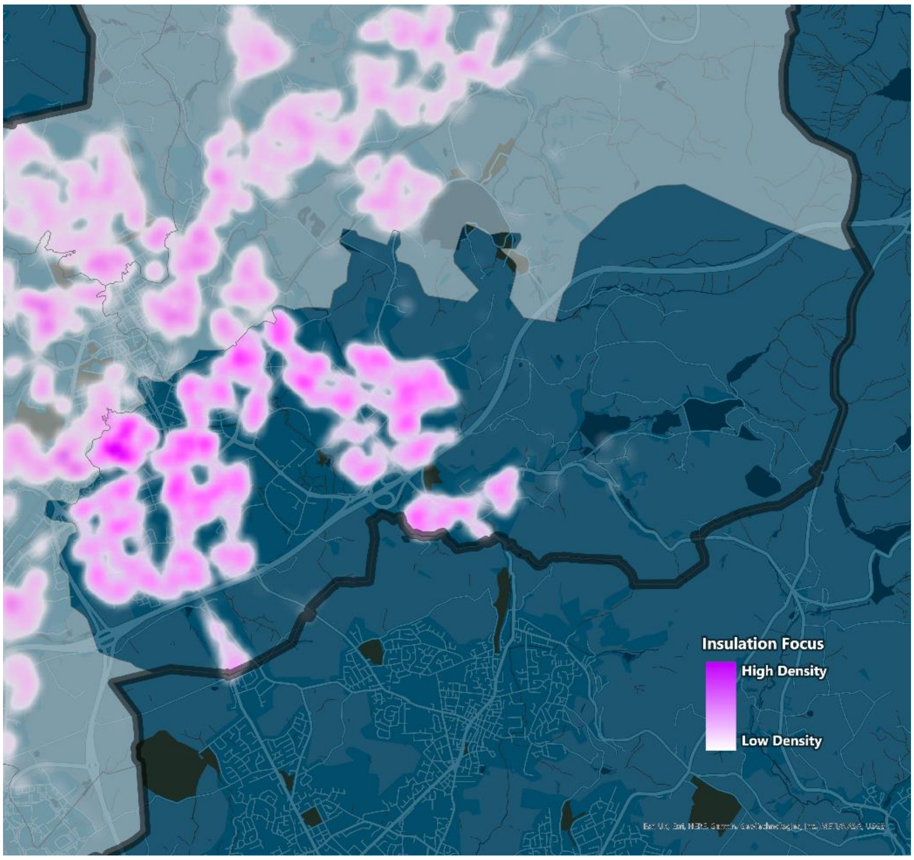


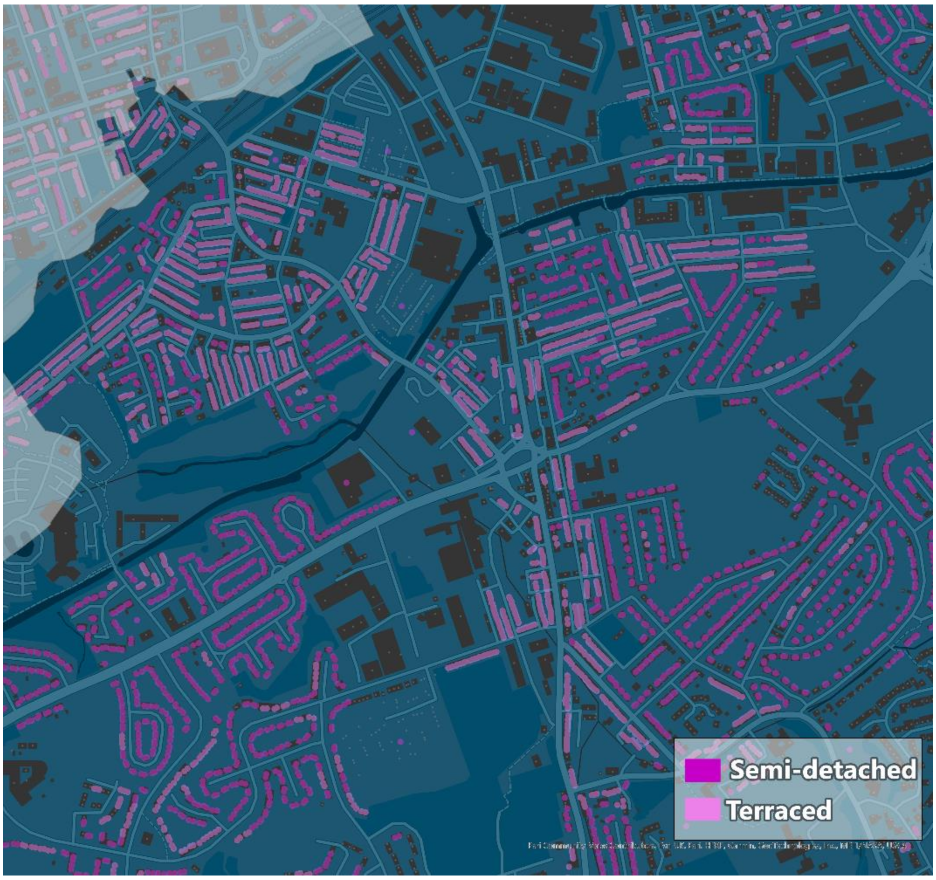
Pennines South is quite different to Rochdale North. It has 22% (Circa 4,000) more homes and the split between housing types is also very different. Pennines South has a much smaller number of Detached homes (circa 2,400 vs 4,900). However, basic and deep retrofit across home types is split evenly. Pennines South has a larger number of homes built between 1914-1944 and 1945-1964 (38% and 50%) than Rochdale North.

Pennines South has an even split between basic and deep retrofit for homes built after 1914. Homes built before 1914 have predominantly deep retrofit, around 95%.

Only 26% of the homes do not receive retrofit, predominantly flat, and terraced houses (16%). In Detached homes, the split between basic and deep retrofit is 1/3 each, with 1/3 not receiving any retrofit, and semi-detached being nearly an even split.

Fabric Retrofit Opportunity in Pennines South

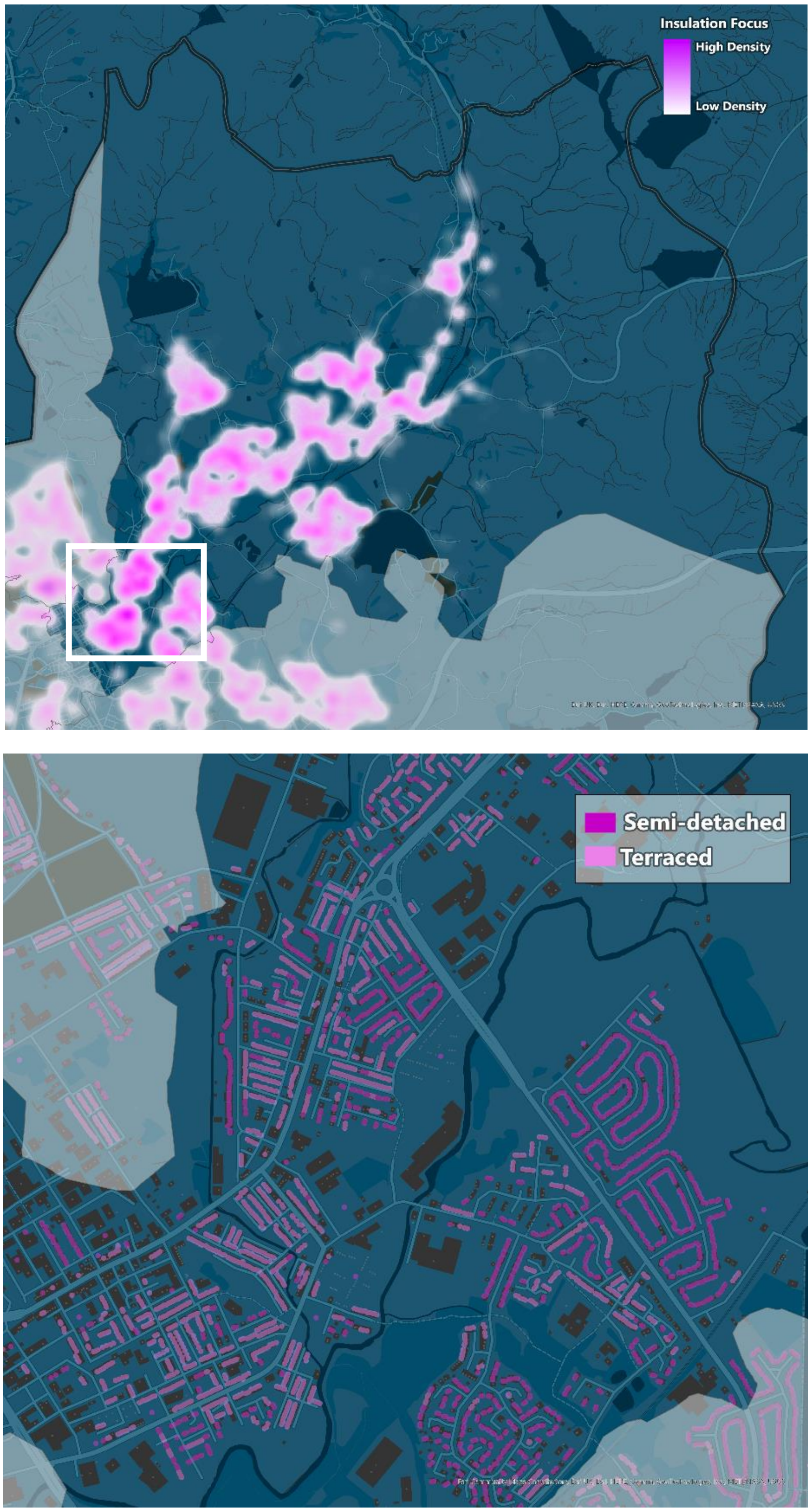




Pennines North has a similar number of dwellings to Rochdale North. The largest property type is terraced houses followed by semi-detached homes, with the split by build year closely resembling Rochdale North. 70% of homes in Pennines North are to be retrofitted, with the split between semi-detached homes being nearly equal, detached homes being split by into thirds, and 85% of terraced houses requiring retrofit, split evenly between basic and deep.

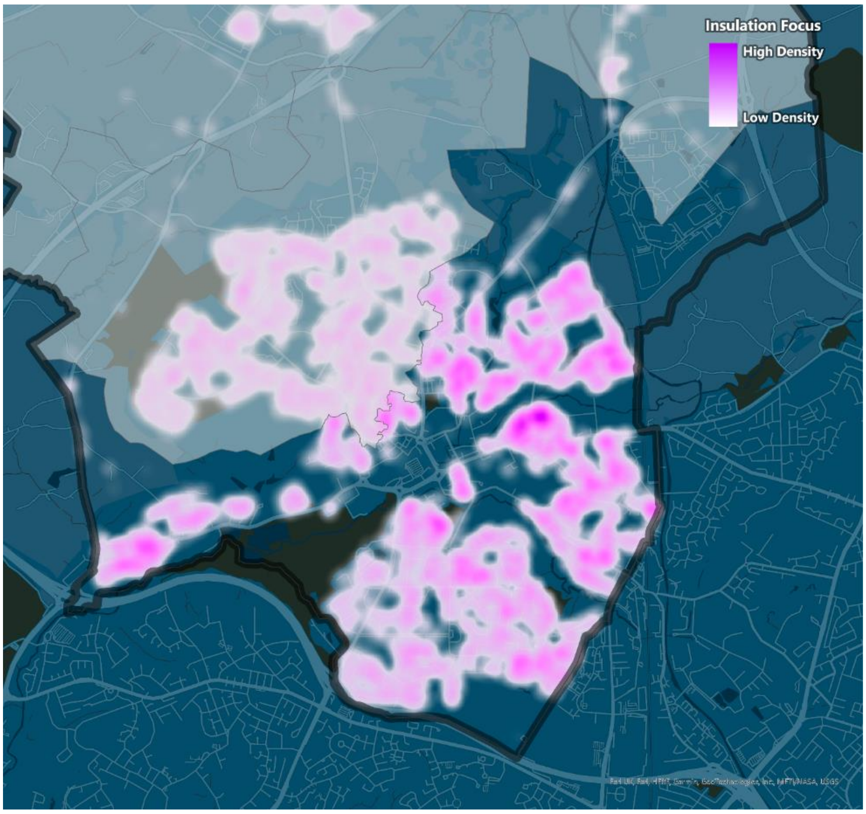
For houses built after 1914, the split between basic and deep is nearly even. For pre-1914 built homes, nearly 95% are deep retrofits.

Fabric Retrofit Opportunity in Pennines North



Middleton East has a similar profile of dwelling types as Pennines South. The spread of house ages is also like Pennines South with a smaller representation in the age range 1980-Present. Retrofit packages are spread in a similar fashion across the dwelling types and ages, with 11,900 homes receiving retrofit.

Fabric Retrofit Opportunity in Middleton East



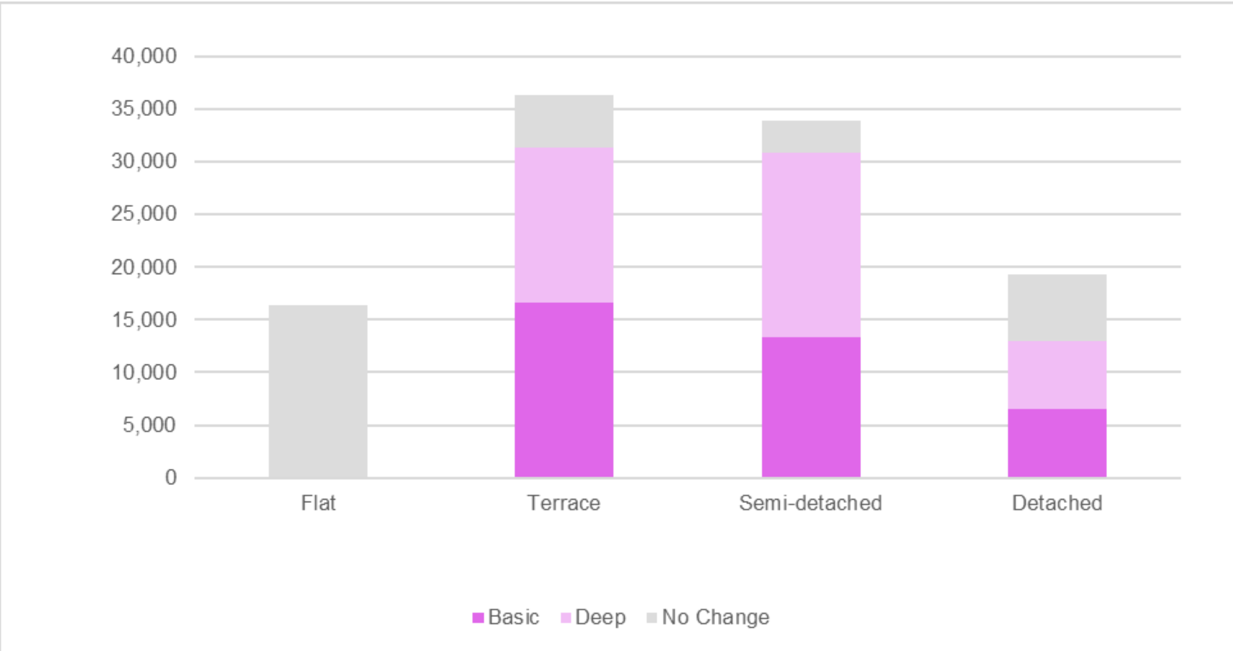
Fabric Retrofit Approach

Retrofit measures should be tailored for the individual dwelling, taking account of its type, age, construction, existing insulation and likely future heating system. For example, cavity wall insulation will only be applicable to dwellings that have suitable* cavities (usually post-1920 properties) that are not already filled. Narrow cavities, common in interwar houses, are likely to be unfilled, having been considered "hard to treat" during previous rounds of cavity treatment; targeting these dwelling (with an appropriate solution) types is a key focus for this LAEP.

The retrofit zones identified on the previous pages are designed to allow the coordinated targeting of interventions across Rochdale in such a way that supports and aligns with Rochdale's wider local energy system transformation.

There is uncertainty in the specific measures needed and most suitable for individual homes as exact details of the existing fabric efficiency of any given dwelling are not known. Survey work will be needed before any works are undertaken.

The distribution of the dwellings in Rochdale expected to need retrofit measures by dwelling type is shown below. This represents around three quarters of the projected domestic building stock in Rochdale of approximately 75,000 dwellings in 2038. This highlights both the scale of the challenge but also the opportunity for building and using local supply chains.



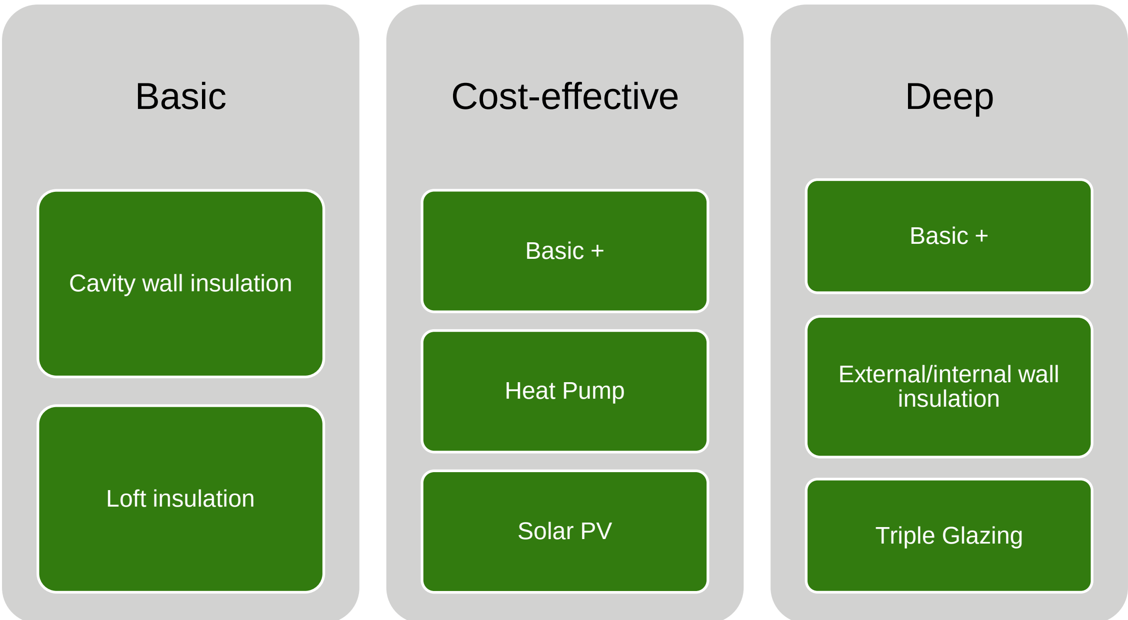
Fabric Retrofit in 2038 by Building Type

* Consideration will be needed to identify a suitable approach for insulating inter-war cavity walls, noting cavity widths are generally smaller than more modern dwellings; considering aspects such as insulation type and damp prevention; where solid wall insulation may be needed on some dwellings with cavity walls

There are over 36,000 homes which receive basic insulation measures and over 38,000 receiving deep measures in both scenarios. Around 6,000 more dwellings will receive deep retrofit in the second scenario compared to the first. Carrying out basic measures in earlier years would not preclude deeper measures being installed in homes in later years. Therefore, basic measures and the majority of deep measures are considered low regret across all scenarios and heating system selections. Due to the ages of housing targeted, a significant proportion of the cost-effective deep measures are based on adding triple glazing to dwellings with basic measures applied, rather than large volumes of external/internal wall insulation to pre-war period dwellings. This is based on the supporting optimisation led modeling, which identifies least-cost options to achieve the carbon targets. Further consideration would be needed to ascertain if individual homes could also benefit from further measures to reduce energy demand and subsequently energy usage costs, for example, considering socio-economic indicators.

Cost-Effective Deployment

The proposed approach centres on ensuring fabric retrofit measures are implemented in the vast majority of suitable homes in Rochdale, which is found to be the most cost-effective approach for the whole system. However, deployment of measures should not be considered in isolation: integration with other components (such as heating system changes, PV installation and EV chargers) can help minimise disruption and offer cost savings, and so opportunities to develop cost-effective whole-house approaches will need to be considered during the development of any activity to take forward this LAEP. The range of different potential packages is illustrated in the diagram below*.



* The modelled packages align loosely with packages in the Pathways to Healthy Net Zero Housing for Greater Manchester, with some differences due to the modelling approach. The ‘deep’ package here is similar to the fabric measures in the ‘deep’ package in Pathways. The ‘basic’ package in this report is loosely comparable to the fabric measures in the ‘cost-effective’ package in the Pathways report, but generally does not include external/internal wall insulation. The cost-effective package illustrated here was not part of the modelling but may be a useful ‘real life’ approach for individual houses when wider factors are taken into account.

Rapid deployment of retrofit measures could be a relatively easy intervention in the near term, which is especially beneficial for staying within the carbon budget. The rate of deployment that is possible will depend on the development of a supply chain and business models; developing this in the next few years could allow for higher deployment rates in the medium term to support progress with decarbonisation where there may not yet be clarity on heating systems across all parts of Rochdale.
In an electrified scenario, the number of dwellings expected to need deep retrofit would be even greater than in a hydrogen scenario. This is a pattern which hasn't been seen in other GM boroughs to date and is due to the greater quantity of larger detached and semi-detached homes present in Rochdale. These homes require fabric retrofit to reduce heat demand and allow domestic heat pump capacity to meet the heat load of these homes. As heat pump technologies and products develop, the optimal choice between deep fabric retrofit or higher capacity heat pumps should be reviewed.

Deeper Retrofit

The approach described is based on finding the most cost-effective route for decarbonising Rochdale overall, in line with the carbon budget. However, there may be strong reasons for additional retrofit work and so deeper and more extensive retrofit for individual dwellings is possible, with the potential to bring benefits including:

- Increased comfort and reduced running costs for individual households. This could also be important for some households to reduce fuel poverty and improve health and general quality of life
- Potential to reduce energy consumption and associated carbon emissions across Rochdale more quickly. This would give greater headroom in the carbon budget, especially if carried out early in the plan, allowing strategic decisions to be made later (e.g. around the future of the gas grid). Or, to replace emissions savings that are currently proposed through other measures (e.g. the significant quantify of local electricity generation)

Supporting Low Carbon Heat

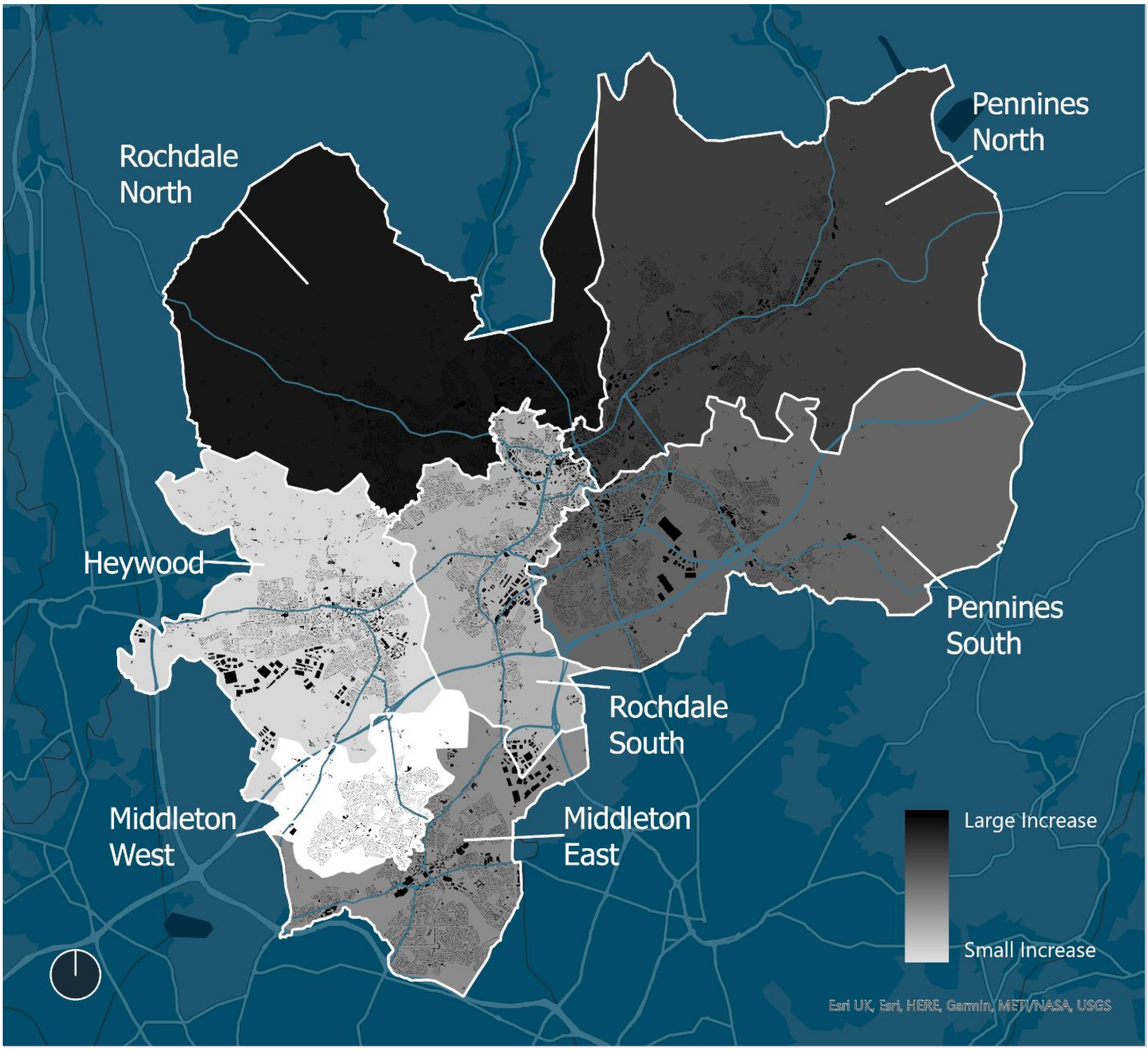
The improvement of building insulation supports the roll out of low carbon heat in several ways. Primarily, by reducing the heat demand, meaning that less powerful heating systems can be installed, reducing capital costs and by reducing energy costs associated with heating (compensating for a shift to a more expensive energy source (gas to electricity or hydrogen). Furthermore, reduced heat losses enable heat pumps and district heat networks to run at lower temperatures, improving their efficiency and running costs, and may also reduce the need for heating distribution system upgrades in homes.

It therefore makes sense to carry out retrofit either before or at the same time as heating system replacements to capture these benefits. Carrying out both activities at the same time would minimise the number of disruptions experienced by households, while insulating earlier would provide further emissions reductions compared to the modelled scenarios.

Vision to 2038

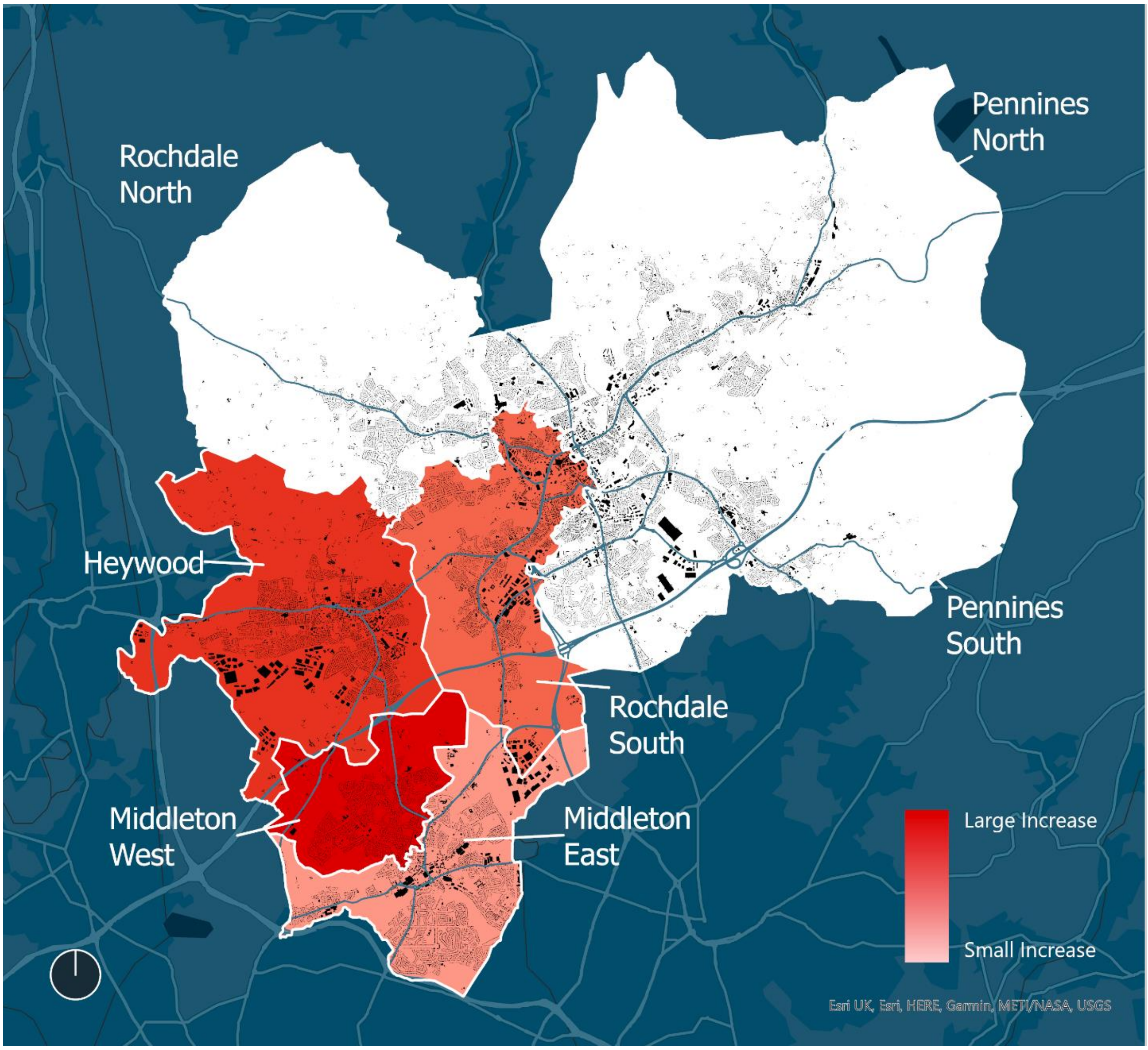
Building characteristics and existing network characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Rochdale. In the primary scenario, the decarbonisation of heat is primarily achieved through installation of electric heat pumps in existing and new homes, comprising approximately 78,000 domestic heat pump installations. These are the predominant heating system in all areas besides Rochdale South, Middleton West and Heywood. Other electric systems are also present in less significant numbers. Alternatively, the secondary scenario sees hydrogen boilers used in a majority of homes – see page 566.

Heat Zones for electric heating in Rochdale by 2038 (Primary Scenario)



A significant proportion of dwellings (21,700), in three zones, were identified as being in district heating system opportunity areas, where new heat networks could be formed to serve high density domestic heat demands, alongside electric options – see page 48.

Heat Zones for District Heating Opportunities in Rochdale by 2038 (Primary Scenario)

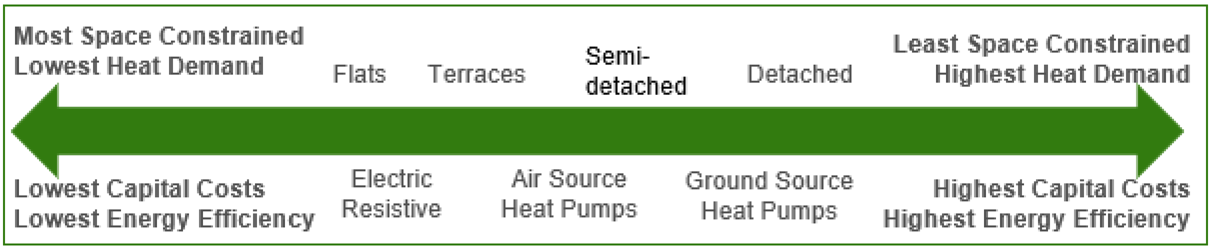


Even where hydrogen is available (as per the secondary scenario), least-regret effort in the near term is focussed on retrofit, priority electrification areas, and monitoring the development of hydrogen (at national and regional levels). The installation of hydrogen-ready boilers could provide optionality given the uncertainty, at minimal additional cost.

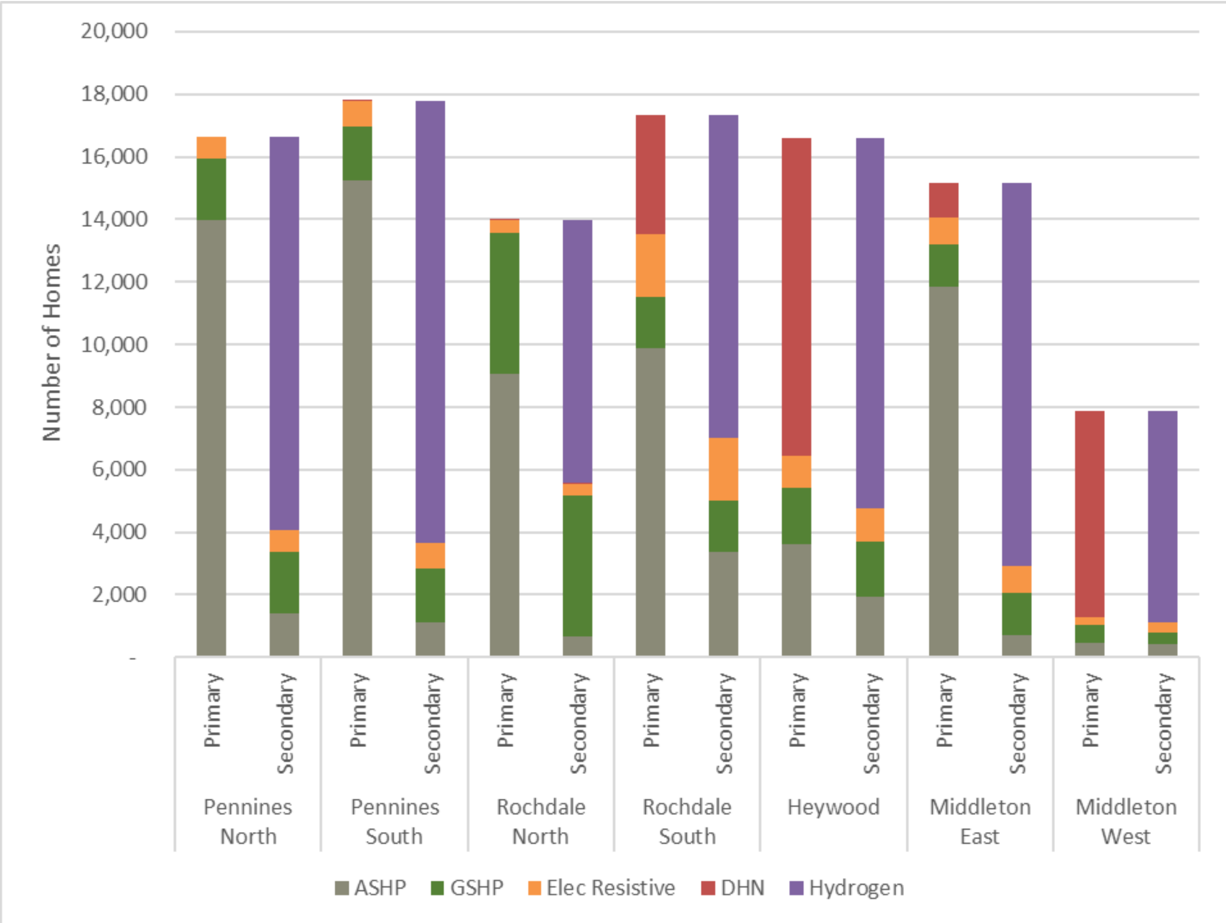
These forecasts are not definitive and represent a view of the future for each zone, to illustrate the scale of change required, it is expected that alternative solutions will be specified when exploring at a more detailed level, for example, there may be opportunities for communal / shared heating systems over the use of individual heat pumps.

Heating System Selection

Standalone electric heating systems are selected according to building characteristics as shown in the diagram below, while there are opportunities for district heating in dense urban areas. In the secondary scenario, hydrogen boilers are selected instead of electric or district heat options for many homes, as shown in the bar chart.



Deployment of Heating Systems by 2038



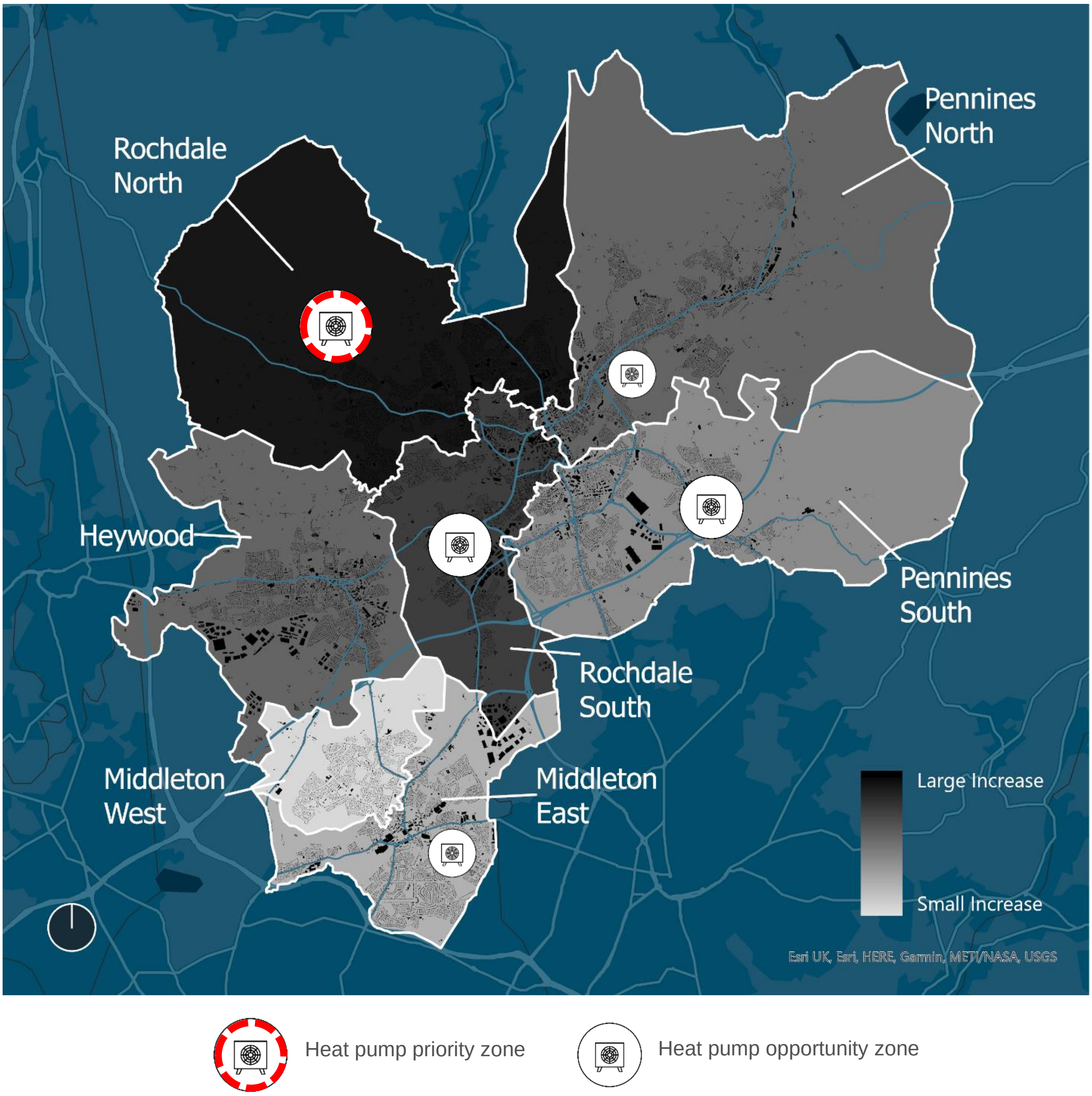
Air source heat pumps are the most widely suited electric heating technology. Although, a small proportion of homes in most areas was found to be suitable for ground source heat pumps, where greater outdoor space permits the installation of a ground collector, and larger properties may justify the higher upfront cost with greater savings in running costs. These properties would also be suitable for air source if preferred. The ASHP category includes high temperature, low temperature and hybrid types, according to the needs of individual buildings. Electric resistive (conventional heaters) can be used in space-constrained buildings with low heat loads, such as modern flats.

Heat pumps are a proven and mature renewable heating technology, capable of delivering deep emissions reductions today. They can be rolled out to individual households gradually, without the requirement for large scale area transitions and buy-in from multiple households that district heating and hydrogen require. Some disruption within the home is typically required for radiator replacements and the installation of a hot water cylinder in homes which do not have one already. These indoor space requirements, together with the need to manage disruption to the household and locating a space for the outdoor unit where it will not cause noise issues for neighbouring properties, must be considered in the design, and can make heat pumps unsuitable for some properties. These issues would be avoided with hydrogen boilers, which would be a like-for-like replacement for natural gas boilers.

Heat pumps perform best in homes with good levels of insulation, so building retrofit should be considered alongside heat pump installations to minimise disruption to dwelling occupants. This would also reduce overall cost by allowing smaller heat pumps to be used and fewer radiators to be upgraded due to reduced heat demand.

First Steps: Heat Pump Priority Areas

Heat Zones for electric heating in Rochdale by 2038 (Secondary Scenario)



The majority of homes would use heat pumps, unless affordable, low carbon hydrogen became available in time, in which case most homes could use hydrogen instead. The exceptions are detached houses which could be more suited to ground source heat pumps, of which the majority are within Rochdale North, with a significant number also in Pennines North, Rochdale South and Heywood. These detached homes remain cost-effectively served by heat pumps regardless of the presence of low carbon hydrogen availability as per HyNet projections. For flats that currently use electric resistive heating, it is cost effective and sufficiently low carbon to remain using this option, whether low carbon hydrogen is available or not.

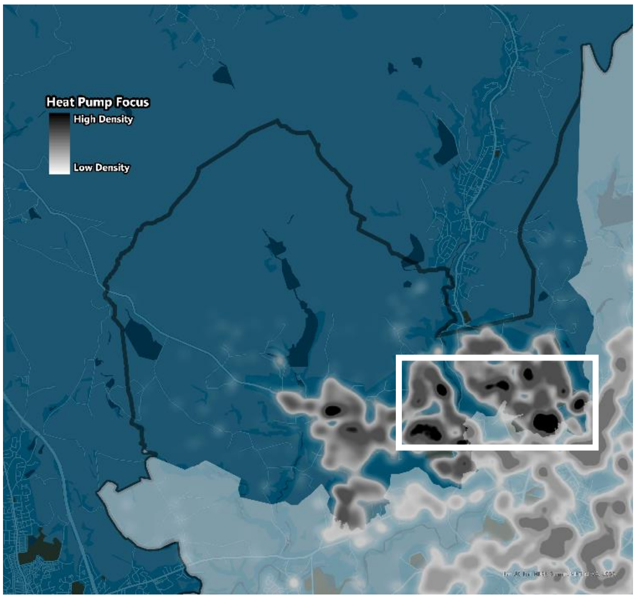
Out of zones Pennines North, Pennines South, Rochdale North, Rochdale South and Middleton East, those with large numbers of heat pump deployment and good levels of spare capacity on the electrical grid are prioritised for early deployment as existing heating systems approach end-of-life (while avoiding the distress replacement of a failed system, which can constrain options). This can help establish supply chains, delivery approach and capacity, and strikes a balance between flexibility and early progress. It leaves the plan open to developments around the future of the gas network, conversion to hydrogen and the UK's heat strategy, ahead of a mass programme of transition in places where the best option is less clear.

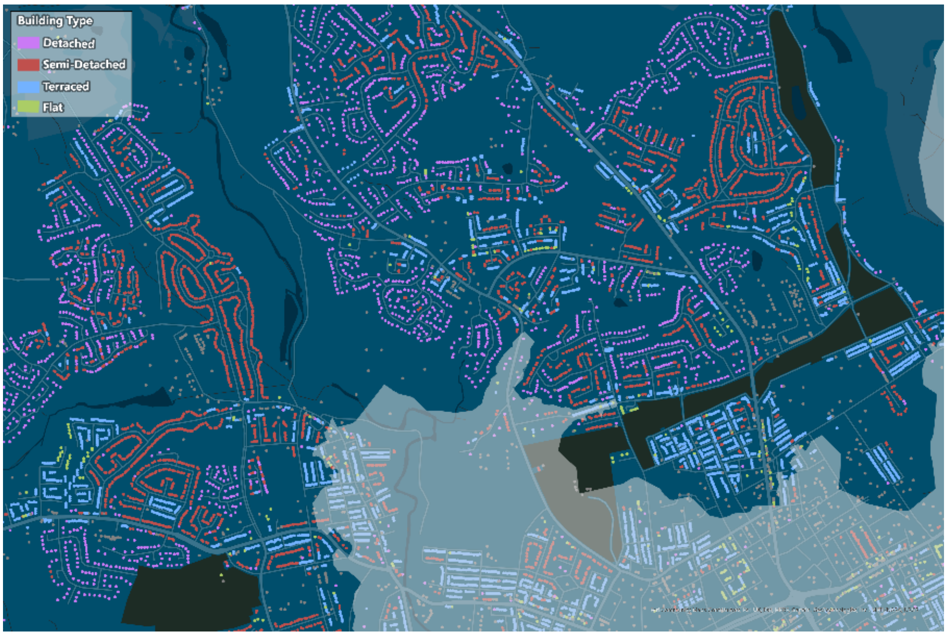
The heat pump priority map on the previous page illustrates suggested priority areas for demonstration and scale-up activity. Consideration will be needed to develop a programme of works which aligns with other interventions to maximise delivery efficiency and minimise disruption to residents.

Heat Pump Priority

Additionally, to the high level of heat pump deployment and distribution headroom, Rochdale North has been identified as a priority area due to its significant number of detached homes for which heat pumps remains the cost-effective heating system regardless of the availability of zero carbon hydrogen modelled in the secondary scenario.

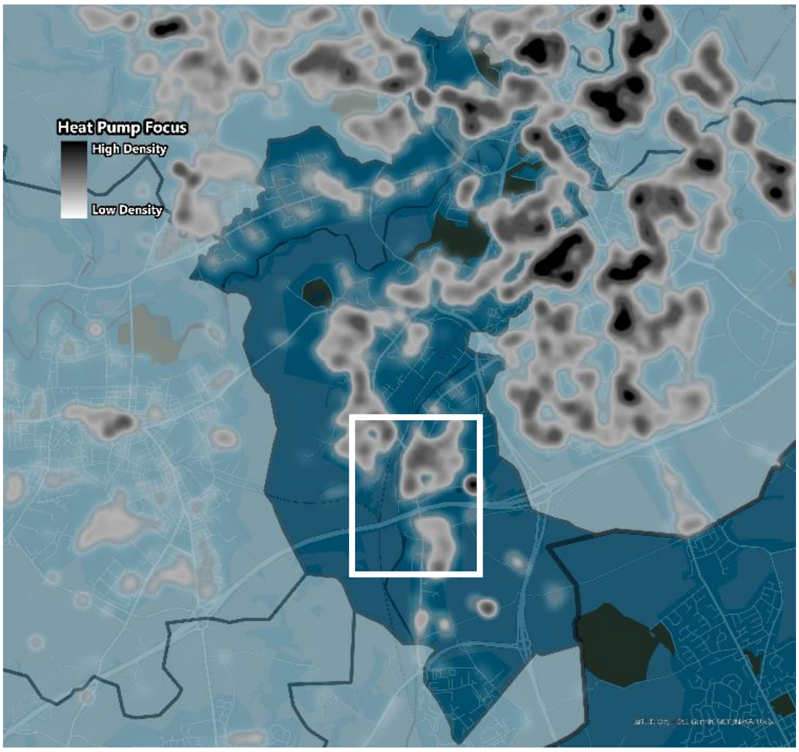
Rochdale North, along with a significant number of semi-detached and terraced homes, contains the greatest number of detached homes (4,500), identified as potentially being suitable for ground-source heat pumps. This provides another opportunity to develop best installation practice before rolling out to other areas, whilst also assessing the benefits of a ground versus air-source based system.

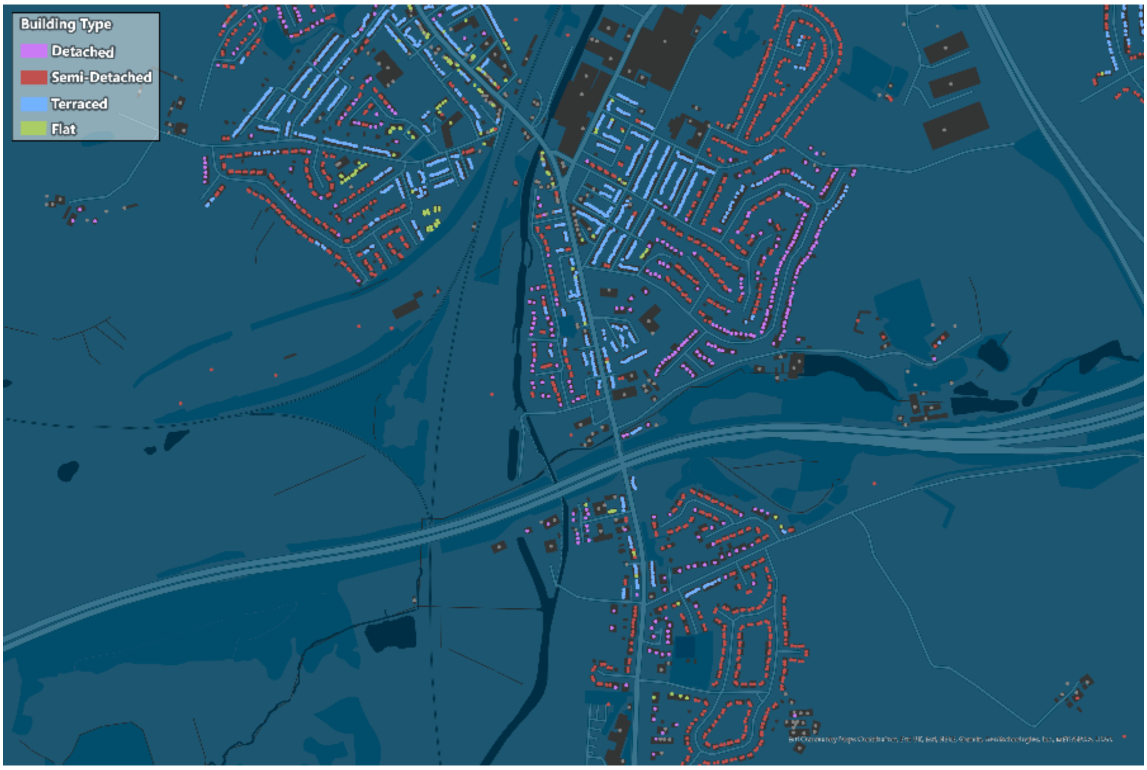




Opportunity Areas

Rochdale South has an even distribution of dwelling types with slightly more terraced houses (34%). Again, along with the demand headroom in the nearby substations, gives ample opportunity to develop approaches to installing heat pumps in different types of home. There is also opportunity to develop a modest (21% of dwellings being connected) sized district heat network in this zone.





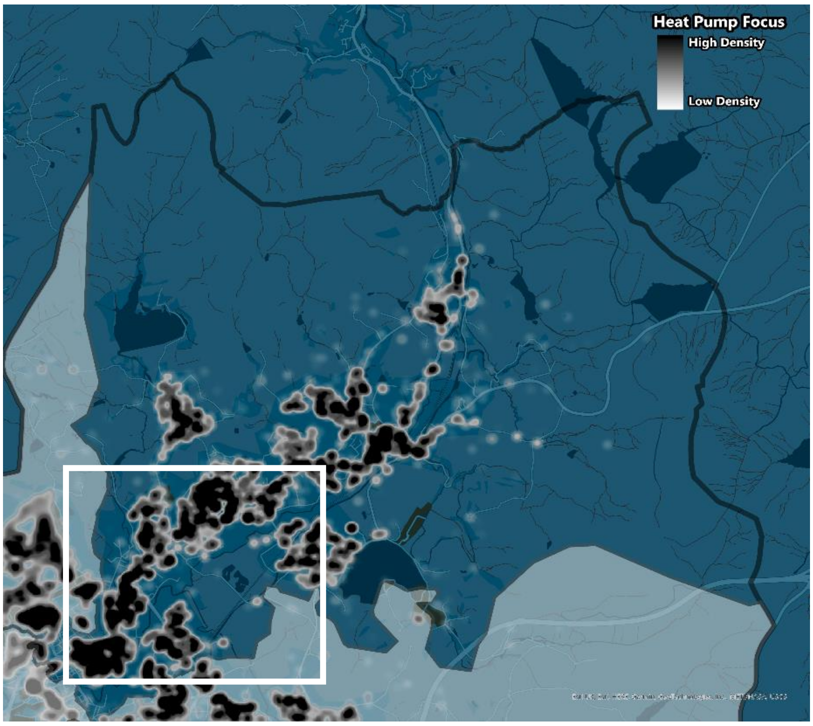
Pennines South has a high proportion of terraced and semi-detached houses (around 13,000 of the 19,500 total, or 73%). The semi-detached homes are likely to offer an easier opportunity to make early progress with heat pump installation, thanks to typically less space-constrained circumstances. The terraces provide the opportunity to establish good practice and overcome obstacles installing heat pumps in space-constrained homes, such as noise regulations and limited garden space. Of the 2,500 flats in this area around 1,600 could also be suited to use air source heat pumps due to their higher heat requirements, rather than district heat or electric resistive heating (which is most economic for small, well-insulated flats), so solutions for converting flats to heat pumps (e.g. through a communal system) can be explored here.

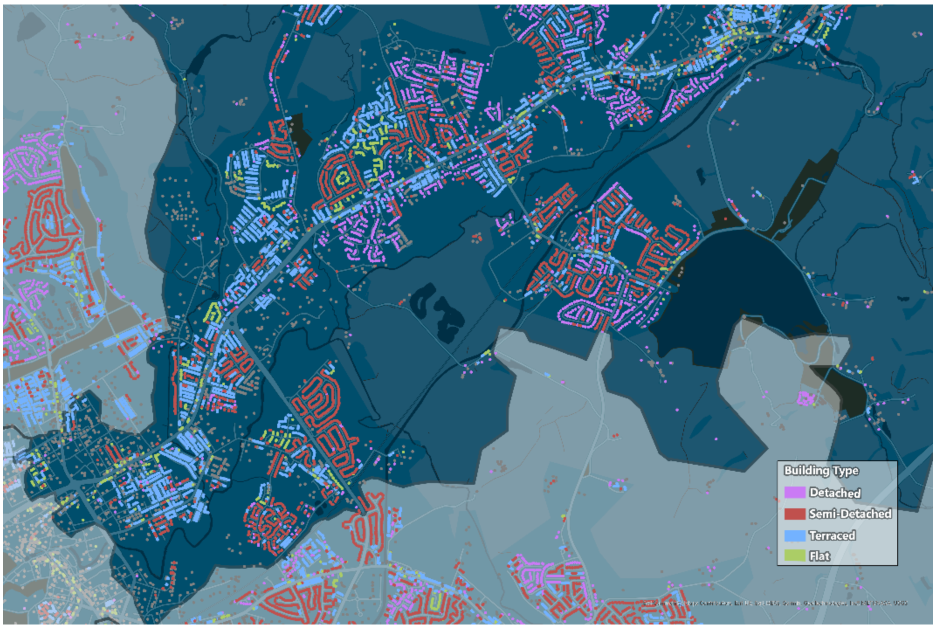
A total of around 15,300 air source heat pumps are recommended in this area (some of which could be hybrid systems), along with 1,700 ground source heat pumps. Electrical capacity in these areas appears sufficient to deploy a large number of heat pumps before electrical network upgrades would be required (see in section 7 Present Day Capacity and First Steps).

Pennines South

Pennines North also sees widescale adoption of heat pumps in nearly every home, meaning there is opportunity to deploy heat pumps with low risk of regret. These areas have not been prioritised since spare electrical network capacity is slightly lower, however in practice there appears to be substantial capacity to make progress before any limits are encountered. Approximately 14,000 air source heat pumps are recommended for Pennines North's flats, semis and terraces, and 1,950 ground source heat pumps for the detached homes. Similarly, Middleton East sees significant deployment of heat pumps alongside

Pennines North





District Heat Networks

Heat supplied through underground pipes from a centralised energy centre tends to be most suitable for denser urban areas, particularly where there are large numbers of dwellings which are either too expensive or impractical (e.g. due to space limitations) to make suitable for heat pumps.

Heat networks can have the advantage of causing less disruption in dwellings during installation compared to some other options, though there are wider considerations such as disruption to roads during pipe laying, and space restrictions in town centres.

Heywood has been identified as an opportunity area for the consideration of district heating in Rochdale based on sensitivity to reducing carbon pricing and carbon cost analysis. Middleton West sees a significant potential for district heat in the primary scenario whilst Rochdale South has a smaller deployment of district heat but strategic consideration could also see heat network opportunities when considering the potential development of a heat network emerging from the town centre.

These ‘opportunity’ areas highlight where it has been identified that district heating could provide an effective heat decarbonisation solution. Greater Manchester’s ambitious carbon targets, along with the set of possible technologies available within the scope of modelling, drive the model to select high levels of heat network deployment to minimise emissions. However, the assumed additional carbon savings from heat networks can be marginal for the additional cost, resulting in a high cost to carbon saving ratio. There may be alternative options in other sectors or in emerging technologies (such as carbon sequestration, agricultural practices, etc.) which could deliver more cost-effective carbon emissions reduction. The district heat areas should therefore be regarded as initial opportunity areas for further consideration, where more detailed feasibility assessment would be required, as would be the case with any heat decarbonisation option.

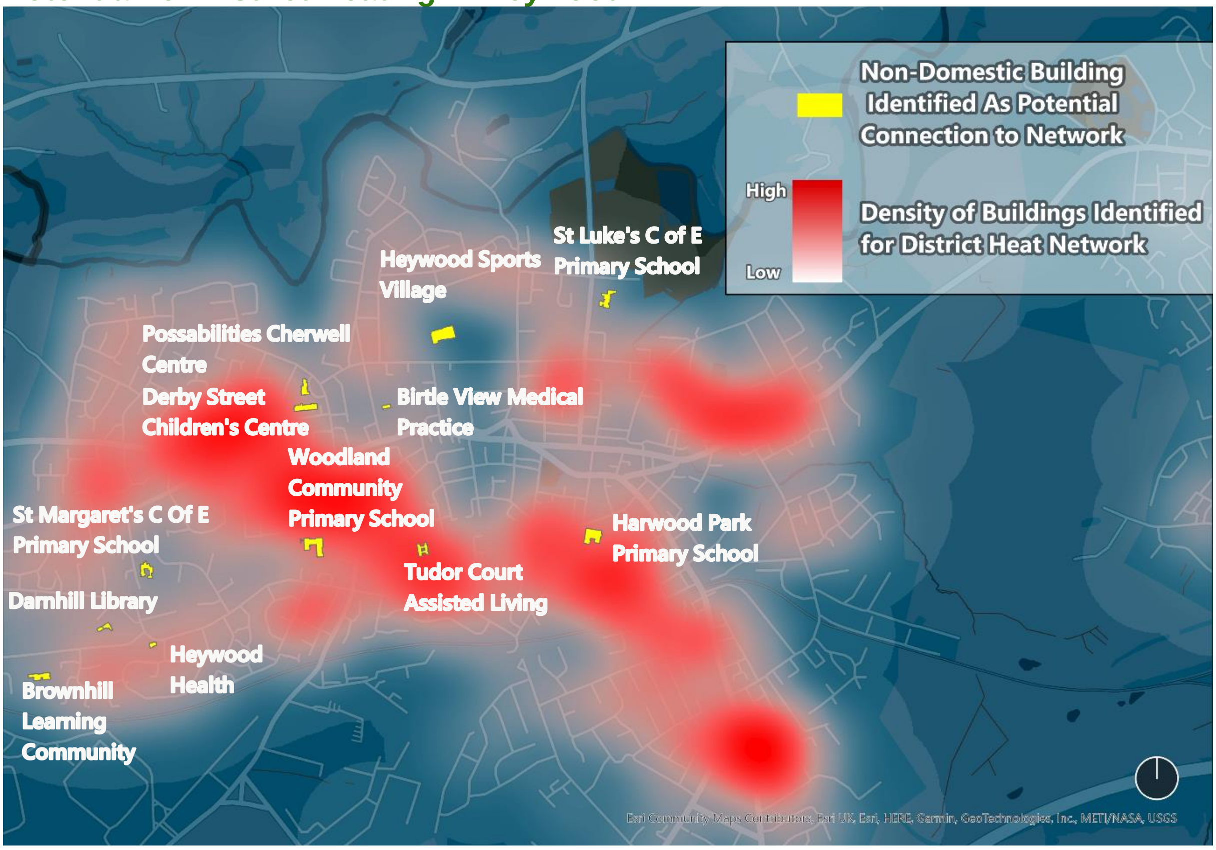
It should also be highlighted those opportunities identified in the modelling work are based on carbon being a driver, an overall cost to society (excluding taxes and funding availability) and a long term focus out to 2038. Therefore, commercially viable heat networks may be identified in other areas since these are likely to be focussed on short term payback, prioritisation around cost from the investor’s perspective and based on the current policy landscape and funding availability.

Whilst the following pages identify areas of interest and these opportunity heat network areas, the maps within “7. Energy Networks – District Heat” highlights some specific areas which have greater heat density and opportunities to connect with heat sources or anchor loads.

Heywood (Opportunity Area) covers a suburban area of Rochdale, in which terraced houses (41%) are the majority of the housing stock with semi-detached houses also significant at 27%) and the remainder made up of a fairly even split of semi-detached houses and flats (15-17%). The majority of flats, semi-detached and terraced houses in this area are identified as being potentially suited for connection to a district heat network. A heat network could be installed to serve up to 10,200 dwellings as well as public and commercial buildings, such as schools, libraries and sport centres across the area. The LAEP process has also identified an adjacent heat network opportunity area in Bury which would warrant further consideration.

Heywood Sports Village has been identified as a non-domestic building that could act as an anchor load, subject to further consideration. Whilst initial thoughts were for this to be an end-user of heat for a network, further desk-based investigation brought to light that this building has its own ground source heat pump. Dependent on their heat pump capacity and desire to do so, there might be an opportunity for Heywood Sports Village to connect to a network which could also serve surrounding homes and non-domestic buildings.

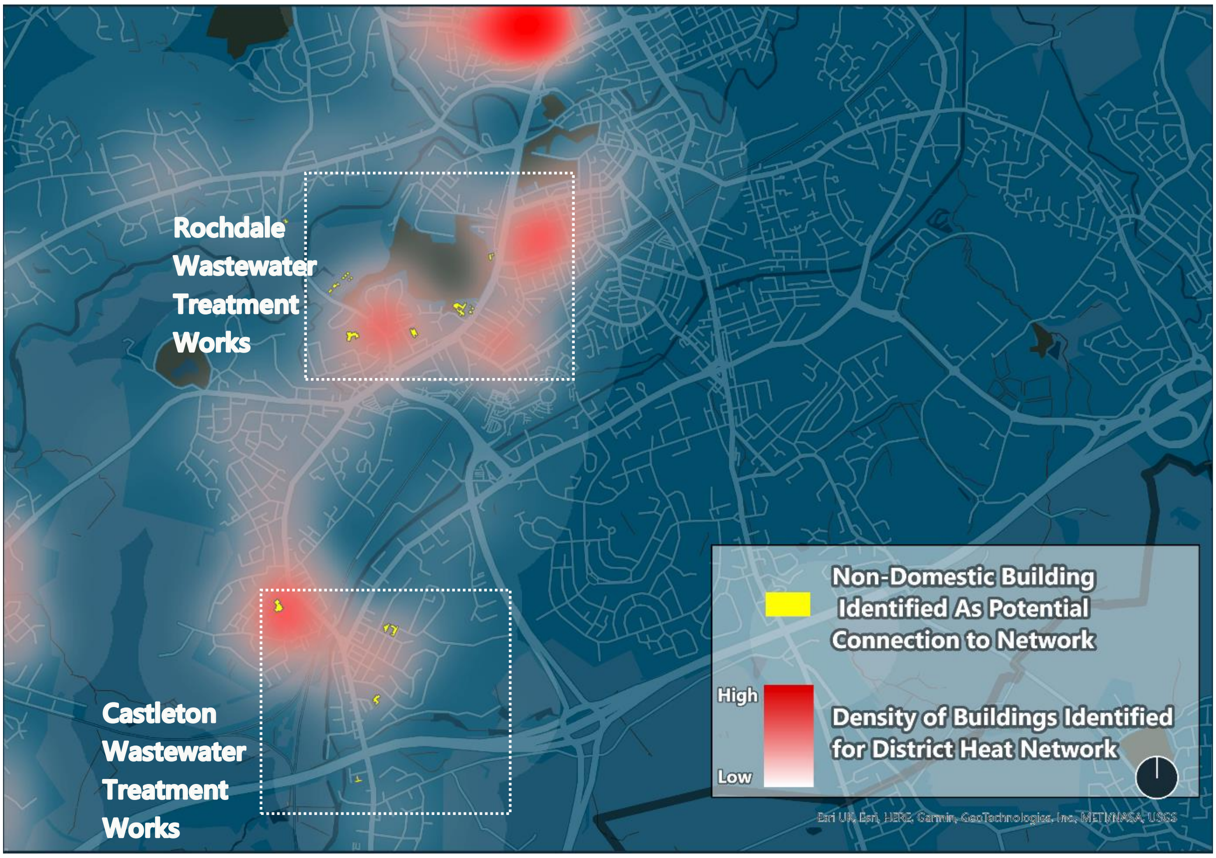
Potential for District Heating in Heywood

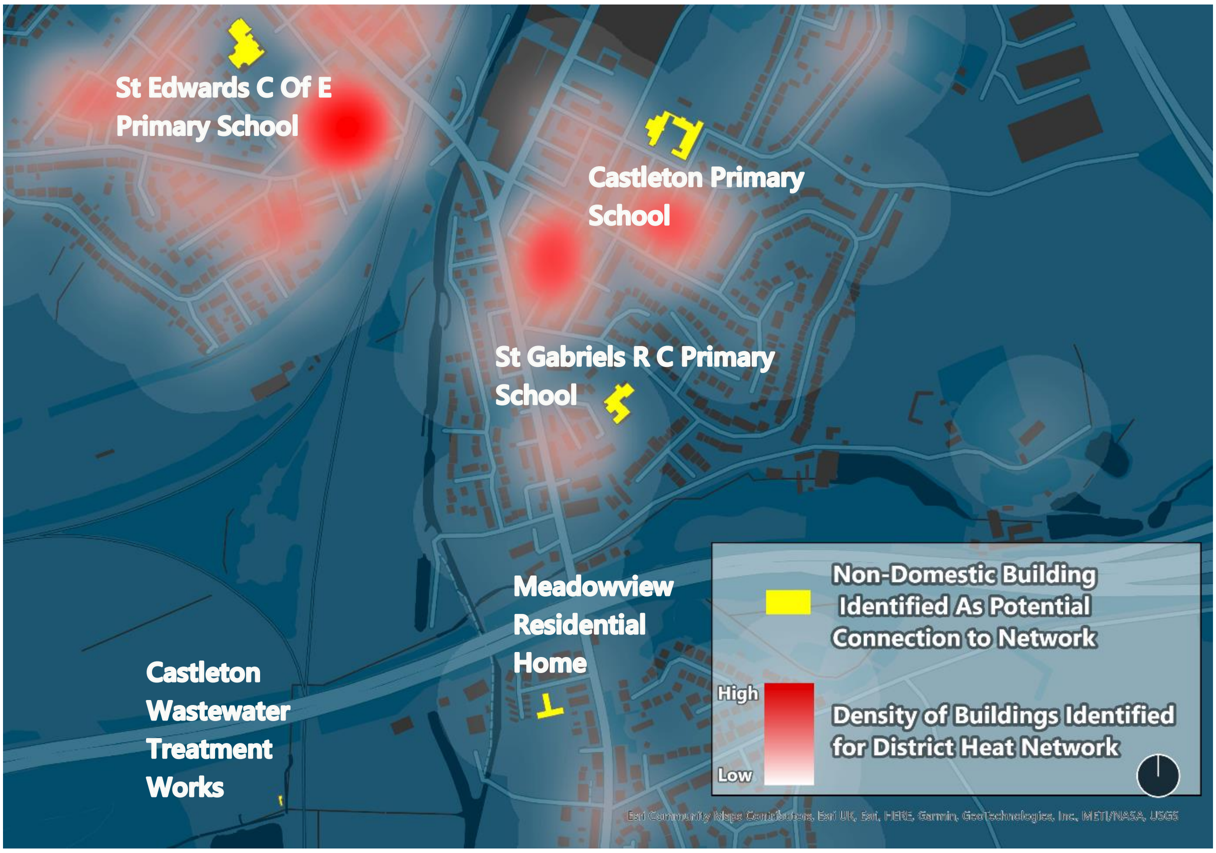


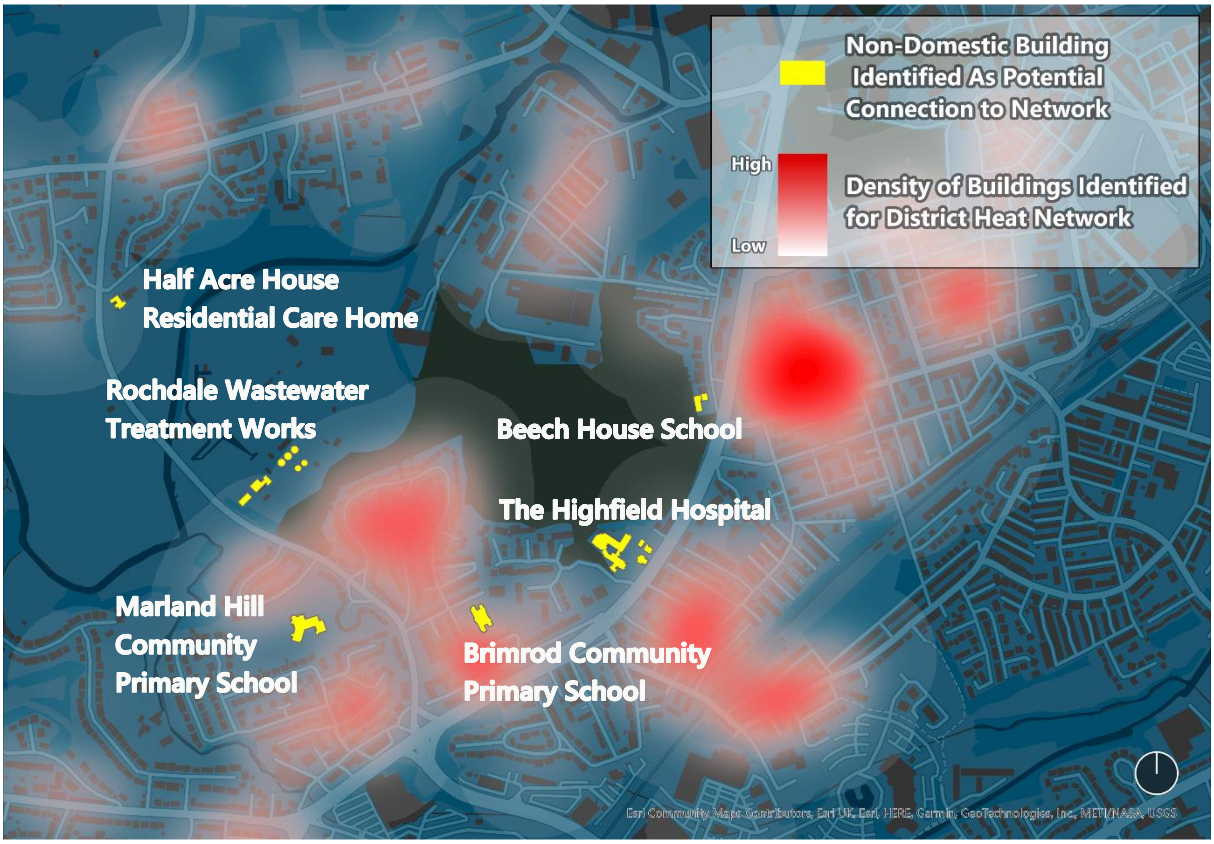
Rochdale South (Opportunity Area) has an even distribution of dwelling types with slightly more terraced houses (34%). Smaller heat networks could be created here to serve 3,800 dwellings focusing on areas of high heat density as well as public and commercial buildings, such as the many schools, care homes and hospital. Castleton and Rochdale Wastewater Treatment Works could be considered to support a heat network system. The maps below show an overview of the area followed by more detailed images at the buildings surrounding each wastewater treatment plant. In particular, the area surrounding Rochdale Wastewater Treatment Works looks to have potential with The Highfield Hospital being a possible anchor load with high heat demand.

A heat network opportunity report produced separately to this LAEP as part of City Decarbonisation Delivery Plan project in Greater Manchester has subsequently identified a further initial network concept which centres around a cluster of public buildings (Rochdale Leisure Centre, No1 Riverside, Rochdale Town Hall, Broadfield community primary school & nursery, Touchstones Arts and Heritage Centre and Rochdale Police Station) with flow data from the River Roch identifying it as a potential source of up to 3MW of heat provision using a water source heat pump. Possible expansions to this network spread north and south of this initial backbone picking up schools, hospitals and potentially linking up with the opportunity around Rochdale Wastewater Treatment Works identified above.

Potential for District Heating in Rochdale South

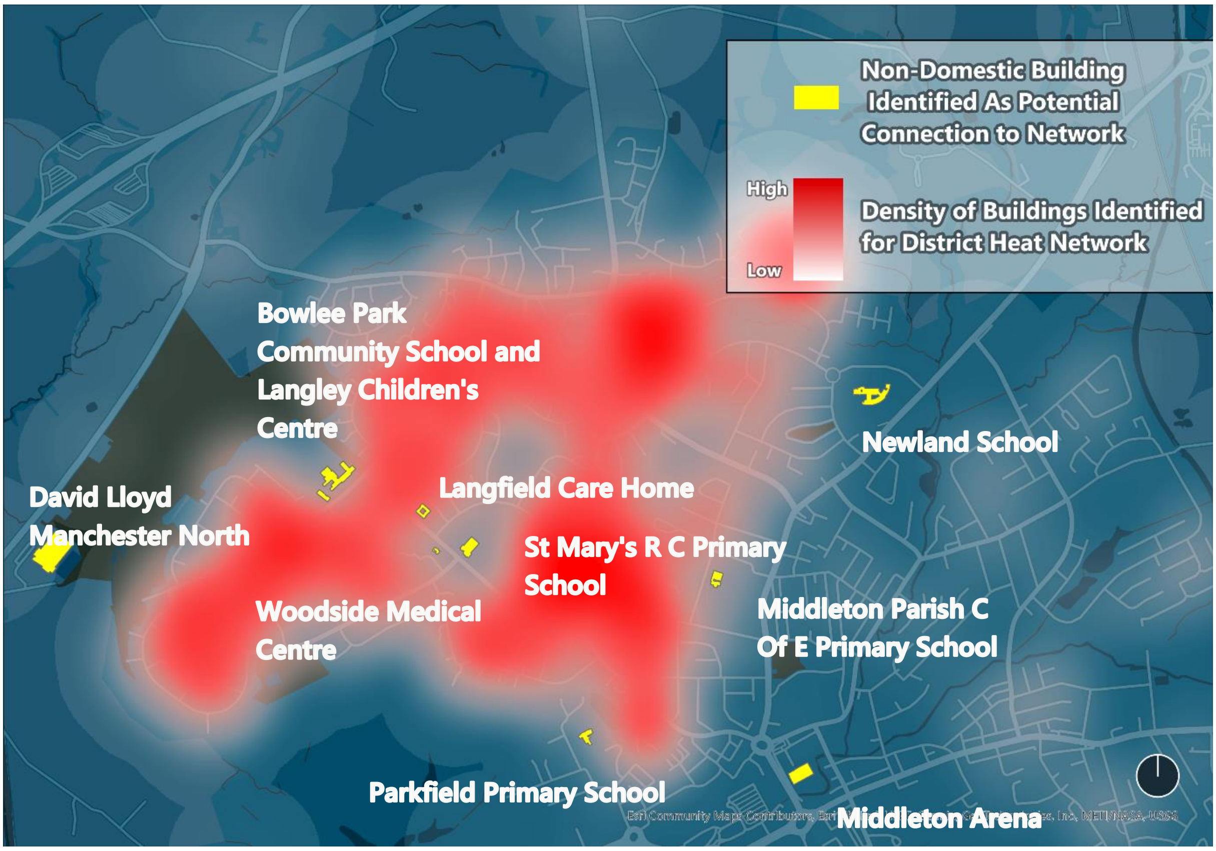



St Edwards C Of E Primary School
Castleton Primary School
St Gabriels R C Primary School
Meadowview Residential Home
Castleton Wastewater Treatment Works
Non-Domestic Building Identified As Potential Connection to Network
High
Low
Density of Buildings Identified for District Heat Network
Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, GeoTechnologies, Inc, METI/NASA, USGS


Non-Domestic Building Identified As Potential Connection to Network
High
Low
Density of Buildings Identified for District Heat Network
Half Acre House Residential Care Home
Rochdale Wastewater Treatment Works
Beech House School
The Highfield Hospital
Marland Hill Community Primary School
Brimrod Community Primary School
Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, GeoTechnologies, Inc, METI/NASA, USGS

Middleton West (Opportunity Area) covers a suburban area of Rochdale, in which semi-detached and terraced houses make about a third each of the housing stock with detached houses (10%), terraced houses and flats (21%) making up the remainder. The majority of semi-detached houses, terraced houses and flats in this area are identified as being potentially suited for connection to a district heat network. A heat network could be installed to serve 6,600 dwellings, such as schools, libraries and sport centres across the area. Opportunities to link this network with the opportunity areas identified in Bury should be considered.

Potential for District Heating in Middleton West



Current heating systems

When assessing the feasibility of buildings to connect to a heat network, the current heating systems within those buildings should be well understood. In particular within flats, there could be a number of different heating systems, ranging from direct electric to a block wide wet plumbing system. The direct electric system would require significant works to provide distribution within the building to utilise a heat network. Conversely, the existence of gas boilers and wet pipework system throughout the building would potentially provide an easier option, such as swapping out the existing boiler for a plate heat exchanger and its ancillary plant.

Hydrogen for Heating

The representation of hydrogen in the analysis for this plan has been aligned with the proposals for HyNet in the North West of England, and the associated opportunities for the GMCA area.

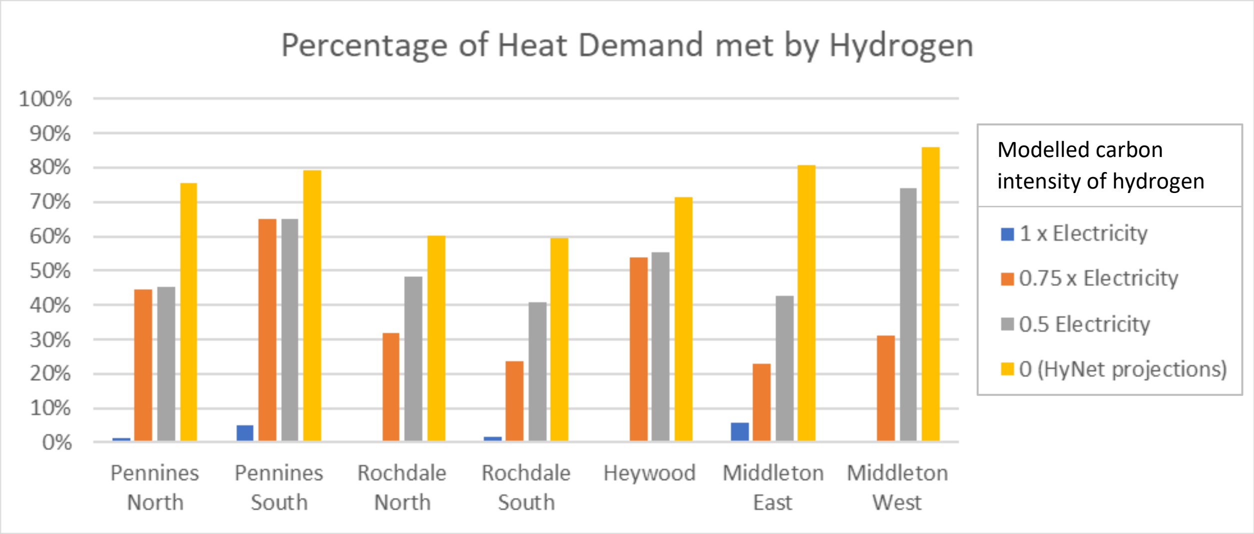
The primary scenario reflects phases 1 and 2 of HyNet, where low carbon hydrogen may be available from 2025 onwards for the largest industrial sites in the region. It is not believed that any of these are likely to be in Rochdale. The secondary scenario includes the possibility of HyNet phase 3, where low carbon hydrogen becomes available for homes and the full range of non-domestic buildings from the early 2030s onwards. This would require the repurposing of areas of gas grid to serve hydrogen to the buildings. Under this scenario it is found to be cost effective to provide hydrogen to domestic and non-domestic buildings in many areas of Rochdale, resulting in a potential shift to hydrogen dominated heating. One of the key considerations being that the hydrogen based secondary scenario is assumed to be significantly cheaper than the primary scenario (£6.3 bn compared to £7.3 bn); however, this is dependent on HyNet phase being delivered on time and at the cost and carbon projections provided by HyNet. Taking a wait-and-see approach is therefore deemed extremely risky when there is a 2038 carbon target; the scale-up and demonstration approach in the identified priority areas are therefore provided so that short to medium term activity can take place in areas of least regret.

A further scenario was also studied where hydrogen was tested as the only low carbon option (detailed in the appendix). Further analysis of both this and the secondary scenario showed that the total carbon emitted was very sensitive to the exact year that low carbon hydrogen became available in suitable quantities, which has a high level of uncertainty. Further detail is provided in Energy Networks section.

Under scenarios where HyNet phase 3 happens and low carbon hydrogen is available to the grid in the early 2030s, hydrogen heating displaces much of the electric and district heating across all clusters. This would occur as individual boilers in homes, although in district heating areas, the energy centre could use hydrogen boilers, making district heating a low regrets option in the face of hydrogen uncertainty.

A sensitivity analysis (see below) suggests hydrogen would most likely be cost-effective to deploy in Middleton East, Pennines South, Pennines North and Heywood in that order of priority and least likely in the remaining zones. For this reason, Middleton East and Pennines South are considered low regret for early progress on heat pump deployment.

Illustration of Hydrogen Sensitivity Analysis for Carbon Intensity



The graph illustrates a sensitivity analysis on the carbon intensity of hydrogen. As the carbon intensity is increased from the base assumption (from HyNet projections), the model reduces the quantity of hydrogen used, and some zones stop using hydrogen entirely. At the highest carbon intensity (equal to grid electricity), Pennines South continues to use hydrogen with a small amount also remaining in Middleton East, suggesting that use in these areas is high value and could be prioritised. However, this sensitivity analysis has resulted in marginal results and other factors are considered to determine areas of priority.

Proposed route and connection points for HyNet phase 2

Hydrogen for Heating - Opportunity areas

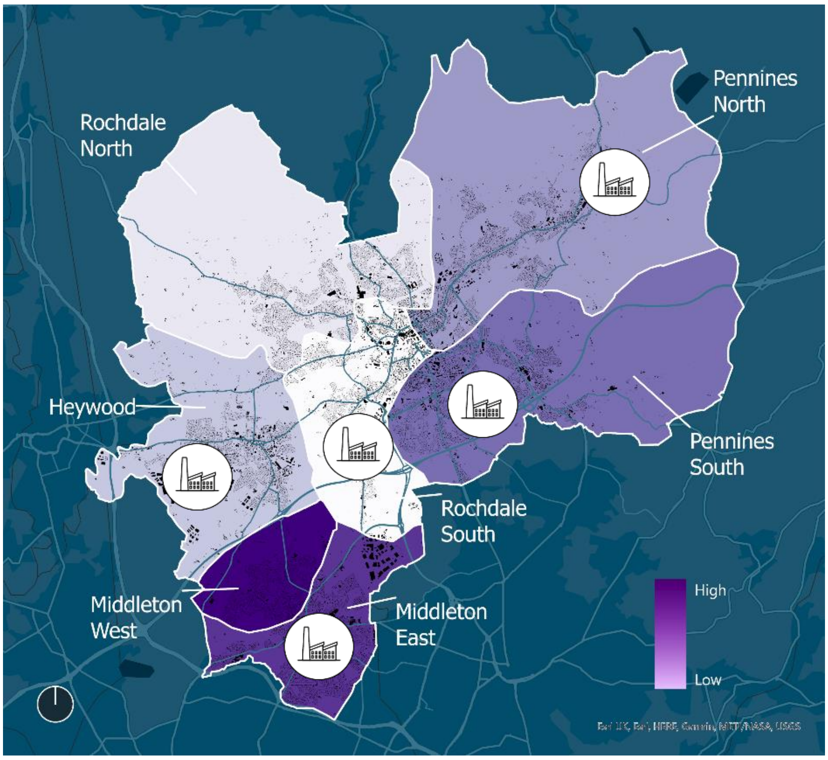
Non-domestic buildings serve a number of different functions, ranging from offices, educational facilities, retail, warehouses and factories (see the following section on non-domestic buildings). It is expected that some of these types of buildings may benefit from having access to hydrogen as the UK transitions away from natural gas. In particular, certain industrial processes may require high temperatures. A high level desk based study of such industrial facilities in Rochdale has been conducted to highlight where these high temperature uses are likely to be – see icons in the map below.

The other possible building type to target is new builds due to be built at the point at which low carbon hydrogen is available. The exact timing of the buildings being complete and the hydrogen coming available is uncertain at this point, but if it can align then it provides a potential option for the buildings.

Analysis has been undertaken to identify the areas of Rochdale where hydrogen should be prioritised if the quantity is limited. Since the model uses the available hydrogen in a cost-optimal way, the areas where hydrogen is deployed in a constrained resource scenario can be seen as priority areas. In this analysis, the difference in hydrogen deployment is marginal when carbon intensity of the hydrogen is increased. Since Heywood and Middleton East have the most significant extent of industrial buildings and are on the west side of Rochdale, closest to where the HyNet phase 2 pipeline is proposed to run, these areas have been taken forward as priority hydrogen areas.

Heywood is an area which would be prioritised for hydrogen connection if supply was limited. Additionally, there are up to 13,000 dwellings would be suited for hydrogen heating in this area. Although there are no dense clusters of industrial buildings which would require high temperature processes, there are a scattering of manufacturing sites which could benefit from being served by hydrogen. Alongside the existing potential demand for hydrogen, Northern Gateway is a major development of which most is in neighbouring Bury. However, there is a significant plot of land within Heywood which is intended for redevelopment within this scheme and strategic use of hydrogen should be considered, especially for any high temperature manufacturing requirements.

Middleton East is, similarly, an area which would be prioritised for hydrogen connection if supply was limited. Additionally, there are more than 12,000 dwellings would be suited for hydrogen heating in this area. Again, there are no dense clusters of industrial buildings which would require high temperature processes, there are a scattering of manufacturing sites and waste treatment facility which could benefit from being served by hydrogen.



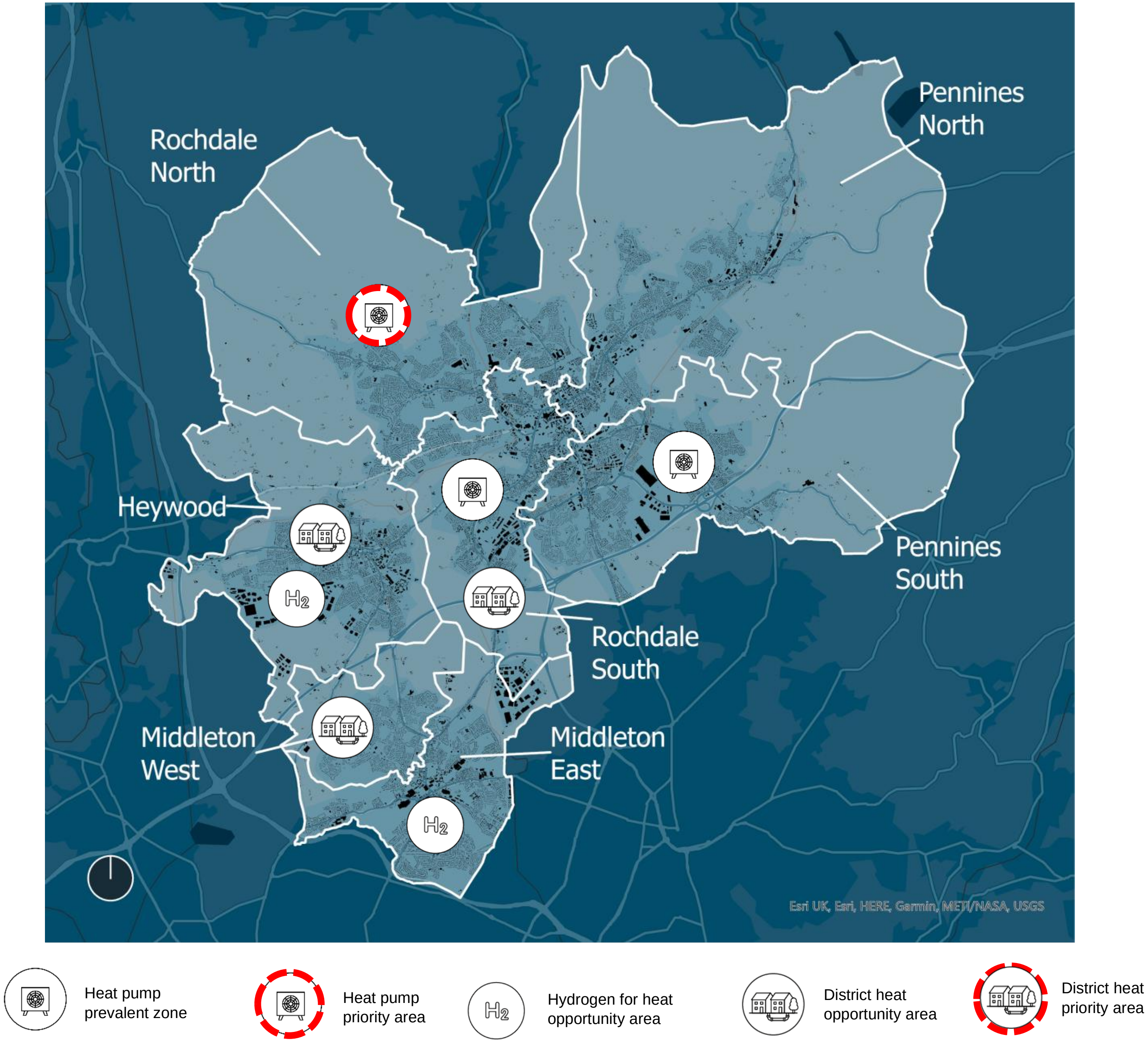
Areas of high gas use by industry which may be difficult to electrify (e.g. for high temperature process heat)

Colour shading shows number of homes identified as suitable for hydrogen heating

Most zones swing between being dominated by air source heat pumps or by hydrogen boilers between the primary and secondary scenarios, illustrating sensitivity to assumptions about the availability, cost and carbon content of hydrogen.

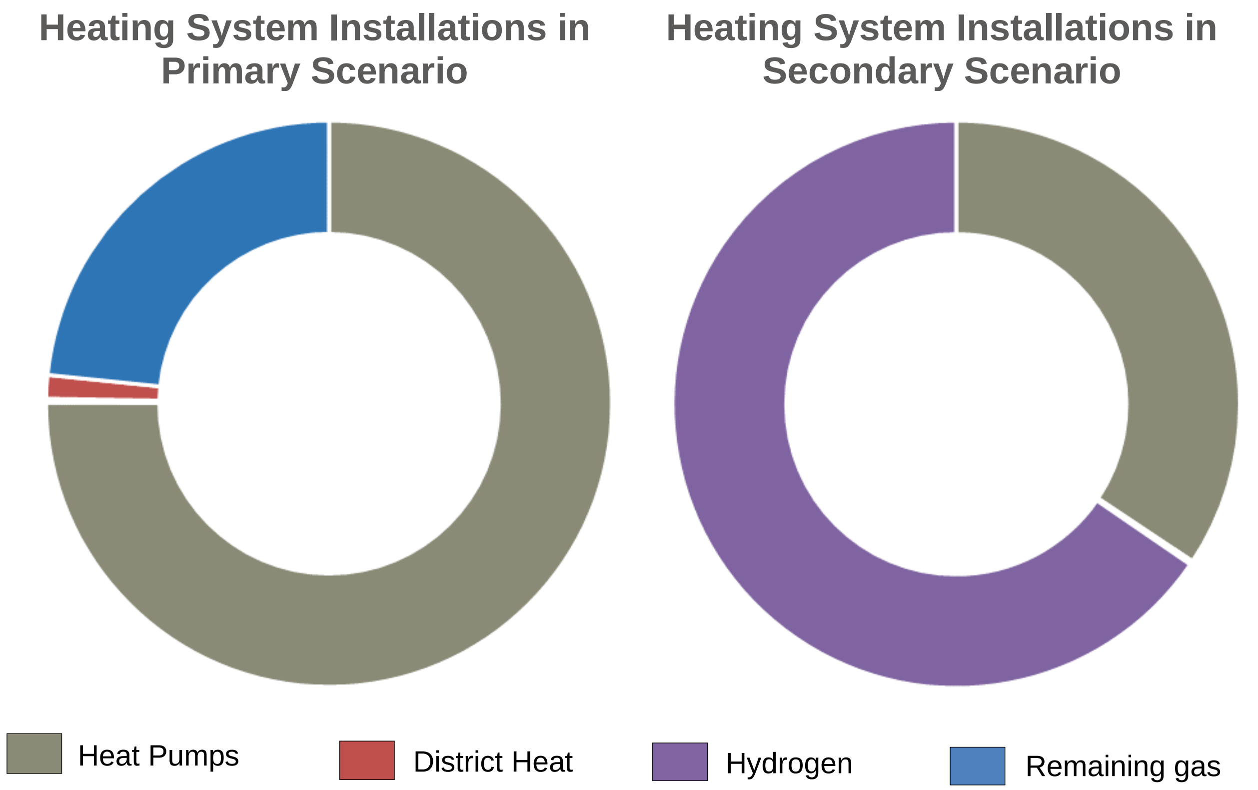
- In the secondary scenario, heat pumps remain the solution of choice for detached homes, while some flats remain on electric resistive heating.
- Heywood and Middleton West swings between either the installation of new district heat networks, or hydrogen between the two scenarios, with a supporting role from heat pumps in both cases in detached houses and a greater representation of homes in the primary scenario. To understand priority within these areas, hydrogen sensitivity analysis has been conducted alongside identifying industrial areas which might require gas for manufacturing processes. Rochdale South also sees district heat networks being chosen in the primary scenario to a smaller extent.
- Industrial estates such as Birch Industrial Estate and Broadfield Industrial Park in Heywood, small clusters of industrial warehouses and manufacturing sites through Middleton East and Pennines South as well as industrial parks dotted along the canal and railway in Rochdale South and Pennines North come become anchor demands for hydrogen around which nearby dwellings could be connected. Potential for hydrogen has been identified in Heywood and Middleton East from this work and its proximity to the proposed HyNet phase 2 pipeline.

Zone	Prevalent heating system		Priority area
	Primary scenario	Secondary scenario	
Pennines North	Heat pumps	Hydrogen	
Pennines South	Heat pump with electrical network capacity	Hydrogen priority (sensitivity analysis)	
Rochdale North	Heat pump priority	Hydrogen with heat pumps for detached homes	Heat pump
Rochdale South	Heat pumps, some heat network with electrical network capacity	Hydrogen	
Heywood	Heat network	Hydrogen priority (non-domestic buildings and location)	Hydrogen
Middleton East	Heat pumps	Hydrogen priority (sensitivity analysis)	Hydrogen
Middleton West	Heat network	Hydrogen	


Rochdale North
Pennines North
Heywood
Pennines South
Rochdale South
Middleton West
Middleton East
Esri UK, Esri, HERE, Garmin, METI/NASA, USGS
Heat pump prevalent zone
Heat pump priority area
Hydrogen for heat opportunity area
District heat opportunity area
District heat priority area

4. NON-DOMESTIC BUILDINGS

With the requirement to rapidly reduce CO_2 emissions in line with the GM carbon budget, the primary scenario is based on an individual heat pump transition for the majority of Rochdale's non-domestic buildings. The estimated combined investment (for improving the energy efficiency and installing heat pumps) is in the region of £1.6b.



- The majority of Rochdale's non-domestic buildings (75% by floor area) have been deemed able to transition to a heat pump option with a further 1% (by floor area) suitable for district heat networks

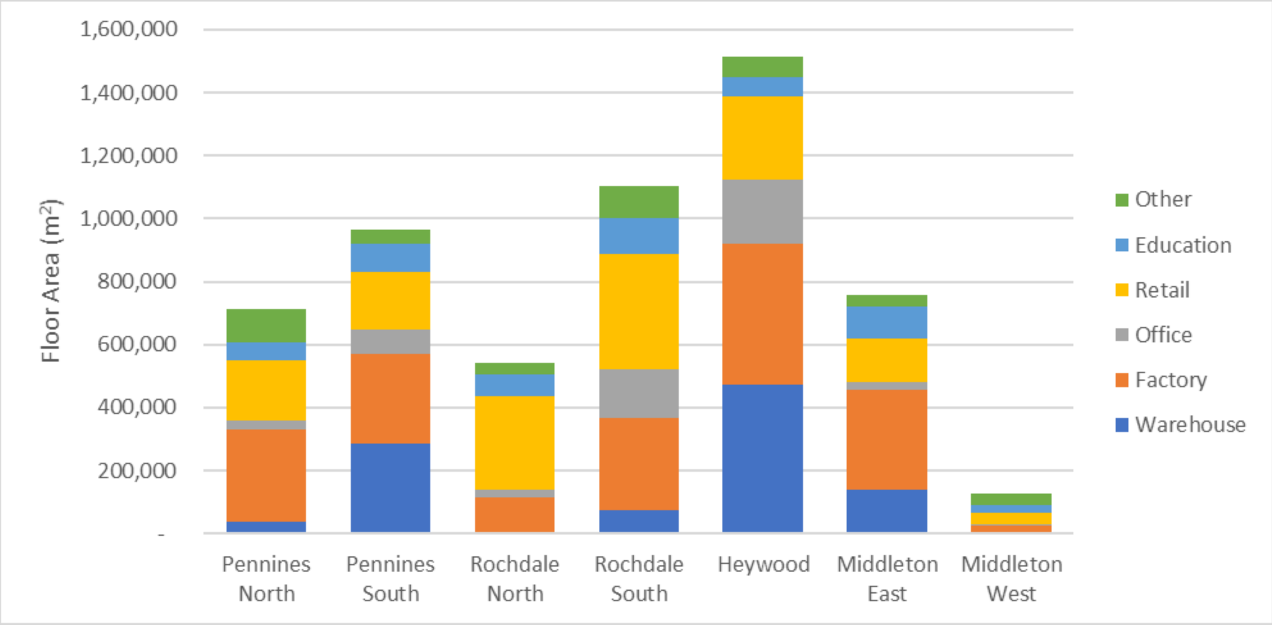
- A notable proportion (23% by floor area) are deemed to be reliant on either gas or hydrogen for use in industrial processes; however, building specific detail e.g. regarding understanding industrial process has not been considered

- Further area-specific and detailed consideration is required to identify the most appropriate non-domestic solutions. For example, whilst the primary scenario is based on individual heat pump based options, Rochdale South, Heywood and Middle West have been identified as areas with potential for heat network development*. With a wide range of building usage types (see following chart),

* More detailed consideration is expected to identify non-domestic buildings where it would be beneficial to connect to a heat network, particularly when considering opportunities to develop district heat networks to supply dwellings in the surrounding areas; specific district heating network master planning, heat mapping, feasibility and subsequent detailed design assessment will be required

solutions will be dependent on building type and aspects such as density of non-domestic buildings

Non-domestic Building Usage by Floor Area (m2)

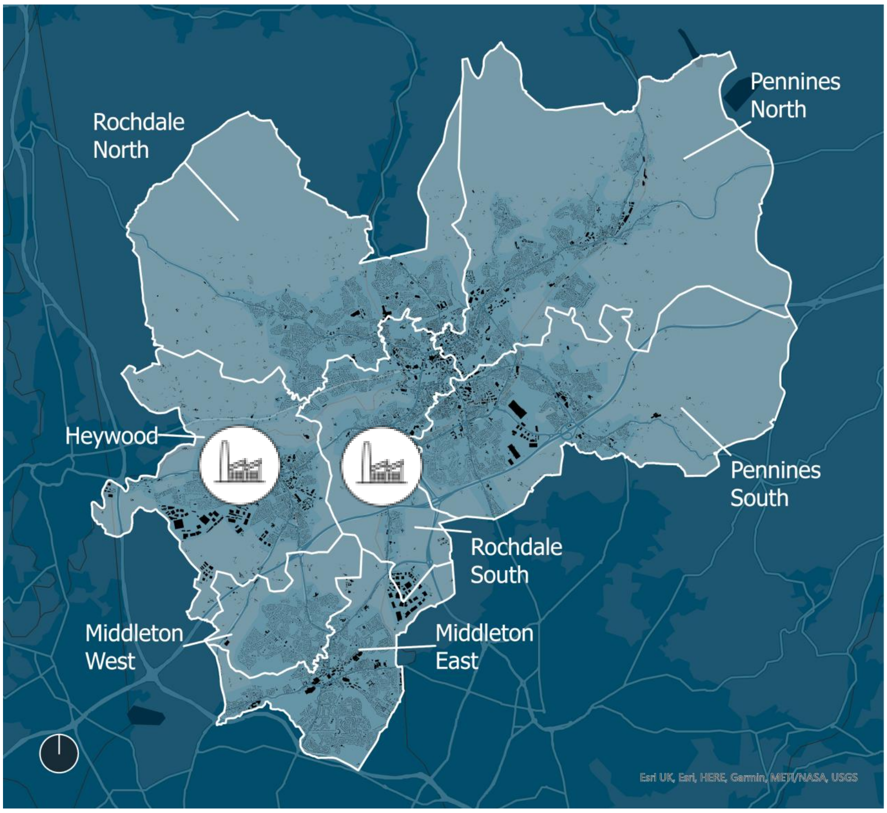


Non-domestic Buildings Priority Area Selection

Heywood and Middleton East have the greatest estimated requirement for gas for industrial processes with Pennines North, Pennines South, Rochdale South and following close behind, meaning they could be good areas to prioritise hydrogen. Along with this gas requirement, Heywood and Middleton East's proximity to Manchester City Centre and where HyNet phase 2 would be coming in from increase the potential for these areas to be prioritised for hydrogen.

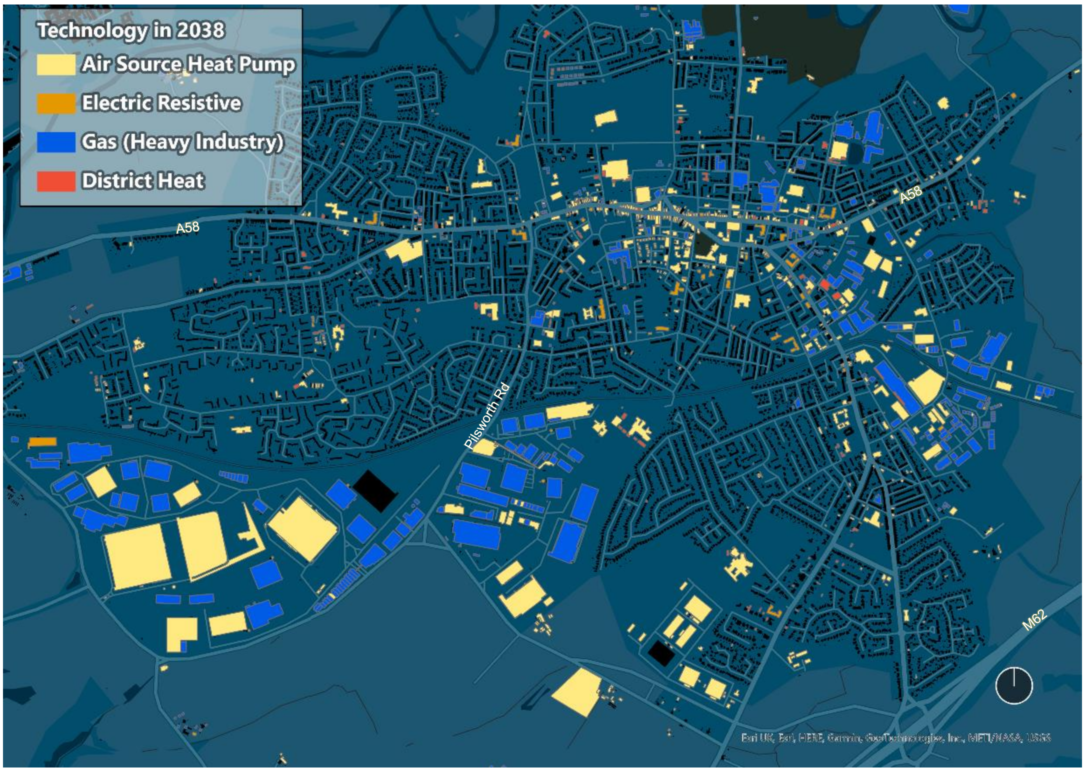
Heywood has the greatest presence of non-domestic buildings overall, making it an area well-suited to early demonstration of non-domestic decarbonisation solutions, ahead of the other zones with Rochdale South also having a significant number of non-domestic buildings. The opportunity for developing district heat networks in Rochdale South and Heywood set them apart from other non-domestic areas, which would be more likely to transition to individual heat pumps than connect to a heat network. Office, retail and education spaces should be most straightforward to transition to heat network connections or heat pumps, due to their compatibility with low temperature heating.

Non-domestic decarbonisation priority areas



Non-domestic opportunity area

Illustrative deployment of heating systems in non-domestic buildings in Rochdale Central



Vision to 2038

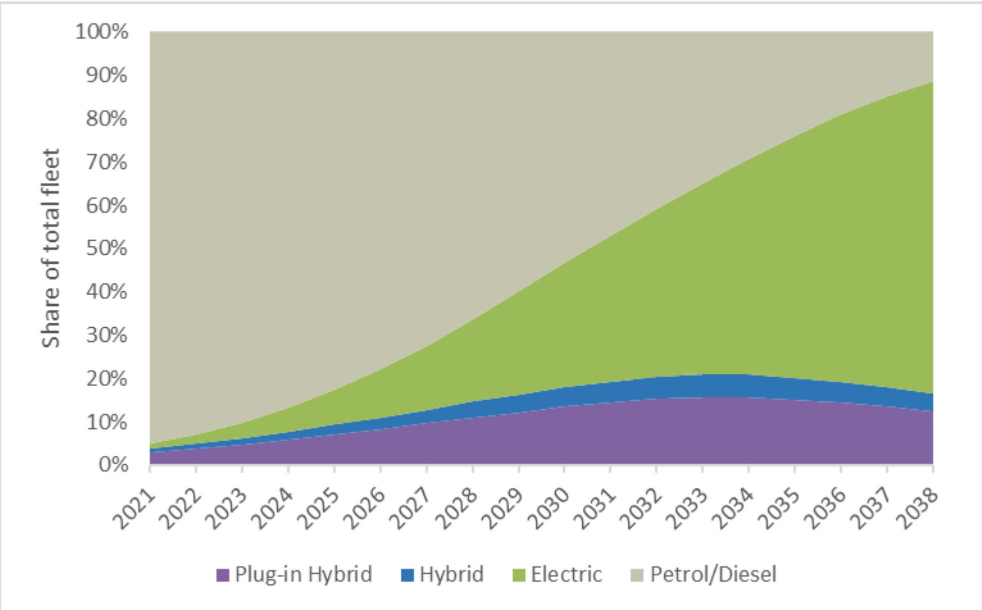
Electric Vehicle (EV) ownership is expected to grow significantly to support local decarbonisation targets and in alignment with national policy, which will see the phasing out of internal combustion engine vehicle sales by 2030 and hybrids by 2035.

Fully electric and plug-in hybrid vehicles (PHVs) in Rochdale are expected to grow from around 3,800 today to almost 88,000 cars by 2038 – 85% of the total fleet. Charging infrastructure will need to be installed to encourage this transition and keep up with this demand, providing confidence that owners will be able to recharge when needed. A mixture of publicly accessible and private residential chargers will be required to provide this amenity.

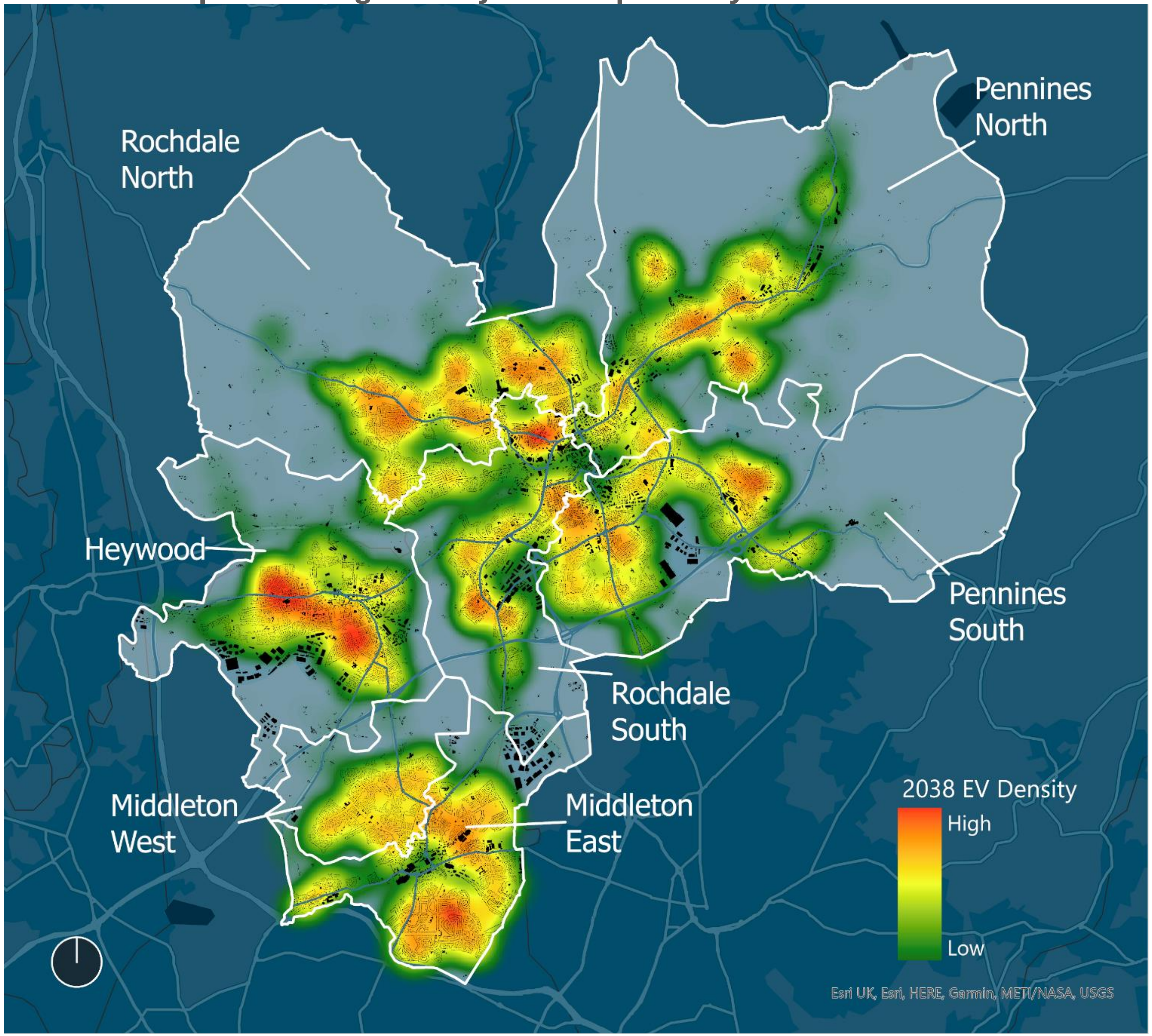
Greater Manchester's Transport Strategy 2040 sets out an ambition that no more than 50% of daily trips (across all modes) will be made by car in 2040, down from 61% today. In light of an expected overall growth in trips, the strategy sets out that meeting this target would mean a reduction of car trips from the current 3.7m per day to 3.4m. However, this still represents a significant demand for EV charging, estimated to increase to 267 GWh per year in Rochdale by 2038.

Since EV transition, supported by publicly accessible and home chargers, is a consistent result across all scenarios, all moves to make first steps in charger deployment can be considered low regret.

Projected Vehicle Mix Over Time



"Heat map" showing density of EV uptake by 2038 across Rochdale



Publicly Accessible EV Charge Points

Charge points will be a mixture of at-home and at-destination (such as workplaces and shopping centres). Transport for Greater Manchester (TFGM) is developing plans for the expansion of the existing network of publicly accessible charge points, to help overcome the inability to charge an EV at home, as experienced by many GM residents, to aid an accelerated transition to EV; aspects of this have been incorporated in this plan.

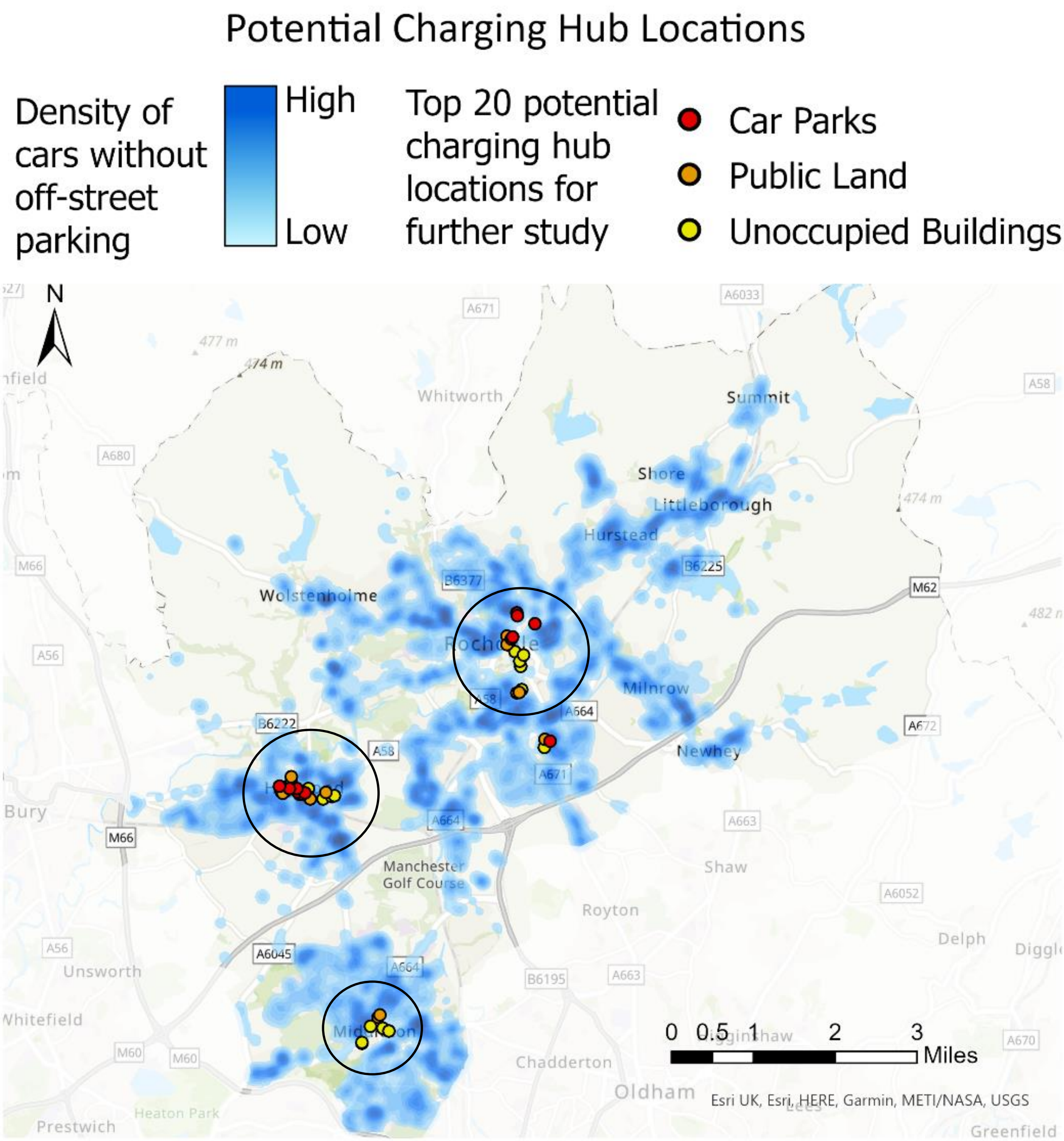
At-home charging for dwellings that have off-street parking is a solution which is well developed, but for dwellings without that potential, other solutions will be needed. One solution may be public charging hubs located in residential areas with limited potential for off-street parking. Other alternatives include developing an EV car club offer and expanding levels of workplace and destination charging provision.

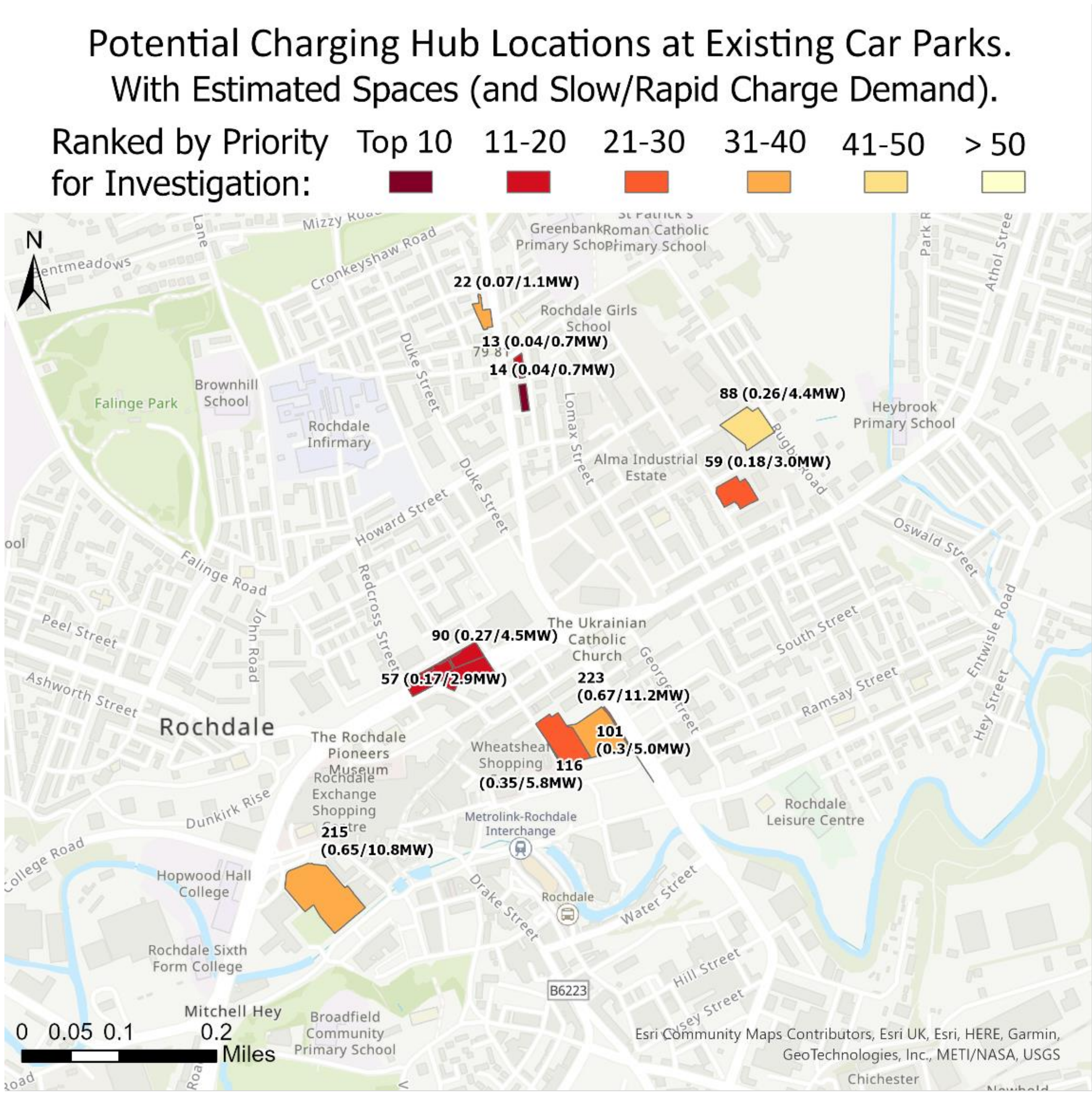
The maps shown on the following page identify potential prioritised charging hub locations, based on dwellings without potential for off-street parking and projected EV use. Further consideration will be needed, working with TFGM to identify and develop public/hub charge points across Rochdale[*].

Home Charge Points

Homes with potential for off-street parking are considered able to install private chargers. EV ownership is projected to significantly outstrip the number of homes with off-street parking, and every home with off-street parking sees a charger installed, amounting to over **40,000 home chargers**. The installation of these chargers could be coordinated with other home interventions, such as PV installation, heating system replacement and insulation, to minimise disruption experienced by households, and avoid multiple changes to wiring. Opportunities should also be explored for smart system integration between these different technologies.

* It is also recognised that EV charging provision should not be considered in isolation from other transport related decarbonisation plans. Rochdale will need to work with GMCA, TFGM and other relevant stakeholders to ensure a joined up transport decarbonisation approach is developed and implemented. As well as aligning with local planning policies as it relates to provision of chargers in new developments and existing dwellings


Potential Charging Hub Locations
Density of cars without off-street parking
High
Low
Top 20 potential charging hub locations for further study
Car Parks
Public Land
Unoccupied Buildings
N
Whitworth
Summit
Shore
Littleborough
Hurstead
Wolstenholme
Milnrow
Newhey
Bury
Manchester Golf Course
Shaw
Royton
Delph
Unsworth
Whitefield
Chadderton
Oldham
Prestwich
Heaton Park
Greenfield
M62
M66
M60
A58
A664
A671
A663
A6045
B6222
B6377
B6225
B6195
A6033
A6052
A680
A56
A670
0 0.5 1 2 3
Miles
Esri UK, Esri, HERE, Garmin, METI/NASA, USGS



As discussed, these maps highlight areas by proposed density/priority. These locations have been taken forward as the proposed 'EV charging hub priority areas in the Demonstration and Scale up Priority Areas aspect of this LAEP. Other public/hub charge points will be needed in other areas across Rochdale; supporting data will be provided in the accompanying detailed and granular data set.

Vision to 2038

The shift to electricity for heating and transport increases the importance of using low carbon electricity sources. Although the electricity grid will need to reach almost zero carbon by 2050 for the UK to meet its net zero commitments, with very low or even negative levels of emissions anticipated as early as 2035, Rochdale will need to shift to zero carbon electricity earlier than the nation as a whole in order to stay within the carbon budget. This could mean generating much more zero carbon energy locally. All modelled scenarios found increases in locally generated renewable energy, primarily through solar PV.

Considering such a significant amount of solar PV would require substantial investment and transformation of land which may have other beneficial uses. In the context of an electricity grid which is already rapidly decarbonising, the relative merit of large-scale solar PV rollout should be considered. Additionally, analysis of matching supply and demand should be conducted to determine the optimal configuration of local renewable assets versus grid supplied electricity (taking a whole energy systems approach), alongside demand side response, flexibility and energy storage; these aspects are discussed further on p.83 where potential priority areas are highlighted to consider further assessment.

This local generation is particularly beneficial in staying within the carbon budget in the early years, while grid emissions are still relatively high. Consequently, early deployment is key to reaping the benefits of renewable generation, although it is recognised that deploying such large volumes of local generation in such timescales would be extremely challenging. If some of the capacity can't be deployed until later years, the carbon benefit will be diminished as the generation displaces cleaner grid electricity. Reassessment of the cost-benefit of such deployment would then be advisable.

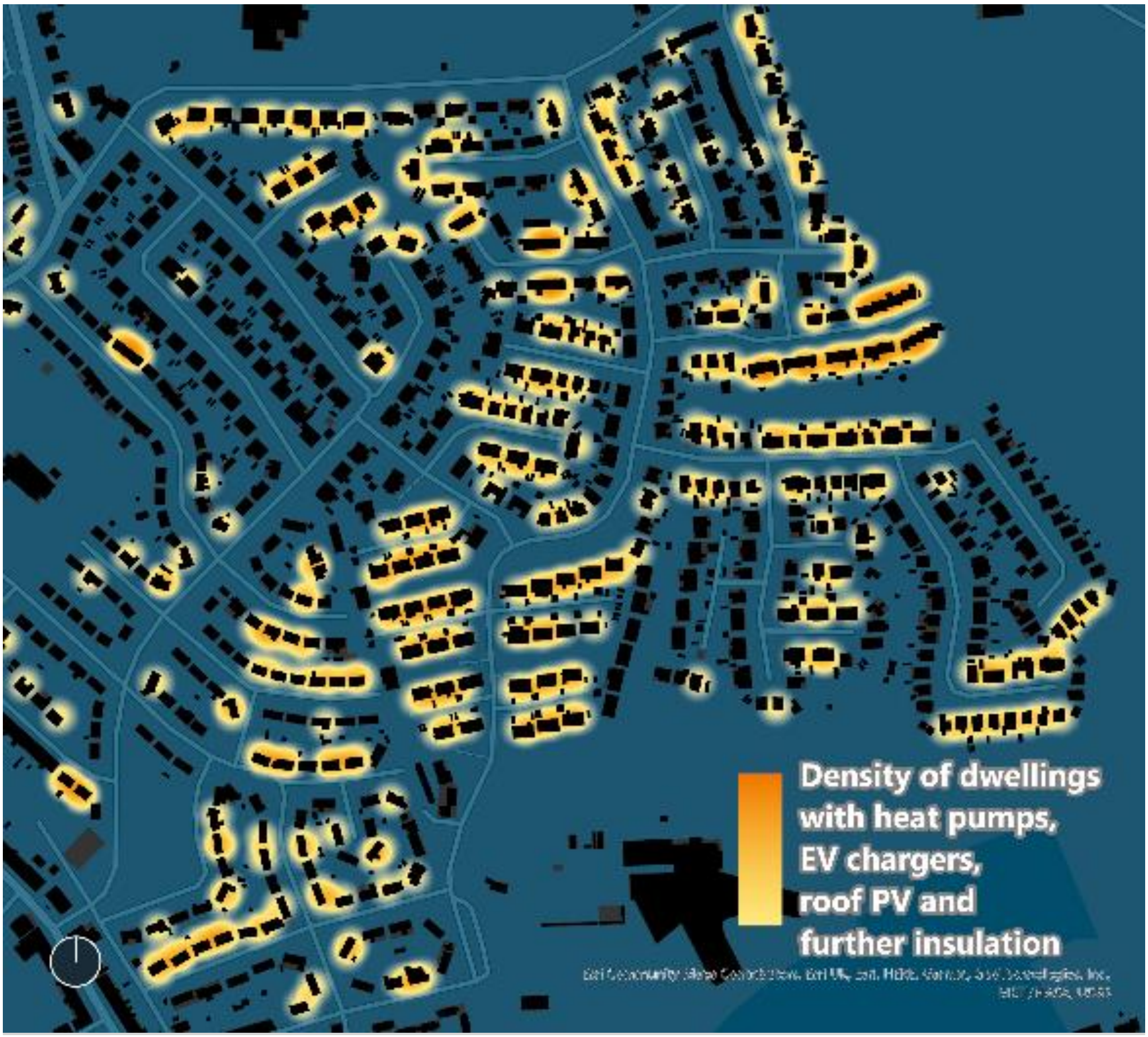
Rooftop Solar and Batteries

Building rooftops are used to meet a portion of energy requirements. Every modelled scenario utilised all suitable rooftop space (generally South East to South West), resulting in approximately 912 MWp rooftop PV capacity installed by 2038, yielding 1,185 GWh of energy annually. In other words, all buildings with suitable roofs are low regrets opportunities to install solar PV, meaning there is plenty of flexibility around the approach for this.

As an indication, the map on the following page highlights homes in a sample area which are suited to both rooftop PV and EV chargers. Combining the installation of these two measures would mean that the design of electrical works (such as cable routing) will integrate the needs of both measures, reducing disruption and potentially reducing overall cost. This opportunity could also be taken to create additional electrical capacity for future heat pump power supplies.

Alongside rooftop PV, there is an opportunity to install home battery energy storage systems. These can store generated energy for times when there is no generation and potentially provide flexibility services to the electricity network; new market incentives which value flexibility may boost the economic case for domestic batteries going forward.

Density of dwellings with both rooftop PV and EVs, by 2038 in Rochdale Pennines South



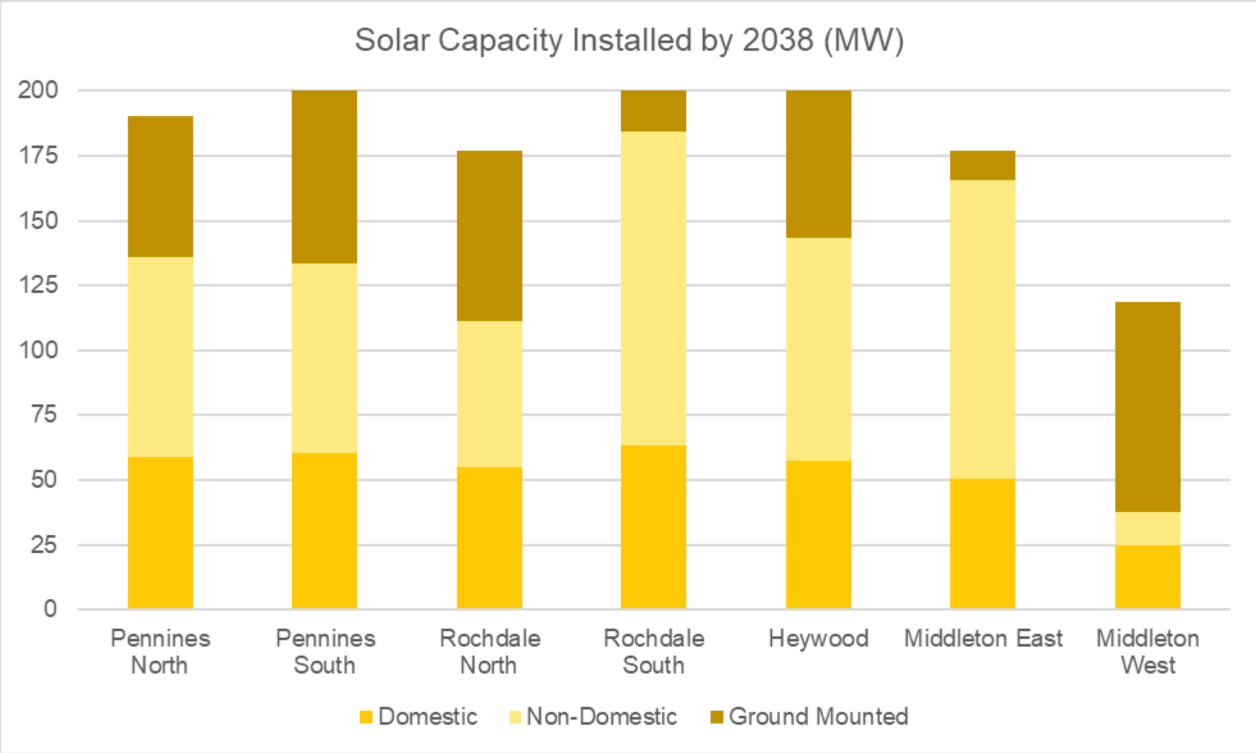
Large Scale Solar PV*, Wind and Hydroelectric

A study to determine the areas of land in Rochdale suitable for ground mounted solar PV, small-scale hydroelectric and wind turbines (including land not owned by the council) was carried out, accounting for factors such as flood zones, protected natural spaces and habitats, infrastructure, agricultural quality of land and future developments. This study found substantial opportunities for solar and only very limited hydro developments, but none for wind. Thirty-five potential sites for ground mounted solar PV

* Opportunities for local energy generation have been identified following a high level screening study in support of this LAEP. Further assessment will be required to consider renewable energy generation opportunities in detail. Screening has been carried out through assessing constraints surrounding location/land suitability e.g. considering aspects such as proposed development, protected areas, land classification, flood risk and available resource (e.g. wind speed and solar irradiance). Impact of large-scale renewables on grid constraints and potential curtailment requirements have not been assessed and will need consideration to ensure optimal integration.

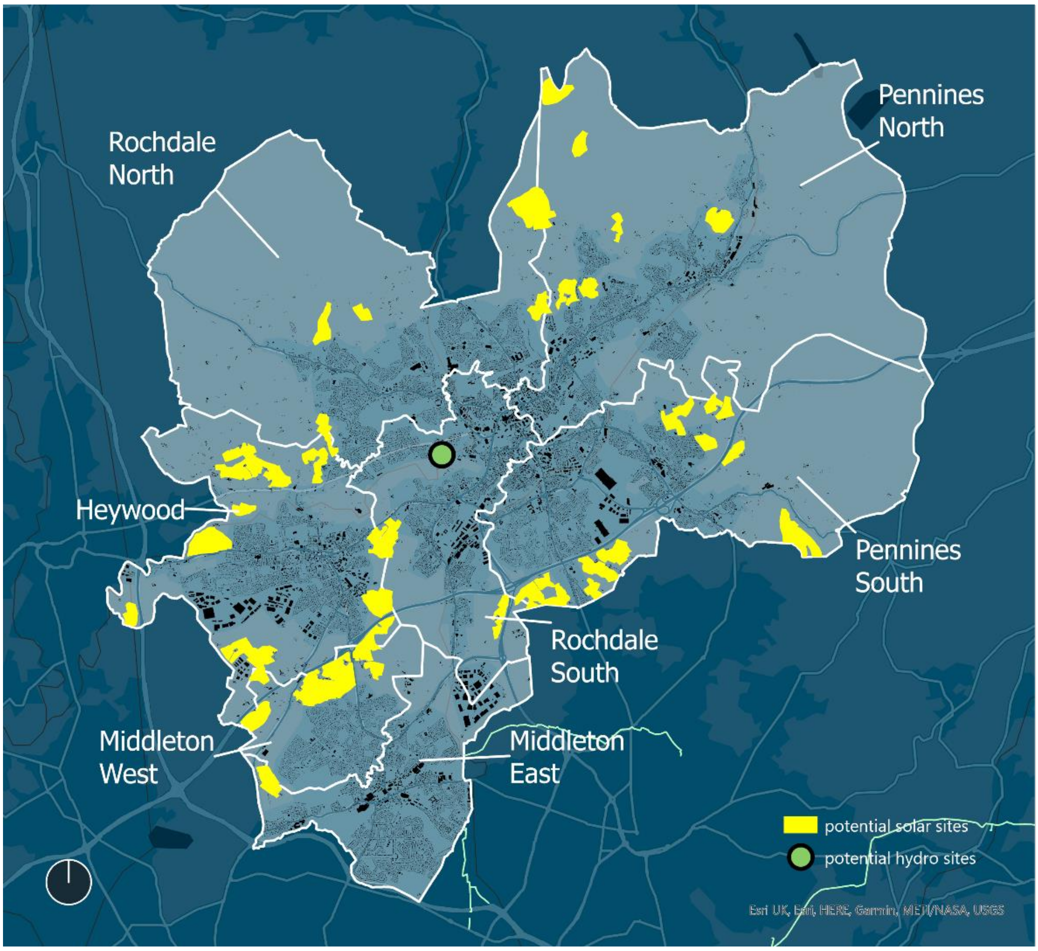
were identified (see map below), covering a total of up to 685 hectares. Such large-scale deployment of solar on the land would clearly require careful consideration around feasibility and public acceptability. If the full extent of solar capacity in this plan could not be deployed in practice, the largest impact would be on near-term carbon budget, whereas beyond 2035, the National Grid emissions are expected to be very low, so local generation becomes less critical to reaching low emissions.

A total of 483 MW of PV capacity could be deployed on this land, yielding 411 GWh of energy per year. Potential for one hydro site was also identified in Rochdale with generation capacity of 63kW, yielding 207 MWh per year.



Of the 912 MW of rooftop PV, 542 MW is provided on non-domestic building roof space. There is a significantly greater extent of non-domestic buildings present in Rochdale than across any of the other boroughs (approximately three times the available non-domestic building roof space), excluding Manchester whose annual electricity demand is proportionally higher. Alongside domestic solar and ground mounted arrays, this could serve up to 76% of Rochdale's annual electricity demand. Time of electricity demand and generation and their impact on the electricity network should be considered alongside the practicalities of rolling out this amount of rooftop PV, in tandem with many other whole energy system considerations.

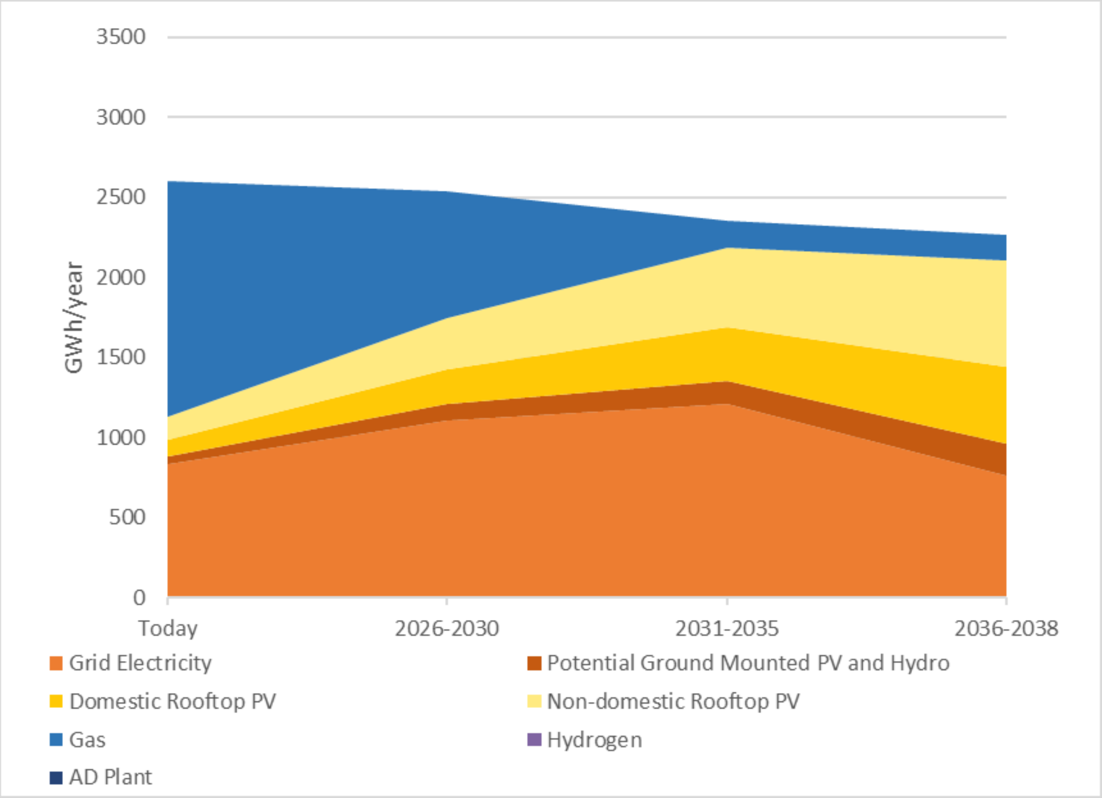
Potential sites for large scale solar PV, wind and hydroelectric in Rochdale



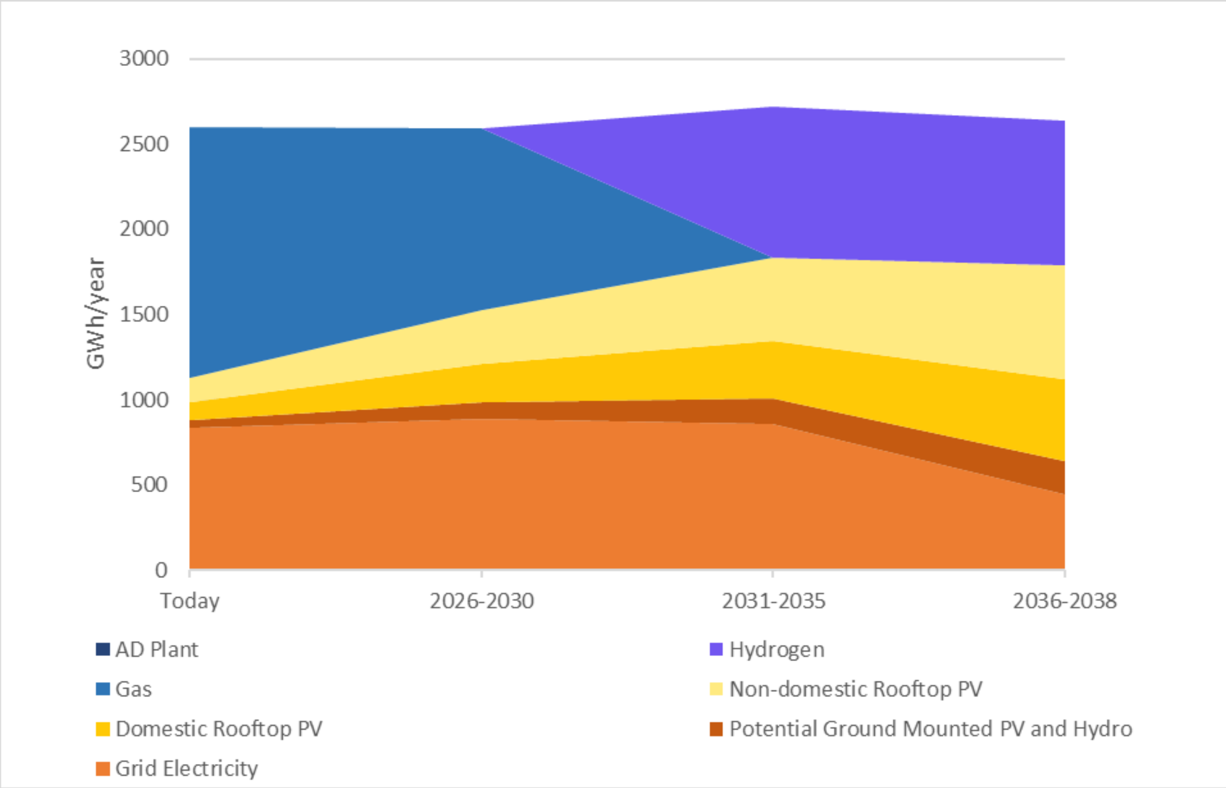
Energy Supply and Demand

The overall trend in the energy balance is an increase in the consumption of electricity to replace fossil fuels, with a shift towards some of that electricity being generated by local renewables. This is a transformation in the way energy is used, meaning the energy system must evolve rapidly. This is explored in the next section: Energy Networks. The increase in energy produced and consumed locally offers the potential to explore local energy market arrangements.

Changes in Energy Supply in Primary Scenario



Changes in Energy Supply in Secondary Scenario



Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, since the reduction in transport fuel consumption is not shown here, whereas the new electrical consumption by vehicles is shown. Overall, electric vehicles use substantially less energy than petrol or diesel vehicles.

Vision to 2038

Energy networks are the backbone of Greater Manchester's carbon neutral future; the large-scale changes in the way we use energy described in the previous sections will require our networks to adapt and evolve in significant ways. For Rochdale to reach carbon neutrality, major changes to the existing gas and electricity networks will be required, as well as the development of new networks including district heat and potentially hydrogen networks to meet future demand without the carbon emissions.

The electrification of heat and transport is likely to drive a major shift towards greater dependency on the electricity network. Greater demand for electricity will require investment in generation capacity and storage and distribution network infrastructure upgrades.

In the primary scenario, to decarbonise Rochdale by 2038, gas demand is reduced to a small residual level due to its use in some non-domestic and industrial applications which are more difficult to electrify.

This section of the report provides an overview of the impact on each of the energy networks of the primary plan as well as insight from the other modelled scenarios and other key considerations given the uncertainties.

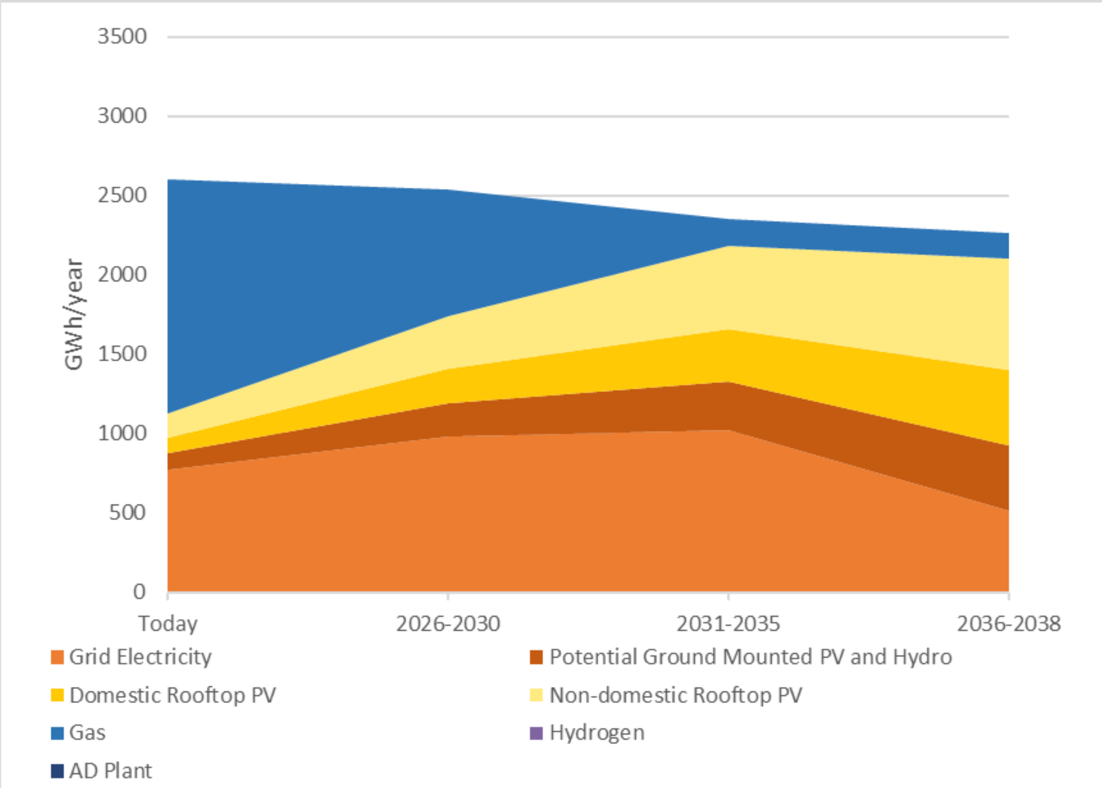
The primary scenario sees gas consumption reducing from c. 1,537 GWh per year currently down to around 158 GWh by the early 2030s, and lower still in the secondary scenario where hydrogen can replace many remaining uses of gas.

There is uncertainty currently about the role of hydrogen to replace heating, including when and where it may be available, in what quantities, the associated carbon emissions, and the cost compared to other solutions

The modelled scenarios considered the possible role of hydrogen for heating aligned to the development of HyNet infrastructure (secondary scenario), serving businesses and dwellings throughout Rochdale.

All scenarios show that some gas or hydrogen remains in use by 2038, largely to support hard-to-decarbonise non-domestic premises, including high-temperature process heat for industry. If hydrogen does not become available to support decarbonisation of these uses, alternatives may need to be considered to achieve the carbon target and budget, such as carbon capture and storage technologies.

Changes in Energy Supply in Primary Scenario



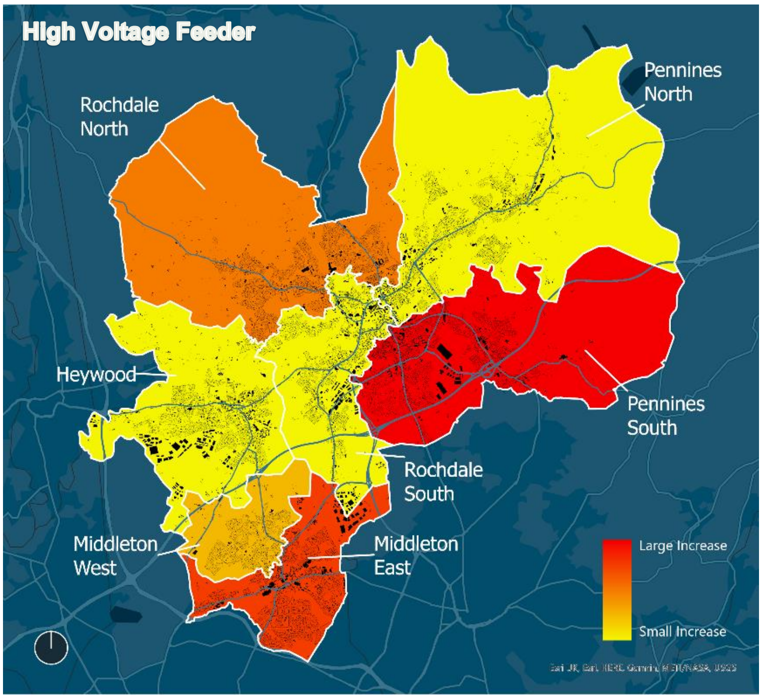
Capacity Requirements for 2038: High Voltage

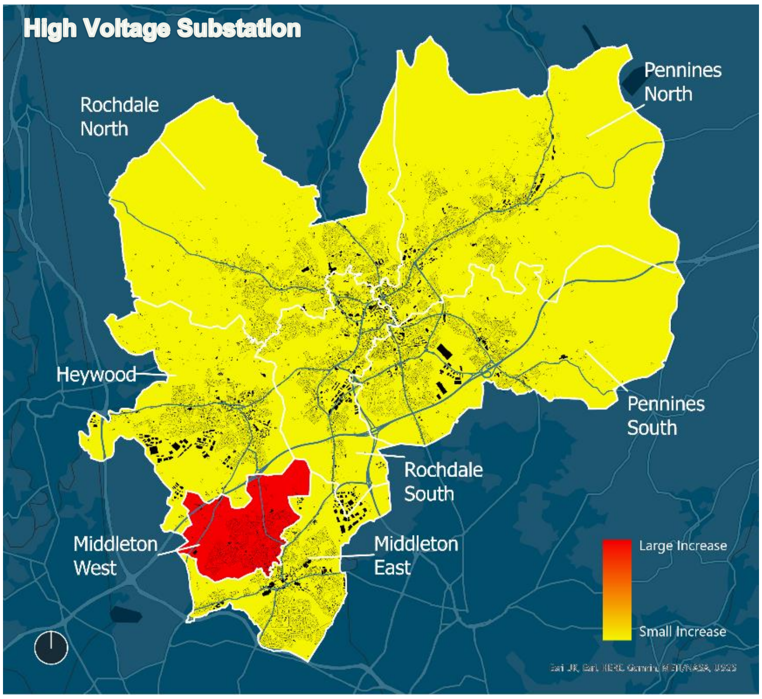
The local electricity distribution network operated under license by Electricity North West supplies electricity to the majority of dwellings and industry in Rochdale today. Modelling indicates the capacity that would be required to meet all projected demand growth through conventional investment, but some of this demand could instead be accommodated through alternative investments, such as flexibility and storage. Hence the physical capacity increase required could be less than shown here. Areas with large increases in required capacity present opportunities for innovation and smart technology. Smart EV chargers and smart heat pump controls could make demand flexible, while storage technologies and vehicle-to-grid could help meet peaks in demand locally and provide other grid services.

The modelled capacity requirements at high and low voltage levels are shown in the following maps and tables (secondary scenario maps omitted as there is no change from base, however upgrades may be required to accommodate high levels of solar generation). The distribution of these impacts is determined by a combination of factors, such as electric vehicle ownership, potential for off-street parking and existing spare capacity in the current electricity infrastructure. For example, a zone may see a large increase in demand for home EV chargers, but not require large capacity increase because it currently has significant spare capacity. The difference in capacity requirement increase is evident between the primary scenario where heat is mostly electrified, and the secondary scenario where heating is mostly provided by hydrogen.

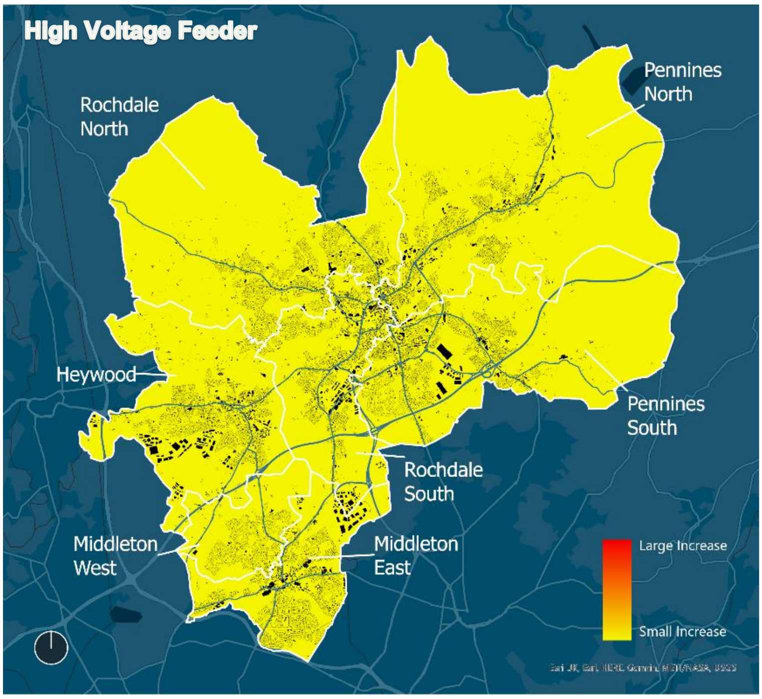
	High Voltage Feeder Capacity (MW)			High Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Pennines North	67	67	67	54	54	54
Pennines South	73	363	73	63	63	63
Rochdale North	77	94	43	43	43	43
Rochdale South	85	85	85	81	81	81
Heywood	91	91	91	90	90	90
Middleton East	56	304	56	99	99	99
Middleton West	37	42	19	37	43	14

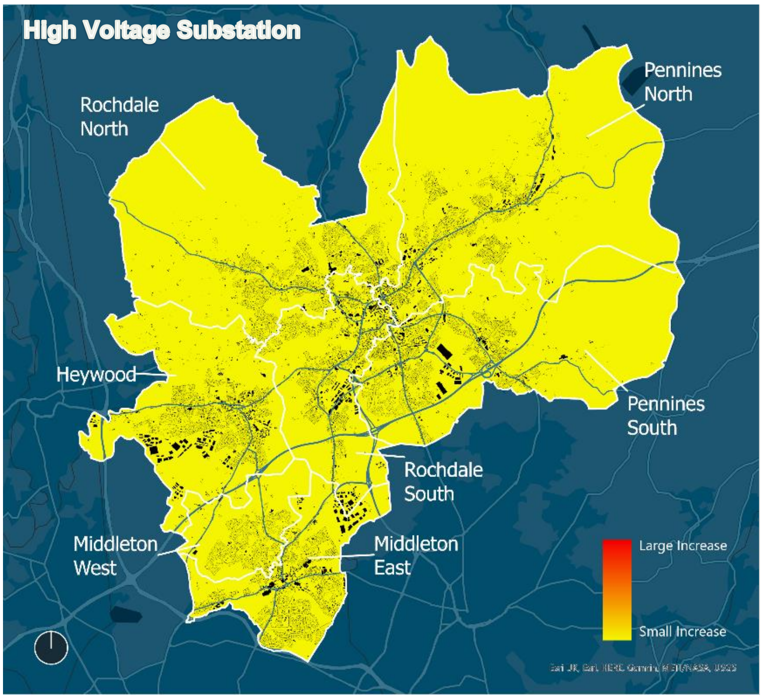
Primary Scenario





Secondary Scenario





Capacity Requirements for 2038: Low Voltage

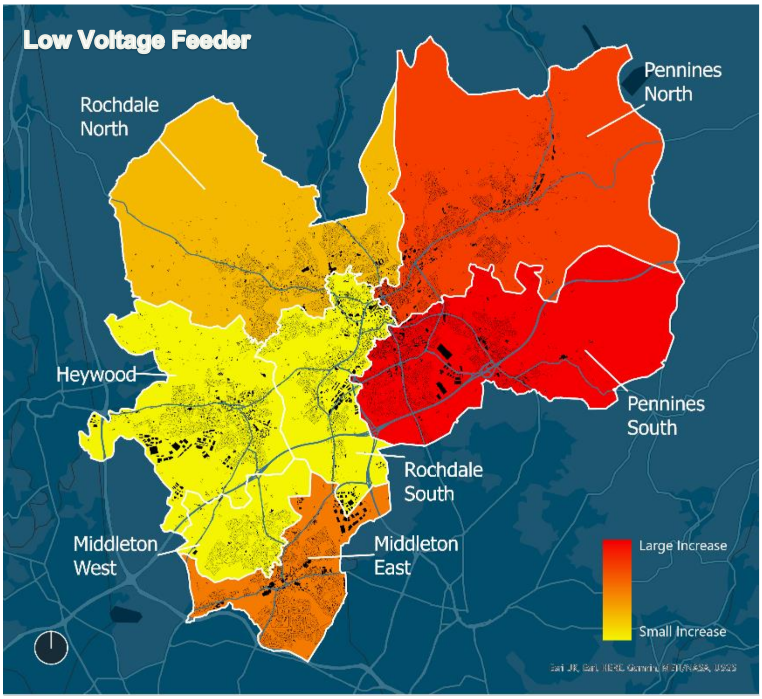
Low voltage feeders are the underground cables serving individual buildings, often located under pavements, so upgrades to these can involve extensive street works. High voltage feeders on the other hand, only run to substations which typically serve multiple streets, so require less extensive works. They are typically laid in ducts under roads. Substations are located on designated plots of land, with exclusive access for the DNO.

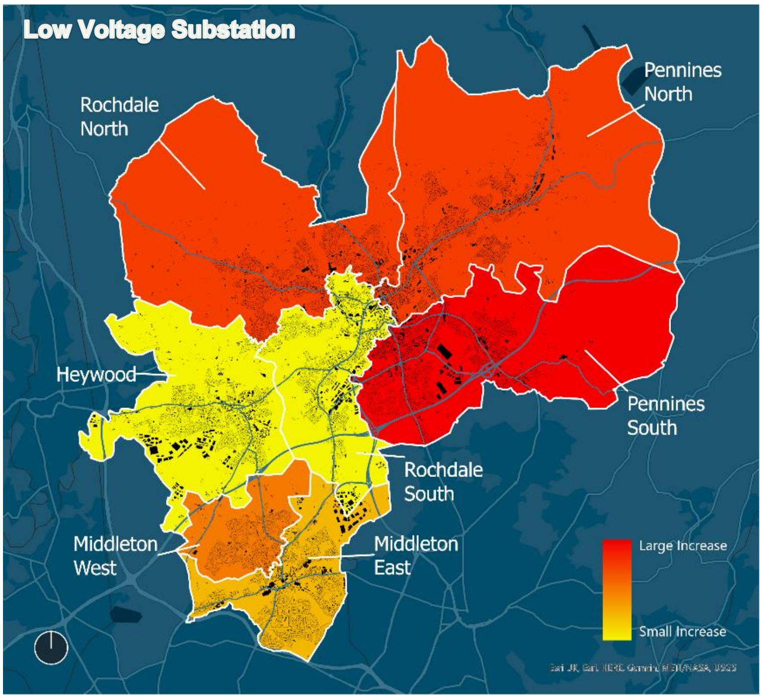
	Low Voltage Feeder Capacity (MW)			Low Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Pennines North	52	126	52	51	310	51
Pennines South	50	94	50	50	345	50
Rochdale North	49	55	39	28	266	266
Rochdale South	69	69	69	71	71	71
Heywood	60	60	60	63	63	63
Middleton East	42	55	42	44	111	44
Middleton West	14	14	14	13	103	13

Capacity increase is notably high in some areas, corresponding with high levels of heat electrification (circa 17,000 heat pumps in Pennines South), where the network must be sized for demand on the coldest day of the year, when heat pump efficiency is also lower. These areas could be a focus for the use of smart, flexible heat pumps or storage to reduce the capacity needed.

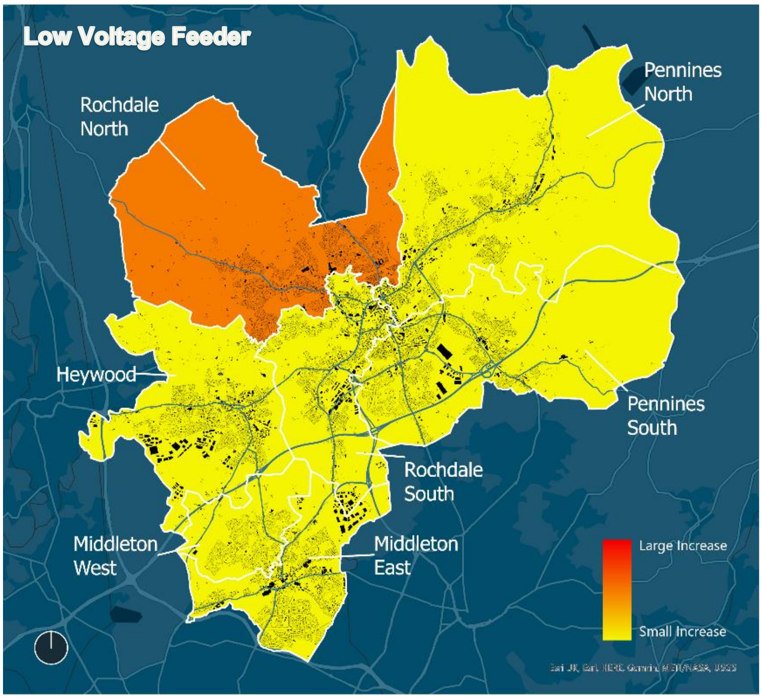
As stated throughout this LAEP, the intention of this work is to highlight the potential change in electrical demand, **not identify the most appropriate and cost-effective solution for providing additional capacity**. More detailed electrical network design and planning work would be required to identify the most appropriate solution.

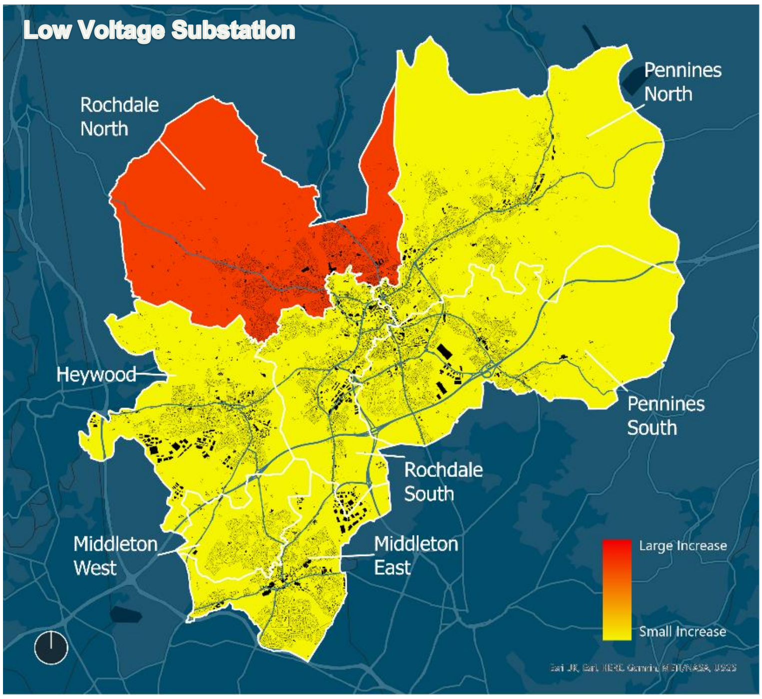
Primary Scenario





Secondary Scenario





Present Day Capacity and First Steps

Examining present network capacity gives some indication of where deployment of low carbon technologies could be prioritised without immediately running into network constraints.

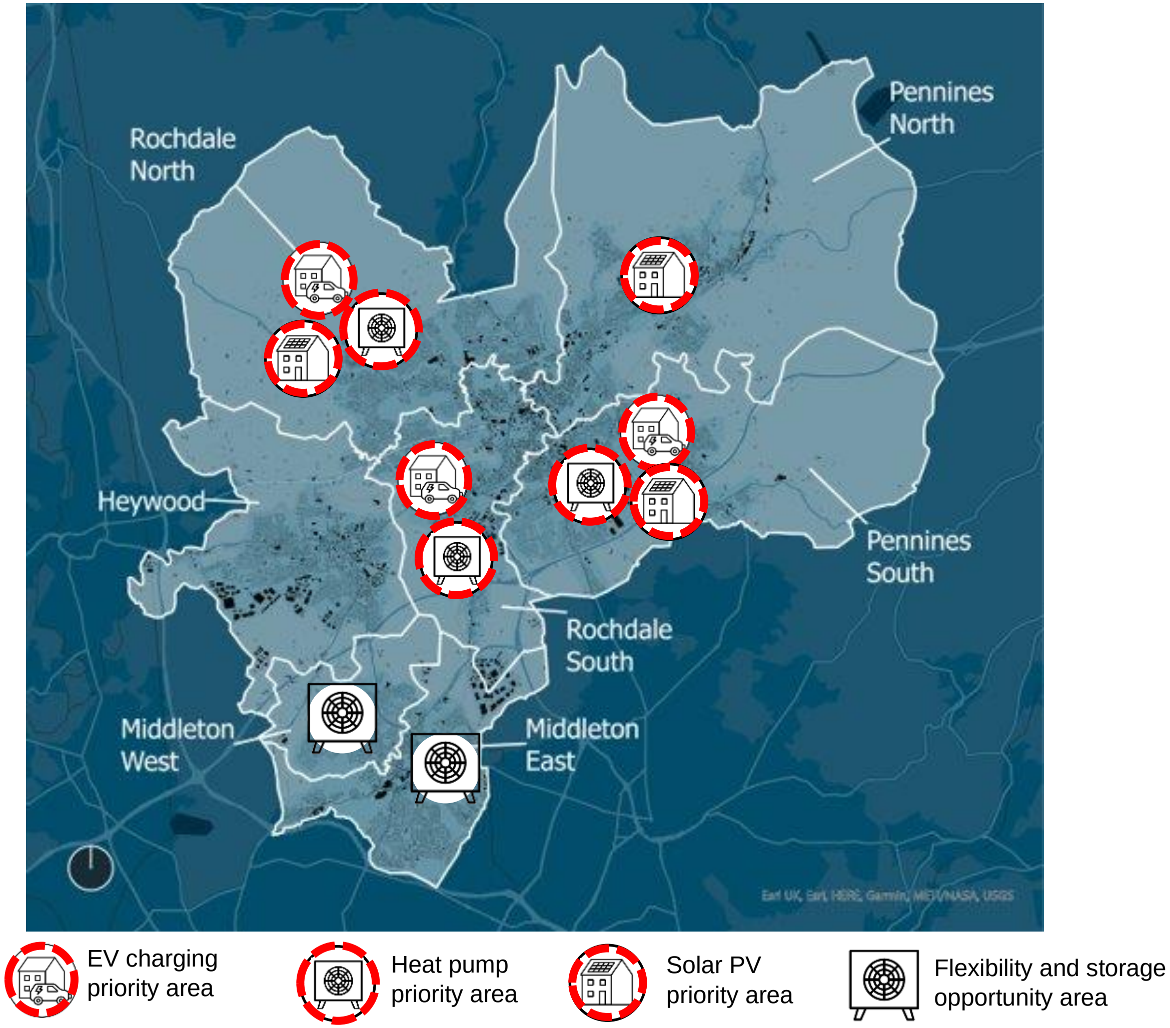
Pennines South, for example, has the greatest capacity headroom for demand, with Rochdale North and Rochdale South also having significant demand headroom. This suggests that roll out of heat pumps and EV chargers could begin here before network upgrades are eventually required to reach the total numbers in the plan. Potential heat networks in Rochdale South could make use of electrical capacity for central heat pumps.

In contrast, Middleton West have very little spare capacity and Middleton East has limited capacity. This suggests that the need for infrastructure reinforcement to deliver the full plan should be assessed early to ensure that it doesn't delay progress. Local flexibility, storage and generation could be trialled as a way to overcome demand constraints. Although it's worth noting that peak network demand typically occurs on winter evenings, when solar generation is negligible, and electrification of heat is likely to compound this. In particular, there is an opportunity in these areas to connect across energy vectors here if heat networks are formed with larger thermal storage.

	Demand			Generation	
Zone	**Headroom (MW)**	**Heat pump installs**	**Households with EV chargers**	**Headroom (MW)**	**Solar PV installs (MW)**
Pennines North	15	15,930	6,384	56.6	132
Pennines South	56.8	16,972	6,813	73.1	130
Rochdale North	27.2	13,576	7,438	46.7	109
Rochdale South	38.1	11,521	4,487	16.1	178
Heywood	10.4	5,404	5,484	40.2	139
Middleton East	18	13,196	6,831	16.2	160
Middleton West	9	1,027	3,230	8.1	37

Demand headroom is non-firm headroom at the primary substation for the zone. Generation headroom is the inverter-based headroom at the primary substation for the zone, which is most relevant for considering solar PV. All figures from ENW's heat map tool
https://www.enwl.co.uk/get-connected/network-information/heatmap-tool/

For solar PV, Pennines South especially stands out as an area with good amounts of generation headroom relative to the amount of potential Solar PV proposed with Pennines North, Rochdale North and Rochdale South also with generation headroom; while Middleton West could run into limitations earlier without network upgrades.


Rochdale North
Pennines North
Heywood
Pennines South
Rochdale South
Middleton West
Middleton East
EV charging priority area
Heat pump priority area
Solar PV priority area
Flexibility and storage opportunity area

Gas Network Today

The gas network operated under license by Cadent supplies gas to the majority of dwellings in Rochdale today, predominantly for heating and hot water but also cooking. It also supports a range of non-domestic and industrial local energy demands. The current total gas consumption across Rochdale is around 1,537 GWh.

To deliver Rochdale and GM's carbon budget and target, it is expected that the vast majority of dwellings will no longer use natural gas by the early 2030s to stay within the carbon budget. Most non-domestic buildings will also transition away from gas.

Future of Gas and Hydrogen for Heat

The primary scenario for Rochdale sees the majority of dwellings converting their heating systems to either be

- connected to a district heat network or, more commonly,
- converted to electric heating, predominantly in the form of different types of heat pumps depending on different factors such as location, energy efficiency and house type.

This would necessitate phased disconnection of homes from the gas network as they are converted to electric or district heating, which would need coordination. However, the secondary scenario sees the majority of buildings supplied by hydrogen, meaning they would remain connected to a repurposed gas network. Around £200m of investment would be required for this network conversion. Of Rochdale’s approximately 1,093 km of gas pipework, around 76% is already made of polyethylene, suggesting that much of the network could already by suitable for carrying hydrogen.

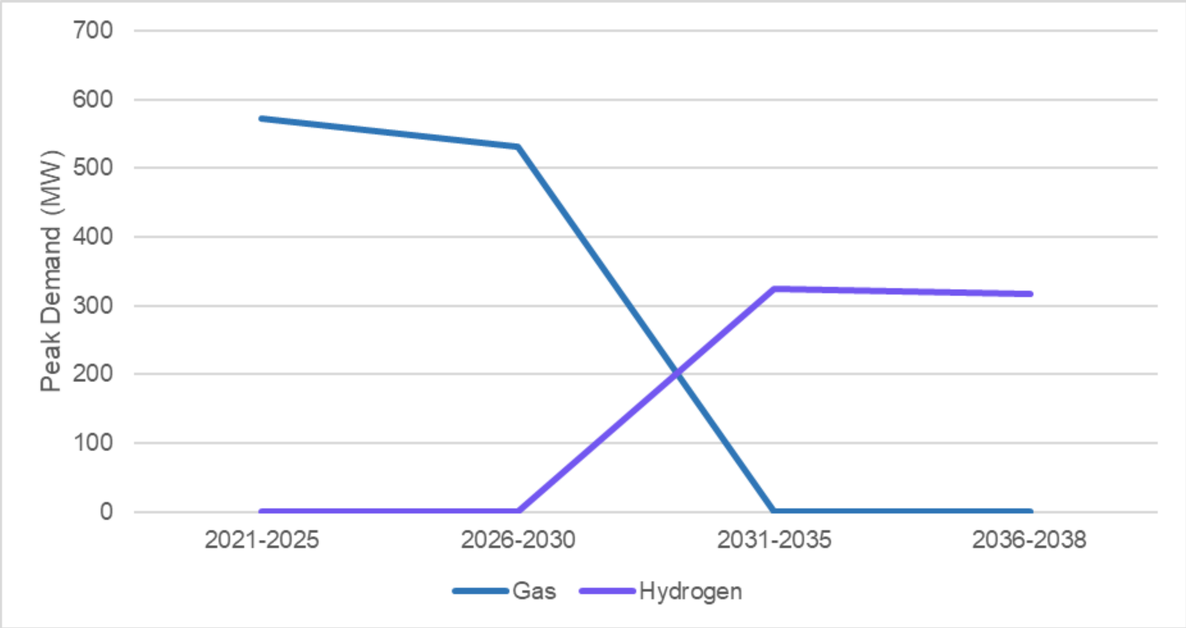
Hybrid heating (air source heat pump/gas boiler hybrid) is an option in certain circumstances and could provide a valuable transition technology to manage uncertainty around the role of the gas network in domestic heating through the 2020s, and to manage demands on the electricity network. Around 450 dwellings may be best suited for this technology (even when the wider whole energy system balancing aspect isn’t considered): generally larger properties where a hybrid solution may become more cost effective than an air source heat pump alone, but where a ground source heat pump is unsuitable due to exterior space and access requirements.

Even in the electrification scenario, gas networks may need to be retained for longer in areas where hybrids are a useful transition option due to property types, particularly Pennines North, Pennines South and Rochdale North.

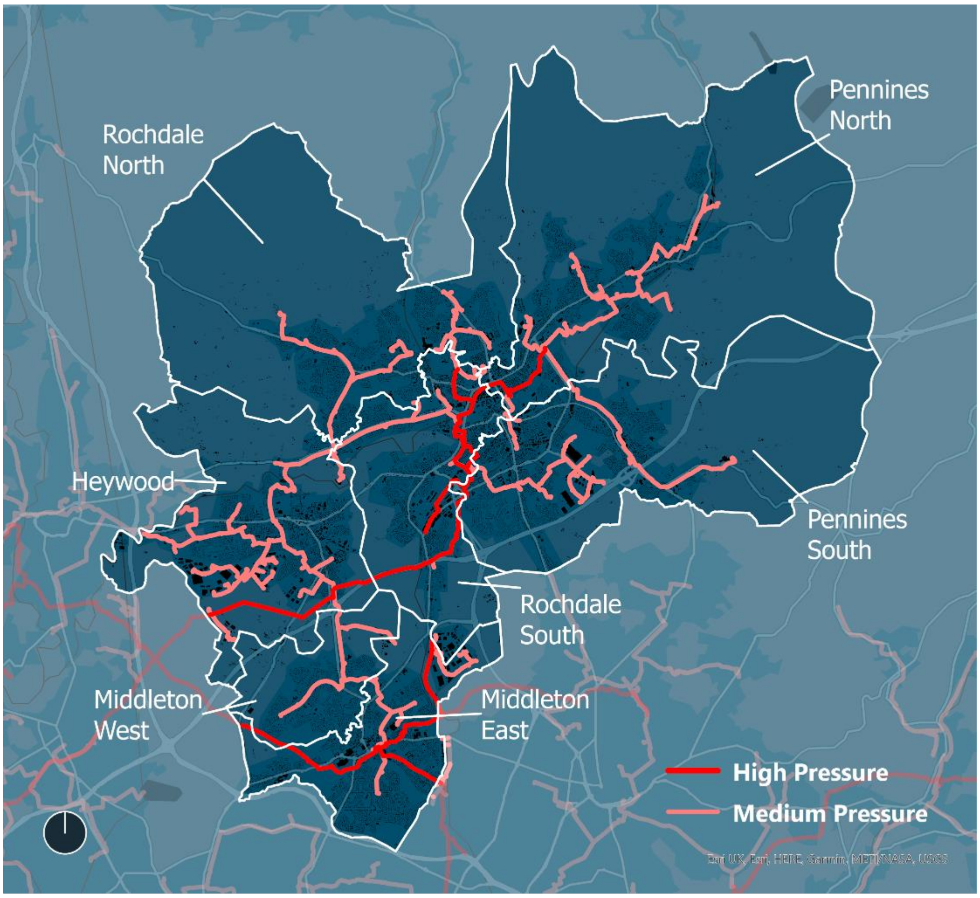
There are a small number of non-domestic properties that are harder to electrify, particularly with industrial uses that require high temperature process heat; these will remain on the gas network under the primary scenario and use hydrogen where possible in the secondary. Most non-domestic gas use can be electrified.

Equitable solutions for dealing with the ongoing gas network maintenance costs for remaining customers will need to be explored for the scenario where usage falls to very low levels. These properties may also be well suited to using hydrogen for heat under a scenario where hydrogen becomes available.

Usage of Gas Network under HyNet Scenario in Rochdale



Current Gas Network in Rochdale



District heating could supply in the region of 21% (21,700) of Rochdale's dwellings. The role of district heating is diminished in the secondary scenario where hydrogen meets much of the demand, although in practice district heating could be supplied by hydrogen boilers in the energy centres, meaning that investment in the heat networks would remain a relatively low regrets option if hydrogen for heating materialised.

In Rochdale South, Heywood and Middleton West, areas of high domestic heat density could provide suitable locations for district heat networks. Potential opportunity areas for district heat are shown in the figures below, which would have an approximate network length of 26km for an investment of £187m*.

Heat generation is assumed to be primarily based on large scale heat pumps, with a total capacity of 7.3 MWp delivered. However, opportunities to make use of any waste heat sources should be explored, as these could improve the cost and carbon credentials of a district heat scheme further.

The specific feasibility and configuration of any district heating networks, including energy centre locations, plant design etc. will require appropriate assessment to take forward, providing opportunities for the consideration of smart local energy systems or community schemes to support network development.

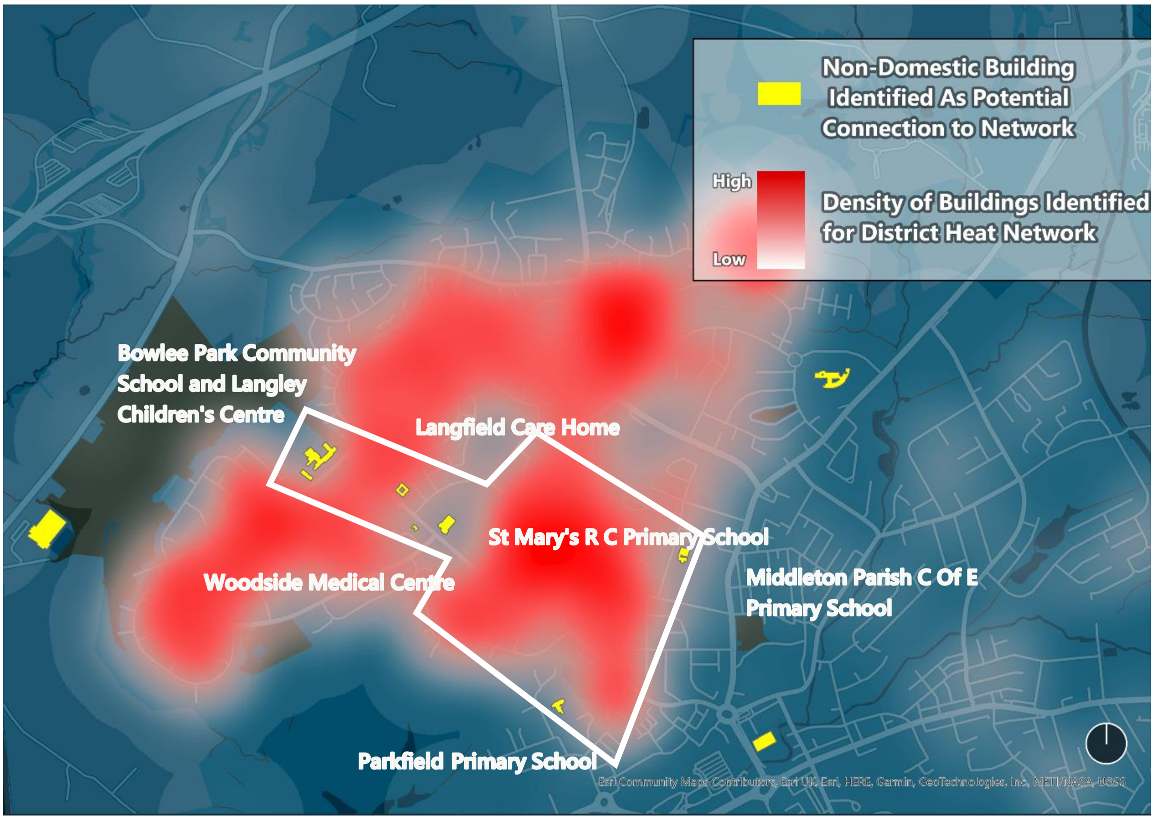
Heat Network Opportunity Area	Approximate Peak Heat Generation Capacity (MWp)	Approximate Network length (km)
Middleton West	4.3	12.0
Rochdale South	1.9	3.0
Heywood (including extension to sports village)	5.2	10.7

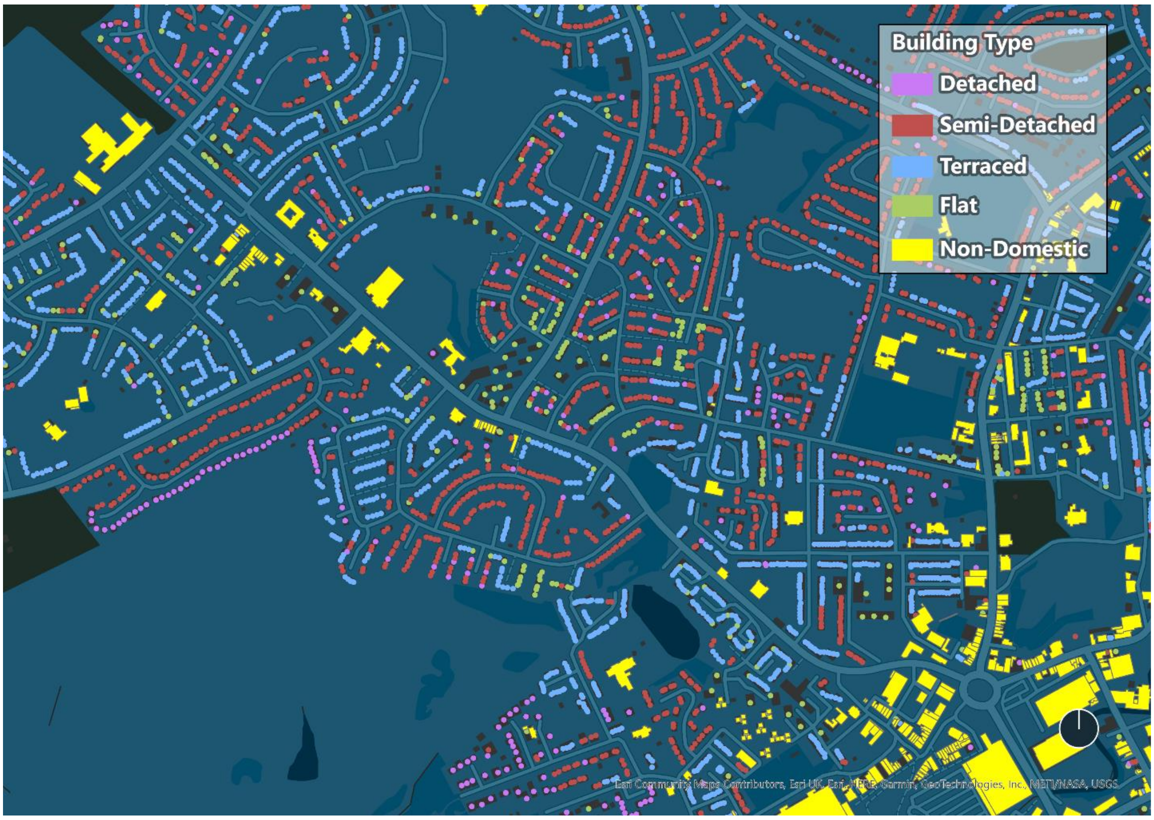
District Heat Opportunity Areas

The following maps illustrate the type of building stock that has been identified within a district heat opportunity area. Noting the general suburban nature of the building stock, further consideration is needed to determine if and where heat networks could provide the most cost-effective solution aligned to the carbon budget and target.

* District heating network (I.e. pipework) cost only.

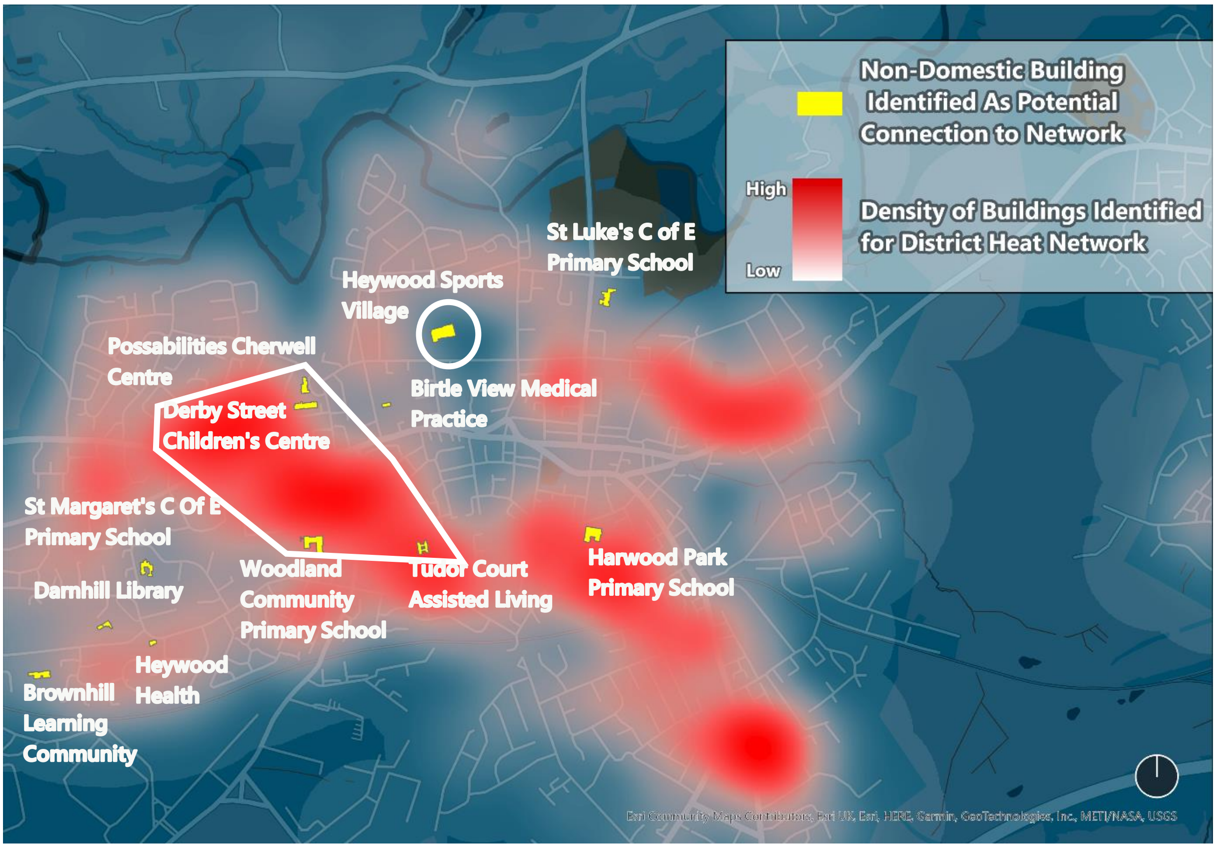
Middleton West



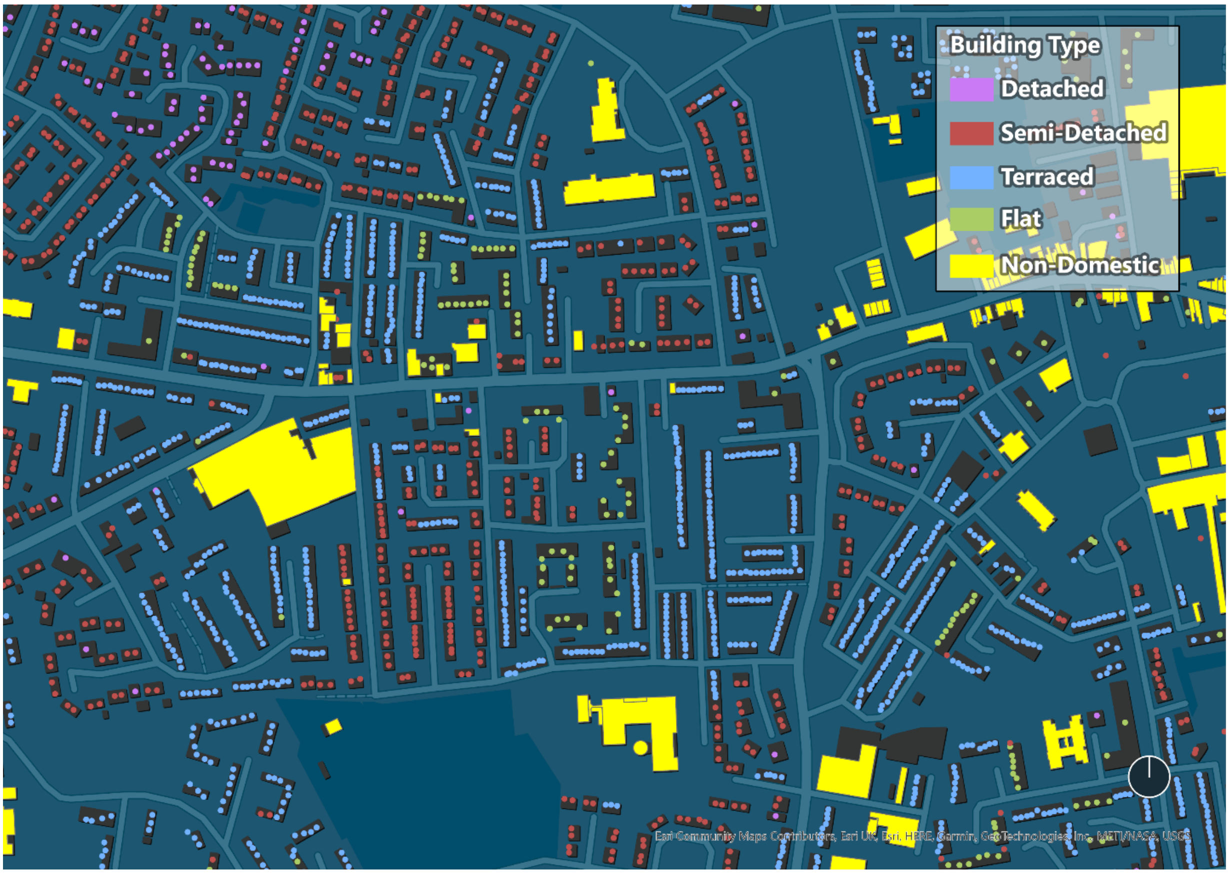


Rochdale South

Heywood



Non-Domestic Building Identified As Potential Connection to Network
High
Low
Density of Buildings Identified for District Heat Network
St Luke's C of E Primary School
Heywood Sports Village
Possabilities Cherwell Centre
Birtle View Medical Practice
Derby Street Children's Centre
St Margaret's C Of E Primary School
Woodland Community Primary School
Tudor Court Assisted Living
Harwood Park Primary School
Darnhill Library
Heywood Health
Brownhill Learning Community



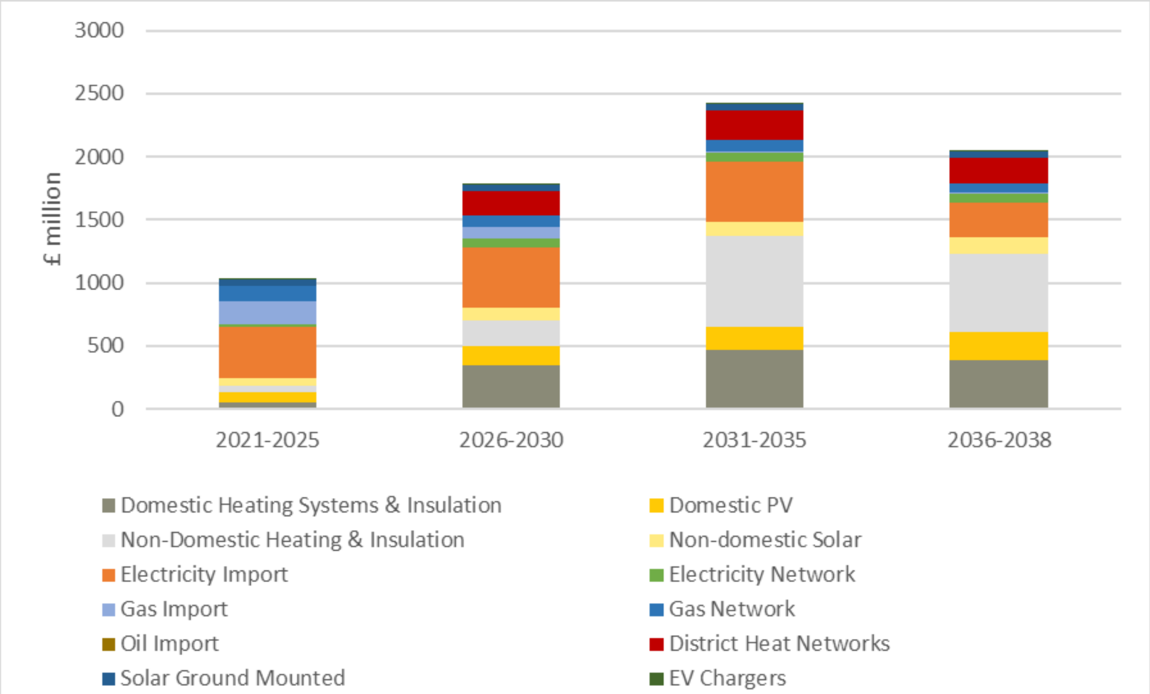
Building Type
Detached
Semi-Detached
Terraced
Flat
Non-Domestic

Total cost (including energy consumption)

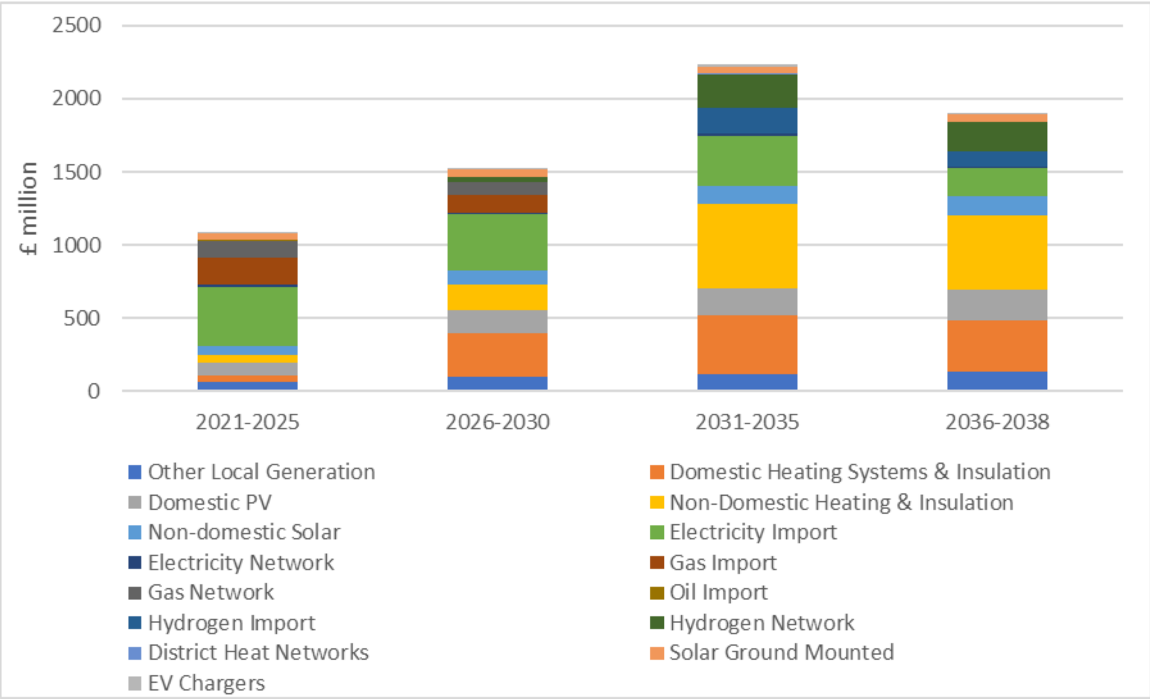
The primary scenario is based on a total energy system spend of £7.3 bn (compared with £6.3 bn in the secondary scenario*). The cost is attributed to investment in energy networks, in buildings (for components such as fabric retrofit, heating system change and roof mounted PV) and for energy consumed. The charts below illustrate the split between these components. Notably, a significant proportion of this cost would have been spent without accounting for decarbonisation; noting that money is spent every day on maintaining existing energy systems, replacing old or failed systems (e.g. gas boilers in dwellings), improving energy efficiency and paying gas and electricity bills. This LAEP sets out an approach for redirecting some of that business-as-usual expenditure, boosted with additional investment, to the areas needed to achieve the carbon neutral target. For example, energy costs are re-directed to electricity use in place of natural gas.

* Secondary scenario results in slightly lower cumulative emissions out to 2038 due to HyNet projections of zero carbon hydrogen being available against grid electricity which will still have some carbon emissions associated with generation by 2038.

Primary Scenario



Secondary Scenario



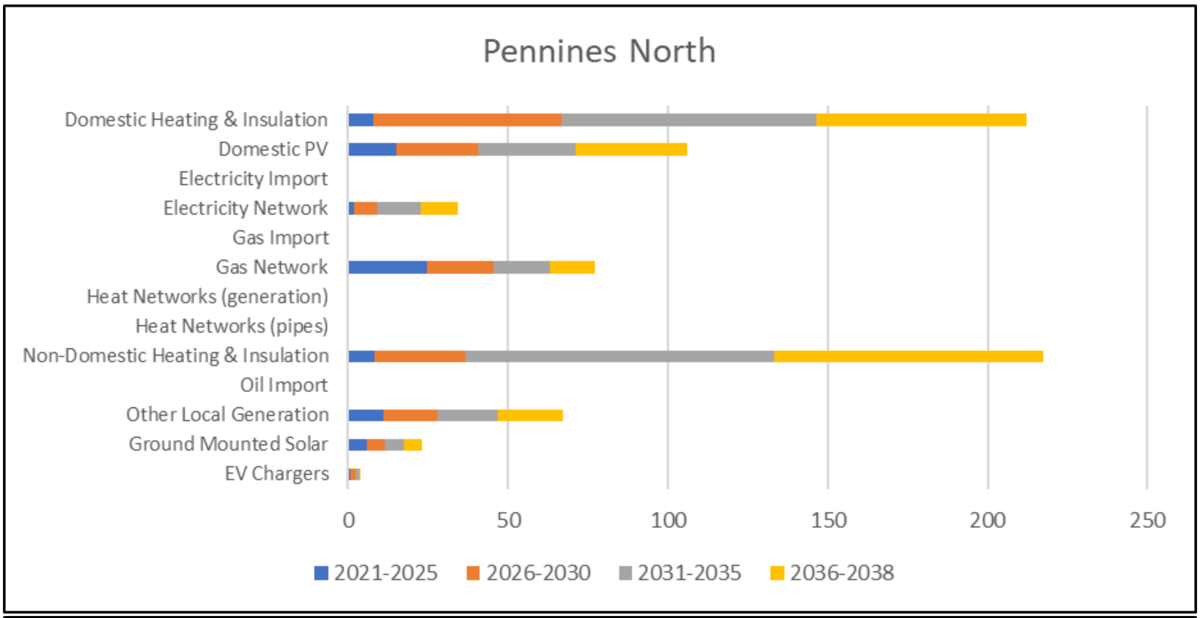
Investment (exclusive of energy consumption)

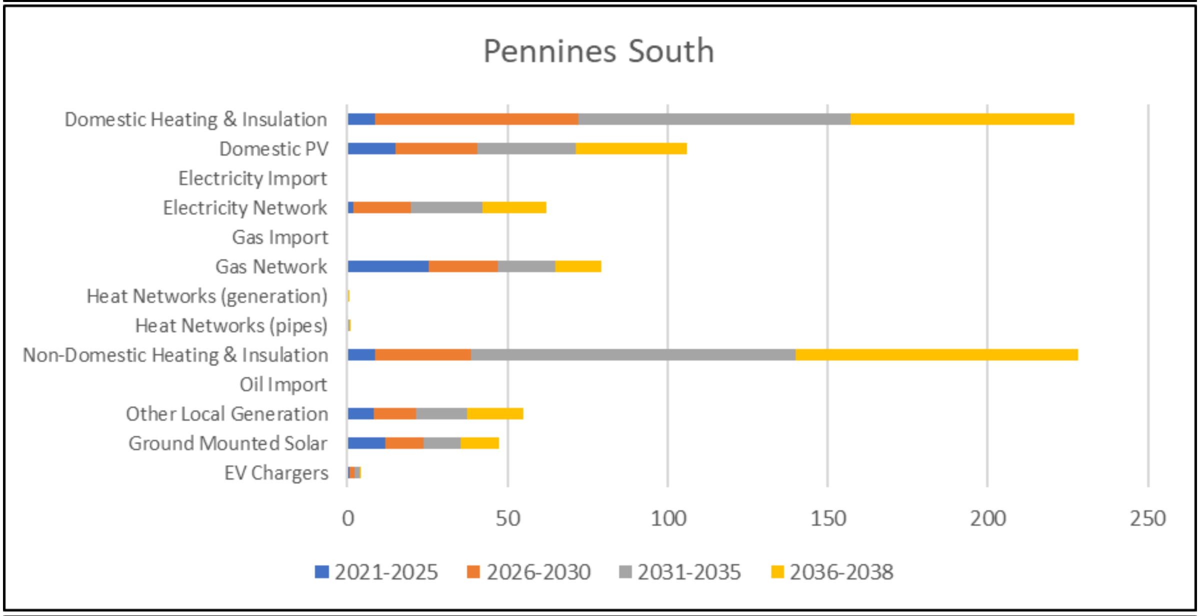
The tables below illustrate the total investment needed in the energy system to deliver the plan, equating to a total of £5.3 bn for the primary scenario and £4.4 bn for the secondary, with the charts on the following page breaking this down by technology. Again, a significant proportion of this investment will be required without working towards carbon neutrality, for example expenditure on replacement gas boilers is instead targeted at low carbon heating systems.

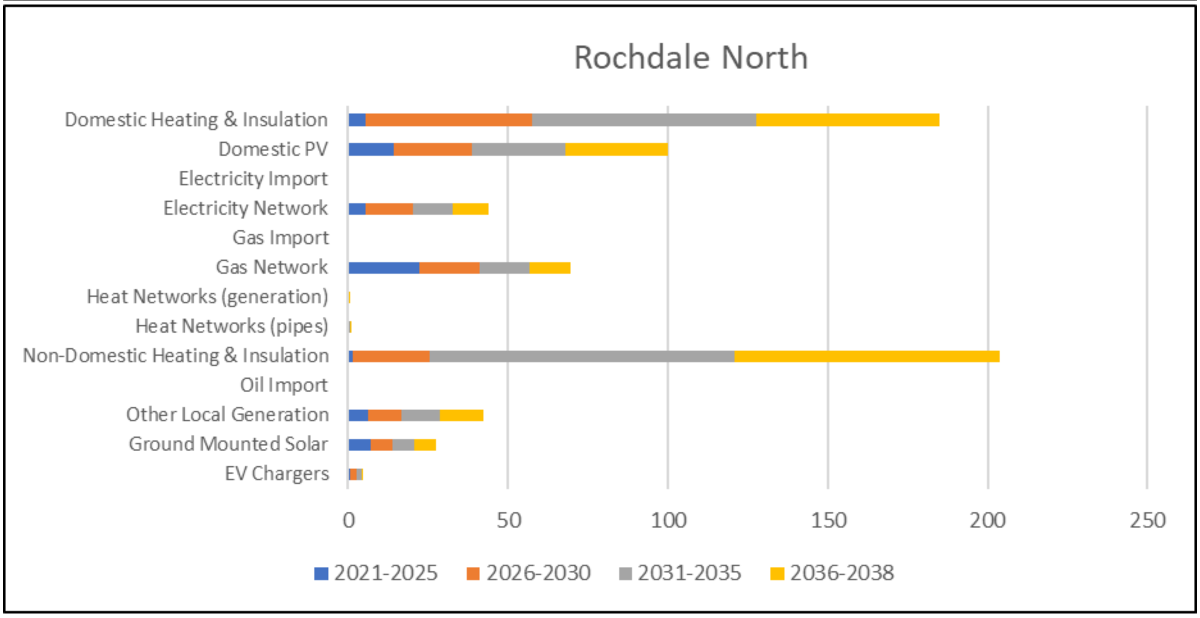
Zone	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Pennines North	741	706
Pennines South	810	762
Rochdale North	678	620
Rochdale South	932	738
Heywood	1,068	796
Middleton East	711	567
Middleton West	404	231

Investment type	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Domestic Heating Systems & Insulation	1,252	1,093
Domestic Solar	645	645
Domestic EV Chargers*	23	23
Non-domestic Heating Systems & Insulation	1,592	1,309
Non-domestic Solar	416	416
Large Scale Ground-mounted Solar	202	202
Electricity Network	214	51
District Heat Network	630	10
Hydrogen Network	0	471
Gas Network	370	202

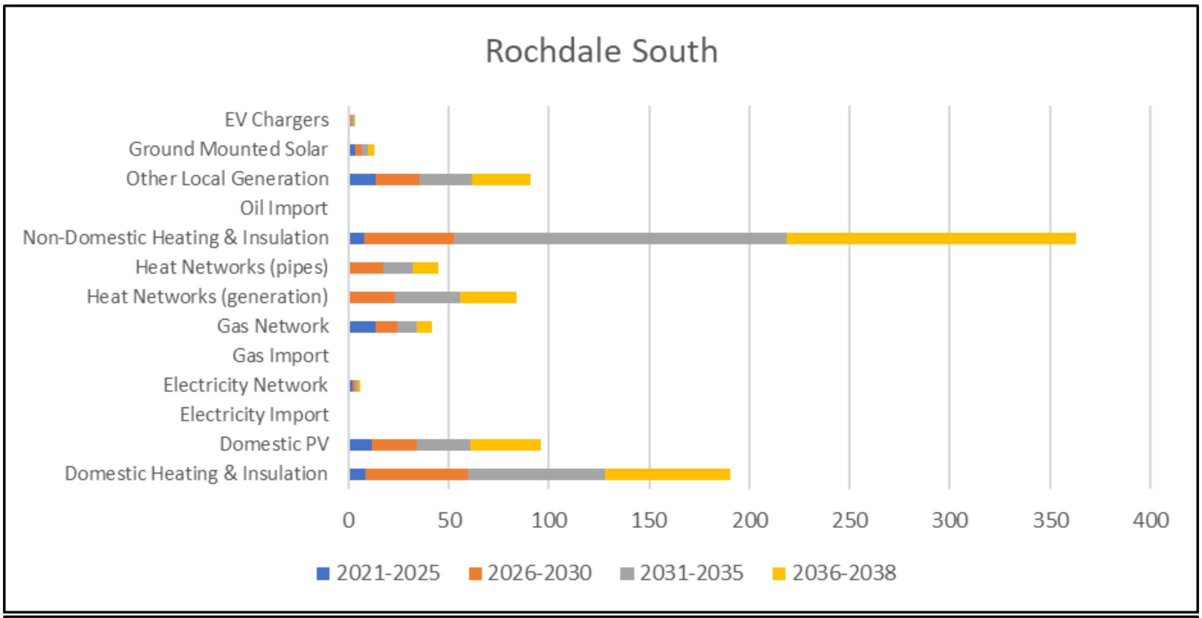
Investment in Rochdale's energy system (£m) by time period across each area

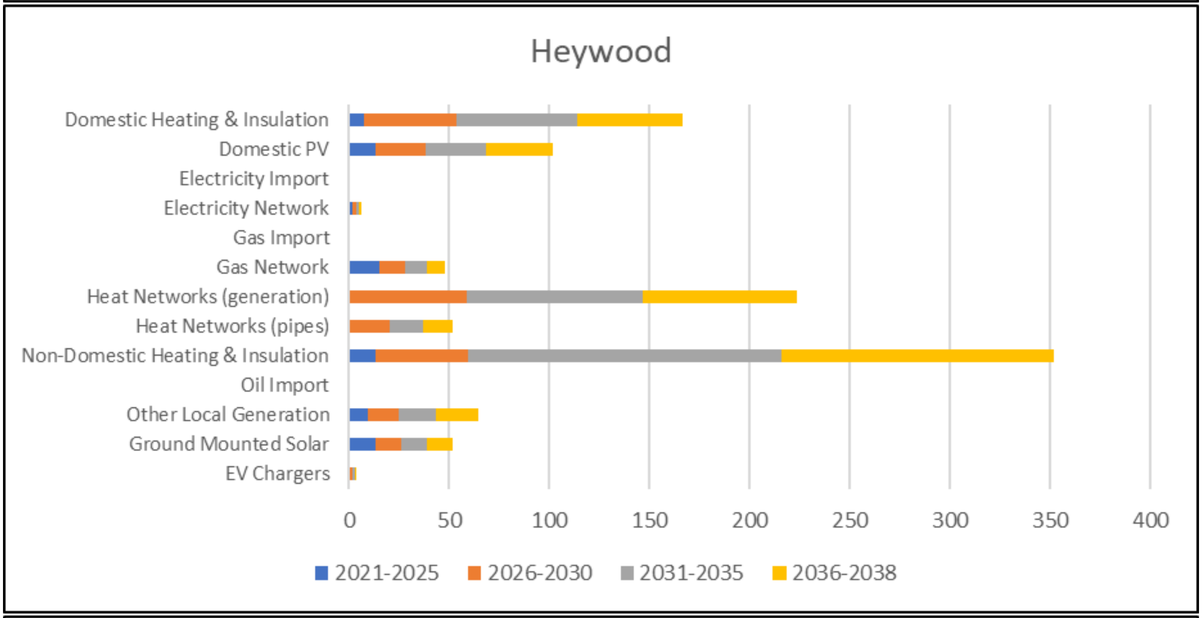


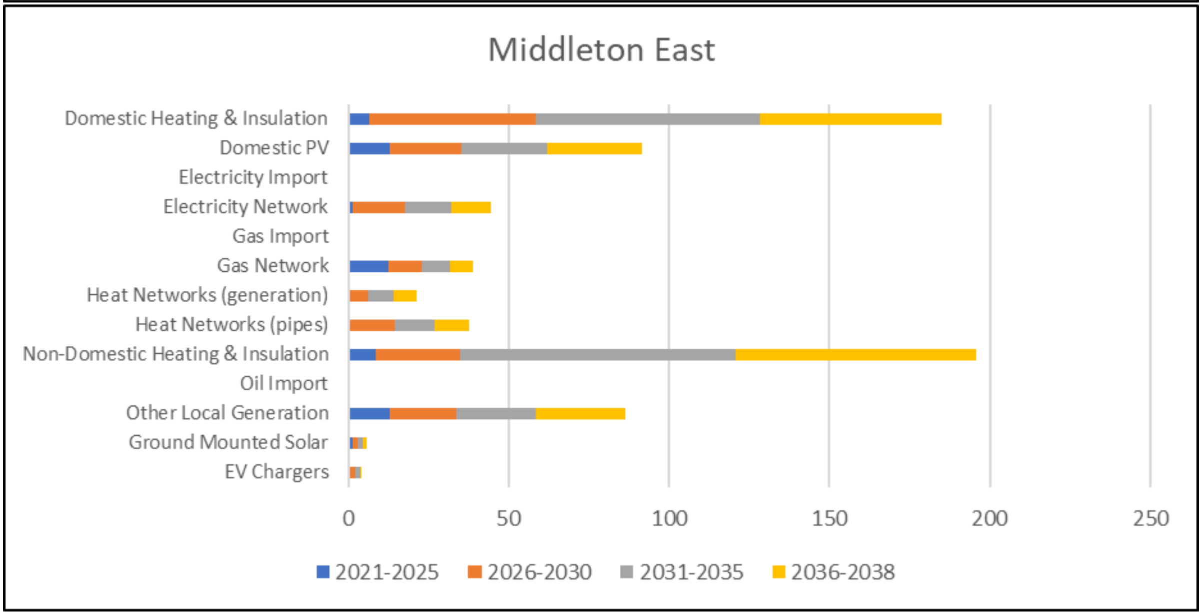




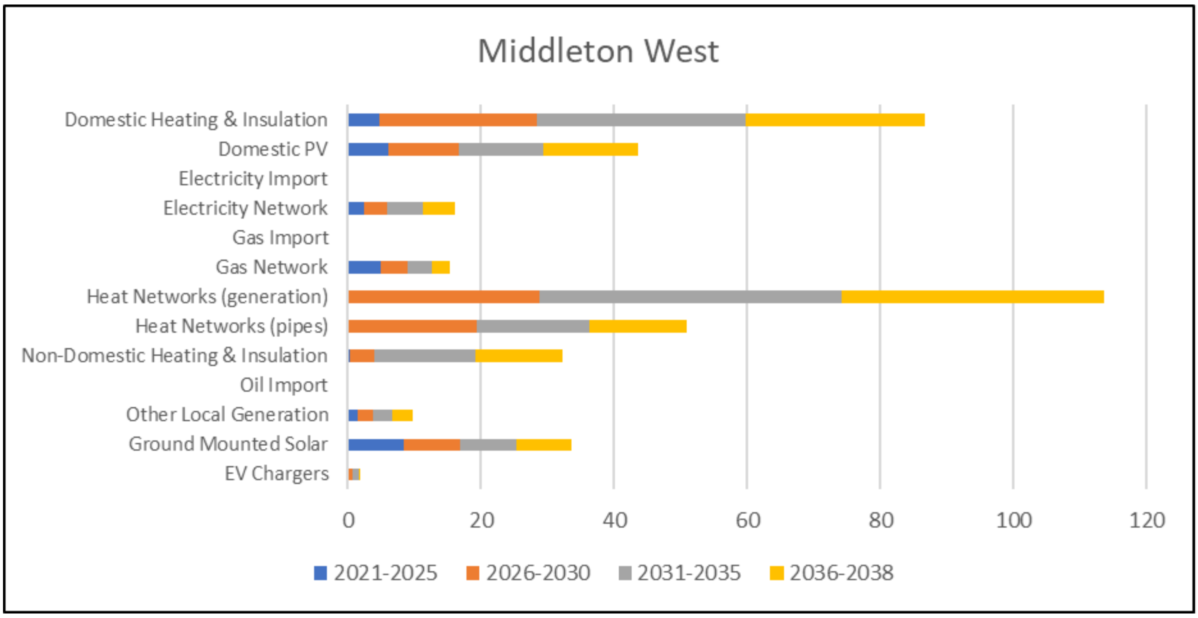
Investment in Rochdale's energy system (£m) by time period across each area







Investment in Rochdale's energy system (£m) by time period across each area



9. SUMMARY AND CONCLUSIONS

There are less than twenty years until 2038, the date by which Greater Manchester aims to be carbon neutral, and less than thirty years until 2050, the latest date by which the UK must reach Net Zero emissions*.

The technologies and infrastructure that make up the energy system typically last for decades, whilst the development, planning, design, delivery and operation of new energy infrastructure can have lead-times of five to ten years.

Whilst there is some flexibility to meet carbon neutrality in different ways depending on societal changes and technology innovation, there is an urgency for Rochdale and Greater Manchester to prepare to start the transition now and over the next few years, focusing on low regret activities, building capacity and supply chains, etc. The key decision point of how to decarbonise heat will need to be made c.2025, primarily based on the role hydrogen will play in providing heat to buildings. The longer the delay in making this decision, the more unrealistic it would be to achieve the 2038 carbon neutral target.

Future Local Energy System in Rochdale

All the scenarios investigated involve strong contributions from core activities and technologies and also identified a number of key opportunities and uncertainties. This have been categorised into four key areas:

1. **Reducing energy demand in Rochdale**
2. **Increasing Uptake of Low Carbon Solutions in Rochdale**
3. **Increasing local low carbon electricity production and storage**
4. **The future role of the gas grid in Rochdale**

1. Reduced energy demand in Rochdale: Reducing emissions, energy use and energy costs through making buildings more energy efficient has been shown to play an important role in all of the scenarios considered. In the primary scenario this means basic fabric retrofit of approximately 36,500 homes and deep retrofit of a further 38,800 homes requiring £515m of investment. Many of these homes can receive a cost-effective retrofit package, combining heating system replacements, solar PV and EV charger installations. Across all scenarios extensive fabric retrofit of existing homes is prominent both in cost-effectively reducing emissions in the near term, but also enabling the future installation of low carbon heating systems. It is important to note that new demands from transport, buildings and industry (moderated by improving energy efficiency) mean electricity demand increases in Rochdale from 1,126 GWh of electricity consumed per year to 2,108 GWh by 2038.

2. Increasing uptake of low-carbon solutions in Rochdale: By the early 2030s all new cars, vans and heating system replacements in homes and businesses must be low carbon. In the primary scenario in the 2020's the majority of this shift is to battery

* On 12 June 2019 the Government laid the draft Climate Change Act 2008 (2050 Target Amendment) Order 2019 to amend the Climate Change Act 2008 by introducing a target for at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050

electric vehicles (BEVs) and electric heat pumps along with development of heat networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.40,700) and public EV charging hubs, targeted at priority locations. Industry in Rochdale must either adopt technologies that use zero carbon electricity or hydrogen instead of fossil fuels or install carbon capture and storage technologies.

3. Increasing production of local low carbon electricity and its storage in Rochdale: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production in Rochdale. In the primary scenario 912 MWp of roof mounted solar PV capacity is installed.

Deploying the maximum potential for rooftop and ground mounted solar PV would produce up to 1596 GWh per annum of local, low carbon electricity, a significant contribution to Rochdale's forecasted annual consumption of 2,108 GWh. A key consideration for progressing and implementing this LAEP will be to determine how best to deploy solar PV systems alongside other components, such as heat pumps and EV charge points that could be provided as an integrated solution.

It is unlikely that such a substantial amount of Solar PV would be realistic or effective, however, the purpose of including is to highlight the potential that Solar PV could play in helping Rochdale and GM meet its carbon target and budget, therefore it should be regarded as a means of setting ambition and further work would be required to understand what would be sensible to consider.

4. The Future role of the Gas grid in Rochdale: The role of hydrogen for heating is uncertain. Whilst there are many activities underway across the sector to develop a potential hydrogen supply, at a suitable scale, there is currently no guaranteed commitment for this to be considered a reliable means of supporting the decarbonisation of Rochdale. Greater Manchester's ambition of carbon neutrality by 2038 creates significant pressures regarding the deliverability of 100% hydrogen heating to all homes in Rochdale. In the primary scenario, in the 2020's, increasing numbers of homes start to switch from gas to electric heating solutions and the majority of existing off-gas and new homes are heated using electricity by 2038. Rochdale should not rule out the potential for hydrogen heating, however, neither should it plan for it with certainty. The secondary scenario found that a similar level of emission reduction could be achieved using predominantly hydrogen for heating (3.67 Mt CO_2 generated through to 2038 compared to 3.9 Mt for the primary scenario) with a reduced total system cost (£6.3 bn compared to £7.3 bn for the primary scenario); however, these results are sensitive to the carbon intensity and cost of hydrogen, which are highly uncertain at this stage. A hydrogen heat-based future could also be more appealing to Rochdale's citizens, being potentially less disruptive. Therefore, the presented heat decarbonisation demonstration and scale-up priority areas have generally been identified in areas where it would not to be cost-effective to utilise hydrogen for heat even if available.

Key Findings

Achieving carbon neutrality by 2038 in Rochdale in support of Greater Manchester's commitment across the Combined Authority area is estimated to represent total energy related costs of between £6.3bn and £7.3b across both scenarios

The primary plan for Rochdale:

- Will require capital investment of £5.3bn (excluding energy costs) in less than 20 years. This investment is broken down with an approximate spend of £1.2 bn on energy networks, £1.3 bn on Rochdale's dwellings, £1.6 bn on Rochdale's non-domestic buildings. This has the potential to build local supply chains and create jobs for the future as part of a green industrial revolution for Rochdale
- By 2038 the local electricity network in Rochdale could supply as many as 40,700 domestic EV charge points distributed across the local area and numerous EV community charging hubs, primarily located around the four central zones.
- Approximately 78,000 homes could have heat pumps with over 79% of homes being electrified for heating. This means that in the 2020's new homes will need to be electrically, or hybrid heated, connected to a heat network or at minimum be hydrogen ready. The majority of existing off-gas grid homes in Rochdale will need to shift to a combination of electric and hybrid solutions
- If hydrogen were to become widely available earlier than anticipated, it could be supplied to approximately 76,000 homes, as well as non-domestic buildings, allowing hydrogen boilers to replace gas boilers for heating and hot water, as well as providing low carbon fuel for high temperature industrial applications. This would mean much of the gas network would be retained and repurposed by 2038.
- The gas network will continue in the immediate term to meet the majority of heating demands of homes and buildings although new connections will start to decline in the 2020s as new development favours electric or district heating solutions.
- If heat networks are developed, existing homes would be connected in clustered groups through targeted connection campaigns and new service offers
- The majority of homes with suitable characteristics will have solar panels and many of those could also have electrical (battery) and thermal storage systems
- A wide range of flexible resources will emerge, including energy storage, heating systems and electric vehicles able to participate in future flexibility and local energy markets

The Scale of the Challenge

- The following table details both modelled and assumed representative numbers. These are provided for illustrative purposes only, intended to demonstrate the scale of implementation, take-up, investment, and deployment needed, by time period, of specific components for Rochdale to achieve carbon neutrality.

Local Energy System Aspects	Key Metrics	Value in 2038	
		Primary Scenario	Secondary Scenario
Local Energy Consumption	Local energy consumption (excluding transport fuels, GWh/yr)	2,264	2,640
	Number of dwellings	105,390	105,390
	Non-domestic buildings (m^2)	5,700,129	5,700,129
Greenhouse Gas Emissions	(ktCO2e/yr)	37	3*
Local Energy Demand Reduction	Basic domestic retrofit measures installed (no of homes)	36,540	31,588
	Deep domestic retrofit measures (no of homes)	38,829	44,031
Local Electrification	Petrol & diesel vehicles on the road (No of vehicles)	11,706	11,706
	Pure electric vehicles on the road (No of vehicles)	75,037	75,037
	Hybrids (including plug-in) on the road (No of vehicles)	17,146	17,146
	Domestic EV charge points installed (No)	40,667	40,667
	Heat pumps installed (No of homes)	77,626	22,911
	Rooftop solar PV generation capacity installed (MWp)	912	835
	Ground-mounted PV generation capacity potential (MWp)	483	483
Local Heat Networks	Domestic heat network connections	21,706	36
Capital Investment* **	Buildings and energy system (£m)	7,283	6,326

* The lower annual 2038 projected ktCO2e/yr figure in the secondary scenario assumes that zero carbon hydrogen is available as per the HyNet projections; previous sections of this LAEP highlight the risks associated with these projections. Noting that this risk needs to be balanced alongside the risks associated with the other proposed measures/technologies in this LAEP, for example, the significant quantity of proposed local solar PV generation and in the primary scenario the adoption (by consumers) and deployment of significant numbers of heat pumps.

It must be recognised that achieving carbon neutrality by 2038 is hugely ambitious and challenging and will require major local policy interventions, investment by government and industry and both technology and business innovation.

A key challenge for Greater Manchester and Rochdale over the next five years is to build collective and coordinated action such that long-term investment in low carbon infrastructure is made in the 2020's and investment scale-up and mass market deployment of low carbon technologies is achieved through the 2030's.

Achieving this will require action in the 2020s to act as the catalyst for change and to ensure supporting infrastructure is invested in as the backbone of a zero-carbon energy system for Rochdale. It will require systematic changes in consumer and business behaviours, Rochdale's local energy networks, the use of energy in its buildings and the ways people move around.

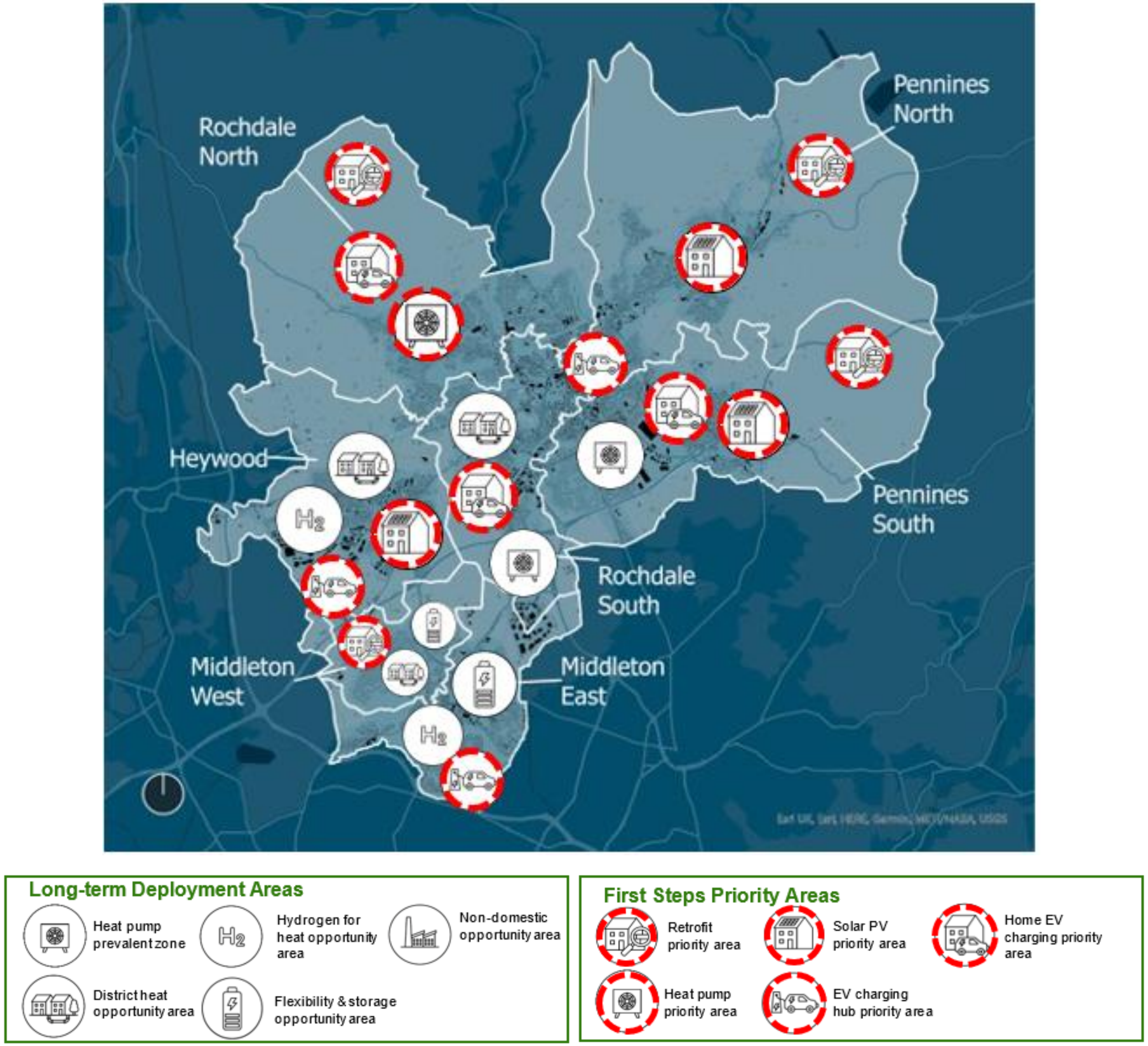
This LAEP provides Rochdale with both:

- An overall vision that illustrates the scale of change needed, through to 2038, to work towards carbon neutrality (based on the primary scenario)
- And importantly, the identification of priority areas to both demonstrate and test how to roll out the measures that will be needed to decarbonise Rochdale, whilst building the capacity needed for wide-scale deployment

The priority areas are summarised in the following map. This illustrates suggested areas and components for Rochdale Council to work with GMCA and other key stakeholders to develop a detailed, area specific*, action plan and delivery programme.

* In addition to this LAEP, Rochdale Council and GMCA are being provided with a more detailed and granular data set that can be used to identify potential target areas for demonstration and scale up activity. This data set identifies interventions and technology options at a neighbourhood level.

Demonstration and scale-up priority areas



Next Steps

Using the insights within this LAEP and in the identified priority areas, Rochdale Council will need to work with GMCA to determine how to take forward this LAEP. Suggested key next steps include:

- Determine approach for wider stakeholder collaboration, engagement, and consultation; utilising outcomes to refine target priority areas and to support the creation of a detailed action plan and delivery programme

- Determine approach for governance and tracking progress; incorporating mechanism for evaluating impact of interventions aligned to GM's carbon budget

- Develop process for evaluating actual intervention and technology options for implementation, in order to understand trade-offs between options*

- Work with ENWL to consider and prioritise potential demonstration and scale up of electricity-based components aligned to ENWL activity

- Work with Cadent regarding commitment and delivery of HyNet to Rochdale, integrating Cadent plans and activity with this LAEP

- Work with both ENWL and Cadent to develop a whole energy system energy network planning approach for taking forward this LAEP

- Work with GMCA to establish process for cross border LAEP reconciliation and interaction with a wider GMCA approach

- Build understanding and evidence around practical approaches to challenging or novel building modifications, such as fabric retrofit of terrace rows, or installation of air source heat pumps to existing flats.

- Conduct further heat network feasibility analysis for the opportunity areas identified

- Determine approach for procurement and working with energy and technology suppliers and service providers, including considering relationship with developing local skills and supply chain

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* For example: considering hydrogen, heat pump and hybrid systems and associated risks and benefits e.g. consumer demands and disruption; evaluating providing greater levels of dwelling retrofit e.g. to target reducing dwelling energy consumption costs

- Work with government and other key stakeholders to establish policy and funding mechanisms

- Establish programme of works and detailed plans for demonstration and scale up activity, including testing how to successfully provide new technologies, products, and services to Rochdale's citizens

- Determine approach for ensuring the integration of components and activity so that measures are not considered in isolation

- Understand how this plan fits together and interacts with Rochdale Council’s Green New Deal

- Understand what role locally generated electricity through Solar PV should have in decarbonising Rochdale

Wider LEM Project Partners

ACKNOWLEDGEMENTS

This report was prepared by Energy Systems Catapult on behalf of Greater Manchester Combined Authority. Support on renewable energy generation opportunities and engineering feasibility review was provided by Buro Happold.

Local knowledge, data, direction and guidance were provided by Rochdale Council and Greater Manchester Combined Authority.

Information relating to existing energy networks, and wider input to the development of this Plan were provided by the electricity distribution network operator Electricity North West and gas distribution network operator Cadent.

The following stakeholders also provided input during the development of this Plan: Department of Business, Energy and Industrial Strategy, Ofgem and Innovate UK.

About the GM LEM project

This report was produced as part of the Greater Manchester Local Energy Market (GM LEM) project, which forms a key part of Greater Manchester Combined Authority's plans for decarbonisation, set out in the 5 Year Environment Plan, complemented by the Smart Energy Plan. Together these enable Greater Manchester to work towards the target for a zero-carbon emissions city region by 2038. The GM LEM project is an ambitious integrated, whole system energy vision that addresses how energy is generated, traded, transported, supplied, and used across the city region. Co-ordinated by the Greater Manchester Combined Authority (GMCA), it brings together a diverse array of partners from the private, public and third sectors, including commercial and legal advisors, service design consultants, financial and regulatory specialists and the energy, technology, and systems resources. The two-year project is funded by Innovate UK.

About Local Area Energy Planning

Energy is a core part of national and local economies and infrastructure. Decarbonisation of the UK will require significant changes to energy systems, yet every local area is unique and the changes needed to decarbonise will be specific to each area. Energy Systems Catapult (ESC) pioneered a new whole system approach to Local Area Energy Planning (LAEP) with pilots in three different local areas of the UK – Newcastle, Bury in Greater Manchester and Bridgend in Wales. ESC has since worked with others to evolve this approach, including with Ofgem and Centre for Sustainable Energy to define a method for LAEP* 'done well', which we have sought to follow in the creation of this Rochdale LAEP, within the constraints of the GM LEM† project. In this project the ESC's EnergyPath Networks toolkit has been used to perform the local analysis.

* https://es.catapult.org.uk/reports/local-area-energy-planning-the-method/
† https://es.catapult.org.uk/reports/local-area-energy-planning/

About Energy Systems Catapult

ESC was set up to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. ESC is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia and research. We take a whole systems view of the energy sector, helping us to identify and address innovation priorities and market barriers, in order to decarbonise the energy system at the lowest cost. We work with innovators from companies of all sizes to develop, test and scale their ideas. We also collaborate with industry, academia and government to overcome the systemic barriers of the current energy market to help unleash the potential of new products, services and value chains required to achieve the UK's clean growth ambitions as set out in the Industrial Strategy.

About Buro Happold

Buro Happold is an international, integrated consultancy of engineers, consultants and advisers. Operating in 26 locations worldwide, with 55 partners and over 1,900 employees; for over 40 years we have built a world-class reputation for delivering creative, value led solutions for an ever challenging world.

Document control:

Project name	GM LEM: WP2 Local Area Energy Planning – Rochdale
Version	1
Status	Approved: Contains reviewed and approved content.
Restrictions	Open

Review and approval:

	Name	Position
Author	Tian Coulsting and Usman Farooq	Systems Integration Consultant Local Energy Area Planning Consultant
Reviewer	Richard Leach	Local & Site Energy Transition Manager
Approver	Rebecca Stafford	Senior Manager

Revision history:

Date	Version	Comments
14/02/22	0.1	Initial draft
18/02/22	0.2	Draft for internal review
21/03/22	0.3	Working draft for initial client consultation
13/04/22	0.4	Updated draft incorporating client consultation
9/05/22	0.5	Updated including further client consultation
13/06/22	1.0	**Client issue**

GREATER MANCHESTER LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Technical Annex

The technical annex summarises aspects of the evidence base that has been used to develop this LAEP; based on scenario based whole energy system modelling and analysis

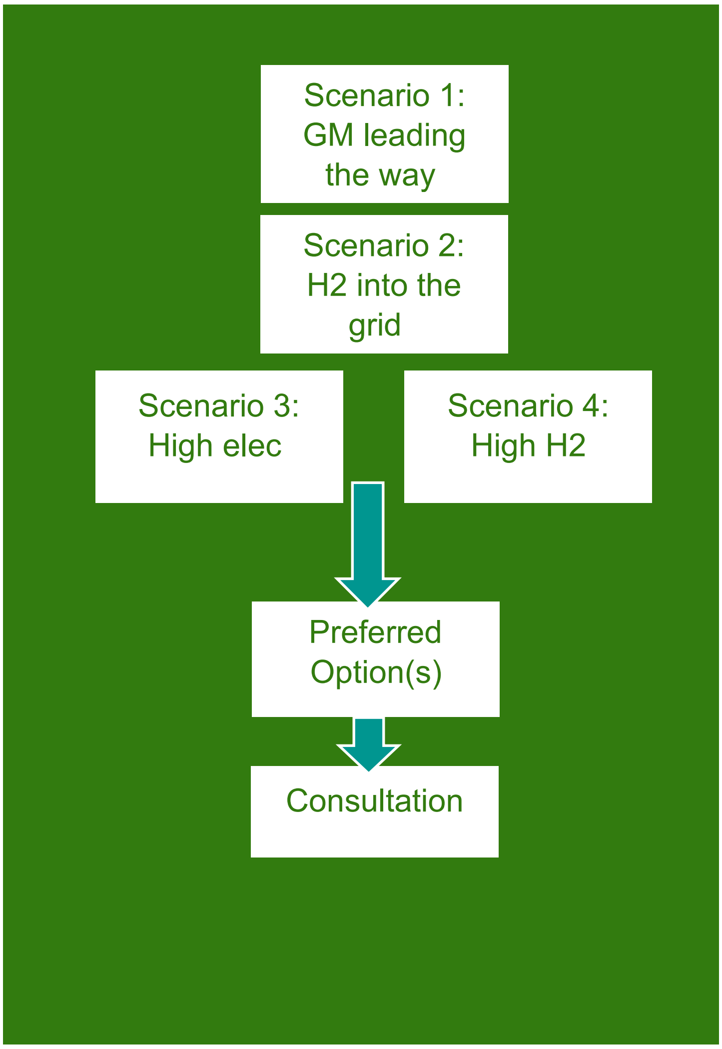
A variety of energy system scenarios are possible to deliver Greater Manchester and Rochdale’s future energy vision. It is not practical to consider every possible configuration of Rochdale 's local energy system in a limited number of scenarios, therefore four main scenarios have been considered; these represent the prominent cost-effective options that could materialise.

The scenarios are not predictions or forecasts of the most probable outcomes. They represent plausible and affordable futures based on available information and have been used to inform a plan for Rochdale. The decarbonisation of any local energy system will require considerable co-ordination, planning and investment as well as consumer and social engagement.

The scenarios have been developed through frequent engagement with GMCA, as well as consulting with a wider group of stakeholders including Cadent and Electricity Northwest. Further consultation and engagement with Rochdale residents is proposed as part of the wider Greater Manchester Local Energy Market project and will continue to inform the development and refinement of the LAEP for Rochdale and other boroughs.

A brief description of the different scenarios developed and used to inform the plan is given here, with modelling outputs from the scenarios provided in the following pages.

Importantly, each future local energy scenario for Rochdale has been developed to reach carbon neutrality by 2038, aligned to Greater Manchester’s decarbonisation ambition and to also act as counterfactuals and alternative futures for Rochdale. These scenarios are constructed using location specific information on Rochdale's existing energy networks, buildings, local constraints and resources in combination with data on technology performance and costs and modelled using ESC's EnergyPath Networks modelling toolkit.



Modelled scenarios and plan development

These scenarios provide an understanding of pace and scale of activity needed, costs and investment needed for local implementation in support of decarbonisation goals and the commonality and variation of measures across the different future local energy scenarios. The scenarios help to explore choices around how to reach carbon neutrality using different technologies and known solutions where they exist.

Scenario 1 – Leading the Way: this scenario focuses on meeting the carbon budget and target by making use of **proven measures within Rochdale's local control** where at all possible.

Scenario 2 – An Alternative Future Local Energy Scenario: we have assumed hydrogen options for residential heating and non-domestic buildings become available in Rochdale from 2030 onwards, aligned to HyNet Phase 3 and the repurposing of the gas grid to hydrogen is an option

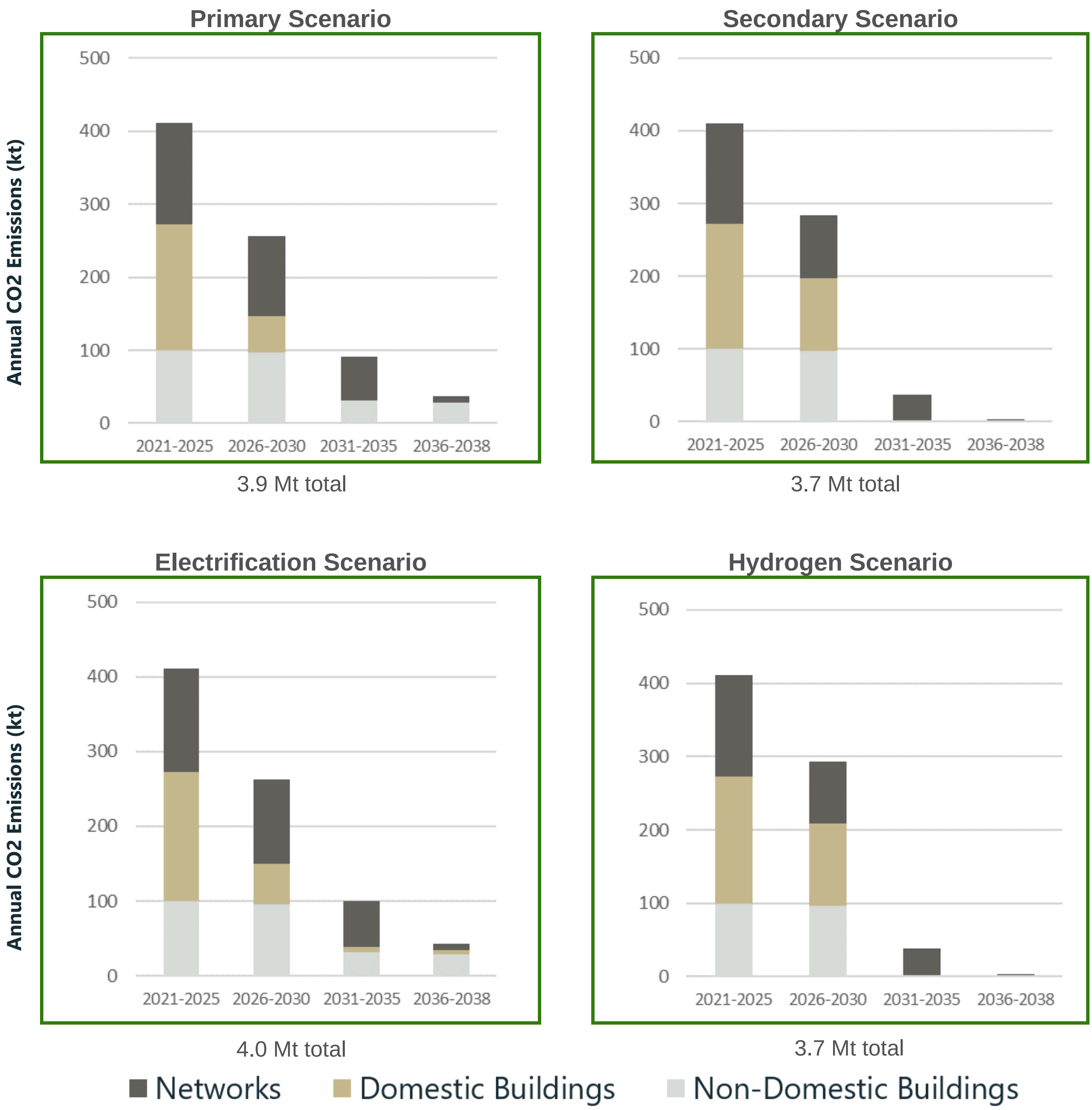
Scenario 3 – High Electrification: we have assumed the only low carbon options for buildings heating and hot water demand are electric based. This includes energy centres feeding local heat networks

Scenario 4 – High Hydrogen - we have assumed the only available low carbon options for buildings' heating and hot water demand are hydrogen based from 2031 onwards

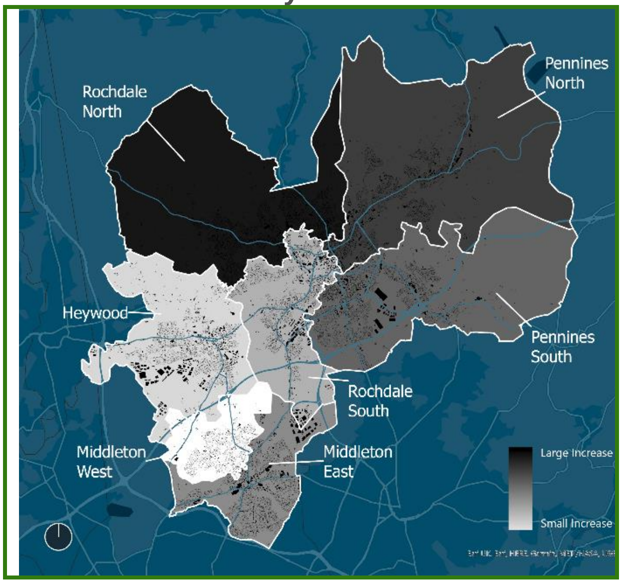
Scenarios 3 and 4 provide context and evidence for what would happen if either hydrogen or electrification were pursued as the sole solution for the decarbonisation of homes and buildings in Rochdale. Whilst this is considered to have a number of practical limitations to feasible implementation by 2038, these were considered useful as comparative scenarios.

ENERGY CONSUMPTION

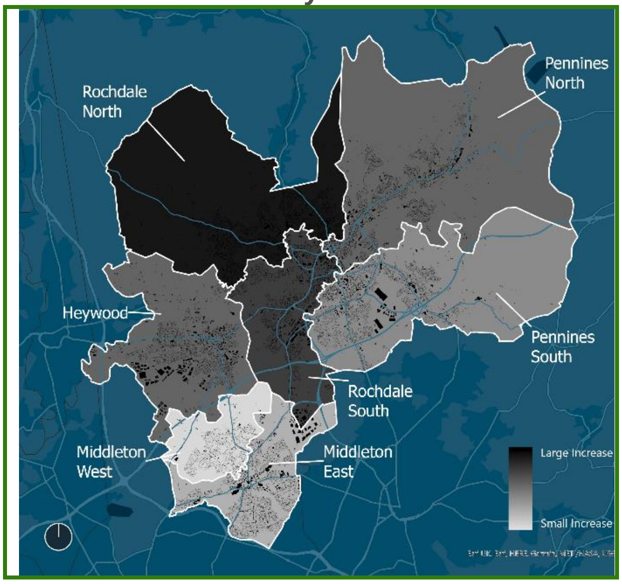
Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, due to the reduction in transport fuel consumption.


Primary Scenario
Secondary Scenario
Annual CO2 Emissions (kt)
500
400
300
200
100
0
2021-2025
2026-2030
2031-2035
2036-2038
3.9 Mt total
3.7 Mt total
Electrification Scenario
Hydrogen Scenario
4.0 Mt total
3.7 Mt total
Networks
Domestic Buildings
Non-Domestic Buildings

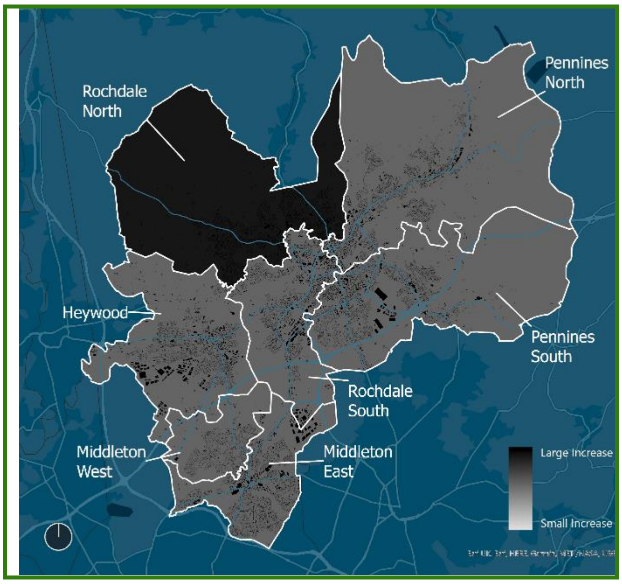
Primary Scenario



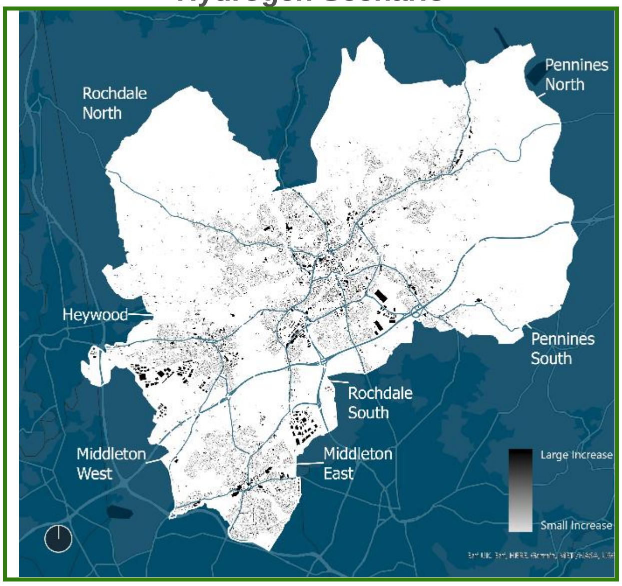
Secondary Scenario



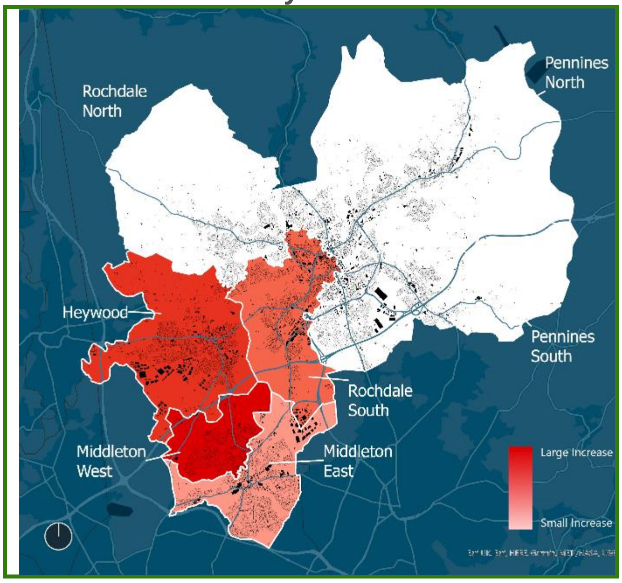
Electrification Scenario



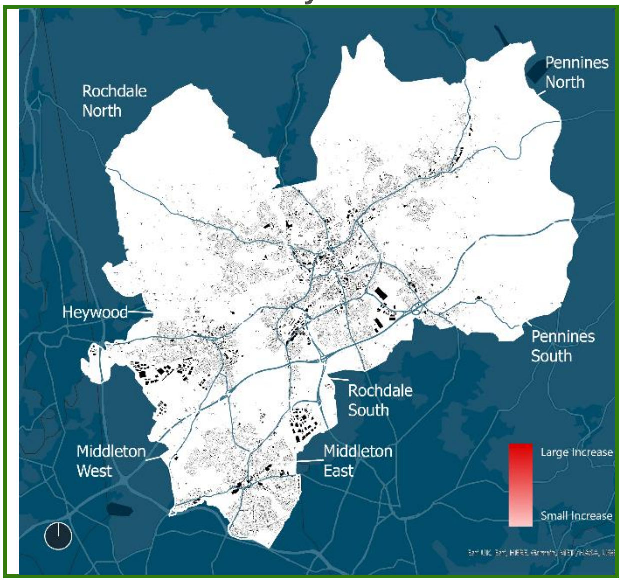
Hydrogen Scenario



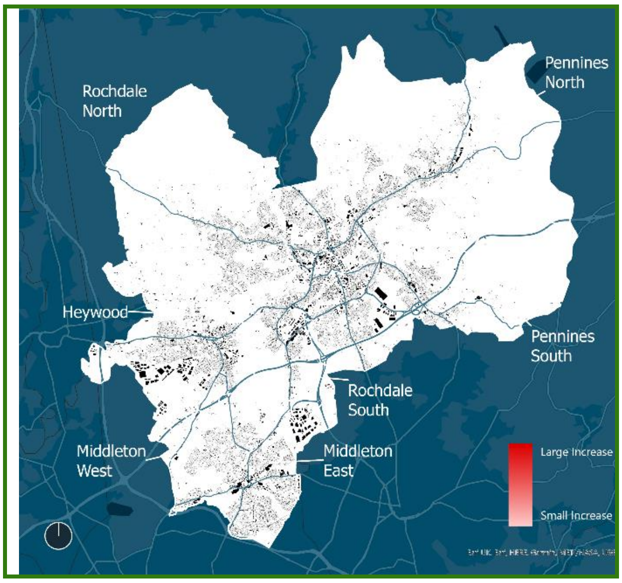
Primary Scenario



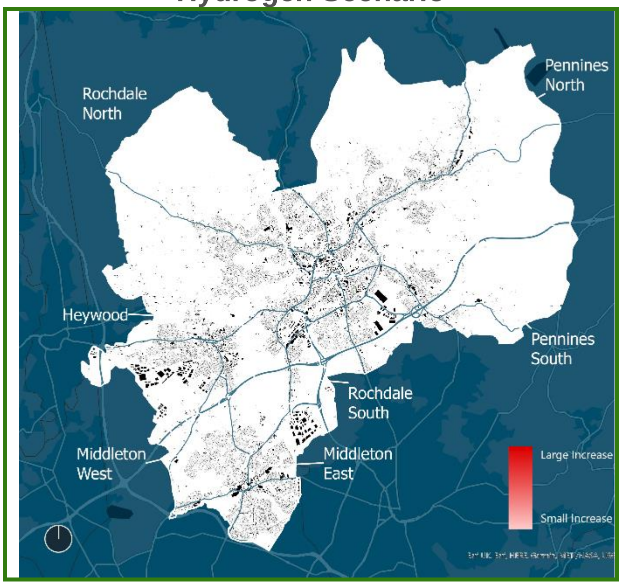
Secondary Scenario



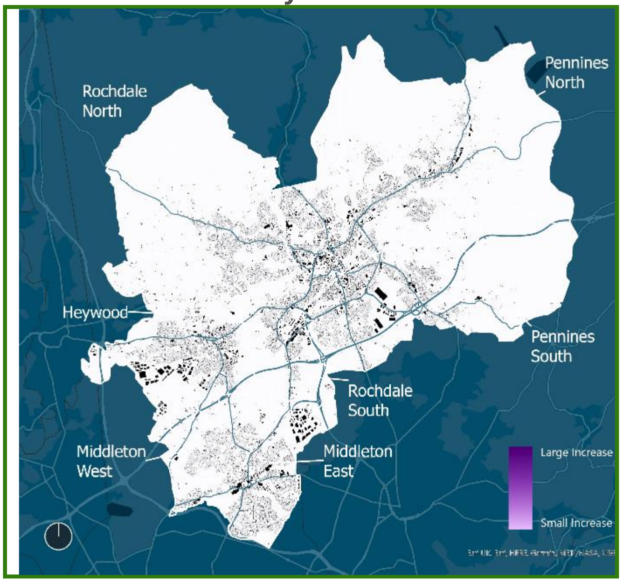
Electrification Scenario



Hydrogen Scenario



Primary Scenario



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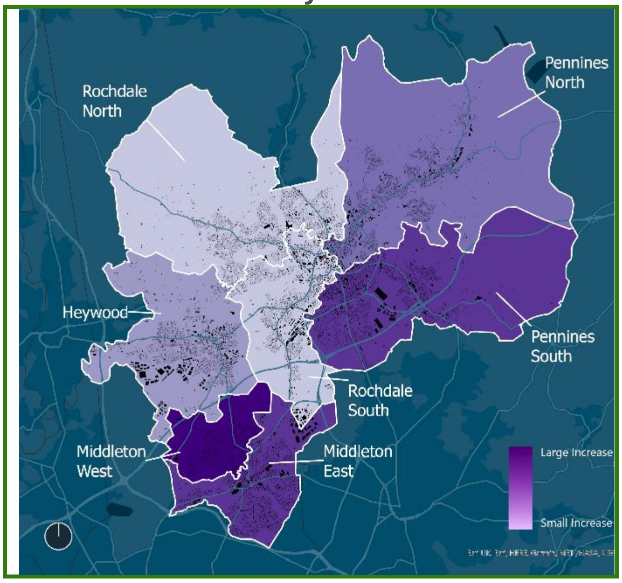
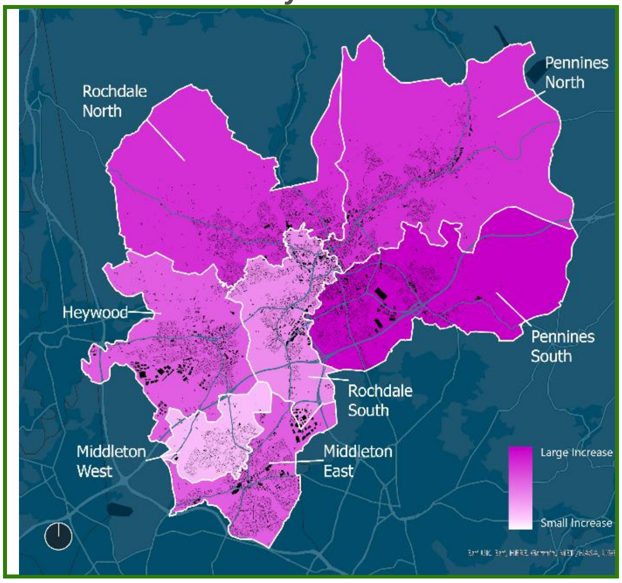


Electrification Scenario

Hydrogen Scenario

Primary Scenario



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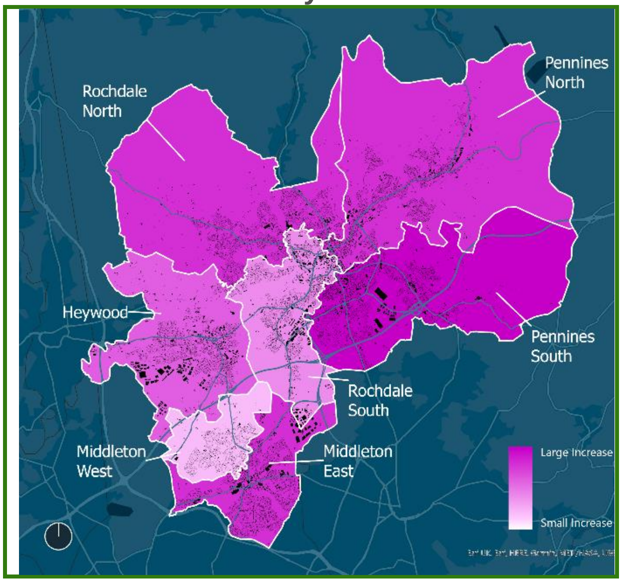
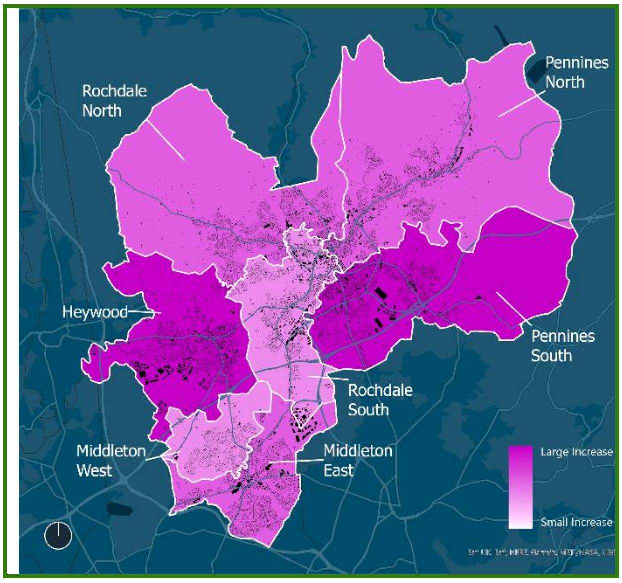
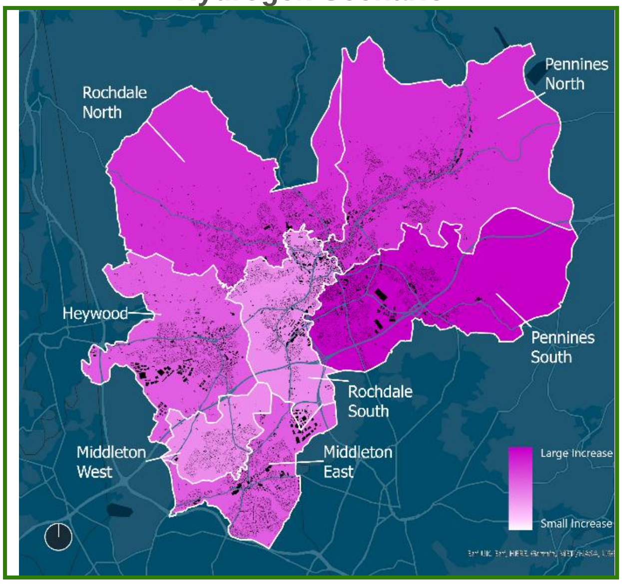


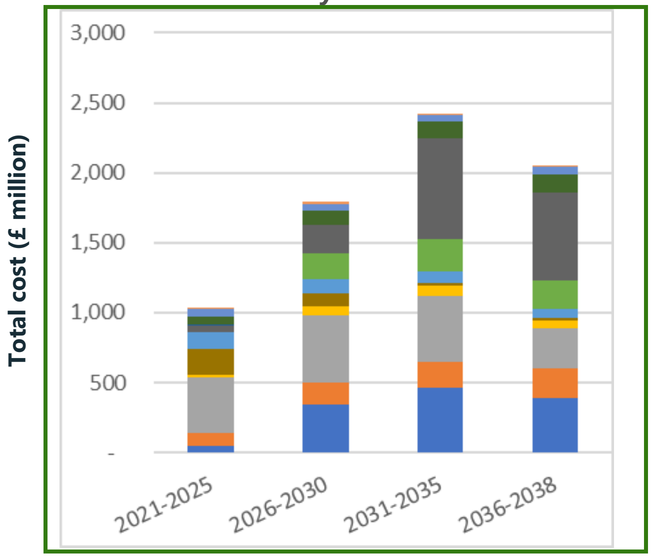
Electrification Scenario



Hydrogen Scenario

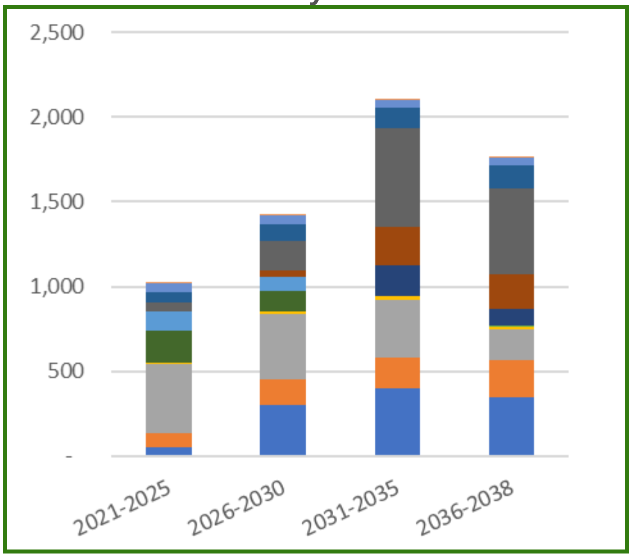


Primary Scenario



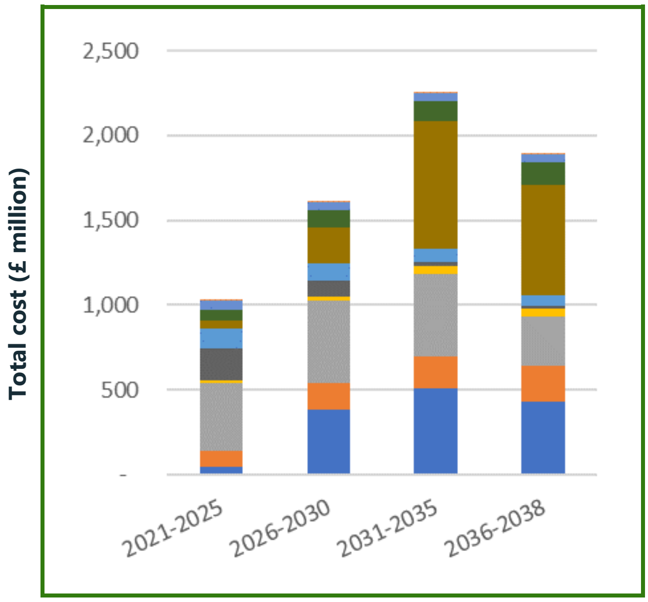
£7.3 bn total

Secondary Scenario



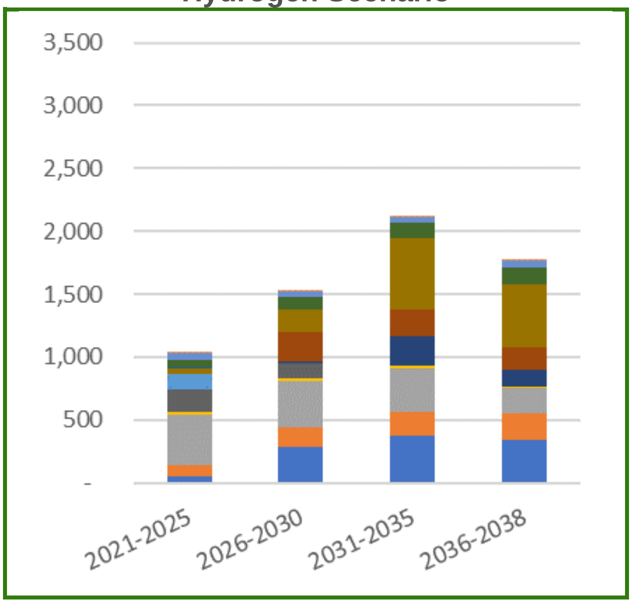
£6.3 bn total

Electrification Scenario



£6.8 bn total

Hydrogen Scenario



£6.5 bn total

- Domestic Heating Systems & Insulation
- Domestic PV
- Electricity Import
- Electricity Network
- Gas Import
- Gas Network
- Heat Networks
- Hydrogen Import
- Hydrogen Network
- Non-Domestic Heating & Insulation
- Oil Import
- Other Local Generation
- Solar Ground Mounted
- EV Chargers

GREATER MANCHESTER
LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Data Sources Annex

The data sources annex summarises the consistent baseline data used by the ESC used to develop this LAEP.

Domestic

- **Ordnance Survey AddressBase Premium, MasterMap Topography, Highways**
  - Shows location, footprint and classification of buildings, plus road layout for network modelling.
  - Latest data obtained December 2020 for buildings and roads.
- **GMCA Accelerating Retrofit Domestic Buildings Dataset**
  - Detailed attributes of all domestic properties in GM produced by Parity Projects, using EPCs and filling gaps with other data.
- **Energy Performance Certificates (EPCs)***
  - ESC-built address matching algorithm to match housing attributes from EPCs
  - Informs building-level attributes – e.g. current heating system, levels of insulation.
- **Listed Buildings** – Historic England† as a potential constraint on retrofit

Non-Domestic

- **Ordnance Survey MasterMap Topography**
  - Provides status and classification of building (e.g. office, retail).
  - Informs building size and height.
- **OpenStreetMap** has not been chosen due to inconsistent national coverage compared with Ordnance Survey.
- **Non-domestic Energy Performance Certificates (EPC) and Display Energy Certificates (DEC)‡‡‡‡‡‡‡‡‡‡‡** to provide further building attributes and demands.
- **GMCA Public Sector Decarbonisation Scheme (PSDS)** to provide further demand data for significant public sector buildings and funded interventions in specific buildings
- **GMCA "Go Neutral"** provides further demand data for public buildings.
- Energy benchmarks (kWh/m^2) developed in conjunction with Arup

Future Building Stock

- **GMCA Existing Land Supply Sites**
  - For domestic, number given split by house/apartment, with planned construction date.
  - For non-domestic, type given (office, retail, industry/warehouse) with planned construction date.

- **GMCA Spatial Framework Allocation Sites**
  - Usage as above.

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* https://epc.opendatacommunities.org/
Note: details of Green Homes Grant (GHG) and Local Authority Delivery (LAD) projects provided separately by Local Authorities where relevant

† https://historicengland.org.uk/listing/the-list/data-downloads/

- In total over 3,000 sites provided

DISTRIBUTION, GENERATION AND TRANSPORT

Networks

- Relationships & NDAs with Electricity North West (ENWL) & Cadent
- **ENWL** (Electricity Distribution Network Operator)
  - Substation locations and capacities (for 11kV-400V upwards)
  - Typical component costs, combined in packages to generate reinforcement costs for different network assets.
- **Cadent** (Gas Distribution Network Operator)
  - Mapping of pipes including material, size and pressure.

Local Generation

- **Renewable Energy Planning Database***
  - Current planned and operational renewable energy installations (above 150kw)
- **Feed-in-tariff install reports†**
  - Current levels of domestic PV by postcode
- **GMCA "Unlocking Clean Energy in Greater Manchester" project**
  - Details of various solar PV, hydro-electric generation, battery storage and electric vehicle (EV) charging projects.
- **ENWL Embedded Capacity Register‡**
  - Identify registered generation assets within the region.

Electric Vehicles

- **Zap-Map§**
  - Location and speed of public chargepoints.
  - **National Chargepoint Registry (NCR)**** has not been used since its data is included within Zap-Map's national database.
- **Future domestic EV uptake**
  - ESC in-house analysis on the expected uptake of EVs on the network.
- **GMCA Transport for Greater Manchester (TfGM) list of potential EV charging sites**
  - Work carried out by Arup to determine 60+ locations, number of connections and charge speed across GM.

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* https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract
† https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-installation-report-31-december-2020
‡ https://www.enwl.co.uk/get-connected/network-information/embedded-capacity-register
§ https://www.zap-map.com/
** https://www.gov.uk/guidance/find-and-use-data-on-public-electric-vehicle-chargepoints