GREATER MANCHESTER
LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Local Area Energy Plan

Bury, Greater Manchester

May 2022

This document is marked as confidential

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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 districts 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 district in the development of a Local Area Energy Plan (LAEP).

This LAEP aims to define the extent of the transformation needed across each district (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 Bury

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

- **Primary Scenario – Leading the Way:** this scenario focuses on meeting the carbon budget and target by making use of **proven measures within Bury's local control** where at all possible.
- **Secondary – An Alternative Future Local Energy Scenario:**
  we have assumed hydrogen options for residential heating and non-domestic buildings become available in Bury from 2030 onwards (aligned to HyNet Phase 3†) and the repurposing of the gas grid to hydrogen is an option

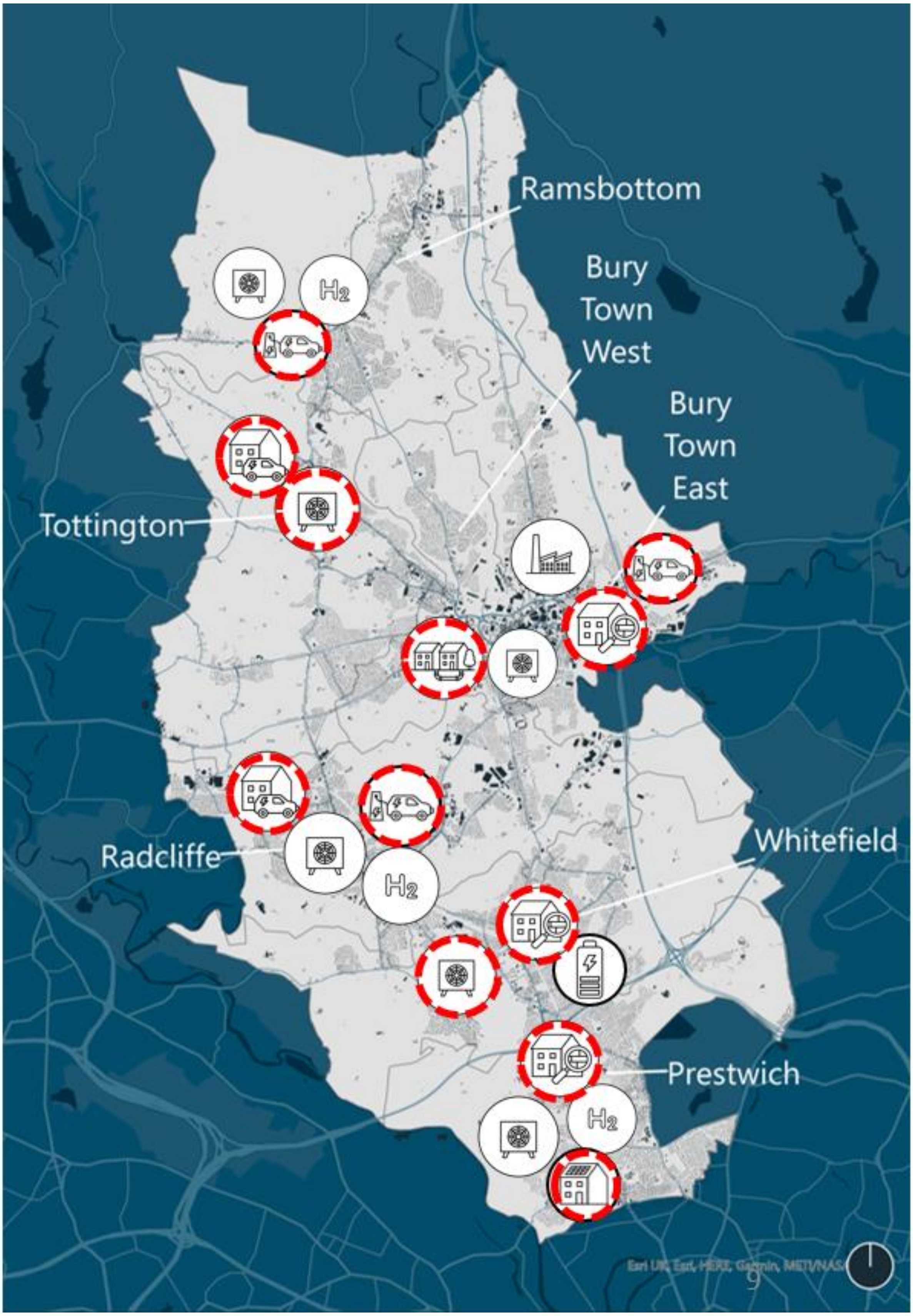
Local Priorities and Measures

Bury has been geographically sub-divided into 8 areas for the purposes of modelling and to understand what is needed for decarbonisation at a more local level. These divisions have been made along the 33-11kV substation boundaries, grouped into roughly equal numbers of dwellings.

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

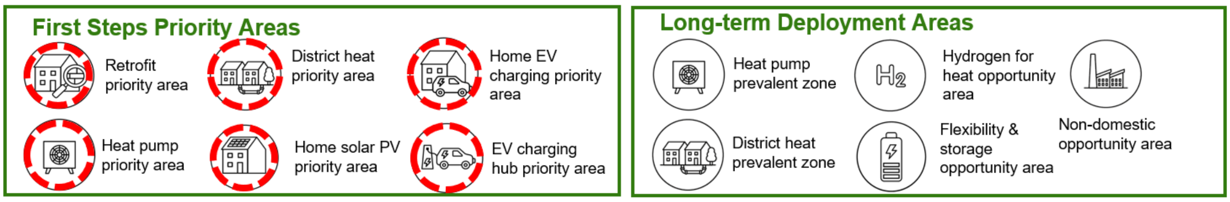
† HyNet North West is being delivered by a consortium of partners, each of which will lead a different part of the project. Progressive Energy is leading the development of the low carbon hydrogen production plant and the CO2 pipeline, while Cadent is leading development of the hydrogen pipeline

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



Ramsbottom
Bury Town West
Bury Town East
Tottington
Radcliffe
Whitefield
Prestwich
Esri UK, Esri, HERE, Garmin, METI/NASA

Key



First Steps Priority Areas
Retrofit priority area
District heat priority area
Home EV charging priority area
Heat pump priority area
Home solar PV priority area
EV charging hub priority area
Long-term Deployment Areas
Heat pump prevalent zone
Hydrogen for heat opportunity area
Non-domestic opportunity area
District heat prevalent zone
Flexibility & storage opportunity area

1. INTRODUCTION

Context

Greater Manchester is committed to achieving carbon neutrality by 2038. To support this, it has a vision of each of its districts transforming its 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 district in the development of a Local Area Energy Plan. This aims to define the extent of the transformation needed across each district (including a focus on identifying first steps to progress), provide a robust evidence base and 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 and Cadent in piloting a data-driven whole system approach. 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 the carbon neutral target will require the transition of Bury's heating systems from natural gas fired boilers to electrified heating systems, district heating networks or converting the gas network to hydrogen.

[*] 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 CO_2/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 CO_2 pipeline, while Cadent is leading development of the hydrogen pipeline

Modelling Approach

We have used the ESC-developed EnergyPath® Networks tool to produce a series of future local energy scenarios for Bury (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. For the impact of the energy system outside of the boundaries of Bury, 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 pathways for the UK energy system to then feed into the local modelling.

The primary scenario illustrates a potential cost effective vision for carbon neutrality in Bury. This explores the actions and investment needed in different areas of Bury between now and 2038 to reduce its emissions in line with Greater Manchester's ambitions for carbon neutrality. The scope of emissions in this plan covers 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.

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.

Scenarios for achieving Carbon Neutrality in Bury

A core aspect of the scenario analysis has been the consideration of resulting emissions (following the implementation of the components that make up the 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.

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.

These 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 across a broad range of scenarios and are resilient to sensitivity analysis warrant prioritisation in preparing for transition; this approach has led to the identification of the priority and pioneer areas within this LAEP.

Conclusions from the scenario analysis have been used to develop this plan, described and illustrated in the following Vision pages. This represents a point-in-time plan of intent, as the basis for Bury taking important implementation steps over the next 5 years to engage industry and businesses, build momentum around a shared plan and to 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

The primary scenario makes assumptions around changes to behaviour and 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 Bury over the coming years. Where hydrogen for building heating does become available, 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 Bury; 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.

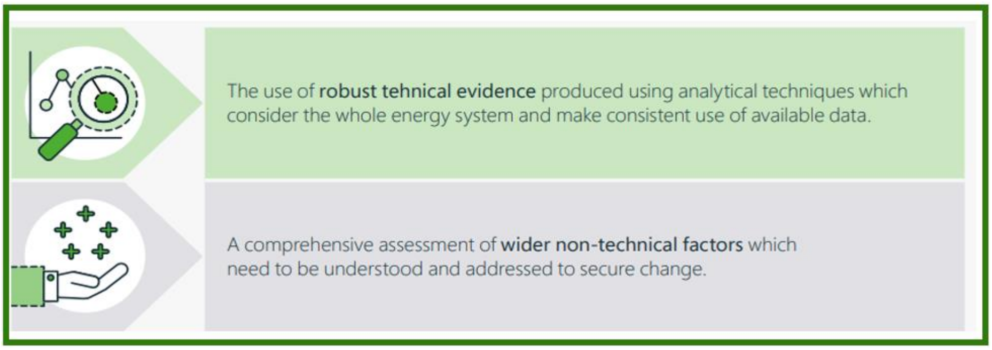
In summary, the primary scenario has been developed in response to the science-based carbon budget for GM: defining a credible plan for Bury, based on currently deployable technologies, to support an understanding of the actions, pace and scale of change as well as the investment needed. Insights from 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 focus areas. These scenarios 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 gives context to the plan for Bury.

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 aligned to the latest guidance on Local Area Energy Planning developed with Ofgem, the ambitions of Greater Manchester and wider UK Net Zero commitments .

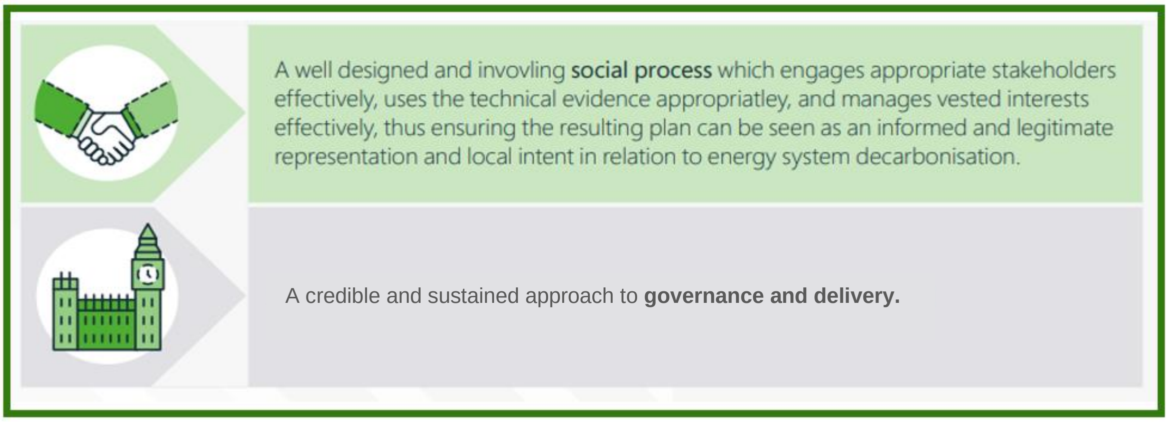
[*] Decarbonisation Pathway for Greater Manchester, Reaching carbon-neutrality in a balanced scenario by 2038, Navigant, July 2020

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 Bury 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 and also the approach of both Greater Manchester and Bury in its ongoing governance and delivery.



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

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

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 five parts (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 Bury, informed by the scenario analysis. The primary scenario demonstrates how Bury could meet Greater Manchester's decarbonisation ambitions across each of its key areas by 2038 in a practical way. A series of first steps are also presented that focus on demonstration and scale-up of some of the key components that will be needed to decarbonise Bury.

Chapters 3-7: set out some of the key aspects of the primary scenario and what this means in relation to implementation for Bury 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 considers key uncertainties and dependencies informed by the wider scenario analysis and specific areas of investigation

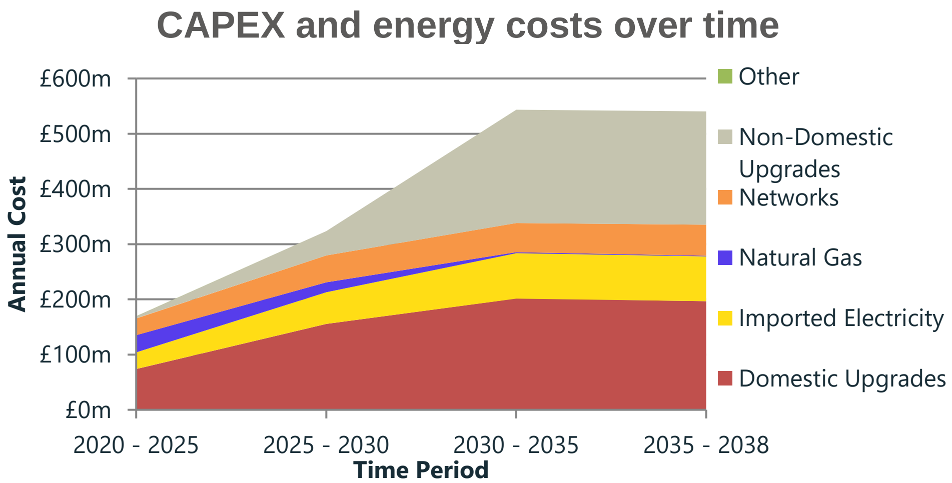
Chapter 8: sets out the estimated system costs and investment needed for implementation of the primary scenario. This includes definition of the total system costs between now and 2038 across different areas of Bury, the capital investment at key time steps in infrastructure and key technologies within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

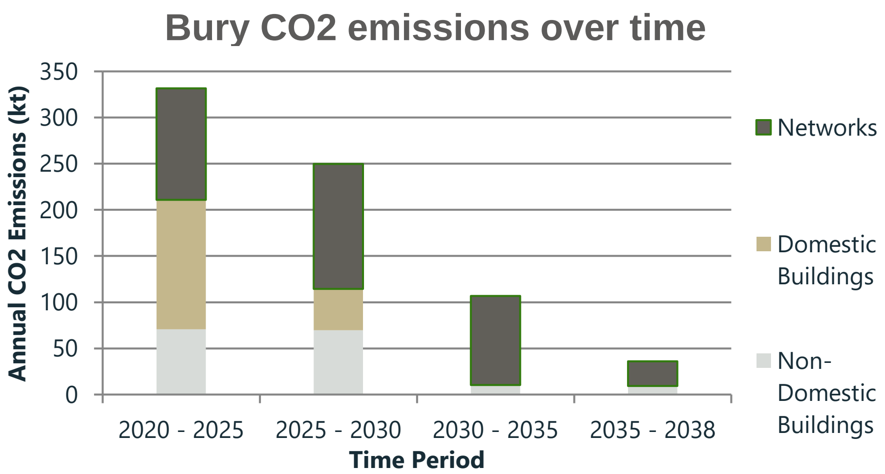
Chapter 9: summarises the key findings and recommended actions to support implementation and ongoing review and monitoring in the context of national and regional energy strategy, carbon budgets and associated policy and regulation.

2. THE VISION

This Local Area Energy Plan (LAEP) aims to support Bury 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 Burys local energy system by 2038 is achievable and expected to require capital investment of up to £3.5b. Total energy costs including capital investments, operations and energy consumed is between £5.3b and £6.3b to 2038*. The top chart below illustrates the breakdown of this expenditure over time for different components (for the primary scenario). The lower chart shows how implementing the transition reduces annual carbon emissions†. The cumulative emissions over the period 2021-2038 in this scenario are 3.55 Mt of CO_2 (from a range of 3.49 to 3.87 Mt across the scenarios assessed), of which 1.77 Mt is due to grid electricity consumption‡.





* Overall total costs are discounted using standard treasury green book assumptions. Annual costs are undiscounted.

† 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.

‡ 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.

How to Interpret this Vision

This transition will involve the greatest infrastructure change across Bury and Greater Manchester for decades; key sections of this LAEP illustrate the scale of change and investment needed, based on a primary scenario. Alternative scenarios, for example, focusing on hydrogen for heat, are presented in the appendix. Given the 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 Bury'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

The majority of Bury's dwellings receive insulation retrofit in the plan: 51,000 in the primary scenario and 76,000 in the hydrogen focused alternative scenario. The greater number of retrofitted dwellings required in the hydrogen scenario is included to help meet the carbon budget. 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 Bury in a timeframe that supports the delivery of the GM carbon budget. Alternatively, over 75,000 heat pumps would need to deployed for most dwellings, except in Bury Town, where district heat supplies a large share of buildings due to the higher density of buildings. The combined cost of fabric retrofit and heating system replacement is £898m for homes, and 1.2bn for non-domestic buildings. It is recognised that 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

To reduce emissions in line with the GM carbon budget, local energy generation needs to increase significantly and be deployed rapidly, consisting predominantly of the installation of solar PV on much of the available roof space across all parts of Bury (under all scenarios considered), providing between 300 MWp and 330 MWp of installed capacity. The combined cost of rooftop PV and district heat energy centres would be £845m. Further CO_2 reduction could also be achieved by deploying ground mounted PV where land permits, to reduce the remaining 3.55Mt of CO_2, at a cost of £203m. Energy networks could expand to accommodate electrification, at a cost of £573m.

EV Infrastructure

The transition to electric vehicles (EVs), with uptake increasing from 2,000 EVs today to over 90,000 by 2038, drives a demand for EV chargers to be installed across all areas. Around 65,000* domestic chargers would be installed, along with multiple public charging stations (or hubs). Bury Town's requirements differs from the surrounding areas in having a lower portion of homes fitted with domestic EV chargers, due to patterns of vehicle ownership and off-street parking.

Consumer Uptake

By the early 2030s all new cars and vans, and all boiler replacements in dwellings and other buildings in Bury are low-carbon†. The vast majority are electrified. For example, more than 75,000 of 92,500 dwellings that will be in Bury by this time are fitted with a form of heat pump; of these, up to 16% could be ground source systems where homes have suitable characteristics. Further work is required to understand where communal ground source systems are beneficial.

By 2038, 76% of cars are electric vehicles or plug-in hybrids, requiring the provision of >65,000 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 Bury largely shift to using renewable electricity or district heat instead of fossil fuels. If hydrogen becomes available, that may be a suitable alternative for the most intensive energy users, or, where some gas usage remains, carbon capture may be required to reduce remaining emissions.

Low-carbon energy supplied to and generated in Bury

The emissions intensity of UK electricity production is expected to fall to around 35% of today's levels by 2035‡. Offshore wind forms a backbone of electricity generation nationally. Renewable electricity production in Bury increases, predominantly in the form of solar PV (220 MWp rooftop and potentially also up to 413 MWp ground mounted). There is limited opportunity for wind generation across Bury. Renewable generation (if the ground mounted PV potential is maximised) provides up to 604 GWh annually (40%), with 921 GWh (60%) of electricity supplied from the grid.

This 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 nearly 130% by 2038.

* 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.

† 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 Bury'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.

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 has a carbon budget that requires immediate action to stay within, and so HyNet may arrive too late to keep within the carbon budget. However, it may have a 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 in each area of Bury, and identify potential priority areas for using hydrogen.

Reducing demand for carbon-intensive fuels

Buildings lose less energy thanks to a series of targeted fabric retrofit programmes across Bury to improve insulation and efficiency and get ready for zero carbon heating, whilst also making a notable contribution to reducing emissions in line with the carbon budget. Over 50,000 of Bury's 94,362 dwellings are retrofitted (circa 53%), primarily with basic retrofit (measures more likely to be cost effective at the building scale through energy saving) packages. Increased fabric retrofit, to a deep specification (e.g. to include glazing and solid wall insulation) 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 nearly 12,000 homes connected to a heat network in 2038, providing a c.£100m cost saving over alternative building specific electrified systems. Bury Town sees the greatest concentration of electric heat network opportunities. Energy centres using predominantly 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.

Annual electricity demand is forecasted to increase from 693 to 1616 GWh by 2038, resulting from 357 GWh for electrified heat and 311 GWh for electric vehicle charging. This requires an increase in electricity network capacity from 400 MWp to 650 MWp, with the greatest network reinforcement requirement in the areas of Radcliffe, Tottington and Ramsbottom, though opportunities to use flexibility and storage in place of reinforcements are explored.

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.

Investment

Bury's transition requires a total energy system and building level investment of £3.5bn (excluding energy costs), This unprecedented level of investment provides a once in a lifetime opportunity for Bury. 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 Bury. How it is delivered will influence the local benefit to Bury, in addition to job creation. For example, there will be opportunities for local/community initiatives to provide 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 £9,500 for the associated measures.

An electric 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[*]. 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 Bury and GM more widely can build knowledge and evidence for policy decisions as well as industry supply chains and make meaningful progress on emissions reduction. Finally, there is a risk that the economic and social benefit may not be captured locally, therefore plans to maximise the opportunity are essential.

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

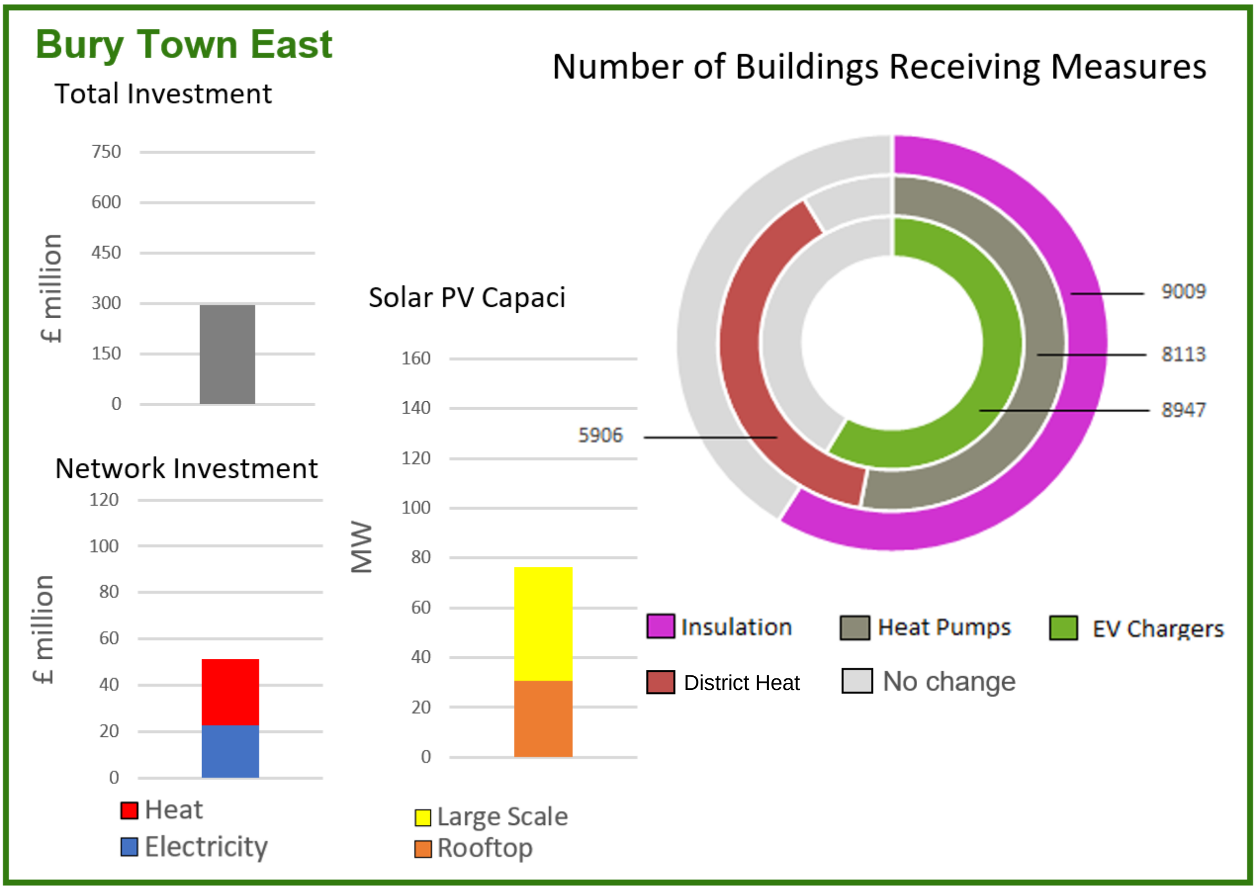
What Bury's transition to carbon neutral could look like

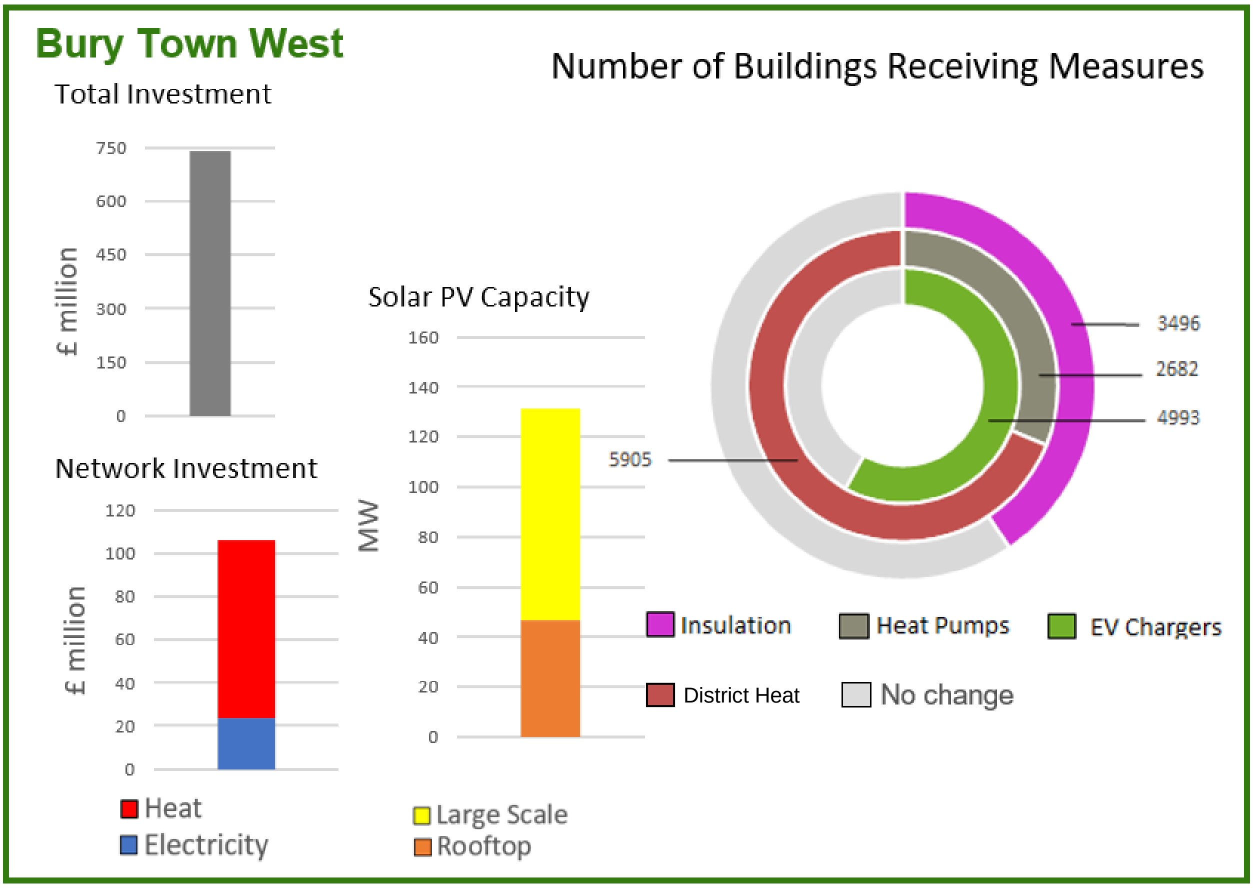
Recognising that predicting what Bury's actual transition to carbon neutral will look like is not possible; the following charts illustrate the scale of change needed to decarbonise Bury, based on the primary scenario. This is intended to illustrate to the stakeholders who will support and deliver Bury's transition, the scale of measures and investment needed by specific area/zone. This scenario to 2038 is most suitable if uncertainty remains around converting the gas grid to zero carbon hydrogen (provided at an appropriate cost) by the mid to late 2020's. 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.

The charts on the following pages illustrate total energy system investment[*], the component of investment focused on energy networks, installed solar PV capacity, and the proportion of Bury's dwellings which receive installations of insulation, heating systems and domestic EV chargers .

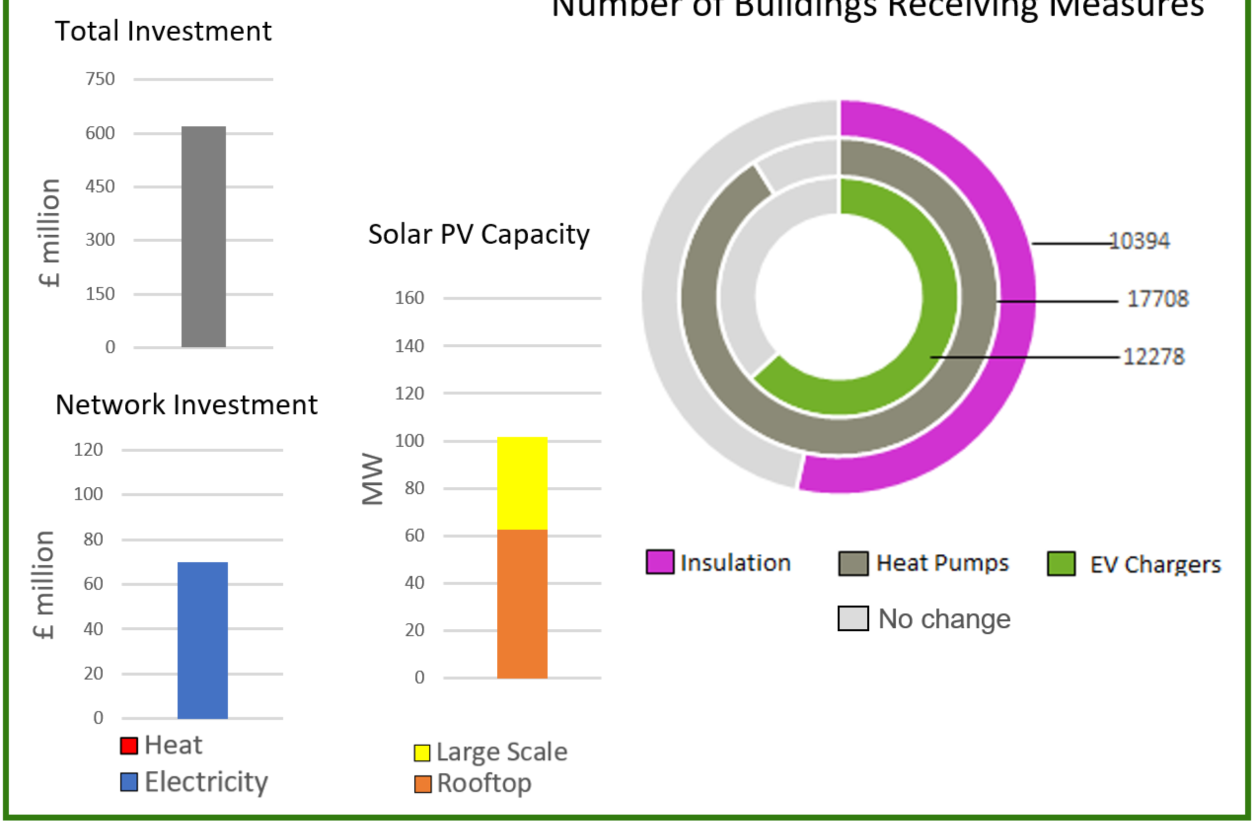
Total investment comprises roof-mounted solar PV, heating systems and insulation for both domestic and non-domestic buildings, EV chargers, energy networks and district heat energy centres. The solar PV capacity is split between roof mounted systems (which are included in the investment and CO_2 reduction figures) and ground mounted systems (which are shown as potential additional capacity and therefore would represent additional investment and CO_2 reduction beyond those shown here).

[*] This is money spent on energy system components and therefore excludes money spent on energy consumed.

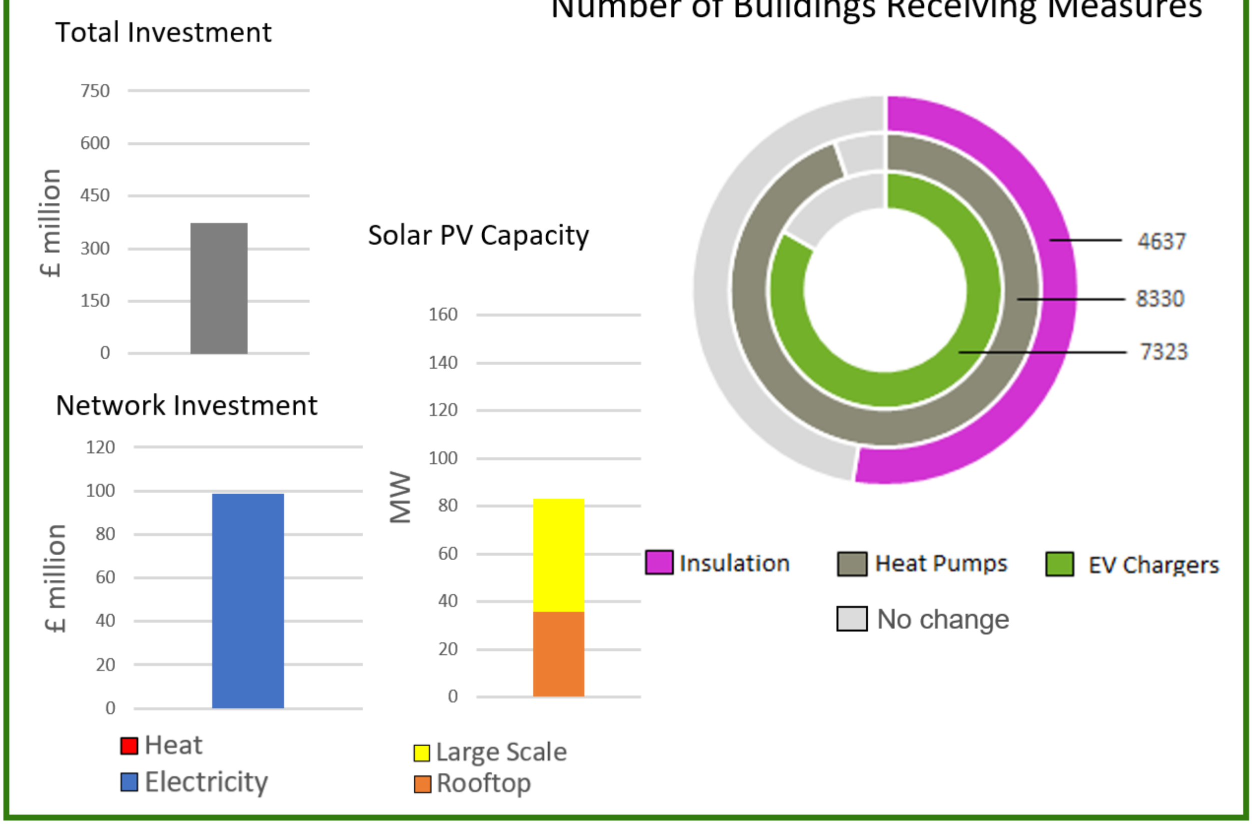

Bury Town East
Total Investment
£ million
750
600
450
300
150
0
Network Investment
120
100
80
60
40
20
0
Heat
Electricity
Solar PV Capaci
MW
160
140
120
100
80
60
40
20
0
Large Scale
Rooftop
Number of Buildings Receiving Measures
9009
8113
8947
5906
Insulation
Heat Pumps
EV Chargers
District Heat
No change


Bury Town West
Total Investment
£ million
750
600
450
300
150
0
Network Investment
120
100
80
60
40
20
0
Heat
Electricity
Solar PV Capacity
MW
160
140
120
100
80
60
40
20
0
Large Scale
Rooftop
Number of Buildings Receiving Measures
3496
2682
4993
5905
Insulation
Heat Pumps
EV Chargers
District Heat
No change

Radcliffe

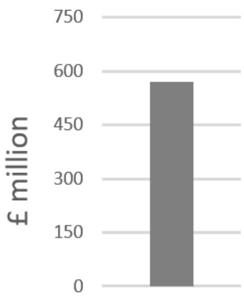


Ramsbottom

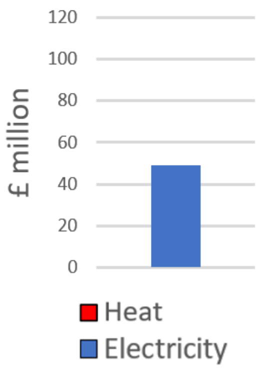


Whitefield

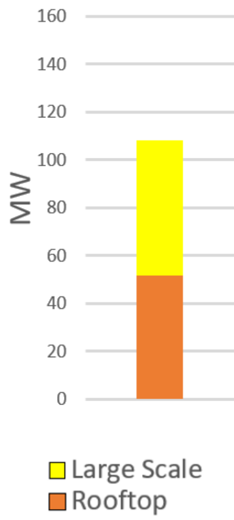
Total Investment



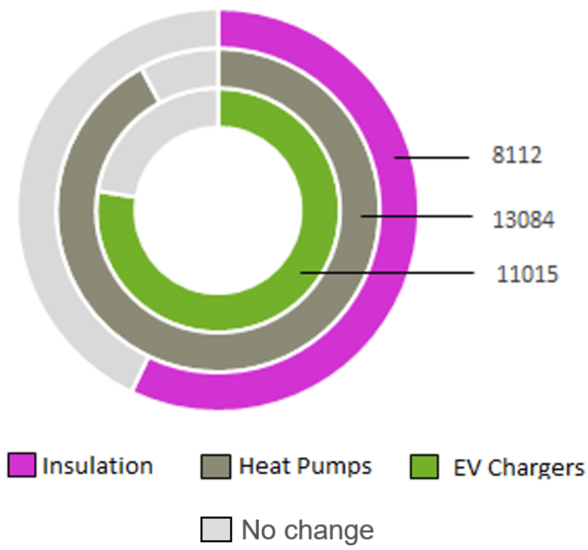
Network Investment



Solar PV Capacity

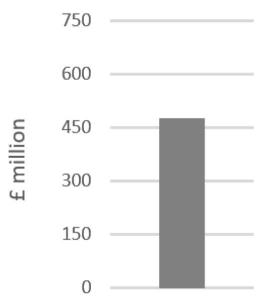


Number of Buildings Receiving Measures

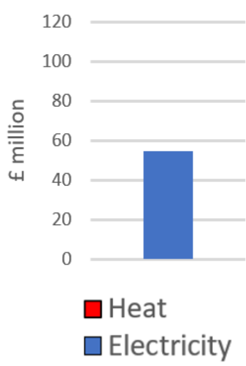


Prestwich

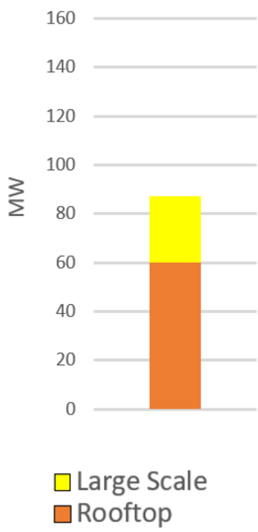
Total Investment



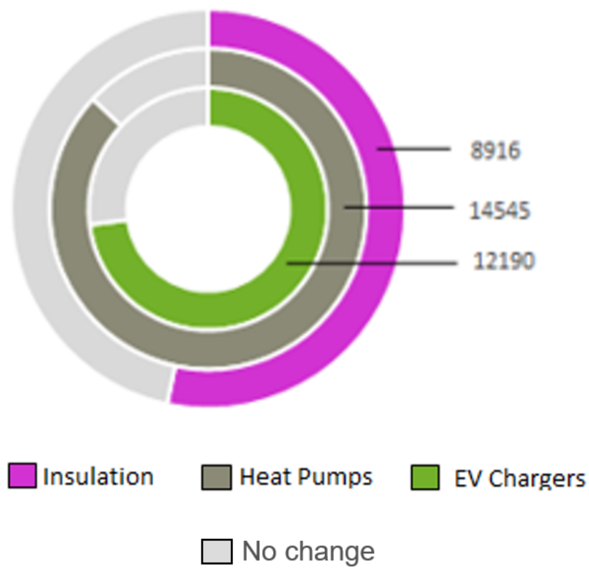
Network Investment

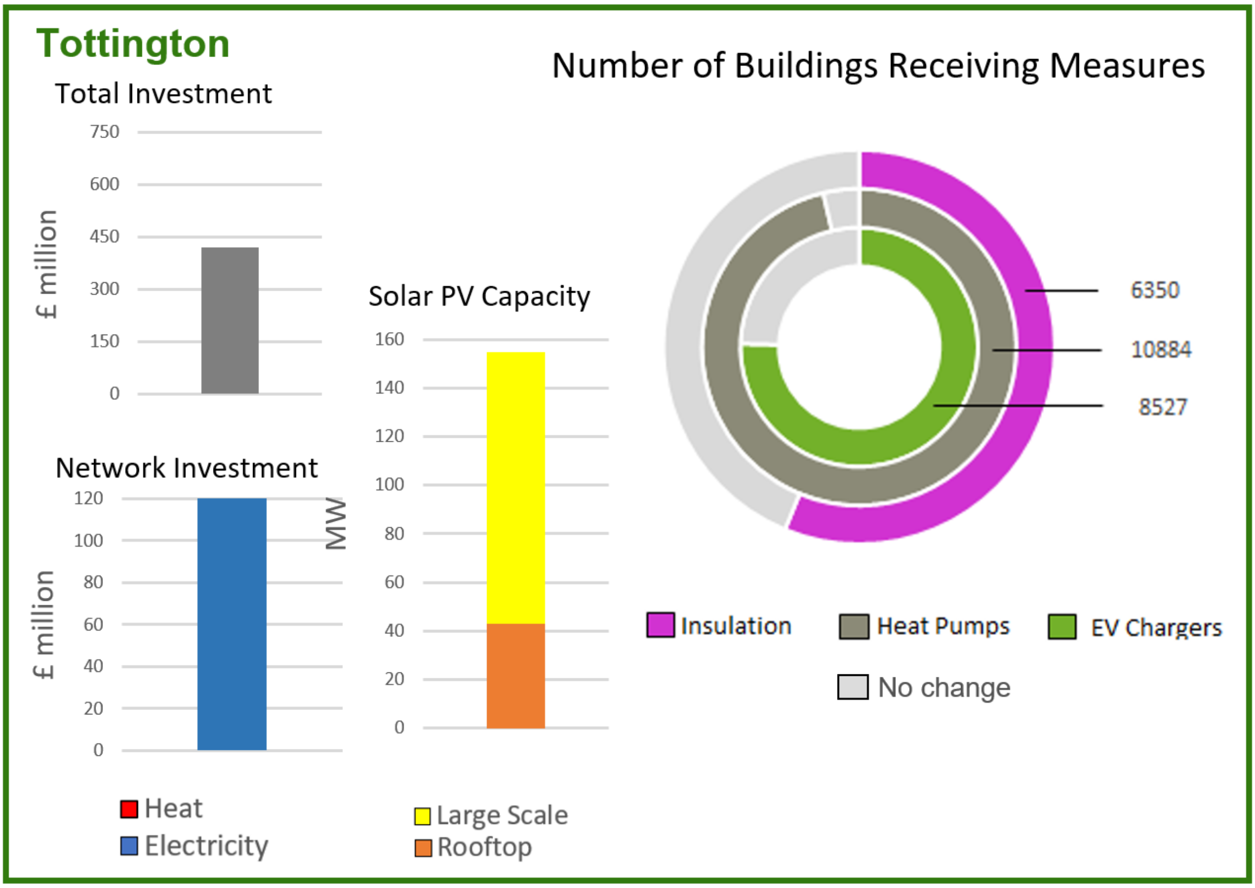


Solar PV Capacity

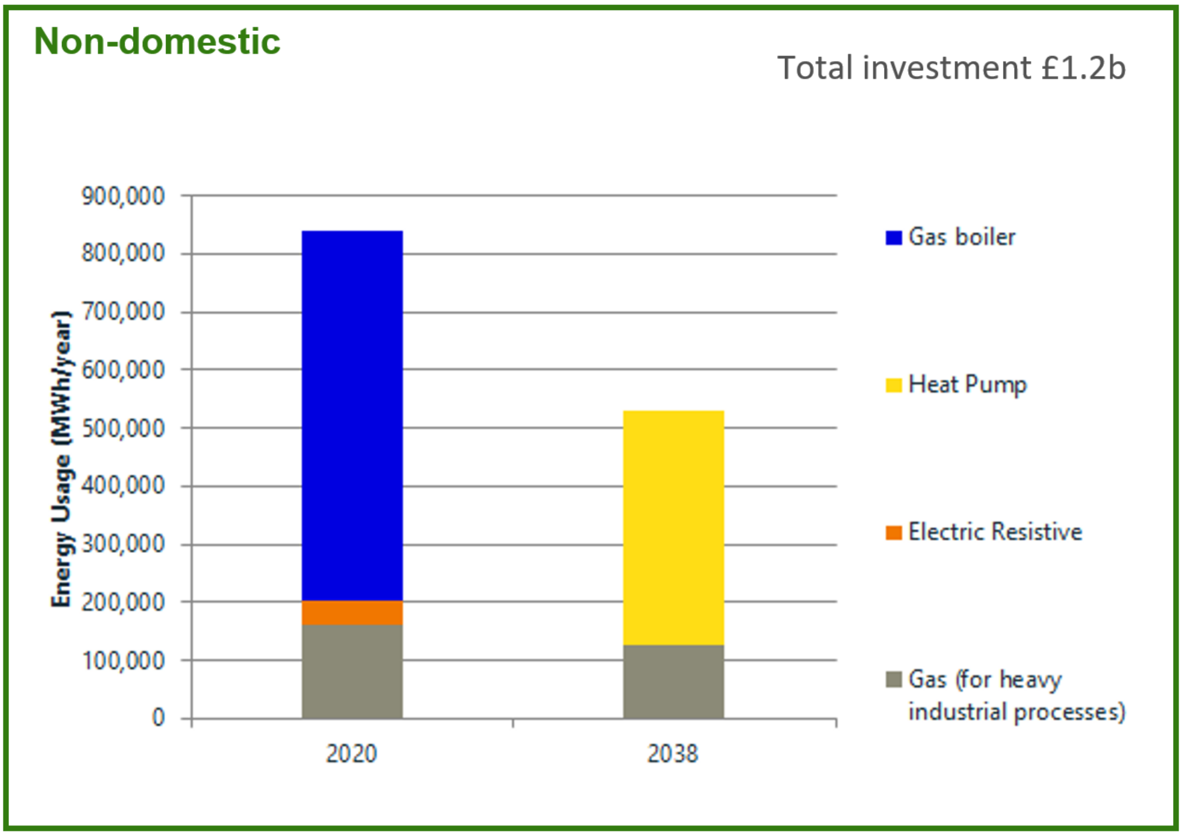


Number of Buildings Receiving Measures





The non-domestic chart below illustrates that in the region of 85% of Bury's buildings could be decarbonised for a total investment of £1.2bn. However, remaining buildings have been classified as hard to decarbonise and will need more specific and targeted assessment related to future building use and energy demands related to the building use.



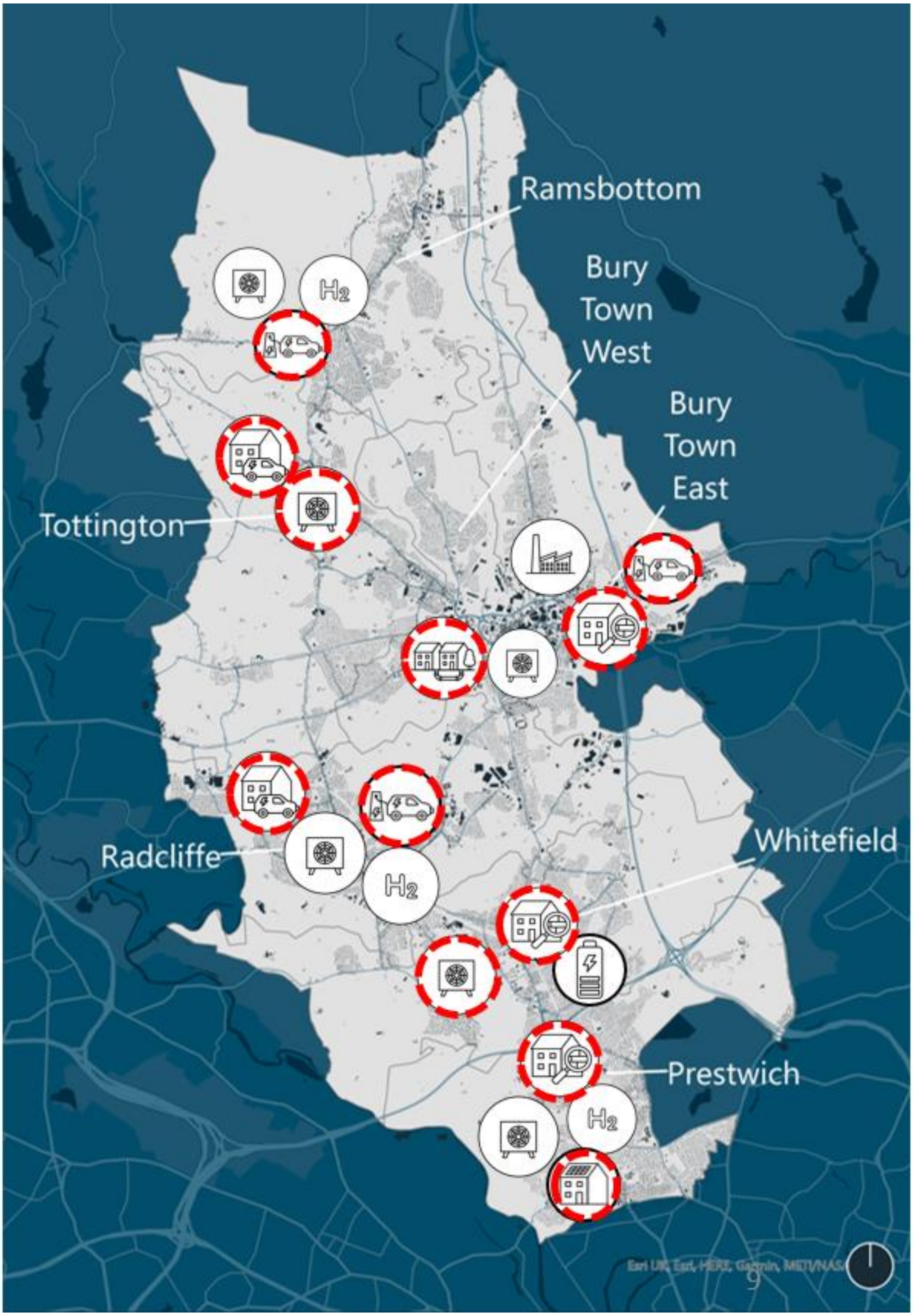
How to use this LAEP

The plan on the following page illustrates the proposed activities to progress this LAEP in the near-term, based on a demonstration and scale-up approach. This highlights a series of activities to test how to roll out Bury's transition to carbon neutral and work with Bury's citizens.

Insight from these activities are expected to be evaluated, for example through demonstrating where proposed components of the LAEP are still the cost-effective thing to do, 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 activity 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 Bury Council will work with other key stakeholders, including GMCA, Cadent, ENWL and delivery partners to develop a detailed demonstration and delivery programme.



Key

First Steps Priority Areas

- Retrofit priority area
- District heat priority area
- Home EV charging priority area
- Heat pump priority area
- Home solar PV priority area
- EV charging hub priority area

Long-term Deployment Areas

- Heat pump prevalent zone
- Hydrogen for heat opportunity area
- Non-domestic opportunity area
- District heat prevalent zone
- Flexibility & storage opportunity area

Demonstration and scale-up priority areas

The following priority/pioneer areas highlight suggested areas to test specific components of this LAEP:

- Whilst both Radcliffe and Whitefield have been identified as areas to test heat pump deployment, due to high numbers of detached and semi-detached dwellings, Whitefield has been prioritised as it has not been highlighted as a cost-effective area for hydrogen fuelled heat. Tottington is also prioritised due to abundant spare capacity for electrical demand.
- Prestwich, Whitefield and Bury Town East are prioritised for fabric retrofit deployment, predominantly due to high proportions of inter-war dwellings (1914 to 1944) that would benefit from thermal improvement
- Prestwich can explore the potential role for widescale solar PV deployment to alleviate network constraints and establish local energy markets

Long-term Deployment

- Ramsbottom, Radcliffe and Prestwich are potential hydrogen for heat opportunity areas.
- Flexibility and storage (combined with other components including heat pumps, solar PV and EV charge points) can be tested in Whitefield, including a focus on evaluating if alternative approaches to electricity network reinforcement provide benefit
- Bury Town East and West are highlighted for the demonstration of solutions for Bury's non-domestic buildings

The following sections of this LAEP set out the rationale for selecting these priority and pioneer areas. It is recognised that consultation with key stakeholders and consideration of combining components, e.g. to provide a whole house retrofit approach, may result in the need to reconsider some aspects.

To summarise, aspects of this LAEP present a Vision (from many possible options), rather than a design, of how Bury could move towards carbon neutrality by 2038. This is not meant to provide a forecast or recommendation on what Bury's actual decarbonisation will be, where it is accepted that an entirely different future will evolve.

The following themes set out both how 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 activity, as plans to take forward this LAEP are developed. It is expected that insights from the demonstration activity and considerations of these themes will influence Bury'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 year on year 15% 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 these alternatives may provide 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. This aspect is one of the main influences for the heat electrification based Vision. The proposed timing of HyNet, and a hydrogen dominated heat transition does not provide sufficient emissions reduction until post 2030 which is not compliant with the GM carbon budget (as illustrated in the hydrogen emissions chart in the Technical Annex). However, before making any widescale and significant commitment to one option or technology over another, evaluation of multiple factors will be needed.

Evaluation

As well as taking account of any lessons learnt from demonstration activity, further evaluation of other aspects will be needed, so that trade-offs between different options and their impacts on consumers, considering associated risks and benefits, are taken into account before moving from demonstration to large scale implementation.

Evaluation of multiple factors will be needed including:

- Investing in local generation to provide early emissions reductions is dependent on the ability to deploy significant volume quickly, ahead of electricity grid decarbonisation
- The timing of HyNet compared to the rate of electricity grid decarbonisation
- The practicality and cost of installing measures in dwellings and non-domestic buildings
- The disruption associated with options – both within homes and at community level (e.g. traffic disruption from street works)
- The ability to scale-up and install options rapidly aligned to the carbon budget
- 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

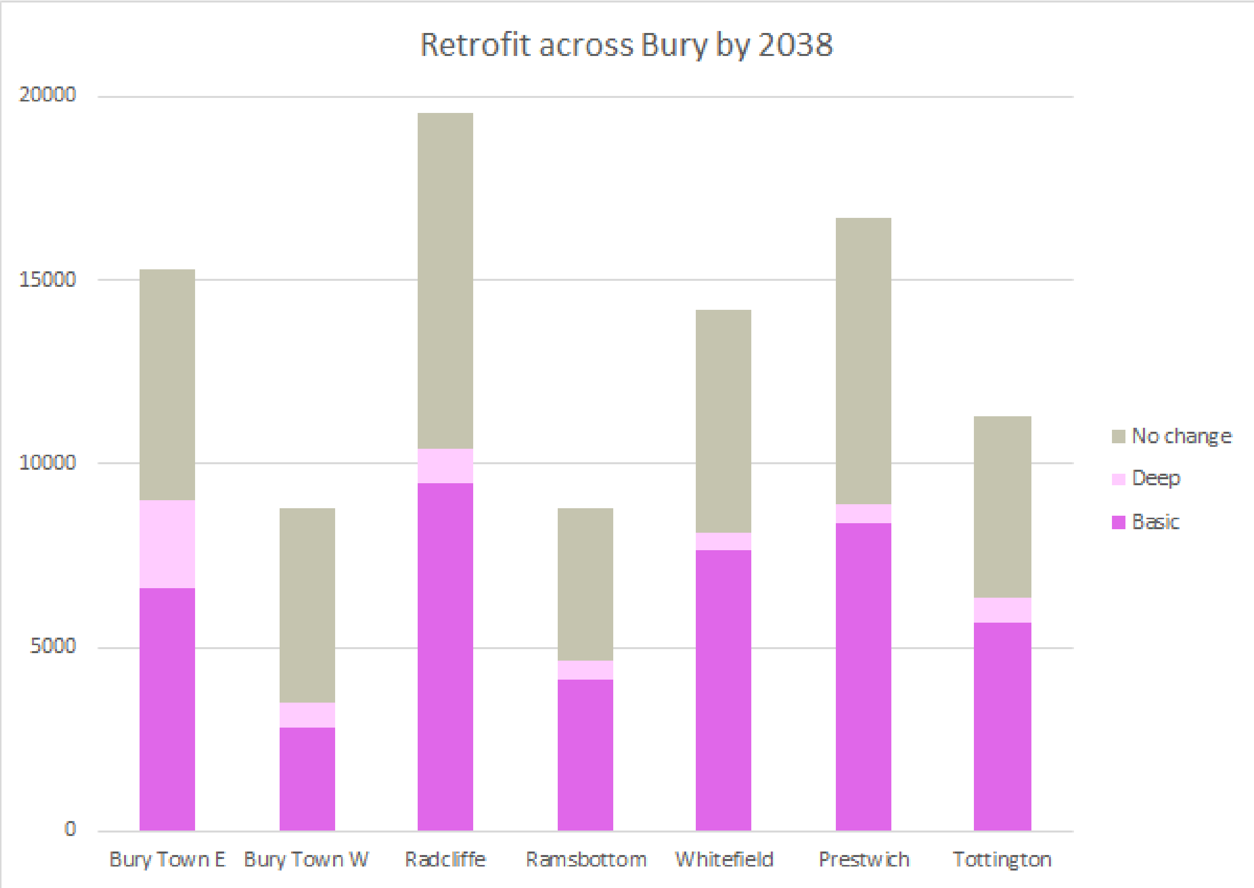
Further consultation will be needed with key stakeholders, including GMCA, Cadent, ENWL and delivery partners to consider the aspects discussed when developing demonstration and scale-up activity.

In addition, consultation with Bury's citizens is essential to help understand attitudes towards Bury's carbon neutrality transition; whilst also forming part of the evaluation process. This will help Bury 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:

- Begin to communicate Bury's proposals to achieve carbon neutrality
- Understand what people want and what options they are supportive of
- Help to identify areas to focus demonstration and then wider roll-out activity
- Help to provide confidence to organisations that will be involved in the delivery of Bury's transition that there is a demand for solutions, products and services

Vision to 2038



A high level of fabric retrofit will be needed across existing homes and buildings in Bury, carrying out insulation of **54% of dwellings** (around 51,000 by 2038). This is true even in areas where there is less certainty on the choice of future low carbon heating systems. Early focus and investment in fabric retrofit would be a low regret step in these areas. 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 deployment" option on page 31.

The dwellings that are most consistently identified as needing fabric retrofit to support decarbonisation are inter-war (1914-44) houses. **Over 70% of these properties will need fabric retrofit across all parts of Bury** (in all scenarios).

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.

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.

Hard-to-treat pre-1914 houses can often be more cost-effectively decarbonised* through heating system change without extensive fabric retrofit. This could include use of high temperature or hybrid heat pumps or, where appropriate, connection to district heating. Again, more detailed consideration will be needed when considering implementation as other factors may influence actual requirements. For example, additional investment could be targeted at dwellings most in need of support in managing energy usage costs.

First Steps – Priority Areas

Whilst large numbers of dwellings will need to be retrofitted, to improve energy efficiency, across all areas of Bury, a number of potential fabric retrofit zones have been identified. These have been selected as high levels of energy efficiency improvements are very likely to be needed.

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)†.

These have been defined as 3 priority retrofit zones for Bury:

RETROFIT ZONE 1 – BURY TOWN EAST

RETROFIT ZONE 2 – PRESTWICH

RETROFIT ZONE 3 – WHITEFIELD

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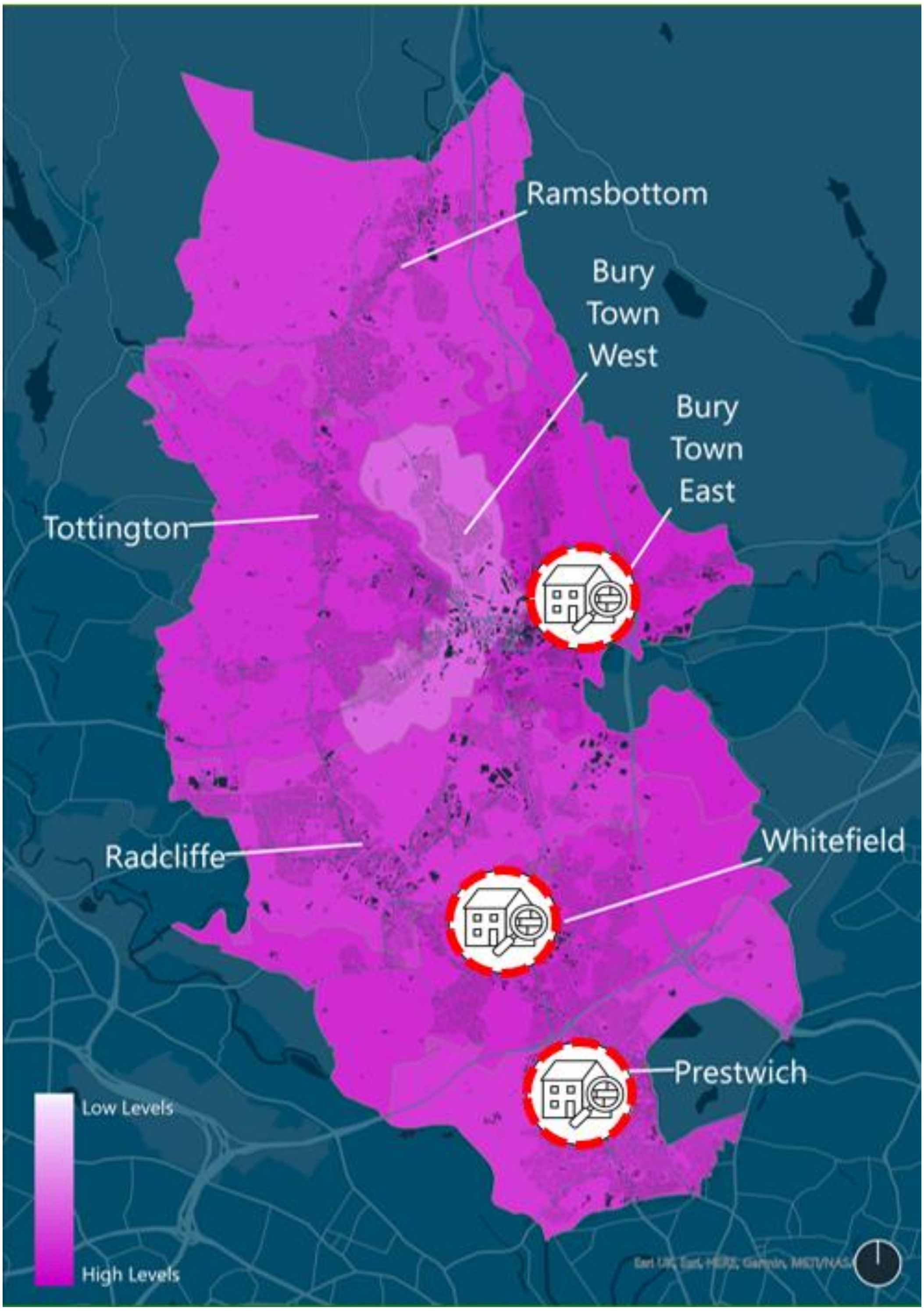
* From a whole life cycle and total whole energy system cost perspective. i.e. it is cheaper overall to provide zero carbon heat than it is to both provide zero carbon heat and install more extensive fabric retrofit measures. This perspective has been taken on the basis that there will be finite resource available to decarbonise Bury.

† 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 Bury. 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

Fabric Retrofit Zones in Bury by 2038

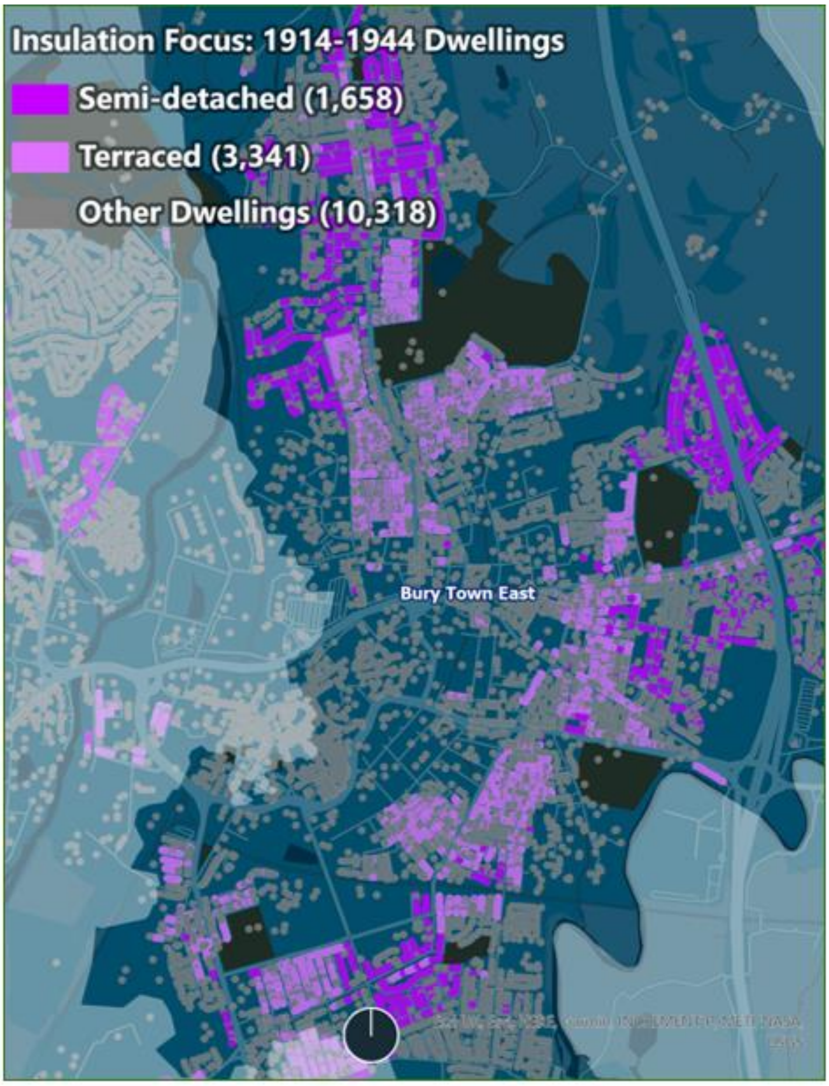


Conversely, Bury Town West is less likely to be an immediate focus for retrofit, as it has the lowest overall levels of required retrofit, driven by a high proportion (over 40%) of properties that are new builds and/or flats. However, retrofit levels are still needed among older houses, being on a par with other areas of Bury, where nearly 60% of dwellings were built before insulation was installed.

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 e.g. heating system change.

RETROFIT ZONE 1 – Bury Town East: highest proportion of terraced and semi-detached inter-war houses in Bury (around a third, c. 4000 houses); these are a focus for retrofit measures.

Current Fabric Retrofit Zone Opportunity in Bury Town East



Retrofit Zone 2 – Prestwich: 6000 inter-war houses will need retrofit (even if non-heat pump solutions (e.g. hydrogen) become available).

Current Fabric Retrofit Zone Opportunity in Prestwich

Retrofit Zone 3 – Whitefield: 3000 inter-war houses will need retrofit (even if non-heat pump solutions (e.g. hydrogen) become available).

Current Fabric Retrofit Zone Opportunity in Whitefield

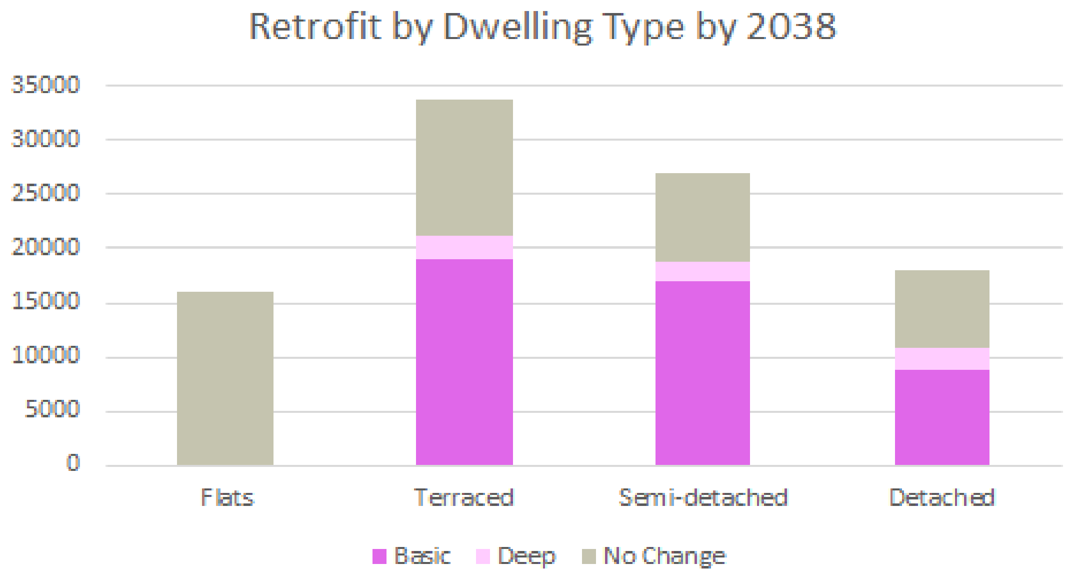
Fabric Retrofit Approach

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.

The retrofit zones identified on the previous pages are designed to allow the coordinated targeting of interventions across Bury in such a way that supports and aligns with Bury'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 Bury expected to need retrofit measures by dwelling type is shown below. This represents around half of the domestic building stock in Bury of approximately 94,362 dwellings in 2038.

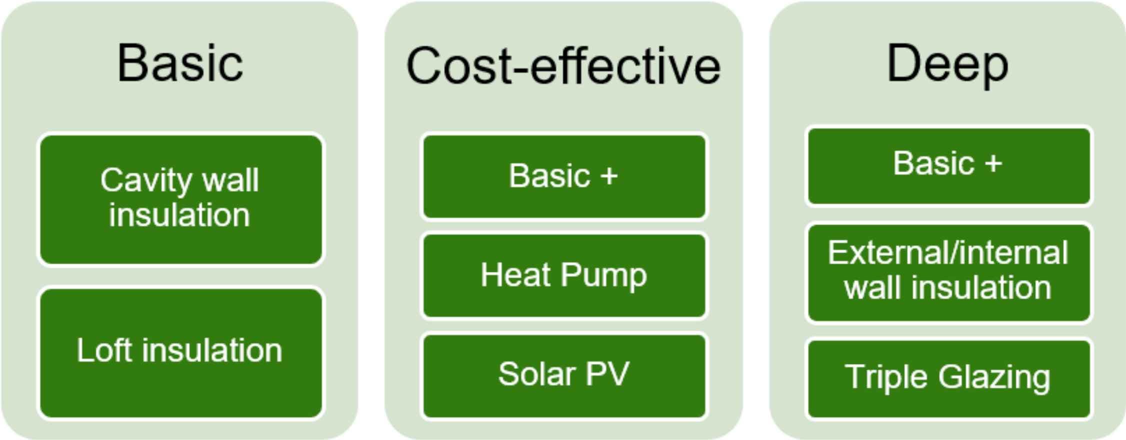


Cost-Effective Deployment

The proposed approach centres on ensuring basic fabric retrofit measures are implemented in the vast majority of suitable homes in Bury, which is found to be the most cost-effective approach for the whole system. The deployment of more advanced measures is much more limited due to the additional cost and disruption to install. However, deployment of measures should not be considered in isolation: integration with other components (such as heating system changes and PV installation) 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

* 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

activity to take forward this LAEP. The range of different potential packages is illustrated in the diagram below*.



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 Bury.

In a hydrogen scenario, the number of dwellings expected to need retrofit would be even greater than in an electrified scenario. This is due to the timing of the introduction of hydrogen and a greater heat saving being required earlier to stay within carbon budgets.

Deeper Retrofit

The approach described is based on finding the most cost-effective route for decarbonising Bury 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 expected, with the potential to bring a number of benefits:

- 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 Bury more quickly. This would give greater headroom in the carbon budget, especially if carried out early in the plan, to wait for more certainty on important options such as that related to the future of the gas grid.

* 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.

A more ambitious approach could see around 20,000 more homes receiving retrofit measures, and almost all retrofit including deeper measures. However, carrying out basic measures in earlier years would not preclude deeper measures being installed in homes in later years, and so basic measures are considered low regret across all scenarios and heating system selections.

Supporting Low Carbon Heat

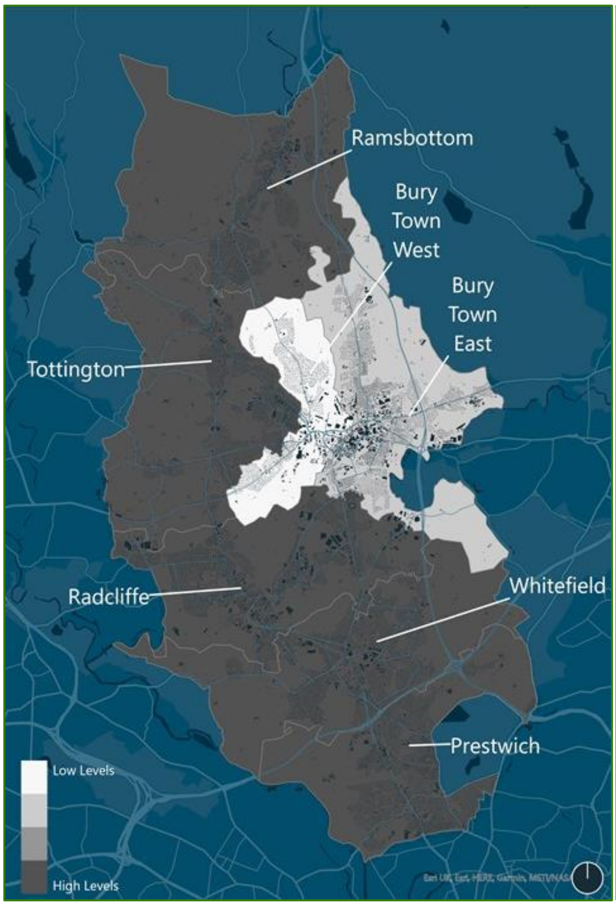
The improvement of building insulation supports the roll out of low carbon heat in several ways. By reducing the heat demand, less powerful heating systems can be installed, reducing capital costs. The reduced demand for heat will also compensate for a shift to a more expensive energy source (gas to electricity). Finally, 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 radiator 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.

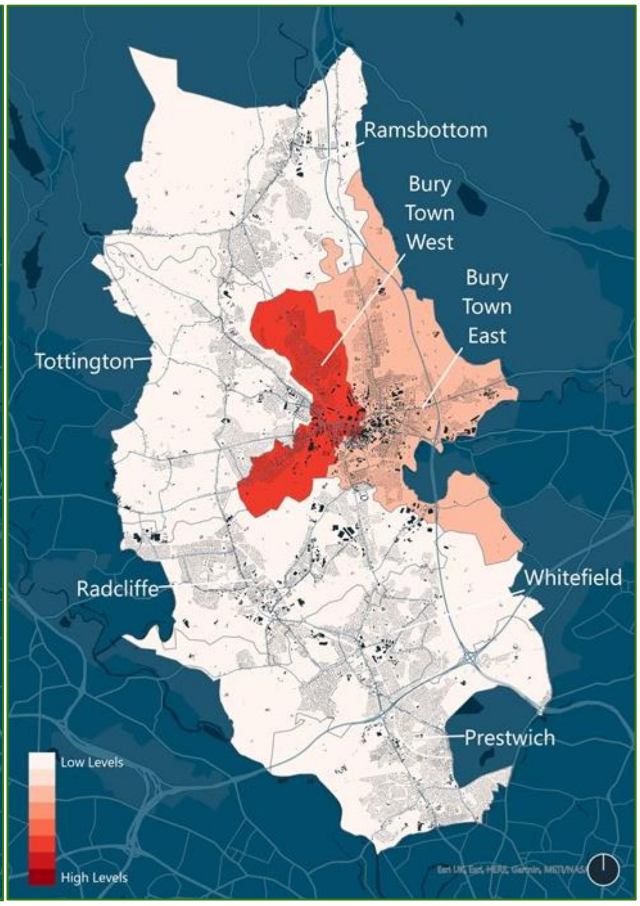
4. HEATING SYSTEM ZONES

Vision to 2038

Electric Heating Zones by 2038



District Heating Zones by 2038



Building characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Bury. The decarbonisation of heat is primarily achieved through installation of electric heat pumps in existing and new homes (under the primary scenario), comprising more than 75,000 domestic heat pump installations. These are the predominant heating system in Ramsbottom, Tottington, Whitefield, Radcliffe and Prestwich, although other electric systems are also present in less significant numbers.

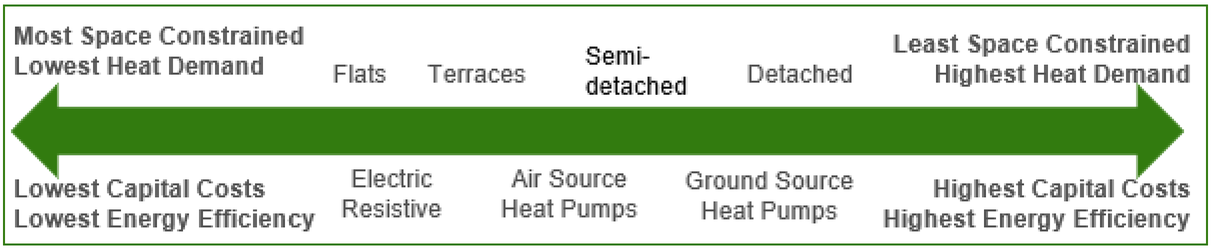
A significant proportion of dwellings (11,811) were found to cost effectively transition to a district heating system, with this being the dominant heating system in Bury Town West, and with 40% of dwellings served by district heating in Bury Town East.

Given the uncertainty surrounding hydrogen, least-regret effort in the near term is focussed on fabric 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

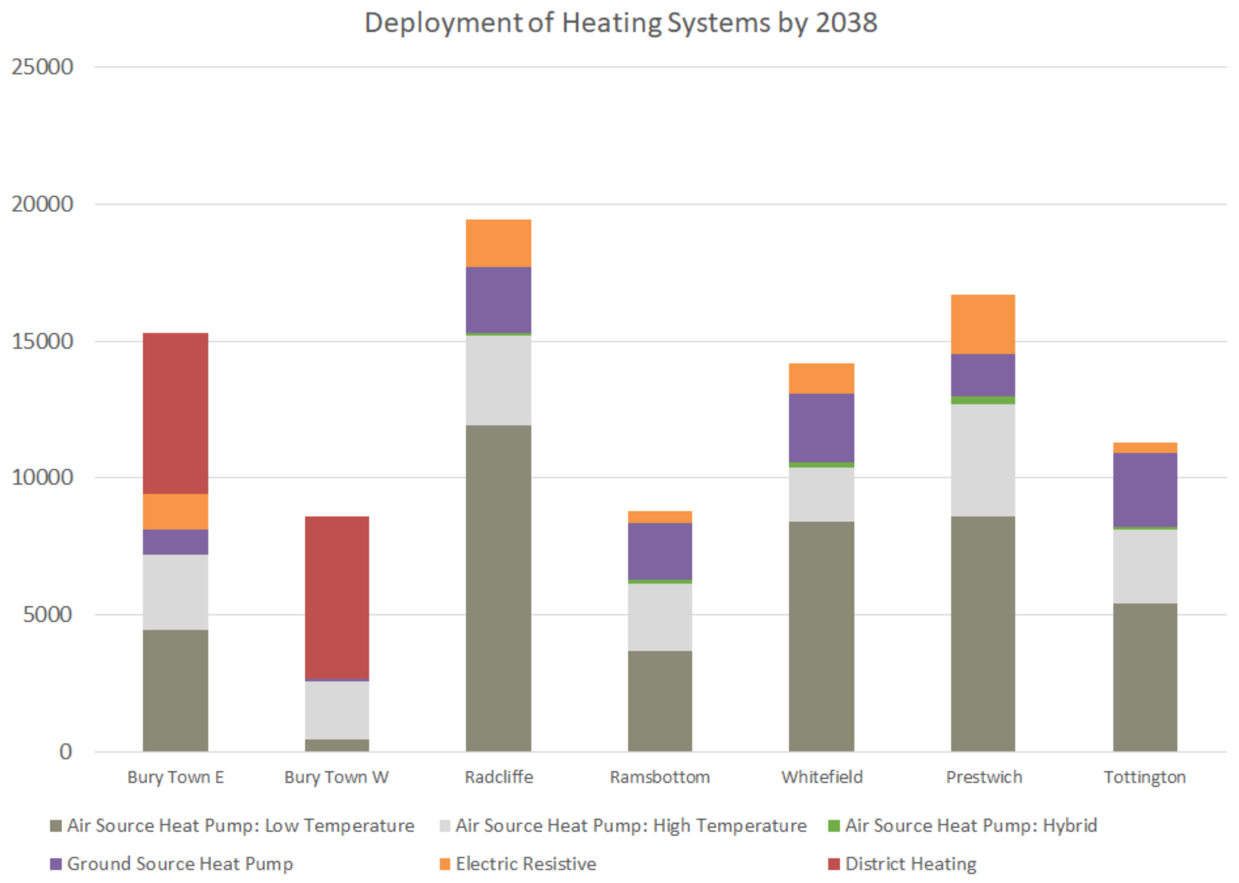
Standalone electric heating systems are selected for buildings as shown in the diagram below, while district heating is chosen in dense urban areas.



Air source heat pumps are the most widely suited technology, though a small proportion of buildings 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 can justify the higher upfront cost with greater savings in running costs. These properties would also be suitable for air source if preferred. 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 site an 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.

Heat pumps perform best in homes with good levels of insulation; so, building fabric retrofit should be considered alongside heat pump installations. This would minimise disruption to dwelling occupants and potentially reduce overall cost due to a reduced heat demand and therefore capacity of required heat pumps and reduced need to increase radiator sizing.


Deployment of Heating Systems by 2038
25000
20000
15000
10000
5000
0
Bury Town E
Bury Town W
Radcliffe
Ramsbottom
Whitefield
Prestwich
Tottington
Air Source Heat Pump: Low Temperature
Air Source Heat Pump: High Temperature
Air Source Heat Pump: Hybrid
Ground Source Heat Pump
Electric Resistive
District Heating

First Steps: Priority Areas

Certain geographic zones within Bury have been highlighted as having a large number of buildings well-suited to a particular heating technology, independent of scenarios. Early progress can be made in deploying systems in these zones, with low risk of regret even before the UK's heat strategy becomes more certain. Prioritising these zones for early deployment as existing heating systems approach end-of-life (while avoiding the distress replacement of a failed system, which can constrain options) can help establish supply chains, delivery approach and capacity. This strikes a balance between flexibility and early progress, leaving the plan open to developments around the future of the gas network, conversion to hydrogen and UK heat strategy, ahead of a mass programme of transition in places where the best option is less clear.

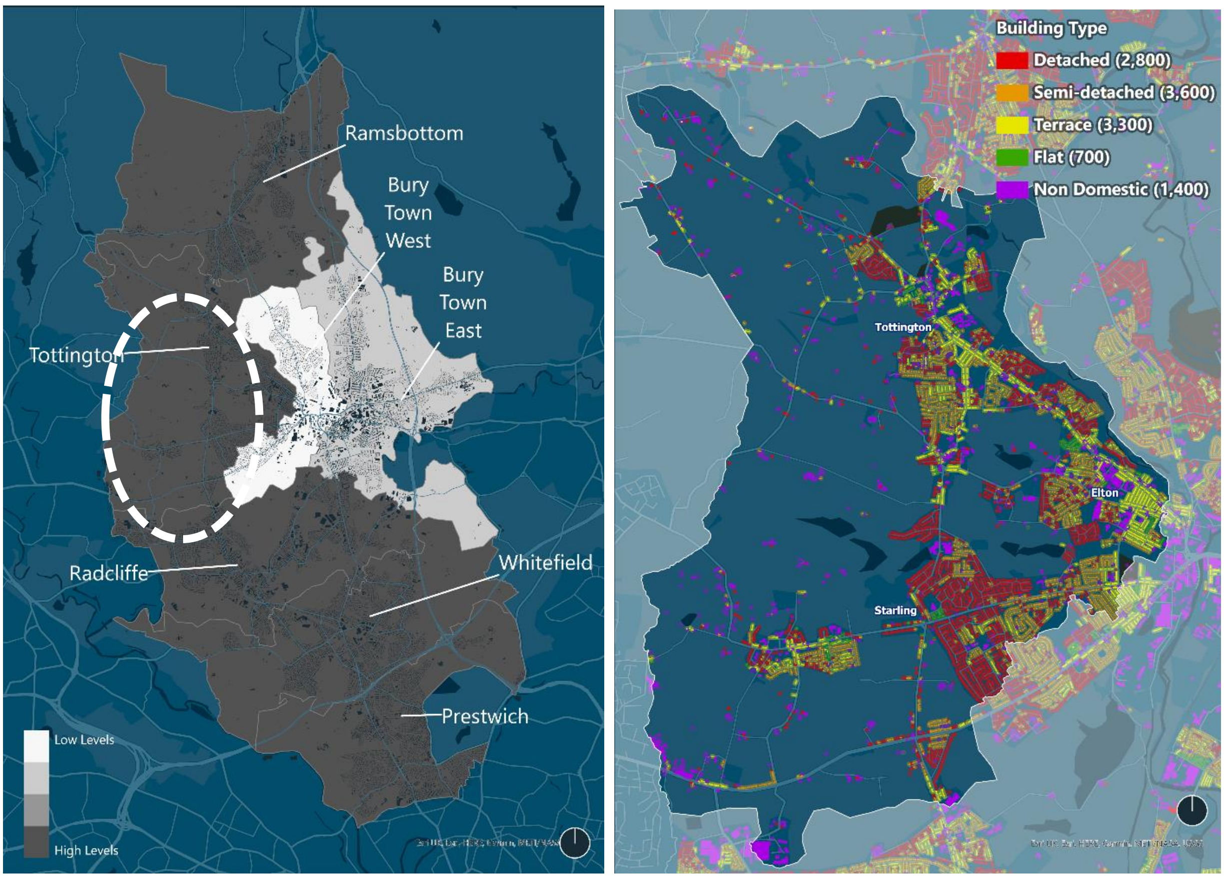
The maps below and on the following pages illustrate suggested priority areas for demonstration and scale-up activity. Consideration will be needed to develop a programme of works that aligns with other interventions to maximise delivery efficiency and minimise disruption to residents.

Heat Pumps

Heating Zone 1 – Tottington

The wide variety of dwelling types within Tottington means individual electric heating systems are a commonly chosen approach, with a small number of these being hybrids or resistive. Detached dwellings use a mixture of air-source heat pumps and ground source where permitted, while semi-detached and terraces use air source.

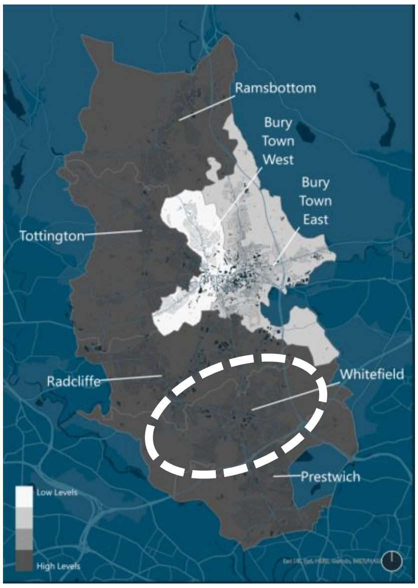
Current Heat Pump Opportunity in Tottington

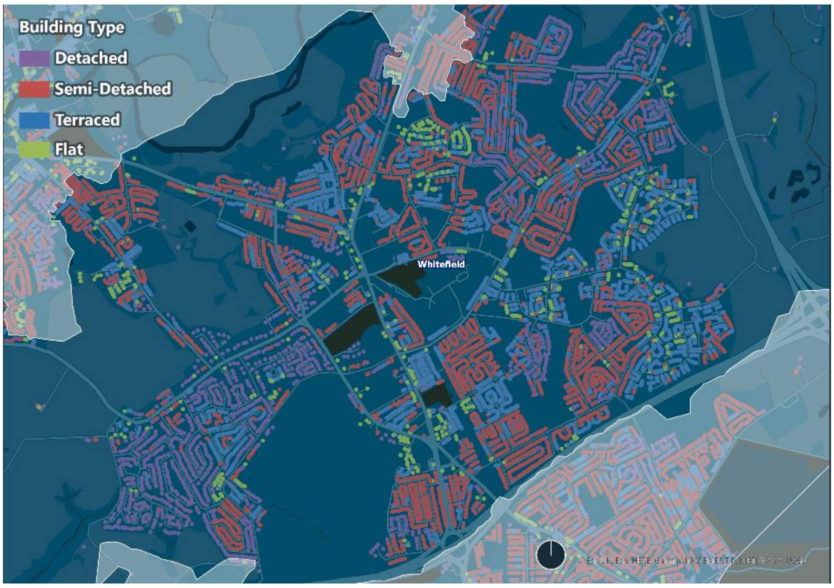


Heating Zone 2 – Whitefield

Similar to Tottington, the wide variety of housing stock means Whitefield is suited to individual electric solutions. Again, high concentrations of detached dwellings use a combination of air-source heat pumps and ground source where permitted, while semi-detached and terraces use air source.

Current Heat Pump Opportunity in Whitefield





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 where it is either too expensive or impractical (e.g. due to space limitations) to make suitable for heat pumps.

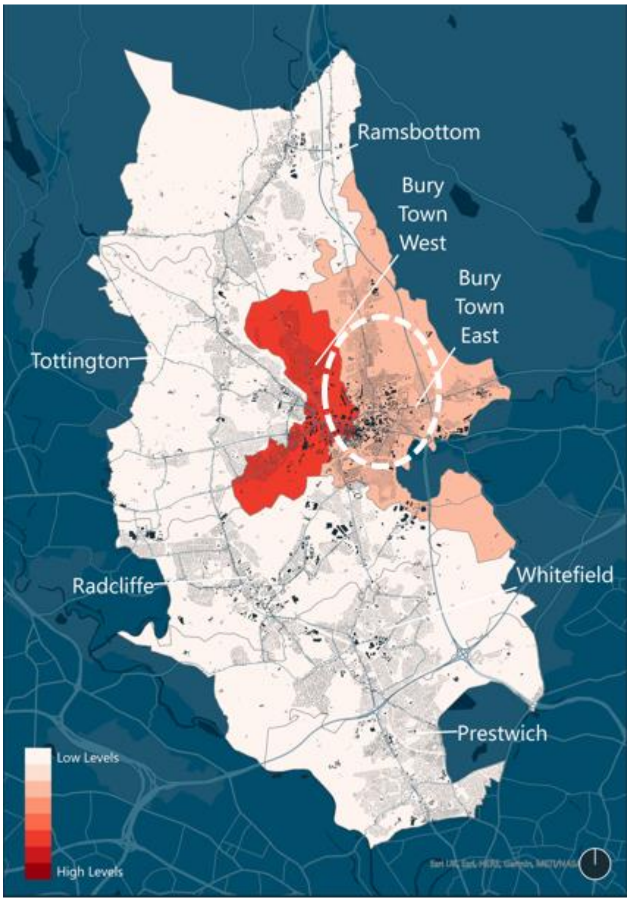
Heat networks can have the advantage of causing less disruption in dwellings during installation compared to some other options, though there are wider considerations such as disruption to roads during pipe laying, and space restrictions in city centres.

Two zones of lowest regret for district heating have been identified for Bury, both within the area of Bury Town itself*.

Heating Zone 3 – Bury Town East

The high concentrations of tightly packed pre-1945 terraced dwellings provide a good opportunity for heat networks, avoiding noise and planning constraints of heat pumps and additional electricity network reinforcement. These dwellings, along with nearby flats, provide an ideal opportunity for the rollout of a scheme. With 600 – 700 flats also due to be built in this area between now and 2038, early development of the heat network would maximise the number of new flats which can benefit from this network.

Current District Heat Opportunity in Bury Town East



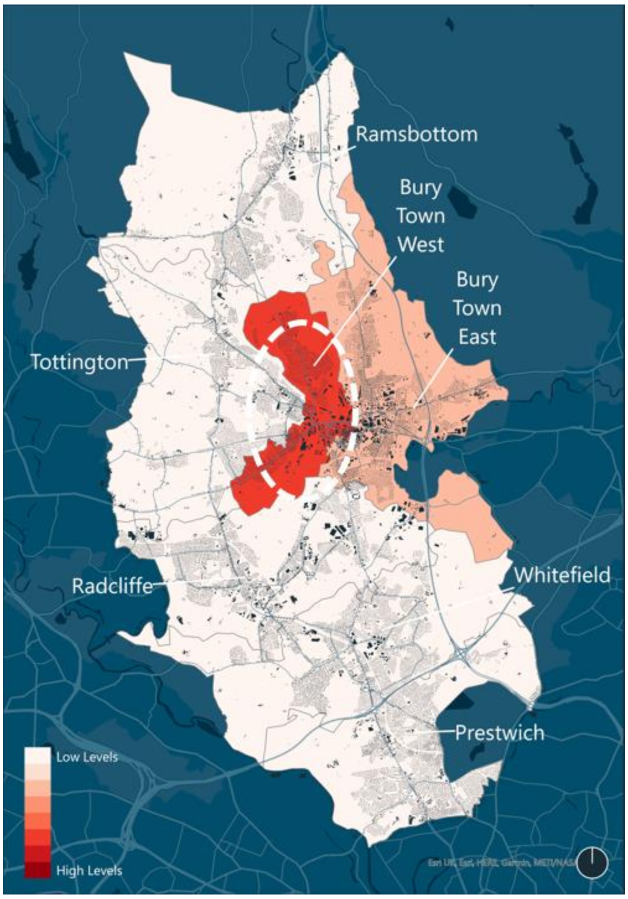
* These 'low regret' areas highlight where it has been identified that district heating could provide the most cost-effective dwelling heat decarbonisation system. They should be regarded as initial opportunity areas for further consideration, where more detailed feasibility assessment would be required, as would be the case with any heat decarbonisation option

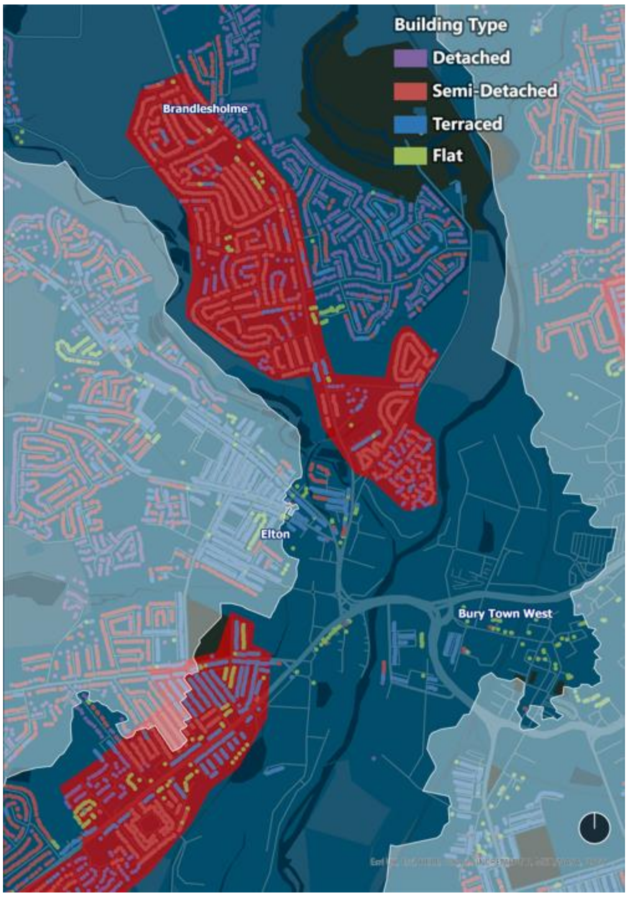
Heating Zone 4 – Bury Town West

This zone consists of a more varied dwelling stock than Bury Town East, but it has the same benefit of laying the groundwork for future dwellings: all 400 – 500 new flats planned in this zone could be connected to the scheme.

The town centre zones identified here are also likely to be located close to buildings that could provide useful heat baseload for heat networks. Many public buildings in this category are already due to be converted to other low carbon solutions through projects such as the Public Sector Decarbonisation Scheme, but consideration should be given in future as to whether suitable buildings that have not yet been decarbonised could support the roll out of district heating in the zones identified here.

Current District Heat Opportunity in Bury Town West





Hydrogen for Heating

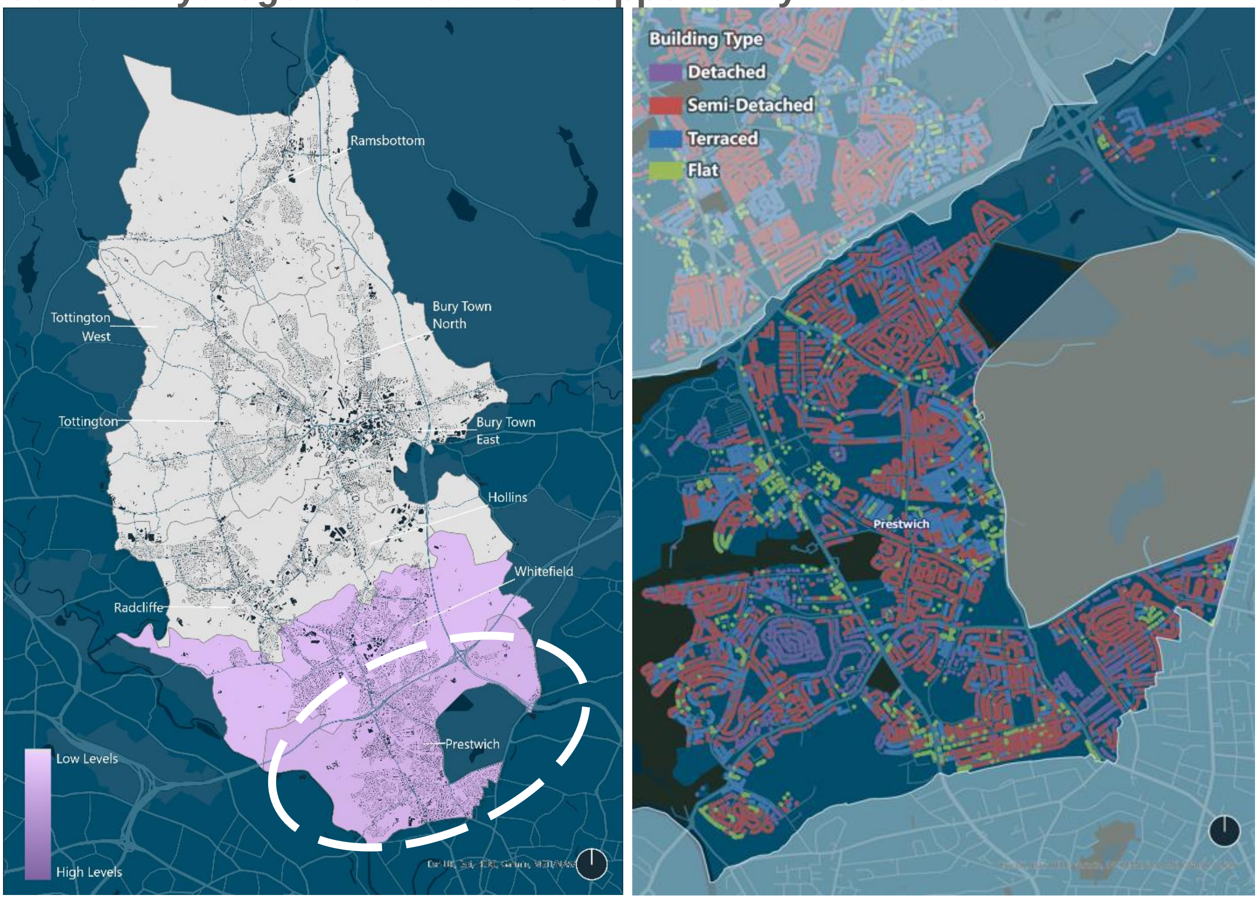
The representation of hydrogen in the analysis for this plan has been aligned with the proposals for HyNet in the North West of England, and the associated opportunities for the GMCA area.

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 Bury. The secondary scenario includes the possibility of HyNet phase 3, where low carbon hydrogen becomes available for the 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 the hydrogen to the users. Under this scenario it is seen as cost effective to provide hydrogen to domestic and non-domestic buildings in some areas of Bury, although as a whole the area is still heat pump dominated.

A further scenario was studied where hydrogen was tested as the only low carbon option. As low carbon hydrogen is unlikely to be available at scale until the 2030s; in this scenario the overall carbon emissions to 2038 were notably higher, with less opportunity for Bury to cut emissions soon and meet the carbon budget. 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.

Current Hydrogen for Heat Zone Opportunity in Prestwich



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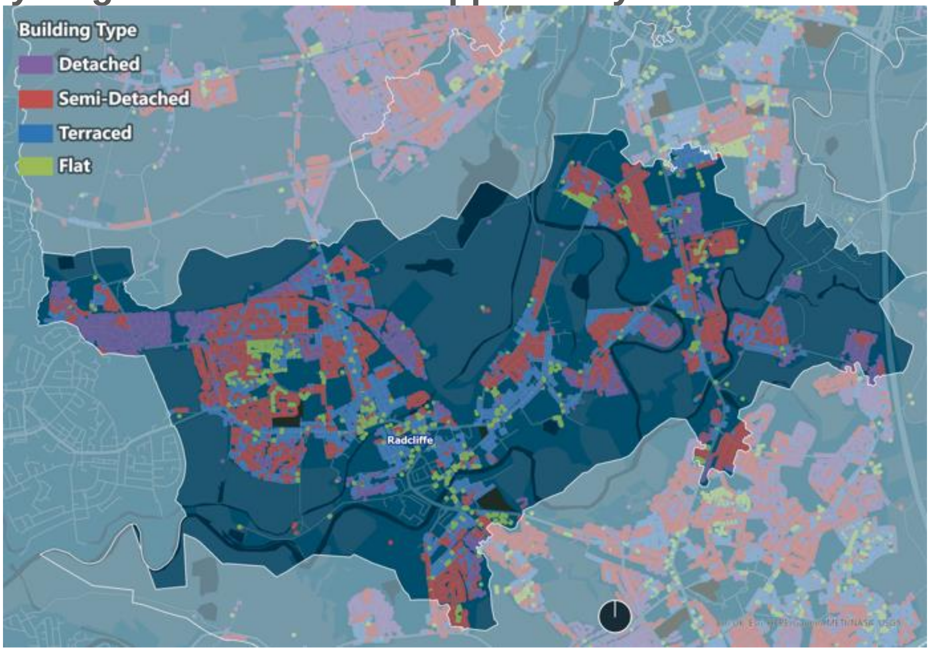
Heating Zone 6 – Radcliffe

The hydrogen network is extended to Radcliffe to serve more industry and a further 6690 homes, 35% of those in the area. Again, electric heat serves the majority in the HyNet scenario, and almost all dwellings in the primary scenario.

Heating Zone 7 – Extension

The hydrogen network is extended to serve further homes in Prestwich and Radcliffe, as well as reaching 4100 homes and some industry in the Ramsbottom area.

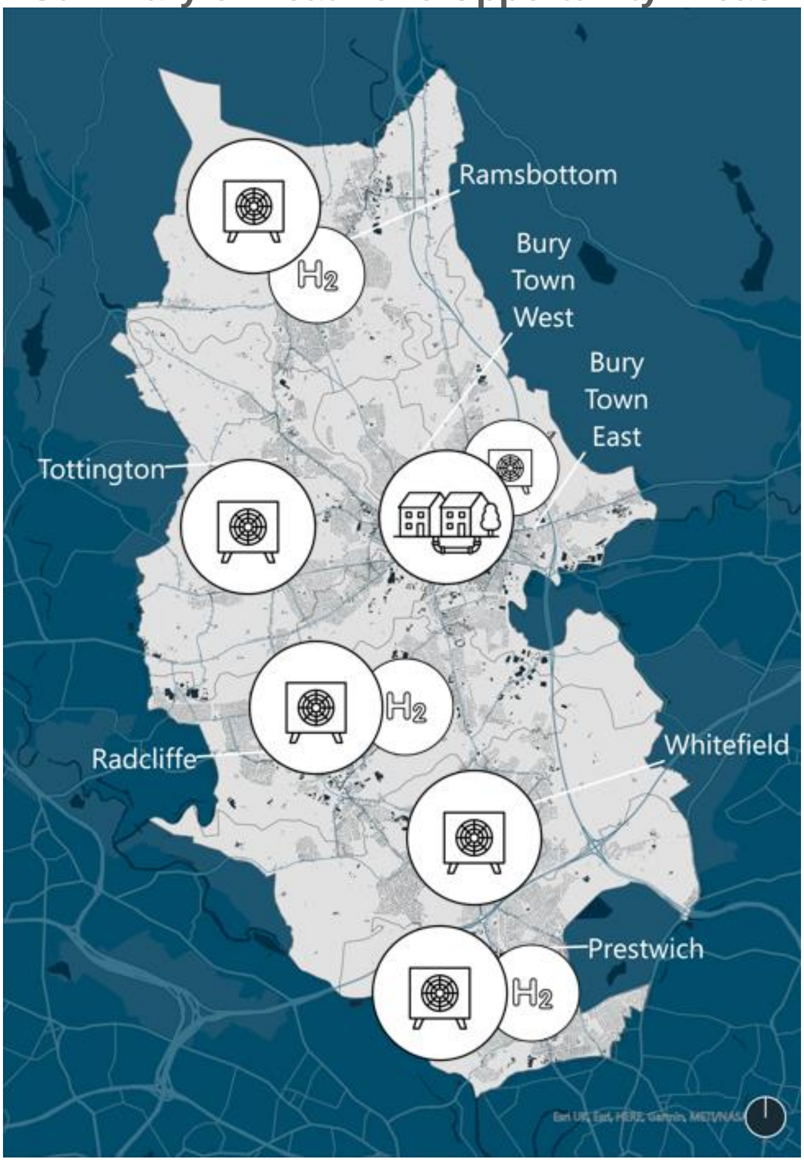
Current Hydrogen for Heat Zone Opportunity – Radcliffe & Extension



Heating System Zones - Summary

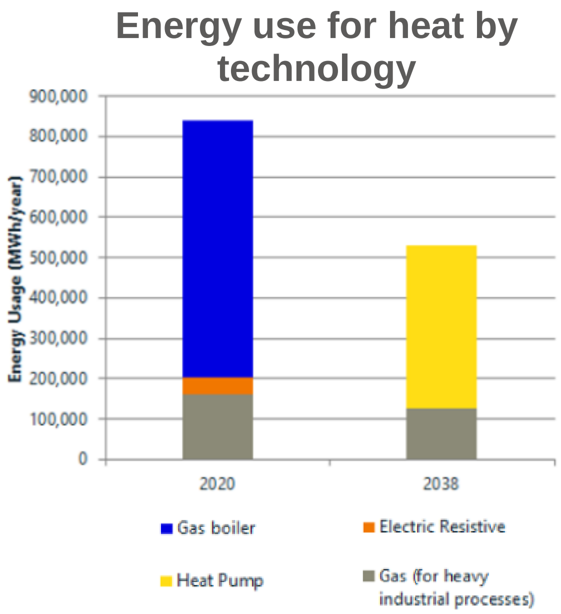
Zone	Electric Heat	District Heat	Hydrogen for Heat
	Coverage of buildings		
Ramsbottom	Majority	None	Potential for some
Tottington	Predominant	None	None
Bury Town West	Secondary	Majority	None
Bury Town East	Majority	Secondary	None
Radcliffe	Majority	None	Potential for some
Whitefield	Predominant	None	None
Prestwich	Majority	None	Potential for some

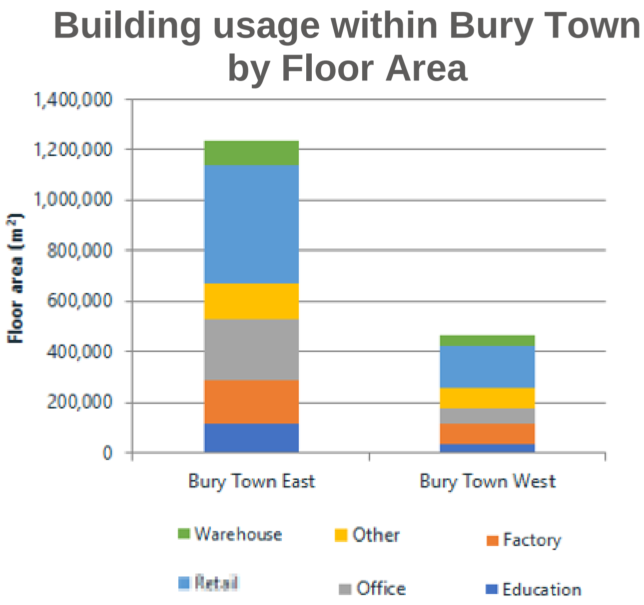
Summary of Heat Zone Opportunity Areas



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 Bury's non-domestic buildings. The estimated combined investment (for improving the energy efficiency and installing heat pumps) is in the region of £1.2b; key associated points include:

- The majority of Bury's non-domestic buildings (85% by floor area) have been deemed able to transition to a heat pump option (left chart)
- A notable proportion are deemed to be reliant on either gas or hydrogen for use in industrial processes
- The practicality of providing zero carbon heat to distributed sites (as per the map on the following page which illustrates an area within Bury Town East) will need consideration and solutions developed. For example, if zero carbon gas is needed, then consideration is required of whether surrounding buildings should also be served by the same network / infrastructure[*]
- 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, Bury Town West and East have been identified as the two zones of least regret for potential heat network development[†]. With a wide range of building usage types (right chart), solutions will be dependent on building type and aspects such as density of non-domestic buildings





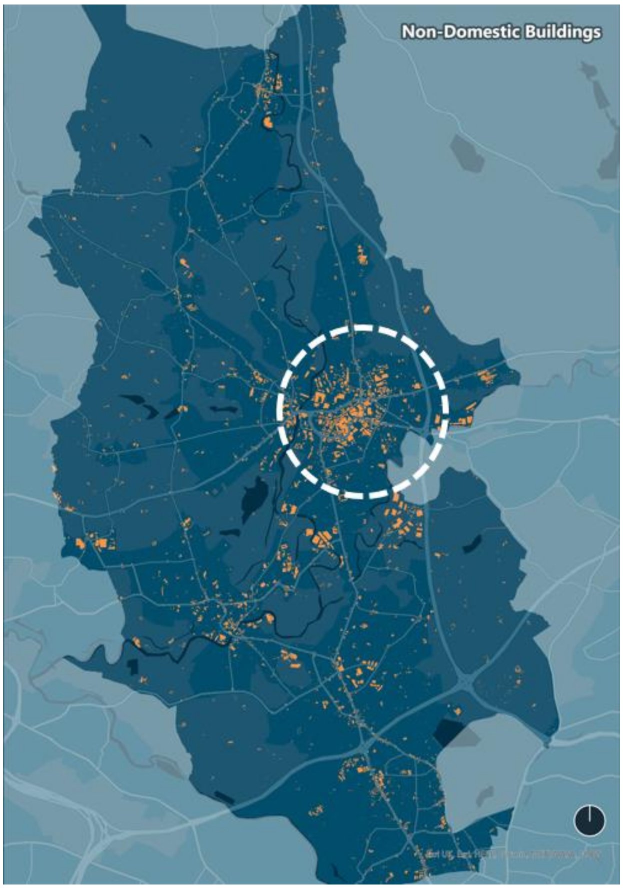
[*] Acknowledging that the primary scenario is based on identifying solution to decarbonise aligned to the GM carbon budget. Further area and building specific consideration will be needed to determine specific, cost-optimal, logical and practical solutions; considering both district heating and hydrogen options. However, delaying the transition of non-domestic buildings will result in a greater amount of CO_2 emissions that would need to be reduced through another means. Plans and timing for heat network development and HyNet will need to be considered in any decision making

[†] 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

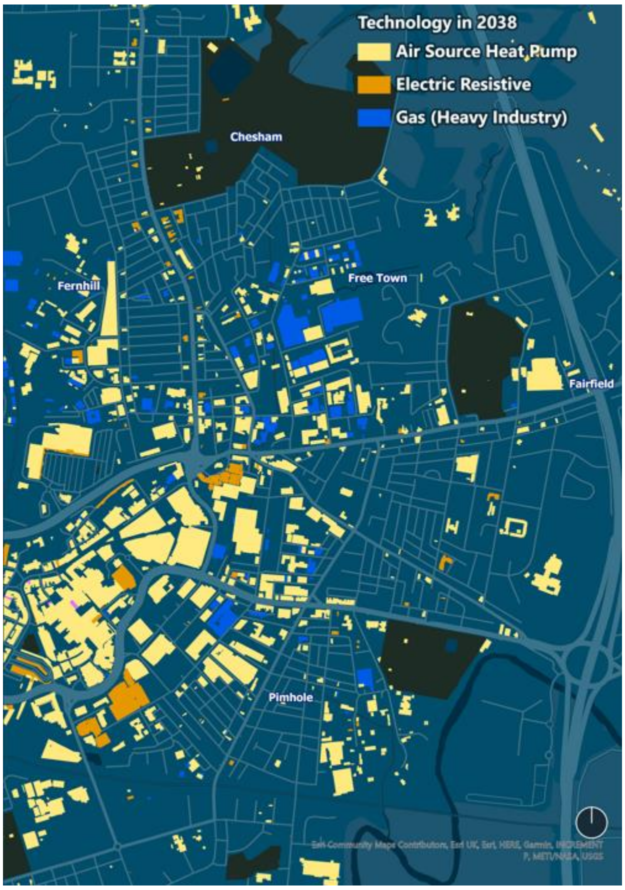
Non-domestic buildings priority area selection

Bury Town East and West have been identified as priority areas to demonstrate how to decarbonise Bury's non-domestic buildings before considering wider scale-up. While Bury Town East has the greatest proportion of non-domestic buildings in Bury, Bury Town West contains a large amount of local retail and office that mean both areas (East and West) have been identified as potential district heating zones. Bury Town East has a cluster of industrial buildings that may be hard to decarbonise through electrification. All of these characteristics provide a good basis for determining an approach that could later be applied to non-domestic buildings across Bury.

Illustrative deployment of heating system in non-domestic buildings in Bury Town East



Bury Town – Non-domestic decarbonisation priority area



5. EV CHARGING

Vision to 2038

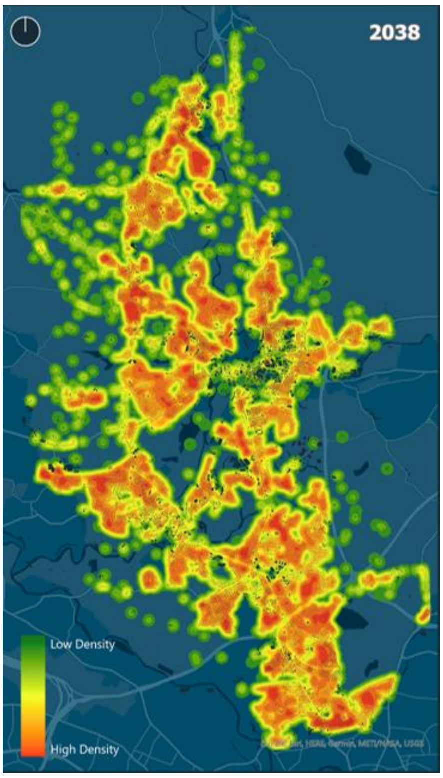
Electric Vehicle (EV) ownership is expected to grow significantly to support local decarbonisation targets and in alignment with national policy, which will see the phasing out of internal combustion engine vehicle sales by 2030 and hybrids by 2035.

Fully electric and plug-in hybrid vehicles (PHVs) in Bury are expected to grow from around 2,000 today to over 90,000 cars by 2038 – over 75% 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.

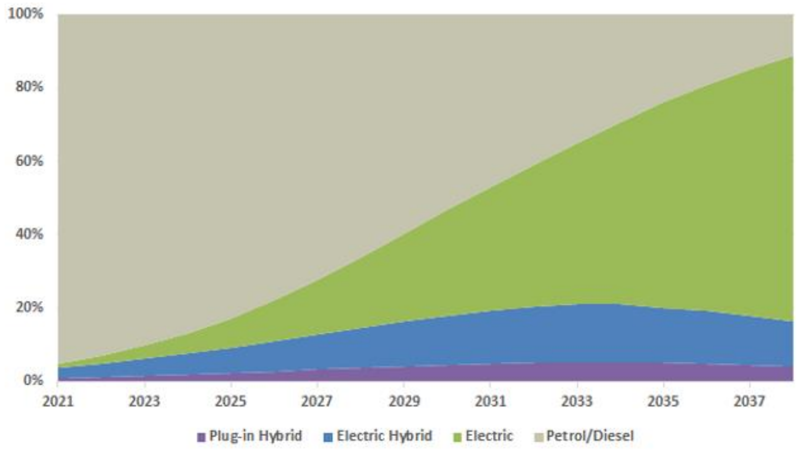
Greater Manchester's Transport Strategy 2040 sets out an ambition that no more than 50% of daily trips (across all modes) will be made by car in 2040, down from 61% today. In light of an expected overall growth in trips, the strategy sets out that meeting this target would mean a reduction of car trips from the current 3.7m per day to 3.4m. However, this still represents a significant demand for EV charging, estimated to increase to 311 GWh per year 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.

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



Projected Vehicle Mix Over Time

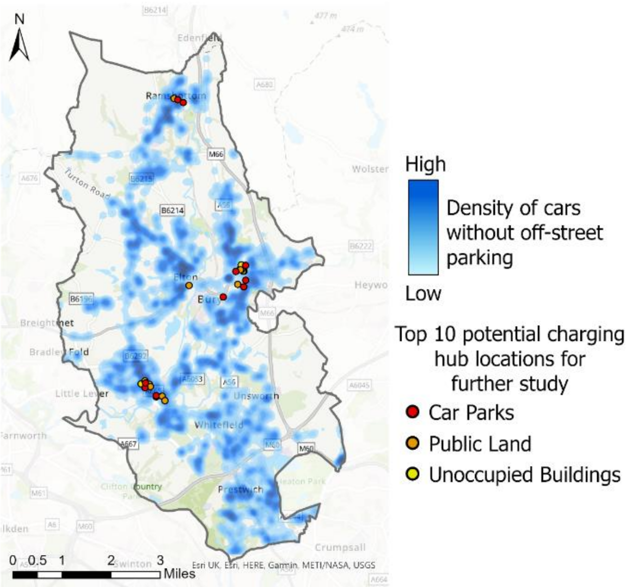


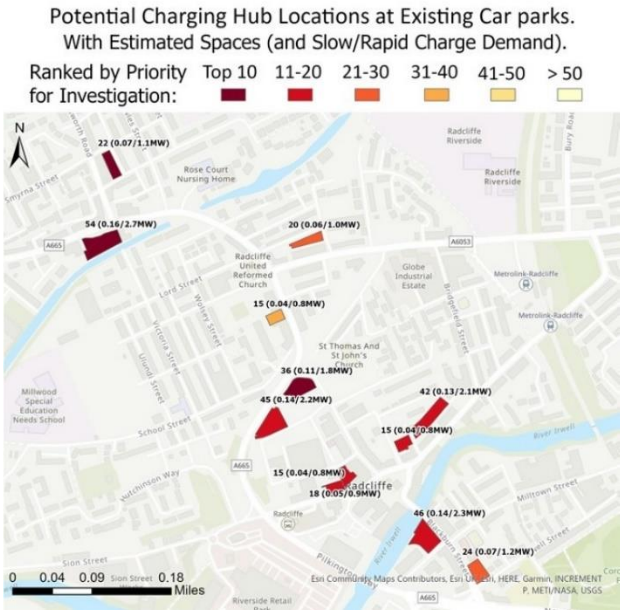
Publicly Accessible EV Charge Points

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, 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 identify potential prioritised charging hub locations, based on dwellings without potential for off-street parking and projected EV use, with the right map zooming in on an example area in Radcliffe. Further consideration will be needed, working with TFGM to identify and develop public/hub charge points across Bury*.





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

* It is also recognised that EV charging provision should not be considered in isolation from other transport related decarbonisation plans. Bury 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

Home Charge Points

Homes with potential for off-street parking are considered able to install private 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.

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, Bury will need to shift to zero carbon electricity earlier than the nation as a whole in order to stay within the carbon budget. This will mean generating much more zero carbon energy locally. All modelled scenarios found increases in locally generated renewable energy, primarily through solar PV.

Domestic Solar and Batteries

Building rooftops are used to meet a portion of energy requirements. Every modelled scenario utilised all suitably oriented rooftop space (generally South East to South West), resulting in approximately 330 MW rooftop PV capacity installed by 2038, yielding 248 GWh of energy annually (dependent on structural suitability). At a cost of £1200 per kW*, total investment would be £396 million. However, economies of scale from mass deployment across all available rooftops may be able to drive down costs. Alongside rooftop PV, there is an opportunity to install batteries to help flatten the load profile and reduce network reinforcement demands. New market incentives which value flexibility may boost the economic case for batteries going forward. Rooftops will need to be assessed to ensure structural integrity can be maintained and orientation of sloped roofs are appropriate.

Large Scale Solar PV†

Large scale ground mounted solar PV is a very cost-effective type of renewable generation. A study to determine the areas of land in Bury suitable for ground mounted solar (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.

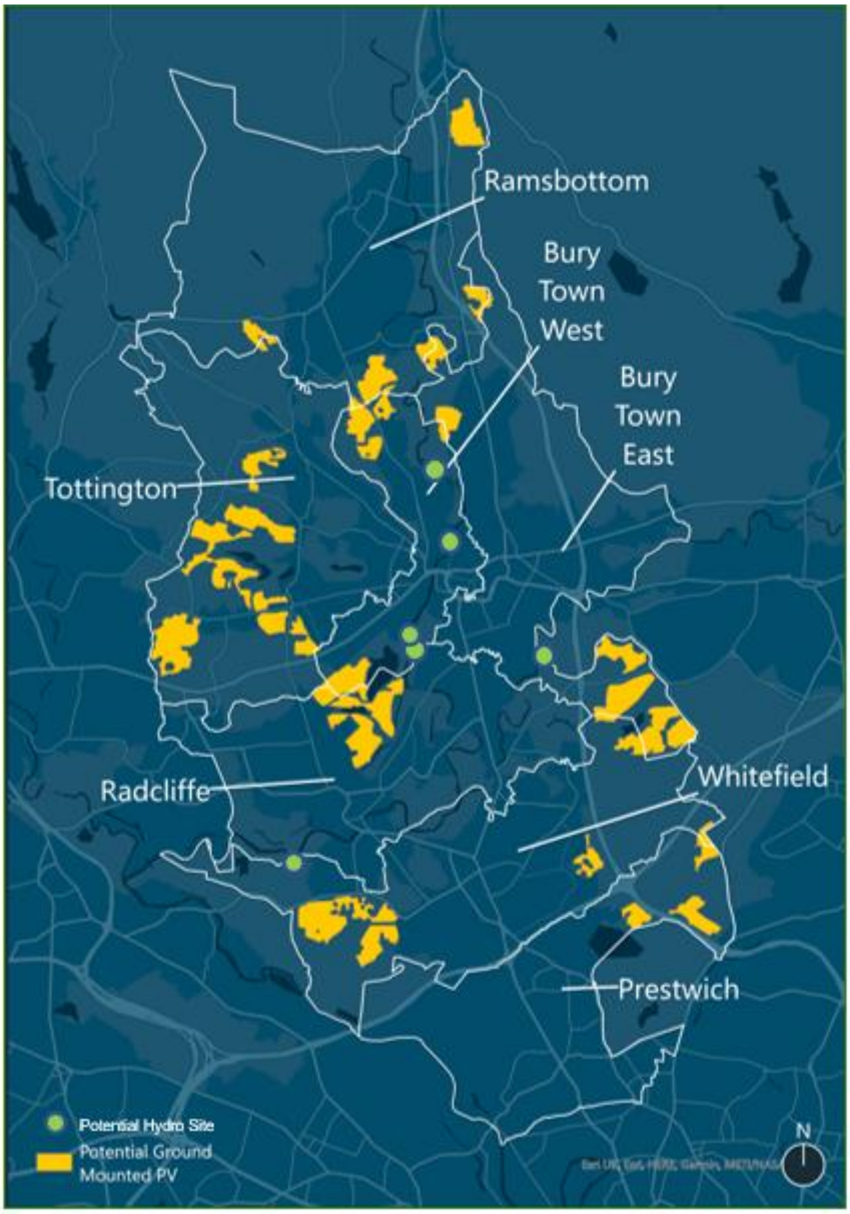
After screening, 29 sites were identified as offering potential for solar developments, covering a total area of 688 hectares, illustrated on the following map. This land could host 413 MW of solar PV capacity, yielding 351 GWh of energy per year. At a cost of £400 per kW*, with an additional £1.3m per site for infrastructure costs, deploying the maximum potential capacity would require an investment of £203 million. This potential

* Based on BEIS construction cost assumptions in 2025, represented in 2018 real value of money with no discounting applied. Rooftop PV cost assumed to be mid-value between <4 kW and 4-10 kW systems. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911818/GC20_Key_Data_and_Assumptions.xlsx

† 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).

has been separately identified as an option to go further and reduce the remaining 3.55Mt of CO_2 emissions, beyond that included in the modelled scenarios.

Current Ground Mount PV Opportunities across Bury



Onshore Wind and Hydro Electric Power

The wind screening did not find any sites suitable for large scale (upwards of 500 kW output, 50 m hub height) wind turbine installations in Bury – smaller installations may be possible.

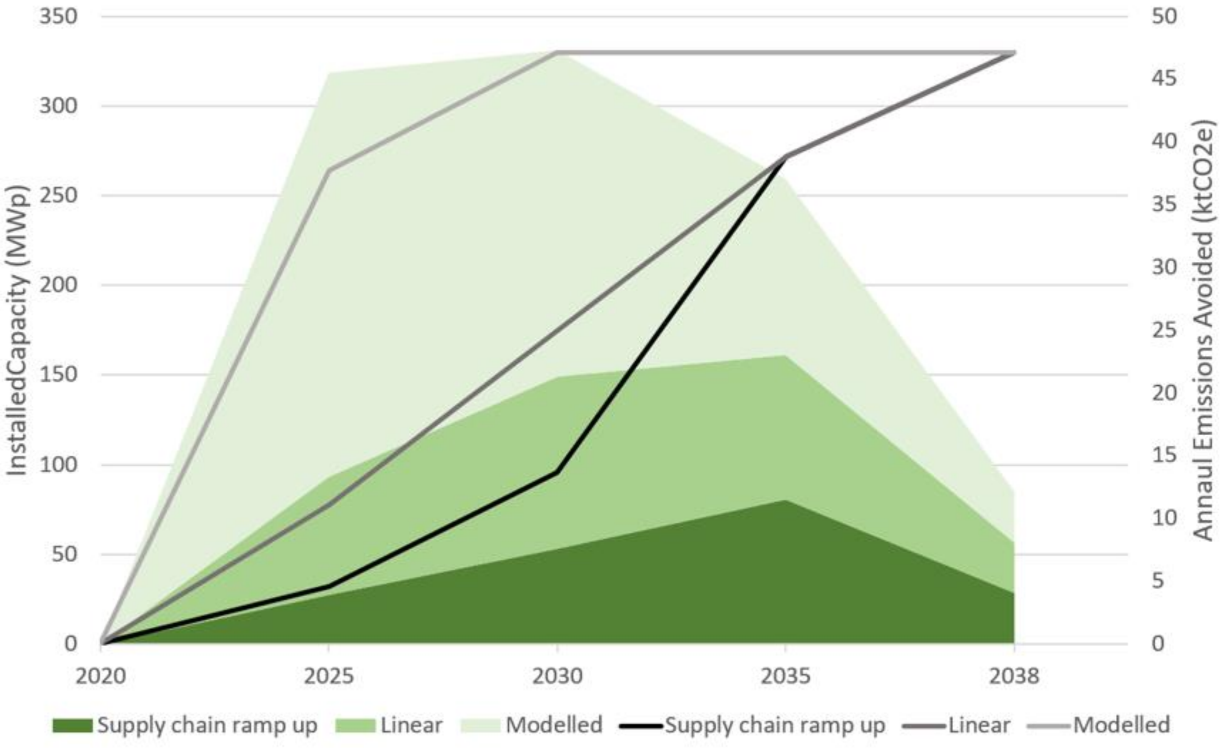
However, 6 sites were identified as potentially suitable for hydroelectric development (shown on map), in addition to the existing hydroelectric plant in Bury. A total capacity of 0.55 MW could be installed across these sites, generating 1.8 GWh of energy per year. This screening considers environmental sensitivity and potential power generation at each site, as well as proximity to the electricity network.

Zone	Large Scale Solar PV Capacity (MW)	Rooftop Solar PV Capacity (MW)	Hydro Capacity (MW)
Bury Town East	84.5	47.0	0.06
Bury Town West	45.9	30.6	0.25
Radcliffe	39.0	62.5	0
Ramsbottom	47.8	35.5	0
Whitefield	56.2	51.9	0.18
Prestwich	27.0	60.0	0
Tottington	112.1	42.9	0

Rooftop PV Deployment Rate

The rate and timing of solar PV deployment has a large influence on the emissions avoidance it can achieve. Since the emissions intensity of the electricity grid reduces rapidly over the period to 2038, local renewable generation has a diminishing carbon benefit in the later years. As the graph below shows, the modelled scenario deploys the rooftop PV capacity very rapidly and early, which is unlikely to be achievable in practice. It does this to maximise the savings early in the plan, while the grid emissions intensity is still relatively high.

Rooftop PV deployment rate and impact on emissions avoided



The most conservative deployment rate shown for rooftop solar, "Supply chain ramp up", would result in the remaining emissions over the period to 2038 reaching 3.77 Mt, compared to the 3.52 Mt in the modelled scenario.

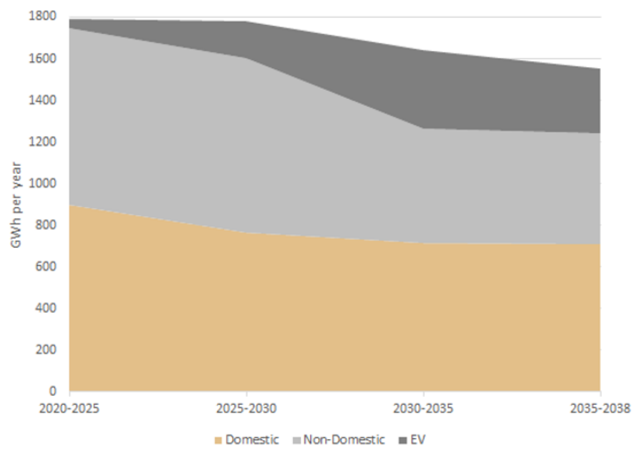
Deployment rates for ground mount PV (not shown in the graph) would have a comparable impact: a similarly conservative rate would reduce the remaining emissions by only a further 0.17Mt, while deploying it rapidly and early to match the modelled deployment of rooftop solar would bring remaining emissions down by 0.48Mt.

In addition to carbon benefits, investment in local generation can generate employment opportunities, and may create opportunities to establish local energy markets. On the other hand, care should be taken to balance these benefits with potentially higher energy prices than might be available from the National Grid, particularly since the shift to electric heating will increase sensitivity to electricity prices. Small scale rooftop solar especially can be a significantly more expensive source of electricity than large scale wind and solar farms sited remotely.

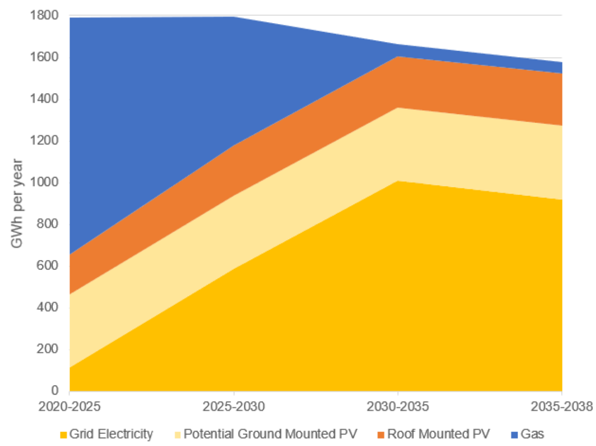
Energy Supply and Demand

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 delivery systems 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.

Energy Consumption



Energy Supply Source



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.

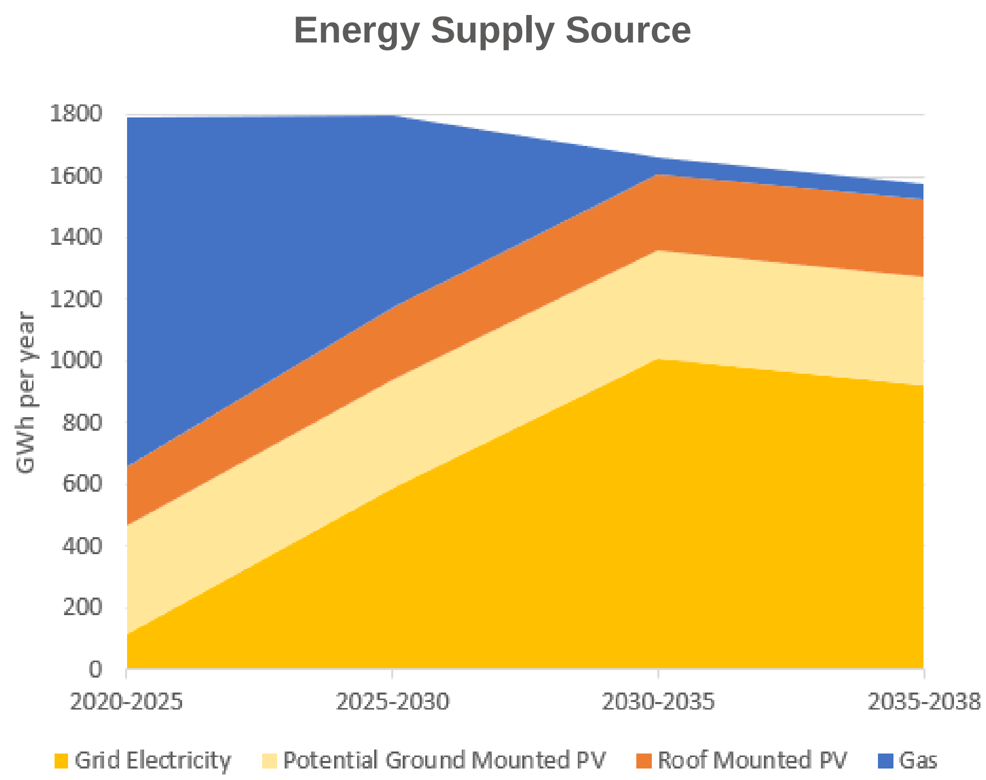
Vision to 2038

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 Bury 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, even in a scenario where all heating is provided by hydrogen, largely due to EV charging.

In the primary scenario to decarbonise Bury 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 scenario as well as insight from the other modelled scenarios and other key considerations given the uncertainties.

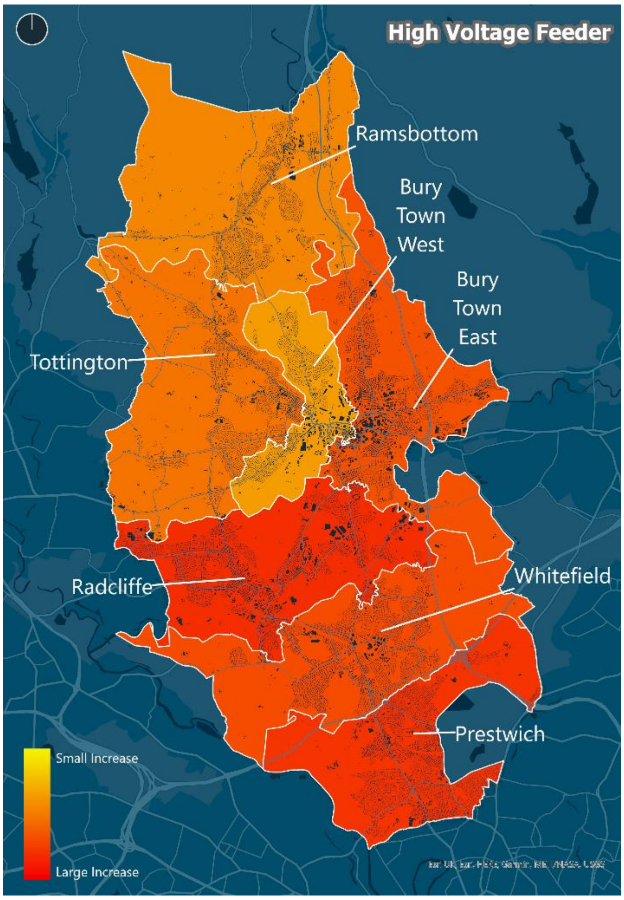


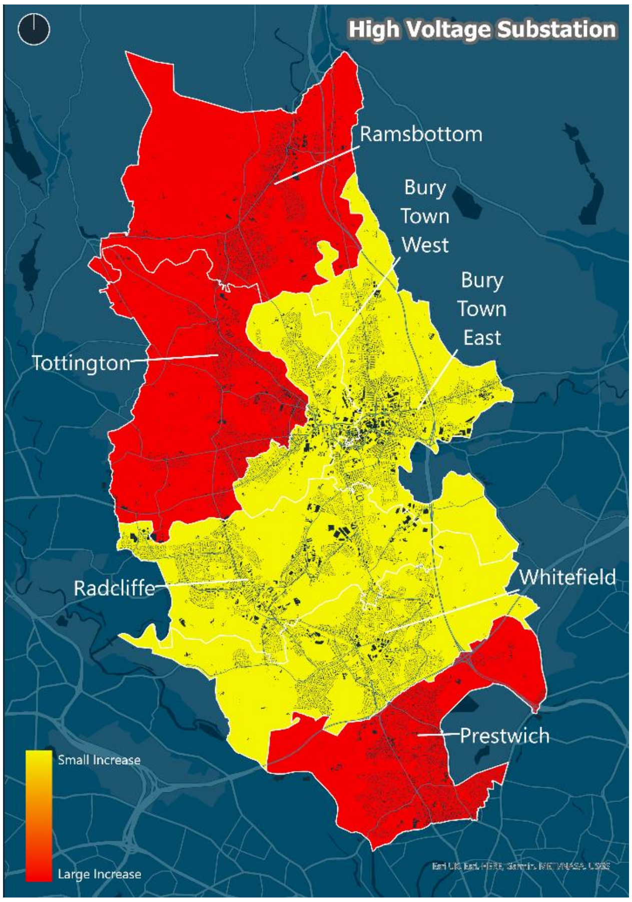
Capacity Requirements for 2038: High Voltage

The local electricity distribution network operated under license by Electricity North West supplies electricity to the majority of dwellings and industry in Bury today. Modelling indicates the capacity 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 voltage and low voltage (see following pages) levels are shown in the maps and tables. The distribution of these impacts is determined by a combination of factors, such as electric vehicle ownership, space 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.

HV Feeder and Substation Capacity Change by 2038



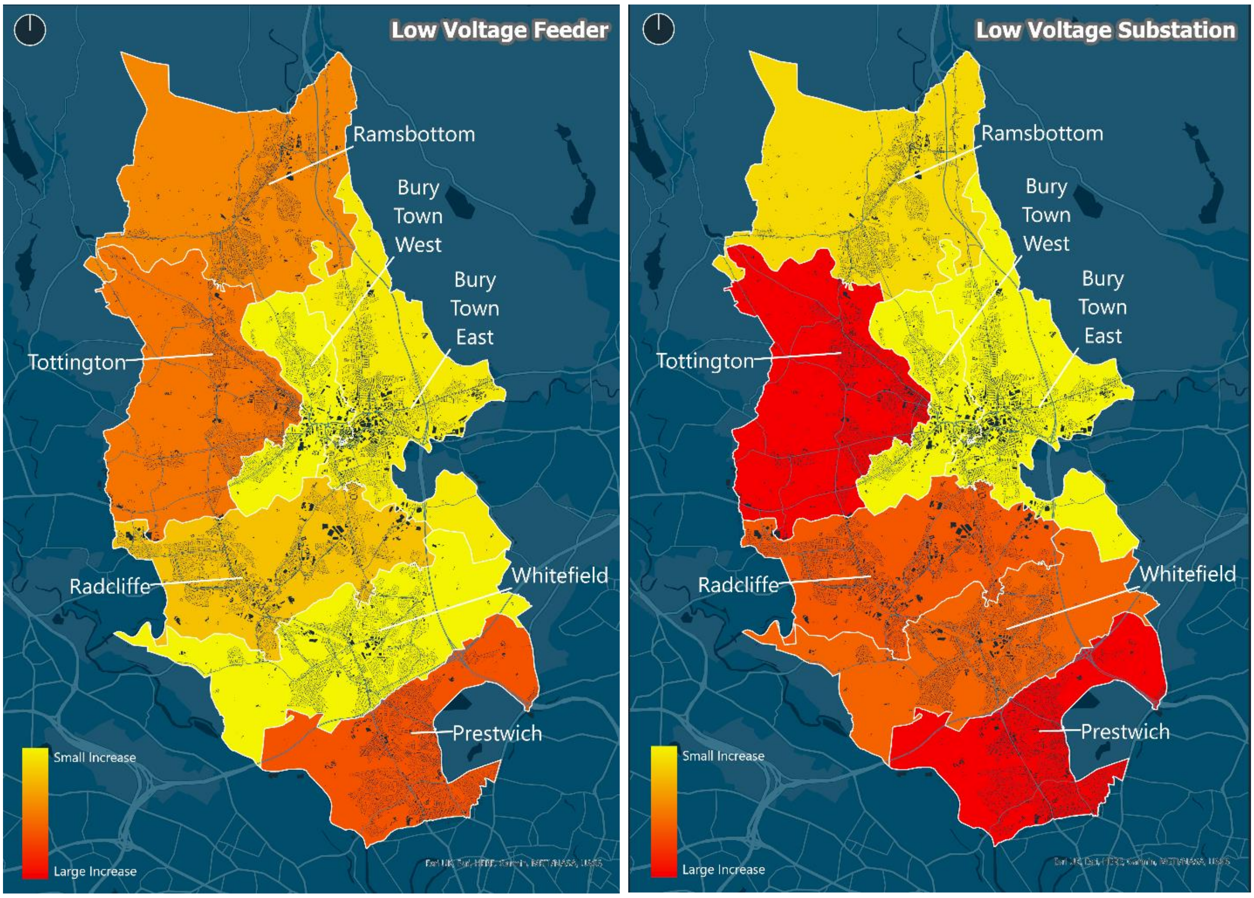


	High Voltage Feeder Capacity (MW)		High Voltage Substation Capacity (MW)	
Zone	2020	2038	2020	2038
Bury Town East	234.8	271.1	85.9	85.9
Bury Town West	122.4	141.9	43.0	43.0
Radcliffe	239.7	284.1	85.9	85.9
Ramsbottom	127.8	152.1	28.6	85.9
Whitefield	210.0	247.8	85.9	85.9
Prestwich	210.2	252.4	43.0	171.8
Tottington	142.3	170.1	28.6	85.9

Capacity Requirements for 2038: Low Voltage

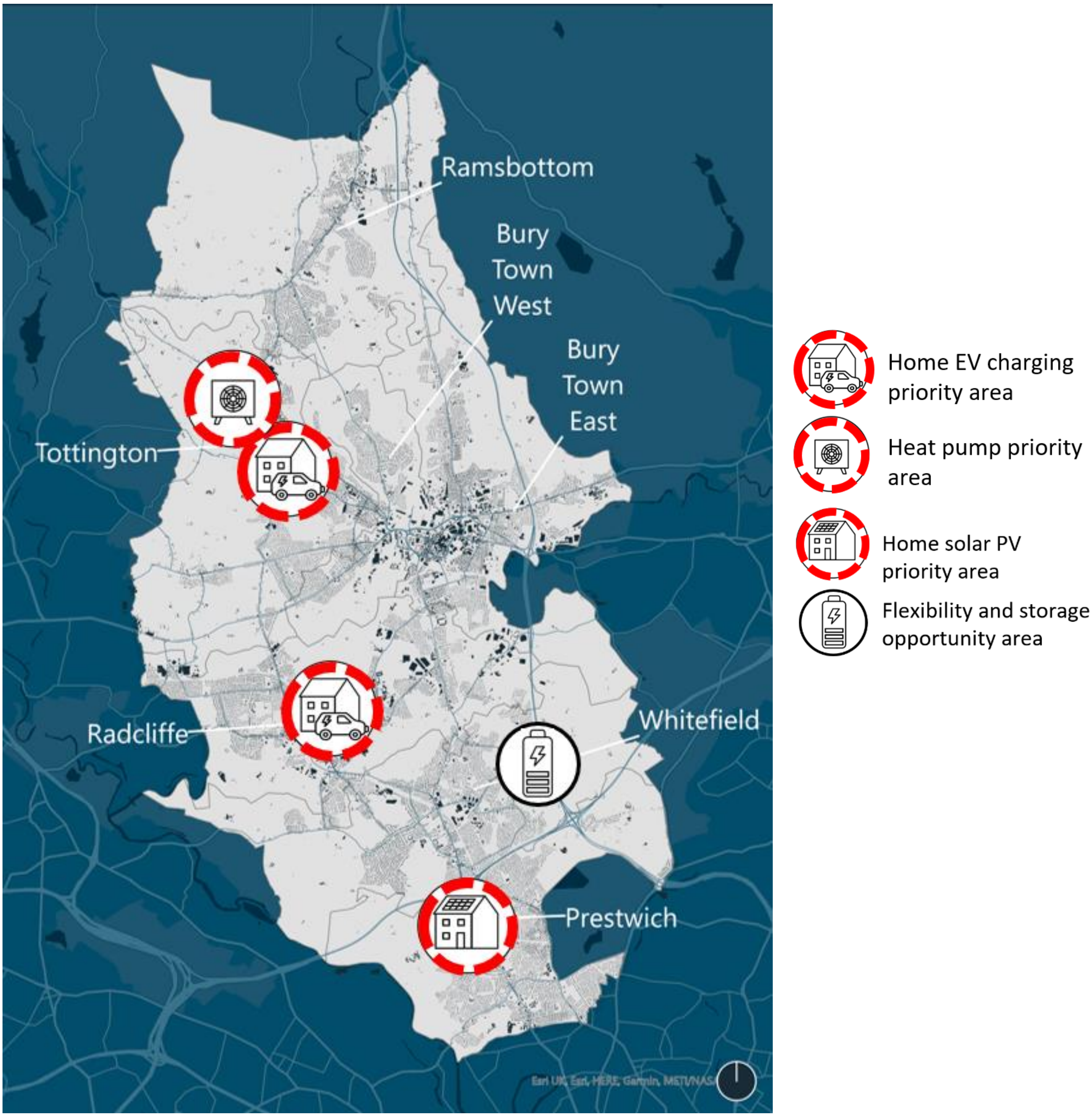
Low voltage feeders are the underground cables serving individual buildings, often located under pavements, so upgrades to these can involve extensive street works. High voltage feeders on the other hand, only run to substations which typically serve multiple streets, so require less extensive works.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

LV Feeder and Substation Capacity Change by 2038



	Low Voltage Feeder Capacity (MW)		Low Voltage Substation Capacity (MW)	
Zone	2020	2038	2020	2038
Bury Town East	72.0	74.4	69.8	69.8
Bury Town West	38.1	38.1	35.7	35.7
Radcliffe	56.4	68.3	195.2	229.5
Ramsbottom	122.8	147.8	49.7	56.5
Whitefield	95.6	95.6	165.6	197.2
Prestwich	37.5	73.6	38.9	142.8
Tottington	141.5	170.2	26.5	113.5

Present Day Capacity and First Steps



An area which stands out from examining present network capacity is Prestwich, which has no headroom for additional demand, but the greatest headroom for generation, suggesting that it could be a suitable area to pioneer mass PV deployment, but would be unlikely to be able to accommodate significant heat or transport electrification without either network upgrades or storage and flexibility. This would present the opportunity to study how local generation may facilitate the connection of additional demand even where the network is constrained. It's worth noting however, that peak network demand typically occurs on winter evenings, when solar generation is negligible, and electrification of heat is likely to compound this.

Conversely, Radcliffe and Tottington have the largest demand headroom available, suggesting they could be ideal zones to pioneer heat and transport electrification without an immediate requirement for network reinforcement. This overlaps with Tottington's suitability for heat pump prioritisation across all scenarios.

Whitefield could be well suited to pioneering storage and flexibility, having less demand and generation headroom relative to the proposed increase of heat pumps, EVs and solar PV. This would be an opportunity to test and demonstrate innovative technologies and business models which enable more demand and generation to be accommodated without conventional capacity upgrades. Examples might include smart EV charging and vehicle-to-grid, smart flexible heat pump operation, batteries and new technologies.

Clearly PV capacity dramatically outstrips generation headroom in all cases, though it should be considered that much of the energy generated will be consumed within the same zone, meaning it does not have to flow upstream through the substation. Furthermore, PV installed across an area will never produce its rated peak output, since real world conditions such as sun angle and temperature do not match lab test conditions. Network upgrades to meet demand increases discussed previously will have the added benefit of increasing the capacity to accommodate generation.

	Demand			**Generation**	
Zone	Headroom (MW)	Heat pump installs	EV chargers	Headroom (MW)	Solar PV (rooftop and ground mounted, MW)
Bury Town East	6.8	8,113	4,215	11.2	131.5
Bury Town West	7.1	2,682	2,853	11.2	76.6
Radcliffe	10.6	17,708	6,465	11.2	101.5
Ramsbottom	6.3	8,330	3,752	11.2	83.3
Whitefield	5.6	13,084	7,368	7.0	108.1
Prestwich	0.0	14,545	8,519	32.0	87.0
Tottington	13.9	10,884	4,699	11.2	155.0

Demand headroom is non-firm headroom at the primary substation for the zone.

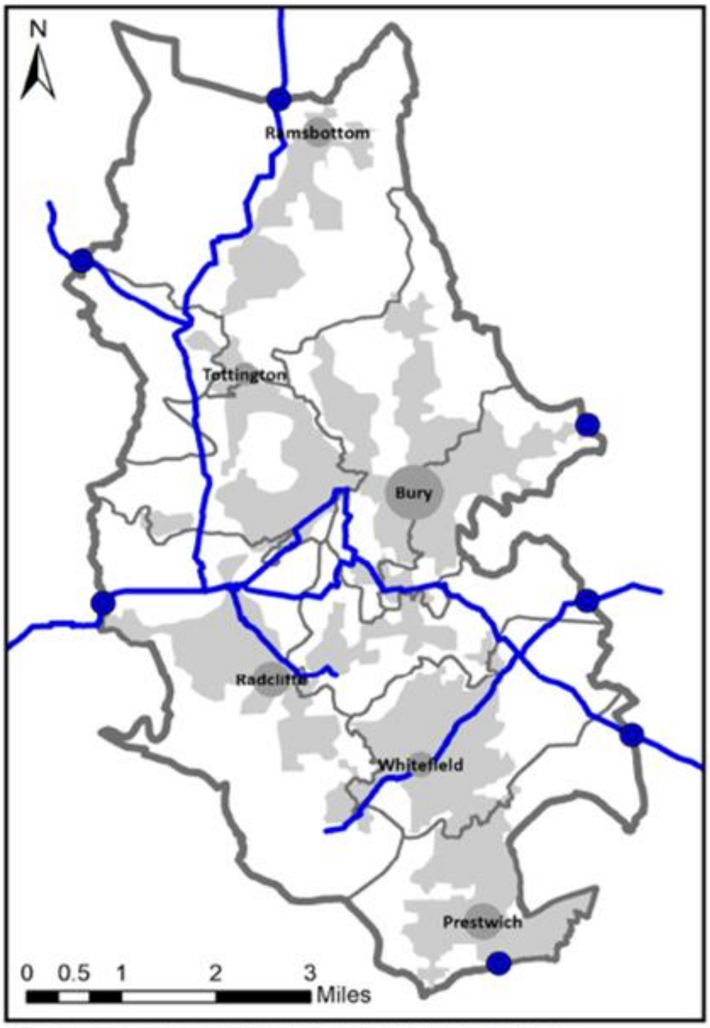
Generation headroom is the inverter-based headroom at the primary substation for the zone, which is most relevant for considering solar PV. All figures from ENW's heat map tool

https://www.enwl.co.uk/get-connected/network-information/heatmap-tool/

Gas Network Today

The gas network operated under license by Cadent supplies gas to the majority of dwellings in Bury 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 Bury is around 1200 GWh – nearly double the current demand for electricity.

Current Gas Network in Bury



To deliver Bury 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 avoid the budget being exceeded. Most non-domestic buildings will also transition away from gas.

Future of Gas and Hydrogen for Heat

The primary scenario for Bury 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.

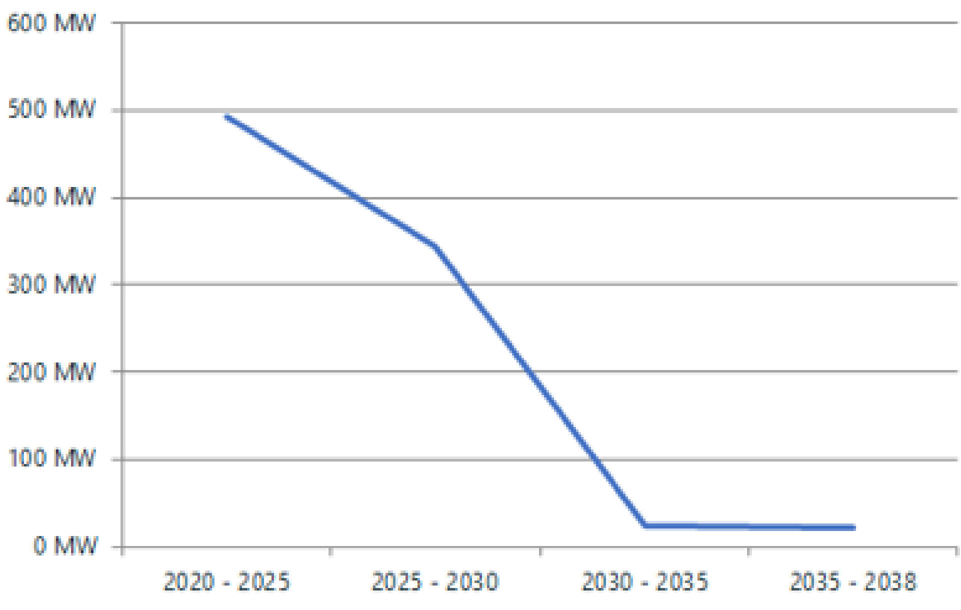
This would necessitate phased disconnection of homes from the gas network as they are converted to electric or district heating, which would need coordination.

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. Around 770 dwellings may be best suited for this technology: 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. .

Gas networks may need to be retained for longer in areas where hybrids are a useful transition option due to property types, particularly Radcliffe, Whitefield and Prestwich.

Most non-domestic properties will also transition away from gas, again connecting to district heat networks or converting to electric heating options. There are a small number of non-domestic properties that are harder to decarbonise, particularly with industrial uses that require high temperature process heat: these will remain on the gas network under the primary scenario.

Change in Peak Gas Demand in Bury

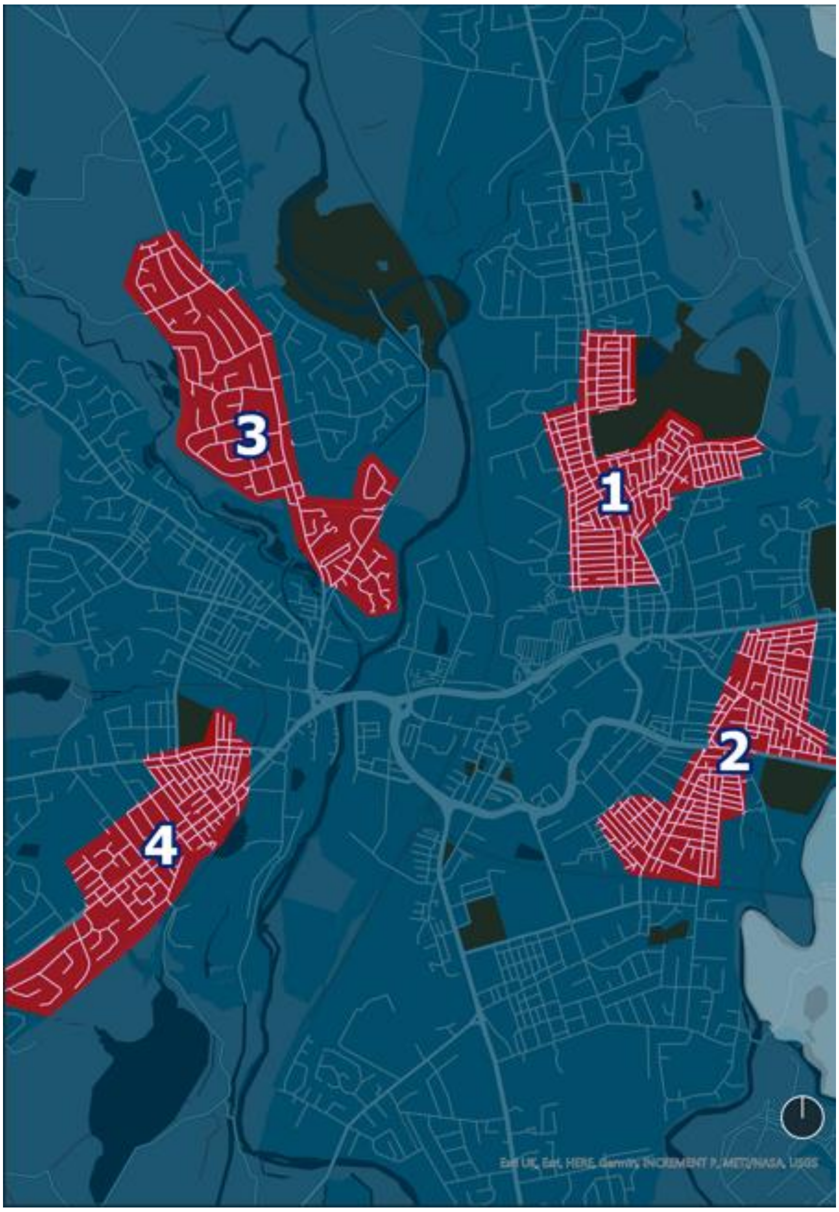


Equitable solutions for dealing with the ongoing gas network maintenance costs for remaining customers will need to be explored. These properties may also be well suited to using hydrogen for heat under a scenario where hydrogen becomes available.

District heating could supply in the region of ~13% (11,800) of Bury's dwellings. It is shown to be cost effective in both of the cost-optimised scenarios considered (scenarios 1 & 2), demonstrating that district heating networks are expected to play an important role in Bury's decarbonisation. For example, when compared to the high heat electrification scenario, district heating provides a c.£100m total energy system cost saving through to 2038).

There are four main opportunity areas for district heating zones, two in both Bury Town West and Bury Town East; providing opportunities to develop networks, in the region of 56km of heat network for an investment of £111m*, in the clusters highlighted below and around suitable non-domestic buildings and areas of proposed new development.

Heat Network Opportunity Areas



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

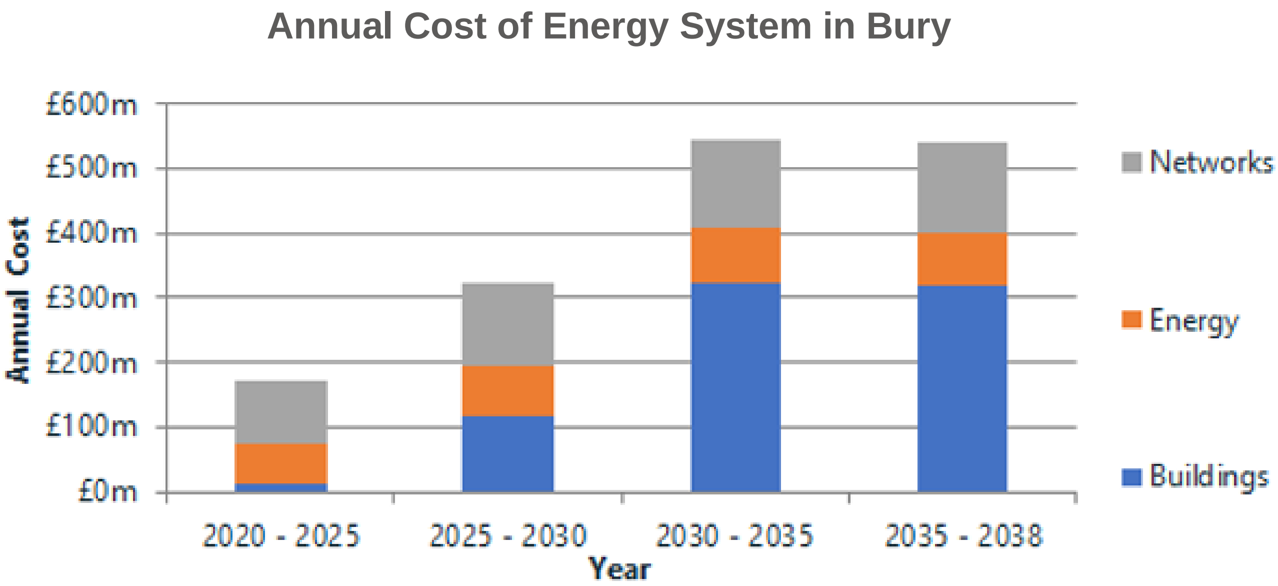
There are limited opportunities for utilising local heat supplies (such as waste heat), therefore heat generation is primarily based on large scale heat pumps, consisting of 17.9 MWp of heat delivered from heat pumps.

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 Heat Generation Capacity (MWp)	Approximate Network length (km)
1 - Bury Town East – Northern cluster	4.1	17
2 - Bury Town East – Southern cluster	3.7	16
3 - Bury Town West – Northern cluster	4.8	11
4 - Bury Town West – Southern cluster	5.3	12

Total cost

The primary scenario is based on a total energy system spend of £5.3bn (with a range of £5.3-6.3bn across all four scenarios). The cost is attributed to investment in energy networks, in buildings (for components such as fabric retrofit, heating system change and roof mounted PV (on homes)) and for energy consumed. The chart below illustrates the split between these three main components. Notably, a significant proportion of this cost would have been spent without accounting for decarbonisation. 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 status quo 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.



Investment (exclusive of energy consumption)

The tables and charts on the following pages illustrate the total investment needed in the energy system to deliver the primary scenario, equating to a total of £3.5bn. 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.

Investment Categories

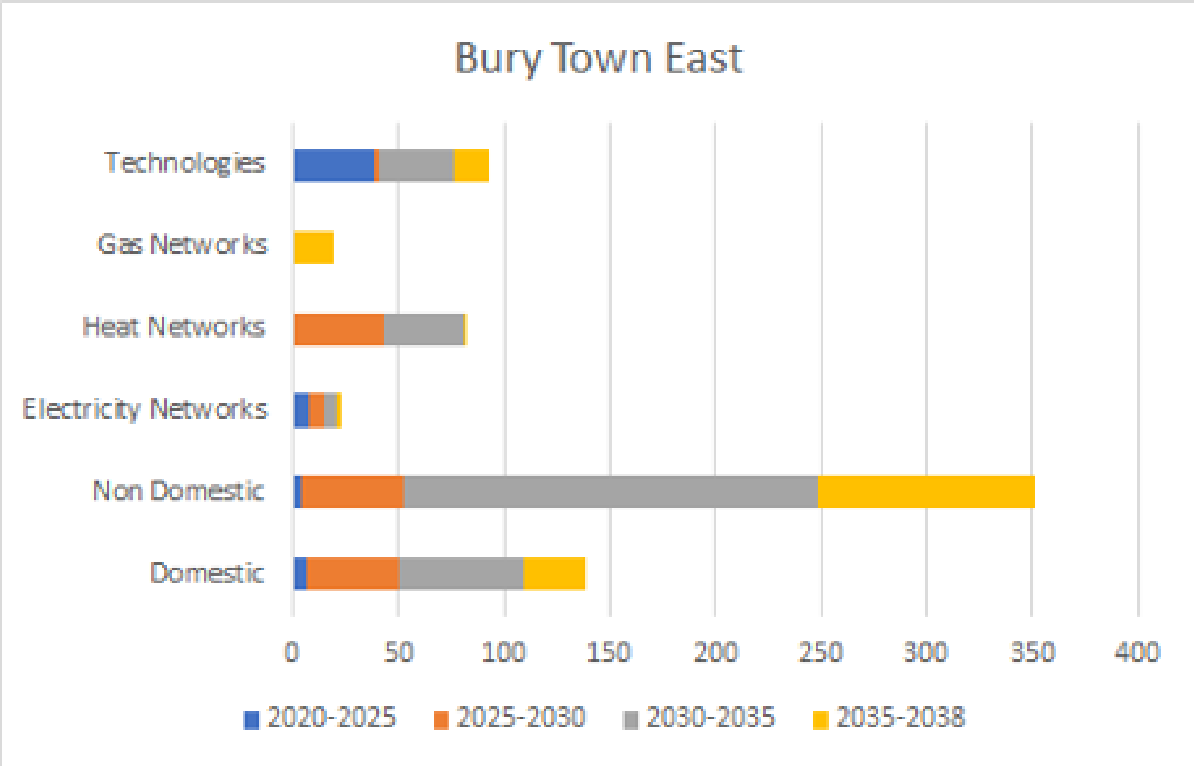
- Technologies = roof mounted PV, heat network energy centres and EV chargers
- Non-domestic buildings = heating system & insulation retrofit
- Domestic buildings = heating *system & insulation retrofit
- Networks = gas, electricity and district heating network investment

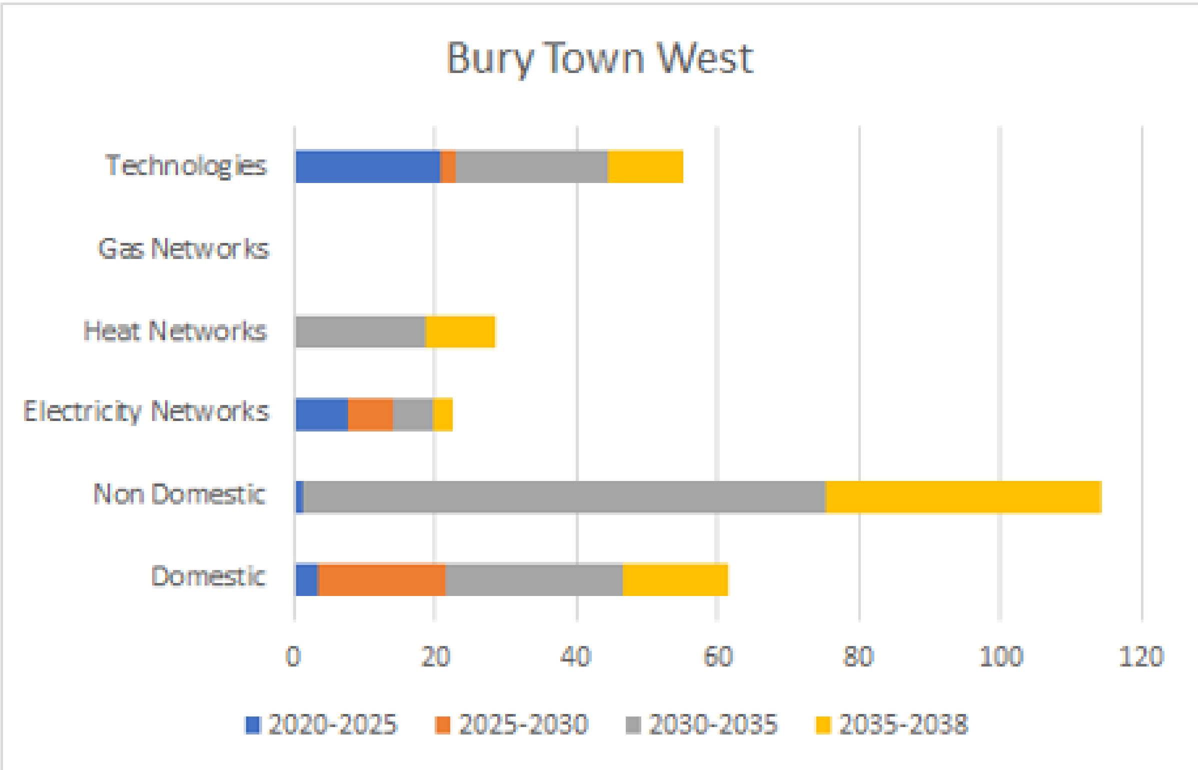
* Status quo expenditure has not been calculated in this LAEP

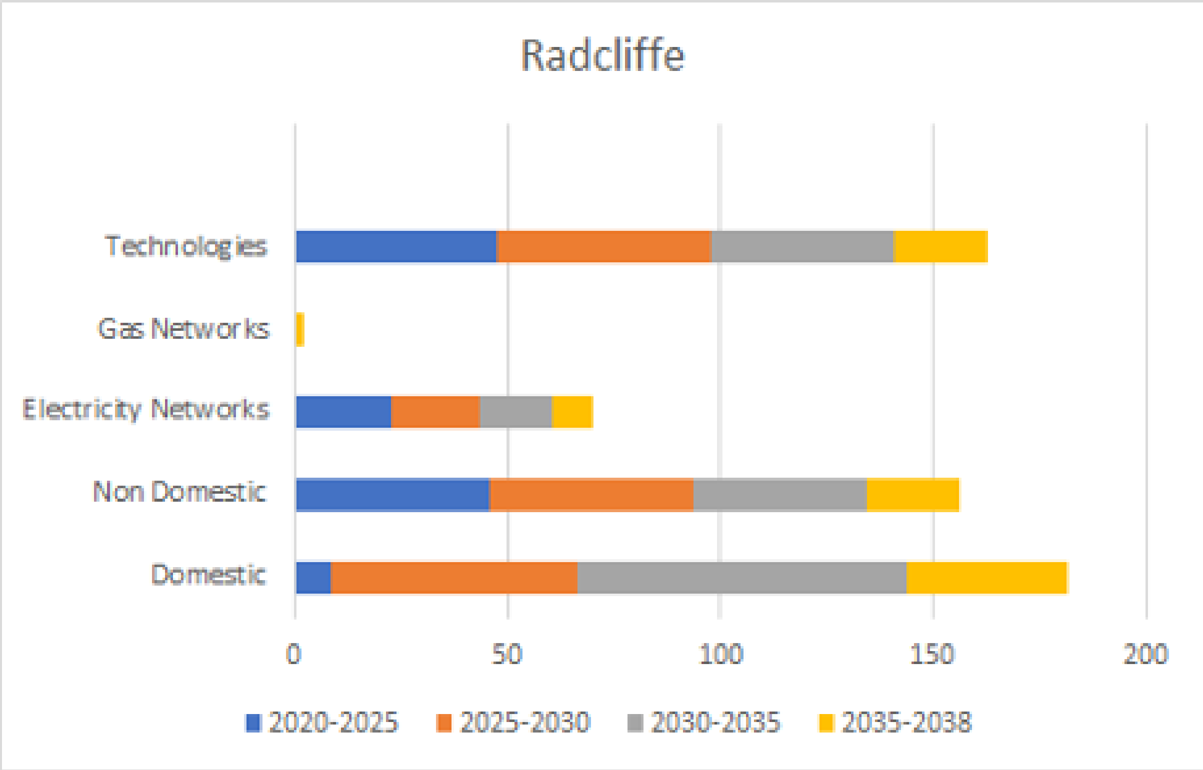
Heat Network Opportunity Area	Approximate Heat Generation Capacity (MWp)	Approximate Network length (km)
1 - Bury Town East – Northern cluster	4.1	17
2 - Bury Town East – Southern cluster	3.7	16
3 - Bury Town West – Northern cluster	4.8	11
4 - Bury Town West – Southern cluster	5.3	12

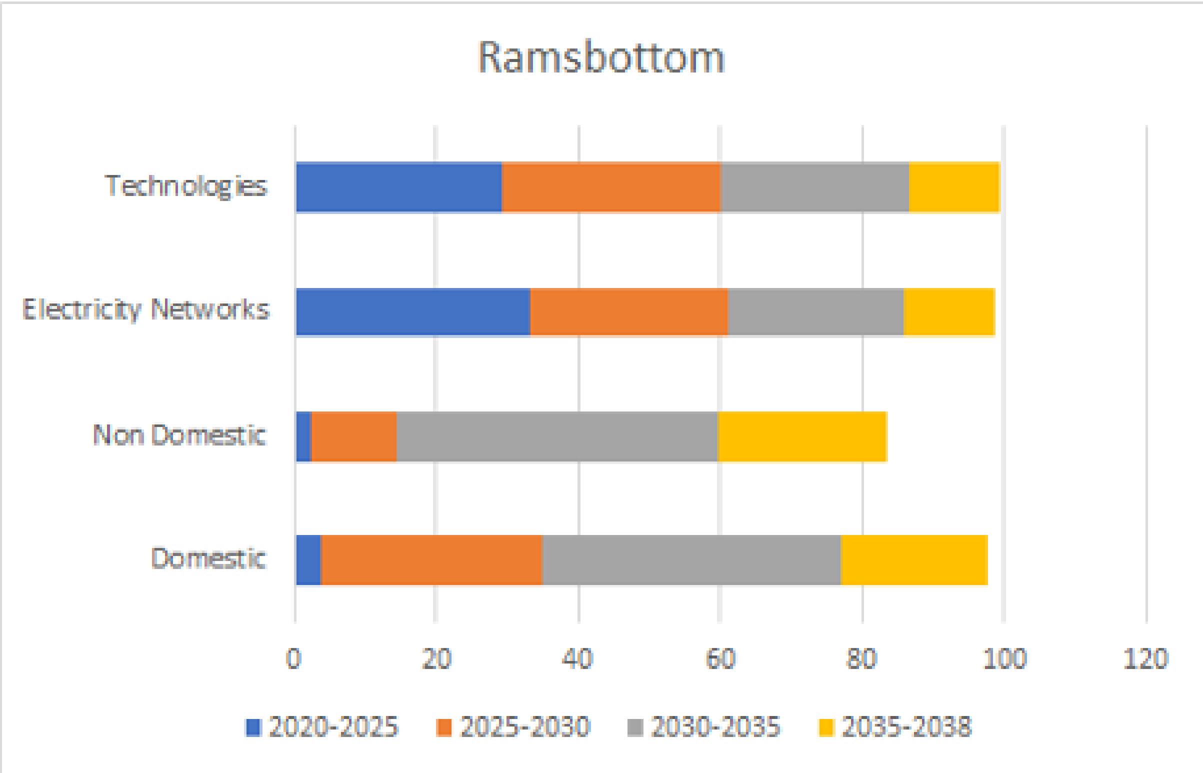
Investment type	Total Investment (£m)
Technologies	895
Non-domestic buildings	1,183
Dwellings	898
Networks	573

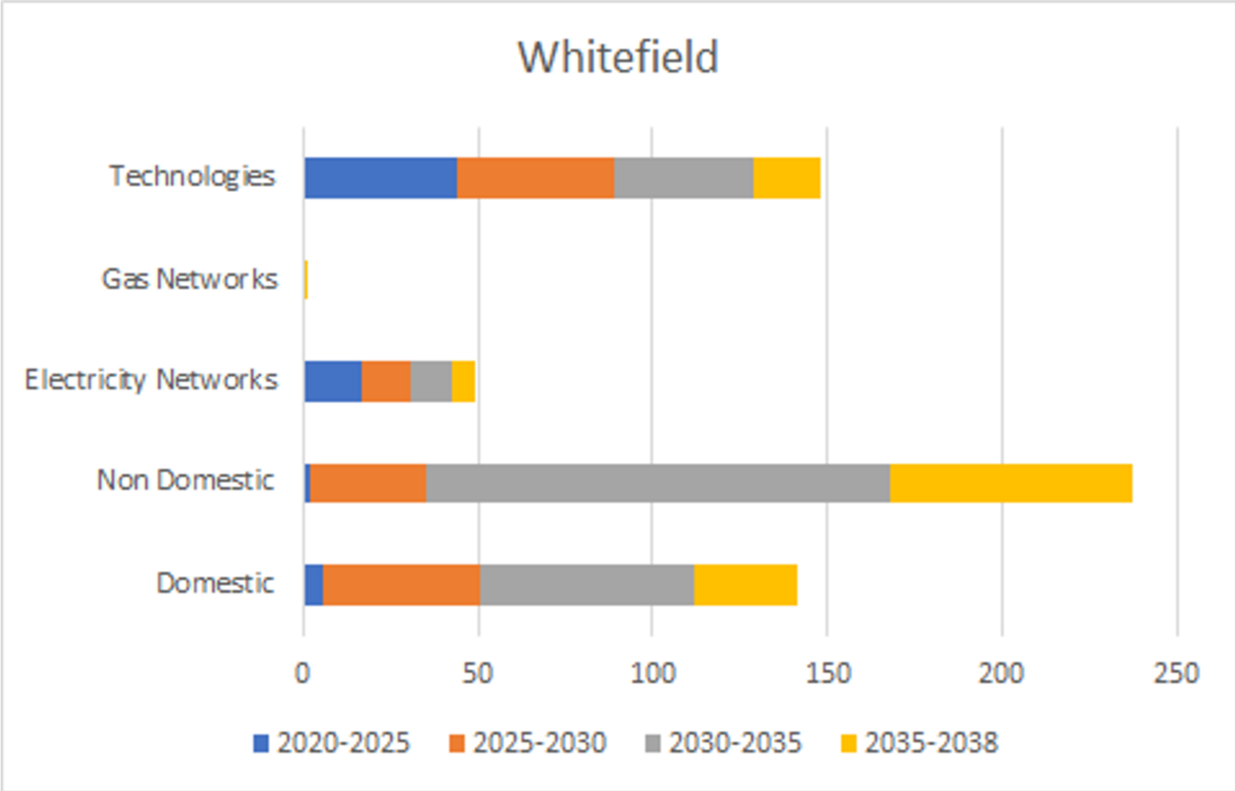
Investment in Bury's energy system (£m) by time period across each of Bury's areas

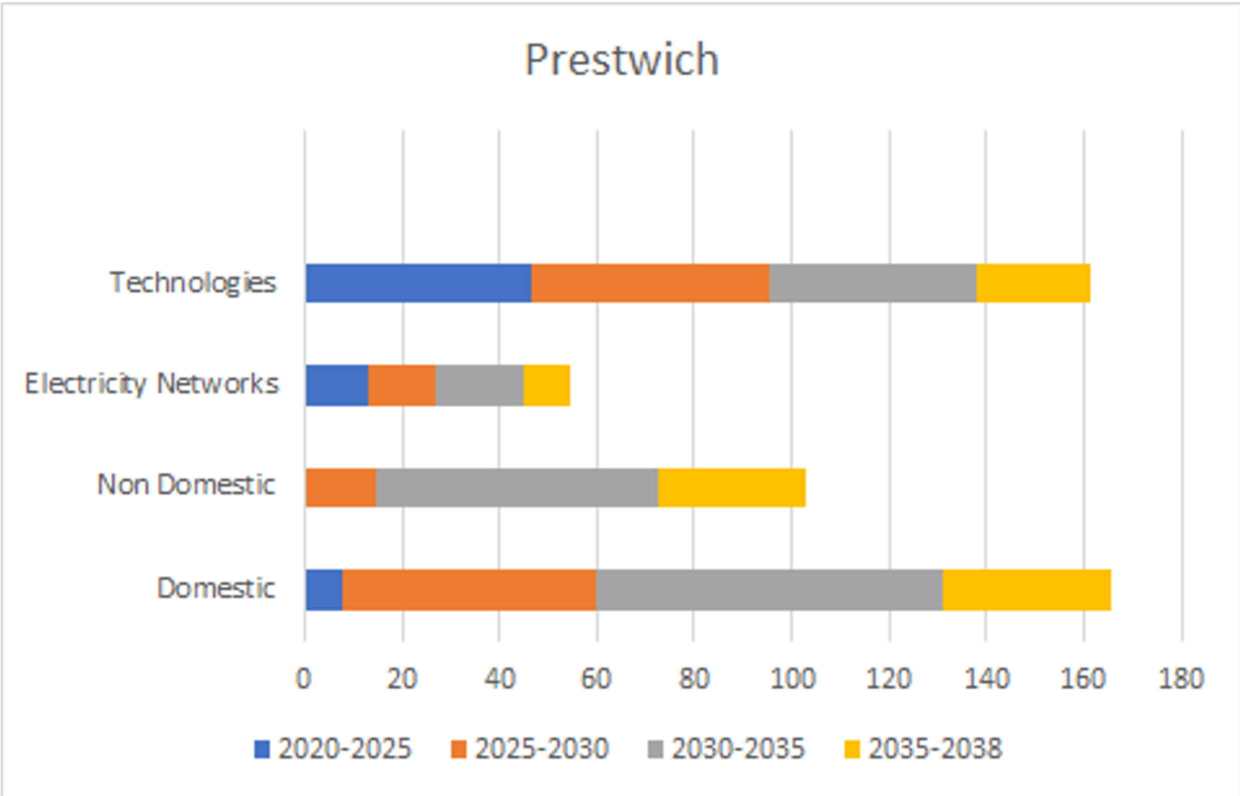


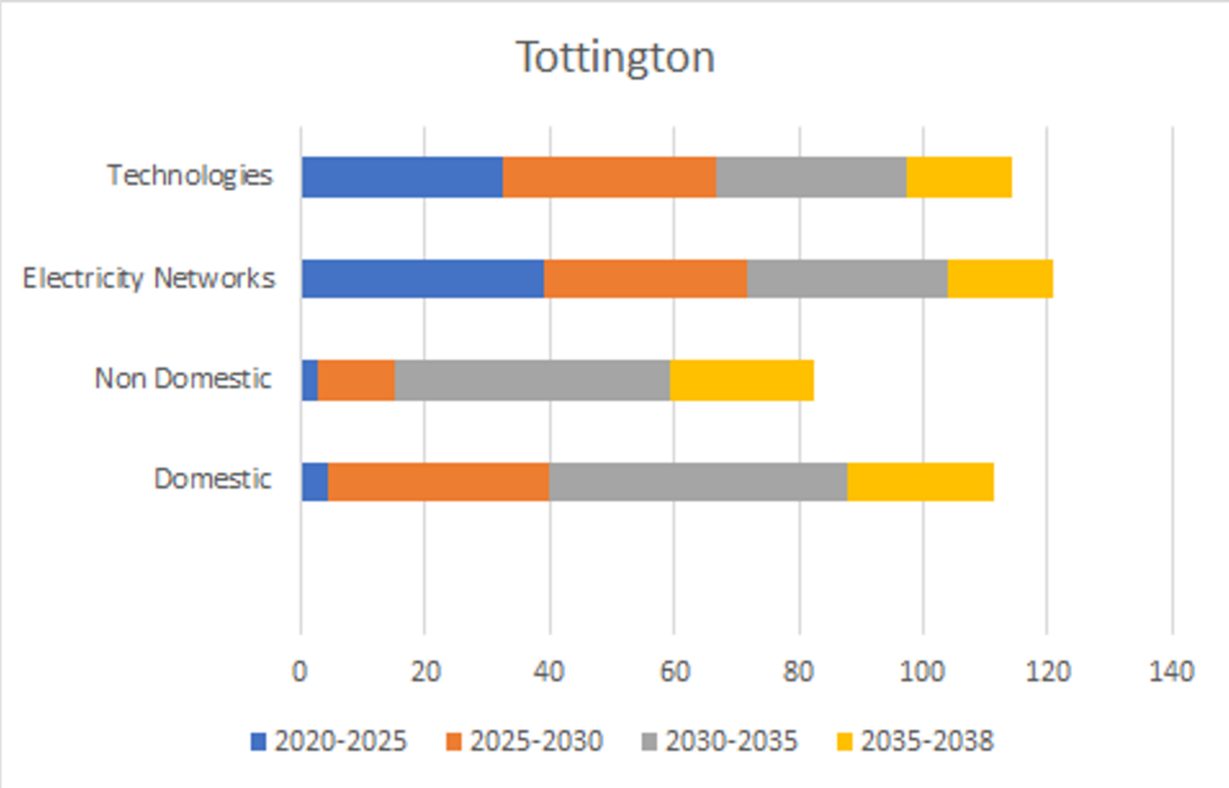



Radcliffe
Technologies
Gas Networks
Electricity Networks
Non Domestic
Domestic
0
50
100
150
200
2020-2025
2025-2030
2030-2035
2035-2038


Ramsbottom
Technologies
Electricity Networks
Non Domestic
Domestic
0
20
40
60
80
100
120
2020-2025
2025-2030
2030-2035
2035-2038


Whitefield
Technologies
Gas Networks
Electricity Networks
Non Domestic
Domestic
0
50
100
150
200
250
2020-2025
2025-2030
2030-2035
2035-2038


Prestwich
Technologies
Electricity Networks
Non Domestic
Domestic
0
20
40
60
80
100
120
140
160
180
2020-2025
2025-2030
2030-2035
2035-2038


Tottington
Technologies
Electricity Networks
Non Domestic
Domestic
0
20
40
60
80
100
120
140
2020-2025
2025-2030
2030-2035
2035-2038

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 Bury 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 Bury

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

1. Reduced energy demand in Bury: 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 nearly 45,000 homes and deep retrofit of a further 6,000 homes requiring £580 m 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 Bury from nearly 700 GWh of electricity consumed per year to 1,610 GWh by 2038.

2. Increasing uptake of low-carbon solutions in Bury: 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 electric vehicles (BEVs) and electric heat pumps along with development of heat

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* 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

networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.65,000) and public EV charging hubs, targeted at priority locations. Industry in Bury 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 Bury: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production in Bury. In the primary scenario 330 MWp of roof mounted solar PV capacity is installed. Ground mounted solar PV could also provide up to a further 413 MWp of local low carbon generation capacity. Depending on the viability and quantity taken forward, this could reduce the remaining 3.55 Mt CO2 (the emissions that are generated throughout the scenario) by up to 0.48 Mt CO2, though this is very sensitive to the timing and deployment rate. Deploying the maximum potential for both rooftop and ground-mount solar PV would produce 600 GWh per annum of local, low carbon electricity, a significant contribution to Bury's forecasted annual consumption of 1,610 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.

4. The Future role of the Gas grid in Bury: 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 Bury. Greater Manchester's ambition of carbon neutrality by 2038 creates significant pressures regarding the deliverability of 100% hydrogen heating to all homes in Bury. 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. Bury should not rule out the potential for hydrogen heating, however, neither should it plan for it with certainty. The high hydrogen scenario (presented in the technical annex) found that a similar level of emission reduction could be achieved (3.87 Mt CO2 generated through to 2038) for a similar total system cost (£5.4bn compared to £5.3bn). A hydrogen heat based future could also be more appealing to Bury'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 Bury in support of Greater Manchester's commitment across the Combined Authority area is estimated to represent total energy related costs of between £5b and £6b across all scenarios

The primary scenario for Bury:

- Will require capital investment of £3.5bn (excluding energy costs) in less than 20 years. This investment is broken down with an approximate spend of £573m on energy networks, £898m on Bury's dwellings, £1,183m on Bury's non-domestic buildings and £845m on energy generation technologies (excluding dwelling/building heating systems). This has the potential to build local supply chains and create jobs for the future as part of a green industrial revolution for Bury

- By 2038 the local electricity network in Bury could supply as many as 65,000 domestic EV charge points distributed across the local area and numerous EV community charging hubs, primarily located around Bury Town, Ramsbottom and Radcliffe

- Over 75,000 homes could have heat pumps with over 75% 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 Bury will need to shift to a combination of electric and hybrid solutions

- 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.

- Hydrogen production and distribution could see some areas of gas network retained and repurposed by 2038, particularly in the south of Bury (Prestwich, and Radcliffe) which could then be extended to Ramsbottom.

- Heat networks will grow and expand, particularly in the town centre of Bury but also potentially in smaller compact off-gas conurbations. Existing homes will 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

- This will provide access to a wide range of flexible resources including energy storage, heating systems and electric vehicles able to participate in future flexibility and local energy markets

The Scale of the Challenge

The table below 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 Bury to achieve carbon neutrality.

Local Energy System Aspects	Key Metrics	2025	2030	2035	2038
Local Energy Consumption	Local energy consumption (excluding transport fuels, GWh/yr)	1,884	1,892	1,761	1,668*
	Number of dwellings	86,710	89,859	92,499	94,362
	Non-domestic buildings (m^2)	3,995,544	4,276,517	4,373,464	4,738,464
Local GHG Emissions	Local greenhouse gas emissions (ktCO2e/yr)	332	250	107	36********
Local Energy Demand Reduction	Basic domestic retrofit measures installed (no of homes)	4,000	12,000	30,000	44,753†
	Deep domestic retrofit measures (no of homes)	500	1,500	4,000	6,161††††††††
Local Electrification	Petrol & diesel vehicles on the road (No of vehicles)	100,103	76,583	41,776	13,644********
	Pure electric vehicles on the road (No of vehicles)	3,904	22,006	52,682	87,460********
	Hybrids (including plug-in) on the road (No of vehicles)	6,934	16,872	25,041	19,984********
	Domestic EV charge points installed (No)	3,000	18,000	48,000	65,273††††††††
	Heat pumps installed (No of homes)	3,000	21,000	59,000	75,346††††††††
	Rooftop solar PV generation capacity installed (MWp)	265	330	330	330********
	Ground-mounted PV generation capacity potential (MWp)	40	120	340	413††††††††
Local Heat Networks	Domestic heat network connections	500	2,500	8,000	11,811††††††††

* Represents final total (not additional) modelled numbers in the primary scenario where preceding time period numbers are based on modelled forecasts

† Represents final total (not additional) numbers in the primary scenario where preceding numbers are illustrative to show potential rate of scale-up and are not based on modelling/analysis

Capital Investment*	Buildings and energy system (£m)	442	860	1444	752

* For the energy system components presented in the cost and investment section I.e. excludes purchase of vehicles and dwellings/buildings

9. SUMMARY AND CONCLUSIONS

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 Bury 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 taking 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 Bury. It will require systematic changes in consumer and business behaviours, Bury's local energy networks, the use of energy in its buildings and the ways people move around.

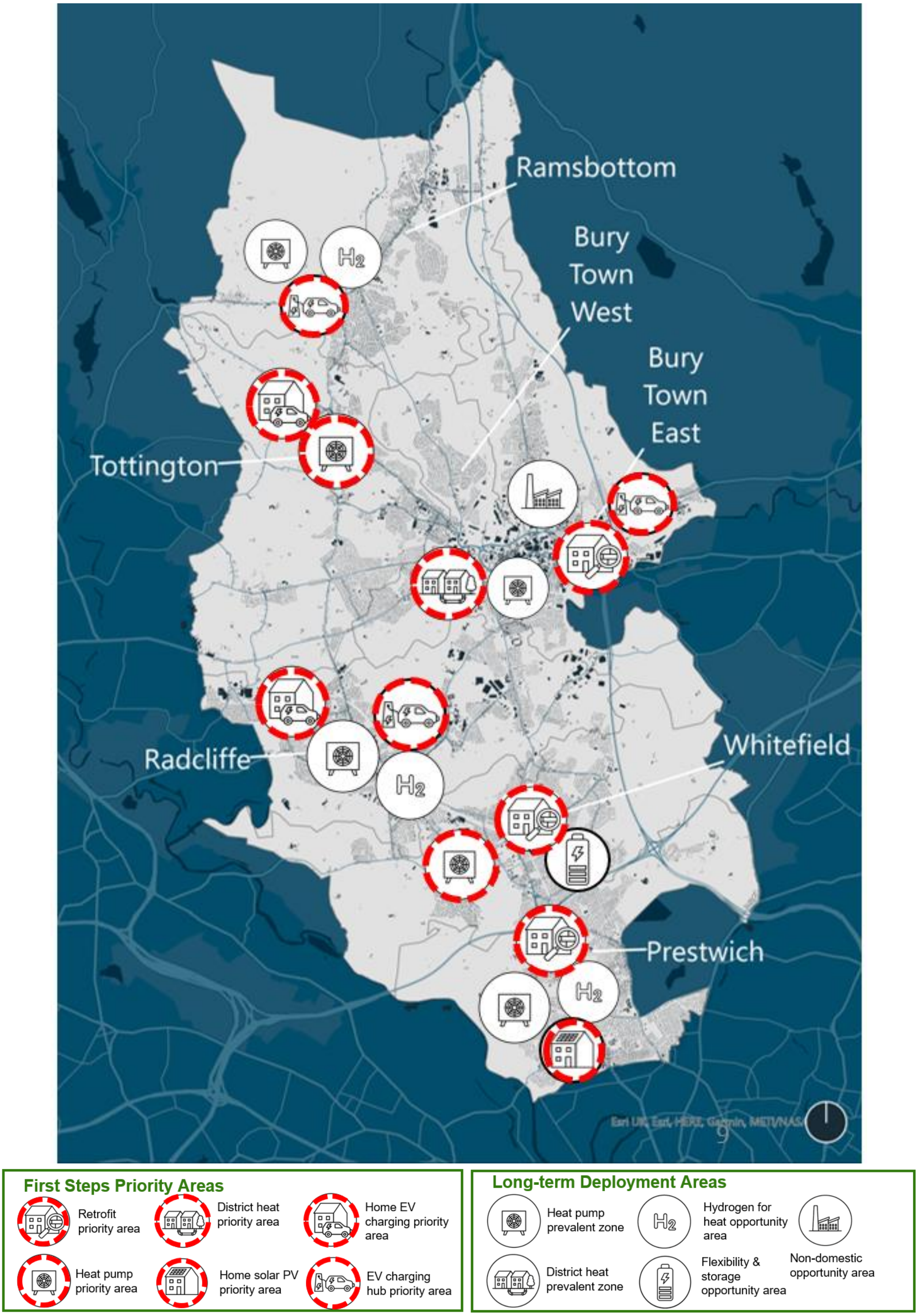
This LAEP provides Bury with both:

- 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 Bury, 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 Bury 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, Bury 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.

First Steps (Demonstration & Scale up)



Next Steps

Using the insights within this LAEP and in the identified priority areas, Bury 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 Bury, 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
- Conduct further heat network feasibility analysis to develop initial schemes and further develop zones
- Determine approach for procurement and working with energy and technology suppliers and service providers, including considering relationship with developing local skills and supply chain
- 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 Bury's citizens
- Determine approach for ensuring the integration of components and activity so that measures are not considered in isolation

* 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

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 Bury Council with Six Towns Housing 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 Bury 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.

About Energy Systems Catapult

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

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 – Bury
Version	1.1
Status	Approved: Contains reviewed and approved
Restrictions	Open

Review and approval:

	Name	Position
Author	Richard Leach and Lewis Bowick	Local & Site Energy Transition Manager Local Energy Area Planning Consultant
Reviewer	Rebecca Stafford	Senior Manager – Local Energy Systems
Approver	Richard Halsey	Capabilities Director

Revision history:

Date	Version	Comments
20/04/21	0.1	Initial draft
06/05/21	0.2	Draft for internal review
07/05/21	0.3	Working draft for initial client consultation
04/06/21	1.0	**Client issue**
16/05/22	1.1	Minor updates to formatting

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

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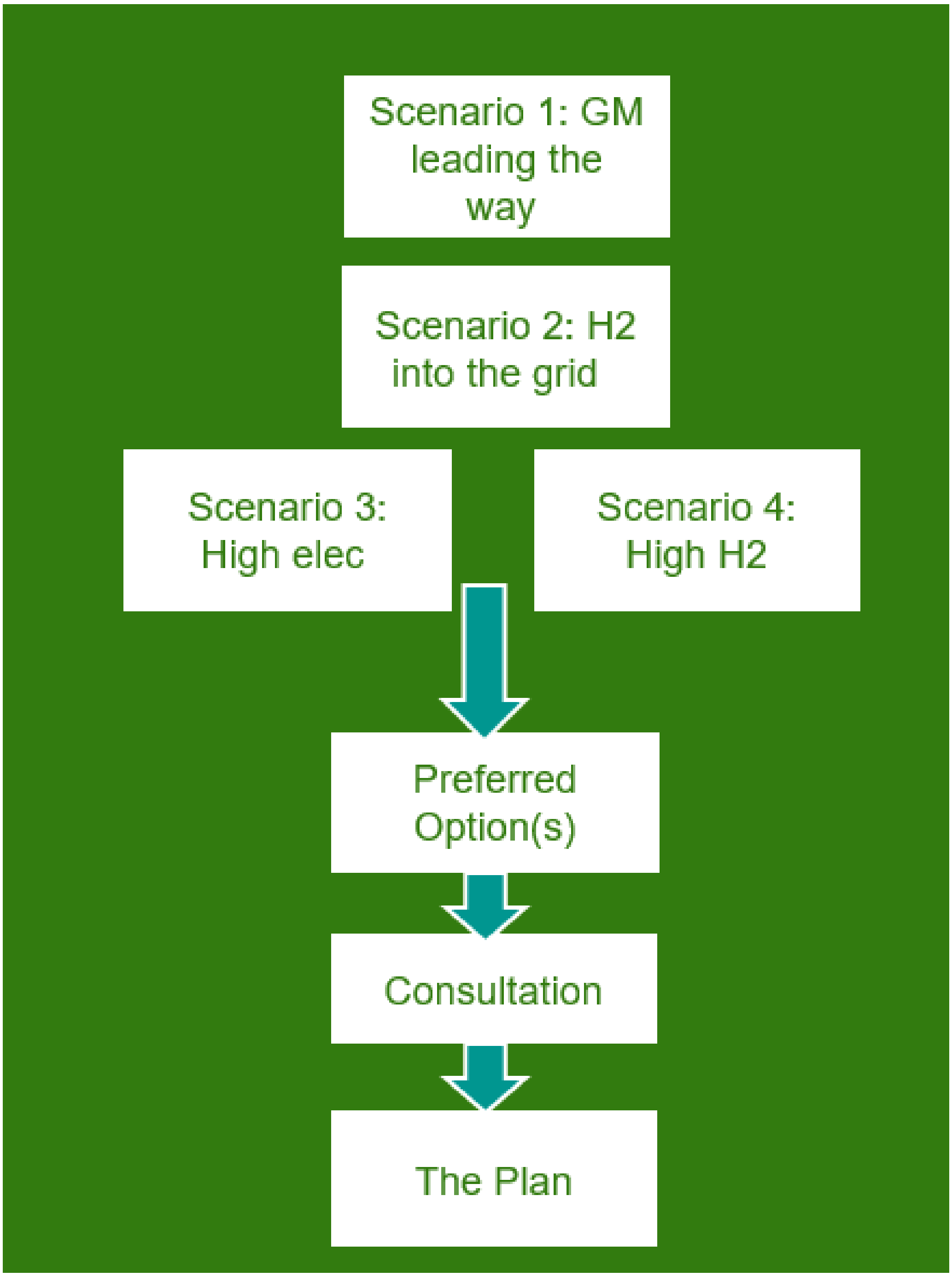
THE FOUR SCENARIOS

A variety of energy system scenarios are possible to deliver Greater Manchester and Bury's future energy vision. It is not practical to consider every possible configuration of Bury'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.

Modelled Scenarios and Plan Development



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 primary scenario for Bury. 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 and Bury, as well as consulting with a wider group of stakeholders including Cadent and Electricity Northwest. Further consultation and engagement with Bury 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 Bury and other districts

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 Bury 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 Bury. These scenarios are constructed using location specific information on Bury'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.

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 Bury's local control** where at all possible.

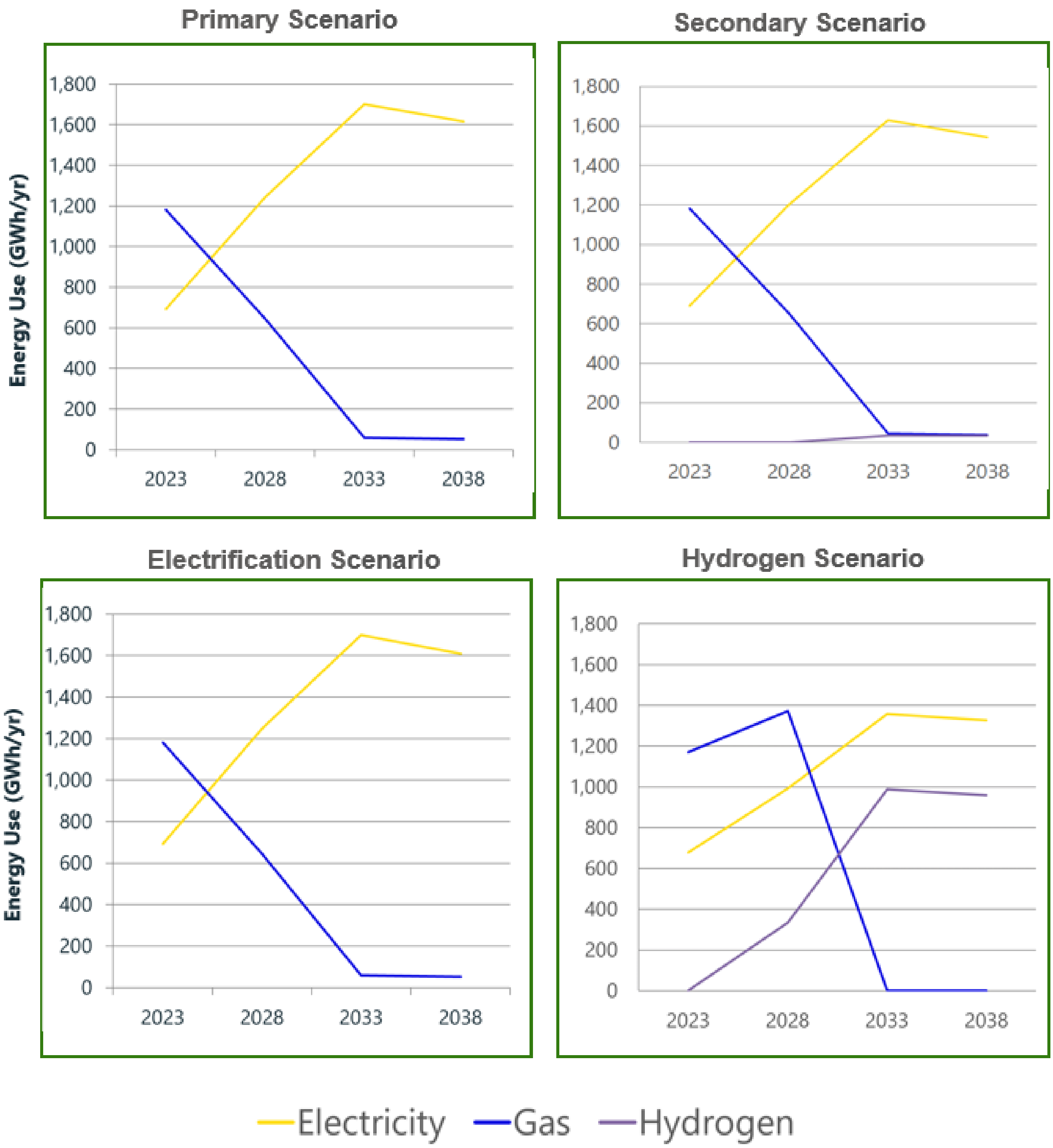
- **Scenario 2 – An Alternative Future Local Energy Scenario:** we have assumed hydrogen options for residential heating and non-domestic buildings become available in Bury from 2030 onwards, aligned to HyNet Phase 3 and the repurposing of the gas grid to hydrogen is an option

- **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

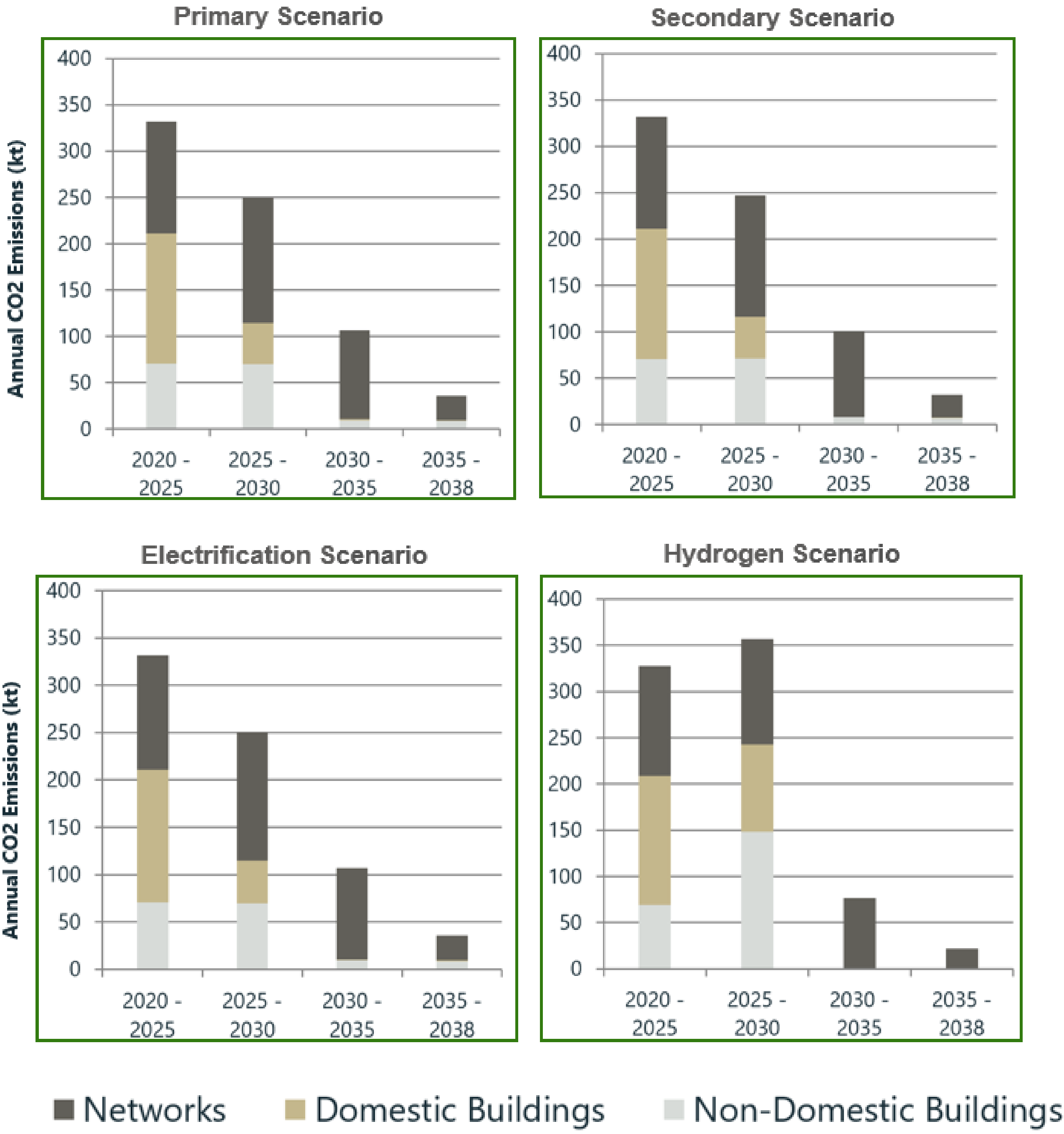
Scenarios 3 and 4 provide context and evidence for what would happen if either hydrogen or electrification were pursued as the sole solution for the decarbonisation of homes and buildings in Bury. Whilst this is considered to have a number of practical limitations to feasible implementation by 2038,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

ENERGY CONSUMPTION

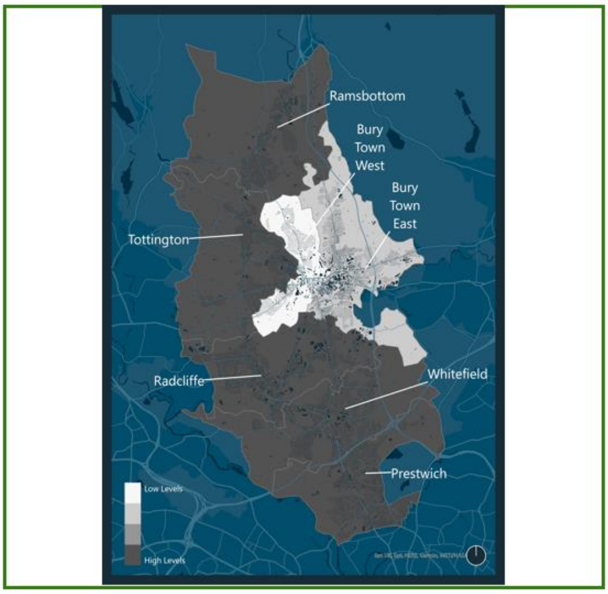


Bury Local Area Energy Plan 2021
Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, due to the reduction in transport fuel consumption.

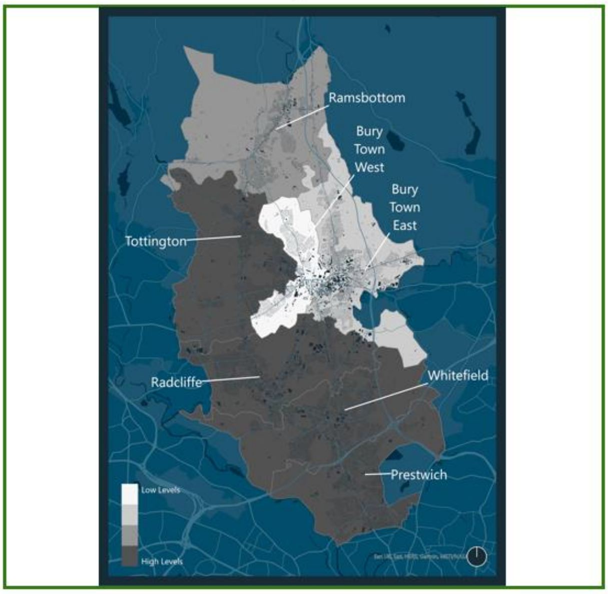
EMISSIONS


Primary Scenario
Secondary Scenario
Electrification Scenario
Hydrogen Scenario
Annual CO2 Emissions (kt)
400
350
300
250
200
150
100
50
0
2020 - 2025
2025 - 2030
2030 - 2035
2035 - 2038
Networks
Domestic Buildings
Non-Domestic Buildings

Primary Scenario



Secondary Scenario

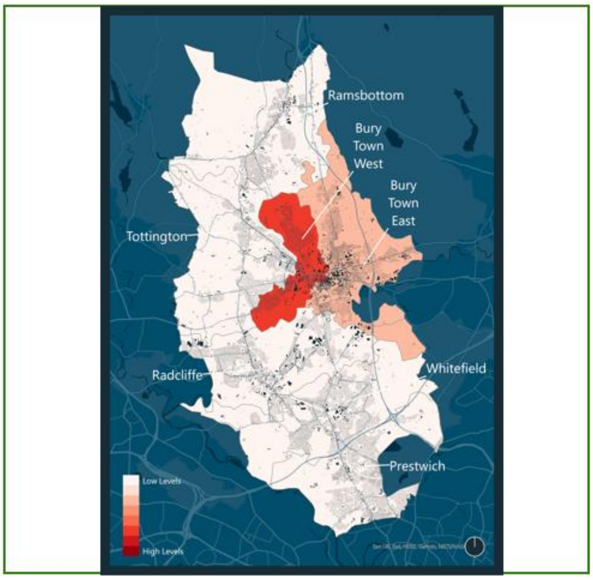


Electrification Scenario

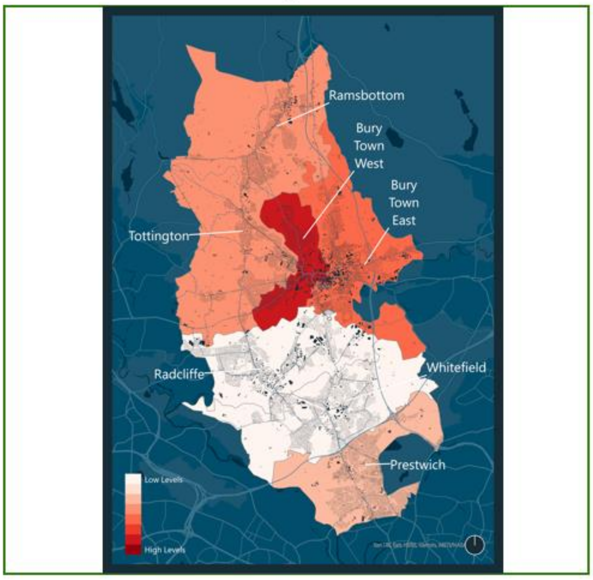
Hydrogen Scenario

HEATING ZONING OPTIONS: DISTRICT HEATING CONNECTIONS BY 2038

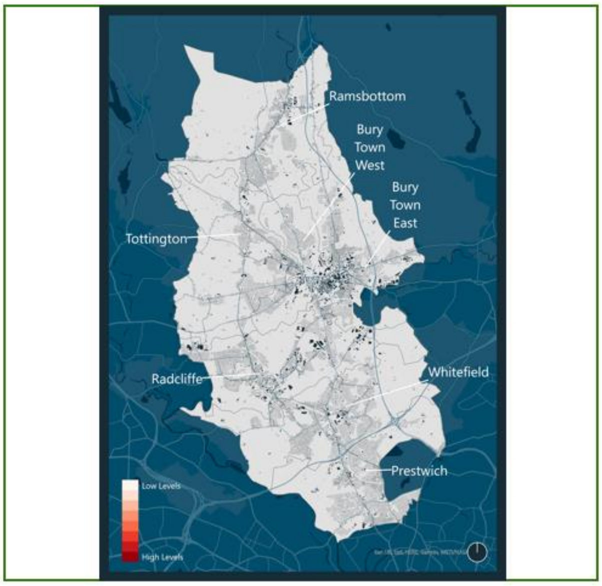
Primary Scenario



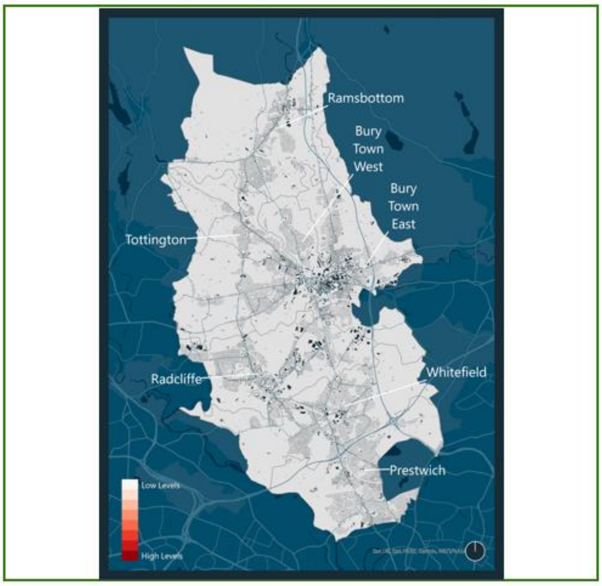
Secondary Scenario



Electrification Scenario



Hydrogen Scenario



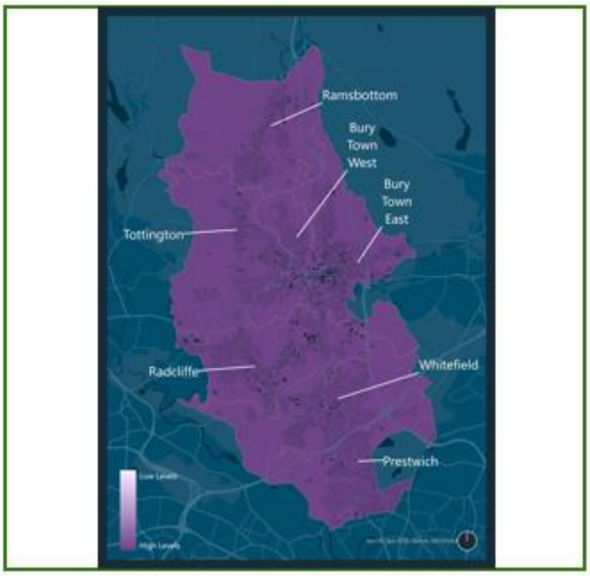
HEATING ZONING OPTIONS – HYDROGEN BOILER DEPLOYMENT BY 2038

Primary Scenario

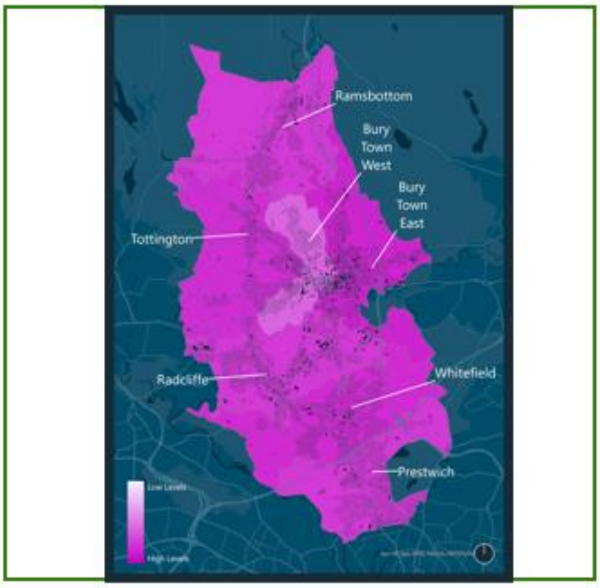
Secondary Scenario

Electrification Scenario

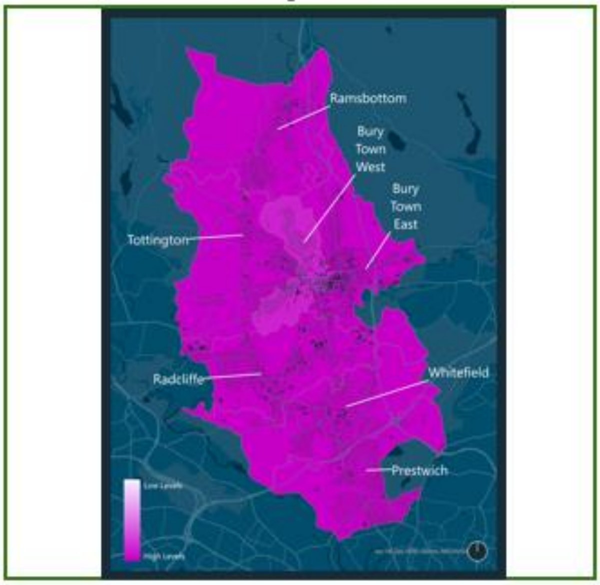
Hydrogen Scenario



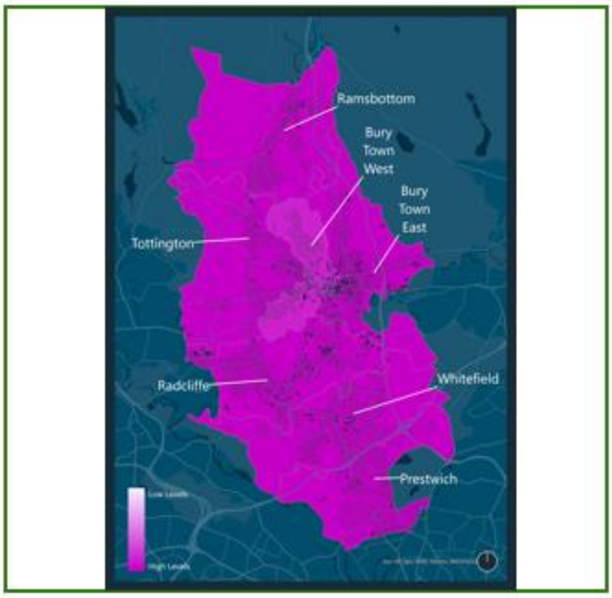
Primary Scenario



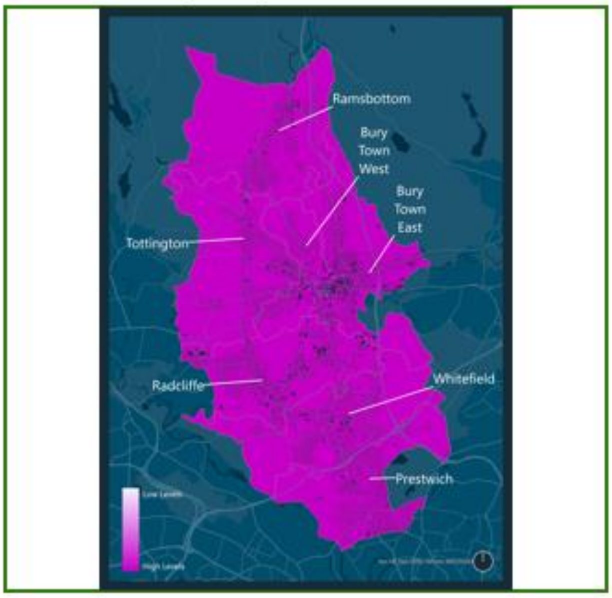
Secondary Scenario



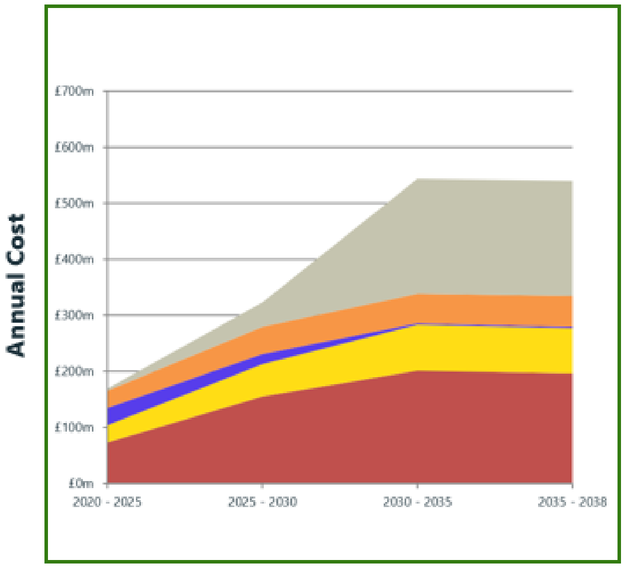
Electrification Scenario



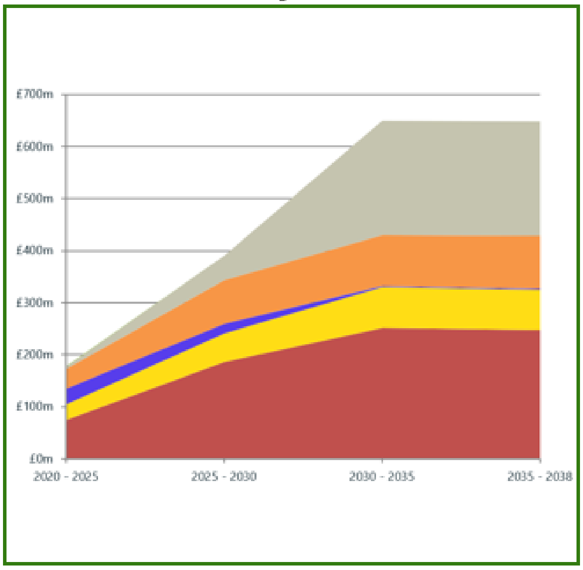
Hydrogen Scenario



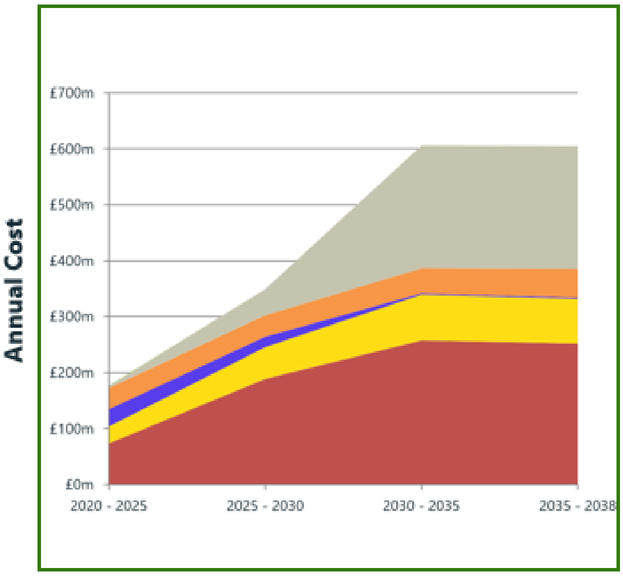
Primary Scenario



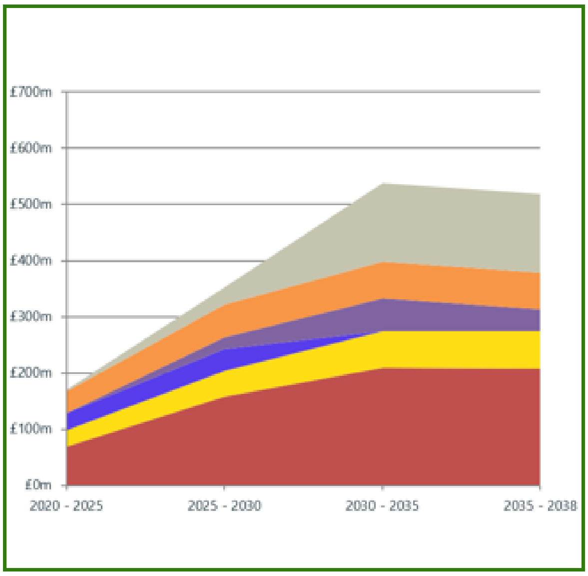
Secondary Scenario



Electrification Scenario



Hydrogen Scenario



Data Sources Annex

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

BUILDINGS

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 (EPC)s***
  - 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.
- In total over 3,000 sites provided

* https://epc.opendatacommunities.org/
† https://historicengland.org.uk/listing/the-list/data-downloads/
‡ https://epc.opendatacommunities.org/
Note: details of Green Homes Grant (GHG) and Local Authority Delivery (LAD) projects provided separately by Local Authorities where relevant

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 charge points.

- **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.

* 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