GREATER MANCHESTER LOCAL ENERGY MARKET

DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Local Area Energy Plan

Salford, Greater Manchester

May 2022

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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.

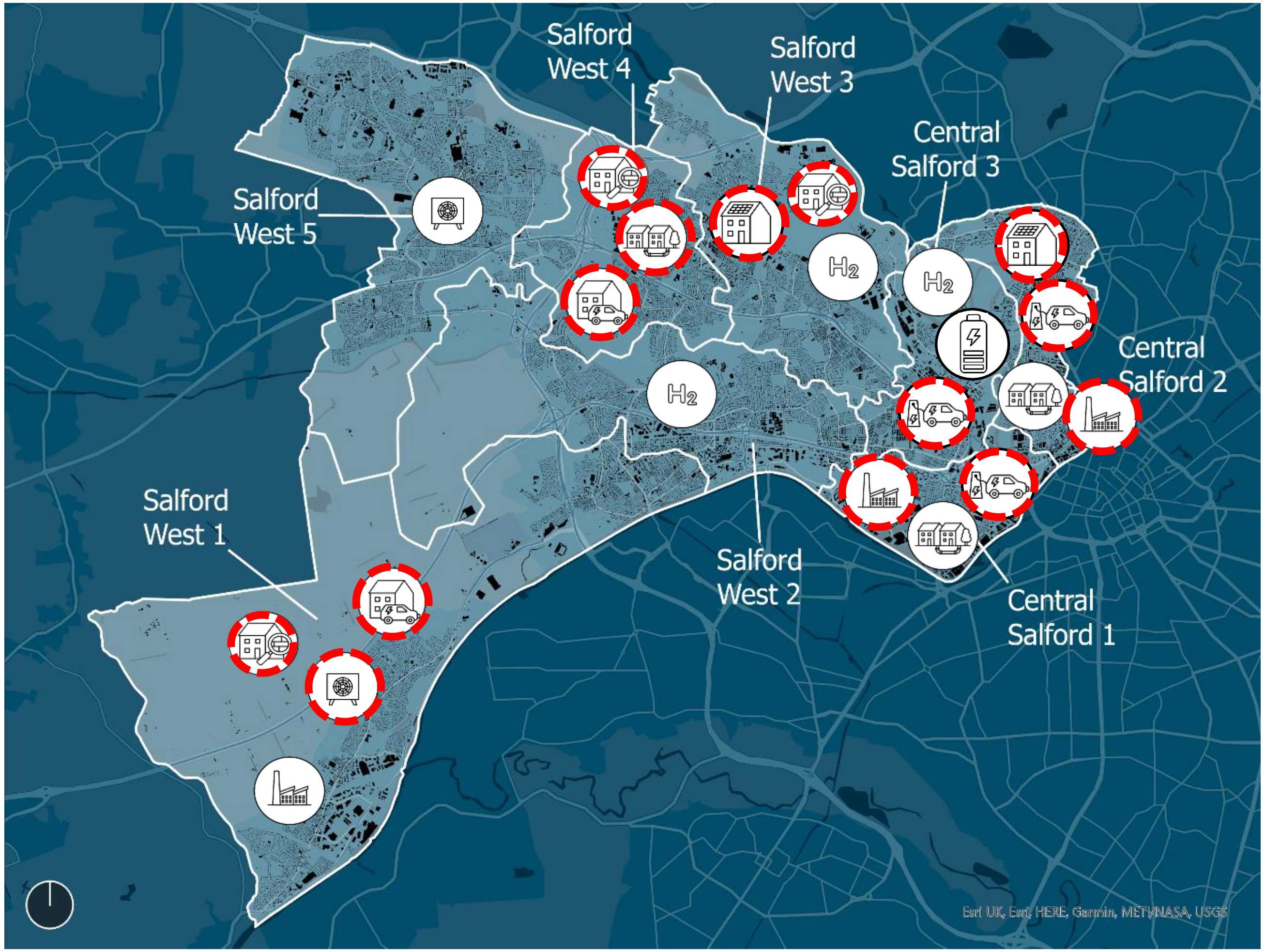
The technologies and future trends considered and assessed for meeting Greater Manchester's carbon neutrality targets include: thermal insulation, heat pumps, district heating, electric resistive heating, hydrogen boilers, solar photovoltaics (PV), wind turbines, hydropower, electric vehicles (EVs), demand flexibility and energy storage.

Scenarios for achieving Carbon Neutrality in Salford

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 Salford'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 Salford from 2030 onwards (aligned to HyNet Phase 3[†]) and the repurposing of the gas grid to hydrogen is an option

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



Local Priorities and Measures

Salford 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.

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

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

First Steps Priority Areas

- Retrofit priority area
- District heat priority area
- Home EV charging priority area
- Heat pump priority area
- Solar PV priority area
- EV charging hub priority 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 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. 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 (ENWL) and Cadent in piloting a data-driven whole system approach in 2018. Since this initial pilot, Greater Manchester has launched its Five-Year Environment Plan, which includes a commitment to be carbon neutral[†] by 2038, and an accompanying science-based carbon budget. Alongside this, there have been significant updates to the supporting whole system modelling approach, including the latest technology attributes and costs, updated building data and network data, changes in EV uptake projections and more detail in options for decarbonising non-domestic buildings. The most significant update has been the addition of hydrogen in line with HyNet[‡] projections, as an option that in certain scenarios can be used to decarbonise heat demand in domestic and non-domestic buildings. This is key as achieving carbon neutrality will require the transition of Salford's heating systems from natural gas fired boilers to electrified heating systems, district heating networks or converting the gas network to hydrogen.

Modelling Approach

We have used the ESC-developed EnergyPath Networks tool to produce a series of future local energy scenarios for Salford (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 Salford, the national Energy System Modelling Environment (ESME) – an internationally peer-reviewed national whole energy system model – has been used to identify the lowest-cost

[*] 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
[‡] 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

decarbonisation scenarios for the UK energy system to then feed into the local modelling.

These scenarios have been used to inform the development of a primary and secondary scenario that illustrate a potential cost effective vision for carbon neutrality in Salford. These explore the actions and investment needed in different areas of Salford 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; home charging of personal electric cars; and process emissions from large industrial installations. Out-of-scope are emissions from agriculture, all usage of liquid fuels for transportation, and electricity use for vehicles other than personal cars.

It should be noted that techno-economic optimisations (i.e. the scenarios that have been considered and modelled) are imperfect. Many low carbon solutions have benefits and drawbacks that cannot be easily represented in modelling approaches. This appreciation has been used to shape the LAEP; however, as the LAEP is taken forward, new significant insight may result in a requirement to update this.

Scenarios for achieving Carbon Neutrality in Salford

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 areas within this LAEP.

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

Both the primary and secondary scenarios make assumptions around changes to behaviour, advances in technology and innovation, whilst recognising uncertainty in key areas such as the potential use of hydrogen for transport and heating in homes and buildings, as well as advances in energy storage and controls. While it is not a prescriptive plan to be followed exactly, it does provide a detailed spatial evidence base and supporting data that can be used to inform the planning and coordination of activity in Salford over the coming years. Where hydrogen for building heating does become available (as per the secondary scenario), it is expected that all the components within the primary scenario (heat pumps, district heating, solar PV, EV charging, building fabric retrofit and flexibility and storage systems) will still be needed to decarbonise Salford; 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.

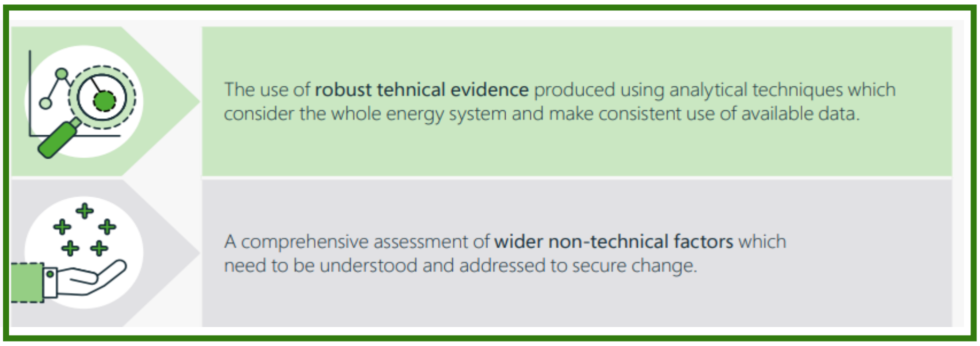
In summary, the scenarios have been developed in response to the science-based carbon budget for GM: defining a credible plan for Salford, based on currently deployable technologies, to support an understanding of the actions, pace and scale of change as well as the investment needed. Insights from the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

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.

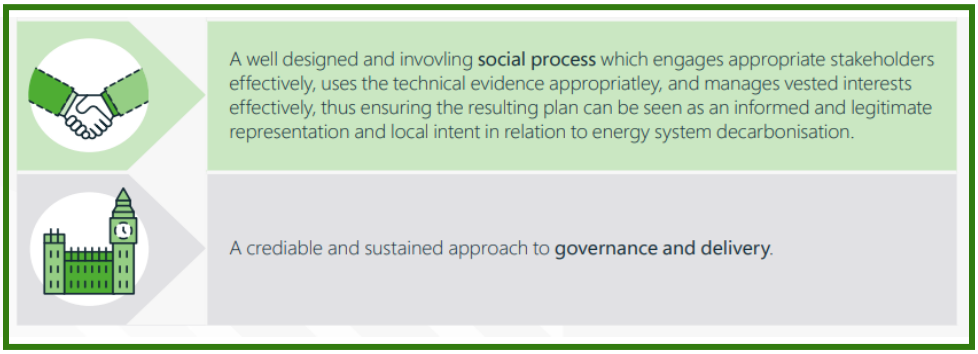
In accordance with the Ofgem LAEP Method[†], which provides guidance and framework for LAEP done well, this plan has been developed through the use of robust technical evidence which considers the whole energy system for Salford and consistent use of available data and assumptions.

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

[*] Decarbonisation Pathway for Greater Manchester, Reaching carbon-neutrality in a balanced scenario by 2038, Navigant, July 2020
[†] From LAEP: The method https://es.catapult.org.uk/reports/local-area-energy-planning-the-method/



The 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 Salford 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 level, streamlining the approach and reducing the need for separate processes with each local authority.

Report Structure

The report is set out in the following structure: it summarises the key aspects of the plan and its supporting modelling and analysis, and is presented in five parts (9 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 to reach carbon neutrality in Salford, informed by the scenario analysis. The primary scenario demonstrates how Salford 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 Salford.

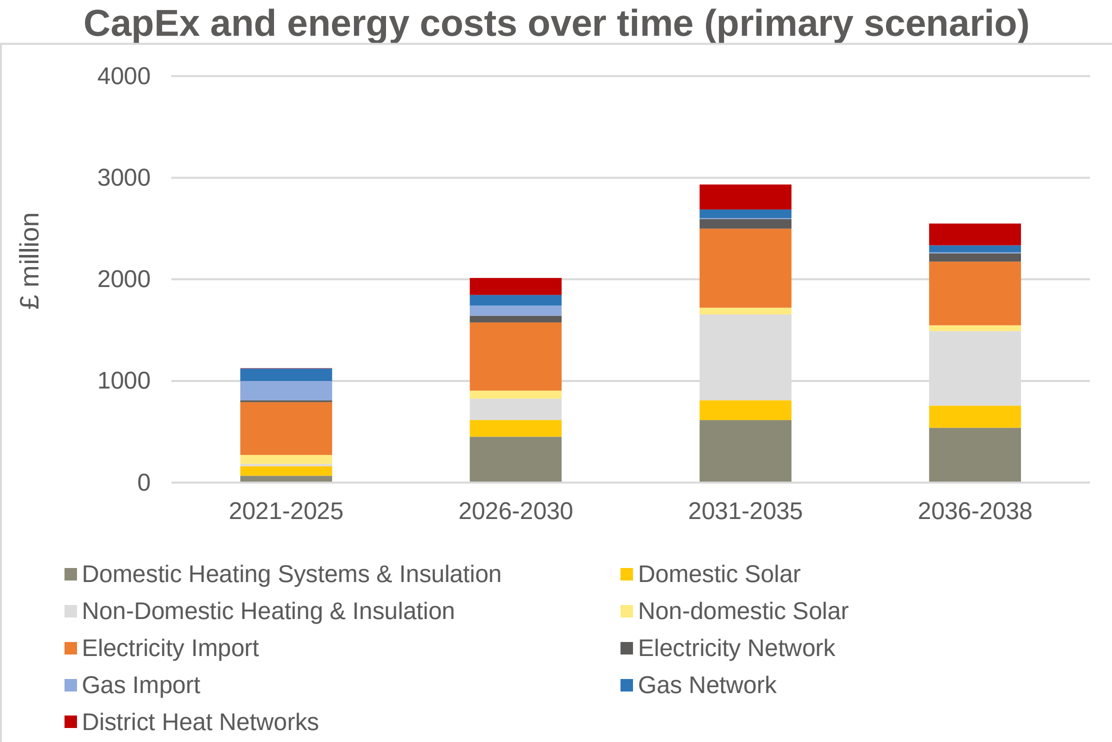
Chapters 3-7: set out some of the key aspects of the primary and secondary scenarios and what this means in relation to implementation for Salford including Fabric Retrofit (Chapter 3), Heating System Zones (Chapter 4), EV charging and infrastructure (Chapter 5), Local Energy Generation and Storage (Chapter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

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

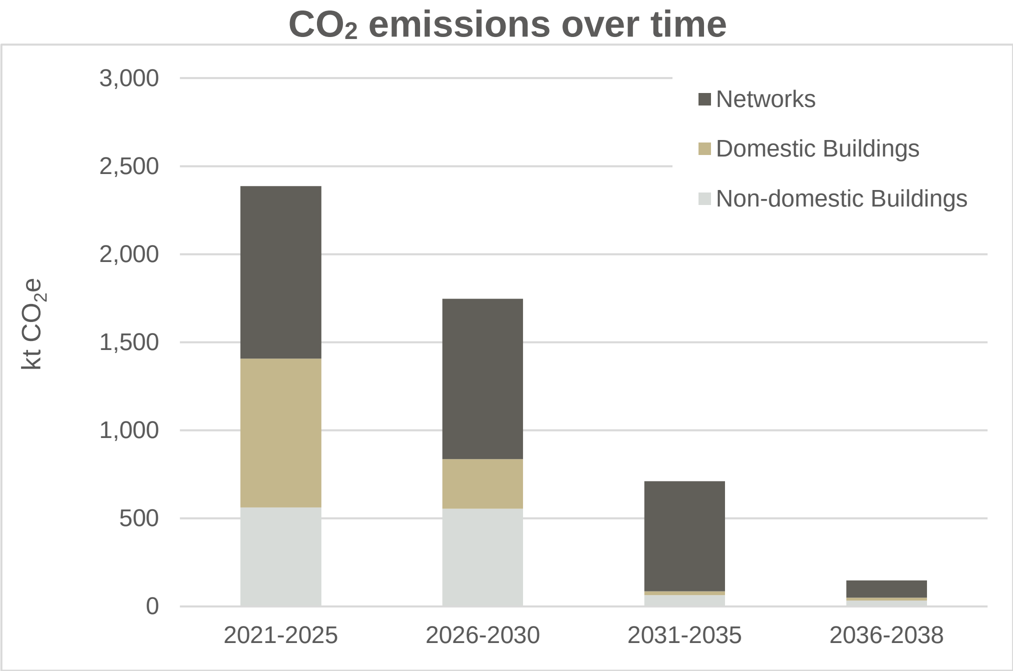
Chapter 9: summarises the key findings and recommended actions to support implementation and ongoing review and monitoring in the context of national and regional energy strategy, carbon budgets and associated policy and regulation.

This Local Area Energy Plan (LAEP) aims to support Salford 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 Salford local energy system by 2038 is achievable and expected to require capital investment of £5.8bn. Total energy costs including capital investments, operations and energy consumed is between £8.1bn and £8.7bn to 2038*; the upper chart illustrates the breakdown of this expenditure over time for different components (for the primary scenario). The lower chart shows how implementing the transition reduces carbon emissions†. The cumulative emissions over the period 2021-2038 in this scenario are 4.9 Mt of CO_2e (from a range of 4.8 to 5.0 Mt of CO_2e across the scenarios assessed), of which 2.6 Mt of CO_2e 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 Salford and Greater Manchester for decades; key chapters of this LAEP illustrate the scale of change and investment needed, based on a primary scenario. An alternative scenario (secondary), incorporating the use of hydrogen for heat, is also presented on page 17 (along with other variations within the appendix), where the supporting analysis indicates that hydrogen could have an important role in decarbonising Salford. 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 Salford’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

At least **30% of Salford’s dwellings receive insulation retrofit** in the plan: around **50,000 in the primary scenario, rising to almost 68,000 in the hydrogen focused secondary scenario**. The greater number of retrofitted dwellings, which involves more extensive (or deep) measures, required in the hydrogen scenario is included to help meet the carbon budget. Fabric retrofit and solar PV are low regret measures to progress in the short-term.

Heat Decarbonisation

Three heating options are explored to decarbonise buildings: electric heating (primarily heat pumps), hydrogen to replace natural gas, and district heat networks. For hydrogen to play a significant heat decarbonisation role, certainty would be required that hydrogen will be available to supply Salford in a timeframe that supports the delivery of the GM carbon budget. Alternatively, over **100,000 heat pumps** are deployed for most dwellings, except in Central Salford 1 & 2, and Salford West 4, where district heat supplies a large share of buildings due to the higher density of buildings and presence of public buildings. The combined cost of fabric retrofit and heating system replacement is £1.6bn for homes, and 1.8bn 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 & Networks

To reduce emissions in line with the GM carbon budget, local energy generation could increase significantly, consisting predominantly of the installation of solar PV on much of the available roof space across all parts of Salford (under all scenarios considered), providing up to 523 MWp of installed capacity, at a cost of £965m. Land in the area has been identified for opportunities to deploy 75 MW ground mount solar PV for further CO_2 reduction. Energy networks could expand to accommodate electrification, at a cost of £262m.

EV Infrastructure

The transition to electric vehicles, with uptake increasing from around 2,000 plug in vehicles today to over 95,000 by 2038, drives a demand for EV chargers to be installed across all areas. Around 43,000[*] domestic chargers would be installed (one for every home with potential for off-street parking) at a cost of £24m, along with multiple public charging stations (or hubs). Areas where fewer car owning households have potential for off-street parking rely more on public charging hubs.

[*] Based on ESC in-house analysis of EV uptake. Quantities will need to be aligned with planning policies such as Policy A10 of the Salford Local Plan as it relates to new developments.

Consumer Uptake

By the early 2030s all new cars and vans, and all boiler replacements in dwellings and other buildings in Salford are low-carbon[*]; the vast majority of heating systems are either electrified or use hydrogen. Between 43,000 and 103,000 of Salford's dwellings are fitted with a form of heat pump, and up to 105,000 boilers could be running from 100% hydrogen. By 2038, nearly 90% of cars are electric vehicles or plug-in hybrids, requiring the provision of ~43,000 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 Salford largely shift to using renewable electricity, district heating or hydrogen instead of fossil fuels; carbon capture may be required to reduce remaining emissions.

Low-carbon energy supplied to and generated in Salford

The emissions intensity of UK electricity production is expected to fall by at least 65% from today's levels by 2035[†]. Offshore wind forms a backbone of electricity generation nationally. Renewable electricity production in Salford increases to contribute to the GM carbon budget, predominantly in the form of up to 523 MWp of rooftop solar PV, with opportunity a further 75MW ground mounted solar PV across Salford. Renewable generation (if the ground mounted PV potential is maximised), provides up to 572 GWh annually (23%), with 1,934 GWh (77%) 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 84% by 2038 in the primary scenario and by nearly 57% by 2038 in the secondary scenario.

Low-carbon hydrogen is likely to be prioritised nationally for the hardest-to-decarbonise sectors such as shipping, heavy transport fuel and energy intensive industry, and therefore the quantity that will be available for building heating is uncertain. However, HyNet is a project which aims to pioneer low carbon hydrogen production, potentially making it available to buildings in the region by 2030. Greater Manchester has a carbon budget that requires immediate action to stay within, and so any delay to HyNet could make it too late to keep within the carbon budget. However, hydrogen may have a significant role to play in combination with other technologies. This has been explored in some of the further scenarios. The similarities across scenarios point to low regret opportunities in each area of Salford, and identify potential priority areas for using hydrogen.

[*] 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 Salford'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.

Reducing demand for carbon-intensive fuels

Buildings will lose less energy thanks to a series of targeted fabric retrofit programmes, improving insulation and efficiency across Salford. Fabric retrofit will prepare buildings for zero carbon heating, whilst also making a notable contribution to staying within the carbon budget. By 2038, almost 50,000 of Salford's 159,000 dwellings are retrofitted in the plan (circa 30%), primarily with basic retrofit – measures with modest costs and attractive payback times. The option of deeper fabric retrofit has the potential to increase headroom in the carbon budget to give some flexibility for deferring decisions on heating systems.

Energy Networks

The creation of district heating networks in targeted areas could see over 42,000 homes connected to a heat network in 2038. Central Salford 2 and Salford West 4 zones see the greatest concentration of heat network opportunities. Energy centres predominantly use large-scale heat pump systems to produce heat, though local opportunities for other forms of heat supply such as waste heat should be considered, where available.

Annual electricity demand is forecasted to increase from 1,215 GWh to 2,505 GWh by 2038, due to electrified heat and electric vehicle charging. This requires an increase in electricity network capacity, with the greatest network reinforcement requirement in the areas of Salford West 5, though opportunities to use flexibility and storage in place of reinforcements are explored.

Depending on the conversion and roll-out of hydrogen for heat, gas networks remain in place in some areas to support some hard-to-decarbonise non domestic buildings that may not be of the scale to have a dedicated hydrogen connection. However, should HyNet phase 3 be available, up to 105,000 homes could be supplied by hydrogen by 2038.

Investment

Salford's transition requires a total energy system and building level investment of £5.8bn (excluding energy costs). This unprecedented level of investment provides a once in a lifetime opportunity for Salford. 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 Salford. How it is delivered will influence the local benefit to Salford, 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 nearly £15,000 for the associated measures.

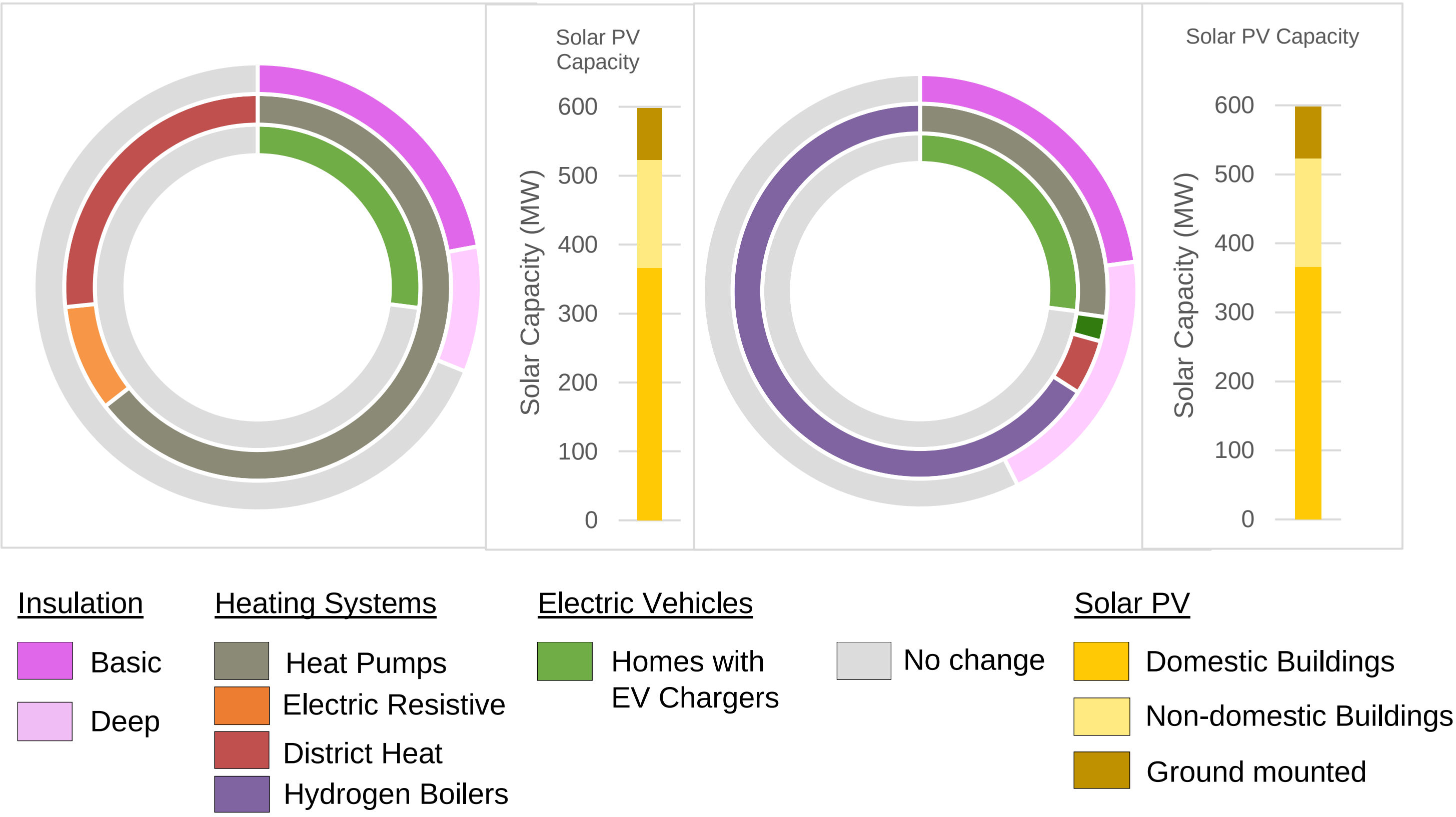
An electric focused heat transition, involving changes to building fabric and internal heating systems (e.g. changes to doors, windows, larger radiators and improved controls) could be more disruptive to residents and it is not clear how this might compare with disruption associated with using hydrogen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

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

What Salford's transition to carbon neutral could look like

Recognising that predicting what Salford's actual transition to carbon neutral will look like is not possible, the charts opposite illustrate the scale of change needed to decarbonise Salford in each scenario. This is intended to illustrate the scale of measures and investment needed to the stakeholders who will support and deliver Salford's transition.

Primary Scenario (left) and Secondary Scenario (right)



The primary scenario to 2038 is most suitable if uncertainty remains around converting the gas grid to zero carbon hydrogen (at an acceptable cost) by the mid to late 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.

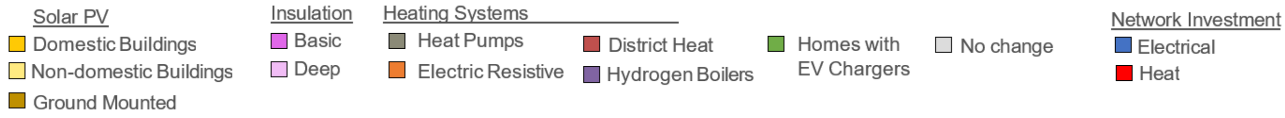
This secondary scenario illustrates an alternative future where hydrogen becomes widely available for heating and hot water in buildings from 2030, in accordance with the aspirations of HyNet phase 3. These graphs show some of the key differences in investment and installation between the primary and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

The availability of hydrogen for home heating in the secondary scenario avoids much of the investment in both electricity and heat networks, although investment for repurposing the gas network to handle hydrogen is needed instead. The need to invest in building retrofit is increased also, as the later availability of hydrogen requires greater savings to be made elsewhere earlier on to meet the carbon budget.

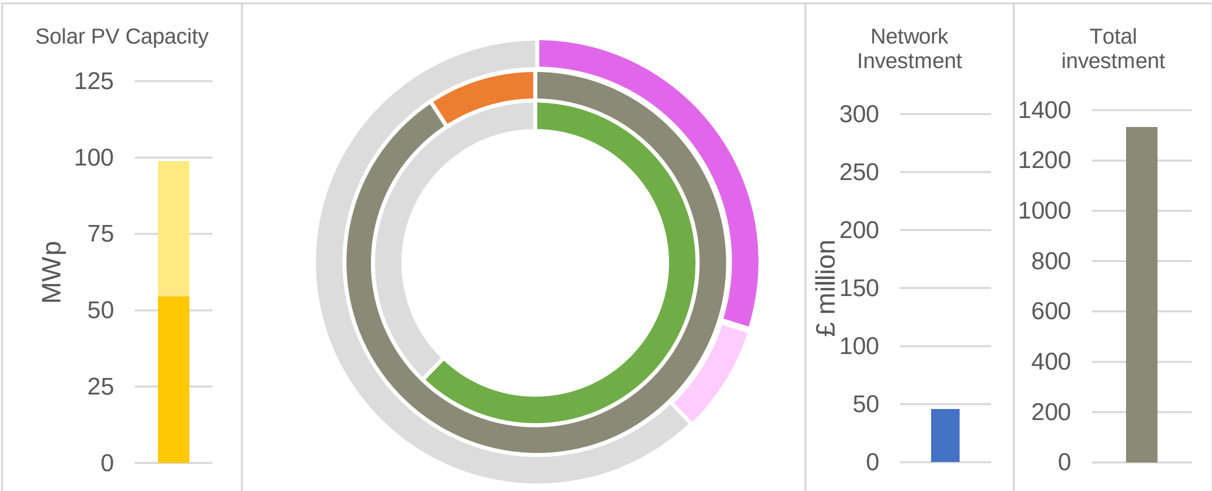
Both scenarios include a similar amount of roof mounted solar PV, required in both cases to provide early emissions reduction to support the carbon budget. EV related aspects are consistent across both scenarios.

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

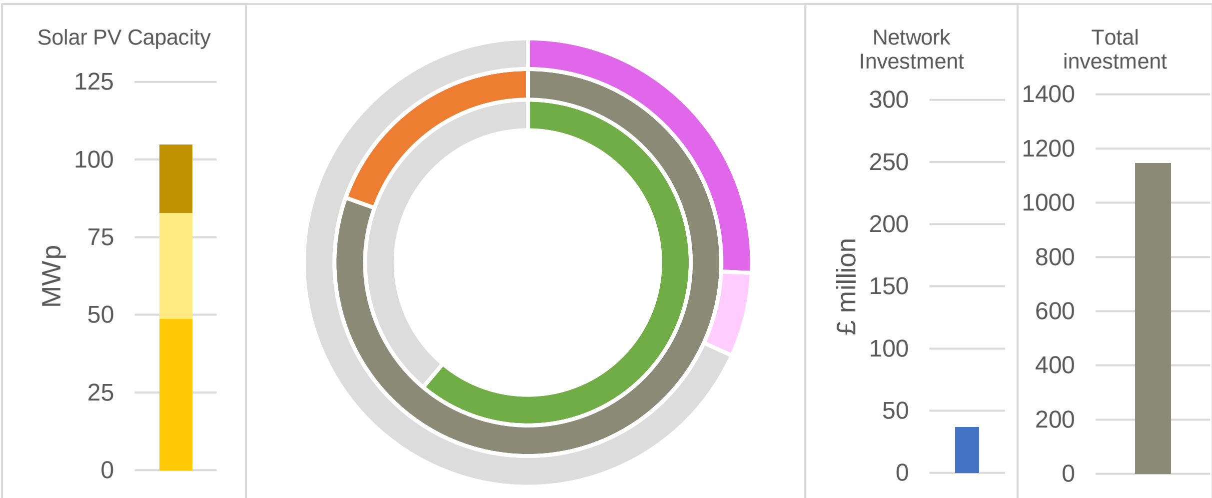
2. THE VISION – BREAKDOWN OF PRIMARY SCENARIO BY ZONE



Salford West 1



Salford West 2



Solar PV
- Domestic Buildings
- Non-domestic Buildings
- Ground Mounted

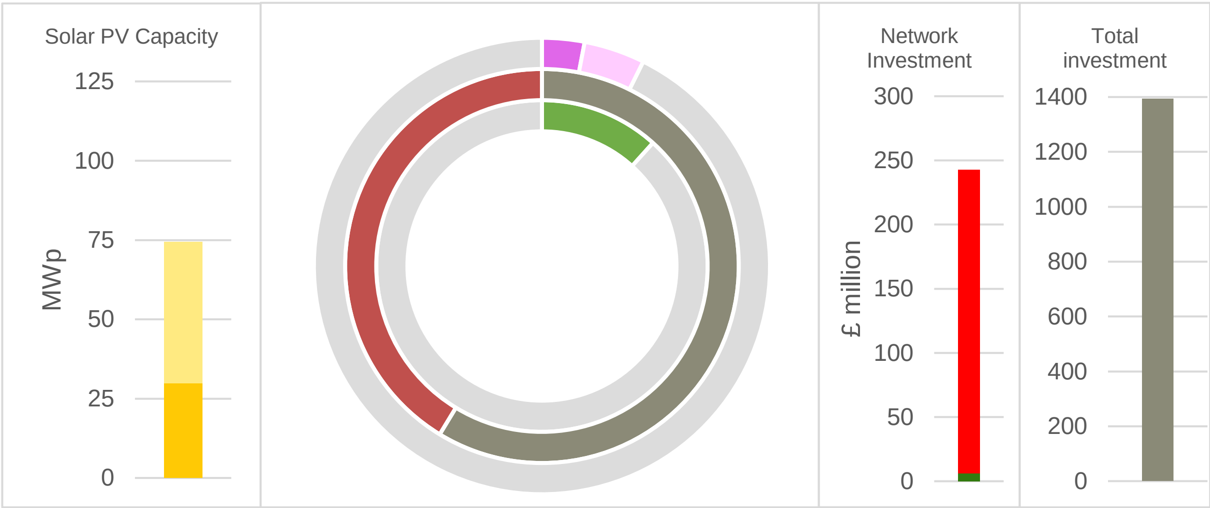
Insulation
- Basic
- Deep

Heating Systems
- Heat Pumps
- Electric Resistive
- District Heat
- Hydrogen Boilers

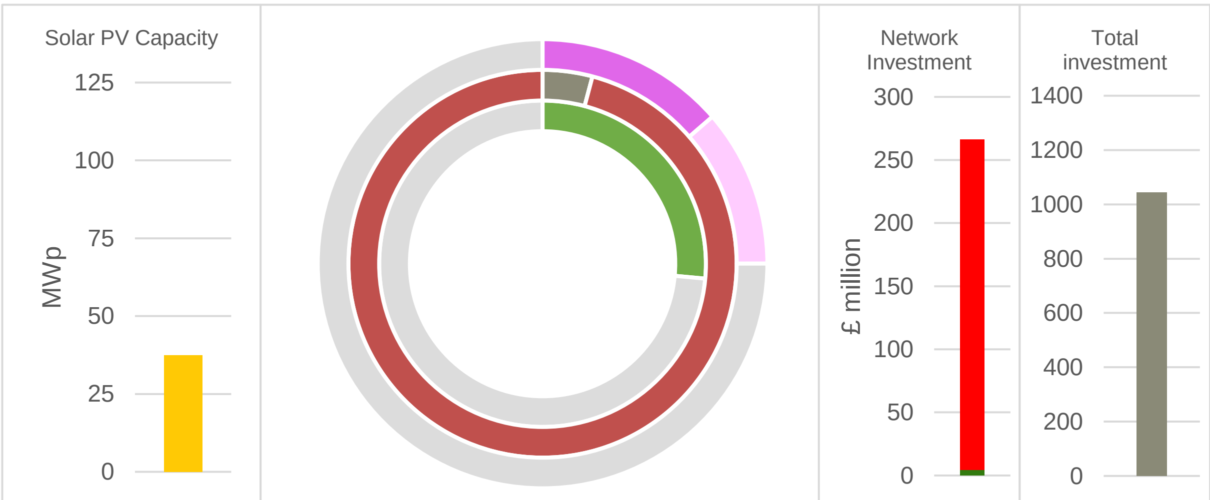
- Homes with EV Chargers
- No change

Network Investment
- Electrical
- Heat

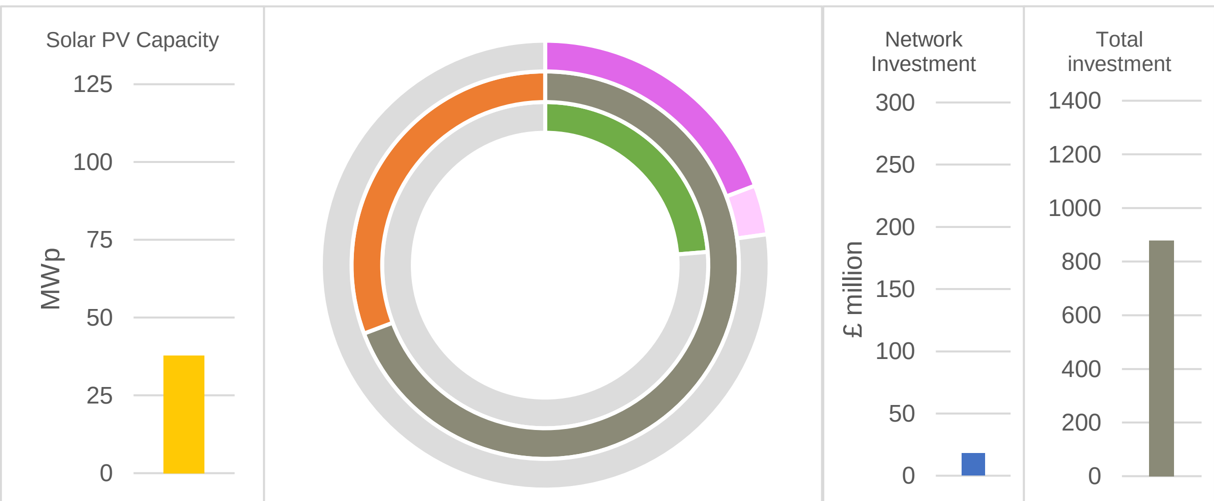
Central Salford 1

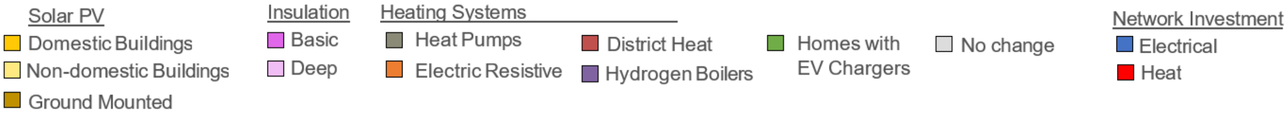


Central Salford 2

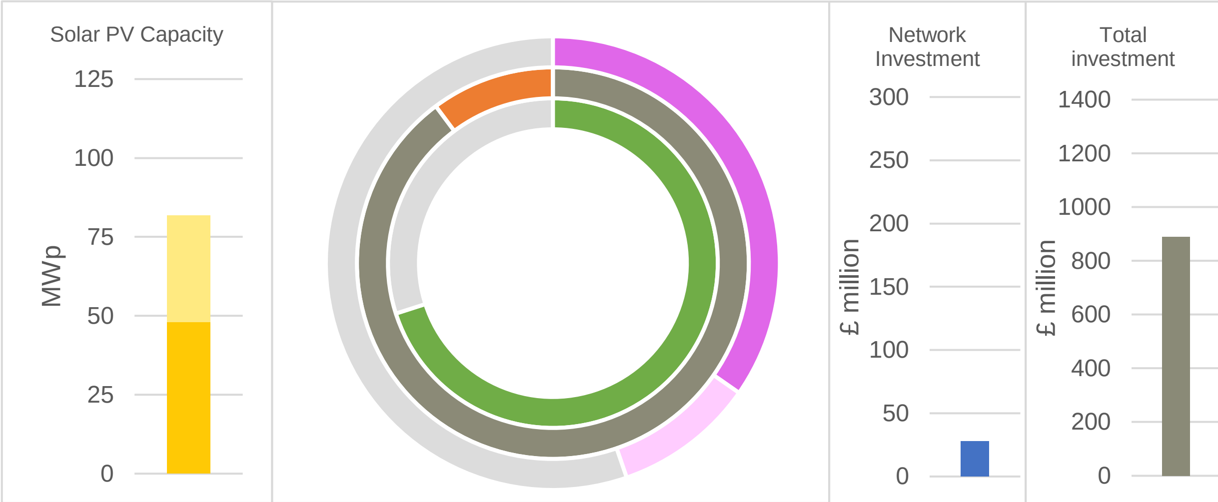


Central Salford 3

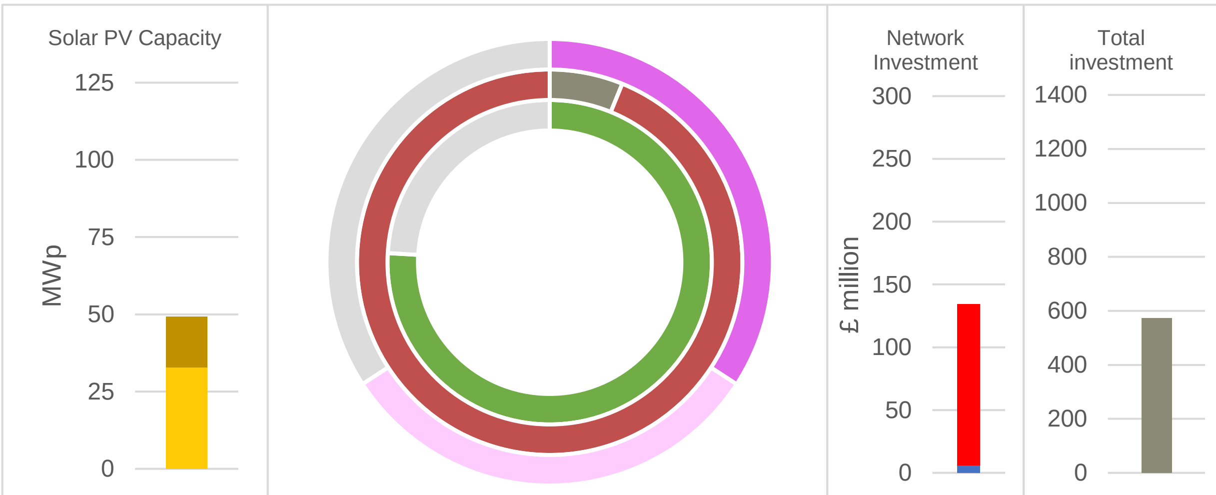




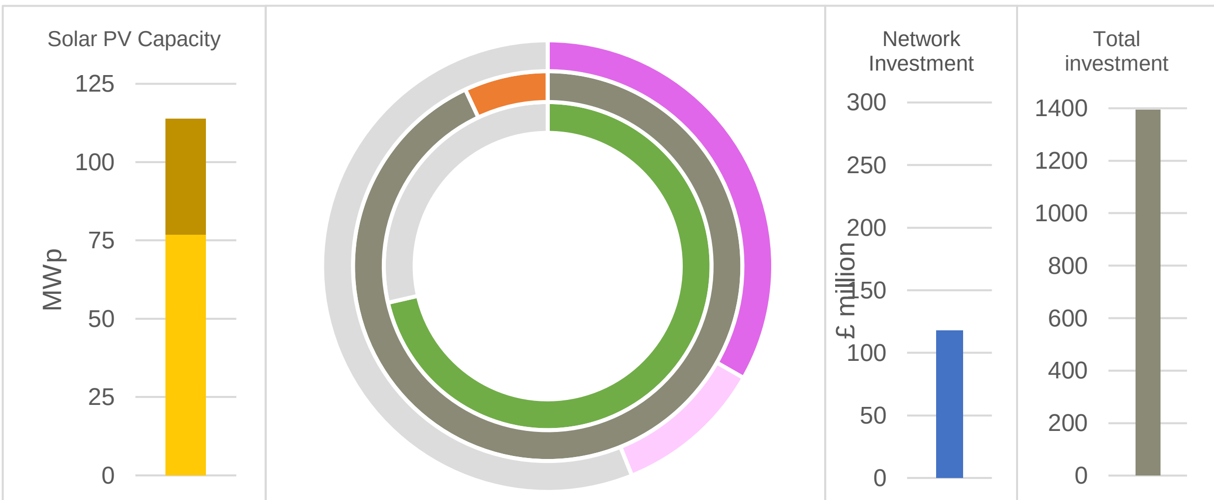
Salford West 3



Salford West 4



Salford West 5



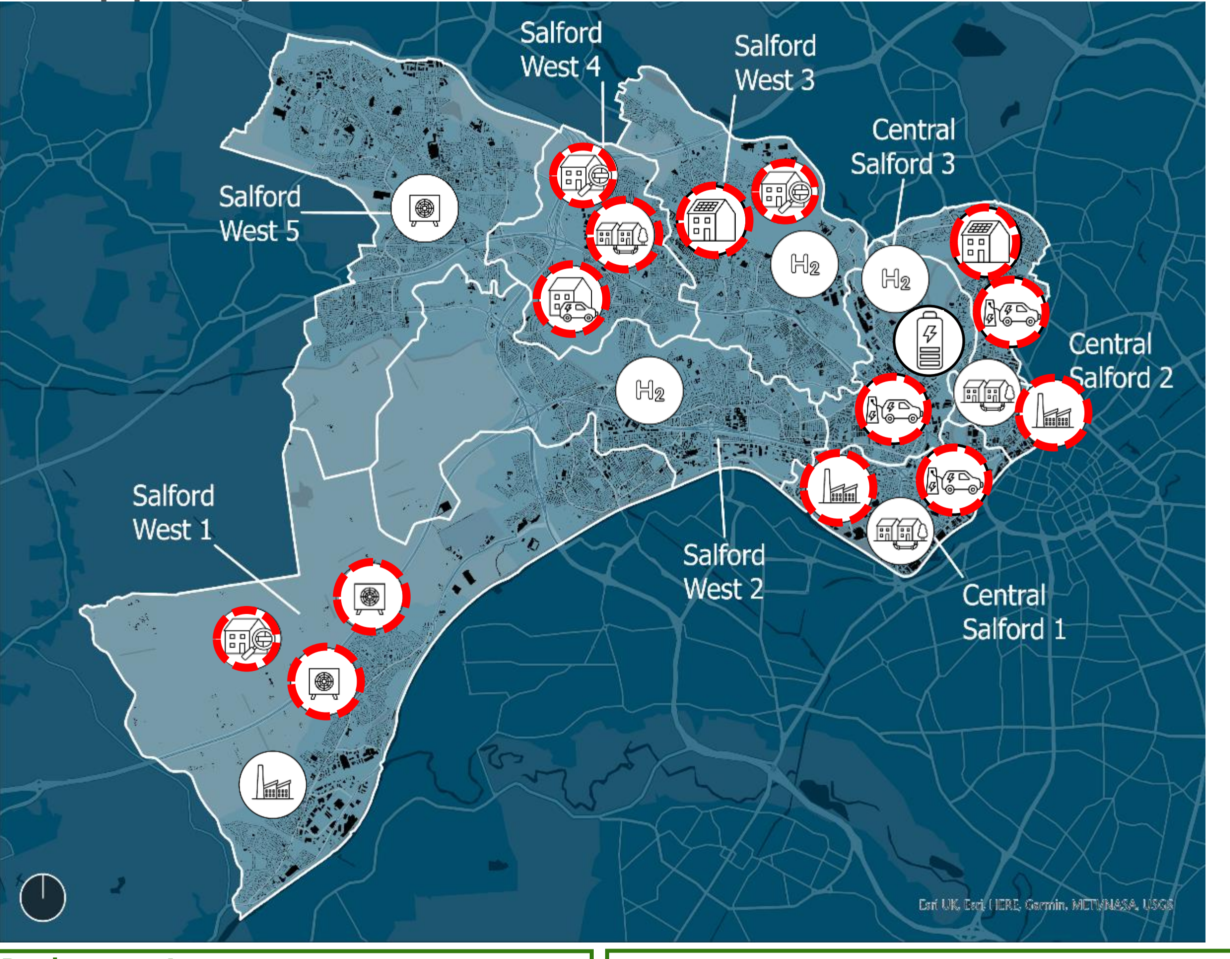
How to use this LAEP

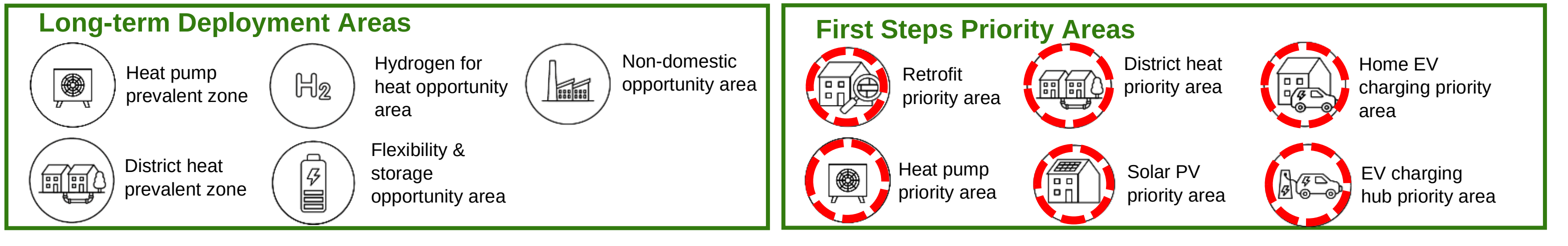
The plan opposite illustrates the proposed activities to progress this LAEP in the near-term, based on a demonstration and scale-up approach, as well as focus areas for changes in the longer term. The red rings highlight priorities to test how to roll out Salford's transition to carbon neutral and work with Salford'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 option, before moving to widescale rollout. For example:

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

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

Demonstration and scale-up priority areas





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

- Salford West 1 (and Salford West 5) have been highlighted as areas where, even if hydrogen becomes widely available for building heating, there would still be significant deployment of heat pumps, meaning that prioritising heat pumps early is a low regrets action.
- Spare electrical capacity in SW1 is additionally conducive to making early progress in this area. In the other zones, heat pumps would also be a low-regrets option for housing far from any industrial areas (which might be served by hydrogen) or potential heat network coverage.
- Salford West 1, 3 and 4 are prioritised for fabric retrofit deployment, predominantly due to high proportions of inter-war (1914 to 1944) semis and terraces that would benefit from thermal improvement, though other types and ages of homes also receive upgrades.
- Central Salford 1 and Central Salford 2 are prioritised for the demonstration of solutions for Salford's non-domestic buildings; continuing in the direction of district heating in which they are already headed.
- Home EV charging and rooftop solar PV can be developed early in areas with spare capacity in the electricity network, such as Salford West 1. Public EV charging is prioritised in central areas where demand is expected to be highest.

Long term Deployment

- Flexibility and storage (combined with other components including heat pumps, solar PV and EV charge points) can be tested in Central Salford 3, including a focus on evaluating if alternative approaches to electricity network reinforcement provide benefit.
- Salford West 1 could benefit from low carbon hydrogen to support industry.
- If hydrogen became widely available, domestic dwellings located near industrial areas of Salford West 2, 3, and Central Salford 3 could benefit from cost effective connection to low carbon hydrogen supplies built to serve industry.

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

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

Modelling Approach and GM Carbon Budget

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

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

Evaluation

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

- Local generation is deployed rapidly and early in the plan, as it is most effective at reducing carbon while grid emissions are higher in the earlier years. If such rapid deployment cannot be achieved in practice, the optimal mix of measures may look different, and total emissions may be higher (see slide 30 for more details)
- The timing (regarding the delivery) of HyNet compared to the rate of electricity grid decarbonisation

- The ability to scale-up and install options rapidly aligned to the carbon budget
- The practicality and cost of installing measures in dwellings and non-domestic buildings
- The disruption associated with options – both within homes and at community level (e.g. traffic disruption from street works)
- Maintaining the gas network to supply sites (e.g. industrial) in areas that are expected to be heat pump or district heat prevalent
- How an electrified heat future would be paid for, recognising the greater in building investment required to move off-gas
- Coordination with other Greater Manchester local authorities in relation to energy network options
- Social and community benefits
- How to fund options and the preferences of investors.

Consultation

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

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

Citizen consultation will help to:

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

Vision to 2038

A significant portion of existing homes and buildings in Salford will require retrofit, carrying out insulation in **at least 30% of dwellings** (around 50,000). This is true even in areas where there is less certainty on the choice of future low carbon heating systems, so early focus and investment in fabric retrofit would be a low regret step in these areas. **More dwellings are retrofitted in the secondary (hydrogen) scenario** (almost 68,000), including a greater share of deep retrofits. This is because of a need to reduce emissions in the early years to comply with the carbon budget while waiting for hydrogen to become available. In contrast, heating systems are decarbonised earlier in the primary scenario by installing heat pumps. Furthermore, the likely higher cost of hydrogen against gas[*] raises affordability issues which fabric retrofit can help address.

Fabric retrofit could be combined with other measures such as heating system replacement, PV installation and EV chargers to minimise number of visits required to homes, as in the "cost effective retrofit" option on page 34.

The dwellings that are most consistently identified as needing fabric retrofit to support decarbonisation are inter-war (1914-44) houses. **60% to 80% of these properties will need fabric retrofit across Salford**. 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.

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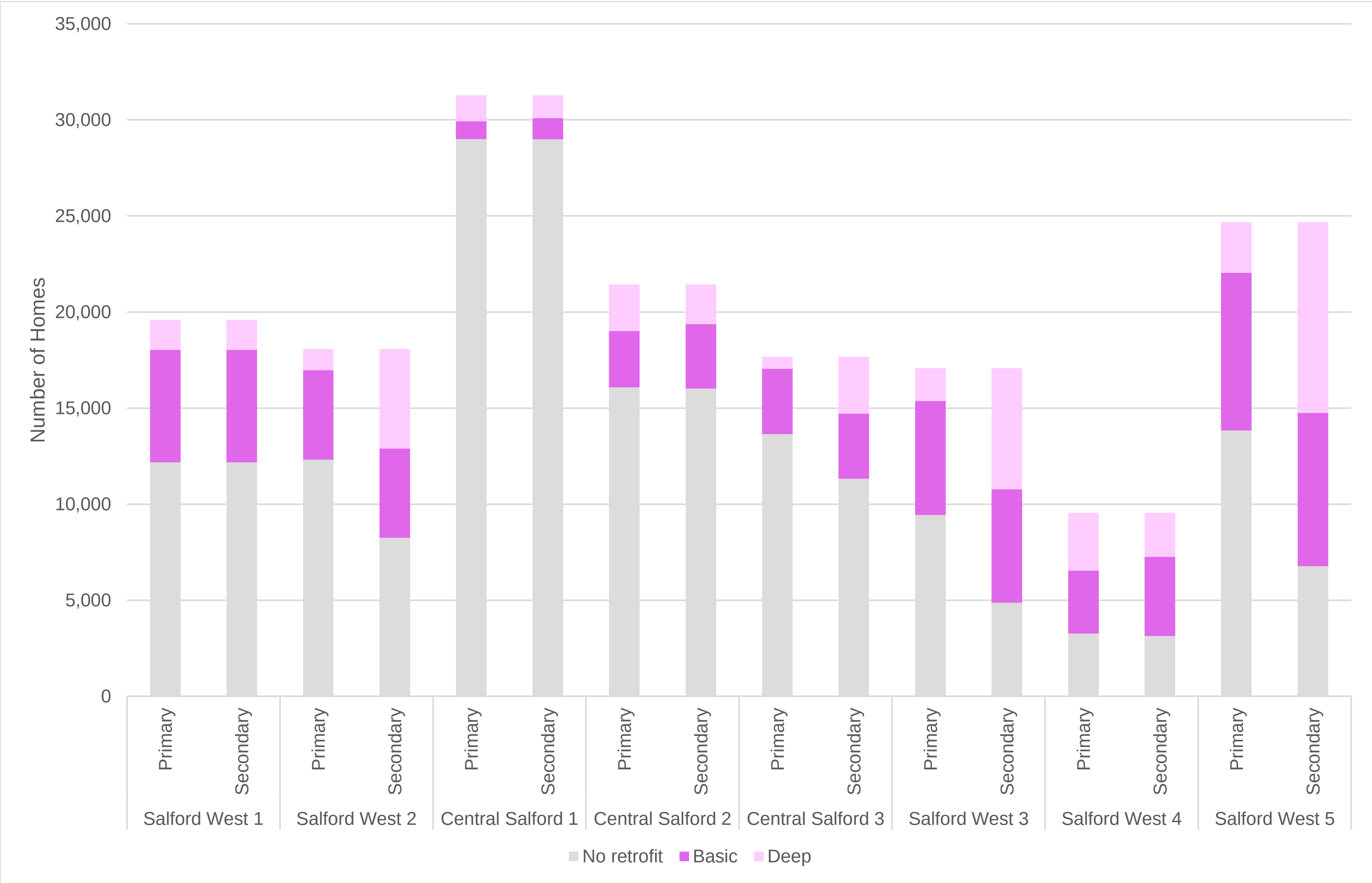
[*] Estimates vary - see for example projections for initial HyNet cost of hydrogen at around 150% uplift over natural gas: https://hynet.co.uk/wp-content/uploads/2021/06/14368_CADENT_PROJECT_REPORT_AMENDED_v22105.pdf [page 15].

[†] 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 Salford.

Retrofit across Salford by 2038

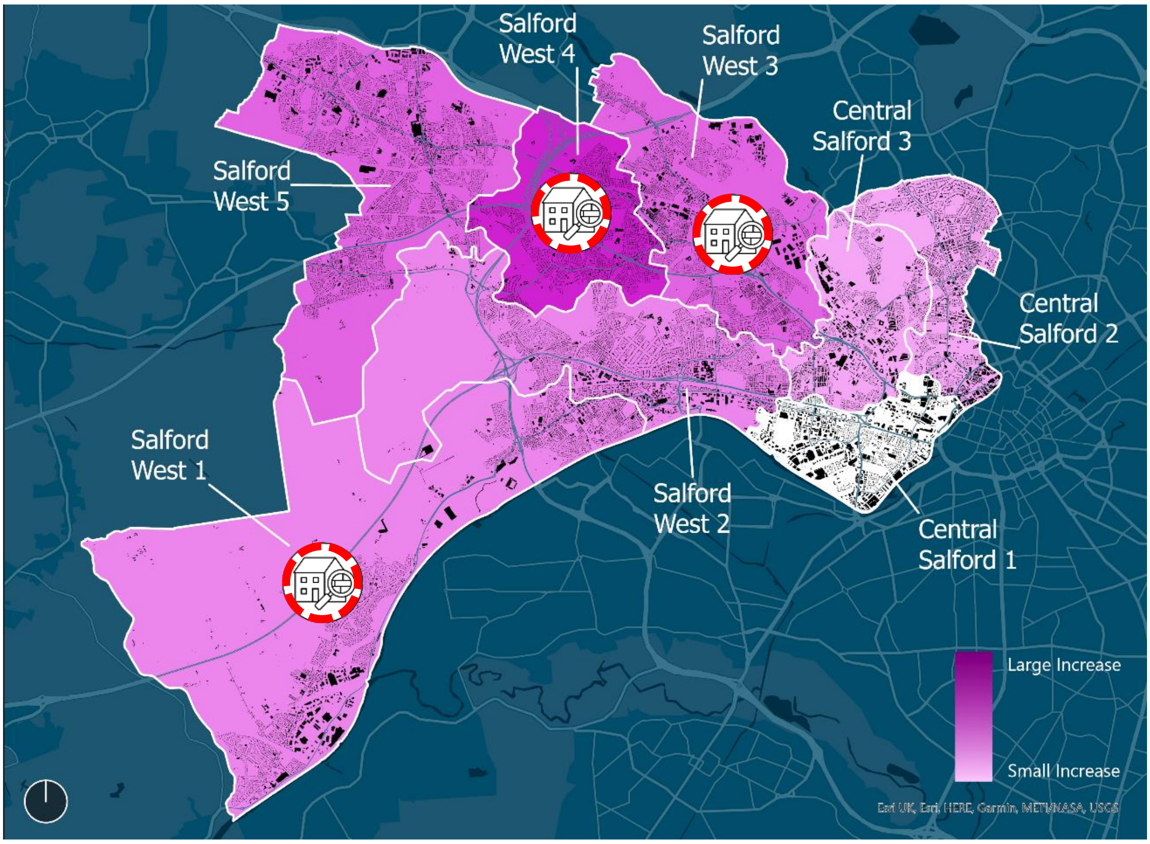


First Steps – Priority Areas

Whilst large numbers of dwellings will need to be retrofitted to improve energy efficiency across all areas of Salford, a number of retrofit priority zones have been identified.

The purpose of providing these priority zones is to highlight areas where demonstration and scale-up could be prioritised over the near-term (<5 years)*. The areas have been selected as they are regarded as low regret, as large numbers of similar housing stock, generally inter-war built homes (1914-1944), are considered to be cost effective to receive fabric retrofit measures, regardless of the type of heating system (e.g. hydrogen or a heat pump) that is used to replace natural gas boilers. Three priority retrofit zones have been highlighted for Salford:

- **Salford West 1**
- **Salford West 3**
- **Salford West 4**



* 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 Oldham. 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

Conversely, Central Salford 1 is less likely to be a focus for fabric retrofit, as it has the lowest overall levels of required retrofit, since with planned developments, flats are expected to account for a high proportion (around 90%) of homes in the area by 2038.

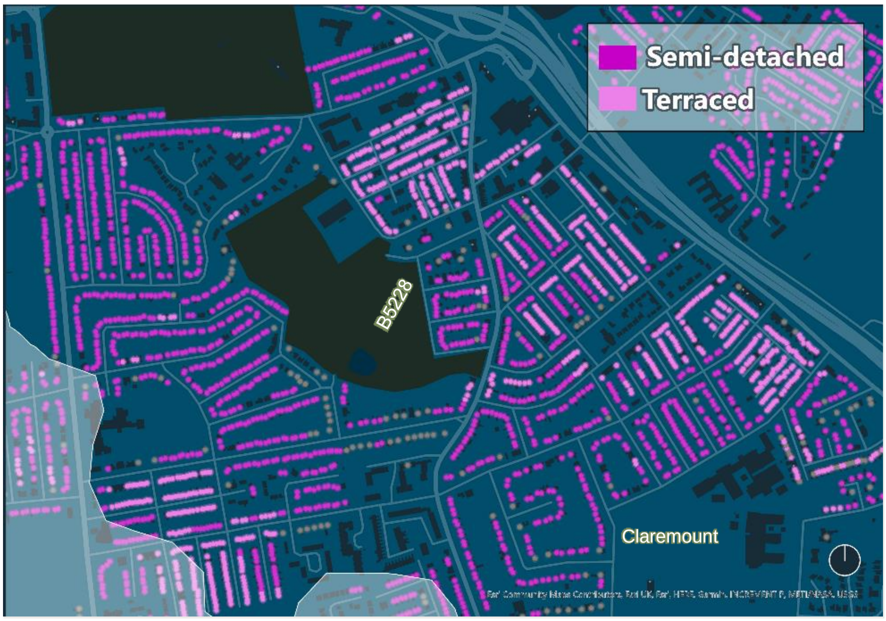
Whether or not a priority area based retrofit approach is pursued, it is essential that any delivery programme considers how to best integrate implementation with other dwelling related components to consider where a whole house retrofit approach would be required.

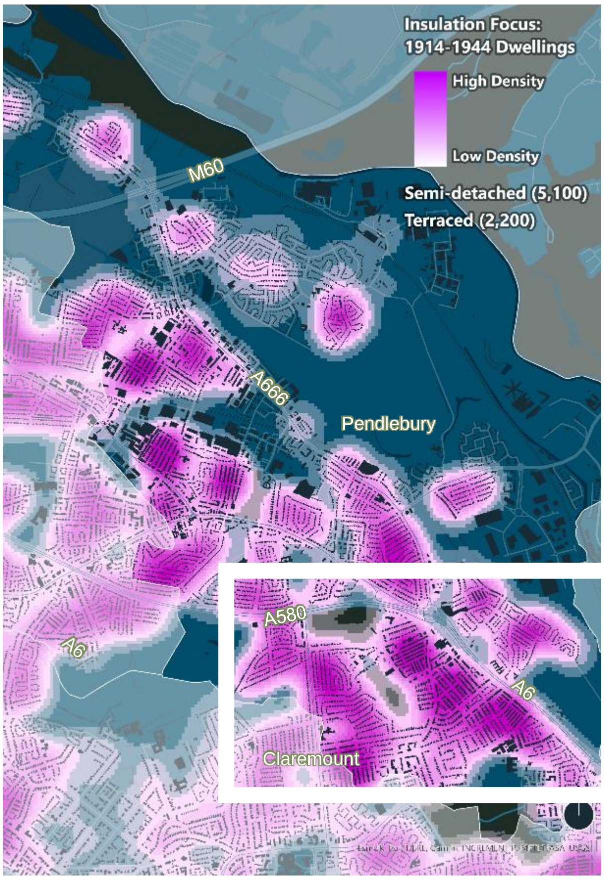
Salford West 1: This area sees a substantial number of homes (over 5,800 – around 30%) receiving basic retrofit and a smaller number (over 1,500) receiving deep retrofit in both scenarios, suggesting a low regrets opportunity for retrofit regardless of the heating pathways taken later. This consistency between scenarios is due to this area relying entirely on electric heating in both scenarios, rather than switching to hydrogen heating when it's available in the secondary scenario.

Fabric Retrofit Opportunity in Salford West 1

Salford West 3: This area differs slightly in that there is a significant increase in the number of homes which receive deep retrofit in the secondary scenario (around 6,300) compared to around 1,700 in the primary scenario. This is because this area transitions to hydrogen as the dominant heating option in the secondary scenario, and deeper retrofits are required to meet carbon budgets in the early years when waiting for hydrogen to decarbonise heating. However, around 5,900 homes (35%) receive basic retrofit in both scenarios, suggesting a low regrets opportunity regardless of the developments with hydrogen.

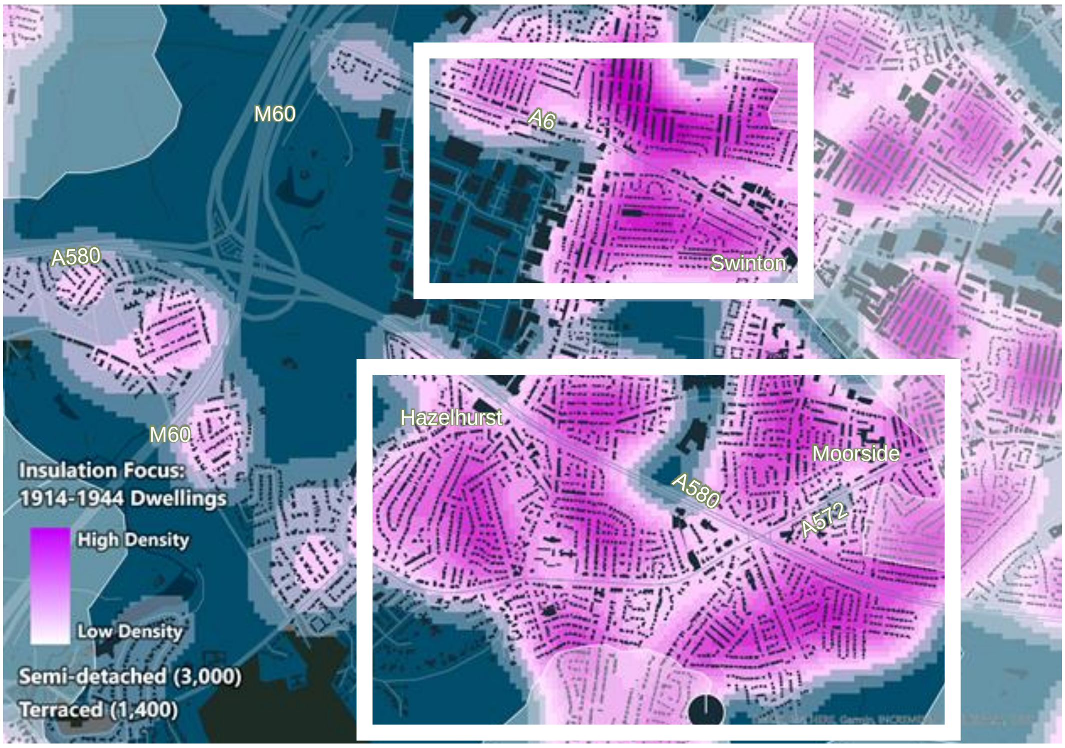
Fabric Retrofit Opportunity in Salford West 3





Salford West 4: With 49% of homes in this area being terraces, semis and detached homes built in the interwar era, there is substantial opportunity for retrofit here. Almost 3,300 homes in this area (34%) receive basic retrofit in both scenarios, making these low regrets opportunities. The secondary scenario sees this number increase further to over 4,100. This zone differs from the others in that a substantial number of homes (around 3,000) receive advanced insulation measures even in the primary scenario, although this falls to just under 2,300) in the secondary scenario.

Fabric Retrofit Opportunity in Salford West 4



Fabric Retrofit Approach

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

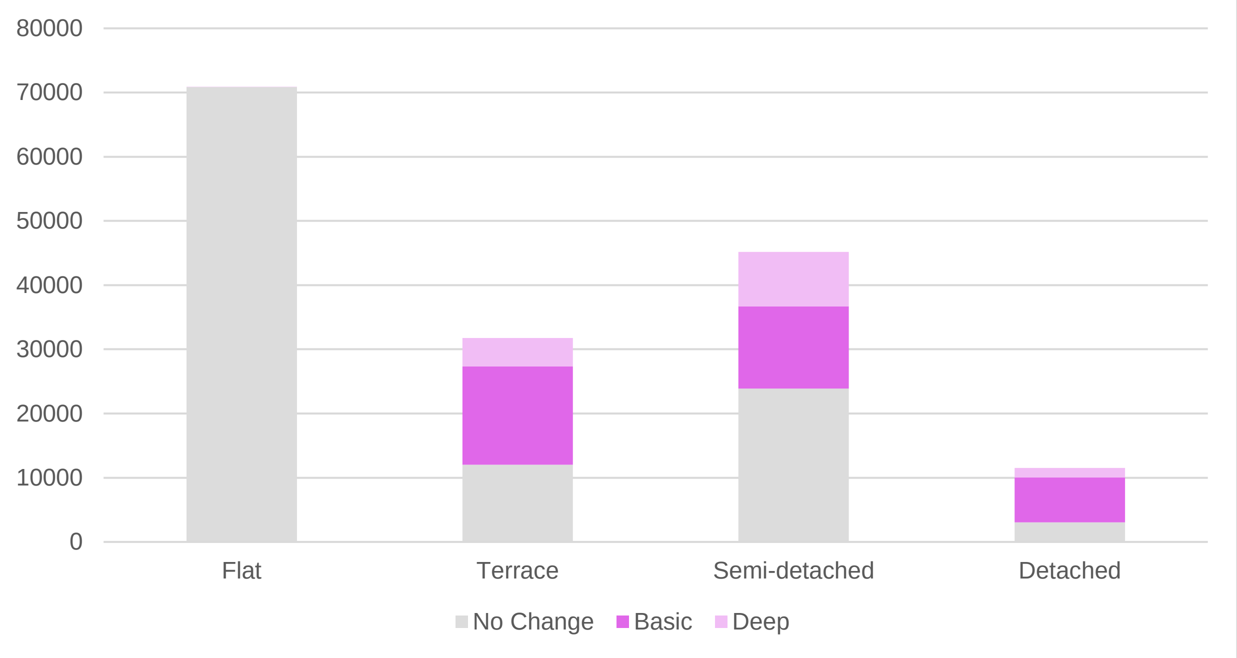
The retrofit zones identified on the previous pages are designed to allow the coordinated targeting of interventions across Salford in such a way that supports and aligns with Salford’s wider local energy system transformation.

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 Salford expected to need retrofit measures by dwelling type is shown below. This represents around a third of the projected domestic building stock in Salford of approximately 159,375 dwellings in 2038; increasing to 43% in the secondary scenario.

* 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.

Fabric Retrofit in 2038 by Building Type

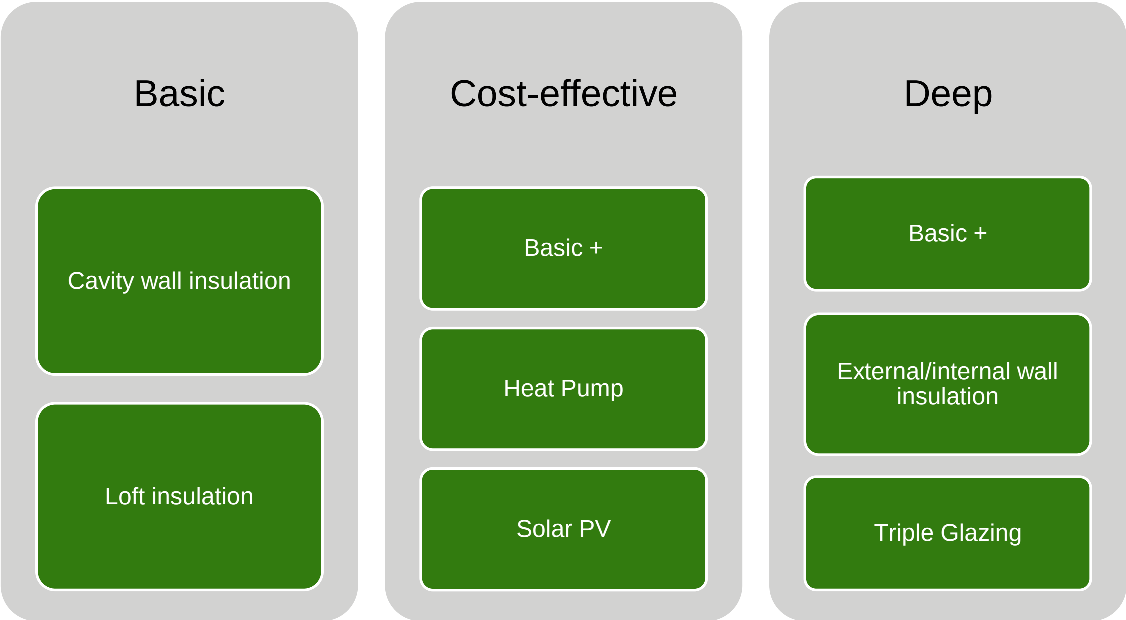


There are over 35,000 homes which receive basic insulation measures in both scenarios. Around 18,000 additional dwellings receive fabric retrofit measures in the secondary scenario, where the additional retrofits are predominantly the ‘deep’ type. This means that carrying out basic measures in earlier years would not preclude deeper measures being installed in homes in later years. Therefore, basic measures are considered low regret across all scenarios and heating system selections. Due to the housing type targeted, a significant proportion of the cost-effective deep measures are based on adding triple glazing to dwellings with basic measures applied, rather than large volumes of external/internal wall insulation to pre-war period dwellings.

Cost-Effective Deployment

The proposed approach centres on ensuring basic fabric retrofit measures are implemented in the vast majority of suitable homes in Salford, 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, PV installation and EV chargers) can help minimise disruption and offer cost savings, and so opportunities to develop cost-effective whole-house approaches will need to be considered during the development of any activity to take forward this LAEP. The range of different potential packages is illustrated in the diagram below*.

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



Rapid deployment of retrofit measures could be a relatively easy intervention in the near term, which is especially beneficial for staying within the carbon budget. The rate of deployment that is possible will depend on the development of a supply chain and business models; developing this in the next few years could allow for higher deployment rates in the medium term to support progress with decarbonisation where there may not yet be clarity on heating systems across all parts of Salford.

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 Salford 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 benefits including:

- Increased comfort and reduced running costs for individual households. This could also be important for some households to reduce fuel poverty and improve health and general quality of life
- Potential to reduce energy consumption and associated carbon emissions across Salford 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.

Supporting Low Carbon Heat

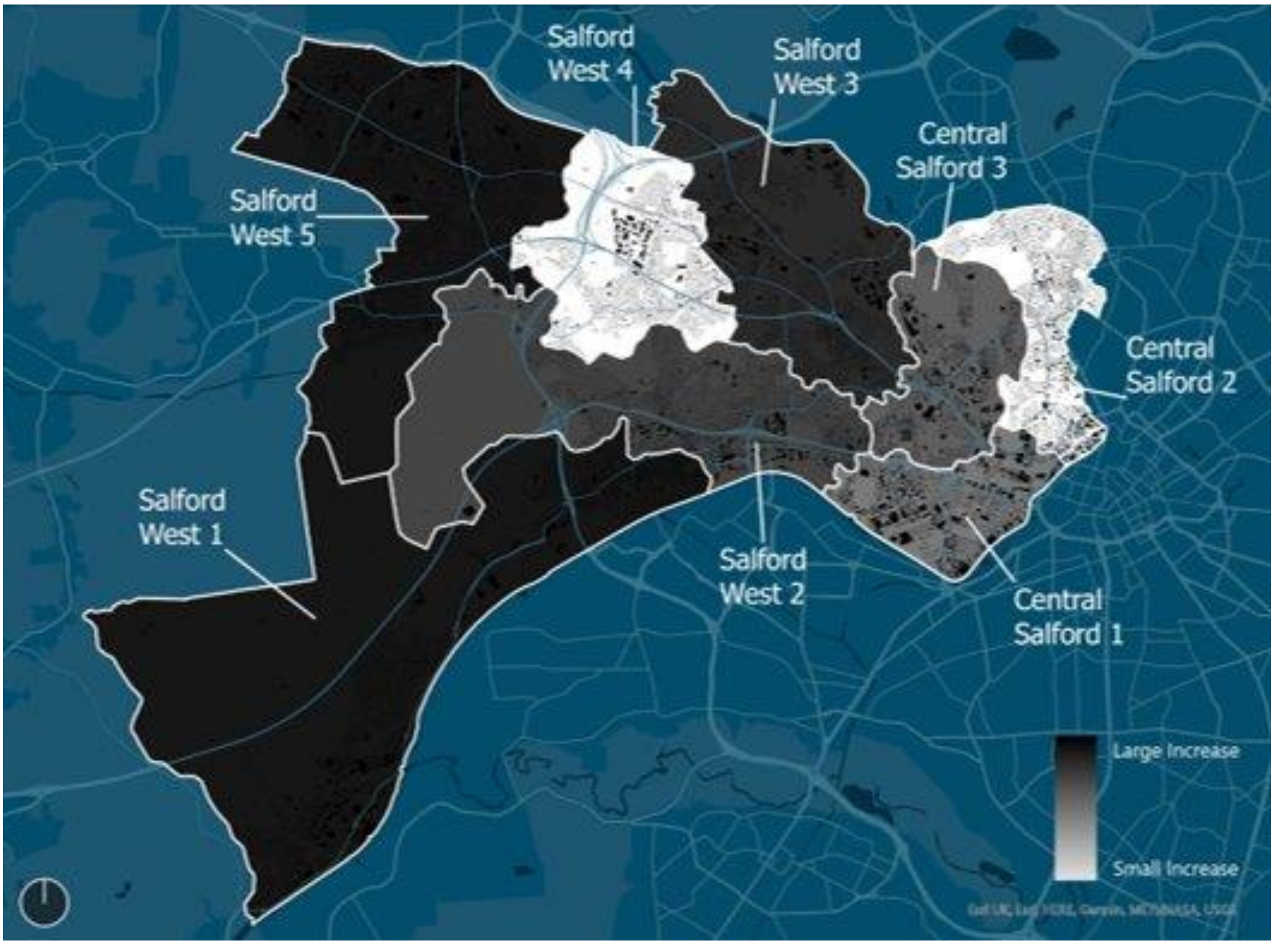
The improvement of building insulation supports the roll out of low carbon heat in several ways. By reducing the heat demand, less powerful heating systems can be installed, reducing capital costs. The reduced demand for heat will also compensate for a shift to a more expensive energy source (gas to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

Vision to 2038

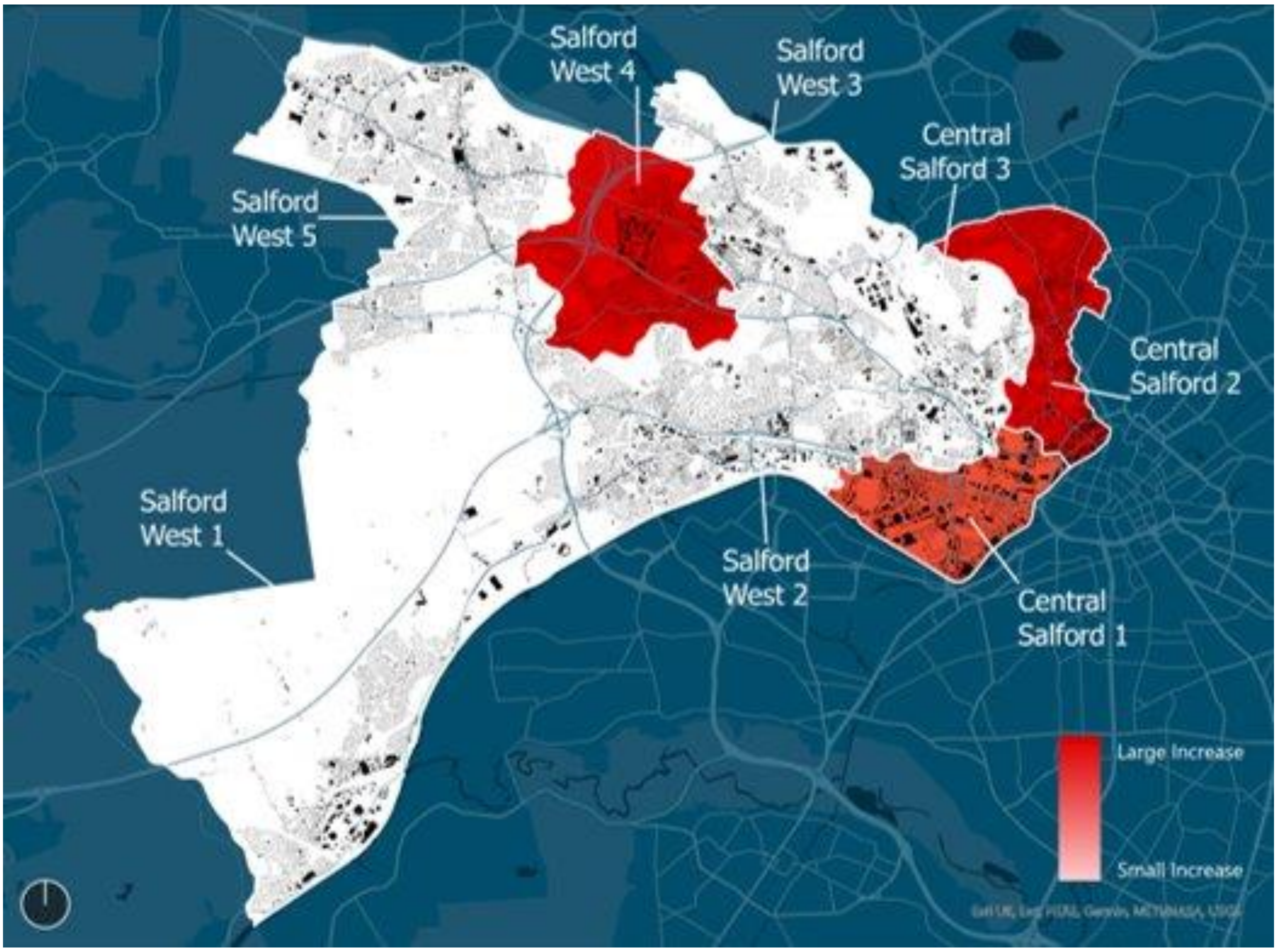
Building characteristics and existing network characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Salford. In the primary scenario, the decarbonisation of heat is primarily achieved through installation of electric heat pumps in existing and new homes, comprising more than 100,000 domestic heat pump installations. These are the predominant heating system in all areas besides Central Salford 2 and Salford West 4, although other electric systems are also present in less significant numbers. Alternatively, the secondary scenario sees hydrogen boilers used in a majority of homes – see page 51.

Heat Zones for Heat Pumps in Salford by 2038 (Primary Scenario)



A significant proportion of dwellings (42,000) were found to cost effectively transition to a district heating system, with this serving a major share of homes in Central Salford 2 and Salford West 4, alongside heat pumps. Central Salford 1 also has a significant number of dwellings (13,000) which could cost effectively connect to a heat network alongside the slight majority of dwellings (18,000) served by heat pumps.

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

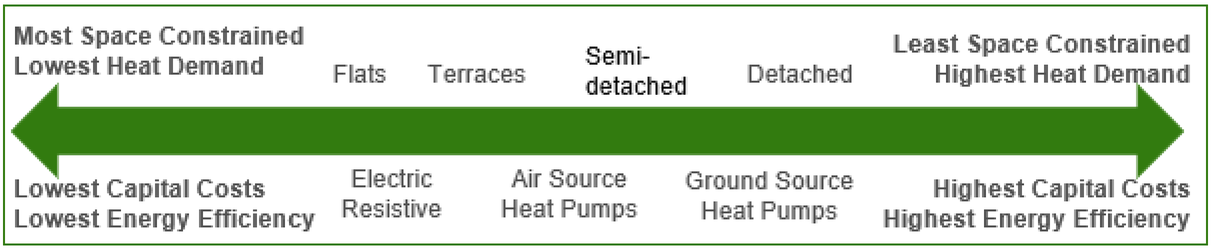


Even where hydrogen is available (as per the secondary scenario), least-regret effort in the near term is focussed on retrofit, priority electrification areas, and monitoring the development of hydrogen (at national and regional levels). The installation of hydrogen-ready boilers could provide optionality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

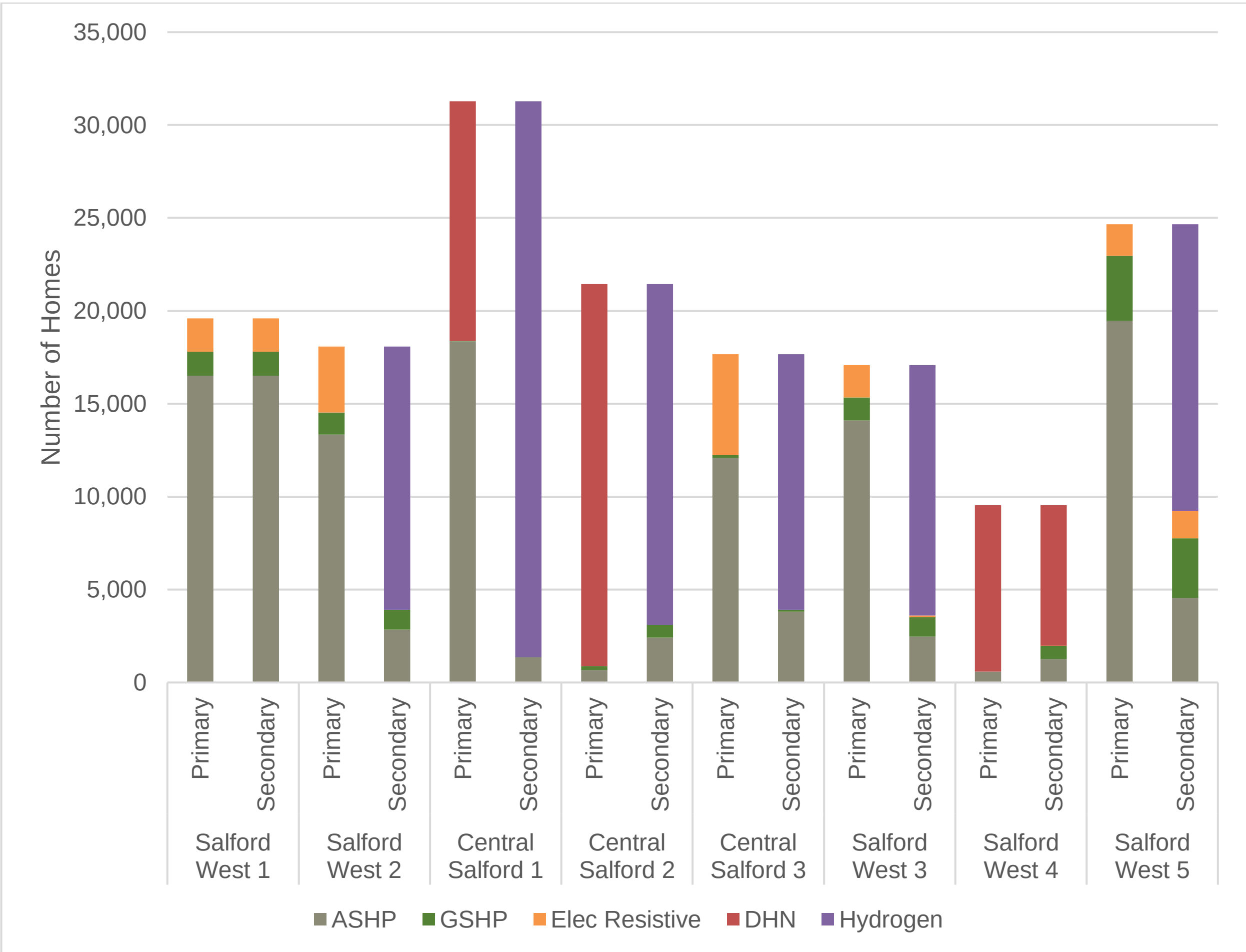
These forecasts are not definitive and represent a view of the future for each zone, to illustrate the scale of change required, it is expected that alternative solutions will be specified when exploring at a more detailed level, for example, there may be opportunities for communal / shared heating systems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

Heating System Selection

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



Deployment of Heating Systems by 2038

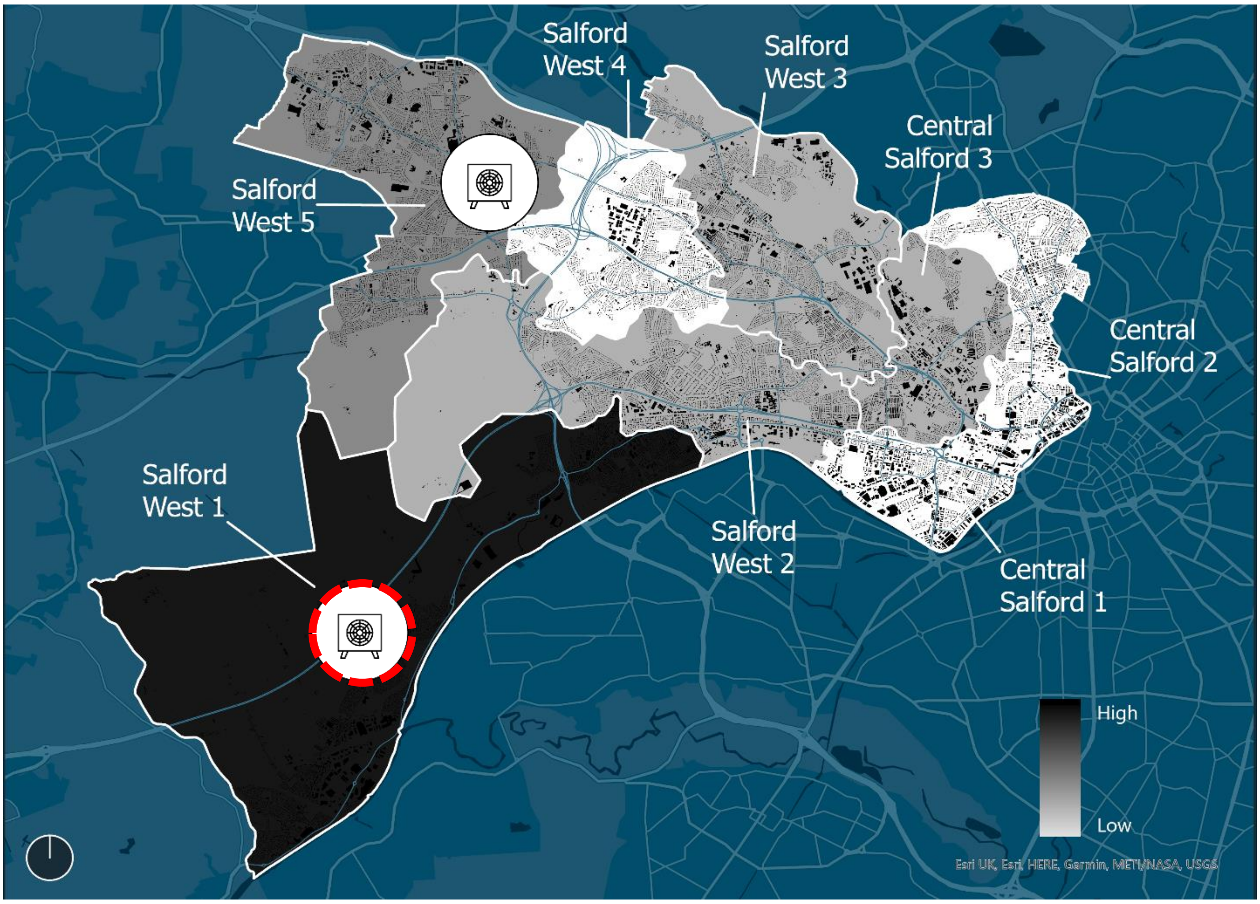


Air source heat pumps are the most widely suited electric heating technology, though a small proportion of homes in most areas was found to be suitable for ground source heat pumps, where greater outdoor space permits the installation of a ground collector, and larger properties can justify the higher 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. These issues would be avoided with hydrogen boilers, which would be a like-for-like replacement for natural gas boilers.

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

First Steps: Priority Areas



Heat pump priority zone   Heat pump opportunity zone

Certain geographic zones within Salford 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 the UK’s heat strategy, ahead of a mass programme of transition in places where the best option is less clear.

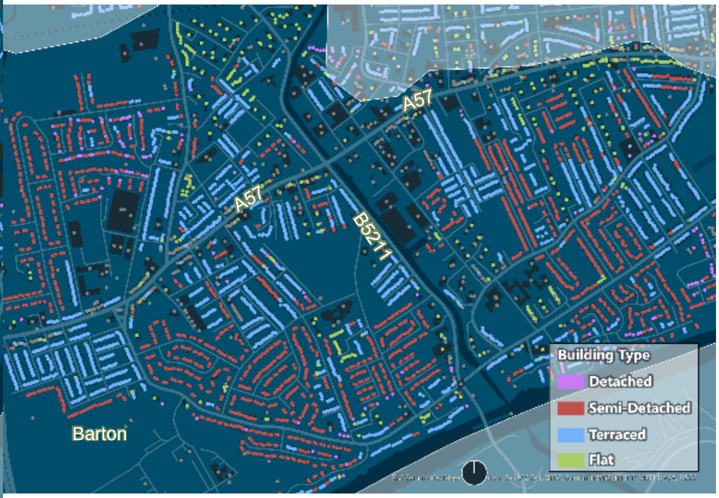
The map illustrates suggested priority areas for demonstration and scale-up activity. Consideration will be needed to develop a programme of works that aligns with other interventions to maximise delivery efficiency and minimise disruption to residents.

Heat Pump Priority/Opportunity Areas

- **Salford West 1** (primarily semi-detached housing with significant terraced housing). Headroom in the electrical network here means deployment can progress before encountering capacity constraints (see page 73)

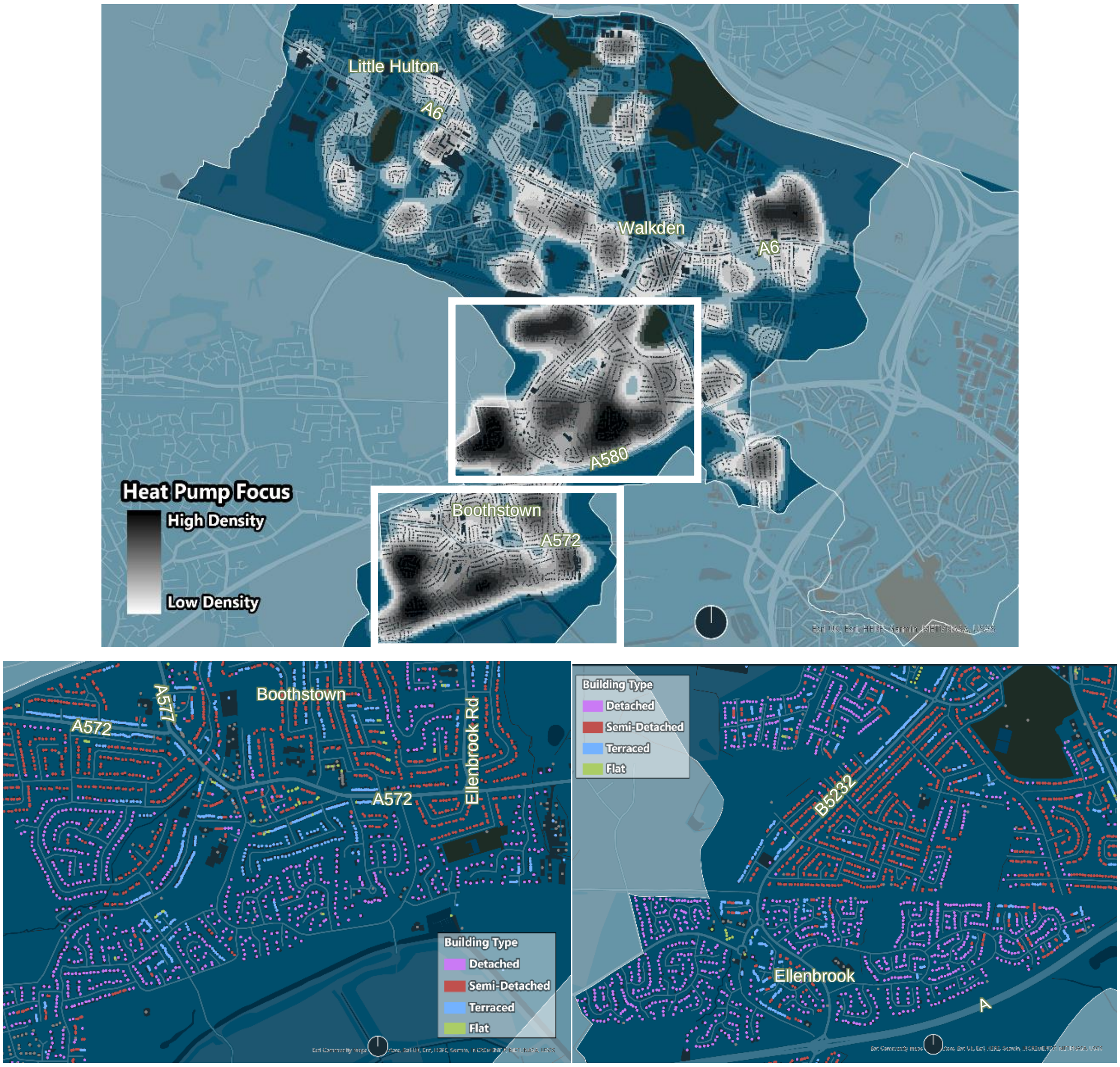
- **Salford West 5** (primarily semi-detached and highest quantity of detached housing). More limited electrical headroom here suggests capacity upgrades may be required early in the deployment.
- **Areas with Smaller Clusters Priority Heat Pump Dwellings:**
    - **Central Salford 3** (primarily flats and terraced housing with significant new builds projected out to 2038)
    - **Salford West 2 & Salford West 3** (quite an even spread between detached, semi-detached and terraced housing for heat pumps in both scenarios)

Salford West 1



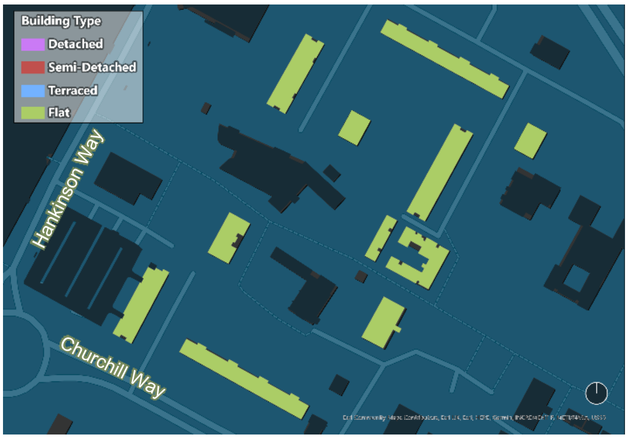
Salford West 1 is an area in which, even in a high hydrogen scenario, heat pumps are still a predominant technology, suggesting they are a low regrets opportunity for early deployment here. The lower density in Salford West 1 means individual electric heating systems are a commonly chosen approach. A small number of homes are served by electric resistive (mostly flats). Air source heat pumps are predominantly modelled in semi-detached and terraces (with a small number in flats); an allowance for high temperature and hybrid systems has also been made for harder to treat homes. The very small number of detached homes have the option of installing ground source heat pumps.

Salford West 5



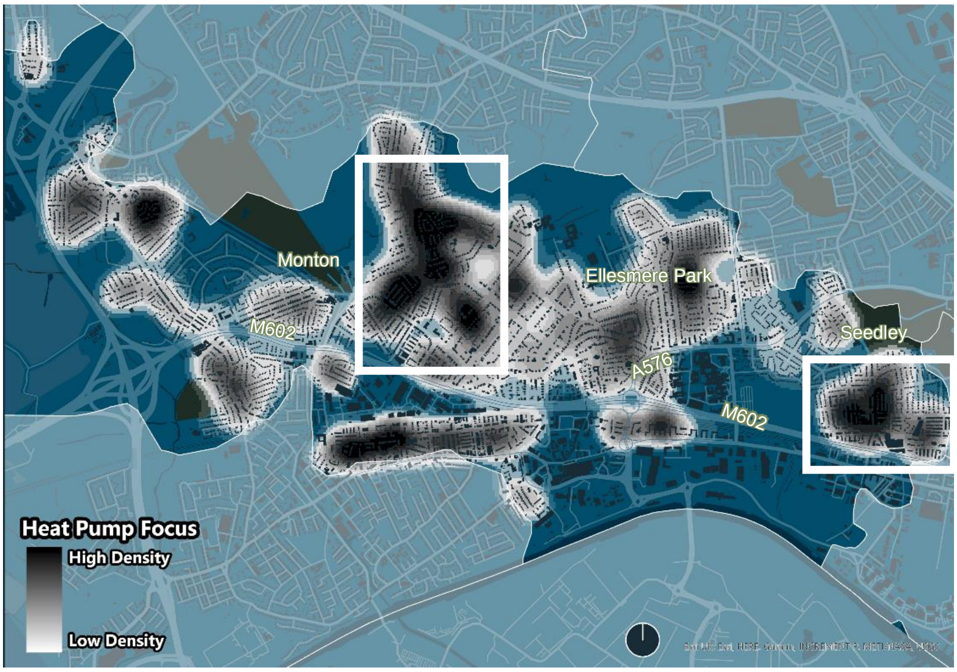
Similar to Salford West 1, Salford West 5 sees a significant, albeit lesser, uptake of heat pumps even in the hydrogen scenario. In this area, the balance of heating technologies is very similar to Salford West 1 although there is a larger proportion of detached houses leading to a greater opportunity for ground source heat pumps. Out of the buildings which share a common heat pump solution within both scenarios, about half of them are detached houses with the rest split mainly between semi-detached and terraced housing.

Central Salford 3

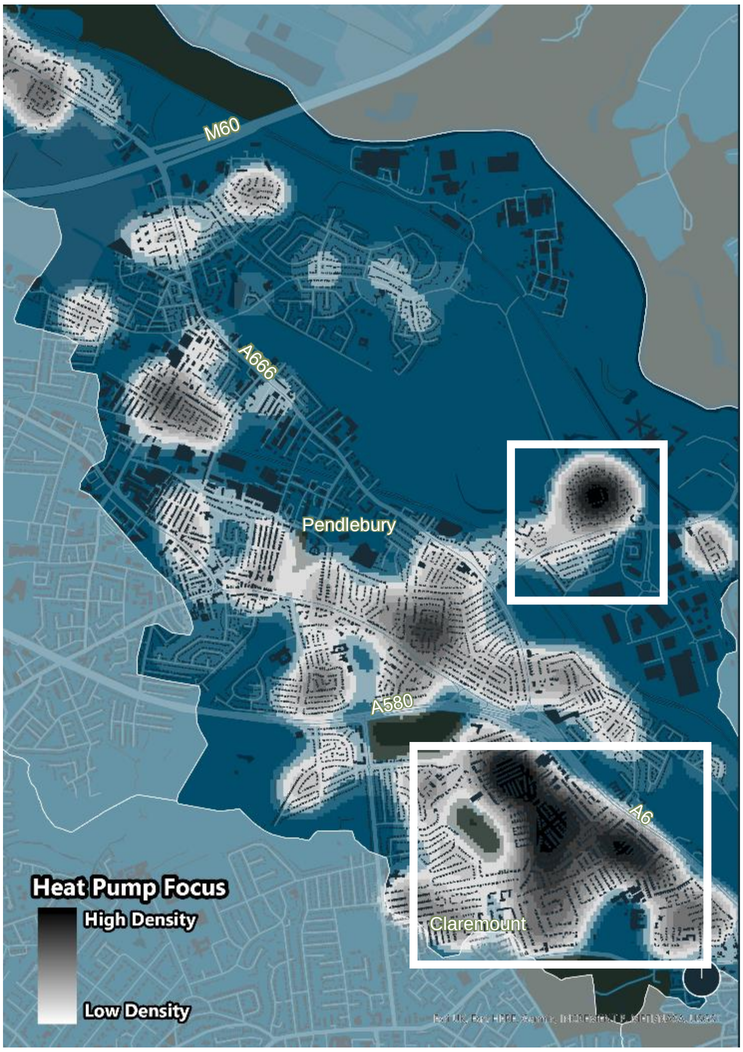


Central Salford 3 has been identified as an area where there is significant heat pump deployment in the cost optimal scenario, and a lesser, yet still significant, number (~a third) in the hydrogen scenario. This suggests there are areas within this zone which will be low regrets to proceed with heat pump installation whether or not zero carbon hydrogen becomes present in the area. The majority of dwellings for which heat pumps are seen as a low regrets option are terraced houses and new builds.

Salford West 2 and Salford West 3



Salford West 2 (images above) and Salford West 3 (below) have a similar number of core dwellings which are identified as low regrets heat pump areas as Central Salford 3. However, they have a different make up of building types for these low regrets dwellings; there is a fairly even spread between detached, semi-detached and terraced houses with a small number of flats also represented.


M60
A666
Pendlebury
A580
A6
Claremount
Heat Pump Focus
High Density
Low Density


A6
B5228
Building Type
Detached
Semi-Detached
Terraced
Flat


A6044
Building Type
Detached
Semi-Detached
Terraced
Flat

District Heat Networks

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

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

Salford West 4 has been identified as an area of lowest regret* for district heating for Salford. There are two additional areas which have a high level of district heating in the primary scenario.

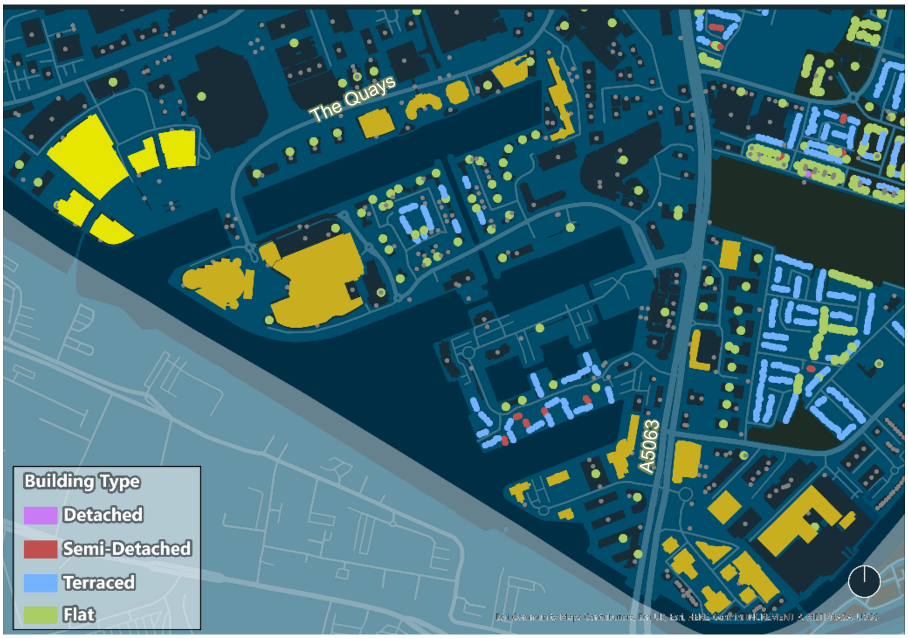
Salford West 4 – (primarily semi-detached housing) although it does not contain a stereotypically dense set of dwellings, such as flats and terraced housing, there are a number of publicly owned buildings within the area which would provide a significant and steady anchor load from which to build a heat network These include, but are not limited to: Salford City Council House, the Swinton Police Station along with a high density of schools and a couple of leisure centres. This allows a core set of ~7,500 dwellings to have a strong case for connecting to a new district heat network in both modelled scenarios.

Potential for District Heating in Salford West 4

* 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

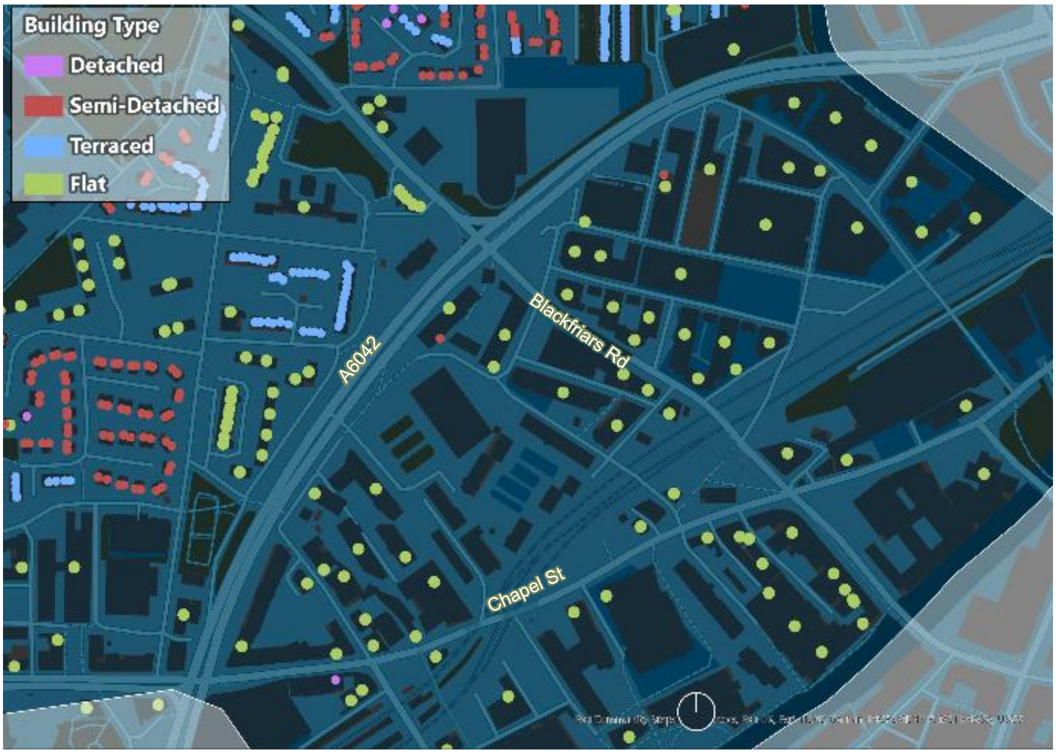
Central Salford 1: The high concentrations of tightly packed flats and some terraced housing provide a good opportunity for heat networks, avoiding noise, planning constraints and additional electricity network reinforcement often involved with heat pump deployment. The existing heat network serving MediaCityUK provides an ideal opportunity for the expansion of the network to serve additional domestic properties. With over 18,000 flats also due to be built in these areas between now and 2038, early development of the heat network would maximise the number of new flats which can benefit from this network.

Potential for District Heating in Central Salford 1



Central Salford 2: Similar to Central Salford 1, Central Salford 2 contains a high density of flats, lending itself to benefitting from a district heat network. There is no existing heat network to extend in this area, however, the Salford Local Plan highlights areas of Central Salford 2 for district heat network development. Within this area there are also a number of non-domestic buildings which may offer an anchor load including an HMRC office and Salford Central train station. With almost 5,000 flats also due to be built in these areas between now and 2038, early development of the heat network would maximise the number of new flats which can benefit from this network.

Potential for District Heating in Central Salford 2



Current heating systems

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

Hydrogen for Heating

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

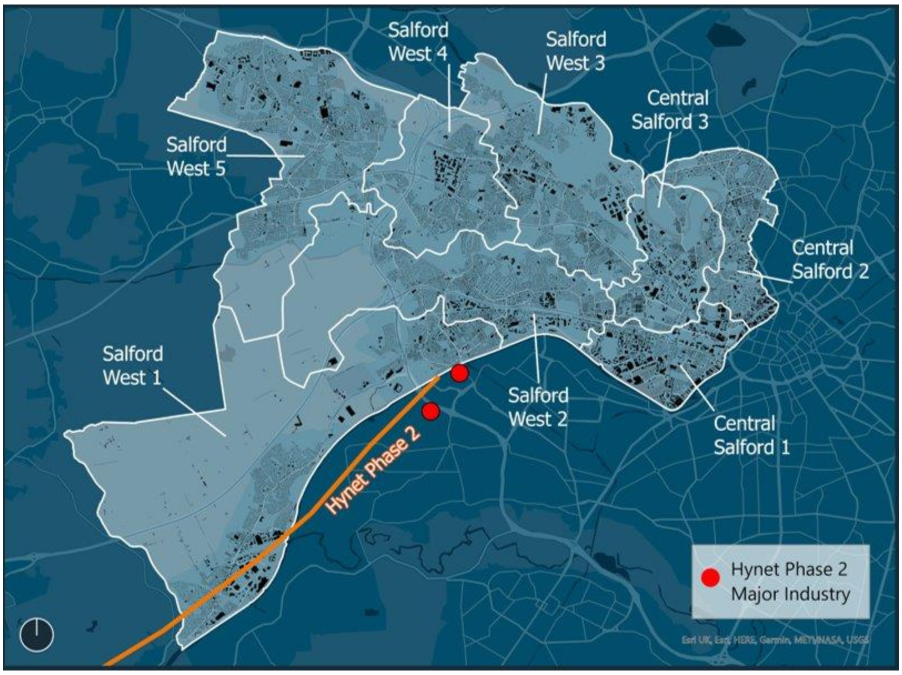
The primary scenario reflects phases 1 and 2 of HyNet, where low carbon hydrogen may be available from 2025 onwards for the largest industrial sites in the region. It is not believed that any of these are likely to be in Salford. The secondary scenario includes the possibility of HyNet phase 3, where low carbon hydrogen becomes available for homes and the full range of non-domestic buildings from the early 2030s onwards. This would require the repurposing of areas of gas grid to serve hydrogen to the buildings. Under this scenario it is found to be cost effective to provide hydrogen to domestic and non-domestic buildings in many areas of Salford, resulting in a potential shift to hydrogen dominated heating.

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

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

HyNet phase 2 is proposed to serve various industrial demands across Trafford Park which boarders Salford West 1, Salford West 2 and Central Salford 1; this could arguably be extended into Salford and serve industrial and domestic buildings in the area, guided by the findings in the following chapter.

Proposed route and connection points for HyNet phase 2



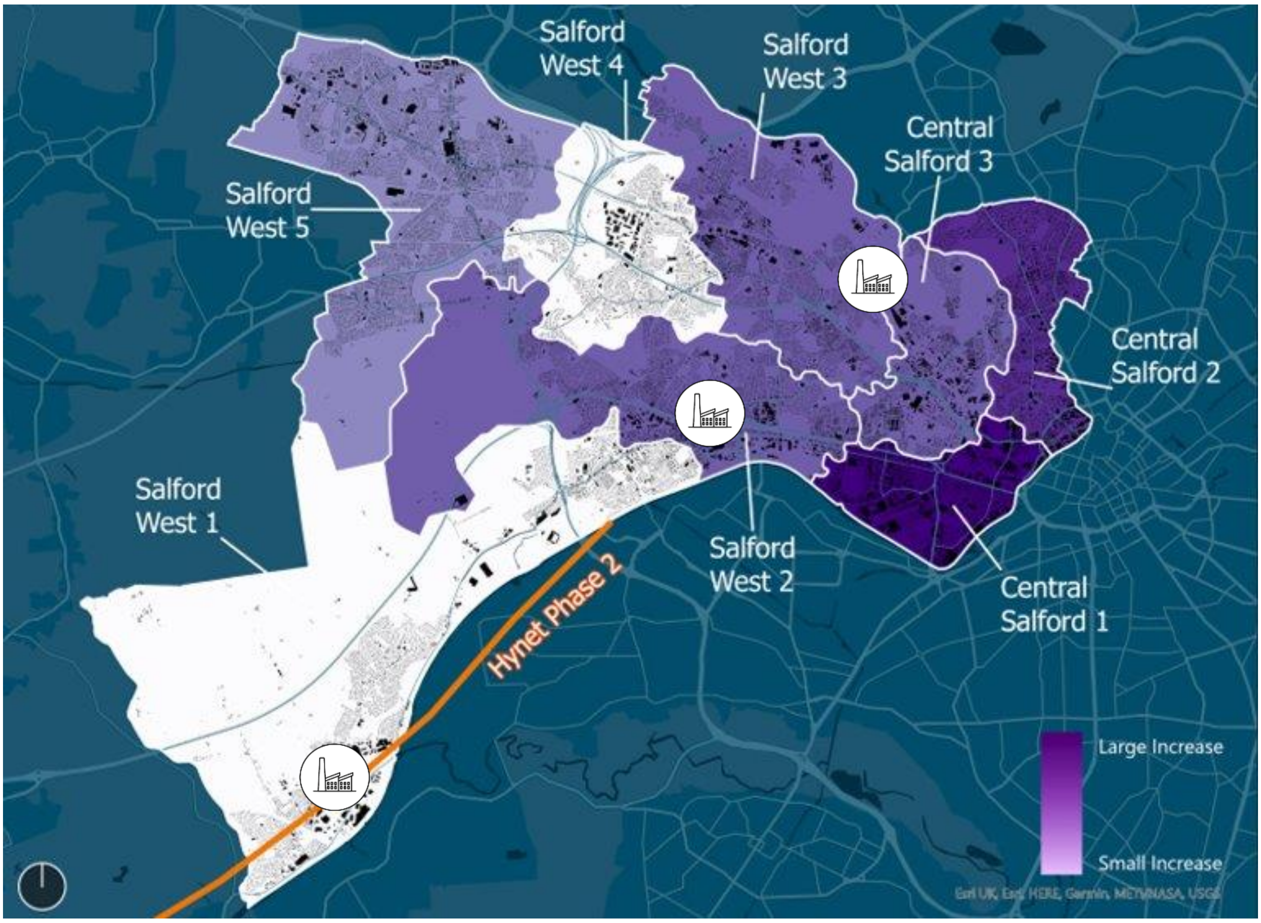
Hydrogen for Heating - Opportunity areas

Under the category of non-domestic buildings, there are a number of different functions these buildings offer, ranging from offices, educational facilities, retail, warehouses and factories. It is expected that some of these types of buildings may benefit from having access to hydrogen as we transition away from natural gas. The majority of these are expected to be industrial processes which may require high temperatures. Thus, a high level desk based study of such industrial facilities in Salford has been conducted.

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

Analysis has been undertaken to identify the areas of Salford where hydrogen should be prioritised if the quantity is limited. Synthesizing this with the non-domestic demand and the presence of and planned development areas of heat networks, the opportunity areas are the following:

- **Salford West 1** – the intersection of Northbanks Industrial Park and the planned HyNet Phase 2 pipe makes this an appropriate choice. However, no domestic dwellings were identified as being appropriate for hydrogen connection.
- **Salford West 2** – approximately 14,000 dwellings have been identified in the HyNet scenario for connection to hydrogen. This, alongside Lyntown Trading Estate and being a continuation of the direction of the proposed HyNet pipe, give reason to make this an opportunity area
- **Central Salford 3 & Salford West 3** – approximately 13,500 dwellings have been identified in both areas to benefit from connection to hydrogen. Along with the presence of Langley Business Park and a further continuation of the HyNet pipe direction would make this an obvious route.



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

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

Although the HyNet scenario has identified nearly 30,000 dwellings in Central Salford 1 for which it would be cost optimal to connect to hydrogen, the existing heat network leads itself to extension and focusing on this area as a heat network prioritised area.

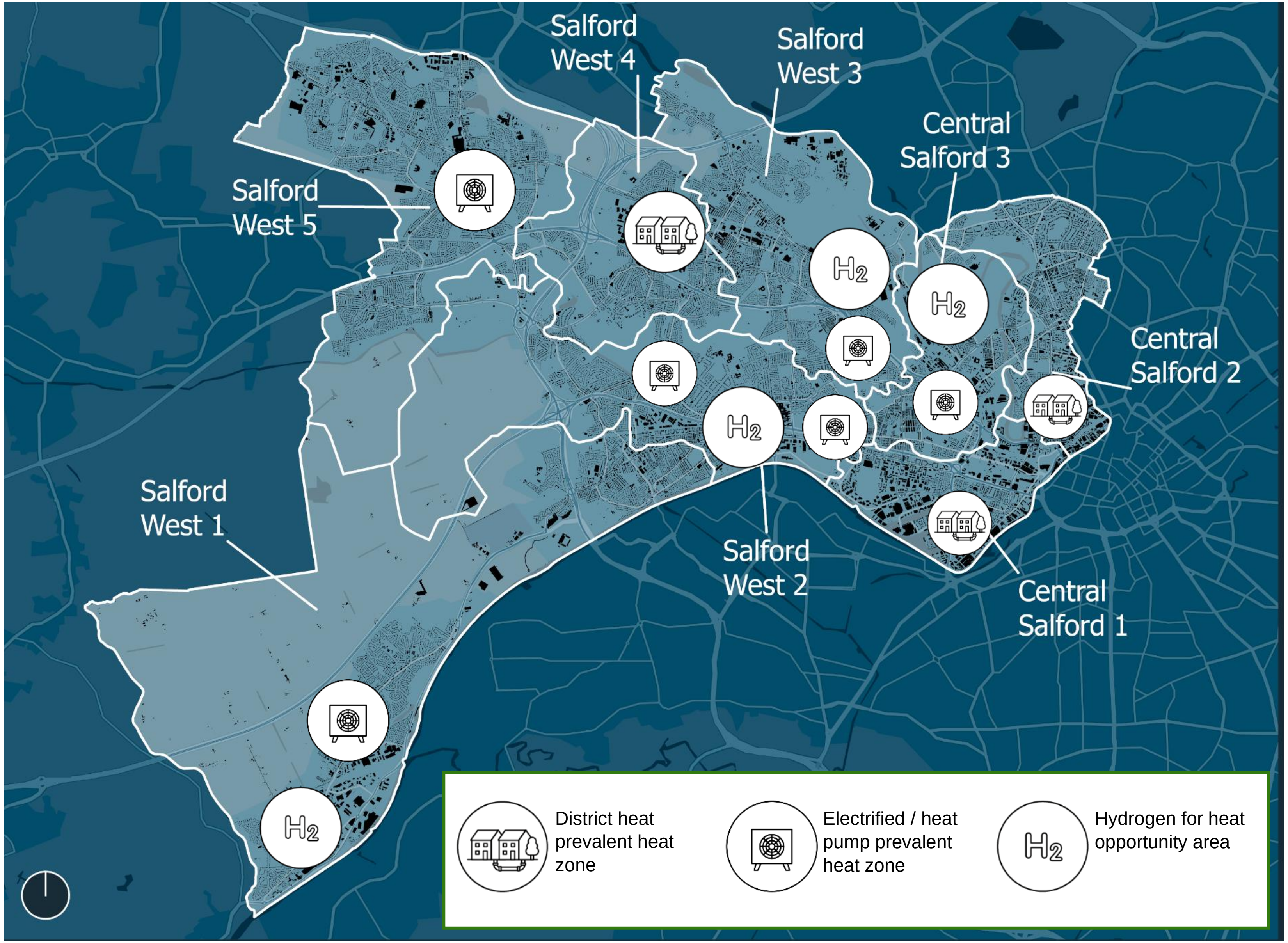
4. HEATING SYSTEM ZONES - SUMMARY

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

- In the secondary scenario, heat pumps still play a supporting role in every zone, and a significant role in Salford West 1 and Salford West 5
- The zones Salford Central 1 and Salford Central 2 swing between heat networks and hydrogen between the two scenarios, with a supporting role from heat pumps in both cases. However, given the existing heat networks and proposed developments in the Salford Local Plan, priority has been given to heat networks here
- An industrial estate straddles Salford West 3 and Central Salford 3 providing an central demand for hydrogen around which dwellings could be connected
- Salford West 4 shows a strong role for heat networks in both scenarios with support from heat pumps.

Zone	Prevalent heating system		Priority area
	Primary scenario	Secondary scenario	
Salford West 1	Heat pump	Heat Pump	Heat pump
Salford West 2	Heat pump	Hydrogen	None
Central Salford 1	Heat pump and heat network	Hydrogen	Heat network
Central Salford 2	Heat network	Hydrogen	Heat network
Central Salford 3	Heat pump and electric resistive	Hydrogen	None
Salford West 3	Heat pump	Hydrogen	None
Salford West 4	Heat network	Heat Network	Heat network
Salford West 5	Heat pump	Hydrogen with significant heat pump supporting role	Heat Pump

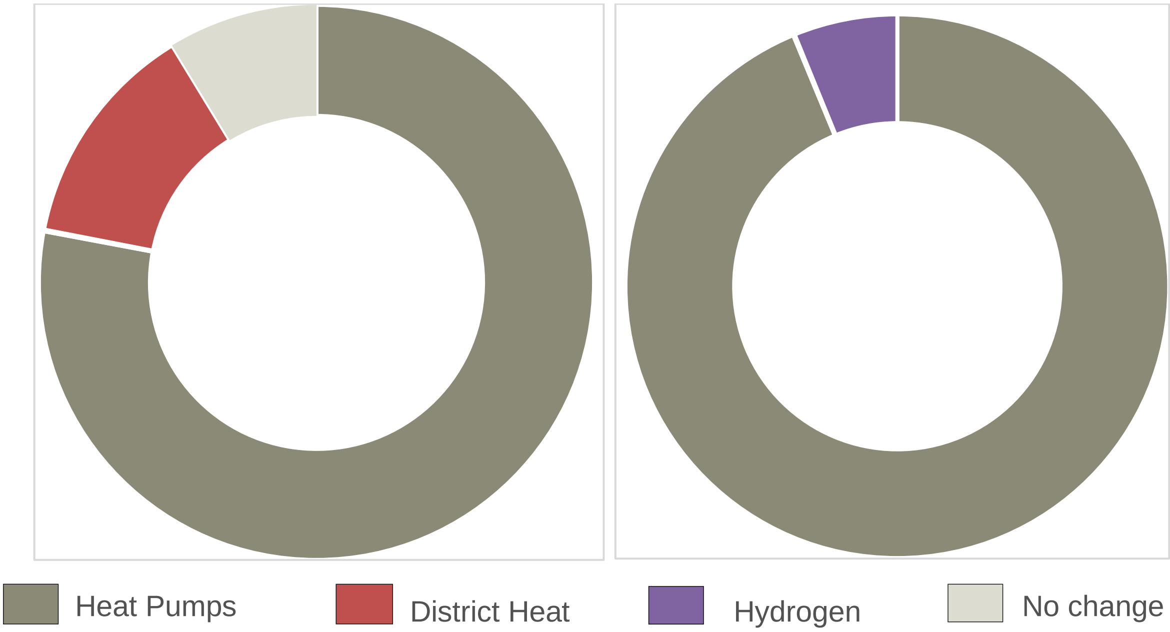
Although hydrogen becomes the dominant technology in the secondary scenario in Salford West 2, Salford West 3 and Central Salford 3, there still remain clusters of dwellings which are more cost-effectively transitioned to heat pumps in this scenario (in the order of 4,000 dwellings in each zone indicated by a smaller heat pump icon in the map below); these clusters of dwellings would also provide low regrets areas to commence with heat pump installation.



Salford West 4
Salford West 3
Central Salford 3
Salford West 5
Central Salford 2
Salford West 1
Salford West 2
Central Salford 1
District heat prevalent heat zone
Electrified / heat pump prevalent heat zone
Hydrogen for heat opportunity area

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 Salford's non-domestic buildings. The estimated combined investment (for improving the energy efficiency and installing heat pumps) is in the region of £1.8b.

Heating System Installations in Primary Scenario (left) and Secondary Scenario (right)

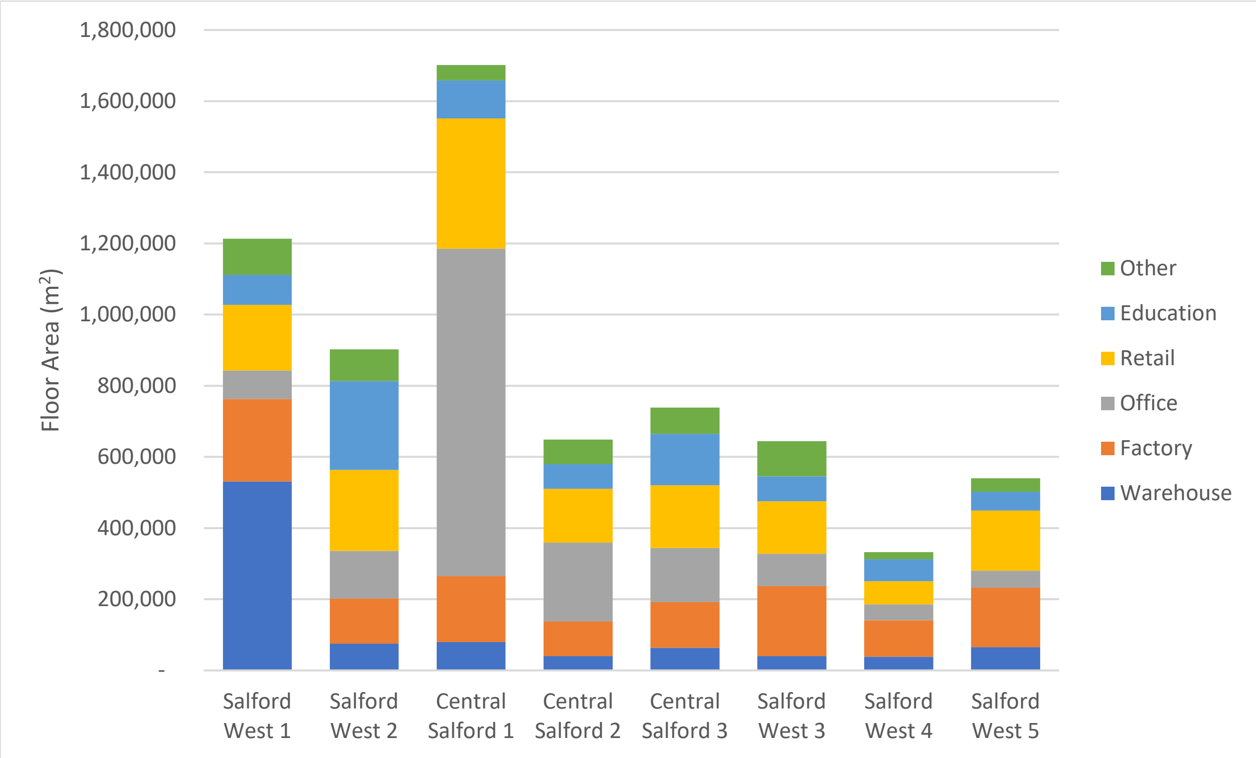


- Majority of Salford's non-domestic buildings (72% by floor area) have been deemed able to transition to a heat pump option with a further 19% (by floor area) suitable for district heat networks
- A notable proportion (8% by floor area) are deemed to be reliant on either gas or hydrogen for use in industrial processes
- The practicality of providing zero carbon heat to distributed sites (as per the map on the following page which illustrates an area within Salford Central 1) 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, Salford West 4, Central Salford 1

* Acknowledging that the primary scenario is based on identifying solutions 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.

and Central Salford 2 have been identified as the three zones of least regret for potential heat network development*. With a wide range of building usage types (bottom right chart), solutions will be dependent on building type and aspects such as density of non-domestic buildings.

Non-domestic Building Usage by Floor Area (m²)

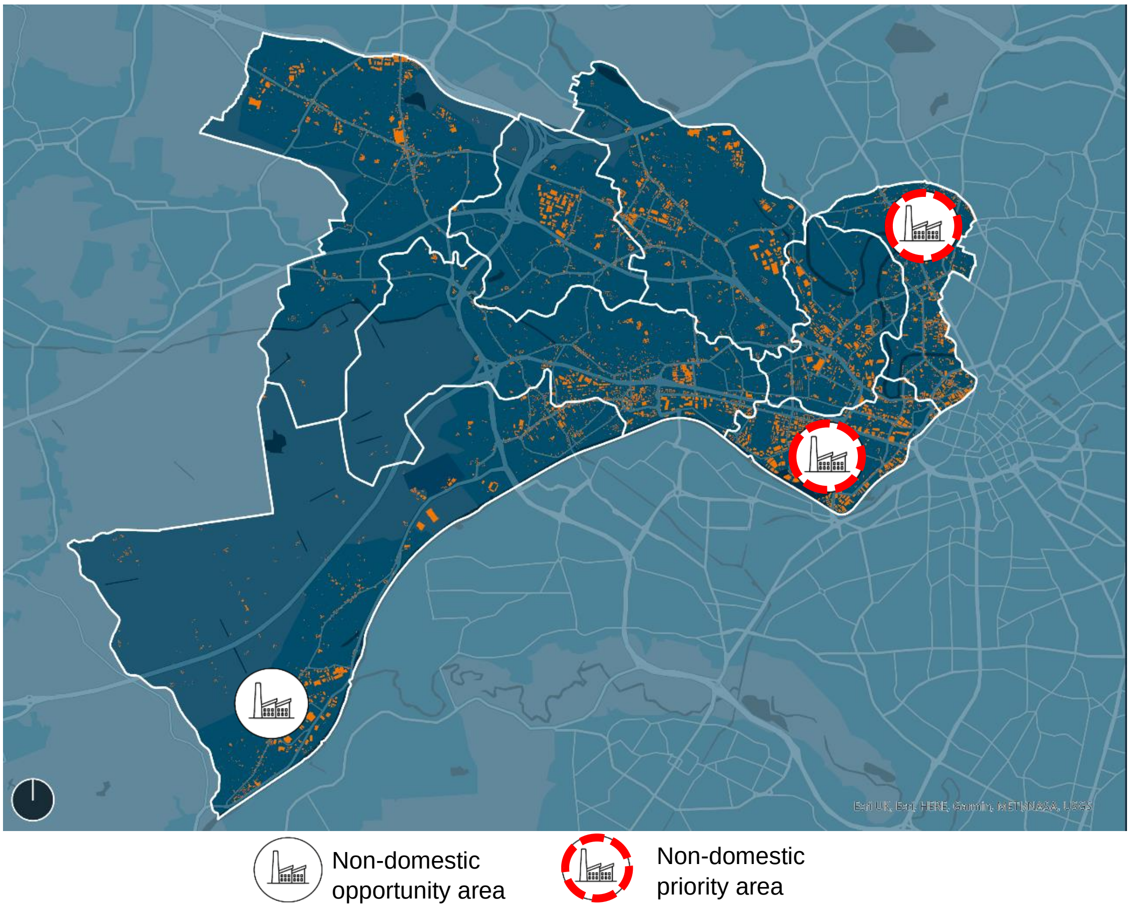


Non-domestic Buildings Priority Area Selection

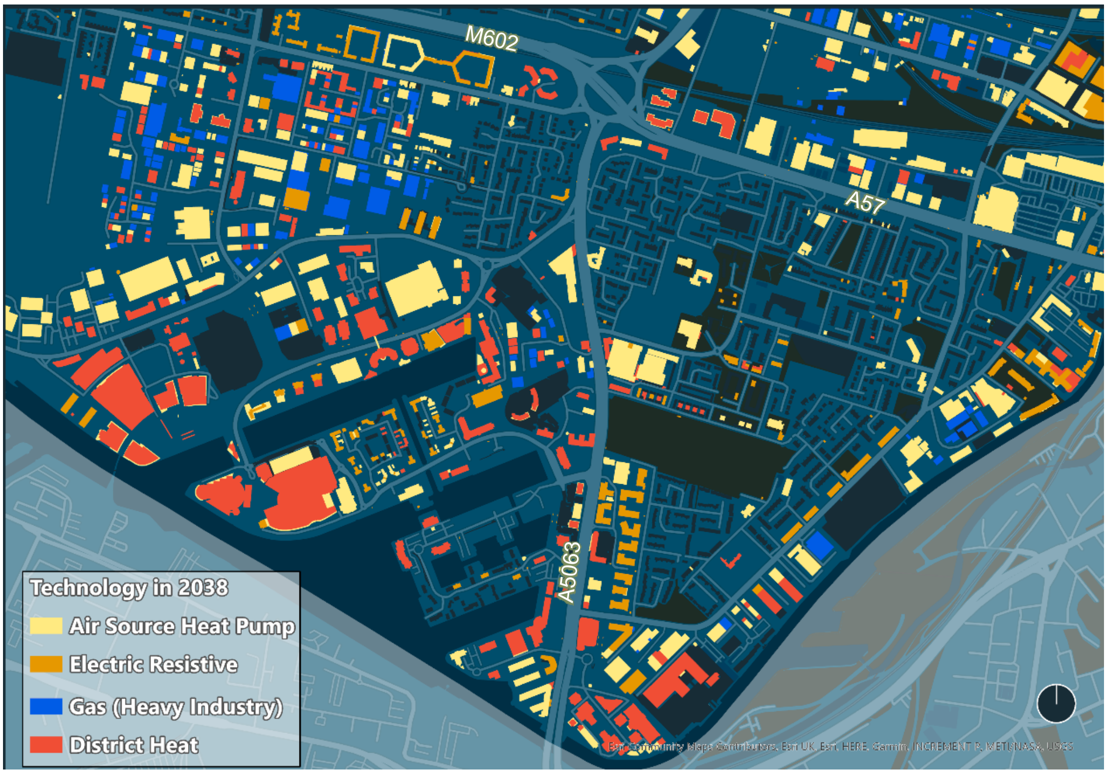
Central Salford 1 and 2 have been identified as priority areas to demonstrate how to decarbonise Salford's non-domestic buildings before considering wider scale-up. While Central Salford 1 has the greatest proportion of non-domestic buildings in Salford, Central Salford 2 contains a large amount of local retail and office. This, along with an existing heat network in Central Salford 1, mean both areas have been identified as potential district heating zones. Salford West 1 has a cluster of industrial buildings that may be hard to decarbonise through electrification, so is assigned as an opportunity area to develop hydrogen for industrial uses.

* 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 decarbonisation priority areas



Illustrative deployment of heating system in non-domestic buildings in Salford Central 1



Vision to 2038

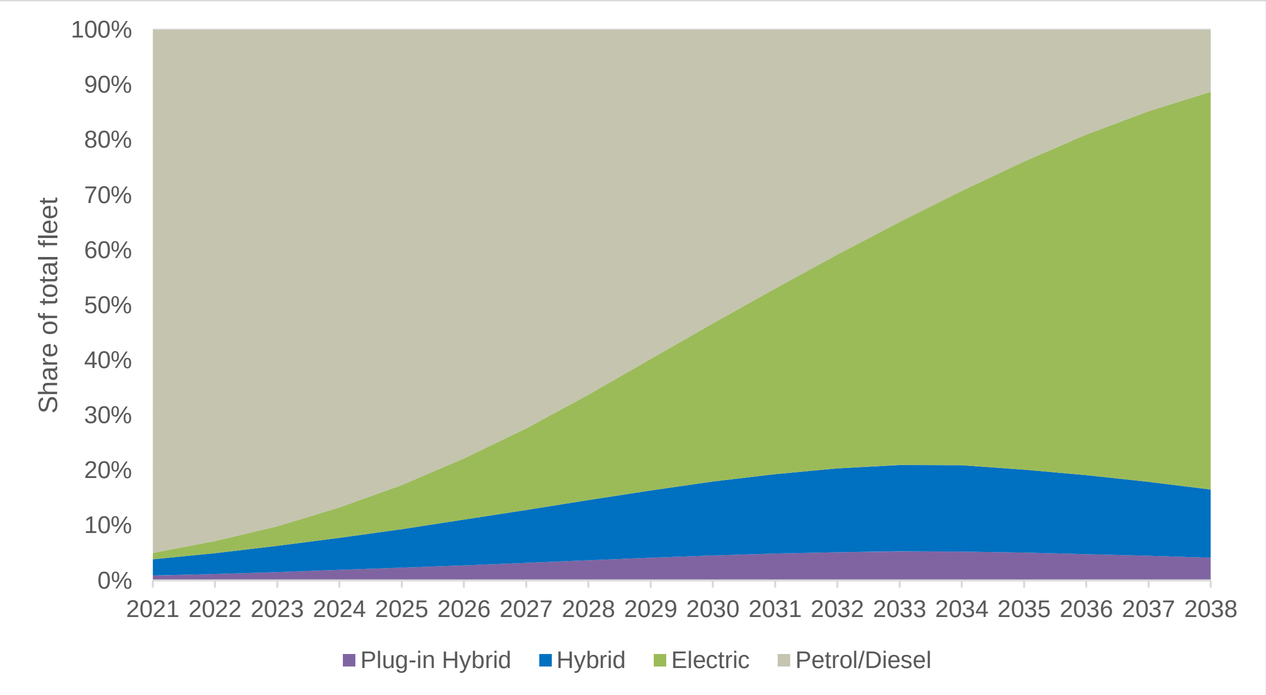
Electric Vehicle (EV) ownership is expected to grow significantly to support local decarbonisation targets and in alignment with national policy, which will see the phasing out of internal combustion engine vehicle sales by 2030 and hybrids by 2035.

Fully electric and plug-in hybrid vehicles (PHVs) in Salford are expected to grow from around 2,000 today to over 95,000 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.

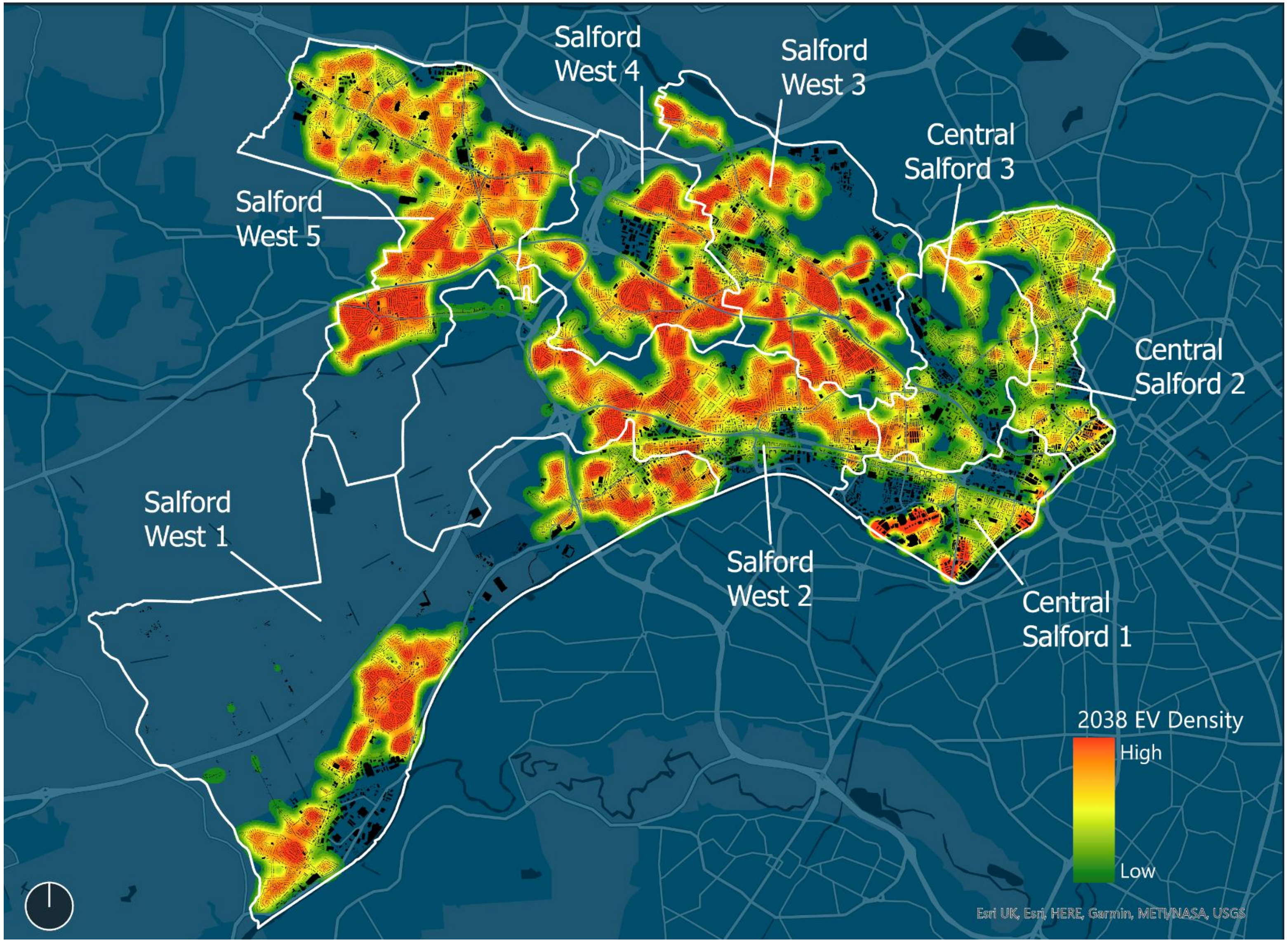
Greater Manchester's Transport Strategy 2040 sets out an ambition that no more than 50% of daily trips (across all modes) will be made by car in 2040, down from 61% today. In light of an expected overall growth in trips, the strategy sets out that meeting this target would mean a reduction of car trips from the current 3.7m per day to 3.4m. However, this still represents a significant demand for EV charging, estimated to increase to 322 GWh per year in Salford by 2038.

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

Projected Vehicle Mix Over Time



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



Publicly Accessible EV Charge Points

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

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

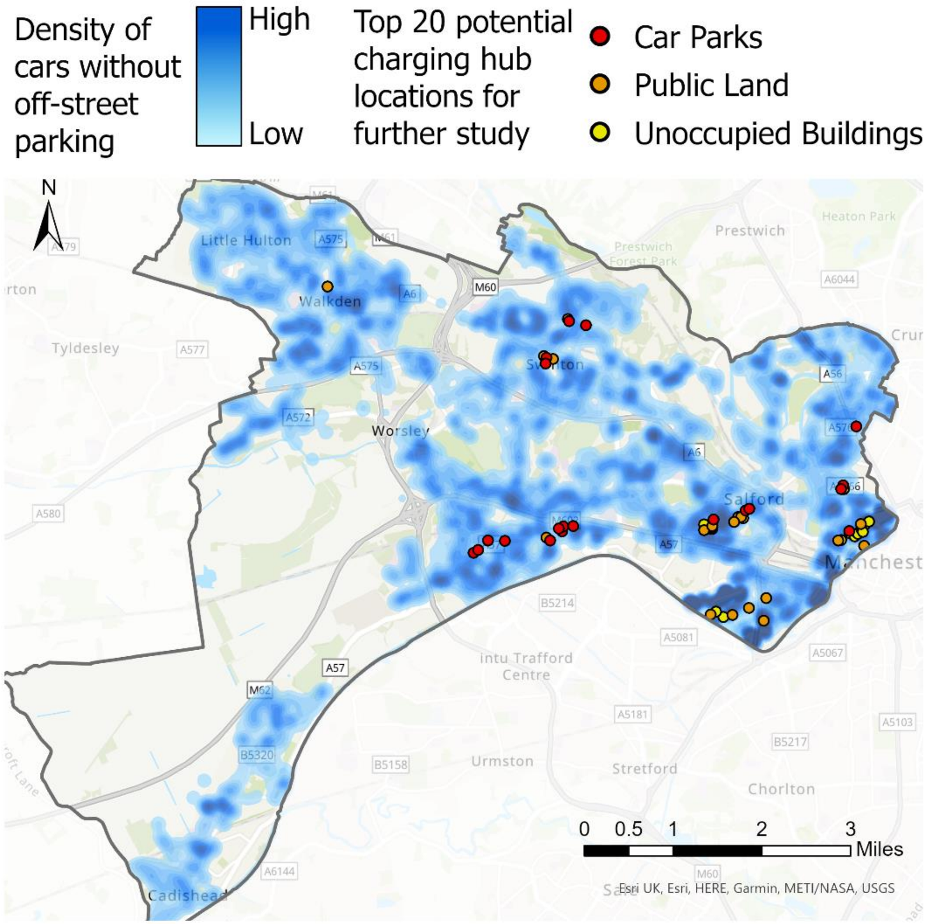
The maps shown identify potential prioritised charging hub locations, based on dwellings without potential for off-street parking and projected EV use. Further consideration will be needed, working with TFGM to identify and develop public/hub charge points across Salford[*].

Home Charge Points

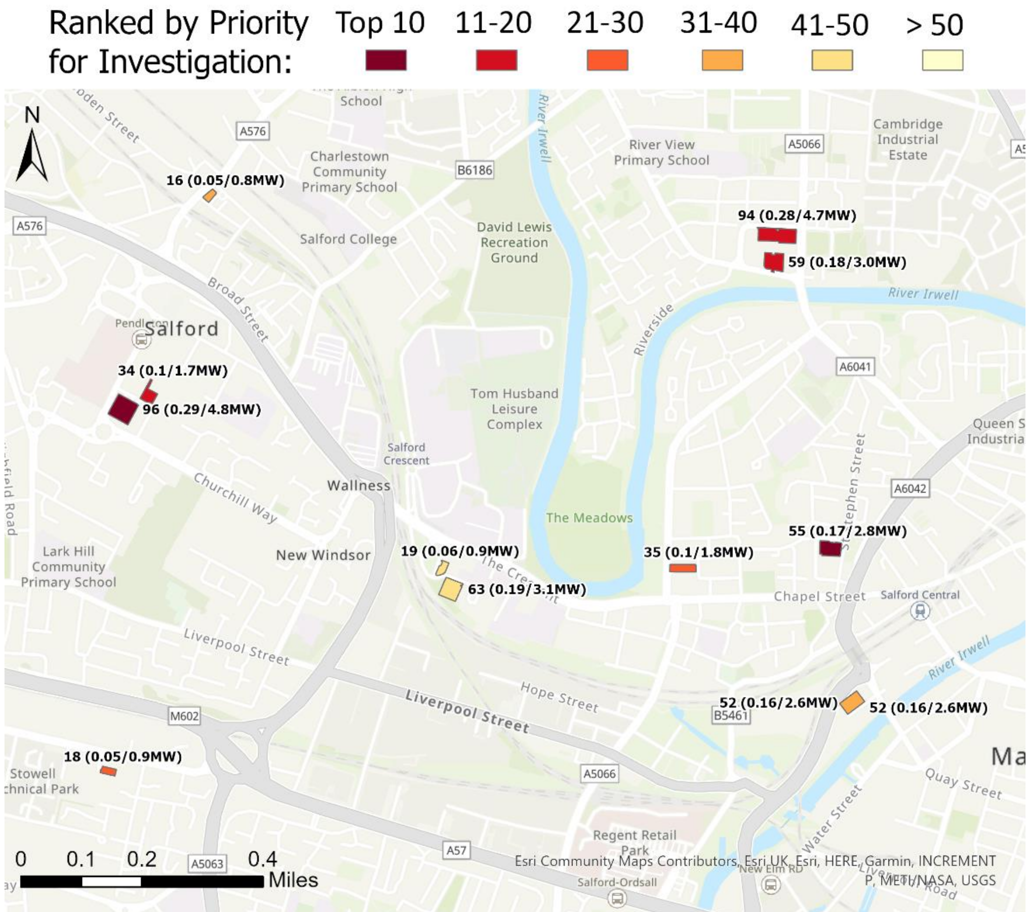
Homes with potential for off-street parking are considered able to install private chargers. EV ownership is projected to significantly outstrip the number of homes with off-street parking, and every home with off-street parking sees a charger installed, amounting to **43,000 home chargers**. The installation of these chargers could be coordinated with other home interventions, such as PV installation, heating system replacement and insulation, to minimise disruption experienced by households, and avoid multiple changes to wiring. Opportunities should also be explored for smart system integration between these different technologies.

[*] It is also recognised that EV charging provision should not be considered in isolation from other transport related decarbonisation plans. Salford 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 planning policies such as Policy A10 of the Salford Local Plan as it relates to new developments.

Potential Charging Hub Locations



Potential Charging Hub Locations at Existing Car Parks. With Estimated Spaces (and Slow/Rapid Charge Demand).



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

Vision to 2038

The shift to electricity for heating and transport increases the importance of using low carbon electricity sources. Although the electricity grid will need to reach almost zero carbon by 2050 for the UK to meet its net zero commitments, with very low or even negative levels of emissions anticipated as early as 2035, Salford 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.

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

Domestic Solar and Batteries

Building rooftops are used to meet a portion of energy requirements. Every modelled scenario utilised all suitable rooftop space (generally South East to South West), resulting in approximately 523 MW rooftop PV capacity installed by 2038, yielding 508 GWh of energy annually. In other words, all buildings with suitable roofs are low regrets opportunities to install solar PV, meaning there is plenty of flexibility around the approach for this.

As an indication, the upper right map highlights homes in a sample area which are suited to both rooftop PV and EV chargers. Combining the installation of these two measures could improve the efficiency of electrician work, while reducing disruption. This opportunity could also be taken to ensure there is spare capacity (e.g. in home distribution boards) for future heat pump power supplies.

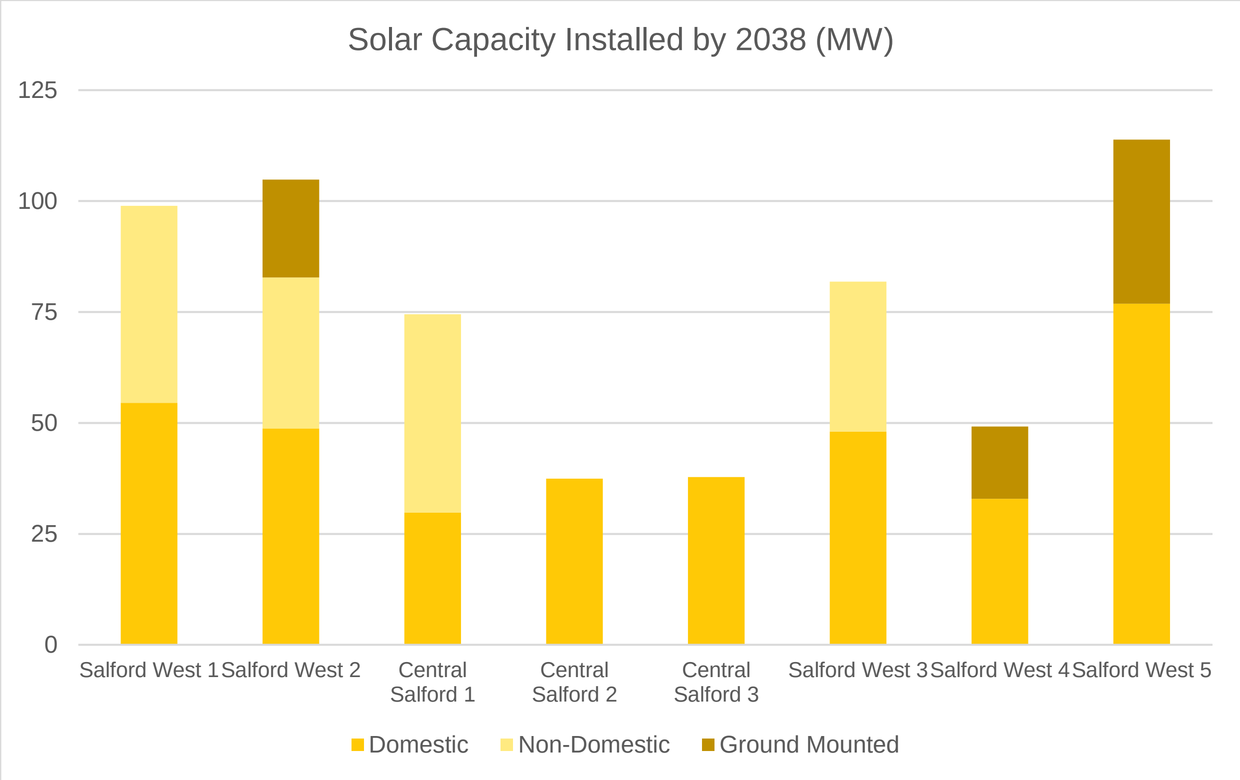
Alongside rooftop PV, there is an opportunity to install batteries to help flatten the load profile and reduce network reinforcement demands. New market incentives which value flexibility may boost the economic case for batteries going forward.

Density of dwellings with both rooftop PV and an EV, by 2038 in Salford West 4

Large Scale Solar PV*, Wind and Hydroelectric

A study to determine the areas of land in Salford suitable for ground mounted solar PV, small scale hydroelectric and wind turbines (including land not owned by the council) was carried out, accounting for factors such as flood zones, protected natural spaces and habitats, infrastructure, agricultural quality of land and future developments. This study only found very limited opportunities for solar and hydro developments, and none for wind. Three potential sites for ground mounted solar PV were identified (see lower right map), covering a total of 125 hectares. A total of 75 MW of PV capacity could be deployed on this land, yielding 64 GWh of energy per year. Potential for a single 0.2 MW hydro site was also identified on the Medlock by Deansgate train station, which would yield 0.8 GWh per year.

* 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).

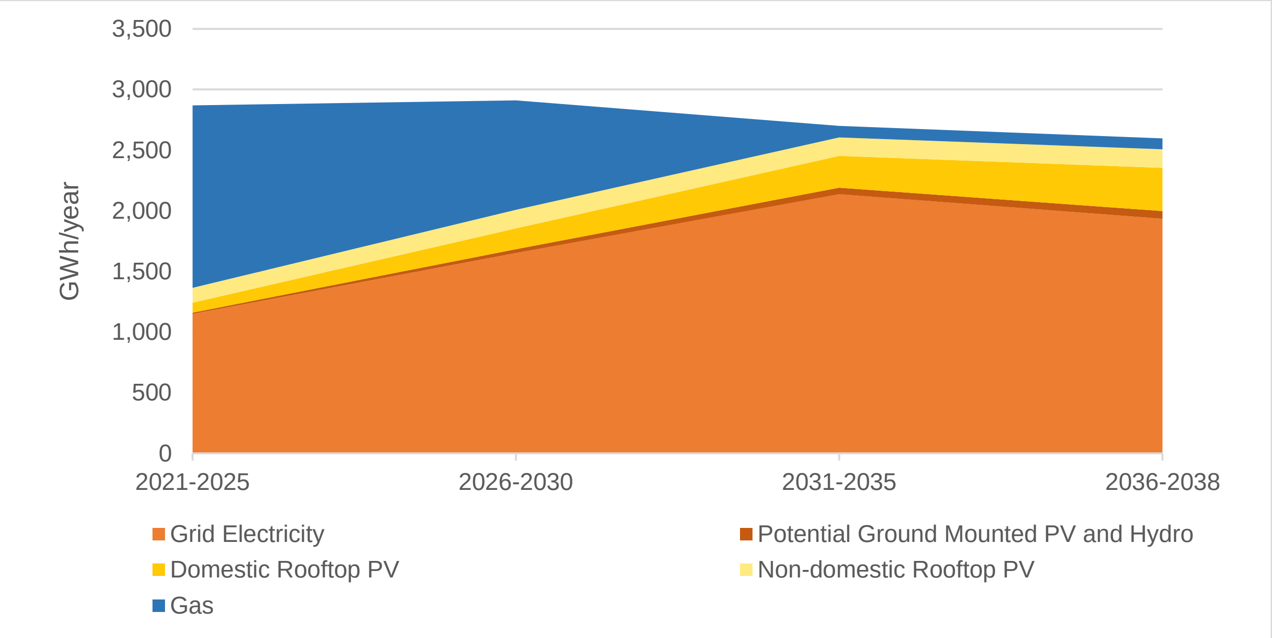


Potential sites for large scale solar PV, wind and hydroelectric in Salford

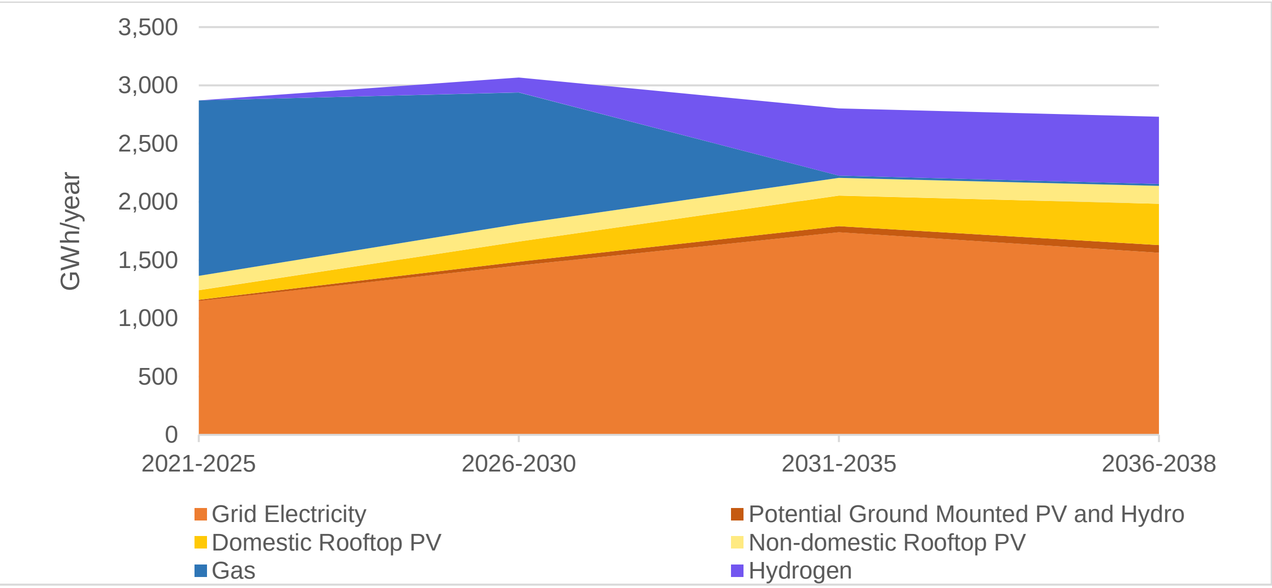
Energy Supply and Demand

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 chapter: Energy Networks. The increase in energy produced and consumed locally offers the potential to explore local energy market arrangements.

Changes in Energy Supply in Primary Scenario



Changes in Energy Supply in Secondary Scenario



Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, 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 chapters will require our networks to adapt and evolve in significant ways. For Salford 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 Salford 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 chapter of the report provides an overview of the impact on each of the energy networks of the primary plan as well as insight from the other modelled scenarios and other key considerations given the uncertainties.

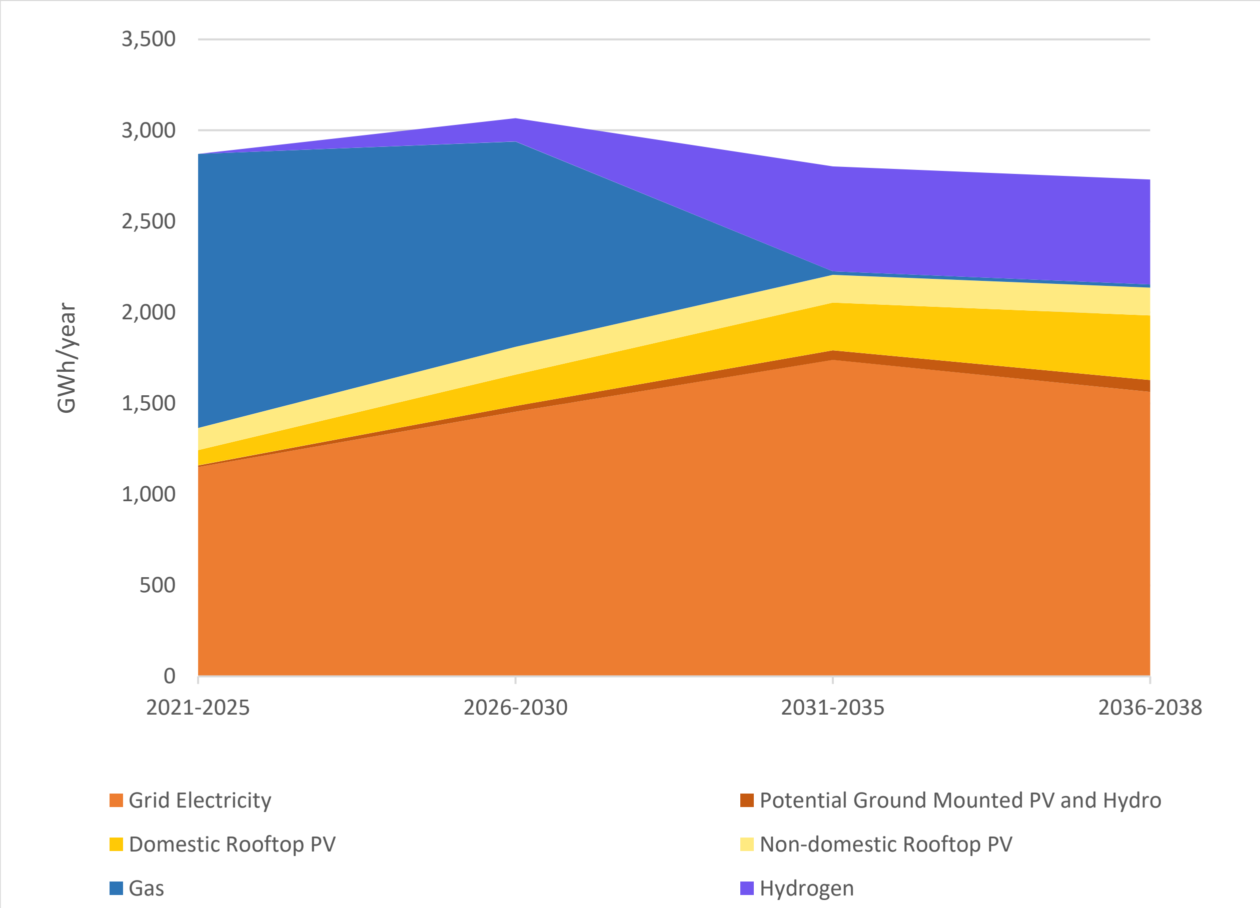
The primary scenario sees gas consumption reducing from c. 1,510 GWh per year currently down to around 90 GWh (or lower) by the early 2030s, and lower still in the secondary scenario where hydrogen can replace many remaining uses of gas.

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

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

All scenarios except scenario 4 show that some gas remains in use by 2038, largely to support hard-to-decarbonise non-domestic premises, including high-temperature process heat for industry. If hydrogen does not become available to support decarbonisation of these uses, alternatives may need to be considered to achieve the carbon target and budget, such as carbon capture and storage technologies.

Changes in Energy Supply in Secondary Scenario



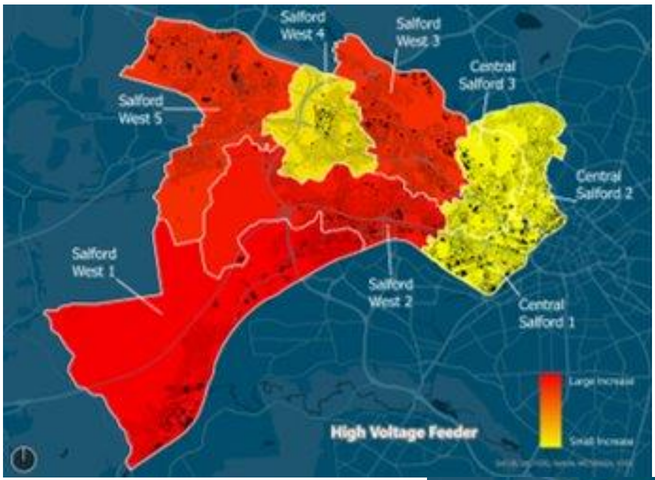
Capacity Requirements for 2038: High Voltage

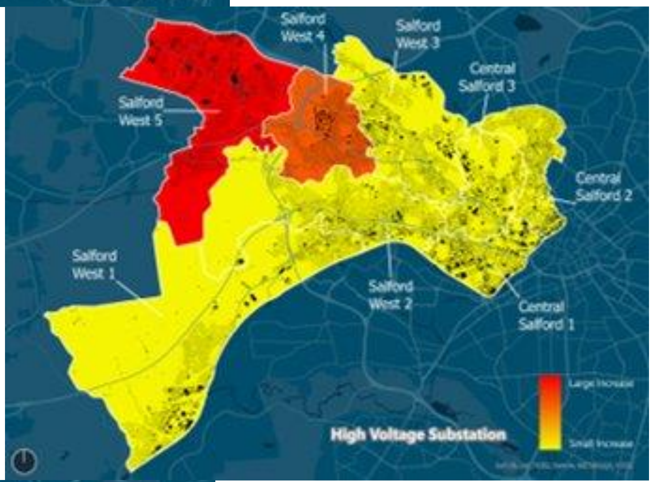
The local electricity distribution network operated under license by Electricity North West supplies electricity to the majority of dwellings and industry in Salford today. Modelling indicates the capacity required to meet all projected demand growth through conventional investment, but some of this 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 next page) 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, potential for off-street parking and existing spare capacity in the current electricity infrastructure. For example, a zone may see a large increase in demand for home EV chargers, but not require large capacity increase because it currently has significant spare capacity. The difference in capacity requirement increase is evident between the primary scenario where heat is mostly electrified, and the secondary scenario where heating is mostly provided by hydrogen.

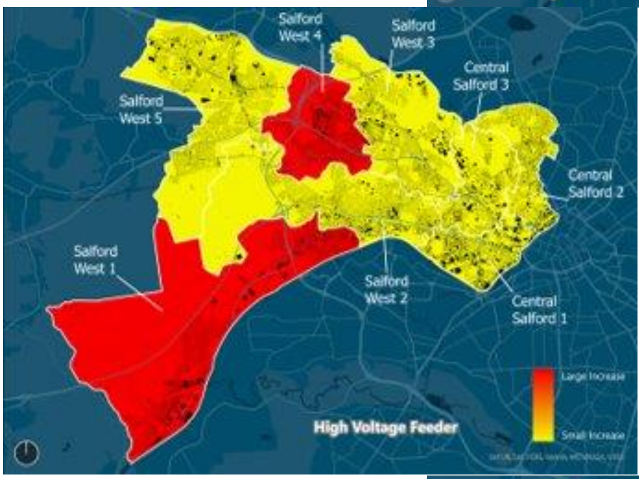
	High Voltage Feeder Capacity (MW)			High Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Salford West 1	70	175	175	77	77	77
Salford West 2	68	156	68	70	70	70
Central Salford 1	120	120	120	132	132	132
Central Salford 2	73	73	73	59	59	59
Central Salford 3	61	61	61	71	71	71
Salford West 3	48	108	48	67	67	67
Salford West 4	30	35	178	29	86	86
Salford West 5	58	127	64	70	283	70

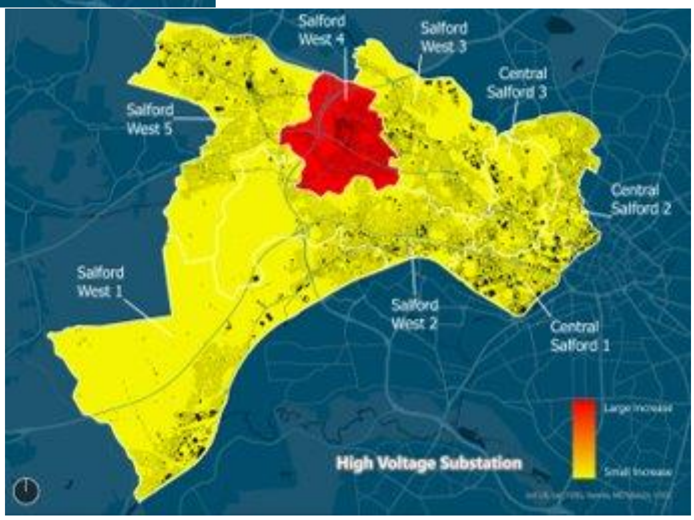
Primary Scenario





Secondary Scenario



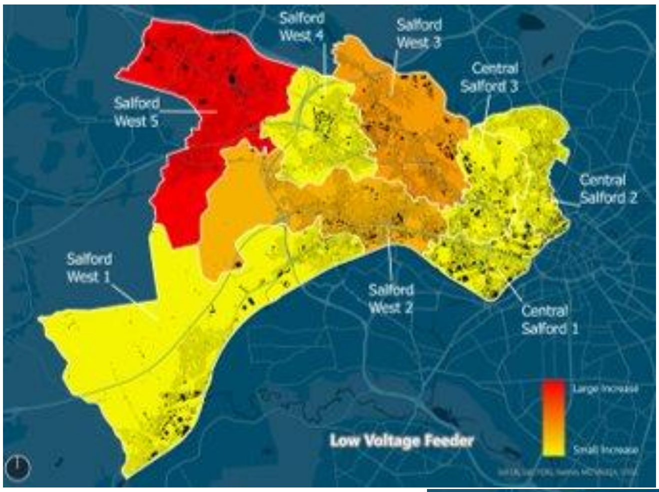


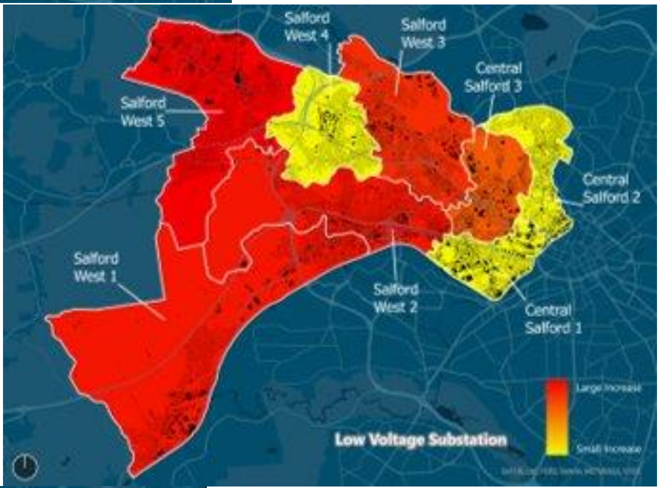
Capacity Requirements for 2038: Low Voltage

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

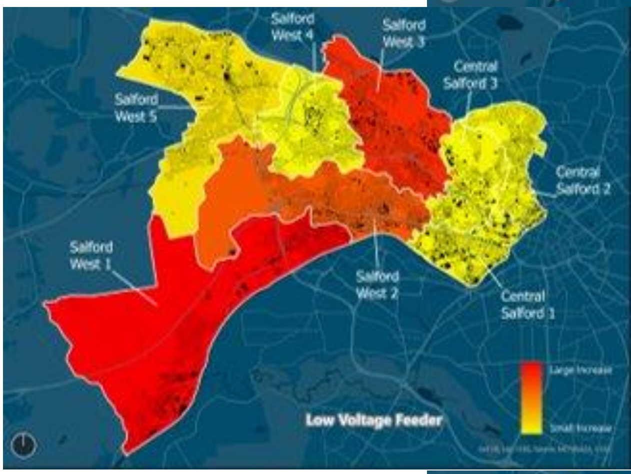
	Low Voltage Feeder Capacity (MW)			Low Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Salford West 1	75	81	133	53	265	265
Salford West 2	53	106	106	54	309	309
Central Salford 1	94	94	94	101	101	101
Central Salford 2	52	52	52	54	54	54
Central Salford 3	74	81	45	46	146	46
Salford West 3	38	81	81	40	167	167
Salford West 4	25	25	25	24	24	157
Salford West 5	48	190	59	50	351	351

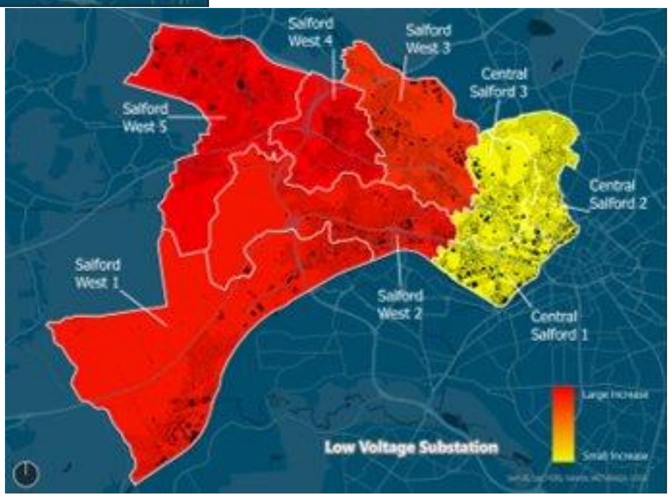
Primary Scenario





Secondary Scenario





Present Day Capacity and First Steps

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

The areas Salford West 1 and Salford West 4, for example, have the greatest levels of capacity headroom for demand, suggesting that EV chargers could be installed at scale in these areas before network upgrades are required, along with heat pumps in Salford West 1 where they are the dominant heating solution. Salford West 4 is an area for which district heating has been identified as a cost effective solution. This along with the network capacity, suggests that this would be a good area in which to proceed with early commencement of a heat pump fed heat network.

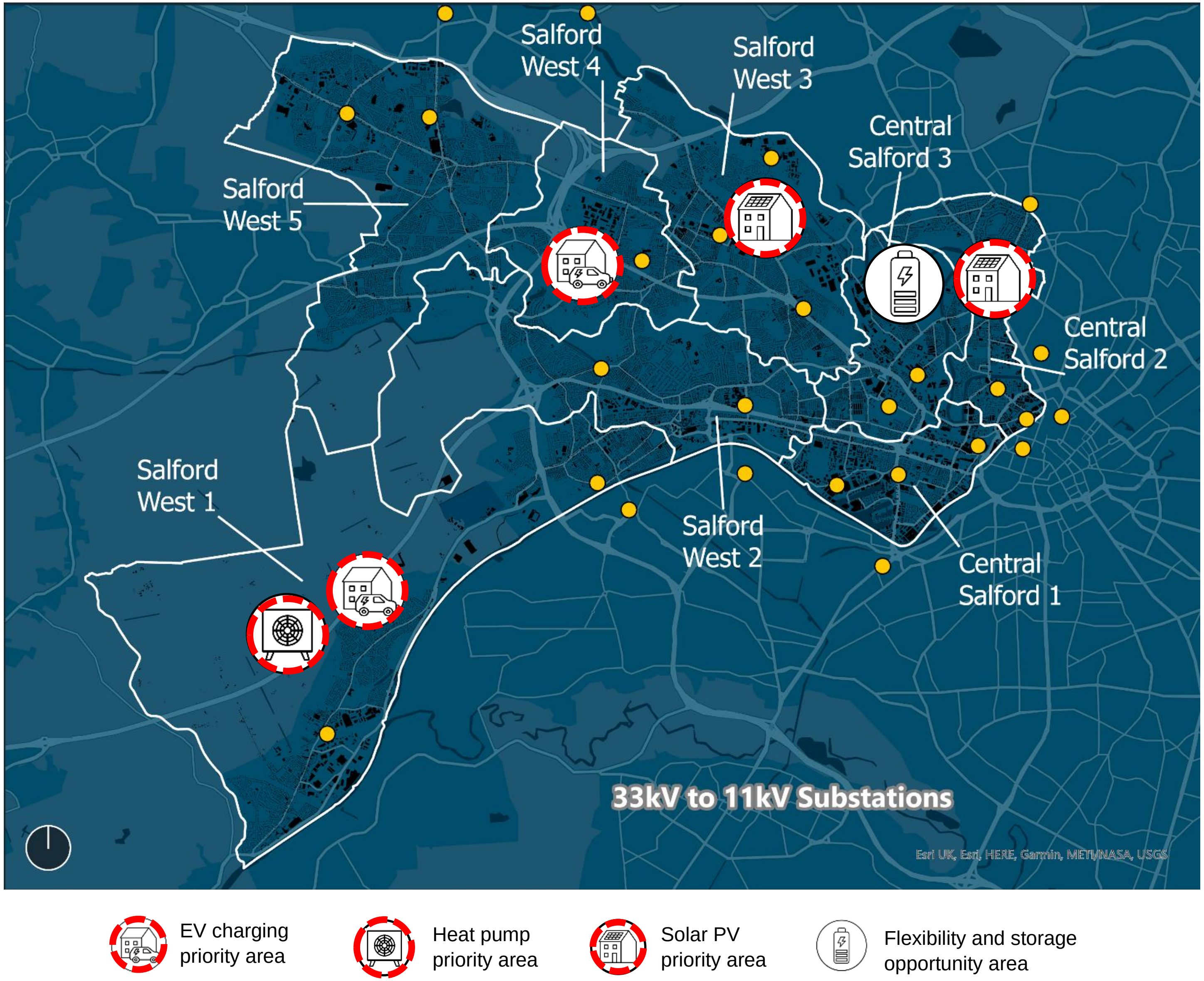
In contrast, Central Salford 1, Central Salford 2 and Central Salford 3 show limited spare capacity. Fortunately, Central Salford 3 has been identified as a hydrogen priority area and Central Salford 1 and Central Salford 2 have been identified as heat network priority areas. It is likely that heat pumps will be the heat generating source within these heat networks, but large heat pumps serving district heating may provide more opportunity to use thermal storage to manage grid constraints. Local generation could also be trialled as a way to overcome demand constraints, although it's worth noting that peak network demand typically occurs on winter evenings, when solar generation is negligible, and electrification of heat is likely to compound this.

	Demand			Generation	
Zone	Headroom (MW)	Heat pump installs	Households with EV chargers	Headroom (MW)	Solar PV installs (MW)
Salford West 1	13.3	17,806	8,167	17.2	99
Salford West 2	10	14,537	6,974	14	83
Central Salford 1	0	18,364	632	14	74
Central Salford 2	0	889	2,919	31.8	37
Central Salford 3	0	12,239	1,968	7	38
Salford West 3	9.9	15,338	7,523	36.7	82
Salford West 4	13.5	588	4,864	7	33
Salford West 5	3	22,955	10,033	14	77

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

For solar PV, the zones Central Salford 2 and Salford West 3 especially stand out as likely to be able to absorb more significant power flows from PV installation, while Central Salford 3 and Salford West 4 would not be able to proceed as far with installations before network upgrades became necessary. Since the modelled deployment of PV is modest in Central Salford 2, Salford West 3 is suggested as a solar PV priority area. In practice, there appears to be sufficient headroom to begin installations in all areas.

Central Salford 3 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. It has also been identified that this area will require some alternative solution to home EV chargers, such as a public charging hub, due to lack of off-street parking. These factors present 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.


Salford West 4
Salford West 3
Central Salford 3
Salford West 5
Central Salford 2
Salford West 1
Salford West 2
Central Salford 1
33kV to 11kV Substations
Esri UK, Esri, HERE, Garmin, METI/NASA, USGS
EV charging priority area
Heat pump priority area
Solar PV priority area
Flexibility and storage opportunity area

Gas Network Today

The gas network operated under license by Cadent supplies gas to the majority of dwellings in Salford 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 Salford is around 1,508 GWh.

To deliver Salford 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 Salford sees the majority of dwellings converting their heating systems to either be

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

This would necessitate phased disconnection of homes from the gas network as they are converted to electric or district heating, which would need coordination. However, the secondary scenario sees the majority of buildings supplied by hydrogen, meaning they would remain connected to a repurposed gas network. Around £445m of investment would be required for this network conversion. Of Salford’s approximately 1,023 km of gas pipework, around 73% is already made of polyethylene, suggesting that much of the network could already by suitable for carrying hydrogen.

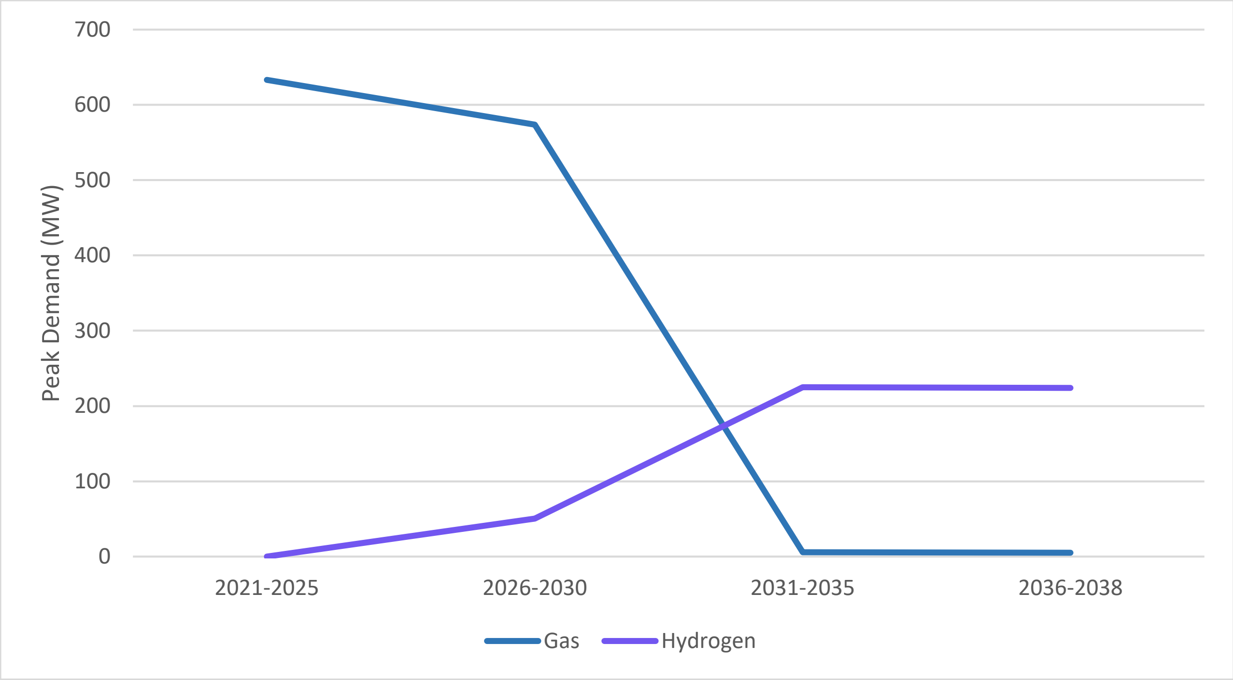
Hybrid heating (air source heat pump/gas boiler hybrid) is an option in certain circumstances and could provide a valuable transition technology to manage uncertainty around the role of the gas network in domestic heating through the 2020s. Around 18,400 dwellings may be best suited for this technology: 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.

Even in the electrification scenario, gas networks may need to be retained for longer in areas where hybrids are a useful transition option due to property types, particularly Central Salford 1 and Salford West 2.

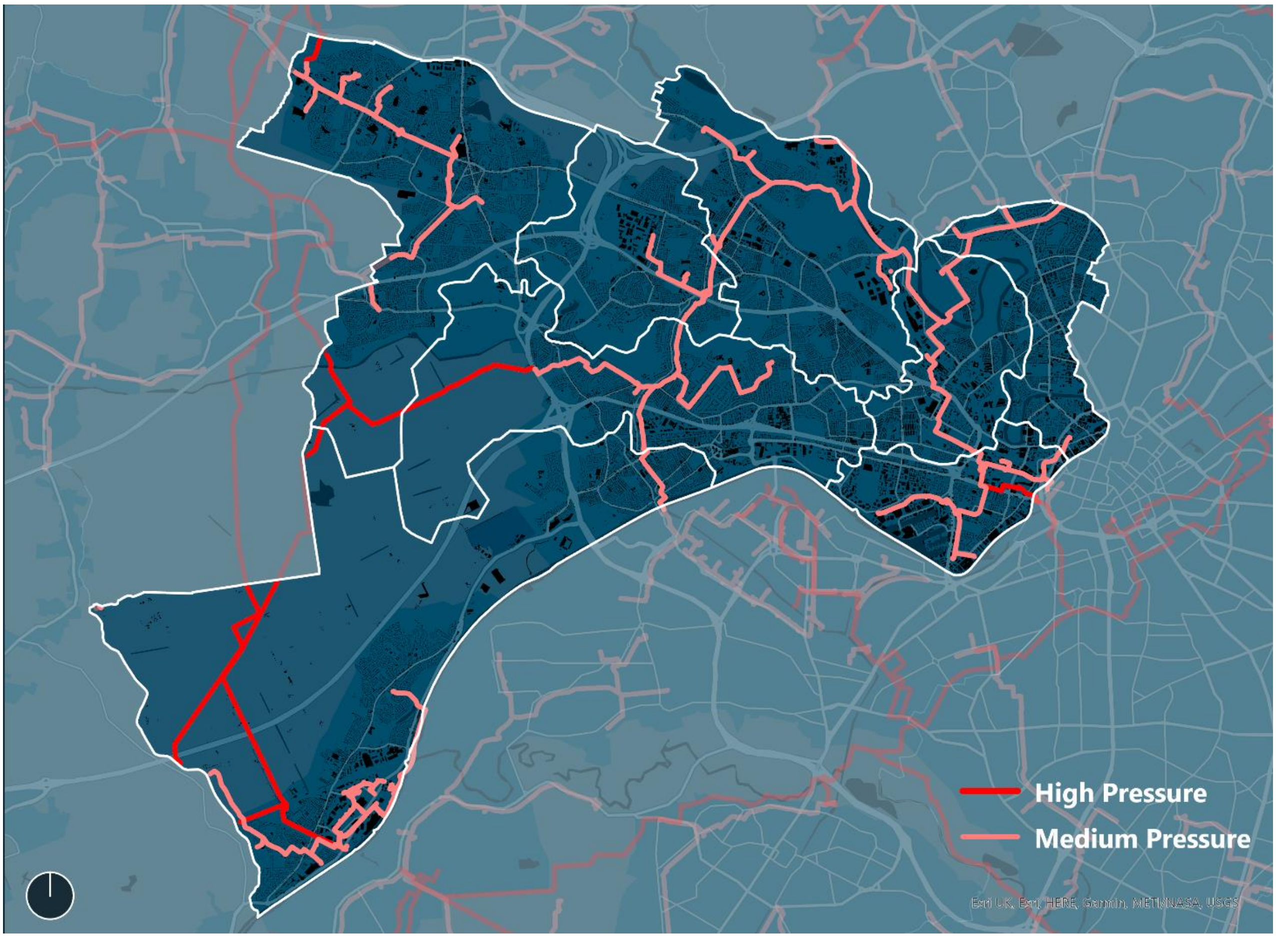
There are a small number of non-domestic properties that are harder to electrify, particularly with industrial uses that require high temperature process heat; these will remain on the gas network under the primary scenario and use hydrogen where possible in the secondary. Most non-domestic gas use can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

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

Usage of Gas Network under HyNet Scenario in Salford



Current Gas Network in Salford



7. ENERGY NETWORKS – DISTRICT HEAT

District heating could supply in the region of 27% (42,000) of Salford's dwellings. The role of district heating is diminished in the secondary scenario where hydrogen meets much of the demand, although in practice district heating could be supplied by hydrogen boilers in the energy centres, meaning that investment in the heat networks would remain a relatively low regrets option if hydrogen for heating materialised. By centralising the hydrogen boilers, the need to replace gas pipework in streets and buildings to make them compatible with hydrogen would be reduced.

In Central Salford 1, an existing heat network (pictured bottom right) can provide the starting point to grow the coverage of district heating to reach more of the buildings identified as suitable. Areas with a high density of buildings suitable for district heat connections are also highlighted for Central Salford 2 (pictured bottom right) which could be starting points for a new heat network in that area, though if the Central Salford 1 network were to grow substantially it could expand into Central Salford 2. Additionally, Salford West 4 has a number of suitable publicly owned buildings, such as schools and local authority buildings, which could provide anchor loads for a heat network to branch from and serve the surrounding dwellings.

There are four main opportunity areas for district heating zones, providing opportunities to develop networks, in the region of 39 km of heat network for an investment of £254m*, in the clusters highlighted opposite and around suitable non-domestic buildings and areas of proposed new development.

Heat generation is assumed to be primarily based on large scale heat pumps, with of 44.5 MWp of heat delivered from heat pumps. However, opportunities to make use of any waste heat sources should be explored, as these could improve the cost and carbon credentials of a district heat scheme further.

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

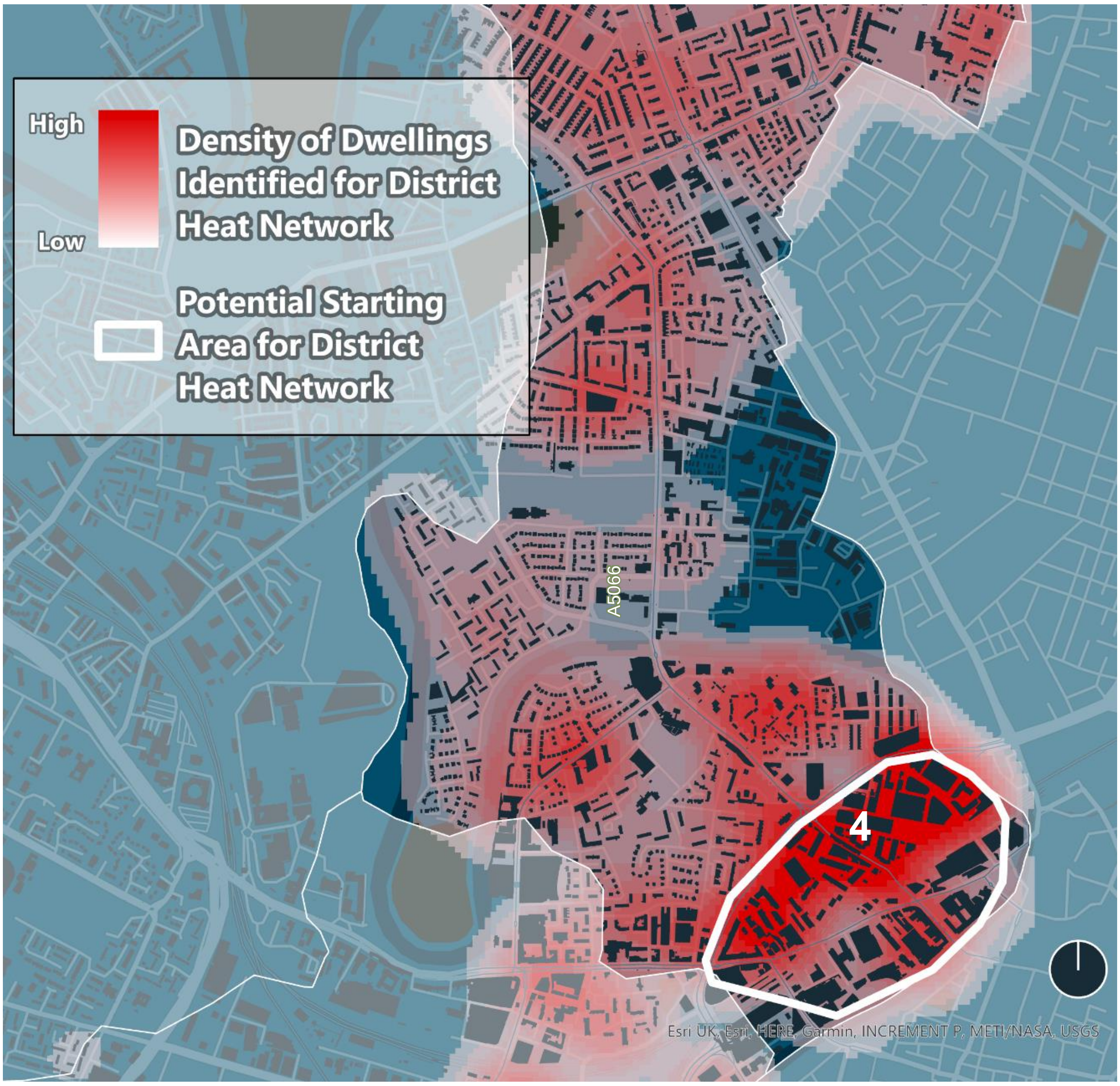
Heat Network Opportunity Area	Approximate Peak Heat Generation Capacity (MWp)	Approximate Network length (km)
1 – Salford West 4	6.4	23
2 – Central Salford 1 – South West	7.3	4
3 – Central Salford 1 – South	19.0	5
4 – Central Salford 2	11.8	7

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

Salford West 4

Central Salford 1

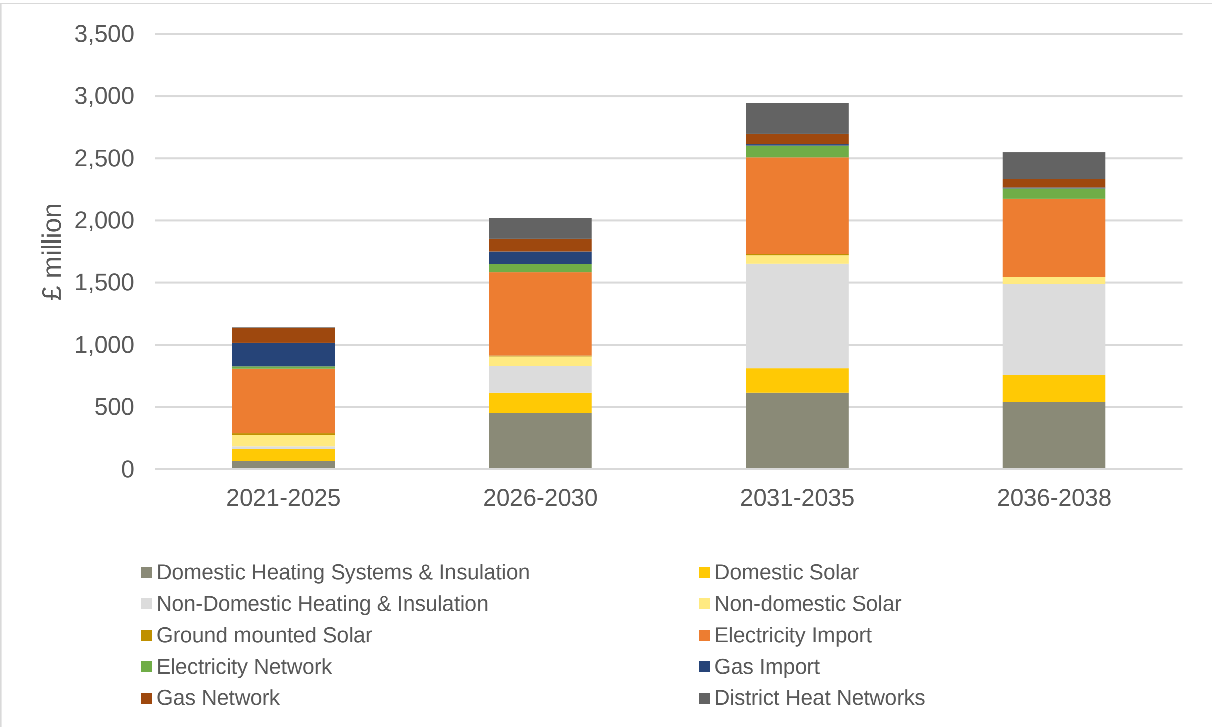
Central Salford 2



Total cost (including energy consumption)

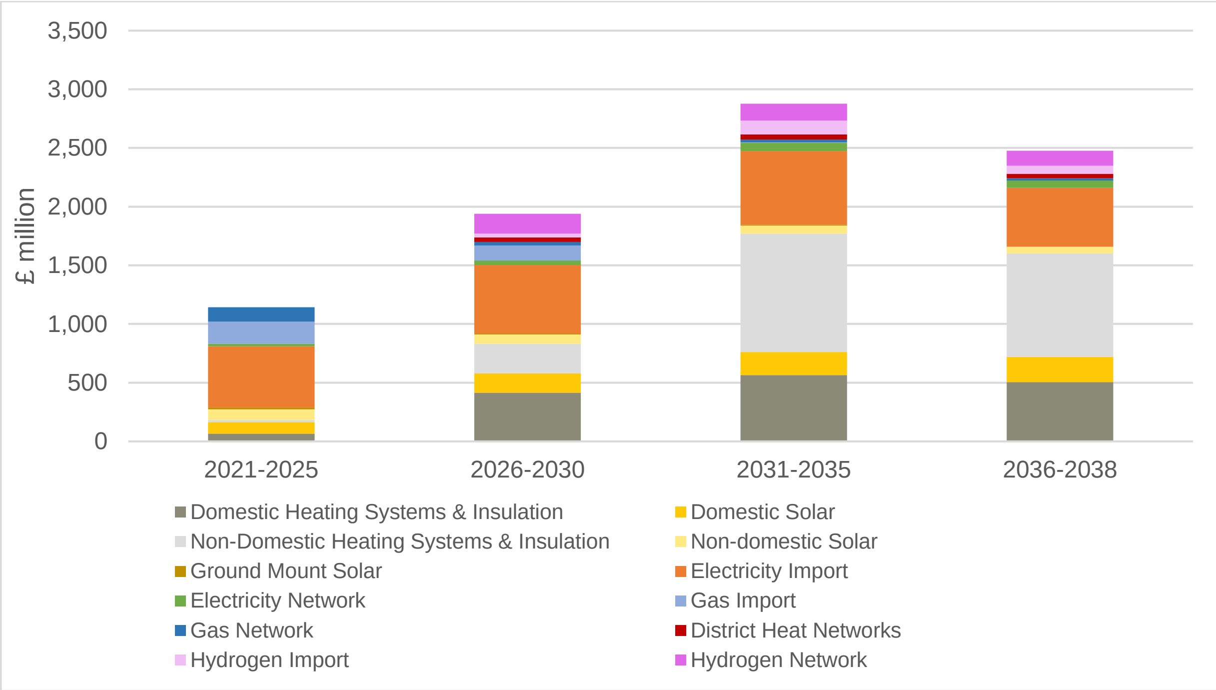
The primary scenario is based on a total energy system spend of £8.7bn (with a range of £8.1 - 8.7bn across all four scenarios). The cost is attributed to investment in energy networks, in buildings (for components such as fabric retrofit, heating system change and roof mounted PV) and for energy consumed. The charts below illustrate the split between these components. Notably, a significant proportion of this cost would have been spent without accounting for decarbonisation. 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.

Primary Scenario



* Status quo expenditure has not been calculated in this LAEP

Secondary Scenario



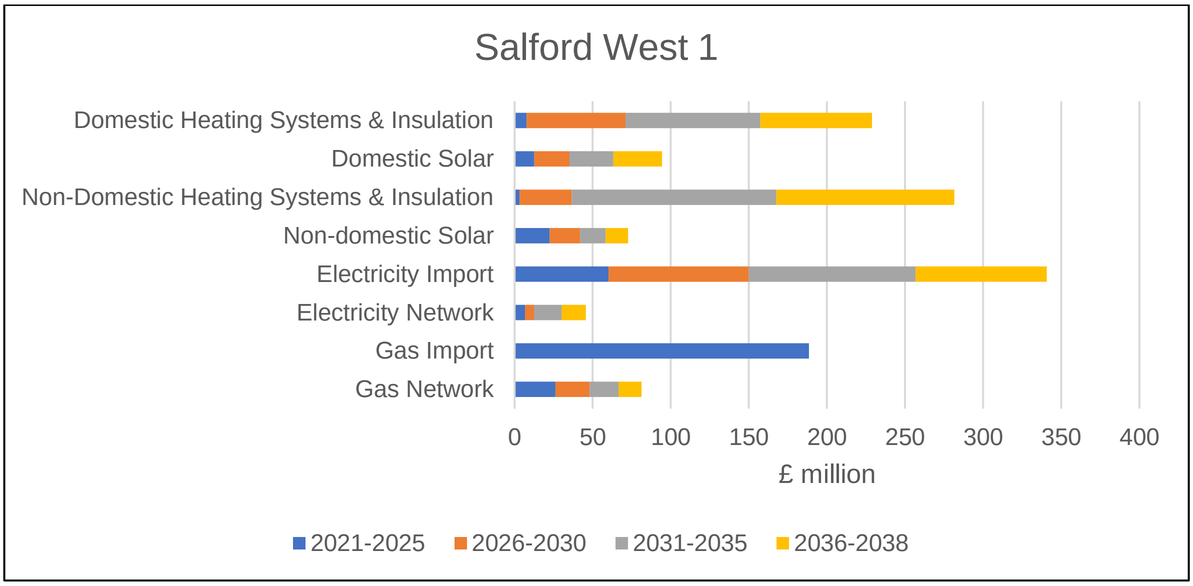
Investment (exclusive of energy consumption)

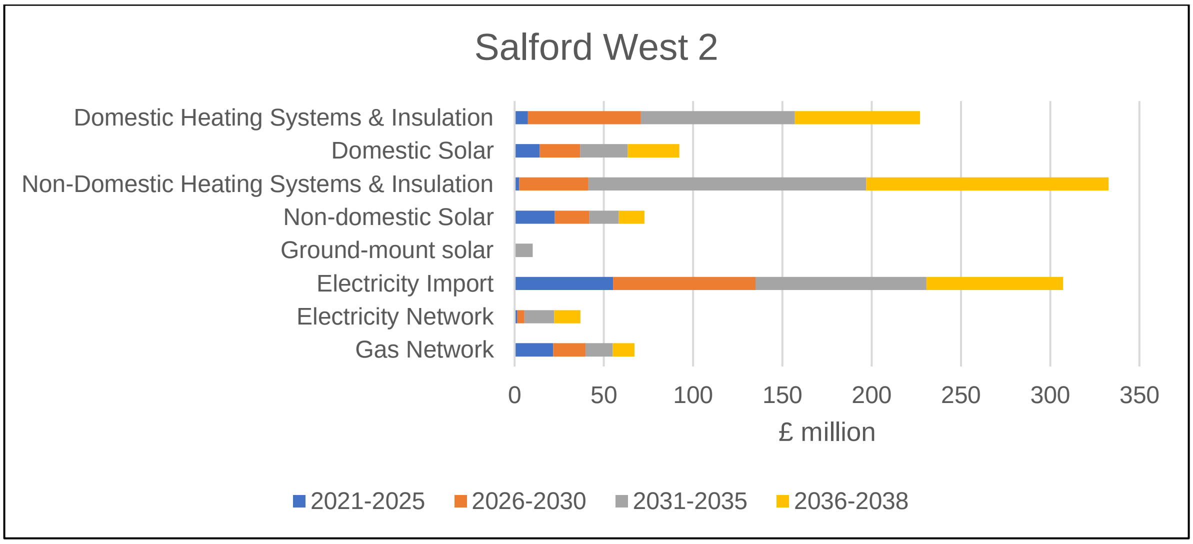
The tables below illustrate the total investment needed in the energy system to deliver the plan, equating to a total of £5.8bn for the primary scenario and £5.7bn for the secondary, with the charts on the following page breaking this down by technology. Again a significant proportion of this investment will be required without working towards carbon neutrality, for example expenditure on replacement gas boilers is instead targeted at low carbon heating systems.

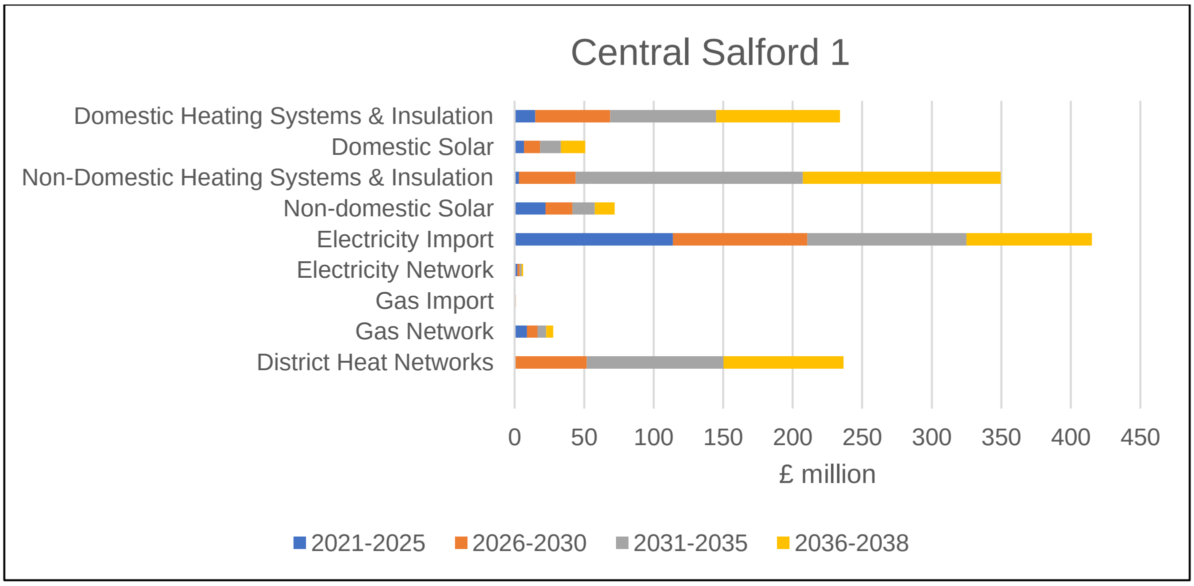
Zone	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Salford West 1	805	815
Salford West 2	830	900
Central Salford 1	975	1,020
Central Salford 2	695	560
Central Salford 3	550	550
Salford West 3	650	650
Salford West 4	380	390
Salford West 5	830	750

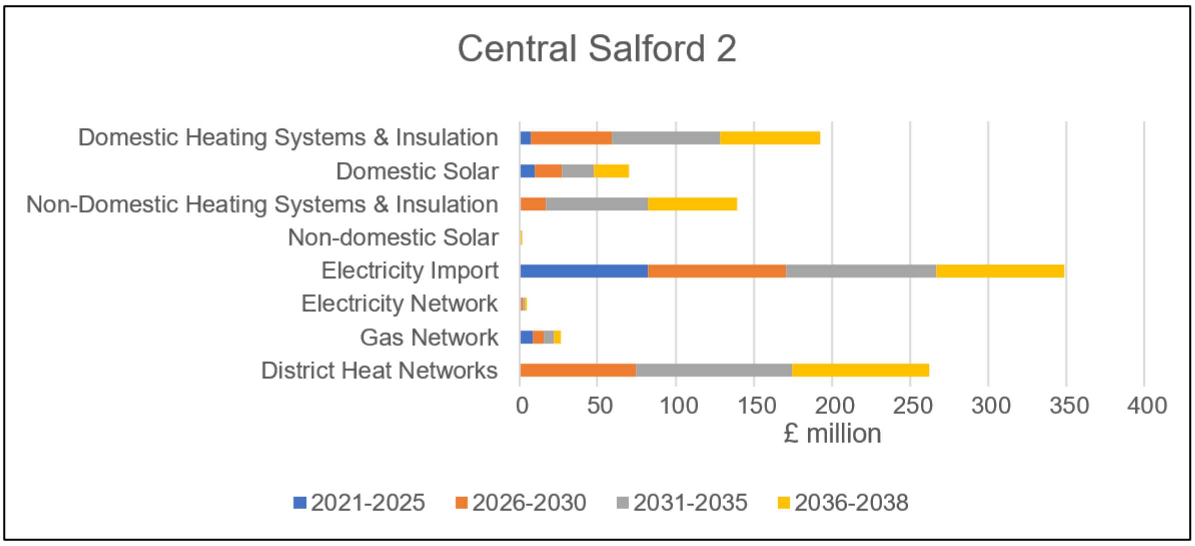
Investment type	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Domestic Heating Systems & Insulation	1,670	1,550
Domestic Solar	675	675
Domestic EV Chargers	24	24
Non-domestic Heating Systems &Insulation	1,810	2,160
Non-domestic Solar	290	290
Large Scale Ground-mounted Solar	34	34
Electricity Network	260	195
District Heat Network	625	120
Hydrogen Network	0	445

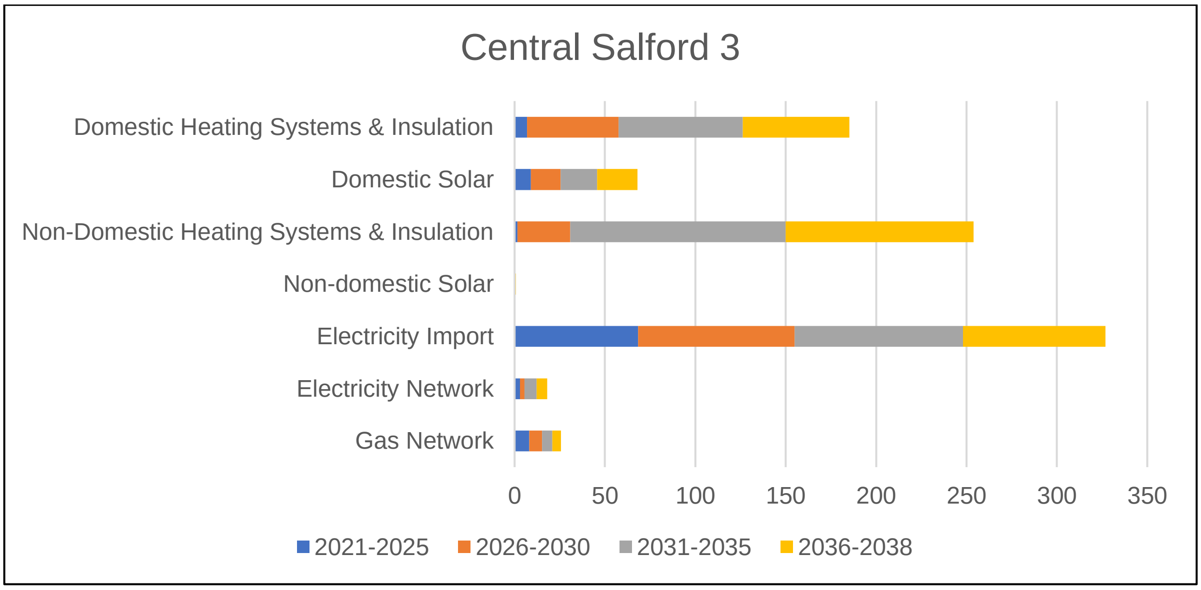
Investment in Salford's energy system (£m) by time period across each area

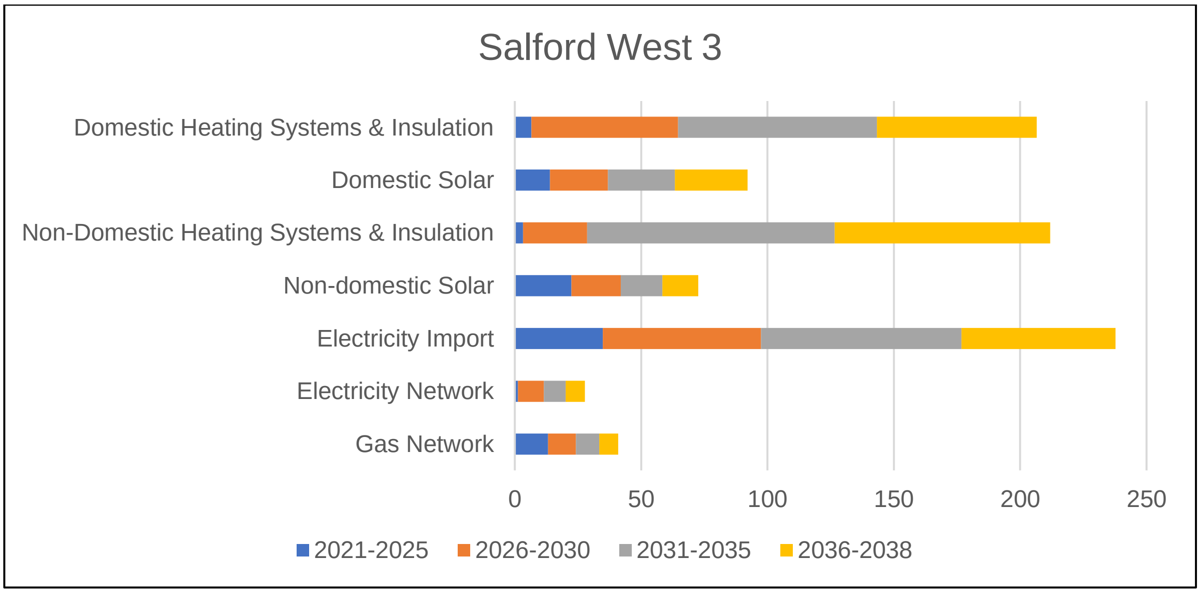


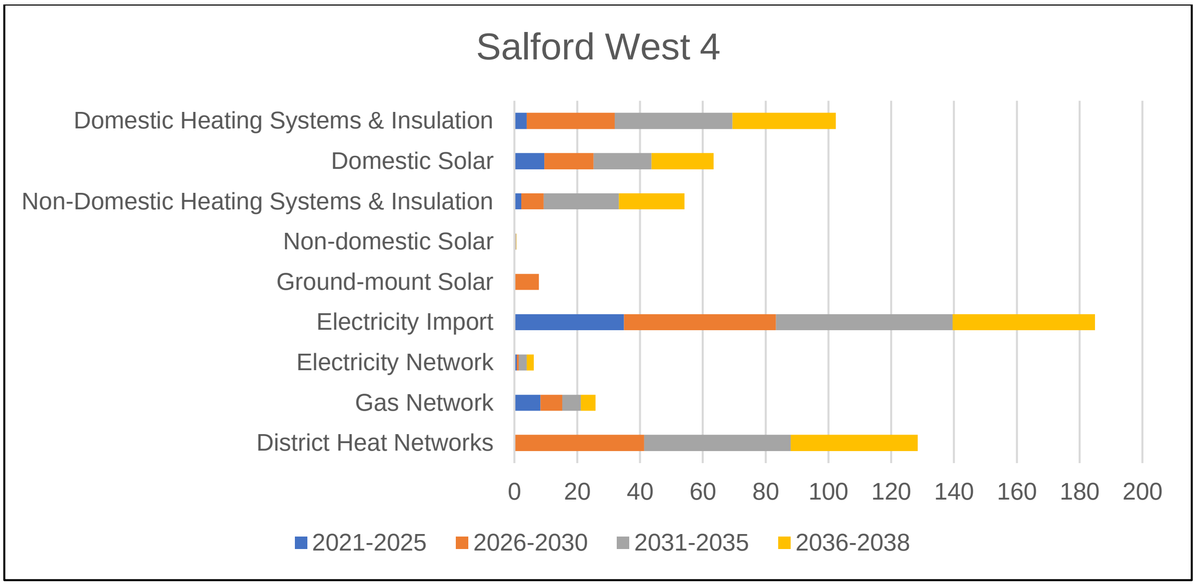


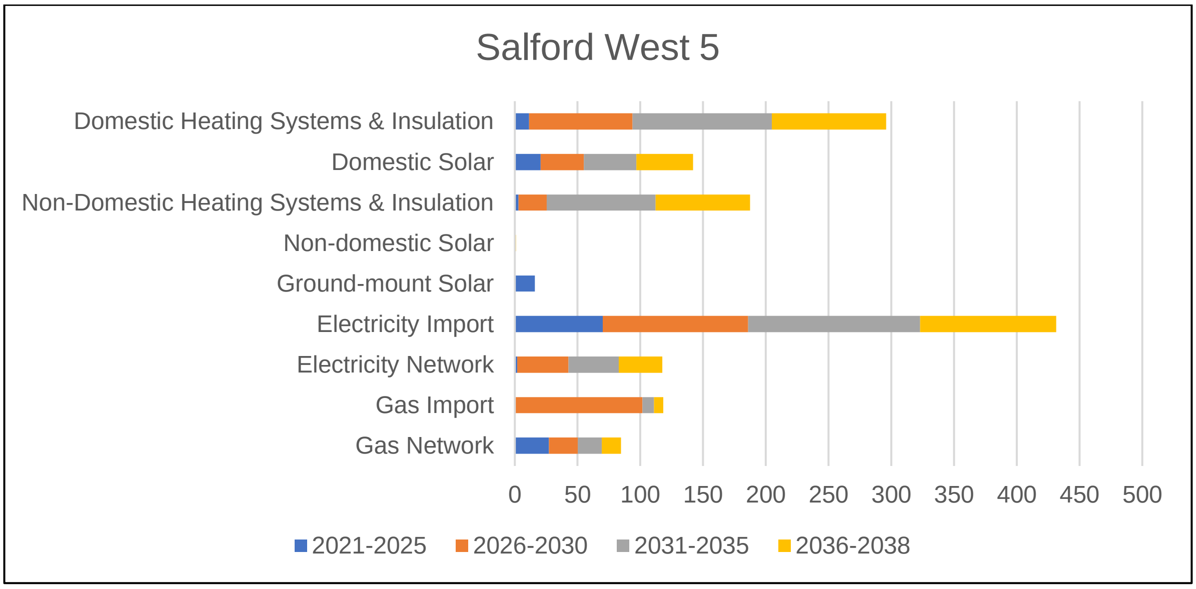



Central Salford 2
Domestic Heating Systems & Insulation
Domestic Solar
Non-Domestic Heating Systems & Insulation
Non-domestic Solar
Electricity Import
Electricity Network
Gas Network
District Heat Networks
0 50 100 150 200 250 300 350 400
£ million
2021-2025 2026-2030 2031-2035 2036-2038


Central Salford 3
Domestic Heating Systems & Insulation
Domestic Solar
Non-Domestic Heating Systems & Insulation
Non-domestic Solar
Electricity Import
Electricity Network
Gas Network
0 50 100 150 200 250 300 350
2021-2025 2026-2030 2031-2035 2036-2038


Salford West 3
Domestic Heating Systems & Insulation
Domestic Solar
Non-Domestic Heating Systems & Insulation
Non-domestic Solar
Electricity Import
Electricity Network
Gas Network
0 50 100 150 200 250
2021-2025 2026-2030 2031-2035 2036-2038


Salford West 4
Domestic Heating Systems & Insulation
Domestic Solar
Non-Domestic Heating Systems & Insulation
Non-domestic Solar
Ground-mount Solar
Electricity Import
Electricity Network
Gas Network
District Heat Networks
0 20 40 60 80 100 120 140 160 180 200
2021-2025 2026-2030 2031-2035 2036-2038


Salford West 5
Domestic Heating Systems & Insulation
Domestic Solar
Non-Domestic Heating Systems & Insulation
Non-domestic Solar
Ground-mount Solar
Electricity Import
Electricity Network
Gas Import
Gas Network
0 50 100 150 200 250 300 350 400 450 500
2021-2025 2026-2030 2031-2035 2036-2038

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 Salford 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 Salford

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

1. Reduced energy demand in Salford: 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 over 35,000 homes and deep retrofit of a further 14,500 homes requiring £710m of investment. Further investment in retrofit is required in the secondary scenario, due to the later decarbonisation of heating with hydrogen, and the higher cost of hydrogen fuel. 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 Salford from 1,215 GWh of electricity consumed per year to 2,506 GWh by 2038.

[*] 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.

2. Increasing uptake of low-carbon solutions in Salford: 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 networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.43,000) and public EV charging hubs, targeted at priority locations. Industry in Salford 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 Salford: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production in Salford. In the primary scenario 523 MWp of roof mounted solar PV capacity is installed.

Deploying the maximum potential for rooftop and ground mounted solar PV would produce up to 572 GWh per annum of local, low carbon electricity, a significant contribution to Salford's forecasted annual consumption of 2,506 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 Salford: 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 Salford. Greater Manchester's ambition of carbon neutrality by 2038 creates significant pressures regarding the deliverability of 100% hydrogen heating to all homes in Salford. 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. Salford should not rule out the potential for hydrogen heating, however, neither should it plan for it with certainty. The secondary scenario found that a similar level of emission reduction could be achieved using predominantly hydrogen for heating (4.8 Mt CO_2 generated through to 2038 compared to 5.0 Mt CO_2 for the primary scenario) for a similar total system cost (£8.5bn compared to £8.7bn for the primary scenario). A hydrogen heat based future could also be more appealing to Salford'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 Salford in support of Greater Manchester's commitment across the Combined Authority area is estimated to represent total energy related costs of between £8.1bn and £8.7bn across all scenarios

The primary plan for Salford:

- Will require capital investment of £5.8bn (excluding energy costs) in less than 20 years. This investment is broken down with an approximate spend of £1.2bn on energy networks, £2.3bn on Salford's dwellings, £2.1bn on Salford's non-domestic buildings. This has the potential to build local supply chains and create jobs for the future as part of a green industrial revolution for Salford
- By 2038 the local electricity network in Salford could supply as many as 43,000 domestic EV charge points distributed across the local area and numerous EV community charging hubs, primarily located around the three central zones.
- Over 100,000 homes could have heat pumps with over 73% 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 Salford will need to shift to a combination of electric and hybrid solutions
- Alternatively, hydrogen could be supplied to over 105,000 homes, as well as non-domestic buildings, allowing hydrogen boilers to replace gas boilers for heating and hot water, as well as providing low carbon fuel for high temperature industrial applications. This would mean much of the gas network would be retained and repurposed by 2038.
- The gas network will continue in the immediate term to meet the majority of heating demands of homes and buildings although new connections will start to decline in the 2020s as new development favours electric or district heating solutions.
- Heat networks will grow and expand, particularly in the town centre of Salford. 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

The Scale of the Challenge

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

Local Energy System Aspects	Key Metrics	Value in 2038	
		Primary Scenario	Secondary Scenario
Local Energy Consumption	Local energy consumption (excluding transport fuels, GWh/yr)	2,596	2,731
	Number of dwellings	159,375	159,375
	Non-domestic buildings (m^2)	6,646,345	6,646,345
Local GHG Emissions	Local greenhouse gas emissions (kt CO_2e/yr)	49	29
Local Energy Demand Reduction	Basic domestic retrofit measures installed (nº of homes)	35,168	36,379
	Deep domestic retrofit measures (nº of homes)	14,448	31,495
Local Electrification	Petrol & diesel vehicles on the road (nº of vehicles)	14,081	14,081
	Pure electric vehicles on the road (nº of vehicles)	90,255	90,255
	Hybrids (including plug-in) on the road (nº of vehicles)	20,623	20,623
	Domestic EV charge points installed (nº)	43,080	43,080
	Heat pumps installed (nº of homes)	102,716	43,366
	Rooftop solar PV generation capacity installed (MWp)	523	523
	Ground-mounted PV generation capacity potential (MWp)	75	75
Local Heat Networks	Domestic heat network connections	42,442	7,565
Capital Investment	Buildings and energy system (£m)	5,775	5,693

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

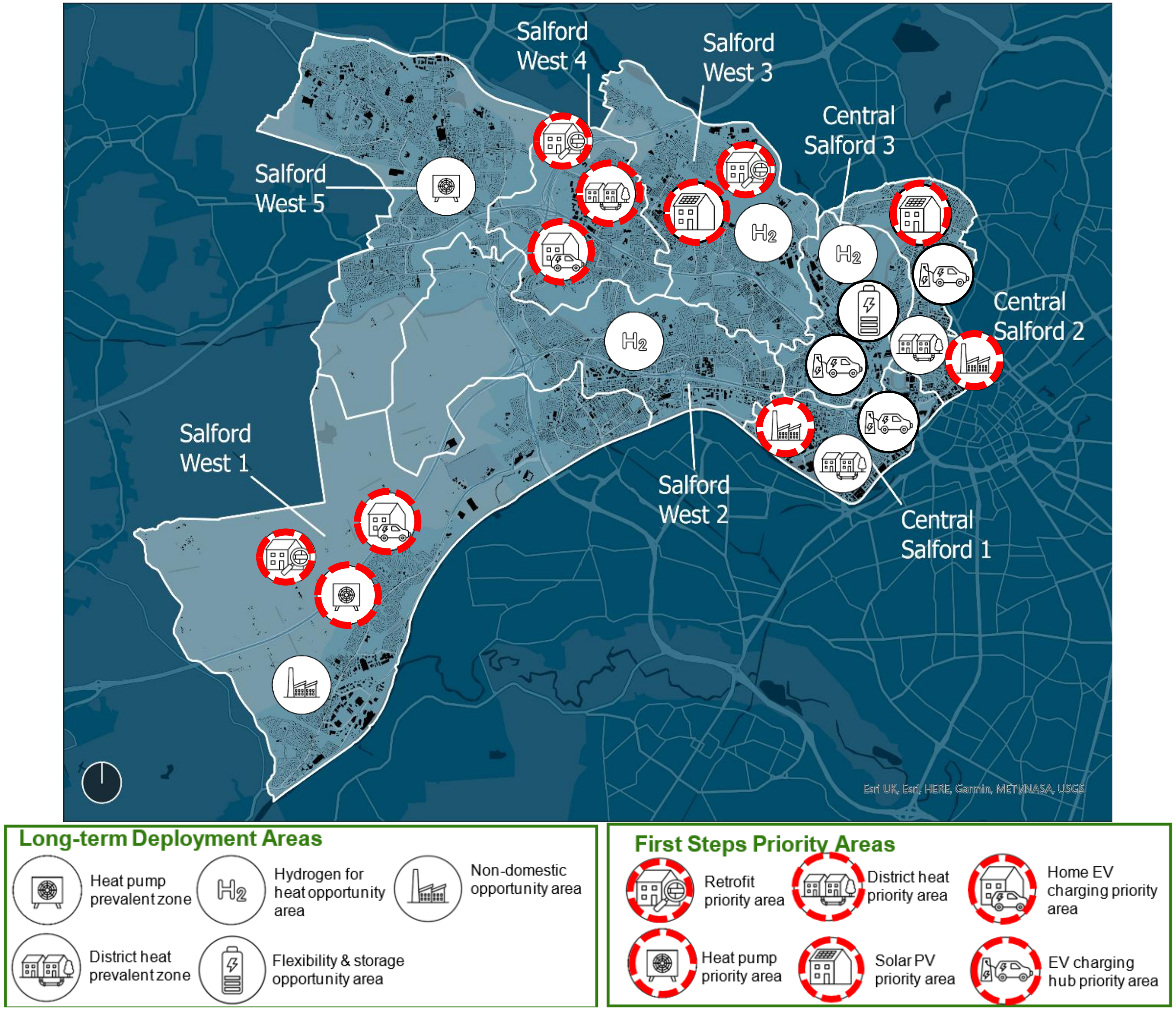
This LAEP provides Salford with both:

- 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 Salford, whilst building the capacity needed for wide-scale deployment

The priority areas are summarised in the opposite map. This illustrates suggested areas and components for Salford City 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, Salford City 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 – Priority Areas (Demonstration & Scale up)



Next Steps

Using the insights within this LAEP and in the identified priority areas, Salford City 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 Salford, 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 Salford's citizens

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

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 Salford City Council and Greater Manchester Combined Authority.

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

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

About the GM LEM project

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

About Local Area Energy Planning

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

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

About Energy Systems Catapult

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

About Buro Happold

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

Document control:

Project name	GM LEM: WP2 Local Area Energy Planning – Salford
Version	1.1
Status	Approved: Contains reviewed and approved content.
Restrictions	Open

Review and approval:

	Name	Position
Author	Lewis Bowick and Tian Coulsting	Local Energy Transition Consultant and Systems Integration Consultant
Reviewer	Richard Leach	Local & Site Energy Transition Manager
Approver	Rebecca Stafford	Senior Manager

Revision history:

Date	Version	Comments
21/07/21	0.2	Draft for internal review
05/08/21	0.3	Working draft for initial client consultation
14/12/21	1.0	**Client issue**
17/05/22	1.1	Minor amendments

GREATER MANCHESTER
LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Technical Annex

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

THE FOUR SCENARIOS

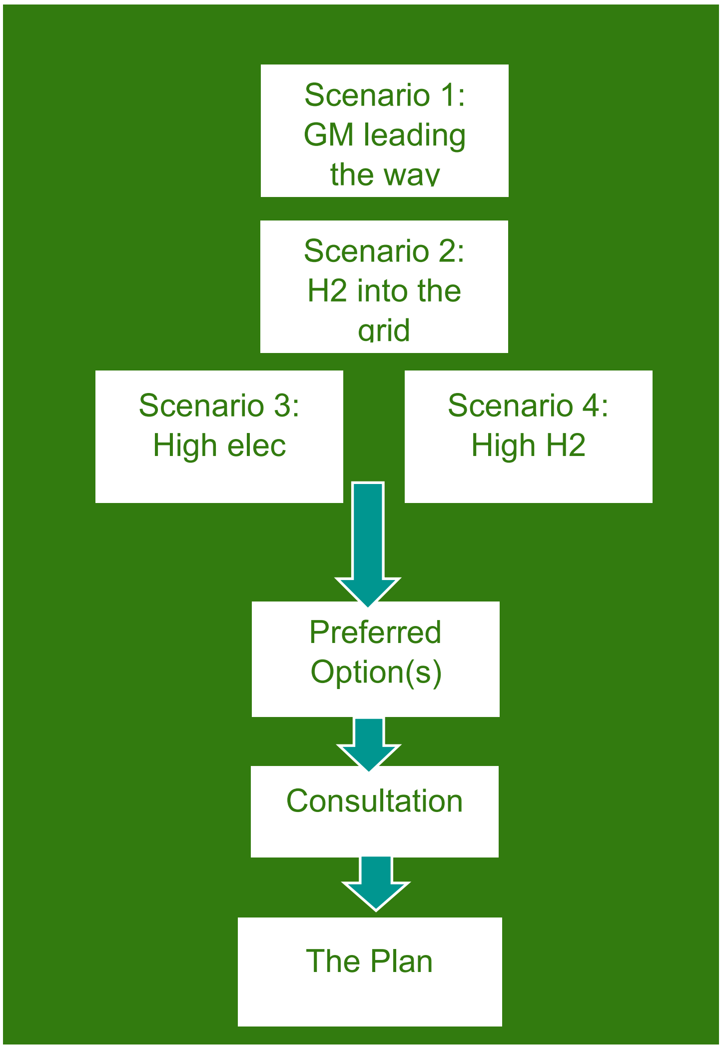
A variety of energy system scenarios are possible to deliver Greater Manchester and Salford’s future energy vision. It is not practical to consider every possible configuration of Salford 's local energy system in a limited number of scenarios, therefore four main scenarios have been considered; these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

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

The scenarios have been developed through frequent engagement with GMCA, as well as consulting with a wider group of stakeholders including Cadent and Electricity Northwest. Further consultation and engagement with Salford 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 Salford 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 below.

Importantly, each future local energy scenario for Salford 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 Salford. These scenarios are constructed using location specific information on Salford's existing energy networks, buildings, local constraints and resources in combination with data on technology performance and costs and modelled using ESC's EnergyPath Networks modelling toolkit.



Modelled scenarios and plan development

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

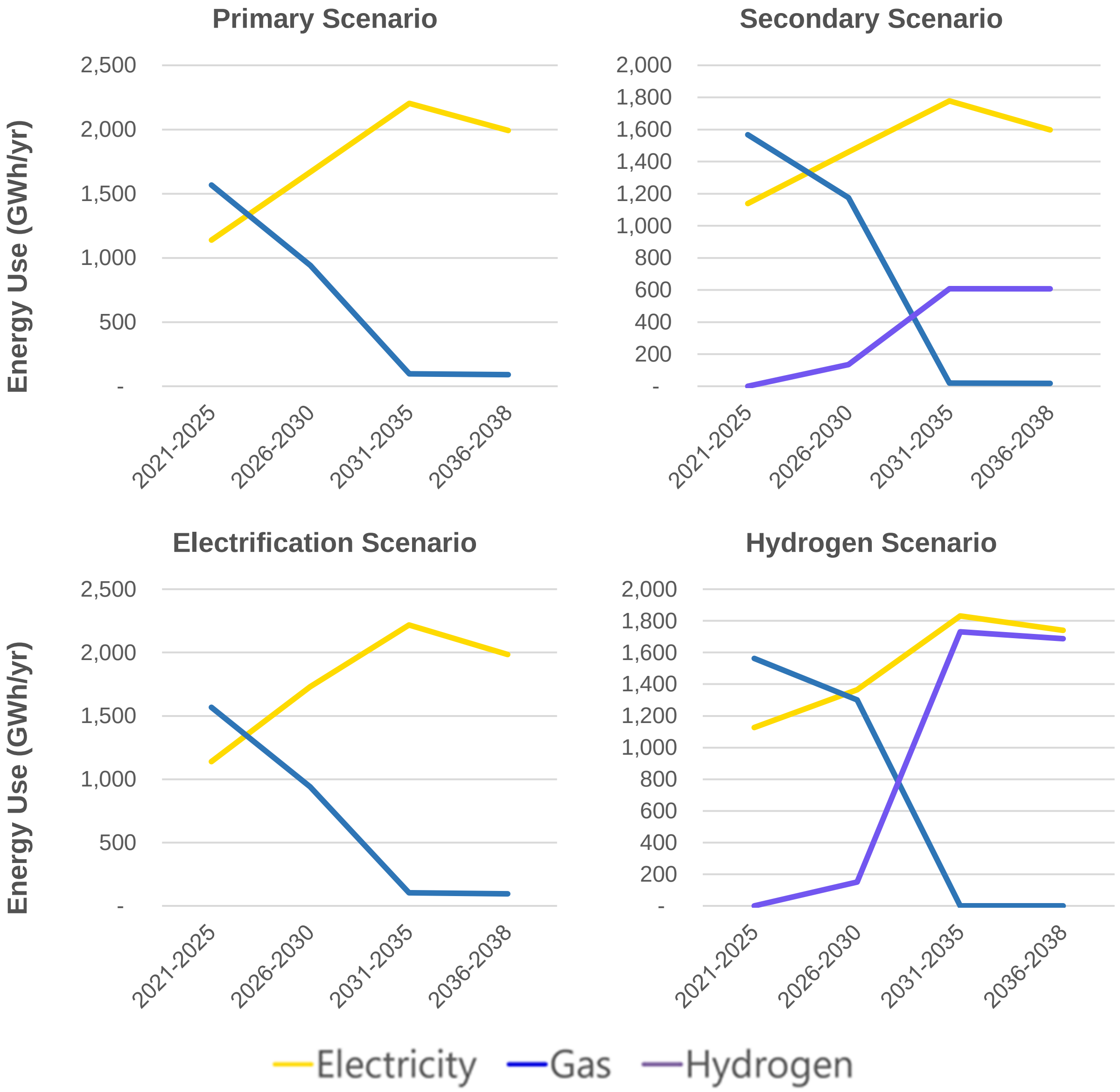
Scenario 1 – Leading the Way: this scenario focuses on meeting the carbon budget and target by making use of **proven measures within Salford's local control** where at all possible.

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

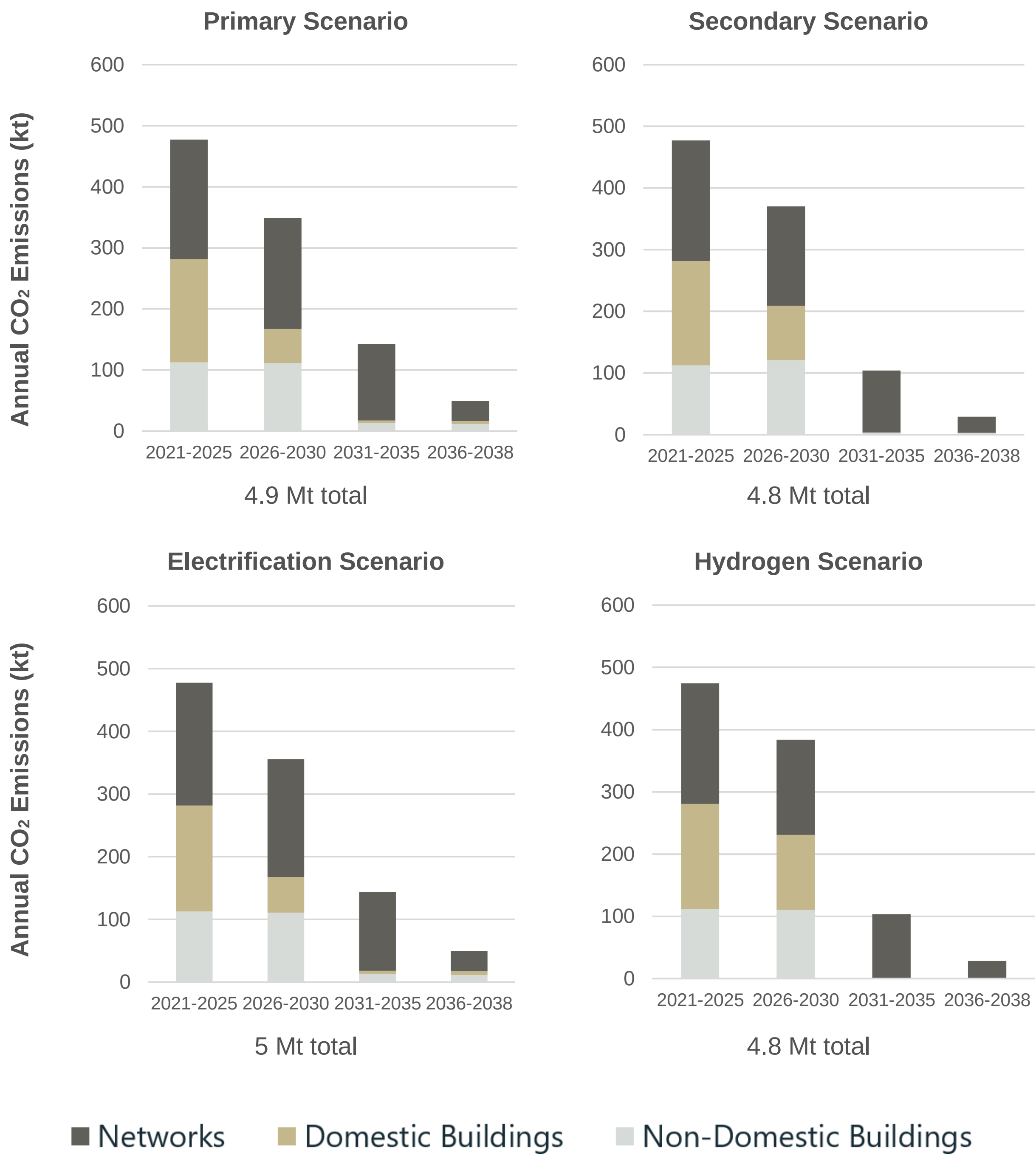
Scenario 3 – High Electrification: we have assumed the only low carbon options for buildings heating and hot water demand are electric based. This includes energy centres feeding local heat networks

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 Salford. Whilst this is considered to have a number of practical limitations to feasible implementation by 2038, these were considered useful as comparative scenarios.



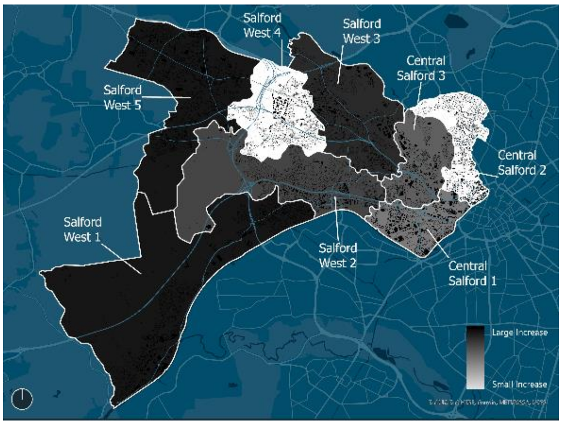
Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, due to the reduction in transport fuel consumption.



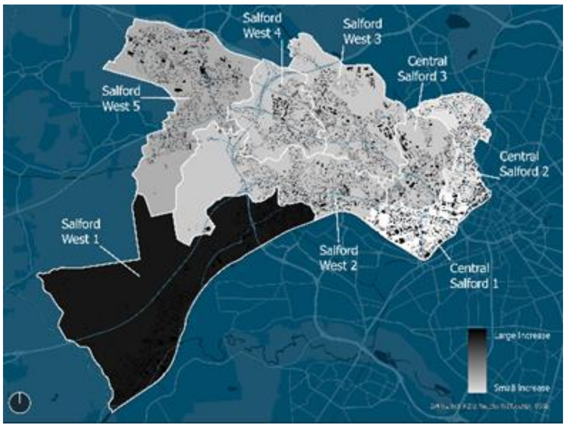
Primary Scenario
Secondary Scenario
Electrification Scenario
Hydrogen Scenario
Annual CO_2 Emissions (kt)
600
500
400
300
200
100
0
2021-2025
2026-2030
2031-2035
2036-2038
4.9 Mt total
4.8 Mt total
5 Mt total
4.8 Mt total
Networks
Domestic Buildings
Non-Domestic Buildings

HEATING ZONING OPTIONS: HEAT PUMP DEPLOYMENT BY 2038

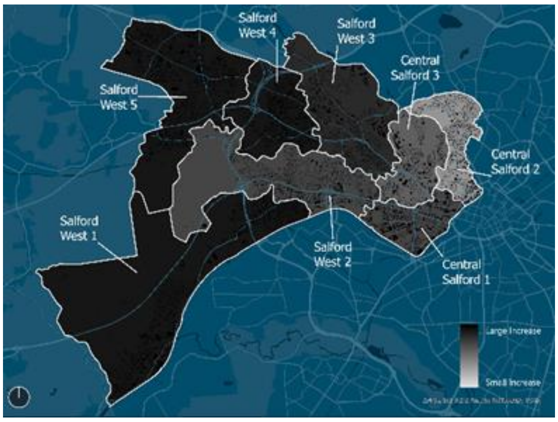
Primary Scenario



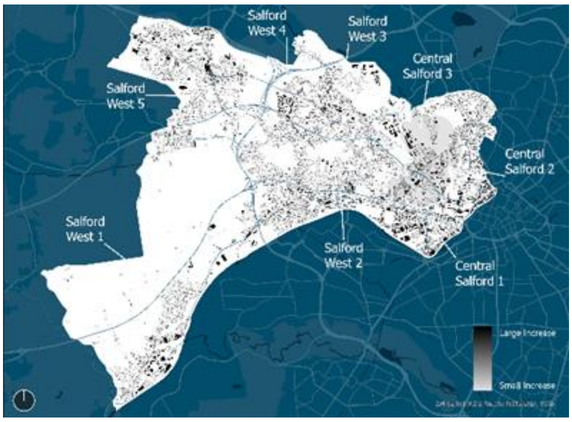
Secondary Scenario



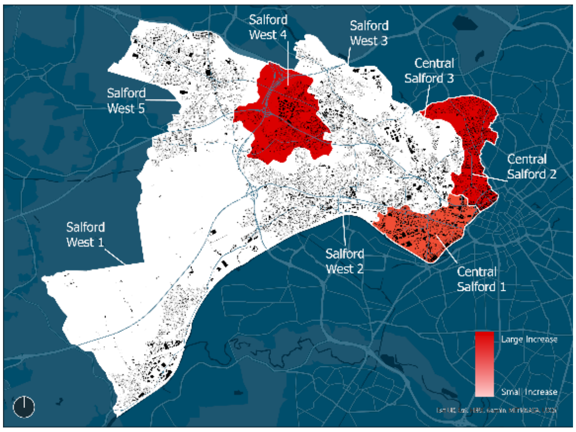
Electrification Scenario



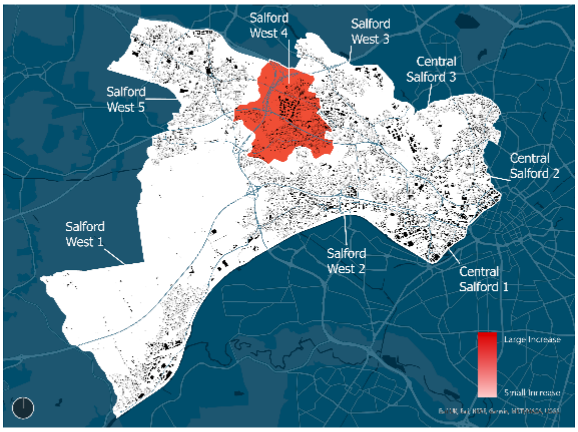
Hydrogen Scenario



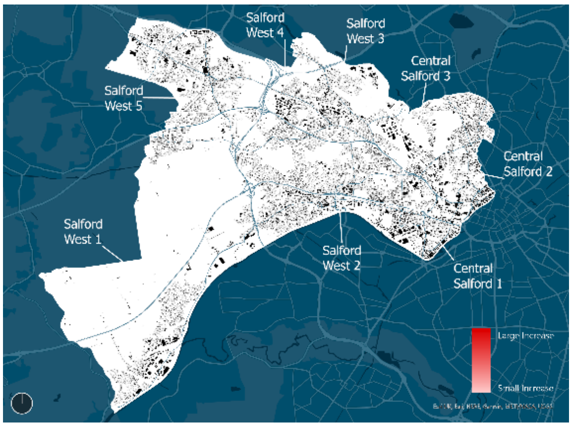
Primary Scenario



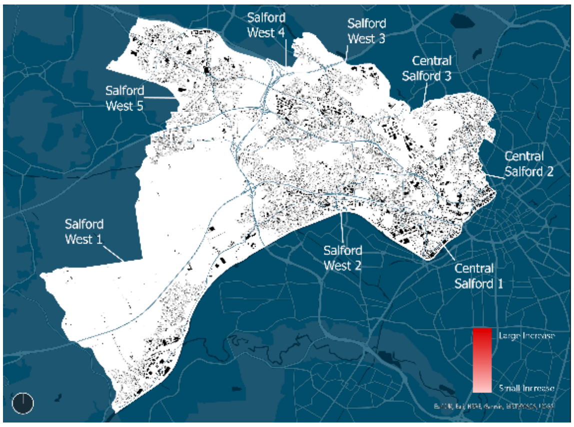
Secondary Scenario



Electrification Scenario

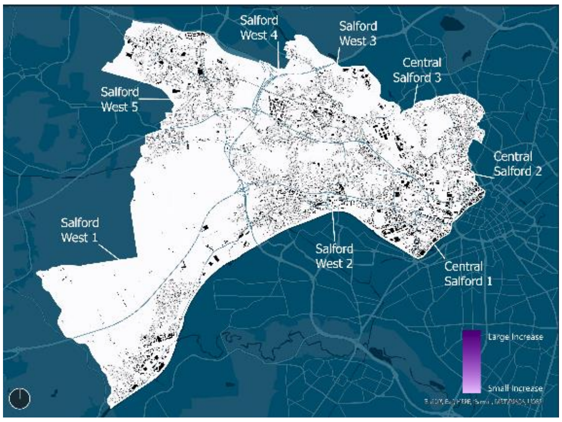


Hydrogen Scenario

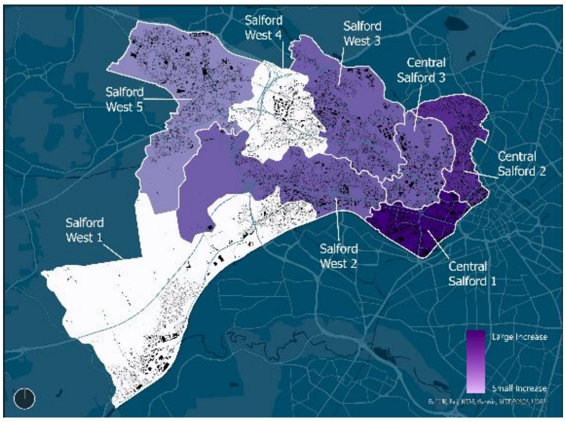


HEATING ZONING OPTIONS: HYDROGEN BOILER DEPLOYMENT BY 2038

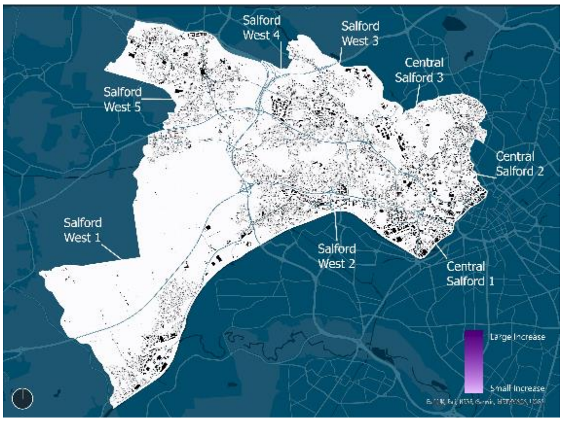
Primary Scenario



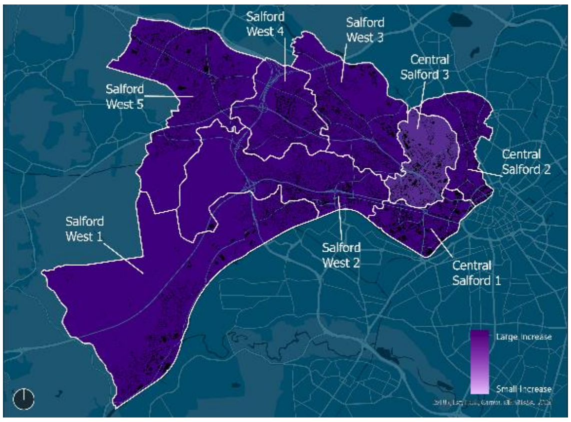
Secondary Scenario



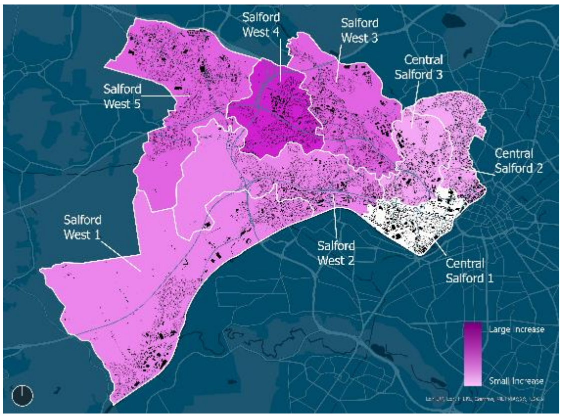
Electrification Scenario



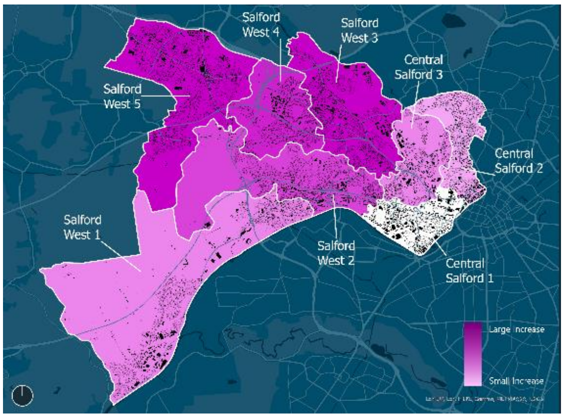
Hydrogen Scenario



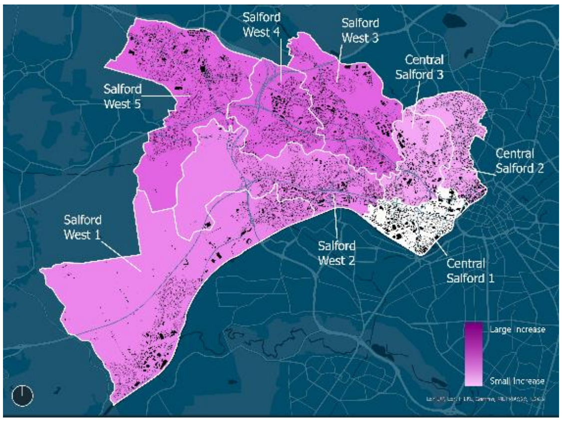
Primary Scenario



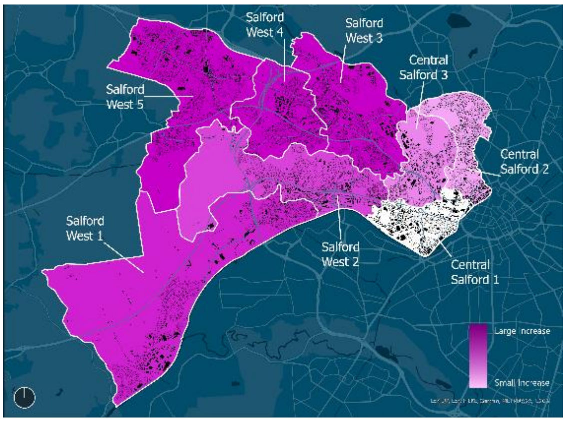
Secondary Scenario



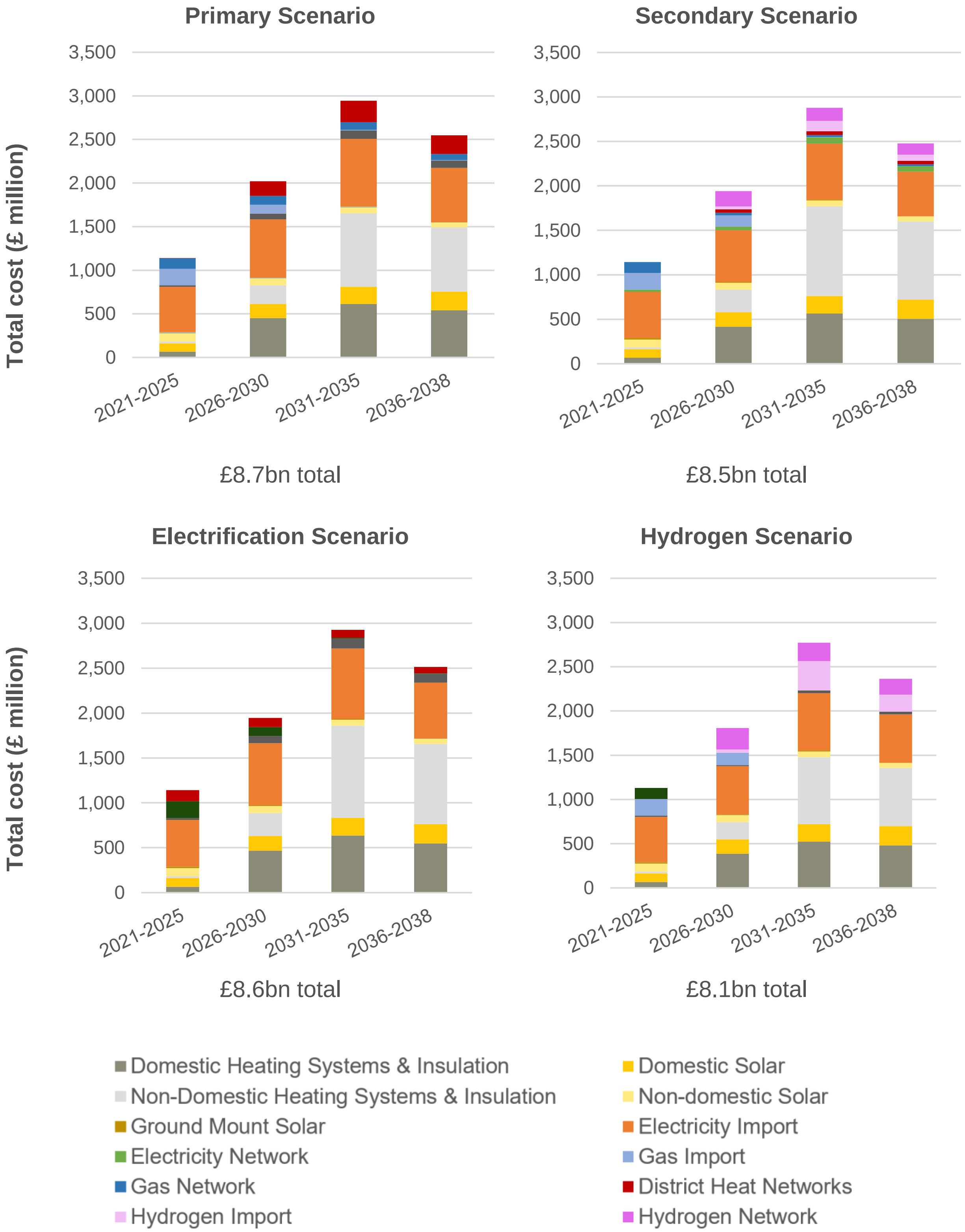
Electrification Scenario



Hydrogen Scenario



SYSTEM COST



Primary Scenario
Secondary Scenario
Electrification Scenario
Hydrogen Scenario
Total cost (£ million)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
2021-2025
2026-2030
2031-2035
2036-2038
£8.7bn total
£8.5bn total
£8.6bn total
£8.1bn total
Domestic Heating Systems & Insulation
Domestic Solar
Non-Domestic Heating Systems & Insulation
Non-domestic Solar
Ground Mount Solar
Electricity Import
Electricity Network
Gas Import
Gas Network
District Heat Networks
Hydrogen Import
Hydrogen Network

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**[*1]
  - 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[†2] 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)**[‡3] 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

[*] 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

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

Networks

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

Local Generation

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

Electric Vehicles

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

[*] 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-chargepoint