GREATER MANCHESTER
LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Local Area Energy Plan

Stockport, Greater Manchester

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Contents

0. EXECUTIVE SUMMARY

Context

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

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

Local Area Energy Planning

Energy Systems Catapult (ESC) developed the concept of Local Area Energy Planning (LAEP) as a mechanism of applying a whole system approach to the planning and design of Net Zero Local Energy Systems.

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

Scenarios for achieving Carbon Neutrality in Stockport

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

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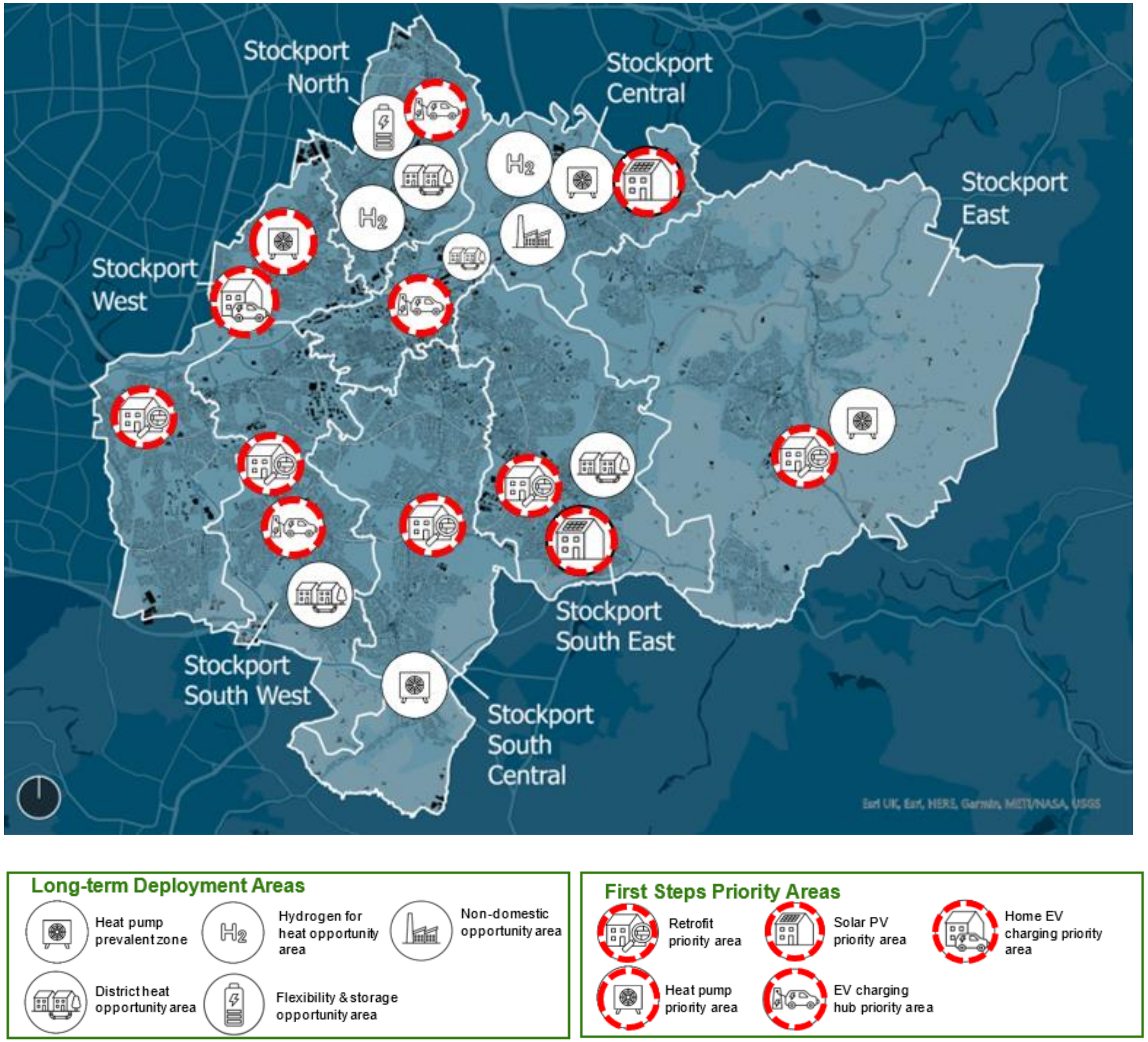
* Climate Change Act 2008 (2050 Target Amendment) Order 2019

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



Local Priorities and Measures

Stockport has been geographically sub-divided into 7 zones for the purposes of assessment and to understand what is needed for decarbonisation at a more local level. The zones have been made along the 33-11kV substation boundaries, as this allows the energy system to be pragmatically represented in the modelling methodology used, with each zone containing roughly equal numbers of dwellings.

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

1. INTRODUCTION

Context

Greater Manchester is committed to achieving carbon neutrality by 2038. To support this, it has a vision of each of its 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 based plan to help engage businesses and citizens in accelerating towards the carbon neutral goal.

Energy Systems Catapult developed the concept of Local Area Energy Planning (LAEP) as a mechanism of applying a whole system approach to the planning and design of Net Zero Local Energy Systems. Bury was one of the first Local Authorities in the country to work with Energy Systems Catapult, Electricity North West (ENWL) and Cadent in piloting a data-driven whole system approach in 2018. Since this initial pilot, Greater Manchester has launched its Five-Year Environment Plan, which includes a commitment to be carbon neutral† by 2038, and an accompanying science-based carbon budget. Alongside this, there have been significant updates to the supporting whole system modelling approach, including the latest technology attributes and costs, updated building data and network data, changes in EV uptake projections and more detail in options for decarbonising non-domestic buildings. The most significant update has been the addition of hydrogen in line with HyNet‡ projections, as an option that in certain scenarios can be used to decarbonise heat demand in domestic and non-domestic buildings. This is key as achieving carbon neutrality will require the transition of Stockport'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 Stockport (these are discussed in the Technical Annex). This tool seeks to develop a full range of decarbonisation options for the local area and then use an optimisation approach to identify the combination that best meets the carbon ambitions in a cost-effective way across the whole system.

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

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

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

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

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

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

Scenarios for achieving Carbon Neutrality in Stockport

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 Stockport 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 Stockport 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 Stockport; any uncertainty is generally around the scale of deployment. Therefore, it is deemed low risk to demonstrate how to deploy these components and prepare for significant scale-up whilst assessing whether HyNet will be able to cost-effectively provide zero carbon hydrogen, across GM in-line with projections.

In addition, as the secondary scenario has significantly lower modelled cost (£7.2 bn compared to £8.3bn for the primary scenario), there is a need to make major decisions that consider the many associated advantages and disadvantages of each option; however, waiting until there is certainty would be too risky, reinforcing the need to commence demonstration in the identified priority areas. Furthermore, there may be a need to prioritise hydrogen supply in the region, therefore regional energy planning will be needed once the picture becomes clearer and all LAEPs for each GM borough are in place.

In summary, the scenarios have been developed in response to the science-based carbon budget for GM: defining a credible plan for Stockport, 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 Stockport.

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.

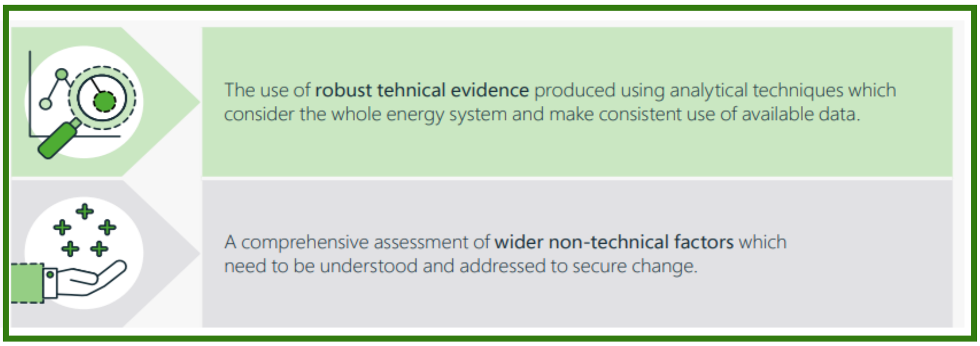
In accordance with the Ofgem LAEP Method†, which provides guidance and framework for LAEP done well, this plan has been developed through the use of robust technical

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

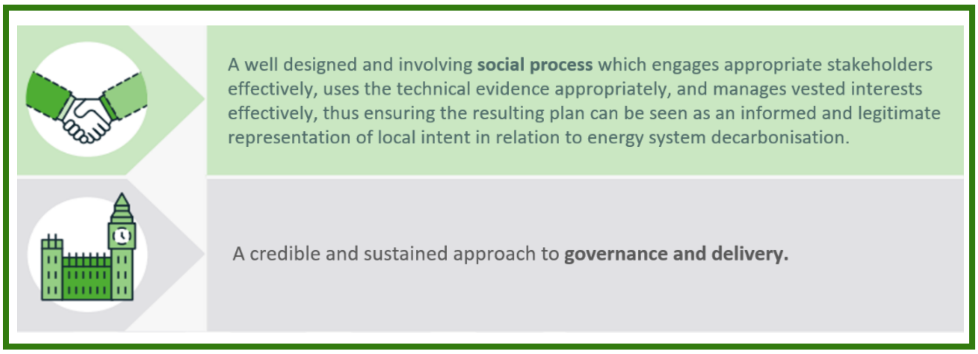
† From LAEP: The method https://es.catapult.org.uk/reports/local-area-energy-planning-the-method/

evidence which considers the whole energy system for Stockport and consistent use of available data and assumptions.

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



The next steps of the development of the plan are expected to comprise wider stakeholder and public consultation on the plan to inform its further development, as well as the approach of both Greater Manchester and Stockport 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 nine chapters, supported by an accompanying technical annex.

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

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

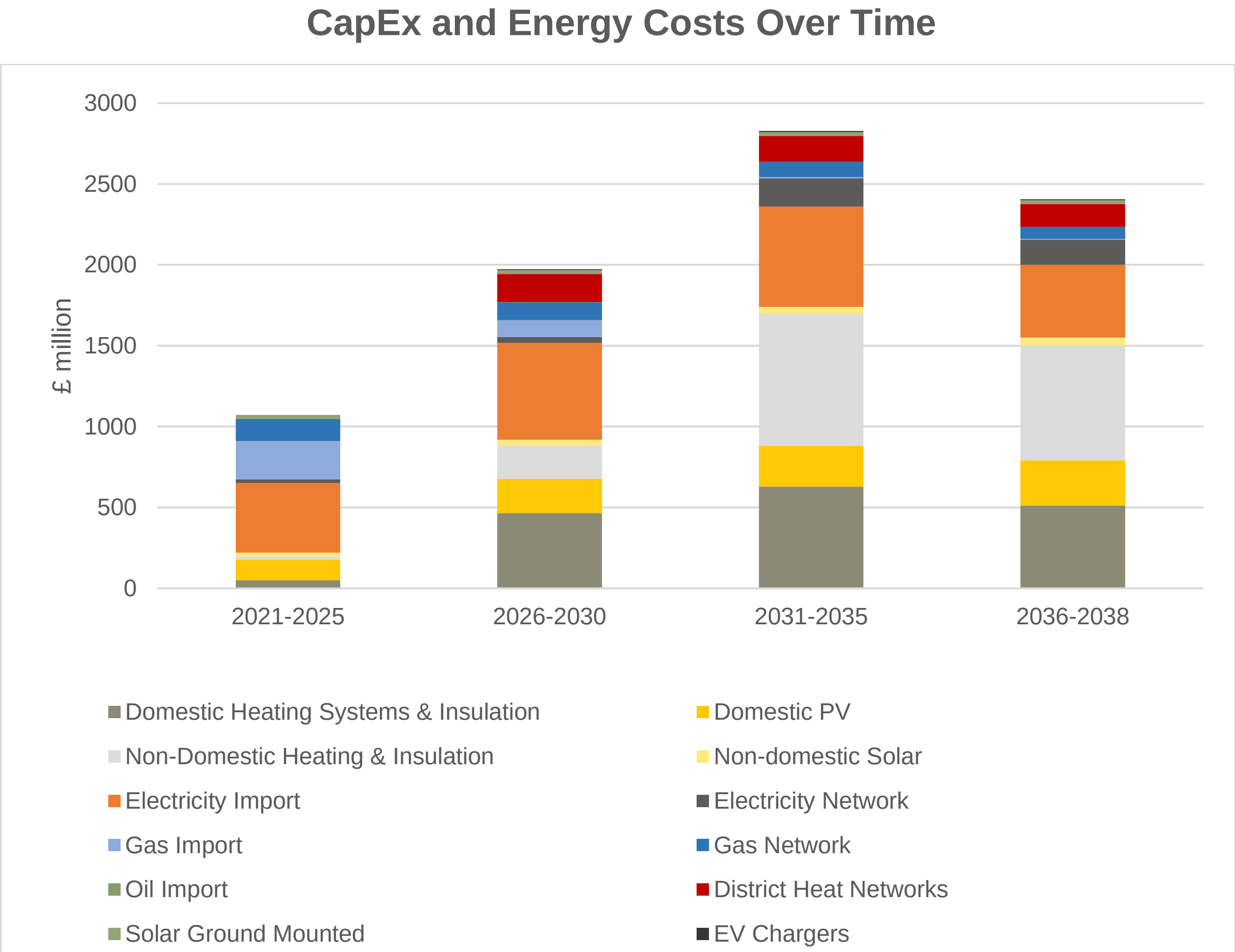
Chapters 3-7: set out some of the key aspects of the primary scenario and what this means in relation to implementation for Stockport including Fabric Retrofit (Chapter 3), Heating System Zones (Chapter 4), EV charging and infrastructure (Chapter 5), Local Energy Generation and Storage (Chapter 6), and 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 Stockport, 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 Stockport 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.

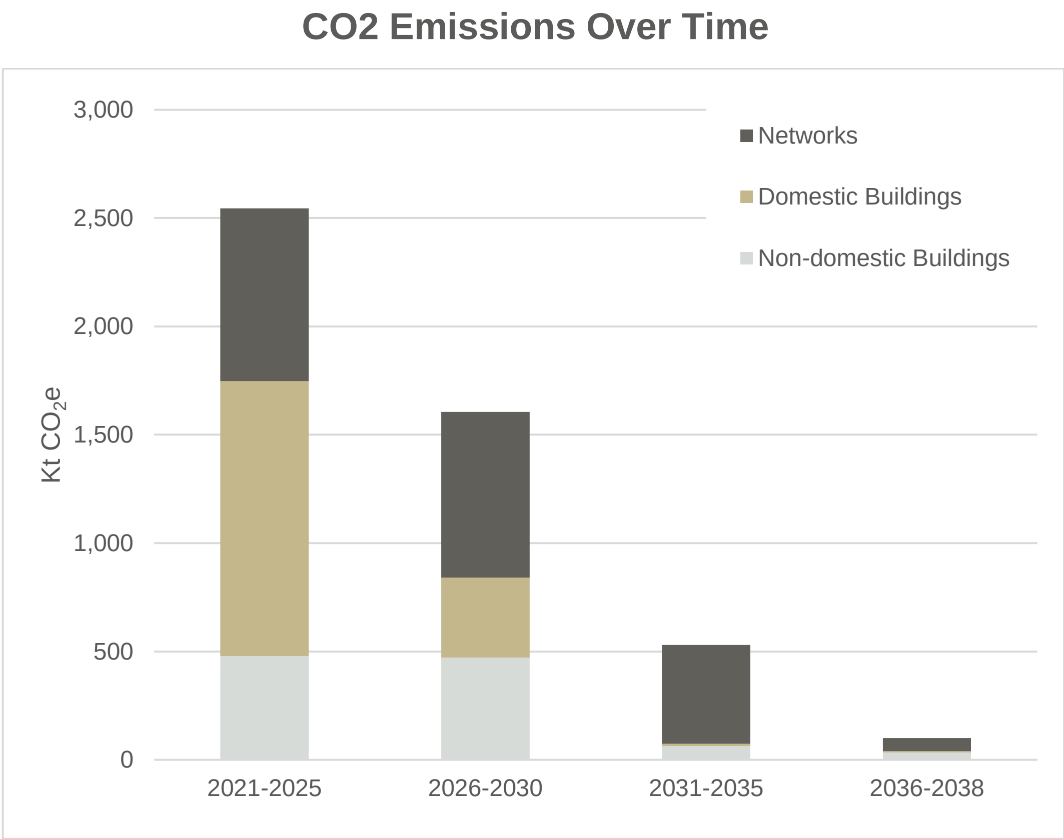
Decarbonising Stockport local energy system by 2038 is achievable and expected to require capital investment of £5.8 bn. Total energy costs including capital investments, operations and energy consumed is between £7.2 bn (secondary) and £8.3 bn (primary) to 2038; the upper chart illustrates the breakdown of this expenditure over time for different components (for the primary scenario). The lower chart shows how implementing the transition reduces carbon emissions*.



With such a variation (£1.1.bn) in total projected system cost between the two scenarios, progress on wider national energy planning and policy decisions would be needed, recognising the current uncertainty (regarding the UK's heat decarbonisation strategy) associated with selecting a preference. In addition, regional (Greater Manchester) collaboration, should be pursued to consider an across GM borough approach, recognising that major decisions do not stop at a local authority boundary, for example, it

* 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.

may be preferential to prioritise the use of hydrogen in targeted areas of GM. Regional collaboration also provides the opportunity to ensure a complete LAEP process is undertaken, where key regional stakeholders (including Cadent and Electricity North West) should support the evaluation and decision making process.



The cumulative emissions over the period 2021-2038 in the primary scenario are 4.8 Mt of CO_2e (from a range of 4.7 to 4.8 Mt across the scenarios assessed), of which 2.1 Mt is due to grid electricity consumption*.

How to Interpret this Vision

This transition will involve the greatest infrastructure change across Stockport and Greater Manchester for decades; key sections of this LAEP illustrate the scale of change and investment needed, based on a primary scenario. An alternative scenario (secondary), incorporating the use of hydrogen for heat, is also presented on page 18 (along with other variations within the appendix), where the supporting analysis indicates that hydrogen could have an important role in decarbonising Stockport. 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 Stockport's citizens and stakeholders. Insights from the alternative scenarios have been used to

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

produce these priority areas. It is expected that this LAEP may need to be updated as lessons are learnt and uncertainties (such as UK policy regarding the decarbonisation of heat) become clearer.

Fabric Retrofit

As much as **73% of Stockport's dwellings receive insulation retrofit** in the plan: around **96,000** in the primary scenario, or 95,000 in the hydrogen focused secondary scenario. A greater number of these retrofits are deep retrofits in the primary scenario (around 4% more of Stockport's homes) to support the transition to low temperature heating systems. 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 Stockport in a timeframe that supports the delivery of the GM carbon budget; this key decision point will need to be made c.2025, primarily based on the role hydrogen will play in providing heat to buildings. Alternatively, almost 98,000 heat pumps are deployed for most dwellings, except in areas where district heat supplies a large share of buildings due to the higher density of buildings and presence of public buildings. Where district heat network opportunities have been identified, analysis of the cost and carbon benefit has identified that there is a marginal case[*] for using district heating over individual building heat pump based systems, therefore further consideration is required.

The combined cost of fabric retrofit and heating system replacement is £1.7 bn for homes, and £1.8 bn 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 Stockport (under all scenarios considered), providing up to 667 MWp of installed capacity, at a cost of £1,019m. Land in the area has been identified for opportunities to deploy 227 MW ground mount solar PV for further CO_2 reduction. Deploying such large volumes of local generation would be very challenging and is highly ambitious.

Under the primary scenario, the electricity network would require capacity reinforcements of substations and underground feeders to accommodate electrification, at an estimated cost of £393m. A significant proportion of this is attributed to the peak demands of the large numbers of proposed heat pumps. Further work would be required, under this high electrification scenario, to determine the most cost-effective, whole energy system, approach for providing this additional capacity.

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

EV Infrastructure

The transition to electric vehicles, with uptake increasing from around 3,000 plug-in vehicles today to almost 125,000 by 2038, drives a demand for EV chargers to be installed across all areas. Around 37,000* domestic chargers would be installed (one for every home with potential for off-street parking) at a cost of £20m, 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 local planning policies as it relates to provision of chargers in new developments and existing dwellings.

Consumer Uptake

By the early 2030s all new cars and vans, and all boiler replacements in dwellings and other buildings in Stockport are low carbon*; the vast majority of heating systems are either electrified or use hydrogen. Between 24,000 and 98,000 of Stockport's dwellings are fitted with a form of heat pump, and up to 99,000 boilers could be running from 100% hydrogen. By 2038, nearly 85% of cars are electric vehicles or plug-in hybrids, requiring the provision of ~37,000 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 Stockport 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 Stockport

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 Stockport increases to contribute to the GM carbon budget, predominantly in the form of up to 667 MWp of rooftop solar PV, with opportunity for a further 227 MW ground mounted solar PV across Stockport. Renewable generation (if the ground mounted PV potential is maximised), provides up to 1,056 GWh annually (48%), with 1,166 GWh (52%) of electricity supplied from the grid. This scale of solar PV is a highly ambitious aspiration and requires further detailed consideration; for example, from a network capacity perspective it may not be the optimal place to locate generation. However, with the 2038 target and GM carbon budget influence, solar PV provides low carbon electricity earlier than the grid is expected to.

The low carbon electricity is used in heating, industry and vehicle charging, more than doubling electricity demand over the next 15 years. Total electricity consumption is expected to increase by 109% by 2038 in the primary scenario and by 67% 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

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* 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 Stockport'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.

to HyNet could make it too late to keep within the carbon budget. However, hydrogen may have a significant role to play in combination with other technologies. This has been explored in some of the further scenarios. The similarities across scenarios point to low regret opportunities for heating system options in each area of Stockport and areas where hydrogen deployment is most likely.

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 Stockport. Fabric retrofit will prepare buildings for zero carbon heating, whilst also making a notable contribution to staying within the carbon budget. By 2038, over 96,000 of Stockport's 132,000 dwellings are retrofitted in the plan (circa 73%), split fairly evenly between basic and deep fabric retrofit packages. The option of deeper fabric retrofit has the potential to increase headroom in the carbon budget to give some flexibility for deferring decisions on heating systems.

Energy Networks

The creation of district heating networks in targeted areas could see almost 25,000 homes connected to a heat network in 2038. These connections are concentrated in Stockport North, South East and South West, where the density of buildings lends itself to a heat network. 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. However, the case for district heating of this scale is finely balanced compared to other options and requires further detailed consideration. In addition, an additional heat network opportunity area has been identified in Stockport Central, in this case based around specific non-domestic and public sector buildings (see p.55).

Annual electricity demand is forecasted to increase from 1,062 GWh to 2,222 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 Stockport East, West and South Central, though opportunities to consider using flexibility, storage (or other alternative measures) in place of grid reinforcements are highlighted in the provided opportunity areas (see map on p.5).

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 99,000 homes could be supplied by hydrogen by 2038, at a 14% lower overall total system (CapEx and Opex inc. energy costs) cost and very similar levels of emissions.

Investment

Stockport's transition requires a total energy system and building level investment of £5.8 bn (excluding energy costs). This unprecedented level of investment provides a once in a lifetime opportunity for Stockport. 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 Stockport. How it is delivered will influence the local benefit to Stockport, in addition to job creation. For example, there will be opportunities for local/community initiatives to provide components of the future energy system.

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

Local Impact and Risks

Without changes to national policy, wider energy market reforms or the introduction of new support mechanisms, household energy bills are forecasted to increase, predominantly as heating homes through electricity is more expensive than using gas. However, the proposed investments in building works will help to mitigate this and consideration will be needed to target measures at homes with the most need. Consideration is also needed to determine how to fund an average household investment of £19,250 (CapEX) for the associated measures.

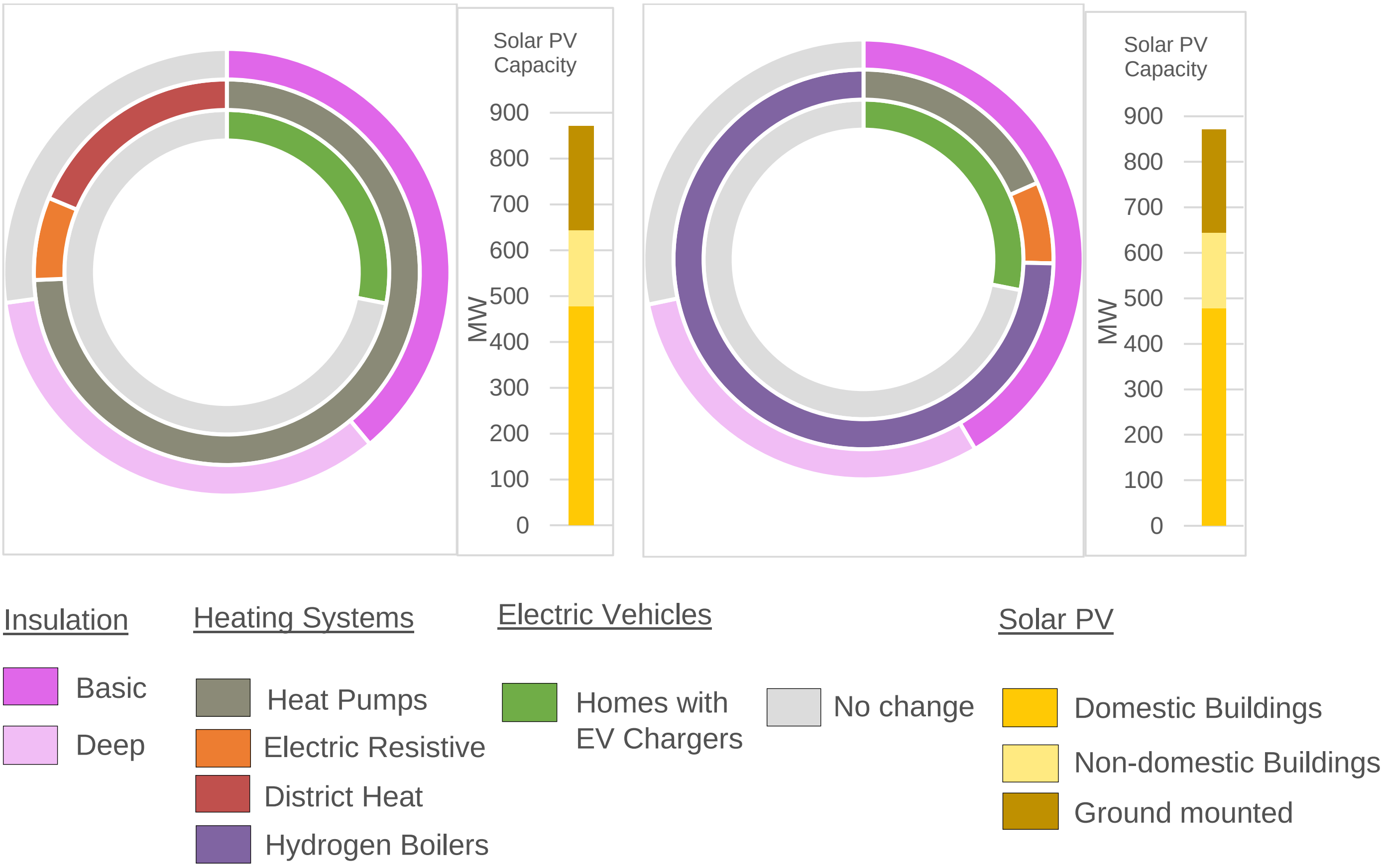
An electric focused heat transition, involving changes to building fabric and internal heating systems (e.g., changes to doors, windows, larger radiators, and improved controls) could be more disruptive to residents and it is not clear how this might compare with disruption associated with using hydrogen for home heating[*], where extensive fabric retrofit would also 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 Stockport 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 Stockport's transition to carbon neutral could look like

The charts below illustrate the scale of change needed to decarbonise Stockport in each scenario; the coloured portion of the rings indicating the proportion of homes that receive measures (the grey parts representing homes with no change). This is intended to illustrate the scale of measures and investment needed to the stakeholders who will support and deliver Stockport'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 2020s. It is around this time that it would be deemed too late to rely on hydrogen for heat to meet the Greater Manchester science-based carbon budget, recognising the timescales needed to carry out widescale infrastructure and building investment and adaptation.

This secondary scenario illustrates an alternative future where hydrogen becomes widely available for heating and hot water in buildings from 2030, in accordance with the aspirations of HyNet phase 3. These graphs show some of the key differences in investment and installation between the primary and secondary scenarios. Total costs vary within 14% between the two scenarios – see section 8 for full cost details.

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

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

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

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

2. THE VISION – BREAKDOWN OF PRIMARY SCENARIO BY ZONE

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

Insulation
- Basic
- Deep

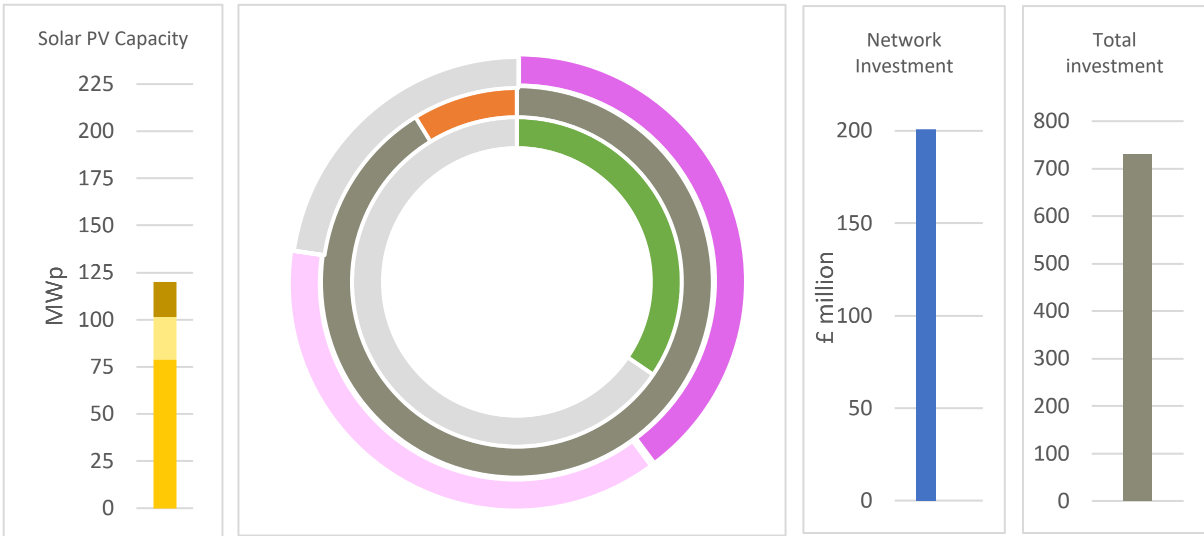
Heating Systems
- Heat Pumps
- Electric Resistive
- District Heat
- Hydrogen Boilers

- Homes with EV Chargers
- No change

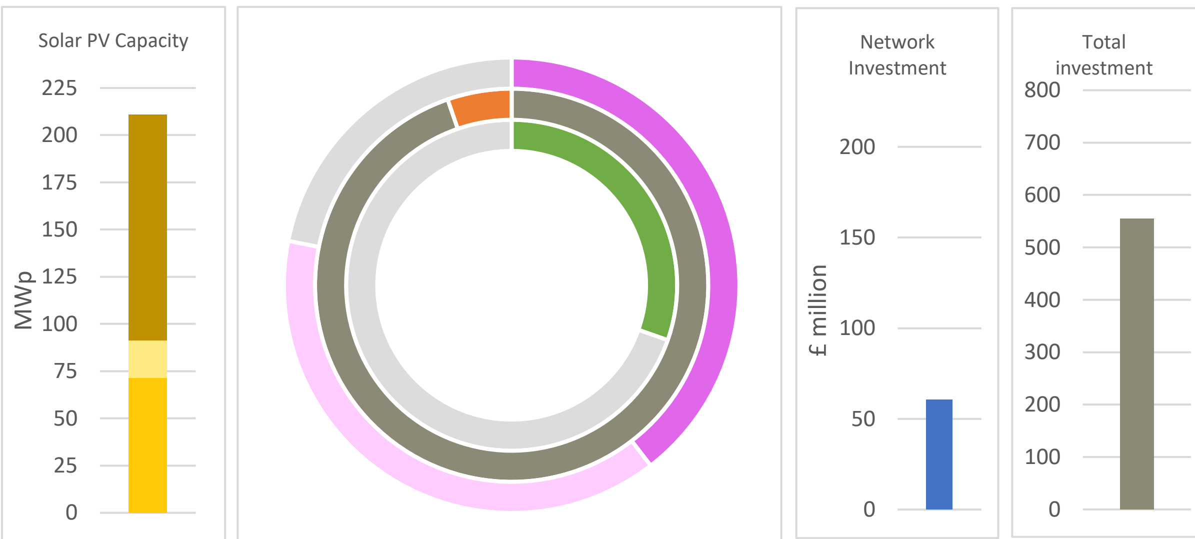
Network Investment
- Electrical
- Heat

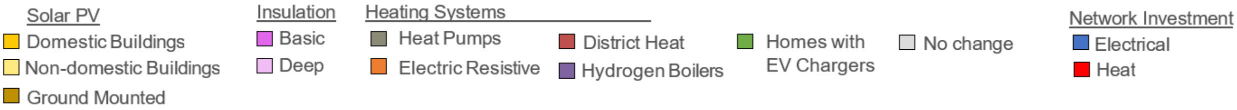
The coloured portion of the rings indicates the proportion of homes that receive measures (the grey parts representing homes with no change).

Stockport West

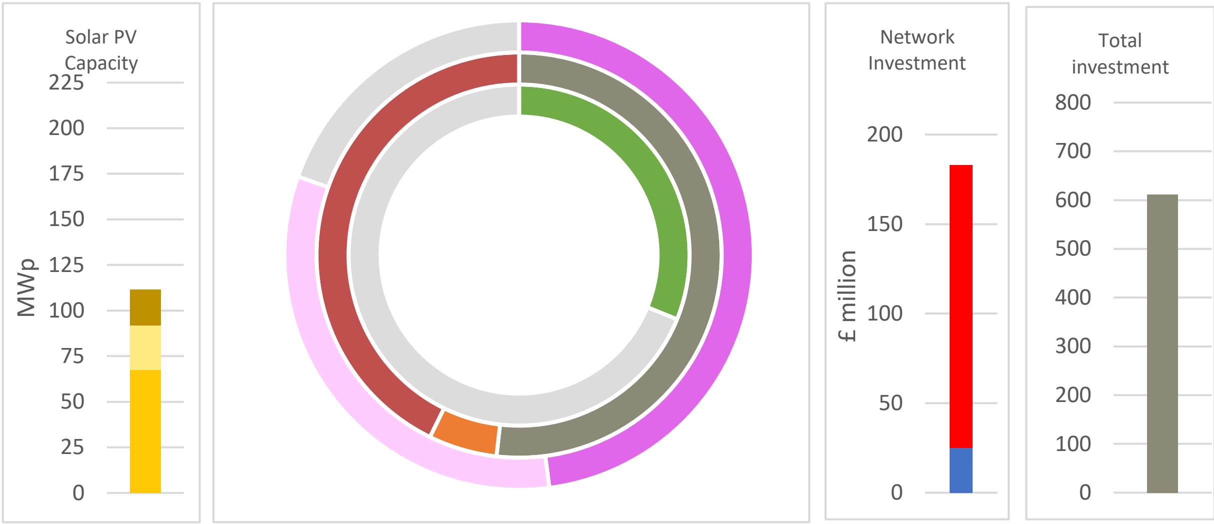


Stockport East

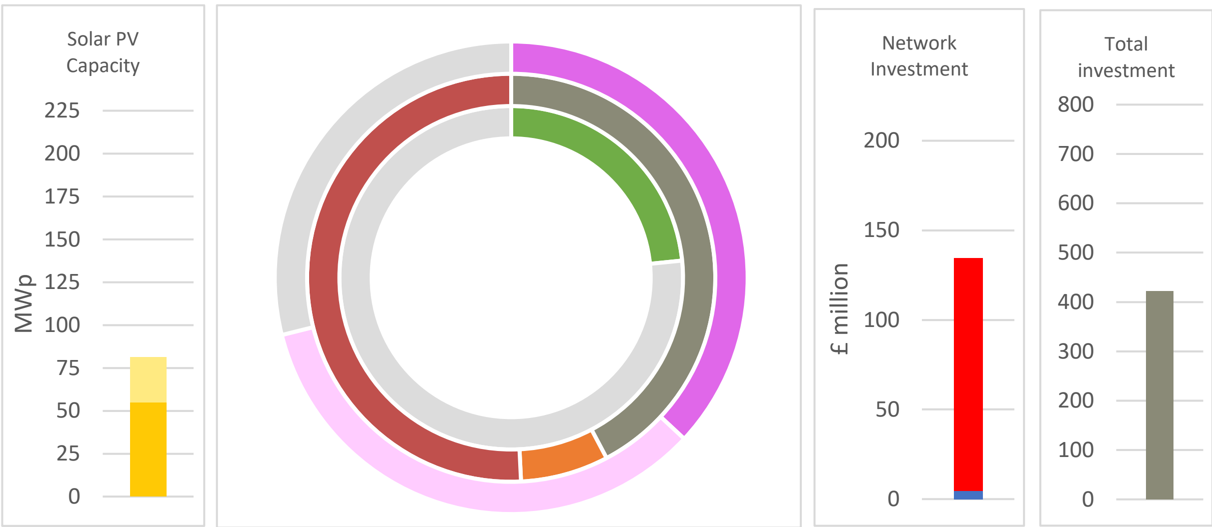




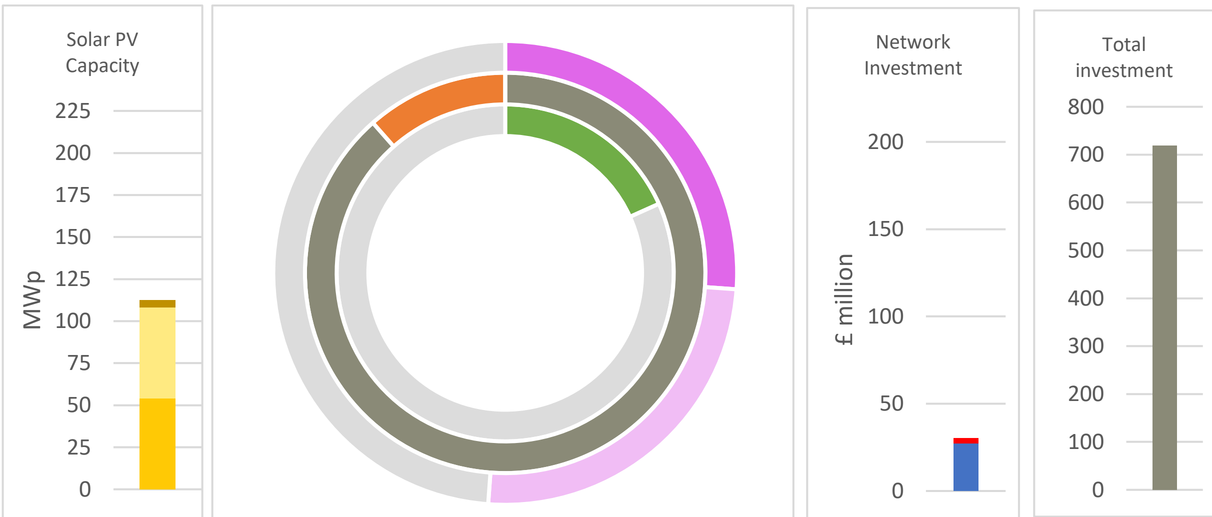
Stockport South West

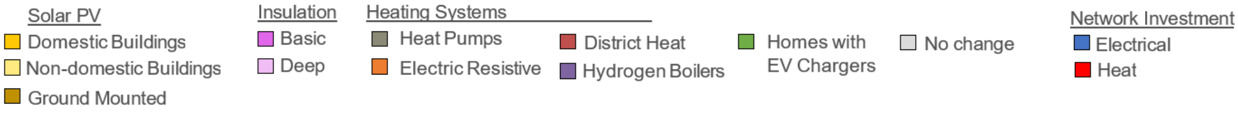


Stockport North

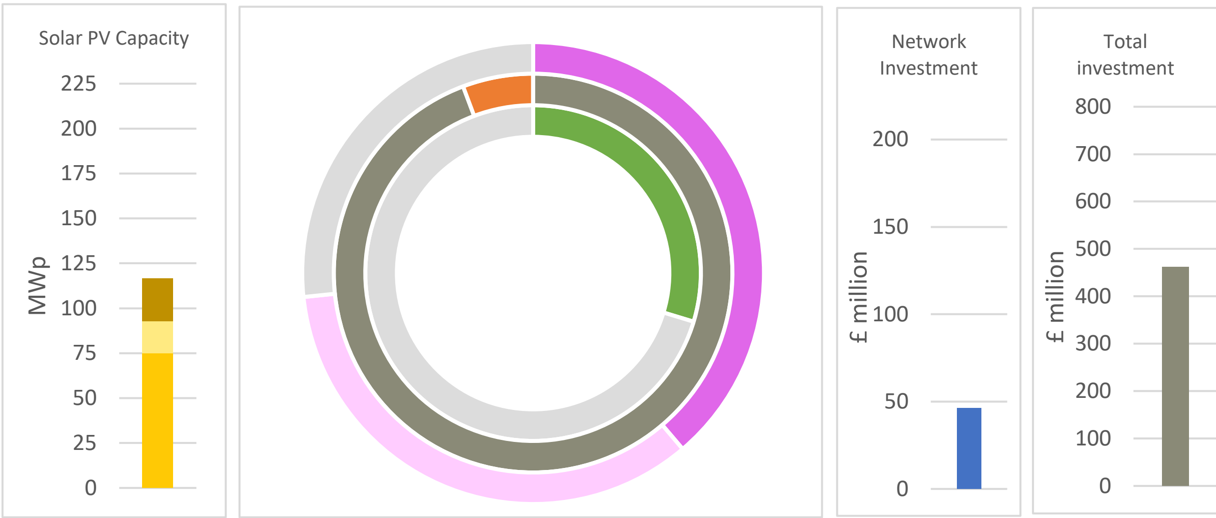


Stockport Central

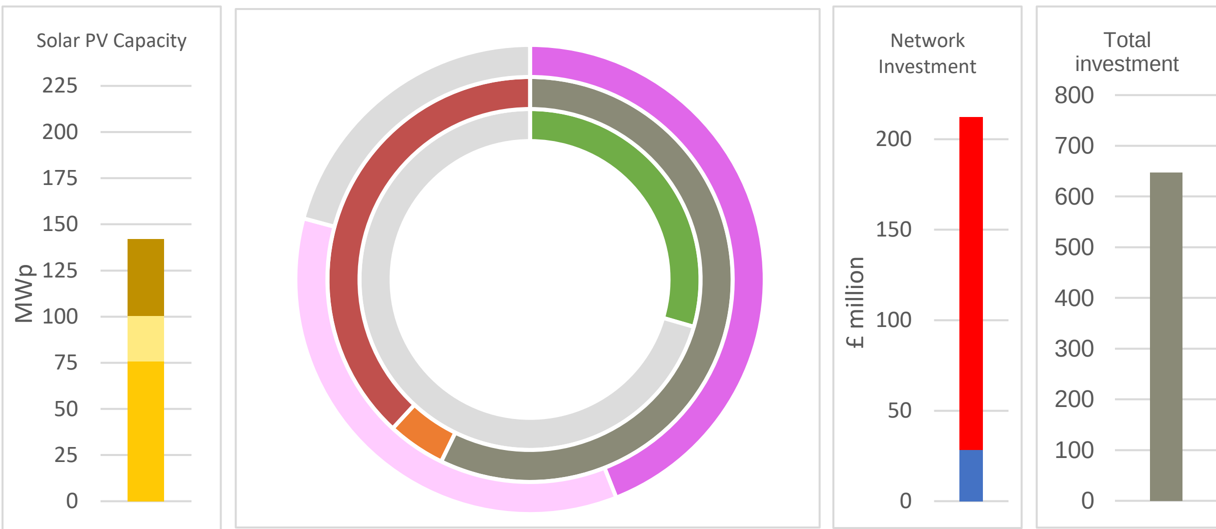




Stockport South Central



Stockport South East



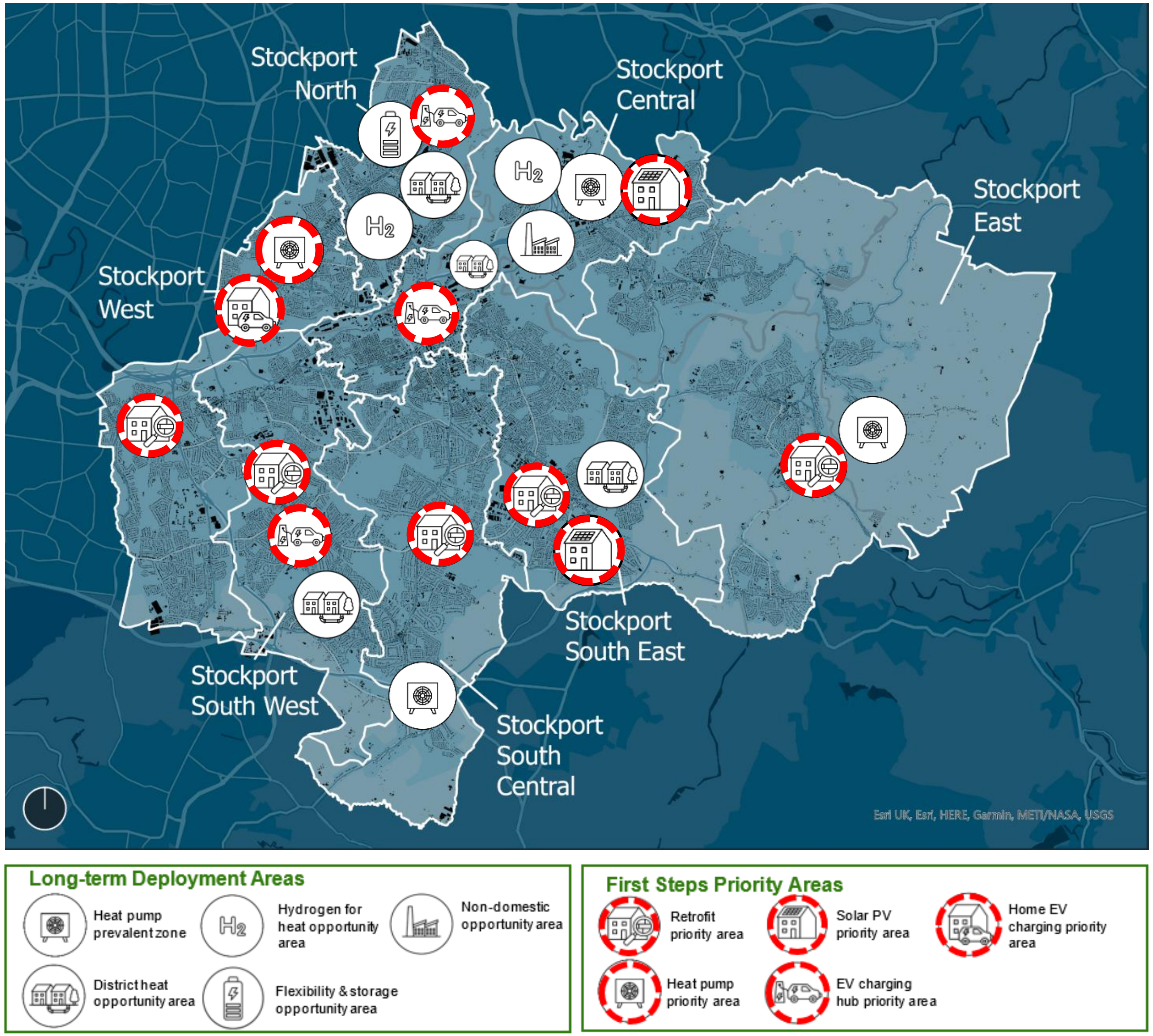
How to use this LAEP

The plan below illustrates the proposed activities to progress this LAEP in the near-term, based on a demonstration and scale-up approach, as well as focus areas for changes in the longer term. The red rings highlight priorities to test how to roll out Stockport's transition to carbon neutral and work with Stockport's citizens. Insights 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 Stockport 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:

- Stockport East, West and South Central are areas that are most sensitive to hydrogen carbon content, meaning that prioritising heat pumps in these areas is a low regret action compared to other zones.

- Spare electrical capacity in Stockport West is additionally conducive to making early progress in this zone first.

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

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

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

- Stockport North and Central are prioritised for the demonstration of solutions for Stockport's non-domestic buildings; with the development of district heating in areas of Stockport North and high potential for hydrogen serving industrial needs in Stockport Central, whilst a non-domestic focused heat network is also being considered by the borough within Stockport Central.

- Home EV charging and rooftop solar PV can be developed early in areas with spare capacity in the electricity network, such as Stockport West. Public EV charging is prioritised in Stockport Central, North and South West where demand is expected to be highest and existing car parks, public land and unoccupied buildings could be repurposed to provide EV charging hubs

Long term Deployment

- Flexibility and storage (combined with other components including heat pumps, solar PV and EV charge points) can be tested in Stockport North, including a focus on evaluating whether alternative approaches to electricity network reinforcement provide benefit

- Stockport Central could benefit from low carbon hydrogen to support industry and heat buildings

- If hydrogen became widely available, domestic dwellings located near industrial areas in Stockport North and South East could also benefit as initial areas to target for cost effective connection to low carbon hydrogen supplies built to serve industry

2. THE VISION – KEY CONSIDERATIONS

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

The following themes set out both the rationale for how this vision has been produced, identifying several key considerations that will need to be thought about and integrated, alongside demonstration and scale-up activities, as plans to take this LAEP forward are developed. It is expected that insights from the demonstration activity and considerations of these themes will influence Stockport'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, Stockport's actual transition may result in a combination of the primary and secondary scenario. Before making any widescale and significant commitment to one option or technology over another, evaluation of multiple factors will be needed.

Evaluation

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

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

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

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

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

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

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

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

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

- Social and community benefits

- How to fund options and the preferences of investors

Consultation

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

In addition, consultation with Stockport’s citizens is essential to help understand attitudes towards Stockport’s carbon neutrality transition; whilst also forming part of the evaluation process. This will help Stockport 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 Stockport’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 Stockport’s transition that there is a demand for solutions, products and services

Vision to 2038

A significant portion of existing homes and buildings in Stockport will require retrofit, carrying out insulation in **at least 72% of dwellings** (around 95,000). This is true for both scenarios, whether electrification or hydrogen forms the bulk of the heating solution, so early focus and investment in fabric retrofit is a low regret step. **More dwellings receive deep retrofits in the primary (GM led) scenario** (over 44,000, compared to circa 39,000 in the secondary scenario). This is a pattern which hasn't been seen in other boroughs to date and is due to the greater quantity of larger detached and semi-detached homes present in Stockport. These homes require fabric retrofit to reduce heat demand and allow domestic heat pump capacity to meet the heat load of these homes. As heat pump technologies and products develop, the optimal choice between deep fabric retrofit or higher capacity heat pumps should be reviewed.

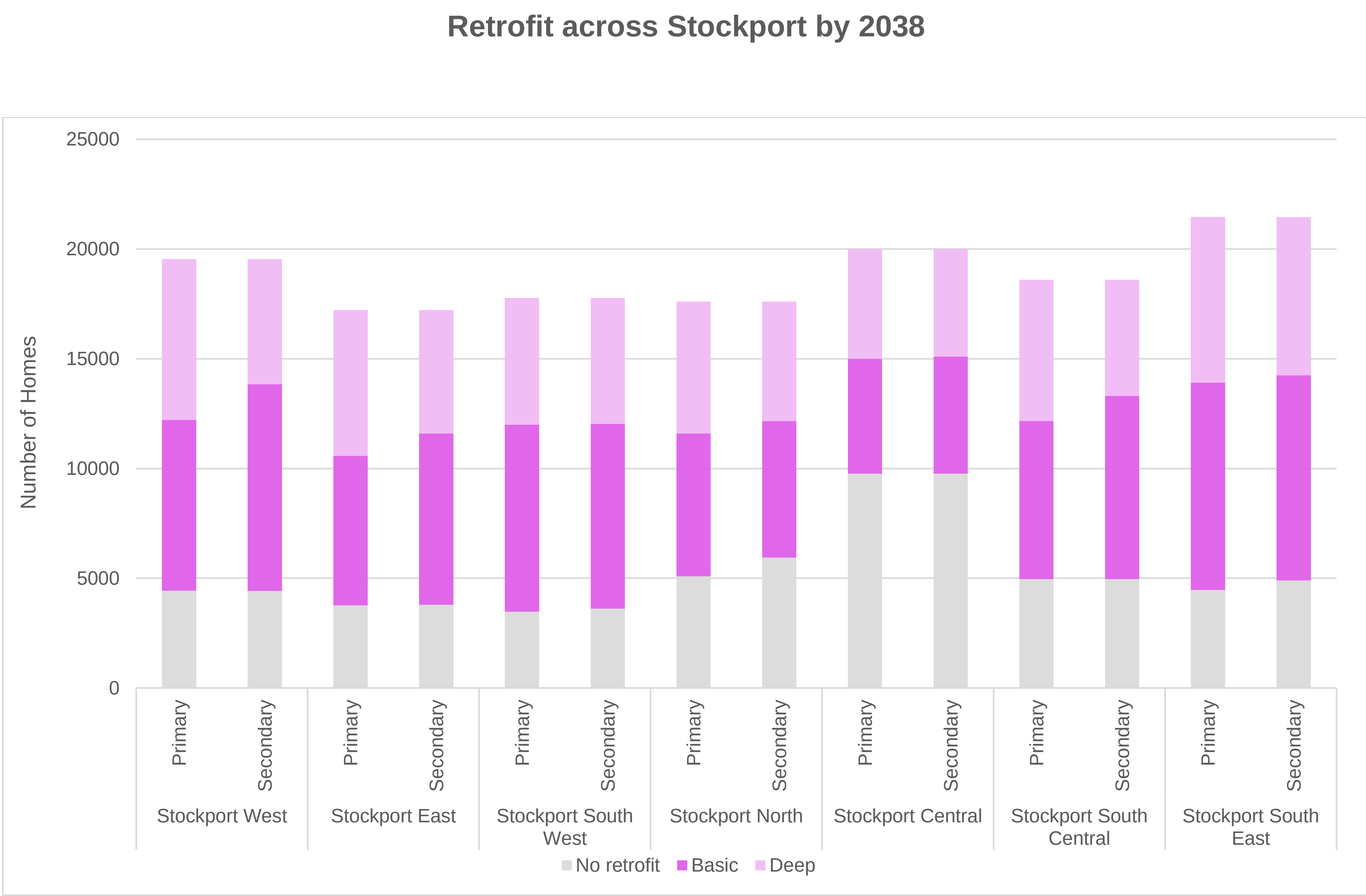
However, regardless of the heating system used, additional level of fabric retrofit may be needed to address affordability issues; for example, the cost of hydrogen is expected to be higher compared to gas*. In the secondary scenario, a marginally smaller number of homes are retrofitted (1,500 fewer) overall, as hydrogen boilers would be able to supply radiators at higher temperatures than heat pumps, making fabric insulation less critical for good performance.

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 38.

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

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

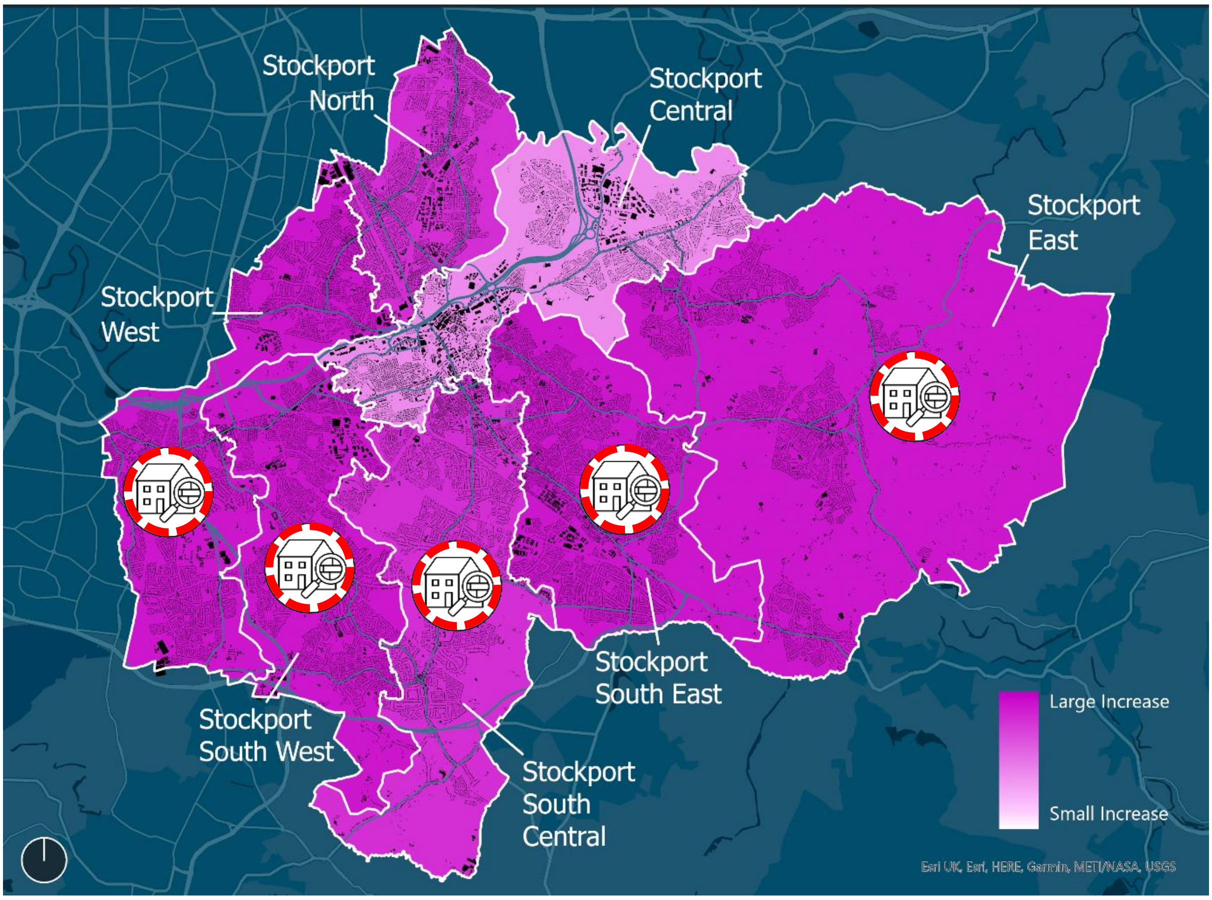
* Estimates vary - see for example projections for initial HyNet cost of hydrogen at around 150% uplift over natural gas https://hynet.co.uk/wp-content/uploads/2021/06/14368_CADENT_PROJECT_REPORT_AMENDED_v22105.pdf [page 15]


Retrofit across Stockport by 2038
Number of Homes
25000
20000
15000
10000
5000
0
Primary
Secondary
Stockport West
Stockport East
Stockport South West
Stockport North
Stockport Central
Stockport South Central
Stockport South East
No retrofit
Basic
Deep

First Steps – Priority Areas

Whilst large numbers of dwellings will need to be retrofitted to improve energy efficiency across all areas of Stockport, 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, 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.

Five priority retrofit zones have been highlighted for Stockport:



* 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 Stockport. 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

Stockport West, Stockport East, Stockport South West, Stockport South Central and Stockport South East

These are areas in which a high proportion of homes (between 70 and 80%) receive insulation measures, with these zones also containing a large absolute number of properties to be retrofitted, so the opportunity in these 5 zones is significant.

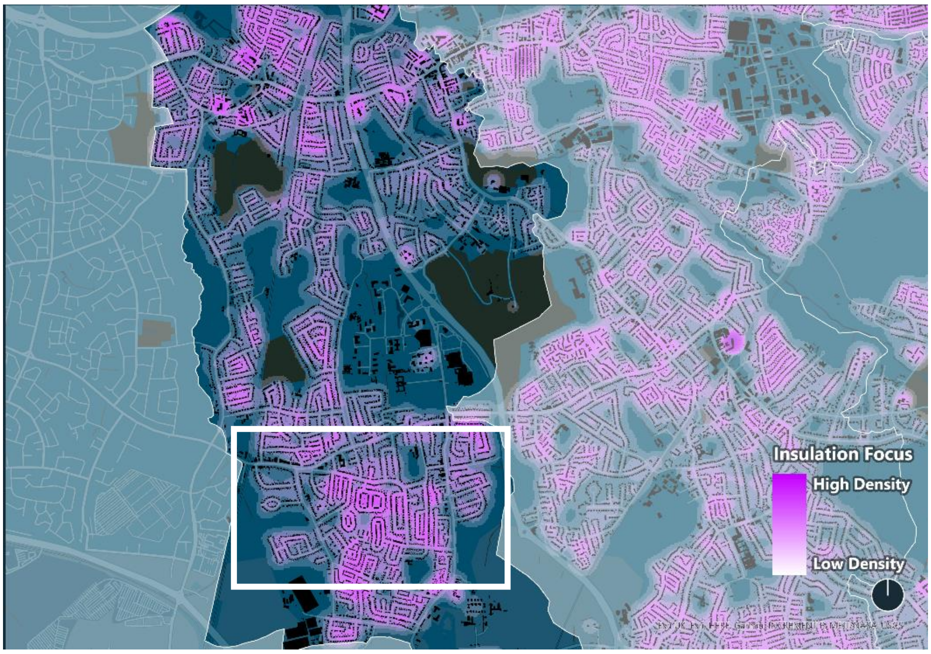
However, all other areas also see high levels of retrofit, with the lowest levels in Stockport Central still being around 50% and Stockport North, in the middle, being 71% in primary and 66% in secondary scenario. Greater proportions of flats, newbuilds or pre-1914 properties which are less economic to apply insulation to lead to lower insulation levels in these zones.

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

Fabric Retrofit Zones in Stockport by 2038

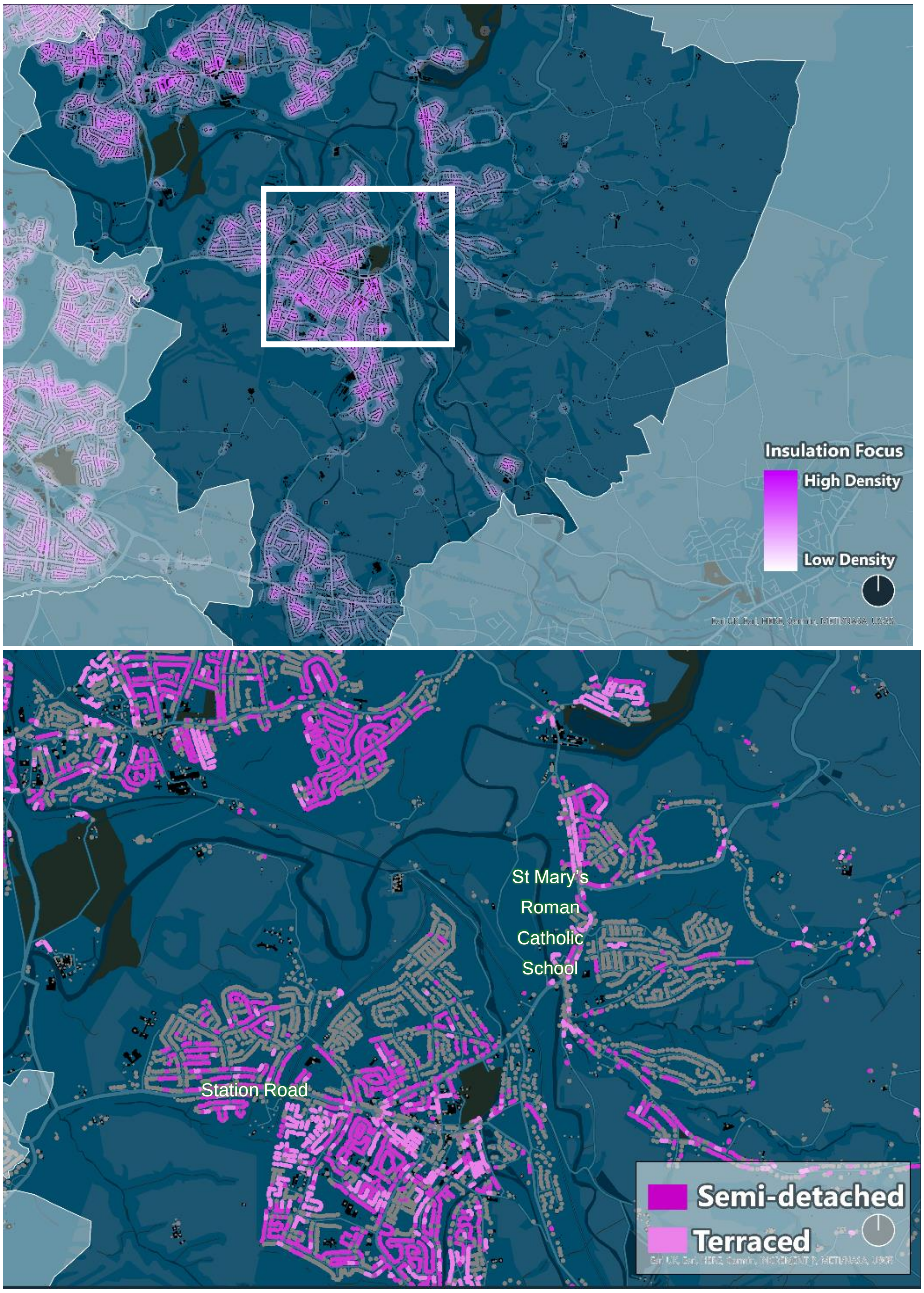
Stockport West is dominated by semi-detached and detached homes, most of which (98% - circa 12,500) receive fabric retrofit. This is split half-and-half between basic and deep fabric retrofit packages in the semi-detached homes and closer to two thirds basic to one third deep split for detached homes. Around 80% of the 3,150 terraced homes in this area receive retrofit, with approximately a half-and-half split between basic and deep. The predominant age groups of homes in this area are 1914-1944 (around 7,200 homes) and 1945-1964 (around 4,800 homes). Retrofit is spread evenly and extensively (nearly all buildings) across all age groups, except 900 pre-1914 homes which receive upgrades to approximately half of the buildings. In the secondary scenario, where hydrogen heating is dominant, overall retrofit numbers are nearly identical, but with more of the semis and terraced homes receiving basic rather than deep retrofit.

Fabric Retrofit Opportunity in Stockport West

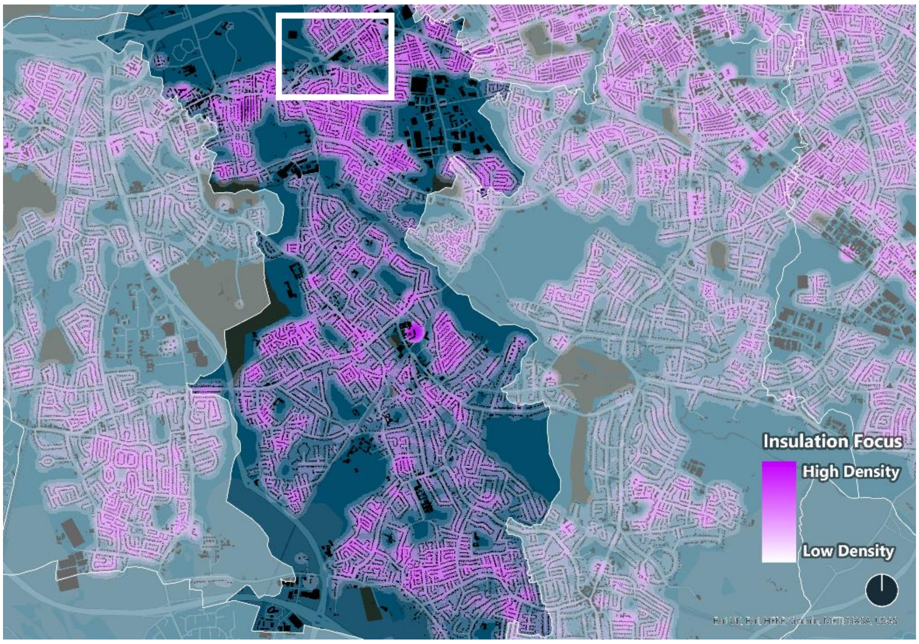


Stockport East looks very similar to Stockport West, only with a greater representation of pre-1914 homes (although still a relatively small proportion of the housing stock at 1,700 of the 17,200 homes in the area, or 10%) and a lesser share of flats (2,300, or 13%), which do not receive retrofit. The share of basic and deep retrofit across home types and scenarios is as described for Stockport West, with almost 13,500 homes receiving retrofit.

Fabric Retrofit Opportunity in Stockport East



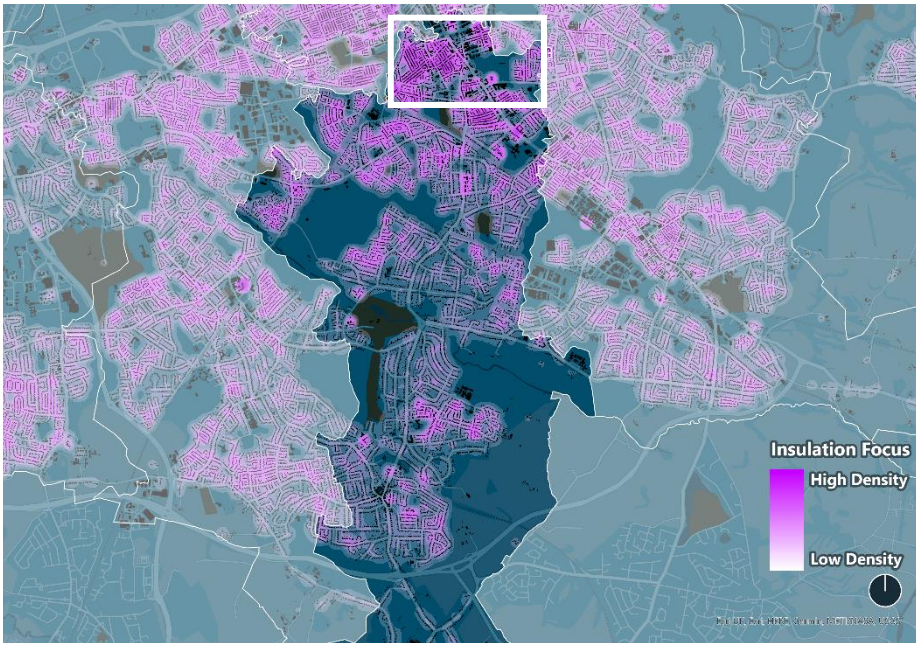
Stockport South West has a similar profile of dwelling types as Stockport West, but with detached homes and flats making up a smaller proportion of the stock (4,000 of the 17,800 total or 23%) and about a thousand more semi-detached homes. The spread of house ages is similar to Stockport West and retrofit packages are spread in a similar fashion across the dwelling types and ages, with 14,300 homes receiving retrofit.



Fabric Retrofit Opportunity in Stockport West

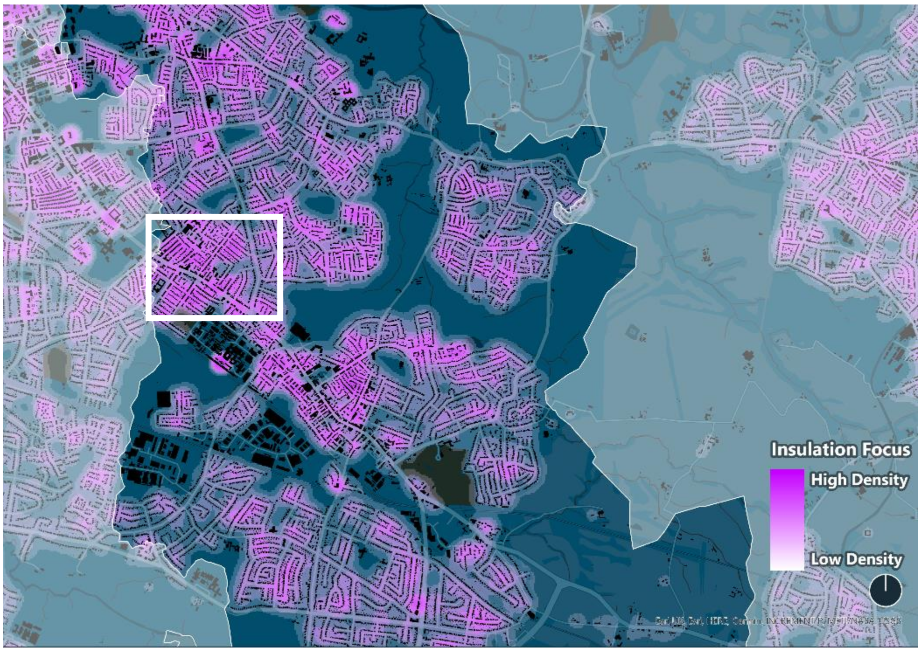
Stockport South Central has a similar profile of dwelling types as Stockport West. The spread of house ages is also similar to Stockport West with a smaller representation in the age range 1945-64 (about 2,900 of the 18,600 total, or 16%). Retrofit packages are spread in a similar fashion across the dwelling types and ages, with 13,600 homes receiving retrofit.

Fabric Retrofit Opportunity in Stockport South Central



Stockport South East has a similar profile of dwelling types as Stockport West with a smaller representation from detached houses (3,550 of the 21,500 total, or 17%) and more dwellings being semi-detached (9,500 or 44%) and terraced houses (5,550 or 26%). The spread of house ages is also similar to Stockport South Central with a smaller representation in the age range 1945-64. Retrofit packages are spread in a similar fashion across the dwelling types and ages, with 17,000 homes receiving retrofit).

Fabric Retrofit Opportunity in Stockport South East



Fabric Retrofit Approach

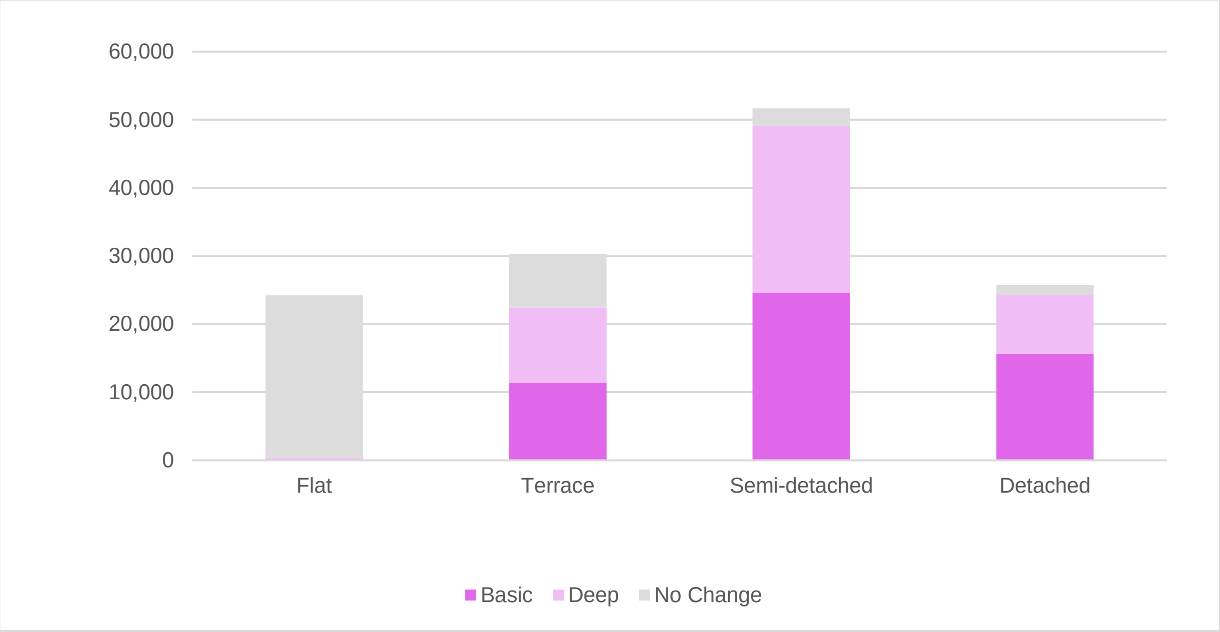
Retrofit measures should be tailored for the individual dwelling, taking account of its type, age, construction, existing insulation and likely future heating system. For example, cavity wall insulation will only be applicable to dwellings that have suitable* cavities (usually post-1920 properties) that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

The retrofit zones identified on the previous pages are designed to allow the coordinated targeting of interventions across Stockport in such a way that supports and aligns with Stockport'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 Stockport expected to need retrofit measures by dwelling type is shown below. This represents around three quarters of the projected domestic building stock in Stockport of approximately 96,000 dwellings in 2038. This highlights both the scale of the challenge but also the opportunity for building and using local supply chains.

Fabric Retrofit in 2038 by Building Type



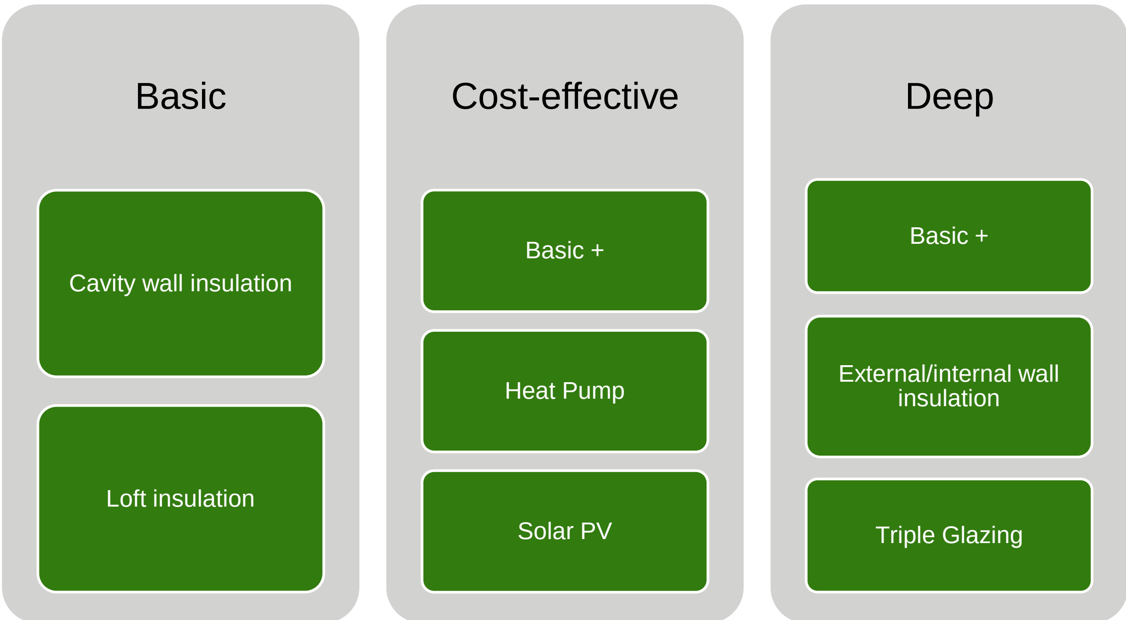
There are over 51,000 homes which receive basic insulation measures and over 39,000 receiving deep measures in both scenarios. Around 5,000 of the dwellings receiving basic retrofit in the secondary scenario would instead receive deep retrofit in the primary scenario. Carrying out basic measures in earlier years would not preclude deeper

* 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

measures being installed in homes in later years. Therefore, basic measures and the majority of deep measures are considered low regret across all scenarios and heating system selections. Due to the ages of housing targeted, a significant proportion of the cost-effective deep measures are based on adding triple glazing to dwellings with basic measures applied, rather than large volumes of external/internal wall insulation to pre-war period dwellings. This is based on the supporting optimisation led modeling, which identifies least-cost options to achieve the carbon targets. Further consideration would be needed to ascertain if individual homes could also benefit from further measures to reduce energy demand and subsequently energy usage costs, for example, considering socio-economic indicators.

Cost-Effective Deployment

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



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

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

Deeper Retrofit

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

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

Supporting Low Carbon Heat

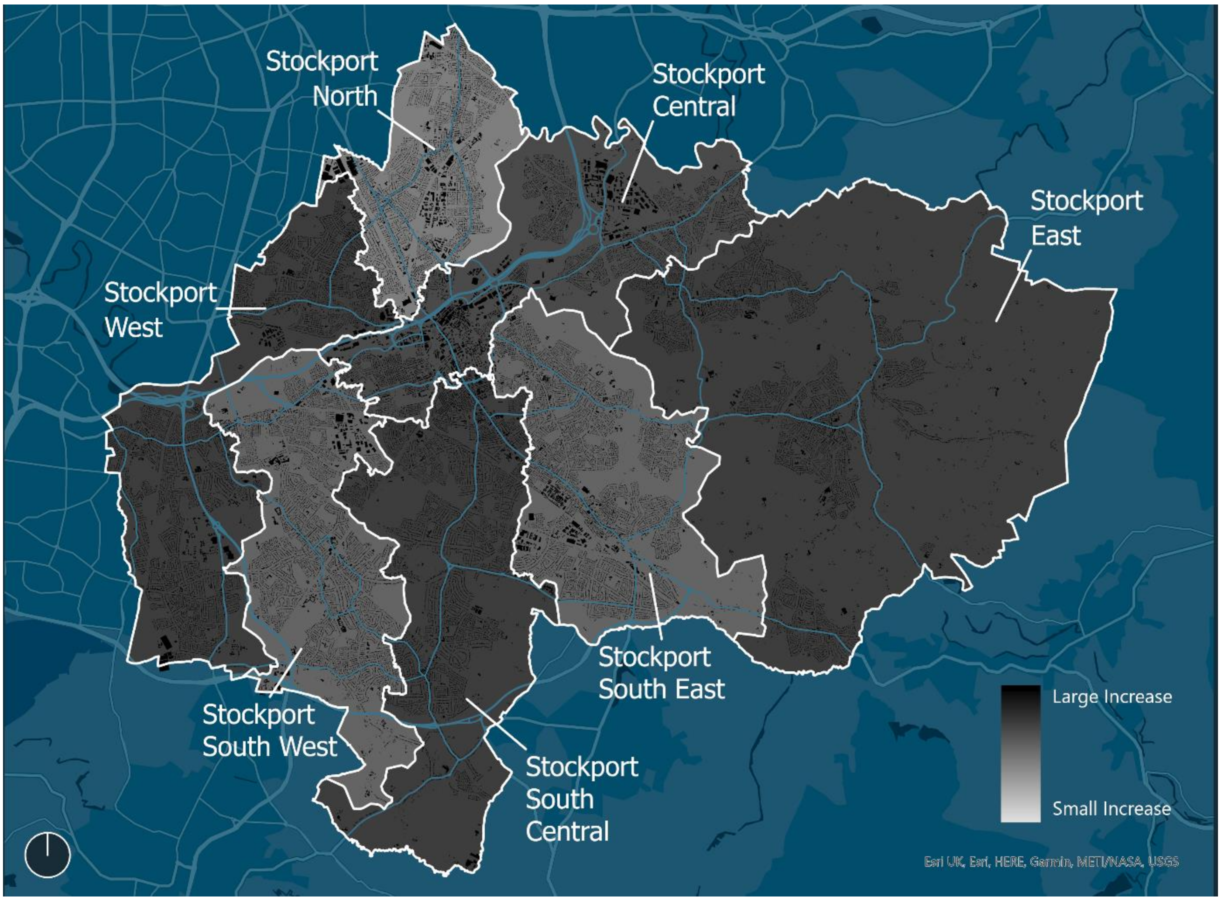
The improvement of building insulation supports the roll out of low carbon heat in several ways. Primarily, by reducing the heat demand, meaning that less powerful heating systems can be installed, reducing capital costs and by reducing energy costs associated with heating (compensating for a shift to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

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

Vision to 2038

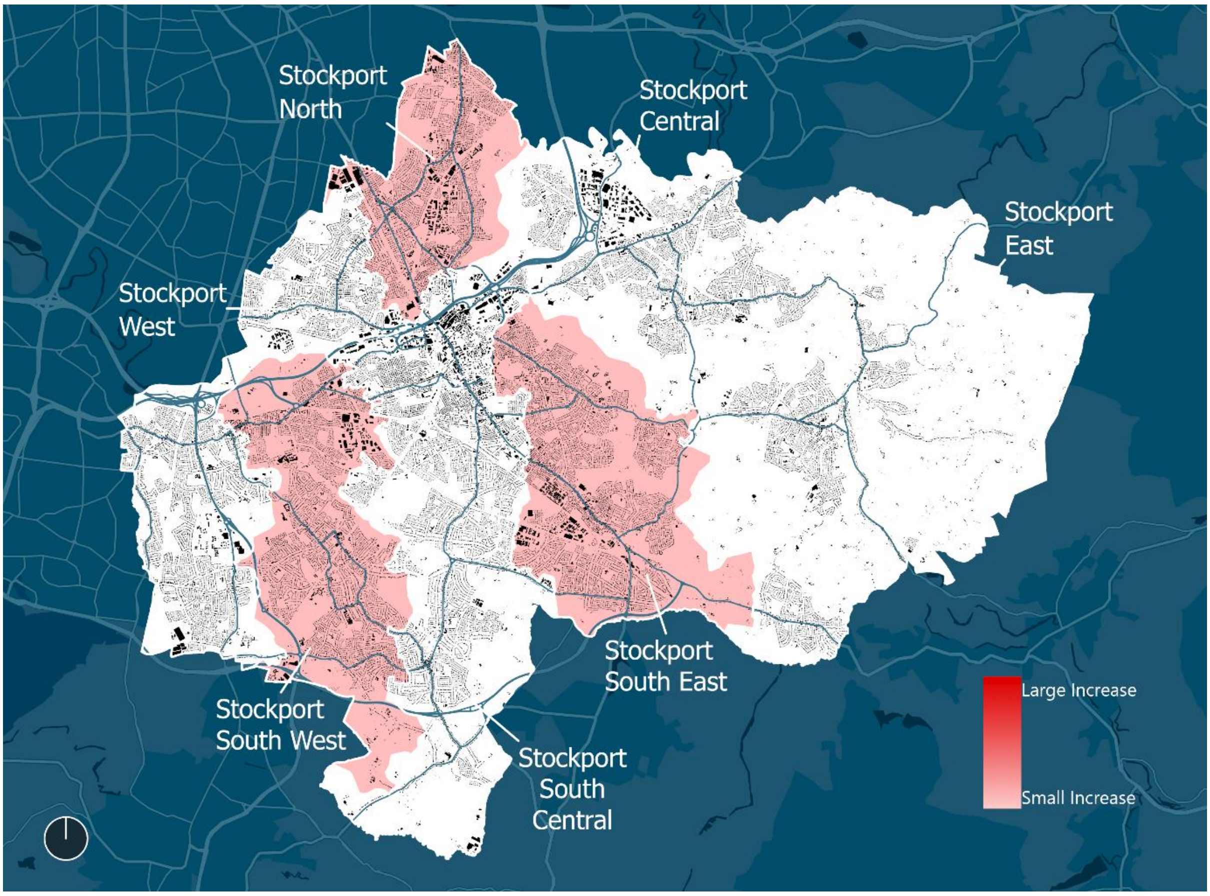
Building characteristics and existing network characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Stockport. In the primary scenario, the decarbonisation of heat is primarily achieved through installation of electric heat pumps in existing and new homes, comprising approximately 98,000 domestic heat pump installations. These are the predominant heating system in all areas besides Stockport South West, North and South East. 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 56.

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



A significant proportion of dwellings (24,700), in three zones, were identified as being in district heating system opportunity areas, where new heat networks could be formed to serve high density domestic heat demands, alongside electric options – see page 51.

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

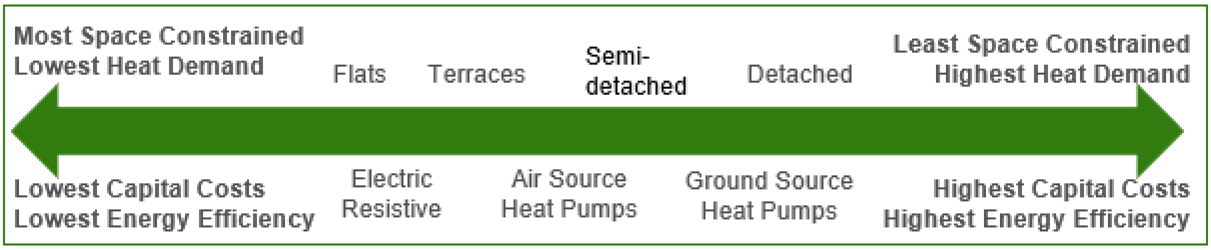


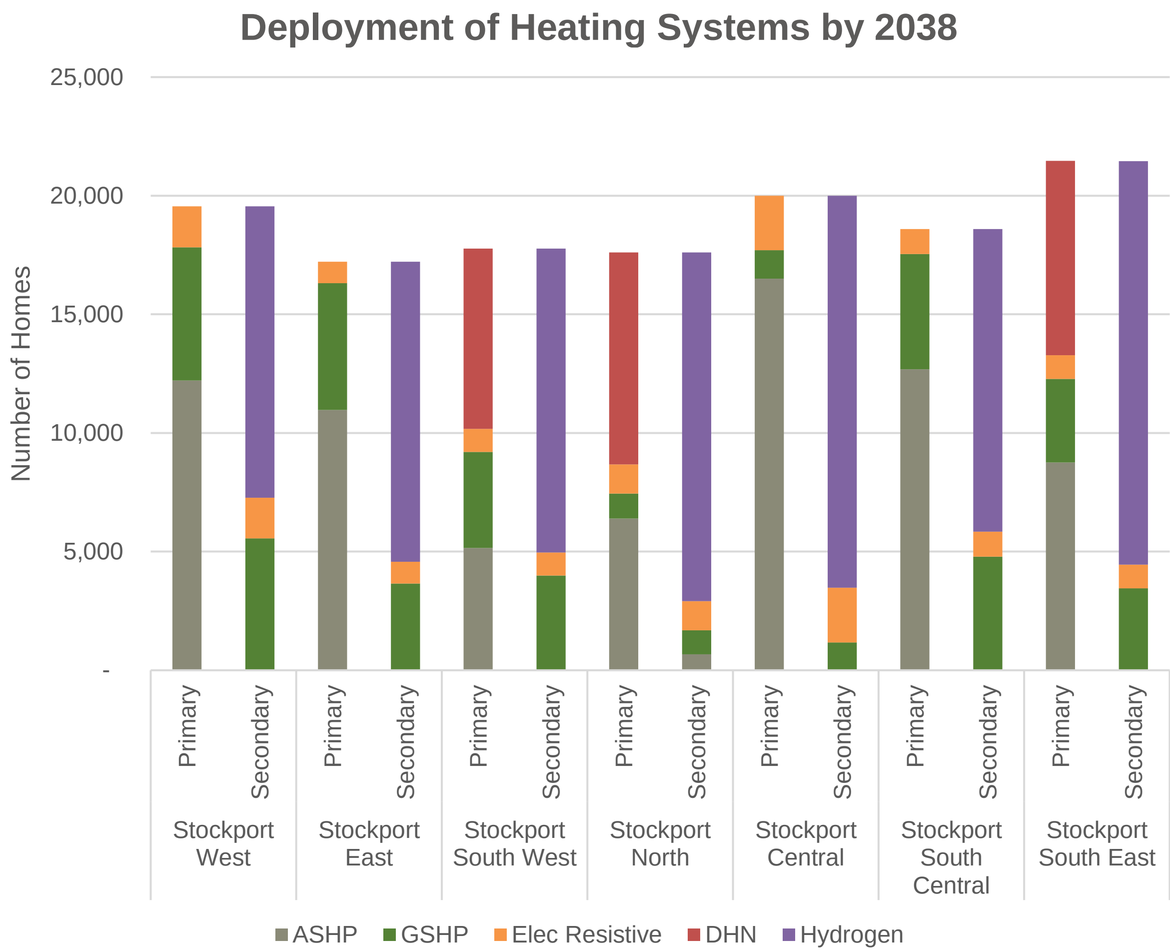
Even where hydrogen is available (as per the secondary scenario), least-regret effort in the near term is focussed on retrofit, priority electrification areas, and monitoring the development of hydrogen (at national and regional levels). The installation of hydrogen-ready boilers could provide optionality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

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

Heating System Selection

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



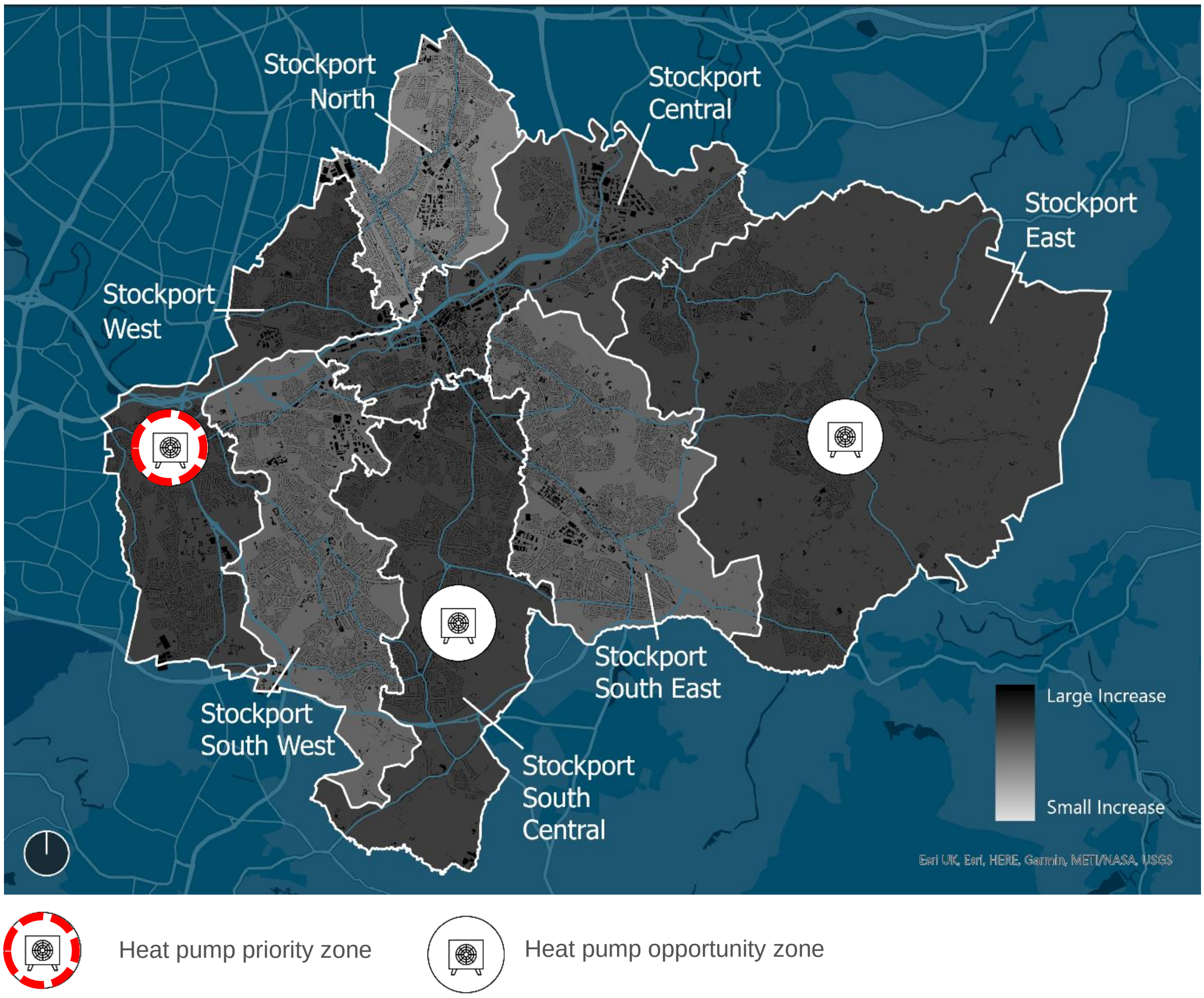


Air source heat pumps are the most widely suited electric heating technology, though a small proportion of homes in most areas was found to be suitable for ground source heat pumps, where greater outdoor space permits the installation of a ground collector, and larger properties may justify the higher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

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

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

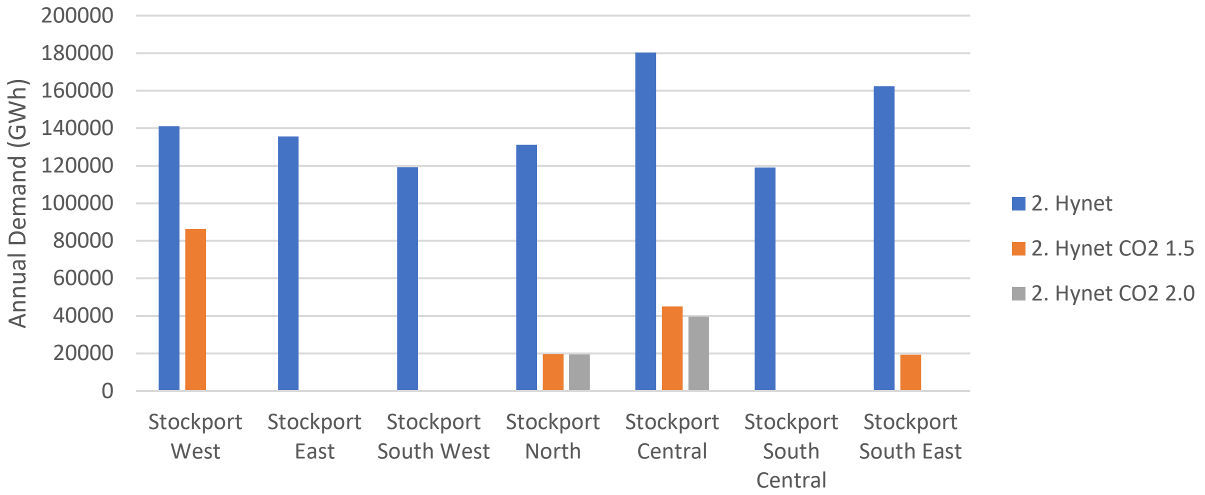
First Steps: Heat Pump Priority Areas



The majority of homes would use heat pumps, unless affordable, low carbon hydrogen became available in time, in which case most homes could use hydrogen instead. The exceptions are detached houses which are generally suited to ground source heat pumps, of which the majority are within in Stockport West and Stockport South Central, with a significant number also in Stockport East, Stockport South West and Stockport South East. For flats that currently use electric resistive heating, it is cost effective and sufficiently low carbon to remain using this option, whether low carbon hydrogen is available or not.

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

Illustration of Hydrogen Sensitivity Analysis for Carbon Intensity



The graph illustrates a sensitivity analysis on the carbon intensity of hydrogen. As the carbon intensity is increased from the base assumption (from HyNet projections), the model reduces the quantity of hydrogen used, and some zones stop using hydrogen entirely. At the highest carbon intensity, Stockport Central continues to use hydrogen with a small amount also remaining in Stockport North, suggesting that use in Stockport Central is high value and should be prioritised.

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

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

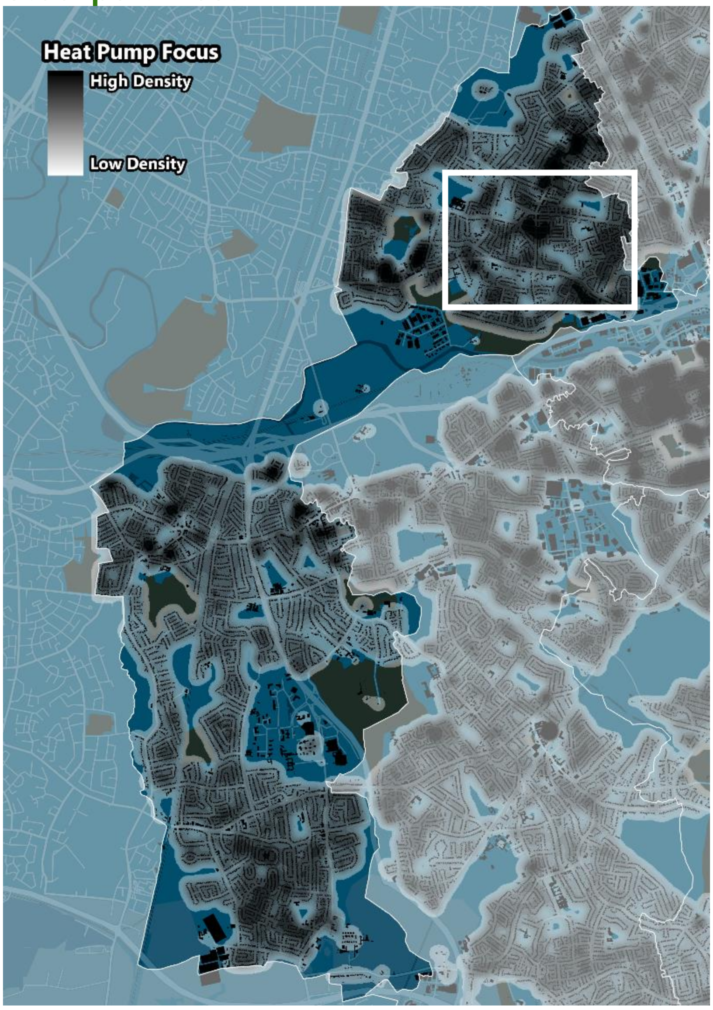
Heat Pump Priority

Stockport West has a high proportion of detached and semi-detached houses (around 7,300 of the 19,500 total, or 37%), along with a good representation of terraced dwellings (3,150). The semi-detached homes are likely to offer an easier opportunity to make early progress with heat pump installation, thanks to typically less space-constrained circumstances. The terraces provide the opportunity to establish good practice and overcome obstacles installing heat pumps in space-constrained homes, such as noise regulations and limited garden space. This zone also contains a sizeable extent of detached homes (5,650), identified as suitable for ground-source heat pumps, providing another opportunity to develop best installation practice before rolling out to other areas, whilst also assessing the benefits of a ground versus air-source based system. Finally, the 3,500 flats in this area could also be suited to use air source heat pumps due to their higher heat requirements, rather than district heat or electric resistive heating (which is most economic for small, well-insulated flats), so solutions for converting flats to heat pumps (e.g. through a communal system) can be explored here.

A total of around 12,200 air source heat pumps are recommended in this area (450 of which as hybrids), along with 5,600 ground source heat pumps. Electrical capacity in these areas appears sufficient to deploy a large number of heat pumps before electrical network upgrades would be required (see in section 7 Present Day Capacity and First Steps).

The suitability of installing individual heat pumps for each flat versus a whole-building approach is an open question which needs trials and evidence. This approach has little precedent in the UK, although individual heat pumps are used ubiquitously overseas for cooling apartments, and wall-mounted heat pumps for commercial cooling are common in the UK. Heat pumps with no outdoor units are also available, which only require ducting through an external wall. A whole-building approach, while a more ambitious project, could allow a visually more appealing solution with less difficulty controlling noise near windows. The option selected in the model is by no means definitive, so if the practicality of supplying flats with ASHPs proves to be too challenging, alternative solutions such as electric resistive heating, or communal systems could be explored.

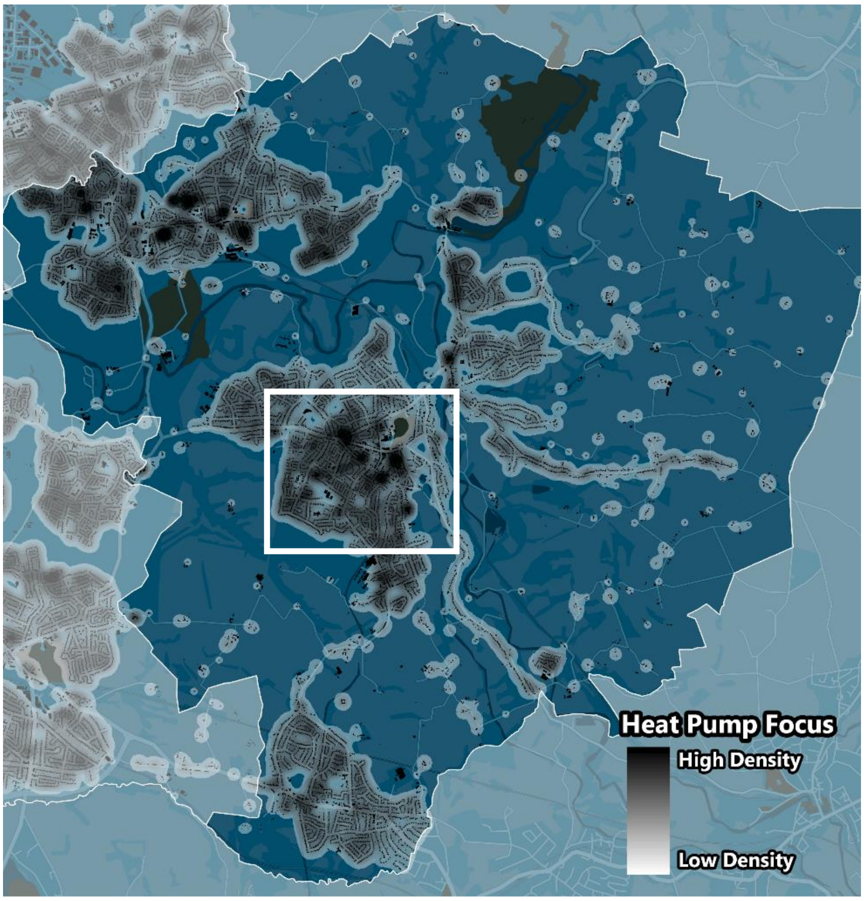
Stockport West



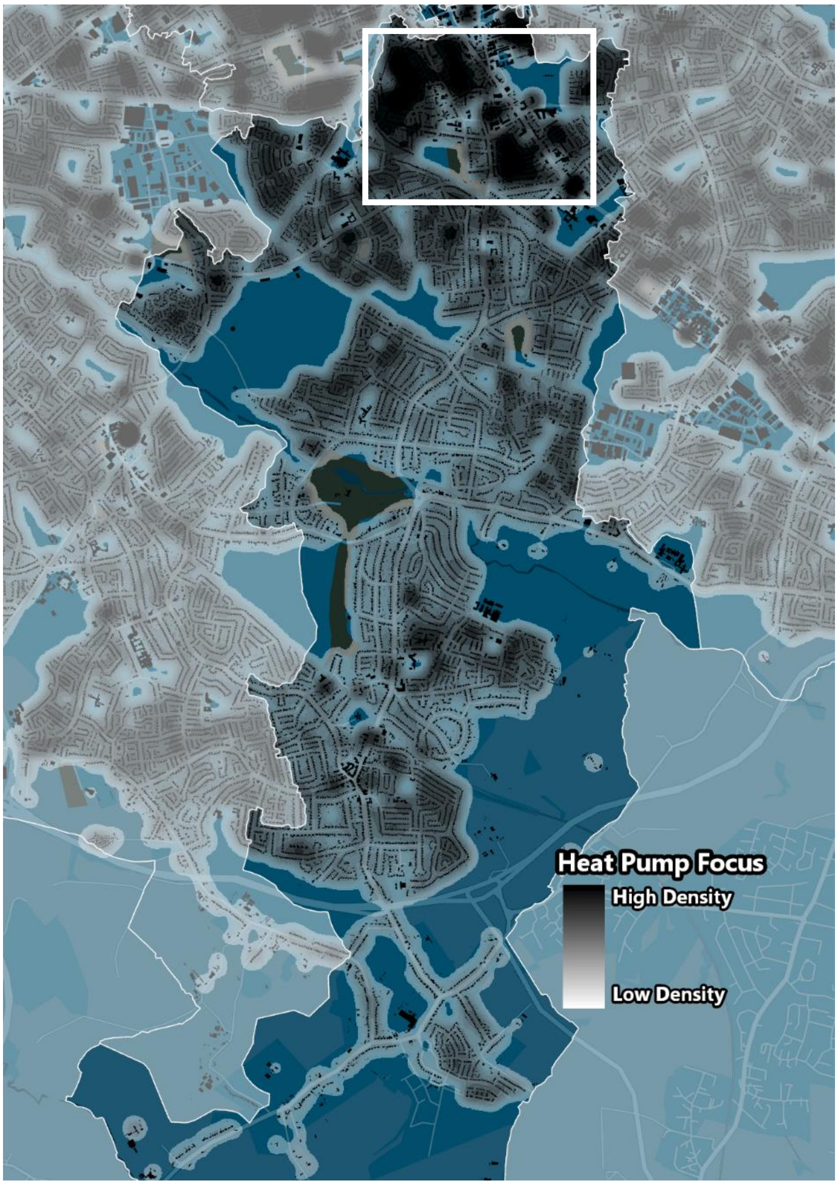
Opportunity Areas

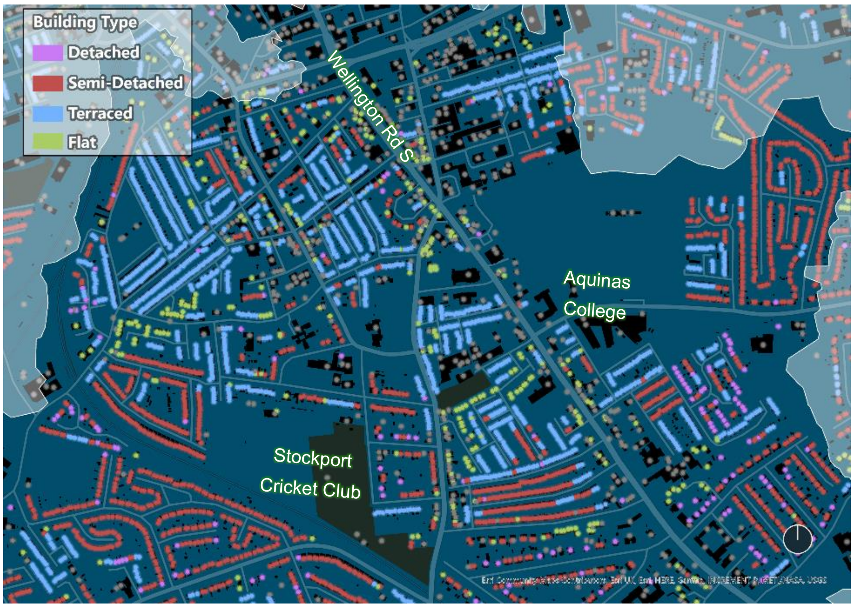
Stockport East and South Central also see widescale adoption of heat pumps in nearly every home, meaning there is opportunity to deploy heat pumps with low risk of regret. These areas have not been prioritised since spare electrical network capacity is slightly lower, however in practice there appears to be substantial capacity to make progress before any limits are encountered. Almost 11,000 air source heat pumps are recommended for Stockport East's flats, semis and terraces, and 5,350 ground source heat pumps for the detached homes. For Stockport South Central, almost 12,700 air source heat pumps and 4,900 ground source heat pumps are used.

Stockport East



Stockport South Central




Building Type
Detached
Semi-Detached
Terraced
Flat
Wellington Rd S
Aquinas College
Stockport Cricket Club

District Heat Networks

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

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

Stockport North, South West and South East have been identified as areas of opportunity for the consideration of district heating in Stockport through modelling heat density of residential properties. Additionally, consideration of existing feasibility studies and public buildings has identified potential within Stockport Central for district heat.

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

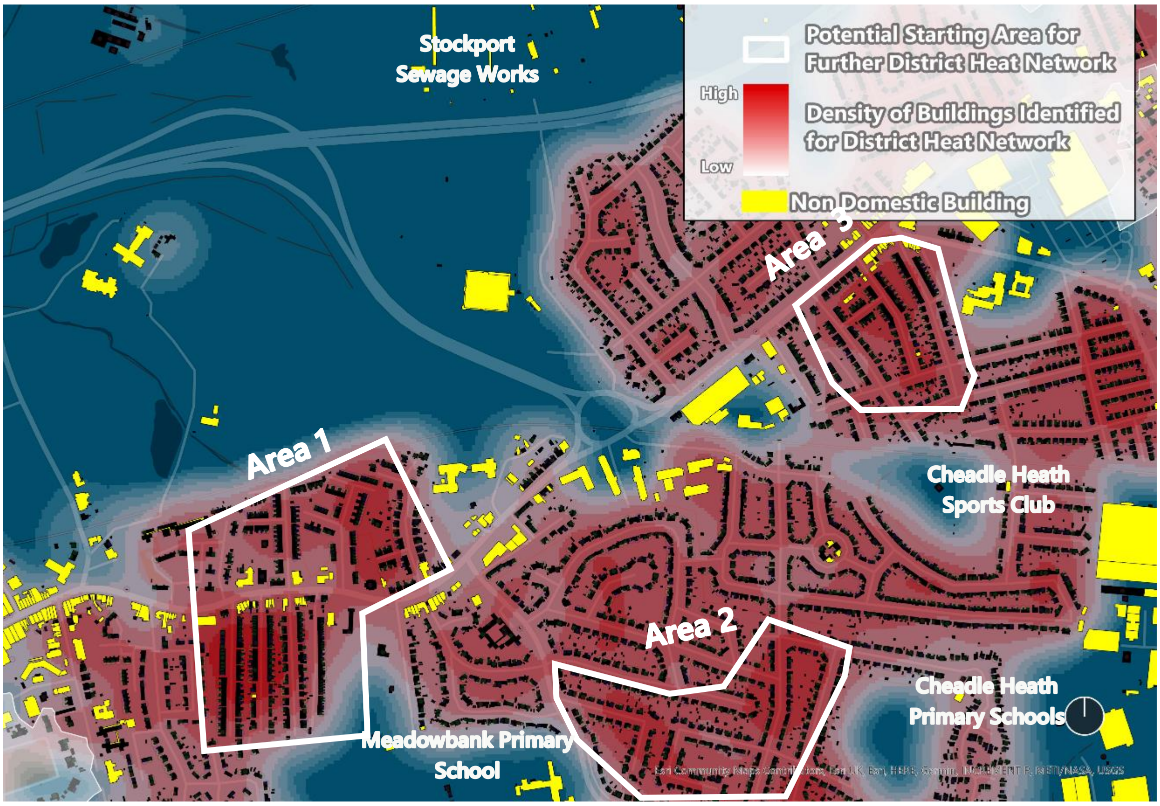
It should also be highlighted those opportunities identified in the modelling work are based on carbon being a driver, an overall cost to society (excluding taxes and funding availability) and a long term focus out to 2038. Therefore, additional commercially viable heat networks may be identified in other areas since these are likely to be focussed on short term payback, prioritisation around cost from the investor’s perspective and based on the current policy landscape and funding availability; for example an initial heat network could be established in Stockport Central to serve public and non-domestic buildings, where it could laterally be extended or connected to heat network in the domestic areas identified below.

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

Stockport South West (Opportunity Area) covers a suburban area of Stockport, in which semi-detached houses make about half of the housing stock with detached houses, terraced houses and flats making up the remainder with a fairly even spread (15-23%). The majority of semi-detached houses, terraced houses and flats in this area are identified as being potentially suited for connection to a district heat network. A wastewater treatment plant to the north of Stockport South West could be a source of heat recovery to feed a heat network installed to serve 7,600 dwellings as well as public and commercial buildings, in particular the multiple schools across the area as well as The Alexandra Hospital.

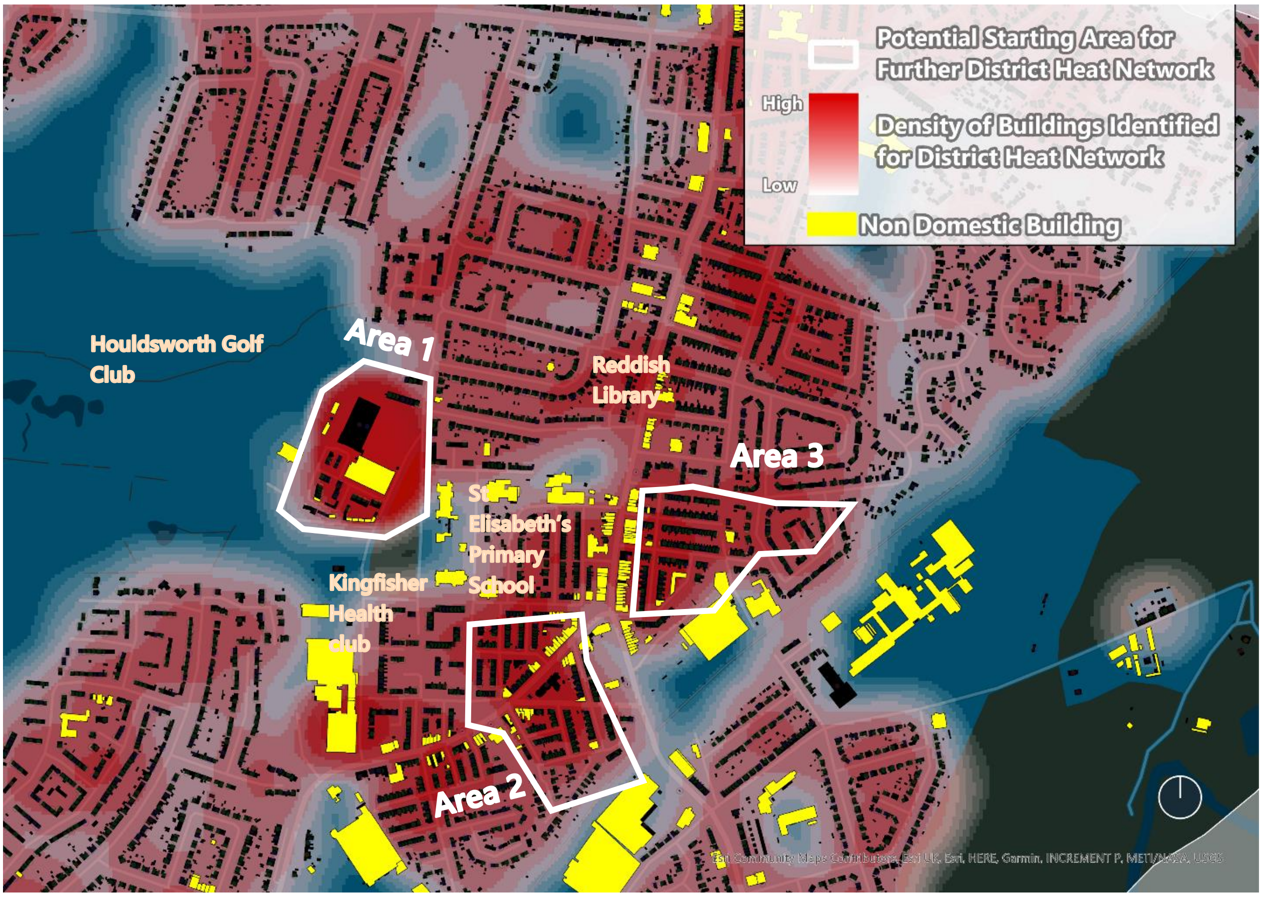
New build flats, with their lower heat demand due to better insulation standards, could be fitted with standalone electric heating systems.

Potential for District Heating in Stockport South West



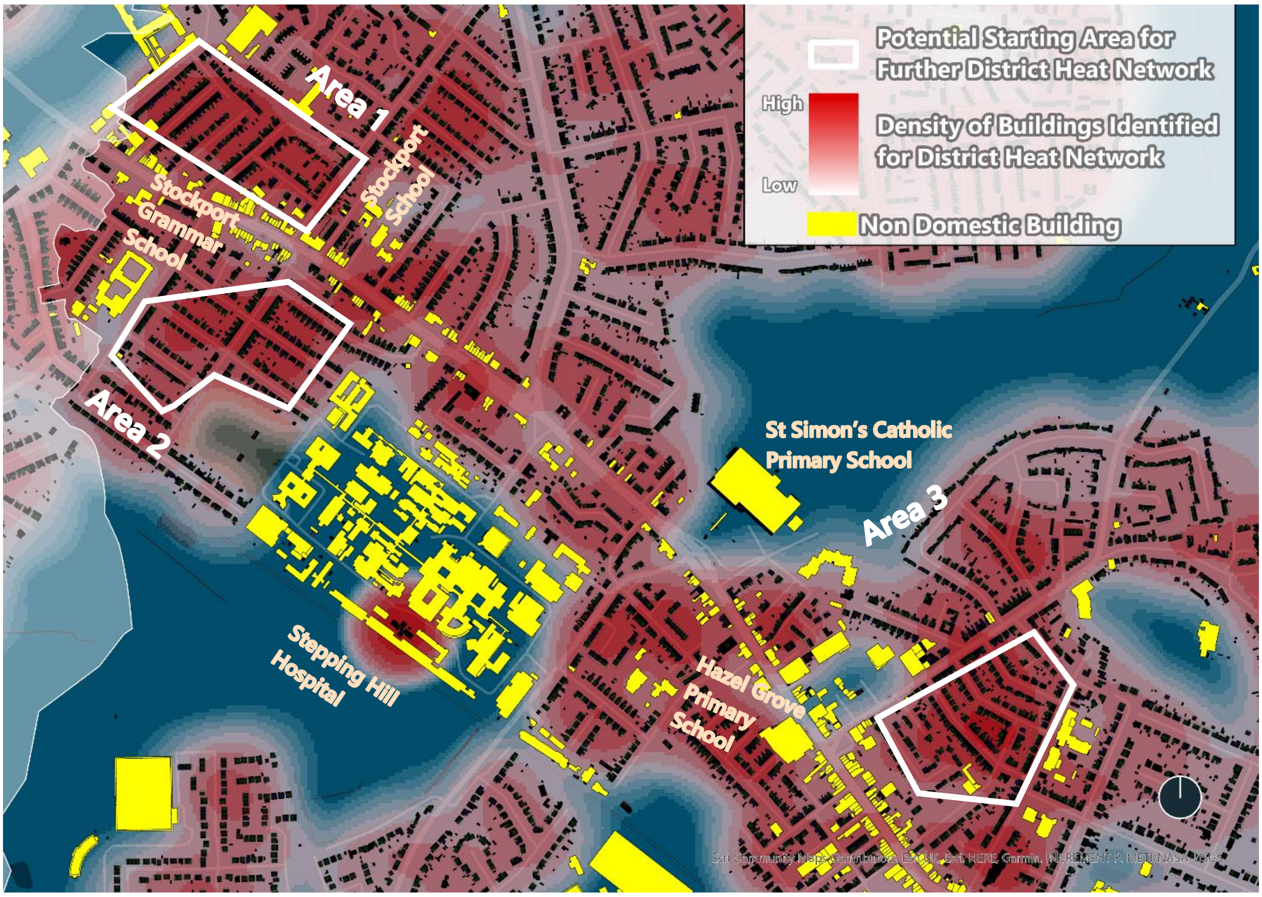
Stockport North (Opportunity Area) covers a suburban area of Stockport, in which semi-detached houses make about half of the housing stock with detached houses, terraced houses and flats making up the remainder with a fairly even spread (15-23%). The majority of semi-detached houses, terraced houses and flats in this area are identified as being potentially suited for connection to a district heat network. A heat network could be installed to serve 9,000 dwellings, as well as public and commercial buildings, such as schools, libraries and leisure centres.

Potential for District Heating in Stockport North



Stockport South East (Opportunity Area) has a housing profile somewhere between Stockport South West and Stockport North. Equally, a heat network could be created here to serve 9,000 dwellings focusing on areas of high heat density as well as public and commercial buildings, such as schools and hospitals. Stepping Hill Hospital has been identified as a

Potential for District Heating in Stockport South East



District Heating in Stockport South Central (Opportunity) Whilst not identified as an opportunity area in the modelling work there may be opportunities in the town centre based on previously conducted feasibility studies. AECOM, for example, have produced a feasibility study* which outlines a heat network starting around a cluster of civic buildings (Town Hall, Fred Perry House and Stopford House) which could be expanded to the Grand Central development, Stockport College and the Covent Garden flats. From these anchor loads, a heat network could expand to serve residential properties to the west in Edgeley. Potential to use the River Mersey as a heat source or as a corridor to run pipework along to reach the Stockport Sewage Works to increase system efficiencies should be explored.

* Stockport Town Centre Heat Network:Feasibility Study by AECOM in 2013

District Heating in Stockport Central (Opportunity)

Whilst the above zones have been identified as opportunities for district heat with a focus on residential heat density, additionally, there are areas of high non-domestic opportunities. The council are scoping out heat network potential which identifies a number of these anchor load buildings which cluster primarily in Stockport Central but also spread out to the south through Stockport South Central and into Stockport South East. The River Mersey, given the appropriate feasibility studies to understand heat capacity related to water flow and environmental constraints, could potentially be used to feed a water source heat pump. Stepping Hill Hospital, identified in Stockport South East, makes up nearly half of the heat demand of the anchor load buildings identified in the council's heat network scoping works and could provide a significant off-taker of heat, making it a worthwhile heart of the south end of the heat network to which residential heat demands identified in modelling could connect.

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. Conversely, the existence of gas boilers and wet pipework system throughout the building would potentially provide an easier option, such as swapping out the existing boiler for a plate heat exchanger and its ancillary plant.

Hydrogen for Heating

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

The primary scenario reflects phases 1 and 2 of HyNet, where low carbon hydrogen may be available from 2025 onwards for the largest industrial sites in the region. It is not believed that any of these are likely to be in Stockport. 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 Stockport, resulting in a potential shift to hydrogen dominated heating. One of the key considerations being that the hydrogen based secondary scenario is assumed to be significantly cheaper than the primary scenario (£7.2 bn compared to £8.3); however, this is dependent on HyNet phase being delivered on time and at the cost and carbon projections provided by HyNet. Taking a wait-and-see approach is therefore deemed extremely risky when there is a 2038 carbon target; the scale-up and demonstration approach in the identified priority areas are therefore provided so that short to medium term activity can take place in areas of least regret.

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

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

Proposed route and connection points for HyNet phase 2

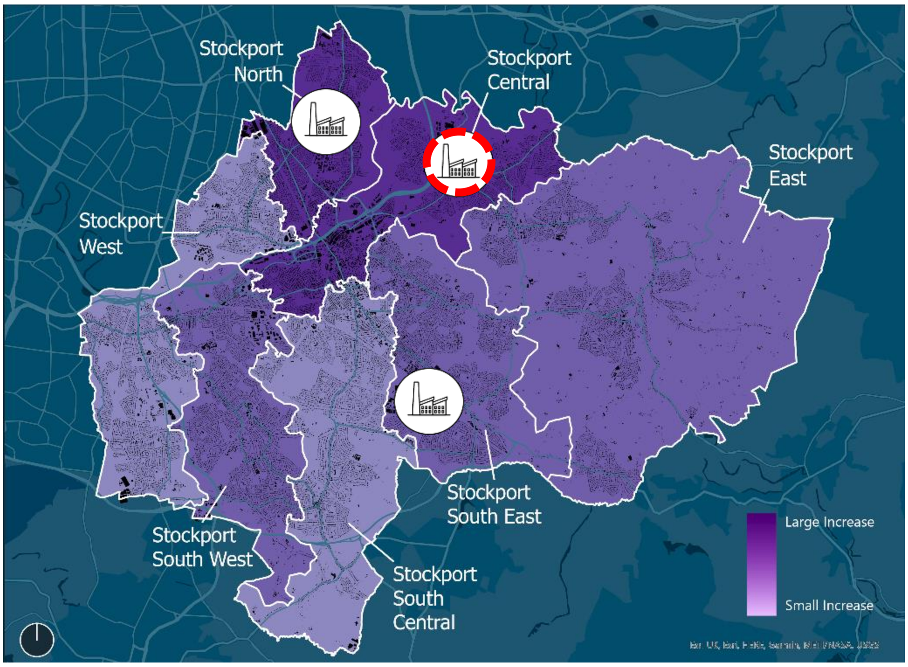
Hydrogen for Heating - Opportunity areas

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

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

Analysis has been undertaken to identify the areas of Stockport where hydrogen should be prioritised if the quantity is limited. Since the model uses the available hydrogen in a cost-optimal way, the areas where hydrogen is deployed in a constrained resource scenario can be seen as priority areas. In this analysis, Stockport Central and Stockport North see prioritised deployment of limited hydrogen. Since Stockport North has also been highlighted for heat network development, Stockport Central comes out as the overall hydrogen priority area.

Stockport Central is an area which would be prioritised for hydrogen connection if supply was limited. Additionally, there is a significant estimated demand for high temperature heat, and over 16,500 dwellings would be suited for hydrogen heating in this area. Bredbury Park Industrial Estate is a modest industrial estate to the north-east of the town centre which could have some use for high temperature heat.



Priority area

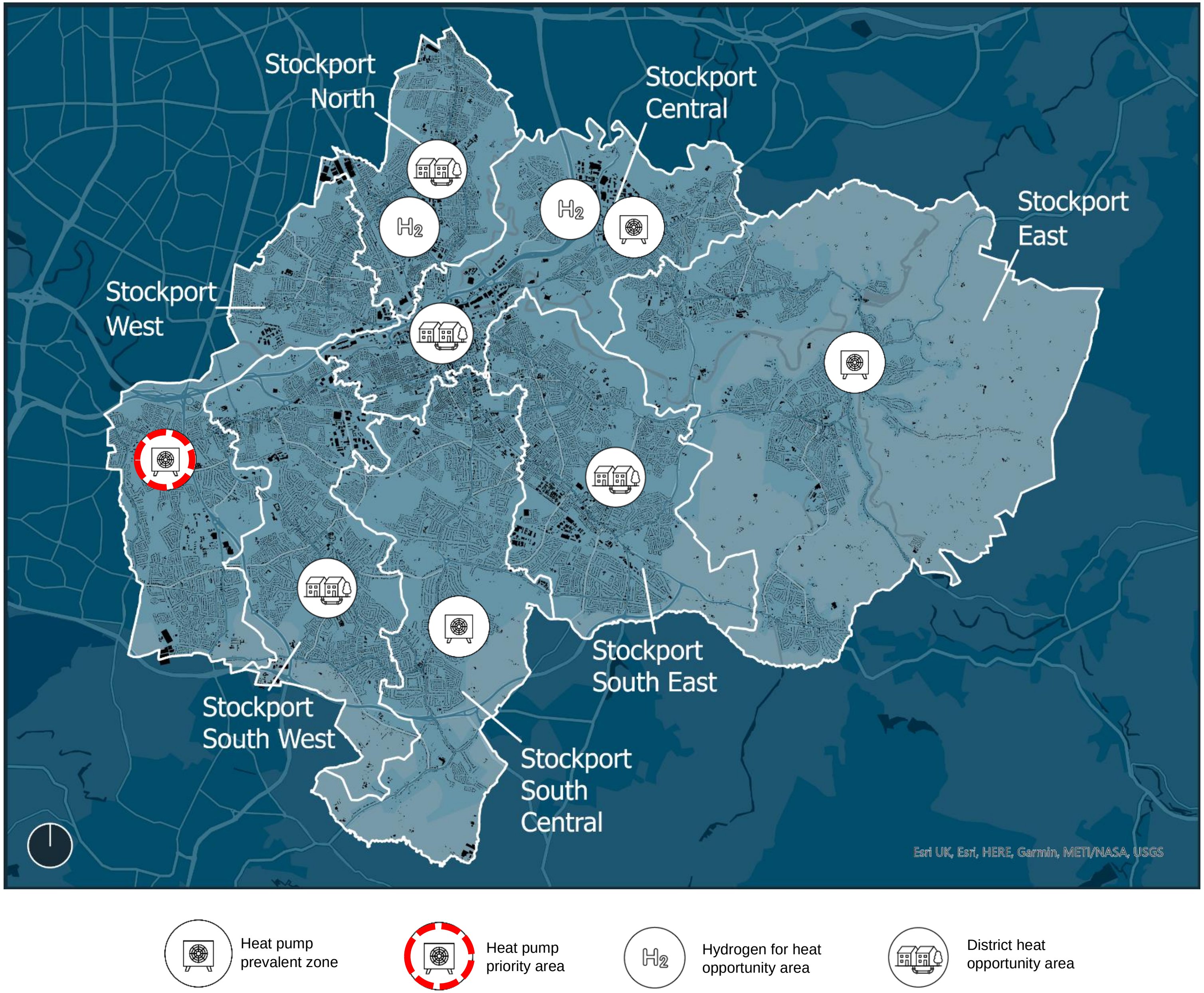
Areas of high gas use by industry which may be difficult to electrify (e.g. for high temperature process heat)

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

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

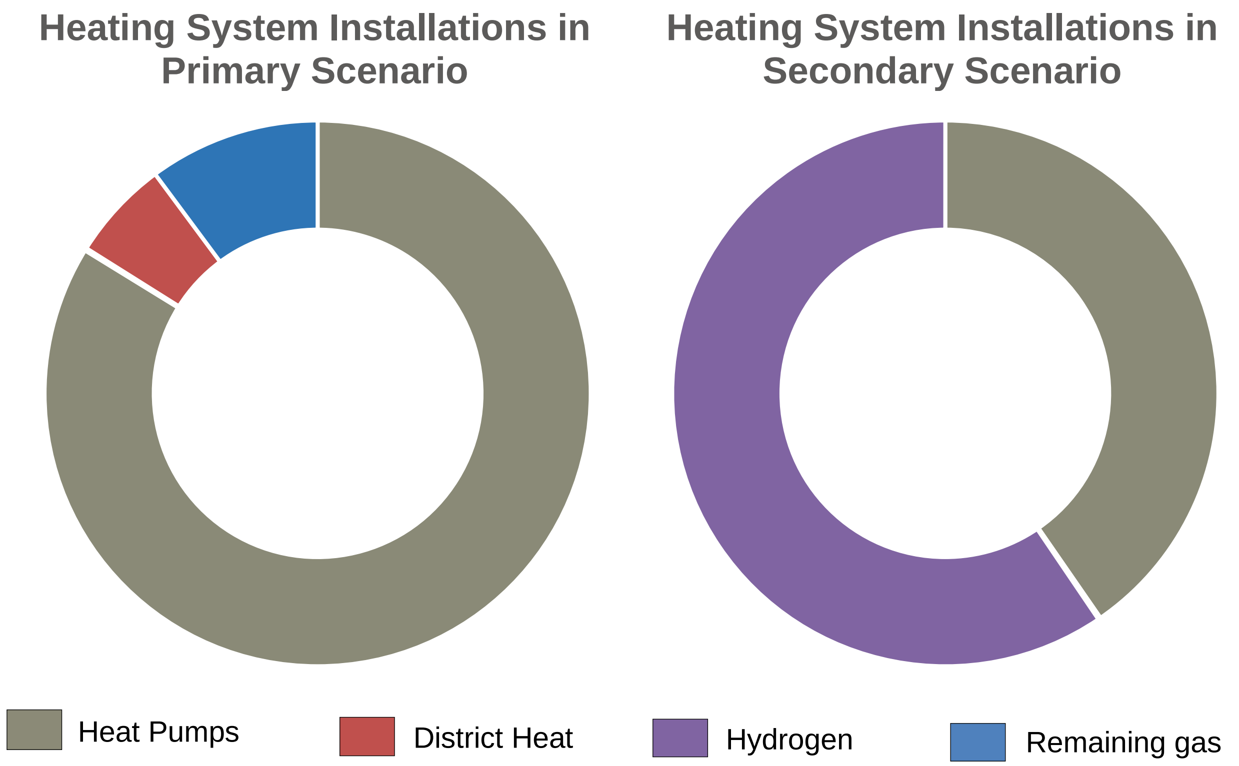
- In the secondary scenario, heat pumps remain the solution of choice for detached homes, while some flats remain on electric resistive heating.
- Stockport South West, North and South East swings between either the installation of new district heat networks, or hydrogen between the two scenarios, with a supporting role from heat pumps in both cases in detached houses and a greater representation of homes in the primary scenario. To understand priority within these areas, hydrogen sensitivity analysis has been conducted.
- Industrial estates such as Bredbury Industrial Estate in Stockport Central, Whitehall and Vauxhall Industrial Estates in Stockport North, and similar zones in the town peripheries could become anchor demands for hydrogen around which nearby dwellings could be connected.

Zone	Prevalent heating system		Priority area
	Primary scenario	Secondary scenario	
Stockport West	Heat pumps	Hydrogen with ground source heat pumps	Heat pumps
Stockport East	Heat pumps	Hydrogen with ground source heat pumps	
Stockport South West	Heat network with some heat pumps and electric resistive	Hydrogen with ground source heat pumps	
Stockport North	Heat network with some heat pumps and electric resistive	Hydrogen	
Stockport Central	Heat pumps	Hydrogen	Hydrogen
Stockport South Central	Heat pumps	Hydrogen with ground source heat pumps	
Stockport South East	Heat network with some heat pumps and electric resistive	Hydrogen	


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

4. NON-DOMESTIC BUILDINGS

With the requirement to rapidly reduce CO_2 emissions in line with the GM carbon budget, the primary scenario is based on an individual heat pump transition for the majority of Stockport's non-domestic buildings. The estimated combined investment (for improving the energy efficiency and installing heat pumps) is in the region of £1.8b.



- The majority of Stockport's non-domestic buildings (84% by floor area) have been deemed able to transition to a heat pump option with a further 6% (by floor area) suitable for district heat networks

- A notable proportion (10% by floor area) are deemed to be reliant on either gas or hydrogen for use in industrial processes

- 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, Stockport South West, North and South East have been identified as areas with potential for heat network development*. With a wide range of building usage types (see following chart), solutions will be dependent on building type and aspects such as density of non-domestic buildings

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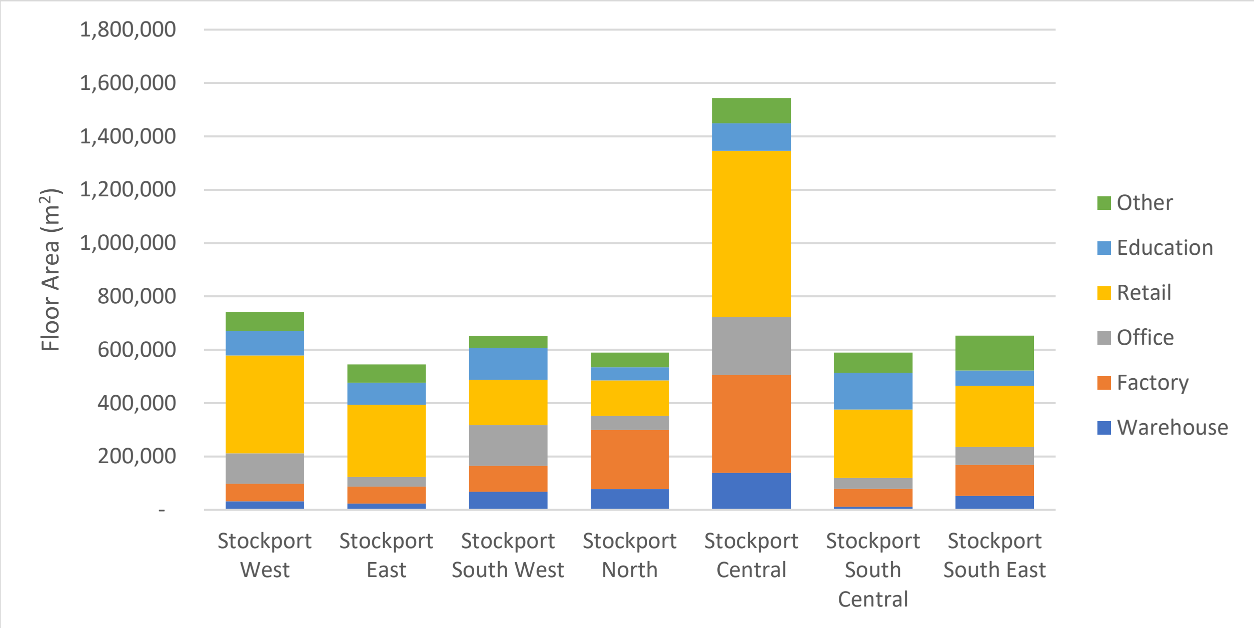
* More detailed consideration is expected to identify non-domestic buildings where it would be beneficial to connect to a heat network, particularly when considering opportunities to develop district heat networks to supply dwellings in the surrounding areas; specific district heating network master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

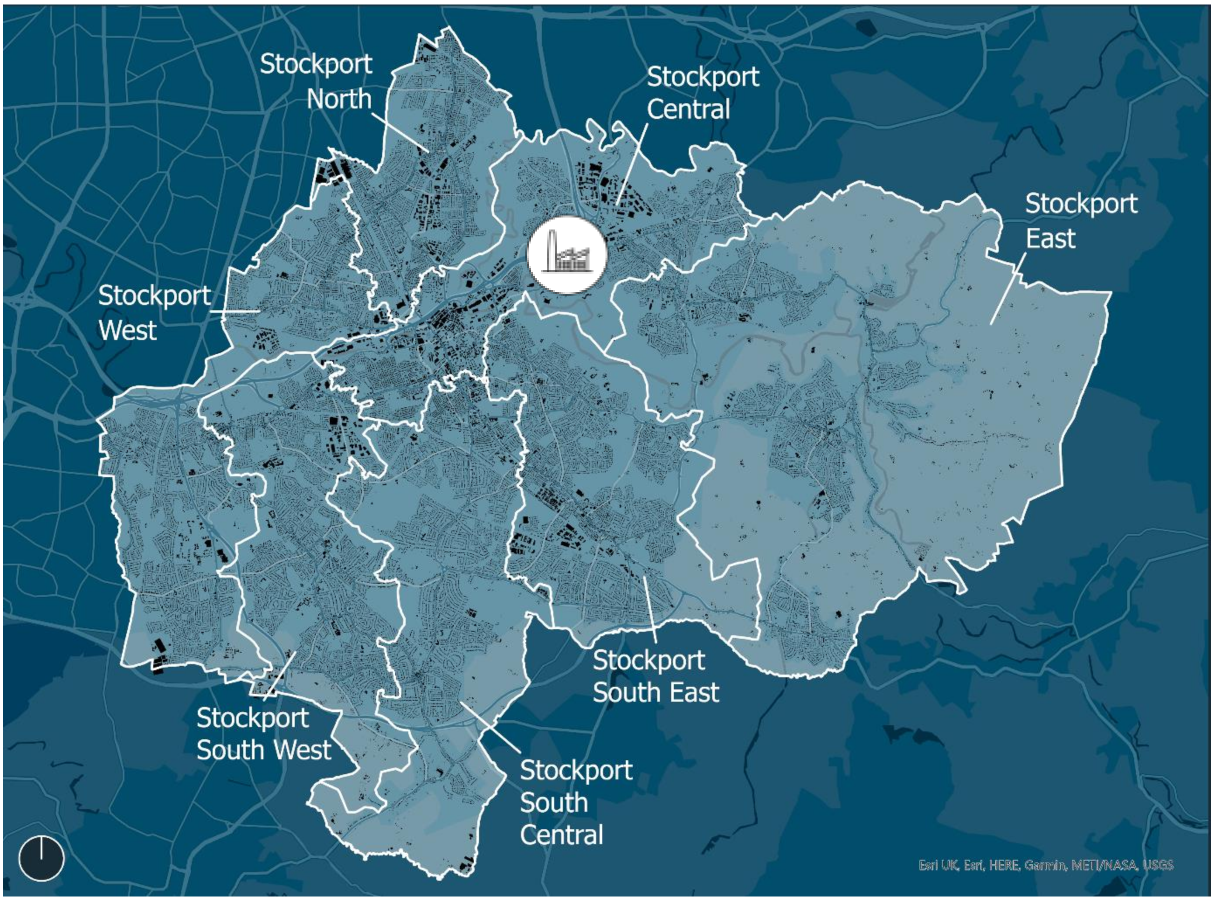
Non-domestic Building Usage by Floor Area (m2)



Non-domestic Buildings Priority Area Selection

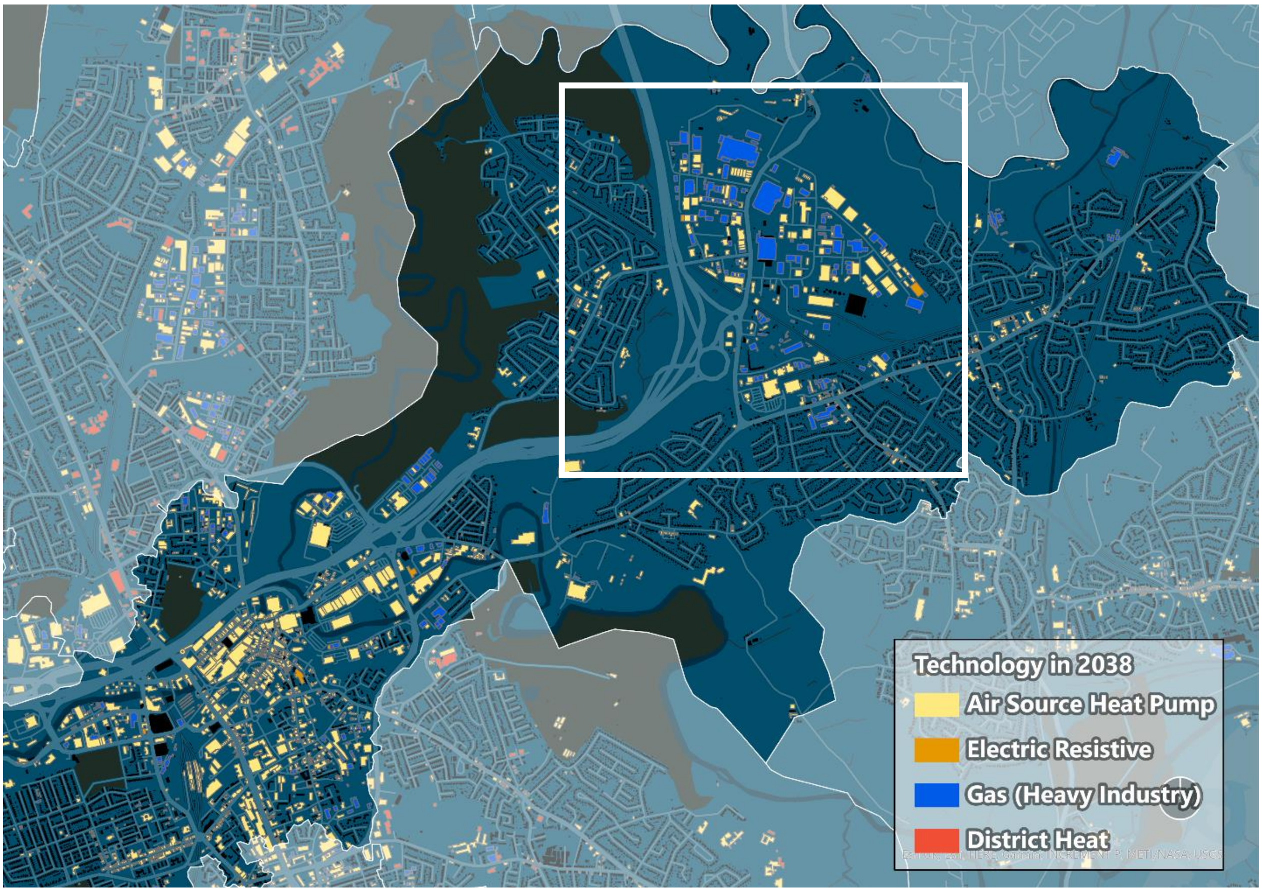
Stockport North and Central have the greatest estimated requirement for gas for industrial processes, meaning they could be good areas to prioritise hydrogen. Stockport Central has the greatest presence of non-domestic buildings overall, making it an area well-suited to early demonstration of non-domestic decarbonisation solutions, ahead of the other zones. The opportunity for developing district heat networks in Stockport North sets it apart from other non-domestic areas, which would be more likely to transition to individual heat pumps than connect to a heat network. Office, retail and education spaces should be most straightforward to transition to heat network connections or heat pumps, due to their compatibility with low temperature heating.

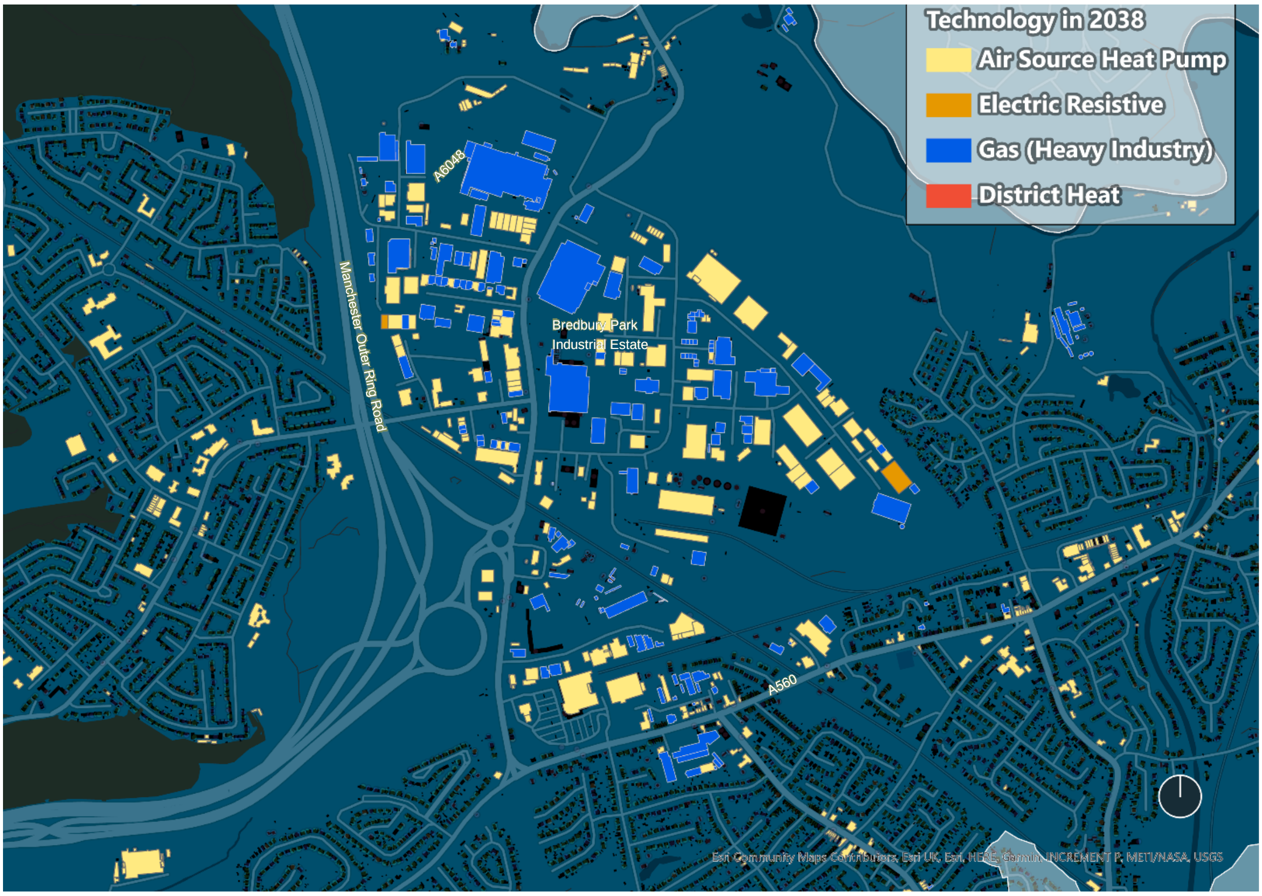
Non-domestic decarbonisation priority areas



Non-domestic opportunity area

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





Vision to 2038

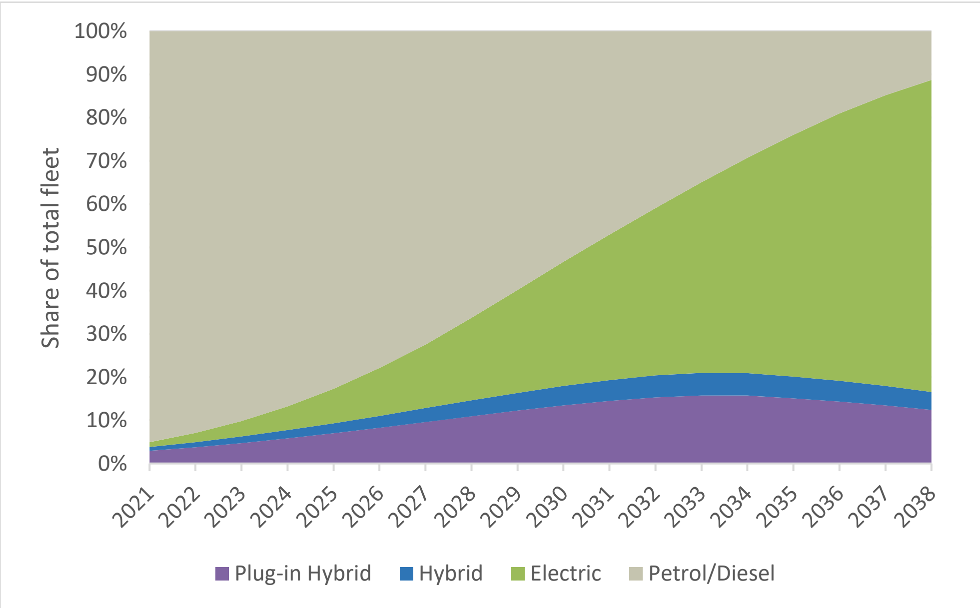
Electric Vehicle (EV) ownership is expected to grow significantly to support local decarbonisation targets and in alignment with national policy, which will see the phasing out of internal combustion engine vehicle sales by 2030 and hybrids by 2035.

Fully electric and plug-in hybrid vehicles (PHVs) in Stockport are expected to grow from around 3,000 today to almost 125,000 cars by 2038 – 85% of the total fleet. Charging infrastructure will need to be installed to encourage this transition and keep up with this demand, providing confidence that owners will be able to recharge when needed. A mixture of publicly accessible and private residential chargers will be required to provide this amenity.

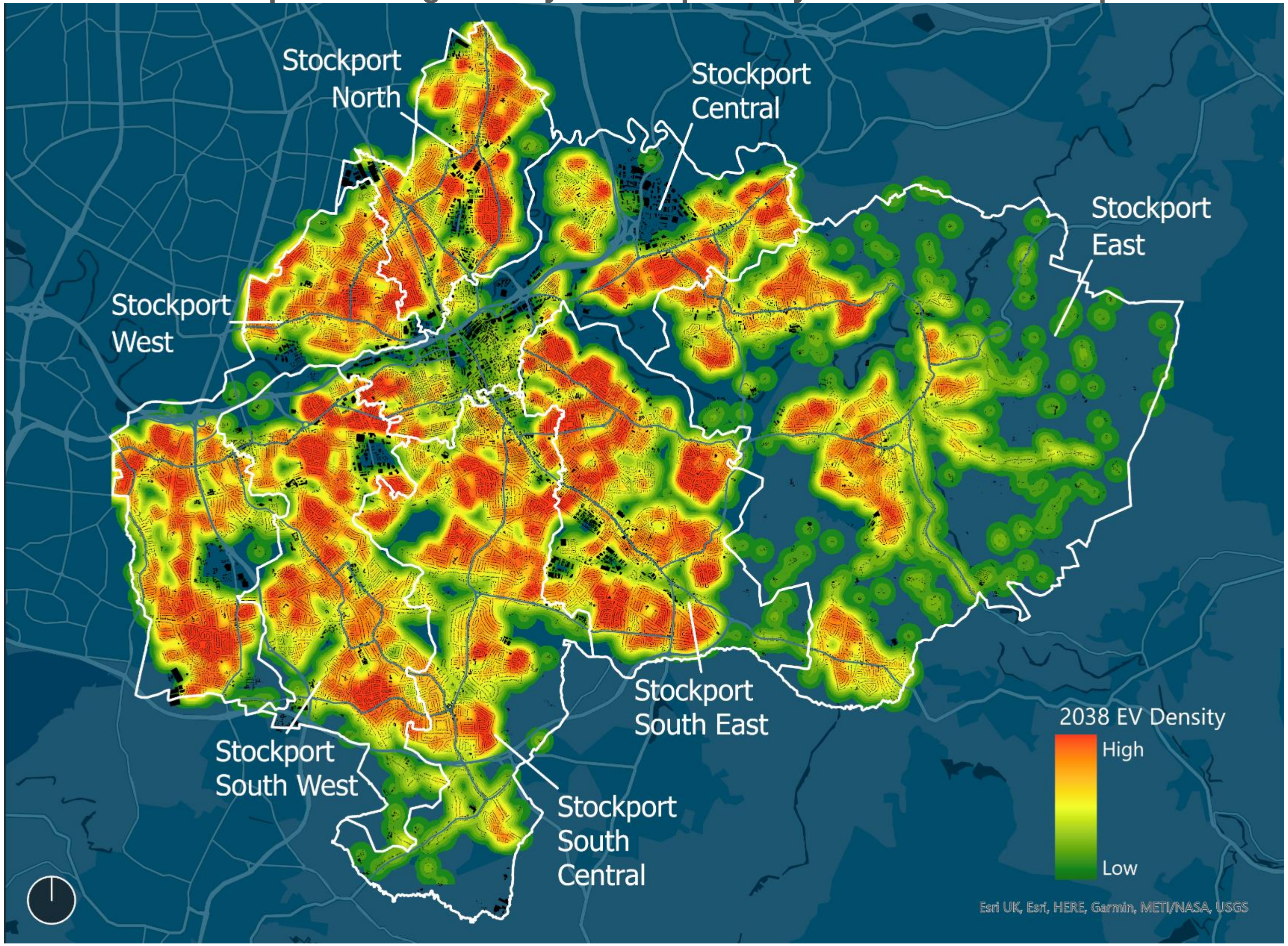
Greater Manchester's Transport Strategy 2040 sets out an ambition that no more than 50% of daily trips (across all modes) will be made by car in 2040, down from 61% today. In light of an expected overall growth in trips, the strategy sets out that meeting this target would mean a reduction of car trips from the current 3.7m per day to 3.4m. However, this still represents a significant demand for EV charging, estimated to increase to 134 GWh per year in Stockport 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 Stockport



Publicly Accessible EV Charge Points

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

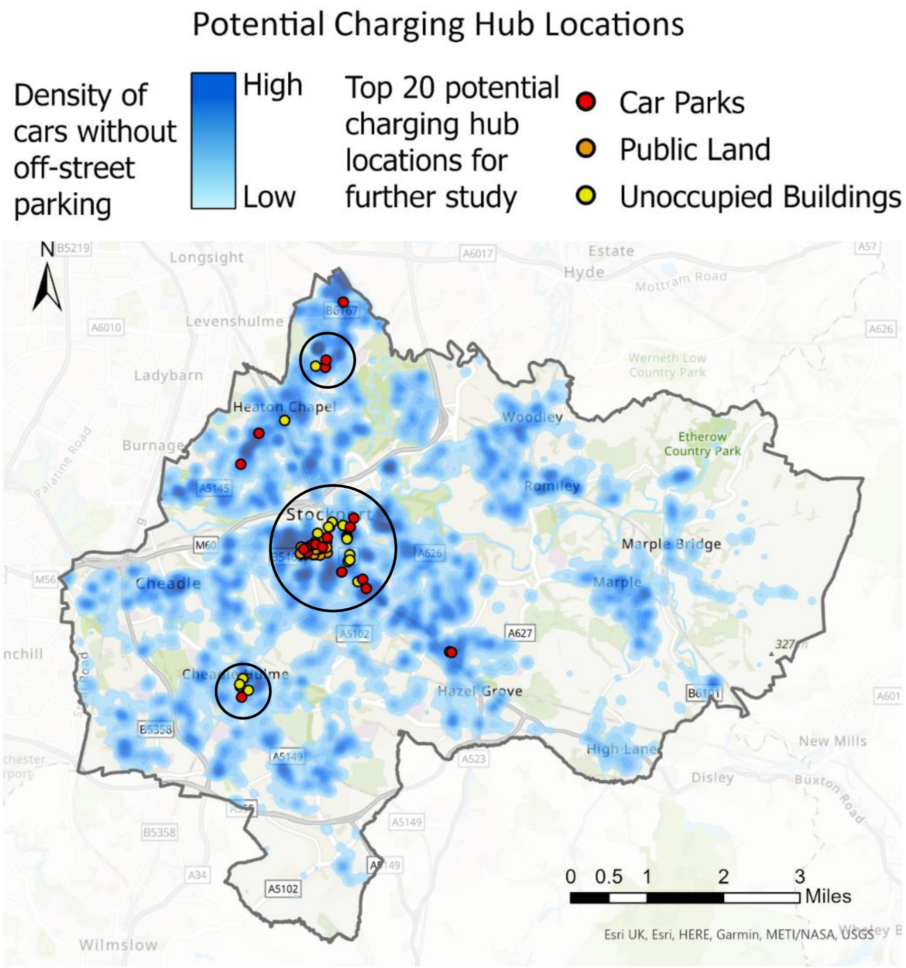
At-home charging for dwellings that have off-street parking is a solution which is well developed, but for dwellings without that potential, other solutions will be needed. One solution may be public charging hubs located in residential areas with limited potential for off-street parking. Other alternatives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

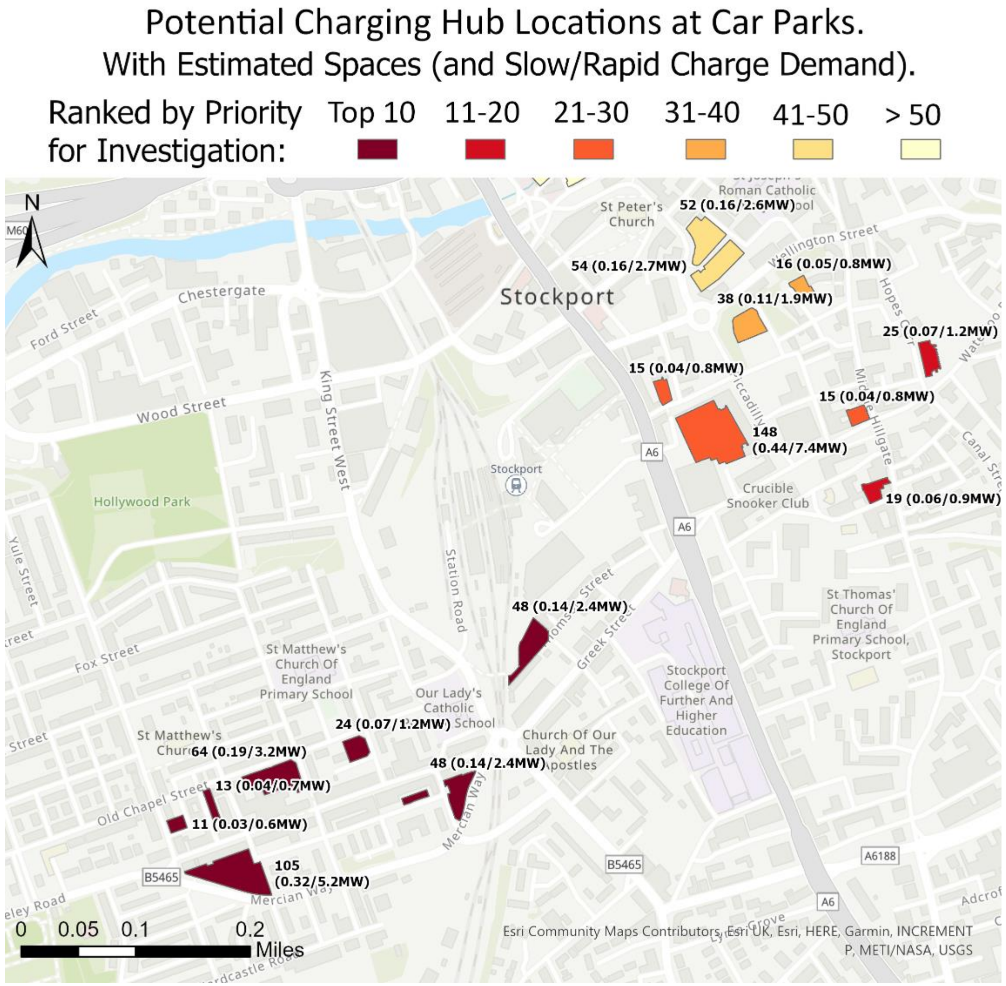
The maps shown on the following page identify potential prioritised charging hub locations, based on dwellings without potential for off-street parking and projected EV use. Further consideration will be needed, working with TFGM to identify and develop public/hub charge points across Stockport[*]. Stockport Council are working with Be.EV to assess feasibility of installing 25-30 EV public charging sites across Stockport. This work could be brought together with the findings in this LAEP to inform areas of demand and potential sites for EV hubs.

Home Charge Points

Homes with potential for off-street parking are considered able to install private chargers. EV ownership is projected to significantly outstrip the number of homes with off-street parking, and every home with off-street parking sees a charger installed, amounting to over **37,000 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. Stockport will need to work with GMCA, TFGM and other relevant stakeholders to ensure a joined up transport decarbonisation approach is developed and implemented. As well as aligning with local planning policies as it relates to provision of chargers in new developments and existing dwellings





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 Stockport; 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, Stockport 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 would require significant investment and transformation of land which may have other beneficial uses. In the context of an electricity grid which is already rapidly decarbonising, the relative merit of large-scale solar PV rollout should be considered. Additionally, analysis of matching supply and demand should be conducted to determine the optimal configuration of local renewable assets versus grid supplied electricity (taking a whole energy systems approach), alongside demand side response, flexibility and energy storage; these aspects are discussed further on p.77, where potential priority areas are highlighted to consider further assessment.

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

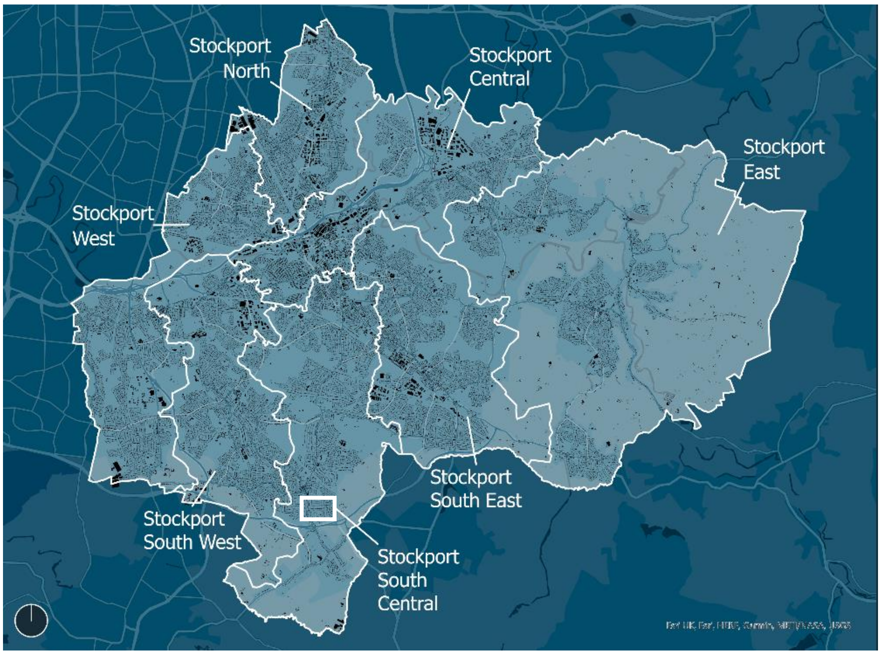
Domestic Solar and Batteries

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 667 MW rooftop PV capacity installed by 2038, yielding 856 GWh of energy annually. In other words, all buildings with suitable roofs are low regrets opportunities to install solar PV, meaning there is plenty of flexibility around the approach for this.

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

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

Density of dwellings with both rooftop PV and EVs, by 2038 in Stockport South West



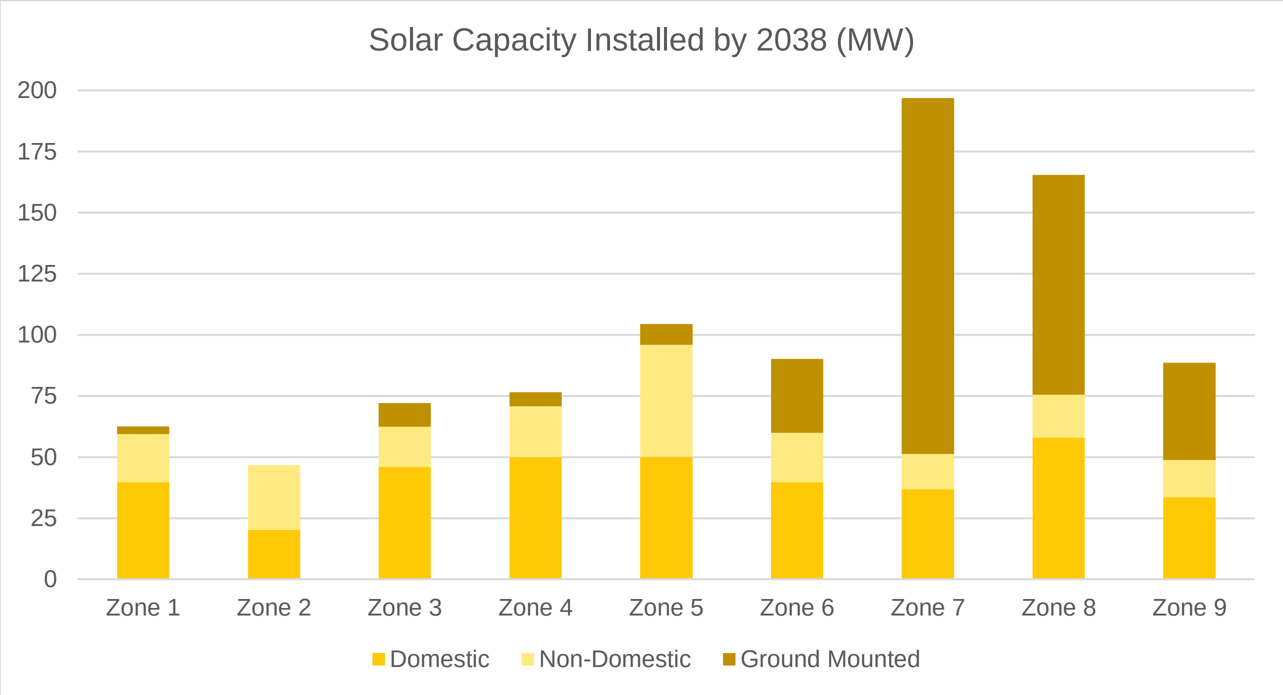
Large Scale Solar PV*, Wind and Hydroelectric

A study to determine the areas of land in Stockport 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.

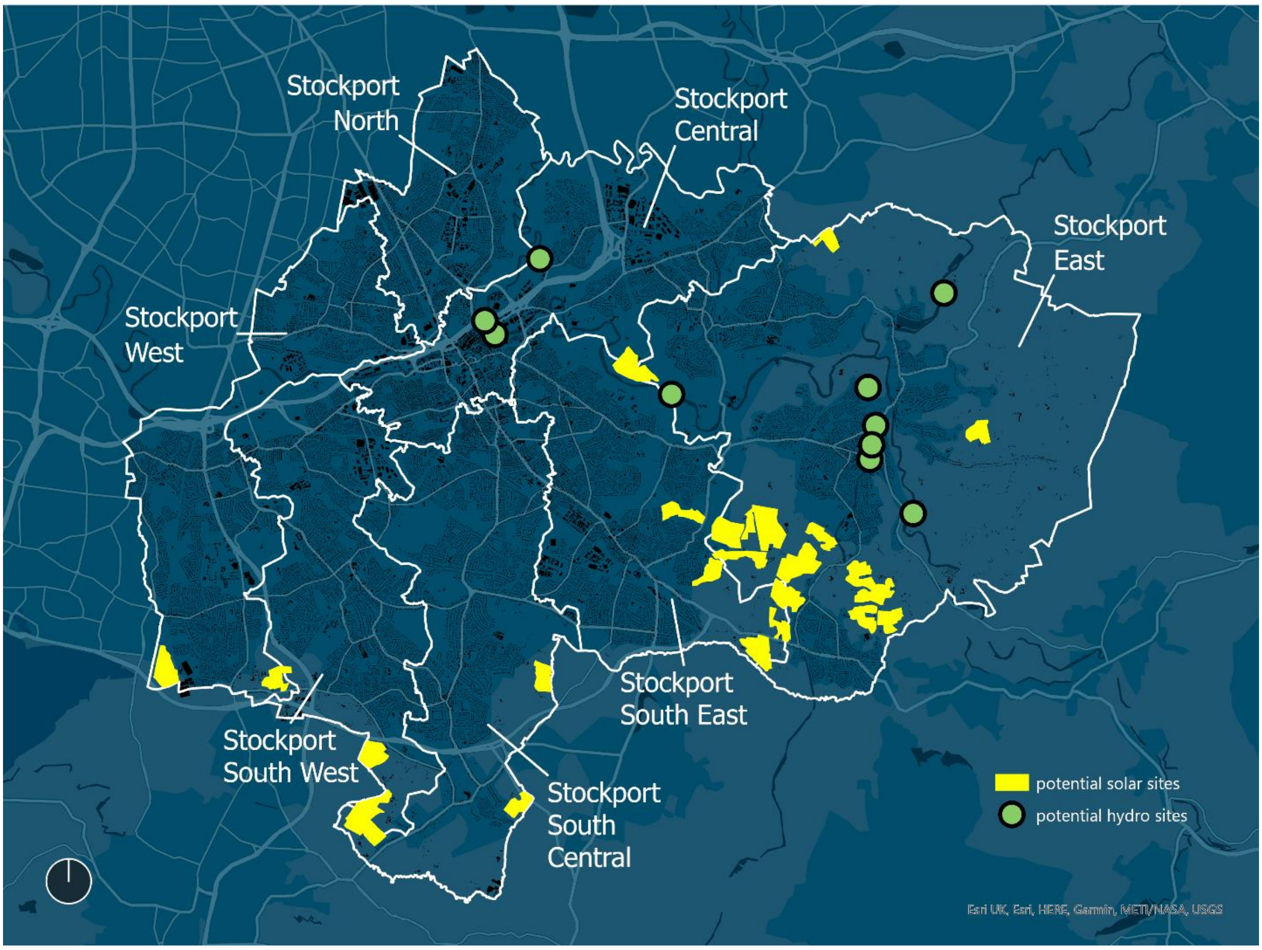
* Opportunities for local energy generation have been identified following a high level screening study in support of this LAEP. Further assessment will be required to consider renewable energy generation opportunities in detail. Screening has been carried out through assessing constraints surrounding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

This study found substantial opportunities for solar and only very limited hydro developments, but none for wind. Twenty-six potential sites for ground mounted solar PV were identified (see map below), covering a total of up to 322 hectares. Such large-scale deployment of solar on the land would clearly require careful consideration around feasibility and public acceptability. If the full extent of solar capacity in this plan could not be deployed in practice, the largest impact would be on near-term carbon budget, whereas beyond 2035, the National Grid emissions are expected to be very low, so local generation becomes less critical to reaching low emissions.

A total of 227 MW of PV capacity could be deployed on this land, yielding 193 GWh of energy per year. Potential for ten hydro sites were also identified in Stockport East and Stockport Central ranging in power generation of 70-400kW, whose sum would yield 6.2 GWh per year.



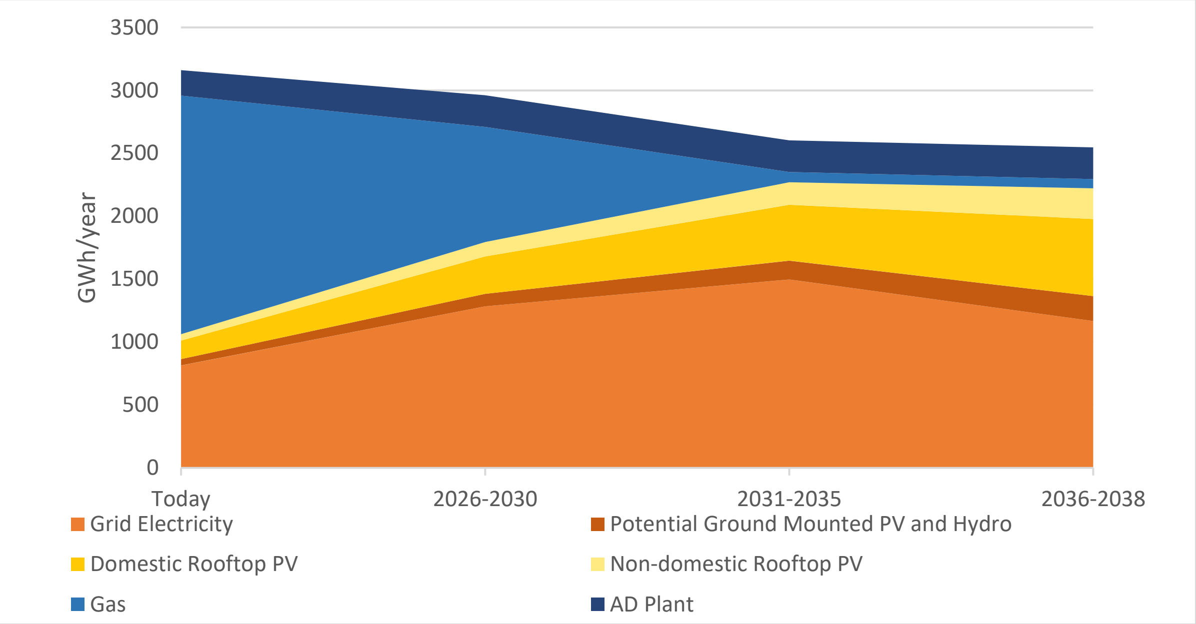
Potential sites for large scale solar PV, wind and hydroelectric in Stockport


Stockport North
Stockport Central
Stockport East
Stockport West
Stockport South East
Stockport South West
Stockport South Central
potential solar sites
potential hydro sites
Esri UK, Esri, HERE, Garmin, METI/NASA, USGS

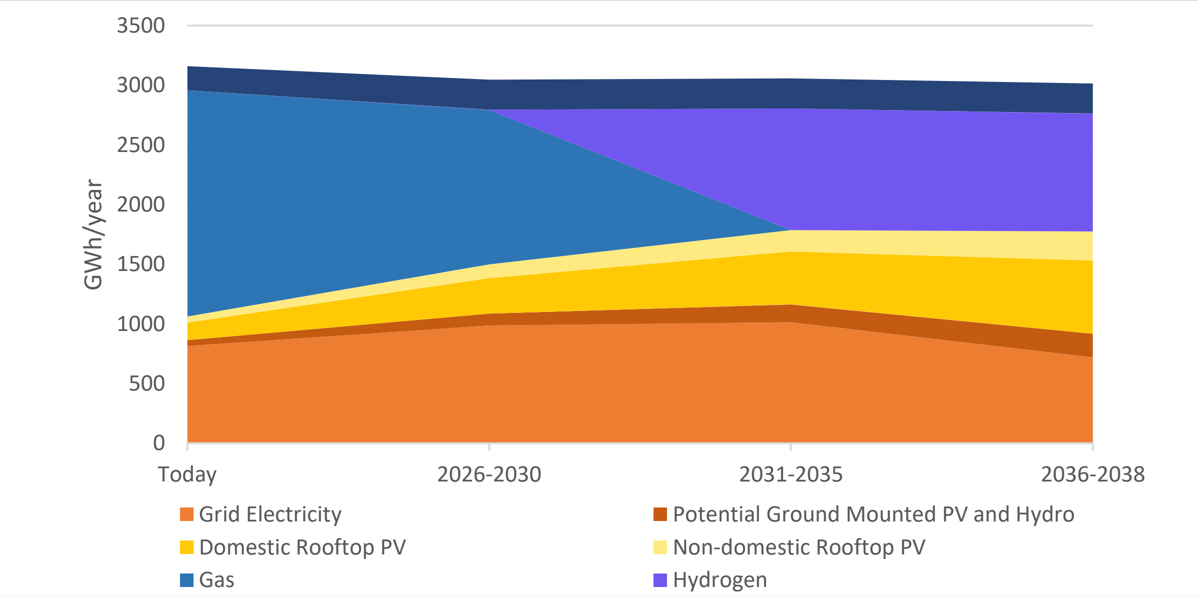
Energy Supply and Demand

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

Changes in Energy Supply in Primary Scenario



Changes in Energy Supply in Secondary Scenario



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

Vision to 2038

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

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

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

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

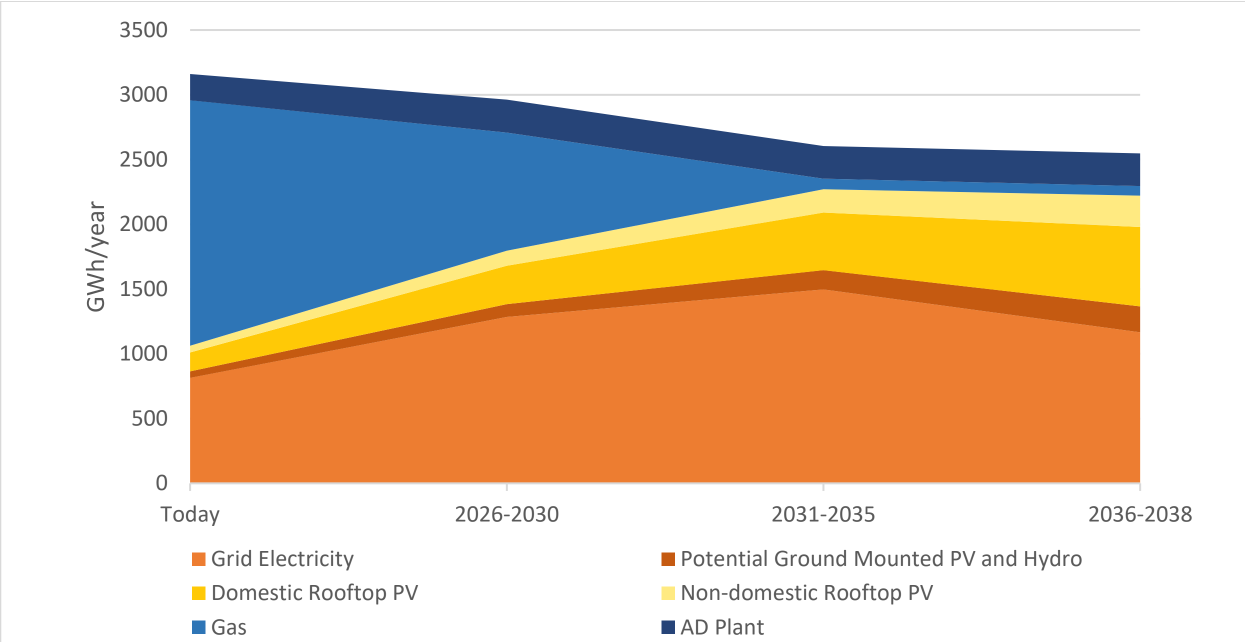
The primary scenario sees gas consumption reducing from c. 1,974 GWh per year currently down to around 80 GWh by the early 2030s, and lower still in the secondary scenario where hydrogen can replace many remaining uses of gas.

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

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

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

Changes in Energy Supply in Primary Scenario



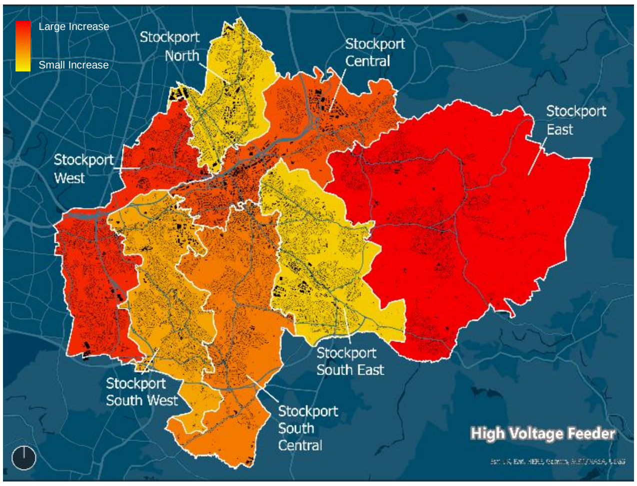
Capacity Requirements for 2038: High Voltage

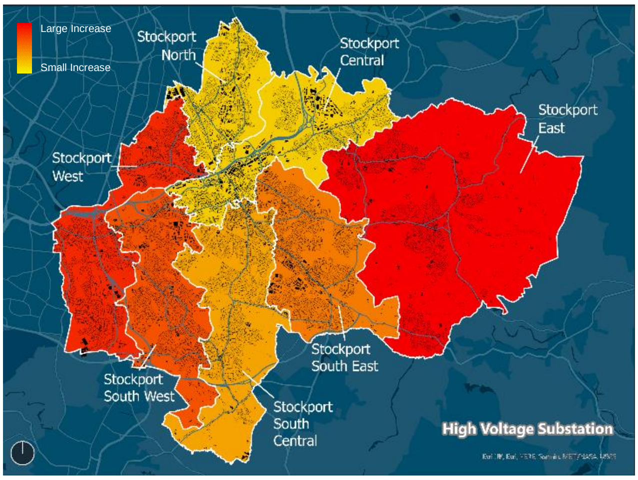
The local electricity distribution network operated under license by Electricity North West supplies electricity to the majority of dwellings and industry in Stockport today. Modelling indicates the capacity that would be required to meet all projected demand growth through conventional investment, but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

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

	High Voltage Feeder Capacity (MW)			High Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Stockport West	48	150	48	49	261	49
Stockport East	47	156	47	43	274	43
Stockport South West	50	58	50	44	216	44
Stockport North	51	51	51	49	49	49
Stockport Central	87	142	87	83	83	83
Stockport South Central	43	68	43	43	194	43
Stockport South East	88	88	88	50	230	50

Primary Scenario





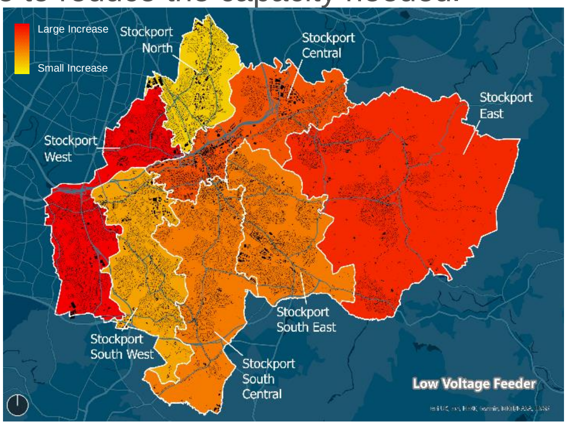
Capacity Requirements for 2038: Low Voltage

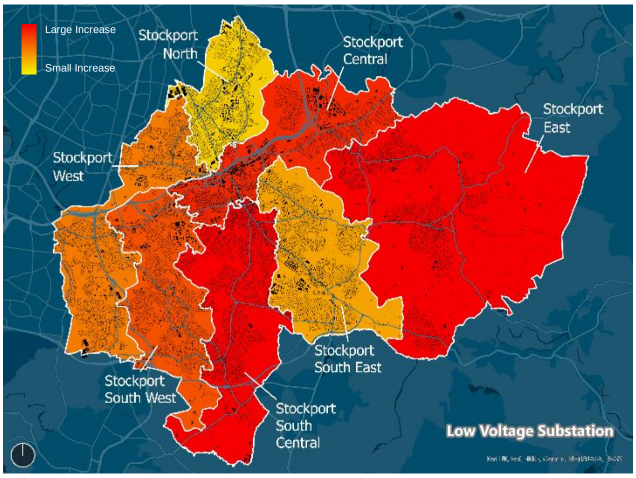
Low voltage feeders are the underground cables serving individual buildings, often located under pavements, so upgrades to these can involve extensive street works. High voltage feeders on the other hand, only run to substations which typically serve multiple streets, so require less extensive works. 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
Stockport West	41	342	41	43	80	43
Stockport East	36	70	36	37	328	37
Stockport South West	47	49	47	39	122	39
Stockport North	37	37	37	39	39	39
Stockport Central	71	87	71	74	265	74
Stockport South Central	59	65	59	37	356	37
Stockport South East	62	67	62	44	77	44

Capacity increase is notably high in some areas, corresponding with high levels of heat electrification (over 17,500 heat pumps in Stockport South Central), where the network must be sized for demand on the coldest day of the year, when heat pump efficiency is also lower. These areas could be a focus for the use of smart, flexible heat pumps or storage to reduce the capacity needed.

Primary 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.

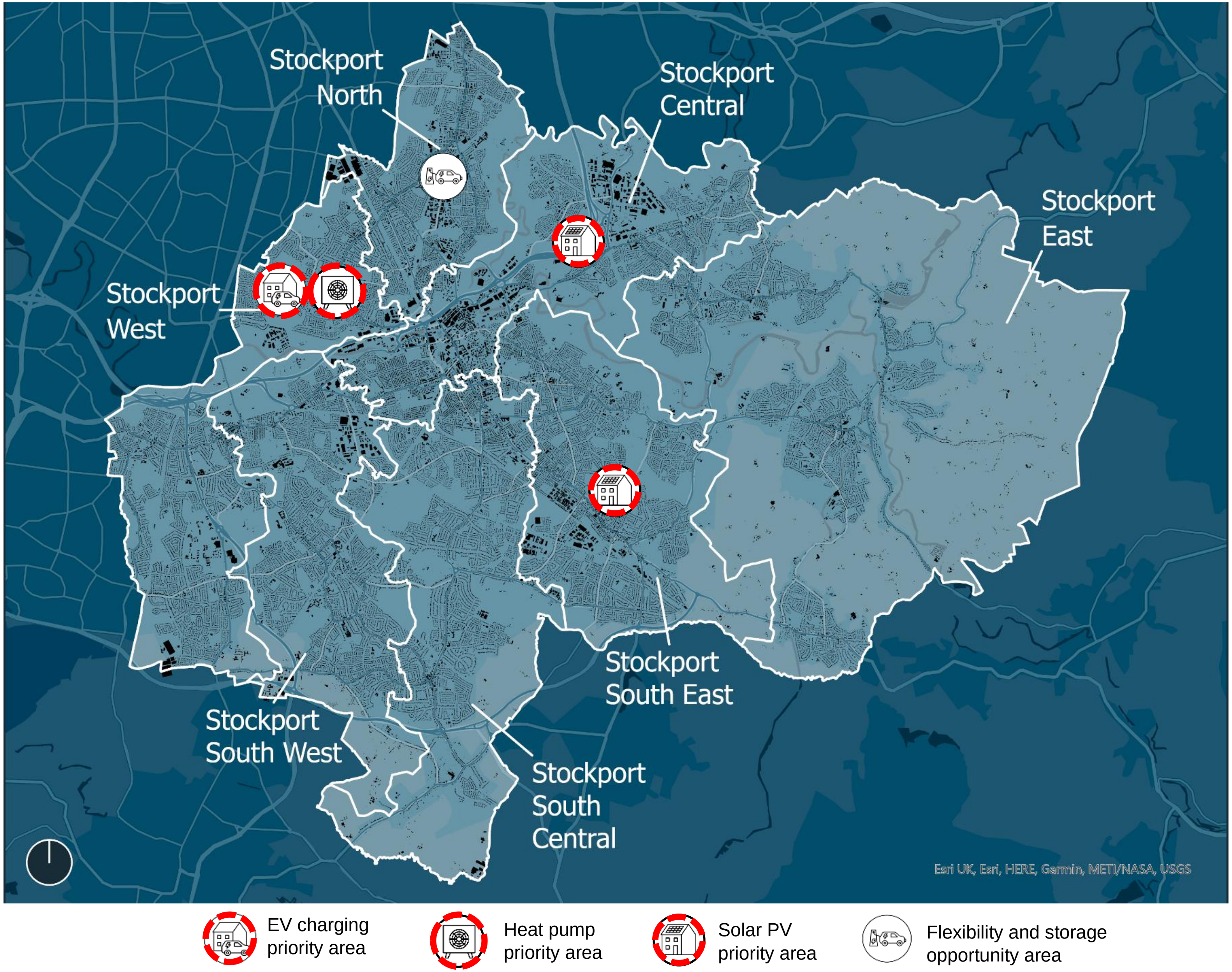
Stockport West, for example, has the greatest capacity headroom for demand, suggesting that roll out of heat pumps and EV chargers could begin here before network upgrades are eventually required to reach the total numbers in the plan. Potential heat networks in Stockport South West and South East could make use of electrical capacity for central heat pumps.

In contrast, Stockport North has no spare capacity. This suggests that the need for infrastructure reinforcement to deliver the full plan should be assessed early to ensure that it doesn't delay progress. Local flexibility, storage and generation could be trialled as a way to overcome demand constraints, although it's worth noting that peak network demand typically occurs on winter evenings, when solar generation is negligible, and electrification of heat is likely to compound this.

	Demand			Generation	
Zone	**Headroom (MW)**	**Heat pump installs**	**Households with EV chargers**	**Headroom (MW)**	**Solar PV installs (MW)**
Stockport West	25.6	17,833	6,749	53.5	120
Stockport East	15.8	16,315	5,233	61.4	91
Stockport South West	21.6	9,200	5,533	53.4	92
Stockport North	0	7,443	4,122	55.7	81
Stockport Central	13.6	17,705	3,656	71.1	108
Stockport South Central	17	17,538	5,520	38.2	93
Stockport South East	23.4	12,283	6,328	70	100

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, Stockport Central and South East especially stand out as areas with good amounts of generation headroom relative to the amount of potential Solar PV proposed, while South Central could run into limitations earlier without network upgrades.


Stockport North
Stockport Central
Stockport East
Stockport West
Stockport South East
Stockport South West
Stockport South Central
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 Stockport 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 Stockport is around 1,974 GWh.

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

Future of Gas and Hydrogen for Heat

The primary scenario for Stockport 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 £700m of investment would be required for this network conversion. Of Stockport’s approximately 1,450 km of gas pipework, around 80% is already made of polyethylene, suggesting that much of the network could already by suitable for carrying hydrogen.

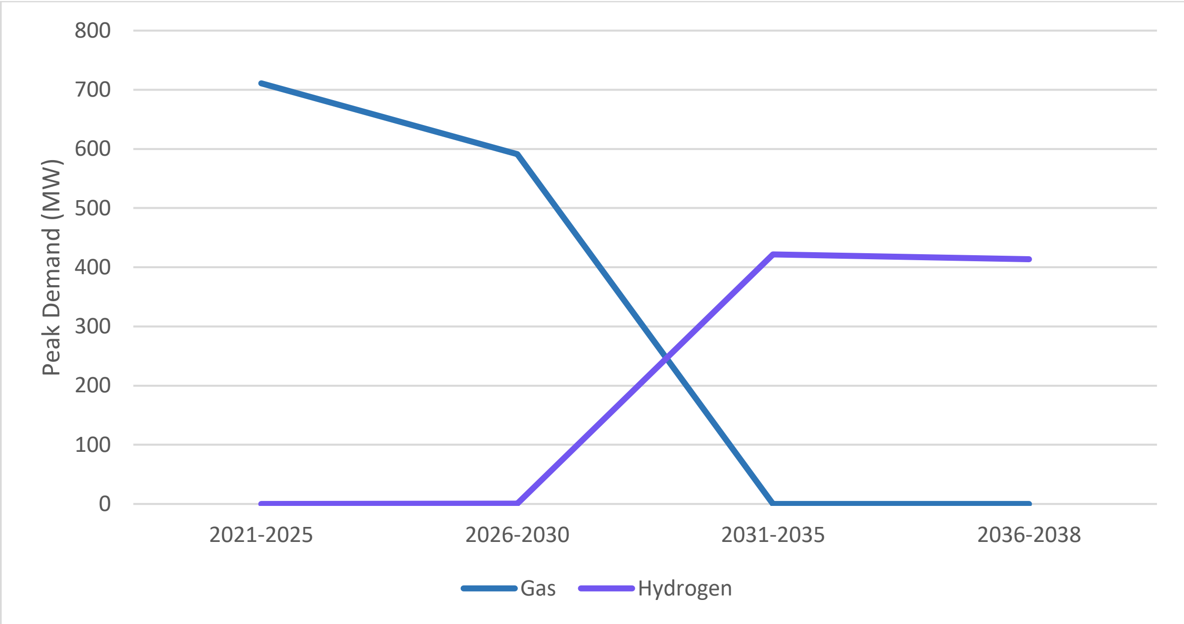
Hybrid heating (air source heat pump/gas boiler hybrid) is an option in certain circumstances and could provide a valuable transition technology to manage uncertainty around the role of the gas network in domestic heating through the 2020s, and to manage demands on the electricity network. Around 1,400 dwellings may be best suited for this technology (even when the wider whole energy system balancing aspect isn’t considered): generally larger properties where a hybrid solution may become more cost effective than an air source heat pump alone, but where a ground source heat pump is unsuitable due to exterior space and access requirements.

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

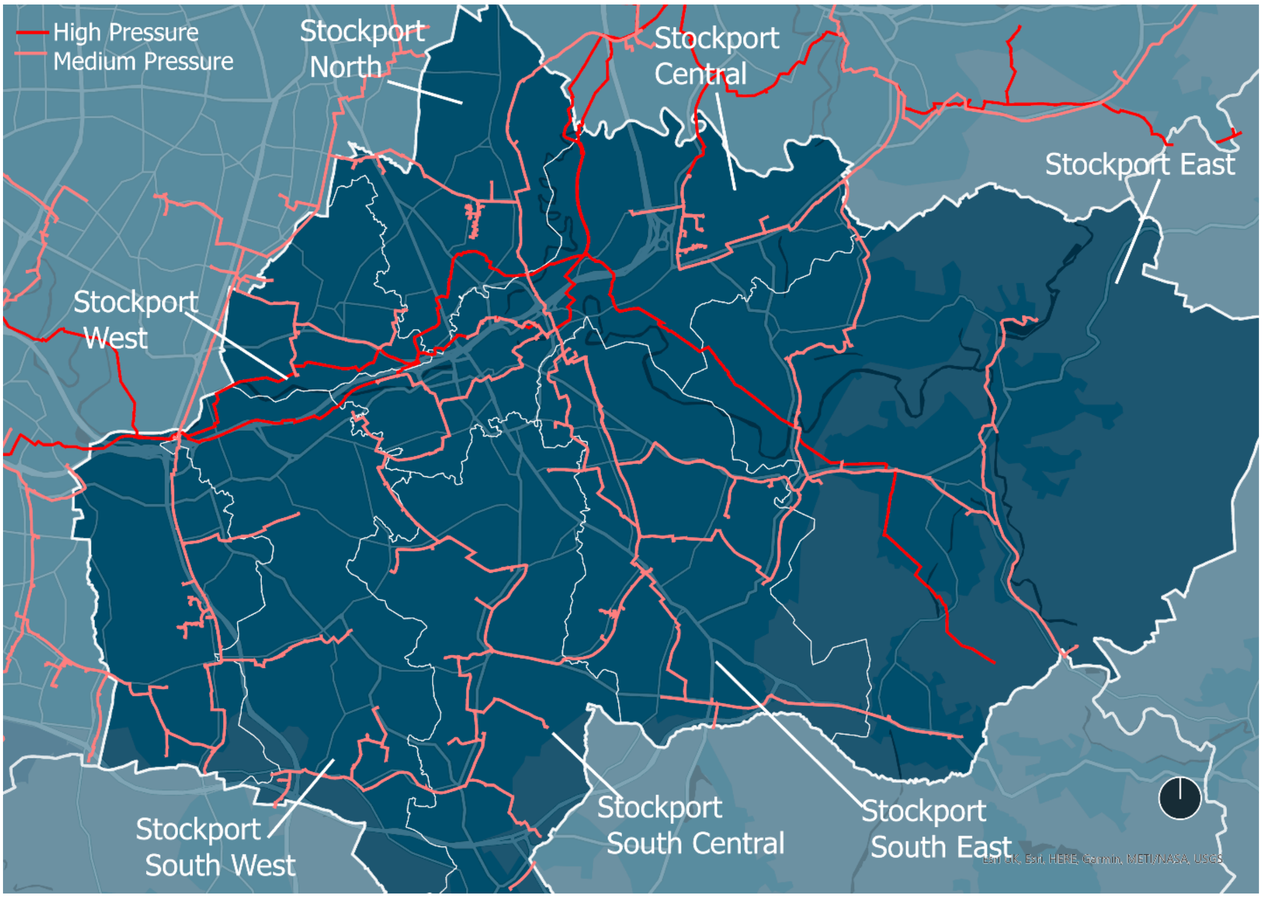
There are a small number of non-domestic properties that are harder to electrify, particularly with industrial uses that require high temperature process heat; these will remain on the gas network under the primary scenario and use hydrogen where possible in the secondary. Most non-domestic gas use can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

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

Usage of Gas Network under HyNet Scenario in Stockport



Current Gas Network in Stockport



District heating could supply in the region of 20% (24,700) of Stockport's dwellings. The role of district heating is diminished in the secondary scenario where hydrogen meets much of the demand, although in practice district heating could be supplied by hydrogen boilers in the energy centres, meaning that investment in the heat networks would remain a relatively low regrets option if hydrogen for heating materialised.

In Stockport South East, North and South West, areas of high domestic heat density could provide suitable locations for district heat networks. Potential opportunity areas for district heat are shown in the figures below, which would have an approximate network length of 14km for an investment of £401m*.

Heat generation is assumed to be primarily based on large scale heat pumps, with a total capacity of 4.5 MWp delivered. However, opportunities to make use of any waste heat sources should be explored, as these could improve the cost and carbon credentials of a district heat scheme further.

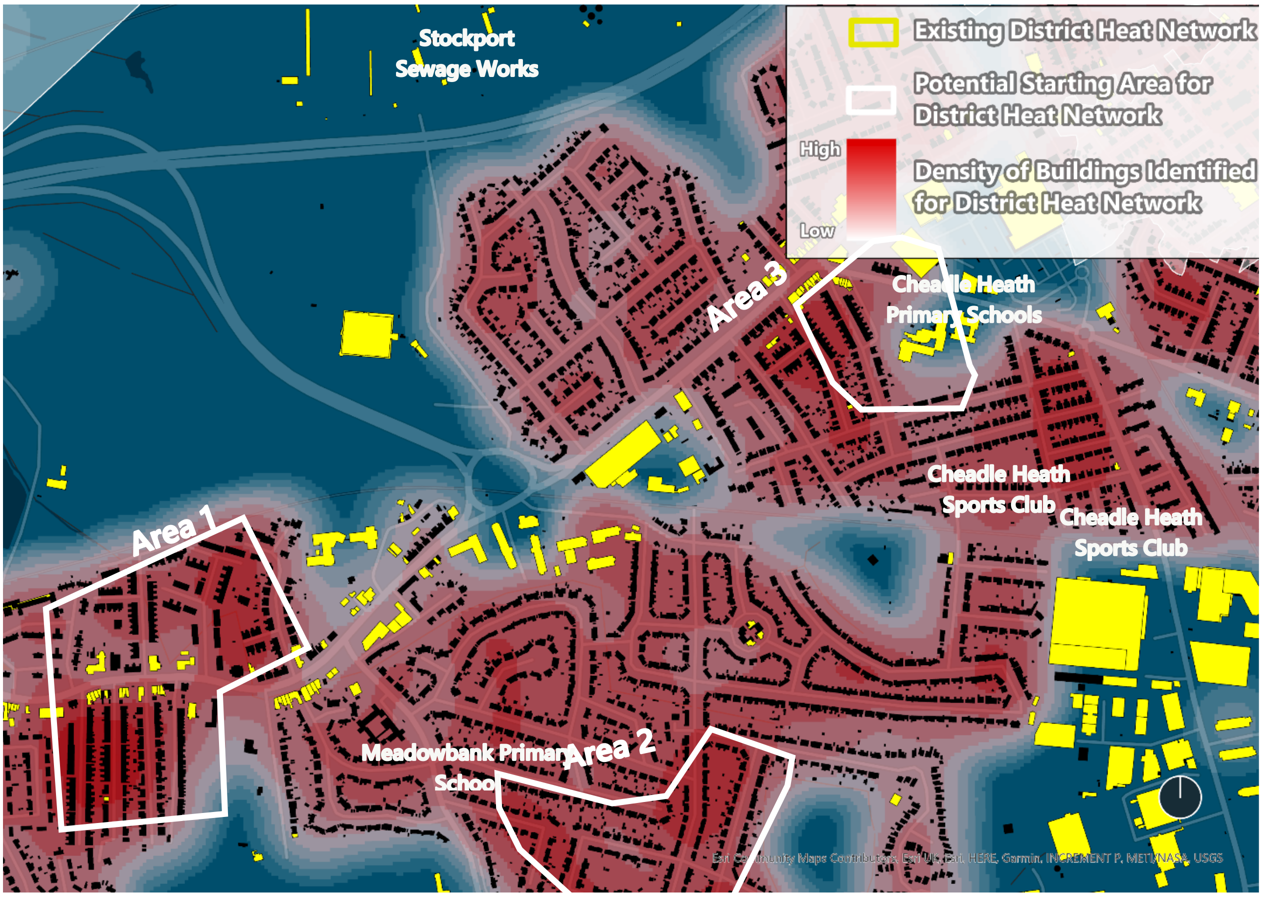
The specific feasibility and configuration of any district heating networks, including energy centre locations, plant design etc. will require appropriate assessment to take forward, providing opportunities for the consideration of smart local energy systems or community schemes to support network development.

Heat Network Opportunity Area	Approximate Peak Heat Generation Capacity (MWp)	Approximate Network length (km)
Stockport South East	0.9	4.6
Stockport South West	1.3	5.4
Stockport North	1.9	4.0

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

Stockport South West District Heat Opportunity Area

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



Area 1


Building Type
Detached
Semi-Detached
Terraced
Flat
Non Domestic Building
Bank St
New Hey Rd
A560
Nursery
Rhymes
Nursery

Area 2


Building Type
Detached
Semi-Detached
Terraced
Flat
Non Domestic Building
Councillor Lane
Palmer Ave
Deane Ave
Meadowbank
Primary School

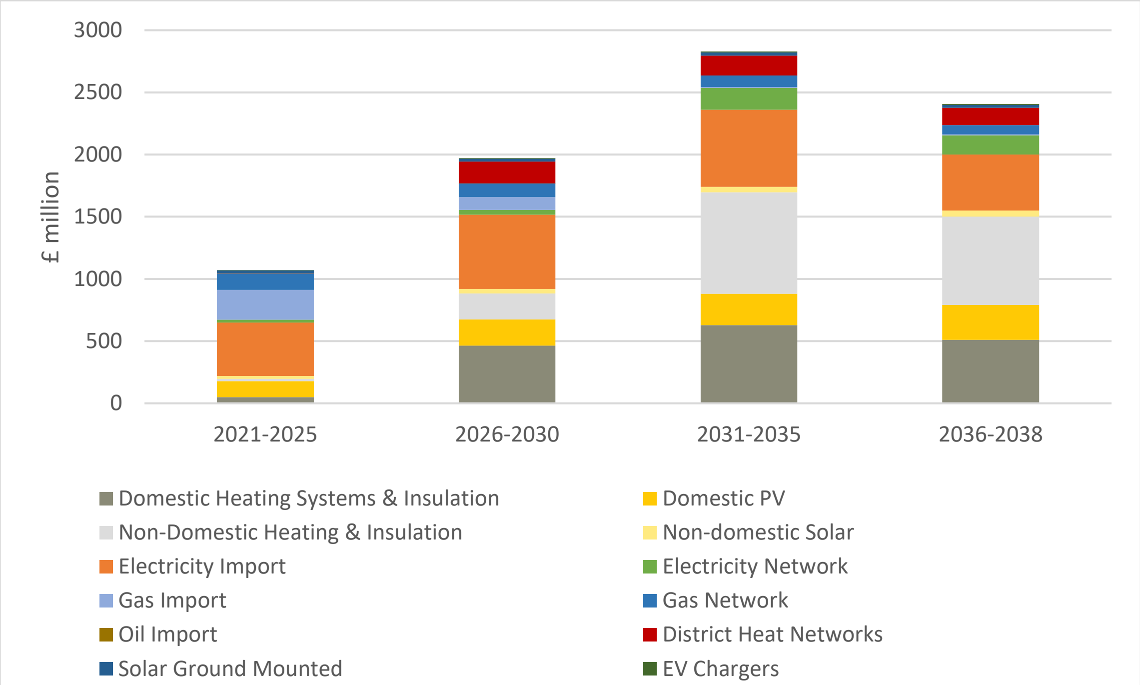
Area 3

8. COST AND INVESTMENT

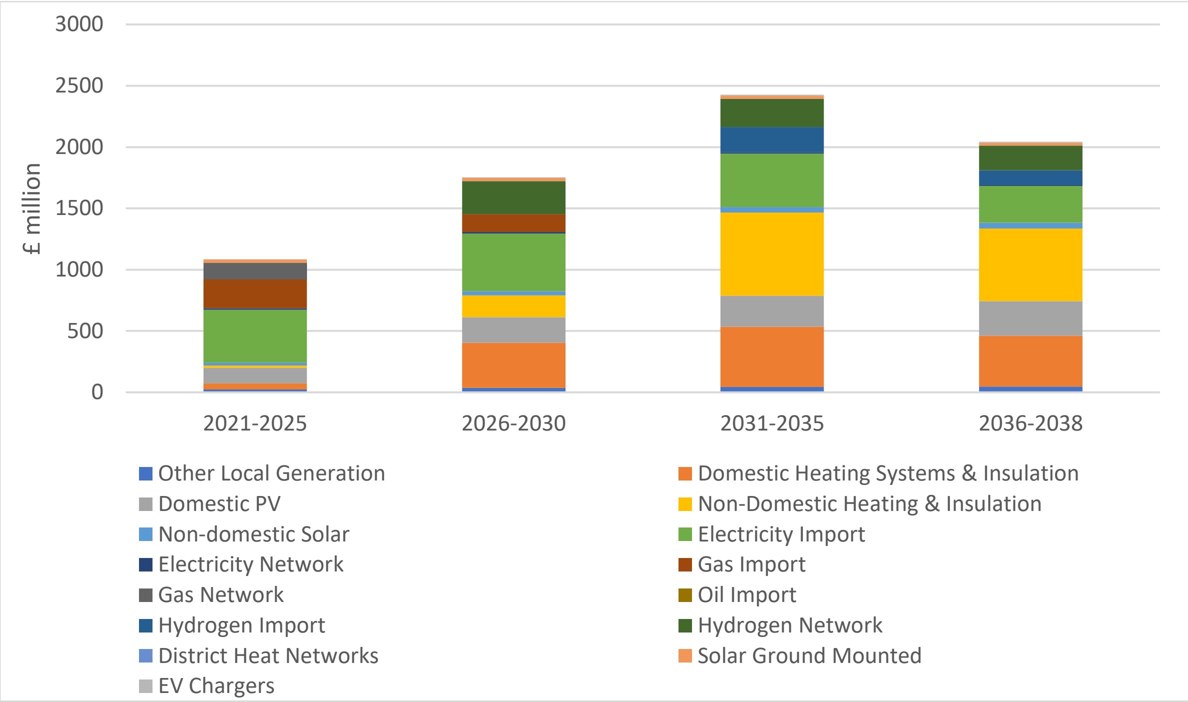
Total cost (including energy consumption)

The primary scenario is based on a total energy system spend of £8.3 bn (compared with £7.2 bn in the secondary scenario). The cost is attributed to investment in energy networks, in buildings (for components such as fabric retrofit, heating system change and roof mounted PV) and for energy consumed. The charts below illustrate the split between these components. Notably, a significant proportion of this cost would have been spent without accounting for decarbonisation; noting that money is spent every day on maintaining existing energy systems, replacing old or failed systems (e.g. gas boilers in dwellings), improving energy efficiency and paying gas and electricity bills. This LAEP sets out an approach for redirecting some of that business-as-usual expenditure, boosted with additional investment, to the areas needed to achieve the carbon neutral target. For example, energy costs are re-directed to electricity use in place of natural gas.

Primary Scenario



Secondary Scenario



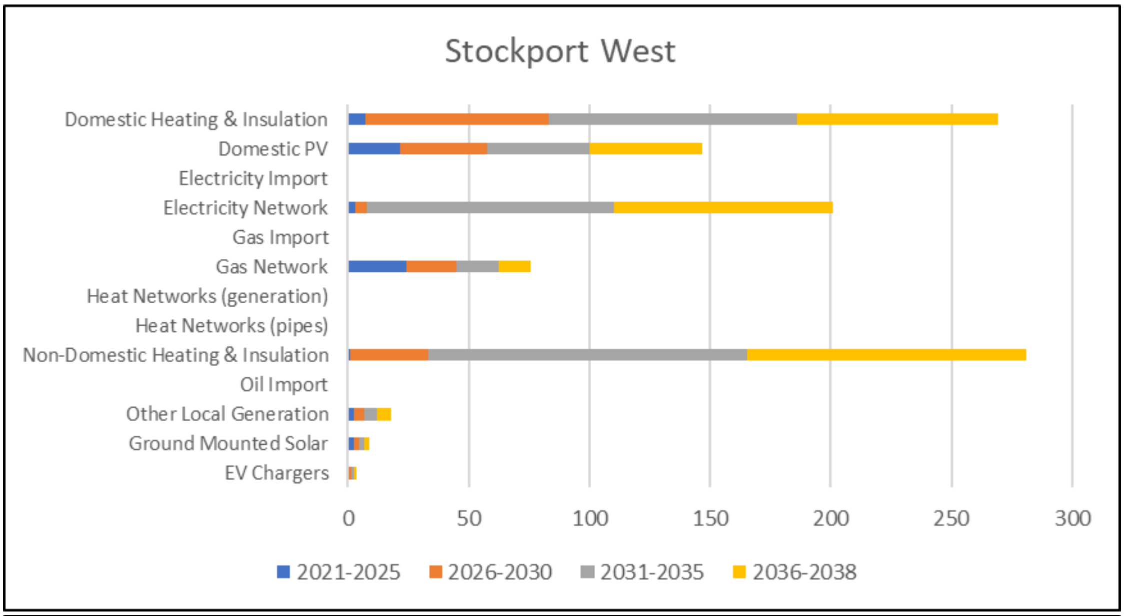
Investment (exclusive of energy consumption)

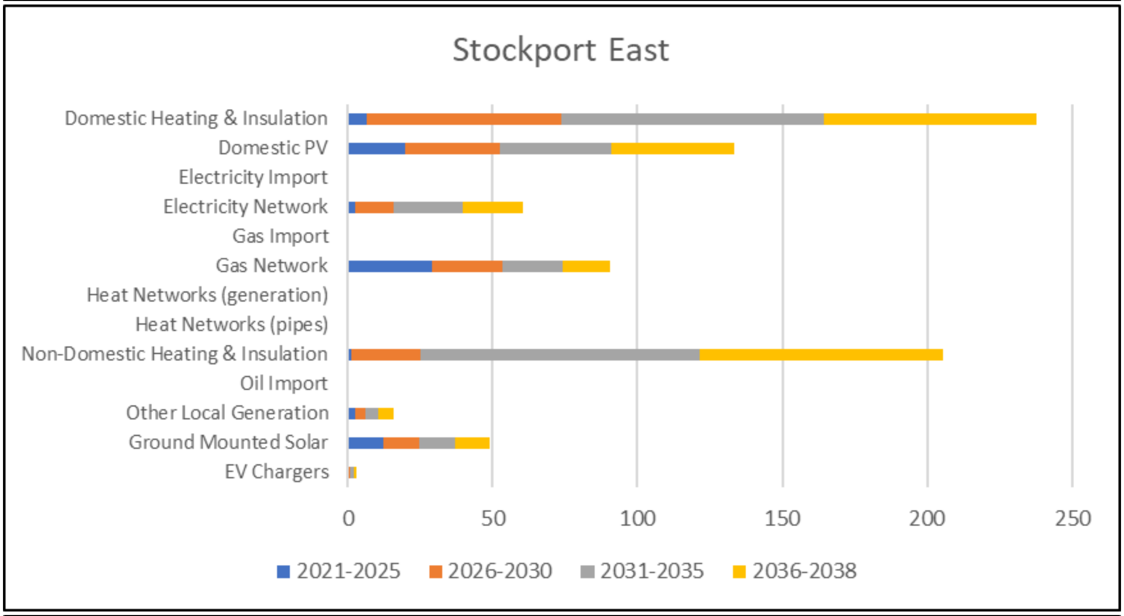
The tables below illustrate the total investment needed in the energy system to deliver the plan, equating to a total of £5.8 bn for the primary scenario and £4.8 bn for the secondary, with the charts on the following page breaking this down by technology. Again, a significant proportion of this investment will be required without working towards carbon neutrality, for example expenditure on replacement gas boilers is instead targeted at low carbon heating systems.

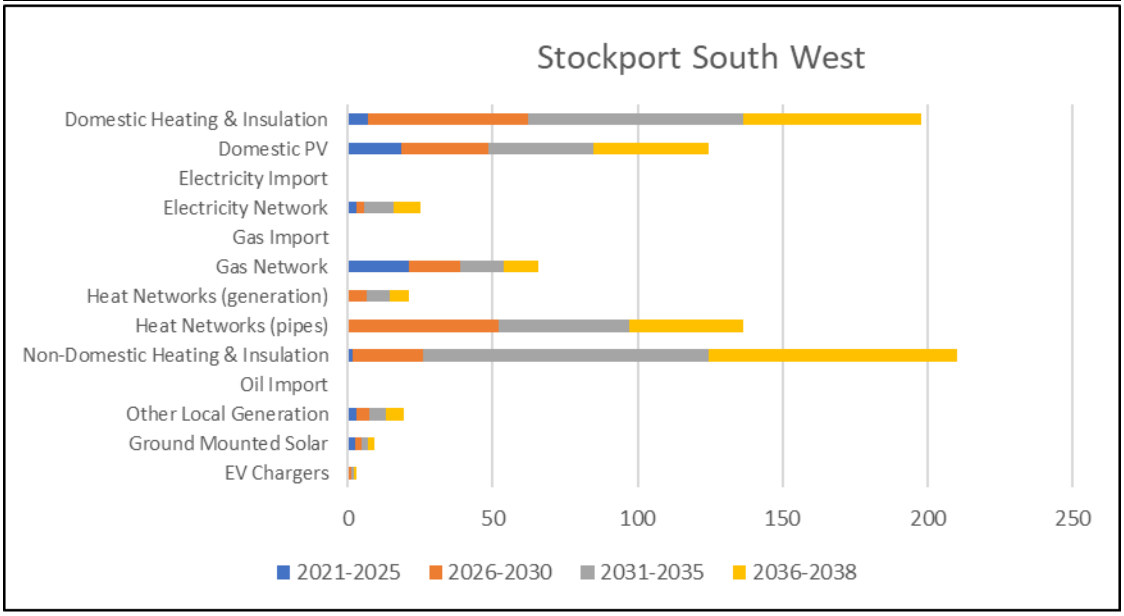
Zone	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Stockport West	1,003	791
Stockport East	796	725
Stockport South West	813	662
Stockport North	622	498
Stockport Central	980	883
Stockport South Central	719	595
Stockport South East	891	656

Investment type	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Domestic Heating Systems & Insulation	1,656	1,324
Domestic Solar	869	869
Domestic EV Chargers*	20	20
Non-domestic Heating Systems & Insulation	1,754	1,469
Non-domestic Solar	150	150
Large Scale Ground-mounted Solar	99	99
Electricity Network	393	44
District Heat Network	475	3
Gas Network	410	131
Hydrogen Network	-	701

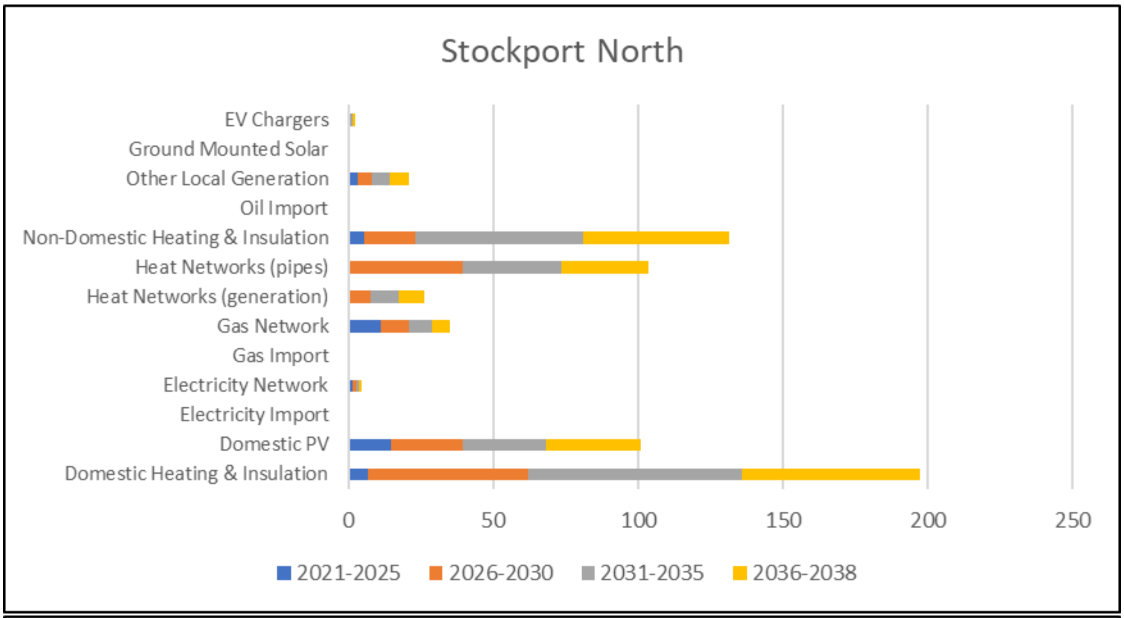
Investment in Stockport's energy system (£m) by time period across each area

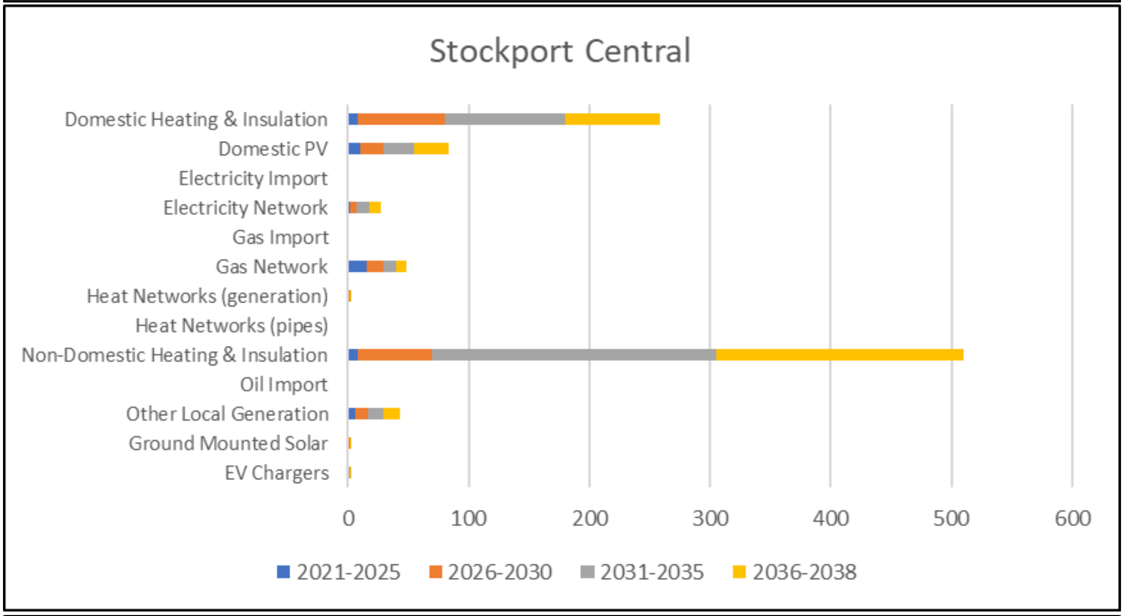


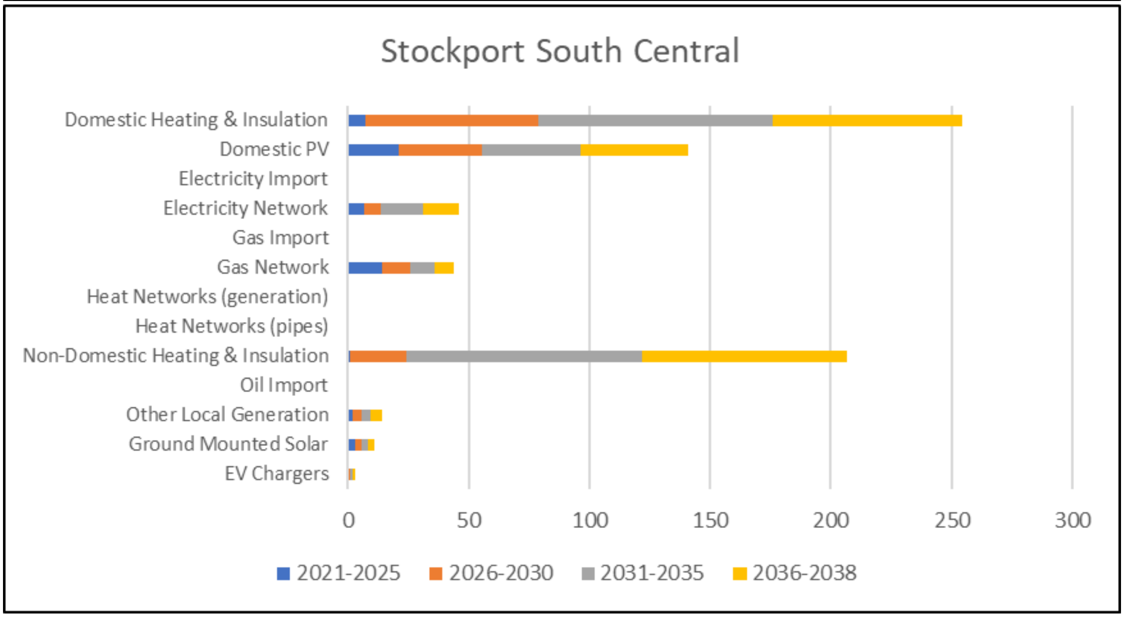




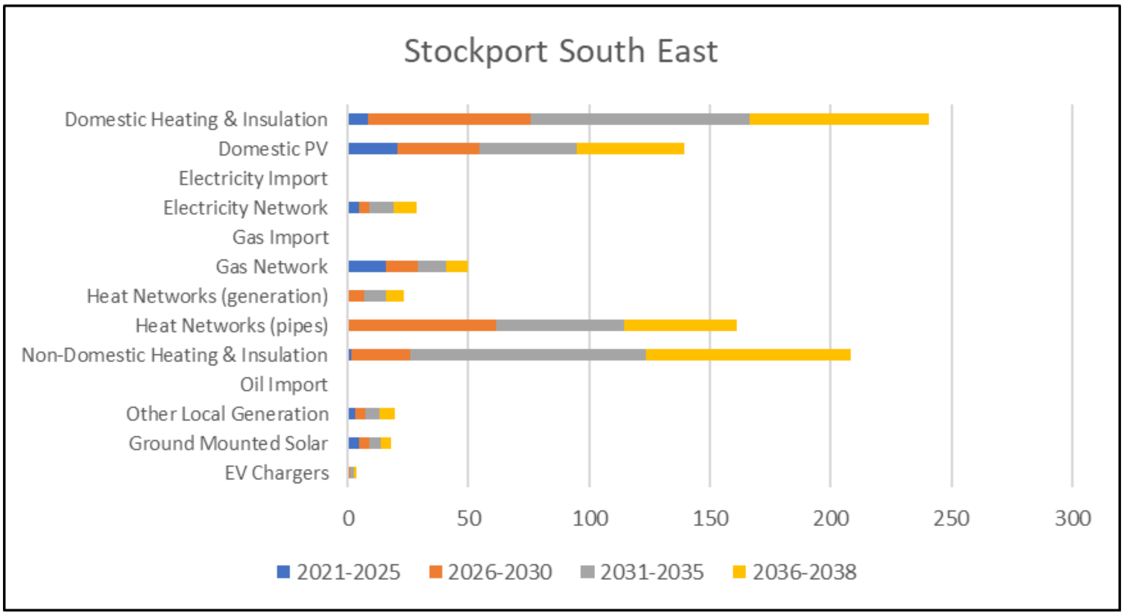
Investment in Stockport's energy system (£m) by time period across each area







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



9. SUMMARY AND CONCLUSIONS

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

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

Whilst there is some flexibility to meet carbon neutrality in different ways depending on societal changes and technology innovation, there is an urgency for Stockport 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 Stockport

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

1. Reduced energy demand in Stockport: Reducing emissions, energy use and energy costs through making buildings more energy efficient has been shown to play an important role in all of the scenarios considered. In the primary scenario this means basic fabric retrofit of approximately 51,500 homes and deep retrofit of a further 44,700 homes requiring £720m of investment. Many of these homes can receive a cost-effective retrofit package, combining heating system replacements, solar PV and EV charger installations. Across all scenarios extensive fabric retrofit of existing homes is prominent both in cost-effectively reducing emissions in the near term, but also enabling the future installation of low carbon heating systems. It is important to note that new demands from transport, buildings and industry (moderated by improving energy efficiency) mean electricity demand increases in Stockport from 1,049 GWh of electricity consumed per year to 2,222 GWh by 2038.

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

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

electric vehicles (BEVs) and electric heat pumps along with development of heat networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.37,000) and public EV charging hubs, targeted at priority locations. Industry in Stockport 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 Stockport: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production in Stockport. In the primary scenario 667 MWp of roof mounted solar PV capacity is installed.

Deploying the maximum potential for rooftop and ground mounted solar PV would produce up to 1,049 GWh per annum of local, low carbon electricity, a significant contribution to Stockport's forecasted annual consumption of 2,222 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 Stockport: 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 Stockport. Greater Manchester's ambition of carbon neutrality by 2038 creates significant pressures regarding the deliverability of 100% hydrogen heating to all homes in Stockport. 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. Stockport 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 (4.69 Mt CO_2 generated through to 2038 compared to 4.78 Mt for the primary scenario) with a reduced total system cost (£7.2 bn compared to £8.3 bn for the primary scenario); however, these results are sensitive to the carbon intensity and cost of hydrogen, which are highly uncertain at this stage. A hydrogen heat-based future could also be more appealing to Stockport'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 Stockport in support of Greater Manchester's commitment across the Combined Authority area is estimated to represent total energy related costs of between £7.2bn and £8.3b across both scenarios

The primary plan for Stockport:

- 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 £1.3 bn on energy networks, £2.5 bn on Stockport's dwellings, £1.9 bn on Stockport'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 Stockport
- By 2038 the local electricity network in Stockport could supply as many as 37,000 domestic EV charge points distributed across the local area and numerous EV community charging hubs, primarily located around the four central zones.
- Approximately 98,000 homes could have heat pumps with over 81% 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 Stockport will need to shift to a combination of electric and hybrid solutions
- If hydrogen were to become widely available earlier than anticipated, it could be supplied to approximately 99,000 homes, as well as non-domestic buildings, allowing hydrogen boilers to replace gas boilers for heating and hot water, as well as providing low carbon fuel for high temperature industrial applications. This would mean much of the gas network would be retained and repurposed by 2038.
- The gas network will continue in the immediate term to meet the majority of heating demands of homes and buildings although new connections will start to decline in the 2020s as new development favours electric or district heating solutions.
- If heat networks are developed, existing homes would be connected in clustered groups through targeted connection campaigns and new service offers
- The majority of homes with suitable characteristics will have solar panels and many of those could also have electrical (battery) and thermal storage systems
- A wide range of flexible resources will emerge, including energy storage, heating systems and electric vehicles able to participate in future flexibility and local energy markets

The Scale of the Challenge

- The following table details both modelled and assumed representative numbers. These are provided for illustrative purposes only, intended to demonstrate the scale of implementation, take-up, investment, and deployment needed, by time period, of specific components for Stockport 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)	2,295	2,764
	Number of dwellings	132,223	132,223
	Non-domestic buildings (m^2)	5,313,116	5,313,116
Greenhouse Gas Emissions	(ktCO2e/yr)	34	12*
Local Energy Demand Reduction	Basic domestic retrofit measures installed (no of homes)	51,508	54,922
	Deep domestic retrofit measures (no of homes)	44,760	39,888
Local Electrification	Petrol & diesel vehicles on the road (No of vehicles)	18,381	18,381
	Pure electric vehicles on the road (No of vehicles)	117,822	117,822
	Hybrids (including plug-in) on the road (No of vehicles)	26,922	26,922
	Domestic EV charge points installed (No)	37,143	37,143
	Heat pumps installed (No of homes)	98,317	24,311
	Rooftop solar PV generation capacity installed (MWp)	667	645
	Ground-mounted PV generation capacity potential (MWp)	227	227
Local Heat Networks	Domestic heat network connections	24,725	0
Capital Investment* **	Buildings and energy system (£m)	8,320	7,197

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

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

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

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

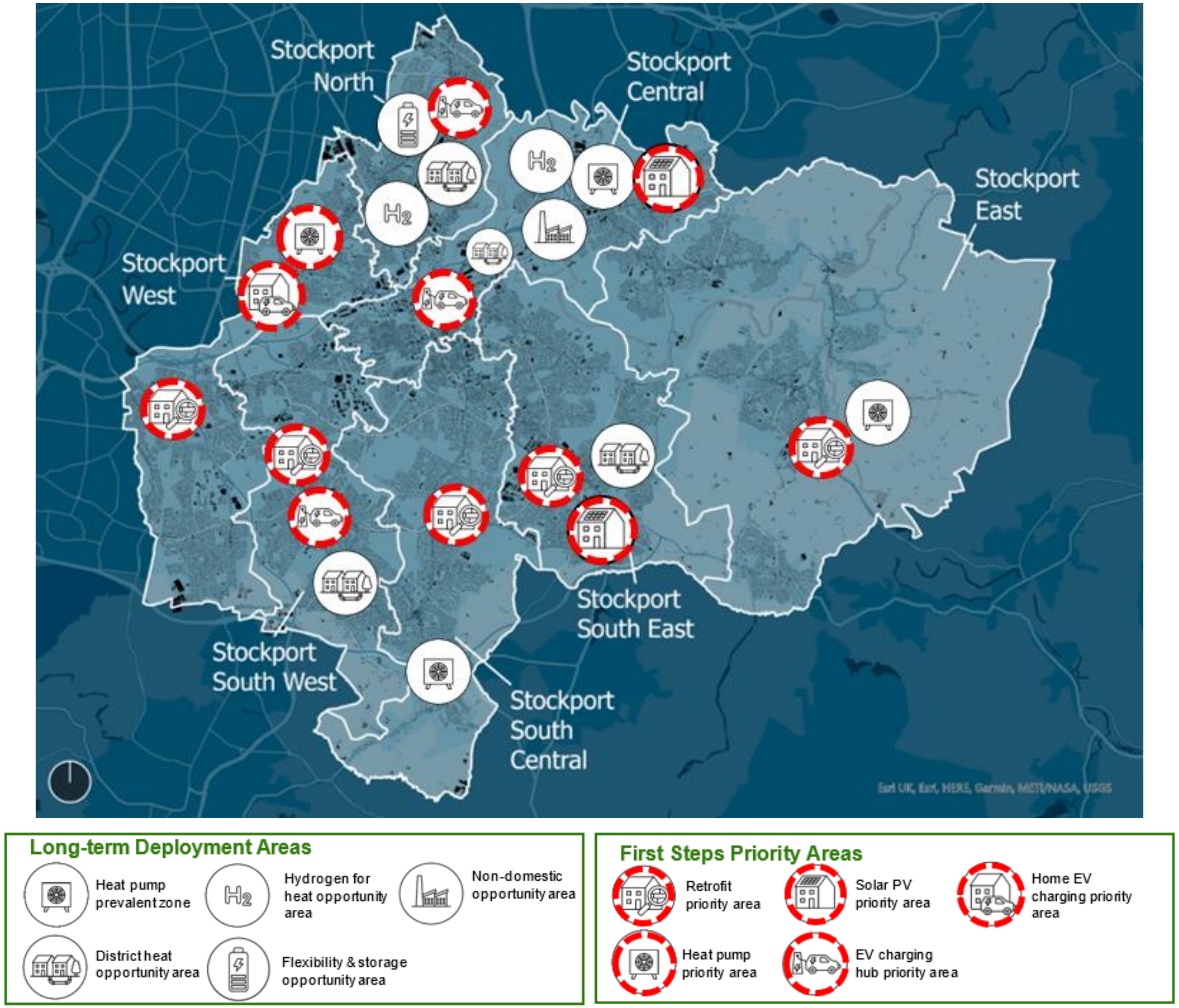
This LAEP provides Stockport with both:

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

The priority areas are summarised in the following map. This illustrates suggested areas and components for Stockport 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, Stockport Council and GMCA are being provided with a more detailed and granular data set that can be used to identify potential target areas for demonstration and scale up activity. This data set identifies interventions and technology options at a neighbourhood level.

Demonstration and scale-up priority areas



Next Steps

Using the insights within this LAEP and in the identified priority areas, Stockport 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 Stockport, integrating Cadent plans and activity with this LAEP

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

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

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

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

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

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

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

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

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

- Understand how this plan fits together and interacts with Stockport Council's Climate Action Now Strategy

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 Stockport 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 Stockport 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 – Stockport
Version	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
17/12/21	0.1	Initial draft
22/12/21	0.2	Draft for internal review
23/12/21	0.3	Working draft for initial client consultation
28/02/22	0.4	Amends in response to GMCA comments
21/03/22	0.5	Updated district heat wording
26/04/22	0.6	Amends in response to Stockport Council comments
13/06/22	1	**Client issue**

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

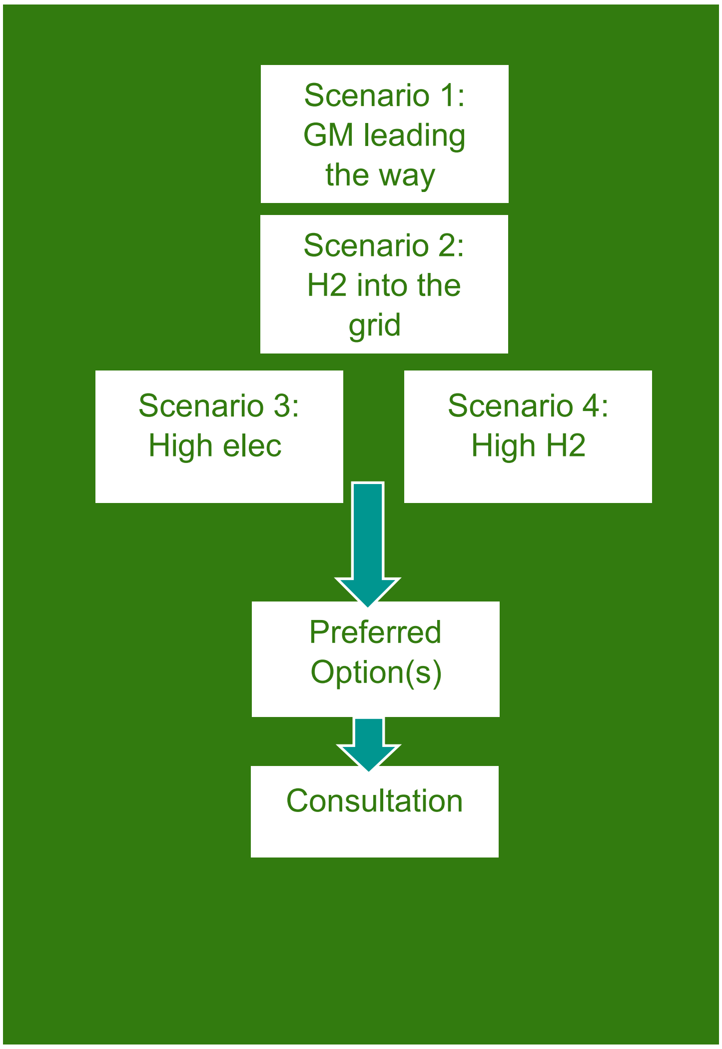
A variety of energy system scenarios are possible to deliver Greater Manchester and Stockport’s future energy vision. It is not practical to consider every possible configuration of Stockport 's local energy system in a limited number of scenarios, therefore four main scenarios have been considered; 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 Stockport. 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 Stockport 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 Stockport and other districts

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

Importantly, each future local energy scenario for Stockport 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 Stockport. These scenarios are constructed using location specific information on Stockport'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.

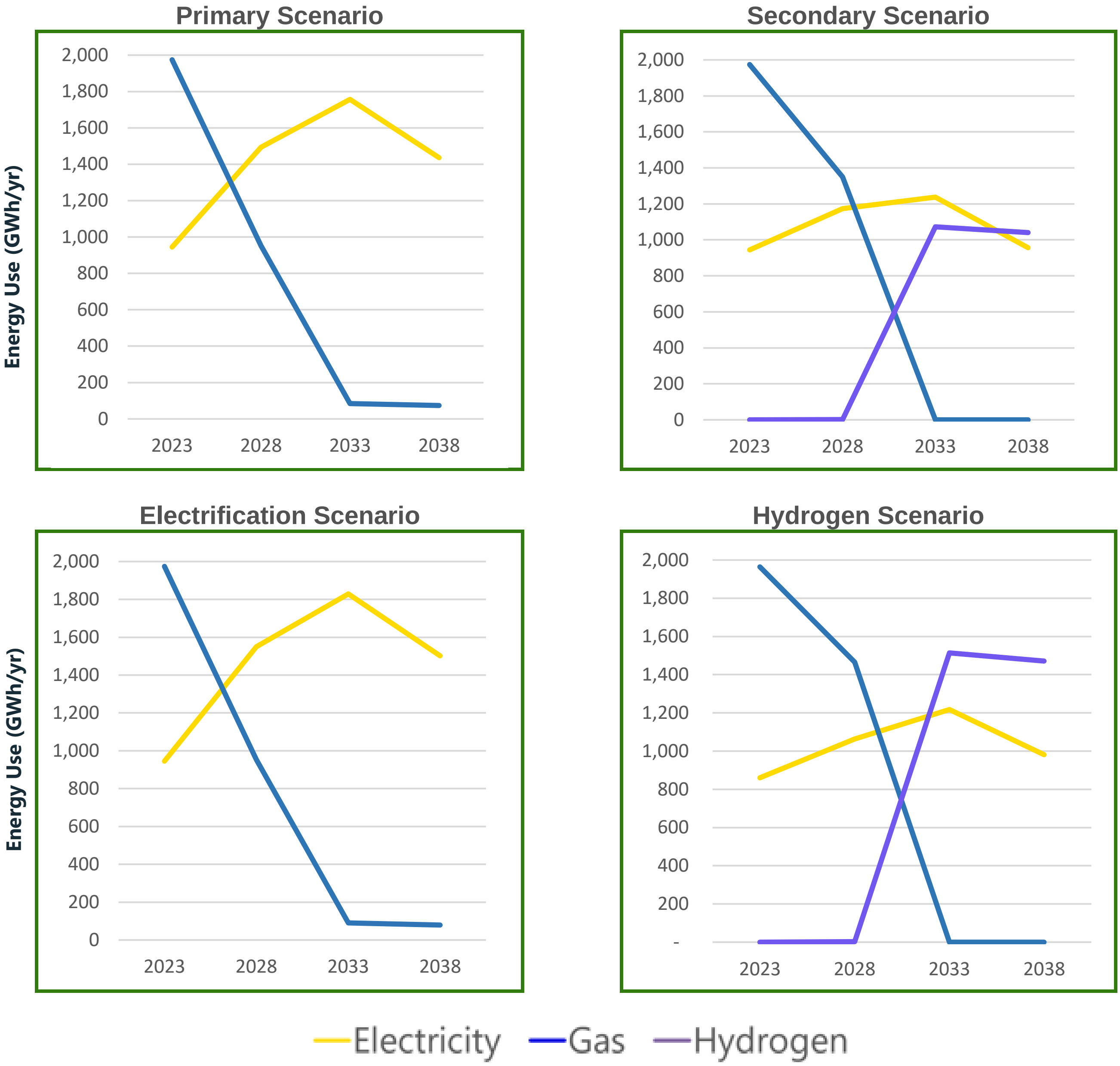
Scenario 1 – Leading the Way: this scenario focuses on meeting the carbon budget and target by making use of **proven measures within Stockport's local control** where at all possible.

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

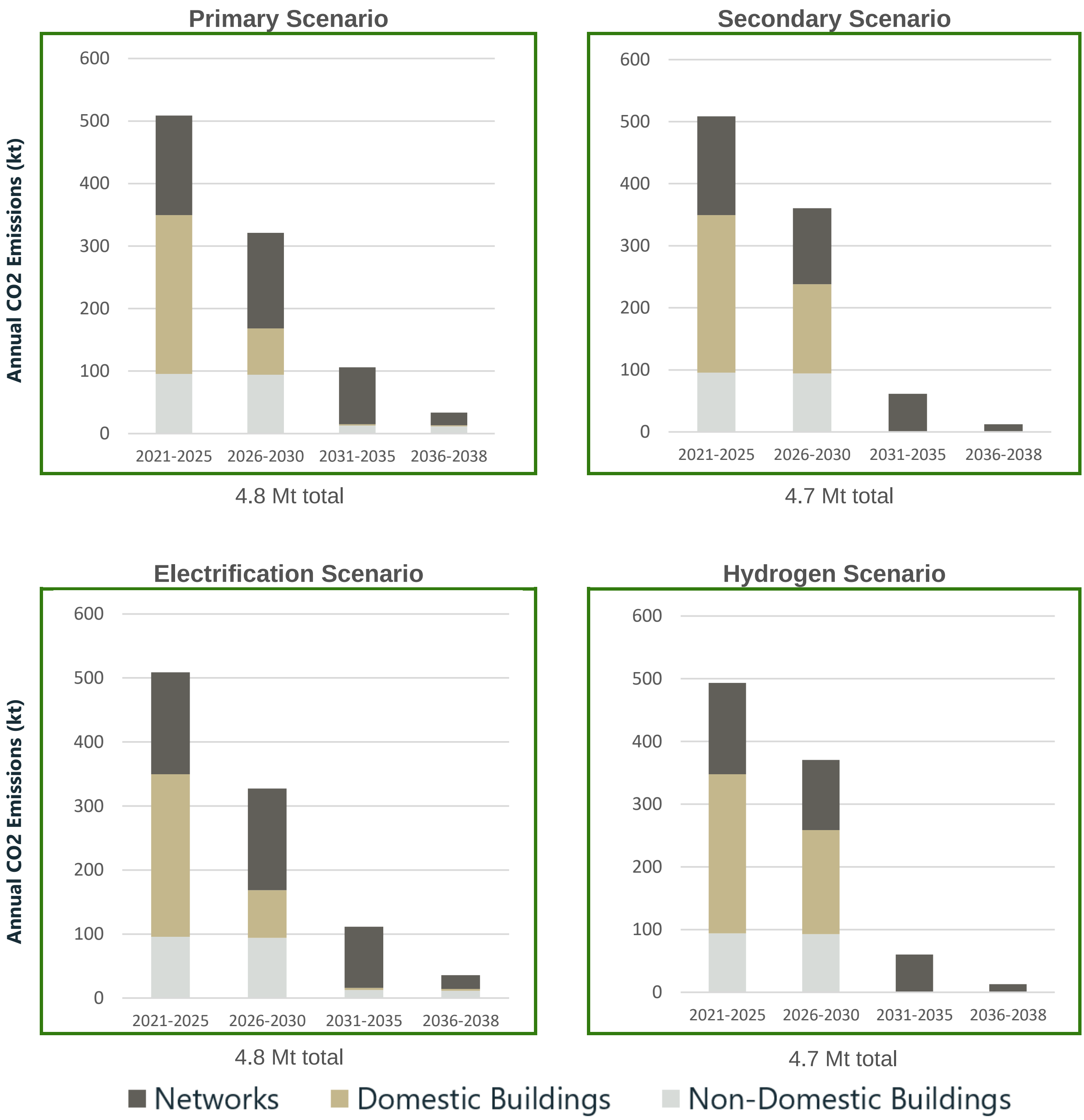
Scenario 3 – High Electrification: we have assumed the only low carbon options for buildings heating and hot water demand are electric based. This includes energy centres feeding local heat networks

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

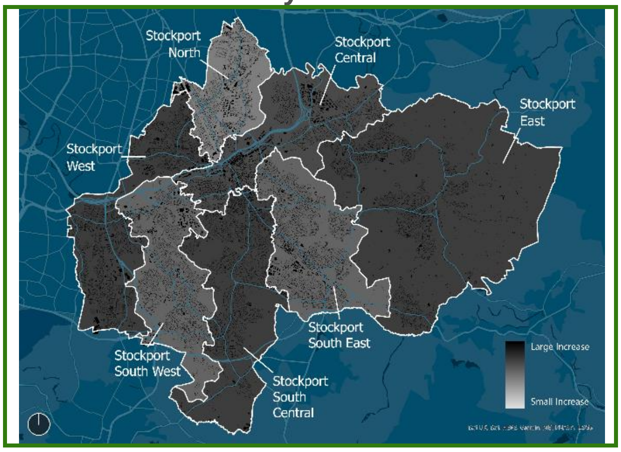
Scenarios 3 and 4 provide context and evidence for what would happen if either hydrogen or electrification were pursued as the sole solution for the decarbonisation of homes and buildings in Stockport. Whilst this is considered to have a number of practical limitations to feasible implementation by 2038,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



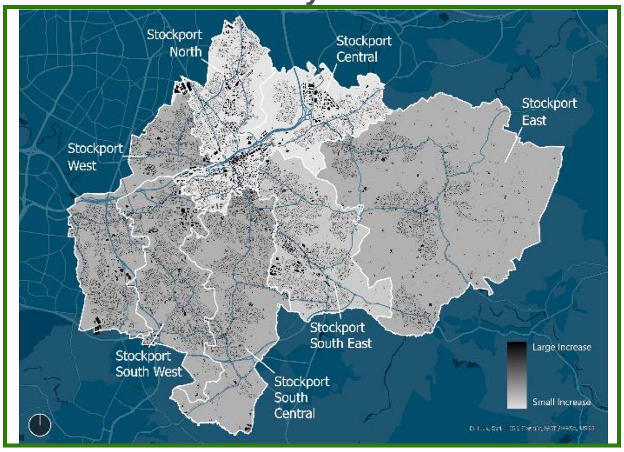
Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, due to the reduction in transport fuel consumption.


Primary Scenario
Secondary Scenario
Annual CO2 Emissions (kt)
600
500
400
300
200
100
0
2021-2025
2026-2030
2031-2035
2036-2038
4.8 Mt total
4.7 Mt total
Electrification Scenario
Hydrogen Scenario
4.8 Mt total
4.7 Mt total
Networks
Domestic Buildings
Non-Domestic Buildings

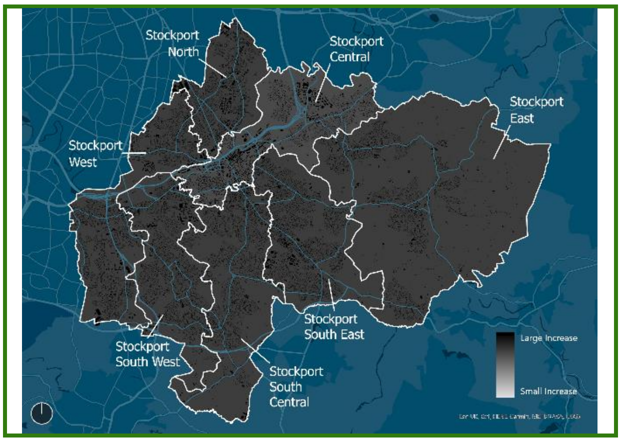
Primary Scenario



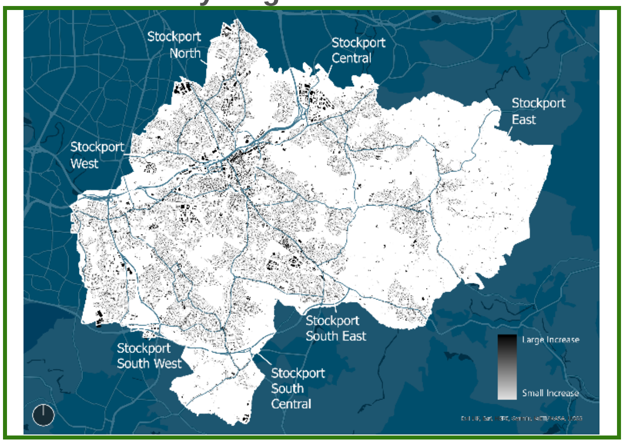
Secondary Scenario



Electrification Scenario

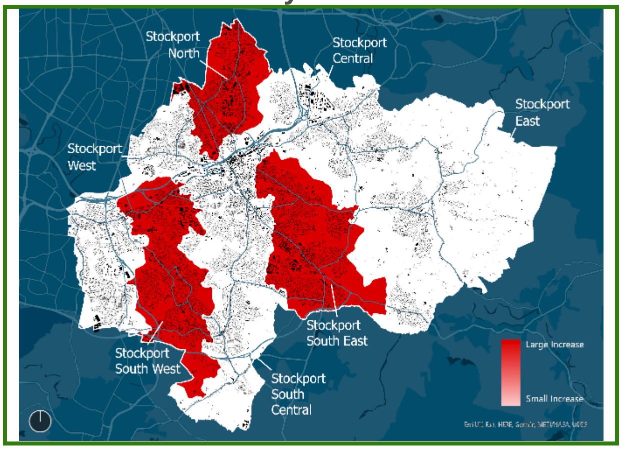


Hydrogen Scenario

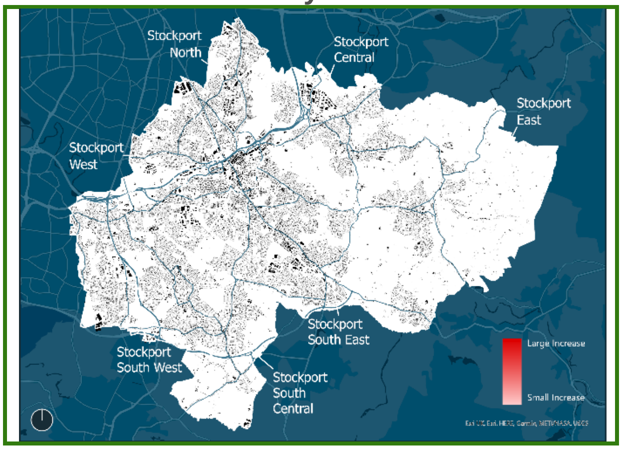


HEATING ZONING OPTIONS: DISTRICT HEATING CONNECTIONS BY 2038

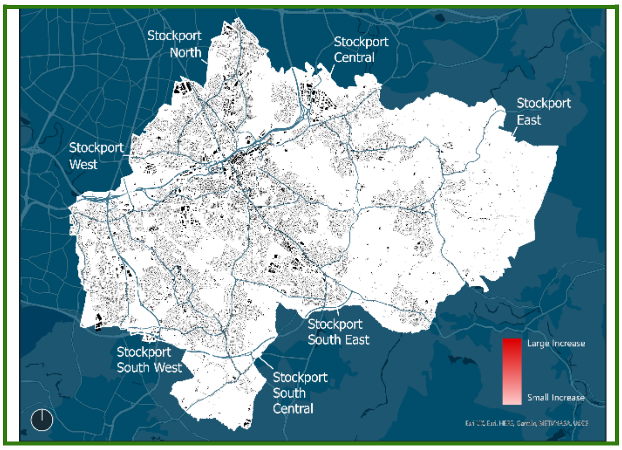
Primary Scenario



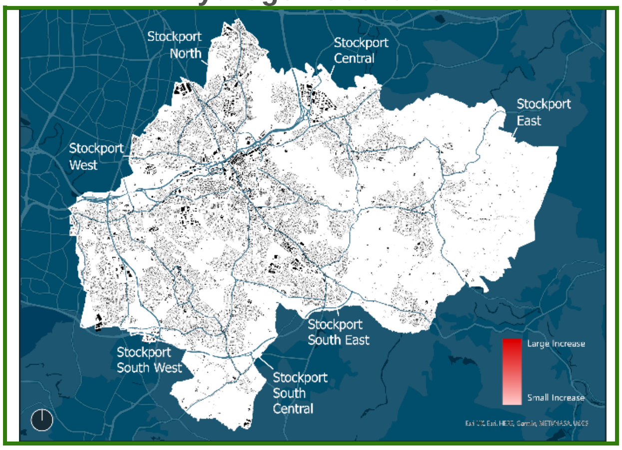
Secondary Scenario



Electrification Scenario

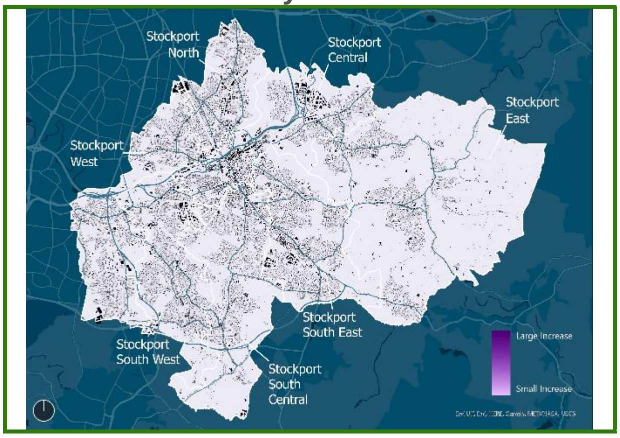


Hydrogen Scenario

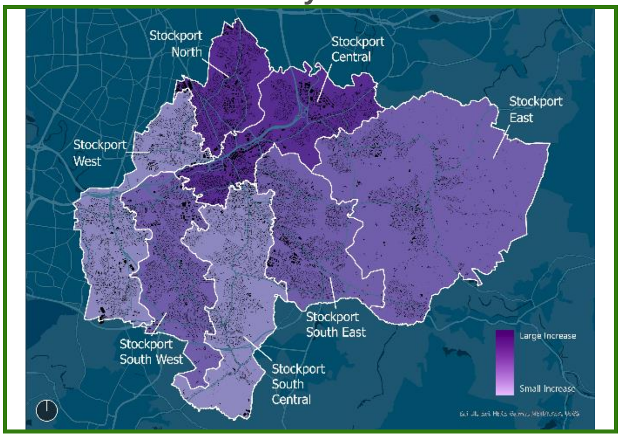


HEATING ZONING OPTIONS: HYDROGEN BOILER DEPLOYMENT BY 2038

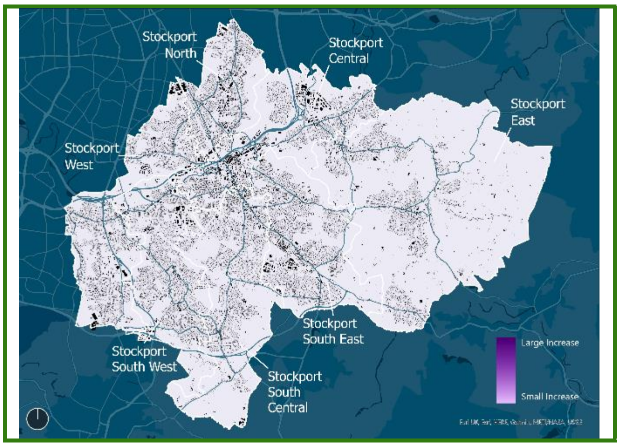
Primary Scenario



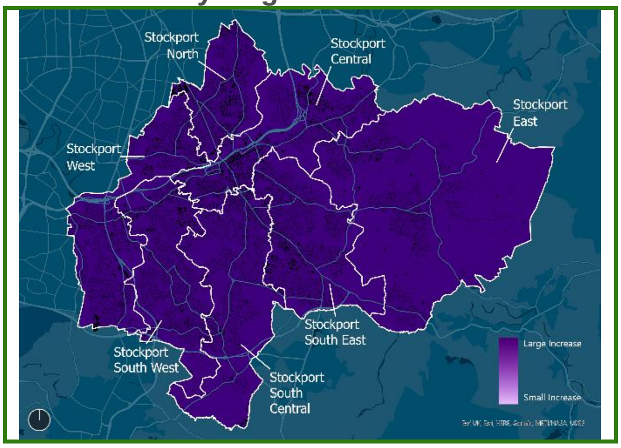
Secondary Scenario



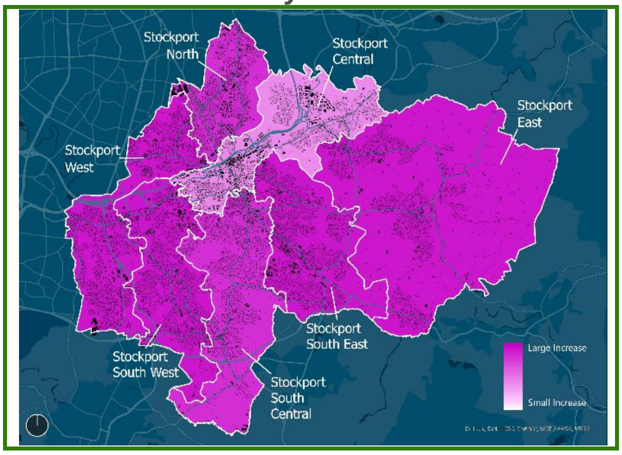
Electrification Scenario



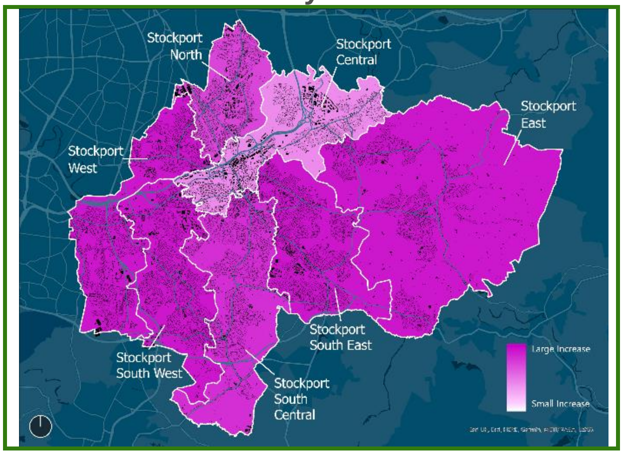
Hydrogen Scenario



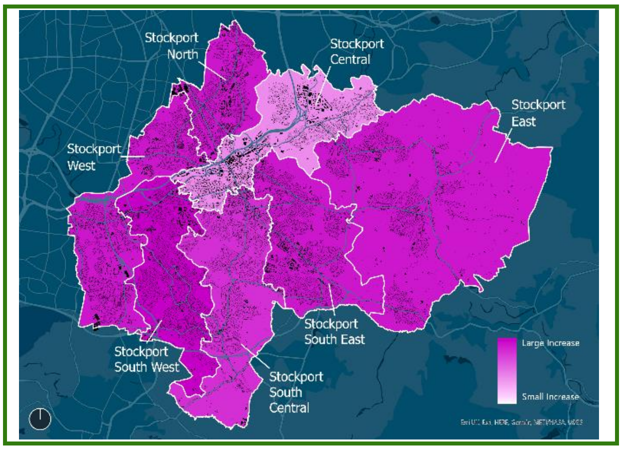
Primary Scenario



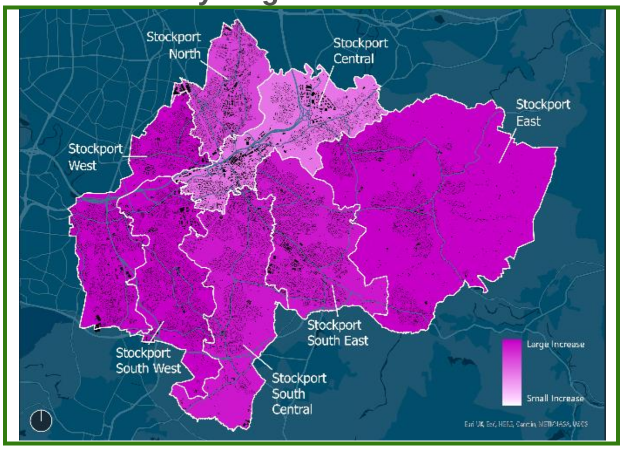
Secondary Scenario



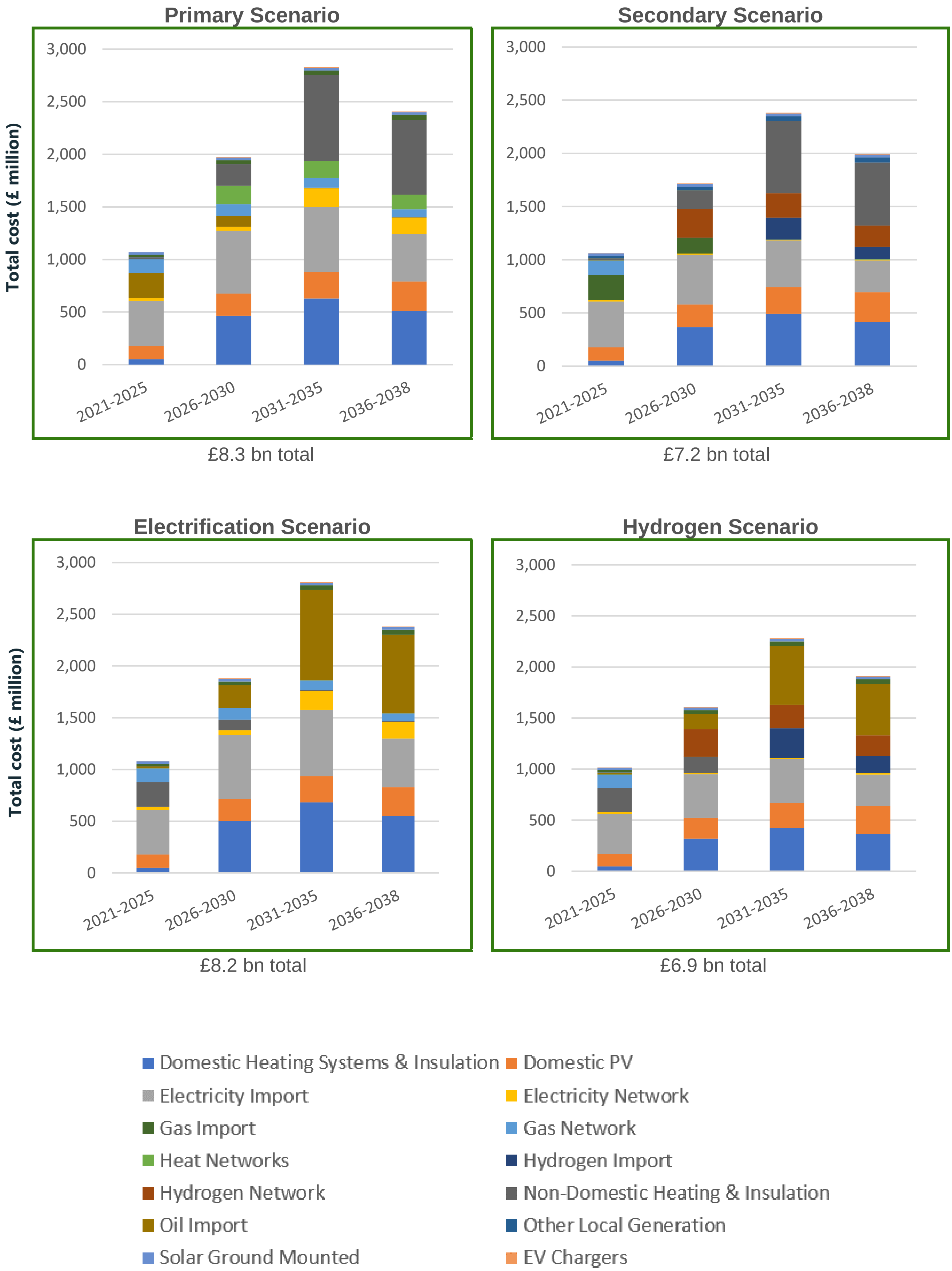
Electrification Scenario



Hydrogen Scenario



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
2021-2025
2026-2030
2031-2035
2036-2038
£8.3 bn total
£7.2 bn total
£8.2 bn total
£6.9 bn total
Domestic Heating Systems & Insulation
Domestic PV
Electricity Import
Electricity Network
Gas Import
Gas Network
Heat Networks
Hydrogen Import
Hydrogen Network
Non-Domestic Heating & Insulation
Oil Import
Other Local Generation
Solar Ground Mounted
EV Chargers

GREATER MANCHESTER LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Data Sources Annex

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

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 (EPCs)***
  - ESC-built address matching algorithm to match housing attributes from EPCs
  - Informs building-level attributes – e.g. current heating system, levels of insulation.
- **Listed Buildings** – Historic England† as a potential constraint on retrofit

Non-Domestic

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

Future Building Stock

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

- **GMCA Spatial Framework Allocation Sites**
  - Usage as above.
  - In total over 3,000 sites provided

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

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

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-chargepoints