GREATER MANCHESTER LOCAL ENERGY MARKET

DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Local Area Energy Plan

Tameside, Greater Manchester

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0. EXECUTIVE SUMMARY - OVERVIEW

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 Tameside

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 Tameside'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 Tameside 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, and we expect hydrogen would be prioritised for other boroughs with greater requirements for industrial uses.

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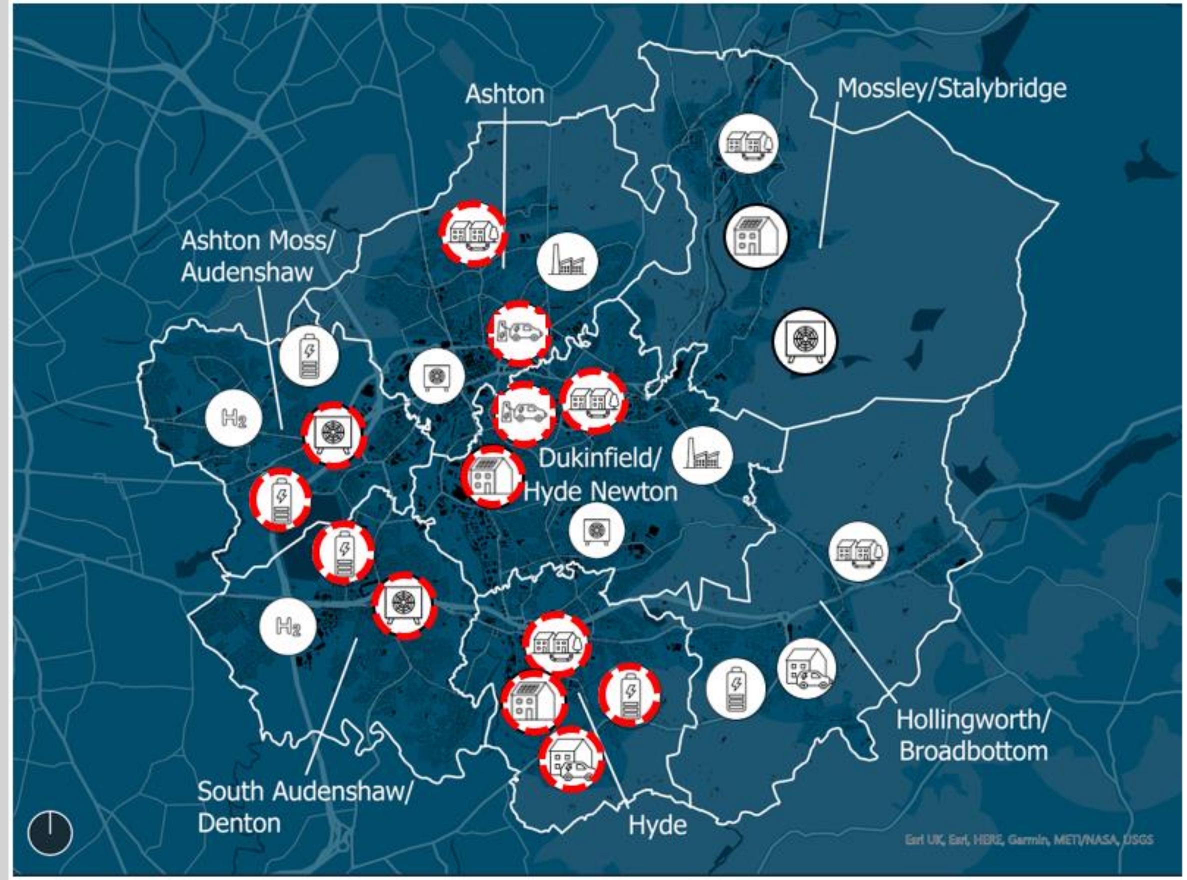
* Climate Change Act 2008 (2050 Target Amendment) Order 2019

† 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

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

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

Long-term Deployment Areas

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

First Steps Priority Areas

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

1. INTRODUCTION

Context

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

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

Separately to this LAEP, Tameside Council have committed to a Climate Change & Environment Strategy, which sets out the council's approach to tackling carbon emissions from their own estate and the borough as a whole, whilst building Tameside's green economic sector and improving the local environment. The Council recognises the role commercial and industrial, as well as residential, sectors have to play and outlines ways stakeholders can engage across different areas of climate action. These areas include Greenspace & Biodiversity, Homes, Workspaces & Council

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

Buildings, Influencing Others, Reducing Consumption & Procuring Sustainably and Travel & Transport. Opportunities to align the Climate Change & Environmental Strategy and the LAEP should be explored, with work required to understand how the two will interact.

Modelling Approach

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

For the impact of the energy system outside of the boundaries of Tameside, 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 a potential cost-effective vision for carbon neutrality in Tameside. These explore the actions and investment needed in different areas of Tameside between now and 2038 to reduce its emissions in line with Greater Manchester's ambitions for carbon neutrality. The scope of emissions in this plan covers those resulting from domestic, industrial and commercial consumption of electricity, gas & other fuels; home charging of personal electric cars; and process emissions from large industrial installations. Out-of-scope are emissions from agriculture, all usage of liquid fuels for transportation, and electricity use for vehicles other than personal cars.

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

Scenarios for achieving Carbon Neutrality in Tameside

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 Tameside 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 Tameside 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 Tameside; any uncertainty is generally around the scale of deployment. Therefore, it is deemed low risk to demonstrate how to deploy these components and prepare for significant scale-up.

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

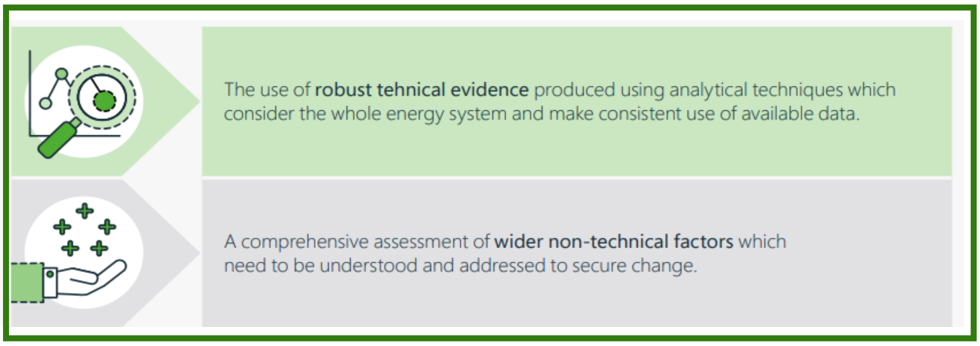
This LAEP has also considered previous studies including the Decarbonisation Pathway for Greater Manchester study completed in 2020 by Navigant on behalf of Cadent Gas and Electricity North West* and is aligned to the latest guidance on Local Area Energy

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

Planning developed with Ofgem, the ambitions of Greater Manchester and wider UK Net Zero commitments.

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

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



The next steps of the development of the plan are expected to comprise wider stakeholder and public consultation on the plan to inform its further development and also the approach of both Greater Manchester and Tameside 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.

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

Report Structure

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

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

Chapter 2: sets out the vision and primary scenario to carbon neutrality for Tameside, informed by the scenario analysis. The primary scenario demonstrates how Tameside 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 Tameside.

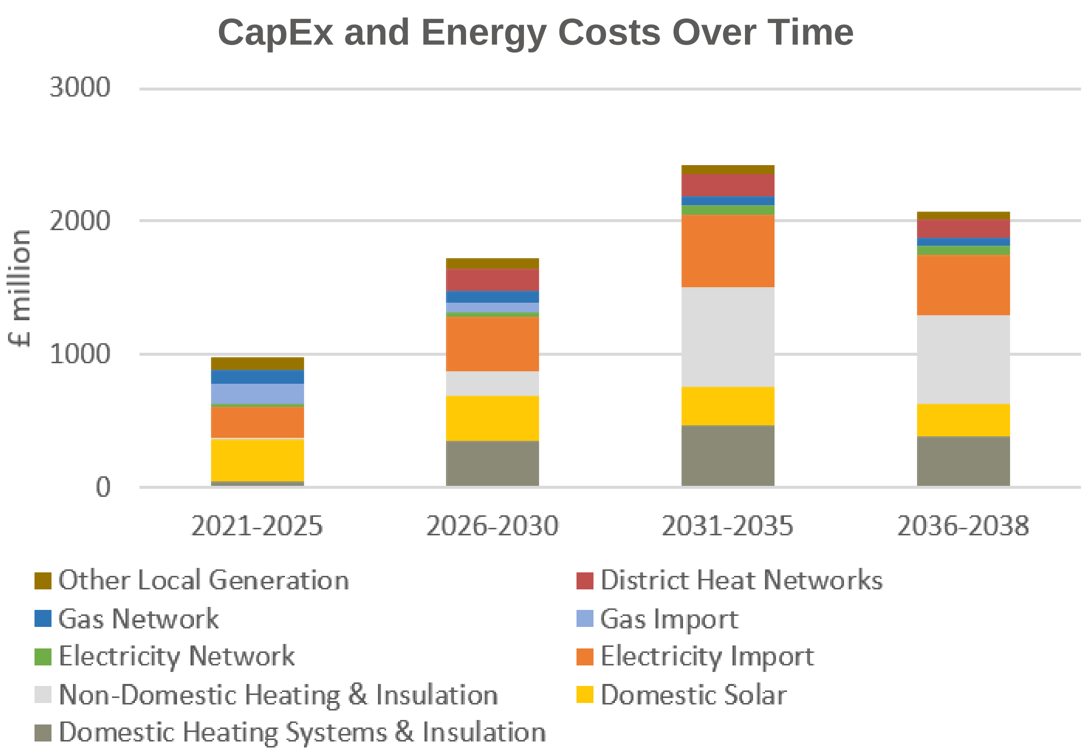
Chapters 3-7: set out some of the key aspects of the primary scenario and what this means in relation to implementation for Tameside including Fabric Retrofit (Chapter 3), Heating System Zones (Chapter 4), EV charging and infrastructure (Chapter 5), Local Energy Generation and Storage (Chapter 6), and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

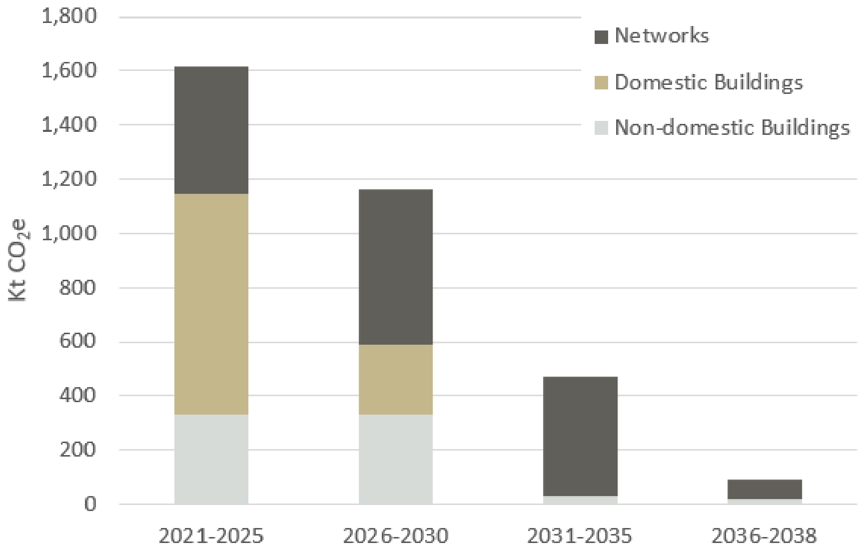
This Local Area Energy Plan (LAEP) aims to support Tameside to transition to an affordable and decarbonised energy system and to support the delivery of Greater Manchester's (GM) commitment to carbon neutrality by 2038.

Decarbonising Tameside local energy system by 2038 is achievable and expected to require capital investment of £5.3 bn. Total energy system costs including capital investments, operations and energy consumed is between £6.3 bn and £7.2bn 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*. For all scenarios, a large proportion of these costs will be incurred by maintaining current energy system regardless of the carbon target to meet the energy needs of Tameside's residents (estimated to be ~ 70%).



* 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.

CO_2 Emissions Over Time



The cumulative emissions over the period 2021-2038 for the primary scenario is 3.3 Mt of CO_2e (from a range of 3.3to 3.4 Mt across the scenarios assessed), of which 1.6 Mt is due to grid electricity consumption*. The modelled pathway predicts a total reduction in emissions of over 94% from early 2020's to late 2030's.

How to Interpret this Vision

This transition will involve the greatest infrastructure change across Tameside 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 p18 (along with other variations within the appendix), where the supporting analysis indicates that hydrogen could have an important role in decarbonising Tameside. 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 Tameside's citizens and stakeholders. Insights from the alternative scenarios have been used to produce these priority areas. It is expected that this LAEP may need to be updated as lessons are learnt and uncertainties (such as UK policy regarding the decarbonisation of heat) become clearer, this may typically be on a 5 year timeframe.

* 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.

Fabric Retrofit

As much as **62% of Tameside's dwellings receive insulation retrofit** in the plan for the primary scenario amounting to a total of **68,300 buildings.** The majority of these buildings are made up of terrace and semi-detached typologies (circa. 54%). In the hydrogen focused secondary scenario, as much as 77,800 buildings receive insulation retrofit in the plan. A greater number of these retrofits are deep retrofits in the hydrogen scenario (around 10% more of Tameside's homes) to help meet the carbon budget, whereas the larger number of basic retrofits in the primary scenario supports the transition to low temperature heating systems. Fabric retrofit and solar PV are low regret measures to progress in the short-term, with all zones having substantial uptake in the model runs.

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, it would require hydrogen to be available to supply Tameside in a timeframe that supports the delivery of the GM carbon budget. Alternatively, over 74,000 heat pumps are deployed making up 68% of the dwellings in Tameside. Of these dwellings 87% will be supplied by ASHP's with the remaining 13% supplied by GSHP's. A considerable amount of district heating has also been identified for the majority of other dwellings (total of 27,400 dwellings identified for district heating). Hyde has the largest uptake of district heating in the primary scenario (~7000 dwellings connected) but is not widely deployed in the secondary hydrogen scenario, whilst Mossley/Stalybridge is the only zone to see large deployment in both the primary (~5600 dwellings) and secondary scenarios (~6100 dwellings) – indicating district heating is a low regrets choice.

Electric resistive heating is the low carbon pathway selected for the remaining 8% of dwellings not heated by heat pumps or district heat networks. For non-domestic buildings the majority of heating is met by ASHP's (~73%) with DHN also playing a pivotal role in decarbonising the remainder of non-domestic buildings. The combined cost of fabric-retrofit and heating system replacement is £0.86 bn for homes, and £0.95 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 Tameside (under all scenarios considered), providing up to 479 MWp of installed capacity by 2038, at a cost of £932m. As much as 62% of the installed capacity comes from utilising domestic roof space. Land in the area has been identified for opportunities to deploy 296 MWp ground mount solar PV and an additional 656 kW of hydro power for further CO2 reduction. Energy networks could require capacity reinforcements of substations and underground feeders to accommodate electrification, at a cost of £174m.

EV Infrastructure

The transition to electric vehicles, with uptake increasing from around 2,000 plug-in vehicles today to over 82,000 by 2038, drives a demand for EV chargers to be installed across all areas. Around 50,000 domestic chargers would be installed (one for every home with potential for off-street parking) at a cost of £28m, 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 rather than domestic chargers.

Consumer Uptake

By the early 2030s all new cars and vans, and all boiler replacements in dwellings and other buildings in Tameside are low-carbon*; the vast majority of heating systems are either electrified or use hydrogen. For the primary scenario as much as 74,900 of Tameside's dwellings are fitted with a form of heat pump. As for the hydrogen focused secondary scenario up to 82,600 boilers could be running from 100% hydrogen and as much as 13,700 dwellings fitted with heat pumps. By 2038, more than 75% of cars are electric vehicles or plug-in hybrids, requiring the provision of ~50,000 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 Tameside 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 Tameside

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 Tameside increases to contribute to the GM carbon budget, predominantly in the form of up to 479 MWp of rooftop solar PV, with opportunity a further 296 MW ground mounted solar PV across Tameside. Renewable generation (if the ground mounted PV potential is maximised), provides up to 607 GWh annually (31%), with 1,326 GWh (69%) of electricity supplied from the grid.
This low carbon electricity is used in heating, industry and vehicle charging, more than doubling electricity demand over the next 15 years. Total electricity consumption is expected to increase by 109% by 2038 in the primary scenario and by 81% by 2038 in the secondary scenario.

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

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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 Tameside'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.

point to low regret opportunities for heating system options in each area of Tameside and identify potential priority areas for using hydrogen.

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 Tameside. Fabric retrofit will prepare buildings for zero carbon heating, whilst also making a notable contribution to staying within the carbon budget. By 2038, over 68,000 of Tameside's 110,000 dwellings are retrofitted in the plan (circa 62%), with over 38% of the dwellings requiring basic 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 has identified a considerable 27,400 homes connected to a heat network in 2038. Moreover, district heating opportunities have been deemed suitable for non-domestic buildings covering large amount of floor area (951,000 m^2). Ashton and Dunkinfield/Hyde Newton have the highest share of these non-domestic properties and as such are likely to dominate early heat network deployment, the current viability of which are generally dependent on large anchor loads. However, non-domestic buildings only make up a small proportion of the total buildings in Tameside. Large 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. The opportunity to deploy low temperature district heating utilising water from nearby sources such as the River Tame should also be explored, which could help with minimising cost and enhancing efficiencies.

Annual electricity demand is forecast to increase from 925 GWh to 1934 GWh by 2038, due to electrified heat and electric vehicle charging. This requires an increase in electricity network capacity, though opportunities to use flexibility and storage in place of reinforcements are explored.

Depending on the conversion and roll-out of hydrogen for heat, gas networks remain in place in some areas to support some hard-to-decarbonise non-domestic buildings that may not be of the scale to have a dedicated hydrogen connection. However, should HyNet phase 3 be available, up to 82,600 homes could be supplied by hydrogen by 2038, at 11% lower overall cost and very similar levels of emissions.

Investment

Tameside's transition requires a total energy system and building level investment of £5.3bn (excluding energy costs). This unprecedented level of investment provides a once in a lifetime opportunity for Tameside. 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 Tameside. How it is delivered will influence the local benefit to Tameside, in addition to job creation. For example, there will be opportunities for local/community initiatives to provide the future energy system.

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

Local Impact and Risks

Without changes to national policy, wider energy market reforms or the introduction of new support mechanisms, household energy bills are forecast 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 just over £16,000 for the associated measures.

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

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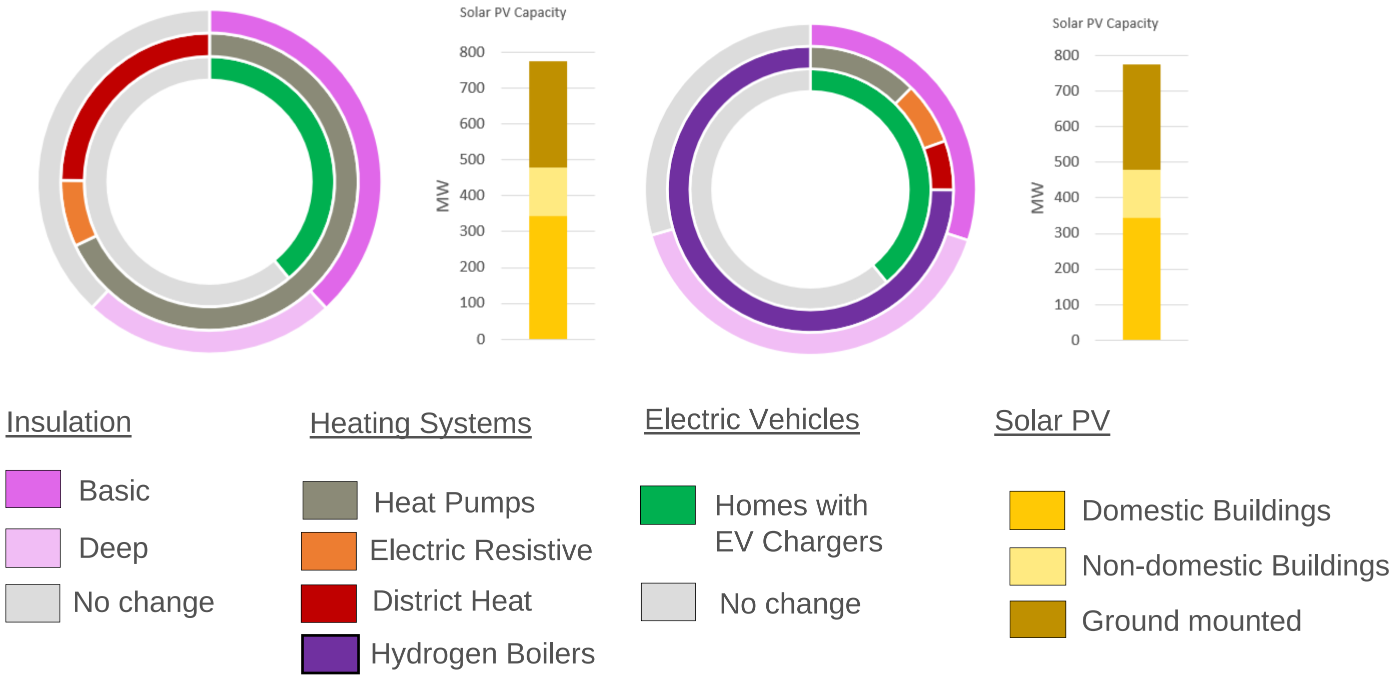
[*] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760508/hydrogen-logistics.pdf

What Tameside's transition to carbon neutral could look like

The charts below illustrate the scale of change needed to decarbonise Tameside in each scenario. This is intended to illustrate the scale of measures and investment needed to the stakeholders who will support and deliver Tameside's transition.

Primary Scenario (left) and Secondary Scenario (right)



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

This secondary scenario illustrates an alternative future where hydrogen becomes widely available for heating and hot water in buildings from 2030, in accordance with the aspirations of HyNet phase 3. These graphs show some of the key differences in investment and installation between the primary and secondary scenarios. Total costs vary within 10% between the two scenarios – see section 8 for more cost details.

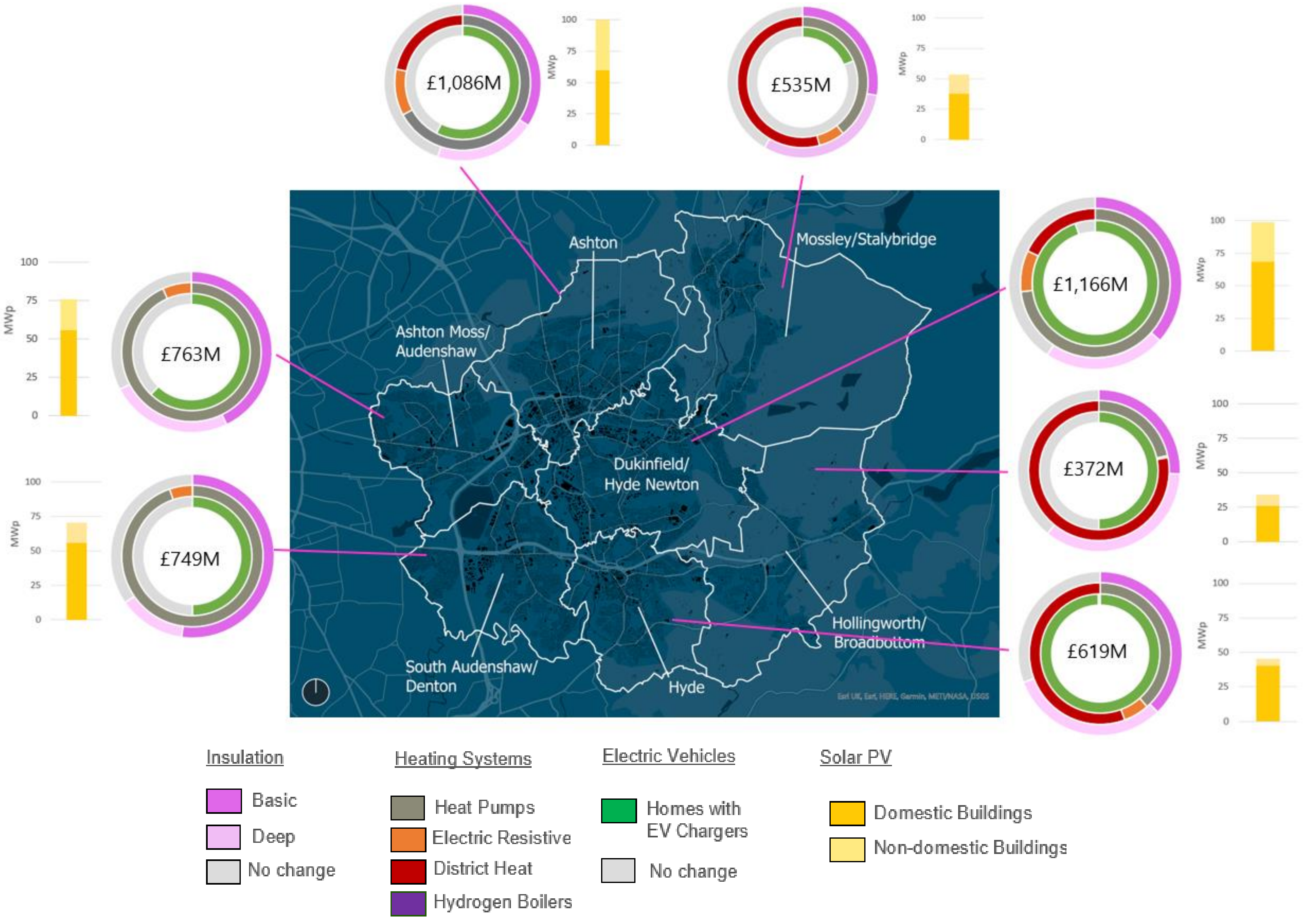
The availability of hydrogen for home heating in the secondary scenario avoids much of the investment in both electricity and heat networks, although investment for repurposing the gas network for hydrogen is required instead. The need to invest in building retrofit is slightly increased also, as the later availability of hydrogen requires greater savings to be made elsewhere earlier on 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. Our 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 the limited available hydrogen is likely to be prioritised for boroughs with substantial industrial requirements. 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 Tameside 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 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 in the map below. This quantifies and shows the different transitions modelled for each area based on their own unique geography and character.

2. THE VISION – BREAKDOWN OF PRIMARY SCENARIO BY ZONE



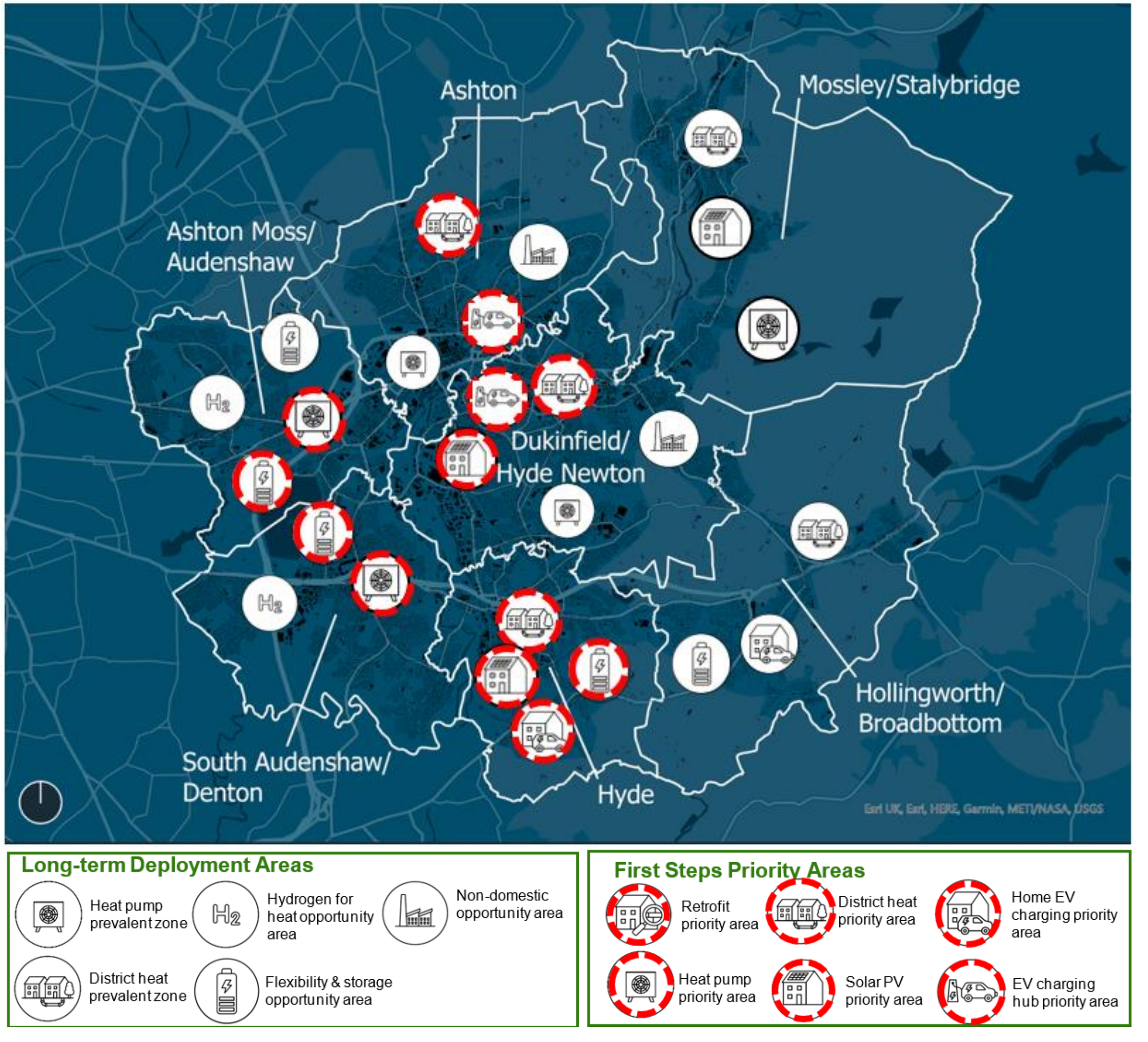
How to use this LAEP

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 Tameside's transition to carbon neutral and work with Tameside'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 Tameside 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:

- Ashton Moss/Audenshaw and South Audenshaw/Denton are flagged as areas prioritised for heat pumps, as they have the highest number of properties identified as utilising this technology in the primary scenario. The typologies of dwellings in these two zones are typical of those throughout Tameside which will adopt heat pumps.

  Spare electrical capacity is also available in Ashton Moss/Audenshaw and South Audenshaw/Denton making them conducive to early progress in heat electrification. In the other zones, heat pumps would also be a low-regrets option for housing far from any industrial areas (which might be served by hydrogen) or potential heat network coverage.

- Ashton Moss/Audenshaw, South Audenshaw/Denton are prioritised for fabric retrofit deployment, predominantly due to high proportions of older semis and terraces that would benefit from thermal improvement. This allows archetypal approaches to be pioneered and developed, e.g. for rows of terraces.

- Ashton and Dunkinfield/Hyde Newton are prioritised for the demonstration of solutions for Tameside's non-domestic buildings, with a large retail presence making non-domestic building stock far more prevalent in these zones.

- Home EV charging and rooftop solar PV can be developed early in areas with spare capacity in the electricity network, Dukinfield/Hyde Newton and Hyde. Public EV charging is prioritised in central areas where demand is expected to be highest.

- Smaller scale quick wins are also flagged in the report with two potential sites for ground mounted solar farms being identified (one in Hyde and one Hollingworth/Broadbottom)

Long term Deployment

- Flexibility and storage (combined with other components including heat pumps, solar PV and EV charge points) can be tested in Ashton Moss/Audenshaw, Hollingworth/Broadbottom and Hyde, including a focus on evaluating whether alternative approaches to electricity network reinforcement can reduce costs and aid speed of deployment. These areas are selected due to rapid electrification in these areas, existing grid constraint or a combination of these factors.

- South Audenshaw/Denton could benefit from low carbon hydrogen to support industry in the area, which could then expand to support heating in other buildings. This area is prioritised for hydrogen as the type of industry in the area is hard to electrify (unlike the non-domestic priority areas of (Ashton and Dunkinfield/Hyde Newton).

- If hydrogen became widely available, domestic dwellings located near industrial areas in zones could benefit from cost effective connection to low carbon hydrogen supplies built to serve industry. This would initially be South Audenshaw/Denton, then Ashton Moss/Audenshaw, followed by Hyde and Dunkinfield/Hyde Newton.

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

The following themes set out both the rationale for how this vision has been produced, identifying several key considerations that will need to be thought about and integrated, and demonstration and scale-up activities, as plans to take this LAEP forward are developed. It is expected that insights from the demonstration activity and considerations of these themes will influence Tameside'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, Tameside'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 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 Tameside's citizens is essential to help understand attitudes towards Tameside's carbon neutrality transition; whilst also forming part of the evaluation process. This will help Tameside 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 Tameside'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 Tameside's transition that there is a demand for solutions, products and services

Vision to 2038

A significant portion of existing homes and buildings in Tameside will require retrofit, carrying out insulation in **at least 62% of dwellings** (around 68,300) for the primary scenario with more of Tameside's dwellings (38%) receiving basic retrofits than more expensive deeper fabric upgrades (24%). For the secondary scenario, where hydrogen forms the bulk of the heating solution, 9% more buildings will require retrofit (around 9,500 additional buildings) with a significantly higher number of dwellings receiving deep retrofit (41%). This is because of a need to reduce emissions in the early years to comply with the carbon budget while waiting for hydrogen to become available. In contrast, heating systems are decarbonised earlier in the primary scenario by installing heat pumps, therefore, the requirement to reduce emissions through fabric retrofit is reduced. For both scenarios, early focus and investment in fabric retrofit would be a low regret step.

However, regardless of the heating system used, additional level of fabric retrofit may be needed to address affordability issues; for example, if there is an expected higher cost of hydrogen compared to gas*. Deeper fabric retrofit and a greater number of homes receiving additional insulation would be required to compensate for any such increases in energy price for both heating scenarios. 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 35.

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. This will be 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.

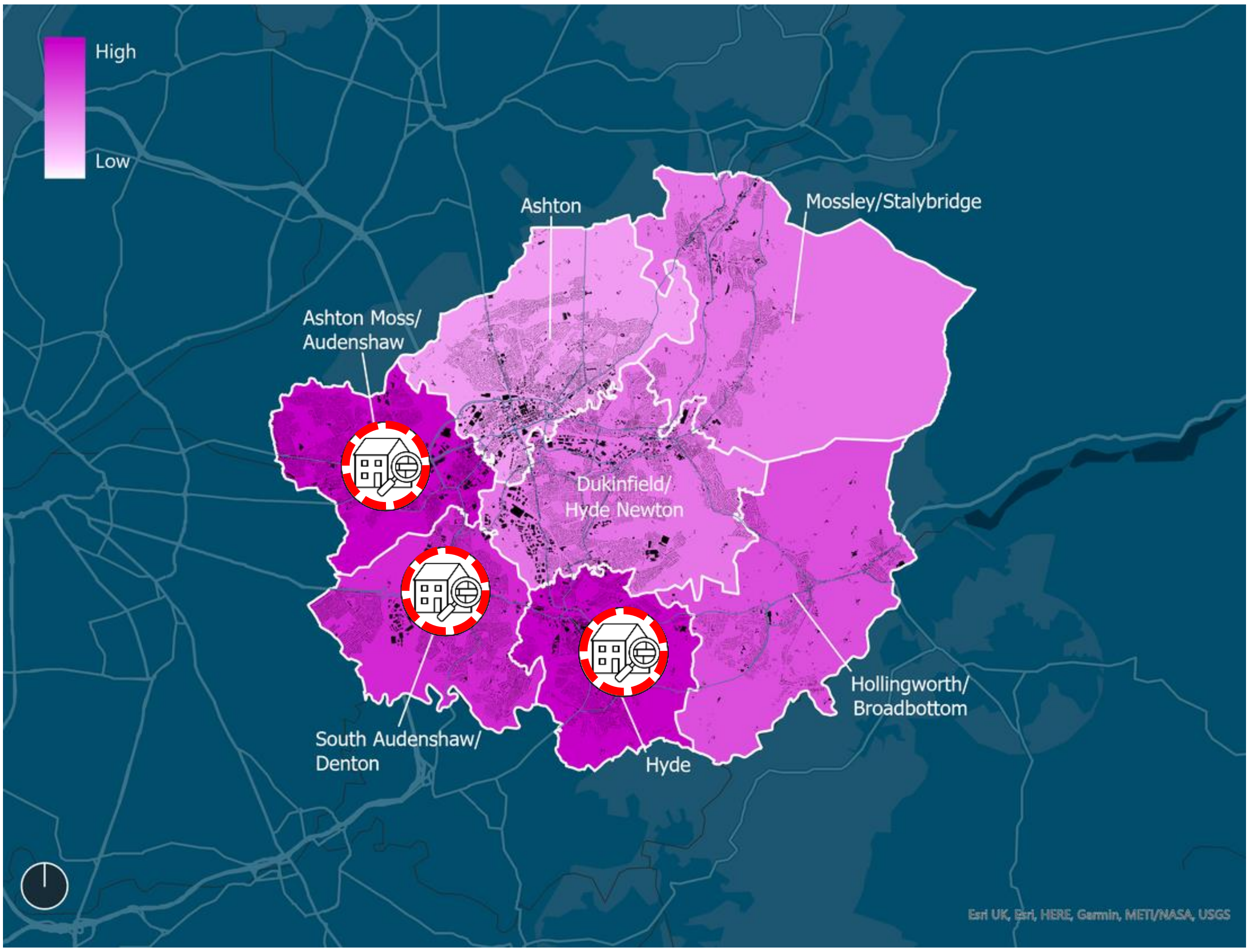
* Estimates vary - see for example projections for initial HyNet cost of hydrogen at around 150% uplift over natural gas https://hynet.co.uk/wp-content/uploads/2021/06/14368_CADENT_PROJECT_REPORT_AMENDED_v22105.pdf [page 15]

Retrofit across Tameside by 2038
Number of Homes
25000
20000
15000
10000
5000
0
Primary
Secondary
Ashton
Ashton Moss / Audenshaw
South Audenshaw / Denton
Mossley / Stalybridge
Dukinfield / Hyde Newton
Hyde
Hollingworth / Broadbottom
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 Tameside, 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.

Three priority retrofit zones have been highlighted for Tameside:



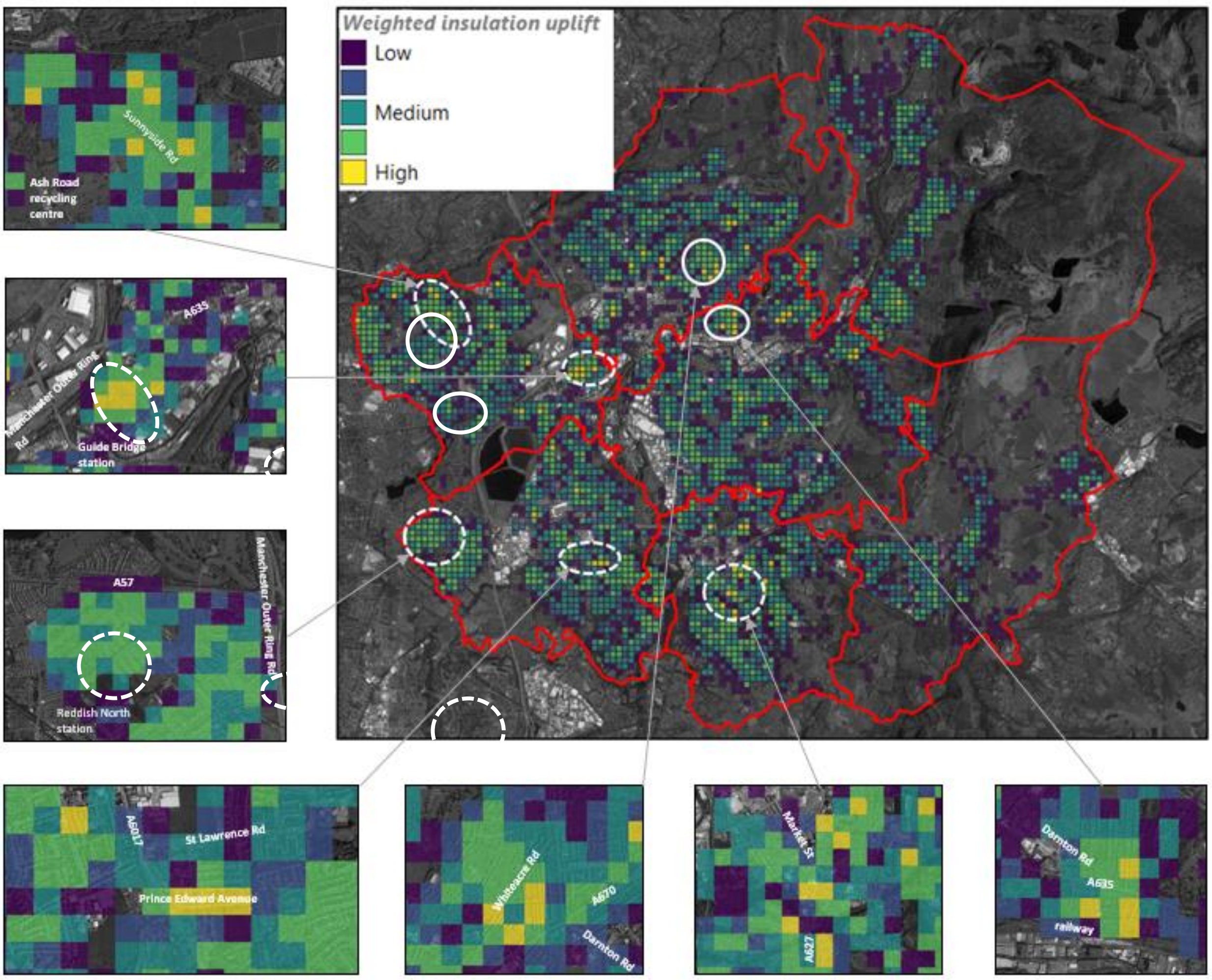
* Fabric retrofit measures have been identified following a whole energy system approach, considering the cost-effectiveness of fabric retrofit measures alongside other options to achieve carbon neutrality in Tameside. This does not mean that individual dwellings or buildings would not benefit from additional 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

- **Ashton Moss/Audenshaw, South Audenshaw/Denton and Hyde**

These are areas in which a high proportion of homes (around 70%) receive insulation measures, as well as this being a large absolute number of properties, so the opportunity in these 3 zones is significant.

However, all other areas also see high levels of retrofit, with the lowest levels in Ashton, Mossley/Stalybridge & Dukinfield/Hyde Newton still being above 55%. Greater proportions of flats, newbuilds or pre-1914 properties exist in these zones (32% to 40% range) which are less economic to apply insulation to lead to lower insulation levels in these zones.

In all zones there are pockets with a high density of insulation uplift. Understanding the distribution of these will help target insulation programmes beyond the primary zones. Buildings closely clustered are likely to require the same type of insulation uplift, so there is likely to be improved economics from treating properties in this way. Five example clusters for insulation uplift are highlighted in the image below (although only one for each priority zone will be explored in more detail) with dashed white outlines. Alongside this report data will be provided at postcode level, which could aid a delivery strategy for insulation across Thameside.



Most zones have significant clusters within them even if they are not one of the three priority zones, two such clusters are highlighted with white outlines in Ashton and Dunkinfield/Hyde Newton.

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.

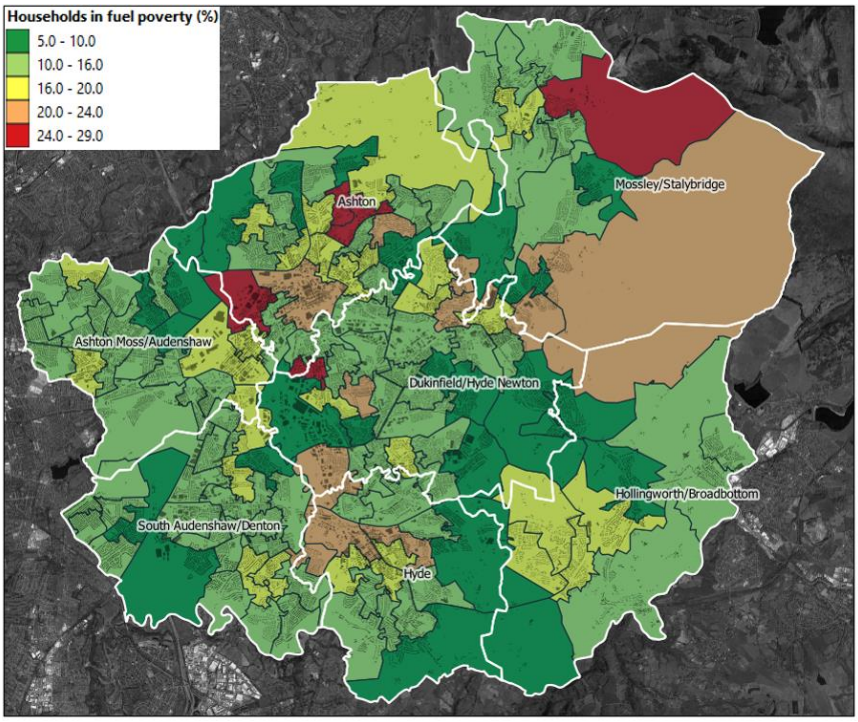
Fabric Retrofit Zones in Tameside by 2038

Ashton Moss/Audenshaw is dominated by older properties, with nearly 60% requiring insulation uplift being built between 1914 and 1944. A typical example area is shown below.

As well as being of a similar age, properties requiring insulation uplift are also of a similar design, with 90% being of terraced and semi-detached.

This is reflected across all three priority zones with South Audenshaw/Denton having 93% of properties requiring uplift being of terraced or semi-detached design and Hyde 87%.

This area also has a high level of fuel poverty (17.5% compared to the English average of 13%), targeting this area with insulation will help reduce spend on bills and thus fuel poverty. There are areas with even higher levels of fuel poverty in the areas of Ashton abutting this priority zone, so it is hoped approaches from this initial site could be applied in these areas. For reference a map showing prevalence of fuel poverty in Tameside is provided below.



Fabric Retrofit Opportunity in Ashton Moss/Audenshaw

The image below highlights the priority fabric retrofit zone within Ashton Moss/Audenshaw, located just to the north of Guide Bridge train station.

South Audenshaw/Denton is similar to Ashton Moss/Audenshaw in terms of a dominance of semi-detached and terraced properties, although the properties tend to be more recent – with only 44% falling into the 1914-1944 age category. As mentioned previously, terraced and semi-detached properties are very prevalent in the area, accounting for 93% of the domestic stock requiring insulation.

Fabric Retrofit Opportunity in South Audenshaw/Denton

The South Audenshaw/Denton priority zone is situated in the Mount Pleasant Road and Prince Edward Avenue area. This is an area dominated by terraced properties in the 1914-1944 period, which is the most common housing type requiring insulation uplift in South Audenshaw/Denton (22% of all properties requiring insulation uplift are 1914-1944 terraced houses).

Hyde has a very similar character to South Audenshaw/Denton, 1914-1944 terraced properties being the most frequent to be identified as requiring insulation with 27% of all properties requiring insulation uplift being 1914-1944 terraced houses.

Fabric Retrofit Opportunity in Hyde

The fabric retrofit in Hyde is clustered to the East and South East of Hyde town centre, with the majority of the southern portion running along the A627. These properties are again in the most part 1914-1944 terraced properties. Along with South Audenshaw/Denton this indicates substantial benefits to having a standard approach for property of this character for insulation. Ashton Moss/Audenshaw on the other whilst having a lot of properties of 1914-1944 terraced type require insulation it is semi-detached properties from that period which have the highest occurrence of insulation requirement.

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"

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* 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

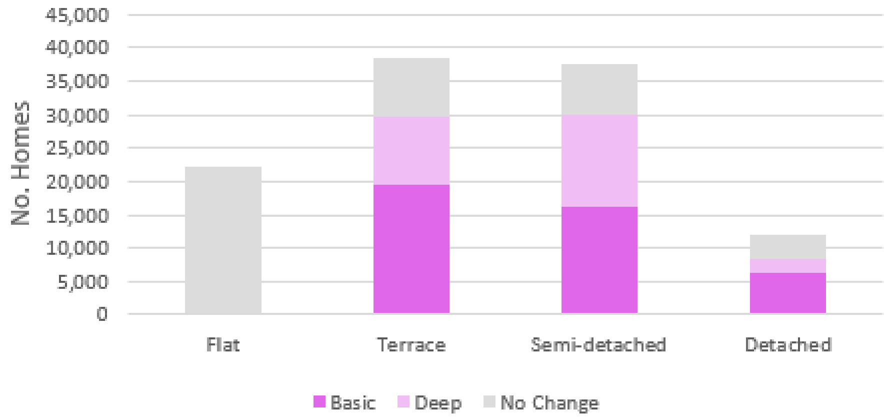
during previous rounds of cavity treatment; targeting these dwelling types is a key focus for this LAEP.

The retrofit zones identified on the previous pages are designed to allow the coordinated targeting of interventions across Tameside in such a way that supports and aligns with Tameside'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 Tameside expected to need retrofit measures by dwelling type is shown below. This represents around 62%of the projected domestic building stock in Tameside of approximately 68,300 dwellings in 2038.

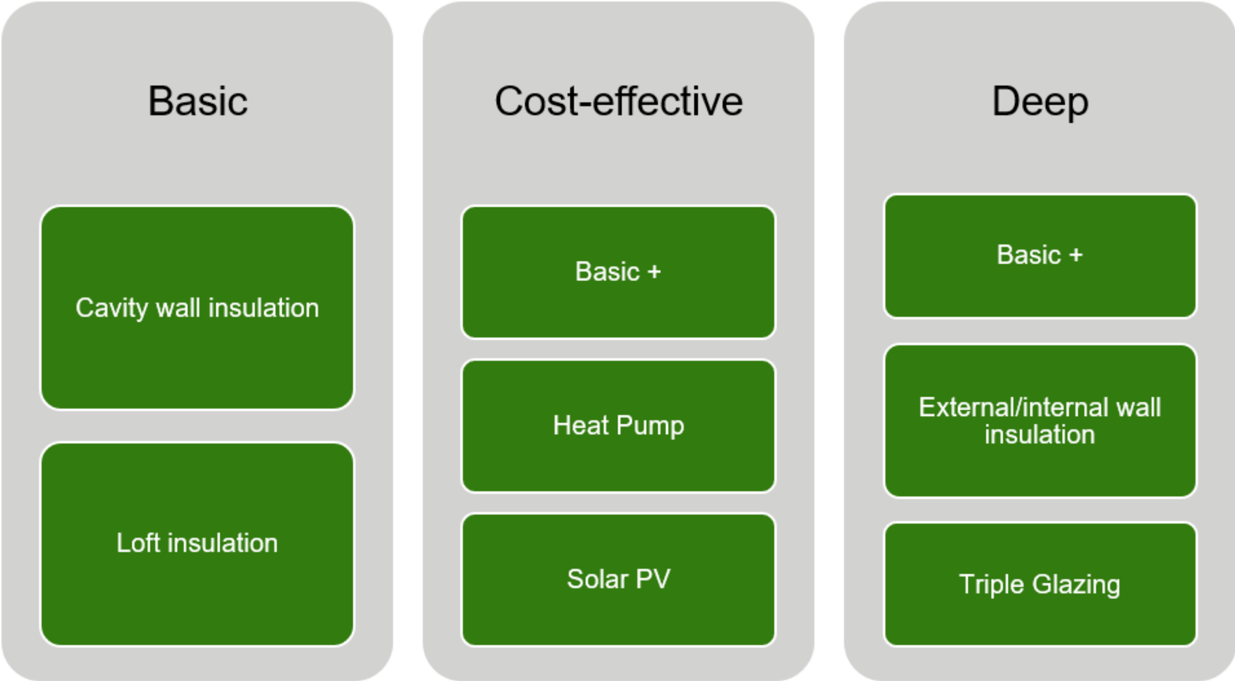
Fabric Retrofit in 2038 by Building Type



There are over 33,000 homes which receive basic insulation measures and a healthy proportion receiving deep measures in both scenarios. Around 9,500 of the dwellings receiving basic retrofit in the primary scenario would instead receive deep retrofit in the secondary scenario. Carrying out basic measures in earlier years would not preclude deeper measures being installed in homes in later years. Therefore, basic measures and the majority of deep measure are considered low regret across all scenarios and heating system selections. Due to the housing type targeted, a significant proportion of the cost-effective deep measures are based on adding triple glazing to dwellings with basic measures applied, rather than large volumes of external/internal wall insulation to pre-war period dwellings.

Cost-Effective Deployment

The proposed approach centres on ensuring fabric retrofit measures are implemented in the vast majority of suitable homes in Tameside, 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*.



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 Tameside.

In a hydrogen scenario, the number of dwellings expected to need deep retrofit would be even greater than in an electrified scenario. This is due to the later introduction of hydrogen than heat pumps, meaning that emissions savings need to be achieved by other means in the early years to stay within carbon budgets.

Deeper Retrofit

The approach described is based on finding the most cost-effective route for decarbonising Tameside 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:

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* 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.

- 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 Tameside 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

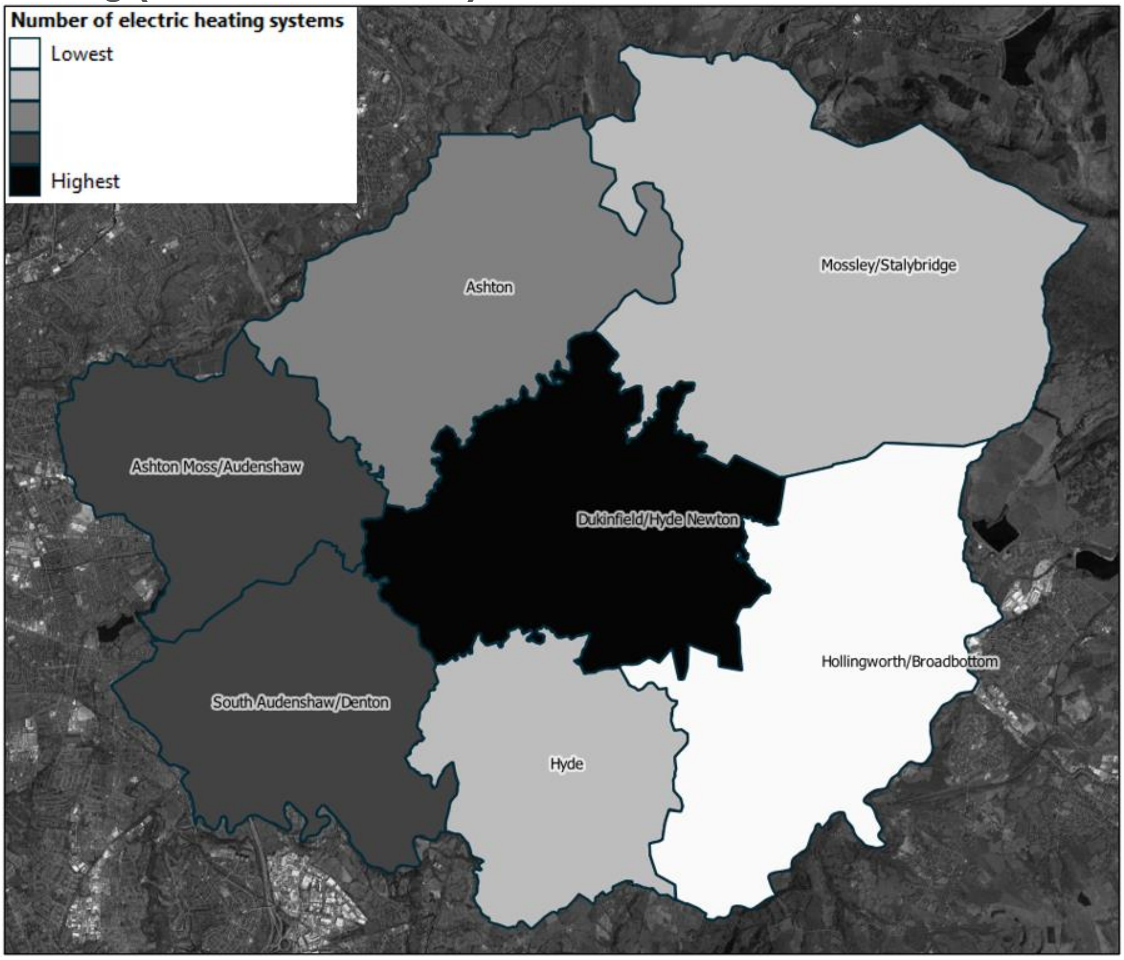
The improvement of building insulation supports the roll out of low carbon heat in several ways. By reducing the heat demand, less powerful heating systems can be installed, reducing capital costs. The reduced demand for heat will also compensate for a shift to a more expensive energy source (gas to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

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

Vision to 2038

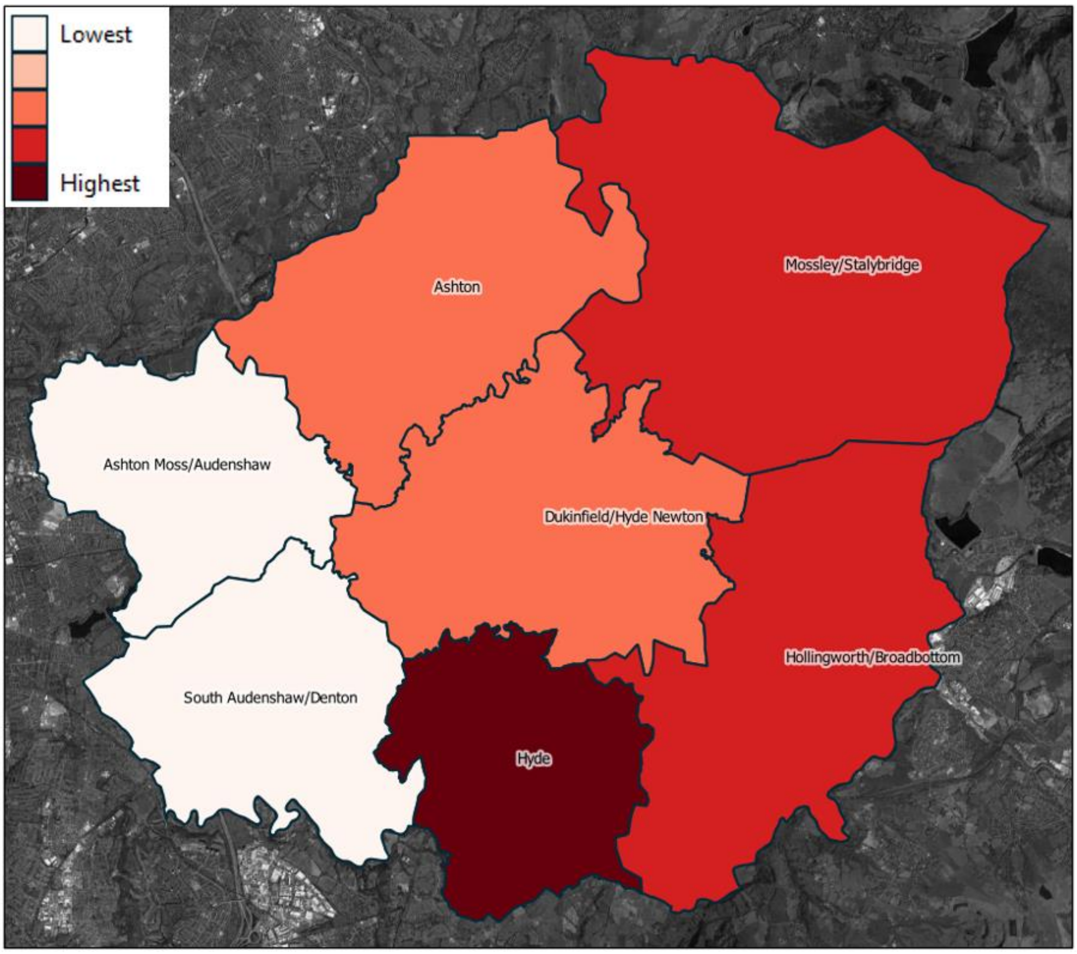
Building characteristics and existing network characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Tameside. In the primary scenario, the decarbonisation of heat is primarily achieved through installation of electric heat pumps in existing and new homes, comprising almost 74,900 domestic heat pump installations of which a small proportion (13%) of these are ground source systems (7:1 ratio split). There are also a number of properties with electric resistive heating, such buildings are particularly prevalent in Ashton Dukinfield/Hyde Newton.

Heat Zones for electric heating in Tameside by 2038 (Primary Scenario) – including all forms of heat pump and electric resistive heating (not heat networks)



Heat pumps are the dominant technology overall, with a 68% share of buildings, however, in three zones (Mossley/Stalybridge, Hollingworth/Broadbottom and Hyde) heat networks are the dominant provider to most buildings.

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

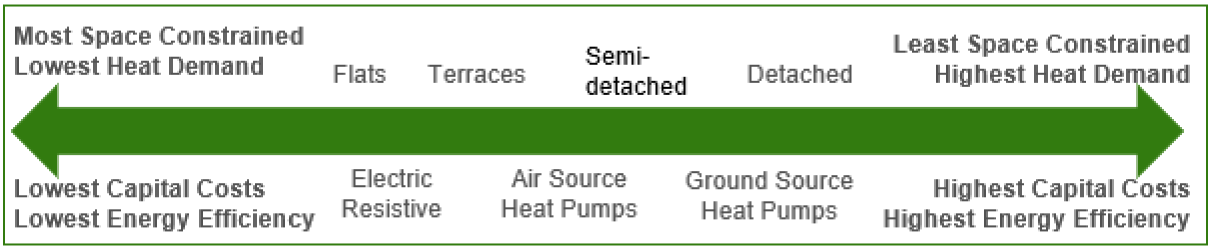


Even where hydrogen is available (as per the secondary scenario), least-regret effort in the near term is focussed on retrofit, priority electrification areas, and monitoring the development of hydrogen (at national and regional levels). The installation of hydrogen-ready boilers could provide optionality, at minimal additional cost. Given the uncertainty this is how hydrogen is considered within this scenario – with national rather than local decisions being the key driver. If hydrogen is considered available, the potential low cost means it dominates across all heating systems. However, its binary nature for large scale deployment (generally being all properties or no properties) means at a domestic level no hydrogen is seen in the primary scenario.

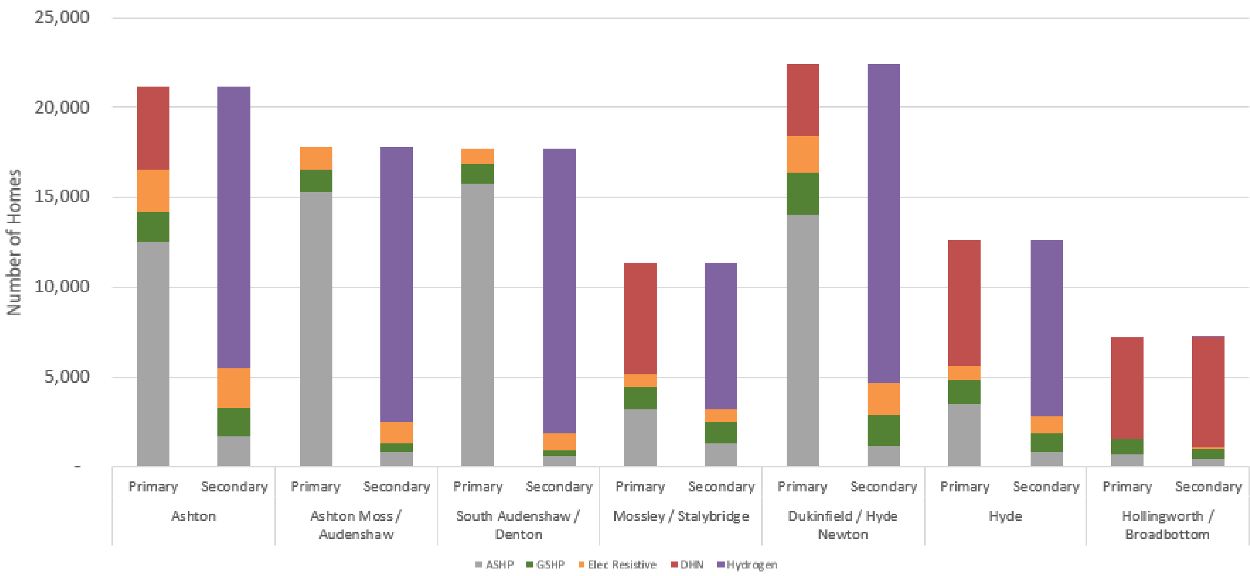
These forecasts are not definitive and represent a view of the future for each zone, to illustrate the scale of change required, it is expected that alternative solutions will be specified when exploring at a more detailed level, for example, there may be opportunities for communal / shared heating systems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

Heating System Selection

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



Deployment of Heating Systems by 2038



Air source heat pumps are the most widely suited electric heating technology, though a small proportion of homes in most areas was found to be suitable for ground source heat pumps, where greater outdoor space permits the installation of a ground collector, and larger properties 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.

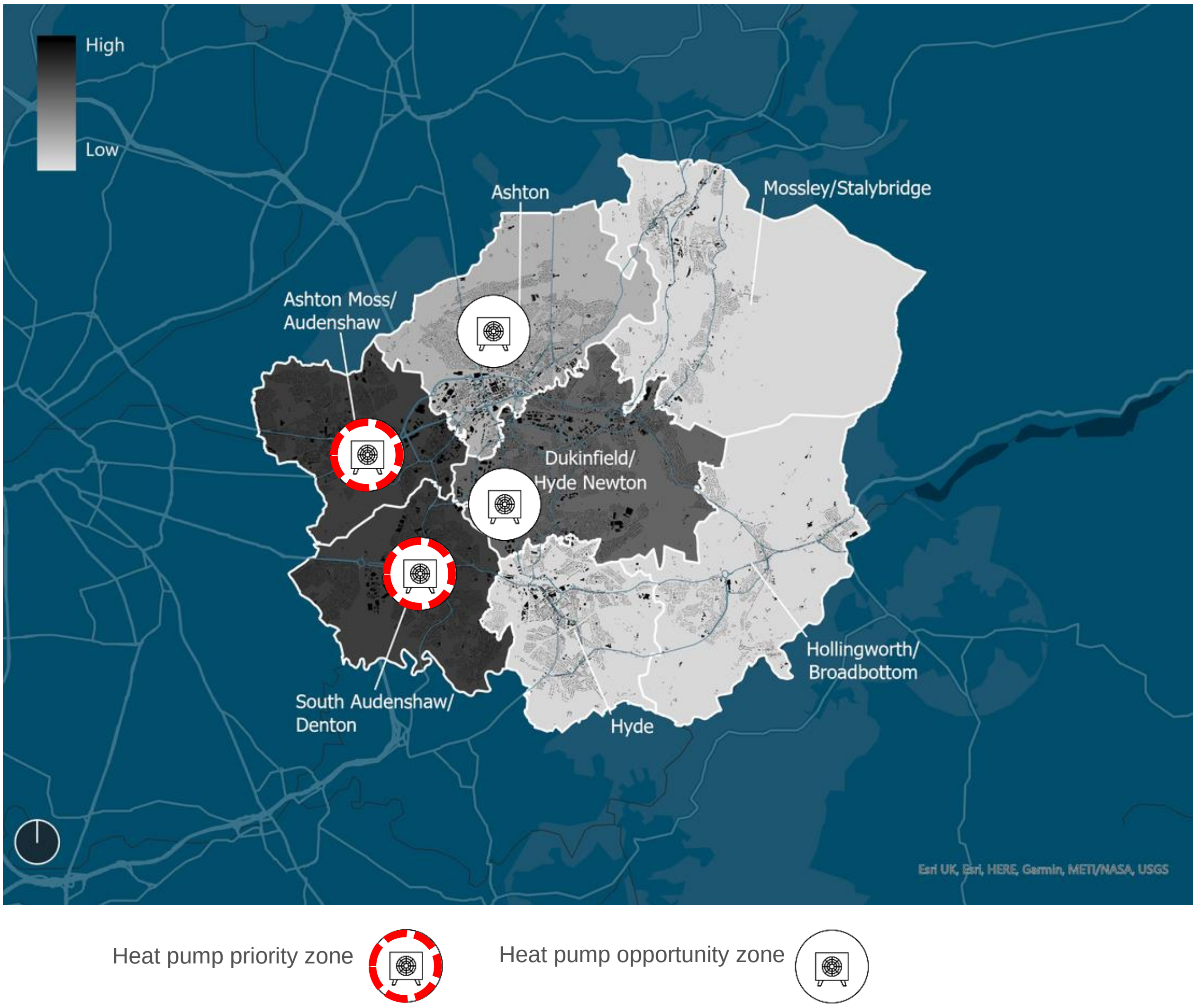
Heat pumps are a proven and mature renewable heating technology, capable of delivering deep emissions reductions today. They can be rolled out to individual households gradually, without the requirement for large scale area transitions and buy-in from multiple households that district heating and hydrogen 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 site an outdoor unit where it will not cause noise issues for neighbouring properties, must be considered in the design, and can make heat pumps unsuitable for some properties.

These issues would be avoided with hydrogen boilers, which would be a like-for-like replacement for natural gas boilers.

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

The majority of homes would use heat pumps, unless affordable, low carbon hydrogen became available in time, in which case most homes would use hydrogen instead. The exceptions are homes in Mossley/Stalybridge, Hollingworth/Broadbottom and Hyde which could connect to a heat network (although large centralised heat pumps are still likely to be the heat source in these instances), and flats which could use electric resistive heating.

First Steps: Priority Areas



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

Heat Pump Priority/Opportunity Areas

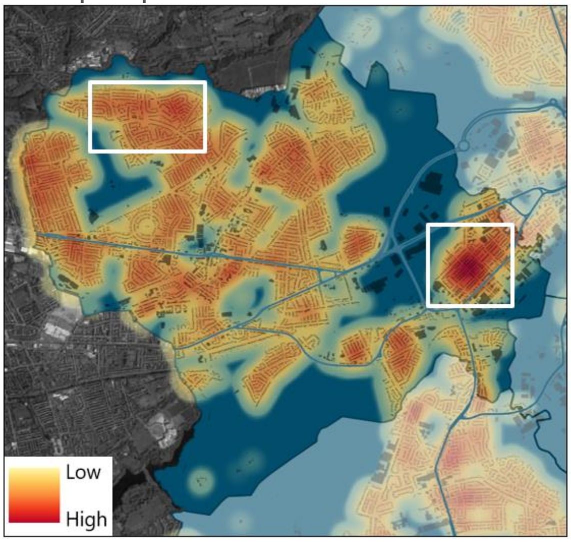
Ashton Moss/Audenshaw and South Audenshaw have the high proportion of heat pumps (Dunkinfield/Hyde Newton has the highest number of total electric systems due to the high level of resistive heating) with over 90% of heat pump deployed. A small proportion of these heat pumps (<10%) are made up of ground source solutions where space and cost are favoured. These two zones have a high proportion of both semi-detached and terraced house. The semi-detached are likely to offer an easier opportunity to make early progress with heat pump installation, thanks to typically less space-constrained circumstances. These are more prevalent in Ashton Moss/Audenshaw, whilst South Audenshaw has a higher share of terraced properties. 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 would provide useful learnings for most of the zones). These zones also contain a sizeable minority of detached homes 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 flats in these areas are predominantly selected 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 can be explored here such as optimised communally heated systems. Electrical capacity in these areas appears sufficient to deploy a large number of heat pumps before upgrades would be required.

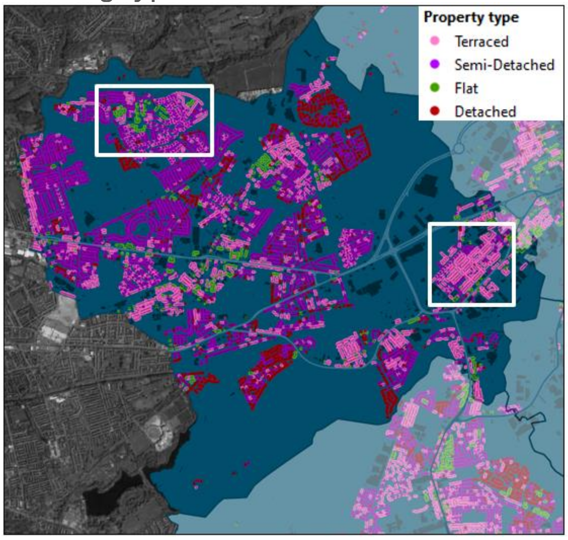
The suitability of installing individual heat pumps for each flat versus a whole-building approach is an open question which needs trials and evidence. This approach has little precedent in the UK, although individual heat pumps are used ubiquitously overseas for cooling apartments, and wall-mounted heat pumps for commercial cooling are common in the UK. A whole-building approach, while a more ambitious project, could allow a visually neater solution with less difficulty controlling noise near windows and also allow for better optimisation with peak sizes dramatically reduced at block level than individual level. High temperature communal heat pumps systems are favoured for buildings where retrofit is not feasible, which is currently being explored by numerous entities. 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 could be explored.

Ashton Moss/Audenshaw

Heat pump focus area



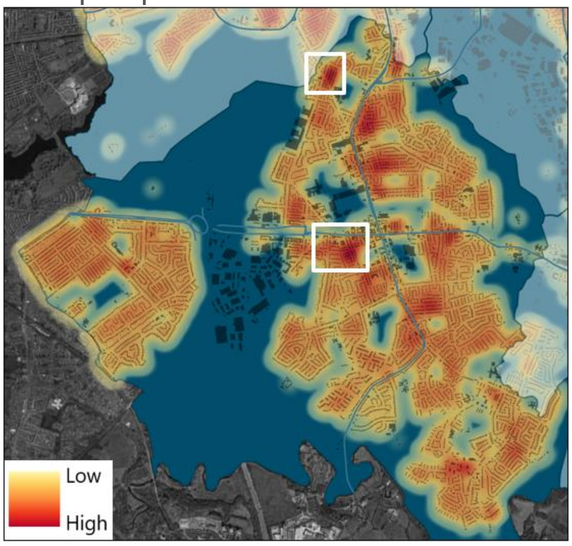
Building type



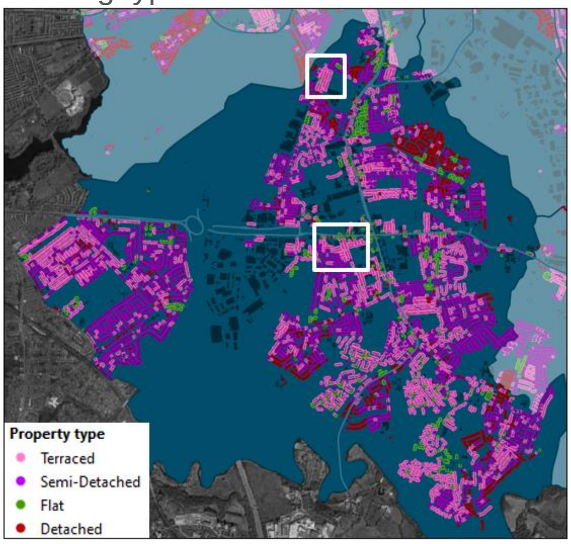
The area to the west has been selected as even though it is less densely grouped in terms of heat pumps. This is in the most part due to flats in the centre of the priority zone not having heat pumps and the semi-detached properties being more widely spaced than terraced buildings.

South Audenshaw

Heat pump focus areas

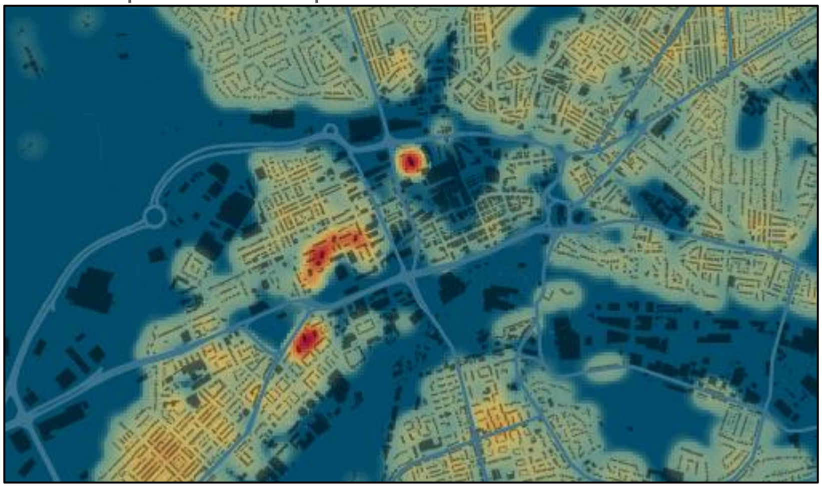


Building type



The clusters highlighted in South Audenshaw are focused around two terraced estates. These would act as useful exemplars of transitioning whole estates of this type to heat pumps. This would provide useful learning at both a building and network level in terms of most cost-effective upgrading of electricity networks. It will be useful for Electricity North West to know that all buildings in an estate are planning to transition to heat pumps as it will impact their upgrade strategy in the area.

Ashton and Dunkinfield/Hyde Newton 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 there is a slightly lower share of heat pumps and a higher proportion of electric resistive heating. Dunkinfield/Hyde Newton is more of a priority than Ashton due to slightly greater electrical network capacity in the zone, and thus less immediate infrastructure upgrades required on the primary side. It should be noted that Ashton does have the highest density clusters for heat pumps, with several blocks of flats having heat pumps flagged as the technology (these blocks are located in the town centre to the west of the Ladysmith Shopping Centre – shown in the map below). These heat pump solutions could be communal, overcoming the space issues associated with this solution and minimising the electrical capacity needs with reduced peak load requirements.



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 generally 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. Public land assets are important to consider in this context, as they provide potential locations for plant room and other infrastructure which can be hard to locate in spatially constrained areas.

Hollingworth/Broadbottom has been identified as an area of low regret* for district heating for Tameside with over 5,600 and 6,100 domestic properties identified for connection for primary and secondary scenarios respectively. Being the only area to prioritise district heating in both the primary and secondary scenarios. However, at the current time it is not seen as a priority area due to the lack of opportunities that would generally be considered economically viable under the current matrices of heat network assessment. These systems are dominated by large consumers, the recent BEIS

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

National Comprehensive Assessment[*] of heat networks places a minimum heat demand of 73 MWh/yr for economically viable connection – far exceeding a normal household's heat demand.

Instead, Hyde is identified as an initial priority zone. It has the highest number of properties (>7,000) identified as being served by district heating and also one of the highest density clusters of such properties – which is key for network viability. A specific example is highlighted below, the large swimming pool could be a useful anchor load for a scheme, and it is located next to a high density of domestic properties flagged for connection. There are also substantial public land assets (highlighted with a yellow overlay), these could potentially host energy centre(s) or boreholes for ground source heat schemes. There are also schools in the area which could act as larger anchor loads to help improve the economics of the scheme and offer diversity in demand compared to the domestic loads.

It should also be highlighted that the opportunities identified in the modelling work (Hollingworth/Broadbottom and Hyde) 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 central Ashton to serve public and non-domestic buildings.The opportunity to deploy low temperature district heating utilising water from nearby sources such as the River Tame should also be explored, which could help with minimising cost and enhancing efficiencies.

Potential for District Heating in Hyde

[*] https://www.gov.uk/government/publications/opportunity-areas-for-district-heating-networks-in-the-uk-second-national-comprehensive-assessment

Current heating systems

When assessing the feasibility of buildings to connect to a heat network, the current heating systems within those buildings should be well understood. In particular within flats, there could be a number of different heating systems, ranging from direct electric to a block wide wet plumbing system. The direct electric system would require significant works to provide distribution within the building to utilise the heat network. On the other hand, the existence of gas boilers and wet pipework system throughout the building would potentially provide an easier option, 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 Tameside. 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 Tameside, resulting in a potential shift to hydrogen dominated heating.

A further scenario was studied where hydrogen was tested as the only low carbon option (detailed in the appendix). Further analysis of both this and the secondary scenario showed that the total carbon emitted was very sensitive to the exact year that low carbon hydrogen became available in suitable quantities, which has a high level of uncertainty. Further detail is provided in Energy Networks 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. As the map below shows the proposed phase 2 stops far short of Tameside and so there is very little certainty of connection, particularly at the desired decarbonization timescales.

Proposed route and connection points for HyNet phase 2

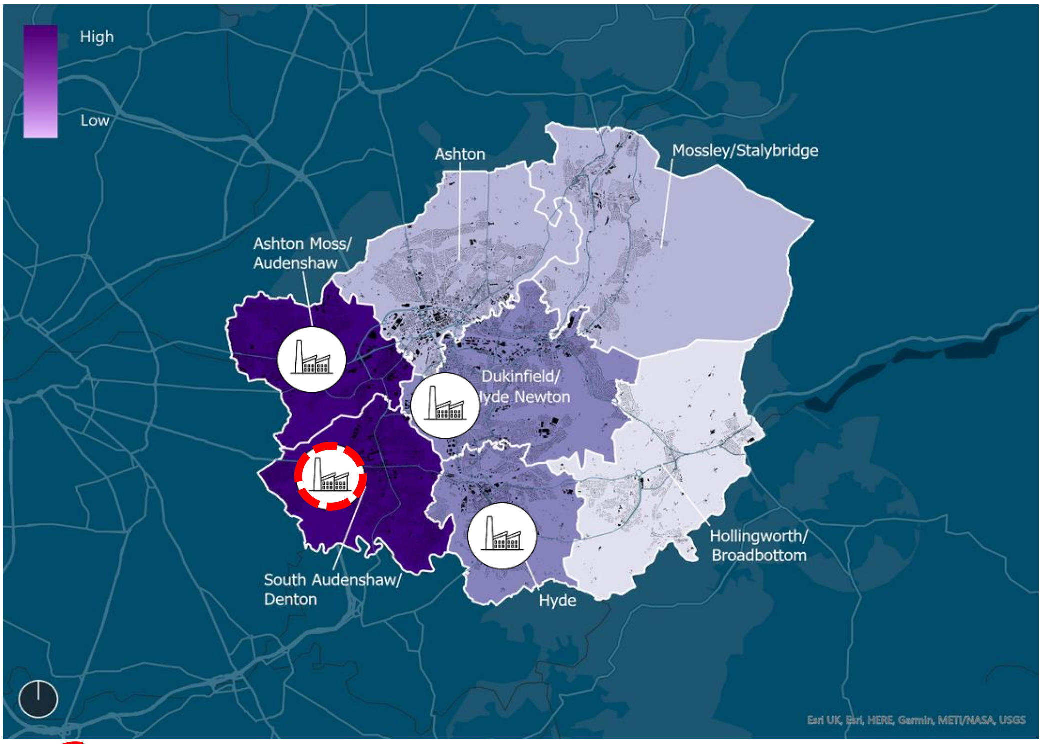
Hydrogen for Heating - Opportunity areas

Under the category of non-domestic buildings, there are a number of different functions these buildings serve, 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, in particular energy intensive industries such as textiles, metal works or consumer goods should be prioritised. A high-level desk-based study of such industrial facilities in Tameside has been conducted to highlight where these high temperature uses are likely to be.

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 Tameside 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. South Audenshaw/Denton, Ashton Moss/Audenshaw, Dunkinfield/Hyde Newton and to a lesser extent Hyde see some level of prioritised deployment of limited hydrogen.

South Audenshaw/Denton is an area which would be prioritised for hydrogen connection if supply was limited. This zone contains Denton brickworks, the largest point emitter of carbon in the area*, and also a high temperature process which is hard to electrify. The philosophy of HyNet is connecting these largest demands first and then potentially spilling out to the lower demands both domestic and non-domestic.



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

Hyde has a large potential for heat networks so presents the lowest priority for hydrogen of the four areas identified; whilst after South Audenshaw/Denton Aston Moss/Audenshaw has the next highest level of priority, followed by Dunkinfield/Hyde Newton. It should be noted the three secondary priority areas for hydrogen are clustered around the priority area, which reflects the likely evolution of a hydrogen, with connections stemming from one central point.

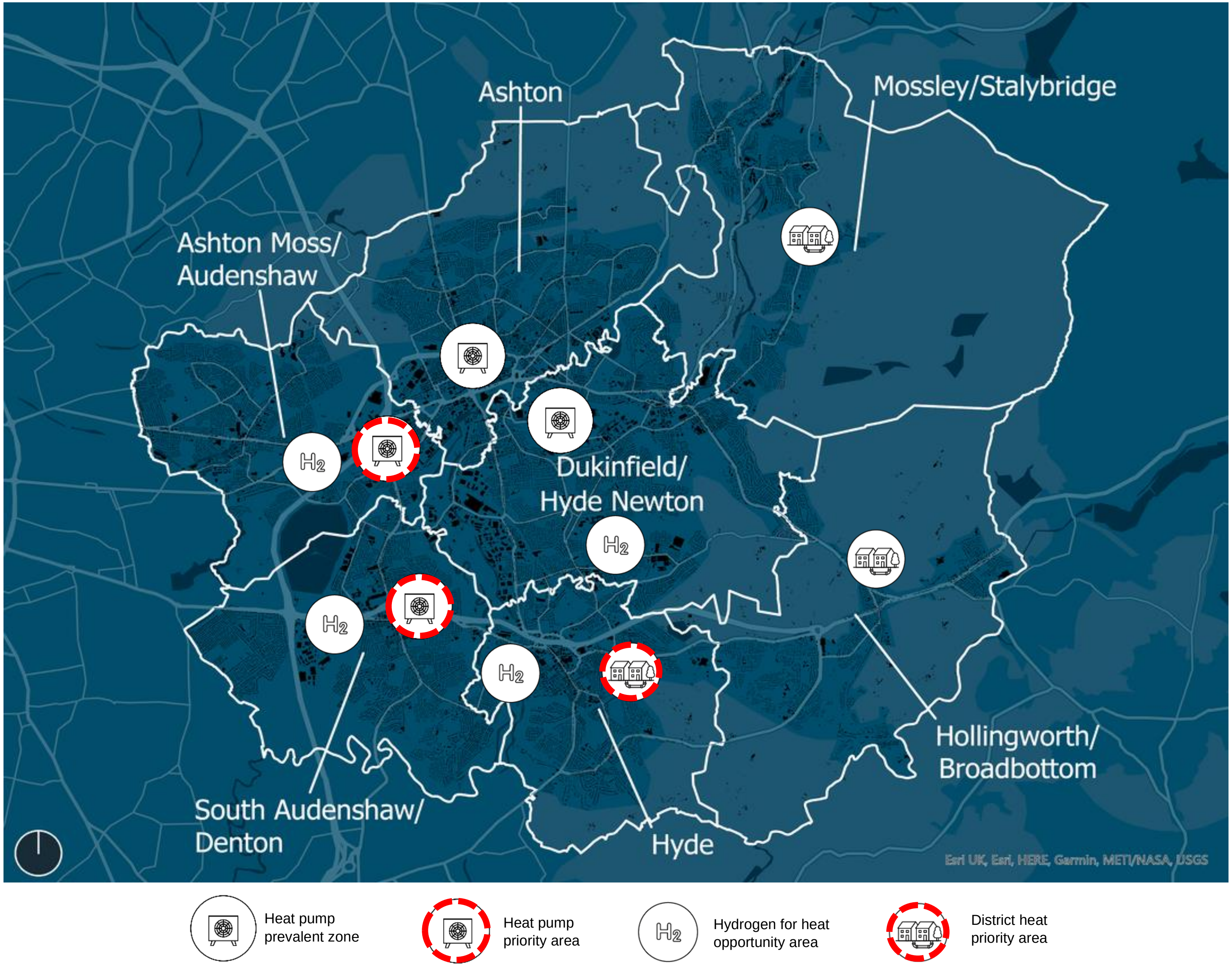
* This information is taken from the National Atmospheric Emissions Inventory https://naei.beis.gov.uk/data/map-uk-das

4. HEATING SYSTEM ZONES - SUMMARY

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

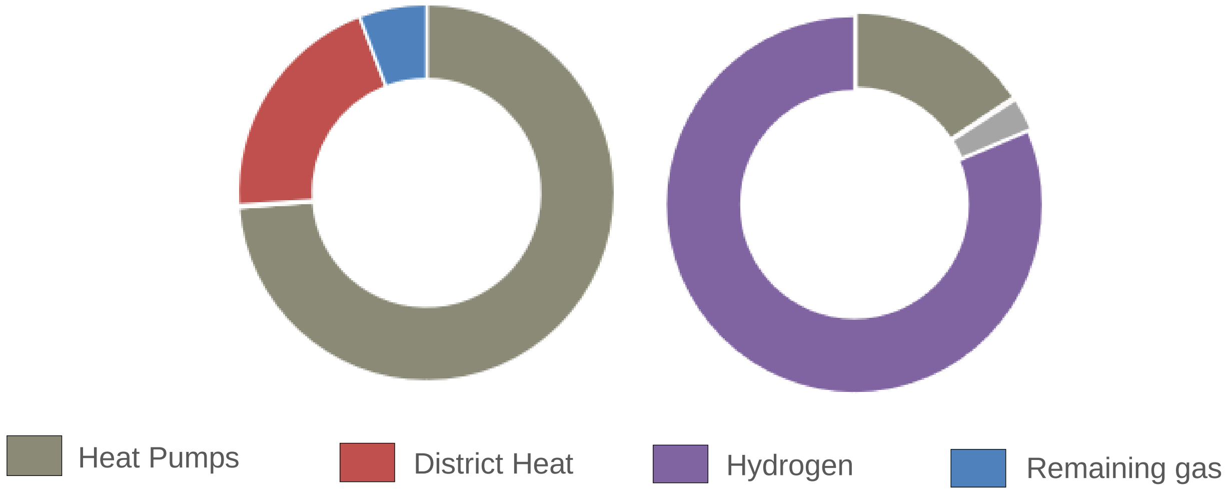
- In the secondary scenario, heat pumps remain the solution of choice for detached homes, while some flats remain on electric resistive heating. The majority of terrace and semi-detached houses transition to hydrogen.
- In the primary scenario, Heat pump options are generally dominated by low temperature air source heat pumps. District heating also makes up a key proportion of heating systems in Ashton and Dukinfield.

Zone	Prevalent heating system	
	Primary scenario	Secondary scenario
Ashton	Heat pumps	Hydrogen
Ashton Moss / Audenshaw	Heat pumps	Hydrogen
South Audenshaw / Denton	Heat pumps	Hydrogen
Mossley / Stalybridge	District Heating	Hydrogen
Dukinfield / Hyde Newton	Heat pumps	Hydrogen
Hyde	District heating	Hydrogen
Hollingworth / Broadbottom	District heating	District heating


Ashton
Mossley/Stalybridge
Ashton Moss/
Audenshaw
Dukinfield/
Hyde Newton
Hollingworth/
Broadbottom
South Audenshaw/
Denton
Hyde
Esri UK, Esri, HERE, Garmin, METI/NASA, USGS
Heat pump prevalent zone
Heat pump priority area
Hydrogen for heat opportunity area
District heat priority area

With the requirement to rapidly reduce CO_2 emissions in line with the GM carbon budget, the primary scenario is based on an individual heat pump transition for the majority of Tameside's non-domestic buildings. The estimated combined investment (for improving the energy efficiency and installing heat pumps) is in the region of £0.95b.

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



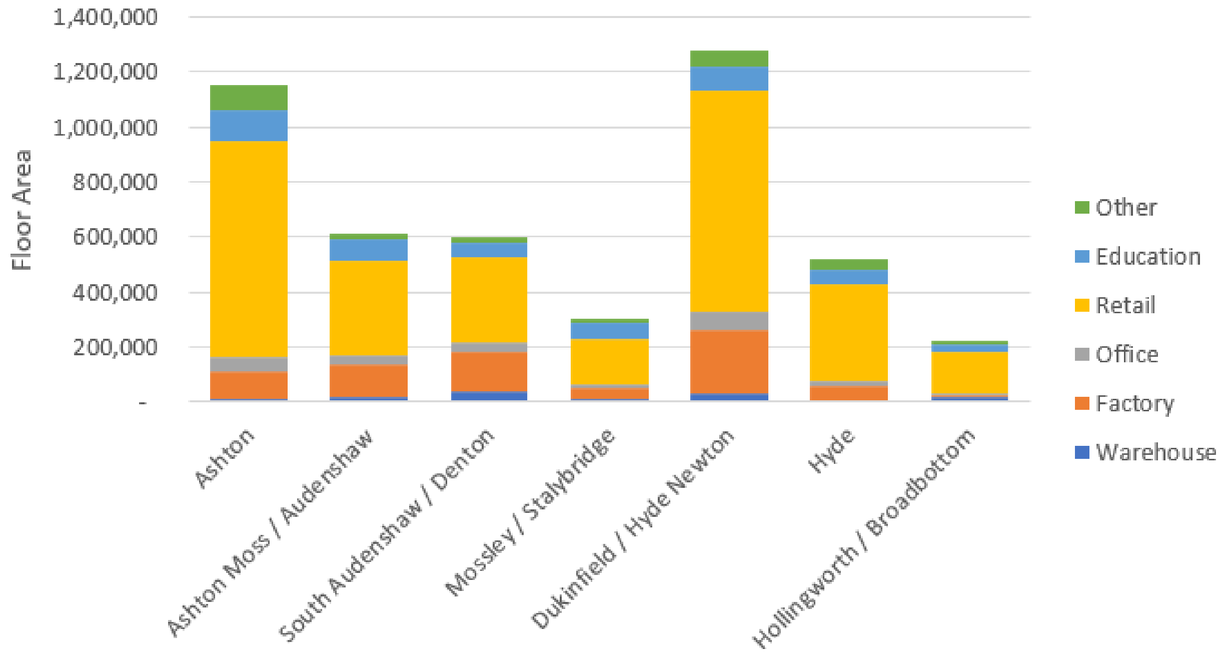
- The primary scenario suggests the majority of Tameside's non-domestic buildings (74% by floor area) have been deemed able to transition to a heat pump option with a further 20% (by floor area) suitable for district heat networks. A small proportion (6% by floor area) are deemed to be reliant on either gas for use in industrial processes.

- The secondary scenario suggests the majority of non-domestic buildings (81% by floor area) to be supplied by hydrogen with a low proportion of non-domestic buildings deemed suitable to implement heat pump and district heating system.

- 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, Hyde has been identified as an area 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.

* 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

Ashton and Dunkinfield/Hyde Newton are the two focus areas for non-domestic buildings. These have the highest density of retail, causing the dominance of non-domestic floorspace in these areas. There is variety in approaches to decarbonisation of retail space but there are general solutions (i.e. insulation and heat pumps or heat networks) which work across the building stock in the retail sector.

Factory floorspace makes up the next largest sector after retail, these can have various requirements for high temperature process heat more suitable to hydrogen or bespoke solutions. Finally, education facilities are the third largest floorspace, these are suitable to solutions such as heat pumps but importantly are also often public assets – meaning they can make important anchor loads for potential heat networks in zones.

Non-domestic decarbonisation main opportunity areas

 Non-domestic opportunity area

The focus on Ashton and Dunkinfield/Hyde Newton for non-domestic decarbonisation is indicative of these areas being better suited to traditional heat networks – an example is provided below for a closely clustered set of education and a care home (which normally carries a high heat load).

There is also substantial opportunity in Ashton-under-Lyne town centre from non-domestic assets. This includes sites like the library, magistrates court, education facilities, various medical sites, hotels and the Ladysmith Shopping Centre. There are also some large flats, which can be suitable anchor loads for heat network connections. There are also substantial public land assets in the area for infrastructure siting. Finally, the river Tame could provide a source of heat for the network and potential waste heat could be used from some commercial activities (e.g. waste heat from chillers in large supermarkets).

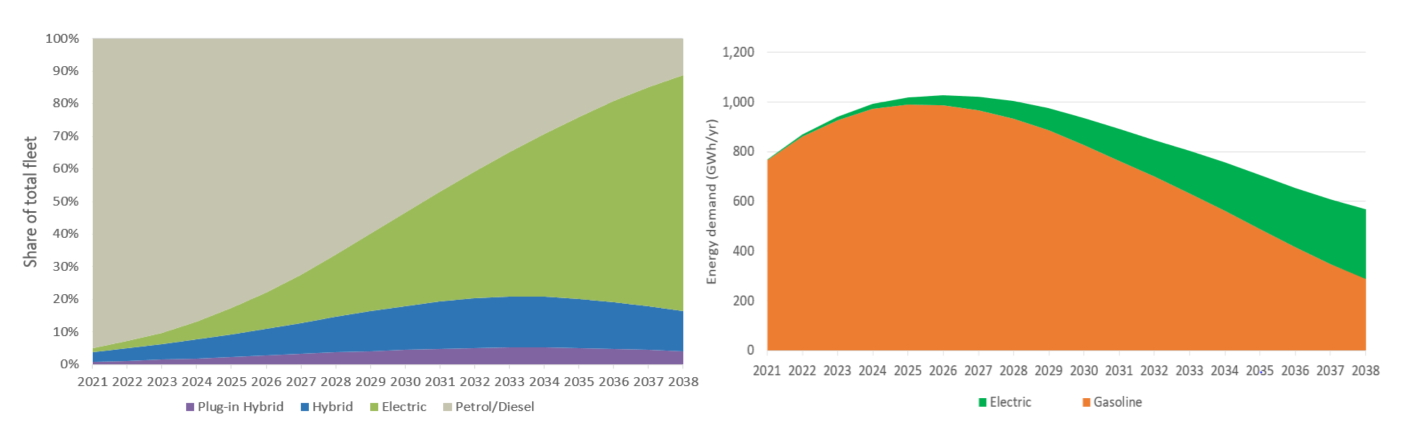
Vision to 2038

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 Tameside are expected to grow from around 2,000 today to over 82,000 vehicles by 2038 – over 76% 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.

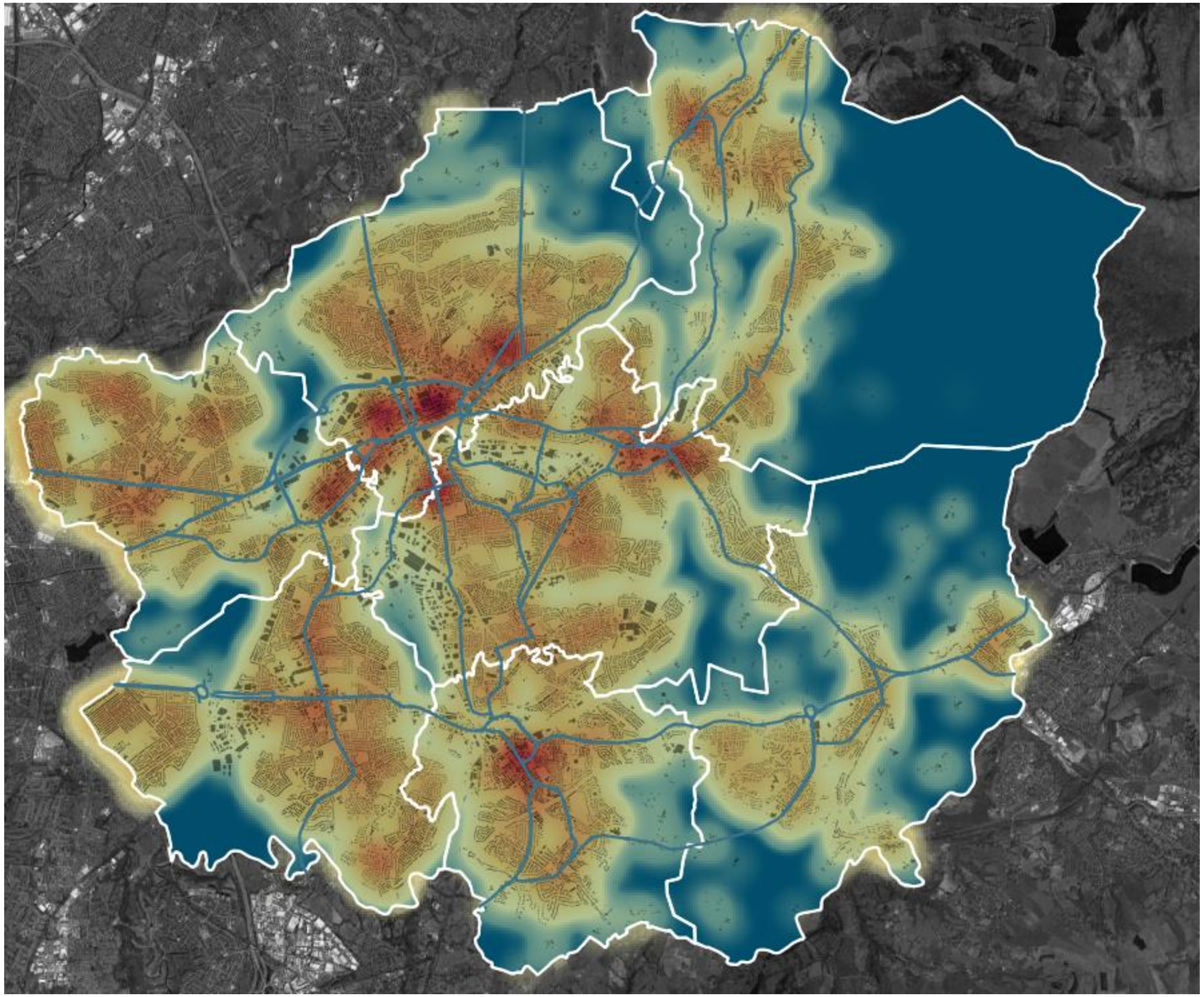
Greater Manchester's Transport Strategy 2040 sets out an ambition that no more than 50% of daily trips (across all modes) will be made by car in 2040, down from 61% today. In light of an expected overall growth in trips, the strategy sets out that meeting this target would mean a reduction of car trips from the current 3.7m per day to 3.4m. Due to the greater efficiencies of EV cars versus internal combustion engines (ICE), a significant reduction in energy demands are expected. However, this still represents a significant demand for EV charging, estimated to increase to 278 GWh per year in Tameside by 2038. The energy which would be consumed by electric cars, which make up to 76% of the total fleet, would be comparable to the energy consumed by the petrol and diesel cars, despite these only making up 24% of the fleet; showing the substantial energy efficiency savings from switching to EVs.

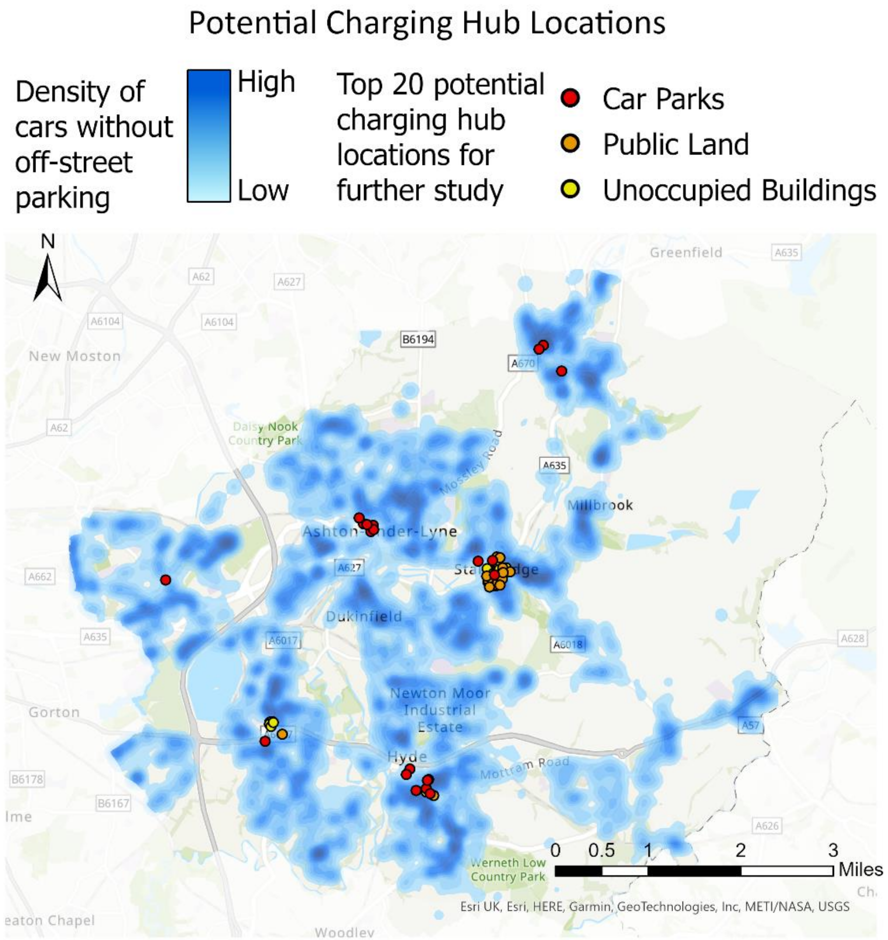
Projected Vehicle Mix Over Time

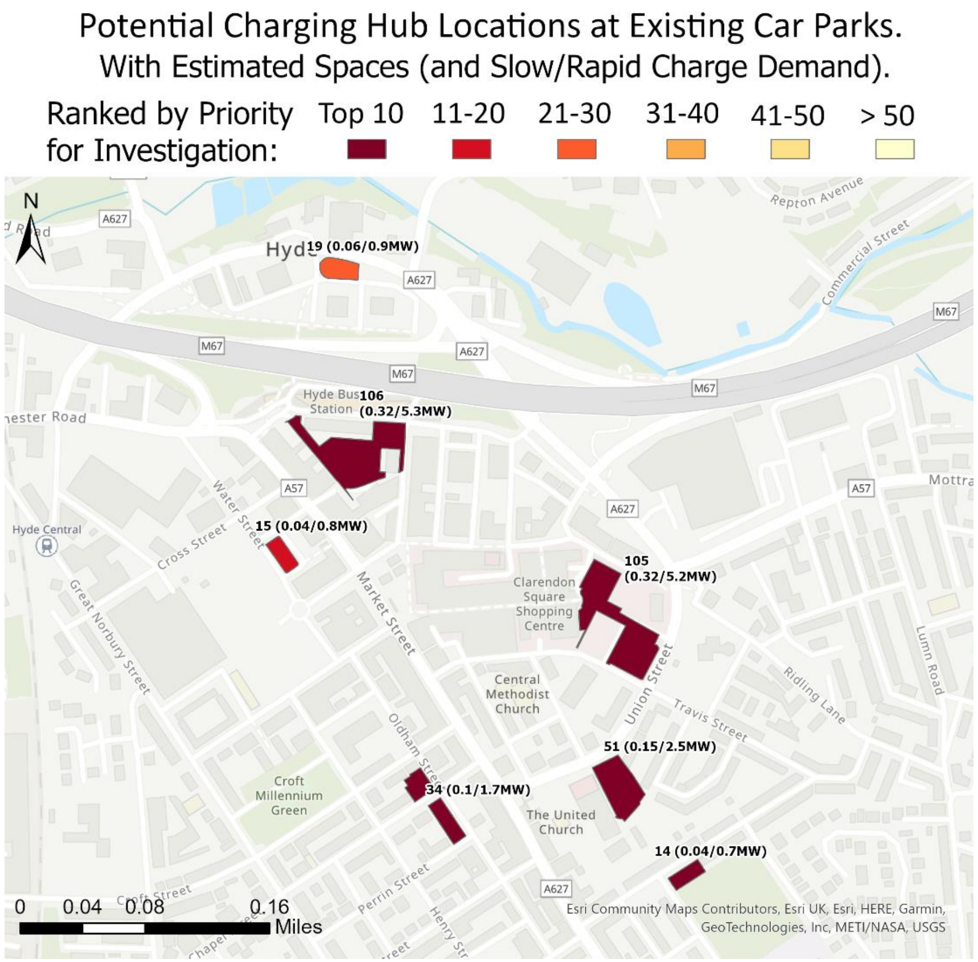


Since EV transition, supported by publicly accessible and home chargers, is a consistent result across all scenarios, all moves to make first steps in charger deployment can be considered low regret.

"Heat map" showing density of EV uptake with off street uptake by 2038 across Tameside







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 Oldham; supporting data will be provided in the accompanying detailed and granular data set.

Publicly Accessible EV Charge Points

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

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

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

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 **50,000 home chargers**. Ashton has the highest density of these chargers, which could place stresses on the local electricity network. To help reduce these stresses and their impact 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. Tameside 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

Vision to 2038

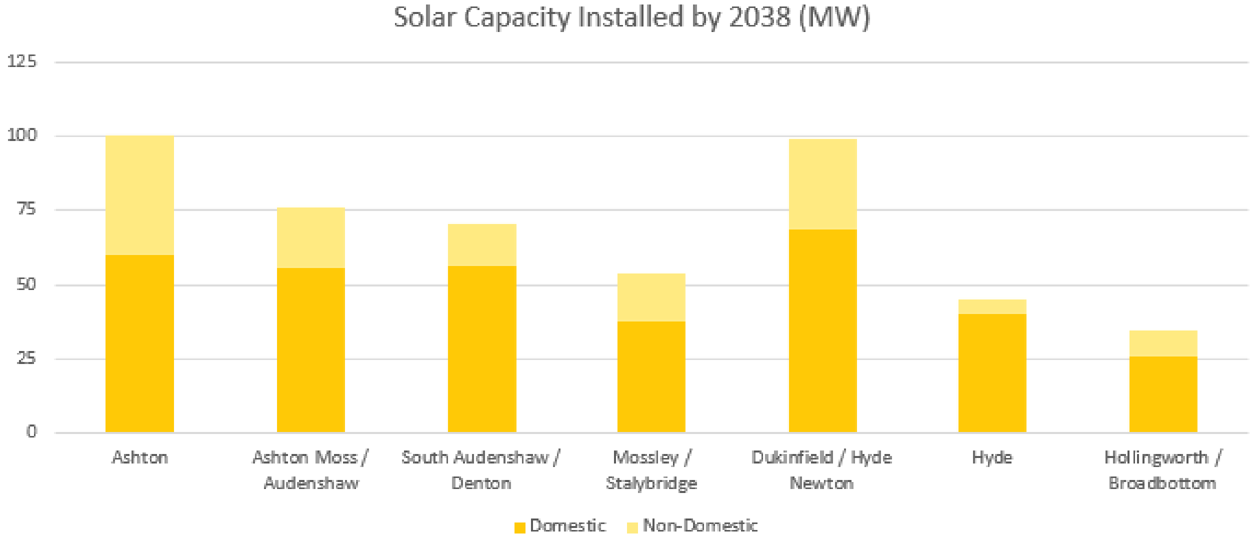
The shift to electricity for heating and transport increases the importance of using low carbon electricity sources. Although the electricity grid will need to reach almost zero carbon by 2050 for the UK to meet its net zero commitments, with very low or even negative levels of emissions anticipated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

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

Domestic Solar and Batteries

Building rooftops are used to meet a portion of energy requirements. Every modelled scenario utilised all suitable rooftop space (generally South East to South West), resulting in approximately 479 MWp rooftop PV capacity installed by 2038, yielding 355 GWh of energy annually. Of this 479MWp installed capacity, 134 MWp has been identified suitable for non-domestic roofs. In summary, all buildings with suitable roofs are low regrets opportunities to install solar PV, meaning there is plenty of flexibility around the approach for this.

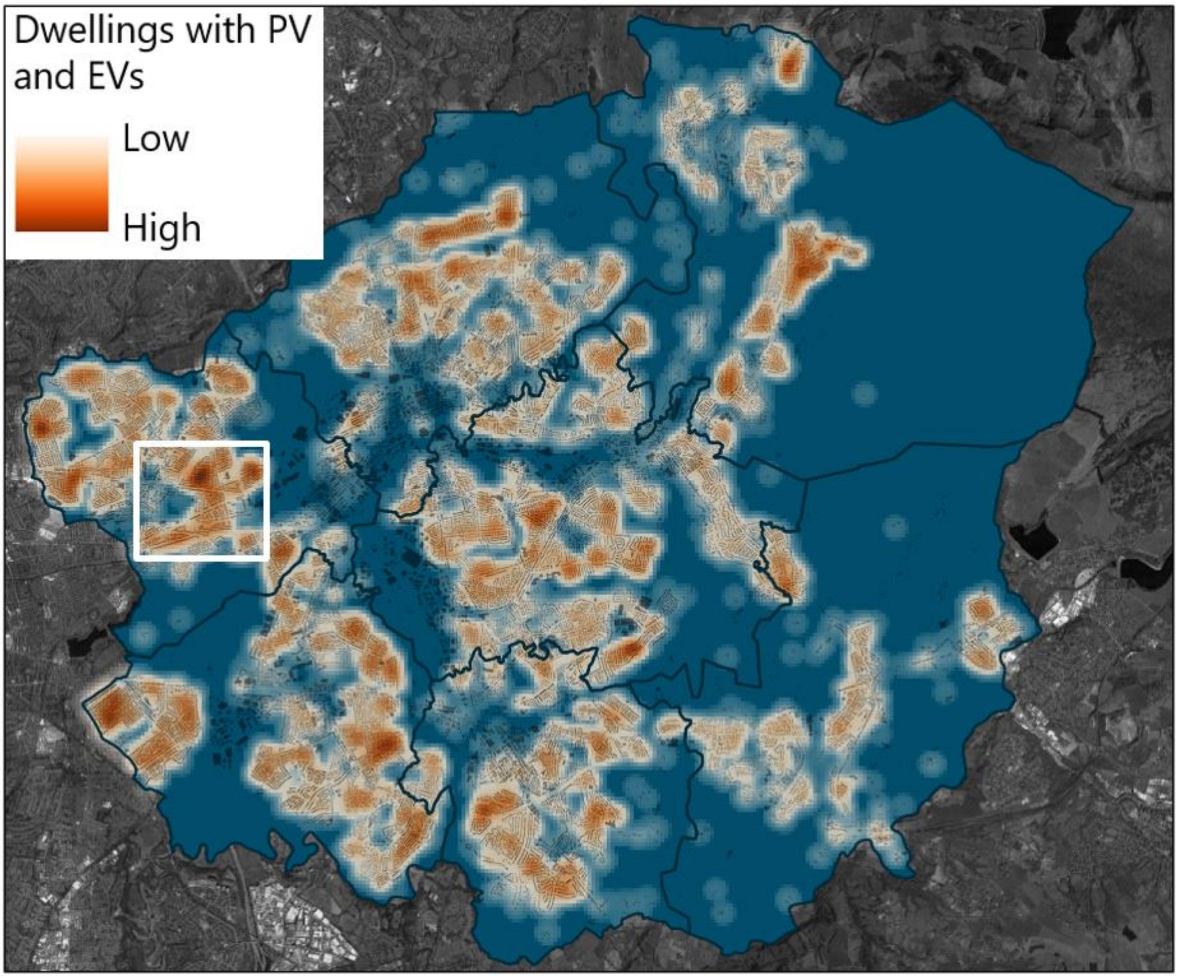


As is clearly shown the model identified greater potential in the domestic sector, to realise this potential most cost effectively combined purchasing schemes across Tameside or Greater Manchester as a whole could bring down prices

Combining the installation of PV and EV chargers could improve the efficiency of electrician work, while reducing disruption (see following two maps highlighting high densities of these measures. This opportunity could also be taken to ensure there is spare capacity (e.g. in-home distribution boards) for future heat pump power supplies.

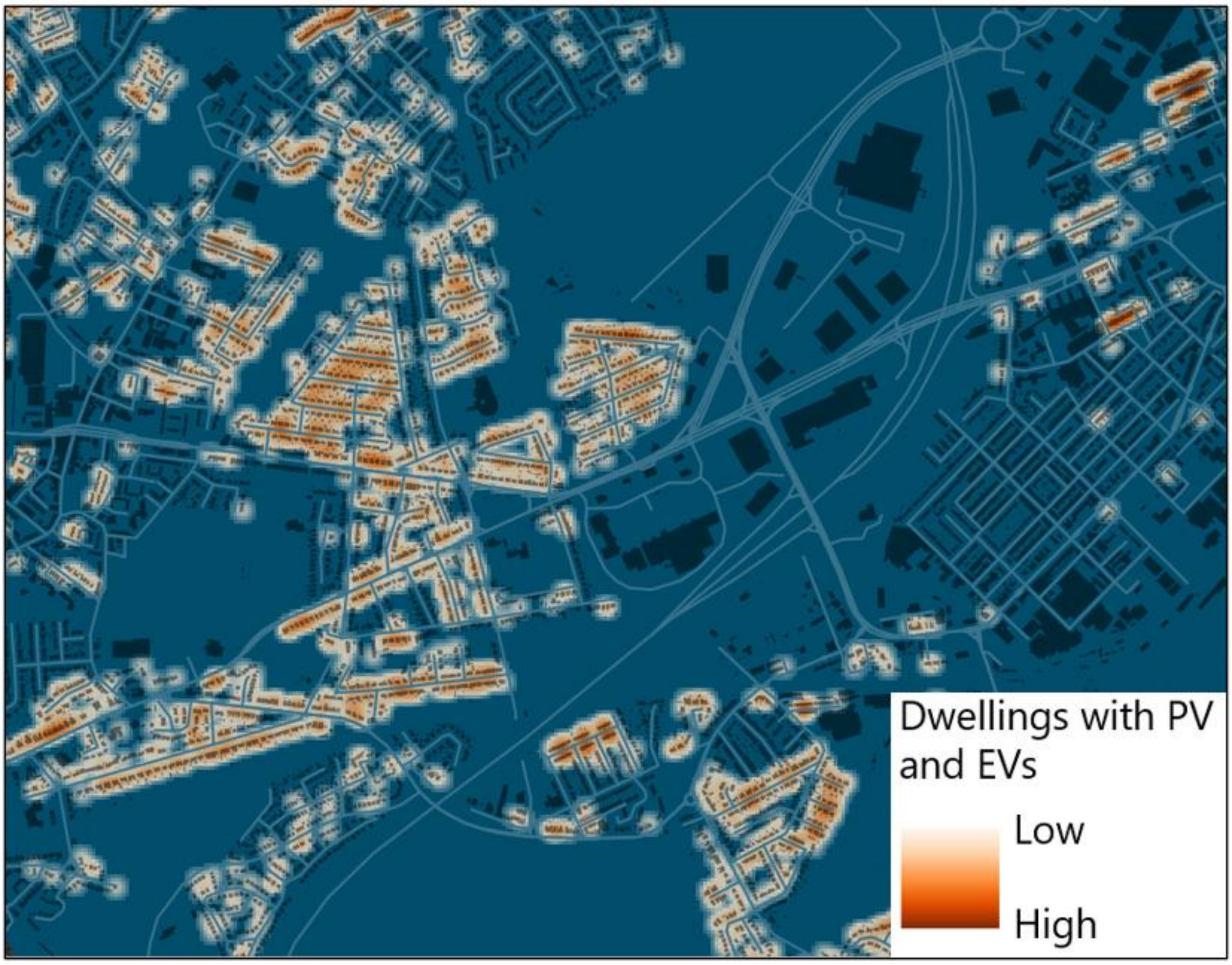
Alongside rooftop PV, there is an opportunity to install batteries to help flatten the load profile and reduce network reinforcement demands. New market incentives which value flexibility may boost the economic case for batteries going forward.

Density of dwellings with both rooftop PV and EVs, by 2038 in Tameside



There is a good spread of dense areas of properties with PV and home EV chargers across Tameside, with Ashton Moss/Audenshaw and South Audenshaw/Denton having the highest density of such properties and Hollingworth/Broadbottom the lowest. Ashton Moss/Audenshaw contains one of the higher densities of such buildings, marked by the white rectangle an enlargement of this area is shown below.

Density of dwellings with both rooftop PV and EVs, by 2038 in Ashton Moss/Audenshaw



Large Scale Solar, Wind and Hydroelectric

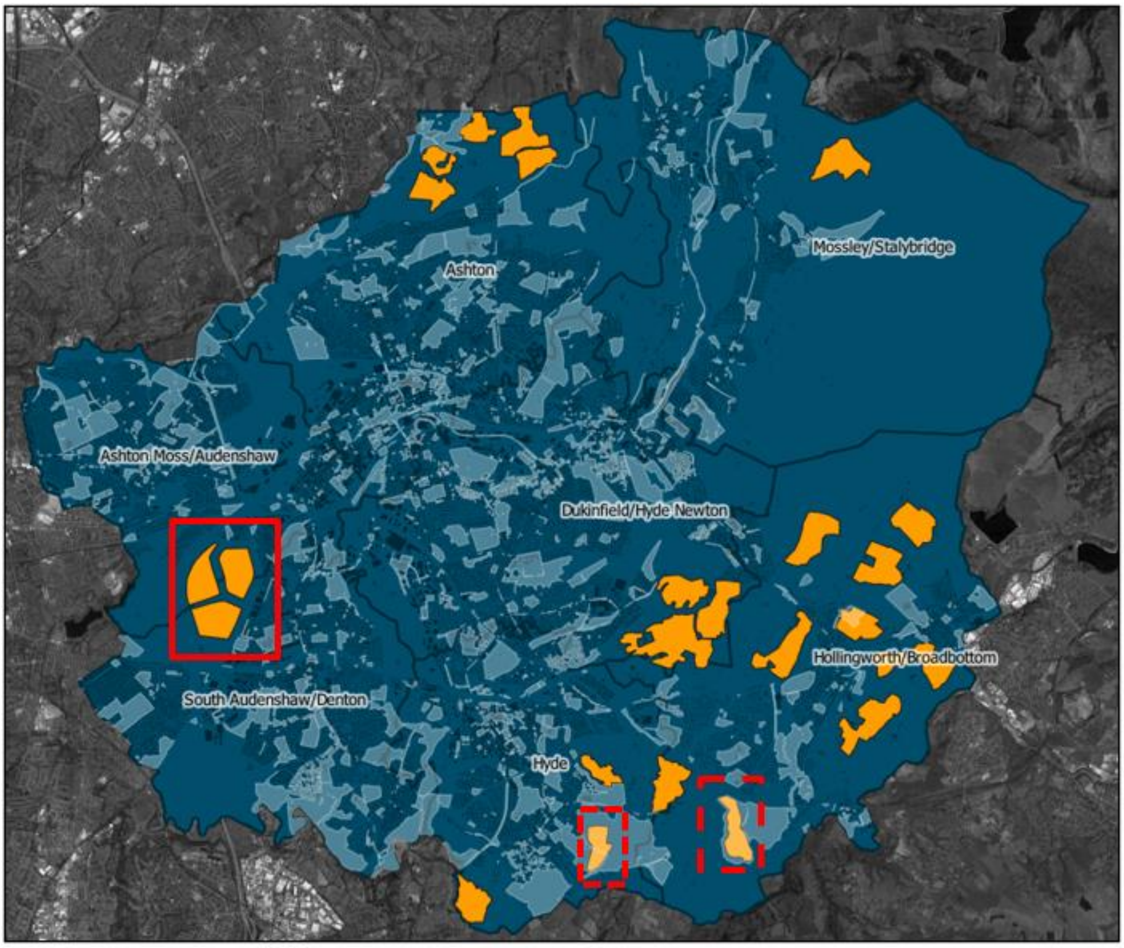
A study to determine the areas of land in Tameside suitable for ground mounted solar PV, small scale hydroelectric and wind turbines (including land not owned by the council) was carried out, accounting for factors such as flood zones, protected natural spaces and habitats, infrastructure, agricultural quality of land and future developments. This study found substantial opportunities for solar and only very limited hydro developments, but none for wind. However, further detailed and site specific assessment may identify individual sites suitable for onshore wind turbines and the outcome of this initial high level study shouldn't preclude further consideration of wind based generation within Tameside.

Twenty-five potential sites for ground mounted solar PV were identified (see map below), covering a total of up to 494 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 296 MW of PV capacity could be deployed on this land, yielding 252 GWh of energy per year. Potential for a single 656 kW hydro site was also identified on the River

Tame, which would yield >0.2 GWh per year. A map of the large solar sites is provided below.

Potential sites for large scale solar PV in Tameside



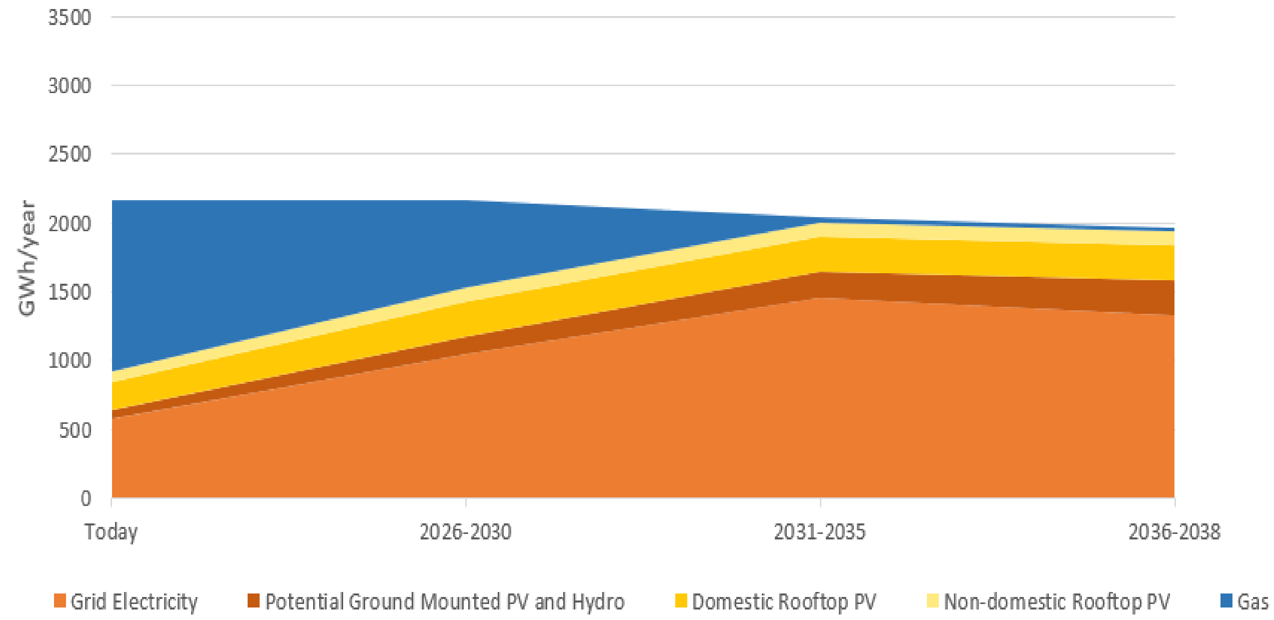
Public land assets (the light white overlay) is included in the map as these projects can be driven forward by the public sector, making them more achievable in the near future. Two potential sites (highlighted with dashed red boxes) are identified on public land assets, these would equate to ~19 MWp of installed capacity.

Three other PV sites are also highlighted in a solid red box. These are all on reservoirs and could host a theoretical capacity of ~39 MWp of PV. These are of interest due to having one direct stakeholder (United Utilities) making it easier to pursue and what is likely to be a large onsite power demand (due to pumping). Tameside already has examples of floating PV deployed at the Goodley Reservoir (also operated by United Utilities); the learnings United Utilities will have from already having a floating PV site in the area should help with the development of a scheme.

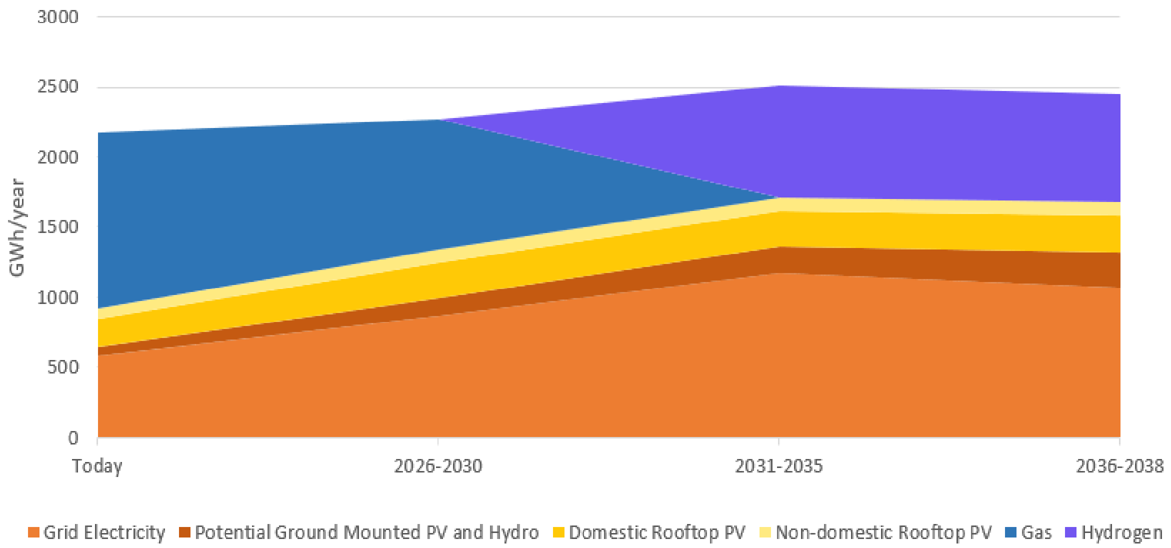
Energy Supply and Demand

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

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 Tameside to reach carbon neutrality, major changes to the existing gas and electricity networks will be required, as well as the development of new networks including district heat and potentially hydrogen networks to meet future demand without the carbon emissions.

The electrification of heat and transport is likely to drive a major shift towards greater dependency on the electricity network. Greater demand for electricity will require investment in generation capacity and storage and distribution network infrastructure upgrades, even in a scenario where all heating is provided by hydrogen, largely due to EV charging.

In the primary scenario to decarbonise Tameside 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.

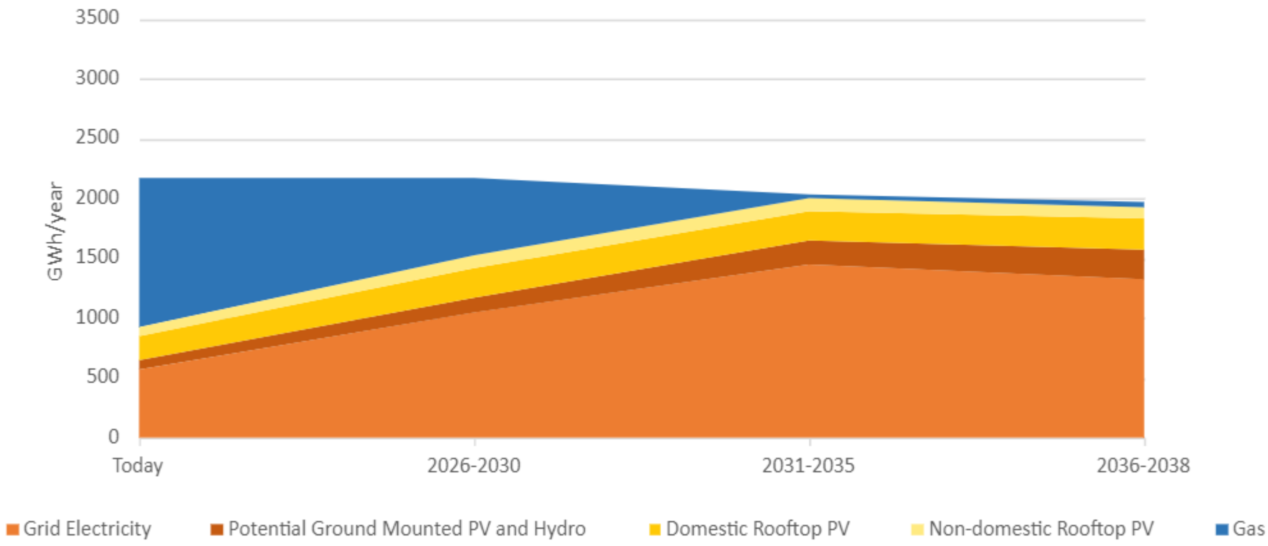
The primary scenario sees natural gas consumption reducing from ~1245 GWh per year currently down to around 37GWh by the early 2030s, and down to zero in the secondary scenario where hydrogen can replace all remaining users of natural gas.

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 Tameside.

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



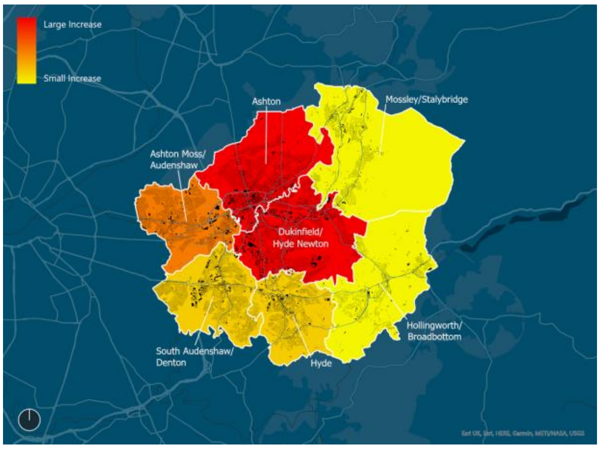
Capacity Requirements for 2038: High Voltage

The local electricity distribution network operated under license by Electricity North West supplies electricity to the majority of dwellings and industry in Tameside 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.

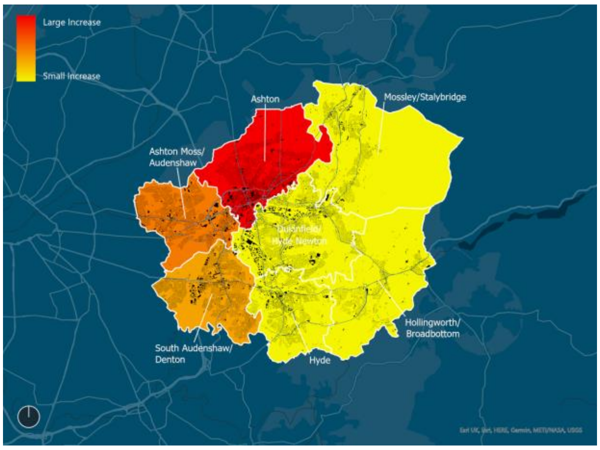
The modelled capacity requirements at high and low voltage levels are shown in the following maps and tables. The distribution of these impacts is determined by a combination of factors, such as electric vehicle ownership, potential for off-street parking and existing spare capacity in the current electricity 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	2021	2038		2021	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Ashton	72	151	72	64	224	64
Ashton Moss / Audenshaw	53	75	53	46	127	46
South Audenshaw / Denton	46	72	46	43	86	43
Mossley / Stalybridge	30	30	30	27	27	27
Dukinfield / Hyde Newton	78	127	78	77	77	77
Hyde	40	41	40	43	43	43
Hollingworth / Broadbottom	21	21	21	18	18	18

Primary Scenario – HV Feeder



Primary Scenario – HV Substation

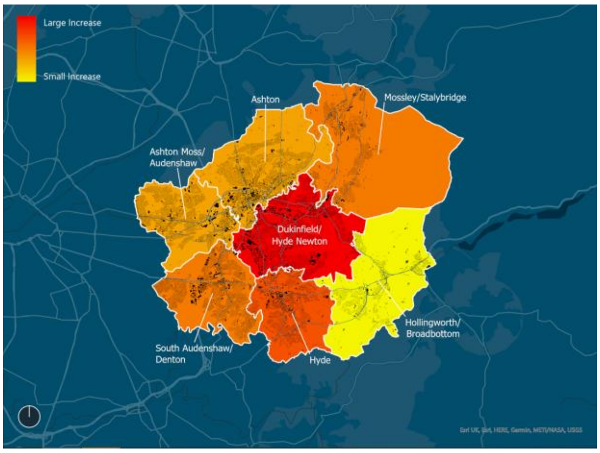


Capacity Requirements for 2038: Low Voltage

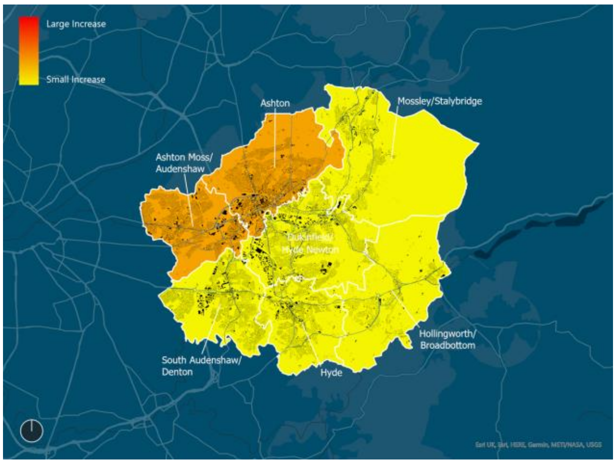
Low voltage feeders are the underground cables serving individual buildings, often located under pavements, so upgrades to these can involve extensive street works. High voltage feeders on the other hand, only run to substations which typically serve multiple streets, so require less extensive works.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

	Low Voltage Feeder Capacity (MW)			Low Voltage Substation Capacity (MW)		
Zone	2021	2038		2021	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Ashton	73	77	73	57	325	57
Ashton Moss / Audenshaw	58	63	63	38	38	38
South Audenshaw / Denton	38	79	38	38	38	38
Mossley / Stalybridge	22	30	22	24	24	24
Dukinfield / Hyde Newton	63	125	63	63	63	63
Hyde	55	42	55	30	30	30
Hollingworth / Broadbottom	16	16	16	15	15	15

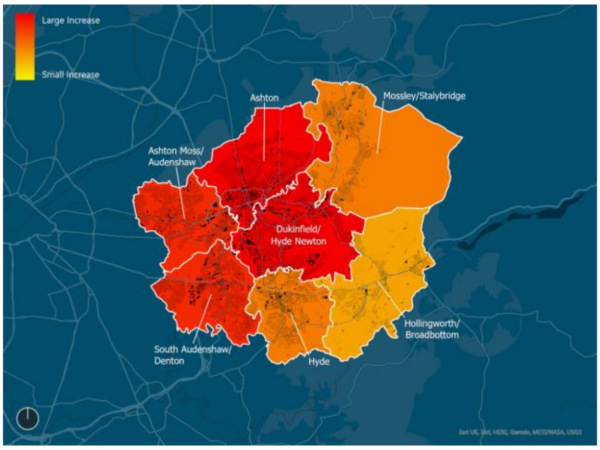
Primary Scenario – LV Feeder



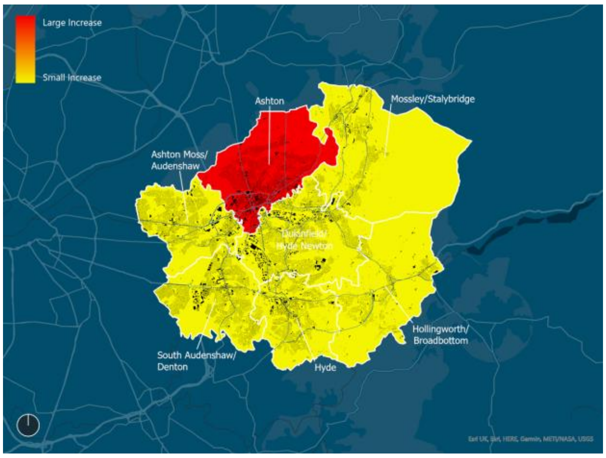
Secondary Scenario – LV Feeder



Primary Scenario – LV Substation



Secondary Scenario – LV Substation



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.

South Audenshaw/Denton and Dukinfield/Hyde Newton, for example, have the greatest levels of capacity headroom for demand, suggesting that heat pumps and EV chargers could be installed at scale in these areas before network upgrades are required. The heat network identified in Mossley/Stalybridge would likely make use of electrical capacity for centralised heat pumps.

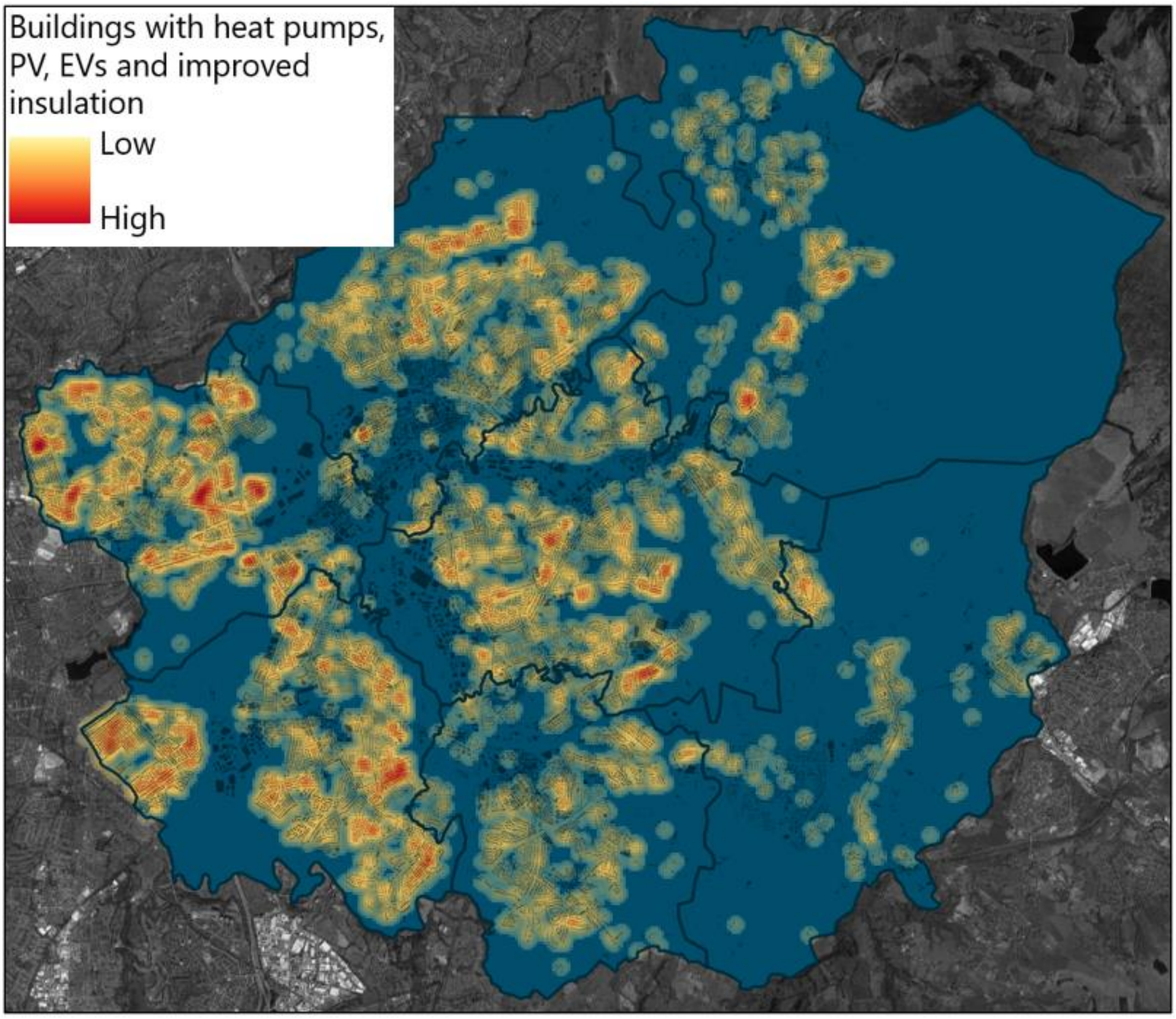
In contrast, Hyde and Hollingworth show limited spare capacity, with Hyde in particular expected to have a much higher installed heat pump capacity than Hollingworth. This suggests that although significant early progress can be made, the need for infrastructure reinforcement to deliver the full plan should be assessed early to ensure that it doesn't delay progress. In addition, Ashton is an area expected to see a high level of heat pumps and domestic EV charger points introduced, which will put pressure on the current primary demand infrastructure. 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)**
Ashton	18.8	14,207	8,343	14	100
Ashton Moss / Audenshaw	23.4	16,583	9,570	2.4	76
South Audenshaw / Denton	28.6	16,828	9,246	2.4	70
Mossley / Stalybridge	27.3	4,466	4,684	14	53
Dukinfield / Hyde Newton	44	16,394	9,645	44.8	99
Hyde	11.4	4,854	5,518	23.7	45
Hollingworth / Broadbottom	8.4	1,555	3,245	14.9	35

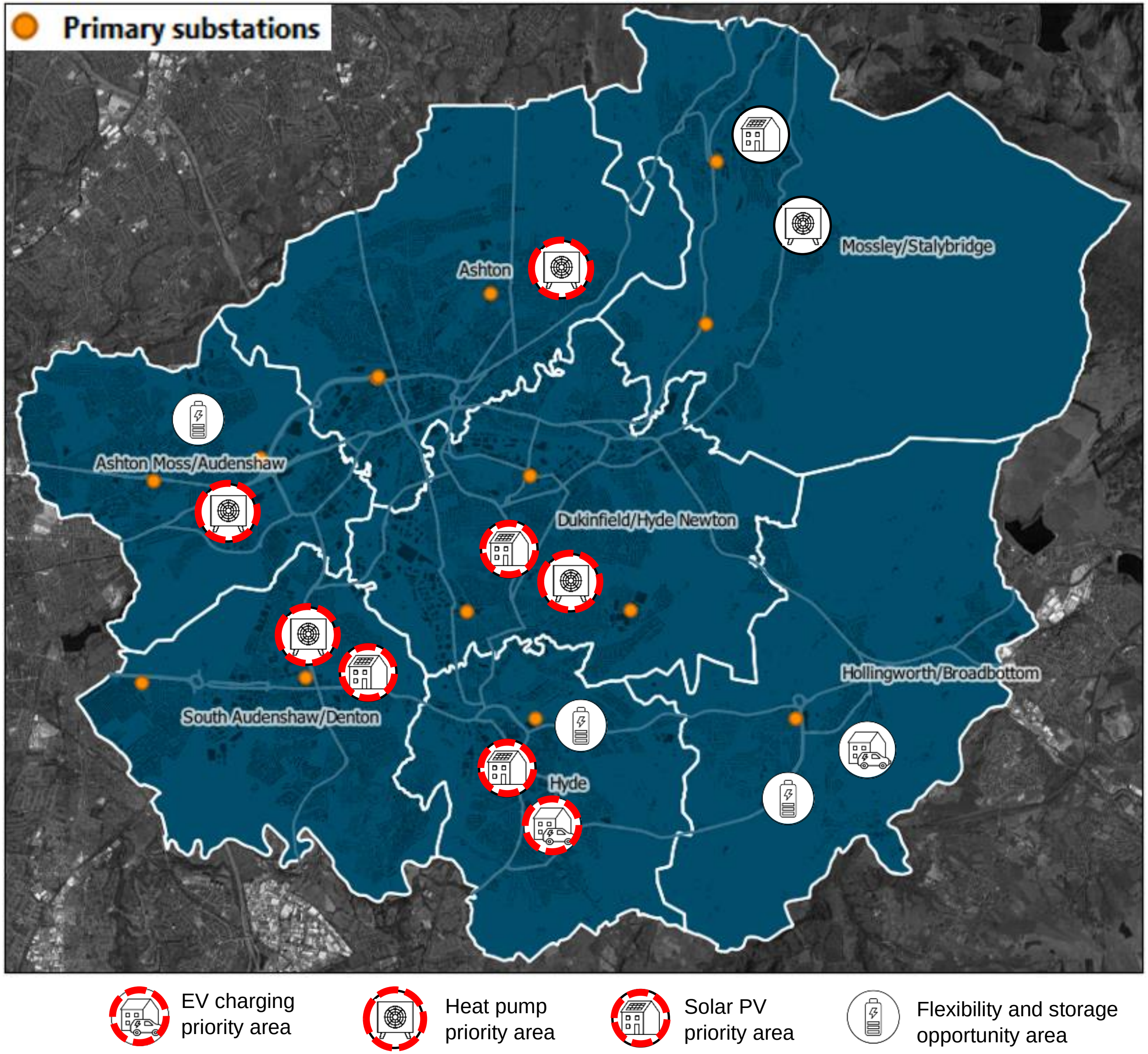
Demand headroom is firm headroom at the primary substation for the zone. Generation headroom is the inverter-based headroom at the primary substation for the zone, which is most relevant for considering solar PV. All figures from ENW's heat map tool
https://www.enwl.co.uk/get-connected/network-information/heatmap-tool/

For solar PV, Dukinfield/Hyde Newton and Hyde especially stand out as likely to be able to absorb more significant power flows from PV installation, while Ashton Moss/Audenshaw and South Audenshaw have immediate capacity limitations which could restrict solar installations without network upgrades. Having the ability to use this electricity behind the meter, through technologies like EVs and electric heating, may reduce the need for immediate upgrades to the network. The map below shows the density of building level interventions for domestic buildings. This indicates that both Ashton Moss/Audenshaw and South Audenshaw have significant potential for this integrated approach to reduce the need for network upgrades. This would require significant engagement with Electricity North West as this would not be the general approach to integration of these technologies. However, it is recognised as an area which needs to be understood by the electricity networks and there could potentially be funding available to carry investigate opportunities further in these areas (e.g. the Network Innovation Allowance and Network Innovation Competition). It is important to note that there is not sufficient capacity in any of the zones to meet the demands of the primary scenario.

High density of building level interventions



The map on the following page shows the key priority areas for different technologies, integrating regard to headroom.


Primary substations
Ashton
Mossley/Stalybridge
Ashton Moss/Audenshaw
Dukinfield/Hyde Newton
Hollingworth/Broadbottom
South Audenshaw/Denton
Hyde
EV charging priority area
Heat pump priority area
Solar PV priority area
Flexibility and storage opportunity area

Gas Network Today

The gas network supplies gas to the majority of dwellings in Tameside 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 Tameside is around 1,245 GWh.

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

Future of Gas and Hydrogen for Heat

The primary scenario for Tameside 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. Approximately £200m of investment would be required to support the conversion to a hydrogen led network. Of Tameside’s approximately 1,083 km of gas pipework, around 80% is already made of polyethylene, suggesting that much of the network could already by suitable for carrying hydrogen.

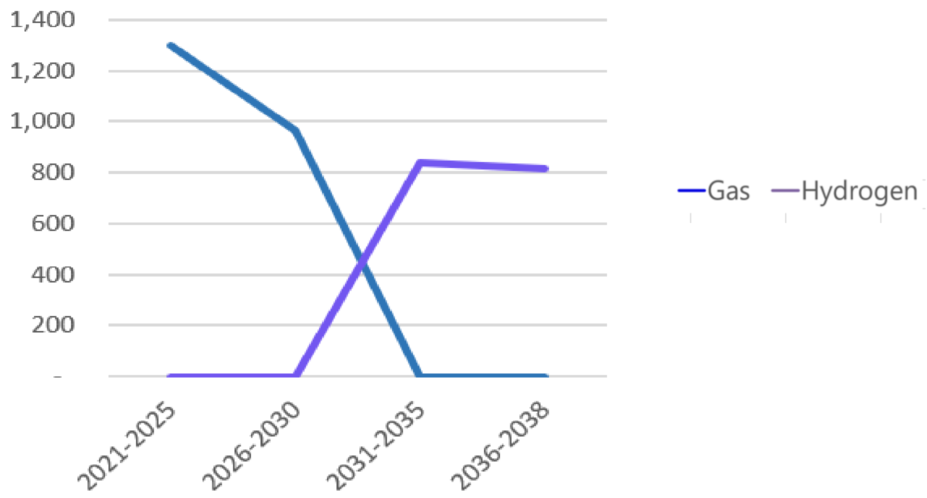
Hybrid heating (air source heat pump/gas boiler hybrid) is an option in certain circumstances and could provide a valuable transition technology to manage uncertainty around the role of the gas network in domestic heating through the 2020s. Generally larger properties are more suited to this technology, 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, all zones except Hollingworth/Broadbottom have at least 1600 domestic properties with such a system.

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

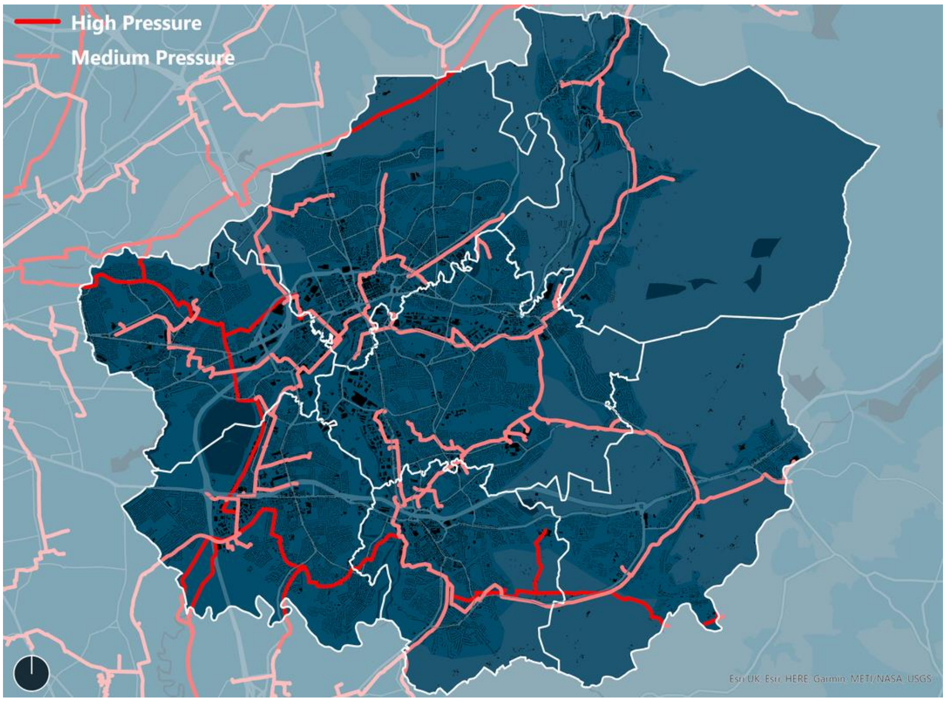
Equitable solutions for dealing with the ongoing gas network maintenance costs for remaining customers will need to be explored for the case where usage falls to very low levels. These properties may also be well suited to using hydrogen for heat under a scenario where hydrogen becomes available.

Usage of Gas Network under HyNet Scenario in Tameside



The map below provides the layout of the gas network in Tameside, illustrating that the large population areas have access to the gas grid. It shows that the network (like much of the UK) is heavily meshed, making it challenging to transition one area and not those surrounding – as is shown in the hydrogen scenario a full switch is the most effective way to integrate hydrogen. The exception is single large point demands – such as large industrial users. These are often supplied by a direct high-pressure connection, these high-pressure pipes tend to be steel which for safety reasons are likely to require replacement when transition to hydrogen. Thus, there can be scope for laying a parallel high-pressure system for hydrogen, which is the model taken for HyNet. South Audenshaw/Denton should be a priority for such a connection.

Current Gas Network in Tameside



7. ENERGY NETWORKS – DISTRICT HEAT

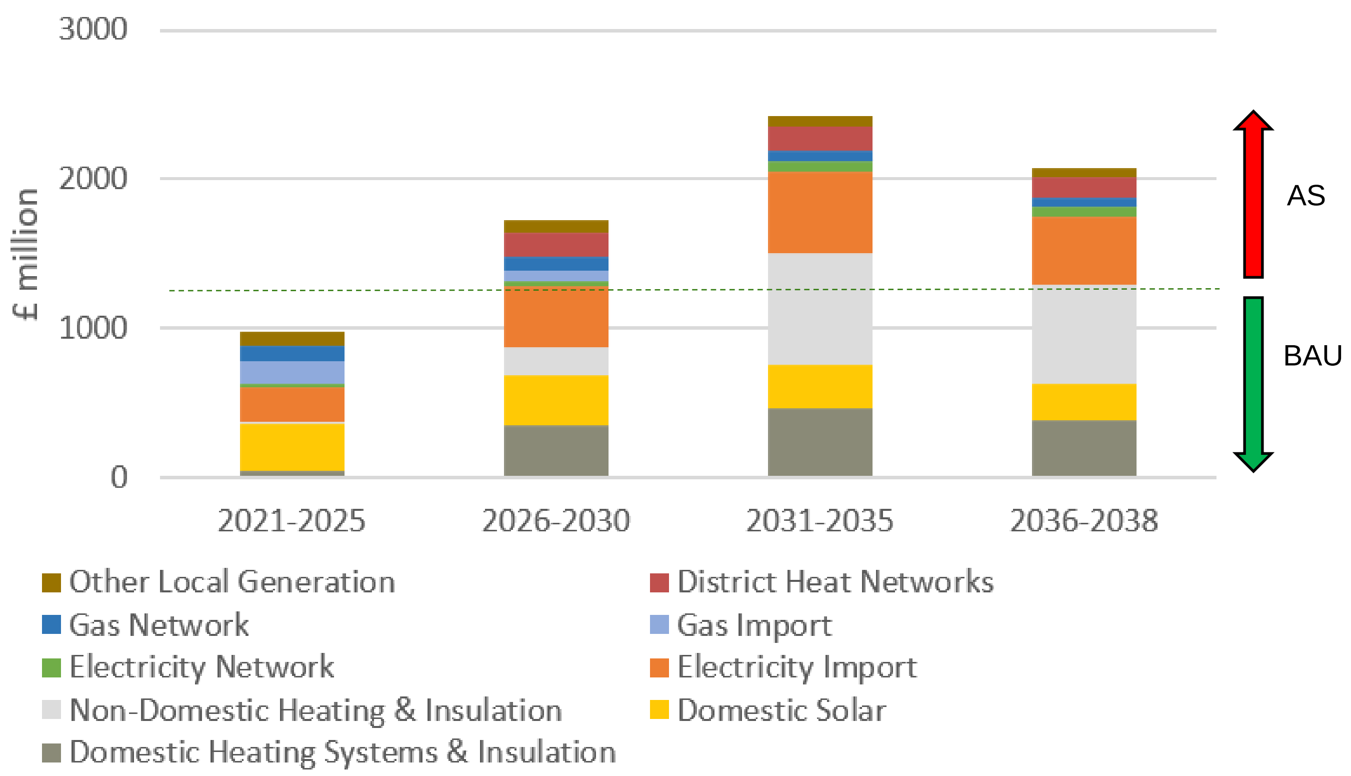
BEIS statistics indicate that there are 18 existing heat networks in Tameside. These could be expanded to integrate wider opportunities and help contribute to significant transition in dwelling heating (currently dominated by gas boilers). Modelling indicates district heating could supply ~25% (27,400) of Tameside's dwellings, which would require a large heat network rollout, beyond the expansion of existing networks. Many of the dwelling-based networks would struggle for financial viability currently due to competition with gas. The immediate opportunities are better suited to zones with a higher number of non-domestic buildings (i.e. Ashton and Dunkinfield/Hyde Newton), where more established heat network designs and models are likely to be viable. In the longer-term Hyde (which has the highest number of dwellings connecting to heat networks in the primary scenario) and Hollingworth/Broadbottom (the only zone to retain a high quantity of district heating in the hydrogen scenario) are the two zones with greatest opportunity.

The role of district heating is diminished in the secondary scenario where hydrogen meets much of the demand. In practice district heating could be supplied by hydrogen boilers in the energy centres, meaning that investment in the heat networks would remain a relatively low regrets option if hydrogen for heating materialised. By centralising the hydrogen boilers, the need to replace gas pipework in streets and buildings to make them compatible with hydrogen would be reduced. It would also mean heating systems could be added at higher pressure (due to the relative size of demand), this would help avoid the issues of the meshed gas network, discussed above, meaning hydrogen could potentially adopted in these areas more rapidly than in dwellings with individual gas boilers.

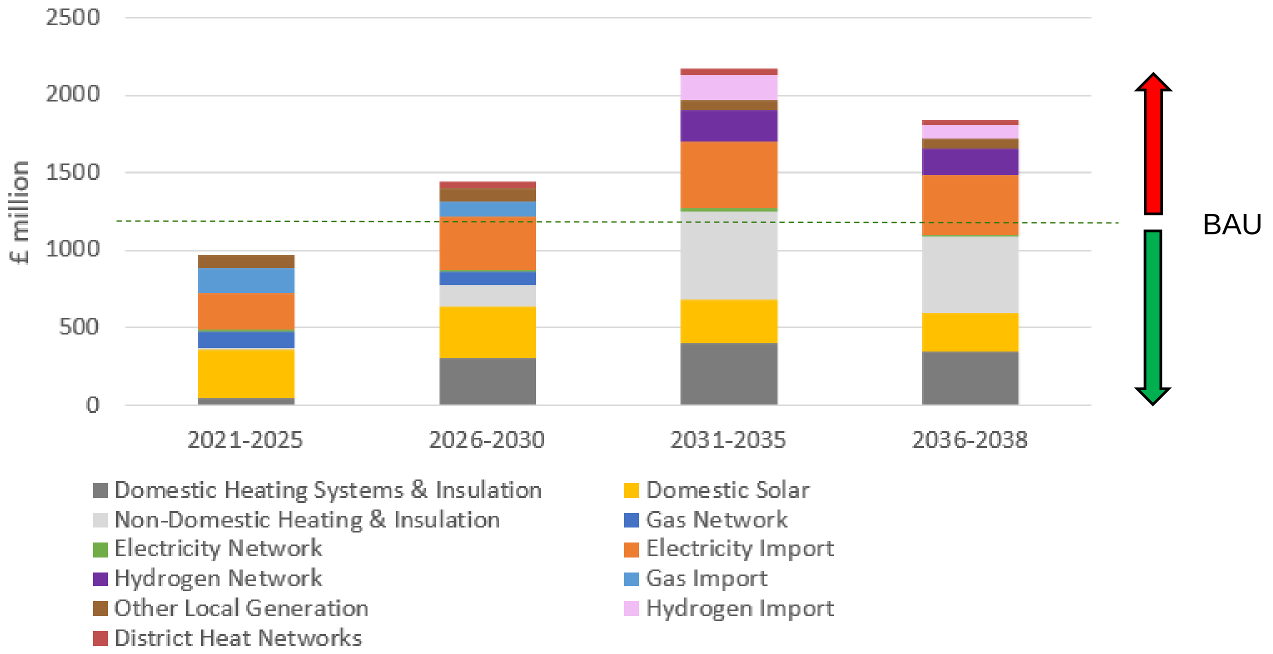
Total cost (including energy consumption)

The primary scenario is based on a total energy system spend of £7.2 bn (compared with £6.4 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 (estimated to be ~ 70%). 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 (~£5.1bn), 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. The arrows on the right-hand side of the graph represent how the costs compare to no zero carbon transition, providing the business as usual (BAU) case and the additional spend (AS) from switching.



Secondary Scenario



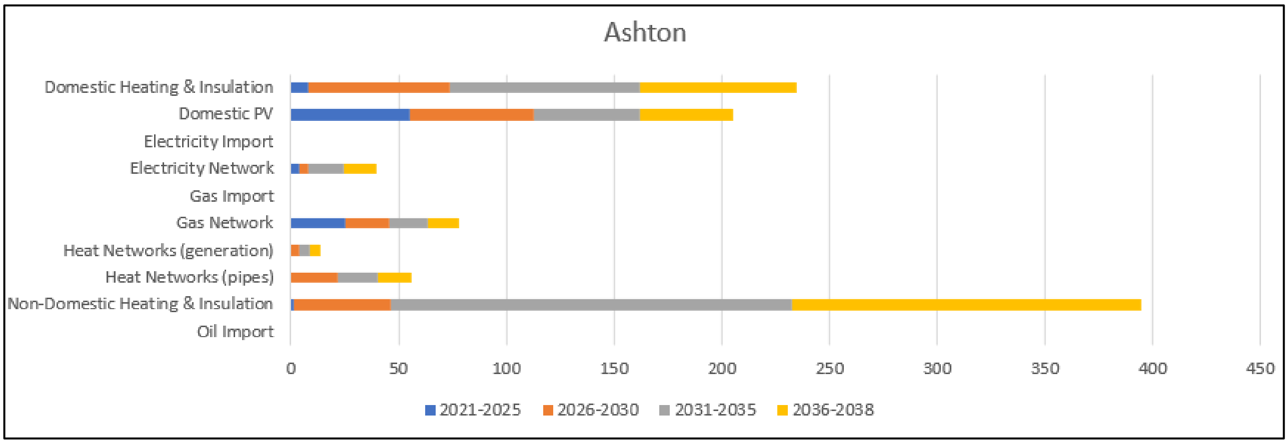
Investment (exclusive of energy consumption)

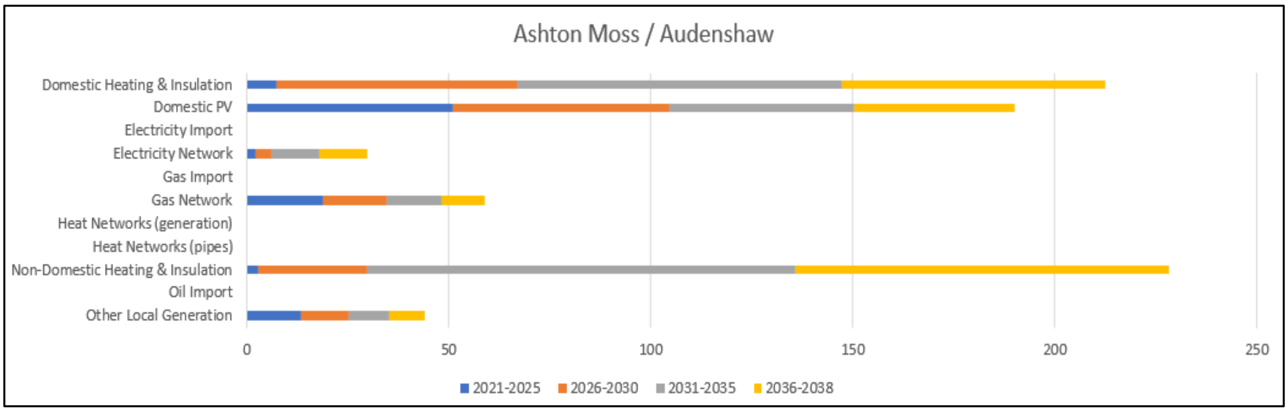
The tables below illustrate the total investment needed in the energy system to deliver the plan, equating to a total of £5.3 bn for the primary scenario and £4.5 bn for the secondary, with the charts on the following page breaking this down by technology. Again, a significant proportion of this investment will be required without working towards carbon neutrality, for example expenditure on replacement gas boilers is instead targeted at low carbon heating systems.

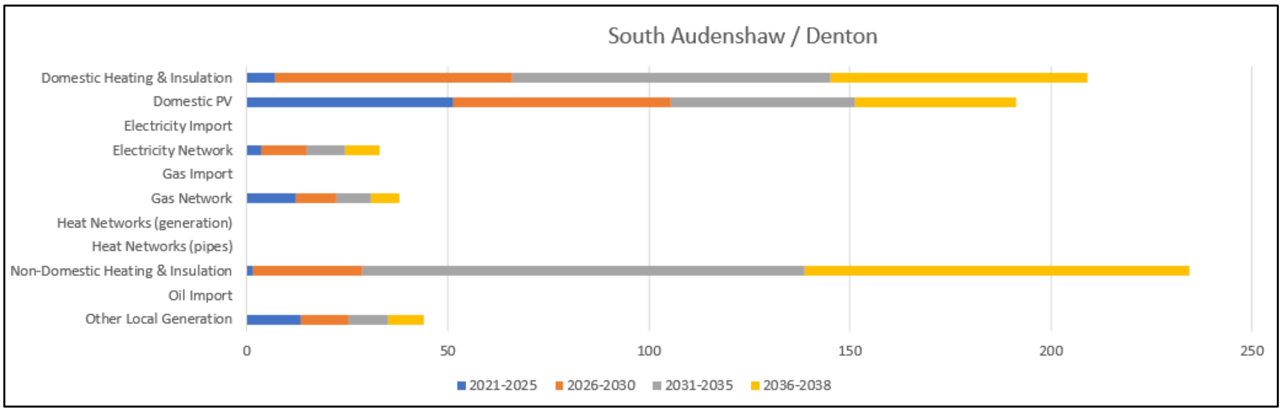
Zone	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Ashton	1,087	979
Ashton Moss / Audenshaw	763	688
South Audenshaw / Denton	749	625
Mossley / Stalybridge	535	419
Dukinfield / Hyde Newton	1,166	941
Hyde	619	480
Hollingworth / Broadbottom	372	385

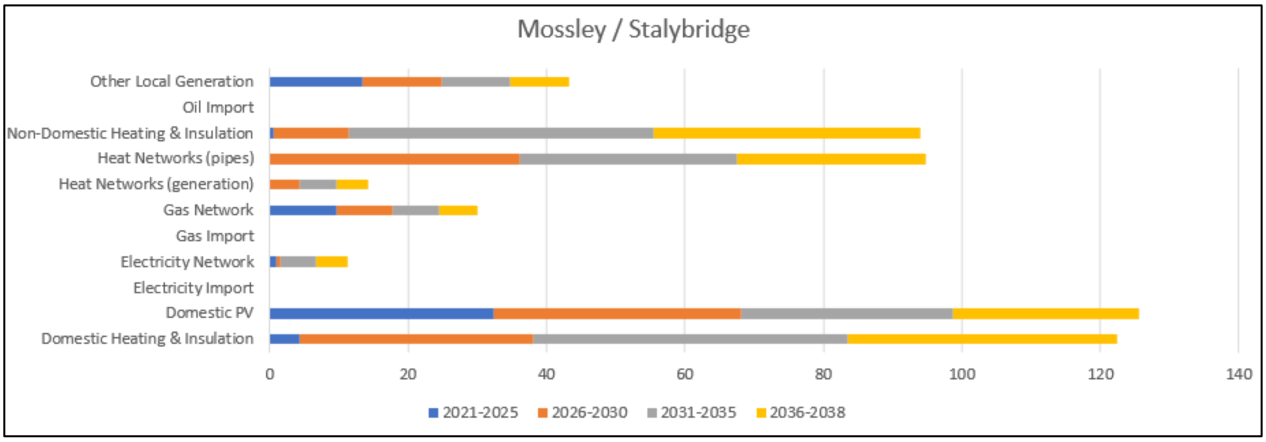
Investment type	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Domestic Heating Systems & Insulation	1,247	1,095
Domestic Solar	1,180	1,179
Domestic EV Chargers	28	28
Non-domestic Heating Systems &Insulation	1,604	1,213
Non-domestic Solar	306	306
Large Scale Ground-mounted Solar	128	128
Electricity Network	174	51
District Heat Network	456	106
Gas Network	325	192
Hydrogen Network	-	198

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

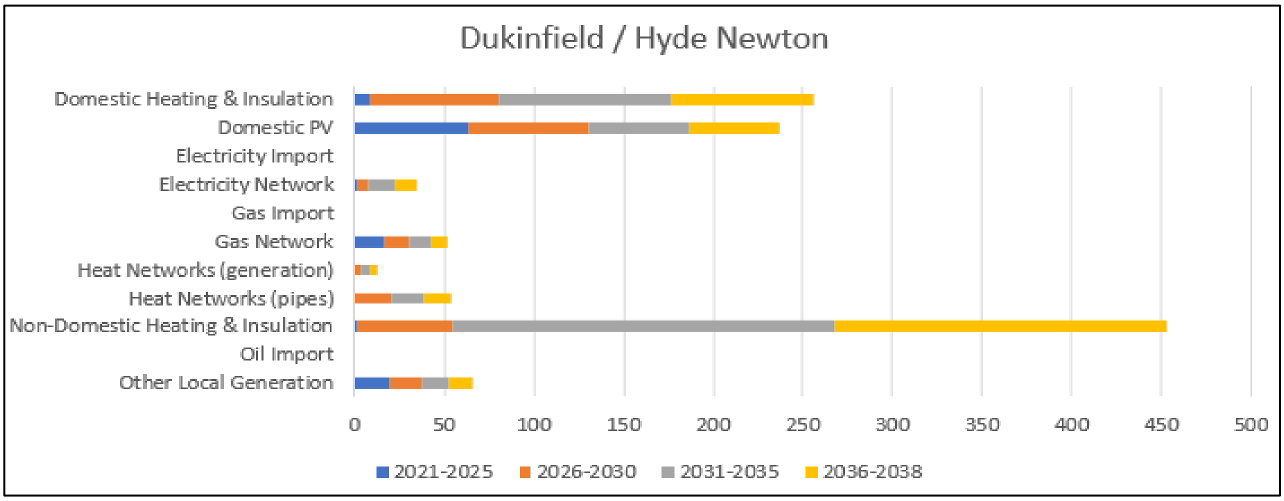


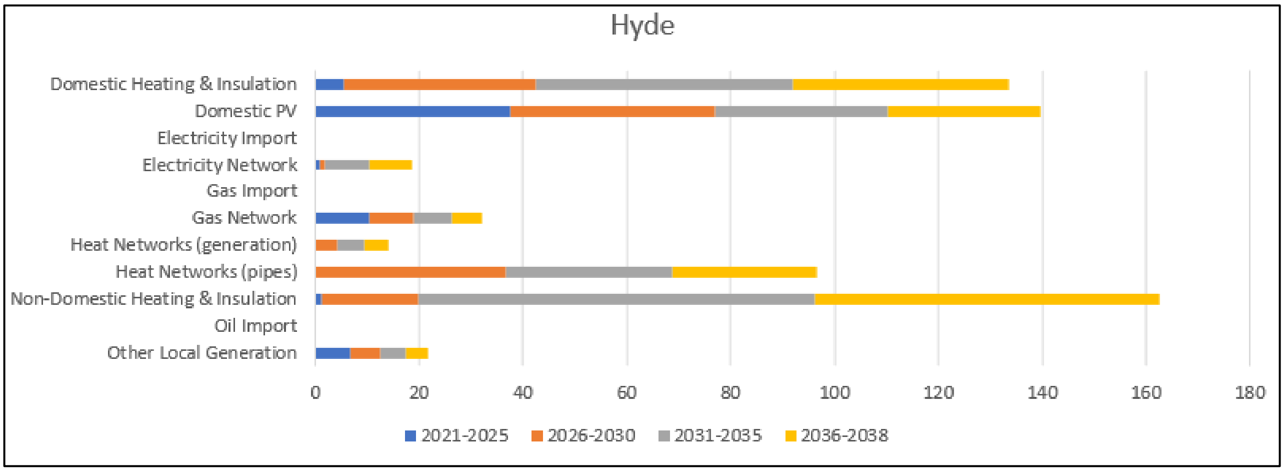


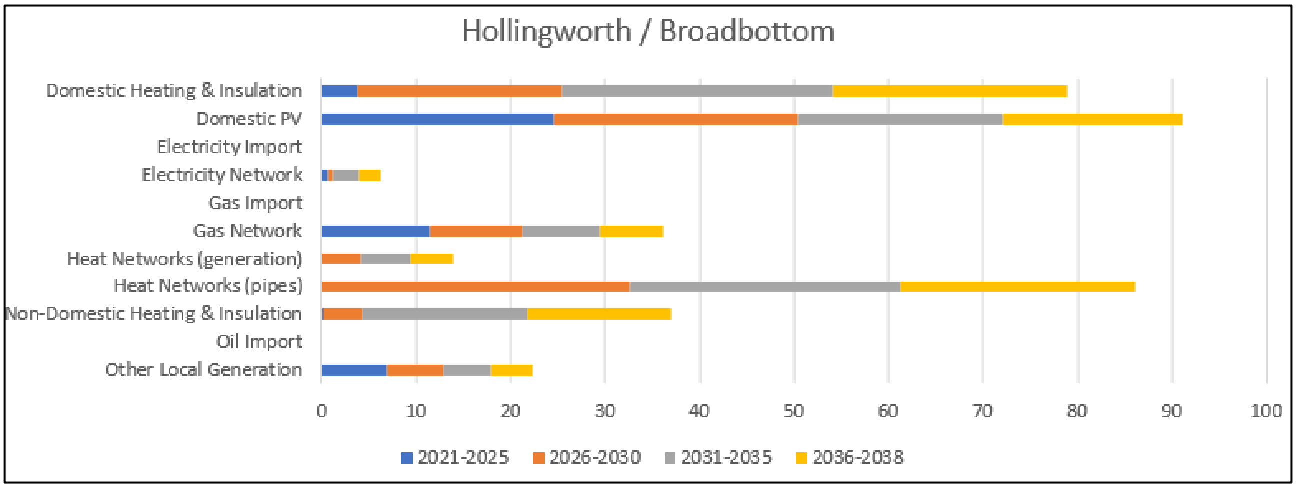




Investment in Tameside's energy system (£m) by time period across each area







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 Tameside 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 Tameside

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

1. Reduced energy demand in Tameside: 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 42,000 homes and deep retrofit of a further 26,250 homes requiring £327m of investment. Further investment in retrofit is required in the secondary scenario, due to the later decarbonisation of heating with hydrogen, and the higher cost of hydrogen fuel. Many of these homes can receive a cost-effective retrofit package, combining heating system replacements, solar PV and EV charger installations. Across all scenarios extensive fabric retrofit of existing homes is prominent both in cost-effectively reducing emissions in the near term, but also enabling the future installation of low carbon heating systems. It is important to note that new demands from transport, buildings and industry (moderated by improving energy efficiency) mean

* 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

electricity demand increases in Tameside from 925 GWh of electricity consumed per year to 1,934GWh by 2038.

2. Increasing uptake of low-carbon solutions in Tameside: By the early 2030s all new cars, vans and heating system replacements in homes and businesses must be low carbon. In the primary scenario in the 2020’s the majority of this shift is to battery electric vehicles (BEVs) and electric heat pumps along with development of heat networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.37,000) and public EV charging hubs, targeted at priority locations. Industry in Tameside 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 Tameside: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production in Tameside. In the primary scenario 479 MWp of roof mounted solar PV capacity is installed.

Deploying the maximum potential for rooftop and ground mounted solar PV would produce up to 607 GWh per annum of local, low carbon electricity, a significant contribution to Tameside's forecasted annual consumption of 1,934 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 Tameside: 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 Tameside. Greater Manchester's ambition of carbon neutrality by 2038 creates significant pressures regarding the deliverability of 100% hydrogen heating to all homes in Tameside. 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. Tameside should not rule out the potential for hydrogen heating, however, neither should it plan for it with certainty. The secondary scenario found that a similar level of emission reduction could be achieved using predominantly hydrogen for heating (3.35 Mt CO_2 generated through to 2038 compared to 3.34 Mt for the primary scenario) for a lower total system cost (£6.4bn compared to £7.2 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 Tameside'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 Tameside in support of Greater Manchester's commitment across the Combined Authority area is estimated to represent total energy related costs of between £6.3bn and £7.2bn across all scenarios

The primary plan for Tameside:

- Will require capital investment of £5.3bn (excluding energy costs) in less than 20 years. This investment is broken down with an approximate spend of £0.38bn on energy networks, £0.86bn on Tameside's dwellings, £0.95bn on Tameside's non-domestic buildings. There is also a further £1.3bn investment opportunity for renewable generation including large scale PV and small-scale hydro. This has the potential to build local supply chains and create jobs for the future as part of a green industrial revolution for Tameside.
- By 2038 the local electricity network in Tameside could supply as many as 50,000 domestic EV charge points distributed across the local area and numerous EV community charging hubs.
- Approximately 74,900 homes could have heat pumps with over 75% of homes having electric heating. This means that in the 2020's new homes will need to be heated electrically, by hybrid solutions, connected to a heat network or at minimum be hydrogen ready. The majority of existing off-gas grid homes in Tameside 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 82,600 homes, as well as non-domestic buildings, allowing hydrogen boilers to replace gas boilers for heating and hot water, as well as providing low carbon fuel for high temperature industrial applications. This would mean much of the gas network would be retained and repurposed by 2038.
- The gas network will continue in the immediate term to meet the majority of heating demands of homes and buildings although new connections will start to decline in the 2020s as new development favours electric or district heating solutions.
- Heat networks will grow and expand, particularly around existing heat networks. Existing homes will be connected in clustered groups through targeted connection campaigns and new service offers
- The majority of homes with suitable characteristics will have solar panels and many of those could also have electrical (battery) and thermal storage systems
- 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 Tameside 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)	1,967	2,453
	Number of dwellings	110,290	110,290
	Non-domestic buildings (m^2)	4,695,058	4,695,058
Greenhouse Gas Emissions	(ktCO2e/yr)	90	59
Local Energy Demand Reduction	Basic domestic retrofit measures installed (no of homes)	42,073	33,062
	Deep domestic retrofit measures (no of homes)	26,245	44,725
Local Electrification	Petrol & diesel vehicles on the road (No of vehicles)	12,127	12,127
	Pure electric vehicles on the road (No of vehicles)	77,736	77,736
	Hybrids (including plug-in) on the road (No of vehicles)	17,763	17,763
	Domestic EV charge points installed (No)	50,251	50,251
	Heat pumps installed (No of homes)	74,887	13,728
	Rooftop solar PV generation capacity installed (MWp)	479	479
	Ground-mounted PV generation capacity potential (MWp)	296	296
Local Heat Networks	Domestic heat network connections	27,411	6,135
Capital Investment* **	Buildings and energy system (£m)	7,193	6,424

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

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

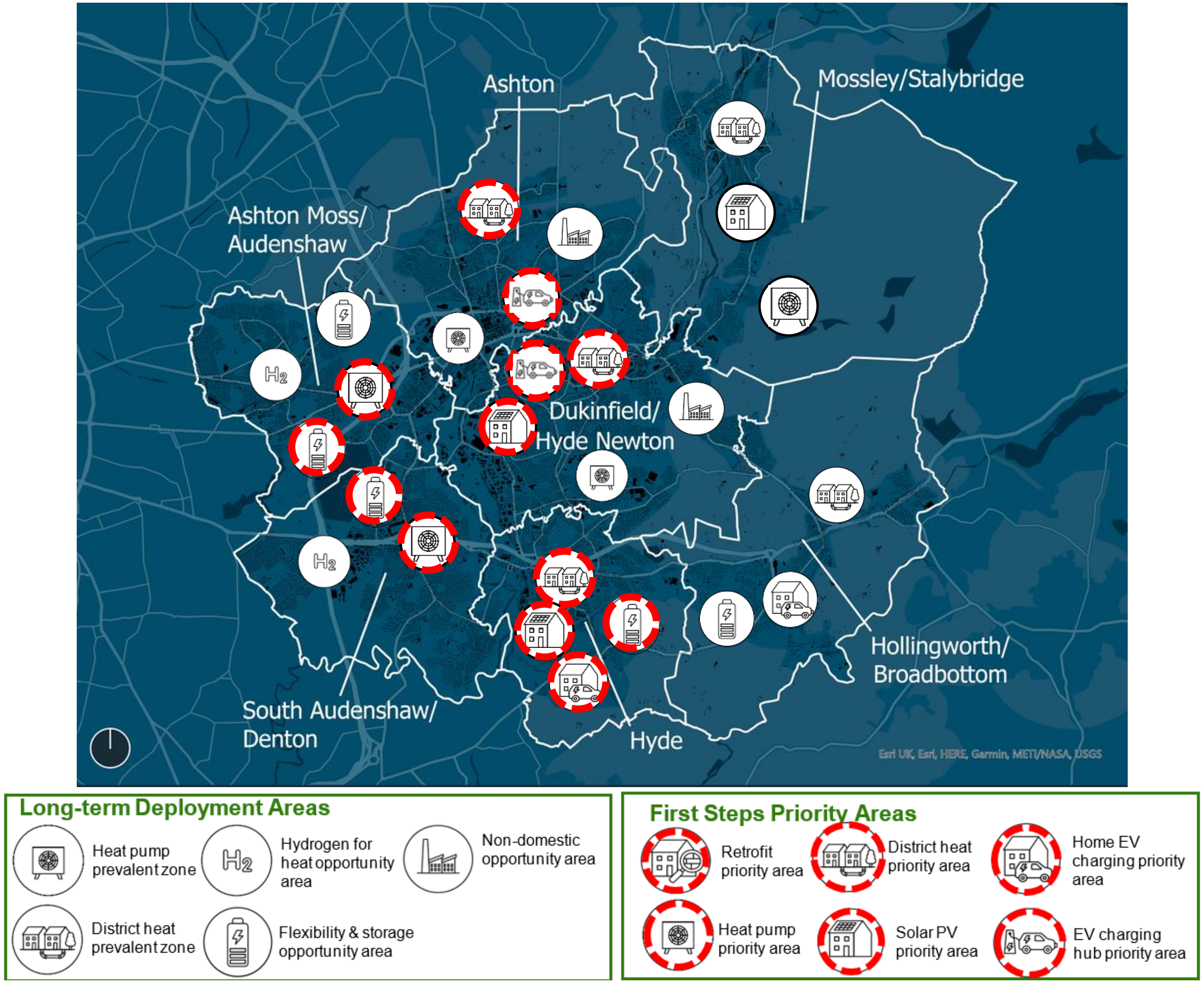
This LAEP provides Tameside with both:

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

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

First Steps – Priority Areas (Demonstration & Scale up)



Next Steps

Using the insights within this LAEP and in the identified priority areas, Tameside 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 Tameside, 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 to develop initial schemes and further develop zones
- Determine approach for procurement and working with energy and technology suppliers and service providers, including considering relationship with developing local skills and supply chain

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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 Tameside'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 Tameside Council's Climate Change & Environment Strategy

Wider LEM Project Partners

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 Tameside 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 Tameside 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 – Tameside
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Restrictions	Open

Review and approval:

	Name	Position
Author	Andrew Commin Will Lockhart	Senior Engineer/Energy Consultant, Buro Happold Graduate Energy Engineer, Buro Happold
Reviewer	Richard Leach	Local & Site Energy Transition Manager
Approver	Rebecca Stafford	Senior Manager

Revision history:

Date	Version	Comments
13/01/22	0.1	Initial draft
03/02/22	0.2	Draft for internal review
22/03/22	0.3	Working draft for initial client consultation
03/05/22	0.4	Updated draft incorporating Tameside Council comments
18/05/22	0.5	Minor amendments
13/06/22	1	**Client issue**

GREATER MANCHESTER
LOCAL ENERGY MARKET
DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Technical Annex

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

THE FOUR SCENARIOS

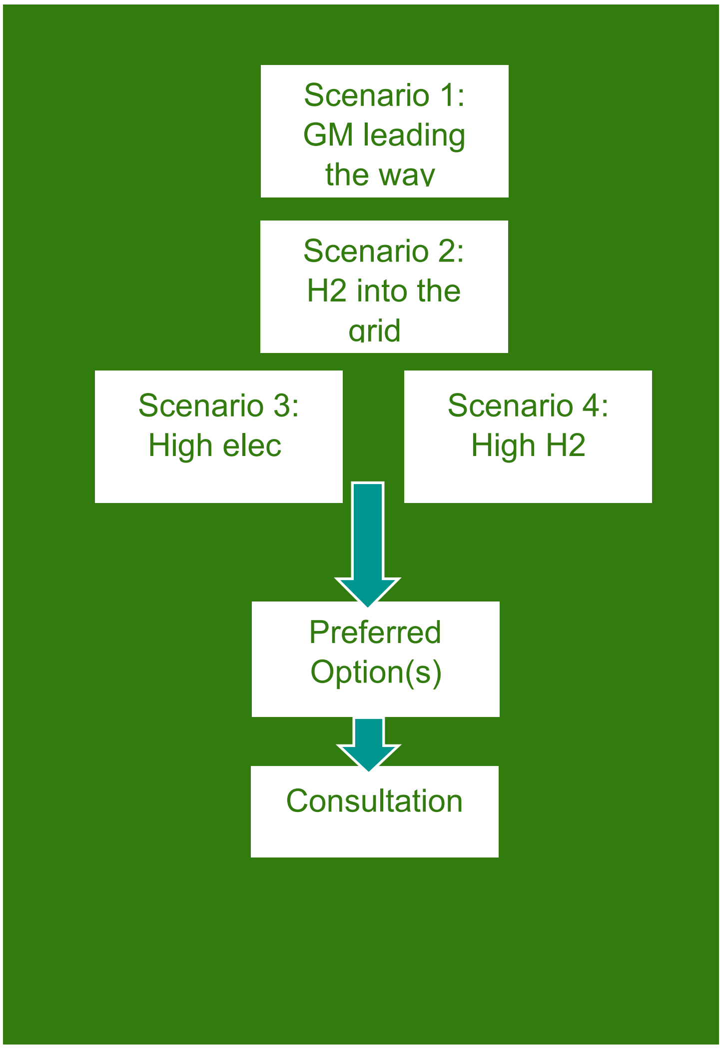
A variety of energy system scenarios are possible to deliver Greater Manchester and Tameside's future energy vision. It is not practical to consider every possible configuration of Tameside 's local energy system in a limited number of scenarios, therefore four main scenarios have been considered; these 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 Tameside. 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 Tameside 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 Tameside 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 Tameside 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 Tameside. These scenarios are constructed using location specific information on Tameside'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 Tameside's local control** where at all possible.

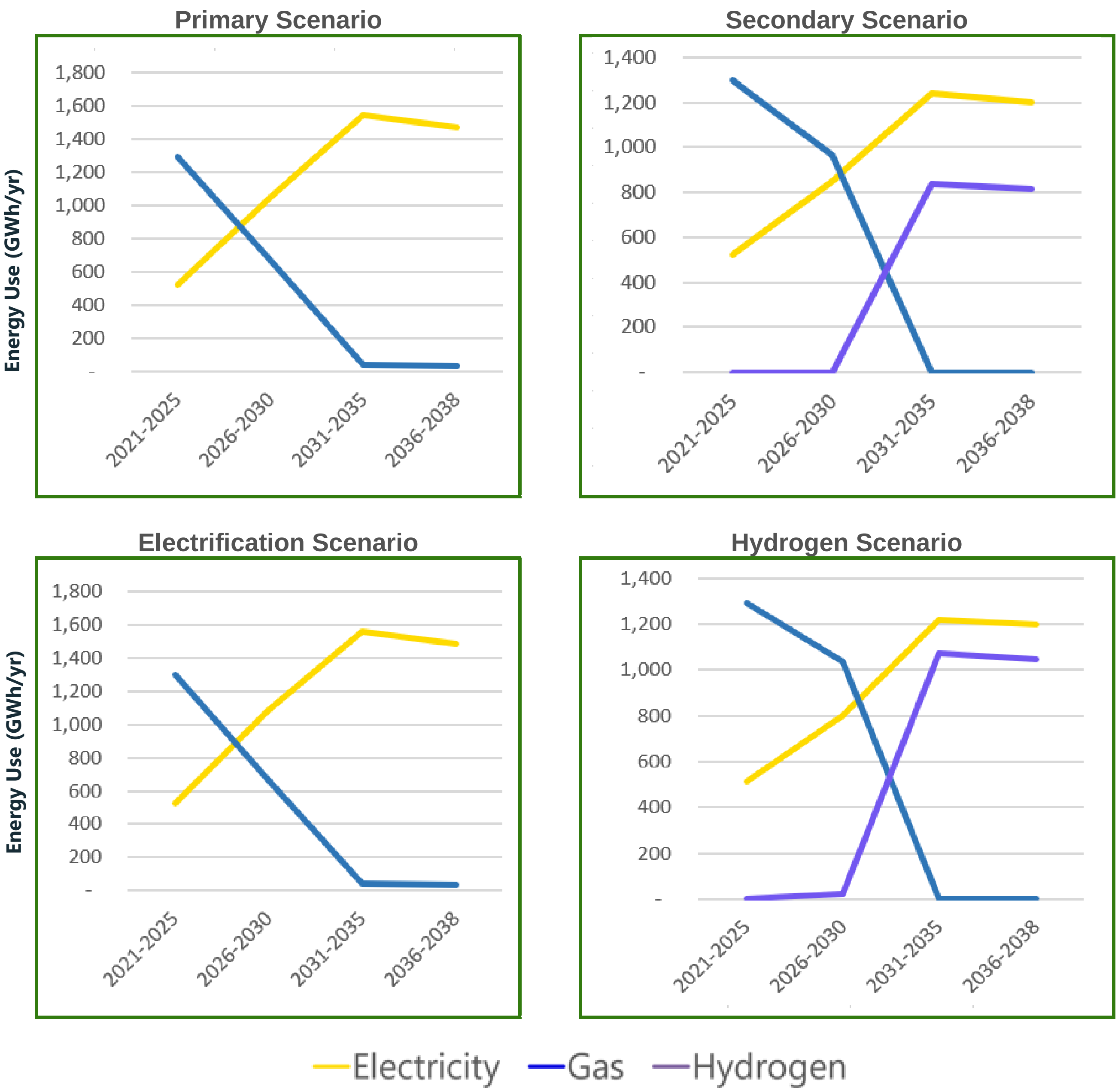
Scenario 2 – An Alternative Future Local Energy Scenario: we have assumed hydrogen options for residential heating and non-domestic buildings become available in Tameside from 2030 onwards, aligned to HyNet Phase 3 and the repurposing of the gas grid to hydrogen is an option

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

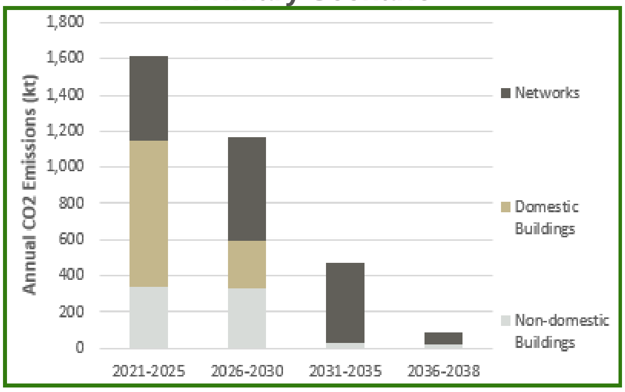
ENERGY CONSUMPTION



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

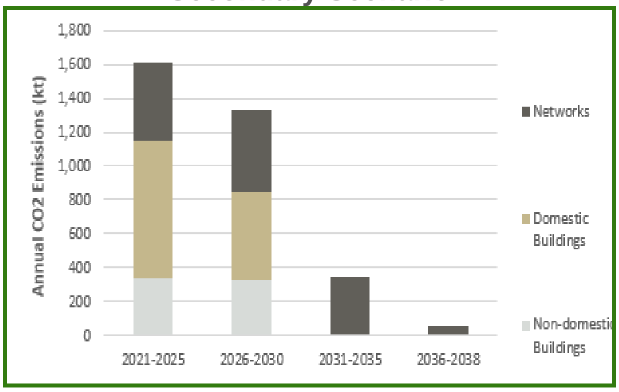
Annual CO2 Emissions (kt)

Primary Scenario



3.3 Mt

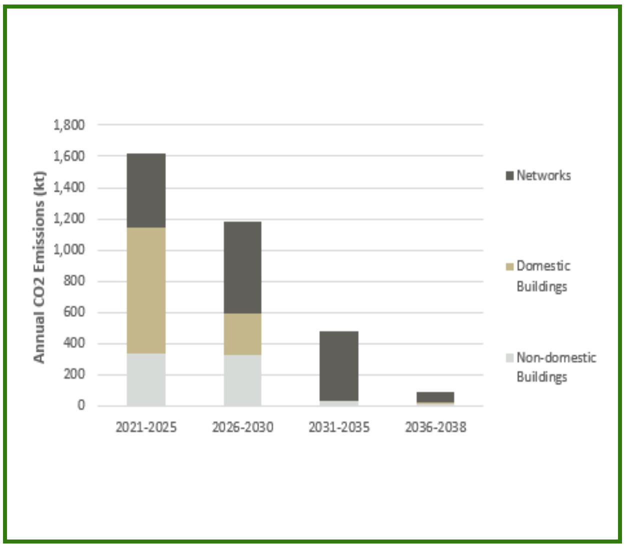
Secondary Scenario



3.4 Mt

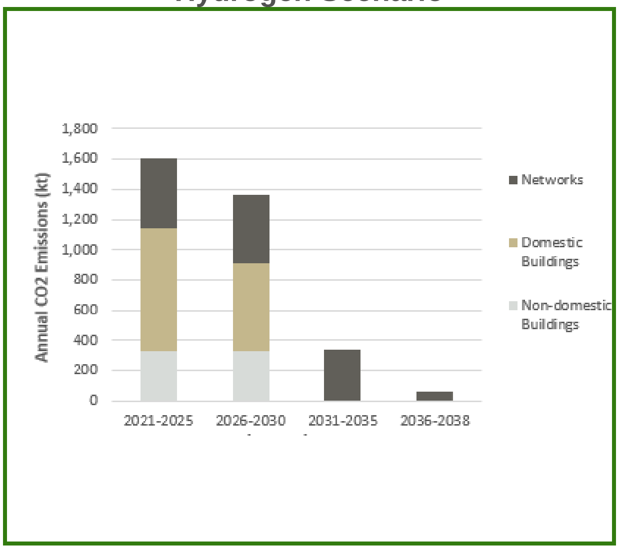
Annual CO2 Emissions (kt)

Electrification Scenario



3.4 Mt

Hydrogen Scenario



3.4 Mt

Networks Domestic Buildings Non-Domestic Buildings

SYSTEM COST

Primary Scenario
Secondary Scenario
Electrification Scenario
Hydrogen Scenario
Total cost (£ million)
0
500
1000
1500
2000
2500
3000
2021-2025
2026-2030
2031-2035
2036-2038
£7.2 bn
£6.4 bn
£7.3 bn
£6.6 bn
Domestic Heating Systems & Insulation
Non-Domestic Heating & Insulation
Electricity Network
Hydrogen Network
Other Local Generation
District Heat Networks
Domestic Solar
Gas Network
Electricity Import
Gas Import
Hydrogen Import

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.

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* https://epc.opendatacommunities.org/

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

‡ https://epc.opendatacommunities.org/

Note: details of Green Homes Grant (GHG) and Local Authority Delivery (LAD) projects provided separately by Local Authorities where relevant

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

DISTRIBUTION, GENERATION AND TRANSPORT

Networks

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

Local Generation

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

Electric Vehicles

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

* 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