GREATER MANCHESTER LOCAL ENERGY MARKET

DOING THINGS DIFFERENTLY FOR THE ENVIRONMENT

Local Area Energy Plan

Wigan, Greater Manchester

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0. EXECUTIVE SUMMARY

Context

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

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

Local Area Energy Planning

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

Scenarios for achieving Carbon Neutrality in Wigan

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

- **Primary Scenario – GM Leading the Way:** this scenario focuses on meeting the carbon budget and carbon neutrality target by making use of **measures within Wigan'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 Wigan from 2030 onwards (aligned to HyNet Phase 3†), considering where it could be cost-effective to use hydrogen alongside the measures / technologies considered in the primary scenario. The quantity of hydrogen expected to be available under the HyNet plans would not be sufficient to allow all GM boroughs to pursue this option; therefore focus has been centred on prioritising where to target the use of hydrogen‡.

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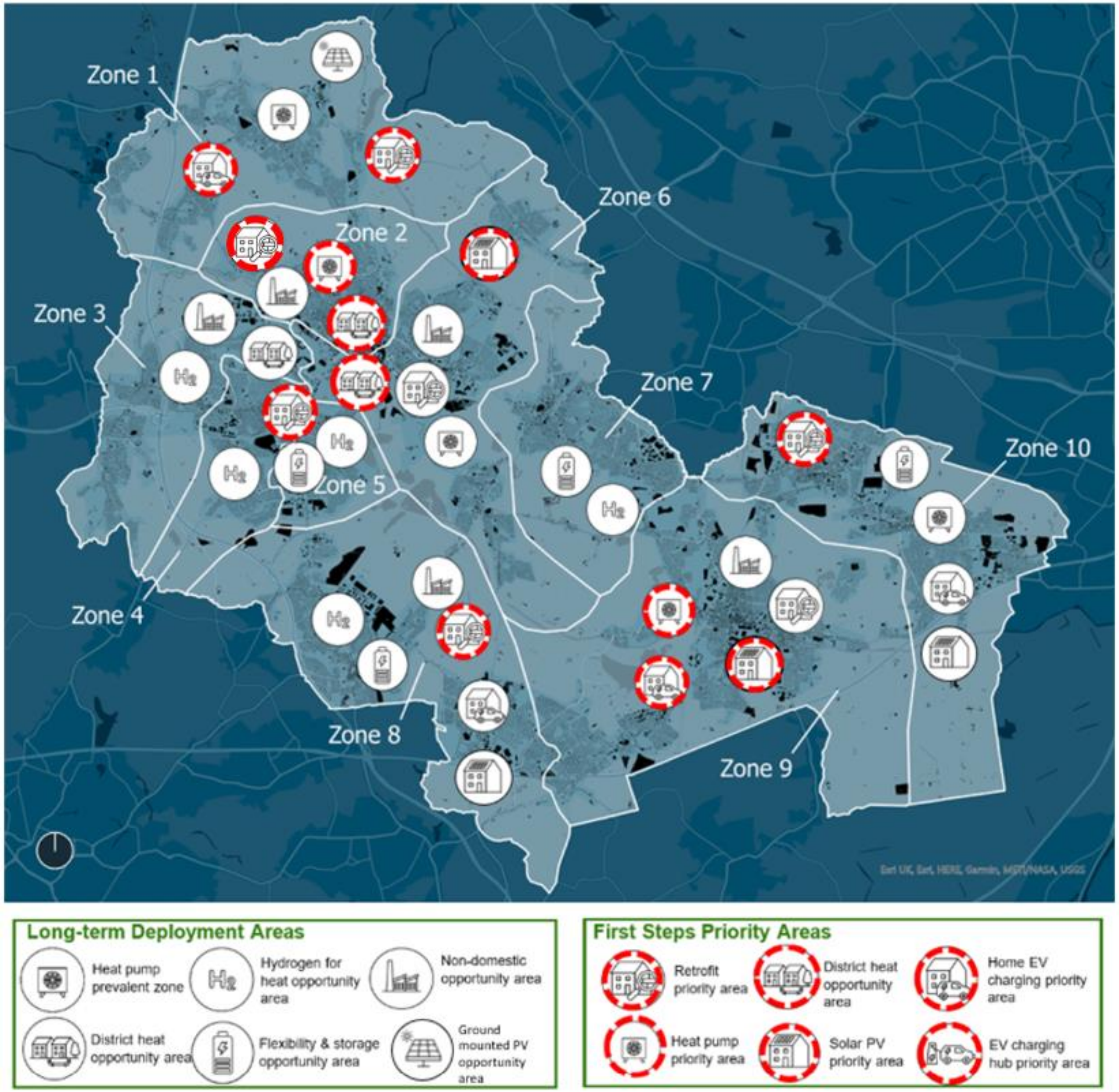
* Climate Change Act 2008 (2050 Target Amendment) Order 2019

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

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



Local Priorities and Measures

Wigan has been geographically sub-divided into 10 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, there is some disparity between the number of dwellings in each zone – with some having a higher portion of industrial and commercial building stock.

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

1. INTRODUCTION

Context

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

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

Modelling Approach

We have used the ESC-developed EnergyPath Networks tool to produce a series of future local energy scenarios for Wigan (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.

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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

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

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

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

Scenarios for achieving Carbon Neutrality in Wigan

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

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

- **Primary Scenario – GM Leading the Way:** this scenario focuses on meeting the carbon budget and carbon neutrality target by making use of **measures within Wigan'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 Wigan from 2030 onwards (aligned to HyNet Phase 3*), considering where it could be cost-effective to use hydrogen alongside the measures / technologies considered in the primary scenario. The quantity of hydrogen expected to be available under the HyNet plans would not be sufficient to allow all GM

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

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

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

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

Conclusions from the scenario analysis have been used to develop this LAEP. This represents a point-in-time plan of intent, as the basis for Wigan 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 Wigan 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 Wigan; any uncertainty is generally around the scale of deployment. Therefore, it is deemed low risk to demonstrate how to deploy these components and prepare for significant scale-up whilst assessing whether HyNet will be able to cost-effectively provide zero carbon hydrogen, across GM in-line with projections.

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

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

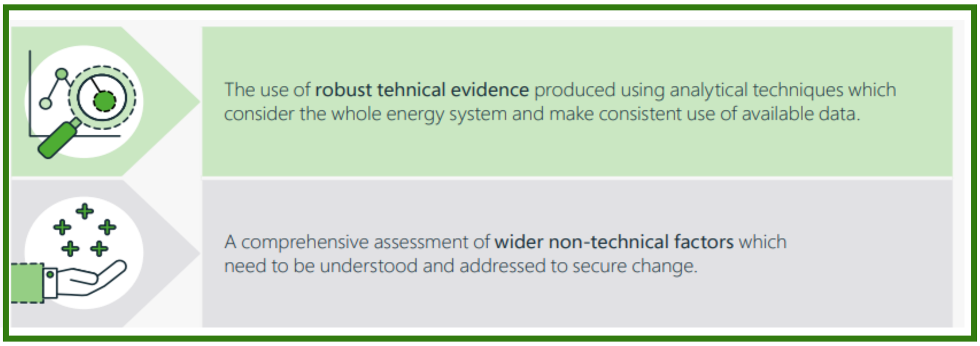
be needed once the picture becomes clearer and all LAEPs for each GM borough are in place.

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

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

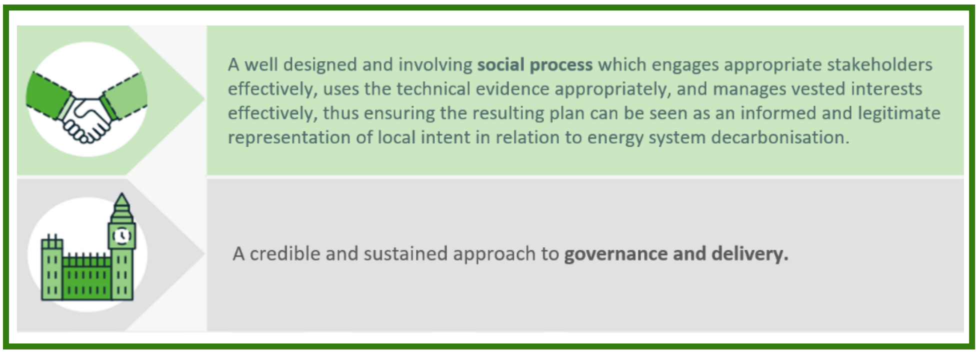
In accordance with the Ofgem LAEP Method†, which provides guidance and framework for LAEP done well, this plan has been developed through the use of robust technical evidence which considers the whole energy system for Wigan and consistent use of available data and assumptions.

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



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

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



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

Report Structure

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

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

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

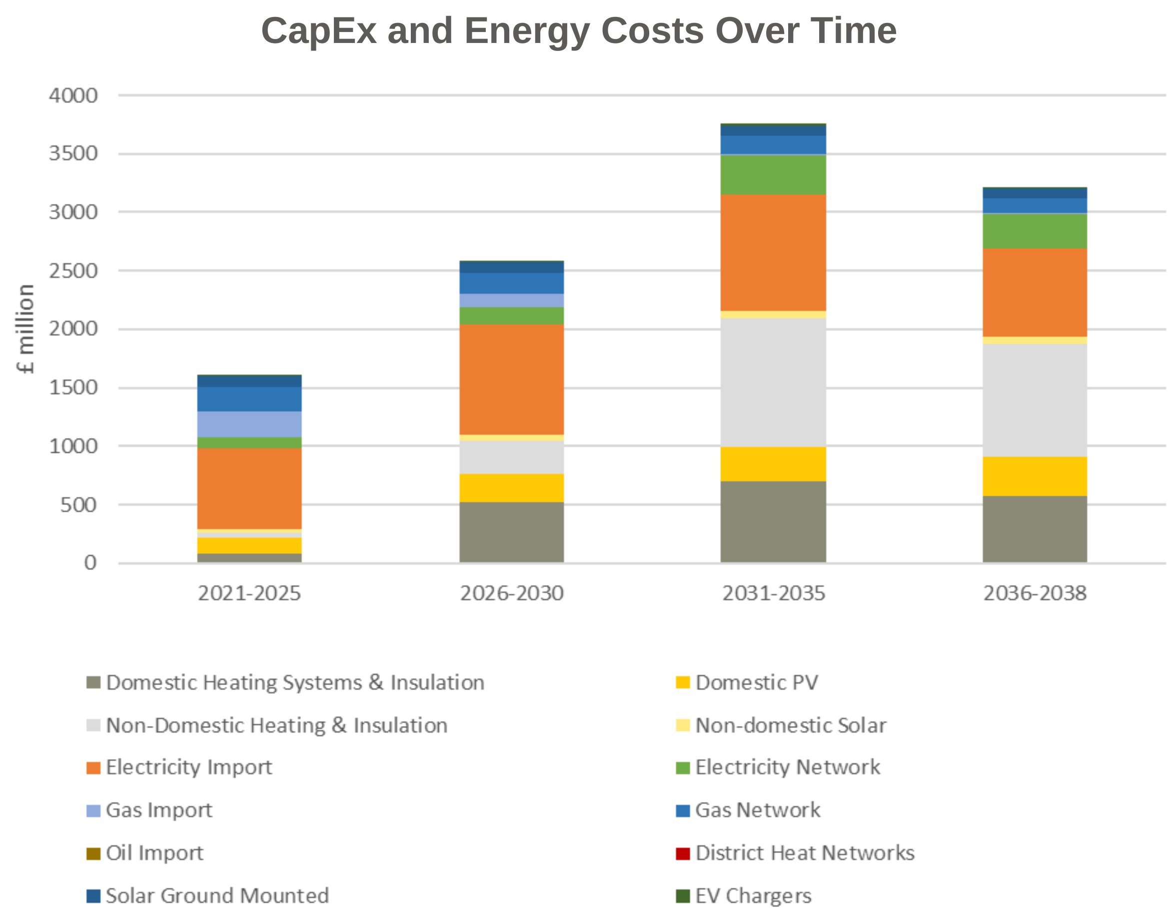
Chapters 3-7: set out some of the key aspects of the primary scenario and what this means in relation to implementation for Wigan including Fabric Retrofit (Chapter 3), Heating System Zones (Chapter 4), EV charging and infrastructure (Chapter 5), Local Energy Generation and Storage (Chapter 6), and Energy 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 Wigan, 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 Wigan 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 Wigan local energy system by 2038 is achievable and expected to require capital investment of between £6.6 bn (secondary) and £7.4 bn (primary). Total energy costs including capital investments, operations and energy consumed is between £10.2 bn (secondary) and £11.2 bn (primary) to 2038; the upper chart illustrates the breakdown of this expenditure over time for different components (for the primary scenario). The lower chart shows how implementing the transition reduces carbon emissions*. For both primary and secondary 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%†).



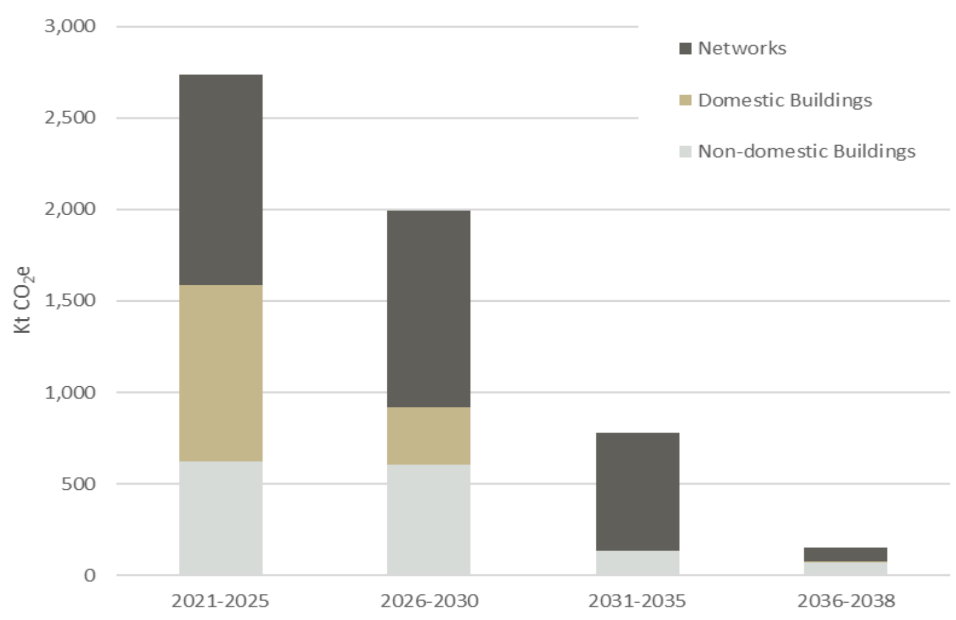
With such a variation (£1.0.bn) in total projected system cost between the two scenarios, progress on wider national energy planning and policy decisions would be needed, recognising the current uncertainty (regarding the UK's heat decarbonisation strategy) associated with selecting a preference on decarbonising heat in buildings (e.g. either

* 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.

† Indicative figure taken from previous area LAEP studies within GM.

through electrification, district heating or hydrogen). In addition, regional (Greater Manchester) collaboration, should be pursued to consider an across GM borough approach, recognising that major decisions do not stop at a local authority boundary, for example, it may be preferential to prioritise the use of hydrogen in targeted areas of GM; noting that the initial proposed HyNet route does not prioritise Wigan, although later phases do note a possible connection (with the likely route going via St Helens). Regional collaboration also provides the opportunity to ensure a complete LAEP process is undertaken, where key regional stakeholders (including Cadent and Electricity North West) should support the evaluation and decision making process.

CO2 Emissions Over Time



The cumulative emissions over the period 2021-2038 in the primary scenario are 5.7 Mt of CO_2e (from a range of 5.4 to 5.7 Mt across the scenarios assessed).

How to Interpret this Vision

This transition will involve the greatest infrastructure change across Wigan and Greater Manchester for decades; key sections of this LAEP illustrate the scale of change and investment needed, based on a primary scenario. An alternative scenario (secondary), incorporating the use of hydrogen for heat, is also presented on page 19 (along with other variations within the appendix), where the supporting analysis indicates that hydrogen could have an important role in decarbonising Wigan. Unless explicitly stated otherwise, quoted values in this report will refer to the primary scenario. 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 Wigan's citizens and stakeholders. Insights from the alternative scenarios have been used to produce these priority areas. It is expected that this LAEP may need to be updated as lessons are learnt and uncertainties (such as UK policy regarding the decarbonisation of heat) become clearer.

Fabric Retrofit

As much as **57% to 64% of Wigan's dwellings in 2038 would have received insulation retrofit for the primary and secondary scenario** plan. This corresponds to around **94,900** in the primary scenario, or **106,800** in the hydrogen focused secondary scenario. A greater number of deep retrofits are seen for domestic properties in the secondary, hydrogen dominated, scenario (around 11% more than the primary). This is to enable earlier demand reduction and thus decarbonisation, which is required to meet carbon budgets due to the later availability of low carbon heating fuel (i.e. hydrogen is not considered until at least 2030). Fabric retrofit and solar PV are low regret measures to progress in the short-term, being cornerstones of both the primary and secondary scenarios.

Heat Decarbonisation

Three heating options are explored to decarbonise buildings: electric heating (primarily heat pumps), hydrogen to replace natural gas, and district heat networks. For hydrogen to play a significant heat decarbonisation role, certainty would be required that hydrogen will be available to supply Wigan in a timeframe that supports the delivery of the GM carbon budget; this key decision point will need to be made c.2025, primarily based on the role hydrogen will play in providing heat to buildings. Alternatively, almost 157,500 heat pumps are deployed – which would supply heat to the vast majority of dwellings. Most of these would be air source heat pumps with 16% of dwellings identified suitable for ground source solutions where space is not a constraining factor. Opportunities for non-domestic and domestic buildings to be supplied by centralised heat pumps, or other low carbon heat, through district heat networks also has some potential – which would decrease the overall number of heat pumps.

The combined cost of fabric retrofit and heating system replacement is £1.9 bn for homes, and £2.4 bn for non-domestic buildings. The delivery of any option presents comparable challenges and risks, resulting in the need to focus on the demonstration and scale-up approach advocated

Energy Generation & Networks

To reduce emissions in line with the GM carbon budget, local energy generation would need to increase significantly, consisting predominantly of the installation of solar PV on much of the available roof space across all parts of Wigan (under all scenarios considered), providing up to 845 MWp of installed capacity including both domestic and non-domestic roofs, with 575 MWp of installed capacity identified for domestic roof space at a cost of up to £1 bn (mass purchasing solar schemes could help reduce this). The total roof top capacity equates to a total annual generation of 740-950 GWh in the Wigan area. Further work is required to understand how achievable and effective this substantial provision of electricity through rooftop solar PV is when taking into account wider system implications (p.68 providing some associated considerations).

Land in the area has been identified for opportunities to deploy a substantial 910 MWp of potential additional ground mount solar PV for further CO_2 reduction. Deploying this capacity would require an estimated land area of 1,288 Ha available. Deploying such large volumes of local generation would be very challenging and is highly ambitious. These solar farms will likely be connected into the transmission network; how this deployment of PV will impact the need for electricity network reinforcement will need to be explored as the modelling in this report is focussed on the effects of demand and generation change within the local distribution network.

Under the primary scenario, the electricity network would require capacity reinforcements of substations and underground feeders to accommodate electrification, at an estimated high cost of £870 m compared to the secondary Hynet scenario at an much low estimate of £145m. A significant proportion of the primary scenario is attributed to the peak demands of the large numbers of proposed heat pumps. Further work would be required, under this high electrification scenario, to determine the most cost-effective, approach for providing this additional capacity.

EV Infrastructure

The transition to electric vehicles, with uptake increasing from around 6,300 (4% of total fleet) plug-in vehicles today to ~148,000 (85% of total fleet) by 2038, drives a demand for EV chargers to be installed across all areas. Around 69,600* domestic chargers would need to be installed (one for every home with potential for off-street parking) at a cost of £39m, 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. It is estimated that ~35,000 houses are without off-street parking by 2038 therefore likely will rely on shared on-street charging hubs.

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

Consumer Uptake

By the early 2030s all new cars and vans, and all boiler replacements in dwellings and other buildings in Wigan are low carbon*; the vast majority of heating systems are either electrified or use hydrogen. The primary and secondary scenario suggests that circa. 158,000 and 29,000 of Wigan's dwellings could be fitted with a form of heat pump. The secondary HyNet scenario could see up to 128,000 boilers running from 100% hydrogen as an alternative to localised heat pumps. By 2038, nearly 85% of cars are electric vehicles or plug-in hybrids, requiring the provision of ~69,600 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 Wigan largely shift to using renewable or zero carbon electricity (either locally generated or grid supplied), or hydrogen instead of fossil fuels; carbon capture such as carbon sequestration through trees may be required to offset remaining residual emissions from grid electricity or non-domestic gas. Alternatively, offsetting through purchasing 100% renewable grid power via a corporate Purchase Power Agreement (cPPA) with a third party generator could be considered.

Low-carbon energy supplied to and generated in Wigan

The emissions intensity of UK electricity production is expected to fall by at least 65% from today's levels by 2035†. By then, offshore wind would contribute a significant source of renewable electricity generation nationally. Renewable electricity production in Wigan increases to contribute to the GM carbon budget, predominantly in the form of up to 845 MWp of rooftop solar PV, with opportunity for a further 910 MWp ground mounted solar PV across Wigan. Renewable generation (if the ground mounted PV potential is maximised), provides up to 1,723 GWh annually (54%), with 1,450 GWh (46%) of electricity supplied from the grid. This scale of solar PV is a highly ambitious aspiration and requires further detailed consideration; for example, from a network capacity perspective it may not be the optimal place to locate generation. However, with the 2038 target and GM carbon budget influence, solar PV could provide low carbon electricity earlier than the grid is expected to.

The low carbon electricity is used in heating, industry and vehicle charging, more than doubling electricity demand over the next 15 years. Total electricity consumption is expected to increase by 99% by 2038 in the primary scenario and by 66% by 2038 in the secondary scenario.

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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 Wigan's future energy system from electrified cars. This LAEP does not provide a fully integrated energy and transport plan where it is recognised that further work will be required to consider and integrate broader transport decarbonisation and net zero plans. This LAEP does not also account for aspects such as modal shift or behaviour change, acknowledging that other measures such as these will be needed to achieve net zero.

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

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

Reducing demand for carbon-intensive fuels

Buildings will lose less energy thanks to a series of targeted fabric retrofit programmes, improving insulation and efficiency across Wigan. Fabric retrofit will prepare buildings for low carbon heating, whilst also making a notable contribution to staying within the carbon budget. By 2038, over 94,000 of Wigan’s 166,000 dwellings are retrofitted in the plan (circa 57%), with the majority of dwellings requiring basic fabric upgrades for both the primary and secondary scenarios. 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

Opportunities to deploy district heating in the Wigan area have not been identified for both domestic and non-domestic properties in the scenarios but should still be considered. There are several opportunities to consider, two being:

- The decarbonisation and expansion of an existing CHP-led network to a WSHP led network in the Town Centre which connects the Wigan Library and the Wigan Life Centre.
- The Galleries redevelopment which has the potential to act as a catalyst for wider decarbonisation of the immediate area using ground source heat including Deanery High school, Wigan & Leigh Technical college and the NHS centre.

The ongoing AECOM study of potential heat networks will help inform opportunities to consider.

Annual electricity demand is forecasted to increase from 1,591 GWh to 3,171 GWh by 2038, due to electrified heat and electric vehicle charging. This requires an increase in electricity network capacity, a particular focus (taking into account all voltage levels) zones 5, 7, 8 and 10. Though opportunities to consider using flexibility, storage (or other alternative measures) in place of grid reinforcements are highlighted in the provided opportunity areas (see map on p.24).

Depending on the conversion and roll-out of hydrogen for heat, gas networks remain in place in some areas to support some hard-to-decarbonise non-domestic buildings that may not be of the scale to have a dedicated hydrogen connection. However, should HyNet phase 3 be available, up to 128,000 homes could be supplied by hydrogen by 2038, at an 8% lower overall total system (CapEx and Opex inc. energy costs) cost[*] and very similar levels of emissions.

Investment

Wigan's transition requires a total energy system and building level investment of approximately 7.4 bn (excluding energy costs). This unprecedented level of investment provides a once in a lifetime opportunity for Wigan. 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 Wigan. How it is delivered will influence the local benefit, in addition to job creation. For example, there will be opportunities for local/community initiatives to provide components of the future energy system.

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

Local Impact and Risks

Without changes to national policy, wider energy market reforms or the introduction of new support mechanisms, household energy bills are forecasted to increase, predominantly as heating homes through electricity is more expensive than using gas. However, the proposed investments in building works will help to mitigate this and consideration will be needed to target measures at homes with the most need. Consideration is also needed to determine how to fund an average household investment of £17,320 (CapEX) for the associated measures including heating systems, fabric upgrades and roof PV installation.

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

[*] Based on the Hynet projections

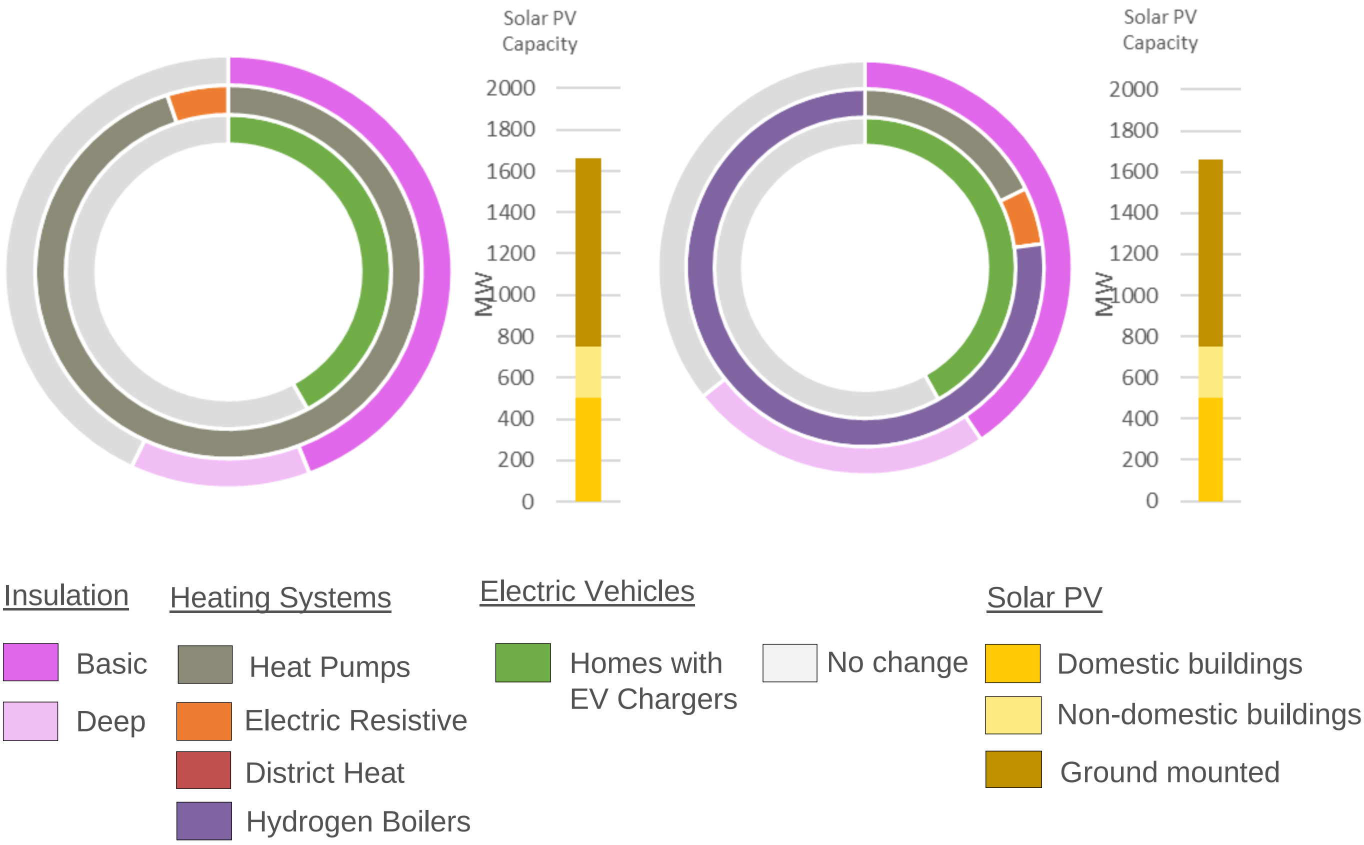
[†] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760508/hydrogen-logistics.pdf

economic and social benefit may not be captured locally, therefore consideration of how to maximise the opportunity is essential.

What Wigan's transition to carbon neutral could look like

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

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



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

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

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

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

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

The primary scenario is broken down by zone in the map below. This quantifies and shows the different transitions modelled for each area based on their own unique geography and character.

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


£825
£563M
£927M
£474M
£708M
£1,015M
£397M
£258M
£952M
£1,296M
MWp
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
Zone 9
Zone 10
Solar PV
Domestic Buildings
Non-domestic Buildings
Ground Mounted
Insulation
Basic
Deep
Heating Systems
Heat Pumps
Electric Resistive
District Heat
Hydrogen Boilers
Homes with EV Chargers
No change
Network Investment
Electrical
Heat

How to use this LAEP

Wigan has been geographically sub-divided into 10 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.

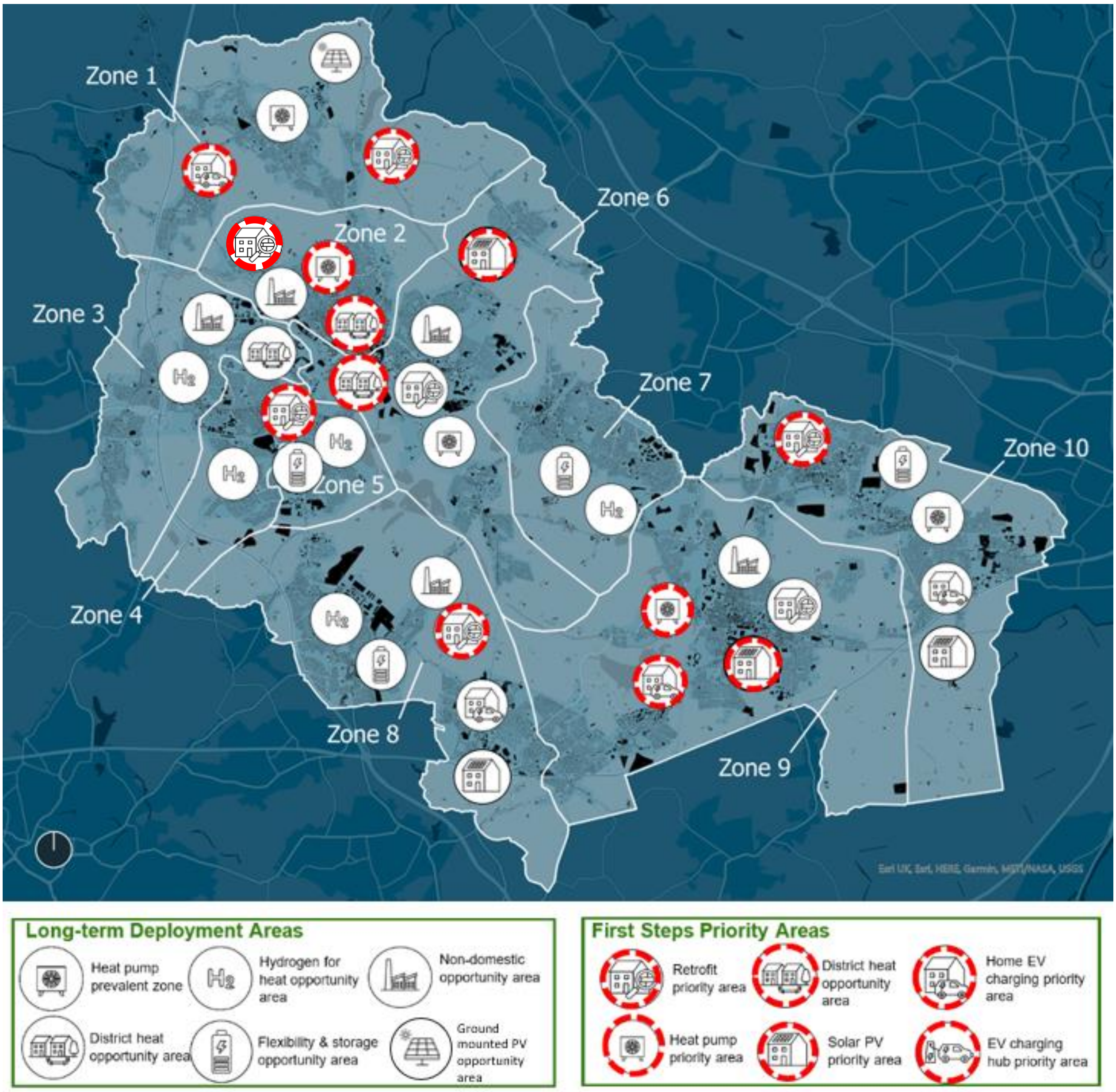
The plan below illustrates the proposed activities to progress this LAEP in the near-term, based on a demonstration and scale-up approach, as well as focus areas for changes in the longer term.

The red rings highlight priorities to test how to roll out Wigan's transition to carbon neutral and work with Wigan's citizens in the short-term. It is recommended that the impact of these early activities be evaluated by the district, for example to demonstrate where proposed components of the LAEP are still the cost-effective option, before moving to widescale rollout. For example:

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

It is expected that Wigan 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 highlighted suggested places to test specific components of this LAEP as demonstrators of possible solutions:

- Wigan in general demonstrates a significant proportion of semi-detached and detached homes that are most suited to heat pump deployment. Modelling has also shown that ground source heat pumps could be cost-effective in detached homes, regardless of presence of low carbon hydrogen in the network.

- For immediate benefits with low challenges, three priority areas have been identified that considers density of proposed heat pumps and available distribution headroom. These include Zones 2, 5 and 9. Zone 9 has the greatest number of houses with a significant proportion of detached houses therefore considered as a priority area of low regrets. The spare electrical capacity in these areas also allows for early deployment of home EV chargers.

- Zones 1, 4, 5 and 8 are the areas in which a high proportion of homes receive insulation measures. Zone 10 is included as a priority due to the focus of social housing. Zone 9 is included as secondary priority, due to the highest total number of fabric improvements, which include a high number of relatively easy to treat cavity walls. Zone 2 has also been considered as a priority with it having a high level of fuel poverty.

- No opportunities have been identified for district heating. Further work is required to determine feasibility of heat networks versus individual heating systems, the ongoing AECOM study can help inform this. There are some promising opportunities around Wigan town centre, with a general focus in the area where zones 2, 3 and 6 meet.

- Zones 4, 6, and 7 are prioritised for the demonstration of solutions for Wigan's non domestic buildings having the greatest estimated requirement for gas for industrial processes, meaning they could be good areas to prioritise hydrogen. Along with this gas requirement, south zones 8 and 9 would be closest in proximity to the proposed HyNet phase 2 route and therefore provides potential for these areas to be prioritised for hydrogen.

- Rooftop solar PV can be developed early in areas with spare generation capacity in the electricity network, such as zone 9. Public EV charging is prioritised in zones 2, 7, 9 and 10 where demand is expected to be highest and dwellings are without off-street parking.

Long term Deployment

- Flexibility and storage (combined with other components including heat pumps, solar PV and EV charge points) can be tested in Zone 9 in the near term, including a focus on evaluating whether alternative approaches to electricity network reinforcement provide benefit. This could help inform the suitability of these approaches in the more grid constrained Zones of 7, 8 and 10 – potentially causing a reduction in network cost upgrades.

- If hydrogen became widely available, the west side of Wigan (Zones 3, 4, 5 and 8) could benefit from low carbon hydrogen to support industry and heat buildings. Additionally, domestic dwellings located near these industrial could also benefit as initial areas to target for cost effective connection to low carbon hydrogen supplies built to serve industry. Zone 7 also has one very large industrial load which could be considered for hydrogen; however, initial deployment of hydrogen is more likely to focus in the west.

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

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

Evaluation

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

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

- The timing (regarding the delivery) of HyNet compared to the rate of electricity grid decarbonisation
- The ability to scale-up and install options rapidly aligned to the carbon budget
- The practicality and cost of installing measures in dwellings and non-domestic buildings, for instance air source heat pumps in existing flats
- 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 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 Wigan's citizens is essential to help understand attitudes towards Wigan's carbon neutrality transition; whilst also forming part of the evaluation process. This will help Wigan 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 Wigan'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 Wigan's transition that there is a demand for solutions, products and services

Vision to 2038

A significant portion of existing homes and buildings in Wigan will require retrofit, carrying out insulation in **at least 57% of dwellings** (around 94,900) for the primary scenario with more of Wigan's dwellings (44%) receiving basic retrofits than more expensive deeper fabric upgrades (13%). For the secondary scenario, where hydrogen forms the bulk of the heating solution, 7% more buildings will require retrofit (around 12,000 additional buildings). **More dwellings receive deep retrofits in the secondary (HyNet) scenario** (circa 39,400 vs 21,600). Evidently, the reduction in energy usage through deep retrofit is prioritised to lower carbon emissions in the short term while waiting for hydrogen to be available from HyNet. However, more basic insulation is proposed in the primary scenario (circa 73,200 vs 67,350). Insulating homes with low temperature heat pumps would also reduce the need to retrofit existing internal heat emitters, which need to be sized sufficiently to enable the required heat output at lower temperatures.

However, regardless of the heating system used, additional level of fabric retrofit may be needed to address affordability issues; for example, the cost of hydrogen is expected to be higher compared to gas*. 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. The greater level of deep retrofit implemented early for the secondary scenario would help towards this with 17,500 more homes requiring deep retrofit to comply with the carbon budget.

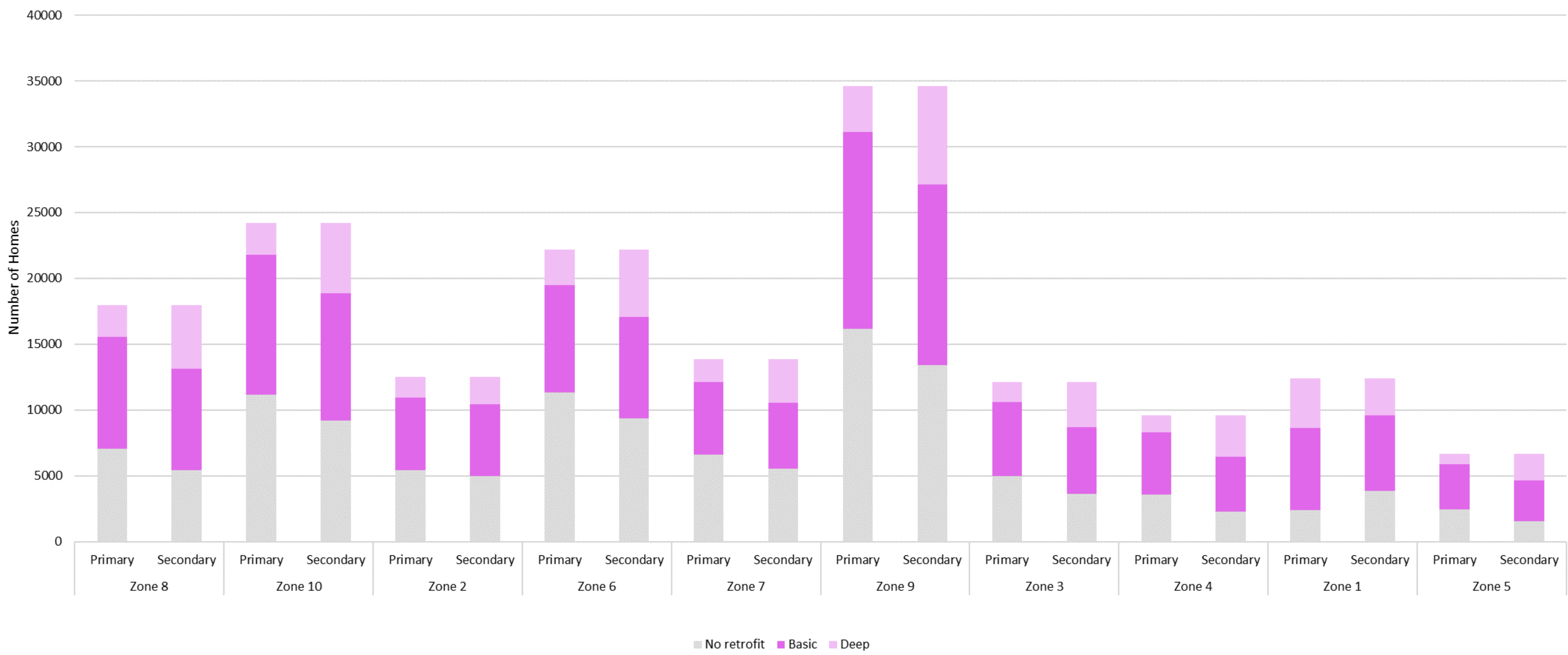
Furthermore, fabric retrofit could be combined with other measures such as heating system replacement, PV installation and EV chargers to minimising disruption to residents and number of visits required to homes, as in the "cost effective retrofit" option on page 39.

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

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

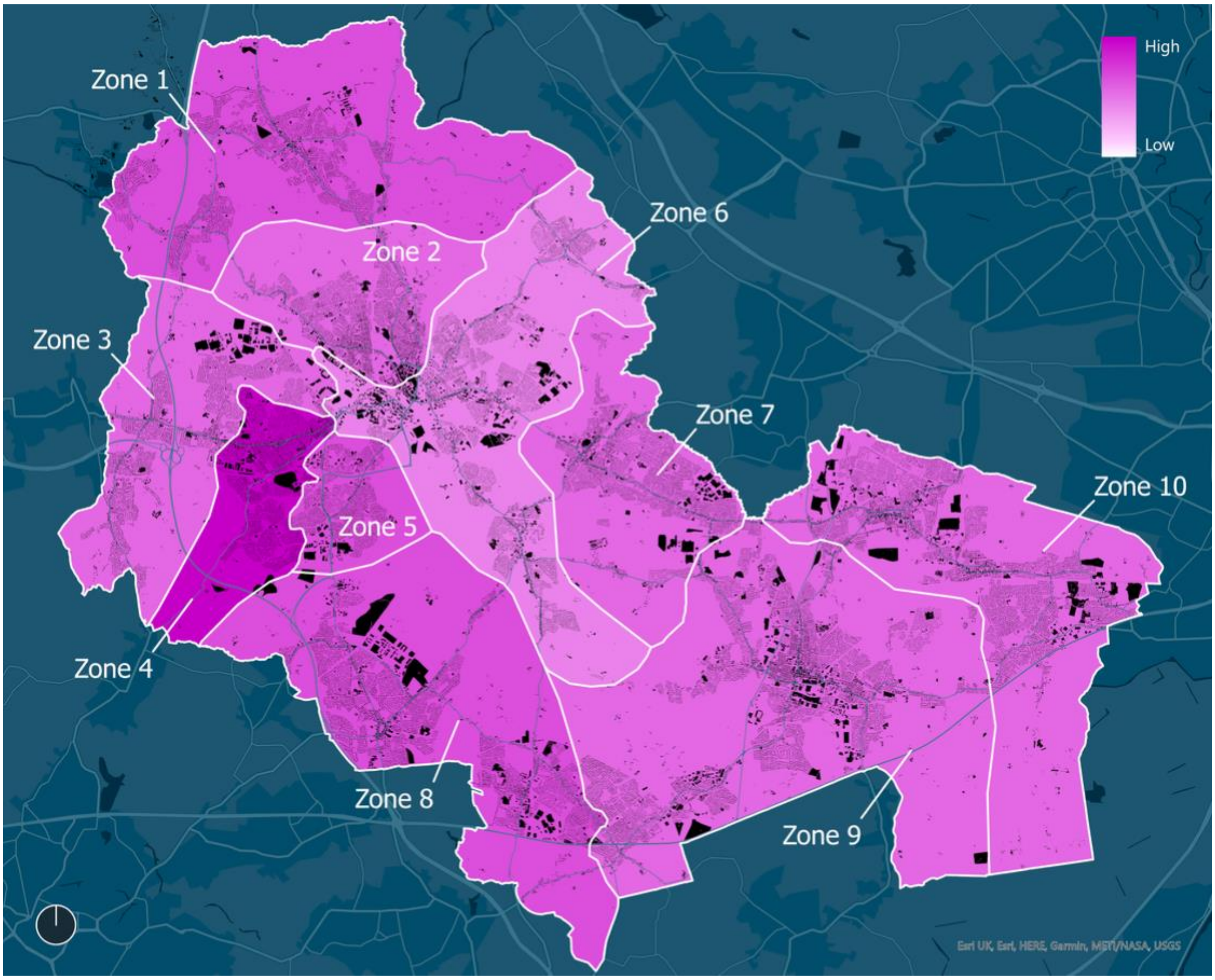
* Estimates vary - see for example projections for initial HyNet cost of hydrogen at around 150% uplift over natural gas https://HyNet.co.uk/wp-content/uploads/2021/06/14368_CADENT_PROJECT_REPORT_AMENDED_v22105.pdf [page 15]

Retrofit across Wigan by 2038



First Steps – Priority Areas

Whilst large numbers of dwellings will need to be retrofitted to improve energy efficiency across all areas of Wigan, there is need to focus on priority zones for this fabric improvement. 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)*. Several factors feed into this prioritisation; these include consideration of prevalence of fabric retrofit among properties in each of the zones – which is explored in the image below.



This is the key factor in inform the prioritisation of zones for fabric retrofit. However, other factors are also considered, including fuel poverty and the type of insulation. For example, cavity wall insulation tends to be a relatively low cost and high reward measure.

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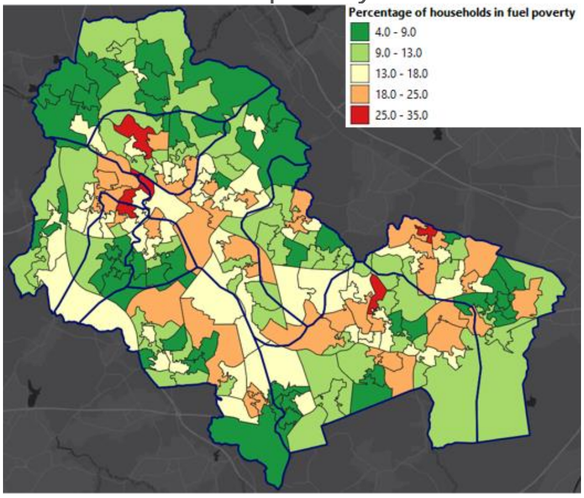
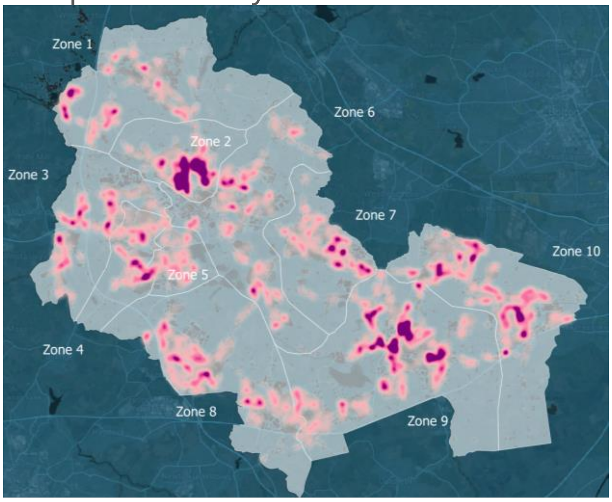
* Fabric retrofit measures have been identified following a whole energy system approach, considering the cost-effectiveness of fabric retrofit measures alongside other options to achieve carbon neutrality in Wigan. This does not mean that individual dwellings or buildings would not benefit from additional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

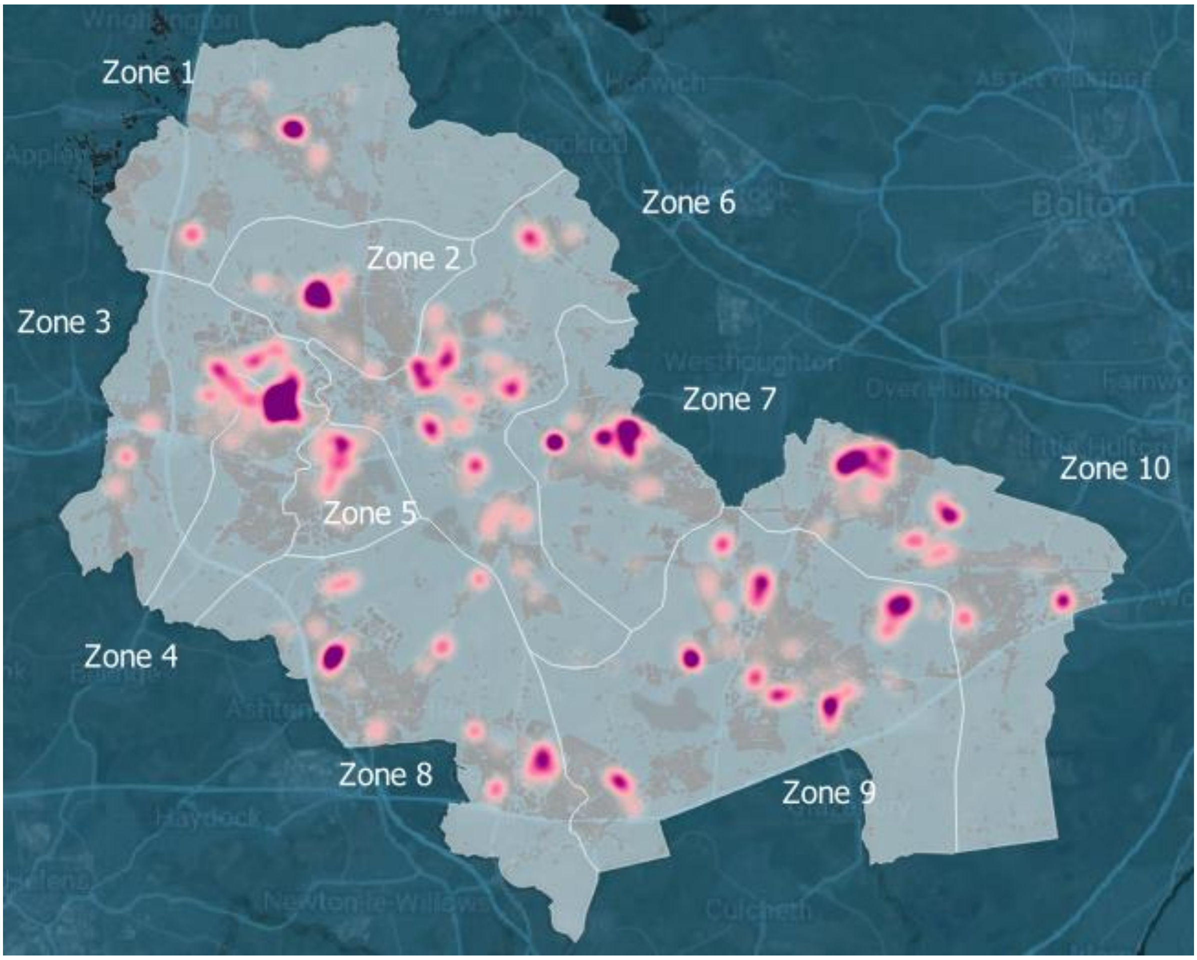
Prevalence of fuel poverty



Hotspots for cavity wall insulation



The different future heating types are also considered. In areas which could transition to hydrogen insulation is seen as an early priority to enable decarbonisation. The final factor considered is tenure type. This provides increased potential for policy leverage, fewer stakeholders to engage and other societal benefits means the social housing sector is a useful area to initially target, these are highlighted in the map below.

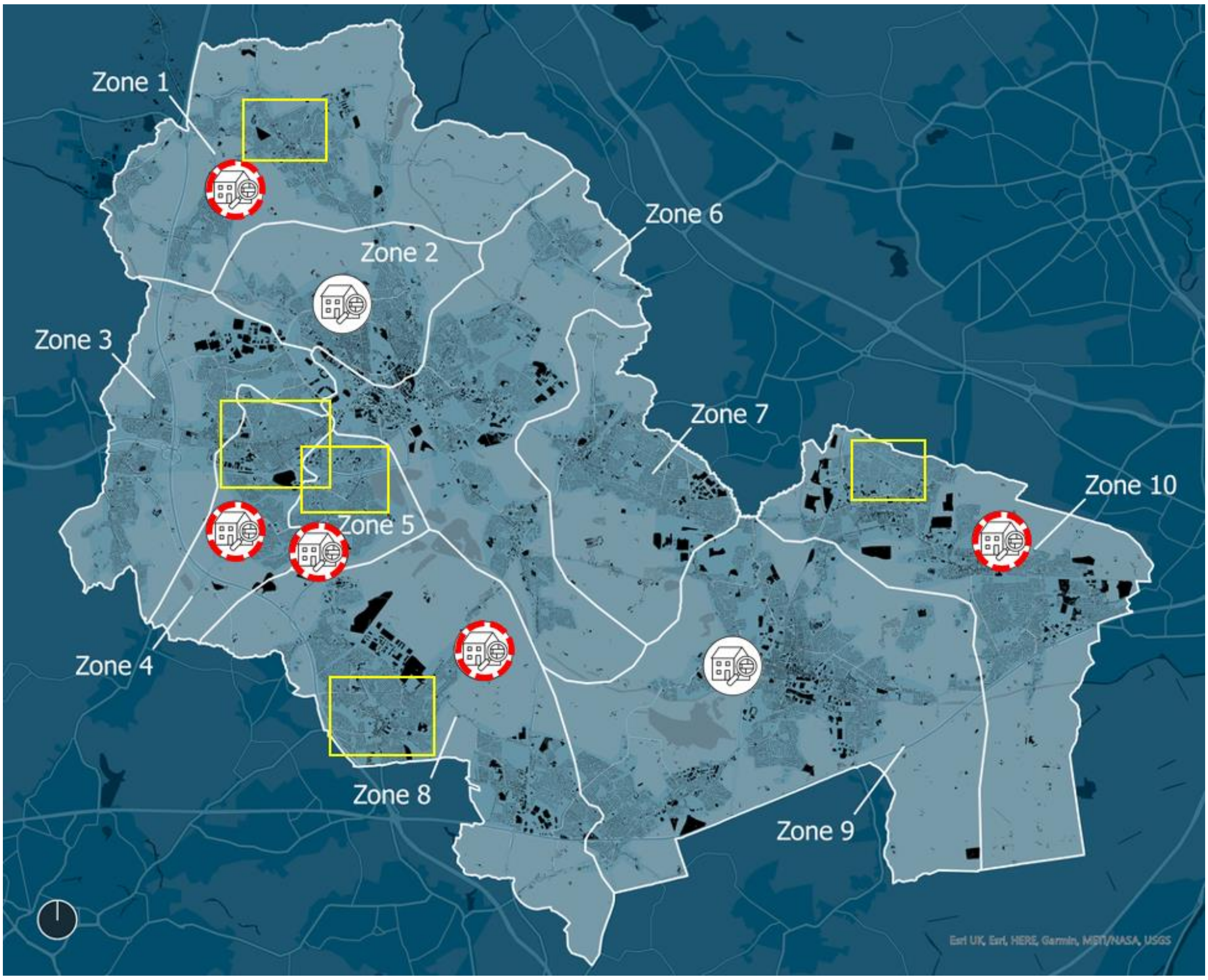


These factors are combined to produce the following priority map for domestic fabric improvement in Wigan.

Of all the zones 1, 4, 5 and 8 are the areas in which the highest proportion of homes (between 61 and 76%) receive insulation measures, with zones 1 and 8 also containing a large absolute number of properties to be retrofitted, so the opportunity in these zones is significant as is understanding the type of properties which require retrofitting in these zones. Zone 10 is included as a priority due to the focus of social housing. Zone 9 is included as secondary priority, due to the highest total number of fabric improvements, which include a high number of relatively easy to treat cavity walls and zone 2 which has a high level of fuel poverty, that coincides with a high number of cavity walls and proportion of social housing.

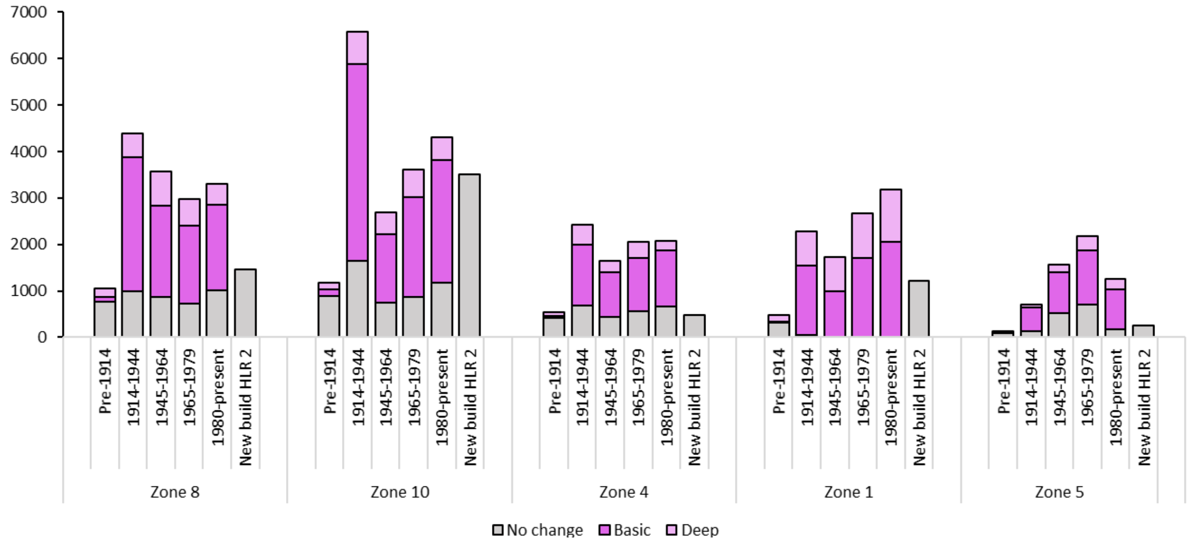
All other areas also see high levels of retrofit, with the lowest levels in zone 6 still being around 49%. Greater proportions of flats, newbuilds or pre-1914 properties which are less economic to apply insulation to lead to lower insulation levels in these zones.

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

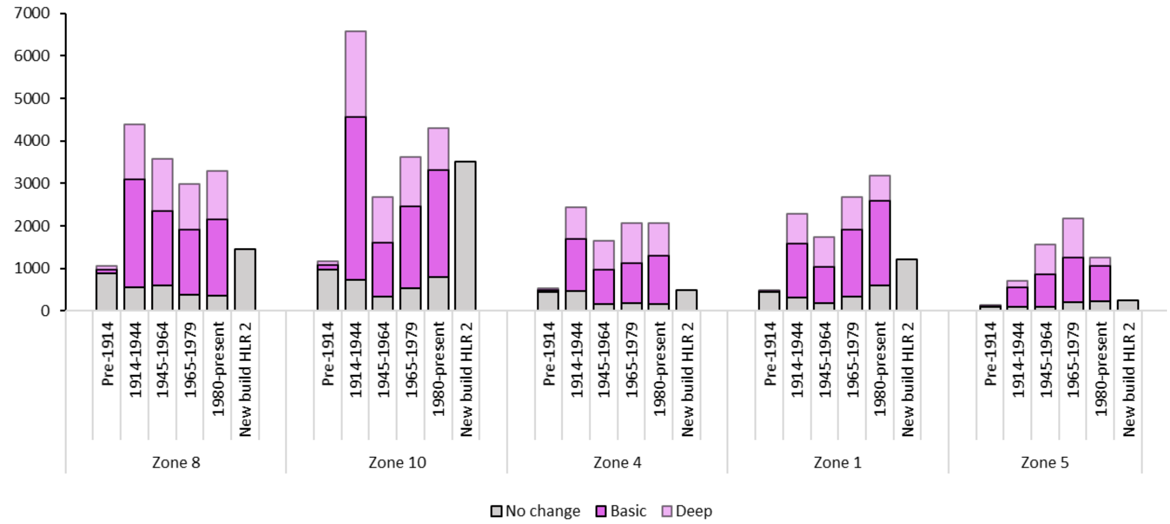


The yellow boxes on the map are focus areas within the priority zones, for which higher resolution maps are provided in the detailed examination of priority zones in the subsections below. An overview of the building ages and level retrofit across these focus zones are shown in the figures below.

Building age and retrofit level priority zones (Primary scenario)



Building age and retrofit level priority zones (Secondary scenario)



Most of the priority fabric retrofit zones show a relatively even split of properties from 1914-present day, indicating varied approaches will be needed to fabric upgrade.

Fabric Retrofit Opportunity in Zone 1

Zone 1 receives the greatest level of retrofit across the buildings (81% making up a total of ~ 10,000 homes) with it predominantly being made up by semi-detached and detached homes. The majority of these receive basic retrofit packages in the semi-detached homes and detached homes (54% versus 33%). The predominant age groups of homes in this area are 1980-present (around 3,400 homes) and 1965-1979 (around 3,400 homes). Retrofit is spread evenly and extensively (nearly all buildings) across all age groups, except pre-1914 homes and new builds which receive upgrades to~ 35% and 0% of their buildings respectively.

The hotspot area identified on the map of priority fabric retrofit zones is typical of the domestic properties in Zone 1, the characteristics of these buildings is explored in the images and accompanying text below.

Insulation density map – there are some areas with a higher insulation focus, relating generally to deeper retrofit measures required as well as dwelling density. The estate to the north west of the B5239 label is particular hotspot on the map.

Building age map – there is a wide split of building ages across the area. This is typical in zone 1. As can be seen when comparing to the map above, more recent buildings have a lower fabric retrofit density, whilst buildings that fall into groups of 1914-1979 have higher fabric improvement requirements.

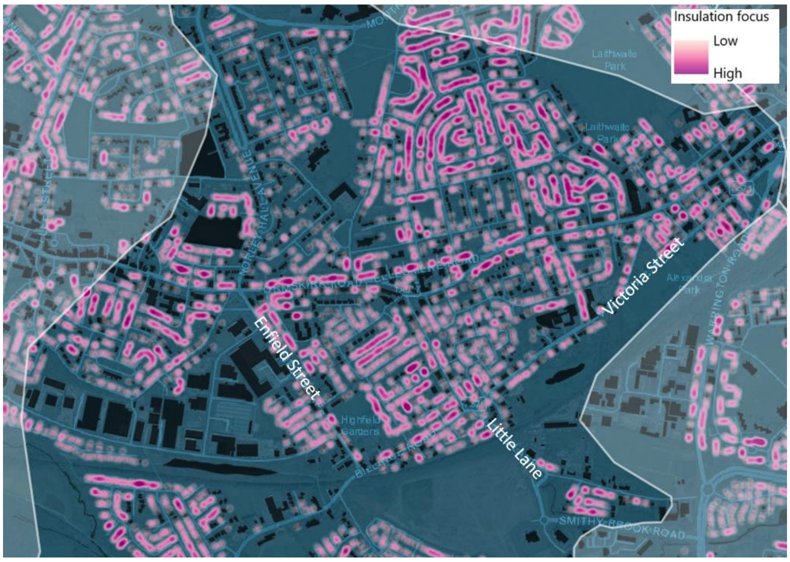
Building typology map – the focus area is typical of zone 1 with the high proportion of semi-detached properties, with a high number of detached properties also in the area. The associated lower demand density compared to flats, for example, is part of the reason why heat network zones are not identified for domestic properties in zone 1, with building level solutions being favoured instead.

Fabric Retrofit Opportunity in Zone 4

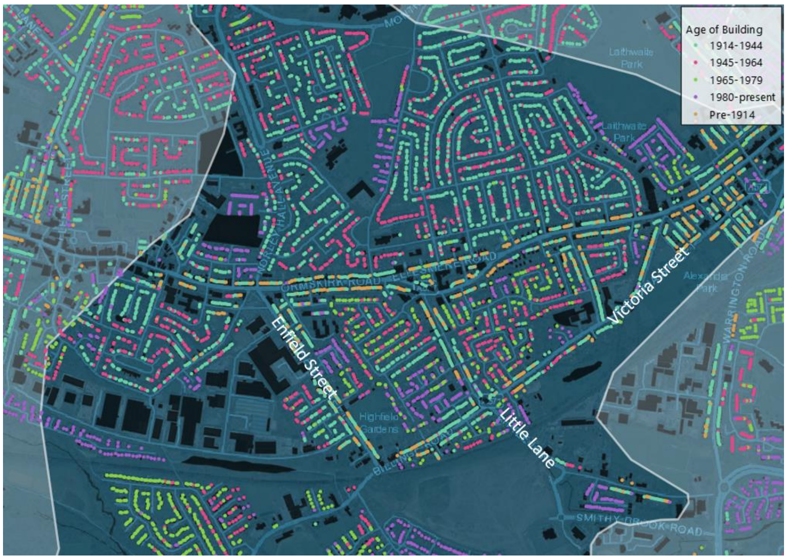
Zone 4 is one of the smallest zones with only ~9,600 homes. The most common property type is semi-detached homes (51%) and only 4% being flats. 76% of the total number of homes in Zone 4 are to be retrofitted, of which 54% are semi-detached. Of the semi-detached homes, there is almost an equal split between basic and deep retrofit measures. Zone 4 is characterised by having some of the oldest building stock in Wigan which may present different approaches to fabric improvement than in other areas.

As well as the high proportion of fabric retrofit zone 4 is an area which is more likely to have the possibility to connect to hydrogen. This is due to the presence of heavy industry which is more likely to connect to HyNet and then make hydrogen available to the surrounding homes.

Insulation density map – the highest density of fabric retrofit (at the top of the image displayed to the right) is in a hotspot for social for housing. This adds further to making it a priority area, with more funding support generally being available and likely to have a greater impact on wider energy related issues – such as fuel poverty.



Building age map – the highest insulation focus area is characterised by the 1914-1944 building stock, which is typical of zone 4, there is also a large number of 1945-1964 properties in the area. When compared to the zone 1 maps this highlights the challenge of different zones likely to need different approaches to fabric retrofit.



Building typology map – whilst there is a mix of ages of property the type of property is much more heavily focused on just one type – semi-detached. Small sections of detached and terraced properties are included but these form a very minor priority in terms of overall numbers. Whilst this typical of zone 4, this focus area emphasises the need to focus on semi-detached properties.

Fabric Retrofit Opportunity in Zone 5

Zone 5 is the smallest zone with ~6,700 homes and shows very similar characteristics to Zone 4. 63% of the homes are to be retrofitted of which 58% are semi-detached. Most of the retrofit measures within Zone 5 are basic retrofit.

Insulation density map – zone 5 is the smallest zone geographically and as such it is hard to identify a particular area to focus on. The focus tends to be along particular streets, such as those above the A49 label. These properties will have the highest focus of retrofit

Building age map – the insulation focus varies across different property ages, with high insulation focus areas being seen in all property age bands from 1914-present. This highlights the need for local solutions, suitable to different building typologies.

Building typology map – whilst there are small clusters of detached and terraced properties the vast majority of the building stock is semi-detached.

Fabric Retrofit Opportunity in Zone 8

Zone 8 is a much larger zone than the previous two priority zones identified. With a total of ~18,000 homes, 47% are to have basic retrofit and only 14% deep retrofit. Like the other priority zones, approximately half of the total dwellings are semi-detached homes.

Insulation density map – Zone 8 is a large zone with two major population centres, Ashton-in-Makerfield and Golborne. Ashton-in-Makerfield is the focus area selected due to a slightly higher density of insulation requirements and the tenure of these properties. The large cluster for insulation focus to the west of the Wigan Road label is a focus area for the social tenure type and would be a useful focus area.

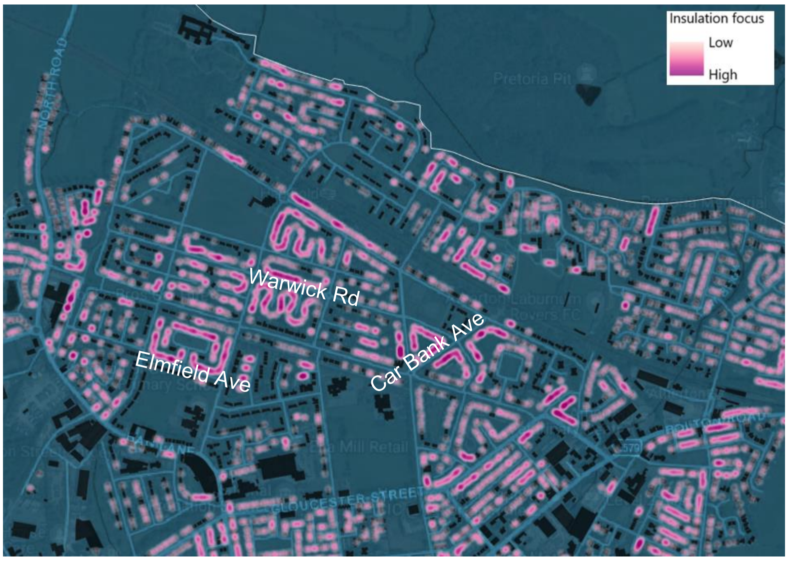
Building age map – the area to the west of the Wigan Road label (highlighted above) is predominantly 1945-1964 building stock. Meaning this could be an initial focus age group for the wide mix of property ages which need additional insulation in the area.

Building typology map – again a clear focus is apparent for semi-detached properties. This semi-detached focus is greater in the high-density area for insulation than the zone 8 as a whole, further highlighting the importance of having a concerted approach to treating these properties.

Fabric Retrofit Opportunity in Zone 10

Zone 10 is a focus area for fabric improvement despite not being an early priority for hydrogen. This is due to the high number and percentage of homes which need fabric improvements and also wider factors including fuel poverty and property tenure. Zone 10 is a large zone with 24,221 homes and a high level of fabric improvement required (at least 63% of the existing building stock). The focus area for Zone 10 is based around a high fuel poverty and social housing area.

Insulation density map – there are multiple insulation hotspots in the area Zone 10 highlighted. The areas of Warwick Road, Elmfield Avenue and Car Bank Avenue are all indicated as initial areas to focus on.



Fabric Retrofit Approach

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

The retrofit zones identified on the previous pages are designed to allow the coordinated targeting of interventions across Wigan in such a way that supports and aligns with Wigan'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 Wigan's dwellings by type that are expected to need retrofit measures is shown below. This represents around 57% of the projected domestic building stock requiring retrofit in Wigan by 2038, which equates to approximately 94,900 dwellings. This highlights both the scale of the challenge but also the opportunity for building and using local supply chains.

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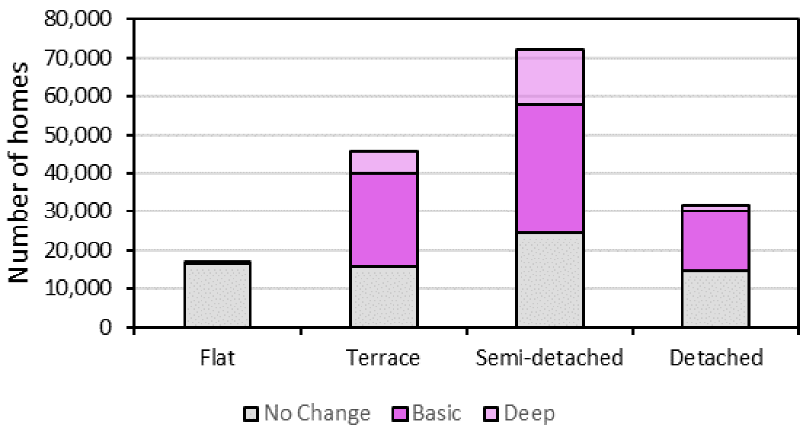
* Consideration will be needed to identify a suitable approach for insulating inter-war cavity walls, noting cavity widths are generally smaller than more modern dwellings; considering aspects such as insulation type and damp prevention; where solid wall insulation may be needed on some dwellings with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

Fabric Retrofit in 2038 by Building Type



There are over 67,000 homes which receive basic insulation measures and over 21,000 receiving deep measures in both scenarios. Around 17,700 more dwellings will receive deep retrofit in the secondary scenario compared to the primary. Carrying out basic measures in earlier years would not preclude deeper measures being installed in homes in later years. Therefore, basic measures and the majority of deep measures are considered low regret across all scenarios and heating system selections. Due to the ages of housing targeted, a significant proportion of the cost-effective deep measures are based on adding triple glazing to dwellings with basic measures applied, rather than large volumes of external/internal wall insulation to pre-war period dwellings. This is based on the supporting optimisation led modeling, which identifies least-cost options to achieve the carbon targets. Further consideration would be needed to ascertain if individual homes could also benefit from further measures to reduce energy demand and subsequently energy usage costs, for example, considering socio-economic indicators.

Cost-Effective Deployment

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

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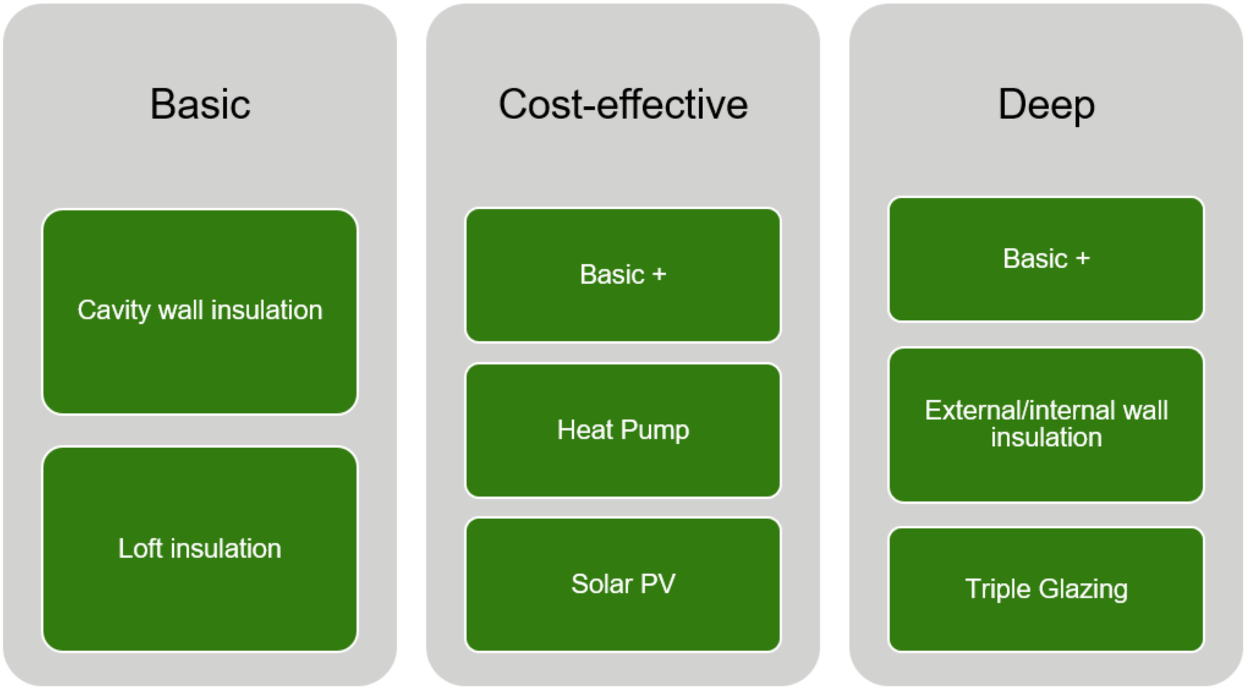
* The modelled packages align loosely with packages in the Pathways to Healthy Net Zero Housing for Greater Manchester, with some differences due to the modelling approach. The ‘deep’ package here is similar to the fabric measures in the ‘deep’ package in Pathways. The ‘basic’ package in this report 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.



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 Wigan.

In the secondary scenario (i.e. a hydrogen scenario), the number of dwellings expected to need deep retrofit would be even greater than in the primary scenario (i.e. 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 Wigan overall, in line with the carbon budget. However, there may be strong reasons for additional retrofit work and so deeper and more extensive retrofit for individual dwellings is possible, with the potential to bring benefits including:

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

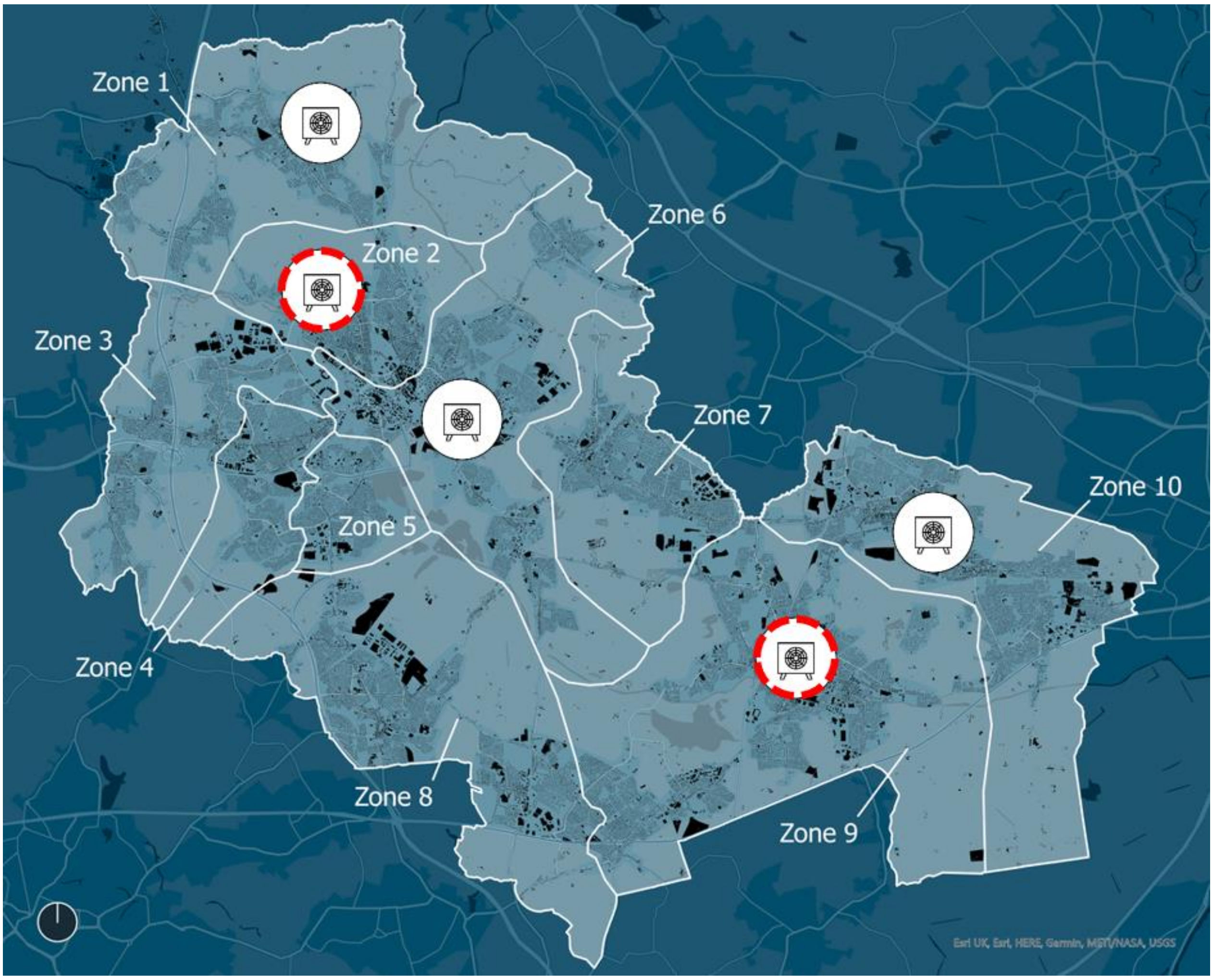
Supporting Low Carbon Heat

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

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

Vision to 2038

Building characteristics and existing network characteristics inform the low carbon heating system best suited to each building, and this causes patterns to emerge between the zones across Wigan. In the primary scenario, the decarbonisation of heat is primarily achieved through installation of electric heat pumps in existing and new homes, comprising approximately 157,500 domestic heat pump installations. Low temperature ASHP's are the predominant heating system in all areas of Wigan, with GSHP also being prevalent in zones 1 and 8. Other electric systems are also present in less significant numbers. Alternatively, the secondary scenario sees hydrogen boilers used in the majority of homes – see page 48. This possibility of hydrogen is used to help determine priority areas for heat pumps, with zones 3, 4, 5, 8 and to a lesser extent 7 all having a higher potential for hydrogen connection due to the industry in these areas.

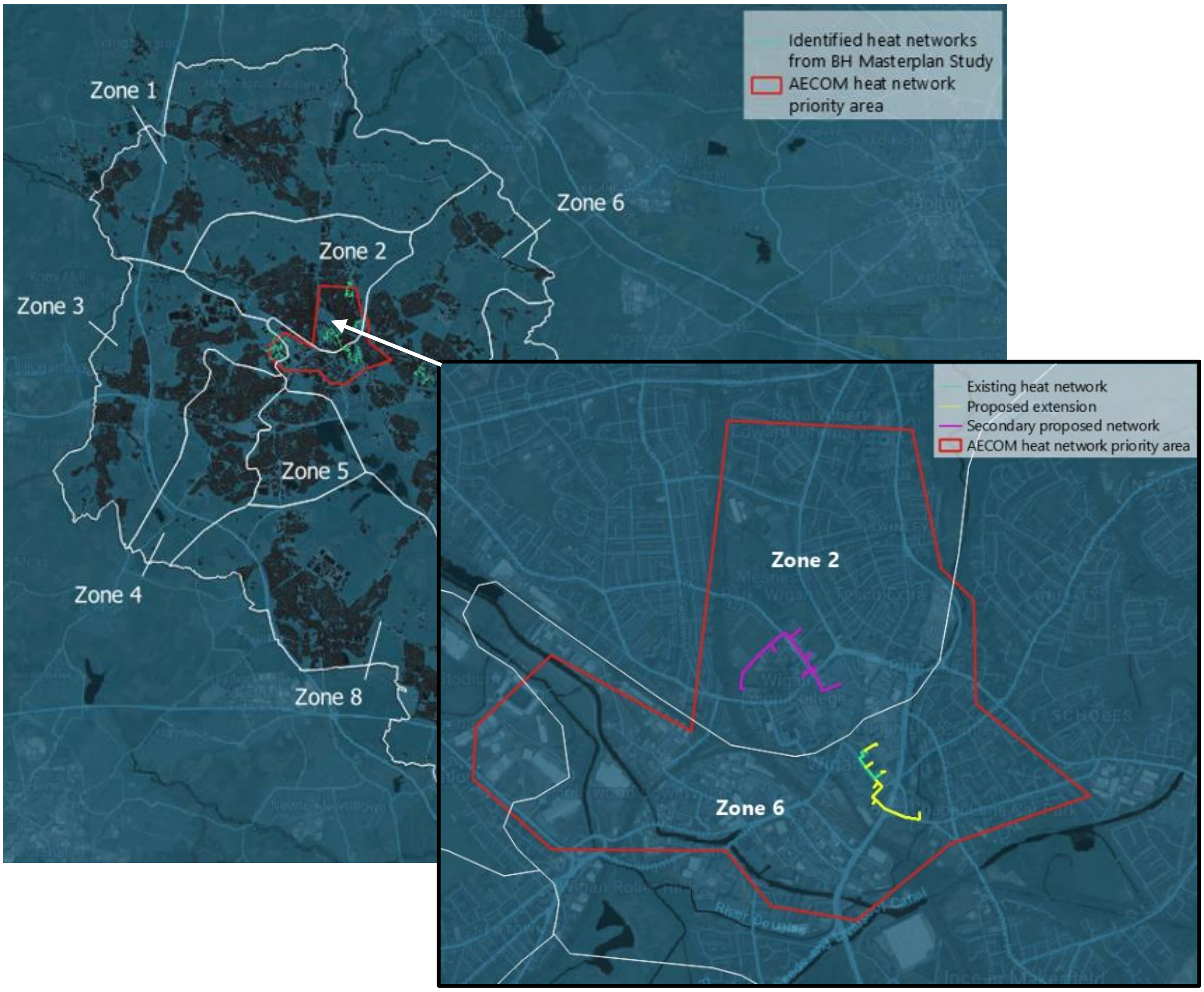


Zone 9 is a priority zone due to having the highest number of total heat pump installs, higher electricity network headroom (allowing for early electrification) and a relatively high proportion of the building stock needing no fabric improvement. In these properties heat pump install is not contingent on fabric improvement, meaning there is a shorter lead time. Despite being lower in total count for heat pumps Zone 2 was a priority for heat pumps due to similar headroom and building fabric considerations, as well as tenure type.

Heat Zones for District Heating Opportunities in Wigan by 2038

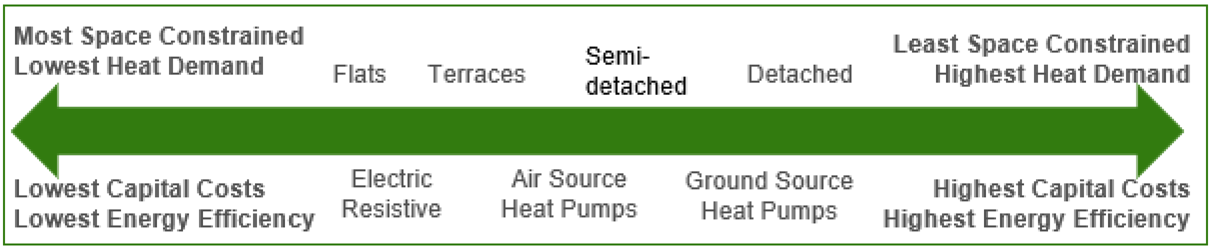
No areas were identified for district heating; however, this does not mean they should not be considered as an alternative heating solution. These modelling forecasts are not definitive and represent a view of the future for each zone, to illustrate the scale of change required, it is expected that alternative 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.

In the centre of large urban areas, like Wigan town centre, the decisions between different heating methods are often very marginal. The centre of Wigan has seen interest for heat network development and even has an existing network which could be decarbonised. For context outputs from both a BuroHappold (BH) and AECOM study are displayed in the image below. Opportunities include: decarbonisation and extension of an existing network in zone 6, a network in the southern area of zone 2 and some penitential for a network in the Robin Park area of zone 3.

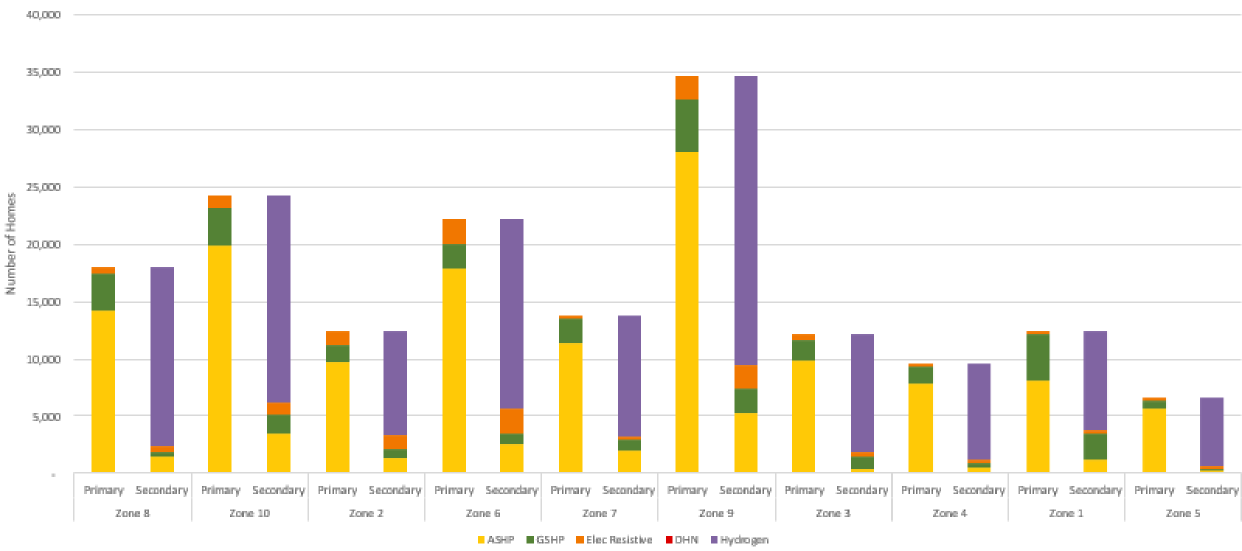


Heating System Selection

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



Deployment of Heating Systems by 2038



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

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

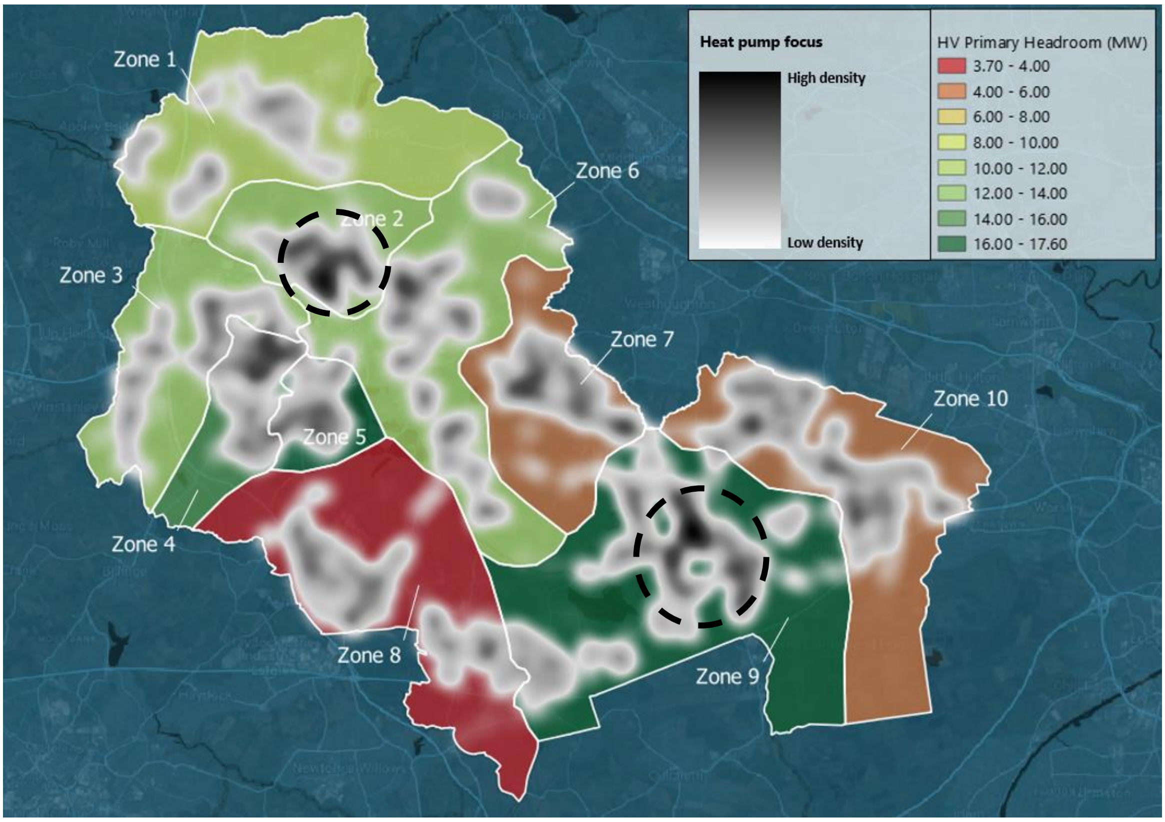
Heat pumps perform best in homes with good levels of insulation, so building retrofit should be considered alongside heat pump installations to minimise disruption to dwelling occupants. This would also reduce overall cost by allowing smaller heat pumps to be used and fewer radiators to be upgraded due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

Zones with large numbers for heat pump deployment and good levels of spare capacity on the electrical grid (e.g. 9, 2 and 1) are prioritised for early deployment as existing heating systems approach end-of-life (while avoiding the distress replacement of a failed system, which can constrain options). This can help establish supply chains, delivery approach and capacity, and strikes a balance between flexibility and early progress. It leaves the plan open to developments around the future of the gas network, conversion to hydrogen and the UK’s heat strategy, ahead of a mass programme of transition in places where the best option is less clear.

The heat pump priority map on page 42 illustrates suggested priority areas for demonstration and scale-up activity. Consideration will be needed to develop a programme of works which aligns with other interventions to maximise delivery efficiency and minimise disruption to residents.

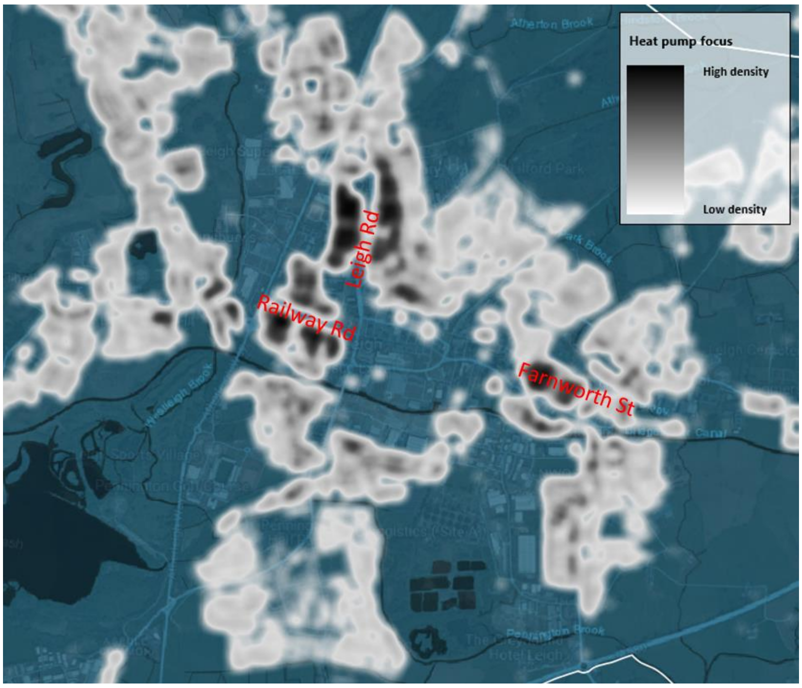
Heat Pump Priority Areas

As noted above, the majority of homes within the Wigan area are identified to transition to heat pump technologies. This is largely related to the significant proportion of semi-detached and detached homes that are most suited to heat pump deployment. For immediate benefits with low challenges, three priority areas have been identified that considers density of proposed heat pumps and available distribution headroom. Good levels of spare capacity on the electrical grid are prioritised for early deployment, as when existing heating systems approach end-of-life heat pumps can be adopted (while avoiding the distress replacement of a failed system, which can constrain options). This can help establish supply chains, delivery approach and capacity, and strikes a balance between flexibility and early progress. It leaves the plan open to developments around the future of the gas network, conversion to hydrogen and the UK’s heat strategy, ahead of a mass programme of transition in places where the best option is less clear.

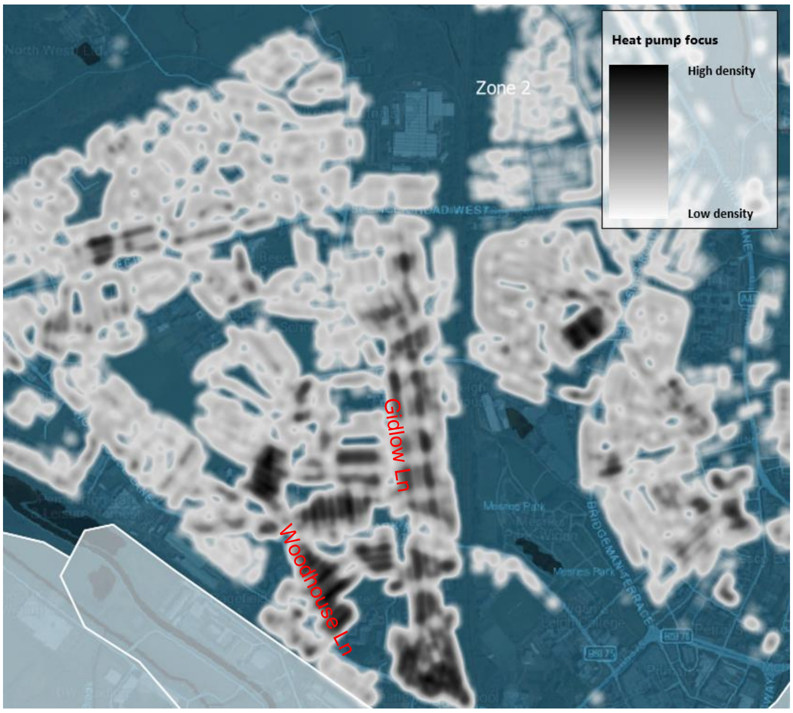


Zone 9 has the greatest number of houses (32,644 homes) of which 94% have proposed future heat pump deployment. The largest proportion of this zone is comprised of semi-detached houses and therefore air source heat pumps are most suited as a low carbon alternative with some ground source heat pumps. In addition, Zone 9 has a large distribution headroom available in the primary substation to reduce the need for imminent reinforcement when transitioning to electrified heat and EV roll out (headroom availability is discussed in more detail later in the report).

Whilst heat pumps are seen widely across the whole of Zone 9 there are focus areas based on density, the red street labels on the image below.



As in Zone 9 in Zone 2 there is also a noticeable increase in density of heat pump deployment around certain streets, in the context of high overall up take. These streets would be priority areas for engagement.



Opportunity Areas

Zone 2 has ~12,500 homes mostly made up by terraced and semi-detached with slightly more semi-detached houses (38% overall). A total of 11,200 heat pump connection opportunities have been identified, with GSHP's making up 13% of this which has been considered suitable for connection to detached homes where space is less of a limiting factor Again, along with the demand headroom in the nearby substations, this zone gives ample opportunity to develop approaches to installing heat pumps in these homes. With this zone showing areas of high density, there could also be an opportunity to develop district heat networks in the area (as discussed in the heat network section).

Zone 9 has the highest number of homes (~34,590) with a high proportion again made up of terraced and semi-detached houses (around 71% of the total). The semi-detached homes are likely to offer an easier opportunity to make early progress with heat pump installation, thanks to typically less space-constrained circumstances.

A total of around 28,000 air source heat pumps are recommended in this area (some of which could be hybrid systems), along with 4,650 ground source heat pumps. Electrical capacity in these areas appears sufficient to deploy a large number of heat pumps before electrical network upgrades would be required (see in section 7 Present Day Capacity and First Steps).

Current heating systems

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

Hydrogen for Heating

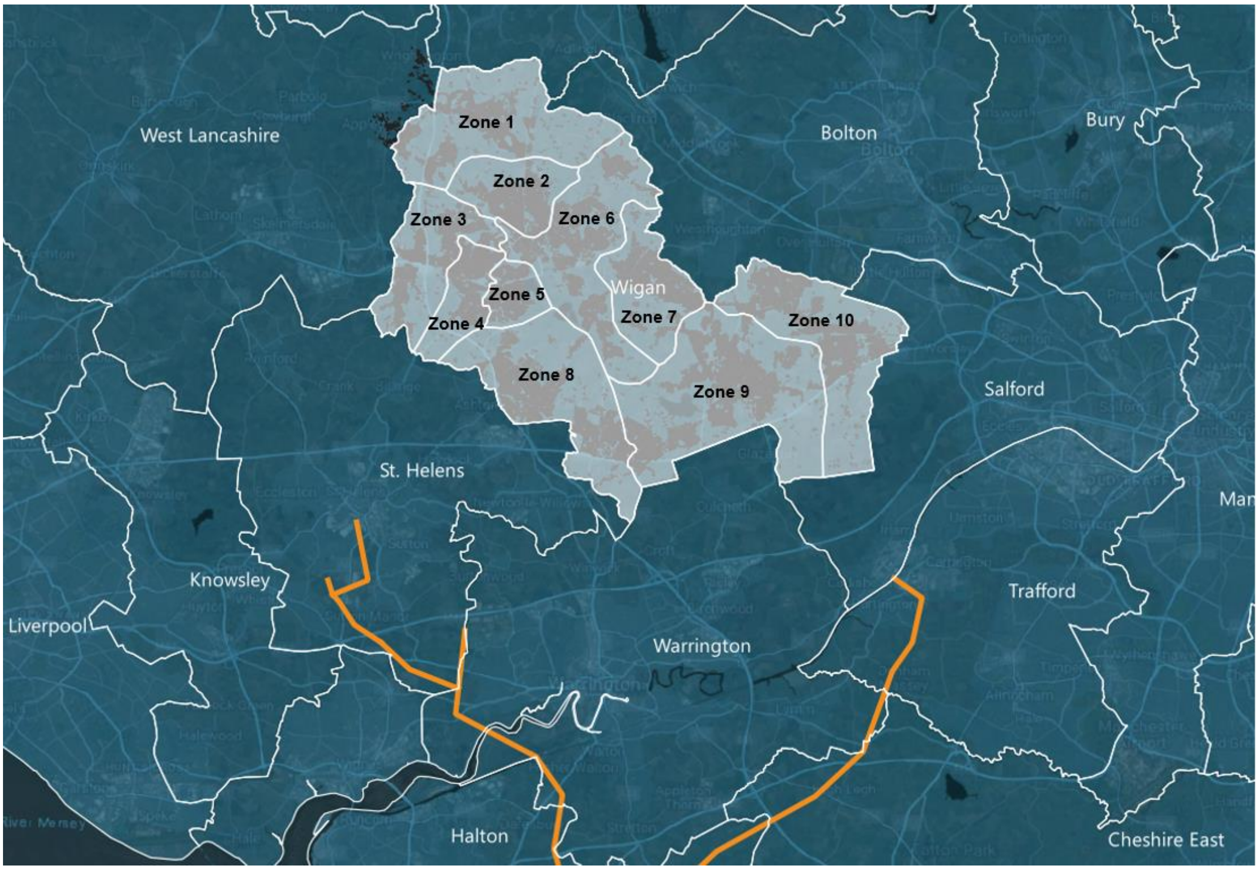
The representation of hydrogen in the analysis for this plan has been aligned with the proposals for HyNet in the North West of England, and the associated opportunities for the GMCA area.

The primary scenario reflects phases 1 and 2 of HyNet, where low carbon hydrogen may be available from 2025 onwards for the largest industrial sites in the region. It is not believed that any of these are likely to be in Wigan. 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 Wigan, resulting in a potential shift to hydrogen dominated heating. One of the key considerations being that the hydrogen based secondary scenario is assumed to be significantly cheaper than the primary scenario (£10.2 bn compared to £11.2 bn); however, this is dependent on HyNet phase being delivered on time and at the cost and carbon projections provided by HyNet. Taking a wait-and-see approach is therefore deemed extremely risky when there is a 2038 carbon target; the scale-up and demonstration approach in the identified priority areas are therefore provided so that short to medium term activity can take place in areas of least regret.

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

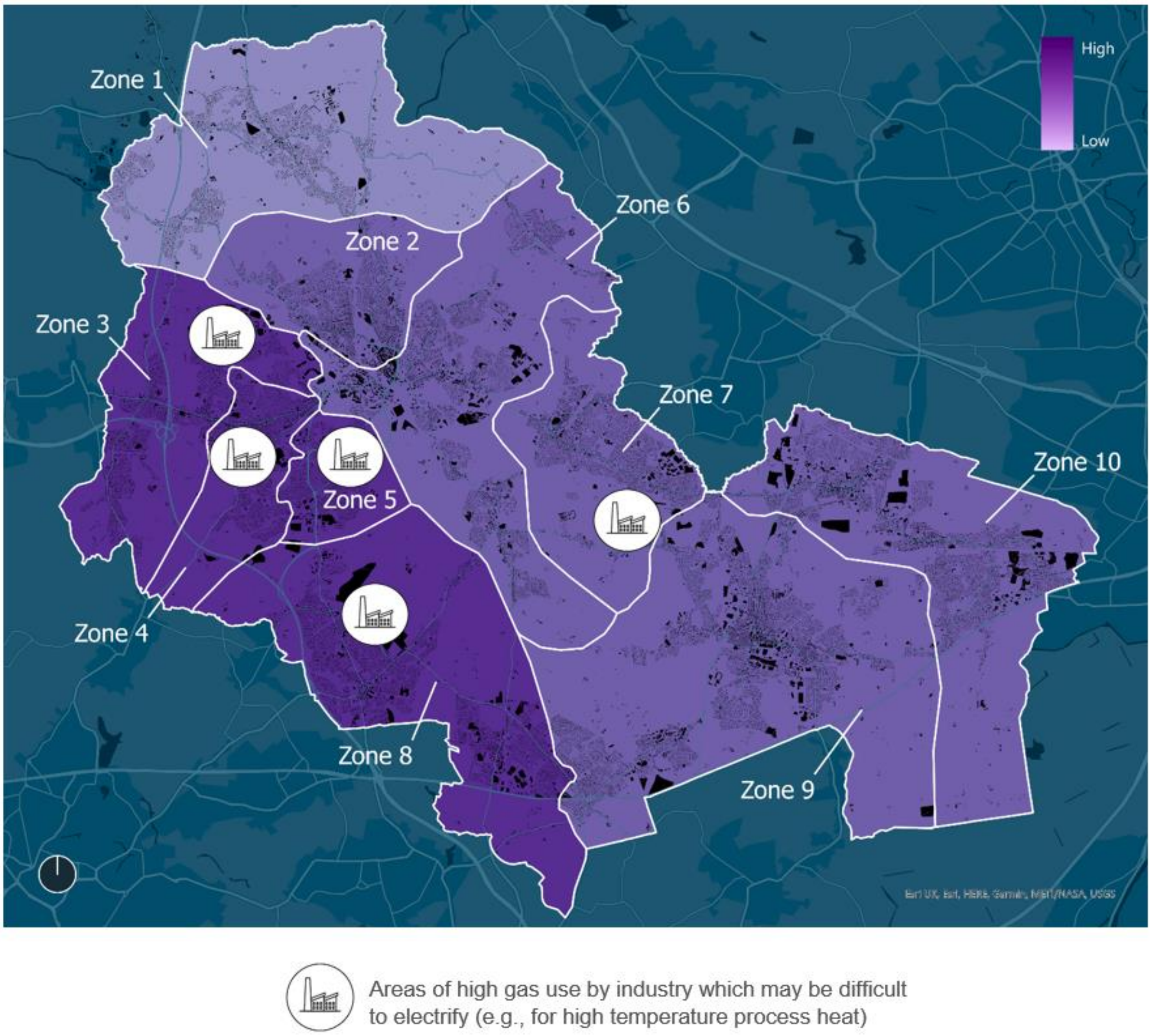
Wigan is not in the initial proposed routes for HyNet Phases 1 or 2 (see image below – where HyNet pipelines are highlighted in orange), which means hydrogen is unlikely to be adopted early.

Proposed route for HyNet phase 2



Hydrogen for Heating - Opportunity areas

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



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

Zone 3 sees the location of the largest food processing facility in Europe – KraftHeinz. It is located in the North East of the zone, ~ 3 miles from Wigan town centre. In 2021, 24 major employees in the North West and North Wales signed up to decarbonising through the connection to the HyNet network, including KraftHeinz*. With such a large anchor load for gas, Zone 3 is viewed as a priority point for a HyNet connection based on single point demand. Additionally, there are up to 10,300 dwellings would be suited for hydrogen heating in this area.

Zones 4 and 5 also have high demands for hydrogen from industrial process, although no single point user of the scale of the KraftHeinz site, so connection to Zone 3 by HyNet would probably required before these zones have hydrogen available. There are more than 8,400 (88%) dwellings would be suited for hydrogen heating in Zone 4 and over 5,900 (90%) in Zone 5.

Zone 8 has 15,500 (86%) homes identified as suitable for hydrogen. As with Zones 4 and 5 this is likely to progress after Zone 3. However, Zone 8 does have a large single point demand identified through the National Atmospheric Emissions Inventory - Hanson Asphalt. This site is likely to be an initial connection point. It sits between the two of the largest population centres in the Zone (Ashton-In-Makerfield and Golborne) helping with rollout from industrial to domestic properties.

* https://hynet.co.uk/wp-content/uploads/2021/10/102021-24-organisations-sign-up-to-HyNet68.pdf

Zone 7 is geographically separate from the other hydrogen zones and is included due to an electric glass fibre production plant at Hindley Green. Due to its geographic separation, it is likely to decarbonise later; however, the high energy demand and processes involved means a hydrogen pathway could be required. This could then enable domestic properties to transition to hydrogen solutions, which would be useful given the levels of network constraint in Zone 2 that makes heat pump adoption challenging.

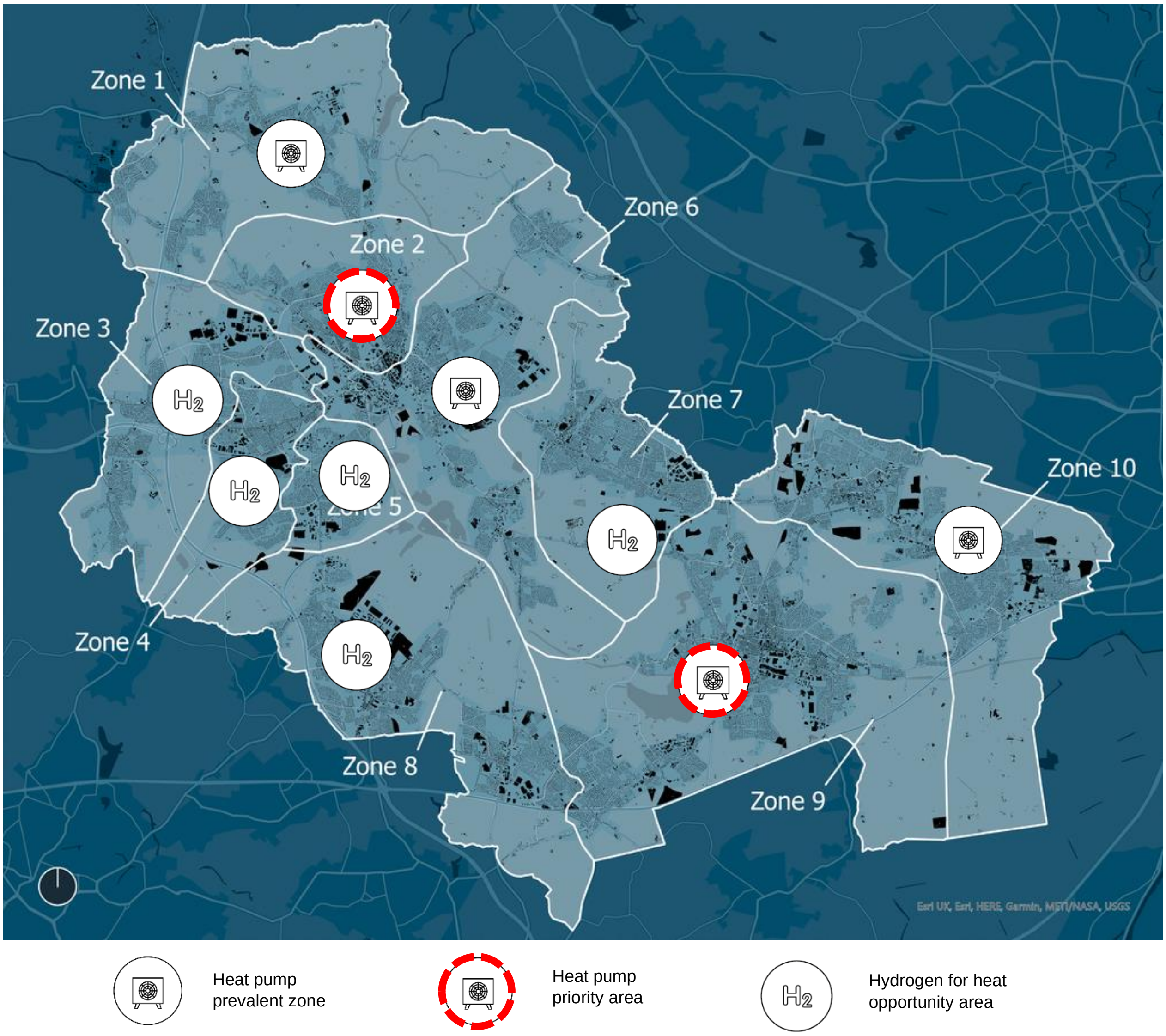
4. HEATING SYSTEM ZONES - SUMMARY

The different 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 primary scenario, low temperature air source heat pumps remain the solution of choice for semidetached and terrace homes, while some flats remain on electric resistive heating.
- GSHP opportunities have been identified as the solution of choice for detached homes where space is a less of a limiting factor and high temperature heat pumps are the preferred selection for new builds.
- Large industrial sites such as KraftHeinz and Nippon Electric Glass Fiber UK present potential for significant anchor demands for hydrogen and connection to the HyNet network. With the main anchor point being KraftHeinz in Zone 3, expansion through the west of the borough (Zones 4, 5 and 8) would enable connection to a large number of commercial and industrial sites.

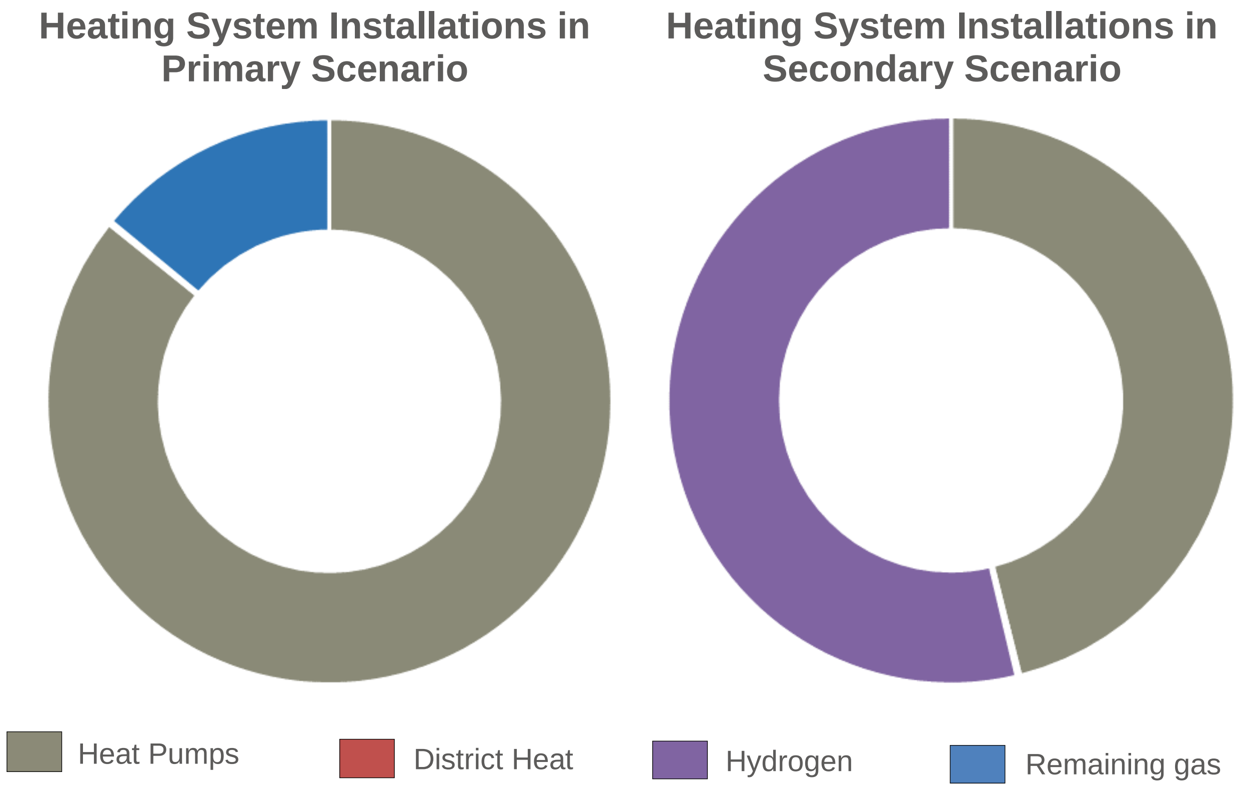
Zone	Prevalent heating system	
	Primary scenario	Secondary scenario
Zone 8	Low temperature ASHP’s	Hydrogen boiler
Zone 10	Low temperature ASHP’s	Hydrogen boiler
Zone 2	Low temperature ASHP’s	Hydrogen boiler
Zone 6	Low temperature ASHP’s	Hydrogen boiler
Zone 7	Low temperature ASHP’s	Hydrogen boiler
Zone 9	Low temperature ASHP’s	Hydrogen boiler
Zone 3	Low temperature ASHP’s	Hydrogen boiler
Zone 4	Low temperature ASHP’s	Hydrogen boiler
Zone 1	Low temperature ASHP’s	Hydrogen boiler
Zone 5	Low temperature ASHP’s	Hydrogen boiler

Although each zone has low temperature ASHP as the dominant solution in the primary scenario and hydrogen boilers in the secondary scenario there are still different levels of likelihood of adoption. The map below summarises the information discussed above for heating systems by zone. The areas with hard to decarbonise industry are flagged as more likely to have hydrogen solutions. As such heat pumps do not represent low regrets options in these zones and as such are not flagged as priority areas for heat pumps, despite this being the selected technology in the primary scenario. This does not mean heat pumps should not be deployed in these zones, it is just that the other zones represent initial target areas.



4. Non-domestic Buildings

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



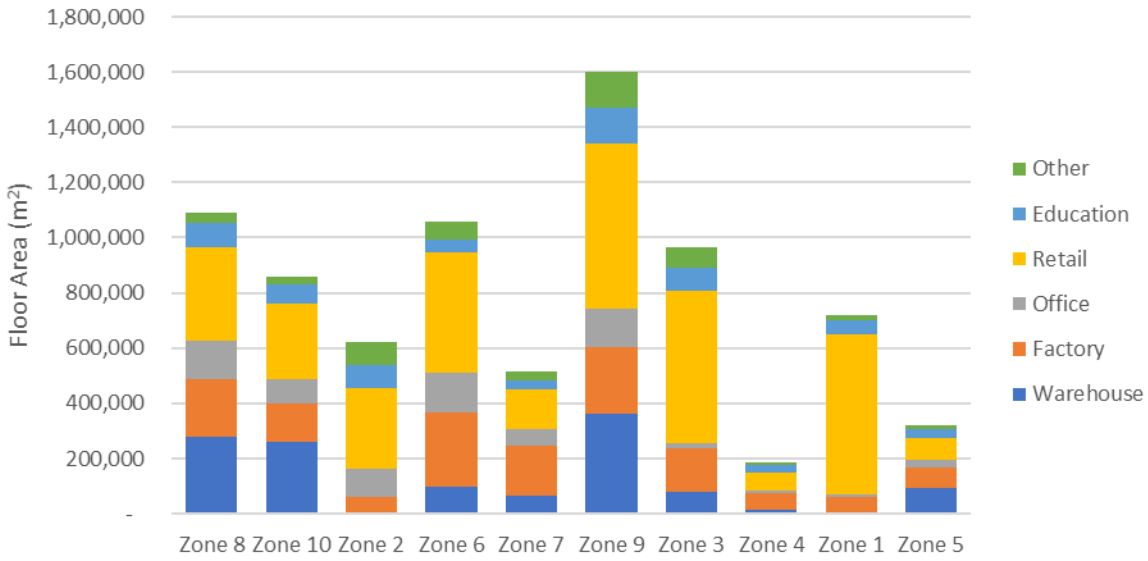
- The majority of Wigan's non-domestic buildings (86% by floor area) have been deemed able to transition to a heat pump option with 7% of this deemed suitable for ground source.

- A notable proportion (14% by floor area) are deemed to be reliant on either gas or hydrogen for use in industrial processes; however, building specific detail e.g. regarding understanding industrial process has not been considered.

- Further area-specific and detailed consideration is required to identify the most appropriate non-domestic solutions. For example, district heating has not been identified as a primary opportunity for any of the zones, but should still be considered as a potential cost effective solution for areas (i.e. areas previously discussed of zones 2, 3 and 6) where there is high heat density and large anchor loads*. 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.

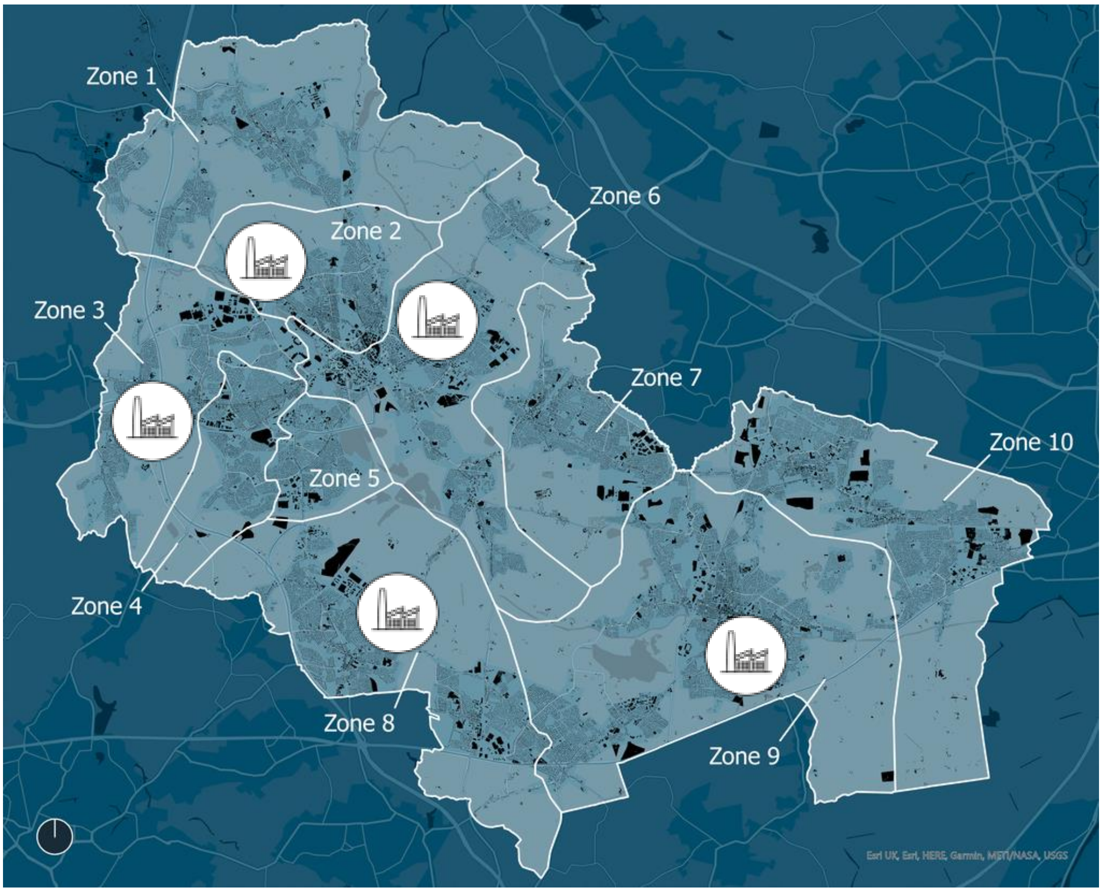
Non-domestic Building Usage by Floor Area (m2)



Non-domestic Buildings Priority Area Selection

Zone 9 has the greatest presence of non-domestic buildings overall, making it an area well-suited to early demonstration of non-domestic decarbonisation solutions, ahead of the other zones with zones 6 and 8 also having a significant number of non-domestic buildings. Office, education and in some instance retail spaces should be most straightforward to transition to heat network connections or heat pumps. The close grouping of many of these buildings in zone 6 is a key factor in it being identified as potential area to consider a heat network. This means zones with a high share of these typologies make up a large portion of the priority areas identified on the map below.

Non-domestic decarbonisation priority areas



Non-domestic opportunity area

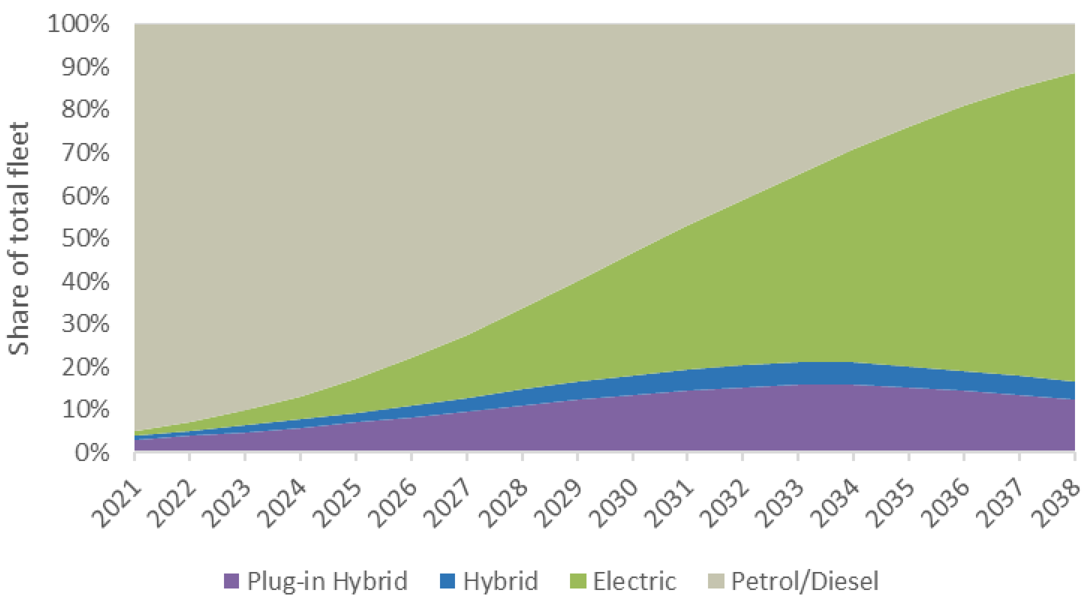
Zones 4, 6, and 7 have the greatest estimated requirement for gas for industrial processes with zone 5 following close behind, meaning they could be good areas to prioritise hydrogen but with the lead time this does not make them immediate priorities. Despite not having the highest natural gas consumption flagged, as discussed previously Zone 3 is the key priority zone for adoption of hydrogen due to the large KraftHeinz site and is thus a priority zone on the map above. Along with this gas requirement, south Zones 8 and 9 would be closest in proximity to where HyNet phase 2 would be coming in from and therefore provides potential for these areas to be prioritised for hydrogen. Zone 8 in particular demonstrate large non-domestic demands suited for gas and not electrified heating solutions.

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 Wigan are expected to grow from around 6,300 today (4% share of total fleet) to almost 148,000 cars by 2038 – 85% of the total fleet (see the graph below for more details on the transition timing). 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.

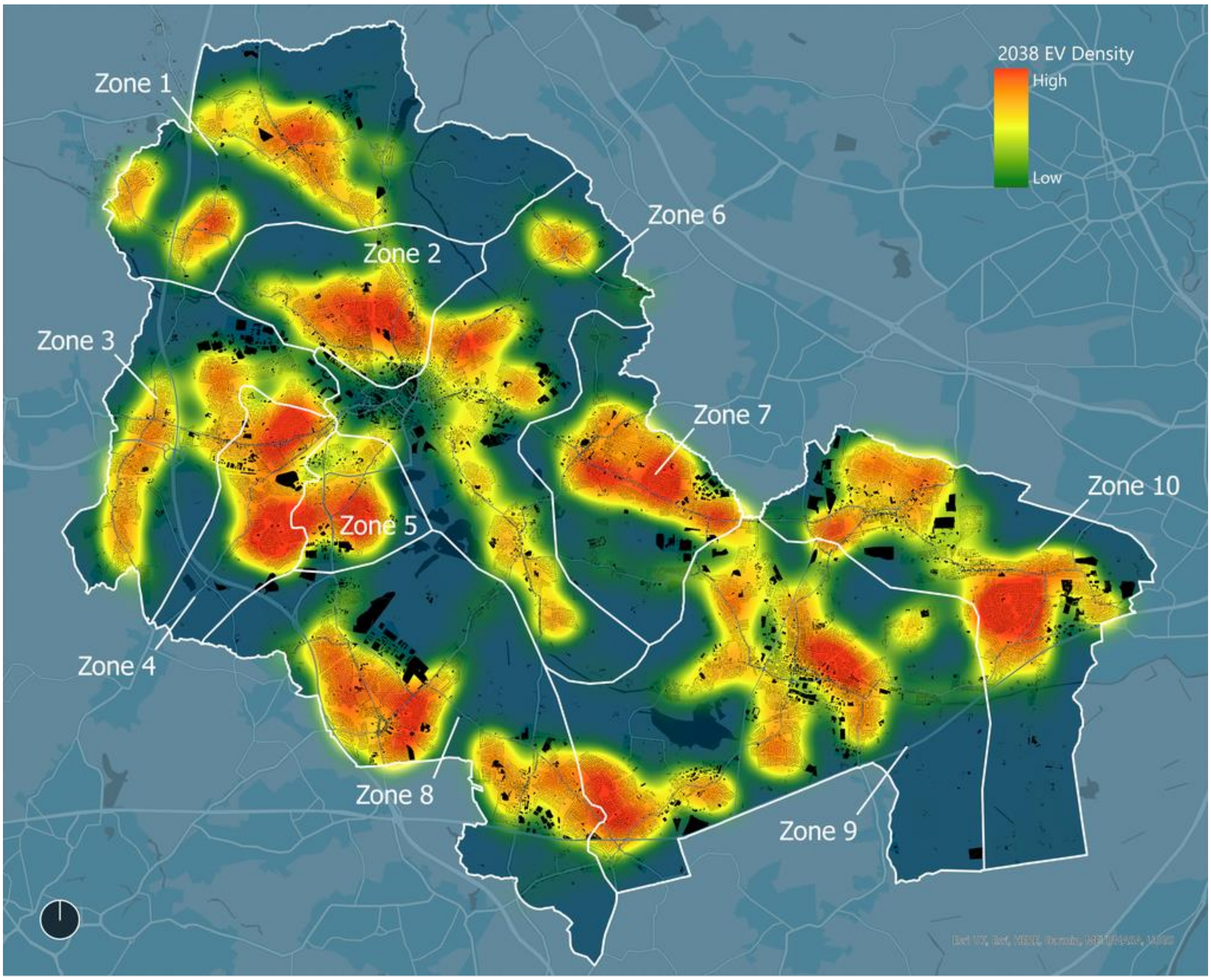
Projected Vehicle Mix Over Time



Greater Manchester's Transport Strategy 2040 sets out an ambition that no more than 50% of daily trips (across all modes) will be made by car in 2040, down from 61% today. In light of an expected overall growth in trips, the strategy sets out that meeting this target would mean a reduction of car trips from the current 3.7m per day to 3.4m. However, this still represents a significant demand for EV charging, estimated to increase to 388 GWh per year in Wigan by 2038.

Since EV transition, supported by publicly accessible and home chargers, is a consistent result across all scenarios, all moves to make first steps in charger deployment can be considered low regret. The map below shows the density of EV uptake and thus charge point deployment across Wigan.

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



Publicly Accessible EV Charge Points

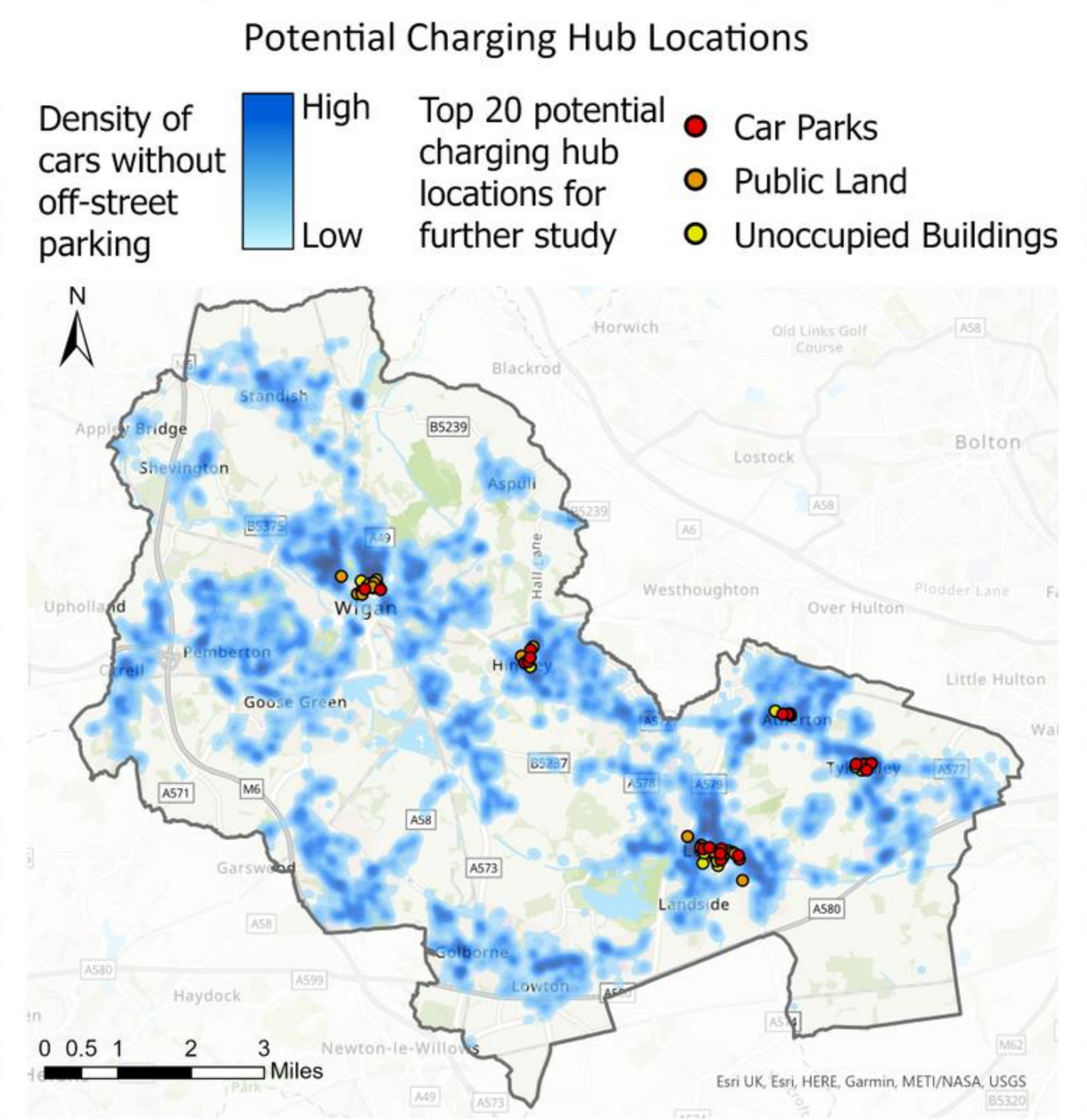
Charge points will be a mixture of at-home and at-destination (such as workplaces and shopping centres). Transport for Greater Manchester (TFGM) is developing plans for the expansion of the existing network of publicly accessible charge points, to help overcome the inability to charge an EV at home,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

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

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

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 ~ **69,000 home chargers**. The installation of these chargers could be coordinated with other home interventions, such as PV installation, heating system replacement and insulation, to minimise disruption experienced by households, and avoid multiple changes to wiring. Opportunities should also be explored for smart system integration between these different technologies.



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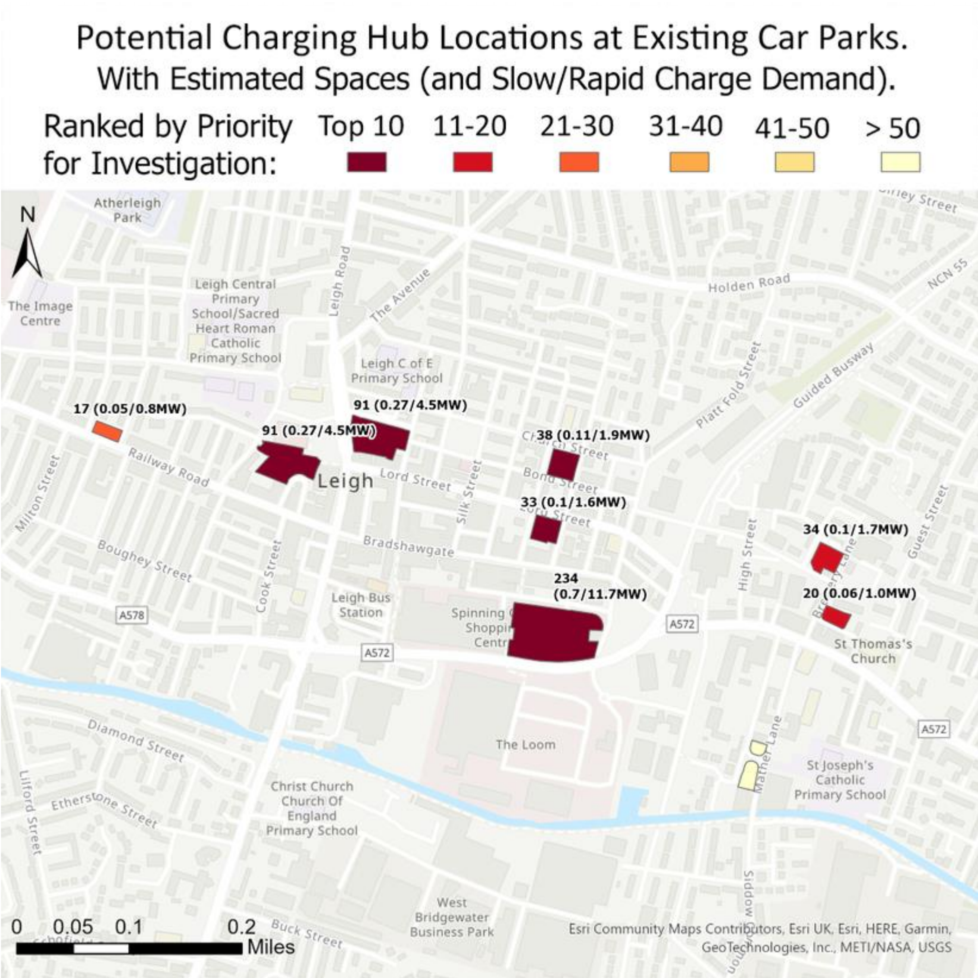
* It is also recognised that EV charging provision should not be considered in isolation from other transport related decarbonisation plans. Wigan will need to work with GMCA, TFGM and other relevant stakeholders to ensure a joined up transport decarbonisation approach is developed and implemented. As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



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

Vision to 2038

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

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

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

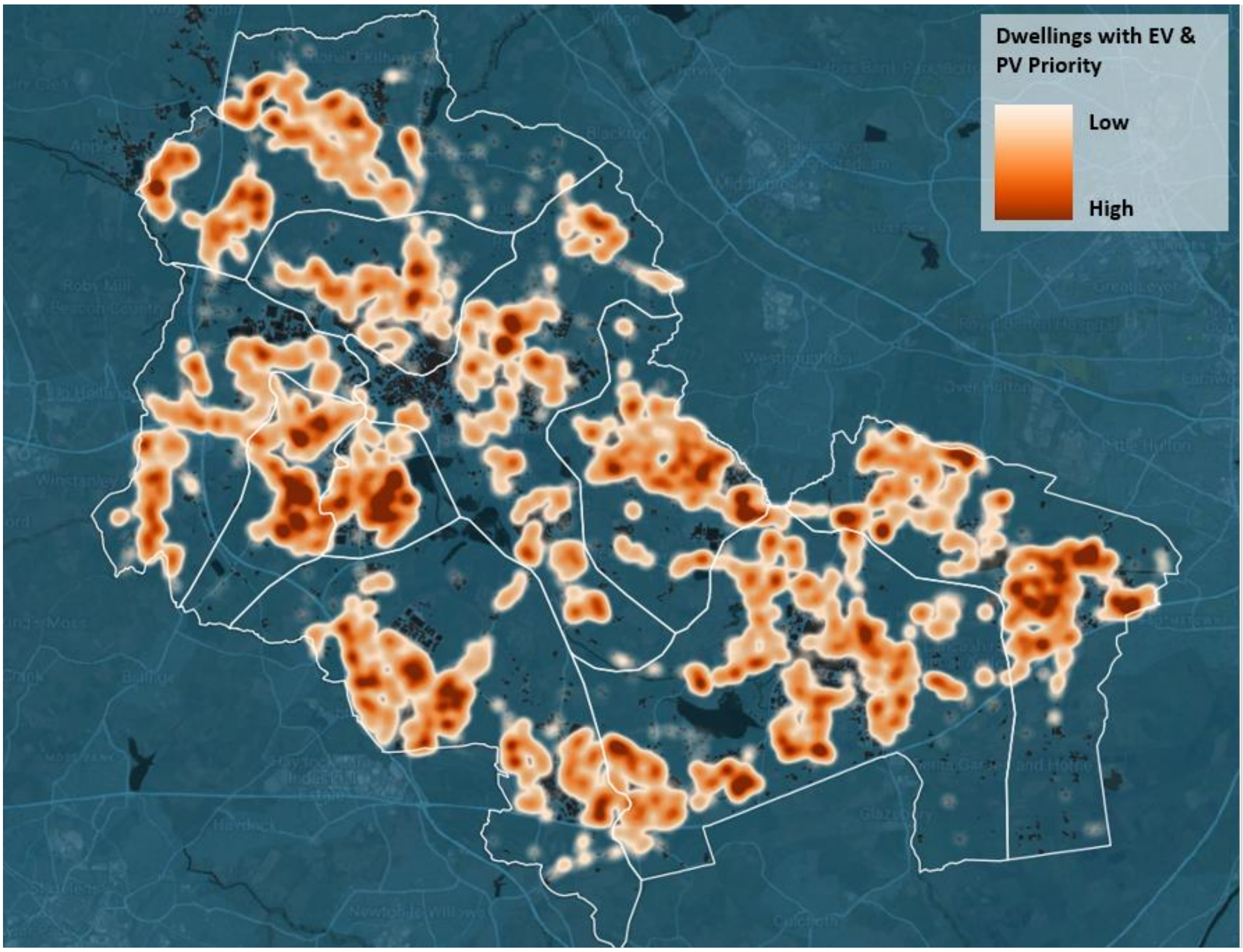
Rooftop Solar and Batteries

Building rooftops are used to meet a portion of energy requirements. Every modelled scenario utilised all suitable rooftop space (generally southeast to southwest), resulting in approximately 845 MWp rooftop PV capacity installed across domestic and non-domestic builds by 2038, yielding 950 GWh of energy annually. In other words, all buildings with suitable roofs are low regrets opportunities to install solar PV, meaning there is plenty of flexibility around the approach for this.

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

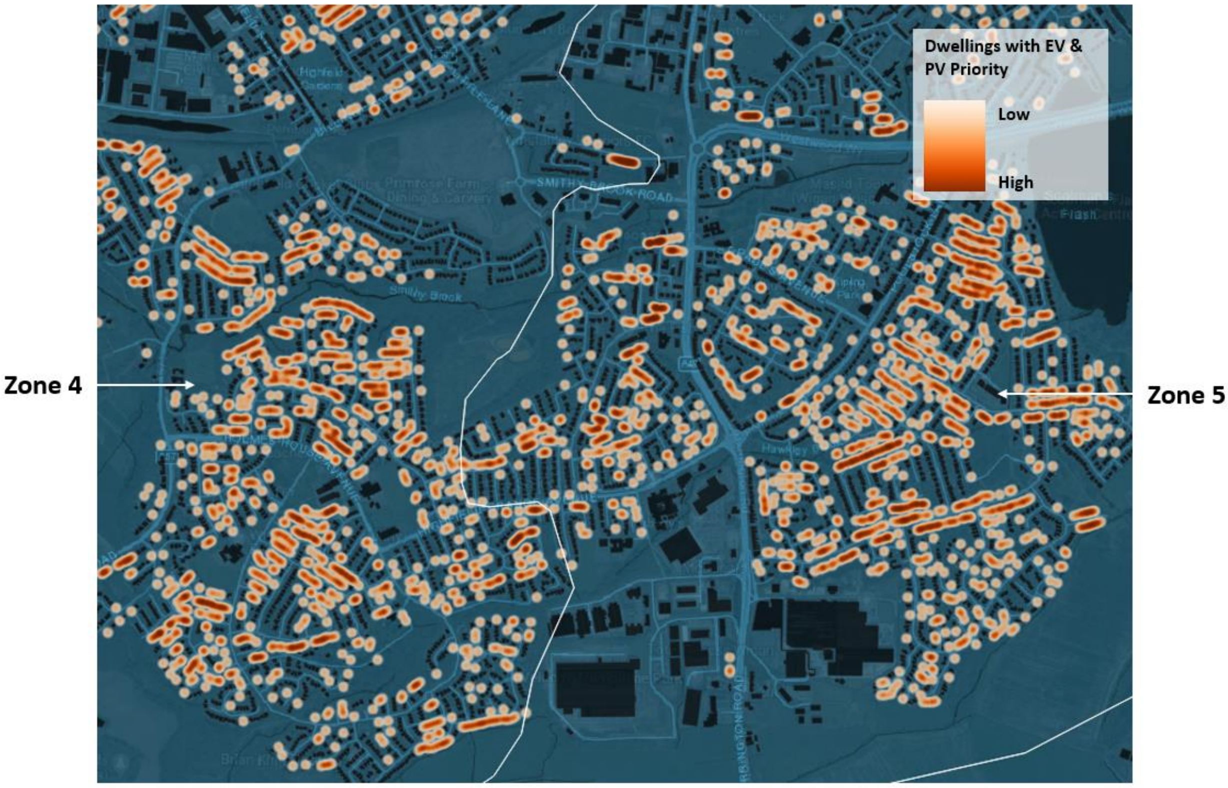
EVs can in some instances act as a battery for PV and charging EVs from rooftop arrays can help reduce the running cost of EVs. As an indication to the distribution of these opportunities the map on the following page highlights homes which are suited to both rooftop PV and EV chargers. Combining the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

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



There is a reasonable spread of dense areas of properties with PV and home EV chargers across Wigan. There is a relatively good spread of shared EV chargers and rooftop PV located at the same dwelling across Wigan. Zones 10 and 9 have the highest number of such opportunities in terms of total number, with 5,100 and 4,100 such dwellings respectively. These high counts are generally used to determine the priority areas, however, it is important to consider the density of such opportunities as well, as the combined consideration of these two technologies can help inform any future electricity network reinforcement strategy. Zones 4 and 5 exhibit the highest overall density and a more detailed map of these is provided below.

Density of dwellings with both rooftop PV and EVs, by 2038 in zones 4 and 5



Large Scale Solar PV*, Wind and Hydroelectric

A study to determine the areas of land in Wigan 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. A considerable number of sites for ground mounted solar PV were identified (see map below), covering a total of up to 1,288 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 910 MW of PV capacity could be deployed on this land, which be expected to yield at least 773 GWh of energy per year. Zone 1 has the highest total potential for ground mounted PV (see map below), which is coupled with available substation capacity – making it a priority zone for ground mounted PV.

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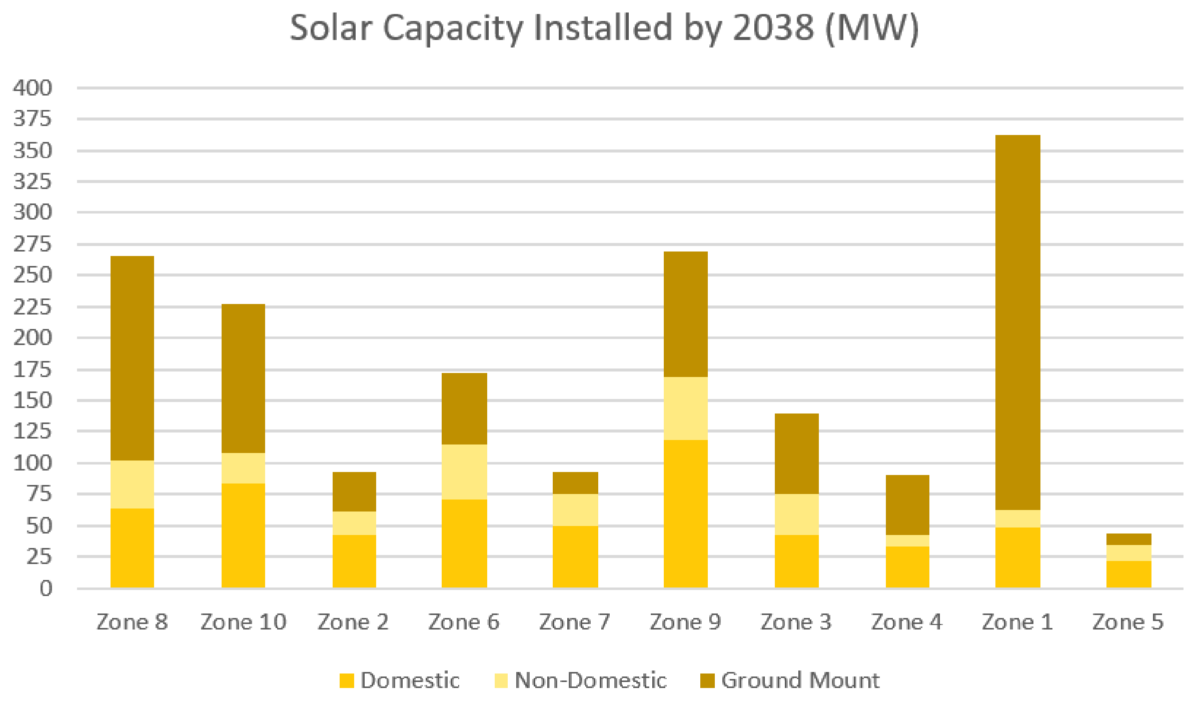
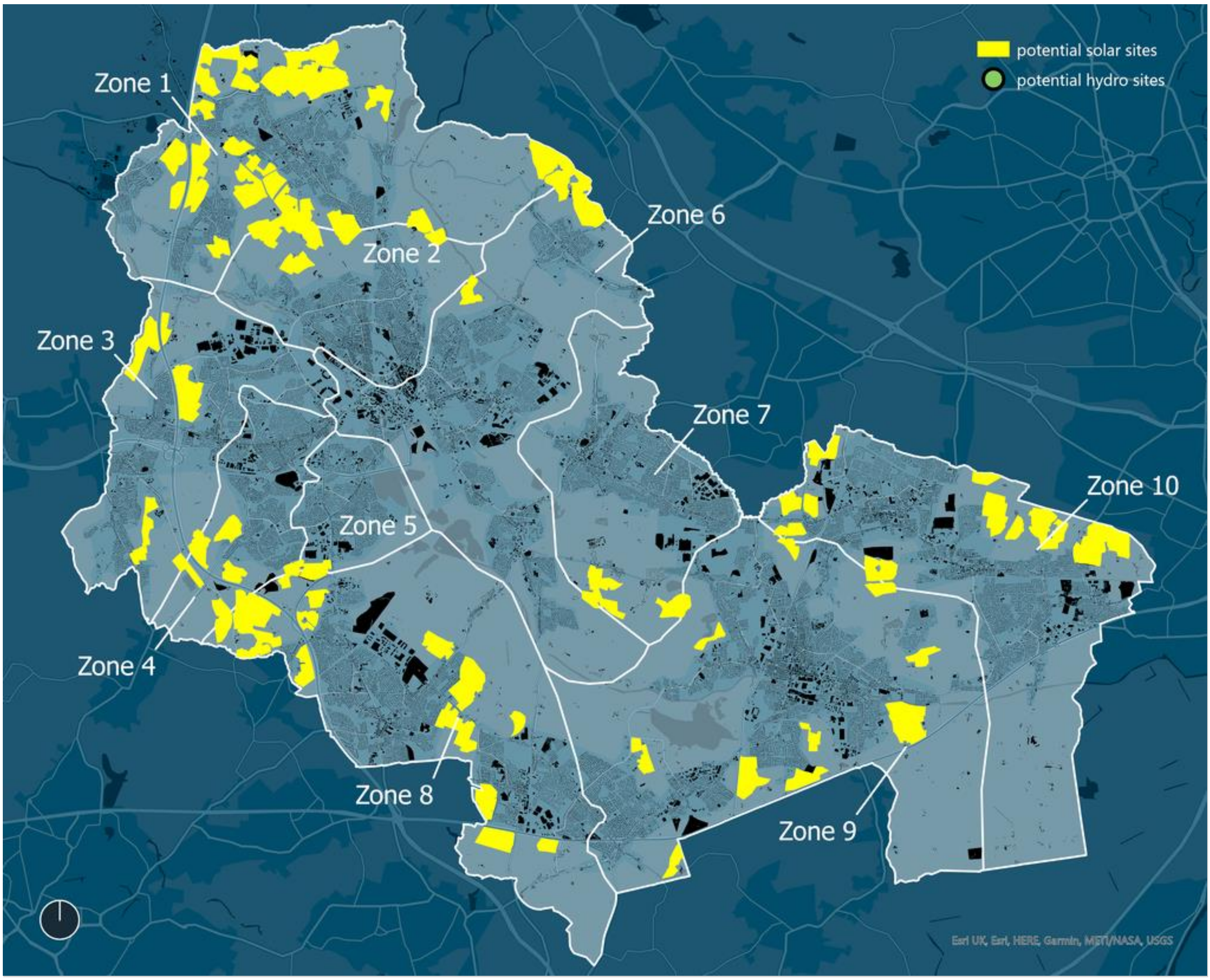
* Opportunities for local energy generation have been identified following a high level screening study in support of this LAEP. Further assessment will be required to consider renewable energy generation opportunities in detail. Screening has been carried out through assessing constraints surrounding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



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



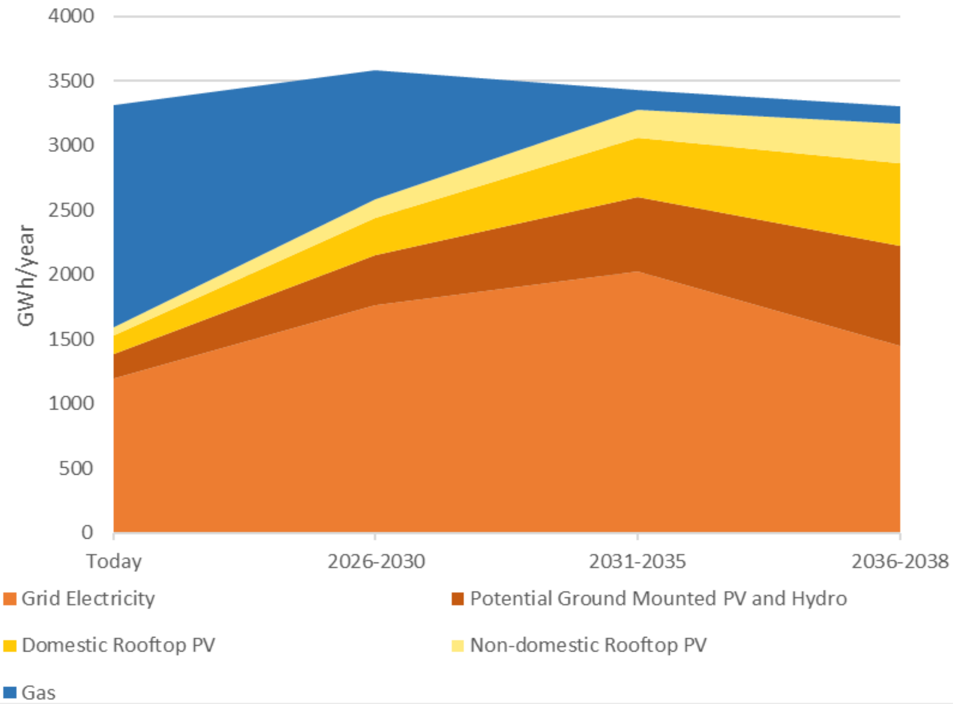
845 MWp of rooftop PV is also identified in Wigan. Of this 270 MWp is provided on non-domestic building roof space. Alongside domestic solar and ground mounted arrays, this could serve up to 54% of Wigan's net annual electricity demand by 2038. Time of electricity demand and generation and their impact on the electricity network should be considered alongside the practicalities of rolling out this amount of rooftop PV, in tandem with many other whole energy system considerations.

Energy Supply and Demand

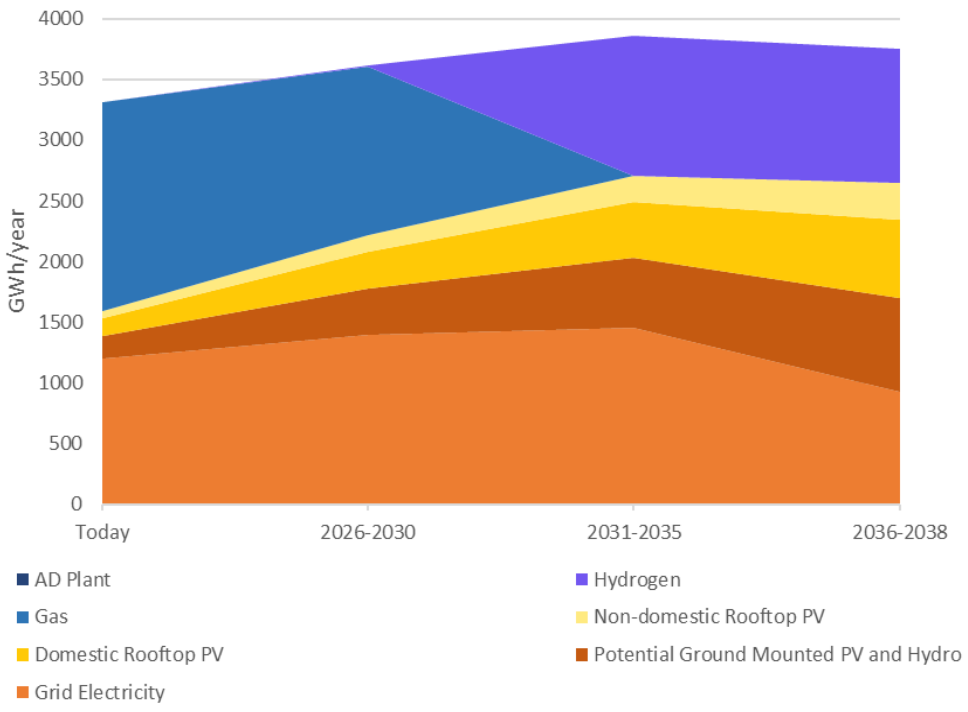
The overall trend in the energy balance is an increase in the consumption of electricity to replace fossil fuels, with a shift towards some of that electricity being generated by local renewables. This is explored for the primary and secondary scenarios in the graphs below.

This represents a transformation in the way energy is used, meaning the energy system must evolve rapidly. This is explored in the next section: Energy Networks. The increase in energy produced and consumed locally offers the potential to explore local energy market arrangements.

Changes in Energy Supply in Primary Scenario



Changes in Energy Supply in Secondary Scenario



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

7. ENERGY NETWORKS

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

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

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

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

The primary scenario sees gas consumption reducing from ~1,725 GWh per year currently down to around 148 GWh by the early 2030s, and lower still in the secondary scenario where hydrogen can replace many remaining uses of gas. This is almost entirely replaced by electricity, which increases from 1,590 currently to 3,170 GWh in 2038. This increase in demand also caters for much of the transport transition, the high efficiency of heat pumps and EVs compared to fossil fuel alternatives helps keep the electricity demand increase relatively low (compared to the fossil fuel demand it is displacing).

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 Wigan.

The primary scenario shows that some gas remains in use by 2038, largely to support hard-to-decarbonise non-domestic premises, including high-temperature process heat for industry. Hydrogen could be considered to decarbonise these industrial loads, however, if hydrogen does not become available to support these uses, alternatives may need to be considered to achieve the carbon target and budget, such as carbon capture and storage technologies.

Capacity Requirements for 2038: High Voltage

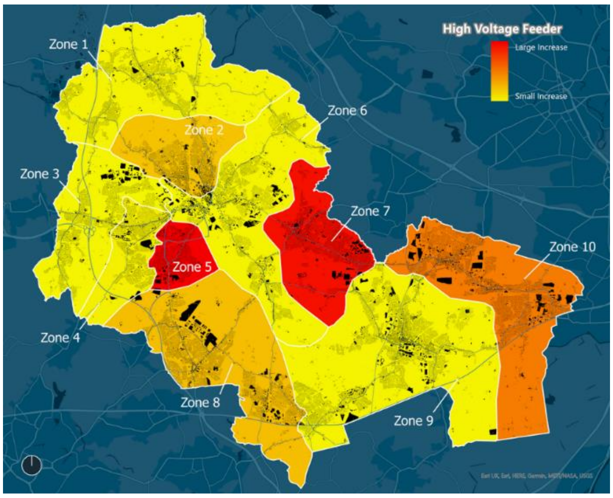
The local electricity distribution network operated under license by Electricity North West supplies electricity to the majority of dwellings and industry in Wigan today. Modelling indicates the capacity that would be required to meet all projected demand growth through conventional investment, but some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

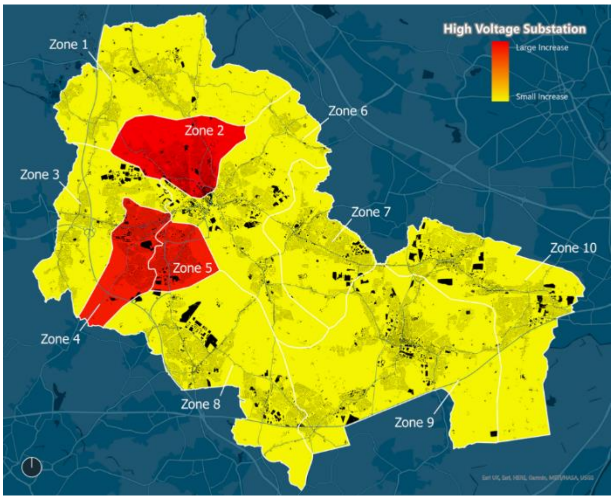
The modelled capacity requirements at high and low voltage levels are shown in the following maps and tables (secondary scenario maps omitted as there is no change from base, however upgrades may be required to accommodate high levels of solar generation). The distribution of these impacts is determined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

	High Voltage Feeder Capacity (MW)			High Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Zone 8	61	107	61	86	86	86
Zone 10	63	164	63	86	86	86
Zone 2	44	75	44	43	86	43
Zone 6	72	101	72	86	86	86
Zone 7	44	176	44	86	86	86
Zone 9	104	152	104	172	172	172
Zone 3	60	62	62	86	86	86
Zone 4	22	43	22	23	43	23
Zone 1	73	78	78	86	86	86
Zone 5	23	99	23	23	43	23

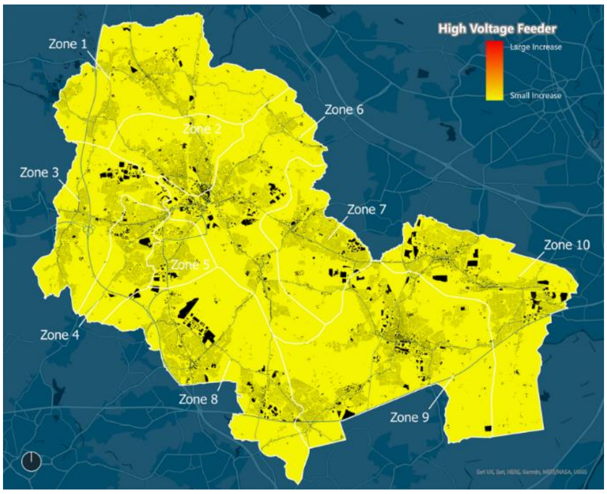
There are some large differences between the scenarios, with the primary scenario having a far greater impact on the electricity network – resulting in the need for substantial upgrades even at higher voltages. This is illustrated in a qualitative manner below.

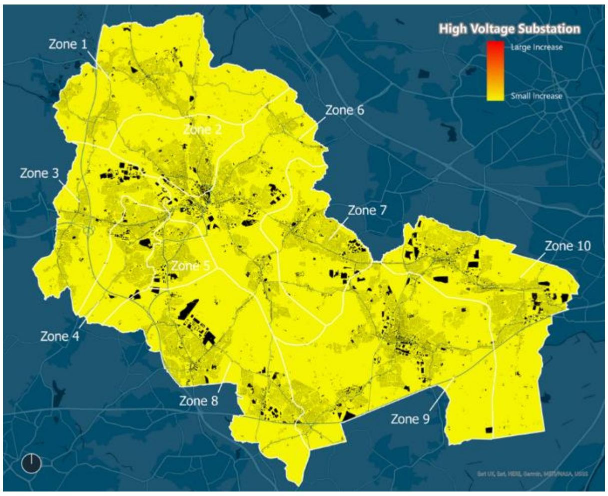
Primary scenario





Secondary scenario





Capacity Requirements for 2038: Low Voltage

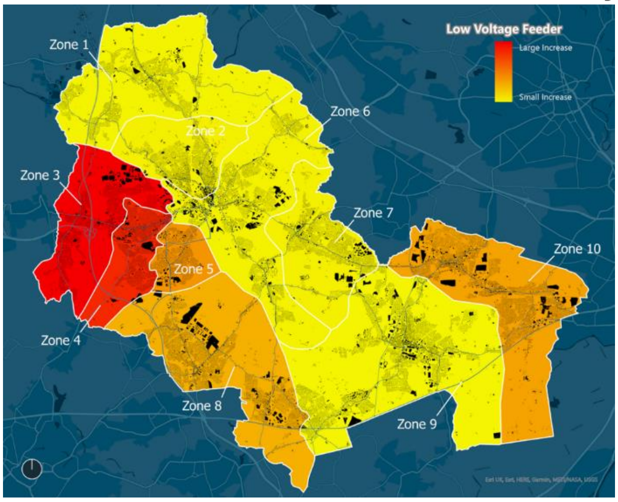
Low voltage feeders are the underground cables serving individual buildings, often located under pavements, so upgrades to these can involve extensive street works. High voltage feeders on the other hand, only run to substations which typically serve multiple streets, so require less extensive works.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

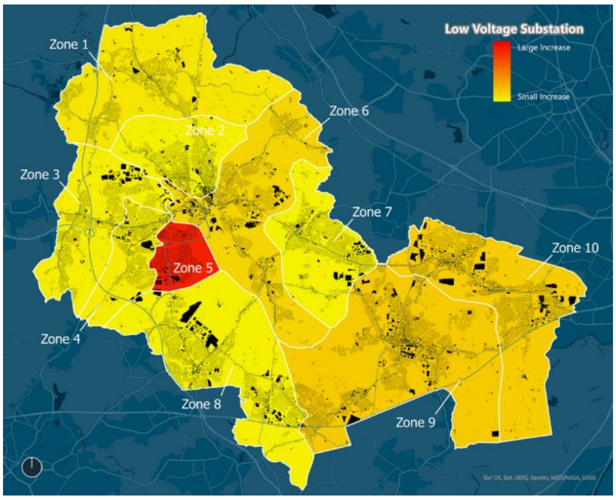
	Low Voltage Feeder Capacity (MW)			Low Voltage Substation Capacity (MW)		
Zone	2020	2038		2020	2038	
		Primary Scenario	Secondary Scenario		Primary Scenario	Secondary Scenario
Zone 8	52	107	53	55	81	55
Zone 10	56	129	56	61	99	61
Zone 2	33	51	33	37	57	37
Zone 6	62	80	62	65	98	65

Zone 7	37	51	38	37	49	37
Zone 9	181	181	181	98	163	98
Zone 3	31	151	32	32	48	32
Zone 4	19	89	19	40	45	45
Zone 1	46	52	46	51	63	51
Zone 5	19	37	20	16	68	68

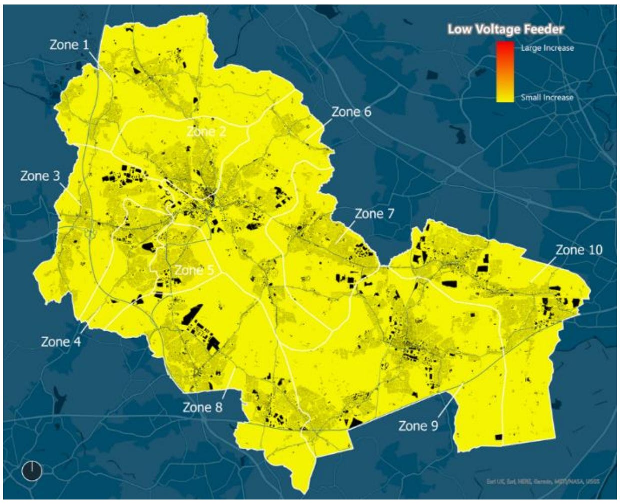
Capacity increase is notably high in some areas for the primary scenario, in particular zone 3 demonstrates the highest capacity step change on the feeder side. These changes correspond with high levels of heat electrification (circa 11,700 heat pumps in zone 3), where the network must be sized for demand on the coldest day of the year, when heat pump efficiency is also lower. These areas could be a focus for the use of smart, flexible heat pumps or storage to reduce the capacity needed. In terms of the secondary scenario, the majority of zones demonstrate sufficient head room for electrical requirements – this is clearly illustrated in the maps below. With Zone 3 being the most likely to receive domestic hydrogen this could potentially represent a substantial cost saving as the level of reinforcement would be more similar to the secondary scenario.

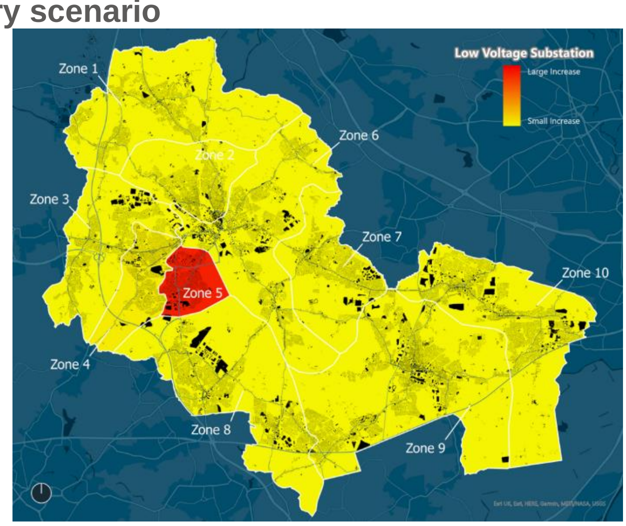
Primary scenario





Secondary scenario





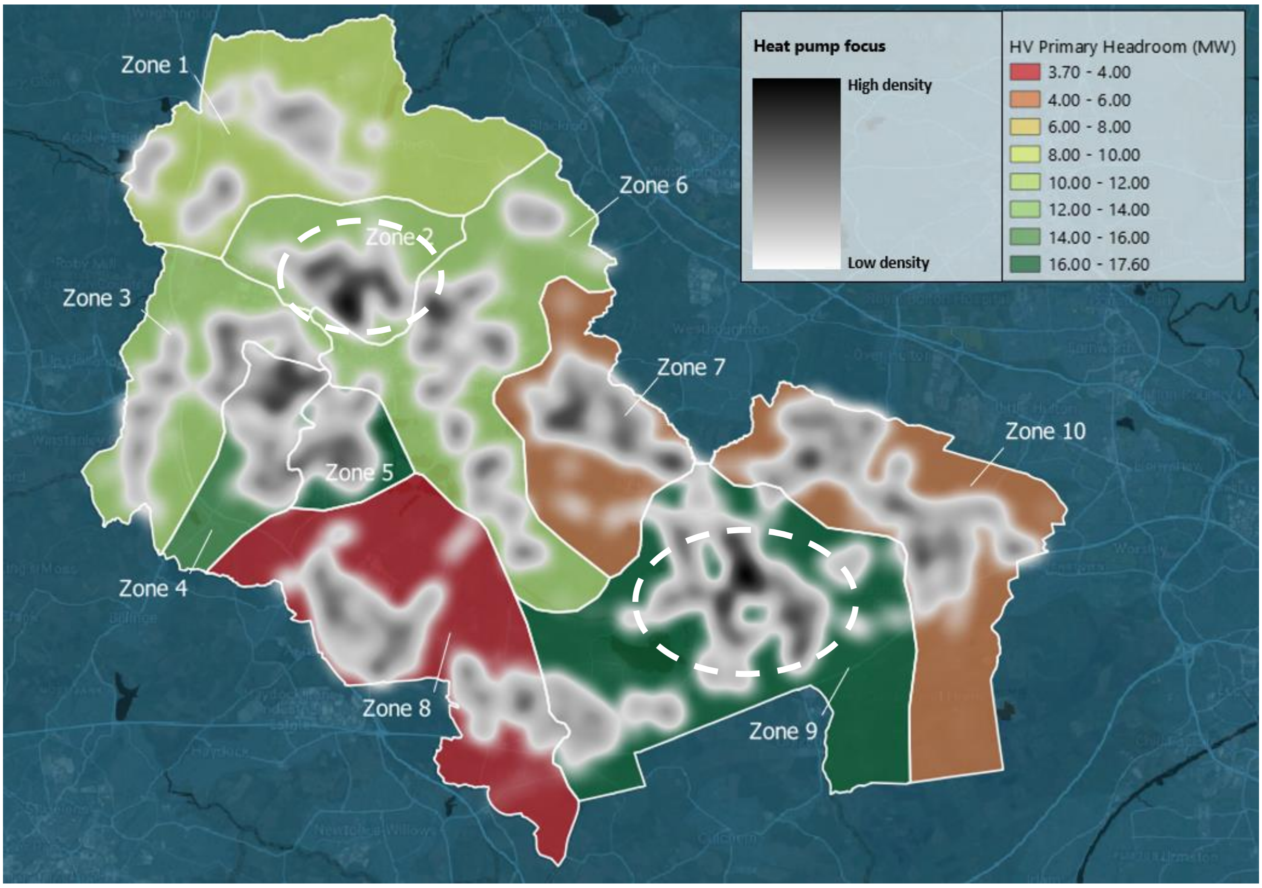
As stated throughout this LAEP, the intention of this work is to highlight the potential change in electrical demand, **not identify the most appropriate and cost-effective solution for providing additional capacity**. More detailed electrical network design and planning work would be required to identify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

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.

Zone 5, for example, has the greatest capacity headroom for demand, with Zone 9 also having significant demand headroom. This suggests that roll out of heat pumps and EV chargers could begin here before network upgrades are eventually required to reach the total numbers in the plan. However, Zone 5 is not considered a priority for heat pumps as it is an area which is more likely to receive hydrogen and therefore does not represent a low regrets decision. Zone 2 also has high demand headroom and a high density of future heat pump deployment, with low likelihood of hydrogen connection, and could therefore make use of electrical capacity for heat pumps.

In contrast, Zone 8 has very little spare capacity. This suggests that the need for infrastructure reinforcement to deliver the full plan should be assessed early to ensure that it doesn't delay progress. Local flexibility, storage and generation could be trialled as a way to overcome demand constraints. Although it's worth noting that peak network demand typically occurs on winter evenings, when solar generation is negligible, and electrification of heat is likely to compound this.



	Demand			Generation	
Zone	Headroom (MW)	Heat pump installs	Households with EV chargers	Headroom (MW)	Solar PV installs (MW)
Zone 8	3.7	17,393	4,917	27	102
Zone 10	5.6	23,169	4,111	29.7	108
Zone 2	10.2	11,217	9,090	32.1	61
Zone 6	10.2	20,001	13,097	32.4	115
Zone 7	5.6	13,517	5,446	2.7	76
Zone 9	16.8	32,644	7,172	67.7	169
Zone 3*	10.9	11,695	3,681	32	76
Zone 4	16	9,395	7,741	23.8	43

Zone 1	8.2	12,119	8,897	17.8	62
Zone 5	17.6	6,414	5,466	30.6	34

Demand headroom is non-firm headroom at the primary substation for the zone. Generation headroom is the inverter-based headroom at the primary substation for the zone, which is most relevant for considering solar PV. All figures from ENW's heat map tool
https://www.enwl.co.uk/get-connected/network-information/heatmap-tool/
* There is a primary substation located just outside of the boundary of Zone 3 that has an approximate headroom of 7MW. This has **not** been included within the table however should be checked to see whether it supplies homes within the zone.

For solar PV, Zone 5 especially stands out as an area with good amounts of generation headroom relative to the amount of potential Solar PV proposed with zones 4, and 2 also with attractive generation headroom relative to proposed PV capacity. Zone 7 stands out as an area that could run into limitations earlier without network upgrades. However, zones 6 and 9 have the highest final installed capacities for rooftop solar and also the most capacity currently (as a MW figure) and thus identified as the initial priority areas for rooftop PV.

Gas Network Today

The gas network operated under license by Cadent supplies gas to the majority of dwellings in Wigan 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 Wigan is around 1,725 GWh.

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

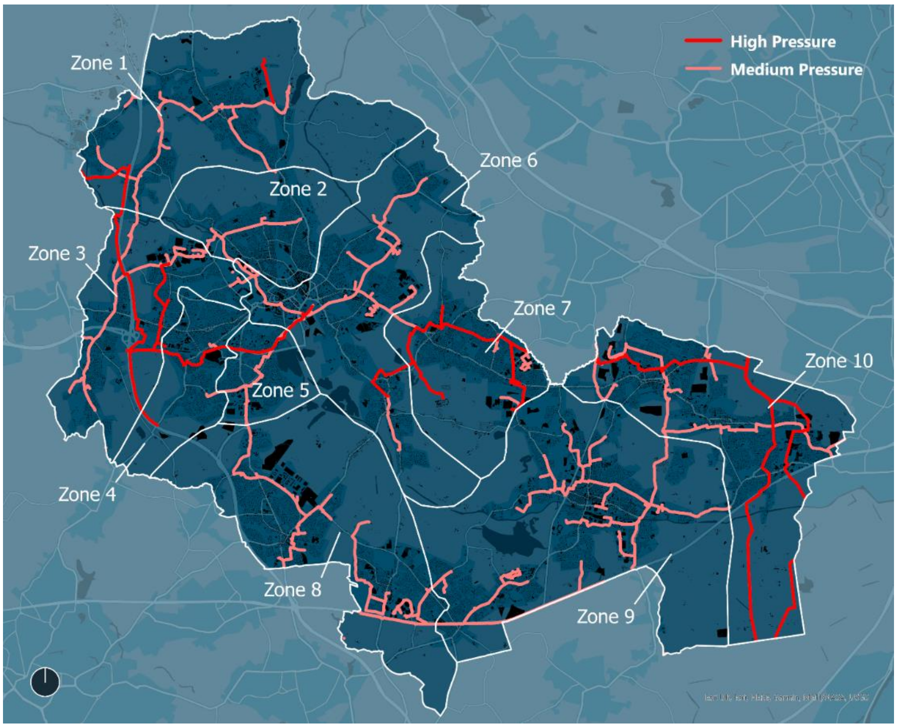
Future of Gas and Hydrogen for Heat

The primary scenario for Wigan 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. This can be complex as the gas network is highly meshed (as shown in the image below), meaning it is hard to treat zones in isolation. Around £1,090m of investment would be required for this network conversion. Of Wigan’s approximately 1,600 km of gas pipework, around 78% is already made of polyethylene, suggesting that much of the network could already by suitable for carrying hydrogen.

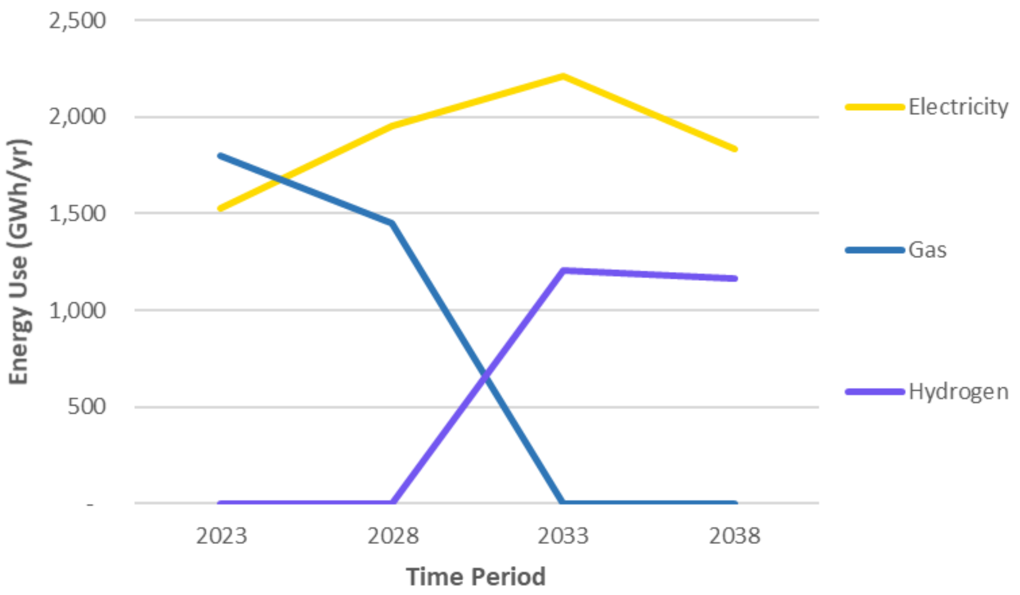
Current Gas Network in Wigan



Hybrid heating (air source heat pump/gas boiler hybrid) is an option in certain circumstances and could provide a valuable transition technology to manage uncertainty around the role of the gas network in domestic heating through the 2020s, and to manage demands on the electricity network. Around 1,200 dwellings may be best suited for this technology (even when the wider whole energy system balancing aspect is not considered): generally larger properties where a hybrid solution may become more cost effective than an air source heat pump alone, but where a ground source heat pump is unsuitable due to exterior space and access requirements.

This hybrid heating solution approach is even seen in the HyNet scenario as seen by the elevation and then drop off in electricity demand in the graph below.

Usage of Gas Network under HyNet Scenario in Wigan



Even in the electrification scenario, gas networks may need to be retained for longer in areas where hybrids are a useful transition option due to property types, particularly Zones 1, 2 and 9.

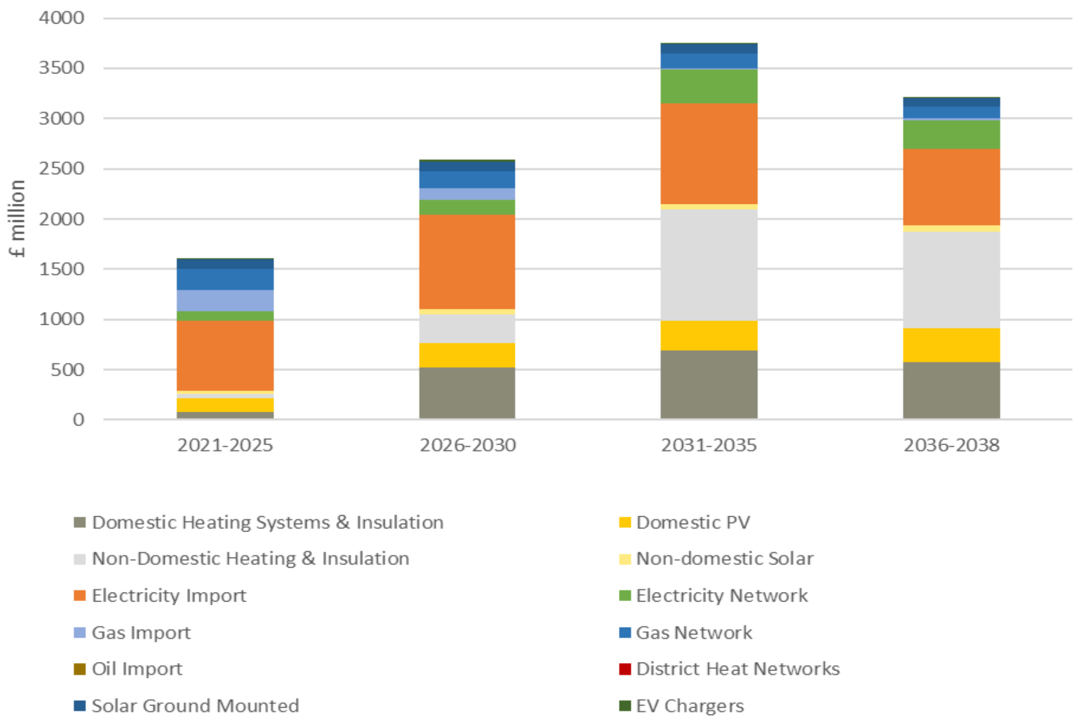
There are a small number of non-domestic properties that are harder to electrify, particularly with industrial uses that require high temperature process heat; these will remain on the gas network under the primary scenario and use hydrogen where possible in the secondary. Most non-domestic gas use can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

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

Total cost (including energy consumption)

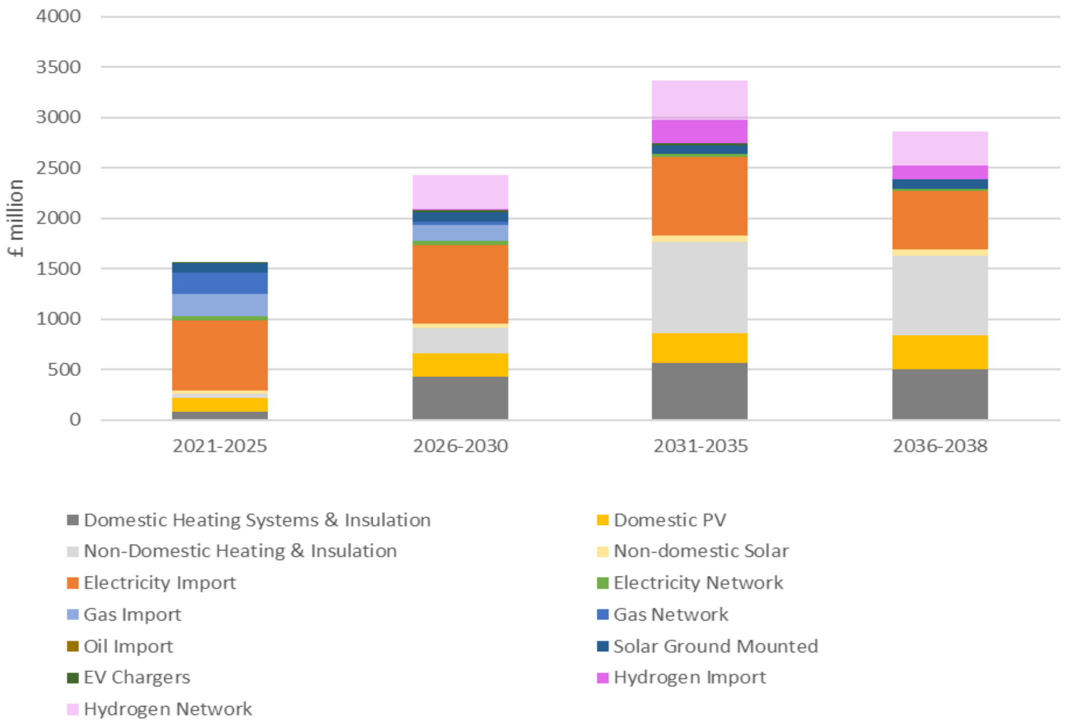
The primary scenario is based on a total energy system spend of £11.2 bn (compared with £10.2 bn in the secondary scenario*). The cost is attributed to investment in energy networks, in buildings (for components such as fabric retrofit, heating system change and roof mounted PV) and for energy consumed. The charts below illustrate the split between these components. Notably, a significant proportion of this cost would have been spent without accounting for decarbonisation; noting that money is spent every day on maintaining existing energy systems, replacing old or failed systems (e.g. gas boilers in dwellings), improving energy efficiency and paying gas and electricity bills. This LAEP sets out an approach for redirecting some of that business-as-usual expenditure, boosted with additional investment, to the areas needed to achieve the carbon neutral target. For example, energy costs are re-directed to electricity use in place of natural gas.

Primary Scenario



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

Secondary Scenario



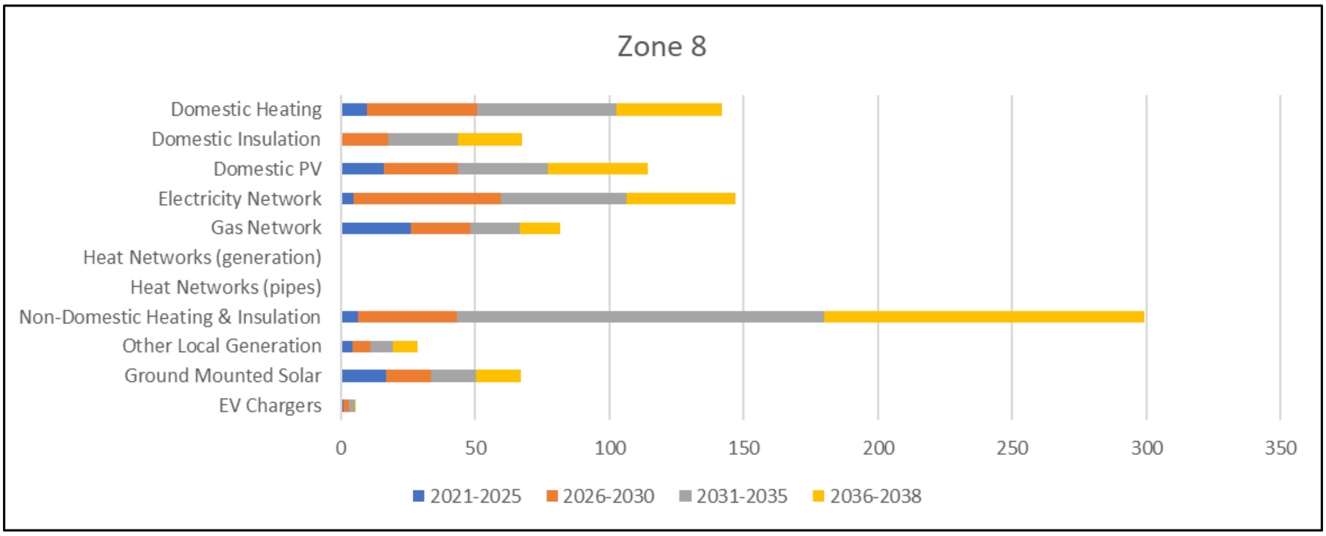
Investment (exclusive of energy consumption)

The tables below illustrate the total investment needed in the energy system to deliver the plan, equating to a total of £7.4 bn for the primary scenario and £6.6 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.

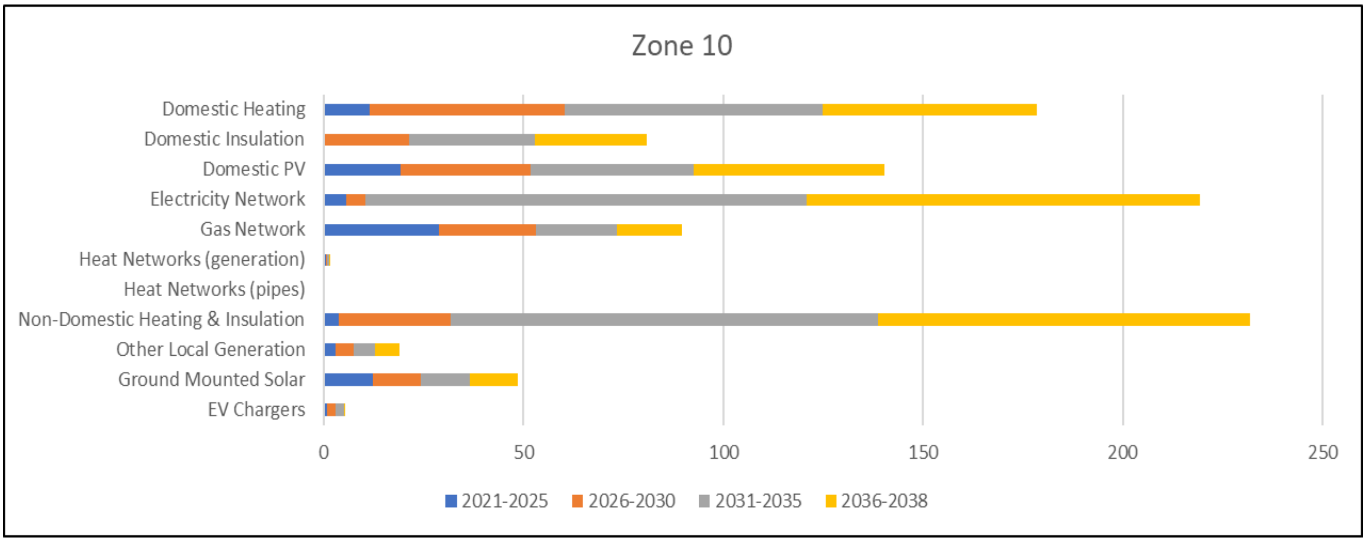
Zone	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Zone 8	952	829
Zone 10	1,015	821
Zone 2	563	523
Zone 6	927	884
Zone 7	474	458
Zone 9	1,296	1,282
Zone 3	708	564
Zone 4	397	309
Zone 1	825	782
Zone 5	258	209

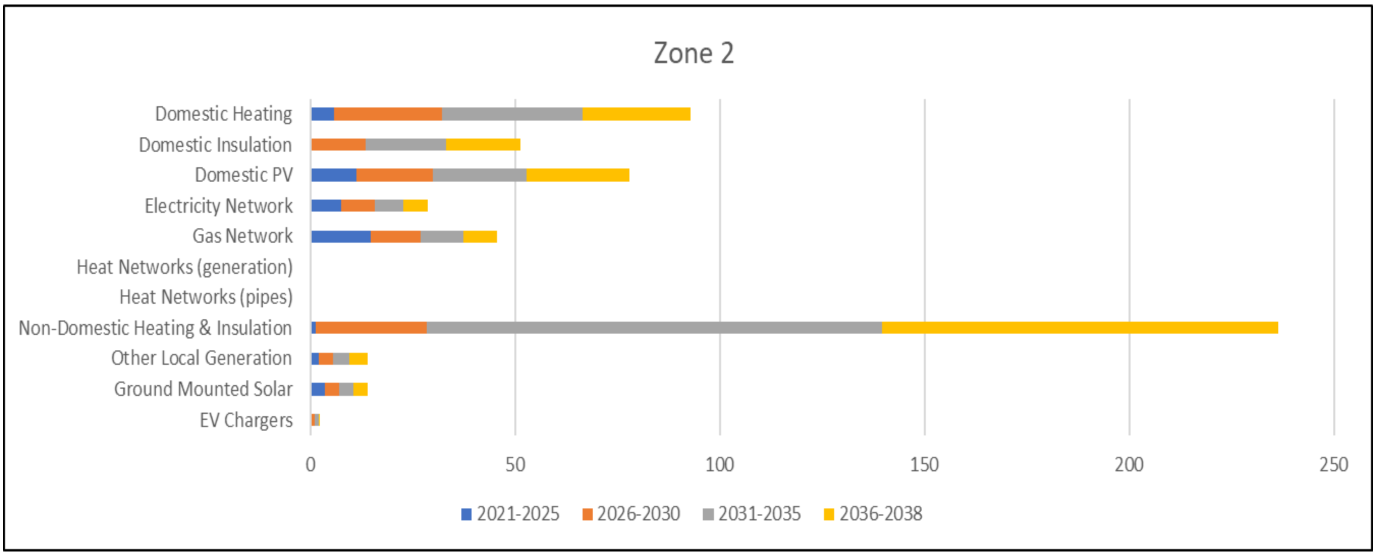
Investment type	Total Investment (£m)	
	Primary Scenario	Secondary Scenario
Domestic Heating	1,257	839
Domestic Insulation	612	723
Domestic PV	1,007	1,007
Electricity Network	866	145
Gas Network	658	249
Hydrogen Network	-	1,087
Non-Domestic Heating & Insulation	2,394	1,986
Other Local Generation	204	204
Ground Mounted Solar	363	363
EV Chargers	39	39

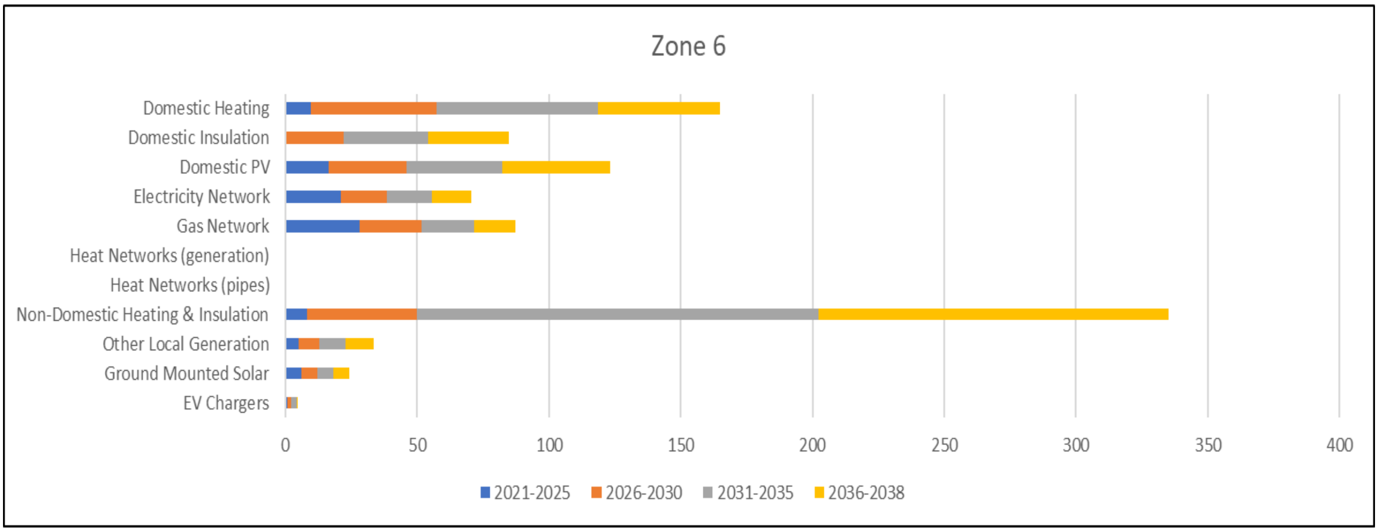
Investment in Wigan's energy system (£m) by time period across each area



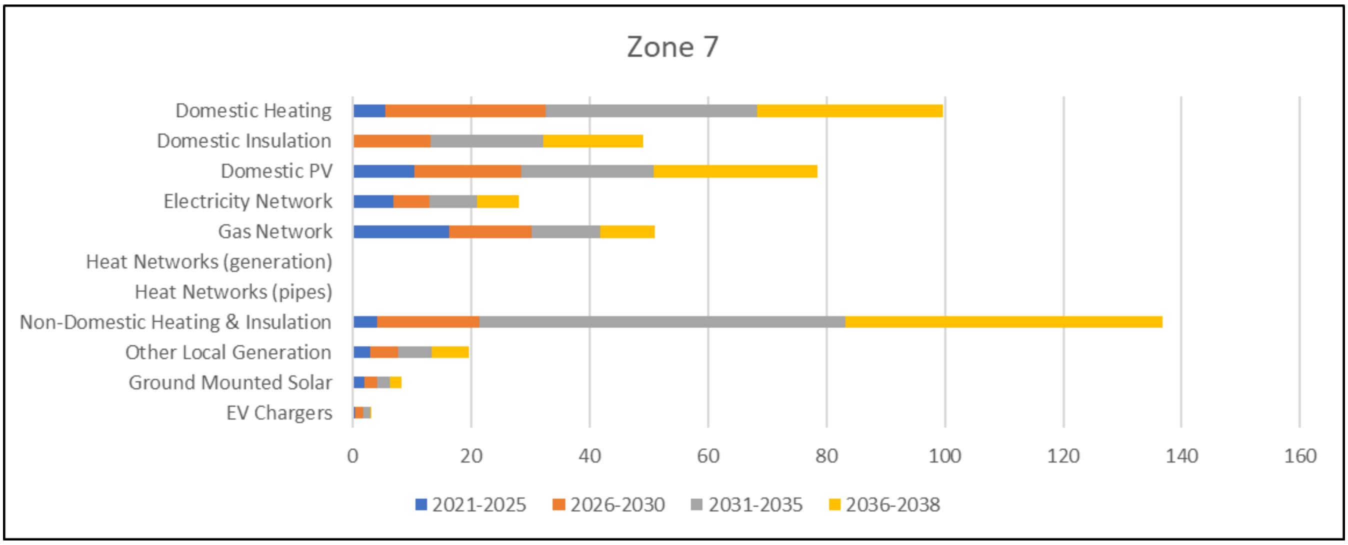
Investment in Wigan's energy system (£m) by time period across each area

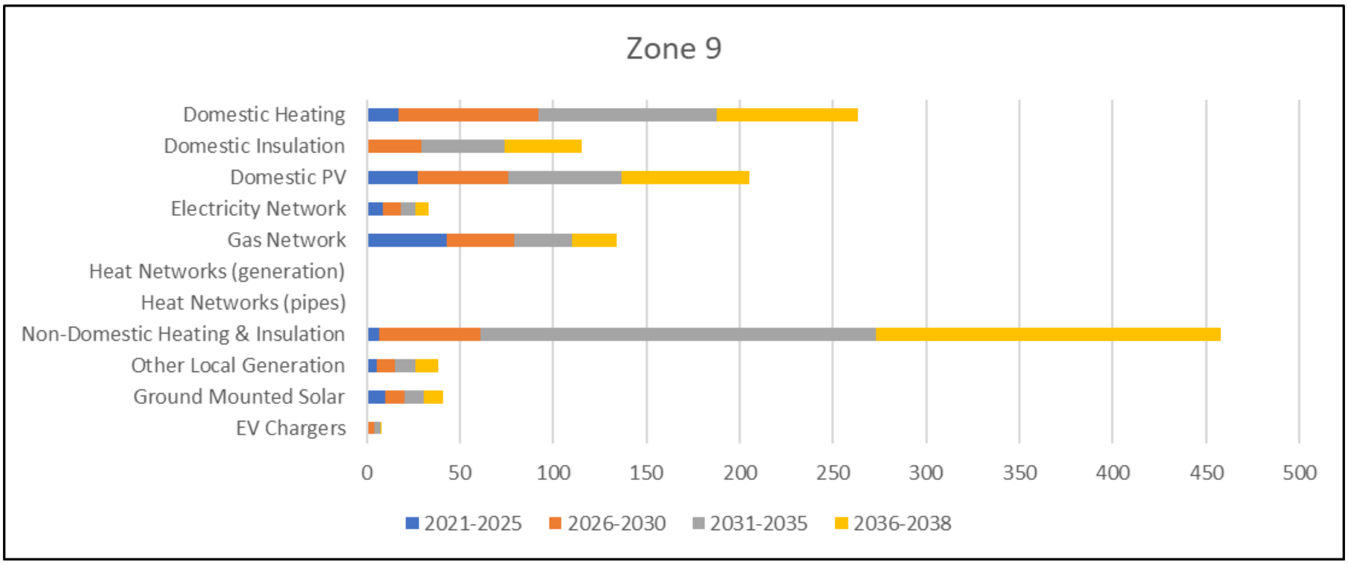


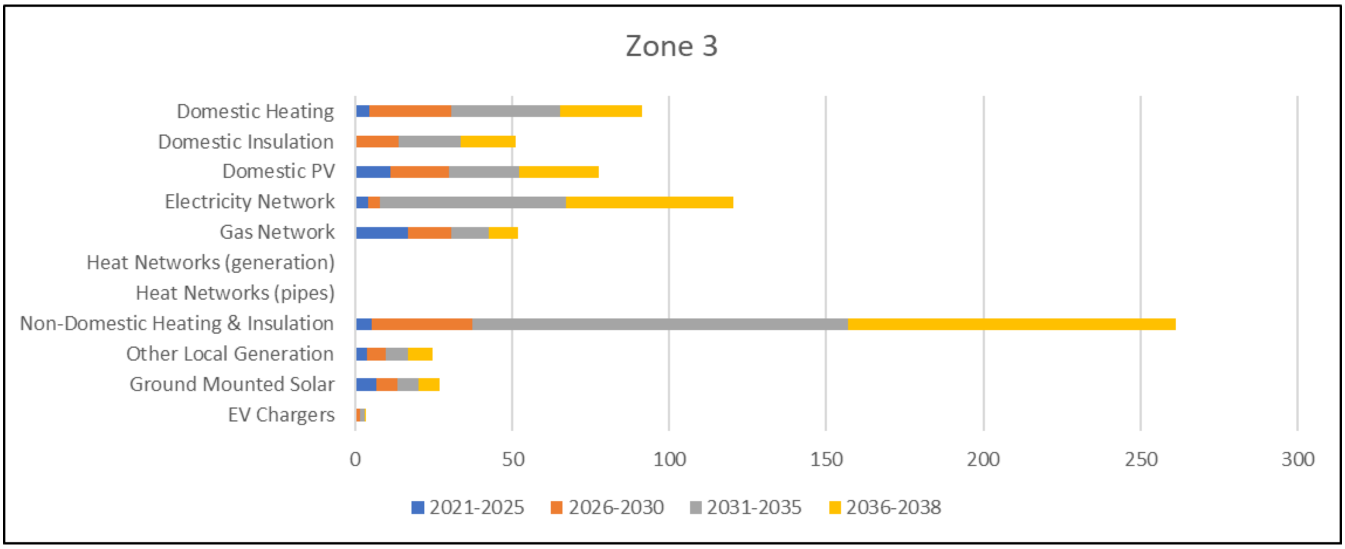




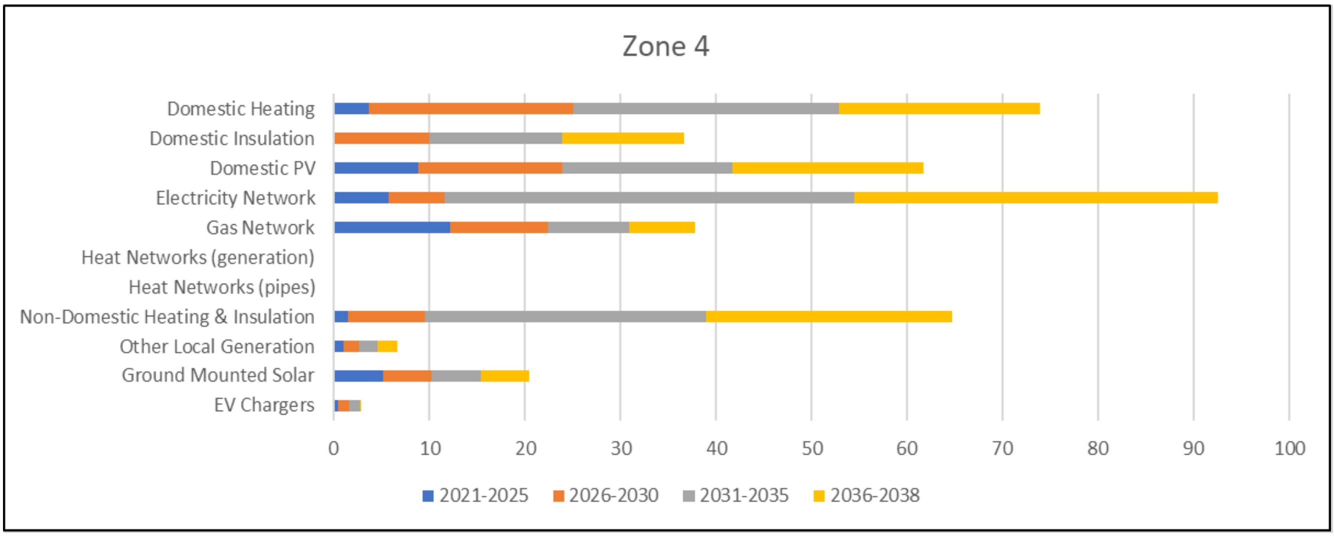
Investment in Wigan's energy system (£m) by time period across each area

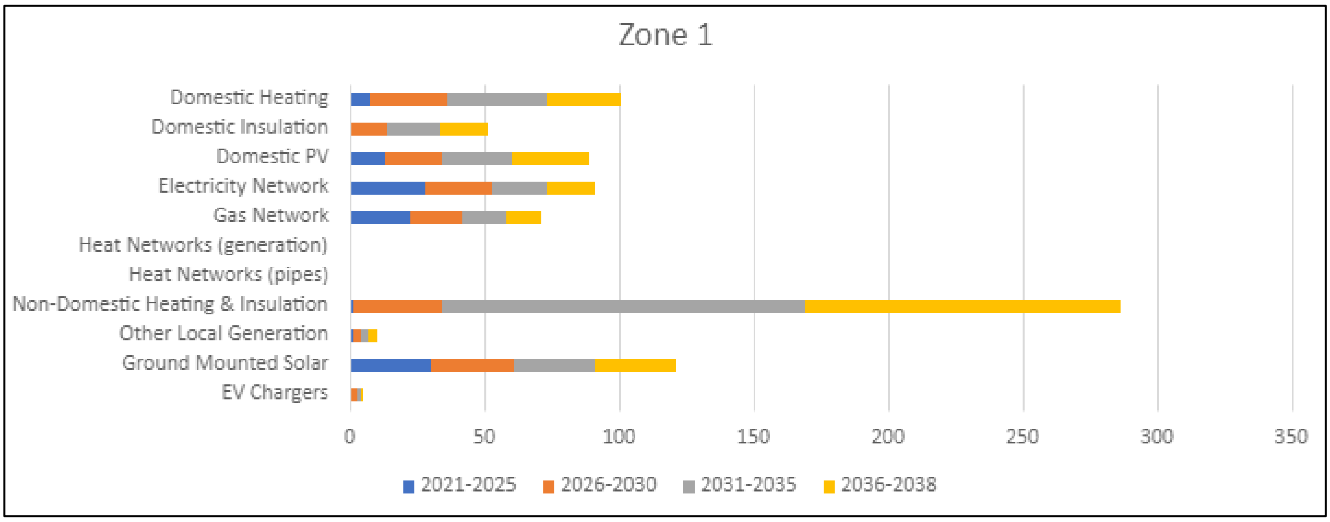


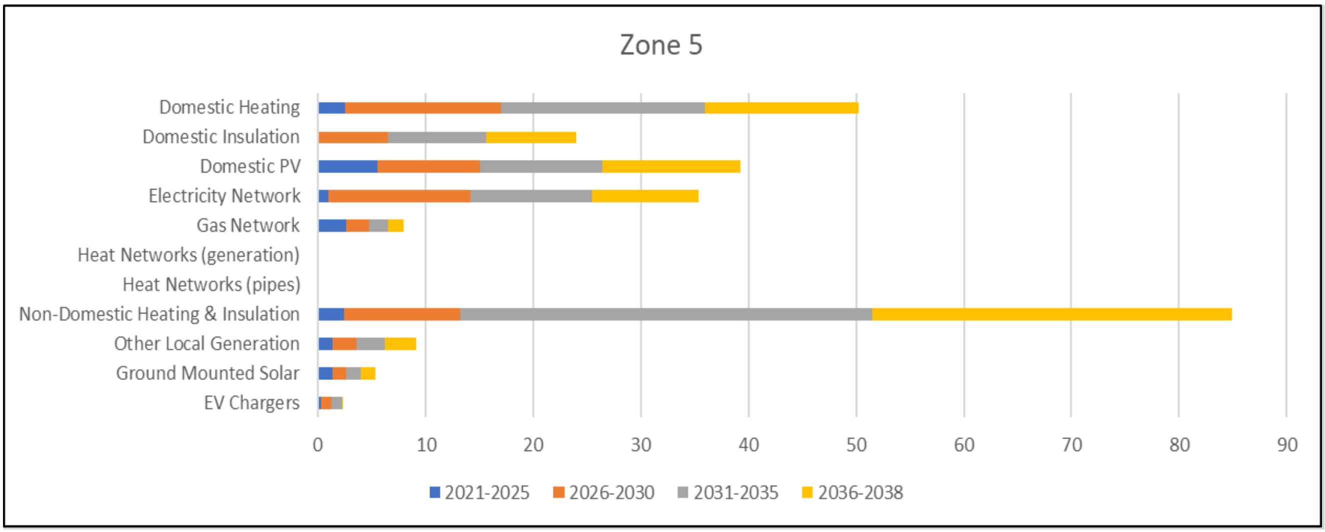




Investment in Wigan's energy system (£m) by time period across each area







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 Wigan 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 Wigan

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

1. Reduced energy demand in Wigan: Reducing emissions, energy use and energy costs through making buildings more energy efficient has been shown to play an important role in all the scenarios considered. In the primary scenario this means basic fabric retrofit of approximately 73,300 homes and deep retrofit of a further 21,600 homes requiring £612m of investment. Many of these homes can receive a cost-effective retrofit package, combining heating system replacements, solar PV and EV charger installations. Across all scenarios extensive fabric retrofit of existing homes is prominent both in cost-effectively reducing emissions in the near term, but also enabling the future installation of low carbon heating systems. It is important to note that new demands from transport, buildings and industry (moderated by improving energy efficiency) mean electricity demand increases in Wigan from 1,591 GWh of electricity consumed per year to 3,171 GWh by 2038 (~100% uplift).

2. Increasing uptake of low-carbon solutions in Wigan: 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

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

networks, that are primarily served by large scale heat pumps providing the heat generation. EV charging comprises a combination of domestic charge points (c.69,600) and public EV charging hubs, targeted at priority locations. Industry in Wigan 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 Wigan: Increasing electricity demand and reducing costs of generation from renewable sources sees an increase in local renewable energy production in Wigan. In the primary scenario 845 MWp of roof mounted solar PV capacity is installed including both domestic and non-domestic buildings.

Deploying the maximum potential for rooftop and ground mounted solar PV would produce up to 1,723 GWh per annum of local, low carbon electricity, a significant contribution to Wigan's forecasted annual consumption of 3,171 GWh. A key consideration for progressing and implementing this LAEP will be to determine how best to deploy solar PV systems alongside other components, such as heat pumps and EV charge points that could be provided as an integrated solution.

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

4. The Future role of the Gas grid in Wigan: 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 Wigan. Greater Manchester's ambition of carbon neutrality by 2038 creates significant pressures regarding the deliverability of 100% hydrogen heating to all homes in Wigan. 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. Wigan 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 (5.40 Mt CO_2 generated through to 2038 compared to 5.66 Mt for the primary scenario) with a reduced total system cost (£10.2 bn compared to £11.2 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 Wigan'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 Wigan in support of Greater Manchester's commitment across the Combined Authority area is estimated to represent total energy related costs of between £10.2bn and £11.2b across both scenarios (including capital investment and energy costs)

The primary plan for Wigan:

- Will require capital investment of £7.4 bn (excluding energy costs) in less than 20 years. This investment is broken down with an approximate spend of £1.52 bn on energy networks, £1.87 bn on Wigan's dwellings including rooftop PV, £2.6 bn on Wigan's non-domestic buildings including roof top PV, and the remained mostly made up of ground solar opportunities. This has the potential to build local supply chains and create jobs for the future as part of a green industrial revolution for Wigan
- By 2038 the local electricity network in Wigan could supply as many as 69,600 domestic EV charge points distributed across the local area and numerous EV community charging hubs, primarily located around the four central zones.
- Approximately 157,600 homes could be supplied with heat pumps with over 95% of homes being electrified for heating. This means that in the 2020's new homes will need to be electrically, or hybrid heated, connected to a heat network or at minimum be hydrogen ready (this includes high fabric efficiency to satisfy intermediate carbon targets). The majority of existing off-gas grid homes in Wigan 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 128,000 homes, as well as non-domestic buildings, allowing hydrogen boilers to replace gas boilers for heating and hot water, as well as providing low carbon fuel for high temperature industrial applications. This would mean much of the gas network would be retained and repurposed by 2038.
- The gas network will continue in the immediate term to meet the majority of heating demands of homes and buildings although new connections will start to decline in the 2020s as new development favours electric or district heating solutions.
- If heat networks are developed, existing homes would be connected in clustered groups through targeted connection campaigns and new service offers
- The majority of homes with suitable characteristics will have solar panels and many of those could also have electrical (battery) and thermal storage systems
- A wide range of flexible resources will emerge, including energy storage, heating systems and electric vehicles able to participate in future flexibility and local energy markets

The Scale of the Challenge

The following table details both modelled and assumed representative numbers. These are provided for illustrative purposes only, intended to demonstrate the scale of implementation, take-up, investment, and deployment needed, by time period, of specific components for Wigan 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)	3,304	3,754
	Number of dwellings	166,098	166,098
	Non-domestic buildings (m^2)	7,941,045	7,941,045
Greenhouse Gas Emissions	(ktCO2e/yr)	51	17
Local Energy Demand Reduction	Basic domestic retrofit measures installed (no of homes)	73,261	67,359
	Deep domestic retrofit measures (no of homes)	21,638	39,489
Local Electrification	Petrol & diesel vehicles on the road (No of vehicles)	19,712	19,712
	Pure electric vehicles on the road (No of vehicles)	126,355	126,355
	Hybrids (including plug-in) on the road (No of vehicles)	28,872	28,872
	Domestic EV charge points installed (No)	69,618	69,618
	Heat pumps installed (No of homes)	157,564	29,411
	Rooftop solar PV generation capacity installed (MWp)	845	845
	Ground-mounted PV generation capacity potential (MWp)	910	910
Local Heat Networks	Domestic heat network connections	0	9
Capital Investment***	Buildings and energy system (£m)	11,170	10,232

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

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

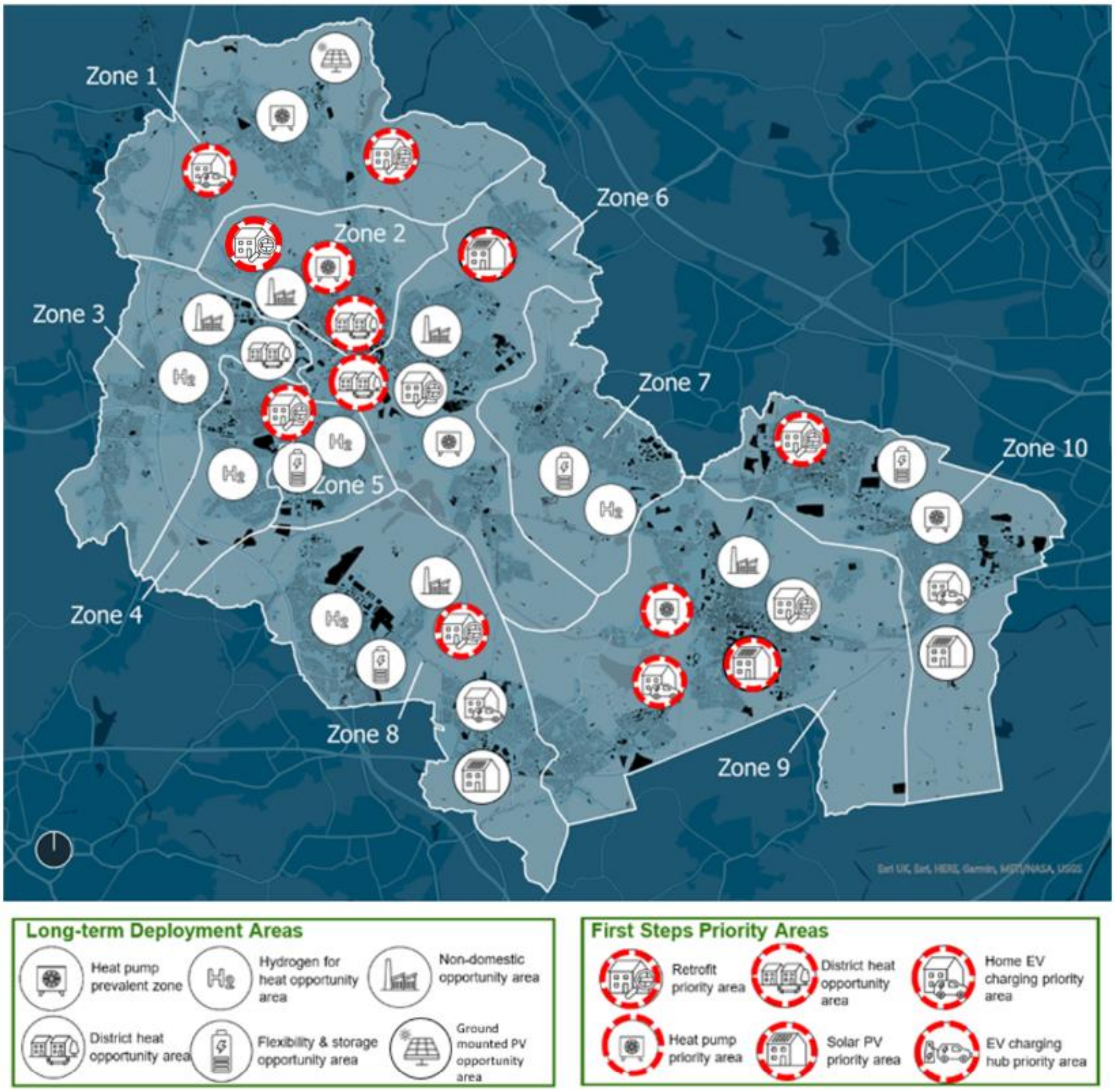
This LAEP provides Wigan with both:

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

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

Demonstration and scale-up priority areas



Next Steps

Using the insights within this LAEP and in the identified priority areas, Wigan 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 Wigan, 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, the high proportion of semi-detached properties makes this a key target typology in Wigan.

- Build on the ongoing heat network modelling currently being undertaken by AECOM, which is highlighting a focus area. Consideration of how public assets including land and buildings could help enable these opportunities is an early first step.

- Several potential EV hubs have been identified in areas with low levels of off-street parking. The areas identified are on public land assets and thus an easier opportunity to progress at an early stage, building confidence among residents to participate in the wider transport transition.

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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

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

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

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

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

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

Wider LEM Project Partners

GMCA Greater Manchester Combined Authority
bruntwood
ovo energy
Carbon Co-op
HITACHI Inspire the Next
DAIKIN
CORNWALL INSIGHT CREATING CLARITY
GrahamOakes Community & Municipal Energy
Cadent Your Gas Network
regen transforming energy
electricity north west
Northwards Housing North Manchester's Council Homes

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 Wigan 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 Wigan LAEP, within the constraints of the GM LEM† project. In this project the ESC's EnergyPath Networks toolkit has been used to perform the local analysis.

About Energy Systems Catapult

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,

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

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 – Wigan
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Status	Approved: Contains reviewed and approved content.
Restrictions	Open

Review and approval:

	Name	Position
Author	Andrew Commin	Senior Energy Engineer and Spatial Analyst at BuroHappold
Reviewer	Richard Leach	Local Energy Transition Manager, ESC
Approver		

Revision history:

Date	Version	Comments
14/04/22	0.1	Initial draft
10/05/22	0.2	Updated draft following ESC comments
12/05/22	0.3	Issued for client review
16/05/22	0.4	Amendment to present day capacity table
13/06/22	1	**Client issue**

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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

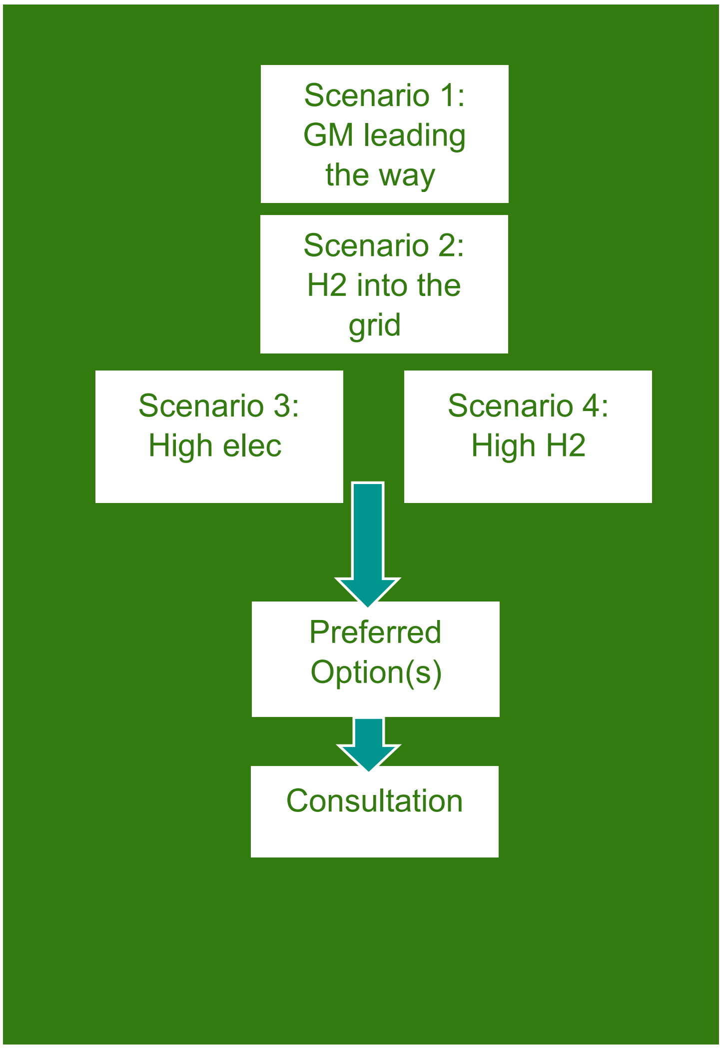
A variety of energy system scenarios are possible to deliver Greater Manchester and Wigan’s future energy vision. It is not practical to consider every possible configuration of Wigan 's local energy system in a limited number of scenarios, therefore four main scenarios have been considered; these represent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

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

Importantly, each future local energy scenario for Wigan 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 Wigan. These scenarios are constructed using location specific information on Wigan'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 Wigan's local control** where at all possible.

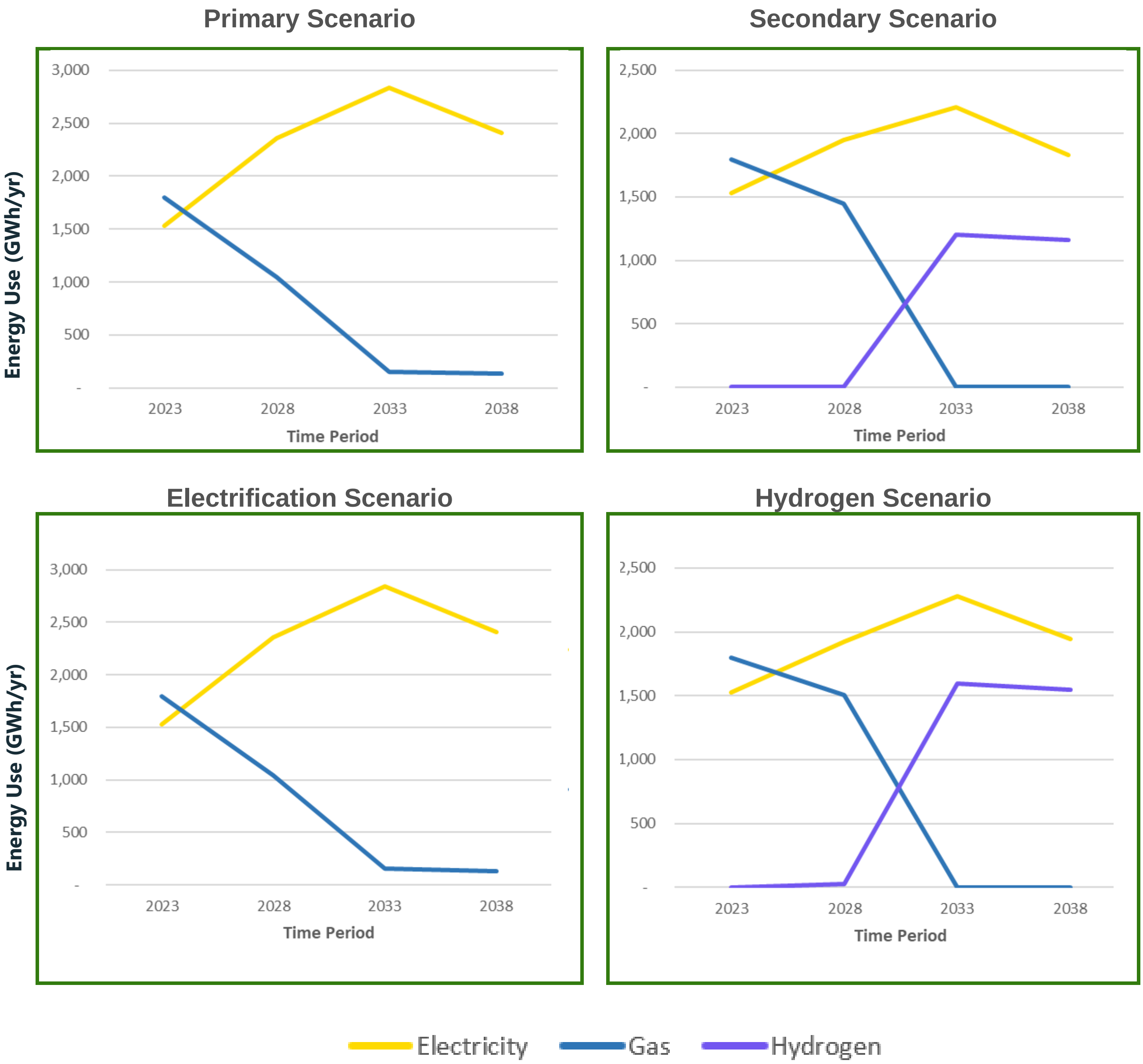
Scenario 2 – An Alternative Future Local Energy Scenario:
we have assumed hydrogen options for residential heating and non-domestic buildings become available in Wigan from 2030 onwards, aligned to HyNet Phase 3 and the repurposing of the gas grid to hydrogen is an option

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

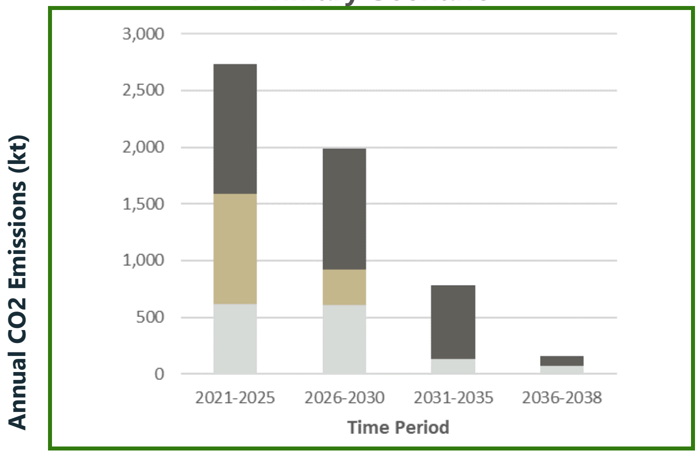
Scenarios 3 and 4 provide context and evidence for what would happen if either hydrogen or electrification were pursued as the sole solution for the decarbonisation of homes and buildings in Wigan. Whilst this is considered to have a number of practical limitations to feasible implementation by 2038,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

ENERGY CONSUMPTION



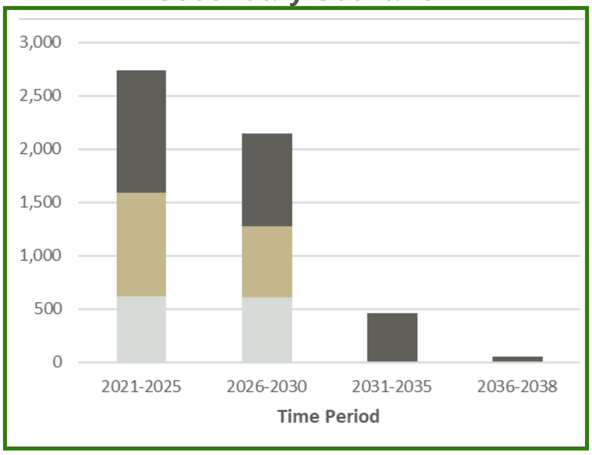
Figures shown exclude petrol and diesel fuel consumed for transport. The overall reduction in energy consumption due to increased efficiency is therefore greater than shown, due to the reduction in transport fuel consumption.

Primary Scenario



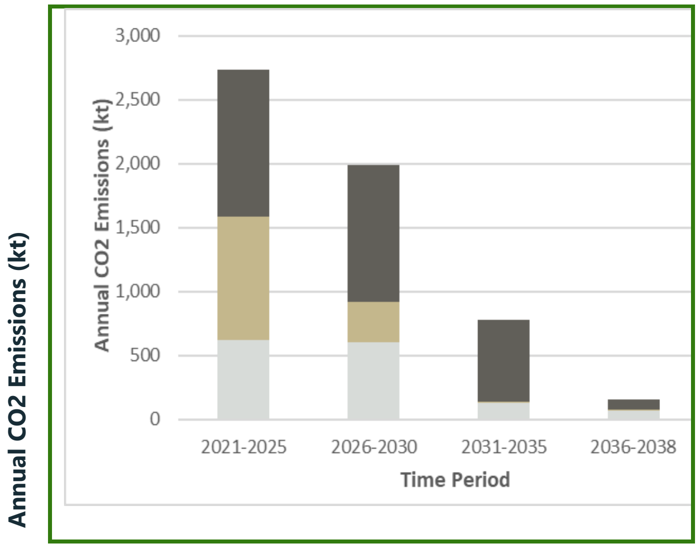
5.7 Mt total

Secondary Scenario



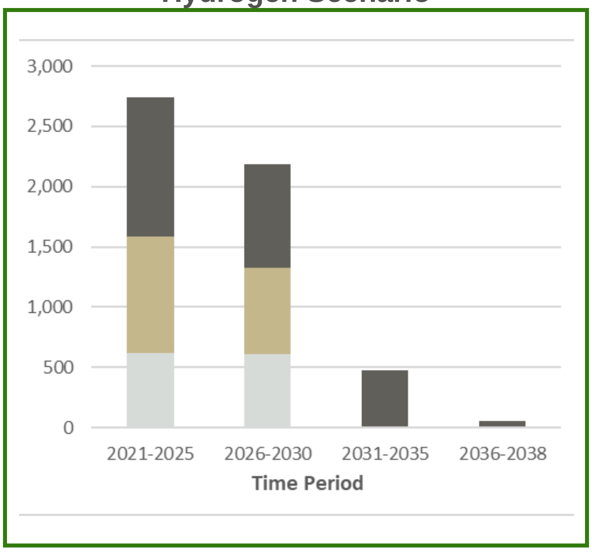
5.4 Mt total

Electrification Scenario



5.7 Mt total

Hydrogen Scenario

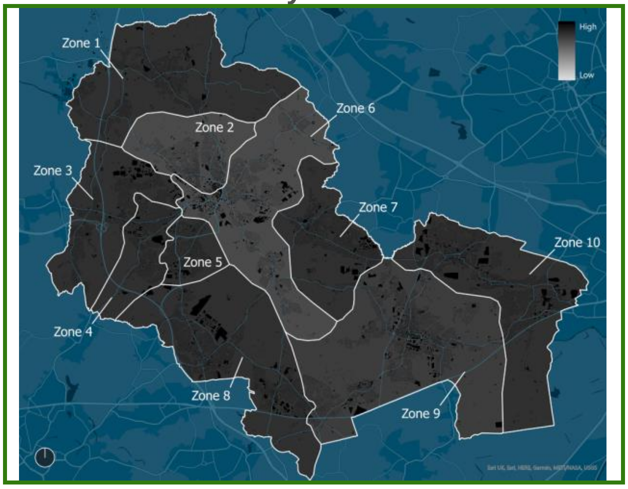


5.5 Mt total

■ Networks ■ Domestic Buildings ■ Non-Domestic Buildings

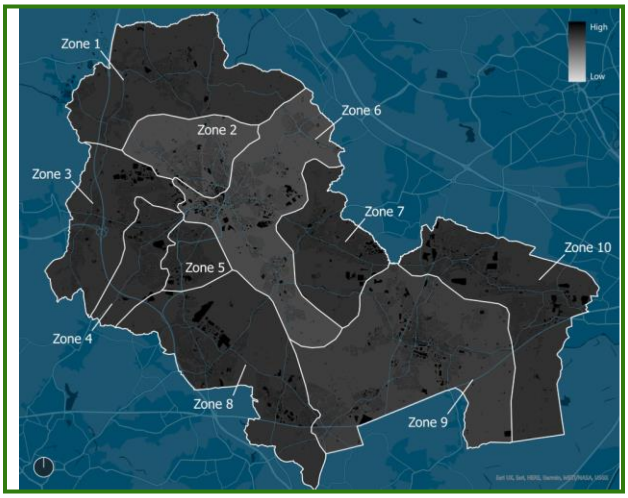
HEATING ZONING OPTIONS: HEAT PUMP DEPLOYMENT BY 2038

Primary Scenario

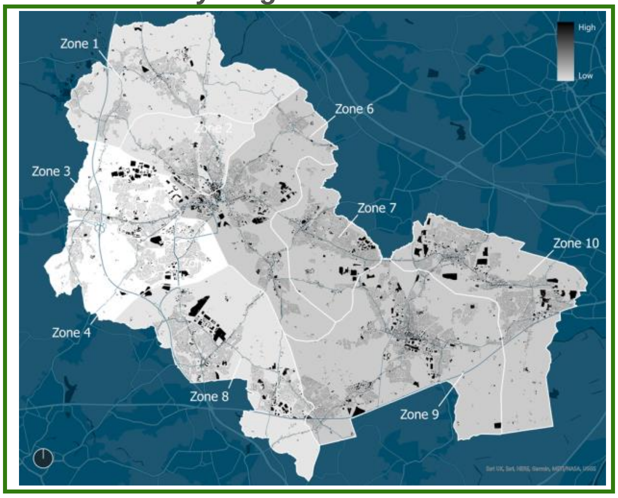


Secondary Scenario

Electrification Scenario

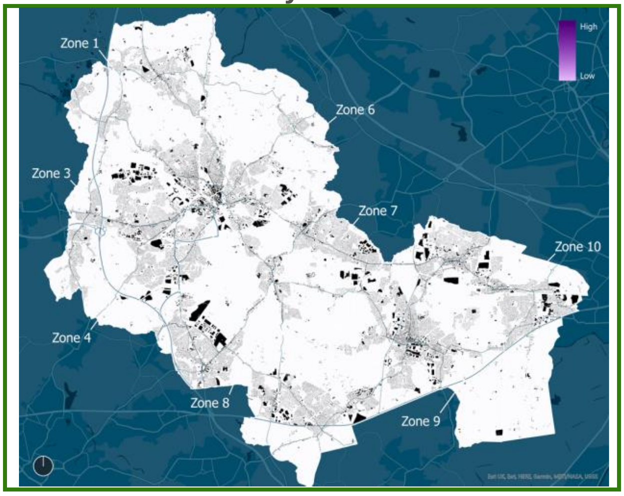


Hydrogen Scenario

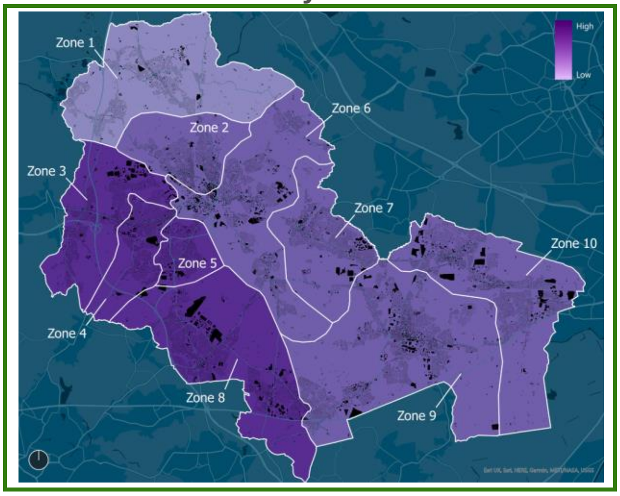


HEATING ZONING OPTIONS: HYDROGEN BOILER DEPLOYMENT BY 2038

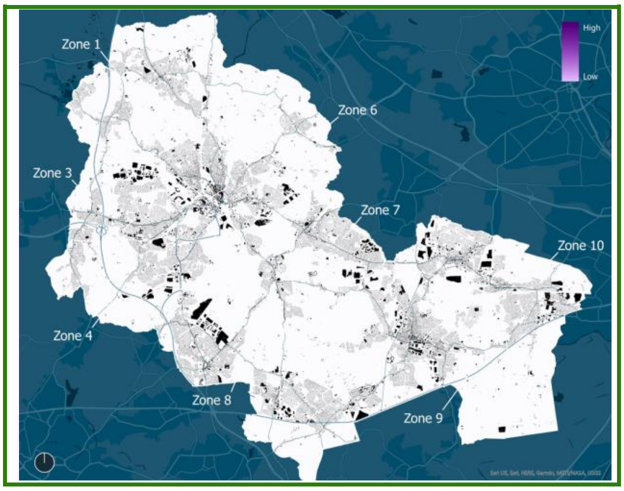
Primary Scenario



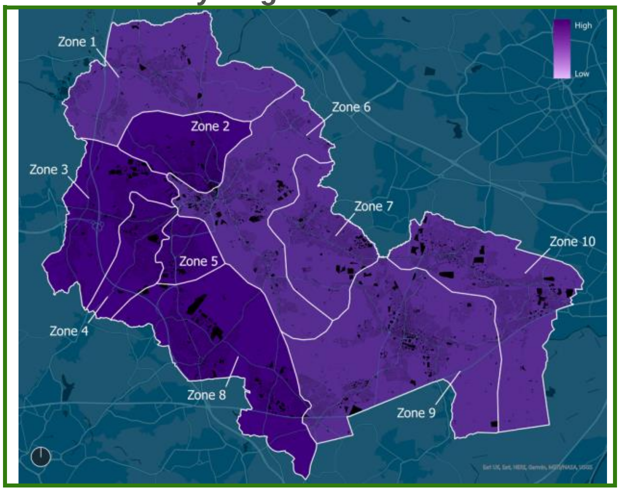
Secondary Scenario



Electrification Scenario

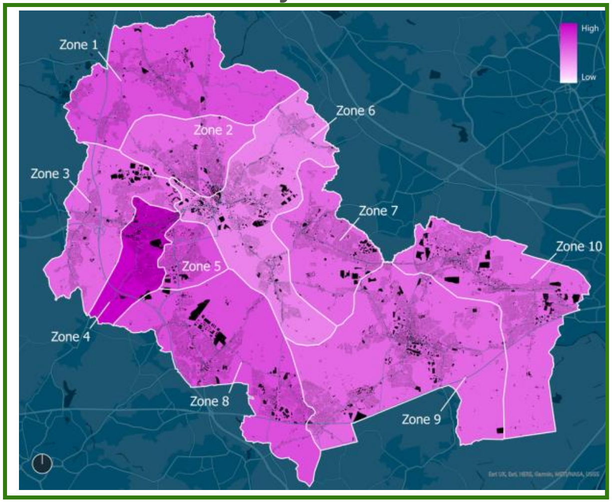


Hydrogen Scenario

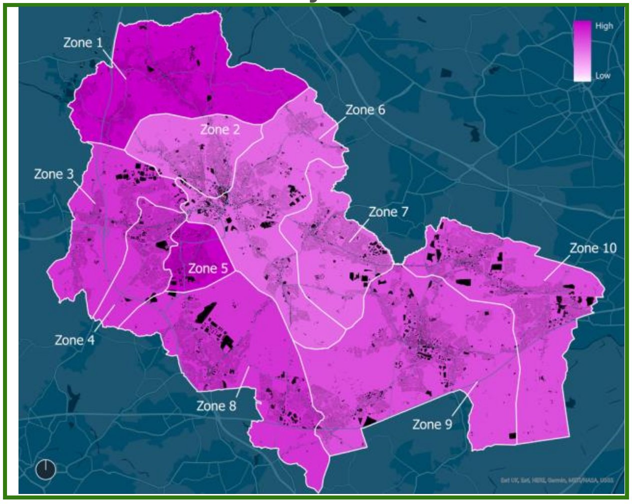


RETROFIT BY 2038

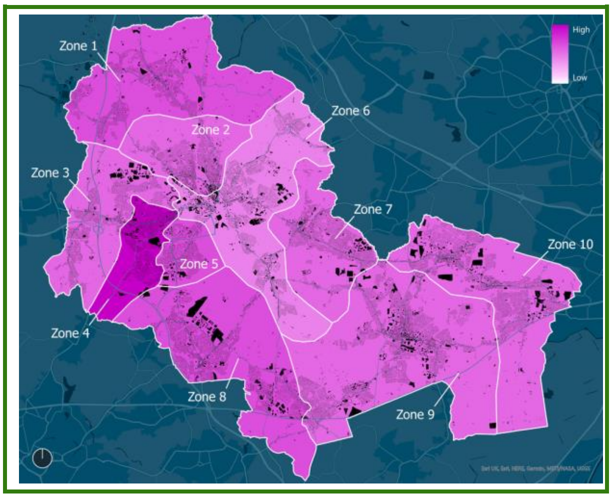
Primary Scenario



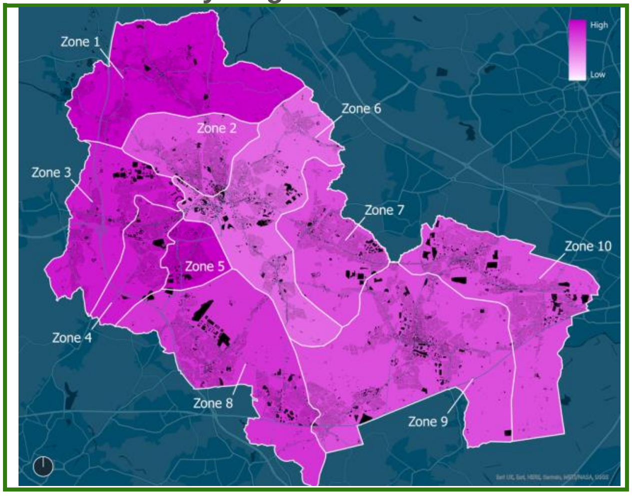
Secondary Scenario



Electrification Scenario



Hydrogen Scenario



Data Sources Annex

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

BUILDINGS

Domestic

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

Non-Domestic

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

Future Building Stock

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

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

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

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

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