Stockport Energy and Carbon Evidence Study 2020

STOCKPORT
METROPOLITAN BOROUGH COUNCIL

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Acronyms

ASHP	air-source heat pump
BEIS	Department of Business, Energy and Industrial Strategy
BEV	battery electric vehicle
BRE	Building Research Establishment
CCC	Committee on Climate Change
CCUS	carbon capture, use and storage
CHP	combined heat and power
DNO	distribution network operator
ESO	electricity system operator
EV	electric vehicle
EVCP	electric vehicle charging point
FCEV	fuel-cell electric vehicle
GMCA	Greater Manchester Combined Authority
GMSF	Greater Manchester Spatial Framework
GSHP	ground-source heat pump
MSOA	middle-layer super output layer
NPPF	National Planning Policy Framework
PV	photovoltaics
SAP	standard assessment procedure
SMBC	Stockport Metropolitan Borough Council
TER	target emissions rate
WSHP	water-source heat pump

1. Introduction

1.1 Stockport Energy and Carbon Evidence Study

Stockport Metropolitan Borough Council (SMBC) have commissioned this Energy & Carbon Evidence study to provide to inform and assist planning policy that will be incorporated into the update of Stockport's Local Plan. SMBC, alongside several other Greater Manchester districts and agencies, has recently declared a Climate Emergency, and the Greater Manchester Combined Authority (GMCA) has launched its 5-year Environment Plan with the ambition for Greater Manchester to become carbon neutral by 2038. As a result, SMBC appointed Element Energy and Cambridge Econometrics to support them in the development of this Energy & Carbon Evidence Study.

The study integrates existing work, local and national plans and builds on these to provide an evidence base and planning policy recommendations to support potential pathways to Carbon Neutrality by 2038. To aid the development of the Local Plan, this study provides an update on existing work in the Stockport and Greater Manchester area and reflects the changing policy landscape and increased level of ambition for Stockport Council relating to design standards for new development (including Passivhaus) and low carbon heating technologies (including district heating), community renewable energy schemes, electric vehicles and energy storage.

The study was split into ten tasks as shown in Figure 1.1 below. Element Energy led on all tasks except for Task 7 – 'Economic Assessment for Developers' which was carried out by Cambridge Econometrics. The report is structured around Tasks 2 – 8 (Sections 3-9) with the addition of 'Background and Policy Context' in Section 2.

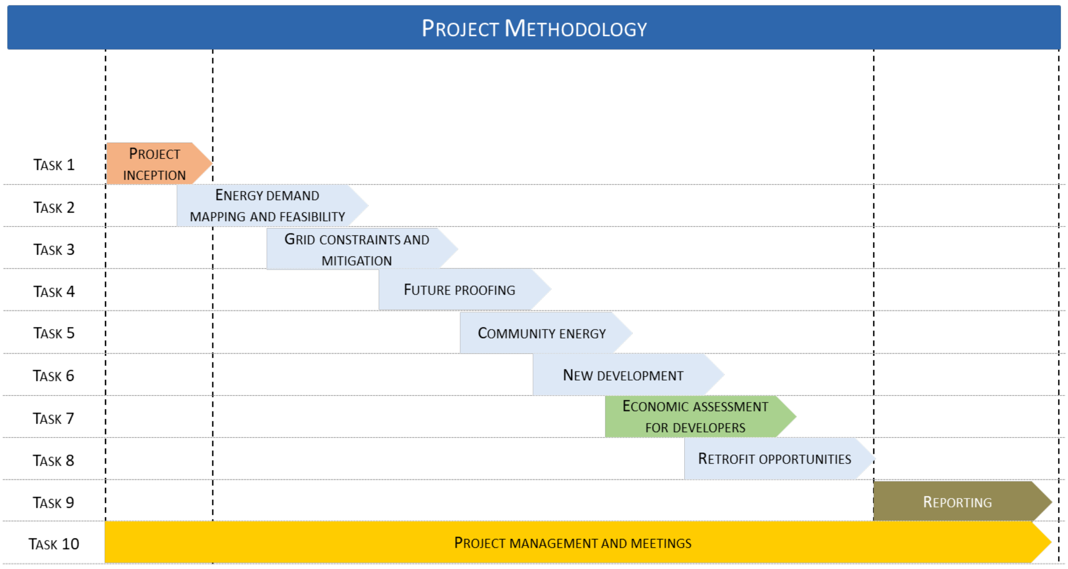

Figure 1.1: High-level overview of project methodology

The objectives of Tasks 2 – 9, as defined in the request for quotation, are set out below:

- **Task 2 - Energy demand mapping and feasibility:**
    - Inform local demand trajectory for the life of the plan allowing for likely near and far future changes in low & zero carbon technologies including in terms of performance

- **Task 3 – Grid constraints and mitigation:**
  - Inform where likely issues around the energy and heating grid networks may occur as a result of planned development
  - Determine electric vehicle grid needs and their potential impacts
  - Establish range of storage demands and priority locations for storage to support low carbon planned developments for both transport and building energy / heating / cooling demand
- **Task 4 – Futureproofing:**
  - Establish basic recommendations of how research and theoretical energy changes in the next 5 and 10 years need to be considered for their effect on planning policy
- **Task 5 – Renewable and Community Energy:**
  - Update existing policy and supporting evidence to facilitate straightforward planning process for renewable energy schemes including community energy projects
- **Task 6 – New development**
  - Encourage Passivhaus design and build on larger scale development
- **Task 7 – Economic assessment for developers**
  - Help planners and developers understand the economic benefits and opportunities of low carbon development and how to maximise that within development budgets
- **Task 8 – Retrofit opportunities:**
  - Examine the contribution planning could make to retrofit of existing housing stock to achieve GM Carbon Neutral target by 2038

1.2 National and International Policy

In June 2019, the UK Government amended the 2008 Climate Change Act to commit the UK to net-zero emissions by 2050. These measures are in line with the Paris Agreement that the UK signed in 2015. Achieving net-zero means any remaining emissions from activities in the UK must be offset by processes that remove carbon from the atmosphere such as using bioenergy with carbon capture and storage technologies. The Committee on Climate Change, a body set up as part of the 2008 Climate Change Act, provided a report to parliament that outlined scenarios for the UK to meet its climate targets with varying degrees of ambition.[12]

1.3 Greater Manchester

Greater Manchester has declared a target of being carbon neutral by 2038[1] 12 years ahead of the UK target. The Greater Manchester Spatial Framework (GMSF) sets out the planning policy framework for the city region upon which local authorities build their own local plans. Ambitious targets have been laid out in the *5-Year Environment Plan for Greater Manchester*[2] covering

[1] Greater Manchester Carbon Neutral 2038 https://www.greatermanchester-ca.gov.uk/news/mayor-sets-out-bold-ambition-for-greater-manchester-to-be-carbon-neutral-by-2038/

[2] 5-Year Environment Plan for Greater Manchester 2019-2024 https://www.greatermanchester-ca.gov.uk/media/1986/5-year-plan-branded_3.pdf

- new build developments
- retrofitting existing buildings
- sustainable transport
- waste reduction and management
- renewable energy generation.

The level of ambition set out the 5-Year Environment Plan represents a step change in the climate targets being pursued and the 5-year timescale pushes for immediate action. The plan also lays out guidance for local authorities on local targets and policies.

1.4 Stockport

In the 2011 Core Strategy, Stockport Metropolitan Borough Council (SMBC) set targets for reducing Stockport's contribution to global climate change; in 2020 SMBC is now due to update those targets and policies. The renewal of planning policies within the Stockport Local Plan will be set within the framework laid out by the GMSF and informed by the ambition of the 5-Year Environmental Plan for Greater Manchester but specifically based on Stockport Council's ambitions and capabilities. SMBC has declared a climate emergency, as have around two thirds of UK councils to date.[3] Such declarations have the opportunity to galvanise councils and local communities into taking stronger action to reduce carbon emissions. Stockport has already taken steps towards reducing the borough's carbon footprint through a variety of measures:

- Two hydroelectric power generation schemes[4]
- Over 4000 photovoltaic installations[5]
- Anaerobic digestion scheme run on food waste[6]
- Schemes for insulating homes
  - Connected for Warmth scheme
  - Get Me Toasty scheme
- EV charging points
  - 70 public charging points across 20 sites[7]
- Stockport Homes (social housing body who manage the Council owned housing stock)[8]
  - 38% of housing stock benefit from some form of renewable energy
  - Nearly 2000 domestic properties fitted with photovoltaic panels
  - Implementing and updating district heating networks in tower blocks
  - Installed insulation in 6300 cavity walls and topped up loft insulation in 4300 properties Explicit recommendation that new developments should "be genuinely sustainably accessible within the urban area"[9]
- Favouring new development plans that have high sustainability standards.

SMBC is now seeking to further reduce Stockport's greenhouse gas emissions and this report will focus on key areas for doing so:

- Reducing carbon emissions from new developments

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[3] Community Energy England: Climate Emergencies https://communityenergyengland.org/pages/climate-emergencies
[4] Community hydro project Stockport Hydro at Otterspool http://www.stockport-hydro.co.uk/ , Pear mill hydroelectric scheme at Stringer's Weir https://pearmill.co.uk/new-hydropower-turbine-pear-mill/
[5] National Statistics: Regional Renewable Statistics 2018 https://www.gov.uk/government/statistics/regional-renewable-statistics
[6] Green Growth article on Fairfield Bioenergy Project https://www.green-growth.org.uk/article/5m-bio-energy-plant-opens-stockport accessed April 2020
[7] Zap-map: Stockport Charging Points https://www.zap-map.com/locations/stockport-charging-points/ accessed May 2020
[8] Stockport Homes: Energy Efficient Homes https://www.stockporthomes.org/my-home/home-improvements/energy-efficient-homes/
[9] SMBC Core Strategy 2011: Page 56 section 3.121 https://www.stockport.gov.uk/development-plan/core-strategy

- Retrofitting existing the existing building stock
- Reducing road traffic and associated emissions
- Encouraging the transfer to electric vehicles
- Investigating options for renewable energy generation
- Encouraging community renewable energy projects.

1.5 Covid-19

This report was written during the Covid-19 global pandemic. The short-term societal and economic have been severe; the medium and long-term effects are currently highly uncertain. The global economy has experienced a major downturn and the recovery methods will vary across countries. There are many calls for the UK government to prioritise a green economic recovery. A green recovery would see support for renewable energy, green companies, and measures for reducing emissions that also create jobs. The extent to which this will happen is currently unknown.

One of the major good news stories during the pandemic has been the revival of nature and the reduction in air pollution (and noise pollution), particularly in cities during lockdown measures. People have seen first-hand the day-to-day advantages of a reduction in emissions. Major behaviour changes have taken place in response to a very immediate and visible threat. The challenge in terms of climate change will be in preserving some of those behaviour changes: reduced car use; increase in working from home and increasing the proportion of journeys that are taken by foot or bike.

2. Background and Policy Context

2.1 Revised National Planning Policy Framework

The revised National Planning Policy Framework (NPPF)[10], published in 2019, set down the national planning policies for England. **Planning policies from local authorities are based on these plans although local authorities have the power to impose stricter regulations**. The revised NPPF explicitly states that *"local planning authorities should not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions"* underlining the fact that any local renewable energy generation has intrinsic merit.

The framework highlights the role of local planning authorities in:

- Promoting low-carbon and renewable heat
- Supporting community led renewable and low-carbon initiatives
- Promoting local renewable energy opportunities by identifying suitable areas and supporting infrastructure
- The approval of low-carbon or renewable development applications where its impacts are *or can be made* acceptable
- Setting policy that will *"expect new developments to take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption"*
- Identifying opportunities for developments to draw their energy supply from decentralised, renewable, or low carbon energy supply systems.

National Planning Practice Guidance[11] clearly reflects the need for climate change to be addressed in Local Plans and what plan makers can do on this issue.

2.2 UK Government and the Committee on Climate Change

In 2015, the UK Government signed the Paris Agreement, committing the UK to playing its role in keeping global temperature rises below two degrees Celsius. In response to the Paris Agreement, the UK **Committee on Climate Change** (CCC) reviewed the scientific evidence on climate change and the UK's options for reducing emissions. The CCC Net-Zero report was published in May 2019 and proposed a **net-zero emissions target for the UK for 2050**.[12]

The previous target set out in the 2008 Climate Change Act had been an 80% reduction on greenhouse gas emissions by 2050. In the Net-Zero report, the CCC outlines a range of measures that should be taken to achieve targets that are technologically feasible and within the budget agreed by the UK government in signing the Paris Agreement. The report covers emissions from across all sectors in the UK from transport, industry and buildings through to agriculture and waste. **After reviewing the recommendations laid out by the CCC, in June 2019, the UK Government committed the UK to being 'net-zero' by 2050**.

As part of the 2008 Climate Change Act, **'carbon budgets' were set by the UK government to monitor progress** over 5-year periods. The first and second budgets were both met and the UK is on track to meet the third.[13] However, current trends suggest the UK is not on track to meet the fourth or fifth carbon budgets and current policy is not strong enough to change those trends to the extent needed.

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[10] www.gov.uk/government/publications/national-planning-policy-framework--2
[11] UK Government Guidance: Climate Change www.gov.uk/guidance/climate-change
[12] Committee on Climate Change Net-Zero Report https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf
[13] BEIS: Updates Energy and Emissions Projections 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794590/updated-energy-and-emissions-projections-2018.pdf

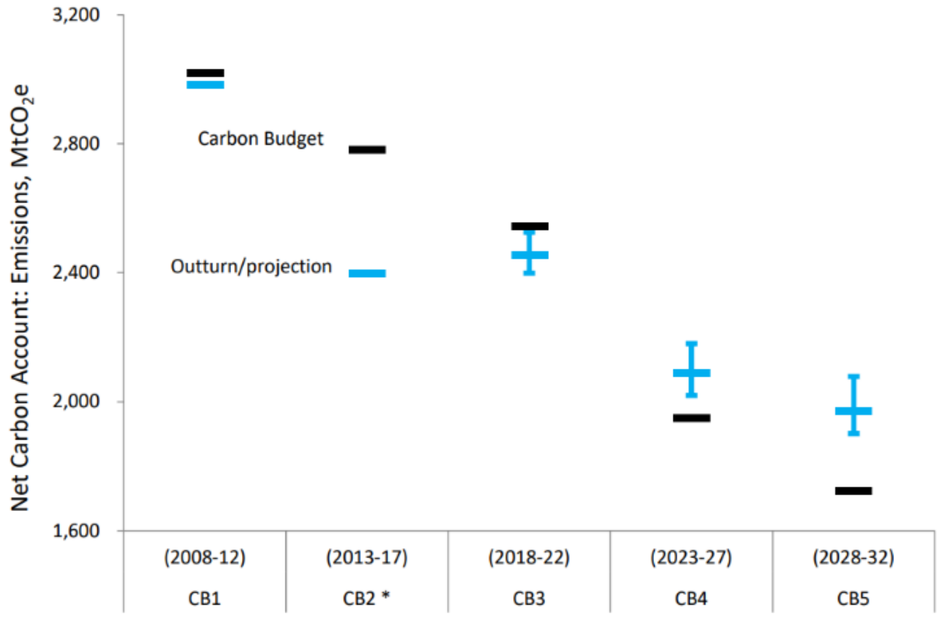

Figure 2.1: UK carbon budgets with current outturns and projections. Figure from BEIS report 'Updates Energy and Emissions Projections 2018'.

The following section will discuss the national policy relevant to Stockport and Stockport Metropolitan Borough Council with a particular focus on the buildings and transport sectors.

Transport

Emissions from the surface transport sector account for around 25% of UK carbon emissions in 2019 (including road and rail but not shipping and aviation) and have remained almost constant over the past two decades.[14] Improvements in vehicle efficiency have been counter-balanced by an increase in the number of miles driven.

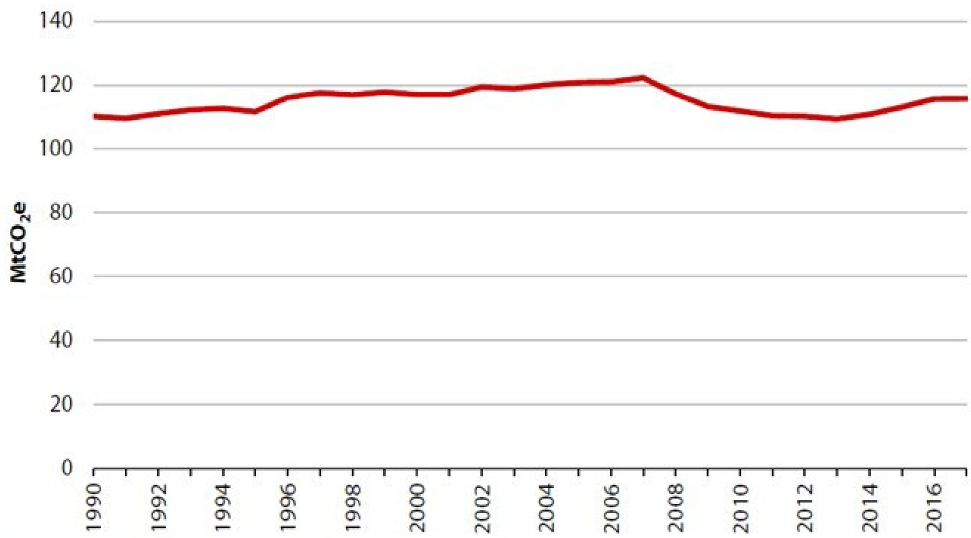

Figure 2.2: Emissions from the UK transport sector over time. Figure taken from the CCC Net-Zero Technical Report.

[14] Committee on Climate Change: Net-Zero Technical Report Chapter 5 www.theccc.org.uk/publication/net-zero-technical-report/

In February 2020, the **UK Government announced that the sale of new petrol or diesel cars (including hybrid versions) would be phased out from 2035**, five years earlier than had previously been proposed. These proposed date, powertrain selection and measures to achieve the phase out (which could include a ban) are under consultation, until end July 2020.[15] The average car in the UK is on the road for around 15 years meaning that, for a net-zero 2050, new fossil-fuel cars cannot be added to the UK car fleet after 2035 without there being a need to 'scrap' vehicles in 2050 that would otherwise have continued to be used. In their analysis, the CCC looked at the future cost of electric vehicles and found that EVs were likely to be on cost parity with fossil-fuel cars by around 2024-25. There is hope that the 2035 'ban' will be somewhat irrelevant as consumers will already have overwhelmingly moved to EVs during the 2020s.

Financial incentives, such as government grants to help cover purchase costs and free vehicle charging, are one means of encouraging people to move to electric vehicles. Other incentives such as limiting access to city centre areas to low or zero emission vehicles is another avenue being explored. These schemes would help to decrease air pollution in the most congested regions of towns and cities. There is also a role for private developments, both domestic and commercial, in ensuring charging infrastructure is set up to accommodate electric vehicles which is not currently being seen at the necessary level in new development applications. Planning policy has means of addressing this issue for new developments with requirements for charging infrastructure as part of planning applications.[16]

Buildings

Buildings account for around 26% of UK carbon emissions.[17] Emissions from buildings have been decreasing gradually over recent years largely due to increases in energy efficiency and decarbonisation of electricity production. Direct emissions from buildings are largely from burning gas for heating and, to a much lesser extent, cooking, while indirect emissions are attributed based on how much electricity is used by buildings and the carbon footprint of generating that electricity.

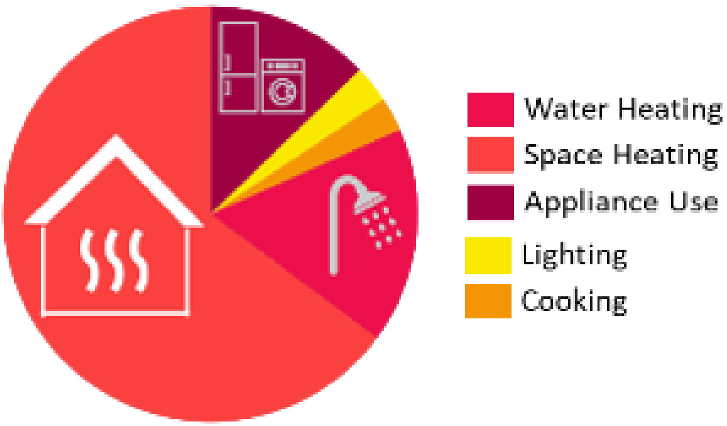

Figure 2.3: End use of UK domestic energy consumption.

[15] https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans

[16] Energy Savings Trust: Developing an Electric Vehicle Charging Infrastructure https://energysavingtrust.org.uk/transport/local-authorities/developing-electric-vehicle-charging-infrastructure

[17] Committee on Climate Change: Net-Zero Technical Report www.theccc.org.uk/publication/net-zero-technical-report/

Buildings are considered even more difficult to decarbonise than transport largely due to the difficulties of retrofitting existing buildings to low-carbon heating systems.[18] Where cars have a turnover of around 15 years and can be replaced with zero-emission models, the vast majority of houses standing now will still be standing in 2050 necessitating extensive retrofitting of low-carbon technologies.

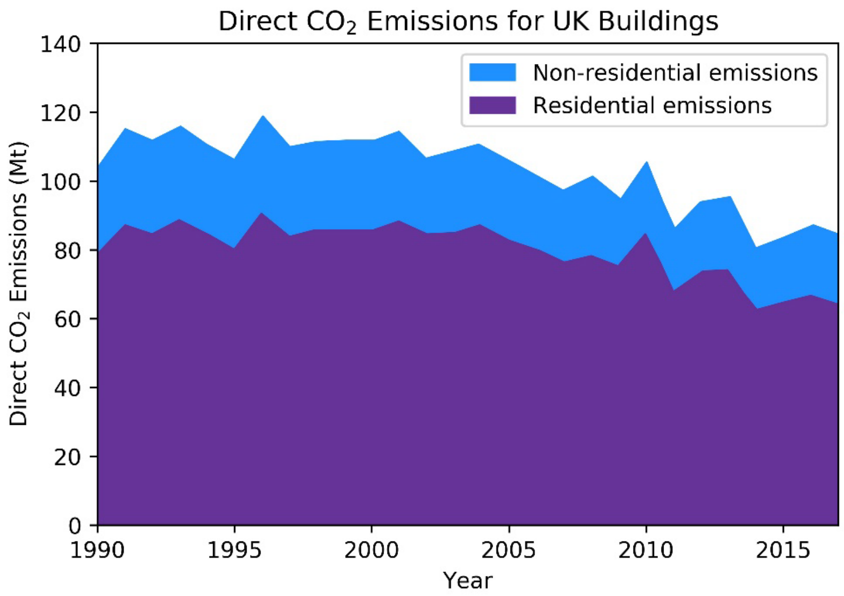

Figure 2.4: Direct CO_2 emissions from UK buildings over time.

Retrofitting is a significantly more expensive process than fitting energy-efficiency measures and low-carbon heating when a building is built. The CCC places great emphasis on the importance of new developments being highly energy-efficient and having low-carbon heating installed from the beginning.[19] The measures suggested by the CCC are now cost-effective but are required to be properly fitted to be energy-efficient and cost-effective. **Energy-efficiency measures must not be treated as a tick-box exercise or there is a risk that neither the carbon savings nor financial savings will be fully realised.**

There are various options for low-carbon heating. The best option will be different for different buildings; the various technologies are discussed in Section 0.

[18] UK Clean Growth Strategy www.gov.uk/government/publications/clean-growth-strategy
[19] Committee on Climate Change: The costs and benefits of tighter standards for new buildings https://www.theccc.org.uk/publication/the-costs-and-benefits-of-tighter-standards-for-new-buildings-currie-brown-and-aecom/

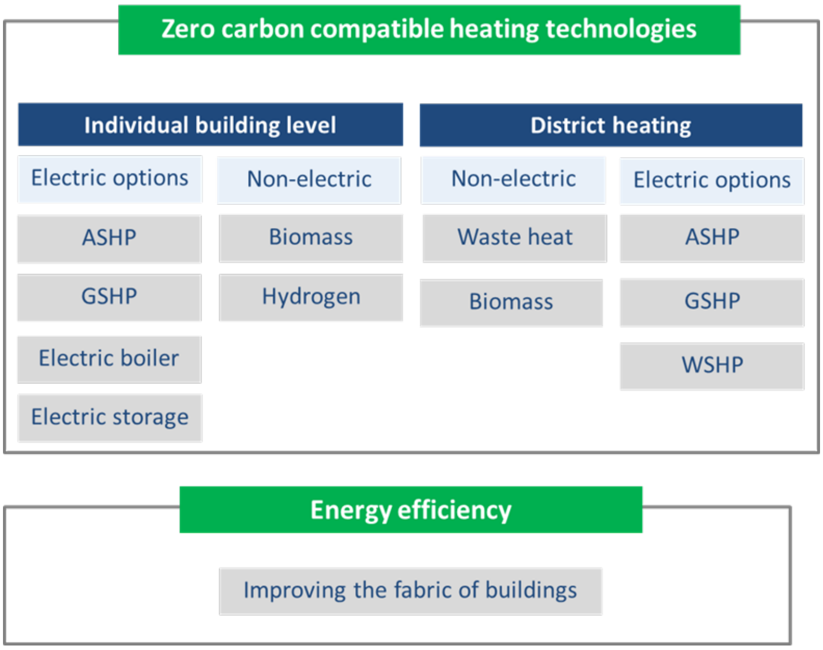

Figure 2.5: Low-carbon heating options for various scales. Heat pumps can draw energy from a range of sources: air-source heat pumps (ASHP), ground-source heat pumps (GSHP) and water-source heat pumps (WSHP).

2.2.1 UK Government: Clean Growth Strategy

The Clean Growth Strategy was published in October 2017 and laid out the UK Government's plans to protect the natural environment while still promoting economic growth. The potential for economic growth within the low-carbon sector was recognised as a particularly promising area of growth for the UK economy. **The Clean Growth Strategy recognises the differing resources and requirements with regards to energy across the UK and acknowledges that devolved administrations and local authorities will have a significant role to play in reducing UK emissions**. The role of local authorities is seen to be particularly significant in

- Waste management
- Transport management including charging points for electric vehicles and the option of zero-emission zones in urban areas
- Encouragement of local energy schemes.

2.2.2 Energy Innovation Needs Assessment

In November 2019, the Department for Business, Energy and Industrial Strategy (BEIS) published a report that aimed to **identify the key innovation needs to transition the UK's energy system to be low carbon**.

- Power sector
  - Optimising and control strategies for demand side response
  - Development of energy storage options
- Heating
  - Development of high-temperature heat pumps to allow for integration with current heating systems and reduce the disruptiveness of retrofitting
  - Innovation within district heating infrastructure with regards to temperature and optimisation
  - Options for decarbonising the gas grid by changing to a hydrogen grid

   - Reducing carbon emissions from hydrogen production through carbon capture
   - Advancements in electrolyser technology to enable the switching of hydrogen production to electrolysis of water using electricity from renewable sources
   - Building demonstration and early commercial plants for the use of liquid or gaseous biofuels.
- Transport
   - Development of lithium ion battery technology to power electric vehicles
   - Development of hydrogen fuel cells to power HGVs
- Renewable energy generation
   - New blade and material technologies for wind turbines
   - Innovations in wind turbine control and yield optimisation
- The development of economically viable carbon capture, use and storage (CCUS) technology to allow for some fossil-fuels to still be used without contributing CO_2 to the atmosphere.

2.2.3 UK Government: Future Homes Standards Consultations

At the time of preparing this report in early 2020, the Ministry of Housing, Communities and Local Government had issued a consultation regarding future updates to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings. The **proposed Future Homes Standards would require a reduction in emissions for new developments above the targets already in place**. New developments will be required to give consideration to 3 energy related aspects:

- Energy efficiency
- Carbon emissions
- Affordability of running costs for occupier.

Within the Future Homes Standards consultation, there is also a decision on whether to enact powers that would prevent local authorities requiring higher standards on new builds than those set out in the Building Regulations. The outcome of this decision will greatly influence how local authorities set their policies and targets in relation to new developments.

2.2.4 BEIS: Future Support for Low-Carbon Heat Consultation

The renewable heat incentive was introduced in 2014 to encourage the transition to renewable heating. The scheme was set up such that consumers paid the upfront costs of the equipment and **were repaid according to the amount of renewable heat they generated**, in much the same way as the feed-in tariff for solar PV installations works. However, **particularly high up-front costs and long payback times meant uptake has been much lower than expected for the scheme.**

The UK government is now consulting on a change to the scheme that would involve a grant to help cover the up-front costs rather than a gradual payback.[20] The key points from the *'Future support for low carbon heat'* report are:

- **Limiting the use of biomass and favouring heat pumps**
- **Flat rate grant of £4000 for all technologies** towards up-front costs
- **Specifically not supporting hybrid heat pumps**
- Aimed at supporting supply chains to develop the market for low-carbon heating
- **Support for biomethane from anaerobic digestion**, the only commercially available green gas in the UK
- Considering the potential for blending hydrogen into the gas grid.

[20] BEIS: Future Support for Low-Carbon Heat https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/881622/future-support-for-low-carbon-heat-consultation.pdf

If the decision is taken to provide a £4000 grant for low-carbon heating technologies, a major barrier to low-carbon heat will be reduced significantly. Government funded financial incentives will make it easier for local authorities to put more forceful policy in place to guide people towards low-carbon heating as there will not be same level of financial penalty for consumers.

The Future Homes Standard is the first stage of a *Low Carbon Heat Roadmap* that BEIS aims to publish in 2020 and which will be a major piece of policy in the transition to low-carbon heating.

2.3 Local Policy

2.3.1 Greater Manchester

Greater Manchester has declared a target of being carbon neutral by 2038,[2] 12 years ahead of the UK target with a commitment to *"playing its full part in limiting the impacts of climate change"*. Greater Manchester has a carbon budget informed by the Paris Agreements and has plans to address the three main types of emissions for which the region is responsible:[21]

- Direct CO_2 emissions
  - Those directly emitter within the region such as transport, buildings and industry
- Aviation CO_2 emissions from Manchester airport
- Indirect/consumption-based CO_2 emissions
  - Emissions associated with goods brought into the region.

Greater Manchester Spatial Framework

The Greater Manchester Spatial Framework (GMSF)[22] sets out the plan for developments in Greater Manchester through to 2037. The spatial framework covers:

- Housing
- Industry
- Environment
- Transport
- Jobs
- Land use.

With regards to the environment, the spatial framework identifies several priorities to enable Greater Manchester to meet its goals of becoming a sustainable city region:

- Significantly upscaling photovoltaic energy generation
- Reducing heat demand in homes
- Moving away from carbon-intensive gas as the primary source of heat
- Reducing heating and cooling demand for public and commercial buildings
- Increasing biofuel use.

To address the priorities listed above, the GMSF details the policies that will be implemented across Greater Manchester relating to energy and carbon emissions:

- Promoting retrofitting
- Positive approach to renewable and low-carbon energy systems
- Planning for a smart electricity grid
- Expectation that new developments will
  - be net-zero by 2028 through minimising demand and the use of low-carbon technologies
  - Have interim emission levels 19% below Part L of the 2013 Building Regulations
  - Incorporate EV charging points considering likely long-term demand
  - Make use of heat networks
  - Reduce carbon emissions by 20% using renewable or low-carbon technologies
  - Assess and minimise whole life cycle carbon emissions.

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[21] Manchester Climate Change: Our Objectives and Targets http://www.manchesterclimate.com/targets

[22] www.greatermanchester-ca.gov.uk/what-we-do/housing/greater-manchester-spatial-framework/

Greater Manchester Spatial Energy Plan: Evidence Base Study

The "*Greater Manchester Spatial Energy Plan: Evidence Base Study*" gives a detailed account of Greater Manchester and each of the regions within it. The study covers various aspects of the regions within Greater Manchester region related to sustainability including:

- Energy demand
- Carbon emissions
- Age of domestic properties
- Low-carbon heating potential
- Potential heat network regions
- Renewable energy generation
- Renewable energy potential broken down for different technologies.

Greater Manchester 5-Year Environment Plan

The *"5-Year Environment Plan for Greater Manchester"*[3] sets out the current environmental situation in Greater Manchester and the immediate challenges. The plan covers 2019-2024 with ambitious targets both in terms of scope and timeframe that cover:

- new build developments
- retrofitting existing buildings
- sustainable transport
- waste reduction and management
- renewable energy generation.

The level of ambition set out in the 5-Year Environment Plan represents a step change in the climate targets being pursued and the 5-year timescale pushes for immediate action. The plan also lays out guidance for local authorities on local targets and policies.

SCATTER

SCATTER stands for Setting City Area Targets and Trajectories for Emissions Reduction and is a tool available to local authorities to assess, report on and reduce the amount of greenhouse gases produced by the area. The SCATTER tool can be used to provide detailed insights into the emissions profile of a region enabling local authorities to tackle the major sources of emissions. **The SCATTER tool also includes a feature called 'Pathways' that allows local authorities to see the impact of different decisions and targets on energy and emissions**. For each sector (low emission vehicles, aviation sector growth, wind energy generation etc) a series of options are given that become increasingly ambitious.

2.3.2 Stockport

Stockport Metropolitan Borough Council (SMBC) has a **Core Strategy** in place from 2011 that details local planning policy including where it goes beyond national policy. The Core Strategy focuses on:

- New developments
- Housing
- Transport.

In each of the above sections there is information relating to sustainability and transitioning to a low-carbon future. Progress in recent years, particularly in relation to low-carbon transport and decarbonisation of the electricity grid, means that the Core Strategy needs to be updated. However, many of the issues in Stockport are still the same as those identified in the Core Strategy:

- Housing shortage, particularly affordable housing

- Encouraging developers to design and construct new developments to high energy-efficiency standards.
- Road congestion
- Air pollution
- Encouraging retrofitting of existing buildings to reduce energy consumption
- Encouraging the development of district heating networks
- Regeneration of regions such as the town centre (planning underway).

The Core Strategy has requirements for target emissions rates (TER) for new developments to be significantly lower than that set out in Part L of the building regulations in 2006: 40% lower than the 2006 TER for domestic buildings and 30% lower for non-domestic buildings. There were additional requirements based on any carbon reduction opportunities identified for a particular site. Where low-carbon opportunities had been identified, the council could require emissions rates up to 100% lower than the TER (effectively zero-carbon) for new developments where developers would be expected to meet the energy demand from renewable sources.

2.4 Stockport housing and development

Stockport is a borough with a high level of wealth within the population compared with the national average but also areas of deprivation. In the 2011 Core Strategy *"addressing inequalities and climate change"* was stated as the first objective of the Local Plan. The map in **Error! Reference source not found.** shows the average income of households within each area of Stockport.[23] The pattern seen in is seen again and again in data for various other parameters throughout this report. The areas around Bramhall, Marple Bridge, the Heatons and the south west of Stockport contain the wealthiest regions while the town centre and Brinnington have the lowest average income households.

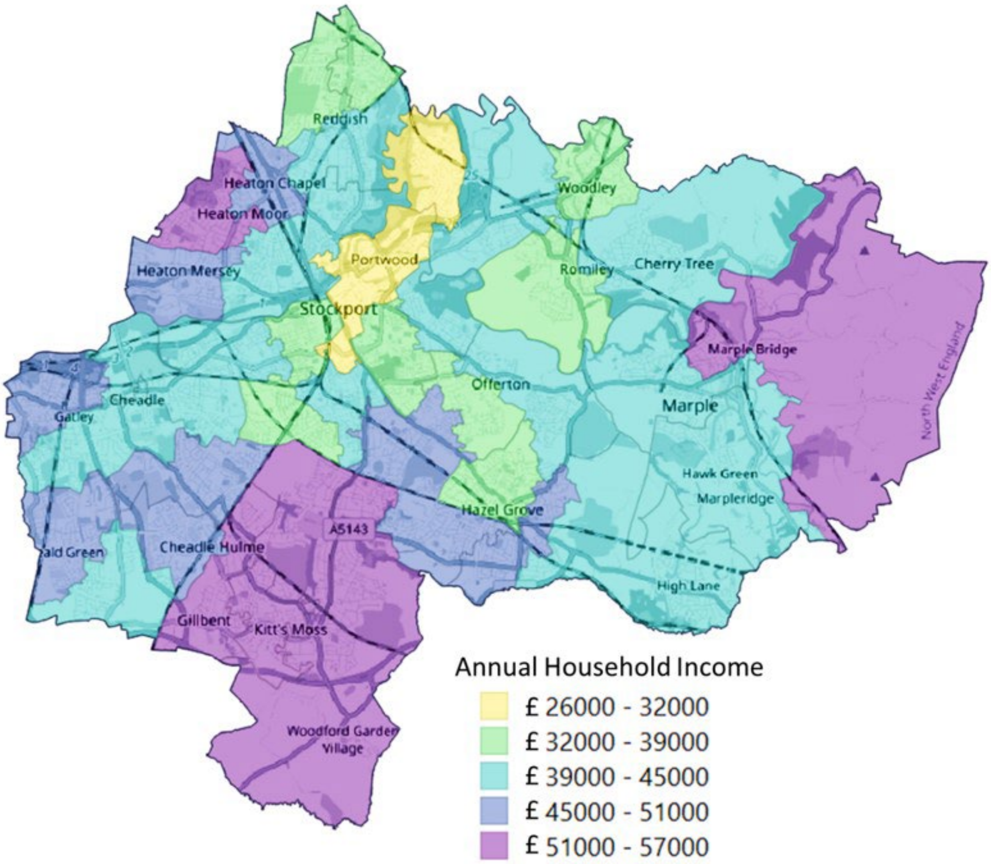

Figure 2.6: Map of average annual household income in Stockport.

2.4.1 Stockport Housing

The Greater Manchester Spatial Energy Plan gives an overview of all the local authorities contained within Greater Manchester in terms of energy.[24] **Stockport, along with Trafford, has the largest portion of older building stock**. Older stock is more likely to have low energy-efficiency with single-glazed windows, draughty floors and uninsulated walls. Very few buildings are demolished in Stockport such that new developments will add to the existing building stock rather than replacing lost dwellings. **Retrofitting of older building stock will be an important**

[23] Average household income data for UK regions https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/smallareaincomeestimatesformiddlelayersuperoutputareasenglandandwales
[24] Greater Manchester Spatial Energy Plan https://www.greatermanchester-ca.gov.uk/media/1363/spatial_energy_plan_exec_summary.pdf

step in combatting domestic emissions as these buildings are very likely to still be standing in a carbon neutral 2038 and 2050.

The area in the far east of Stockport that includes Marple Bridge, is one of only two regions of Greater Manchester to have less than 10% of the domestic building stock rated EPC band C or better; in most regions of Greater Manchester at least 40% of domestic building stock is rated EPC band C or above.

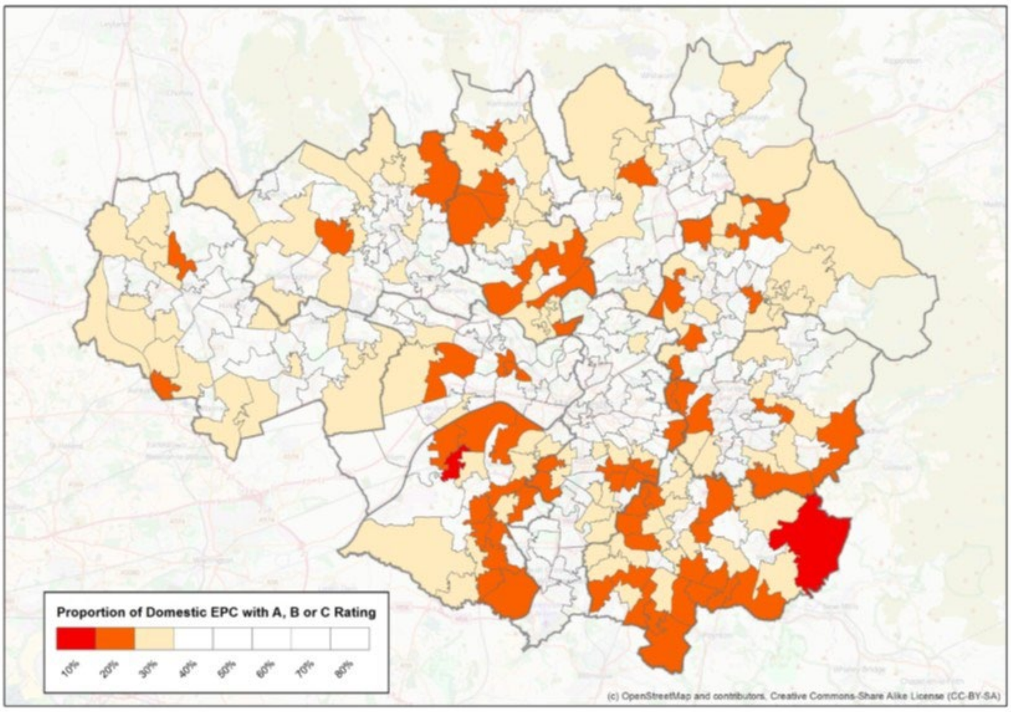

Figure 2.7: Proportion of domestic properties in areas of Greater Manchester with EPC ratings of A, B or C. Image from GMSF.

Stockport has the third largest population of the Greater Manchester regions and correspondingly is the third largest emitter in terms of domestic carbon emissions, behind the more densely populated Manchester City and Wigan.[25] **Methods to address domestic emissions will be a mixture of energy-efficiency measures and a change to low-carbon heating.**

As of 2019, Stockport has just over 128,000 dwellings according to data from the Building Research Establishment (BRE).[26] As illustrated in Figure 2.8, the Stockport housing sector is dominated by owner-occupied dwellings with a much lower proportion of private rented accommodation than the UK as a whole. The BRE data provides information relating to insulation levels in dwellings according to tenure type, shown in Figure 2.9. Social housing in Stockport has higher levels of loft insulation than other tenure types, typical in the UK, while private rented properties have the lowest levels.

According to BRE data, as of 2019, 27% socially rented properties in Stockport still have uninsulated cavity walls. Stockport Homes manage around two thirds of Stockport's social housing stock which includes around 8,000 dwellings with cavity walls all of which were reblown between 2008 and 2012. The BRE data indicates that there are nearly 3,700 socially rented properties in Stockport with uninsulated cavity walls, which accounts for more than half of the social housing outside the management of Stockport Homes.

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[26] BRE Data December 2019

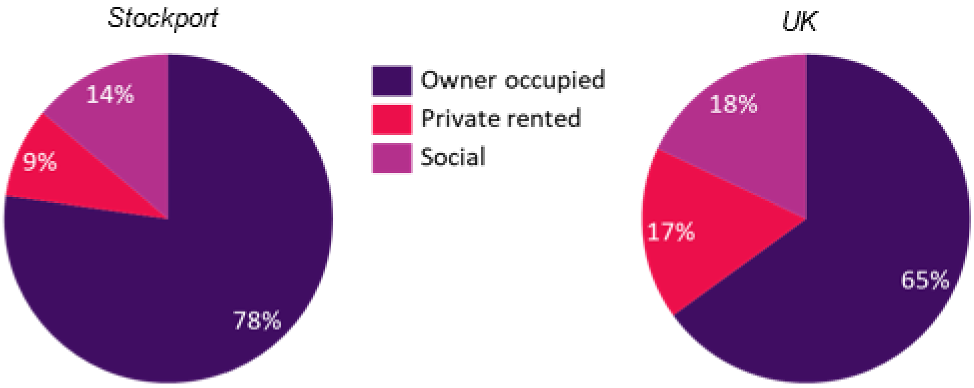


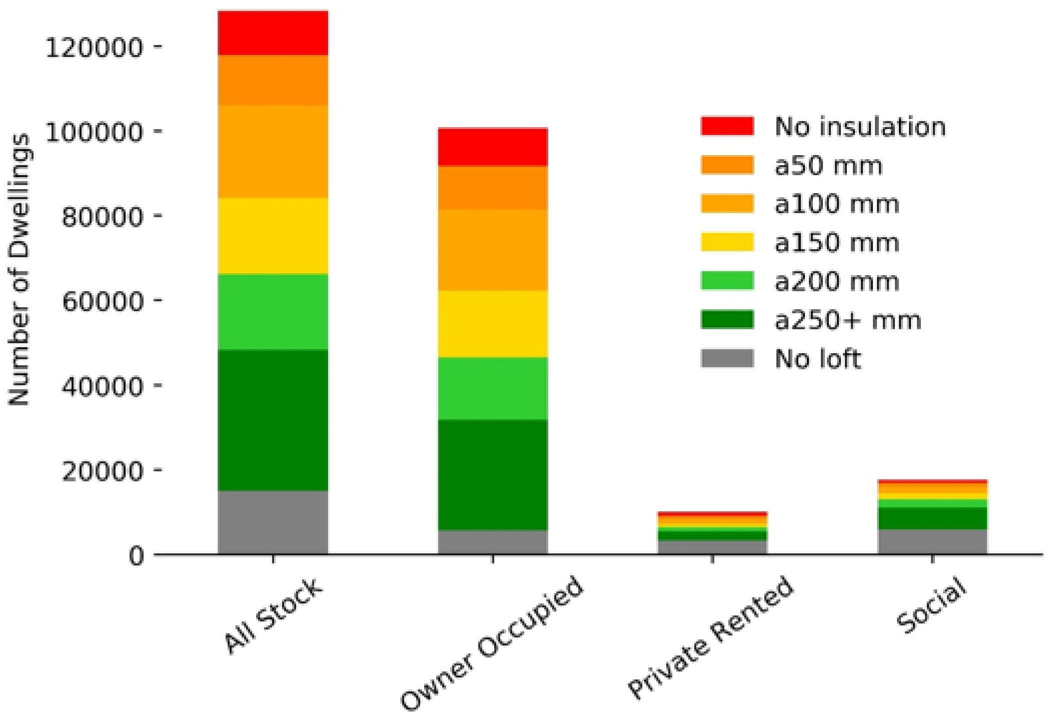
Figure 2.8: Housing tenure type for Stockport and UK.

A significant portion (~34%) of houses of all types in Stockport have uninsulated cavity walls. Around 10% of Stockport properties with a loft do not have insulation, 45% have high levels of loft insulation (200+ mm) and the remaining 45% have some insulation (50-150 mm) that would see efficiency improvements with increased insulation.

In numbers of dwellings, Stockport has:

- over 10,000 lofts requiring loft insulation
- nearly 52,000 lofts that would benefit from loft insulation being topped up to various degrees
- nearly 72,000 uninsulated cavity walls requiring insulation[27]
- some portion of 18,000 solid walls that could benefits from internal or external wall insulation.

[27] Some of these properties may be considered 'hard to treat' and therefore may be better suited to internal or external insulation like that used for buildings with solid walls.



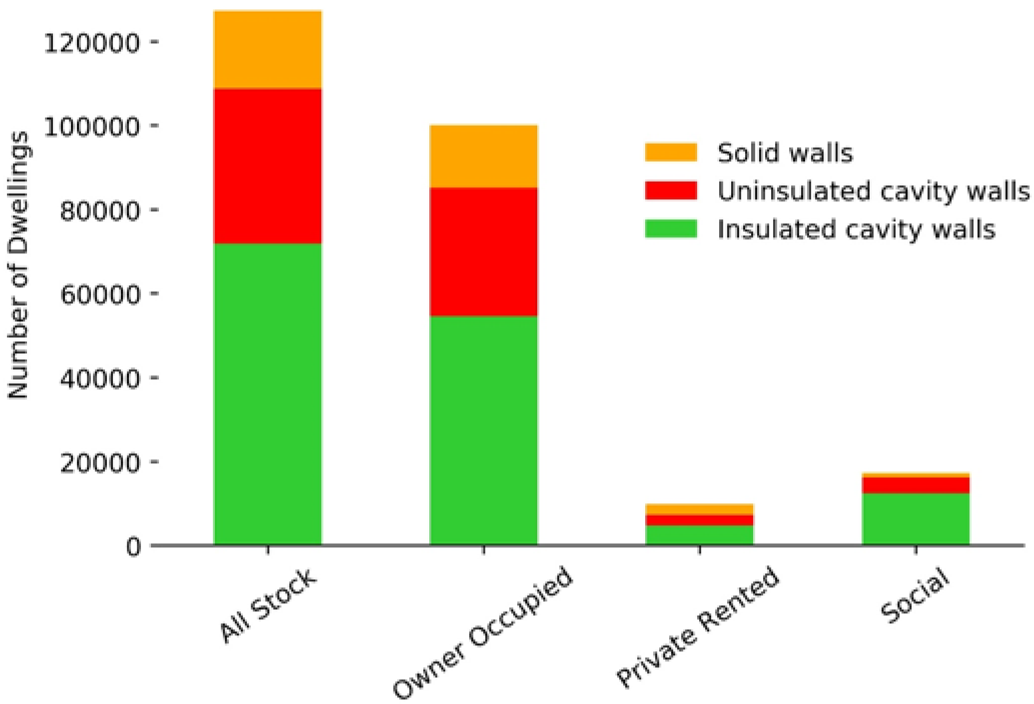


Figure 2.9: Insulation levels in Stockport dwellings by tenure.

2.4.2 New Developments in Stockport

While "addressing inequality and climate change" was the first objective in SBMC's 2011 Core Strategy, "housing" was the second. The SMBC Stockport Housing Strategy 2016-2021 opens by saying *"Stockport faces a housing crisis",* a sentiment echoed by many individuals in the

Council.[28] Average house prices in Stockport are around £225,000, second only to Trafford in the Greater Manchester region (as of September 2019). Prices in Stockport are below the average for England at £240,000 but substantially higher than the average for the North West region of £165,000. To meet housing need SMBC has set housing goals related not only to the number of new homes, but also to achieve a mix of housing type and affordability.

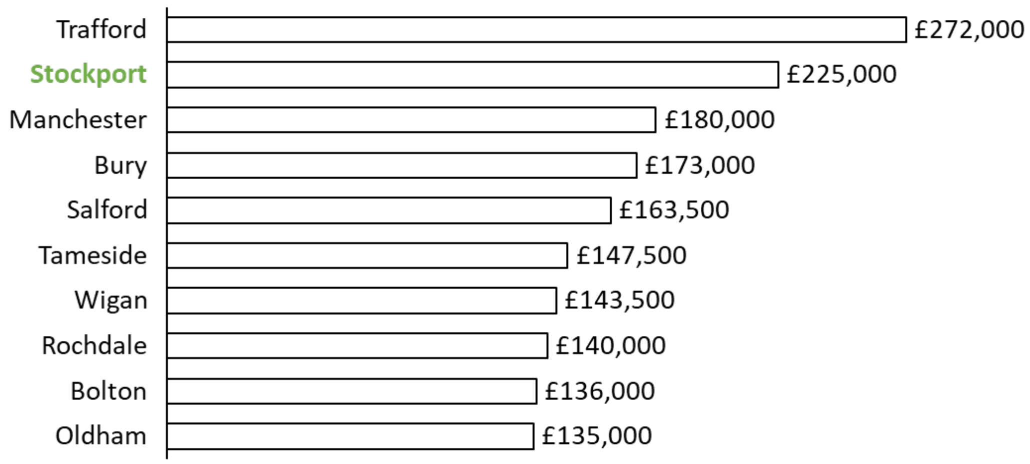


Figure 2.10: Average house prices across Greater Manchester regions.

The 2011 Core Strategy set an aim of delivering at least 450 dwellings per year in Stockport and was particularly focussed on developing the town centre area. Redevelopment of the town centre is attractive for multiple reasons:

- Aligns with the *'brownfield first'* preference for new developments set out in the Greater Manchester Spatial Framework
- Aligns with the Core Strategy aims for new developments to be *"genuinely sustainably accessible within the urban area"*
- Aligns with a preference expressed by the council and the local community to limit development of greenfield sites and preserve the local natural surroundings
- The town centre has been identified as a neighbourhood renewal priority area by Stockport Council.

More recent figures from the GMSF project that **Stockport's housing target will be an average of 580 new dwellings per year between 2018 and 2023, increasing to 830 per year between 2024 and 2037**.[29] Around a third of these new dwellings are expected to be in the town centre, at least in the shorter term, with a local trajectory of 200 new dwellings per year planned as part of the town centre redevelopment. Most these new dwellings, around 80%, will be flats although there are plans to include a portion of houses. In addition to domestic properties, regeneration plans for the Town Centre include new office spaces and leisure facilities.

Within the town centre development, consideration is being given to various sustainability options including:

- Zero-carbon homes

[28] SMBC Stockport Housing Strategy 2026-2012 http://democracy.stockport.gov.uk/mgConvert2PDF.aspx?ID=105159

[29] Greater Manchester Plan for Homes, Jobs and the Environment https://www.greatermanchester-ca.gov.uk/media/1710/gm_plan_for_homes_jobs_and_the_environment_1101-web.pdf

- EV charging infrastructure
- Sustainably managed waste streams
- Public transport.

To realise the Council's ambition to create a sustainable development within the town centre, Stockport Council wishes to attract green developers to bring expertise, innovation and a genuine wish to protect the natural environment to all aspects of the development process.

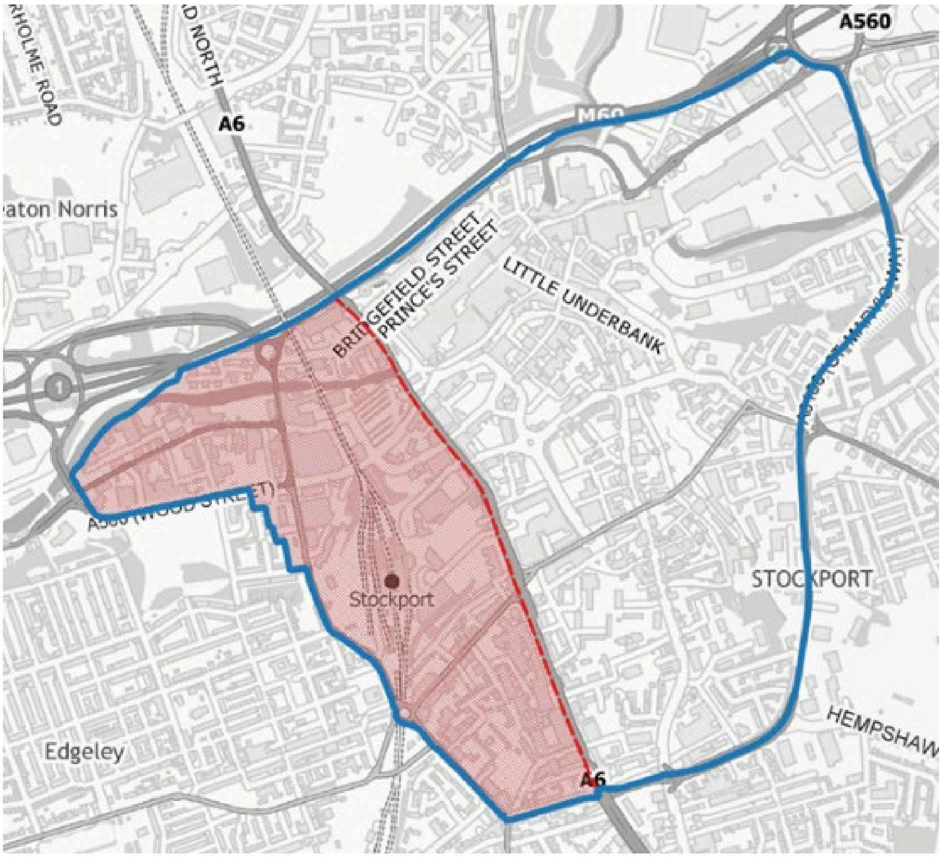


Figure 2.11: graphic showing the boundary of Stockport Town Centre West Mayoral Development Corporation Area

- The pink shaded area been identified for around 3,500 new dwellings; primarily flats with a small number of houses.
- An additional 1,500 new dwellings are planned in the rest of the Town Centre (blue boundary).
- Building in this region is in line with the plan to deliver housing that is "genuinely sustainably accessible within the urban area" as laid out in the Core Strategy document.
- In this development, consideration is being given to various sustainability measures
- Planning of this development is in progress.

3. Energy Mapping

3.1 Overview

This section of the report considers the energy demand of the Stockport building stock including residential, commercial and industrial buildings. Firstly, the trends for electricity and gas consumption since 2005 for Stockport as a whole are shown alongside the trends for Great Britain as a whole.

To gain further insights into energy usage in Stockport, this section also contains maps of energy consumption for the various subregions of Stockport called Middle Super Output Areas (MSOAs). These maps show the distribution of gas and electricity consumption across Stockport for domestic and non-domestic consumers.

The last section, Technology Feasibility Mapping in Stockport, provides a set of maps relevant to renewable energy technologies in Stockport.

The electricity and gas demands of the UK have been falling steadily since around 2005.[30] Several factors have contributed to the reduction in demand:

- More energy efficient domestic appliances and lighting
- More energy efficient industrial processes
- Energy intensive industries moving overseas.

3.1.1 Electricity

The electricity sector (also referred to as the power sector) has largely been responsible for the drop in UK greenhouse gas emissions in the past few years.[31] The reduction in emissions has been a result of

- reduced electricity demand
- increasing renewable electricity generation in the UK.

Energy from renewable sources is replacing highly polluting energy sources such as coal.

Figure 3.1 shows the electricity demand for Stockport alongside the total for Great Britain. Electricity demand is split into domestic and non-domestic consumption, where non-domestic includes industrial and commercial uses. **Stockport's electricity demand shows a similar pattern to the Great Britain demand, with non-domestic consumption being higher than domestic but both showing an overall downward trend.**

Stockport's non-domestic electricity demand is decreasing faster than the GB trend. While the electricity consumption has shown an almost linear decrease over the 2005-2018 timeframe, the same trend is not expected to continue over the coming years. Demand reduction is expected to slow, reflecting the fact that many energy-efficiency measures, such as LED lighting, have already been widely implemented. The reductions in emissions that have been seen in recent years have not been the result of business as usual but of concerted efforts to increase the efficiency of appliances, business and homes, and through promotion of renewable energy generation. While the expectation is that baseline demand from current sectors would continue to fall, there cannot be an expectation that this fall will happen of its own accord.

[30]BEIS: Digest of UK Energy Statistics 2019
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820277/DUKES_2019_Press_Notice_GOV.UK.pdf
[31] Committee on Climate Change: Net-Zero Technical Report, Chapter 2
https://www.theccc.org.uk/publication/net-zero-technical-report/

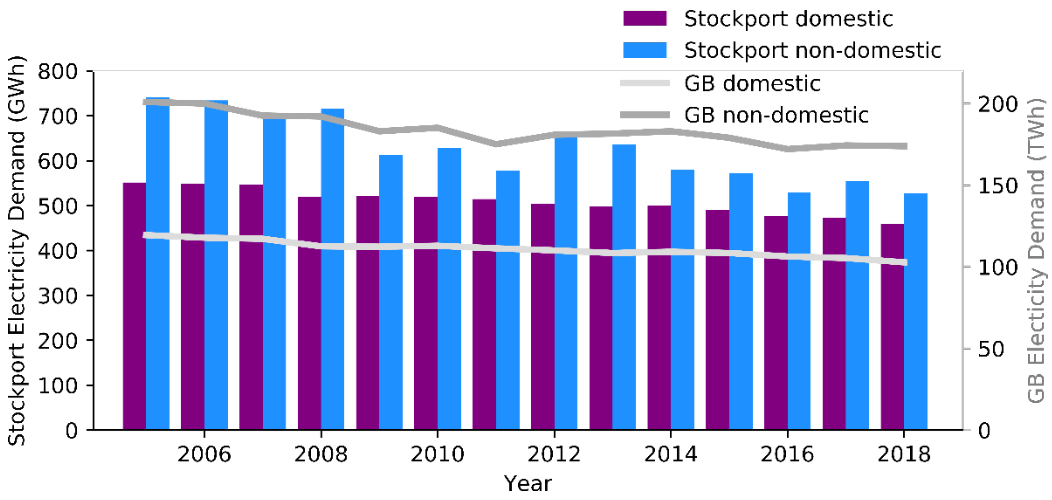


Figure 3.1: Electricity demand for Stockport and Great Britain.

While the hope is that homes and businesses will continue to become more energy efficient, it is expected that the current downward trend of electricity consumption will slow and soon begin to increase again. This increase in demand will come from two new demands placed on the electricity grid:

- electrification of heating
- electrification of transport.

3.1.2 Gas

As with electricity demand, there has been an overall downwards trend in gas demand in Stockport and Great Britain as a whole. As with electricity demand, Stockport has shown a faster decrease in gas demand than GB since 2005. However, while electricity demand has been decreasing steadily since 2005, **gas demand decreased steadily from 2005 until 2012 but has remained steady since**. Gas demand has even increased slightly in recent years in both the domestic and non-domestic sectors. As gas is largely used for heating, the gas demand data used has been weather corrected to account for differences in temperature between years.

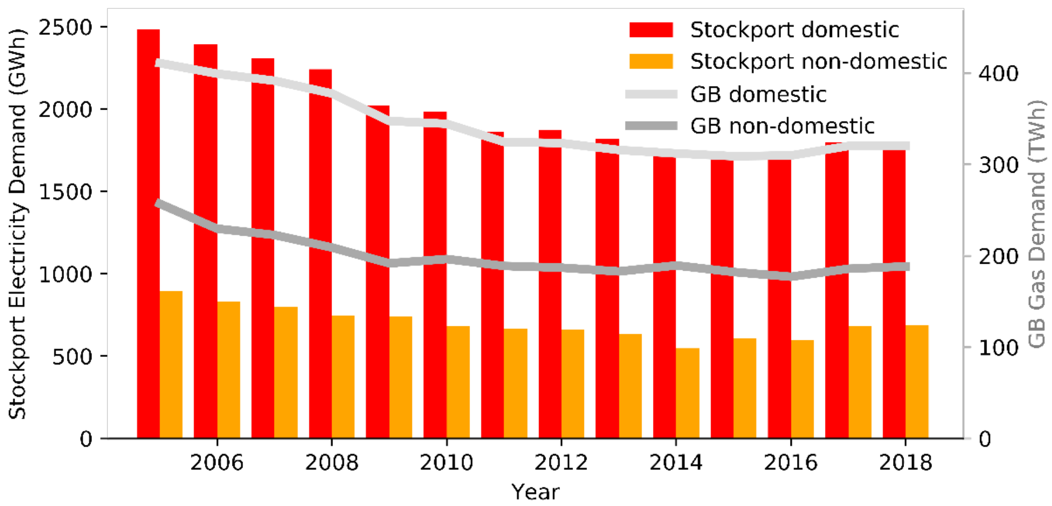


Figure 3.2: Gas demand for Stockport and Great Britain.

3.2 Stockport Energy Demand Projections

Historical gas demand data can be used as a baseline for future gas demand for Stockport. In the predicted gas demand for Stockport is shown out to 2050 including the contributions from new developments; on the right-hand y-axis, the number of houses in Stockport is shown. In this figure, new homes are assumed to have a gas demand of 4,000 kWh per year. In current UK plans, gas boilers will be phased out by 2025 such that the picture shown in **Error! Reference source not found.** should never materialise. However, the projection serves to illustrate the point that even if new developments came onto the gas grid, their demand would be dwarfed by the demand from current buildings. **Reducing both domestic and non-domestic gas demand in existing buildings will be vital for meeting net-zero targets for either 2038.**

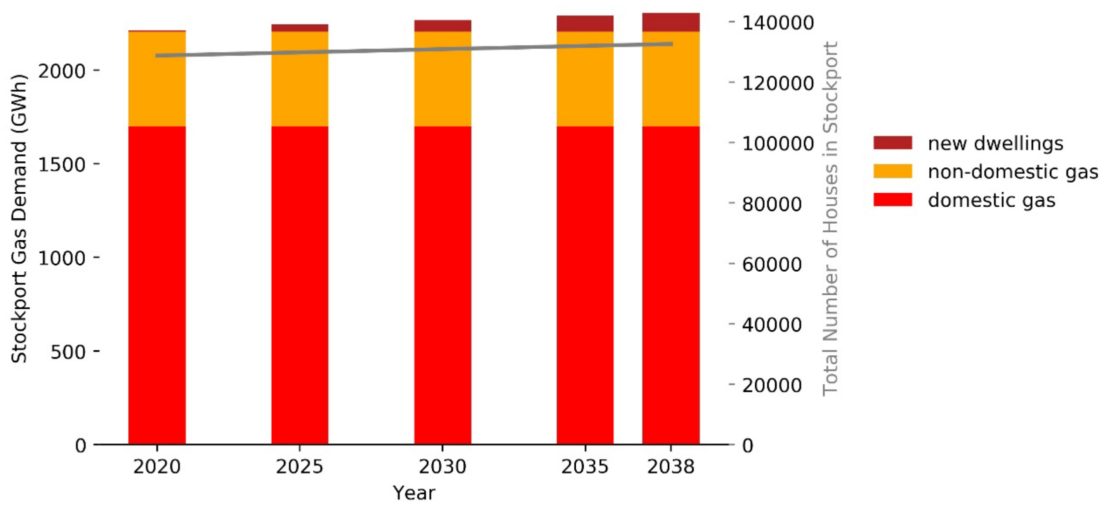


Figure 3.3: Projected gas demand for Stockport including current buildings and demand increase from new developments assuming gas heating

Likewise, the electricity demand for Stockport can be projected with the inclusion of new developments. In

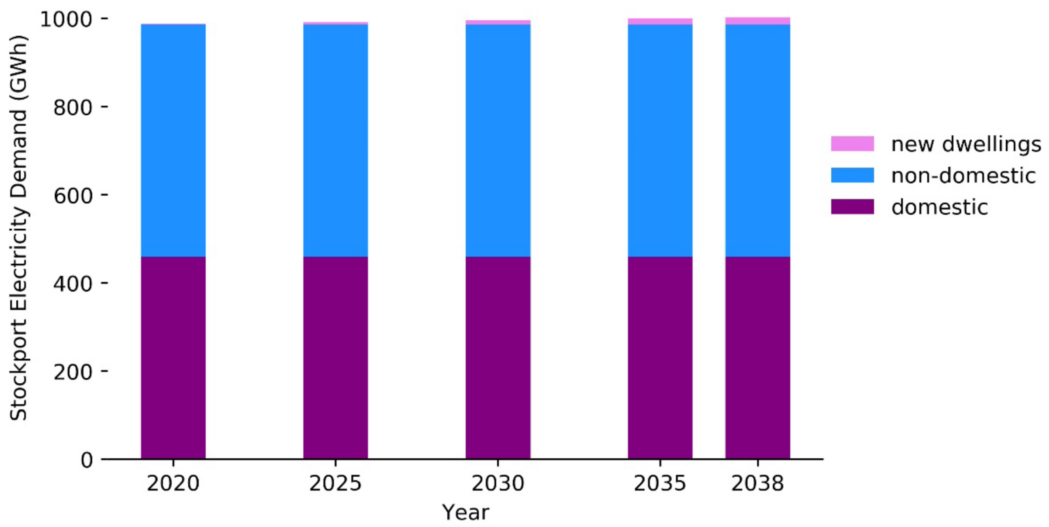


Figure 3.4, the projected electricity demand for Stockport is shown including demand from new developments. The demand from new developments is shown for developments as built currently with gas heating. These projections do not include demand from retrofitting electric heating into existing buildings or the expected demand from electric vehicles (EVs) and as such serves as a

'business as usual' scenario. The increase in electricity from the electrification of heating as decarbonisation progresses is highly uncertain as it depends strongly on the overall uptake and mix of low carbon heating technologies, due to the significant variations in efficiency (e.g. heat pumps are 3-4 times more efficient than direct electric heating), and the level of energy efficiency measures carried out to reduce the overall heating demand. The projected increase in electricity demand in Stockport as a result of uptake of EVs is shown in Section 0.

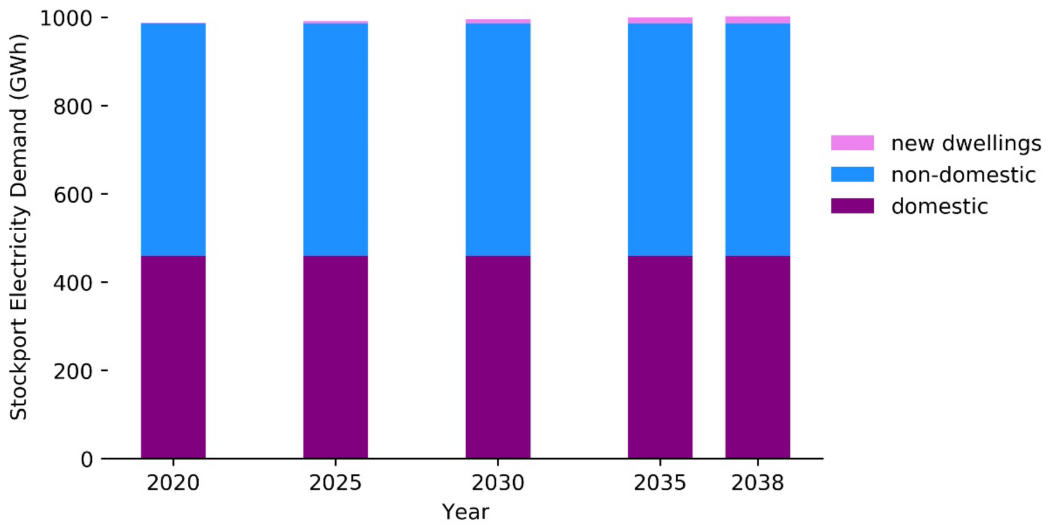


Figure 3.4: Projected electricity demand for Stockport from current buildings and new developments.

3.3 Stockport Existing Energy Demand Mapping

3.3.1 Information

The demand maps in the following section are shown for various areas within Stockport called Middle Super Output Areas, or MSOAs. MSOAs are used for various data gathering processes including census data, health, wealth and poverty levels, as well as energy consumption. MSOAs have a population of at least 5000, with an average of 7200, meaning the size of MSOAs is largely dependent on population density.[32]

Annual energy consumption for buildings is split up into four categories:

- Domestic electricity
- Non-domestic electricity
- Domestic gas
- Non-domestic gas.

In this report, 3 maps are shown for each annual energy consumption sectors:

[32] NHS: Middle Layer Super Output Area
https://www.datadictionary.nhs.uk/data_dictionary/nhs_business_definitions/m/middle_layer_super_output_area_de.asp?shownav=1

- Total consumption
  - shows the total energy consumption for that area.
- Total consumption per km2
  - shows the total energy consumption per square kilometre
  - accounts for the different area assigned to each MSOA
  - offers a means of studying the density of energy demand in an area.
- Mean consumption
  - shows the mean consumption per energy meter
  - accounts for the different number of properties per MSOA
  - offers a means of comparing the average energy demand of properties within different areas.

3.3.2 Domestic Electricity Demand

The domestic electricity demand for Stockport is shown in Figure 3.5. The patterns that emerge for domestic electricity data indicate

- High electricity demand in the region around Stepping Hill Hospital, a largely residential region
- A higher density of electricity consumption in the regions surrounding the town centre but also with high consumption around the Heatons and Reddish
  - these are the regions with a high density of domestic properties
- Mean energy consumption is largely in line with the UK average of 3800 kWh/year[33]
- Mean energy consumption is highest in the areas further away from the town centre such as Bramhall, Marple Bridge and the south west of the borough
  - these are the areas with larger properties and generally wealthier property owners.

It is likely that these maps overestimate the domestic consumption in the town centre areas due a number of small non-domestic properties being incorrectly assigned as domestic properties.

[33]Ovo Energy: How much electricity does a home use? https://www.ovoenergy.com/guides/energy-guides/how-much-electricity-does-a-home-use.html

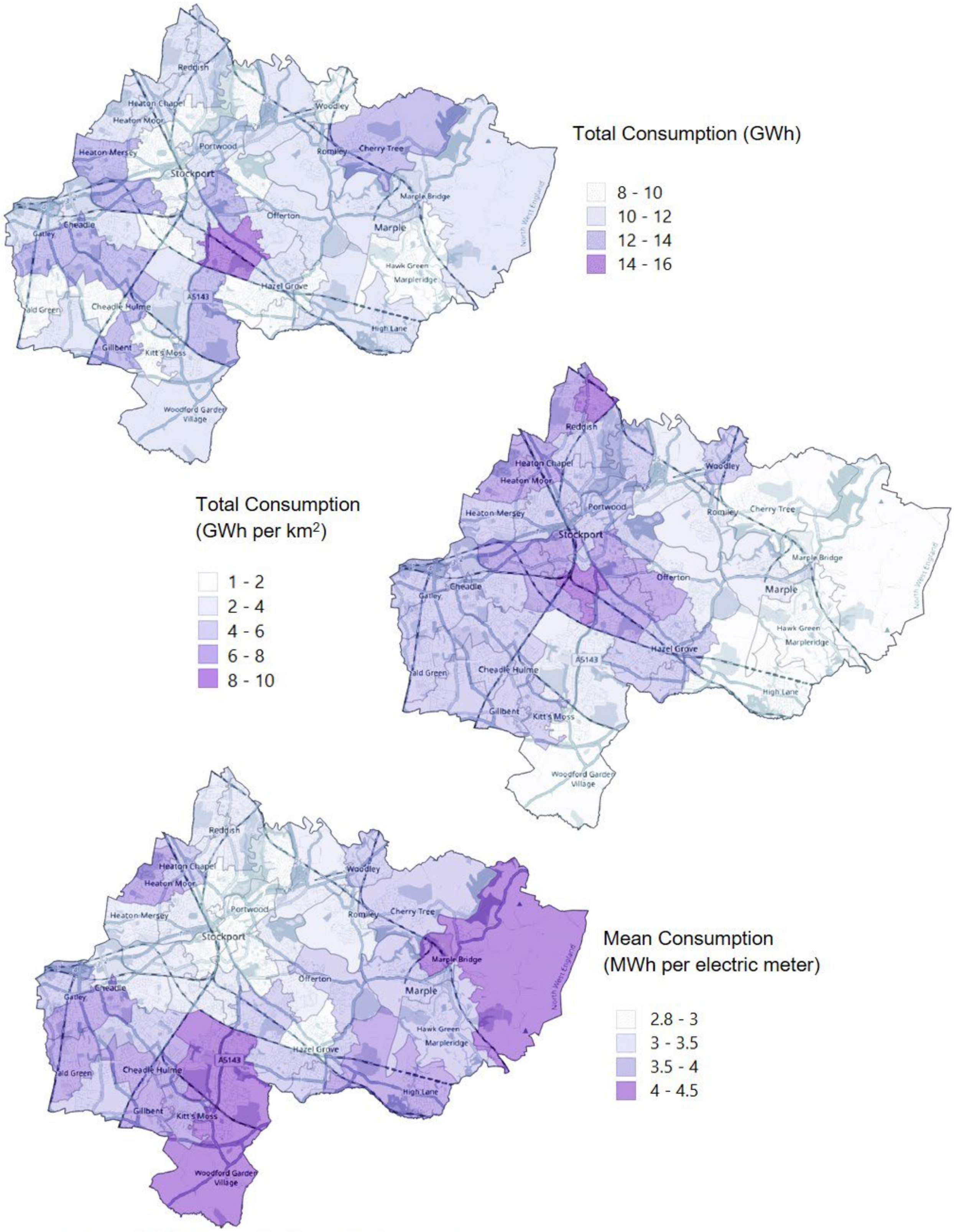


Figure 3.5: Domestic electricity demand.

3.3.3 Non-Domestic Electricity Demand

The non-domestic electricity demand for Stockport is shown in Figure 3.6.

- The non-domestic electricity demand shows concentrated demand around the town centre, as would be expected for the main commercial district.
- There is an additional region of high demand around Hazel Grove where there a shopping centre and a number of supermarkets.
- As with the domestic consumption, the mean consumption map shows a distinctly different picture.
- The map of mean consumption indicates that the more energy intensive non-domestic electricity users are located outside of the town centre.

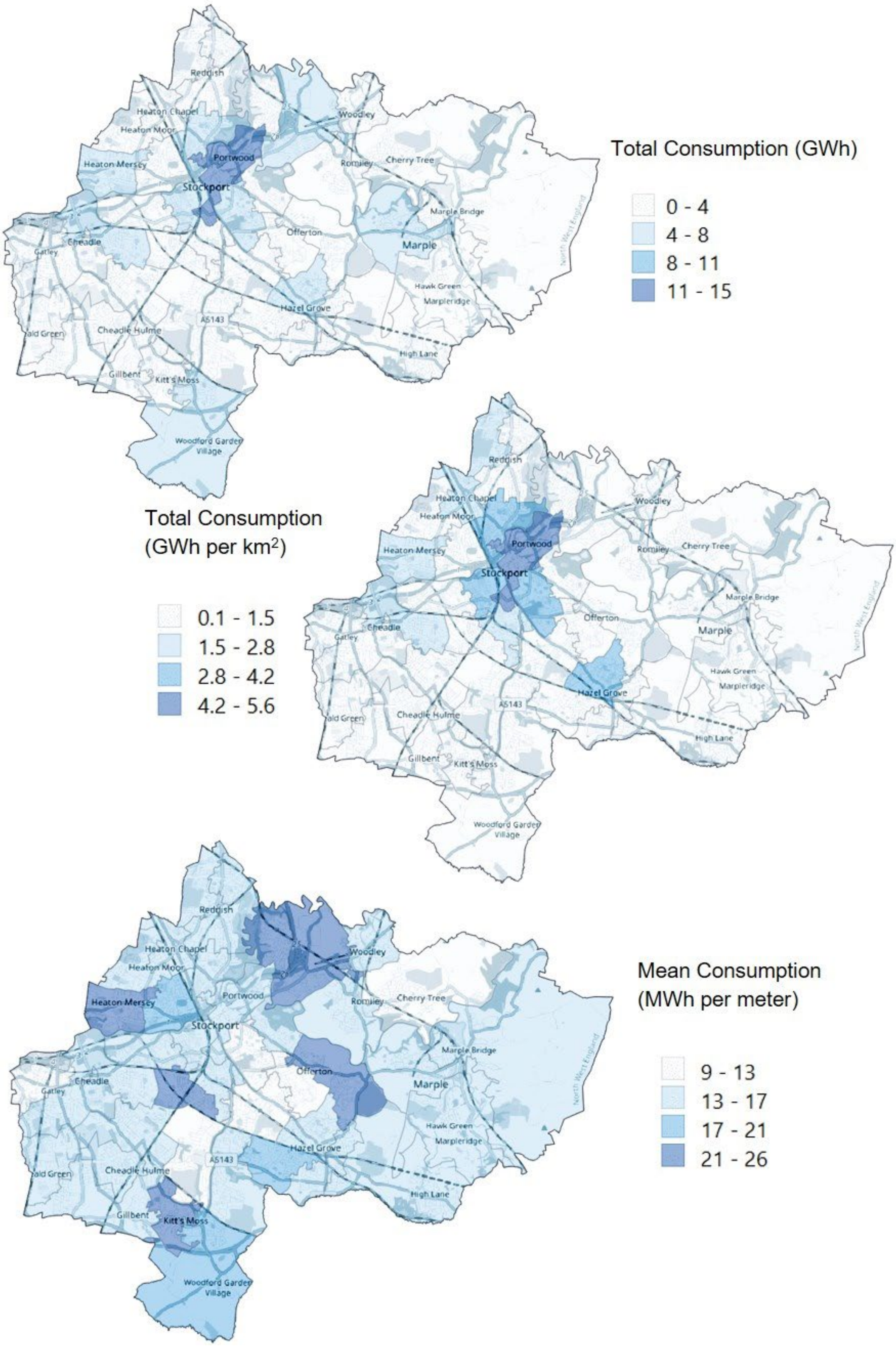


Figure 3.6 Non-domestic electricity demand

3.3.4 Domestic Gas Demand

Figure 3.7 shows the domestic gas demand for Stockport MSOAs. Gas demand is primarily associated with space heating and hot water with a very small portion of demand being used for cooking.

- Total domestic gas demand shows the residential gas demand spread across Stockport
- The more commercial regions around the town centre are particularly low as would be expected for a region with a low proportion of residential buildings.
- The areas of Portwood and Brinnington also have noticeably low demand, the same regions that have the lowest average household incomes in Stockport.

The correlation observed between household income and total gas demand is expected to have three contributing factors in Stockport:

- Lower income households have less to spend on heating
- Social housing is typically better insulated that the housing stock in general
- Stockport Homes, the organisation that manage Stockport Council's housing stock, has 433 off-gas properties.

Stockport Homes has recently upgraded the district heating network within the tower blocks that they manage to run off biomass with a gas back-up. Stockport Homes district heating systems:

- Run off 7 biomass generators (gas back-up)
- Serve 22 tower blocks across 7 sites
- Heats 2,174 properties
- Has a 4.3 MW generation capacity.

The map in Figure 3.8 shows the number of properties not connected to the gas grid for each MSOA. As Stockport Homes is known to manage a portion of Stockport's off-gas properties, residential land managed by Stockport Homes is overlaid on the map. In addition to district heating, Stockport Homes has retrofitted electric heat pumps into a number of properties which will account for another portion of off-gas properties. The main overlaps between Stockport Homes managed residences and areas with high numbers of off-gas properties is in the Brinnington area where there are a number of Stockport Homes managed tower blocks.

The figures show that Stockport has around 7800 dwellings not connected to the gas grid, 433 of which are Stockport Homes managed properties that use electric heating systems.[34] The high number of off-gas homes in the town centre and Portwood area could also be due to small businesses in the town centre that do not use gas being mislabelled as domestic due to low usage.

[34] All electric heating systems in dwellings managed by Stockport Homes are in programmes to be removed over the next 18 months. Of the 433, 241 of these are being converted using funding from the European Regional Development Fund.

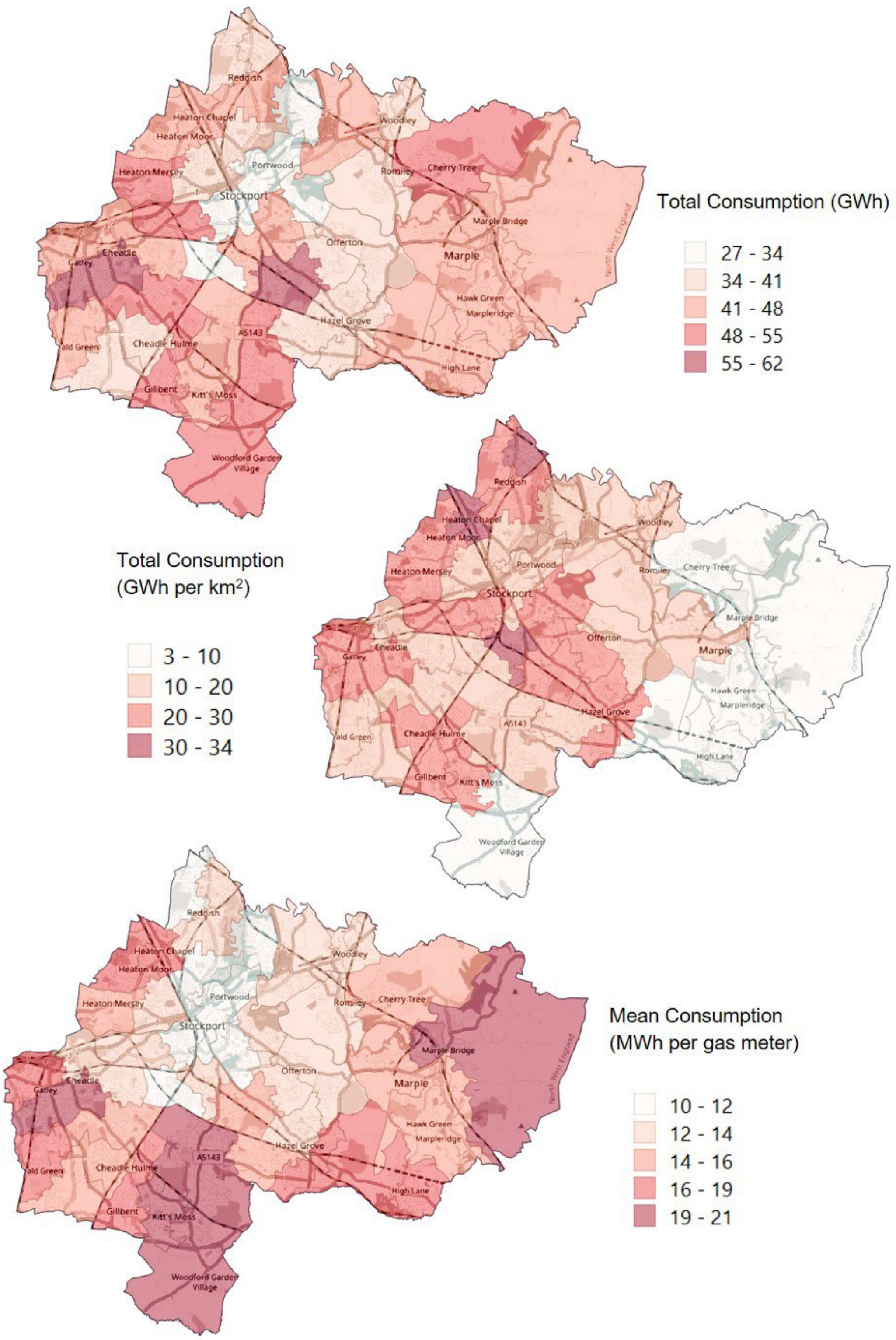


Figure 3.7 Domestic gas demand

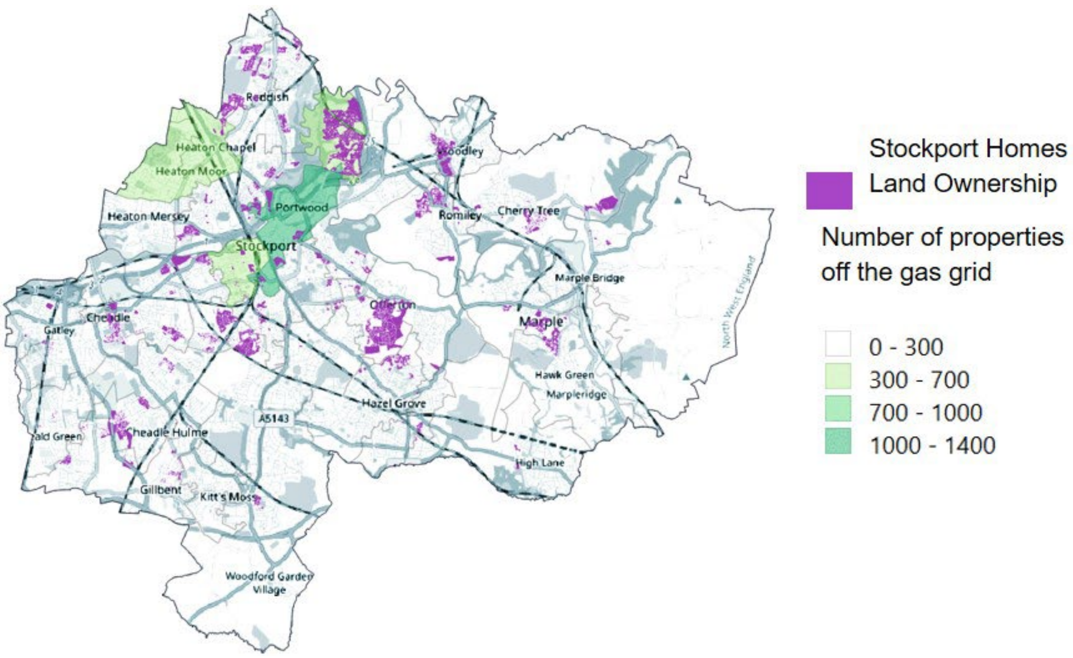


Figure 3.8: Number of properties off the gas grid. The map is overlaid with Stockport Homes properties in purple.

Domestic Gas Demand Density

The areas of higher demand density (middle figure of figure 3.7) largely overlaps with the designated urban area of Stockport shown in Figure 3.9. There are additional regions of urban area, such as Marple, that have a very low consumption density due to the demand being averaged over a large rural area. The gas demand density highlights the regions of highest domestic demand density are around Heaton Chapel and Heaton Moor, Reddish and the region around Davenport to the south of the town centre. The areas of high domestic gas demand have averages across the MSOA in excess of 30 GWh/km^2, which is promising for district heating. Requirements for district heating will be discussed further in section 0.

Mean Domestic Gas Demand

The mean gas demand, the bottom image in Figure 3.7 shows the average gas consumption per domestic meter. The distribution observed here is very similar to that for mean electricity consumption with the wealthiest areas showing highest demand. Wealthier areas are more inclined to have larger homes, more likely to be detached homes and can better afford to heat their homes.

Another contributing factor is that the most easterly MSOA, that which includes Marple, has the lowest portion of EPC band A-C houses of any area in Greater Manchester. Figure 3.10 shows the housing conservation areas in Stockport, with buildings of historical or architectural interest, on top of the mean domestic gas demand. Historic homes are typically much less energy efficient than modern homes and significantly more difficult to retrofit to higher energy-efficiency standards. It is therefore unsurprising that the areas with more conservation areas have higher average heat demand per property. Historic buildings and those in conservation areas are likely to be some of the most difficult homes to decarbonise but that does not mean improvements and changes cannot be made.

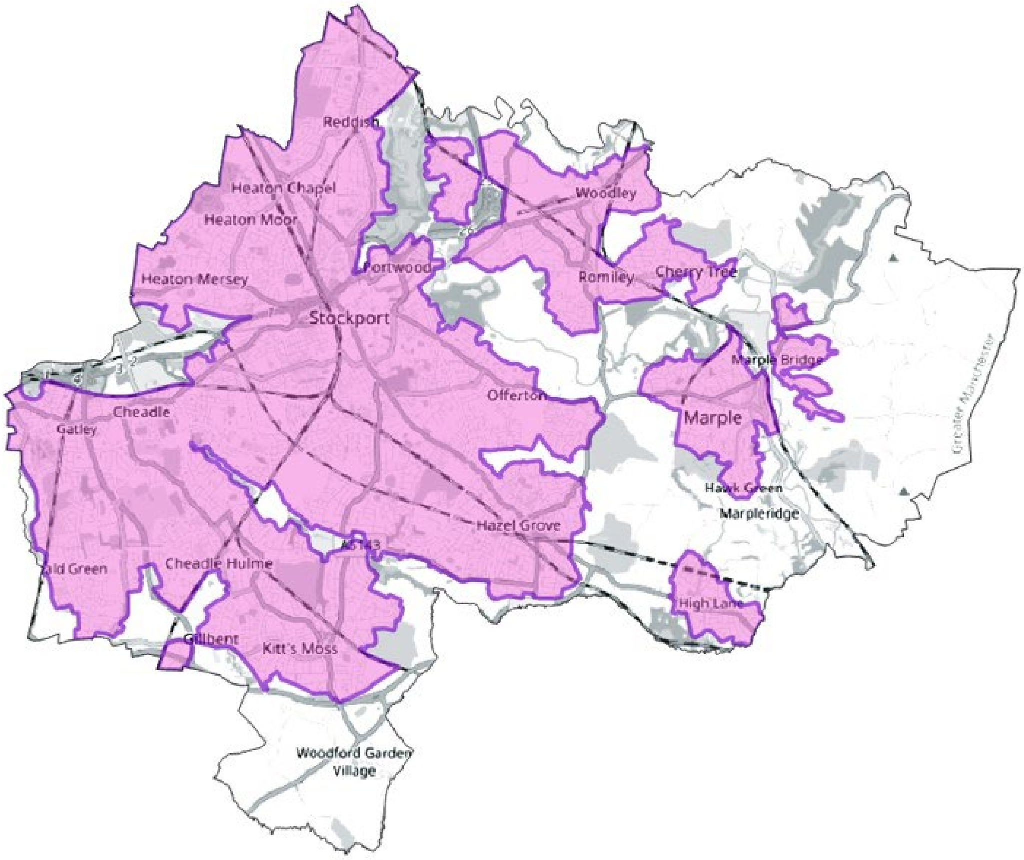


Figure 3.9: Stockport urban area.

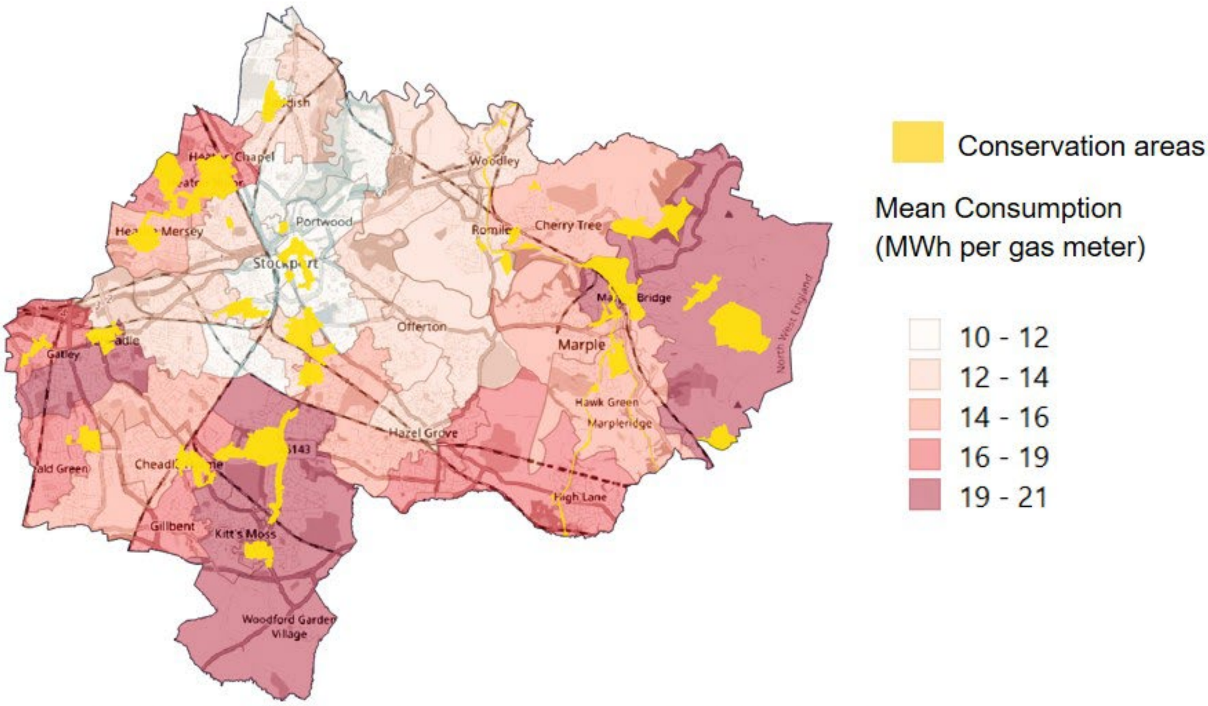


Figure 3.10: Mean domestic gas demand overlaid with conservation areas.

3.3.5 Non-Domestic Heat Demand

The non-domestic gas demand distribution is shown in Figure 3.11. As with non-domestic electricity demand, non-domestic gas demand is concentrated around the town centre.

- Where domestic gas demand was spread across the borough, non-domestic gas demand is very localised on a few areas around Stockport.
- The region around Bredbury has the highest non-domestic gas consumption, which is likely to be a result of the Bredbury Park Industrial Estate.
- Noticeably, the area around Heaton Moor and Heaton Chapel has high non-domestic gas consumption; it was also the region of highest domestic gas consumption. There are areas of employment and retail peppered throughout these areas.
- The distribution of mean energy demand is again similar to the non-domestic electricity demand in having discrete areas of higher demand
- The region around Heaton Moor and Heaton Chapel particularly has the highest non-domestic gas consumption at just below 40 GWh/km^2.

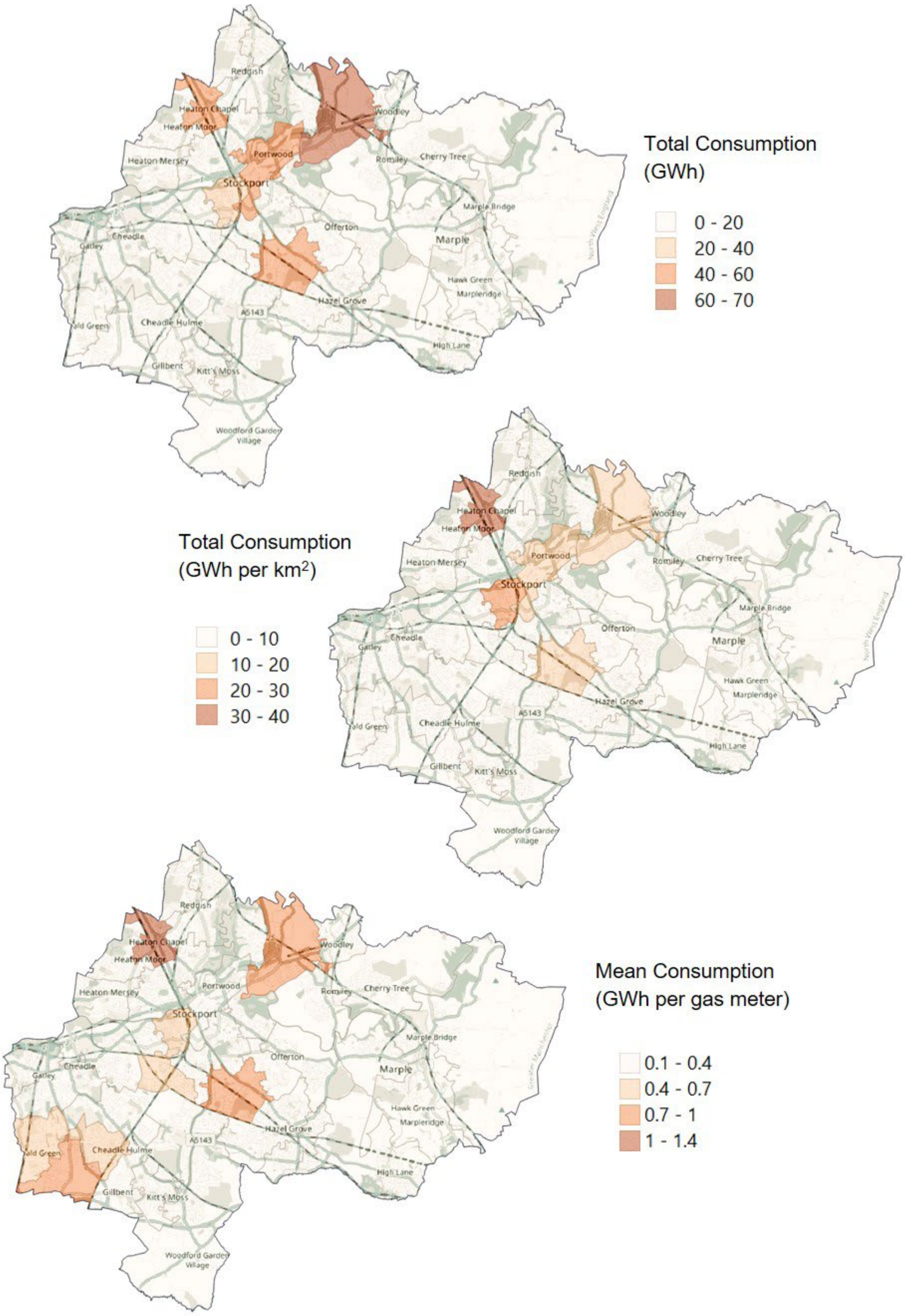


Figure 3.11: Non-domestic gas demand.

3.3.6 Total Gas Demand

In Figure 3.12, the total gas demand from domestic and non-domestic consumers is shown. The areas outside the urban area show the lowest demand density. As the area around Heaton Moor and Heaton Chapel had been amongst the highest domestic and non-domestic demand, the area has significantly higher total gas demand than any other area with a total gas demand density across the area in excess of 70 GWh/km^2. The other areas with particularly high demand are those to the west and south of the town centre and Reddish, all with total gas demand density over 30 GWh/km^2. These areas of highest total heat demand density are of particular interest as district heating is most effective when it supplies heating to both domestic and non-domestic sources to spread heat demand across the day.

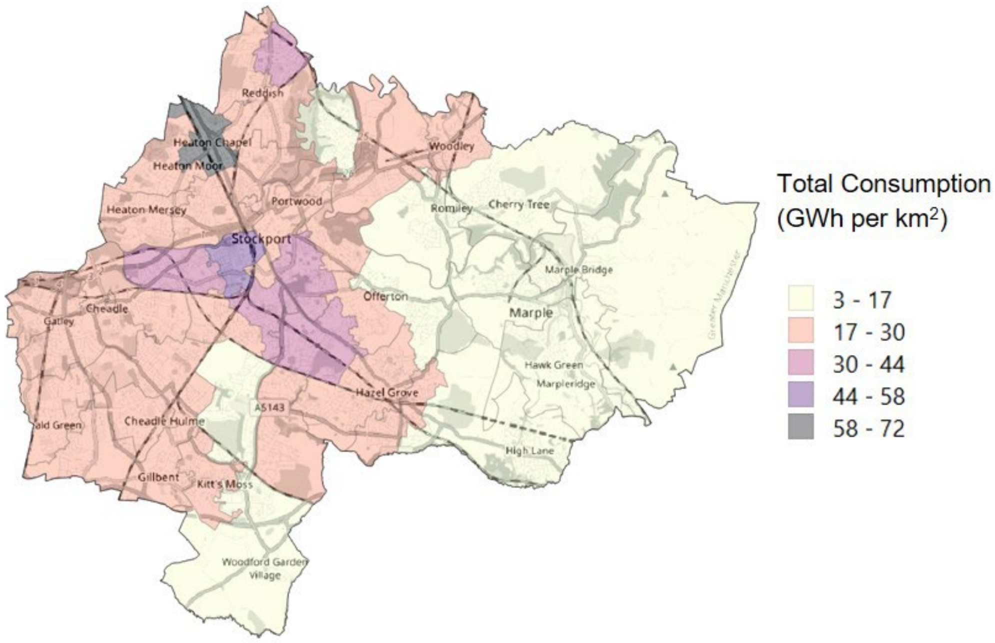


Figure 3.12: Total gas demand from domestic and non-domestic users.

3.4 Technology Feasibility Mapping in Stockport

Stockport Council owns a significant number of sites within Stockport, shown in Figure 3.13. Different sites have potential for different renewable energy and heat generation technologies

- Buildings
  - Roof mounted solar PV and solar thermal
  - Air-source heat pumps
- Open land
  - Ground-mounted solar PV
  - Wind turbines
  - Anaerobic digestion facilities
  - Ground-source heat pumps
  - Biomass generators
- Agricultural land
  - Anaerobic digestion
  - Ground-source heat pumps.

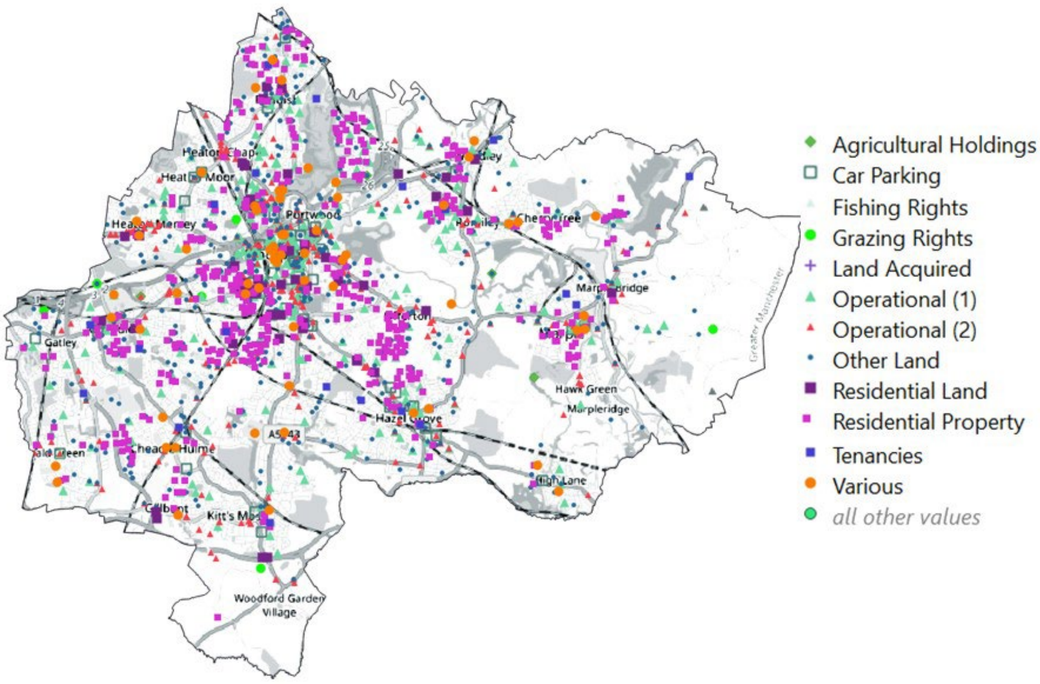


Figure 3.13: Sites in Stockport owned by Stockport Metropolitan Borough Council.

3.4.1 District Heating

To investigate the possibility of district heating, it is useful to know:

- the level of heat demand on a resolution smaller than MSOA level
- the mix of energy demand in a given region (beneficial for district heating to serve a range of building uses to spread demand over the day)
- any potential barriers such as roads, railways and waterways between demand centres and production sites
- possible generation sites (availability, suitability, land ownership etc).

BEIS compiles postcode level data for domestic gas consumption but not non-domestic gas consumption. The postcode level data for domestic consumption is shown as a heat map in the upper figure in figure 3.14 while the lower figure shows the ratio of domestic to non-domestic consumption to investigate which areas have a favourable mix of domestic and non-domestic heat demand. **The regions with the highest portion of non-domestic demand are those around the town centre, close to the regions identified in the heat map of high domestic gas demand.**

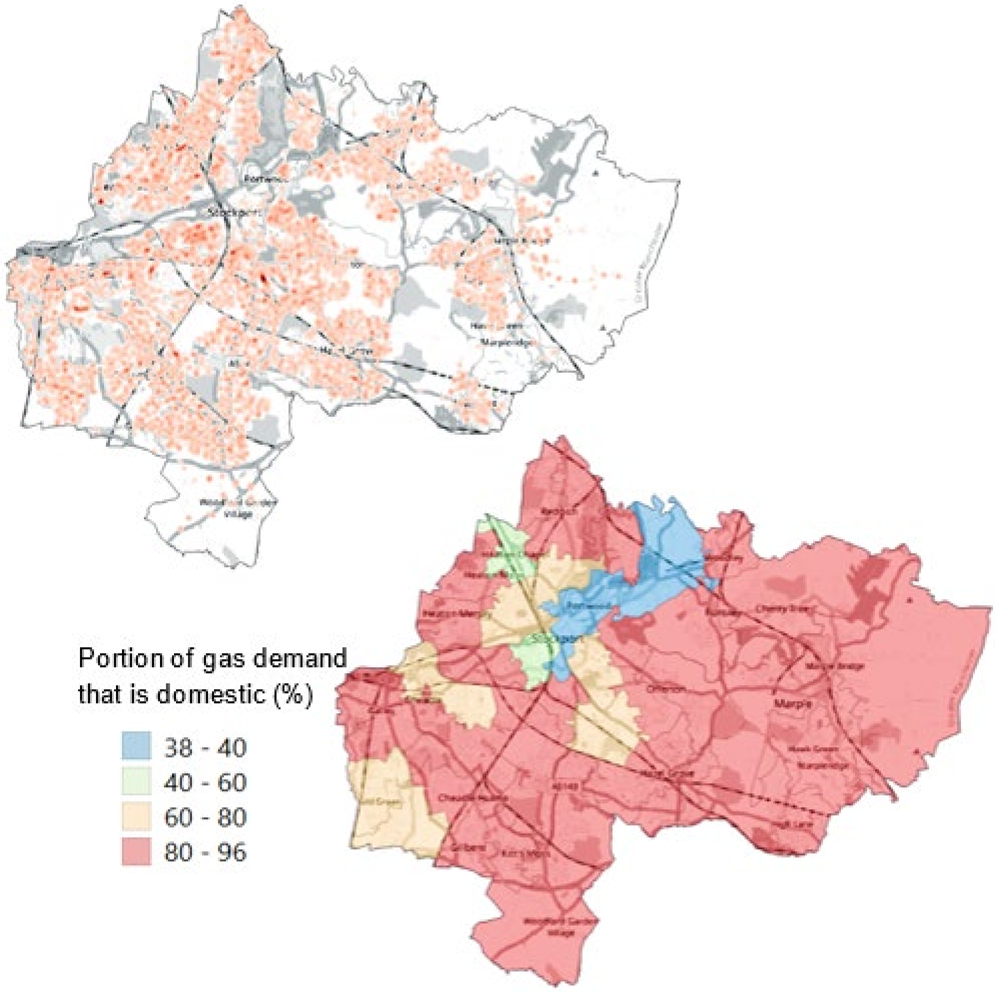


Figure 3.14: Upper figure shows a heatmap of domestic gas demand at postcode level. Lower figure shows the percentage of the total gas demand that is domestic, highlighting the regions with a high portion of non-domestic users.

Unfortunately, the area around the town centre is the region with the highest density of obstructions for district heating such as roads, railways and the river shown in Figure 3.15. District heating systems distribute hot water or steam through pipes that connect a series of buildings within a close geographic area. **Roads, rivers and railways pose an issue for district heating as it is difficult to get piping across them with the insulation required to keep the pipes hot**. While obstacles are present in Stockport town centre, they do not necessarily preclude development of district heating which can be designed around obstacles especially in areas of new development. The potential to connect existing buildings to any new district heating schemes will need to consider these obstructions into order to fully assess the viability.

Figure 3.15: Map of Stockport showing obstructions for district heating including roads, railways and waterways.

In Figure 3.16, an area on the edge of the town centre is shown that would be a potential candidate for district heating. Edgeley lies immediately to the west of Stockport railway station and has a high domestic heat demand, a mix of domestic and non-domestic heat demand, several large potential users (anchor loads), a mix of Council owned land and is free of major obstacles. These requirements are the basic requirements for a local district heating network to be feasible.

Possible anchor loads in this area include:

- Stockport Academy
- Avondale Leisure Centre (linked to academy)
- Morrisons and Homebase stores are just left of this map.

The area to the east of the train station, that includes several Council buildings, was the focus of a GM **2013 Heat Network feasibility study that included Stockport** as well as other areas of Greater Manchester. **The study indicated that there was not a strong commercial case for a district heating network in that area of Stockport on a small scale or a large scale at that time.** The proposed scheme was based on a combined heat and power (CHP) plant powered by a combination of biomass and gas. The idea of using gas, and even now biomass, CHP to power district heating schemes is an idea that is losing ground in favour of using electric heating options to provide the heat for district schemes.[35] For large scale systems, ground-source heat pumps can be a particularly economical and low-carbon option. **Heat pumps were discounted in the previous study on the basis that they were not predicted to reduce carbon emissions based on the carbon intensity of the grid at the time**. In the past decade, however, the UK

[35] Setting up district heating schemes that initially run on gas (or preferably biomass) can still be a means of reducing emissions as the system benefits from economies of scale reducing energy demand and associated emissions. Additionally, moving a district heating scheme to low-carbon energy sources, such as ground-source heat pump, requires less intrusive retrofitting than fitting heat pumps to individual properties.

electricity grid has rapidly decarbonised and is set to continue meaning that **heat pumps now have considerably lower carbon emissions that gas.**

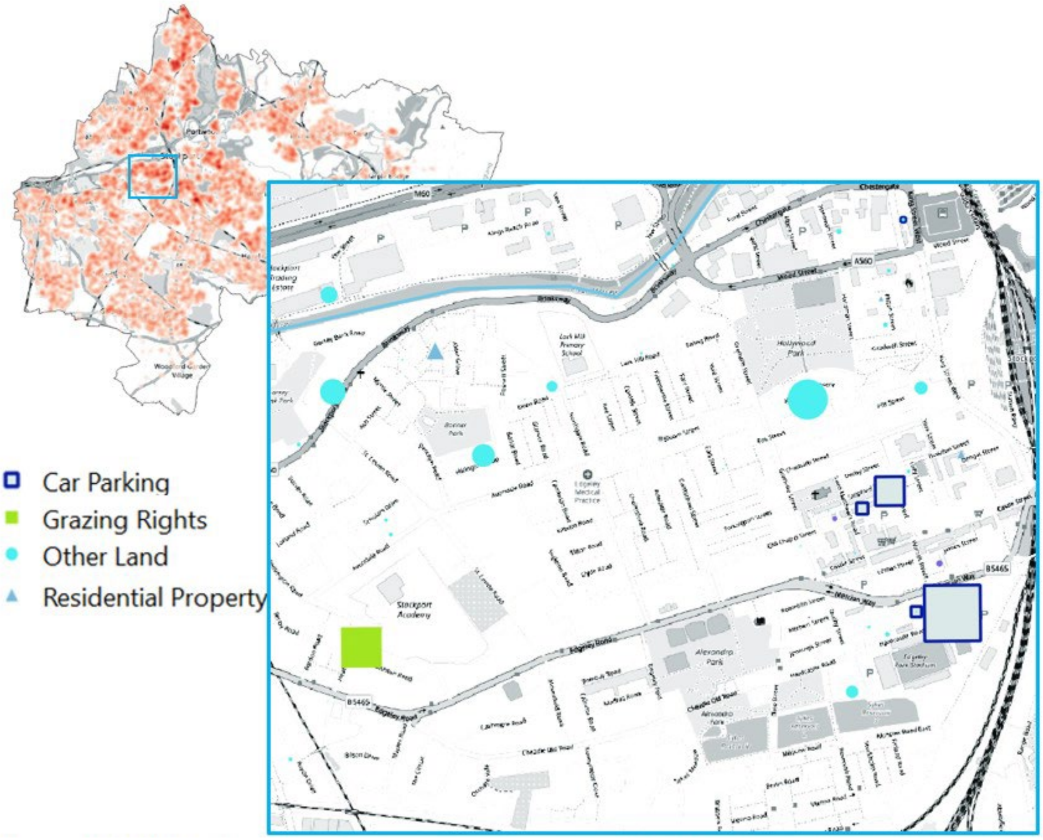


Figure 3.16: District heating opportunity area with a high heat demand density, a mix of domestic and non-domestic demand.

3.4.2 Solar

Solar **energy has been the easiest form of renewable energy to implement in Stockport with over** 4000 solar PV installations in the borough.[36] Figure 3.17 shows the energy output expected for solar PV panels across the UK, Stockport and Greater Manchester are shown on that map but the location variations (i.e. across Stockport) are too small to be meaningful. The Greater Manchester region is fairly average for the UK with the south of England being the highest and the Highlands the lowest along with the high regions of England and Wales.

Stockport Council is part of a Greater Manchester Combined Authority scheme currently undertaking a feasibility study of all council owned land to assess the capacity for solar and storage. The Council has provided a list of Council owned land that is used for various purposes as described in the legend of Figure 3.18. As can be seen from the figure, Stockport Council owns a large number of sites within Stockport. The solar capacity of these sites will depend on the current use, the lease type that the Council has on the land and the area of the land.

[36] BEIS: Renewable Energy Statistics https://www.gov.uk/government/statistics/regional-renewable-statistics

Figure 3.17: Predicted output from solar photovoltaics across the UK. The outlines of Greater Manchester and Stockport are shown in white.

A volunteer organisation called Greater Manchester Community Renewables has 9 solar PV projects on school roofs in Greater Manchester, most of which are in Salford**. Schools are attractive locations for community PV projects as they have high daytime usage.** Daytime usage means that schools can use a lot of the energy generated from the panels, which is more economical than feeding into the grid. Schools are centres of the community and local residents are often happy to invest in a project that benefits the local school. Additionally, PV on schools in an excellent educational tool for engaging children, and the wider community, in sustainability and normalising renewable energy. The locations of Council owned schools in Stockport are shown in Figure 3.19.

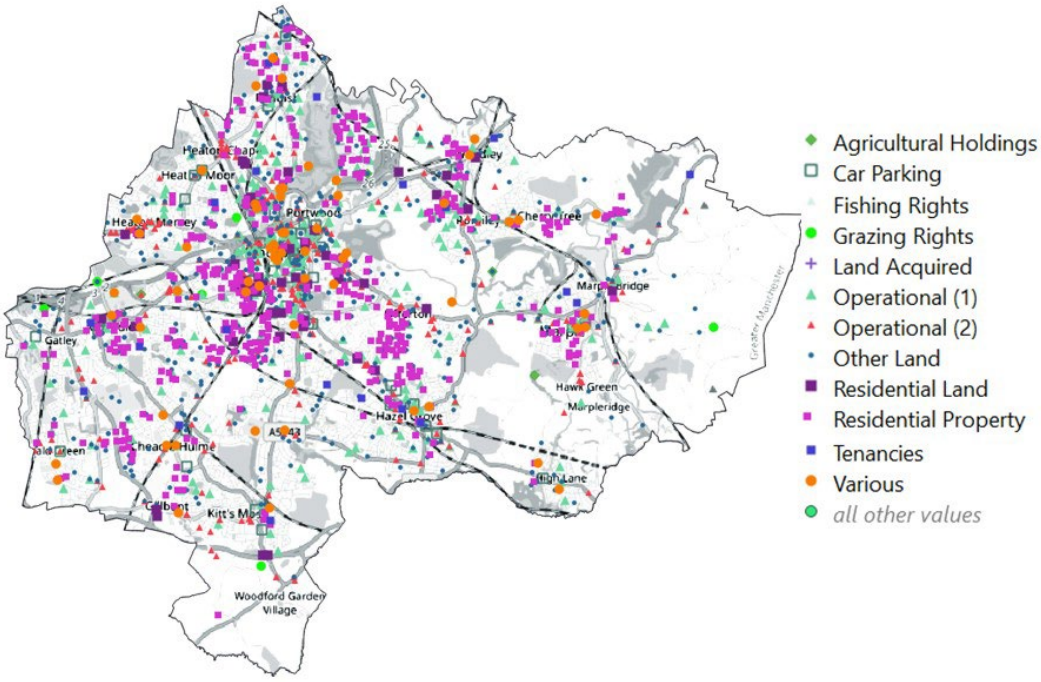


Figure 3.18: Land in Stockport owned by Stockport Metropolitan Borough Council.

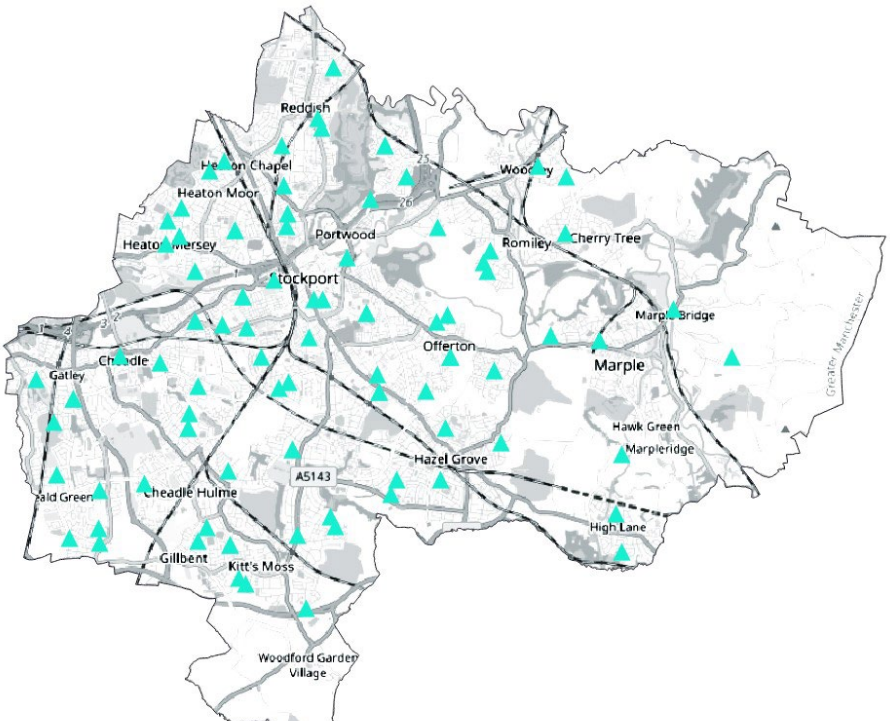


Figure 3.19: Schools owned by Stockport Council.

3.4.3 Wind

Stockport

Average annual windspeeds across Stockport vary between 4 meters per second (m/s) and 6 meters per second (around 10-20 mph) at heights of 10 m, as shown in Figure 3.20. The data for these maps comes from the UK Met Office.[37]

Utility scale wind farms require annual average windspeeds of at least 6 m/s.[38] **In Stockport, windspeeds reach a 6 m/s annual average in the far east of the borough** at heights of 10 m.[39] At heights of 25 m, windspeeds of 6 m/s are still only found in the west of the borough but covering more area including around the village of Mellor.

Small wind turbines require lower windspeeds than utility scale turbines to be viable, only 4 m/s.[39] **The vast majority of the Stockport area has windspeeds in excess of 4 m/s** at heights of 10 m, such that there could be areas feasible for small scale wind generation across the borough. Wind speed varies locally according to topography and obstacles, such as buildings and trees. These variations mean that sites should be assessed on a site by site basis.

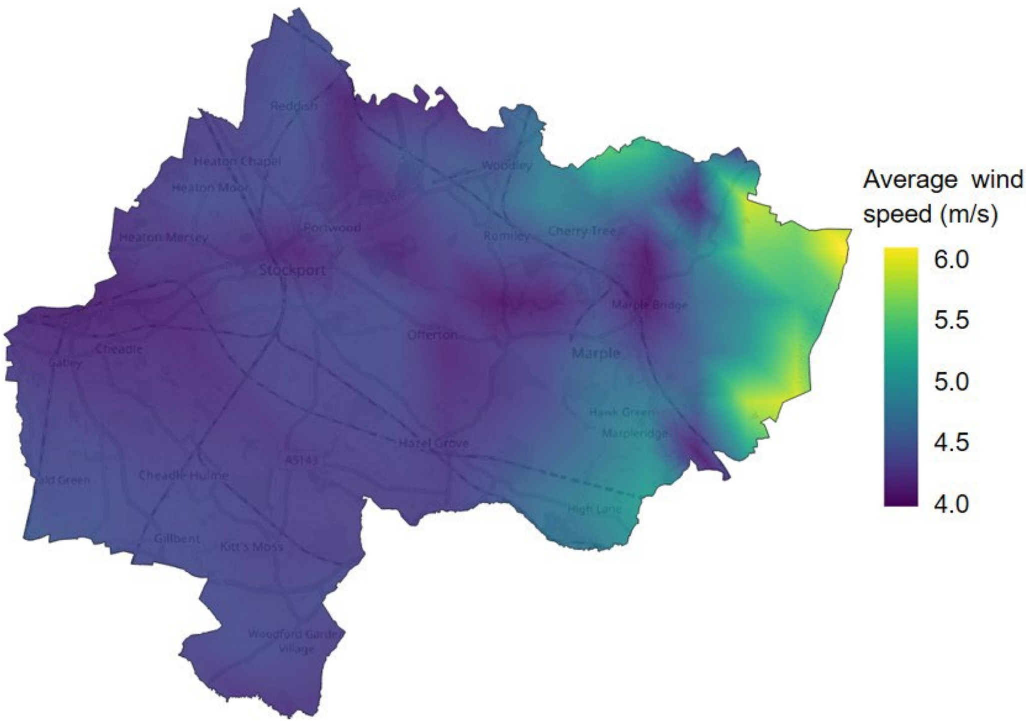


Figure 3.20: Average annual wind speed map of Stockport at a height of 10 m.[37]

It is unsurprising that the **highest windspeeds are to be found in the east of the borough** as the land rises towards the Peak District National Park. The National Park itself does not object to wind turbines (subject to appropriate planning processes) and have agreed that there are no specific protected views out of the National Park. However, multiple planning applications have been refused around the Peak District National Park, as a result of local objections on the grounds of proposals being in the green belt and local visual impacts.

[37] UK Met Office: Datasets https://www.metoffice.gov.uk/research/climate/maps-and-data/data/haduk-grid/datasets
[38] Culture Change: Wind http://www.culturechange.org/wind.htm
[39] RenSMART https://www.rensmart.com/Maps#NOABL

Objections to wind turbines in the green belt are in line with the National Planning Policy Framework (NPPF) guidelines on renewable energy projects in the green belt.[40] However, national surveys show that attitudes towards wind energy are changing,[41] and the NPPF recognises that special circumstances for allowing use of land in the green belt *"may include the wider environmental benefits associated with increased production of energy from renewable sources".* The Stockport Landscape Character Area Study 2018 provides analysis of the impact of wind turbines in Stockport.[42] Although the analysis is carried out specifically for medium-scale turbines (75 m), his study has to be taken into account for all wind energy developments in the borough.

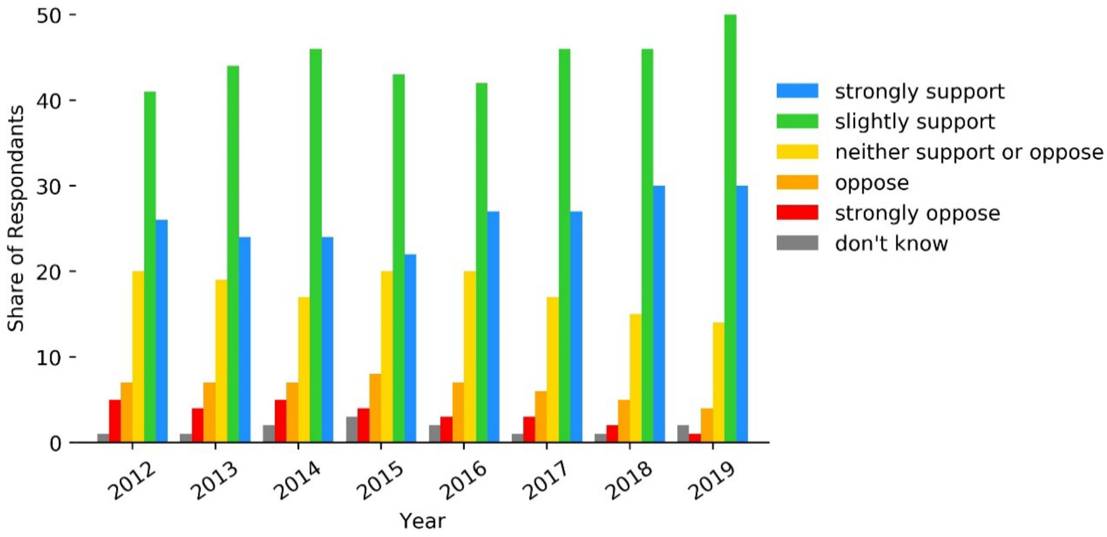


Figure 3.21: UK attitudes to onshore wind renewable energy developments.[41]

Greater Manchester

Wind farms around Greater Manchester are generally found in the rural areas to the north of Rochdale rather than in the Greater Manchester region itself. In the Greater Manchester Spatial Energy Plan, potential wind deployment areas were identified across Greater Manchester.[43] The most promising regions were largely concentrated in Wigan, the west of Salford and Trafford with areas identified for large scale wind farms in Oldham and the east of Tameside. The study covered certain regions of Greater Manchester but Stockport was not examined. Figure 3.22 shows the windspeeds across Greater Manchester on the same scale as that shown for Stockport in Figure 3.20, the majority of Stockport is largely similar to that of Greater Manchester confirming that windspeeds in Stockport could support renewable energy generation from wind turbines.

[40] Revised National Planning Policy Framework paragraph 147 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf
[41] Statistica: UK Attitudes to Onshore Wind Energy https://www.statista.com/statistics/425029/united-kingdom-uk-attitudes-towards-onshore-wind/
[42] Stockport Landscape Character Assessment and Landscape Sensitivity Study https://s3-eu-west-1.amazonaws.com/live-iag-static-assets/pdf/LDF/Evidence/Stockport+Landscape+Character+Assessment+2018.pdf
[43] Greater Manchester Spatial Energy Plan : Evidence Base Study, Figure 5-5 Potential wind deployment areas.

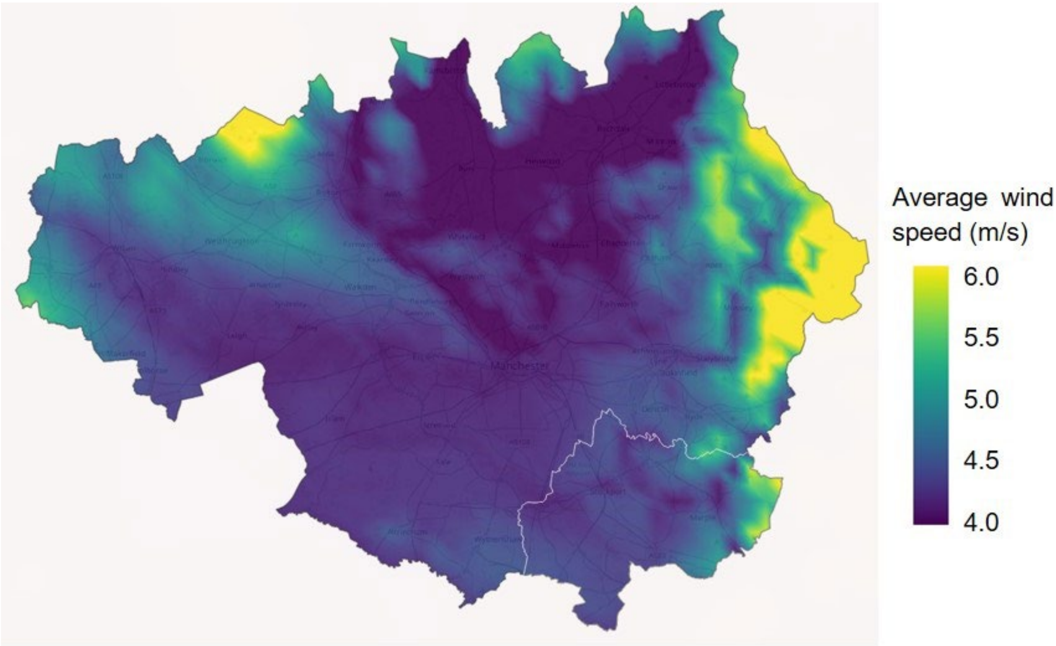


Figure 3.22: Average annual wind speed map of Greater Manchester.

Stockport Council Owned Land

The list of Council owned land put together by Stockport Council lists land, land area and current land use; one of the land use categories is 'common grazing land'. Such land has been used elsewhere for wind farms though objections have been raised if this land is actively used for grazing rights or serves some other local purpose. Objections to one application for a wind farm on common land were made on the basis that common land should be for common projects and locals were against the idea of the site being developed by a commercial developer. Such sites would be more likely to gain approval for community energy projects.

In Figure 3.23, a series of maps is shown for the Council owned communal grazing land in Stockport with the inclusion of several potential restrictions:

- Manchester Airport air safety zone
- Designated urban area
- Conservation areas
- Landscape Character Areas
- Greenbelt
- Flood zones.

Flood zones would not be considered an issue in themselves for wind energy but flood zones occur in low lying land that is less likely to be suitable for wind power generation.

As can be seen from Figure 3.23, landscape character areas and the green belt cover the same areas. Between greenbelt restrictions and restrictions based on wind turbines in the urban area, **none of the Council owned common grazing land sites are free of restrictions** despite only the two sites in the west of the borough being unlikely candidates on practical grounds.

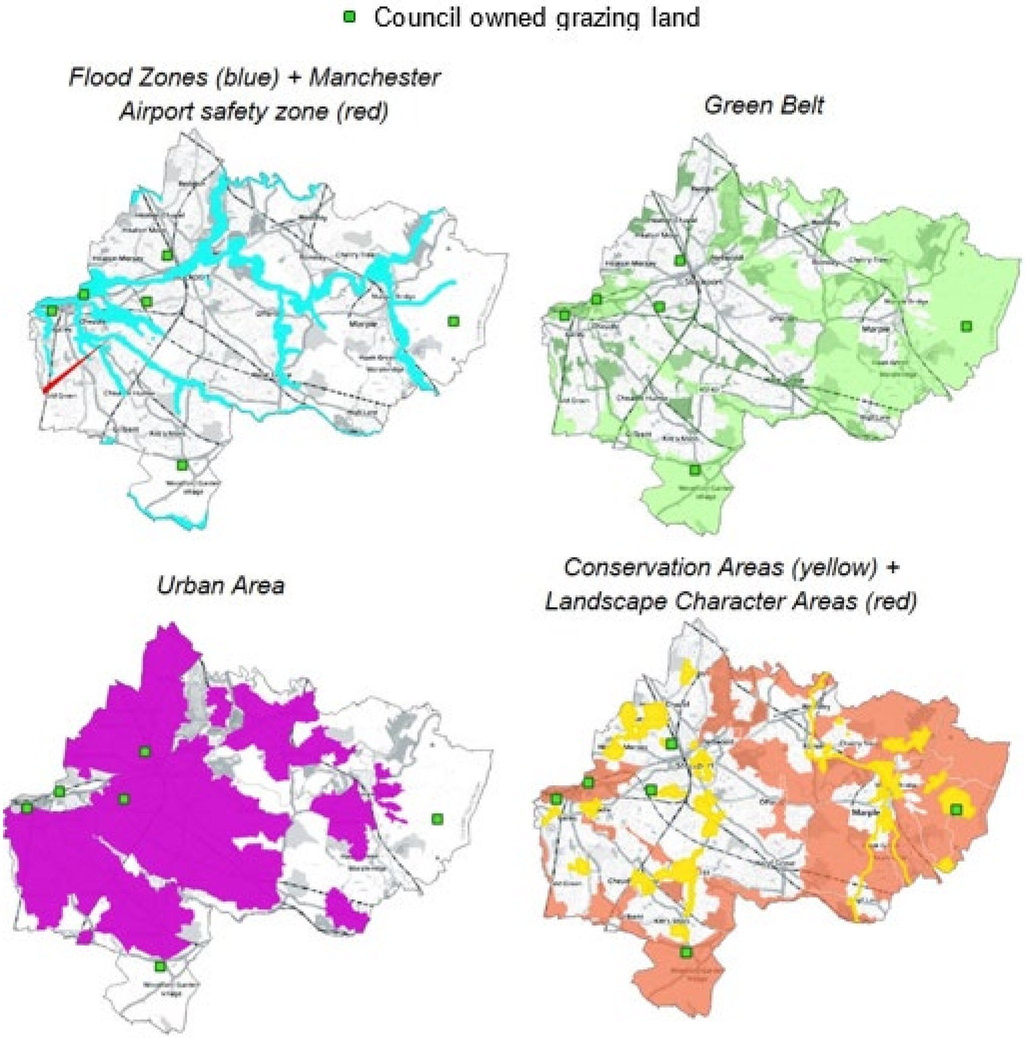


Figure 3.23: Local barriers to wind energy in Stockport on Council owned public grazing land.

4. Grid Constraints and Mitigation

Grid constraints refer to the case when the grid infrastructure that distributes power to electricity end users is at capacity and cannot accommodate an increase in demand and/or generation. Grid constraints are an issue that should be considered for grid supply points, bulk supply points, primary substations, and secondary substations, as well as the cables (also known as feeders) that connect these substations. In most cases, grid supply points connect to the transmission network, and step the voltage down to 132 kV. This is then stepped down further by bulk supply points and then primary substations, with an output voltage of 11 kV. This 11 kV electricity is then stepped down to 240 V at secondary substations for distribution to domestic customers.

4.1 Predicting grid constraints

Predicting grid constraints is not straightforward. Current electricity demand data is available to DNOs at and above primary substation level, however this data is not available at secondary substation level (as the monitoring equipment is expensive). Additionally, this data alone is not sufficient to predict the likelihood of future grid constraints; forecasts of future electricity demand must also be produced. Electricity North West Ltd (ENWL) is the distribution network operator (DNO) that manages the electricity distribution network in Stockport. **It is incumbent on Electricity North West to forecast future network loads, and hence to analyse where and when constraints are expected**, so that network reinforcement or mitigation strategies for constraints can be costed and implemented in a timely fashion.

Prediction of where and when grid constraints are likely to occur is informed by analysis of current electricity distribution network data along with modelling of uptake of technologies expected to have a large effect on loads on the network. These technologies include not only electric vehicles (EVs) and heat pumps, which are sources of increased electricity demand, but also distributed generation, such as photovoltaic installations,, which lead to additional electricity supply. ENWL work with Element Energy to perform advanced modelling to generate scenarios for uptake of these new technologies and where they will be connected on the distribution network.

The case of network demand from EVs is particularly challenging to forecast. Assets such as distributed generation or heat pumps will connect to a single substation, however a single EV is likely to charge in multiple locations (e.g. at home, at work, or at public charge points), so electricity demand from charging the vehicle will be distributed across multiple substations. The Reflect project is a network innovation allowance project funded by Ofgem and led by ENWL, which focuses on forecasting EV charging demand. An overview of the project objectives and scope is given in Figure 4.1.

For all electric vehicle charging points (EVCPs), both public and private, customers must either apply for a connection to the DNO or, in the case of small domestic chargers, connect and notify the DNO.[44] For installation of rapid or high capacity chargers the DNO is responsible for determining if network reinforcement is necessary and costing the required reinforcement, known as the connection cost. If reinforcement is required, the customer installing the charging point is liable to pay these connection costs. DNOs therefore have good visibility over where charging infrastructure will be installed in the short term; however, forecasting future locations where charging infrastructure could be installed and planning to ensure sufficient network capacity at these locations is a challenge.

[44] More information on the connection process for EVCPs to the ENWL managed distribution network is available here

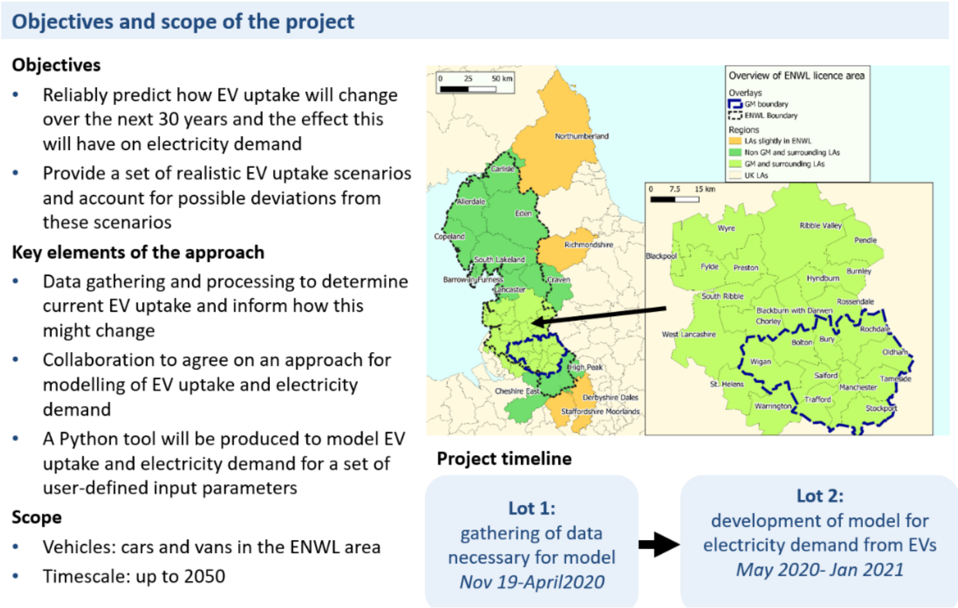


Figure 4.1: Overview of the Reflect project – led by Electricity North West Limited and funded by Ofgem.

4.2 Electric Vehicle Demands and Opportunities

4.2.1 Current and projected EV uptake

The current EV uptake in Stockport is 0.42% (of car and van stock), which compares to 0.63% nationally and 0.32% in Greater Manchester. Based on these figures, future EV uptake in Stockport is expected to lag slightly behind national level uptake but be slightly ahead of the rest of Greater Manchester. However, as EV uptake is currently so low, this is likely to be a small effect. EV uptake forecasts were produced for ENWL's Reflect project using a dedicated uptake modelling tool.[45] A summary of the policy inputs assumed for the five scenarios produced is shown in Table 1. By 2030, EV uptake for the whole of Stockport is projected to increase to at least 23% (in the 'Medium' scenario) and at most 43% (in the 'Maximum BEV[46] Uptake' scenario) in 2030.

Figure 4.2 shows the projected distribution of EV cars and vans across middle layer super output areas (MSOAs) in Stockport for the ECCo 'High' scenario in 2030. The number of projected EVs in each MSOA varies from a minimum of 761 in Stockport 004, to a maximum of 1,911 in Stockport 027. There are many factors that could lead to this variation, including differences between MSOAs in population size, car ownership, and current EV uptake.

Electricity demand for charging EVs registered in Stockport is currently estimated to be less than 2 GWh.

[45] EV uptake forecasts were produced using Element Energy's Electric Car Consumer Model, ECCo. More information on ECCo is available here

[46] Battery Electric Vehicle

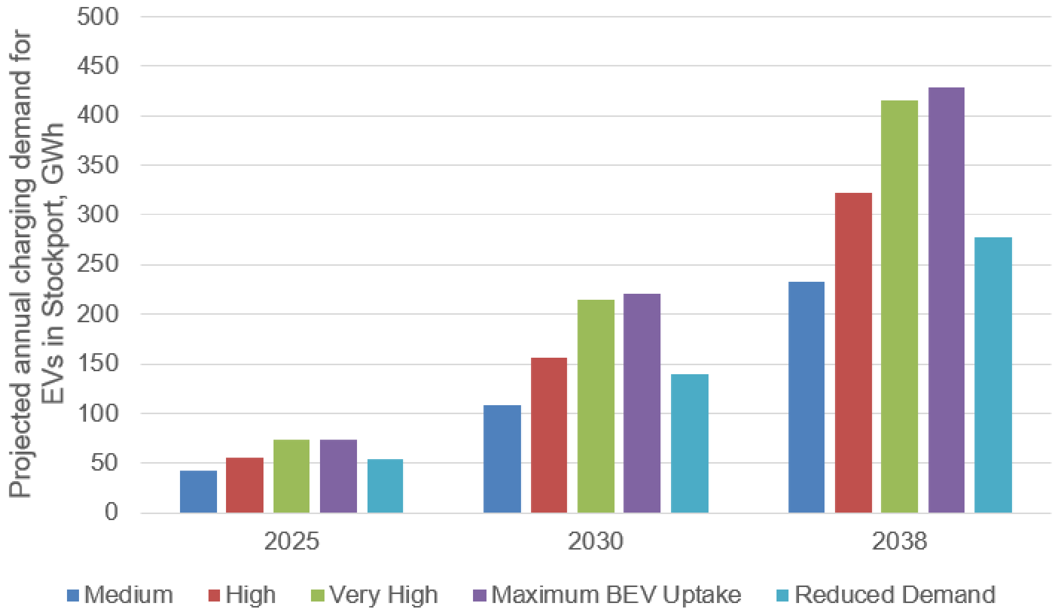


Figure 4.3 shows the projected annual electricity demand for charging EVs in Stockport in the years 2025, 2030, and 2038. By 2030, charging demand is predicted to increase to at least 108 GWh (in the 'Medium' scenario) and at most 220 GWh (in the 'Maximum BEV Uptake' scenario). This represents a large challenge in forecasting where network capacity upgrades will be needed, as the current level of EV uptake and charging infrastructure is so small compared to the level expected in only 10 years' time. The current demand distribution is therefore not necessarily representative of how demand will be distributed in the future.

Table 1: Summary of the policy inputs for the five ECCo scenarios used for the ENWL Reflect project

Scenario name	Description
Maximum BEV Uptake	Internal combustion engine, hybrid electric vehicle, and plug-in hybrid electric vehicle sales are banned in 2030. This exceeds the Committee on Climate Change's (CCC's) most ambitious recommendations and provides a very rapid uptake of battery electric vehicles (BEV).
Very High	Driven by new internal combustion engine and hybrid electric vehicle sales ban in 2030, with plug-in hybrid electric vehicle removed from sale in 2035. This reflects the CCC's more ambitious recommendations
High	Policies to achieve 70% ultra-low emissions vehicle sales in 2030 (upper bound of Road to Zero47 ambition) and 2035 ban on new internal combustion engine and hybrid electric vehicle sales (consistent with CCC's "at the latest" recommendation)
Medium	Policies to achieve 50% ultra-low emission vehicles sales in 2030 (lower bound of Road to Zero ambition) and 2040 ban on new internal combustion engine and hybrid electric vehicle sales
Reduced Demand	Same EV policy assumptions as for 'Maximum BEV Uptake', however reduced stock uptake and vehicle kilometers driven are assumed based on reduced travel demand (lower transport emissions scenario)

[47] https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy

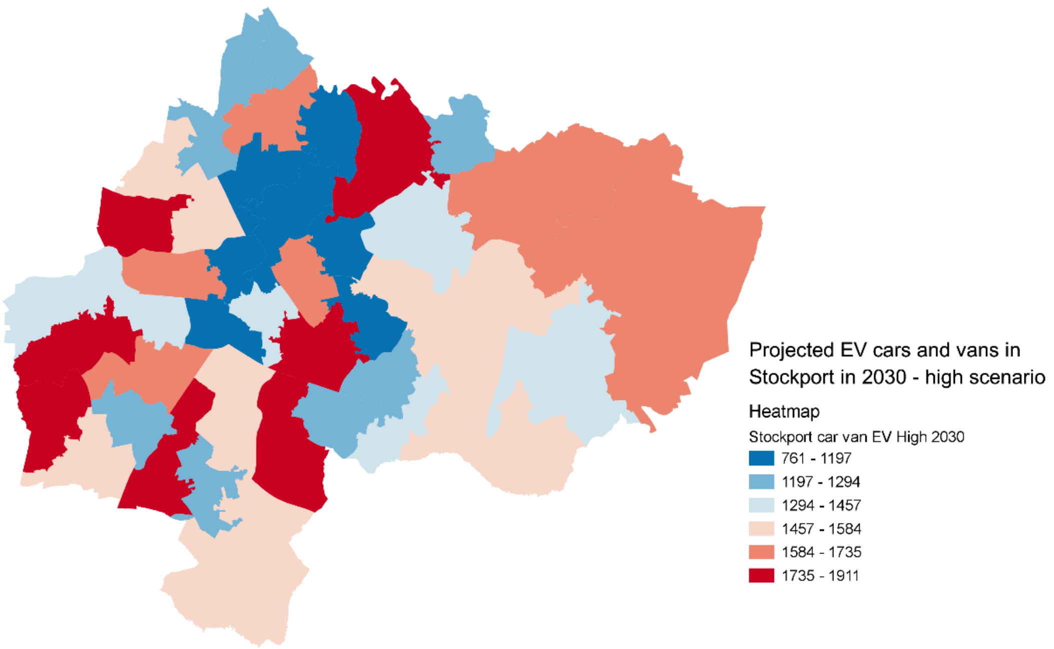


Figure 4.2: Heatmap showing number of EV cars and vans in each MSOA in Stockport for the ECCo 'High' scenario in 2030.

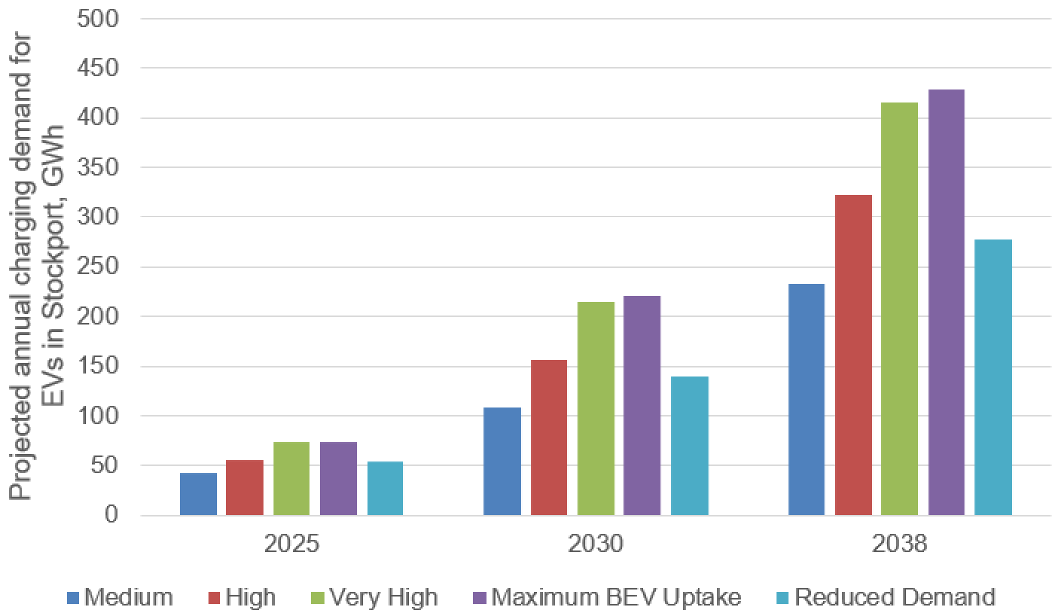


Figure 4.3: Projected annual charging demand for EVs in Stockport for the five EV uptake scenarios.

4.2.2 Opportunities for Stockport Council

While local authorities cannot directly identify and plan for grid constraints, there are two broad categories of actions Stockport can take to support the work of ENWL:

- **Sharing data with ENWL**: this allows for more accurate demand forecasting and more effective investment in network infrastructure. This data sharing is mediated by the

Greater Manchester Combined Authority (GMCA), who gather data from all local authorities in Greater Manchester and share this with ENWL.[48]

- **Deploying smart charging EV charging points**: while Stockport cannot intervene in many charging point locations, there are several opportunities to be aware of for private, home, and the Council's own deployments.

These two sets of actions are discussed in detail below.

4.2.3 Data sharing with ENWL

Sharing of data related to uptake of low-carbon technologies, such as EVs and heat pumps, allows ENWL to better understand where and when increases in electricity demand will be expected. A data exchange framework already exists, whereby GMCA aggregates data from its constituent local authorities and shares this with ENWL.

ENWL has shared the Reflect project data with the Council ahead of its publication. This data will give Stockport Council greater visibility over the expected trajectory of EV uptake and how best to plan for the growth in EV numbers and charging demand.

4.2.4 Deploying smart charging for EVs

Installing smart chargers in public charging points, allows charging rate to be managed based on real-time network demand to prevent gird constraints, which will also assist DNOs in mitigating grid constraints. While the Council cannot directly intervene in the installation of many chargers, it is important to understand the opportunities for smart charging. For rapid charging points (charging rate of 50 kW or over) smart charging is not possible. Buffer batteries can be used to lower the grid connection capacity needed, however this is more in the realm of private operators. For home charging points, the national grant is only available for smart charge points, which ensures that many of these points will have smart capabilities.

In locations where multiple non-rapid charging points are planned for installation and sharing a single grid connection, such as car parks, load management can help prevent grid constraints. Load management is possible if the chargers have smart capability, meaning they can communicate with each other and coordinate charging rates. This allows for more chargers to be installed than if load management was not being implemented, as charging rates can be limited when many chargers are in use to avoid grid constraints. The ability to avoid grid constraints can also prevent the need for network capacity upgrades where limited capacity is available. Many companies offer car park charging solutions with load management capability, at a cost of approximately £1,000 - £2,500 per charger.

The Department for Business, Energy and Industrial Strategy (BEIS), is running 'Beyond Off Street', a trial into smart on-street EV charging. This project aims to produce and trial smart on-street charging points, which could reduce the need for network upgrades if the chargers are found to be successful at reducing overall demand on the distribution network. An overview of this competition is presented in Figure 4.4. Smart on-street charging infrastructure is not expected to be available at a large scale until 2022 at the earliest, once the 'Beyond Off Street' competition has been concluded, however it is worth monitoring and considering for future developments.

[48] Further details on how information from stakeholders, including local authorities, is incorporated into ENWL's network planning, can be found here

Key facts on the BEIS 'Beyond Off Street' competition

- BEIS are keen to extend the scope of smart charging beyond domestic and microbusinesses contexts – the long-term solution for smart charging must include public smart charging
- In line with this, BEIS are running the 'Beyond Off Street' competition to promote the innovative use of smart charging. Projects must develop technology that:
  - Can be successfully integrated into the grid
  - Has load control functionality
  - Meets all regulation and standards (focusing on security of the system)
  - Demonstrates at least one Demand Side Response use case
  - Is used in an on-street (priority) or workplace charging context
- Smart public charging will allow more charge points to be safely/securely integrated into the network in the future, and allows end users to access cheaper charging rates

	Description	Timeline	Budget	No. of projects
Phase 1 Device development	Manufacture & test 10 prototypes	June 2020 to March 2021	£ 1,080,000 per project	2 projects
Phase 2 Demonstrator Trial	Trial of ~100 smart charge points	April 2021 to Feb 2022	£ 1,270,000 per project	2 projects

Figure 4.4: An overview of the 'Beyond Off Street' competition, giving the context and timeline of the project.

4.3 Storage Demand and Opportunities

4.3.1 Current demand and use cases

Energy storage is an important enabler for the transition to a decarbonised electricity system. As the penetration of intermittent renewable generation increases, this will increase the need for sources of flexibility, to maintain the stable operation of the electricity system, and energy storage is a key potential source of flexibility. In this report, the **focus is on lithium-ion batteries, since this is currently the most mature technology and most relevant for the short to medium term**. However a range of other technologies are also available and may become important in the medium to long term.

Uptake of battery storage to date is low – we are not aware of any uptake in the Stockport region although there is limited availability of data and so some very small volumes could have been installed (e.g. small batteries paired with solar PV in households). A range of revenue sources are possible for energy storage, such as reduced energy bills by increasing the amount of solar PV generation consumed on-site, wholesale price arbitrage[3], reduced network charges, and provision of services (such as frequency response, demand turn-up, generation turn-up/reserve, voltage management, and reactive power management either during normal operation or post-fault) to National Grid Electricity System Operator (ESO) or to the local Distribution Network Operator (DNO), in this case ENWL. As increasing levels of renewable generation are seen in the electricity system, this is expected to lead to increasing revenue opportunities for energy storage, which, combined with falling battery costs, is hence driving uptake. Note that the revenues available to a specific project will depend on the specific application.

There are a range of potential applications for battery storage. Small-scale battery storage can be installed in homes, usually co-located with solar PV, in order for the household to save on their energy bills by increasing the amount of solar generation that is consumed on-site (since the unit cost for households of purchasing electricity from the grid is significantly higher than the payments available from selling to the grid). Households could also benefit from using a time of use tariff to charge the battery at lower electricity prices and sell at higher electricity prices; although few time of use tariffs are currently available (e.g. Agile Octopus from Octopus Energy). Payback times for domestic battery storage are long (generally 15 - 20 years for adding storage to a home with existing solar PV), and individual installations are typically around 1 - 5 kW, with a discharge duration of 1 - 3 hours. As such, relatively low volumes of storage are expected for domestic battery storage applications. While uptake of household battery storage is likely to be driven by revenues from increasing on-site consumption, there is potential for this to be used to provide flexibility services or to mitigate grid constraints. In order to do this, it will be necessary for the household to have a smart meter installed (although early demonstration projects have used alternative energy monitoring) and for an aggregator to manage a portfolio of many batteries in order to achieve the scale needed to provide grid services. Aggregators are typically businesses, although community aggregation schemes are also being trialled, such as in Manchester-based Carbon Co-op's Open Demand Side Response project (OpenDSR).[49] Another trial, the Distributed Solar & Storage Study,[50] deployed 40 batteries in social housing in Barnsley, which were controlled in order to demonstrate mitigation of local grid constraints for the local Distribution Network Operator, Northern Powergrid.

Battery storage can also be installed behind the meter at larger industrial and commercial sites. Such installations can involve the "stacking" of a number of different revenue streams, including avoiding costs from transmission and distribution network charges, electricity price arbitrage, and provision of flexibility services. The outlook for new projects is uncertain as Ofgem are currently reviewing network charges, and the impact of this could be to drastically reduce the revenues available to behind the meter storage from avoiding network charges.

Another application of batteries is for grid-scale energy storage. These projects are typically 10s of MW in size and they are located either based on proximity to electricity network infrastructure, co-located with generation, or co-located with large electric vehicle charging hubs. Uptake was initially driven by projects bidding for contracts to provide frequency response to National Grid, as well as entry into the Capacity Market. In particular, 201 MW of storage was awarded contracts across eight installations, as part of National Grid's first enhanced frequency response tender. Furthermore, there is now a pipeline of several GW of grid-scale energy storage that could be installed in the UK in the coming years.

There are a number of local authority projects to deploy grid-scale energy storage in the UK for example:

- South Somerset County Council is installing a 25 MW standalone battery, for the purposes of providing services to National Grid.[51]
- Cambridgeshire County Council has a project to install 10 MW of battery storage alongside 2.25 MW of solar generation on a landfill site.[52]
- Oxford City Council is involved in an European Regional Development Fund (ERDF) innovation project to install a hybrid storage project, with 50 MW of Lithium Ion storage and 2 MW of Vanadium Flow storage, which will demonstrate the provision of flexibility services and also connect to a network of electric vehicle charging stations, both at a public charging stations and Oxford City Council's main vehicle depots.[53]

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[49] Carbon Co-op: OpenDSR https://carbon.coop/portfolio/opendsr
[50] Northern Powergrid (2020), DS3 Distributed Solar & Storage Study: https://www.northernpowergrid.com/innovation/projects/distributed-storage-solar-study-nia-npg-011
[51] https://www.southsomerset.gov.uk/news/2019/3/council-s-ground-breaking-new-energy-storage-facility-set-to-be-completed-by-the-end-of-march/
[52] https://www.solarpowerportal.co.uk/news/cambridgeshire_county_council_unveils_first_of_their_kind_landfill_solar_pl
[53] https://energysuperhuboxford.org/about-the-project/, https://www.pivot-power.co.uk/energy-superhub-oxford/

- Northumberland County Council and City of York Council have plans to pair battery storage with solar generation and electric vehicle charging hubs, each supported by ERDF funding.[54]

4.3.2 Use of energy storage to help mitigate grid constraints

DNOs may not own battery storage themselves. As such, for battery storage to be used for the mitigation of local grid constraints, this must take place through DNOs procuring flexibility services from battery storage owned by third parties (note that there are a range of other means by which flexibility services could be procured, such as demand shifting, EV smart charging, or curtailment of generation). Typically, flexibility is procured from existing battery storage, as this is lower cost than installing new battery storage units for flexibility purposes. Where DNOs procure flexibility from small domestic battery storage, this takes place via an aggregator (as described above) in order to achieve the scale required. Larger storage (e.g. MW scale) can typically bid directly to DNOs for flexibility contracts. Procurement of flexibility by DNOs is still at the relatively early stages, with the first tenders only taking place in the past 3-4 years, focusing on specific geographic areas. However, these are likely to be scaled up in the coming years. Electricity North West announced their sixth flexibility tender in March 2020.

4.3.3 Opportunities for Stockport Council

In general, local authorities cannot directly identify and plan for grid constraints and so it is not necessary for Stockport Council to actively seek to encourage deployment of energy storage for this purpose. However, as noted in the examples above, there are opportunities for Stockport to take part in and support projects looking to use aggregated domestic battery storage to provide grid services. Similarly, there are potential opportunities to install grid-scale storage, either standalone, co-located with renewables, or co-located with EV charging. However, note that the majority of these local authority projects to date are based on external funding such as ERDF rather than being fully commercial projects.

54 https://www.solarpowerportal.co.uk/news/northumberland_council_800kw_solar_carport_install_to_get_go_ahead, , https://www.solarpowerportal.co.uk/news/york_set_for_400kw_hyperhub_solar_carport_with_storage

5. Future Proofing

This section provides an overview of low-carbon technologies across four sectors: heating and cooling, transport, energy generation and energy storage. For each sector, an overview of the technology options is provided along with relevant policy and strategies at National and local level.

Using the information provided, this section aims to provide Stockport Council's Planning Department with an understanding of current and likely options for low-carbon energy in the next five to ten years. This will inform flexible planning policy that is able to adapt to forthcoming changes in technologies. The advice given here should be considered in the context of a changing technology landscape with regards to low-carbon energy, heating and transport.

5.1 Heating and Cooling

In order to significantly reduce carbon emissions from heating and cooling, oil and natural gas consumption for space and water heating needs to be reduced considerably. Building fabric energy efficiency measures are required to minimise space heating demand, and alternative, low-zero-carbon heating technologies are essential. A range of low-carbon heating technologies and energy efficiency measures are available, and it is likely that a combination of different measures will be needed in order to meet Stockport's ambitious decarbonisation targets. Building fabric energy efficiency measures could allow for significant reductions carbon emissions but will not allow for full decarbonisation unless combined with zero-carbon compatible heating technology.

5.1.1 High-level overview of sector

There are a number of low and zero-carbon compatible heating technologies available at an individual building-level as well as at a district heating level; the viability of each depends on location, heat demand and local opportunities and constraints.

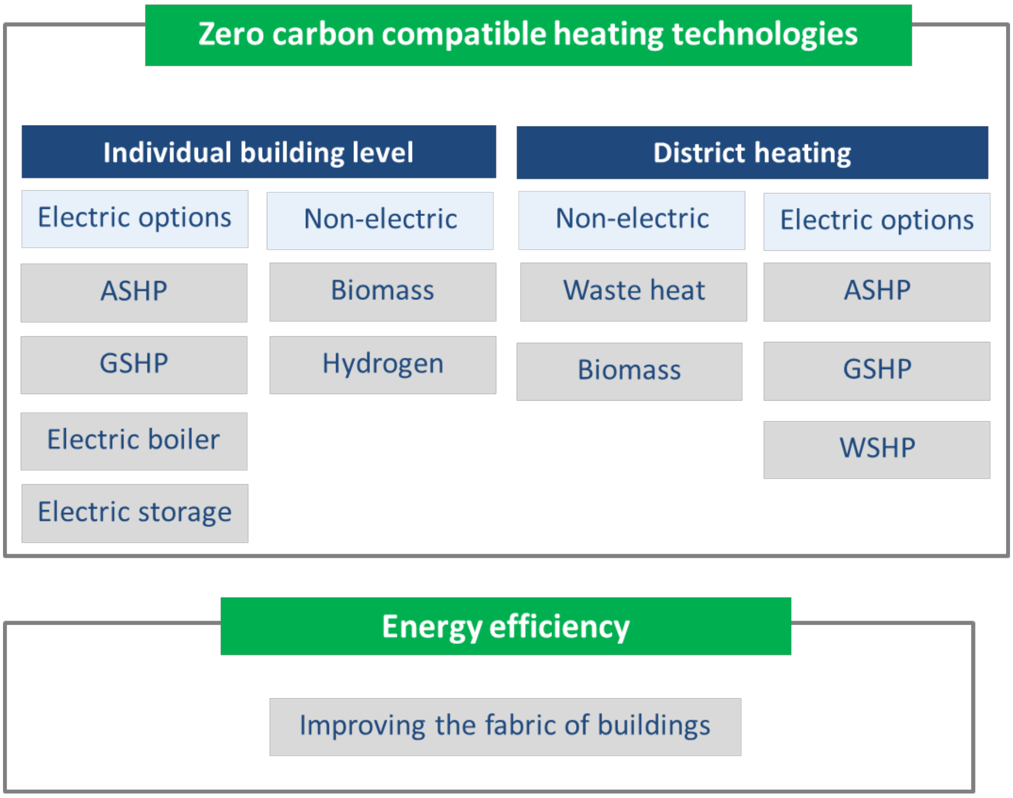

Figure 5.1: A summary of zero carbon compatible heating technologies

Heat pumps

Heat pumps are a form of electric heating where energy is extracted from the environment in order to provide space or water heating at a high efficiency. They operate via a cycle of vaporization and subsequent condensation of a refrigerant and typically transfer an amount of heat energy 3-4 times larger than the electrical energy used. Heat pump operation emits no greenhouse gases on site (other than any leakage of refrigerants), and their high efficiency means they can achieve very low levels of carbon emissions from power generation when combined with overall decarbonisation of the electricity grid. Heat pump systems normally involve some form of heat storage such as a hot water cylinder, and often use an additional heat source to provide hot water. The vast majority of heat pumps currently in use operate at a lower flow temperature than that of a conventional gas boiler; this limits the suitability in properties with a high peak heat demand. While heat pumps are the most common renewable heating technology domestically in the UK,[55] the rate of non-domestic installation is low – less than 2,000 heat pumps were installed under the non-domestic Renewable Heat Incentive between 2011 and 2019.[56] It is however noted that heat pumps for cooling and cooling/heating purposes (i.e. chillers) are very common, with several retailers installing them in Stockport in recent years.

There are two kinds of heat pump commonly in use in the UK – air source and ground source. Air source heat pumps extract heat from the outside air, while ground source heat pumps use heat from the soil or ground water. Of around 17,000 heat pumps installed in the UK in 2017, 80% were air source[57]. Ground source heat pumps can often operate at higher efficiency than air source heat pumps and deliver more heat per unit electricity than air source heat pumps when measured over a full year.[58] However, they have minimum space requirements for installation and are generally more expensive due the requirement for groundworks during installation.

Direct electric heating

Direct electric heating works by passing an electric current through a resistive element to generate heat. There are various systems for distributing this heat (convection heaters, infrared, electric boiler), but in each case the efficiency cannot rise above 100%. This causes the key disadvantage of direct electric heating compared to heat pumps; both the running costs to the consumer and the carbon emissions of direct electric heating are significantly higher. Electric storage heaters, which make use of cheaper, off-peak electricity mitigate this first disadvantage to some extent but do not change the associated carbon emissions.

However, there are advantages of direct electric heating which make it attractive in some circumstances. It typically has a considerably lower capital cost, with a cost (including installation) of around £1,200 for a domestic property, as compared to around £7,000 for an air source heat pump. In addition, it can be installed in the majority of the building stock without the need for a low temperature heating system or deep energy efficiency improvements. It is however noted that the technical feasibility of direct electric heating as a retrofit may often be severely restricted by the lack of grid capacity, given the significant loads it would create.

Biomass boilers

Biomass boilers operate similarly to a conventional gas boiler, providing both hot water and space heating by the combustion of fuel to heat water. However, rather than using natural gas as fuel they use wood pellets or logs. On combustion, carbon in the wood combines with oxygen in the air to form the same amount of carbon dioxide which was absorbed from the atmosphere during

[55] Department for Business, Energy & Industrial strategy, 2019. *Energy Innovation Needs Assessment, Sub-theme report: Heating & cooling*

[56] Department for Business, Energy & Industrial strategy. *RHI monthly deployment data: November 2019*. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-november-2019

[57] European Copper Institute (2018), *Heat pumps: integrating technologies to decarbonise heating and cooling*. Available at: http://www.buildup.eu/sites/default/files/content/ehpa-white-paper-111018.pdf

[58] *Analysis of heat pump data from the renewable heat premium payment scheme*, UCL, 2017

that wood's life. As a result, the burning of biomass can be considered carbon neutral, although only when replenishment of the tree or plant is assumed, when any required transportation is net zero (from within at least 25km of the user), and when emissions are considered over a long enough time period. In addition to carbon emission, the burning of biomass releases particulate matter, nitrogen oxides and sulphur oxides. As such, biomass for heating is generally unsuitable in urban areas because of adverse air quality impacts. Because of the lower energy density of wood fuel, biomass boilers are physically larger than gas boilers, and storage space is also required for the fuel. A biomass boiler also needs additional maintenance as compared to a traditional gas boiler – ash must be removed frequently, and the fuel store replenished. Accessibility and delivery schedules can be a key factor in planning.

Hydrogen boilers

An alternative pathway for the decarbonisation of heating to the electric and biomass based options described above is the provision of low-carbon hydrogen, likely via a repurposed gas distribution network, which would be burned in boilers similar to those currently in use for natural gas. The potential benefits of such an option include low building scale costs (similar to current costs for gas boilers once produced at scale) and no additional space or building energy efficiency requirements compared to gas boilers. Additionally, hydrogen boilers would imply minimal change in user experience as compared to gas boilers.

However, the deployment of hydrogen boilers within the Borough of Stockport will only be possible with large scale rollout of the required infrastructure at a national/regional scale such that a hydrogen supply is made available. There are significant barriers and challenges associated with the widespread use of hydrogen for heating. Hydrogen boilers are not yet a proven technology and there are concerns around safety of use and distribution, and the associated consumer acceptability. In addition, there is uncertainty over the commercial viability and optimal method of producing large quantities of low-carbon hydrogen.[59]

District heating

District heating systems, or 'heat networks', use centralised energy sources to supply heat to multiple users. Water is heated centrally, and then hot water or steam is distributed via a network of insulated pipes. Networks vary in size; they can span across large areas of a city but can also cover a small cluster of several buildings. A key advantage of district heating over building-scale heating systems is that they benefit from economies of scale and the diversity of heat demand profiles across users. They can also utilise multiple heat sources, including waste heat sources, such as from industry or power generation. A further advantage of district heating is overcoming space constraints as plant is shared between the network freeing up space in more constrained buildings. Most district heating systems provide the desired temperature directly, but schemes exist in which distribution occurs at a lower temperature and then increased within individual buildings using small heat pumps. This has the advantage of reducing thermal losses along the network.[60]

District heating is cost-effective in areas of high heat demand density, since the costs of distribution pipework and energy generation facilities are then shared between a larger number of users. They are most efficient when combined with low temperature heating systems as this reduces thermal losses along pipes. If powered using heat pumps, a low operating temperature also increases the efficiency of heat generation. However, successful space heating at low temperature requires high energy efficiency standards.

[59] For example, see *Options for producing low-carbon hydrogen at scale*, Royal Society

[60] Department for Energy and Climate Change, 2016. *Heat pumps in district heating*, a report by Element Energy and Carbon Alternatives

There are around 5,500 district heat networks in the UK. While the majority of currently operating heat networks are powered by natural gas, the proportion of networks powered by low-carbon sources, such as waste heat and heat pumps, is growing.[60]

Energy efficiency measures

Building fabric energy efficiency measures reduce the energy required to maintain the same internal temperature profile for a building and hence reduce the space heating demand whilst having little or no impact on the energy demand for hot water. Building fabric energy efficiency measures typically reduce thermal energy loss by improving the insulation of the walls, roof, floor and / or windows or by improving the airtightness. Heat recovery can be used to further reduce the heat loss and hence lower the space heating energy demand.

The associated carbon emission reduction is in proportion with the energy demand reduction, but the absolute saving will depend on the heating system supplying the heat demand. As such, the impact of energy efficiency measures on reducing carbon emissions is greatest for high carbon technologies and falls to zero for absolute zero emission technologies. Beyond reducing carbon emissions, building fabric energy efficiency measures also perform a second function which is likely to be more important when pursuing a rapid transition to absolute zero emissions; they facilitate the use of low temperature heating systems, which allow certain low-carbon heating systems, such as heat pumps, to operate more efficiently (as discussed in Section 5.1 above).

It is noted that retrofit energy efficiency improvements will be vital in order to mitigate the impacts of any additional loads placed on local and national energy infrastructure. Energy efficiency measures could partially alleviate the need for additional electricity production, as well as reinforcement of local infrastructure. Airtightness is an important aspect of energy efficiency, eliminating draughts particularly around windows, doors and through floors. However, sealing off draughts also reduces the ventilation within a property. High indoor humidity is associated with damp and mould such that some kind of ventilation system is required. For highly airtight properties, mechanical ventilation can be provided. Heat recovery systems use the heat from outgoing air to warm the incoming fresh air to reduce the heat losses as a result of ventilation.

5.1.2 Technology progress and outlook

The vast majority of space and hot water heating in the UK is currently provided by gas boilers. Many of the low-carbon heating technologies, including biomass boilers and heat pumps, are well established technologies but currently have low uptake despite financial incentives provided through the Renewable Heat Incentive (RHI). Cost reductions are unlikely to be significant for well-established technologies although wide scale uptake could lead to cost reductions through economies of scale and reduced labour costs. Significant energy efficiency improvements are also unlikely, although some efficiency improvements are expected with HPs, especially high temperature HPs.

Heat pumps are most efficient when they are operated at a low output temperature (typically 45-55°C) rather than the typical 80°C output for a gas boiler. The majority of heat pumps in operation today are therefore low temperature heat pumps. However, low temperature heating is only suitable for buildings where the existing heat distribution system (radiators, pumps and pipes) is able to provide sufficient thermal output to maintain thermal comfort, typically in well insulated buildings. Alternatively, high temperature heat pumps (operating at up to 80°C) are available and are suitable for a greater number of properties given their ability to supply the existing heat distribution system at the same temperature as the counterfactual technology that the system was designed for. The main drawbacks of high temperature heat pumps are the additional capital cost and the reduced efficiency relative to low temperature heat pumps. High temperature heat pumps are a relatively immature technology so cost reductions and improved performance is expected in the future but is currently highly uncertain.

The supply chain of low-carbon technologies in the UK is developing slowly but is likely to increase significantly as the transition to a low-carbon economy progresses. In the short term, upskilling and production within the UK is required to ensure future demand can be met. Stockport Council can contribute to developing skills in relevant sectors to enable the Borough to continue to be a leader in low and zero carbon innovation.

In the long term it is likely that demand for biomass will surpass the available sustainably sourced supply, in which case only the most efficient uses at a national level ought to be pursued.[61] This would likely exclude biomass boilers, except in some limited circumstances, such as in hard-to-insulate buildings away from urban areas. The Committee on Climate Change has indicated that using biomass for building materials (as opposed to a fuel) is a particularly beneficial way to use limited biomass resources as the carbon is locked away in building materials. As with low-carbon technologies, knowledge and skill level around timber house building is relatively low as timber use in new developments has been largely phased out. Modular construction is considered as a means of overcoming lack on on-site knowledge by allowing partial fabrication off site by specialists that can be constructed on-site at a reduced cost but with higher quality.

As noted above, hydrogen for heating is not currently available. Whilst research and testing is currently underway, it is unlikely that hydrogen will available via the gas grid before 2040 (except in small proportions mixed with natural gas). The government has not yet taken a policy position on the future of the gas grid; the Clean Growth Strategy states the government's ambition for a decision to be made over decarbonising heat, including the future of the gas grid, in the first half of the 2020s.

5.1.3 Policy outlook and incentives

The UK's renewable heat incentive (RHI) currently supports low-carbon heating technologies in both the domestic and non-domestic sectors but is closing to new applications next year (2021). The renewable heat incentive was introduced in 2014 to encourage the transition to renewable heating. The scheme was set up such that consumers paid the upfront costs of the equipment and were repaid according to the amount of renewable heat they generated, much the same as the feed-in tariff for solar PV installations. However, particularly high up-front costs and long payback times meant uptake has been much below that envisioned for the scheme.

The UK government is now consulting on a change to the scheme that would involve a grant to help cover the up-front costs rather than a gradual payback.[62] The key points from the *'Future support for low-carbon heat'* consultation are:

- Limiting the use of biomass and **favouring heat pumps**
- **Flat rate grant of £4,000 for all renewable heat technologies**, allowing the market to control the natural update of a range of renewable heating technologies[63]. Whilst a grant of £4,000 is higher than that provided in other EU countries, this was deemed necessary as the UK is further from supply chains and heat pumps are a less established technology in the UK than mainland Europe
- Provide grants up to a capacity limit of 45 kW, to focus the scheme on smaller installations (domestic heat pumps generally 4-15 kW)[64]
- No support for hybrid heat pumps (typically involving a heat pump to provide the baseload with a gas boiler providing the peak demand)
- **Aimed at supporting supply chains to develop the market for low-carbon heating**

[61] Committee on Climate Change, 2018. *Biomass in a low carbon economy*
[62] UK Government: Future for low carbon heat consultation https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/881622/future-support-for-low-carbon-heat-consultation.pdf
[63] £4,000 grant was suggested by the Heat Pump Association

[64] Home Heating Guide: Sizing Guide for Air-Source Heat Pumps https://www.homeheatingguide.co.uk/renewables-advice/air-source-heat-pumps-a-sizing-guide

- Support for the Green Gas Grid:
  - Support for biomethane from anaerobic digestion; currently the only commercially available green gas in the UK
  - Considering the potential for blending hydrogen into the gas grid.

5.1.4 Future proofing

There is not yet a clear indication of which low-carbon heating technologies will dominate, and it is likely that a variety of low-carbon heating technologies will be suitable in different settings. The carbon intensity of low-carbon heating options will depend on the electricity grid decarbonisation, source of hydrogen or biogas, or the source of biomass. As such, the national direction of decarbonisation and the availability of energy sources will need to be continuously reviewed.

The role of energy efficiency measures in existing buildings is also highly uncertain. Despite bringing a whole range of benefits to both the property owner and to the wider energy infrastructure, the high upfront costs continue to be a barrier to uptake. Energy efficiency should in all cases be considered at the time of heating technology conversion to ensure co-benefits are realised and to avoid future redundancy (e.g. oversizing of heating technology), but should not act as a barrier to the transition to low-carbon heating technology where the combined costs are deemed prohibitive.

Where heat pumps have been initially installed in a building, there is currently no reason to believe those buildings might be retrofitted to hydrogen boilers. To synthesise green hydrogen, electricity from renewable sources is used to split water, a process that incurs energy losses; heat pumps can use the renewable energy directly. A hydrogen boiler can only ever be close to 100% efficient while a heat pump is 300-400% efficient in terms of electrical energy used versus heat energy generated due to heat pumps pulling in heat from external sources. As such, the possible realisation of a hydrogen gas grid would not make heating systems based on heat pumps obsolete.

A key advantages of hydrogen boilers over heat pumps is in the relative ease of retrofitting properties currently on gas to a low-carbon technology. Hydrogen boilers can directly replace a gas heating system while heat pumps typically require more extensive changes to a property's heating distribution system and/or building fabric energy-efficiency measures. As such, it is hoped that a hydrogen gas grid will be a means of moving hard-to-treat properties away from natural gas heating systems.

5.1.5 Recommendations for planning policy

- Planning policy needs to be flexible enough to accommodate the range of low-carbon heating and energy technology options available and should not adversely impact the market for a given low-carbon technology.
- Local planning policy should be monitored and revised on a regular basis to ensure ongoing alignment with the direction of national policy and decarbonisation of the electricity and gas grids.
- Planning policy needs to be sufficiently ambitious in the near term to allow Stockport's carbon targets to be met, whilst acknowledging the uncertainty of potential future decarbonisation options such as decarbonisation of the gas grid.
- Planning policy should support energy efficiency measures and recognise the wide range of associated benefits whilst not introducing arduous measures that stifle the decarbonisation of heating.
- Low carbon cooling demand needs to be taken account of where retailers in particular are making use of such and the UK average summer temperatures are increasing.

5.2 Transport

5.2.1 High-level Overview of Sector

The transport sector was, until fairly recently, considered one of the more difficult sectors to decarbonise. This is because finding a low carbon fuel that is small and light so it can be transported and energy dense so that it can provide for long range travel is very challenging. In the previous energy study commissioned by Stockport Council in 2009, biogas was expected to be the way forward for reducing carbon emissions associated with transport. Industry consensus at this time was that biofuels and hybrid vehicles would provide early decarbonisation, with battery electric vehicles coming in, in the medium term for short journeys and a transition to hydrogen in the long term for medium and long journeys.

However, since 2009 the transport market has changed significantly. Biofuels which were initially expected to be a major energy source for sustainable transport have not seen expanding government support due to limited feedstock and issues in achieving sustainability in the supply chain. Battery electric vehicles by comparison have exceeded previous expectations with battery costs and battery energy densities improving faster than projected. With the progress already made in batteries, and with further developments expected in the near future, battery electric vehicles now look to be a viable option for decarbonisation of a significant proportion of all land transport vehicles.

Even with the significant developments made in batteries, some vehicles will require longer ranges and faster refueling than batteries can provide. For these applications, such as some long-haul trucks and coaches, longer distance suburban and rural bus routes, non-electrified train routes and ships, hydrogen has become the leading candidate for a green fuel of the future. As with biofuels, sustainable production of hydrogen is still an issue with current hydrogen production methods involving the reforming of natural gas and the release of carbon. However, avenues for the sustainable production of hydrogen, using renewable electricity, are available and will be realised at scale in time. Hydrogen is also a potential green fuel for heating and industry suggesting the opportunity to realise significant cost reductions through scale.

Electric cars are now a commercial proposition with growing sales while hydrogen cars are still at trial volumes and the use of biofuels is limited to a low blend in diesel and petrol. The exception is in HGVs where biomethane is used solely to power a growing number of gas HGVs.

Some modes of transport will not be able to decarbonise by turning electric: aviation and shipping are two modes of transport that will continue to require a chemical fuel, although short range trips by battery power are already taking place.[65] HGVs and trains are also more likely than light vehicles to continue to need chemical fuels and are likely to decarbonise using a mixture of electric and hydrogen technologies.

5.2.2 Policy outlook and incentives

For a net-zero 2050, the UK car fleet will need to be close to 100% electric. As cars are on the road for around 15 years, a net-zero 2050 would require that no new petrol or diesel cars are added to the UK roads after 2035. The CCC are pushing for the government to phase out fossil fuel cars from 2030 rather than the current plans for 2035. The CCC's projections suggest that within the current decade electric cars will be cheaper over their lifetime than fossil fuel cars.[66]

Meeting this target will require a range of policy support mechanisms such as the plug-in grant, which provides a grant at point of vehicle purchase, or lower tax rates for cleaner vehicles as is

[65] Short range aviation and shipping have been investigating the use of battery power with electric ferries now running in Iceland and Denmark, and local flights on the west coast of Canada being taken under battery power.

[66] Committee on Climate Change: Net-Zero Technical Report Chapter 5

the case with the Vehicle Excise Duty (VED). Exemptions from or discount on local charges, such as parking permit, tolls, congestion charge, low emission zones/clean air zones are also a widely used support mechanism. Clean air zones, designed to improve air quality by imposing a fee on the eldest vehicles, could over time become Zero Emission Zones. A few places in the UK are introducing ZEZs (e.g. some London Boroughs, Oxford) but they are limited to a few streets currently, as the uptake of Zero Emissions vehicles is not high enough for widespread ZEZs.

5.2.3 Future proofing

Electric vs Hydrogen

The recent progress in battery storage has made it very likely that most vehicles will be battery powered in the future. The issue for battery electric vehicles will be in ensuring the demand on the electricity grid and electricity producers is managed. The introduction of electric vehicles without smart management could result in a significant increase in energy demand at peak times leading to a need for more energy generation and upgrades to the grid. However, if managed correctly electric vehicles can help to manage supply and demand on the grid making it possible to increase the percentage of intermittent renewable electricity producers in the UK electricity mix. **National Grid, as well as local distribution network operators, are modelling the impact of electric vehicles upon the electricity grid and the National Grid is confident that the grid can cope with increased demand from EVs.**[67]

Electric vehicles cannot currently solve all of the issues of powering transport and it is likely that the green solution for some modes of transport will be hydrogen. **Hydrogen powered vehicles have weight, charging time and range advantages over electric vehicles. This makes them likely to have a significant role to play for larger, longer range vehicles such as some HGVs and buses**. The Hydrogen Council has projected that hydrogen fuel cell buses will account for up to 30% of the bus fleet in 2050 and 25% of the truck fleet. Currently, fuel cell trucks are only in the development and demonstration phase but the Hydrogen Europe Roadmap suggests that by 2026 there could be 10,000 fuel cell trucks deployed in Europe. It should be noted that battery electric buses are currently much more deployed than hydrogen buses, as they have a cost advantage and are suitable for a large proportion of routes. When operators move to decarbonise the longest routes, the share of hydrogen bus sales will increase. The same comment stands for trucks, but this sector is much less mature (>500,000 zero emission bus sales globally, vs ca. 10,000 zero emission HGV sales).

It is likely that most train lines that currently run on diesel will transfer to hydrogen. **The government aims to phase out diesel-only trains by 2040.**[68] The primary recommendation for trains is to electrify as much of the lines as possible for the same reasons as with battery electric cars, however, for sections of line where it is not possible or economical to electrify the lines, hydrogen will provide the power. **There are currently two hydrogen trains running in Germany** with plans to bring in more.[69] These hydrogen trains have been found to have a similar range to diesel trains in operation. The UK is looking to follow suit with a demonstration project already having taken place in the West Midlands.[70]

Modal Shift

The adoption of either electric and hydrogen vehicles would reduce air and noise pollution associated with road transport but neither would address the issue of congestion. Reducing congestion will require a modal shift where people travel less miles by car either by travelling less

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[67] National Grid: Future Energy Scenarios http://fes.nationalgrid.com/
[68] Railway Technology: UK to phase-out diesel-only trains by 2040 https://www.railway-technology.com/news/uk-phase-diesel-trains-2040/
[69] Alstom: World's first hydrogen powered trains https://www.alstom.com/our-solutions/rolling-stock/coradia-ilint-worlds-1st-hydrogen-powered-train
[70] BBC: Britain's first hydrogen train https://www.bbc.co.uk/news/business-48698532

or by using other modes of transport such as walking, cycling or public transport. The associated benefits of such a modal shift are manifold ranging from health to higher productivity to biodiversity recovery. The CCC suggested strengthening policy to try to achieve a drop in car-driven miles of at least 5% below the baseline trajectory in 2018,[71] which was still considered ambitious as it required a turnaround of the general upward trend in miles driven since the car was introduced.

On the 29th March 2020, road travel dropped by 73% as a result of the 'stay at home' message issued by the UK Government in response to the Covid-19 pandemic.[72] Such low levels of road travel have not been seen since the 1950s. This magnitude of drop is a temporary phenomenon but the necessity of working from home may lead to a more permanent change and more people wishing to work from home more often as well as employers recognising the financial and social benefits of employees working from home. One result of this pandemic could be a reduction in car miles beyond any expectations or policy targets.

5.2.4 Recommendations for Planning Policy

Stockport Council's planning policy with respect to transport should prioritise improving infrastructure to encourage walking, cycling and using low-carbon public transport whilst also encouraging and supporting the uptake of electric vehicles.

Some measures, such as free parking for electric vehicles in SMBC car parks, are already in place in Stockport and measures such as these should be encouraged as well as those that promote smart charging. The transition to electric vehicles plays a role in policies to reduce emissions, air pollution and noise pollution associated with transport.

SMBC has already produced '*A Plan for Walking and Cycling in Stockport 2019-2029'* that lays out an action plan for improving walking and cycling infrastructure in Stockport. The report notes that only a modal shift will result in a reduction in congestion on Stockport's roads and realise associated health benefits.

5.3 Local Energy Generation

The cost of generating energy from renewable sources has come down dramatically in recent years. **Generating energy from wind and solar is now cheaper than any other standard form of energy generation in the UK**.[73] **The issues associated with large-scale renewable energy generation are no longer cost but instead intermittency and that supply is not yet high enough to cover the UK's peak requirements**.

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[71] Committee on Climate Change: Reducing UK Emissions, 2018 Progress Report to Parliament https://www.theccc.org.uk/publication/reducing-uk-emissions-2018-progress-report-to-parliament/

[72] The Guardian: UK road travel falls to 1955 levels as Covid-19 lockdown takes hold https://www.theguardian.com/uk-news/2020/apr/03/uk-road-travel-falls-to-1955-levels-as-covid-19-lockdown-takes-hold-coronavirus-traffic accessed 19th May 2020

[73] Lazard: Levelized cost of energy and levelized cost of storage 2019 https://www.lazard.com/perspective/lcoe2019

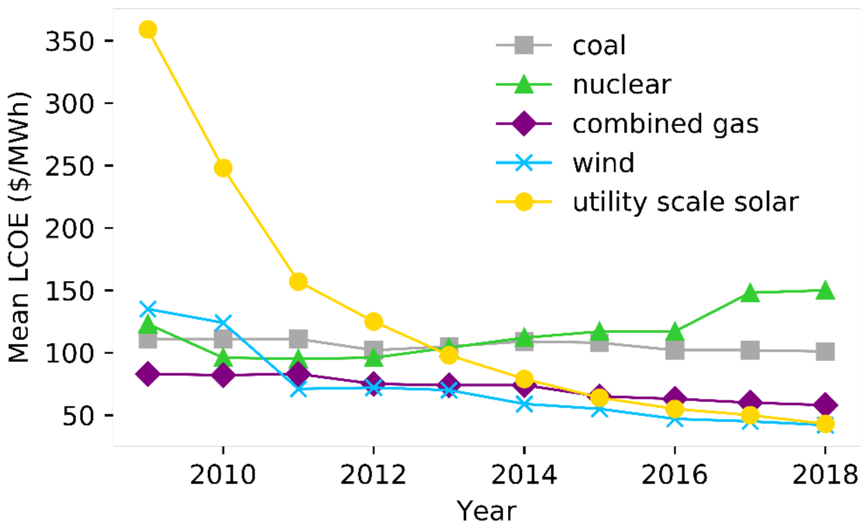

Figure 5.2: Levelised cost of energy (LCOE) of large-scale energy generation from various sources. Data from Lazard.[73]

For local generation, however, the cost of renewable technologies is still a barrier as it is not a choice between the upfront costs of renewable technologies versus the up-front cost of fossil-fuel based technologies. In the UK, a record is kept of costs associated with small-scale solar PV installations for various sizes of installation. The price drop for small-scale installations has been more on the order of 10-15% since 2013.[74]

In the year from April 2018 to April 2019, the costs were as follows

- 0-4 kW average of £1,800 per kW installed (standard domestic)
- 4-10 kW average of £1,500 per kW installed (large domestic)
- 10-50 kW average of £1,140 per kW installed (office building, school).

Technology Overview and Progress

Solar Photovoltaics

Solar photovoltaic technologies absorb sunlight and convert it to electricity. Solar PV is a very similar technology to LED lighting but connected up in reverse. Solar panels generate the most energy when directly facing the sun and are therefore best installed facing south although east and west facing panels can still generate well. As the sun is rarely overhead in the UK, it is most efficient to have panels tilted towards the sun; the ideal tilt in the UK is between 30 and 40 degrees to the horizontal. Where the tilt of a roof is already within this range the panels can be installed flat, otherwise they may be given an additional tilt during installation. Solar PV still generates on cloudy days although generation levels may be reduced.

Each square wafer that can be seen in a silicon solar panel produces a portion of the panel's electricity. The individual contributions from each cell are then combined by the electronics connecting the cells to produce a combined power output. One of the major issues for solar panels is that if one of the cells is in shade it can greatly affect the overall output of the panel. A shaded section of a solar panel conducts electricity very poorly, meaning the electricity from the cells around it is blocked. The same is true if one section of the panel is damaged. To avoid major power loss, some panels are fitted with bypass diodes that provide an alternative path around

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[74] UK Government: Solar PV Cost Data https://www.gov.uk/government/statistics/solar-pv-cost-data

insulating cells. Care should be taken when installing solar panels to avoid shade from trees and chimneys.

Energy generation from solar photovoltaics (PV) has shown the greatest decrease in cost per kWh of the major energy generation methods over recent years. Improvements in manufacturing and mass production have driven down costs. The efficiency of individual solar panels has also been increasing over time resulting in larger energy outputs per panel and therefore by unit area.

Following discussions with SMBC a more thorough review of developments in Appendix 2: Solar Photovoltaic Technologies.

Wind Energy

Wind turbines convert the kinetic energy stored in wind and convert it to electrical energy, like the inverse process of a fan. **The power output of a turbine depends on two primary factors: the wind speed and the 'swept area' of the blades**.

The windspeed is a measure of how much energy is contained in the wind and therefore affects how much energy the turbine can take from the wind. Wind speed increases with height above the ground meaning wind turbines should ideally be installed on high ground and the turbines themselves be as tall as possible. The energy generated by a wind turbine is equal to the cube of the windspeed such that as the windspeed doubles, the power increases by a factor of 8. The average windspeeds in Stockport vary between 4 m/s and 6 m/s which would affect the power output by a factor of 3.

The swept area of the blades refers to the area through which the blades turn and is therefore dependant on the size of the blades. The power output of the turbine is proportional to the square of the blade length such that blades that are twice as long will generate four times as much energy.

How turbines are arranged with respect to each other also affects the collective energy output from them. Turbines in a wind farm are arranged to minimise the effect of the upwind turbines of the wind received by the downwind turbines. There are various algorithms available to optimise the siting of turbines in a wind farm.

The major changes in wind technology in recent years have been:

- Maximum height increases from 15 m to 250 m
- Turbine capacity increasing from 20-500 kW to 2-5 MW
- Dominance of the 3-blade turbine (as opposed to 1 or 2 blades)

These changes are unlikely to have a major impact on local energy generation capacity as turbines close to urban areas will be at the low end of the range in terms of size and therefore capacity.

Recent progress in wind turbine research has indicated that an alternative wind turbine shape, the vertical axis wind turbine (VAWT), can produce more energy per area than the more familiar 3-bladed wind turbine, the horizontal axis wind turbine (HAWT).[75] It is predicted that with the same space, using VAWTs for a wind farm could produce 10 times as much energy than current HAWTs.

Hydroelectric Power

Hydroelectric power can be used as a means of generating renewable electricity from a flowing body of water or as a means of storing energy to provide power at times of peak demand. For

[75] Vertical Axis Wind Turbines https://www.sciencedirect.com/science/article/pii/S1364032113000312

energy storage purposes, water is pumped above a dam during periods of low demand; the water is then released through turbines to generate energy at peak demand.

For energy generation purposes, hydroelectric sites are assessed based on two basic criteria: head and flow. Head is the drop in height the water goes through at a given point while flow is the flow rate of the body of water. The greater the height and the flow, the greater the power output. Other contributing factors to the feasibility of a site include site access as well as cost and ease of construction. The access to the site must allow for construction vehicles to enter and to bring in the turbines themselves. The site itself must have space as part of the weir to allow for turbines to be inserted.

Anaerobic Digestion

Anaerobic digestion (AD) is the process by which **organic matter decomposes in the absence of oxygen**. The organic matter used can be crops, sewage, animal waste and food waste. The **decomposition creates a methane-rich gas** that is collected and can be burned for heat and power. **If further enriched, methane biogas can be inserted into the gas grid or used as a fuel for vehicles**. The major advantage of anaerobic digestion from an environmental point of view is that anaerobic digestion of organic waste happens naturally, releasing methane into the atmosphere. Methane is a potent greenhouse gas, with 84 times the warming effect of CO_2, although it's lifetime in the atmosphere is shorter.[76] **By burning methane to produce CO_2 and water, the overall environmental impact of the waste is reduced.**

While natural gas typically contains around 90% methane and 10% other hydrocarbons, the mix in biogas is more likely to be 60-70% methane with 30-40% carbon dioxide. When biogas is enriched the two gases are separated into two streams and the CO_2 stream is released. As the separation process is not 100% efficient, there remains some methane in the released CO_2 stream. Direct release of methane into the atmosphere is problematic due to the global warning effect of methane so further treatment of the CO_2 is required to remove residual methane. The biogas stream goes through additional cleaning to remove other contaminants in various 'scrubbing' processes, particularly sulphur compounds which have a strong smell and can be toxic.

The technologies for enriching biogas to a quality suitable for the gas grid or vehicles have already been shown to be economically viable and research continues to optimise the processes. Various technologies for upgrading biogas exist with preference depending on both the input gas and the desired final use of the enriched gas. The technologies are generally still expensive, however, and currently gas-to-grid cleaning processes are not economical for small-scale generators.

Where practical, heat from anaerobic digestion can be provided directly to local demand centres. In this case, it is best for the heat demand to be constant meaning domestic properties are not ideal. For smaller scale plants it is often not economical to go through the process of enriching biogas to feed into the grid and instead the gas is burned onsite to produce renewable electricity.

5.3.2 Future Proofing

Although energy usage is higher during the day (when solar is online) than during the night, solar energy cannot cover the morning and evening peaks in electricity demand. Fossil-fuel based technologies are still required to help the grid cope with times of high demand at either side of the peak hours for solar, even in the height of summer. When production from wind energy is high it can cover a significant portion of the baseload electricity demand for the UK but is very variable. It is likely that some form of combustion-based energy generation will remain on the grid right through to 2050 to cover periods of high demand and low output from renewable sources.

[76] EDF: Methane as a Greenhouse Gas https://www.edf.org/climate/methane-other-important-greenhouse-gas

Biomass or fossil fuel burning coupled with carbon capture and storage technology is part of the UK Committee on Climate Change's predictions for a Net-Zero 2050.

Curtailment

During particularly windy times in the UK or times with low demand, wind and solar farms can be forced to shut down a portion of their capacity or slow turbines to sub-optimal speeds to avoid overloading the electricity grid. This process is called curtailment and is common practice in many countries. During these times, the generation sites still receive money from the National Grid for energy they are not producing. This cost is passed on to customers.

To overcome the curtailment issue, energy storage mechanisms will need to be put in place to take in excess energy when renewables are over producing and release it again at times of peak demand. Storage options include batteries, pumped hydro and the production of hydrogen.

Renewable Heat Incentive

While support of biomass is being phased out, support for anaerobic digestion looks set to continue. The RHI will finish in 2021 and the replacement is still out for consultation. The consultation indicates plans to limit support for biomass but continue support for anaerobic digestion. Biomethane produced through anaerobic digestion is the only green gas commercially available in the UK**. Increasing the use of anaerobic digestion is considered a low-regret option by the Committee on Climate Change**. Low-regret options are those expected to have good returns, low risks and that will continue to be important for the UK in a low-carbon future.

While the RHI process of providing a return based on the amount of renewable heat generated is likely to be changed to an upfront grant for heat pumps, the proposed **return for anaerobic digestion is to remain based on the amount of renewable heat generated.**

Currently the RHI provides a Tier 1 tariff for the first 40,000 MWh of eligible biomethane produced from anaerobic digestion, a lower Tier 2 tariff for the next 40,000 MWh then a lower again Tier 3 for remaining production. **The current proposals in the *'Low-Carbon Heat Incentive'* consultation lays out plans to increase the scope in Tier 1 to cover the first 60,000 MWh of eligible biomethane.**

The proposed tariff levels are:

- Tier 1 in the range of 4.9-5.5 p/kWh
- Tier 2 in the range of 3.25-3.75 p/kWh
- Tier 3 in the range of 1.5-2.75 p/kWh.

While increasing the amount of biomethane covered by the higher tariff, the **lifetime of the tariff is proposed to be decreased from 20 years to 15** to recognise the fact that the anaerobic digestion is now an established technology.

5.3.3 Policy Recommendations

The ability of the electricity grid to continue decarbonising whilst meeting the annual and peak demand as other sectors decarbonise requires significant planning and reduction of energy demand from buildings. Currently, many developers use solar PV to help new developments meet emission requirements but this method becomes increasingly less effective with time as the grid continues to decarbonise.

Without electric heating, solar PV panels can bring about no reductions in carbon emissions associated with gas heating, the main contribution to emissions from the UK building stock. The UK Committee on Climate Change has stated explicitly that

"Photovoltaics are not a substitute for low-carbon heating"   Committee on Climate Change

Policy makers therefore have to be careful about requirements for new builds in terms of CO_2 reductions: with the grid becoming increasingly low carbon, **PV cannot be placed on a roof and expected to achieve significant carbon savings for a house with a gas boiler**.

5.4 Energy Storage

5.4.1 High-level overview of sector

Energy storage is an important enabler for the transition to a decarbonised electricity system, and lithium-ion batteries are the most mature technology and the most relevant for the short to medium term, and are the focus here. As the penetration of intermittent renewable generation increases, this will increase the need for sources of flexibility, to maintain the stable operation of the electricity system, and energy storage is a key potential source of flexibility.

A range of revenue sources are possible for energy storage, depending on the application, as discussed in Section 4.3 above. For domestic battery storage, the main revenue source is increasing the amount of solar PV generation consumed on-site, although revenues from electricity price arbitrage[77] and services to the DNO and/or National Grid ESO (through an aggregator) could also be possible. Industrial and commercial storage can involve the "stacking" of a number of different revenue streams, including avoiding costs from transmission and distribution network charges, electricity price arbitrage, and provision of flexibility services (which may need to be through an aggregator depending on the scale). Grid-scale storage is generally focused on the provision of services to the DNO and/or National Grid ESO, along with possible benefits wholesale price arbitrage[78] and smoothing the load profile of co-located generation or demand sites (e.g. EV chargers).[79] Uptake of storage will primarily be driven by the revenues available, as well as the availability of sites with a suitable grid connection available (for grid-scale storage). The cost case will be improved as battery costs continue to fall.

5.4.2 Technology progress and outlook

The key driver for the emergence of energy storage in recent years has been the significant cost reductions seen, with costs falling by 87% between 2010 and 2019.[80] At the same time, increasing proportions of intermittent renewables on the electricity system have increased the need for flexibility from technologies such as energy storage. Uptake in the UK is relatively low currently, with around 700MW of grid-scale storage (which comprises the majority of the total installed capacity) installed as of June 2019.[81] Further decreases in battery costs (Lazard's Levelized Cost of Storage report projects a 28% decrease in capital cost over 5 years)[82] along with increases in the penetration of intermittent renewables will drive significant levels of future uptake. Furthermore, there is now a pipeline of several GW of grid-scale energy storage that could be installed in the UK in the coming years, although only a portion of these projects are expected to reach completion.

[77] i.e. charging the battery when their tariff is low and discharging when their tariff is high. This requires the customer to have a time of use tariff, which could be a simple Economy 7 tariff with different day and night rates or a more advanced time of use tariff with a smart meter (although few of these are available on the market to date, with those that are available mainly being offered by Octopus Energy).
[78] i.e. charging the battery when the electricity wholesale price is low (e.g. at times of low demand or high renewable generation) and discharging when the price is high (e.g. during the evening peak in demand)
[79] Co-location also has benefits in reduced installation and grid connection costs
[80] Bloomberg NEF 2019 Battery Price Survey
[81] Solar Power Portal: UK Battery Storage https://www.solarpowerportal.co.uk/blogs/uk_battery_storage_capacity_could_reach_70_growth_in_2019_as_business_model
[82] Lazard's Levelized Cost of Storage Analysis – Version 4.0 (2018)

5.4.3 Policy outlook and incentives

There are no explicit incentives in place to encourage uptake of energy storage, as policy has focused on removing barriers for smart technologies such as storage and enabling markets for flexibility, including flexibility procured by National Grid ESO and DNOs. Future uptake is expected to be driven by the need of the electricity system, which will be reflected in the revenue streams available to energy storage.

5.4.4 Future proofing

Deployment of energy storage to date has been driven both by the needs of the electricity system and by a range of demonstration projects, as well as by National Grid's Enhanced Frequency Response tender in 2017, which procured 201 MW of energy storage. As such, deployment is sufficiently well progressed relative to the system need to date, and so early action from local authorities is not expected to be required for future proofing to support energy storage. Note also that energy storage will in future be competing with other sources of flexibility, such as domestic, industrial and commercial demand response (either through behavioural change or direct control of appliances), EVs providing smart charging, and flexible generation (although this is currently fuelled mostly by diesel and gas). As such, there is some uncertainty around how much energy storage is likely to be required as it competes with these other sources of flexibility.

5.4.5 Recommendations for planning policy

It is not expected that planning policy will need to include requirements for the installation of energy storage, since uptake will be driven by the revenues available, reflecting the need for flexibility in the electricity system. As such, this is expected to be sufficient for determining the necessary level of uptake of energy storage, without the need for interventions around planning policy. However measures (such as guidance and training) to increase local authority officers' awareness of the benefits of energy storage could be valuable to support uptake where it is beneficial.

6. Renewable and Community Energy

6.1 Renewable energy in Stockport

This section of the report covers current and potential renewable energy projects in Stockport as well as recommendations of actions for Stockport Counci

The number of renewable energy sites and the associated energy generation is shown for Stockport along with the other districts of Greater Manchester for comparison. Additional renewable energy opportunities are discussed with reference to the maps in sections 0 and 0.

Policy recommendations and guidance are given based on stakeholder engagements with Stockport Hydro, Greater Manchester Community Renewables and Community Energy England. The policy recommendations are also informed by national and local recommendations and best practice of other local authorities.

6.1.1 Overview

As of the end of 2018, **renewable energy in Stockport** equated to

- 3,968 installed sites
- 20 MWh of installed capacity
- 31.9 GWh of annual generation.

In the figures below, renewable energy in Stockport is compared to that of the other districts in Greater Manchester. Solar PV is shown in a separate figure as the installation numbers for PV dwarf the number of other installations due to a very large number of small installations.

In terms of number of installations shown in Figure 6.1, Oldham and Rochdale dominate the statistics with a number of wind farms. The number of solar installations is shown separately in **Error! Reference source not found.** as solar installations dwarf other forms of the renewable energy in terms of numbers. After wind, plant biomass installations account for the second highest number. Manchester City has the highest number of solar PV installations with Stockport, Tameside and Wigan all above average for the Greater Manchester region.

In terms of the energy generation for each borough (as opposed to the number of installations) a very different picture appears from that of the installation numbers (**Error! Reference source not found.**). Despite a number of wind installations in Oldham and Rochdale, energy from wind almost disappears in the generation statistics due to the relatively small generation capacity of the wind farms. **Solar PV has a significant contribution to renewable energy generation in each of the districts. Other notable technologies in terms of generation are combustion-based technologies: plant biomass, landfill gas, sewage gas and anaerobic digestion.**

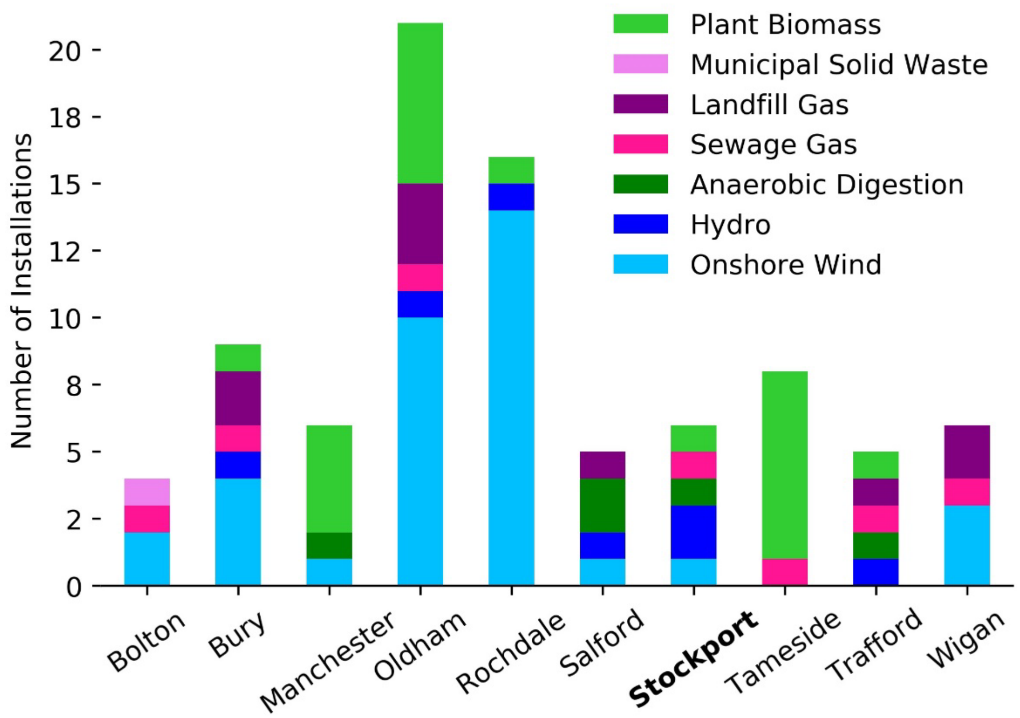

Figure 6.1: Number of renewable energy installations by type for each Greater Manchester District.

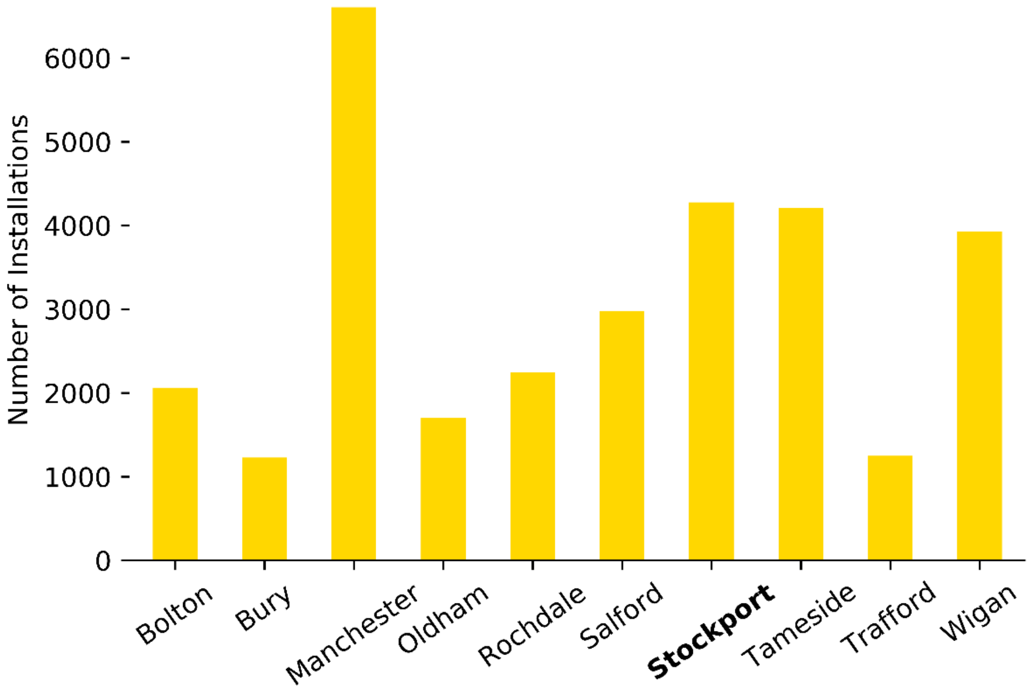

Figure 6.2: Number of solar photovoltaic installations for each district of Greater Manchester.

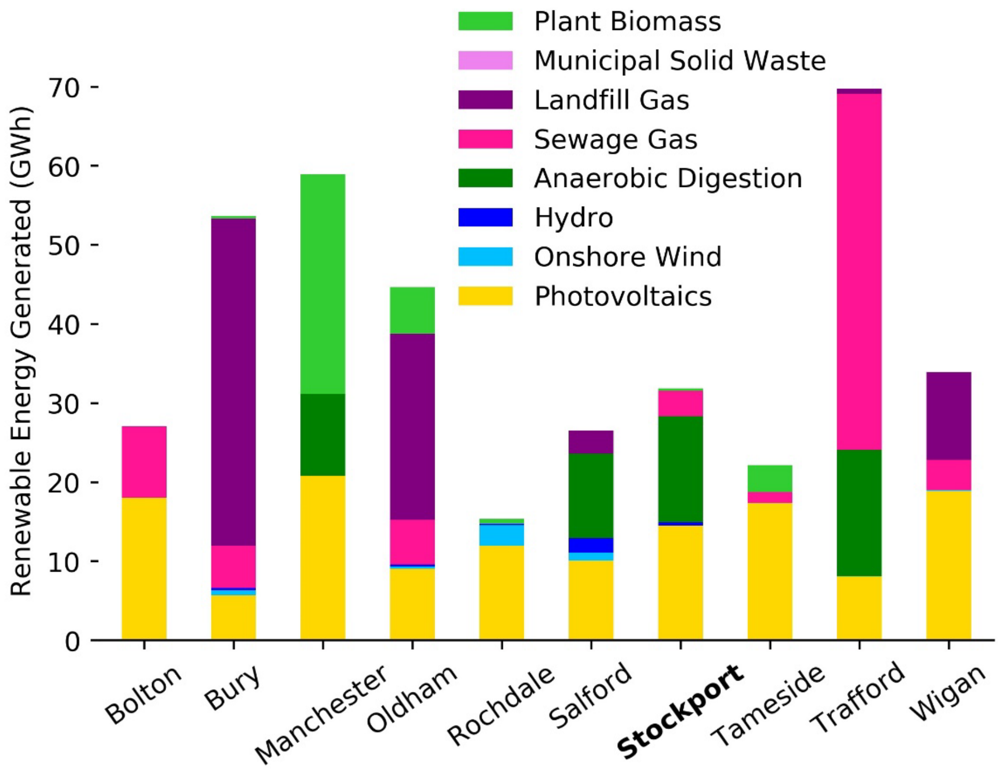

Figure 6.3: Renewable energy generation by type for each district of Greater Manchester.

6.1.2 Hydro Power

In 2008 a study was carried out to assess the feasibility of hydroelectric power schemes in Stockport. Eight sites were identified for initial assessment:[83]

- Castle Hill Weir
- Stringer's Weir
- Brinnington Weir
- Chadkirk Weir
- City Centre
- Strawberry Hill
- Brinksway Weir
- Otterspool
- Marple Bridge.

Of these sites, five were identified as potentially viable for hydropower schemes and are shown on the map in Figure 6.4. Of the five sites identified as feasible, two have now become functioning hydroelectric generators: Otterspool and Stringer's Weir. These sites are circled in orange on the map in Figure 6.4

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[83] Stockport Metropolitan Borough Council: Hydro Feasibility Study 2008

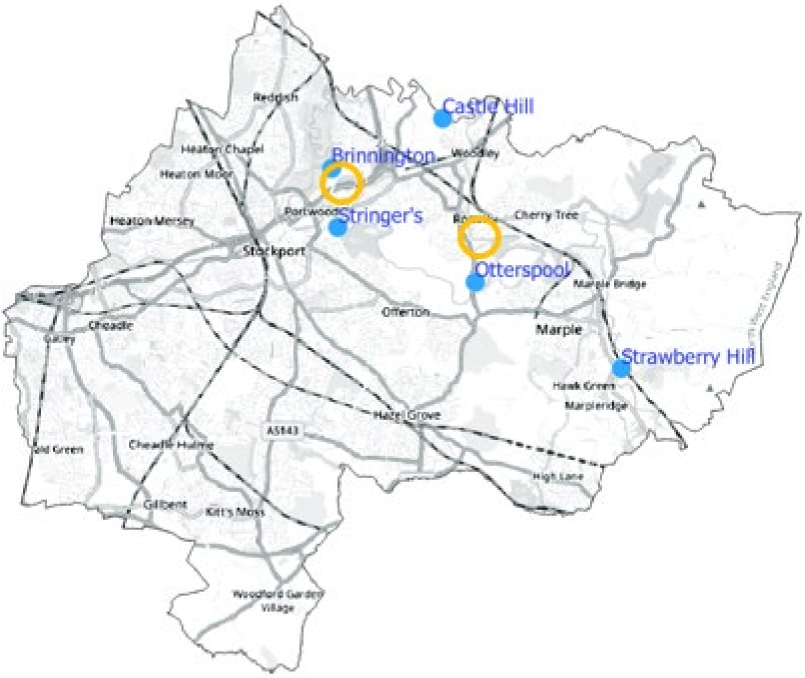

Figure 0.4: Viable hydro sites identified in Stockport.

Otterspool was identified to have a lower potential output than most of the sites considered viable due to the height of the weir being relatively small, however, the ease of access for this site made it attractive. Stringer's Weir presented a more difficult challenge in terms of construction but had higher potential power output.

The hydroelectric power system at **Stringer's Weir was built on the site of Pear Mill**, once a cotton spinning mill.[84] The mill has since been converted into commercial units but reintroducing hydropower has restored some of the heritage of the mill. The hydroelectric scheme, like the mill, is privately owned. In the original feasibility study, the site capacity was placed at 261 MWh per year but information provided on the construction predicted a capacity of 281 MWh per year. Images of the site can be found at the link in the footnote.[84]

The second hydroelectric scheme in Stockport is at Otterspool and is run by a local community organisation called Stockport Hydro.[85] The scheme officially opened in May 2013 and was the first community-owned hydro scheme in Greater Manchester. In early 2020, the two turbines (named Thunder and Lightening) passed the milestone of generating a total of 1.5 GWh of renewable energy.

Stockport Hydro was funded through a mixture of sources: an EU grant (for necessary environmental protection processes); a loan from the Charity Bank, and 329 shareholders. The majority of the shareholders live locally but there are also investors from outside the Greater Manchester area. Stockport Council was not involved with funding of the project but did provide support to establish the scheme. Returns from the scheme were initially used to pay off the loans

[84] Stringer's Weir Hydroelectric Scheme https://www.hallidayshydropower.com/casestudy/stringers-weir/
[85] Stockport Hydro http://www.stockport-hydro.co.uk/

but now the scheme pays dividends to its investors and provides funding for other local community projects. The **feed-in tariff accounts for 80% of the scheme's income** which will finish in 2033 and which the scheme is already planning for.

Stockport Hydro has nurtured strong community links with:

- Educational visits to the site that include the turbines and control room
- Site visits by schools
- Site visits by university students
- Funding for local projects
- Talks given elsewhere on community hydro schemes.

The scheme encountered several difficulties at its inception relating to financial issues and in securing the lease for the land beside the weir. Miscommunications within the council relating to land ownership led to significant delays and uncertainties at the early stages of the project. **Community Energy England indicated that bureaucratic costs for community projects are often much higher than expected with some projects reporting that legal compliance costs and waiting for permissions to be granted were 30% of their project costs.**

The Council can help to minimise these costs by:

- Keeping **accurate and up to date information on leases and ownerships** for buildings and land
- **Establishing set contracts** for community energy projects that are already cleared with their legal team
- Having a **designated member of staff** within the Council responsible for community energy projects
    - *"The Council needs a champion" Local Stakeholder.*

6.1.3 Wind Power

Stockport's 2011 Core Strategy has a policy that is strongly in favour of wind energy projects brought about by both community energy projects and commercial developers as a means for reducing CO_2 emissions. However, **multiple applications for wind turbines have been submitted in the Stockport area in the past decade and almost all have been refused**.

This fact makes wind energy too risky a venture for a community energy group at present. If a specific site were identified by the Council, or another group in partnership with the council, and planning permission granted then it may be possible to pass on such a project to a community group to manage and bring to fruition.

Wind energy is highly dependent upon the specific site, and sites are **discussed earlier in this report in 0.** There is currently only one wind installation in Stockport, according to nationally compiled statistics. The energy generated from wind in Stockport is only 10 MWh annually (by comparison, hydro produces 440 MWh annually from the two schemes). **Wind energy is currently a significant untapped renewable energy source in Stockport.**

The Greater Manchester Spatial Energy Plan estimates that **energy generation from wind in Greater Manchester has the potential to increase from 2.2 GWh per year in 2015 to 140 GWh per year.** Wind generation has generally been focussed on the northern boroughs in Greater Manchester such that Stockport would not be expected to see 10% of that generation. However, with **only around 0.2% of wind energy in Greater Manchester coming from Stockport**, the Borough could be said to be falling well below its fair share of wind installations.

The GMSF indicates the wind potential for GM based on a 2014 study from JBA Consulting. The study considered 6 of the 11 GM districts: Trafford, Salford, Wigan, Bury, Oldham and Tameside. The study identified potential for the installation of around 60 MW of wind energy across these boroughs although that potential was spread very unevenly across the boroughs: Wigan, with a relatively large amount of green space, was identified to have around 25 MW of potential; Oldham, Salford and Tameside were all identified to have around 10 MW each, while Bury and Trafford had potential only for around 2 MW each.[86]

In terms of windspeeds, **Stockport compares favourably to Bury and Trafford but lacks the larger areas of high windspeeds present in Oldham and Tameside**. These comparisons indicate that the wind potential in Stockport is in the range of 2-10 MW. Stockport also compares favourably to Salford in terms of windspeed though Stockport has slightly less open land. As Salford was identified to have potential of around 10 MW **is it likely that Stockport would sit towards the upper end of the 2-10 MW range for wind energy potential**. This is consistent with the fact that generation potential depends heavily on windspeed (discussed in 0). Based on the output factor from existing wind turbines in the GM area noted in the GMSF, this **installation potential would equate to 5-24 GWh of energy generation per year**, significant when compared to Stockport's current renewable energy generation of 31 GWh per year.

6.1.4 Solar Photovoltaic

Solar photovoltaic (PV) energy generation has seen major technological progress in the past two decades that has led to PV panels becoming an everyday sight in the UK.

The *'5-Year Environment Plan for Greater Manchester'* sets a target for **50% of Greater Manchester Homes to have 16 m^2 of solar panels by 2040**. According to national statistics, **Stockport had 4,276 solar PV installations at the end of 2018, just over 3% of households, generating 14.5 GWh of energy**. The planning office at Stockport Council has reported a fall in solar PV applications received over recent years, thought to be the result of several factors, including:

- Phasing out of the feed-in tariff
- Easiest properties/most willing homeowners have already installed PV
- Not all PV installations require planning permission.

Stockport Homes has installed 1,924 solar PV installations on the Council's residential properties and also manages some of the installations on other non-residential buildings owned by Stockport Council. As such, **Stockport Homes is responsible for almost half of solar installations in Stockport** despite only accounting for 14% of Stockport's total dwellings. Of the properties managed by Stockport Homes suitable for solar PV installations, 30% have PV installed, below the 50% ambition of the GM 5-Year Environment Plan; even amongst the leading entities in Stockport with regards to housing sustainability. To meet the Greater Manchester target, significant upscaling of installation will be required.

The histograms in Figure 0.5 show how Stockport compares to other local authorities in England. In terms of overall number of installations, Stockport is well above the average for local authorities in general. However, when the number of installations is considered as a percentage of the number of houses in a local authority, **Stockport is around the national average in terms of the percentage of houses with PV installations**.

Stockport does not have any large-scale solar PV farms but Stockport Council is part of the Greater Manchester process of assessing council owned land across GM for solar potential. There is currently a scheme in Salford at the Salford Road Recycling Centre which generates 2 GWh of renewable electricity per year. Based on the number of installations and energy

[86] The capacity of generation in given in units of power: kilowatt kW, megawatt MW, gigawatt GW. Power is energy produced per unit time, as such energy is described in units of power multiplied by time such as megawatt hours, MWh. The energy that is produced by an installation is given in units of energy over a given period such as MWh produced per year.

generation from current PV installations in Stockport, a scheme of the size at Salford Road would be equivalent to around 600 individual rooftop installations.

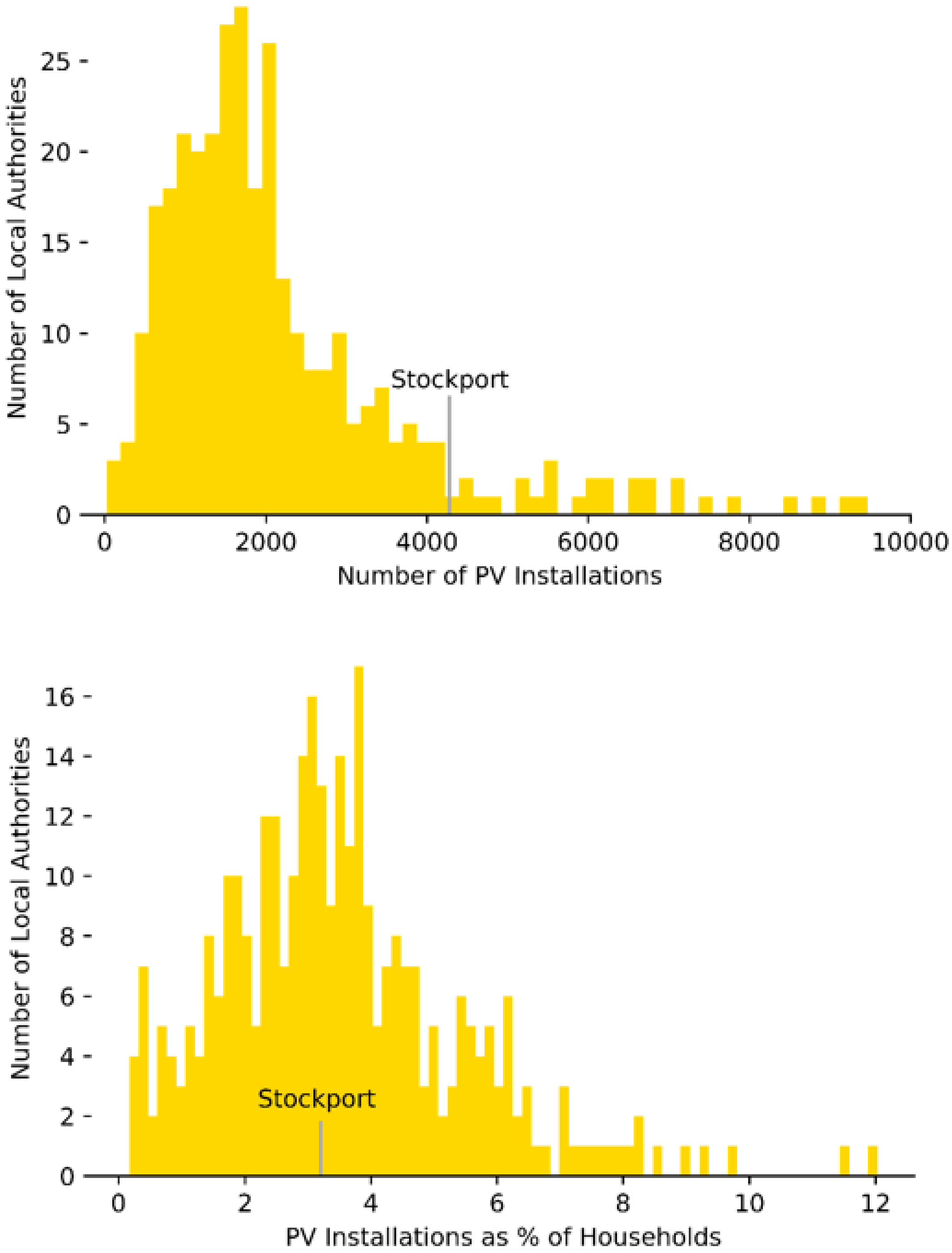

Figure 6.5: Number of solar photovoltaic installations for local authorities in England.

The website **PVsol provides a free online tool for predicting the annual energy generation from solar PV panels.**[87] Users can adapt the model to account for

- Location
- Solar array size
- Roof angle and orientation

[87] PVsol http://pvsol-online.valentin-software.com/#/

- Solar panel type
- Invertor type
- Household energy consumption.

A standard rooftop system in the UK is likely to have around 3-3.5 kW generation potential (also referred to as kilowatt peak, kWp). With an area of around 19-22 m^2, such a system would be slightly larger than the 16m^2 aim for 50% of homes in Greater Manchester but with increasing panel efficiencies area requirements will come down over time.[88]

Using a 3 kW system, a house in Stockport could expect to generate around 2,700 kWh of electricity per year. The average home in Stockport uses around 3,800 kWh per year. However, PV energy cannot cover energy demand outside daytime hours without being coupled with storage. Additionally, peak solar energy generation is in the middle of the day when domestic usage is generally low. Excess energy that is not used by the panel owner is fed into the grid, for which the panel owner is currently paid 5.5 pence per kWh. The homeowner then has to purchase electricity from the grid at other times of day at a higher cost, typically 15.8p in early 2020. **There are two ways to maximise returns from solar PV installations on the home:**

- Use the energy during the day
- Store the energy to use later.

Energy storage systems, such as batteries, are becoming increasingly popular in-home installations. Prices have been falling quickly, benefitting from advances in battery technology fuelled by the drive towards electric vehicles. Battery storage options are discussed further in section 0.

Methods for using the energy generated from panels can be as simple as using electricity heavy appliances such as dishwashers and washing machines during sunlight hours. Charging EVs from solar panels is another useful way of using solar energy but this option is often more restricted to weekends when people are not driving to work.

Places with high daytime energy usage are particularly well placed to take advantage of solar panel: offices, leisure centres and schools being obvious examples. Workplaces such as offices and business parks can take advantage of EVs using energy generated from solar panels. With EV battery capacity increasing there is a vision for the future where EVs charge at workplaces using energy from PVs then take that energy home and power their homes during the evening peak hours. Such schemes would be beneficial to the grid in reducing peak demand but they can also reduce emissions as fossil fuel and biomass generators are likely to still be used to cover peak demand on the electricity grid.

Schools have been identified as ideal places to create community solar projects as they offer a number of advantages:

- High daytime usage
- Large roof space
- Centres of local community
- Stay the same use for many years reducing risk of site changing hands/demand
- Act as educational resource
- Increase school children's awareness of renewable energy.

Greater Manchester Community Renewables (GMCR) is a community energy group run by volunteers.[89] The group raises funding through community shares to install solar panels on public buildings. The group was started with peer support from Bath & West Community Energy, which

[88] Greenmatch: How many solar panels do I need? https://www.greenmatch.co.uk/blog/how-many-solar-panels-do-i-need
[89] Greater Manchester Community Renewables https://www.gmcr.org.uk/

was significantly more established. Currently GMCR have installations on eight schools and a community centre. The panels provide cheap electricity to the schools and community centre with financial returns going into a community fund that supports other local carbon reduction and environmental projects.

Seven of the eight school projects that GMCR run are in Salford with one in Bury. **GMCR have a cooperation agreement with Salford Council** in which the Council agrees to

- Help identify potential sites
- Promote share offers.

The promotion of share offers by the Council is particularly useful for GMCR as it means their share offers are being promoted by a trusted source.

GMCR were also able to establish a set lease that could be reused for all of the projects with Salford Council. Removing the requirement for each site to have a separate lease written and agreed reduced administration, delays and costs associated with each project. **Community Energy England indicated that bureaucratic costs for community projects are often much higher than expected with some projects reporting that legal compliance costs and waiting for permissions to be granted were 30% of their project costs.** When GMCR set up their first project in Bury they were able to use the same lease template with some minor changes requested for the project in Bury. **GMCR now has a lease template to enable the group to limit administrative and legal costs associated with starting a new project.**

Currently all GMCR's projects have a capacity below 50 kW as schemes of this size can generally be installed without planning permission. GMCR are considering upscaling and may be involved with larger projects in the near future.

The 5-Year Environment Plan for Greater Manchester sets a target for 10% of local renewable energy to come from community energy projects.

- Currently Stockport produces 31 GWh of renewable energy each year
- Around 0.2 GWh is currently produced by the community run Stockport Hydro
- Several 50 kW PV projects on schools run by GMCR generate approximately 20 MWh annually

  Meeting the GM target of 10% of renewable energy from community energy would require138 projects on the scale of GMCR's solar schools in Stockport based on current renewable energy generation in the borough. Ideally, renewable and community energy projects will cover a range of technologies to provide diversity and flexibility in the supply.

6.1.5 Solar Thermal

In the '*Leading Lights'* report from the Solar Trade Association, there is a message that warns local authorities[90]

*"**Don't forget solar thermal**: This highly reliable technology cuts bills and emissions in both dense, urban areas as well as rural areas off the gas grid, where fuel-poor households are often more prevalent. It's also a natural choice for leisure centres and will become increasingly important as a zero-carbon heat source for local heat networks."*

While solar PV has received far greater attention in recent years, solar thermal technology is a viable option for reducing bills and emissions for various sites. Solar thermal is very commonly

[90] Solar Trade Association: Leading Lights report https://www.solar-trade.org.uk/wp-content/uploads/2018/04/local-authority-solar-guide-WEB.pdf, Cardiff Leisure Centre case study on page 12.

seen on rooftops on mainland Europe, particularly in the south, where solar thermal is used to provide hot water.

Solar thermal differs from solar photovoltaic in that solar thermal directly collects heat from the sun where solar photovoltaic uses light to generate electricity. Solar thermal is therefore particularly suited to sites with a high hot water demand such as leisure centres. Leisure centres typically have very large roof areas covering indoor courts and swimming pools as well as high hot water demand for showers and pool heating. Payback times for solar thermal schemes on leisure centres are expected to have payback times of around 10 years with technology guarantees of 20 years.

The leading lights report includes a case study of a **City of Cardiff Council scheme that involved the installation of a solar thermal scheme during the regeneration of a leisure centre**. The scheme brings down annual energy costs by 30% compared to using a gas boiler and is expected to save 375 tonnes of carbon over its lifetime.

Recommendations from the Solar Trade Association

The **Solar Trade Association** issued a report aimed at local authorities titled "*Leading Lights: How local authorities are making solar and energy storage work today"*. The report covers various options for local authorities to boost solar energy generation within their region including **community schemes and Council owned schemes**, an increasingly feasible option for councils to generate revenue while reducing carbon emissions. The report also provides a set of case studies from across multiple local authorities that demonstrate successful use of solar technologies.

As part of the Leading Lights report, ten recommendations are given for local authorities with regards to solar:

1. Make full use of planning powers to **stipulate higher energy performance in new developments** at all scales.
2. Make wider use of planning powers to support solar, including making use of **Local Development Orders** to identify and support the development of larger solar schemes, which helps to reduce costs.
3. Be ambitious. High volumes and larger rooftop schemes mean lower unit cost, improving project economics for rooftop solar. **Efficient tender schemes**, such that run by Portsmouth City Council,[91] enable local solar companies to bid competitively.
4. Make full use of **Salix Finance interest-free loans** to retrofit existing Council buildings and **always go solar when replacing roofs as part of a buildings upgrade** programme.
5. Help local people and SMEs to go solar by running **bulk purchase discount schemes**.
6. At a minimum, provide **relief from business rates** for solar and storage for state schools, health centres and Community Benefit Societies, Community Interest Companies and Co-ops that have invested, or want to invest in, onsite solar power and storage for self-consumption.
7. **Support community-led solar initiatives by providing land or roof-space, expert advice, and by facilitating administration, including of financing options**.
8. Don't forget **solar thermal**.
9. Plan for **smart** neighbourhoods.

[91] The News: Portsmouth City Council's Solar Scheme https://www.portsmouth.co.uk/news/politics/portsmouth-city-councils-solar-panel-work-wins-warm-praise-sunny-outlook-298917

10. Engage with **BEIS's new Local Energy Programme** which funds all Local Enterprise Partnerships (LEPs) to develop a local energy strategy and is a good opportunity to set out each local authority's solar ambitions.

Stockport Council already has taken action on some of these recommendations including in requiring higher energy performance for new developments and using bulk purchase orders (recommendations 1 & 5). The recommendations for support for community energy projects were similar to those from Greater Manchester Community Renewables and Community Energy England in providing sites, facilitating administration and providing/highlighting funding options.

The recommendation to **'always go solar'** (point 4) during other building upgrades highlights the fact that it is very rarely the case now where solar is not a viable option for reducing emissions, and costs associated with installation are significantly reduced when roof works are already taking place.

6.1.6 Anaerobic Digestion

There is one anaerobic digestion facility in Stockport, Fairfield Bio Energy in Bredbury, which is a combined heat and power plant.[92] **The Bredbury site uses food waste collected from local business to produces biogas** that is used to provide renewable heat and electricity. According to national statistics, the site has a 2.8 MW capacity and generated over 13 GWh of renewable energy in 2018, about 0.5% of Stockport's annual energy demand and over a third of Stockport's renewable energy generation.

Another option for anaerobic digestion is sewage waste. The use of sewage gas contributes significant amounts of renewable energy in other boroughs of Greater Manchester, **particularly in Trafford where the majority of renewable energy comes from sewage gas.** Stockport has one waste-water treatment plant. Using energy produced onsite, waste-water plants can provide power for their own processes rather than using the electricity grid or fossil fuels.

6.2 Planning policy recommendations

6.2.1 Existing policy in Greater Manchester

The GM 5-Year Environment Plan contains a number of recommendations for local authority actions and local policies relating to renewable energy and community energy projects:

- Local authority actions
  - Procure renewable energy tariffs (from GM sources if possible) when they are next available
  - Complete a full assessment of assets for renewable energy generation (underway in Stockport) and develop these assets (where financially viable) by the end of 2021
- Local polices
  - Establish an investment vehicle to develop assets for renewable energy and deliver renewable energy generation on estate
  - **Require 20% renewable energy generation at new developments (GMSF policy may incorporate this)**
  - Examine the potential to establish a GM collective solar PV/battery purchase scheme to drive up local uptake

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[92] Green Growth: Fairfield Bio Energy https://www.green-growth.org.uk/article/5m-bio-energy-plant-opens-stockport

- ▻ Seek funding to identify which low-carbon heating solutions are best suited to their region
- ▻ Identify heat network opportunity areas
- ▻ Convene key partners with a view to the development of a hydrogen strategy for GM.

In consultation, Greater Manchester Community Renewables provided a '*wish list'* for councils to provide to aid community energy projects:

- ▻ **A list of potential sites**
- ▻ **A standard legal agreement**
- ▻ **Grants to help establish new community energy groups.**

With the GMCR wish list in mind, Councils can:

- ► Survey Council owned sites for wind and solar potential
  - ▻ Publicise these findings with local community groups that may be interested in setting up a community project
  - ▻ Where possible, carry out feasibility studies to reduce risks to community projects
- ► Establish a standard agreement for community energy projects
  - ▻ Liaise with local community groups
  - ▻ Agreed with the Council's legal team
- ► Provide information and grants for community energy projects
  - ▻ Options for Council funding include
    - grants to help establish groups
    - low-interest long-term loans
    - short-term loans to cover up-front costs such as VAT that will be refunded
  - ▻ Direct community groups towards other sources of funding
  - ▻ Support community groups in securing other sources of funding
    - Salix Finance
    - Charity Bank
    - Rural Energy Fund.

GMCR also noted that Electricity North West (ENWL), the local electricity network distribution operator, had been particularly helpful in identifying any issues with sites and general support with projects. ENWL runs workshops for renewable energy projects where groups can check how their project would affect the grid and any processes they might have to put in place to mitigate effects on the local grid. ENWL provides funding for local energy projects and has a web page dedicated to community and local energy found in the footnote.[93]

6.2.2 Best Practice in UK Local Authorities

Community Energy England (CEE) is a not-for-profit organisation that supports community energy groups and projects throughout England. CEE carried **out research into community energy projects across various local authorities** and found that:

"Where local authorities have made a serious commitment to invest in the creation and development of both community energy organisations, and subsequent community led renewable energy and energy efficiency projects there has been significant, sustained and recognised success." Community Energy England

[93] Electricity North West: Community and Local Energy https://www.enwl.co.uk/zero-carbon/community-and-local-energy/

Leading local authorities with regards to community energy have generally been those with community projects that go back many years that have forced the Council to think forward. Sustainability has been very visible in **Bristol** for a long time and allowed new ideas to come through and be supported. **Oxford** has been a low carbon hub for a long time which gives it the confidence to go ahead with new projects.

Recurring characteristics within forward thinking Councils are:

- Experience
- Confidence
- Confidence to look long term
- Being open and accepting in solutions
- An engaged population who push the Council
- Experienced and willing officers
- Civic imagination.

Experience and confidence are naturally built over time but can be accelerated by bringing in good people and actively pursuing information and education around low-carbon technologies. Where individuals or departments within a Council make an effort to be forward thinking there must be means to spread that expertise through programs like carbon literacy training. **Those at the top levels of the Councils must be pushing for sustainability awareness across all sectors of the Council to avoid pockets of enthusiasm and good will being isolated.**

An engaged population can be a major driving force in pushing those at the top of the Council to place sustainability high on the list of priorities. The UK is currently seeing an increasingly engaged and enthusiastic population when it comes to the climate crisis. Places like Bristol are well known within the UK for being a green hub which has created a positive feedback loop of a population that is increasingly aware and engaged with sustainability issues and a Council who has the confidence to accept new solutions and look long term.

To plan long term for a zero-carbon future requires a level of imagination within the Council. The UK's energy, housing and transport systems of the future will not look the same as today's: many of the same buildings will still stand but be powered differently; energy generation will be more local and much more visible to most of the population; and transport systems will be cleaner and quieter. **Councils' future plans will have to incorporate imagination into their planning and spatial planning to effective change on the required scale**.

6.2.3 Common Issues for Community Energy Projects

Community Energy England identified some common issues for community energy projects

1. **Land leases: Councils should have a thorough understanding of lease and licensing issues around Council land and buildings**, especially schools where there may need to be communication with the Department for Education.
    - *Incomplete knowledge around Council owned land was a major issue at the start of the Stockport Hydro project.*
2. **Full transparency around any associated buildings works (insulation etc).** Lack of communication and understanding with buildings works going on around new solar installations for instance, has previously caused delays and financial issues for community energy projects.
3. **Bureaucratic costs**: projects have reported **that legal compliance costs and waiting for permissions to be granted were 30% of their project costs** which can be crippling at the start of a project.
4. **Cash flow:** when installing solar PV, VAT can be reclaimed, however, the money needs to be paid up front then reclaimed from HMRC. This process takes time and can put serious financial strain on projects.

Unsurprisingly, **many of the points made about local authority involvement in community energy projects made by Community Energy England echoed those made by Greater Manchester Community Renewables**.

On the issue of **cash flow**, the CEE suggested that if a Council could provide an interest-free loan for the VAT period that would carry projects across. The loan could start to acquire interest after the time that the VAT is returned. Installing to project deadlines can be helpful for getting projects moving. Where possible, the use of development loans that can convert into grants if a project has life threatening difficulties may save local projects. Such grants often still show a return over the longer term to the Council.

CEE also noted **the importance of having an individual or group within the Council that was responsible for supporting community energy projects**

- This person should ideally be knowledgeable about planning policy and energy projects and must be enthusiastic about the seeing the project through
- Provision should be put in place such that this responsibility is formally passed on in the event of an individual leaving/being on long term leave.

While community energy projects may be assigned to one person's job description, **CEE emphasised that carbon reduction should be in everyone's job description**, in everyone's annual appraisal and that carbon reduction targets should be led from the top.

6.2.4 Policy Recommendations

A number of policy recommendations relating to renewable and community energy are provided, some of which might not specifically be planning policy but require consideration by the Council to support planning policy implementation that delivers carbon reduction. These cover a range of issues including but not limited to ease of application, associated cost and resources and expected levels of impact on the uptake of renewable and community energy:

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td rowspan="3">Promote</td><td colspan="4">Objective: Promote renewable energy generation</td></tr>
<tr><td rowspan="2">Increase renewable energy generation in Stockport.</td><td>RE Policy 1: Keep the current policy (Development Management Policy SD-5) in place that promotes local renewable energy generation from commercial, individual and community projects.</td><td>Local opposition, to commercial projects in particular.

Land availability.</td><td>Reduction in electricity costs.

Community engagement, empowerment and education.</td></tr>
<tr><td>RE Policy 2: Add requirement for local diversity and flexibility of electricity supply to be considered in all renewable energy planning applications.</td><td>Financial constraints with the removal of the feed-in tariff.</td><td>Profits often used to fund other community initiatives.</td></tr>
</table>

	Target	Policy	Risks and Barriers	Associated Benefits
		RE Policy 3: Require local benefits to be included in all renewable planning applications, for example carbon savings, reduced fuel prices, community benefit scheme, reinvestment of revenues into local schemes.		
	Justification: Current policy is worded positively with regards to renewable energy. The GM 5-Year Environment Plan targets at least a further 45 MW of renewable energy generation within GM alongside a priority for increasing the diversity and flexibility of GM's electricity supply.			
Promote	**Objective:** Promote wind energy generation			
	Increase energy generation from wind in Stockport.	**RE Policy 4:** Identify potential sites for wind energy. **RE Policy 5:** Carry out feasibility studies on Council owned sites within Stockport. **RE Policy 6:** Publicise options for wind energy in the borough.	Local opposition. Peatlands should be specifically avoided as sites for any kind of development including renewable energy as they are a valuable carbon sink but easily damaged.	Establish a planned methodology for delivering wind energy in Stockport Opportunities to engage and support local groups who wish to support / take forward wind schemes

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td></td><td colspan="4">Other recommendations: Pre-assess planning requirements for a site to ensure that projects could get through planning. Ensure all planning officers are clear on the Council’s aims around wind generation and the opportunities it offers.

Avoid use of wording that makes for easy objections to be made purely on their being any visual impact associated with a project. However take account of Stockport’s 2018 Landscape Character Assessment findings concerning sensitivity of sites to wind energy.

Justification: There is significant untapped potential for wind energy in Stockport.

The wording of current policy with regards to wind energy is strongly positive and could be retained, however, almost all applications for wind turbines in the borough have been denied to date.</td></tr>
<tr><td rowspan="5">Promote</td><td colspan="4">Objective: Promote solar energy generation</td></tr>
<tr><td rowspan="2">50% of households to have 16 m^2 of solar PV installed (GM 5-Year Environment Plan)</td><td>RE Policy 7: Encourage the establishment of a GM collective solar PV/battery purchase to drive up residential uptake</td><td>Renewables get value engineered out of projects at later stages.</td><td rowspan="2">Reduced bills for local users.

Potential revenue source for council.</td></tr>
<tr><td>RE Policy 8: Carry out a feasibility study of Council owned land for solar energy generation[94]</td><td></td></tr>
<tr><td colspan="4">Justification: Some new developments in Stockport have not installed solar PV despite being in a suitable position to.

Solar PV is now relatively cheap to install when roof works are already being undertaken and can add to the sale / rental value of the property reflecting lower running costs.</td></tr>
</table>

[94] This is already underway across GM (including Stockport) led by GMCA as part of the Go Neutral programme

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td></td><td colspan="4">Allows Council to deliver likely GMSF targets or set realistic targets for local renewable energy generation and assess earning potential of assets.</td></tr>
<tr><td rowspan="7">Promote, Support and Fund</td><td colspan="4">Objective: Promote community energy projects.</td></tr>
<tr><td rowspan="5">Make the process of gaining planning permission and securing land/roof leases as easy as possible for community energy projects.</td><td>RE Policy 9: Establish a staff position within the Council that has responsibility for supporting community energy projects.</td><td rowspan="5">Current existing policy has not resulted in large numbers of community energy projects

Time requirements may not be enough to justify a new member of staff but may be too much to add onto the workload of an existing member.

In this situation, a case should be put forward to GM to have a designated person for the GM regions without their own officer.</td><td rowspan="5">Community energy projects are educational resources for learning about energy, sustainability and increase science capital in the local community.

Returns from community energy projects are often invested into other community projects, as with Stockport Hydro.</td></tr>
<tr><td>RE Policy 10: Establish a set agreement that can be applied to multiple renewable energy projects.</td></tr>
<tr><td>RE Policy 11: Carry out feasibility studies on sites to assess their potential renewable energy.</td></tr>
<tr><td>RE Policy 12: Share the findings of feasibility studies with community groups with an environmental interest within Stockport and Greater Manchester.</td></tr>
<tr><td>RE Policy 13: Provide grants or short-term loans to reduce up front costs, particularly those that will be recovered such as VAT.</td></tr>
<tr><td colspan="4">Other recommendation: Salford has multiple community energy projects – make use of peer support within the GM boroughs to establish best practice locally. Salford currently has a cooperation agreement with GMCR, SMBC should establish a similar system.

Justification: The GM Community Energy Action Plan has a vision for 2024 in which community energy will be generating at least 10% of GM's community energy targets.

Retention of existing policy supported by actions that enable Council to support renewable energy schemes, including community owned types. The policy</td></tr>
</table>

	Target	Policy	Risks and Barriers	Associated Benefits
	requires support as suggested below in terms of translation into actual renewable energy schemes. Issues encountered in previous community energy projects (both within Stockport and elsewhere) have been with securing council approval not solely associated with planning policy. Reduce costs and time associated with lease, legal and administrative issues. These costs are often a large portion of initial costs for community energy projects. Organisations like Greater Manchester Community Renewables identify projects then bring together communities to bring the project to fruition. Identification of potential sites is an important step in enabling community renewable projects. Carrying out feasibility studies removes much of the initial risk for community projects. With the abolishment of the feed-in tariff, community energy projects are significantly harder to finance.			

7. New Developments

While "addressing inequality and climate change" was the first objective in SBMC's 2011 Core Strategy, "housing" was the second. The SMBC Stockport Housing Strategy 2016-2021 opens by saying "Stockport faces a housing crisis", a sentiment echoed by many individuals in the Council. To meet the housing need SMBC has set housing goals related not only to the number of new homes, but also to achieve a mix of housing types and affordability.

Stockport Council has designated a number of areas in Stockport as neighbourhood renewal priority areas. These areas are shown in Figure 7.1 and are largely concentrated around the town centre with other sites spread across the borough. **The Committee on Climate Change has urged local authorities to play a role in "ensuring that new housing developments are designed for access to public transport"**. Stockport's 2011 Core Strategy already included this intention with the proposal that:

"Residential development will also be focused in the areas surrounding the Town, District and Large Local Centres, as well as in other locations that are genuinely sustainably accessible within the urban area." 2011 SMBC Core Strategy

Projections from the GMSF predict that **Stockport will have an average of**

- **580 new dwellings per year between 2018 and 2023,**
- **830 new dwellings per year between 2024 and 2037**.[95]

Around a third of these new dwellings are expected to be in the town centre, at least in the short term, with a local trajectory of 200 new dwellings per year planned as part of the town centre redevelopment.

[95] GMSF https://www.greatermanchester-ca.gov.uk/media/1710/gm_plan_for_homes_jobs_and_the_environment_1101-web.pdf

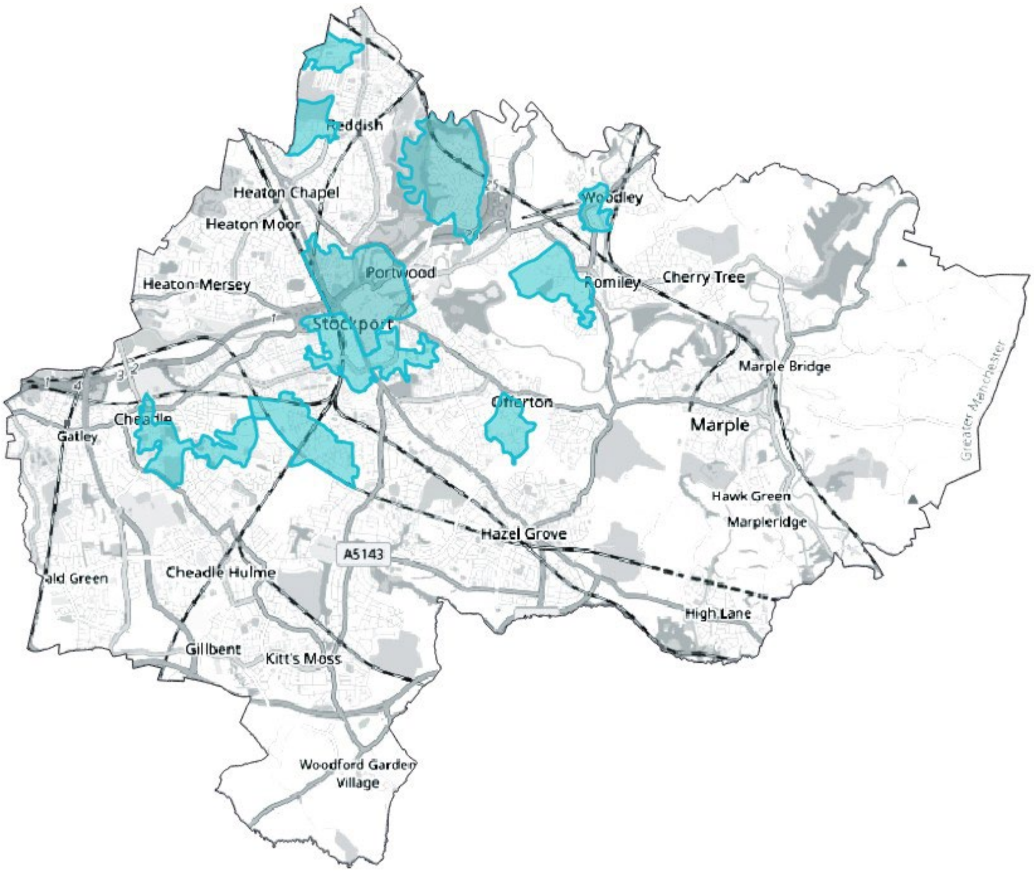

Figure 7.1: Priority neighbourhood renewal areas in Stockport.

7.1 Town Centre Development

The redevelopment plans for Stockport town centre include new dwellings and commercial developments/floorspace and a lot of change of use in buildings. The intention is to add 5,000 new dwellings to the town centre area within the area outlined in the box below. The redevelopment will shift a number of areas from predominantly industrial areas to predominantly residential areas. Most of these new dwellings in the town centre will be flats (around 80%) although there are plans to include provision of family homes.

The focus on the town centre for redevelopment aligns with a number of strategic aims within both Stockport Council and Greater Manchester:

- The *'brownfield first'* preference for new developments is set out in the Greater Manchester Spatial Framework
- The Core Strategy aims for new developments to be *"genuinely sustainably accessible within the urban area"*
- A preference expressed by the council and the local community to limit development of greenfield sites and preserve the local natural surroundings
- The town centre has been identified as a neighbourhood renewal priority area by Stockport Council
- Increasing the residential population of the town centre is a key part of the Council's long-term approach to maintaining and enhancing the town centre as a place to live, work, visit, and connect.

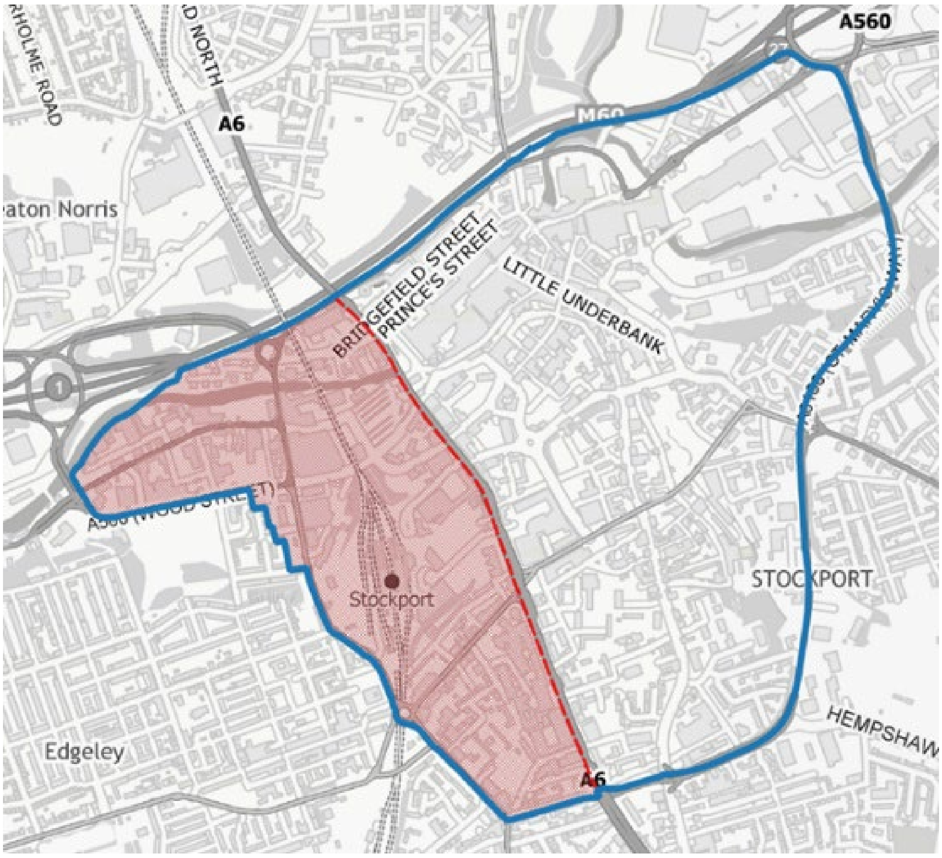

Figure 7.2 Stockport Town Centre West

- The pink shaded area been identified for around 3,500 new dwellings; primarily flats with a small number of houses.
- An additional 1,500 new dwellings are planned in the rest of the Town Centre (blue boundary).
- Building in this region is in line with the plan to deliver housing that is “genuinely sustainably accessible within the urban area” as laid out in the Core Strategy document.
- In this development, consideration is being given to various sustainability measures
- Planning of this development is in progress.

In the planning of the town centre redevelopment, the Council is working to deliver an overall ambition through a number of initiatives including:

- Zero-carbon homes:
    - Highly energy-efficient homes
    - Electric heating options
        - Electric heating demand has been informed by data from Salford high rises
    - District heat networks
- EV charging infrastructure:
    - Including smart charging to alleviate pressure on the electricity grid
    - The inclusion of solar panels on car park roofs and facades to generate power for electric vehicle charging
    - Use of battery storage options to store energy generated by solar panels
- Sustainably managed waste streams

- Enhancing the provision of public transport (e.g. through redevelopment of the Interchange and through the GM Mayor's commitment to extend the Metrolink network to Stockport)
- Providing more opportunities for cycling and walking within an approach to public realm that encourages healthier lifestyles.

The **Stockport Mayoral Development Corporation (MDC)** is spearheading the regeneration in Town Centre West. The MDC is committed to putting sustainability at the heart of its development programme and finding solutions to current viability and feasibility constraints. MDC noted that there was a *'viability gap'* between the aims of the regeneration plans and the likely reality. The MDC identified some of the major barriers to closing the viability gap:

- Funding models for development that do not currently encourage zero carbon development
- Lack of detailed specialist knowledge around carbon reduction technology options
- Lack of maturity and proven track record of delivery associated with some technology options

Lack of widespread experience of successfully delivering zero carbon development in industry and in the public sector.

7.2 Other Developments in Stockport

The Greater Manchester Spatial Framework plan will allocate areas around Greater Manchester as future residential areas and employment areas. In the responses to the initial GMSF consultation, there has been strong opposition to the release of greenbelt land for new developments. As can be seen in Figure 7.3, all of the proposed development areas in Stockport are in the green belt, including 7 residential allocations and one employment area allocation at Bredbury.

Figure 7.3: Draft GMSF allocations for residential and employment areas.

7.2.1 Site Appraisal in Stockport

Throughout Stockport, a number of site appraisals have taken place some of which are of potential brownfield redevelopment sites. Almost all of these sites are within the designated urban area.

Several site appraisals have taken place in the area around Stepping Hill Hospital which was a area identified as having high domestic heat demand and may therefore be a promising area for district heating.

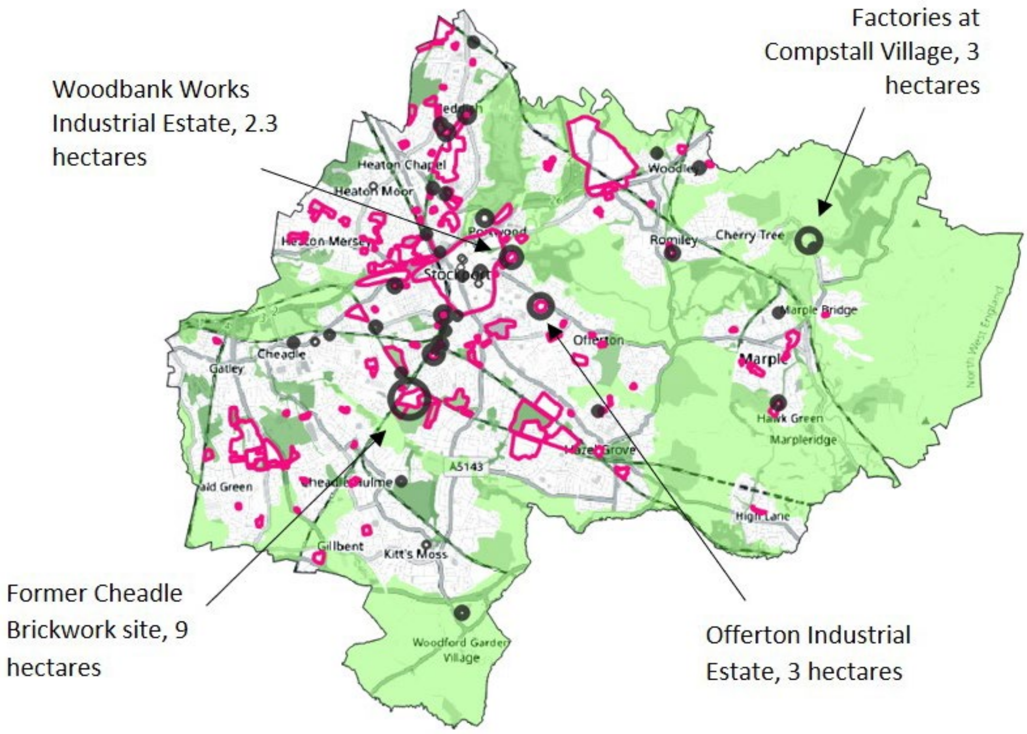

Figure 7.4: Site appraisals (pink) and brownfield sites (black circles) in Stockport.

7.3 Policy Review and Best Practice

7.3.1 Changes to UK Planning Policy

Planning policy concerning the design and construction of new developments allows for the government and local authorities to set minimum requirements relating to emission rates of a new development. **To calculate the emissions rate, a notional building of the same size and shape of the dwelling is defined then a series of calculations are carried out to provide a target emission rate (TER).** The TER system was established in 2006 and amendments have been made since to bring the TER down overtime with the eventual aim of having zero-emission new developments. There were previously government plans to bring in zero-emission new developments from 2016 but these plans were scrapped.

Future Homes Standard

At the time of this report, a consultation was underway from the Ministry of Housing, Communities and Local Government on proposed changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings from 2020.

Two options were being considered by the government for energy efficiency standards and requirements in new developments:

1. Option 1: **Fabric-based improvements - 20% reduction in carbon emissions** compared to the current standard for an average home. Expected to be delivered by very high fabric standards (typically with triple glazing and minimal heat loss from walls, ceilings and roofs).
2. Option 2: **Fabric- and technology-based improvements - 31% reduction in carbon emissions** compared to the current standard for an average home. Expected to be delivered by carbon-saving technology such as photovoltaic (solar) panels and better fabric standards, though not as high as in option 1 (typically double not triple glazing).

The government currently favours option 2 as it has greater carbon savings and lower energy bills for occupiers, however, option 2 does have higher build costs. Early indications suggest that the construction industry also favours the second option of a 31% reduction target.

The calculations for carbon emissions on new properties has been carried out with the assumption that they will be built with a gas boiler. However, the **31% carbon reduction is likely to encourage the use of alternative, low-carbon heating technologies** to meet the emissions target cost-effectively. With an emphasis on technology in option 2, the hope is that extra demand will prepare supply chains in low-carbon heating technologies and increase the number of trained installers.

Consideration has been given to the affordability of running alternative heating technologies. The cheapest (in terms of upfront costs) form of low-carbon heating to install is direct electric heating. Direct electric heating can be low carbon (and will become increasing low carbon as the electricity grid decarbonises) but very expensive to run. To avoid developers simply putting in the cheapest form of low-carbon technology, an energy-cost calculation is being proposed as part of the Energy Performance Certificate. These calculations would use the Energy Efficiency Rating to set a minimum Energy Efficiency Rating that must be achieved by the developer. By setting restrictions on the energy efficiency, as opposed to simply carbon emissions, policy can have a greater influence over affordability for the end user.

Another part of the Future Homes Standards consultation relates to whether the government should enact a law that prevents local authorities from requiring higher energy standards than those set out in Part L of the building regulations. The planned restrictions on local authorities aims to reduce disparity in energy-efficiency of new developments across England which the report suggests

- *“creates inefficiencies in supply chains, labour and potentially quality of outcomes”*
- *“means that decisions about the technical appropriateness, application and enforcement of energy standards need to be considered by planning officers, committees and Planning Inspectors rather than by a building inspector.”*

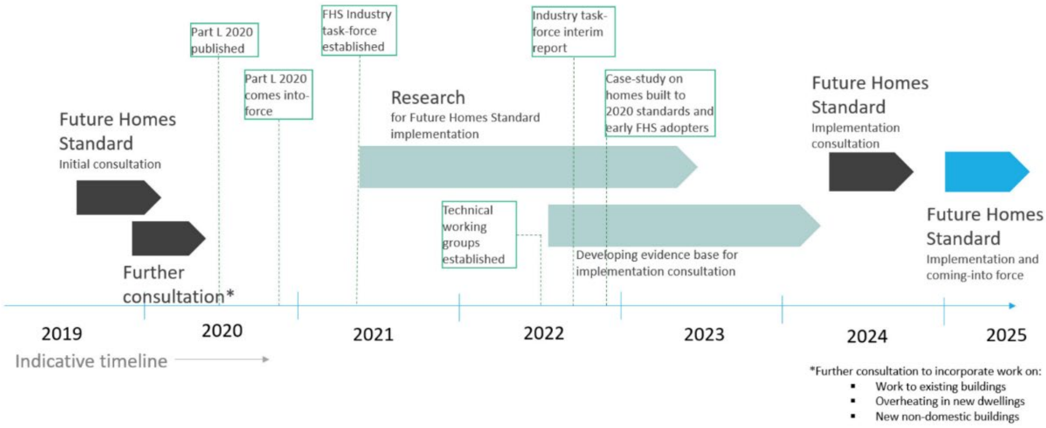

Figure 7.5: Timeline of consultations and updates to Part L of the building regulations proposed in the Future Homes Standards consultation.

Gas Boilers in New Developments

The UK Government has announced the intention to ban the installation of gas boilers in new homes from 2025, as part of the Future Homes Standard implementation. This move will have a major effect on the emission levels from new developments in the UK.

7.3.2 Greater Manchester Energy Plan

Greater Manchester has the ambition to be carbon neutral by 2038 but also wishes to increase the number of houses and commercial spaces within the region. Based on the projected development numbers, the GMSF estimates that:

"Without any mitigation, new development will increase the demand for energy and is estimated to result in around a 3% increase in carbon emissions" GMSF

To provide mitigation, Greater Manchester has drafted a policy requiring that all new developments in the region are to be net-zero by 2028. **New developments will also be required to generate 20% of their energy demand from renewables**. The GMSF recognises that Greater Manchester is behind the national average when it comes to small-scale renewable energy generation and therefore deems the ambitious uplift targets to be achievable. The GMSF is keen that any requirements on renewable technologies should be *"technologically agnostic and include suitable flexibility to reflect varying constraints of different developments' energy demands".*

The **GMSF identifies new developments as *"a catalyst for low carbon energy infrastructure"*** and recognises the role of local policy in supporting the transition to low-carbon energy. Developing skills amongst the local construction workforce and tradespeople through installing insulation and low-carbon heating in new developments will prepare the workforce for the more complicated task of retrofitting the existing building stock.

The GMSF also discusses the role of *carbon-offset payments* that would be required as part of the planning process, which are then **used to fund carbon saving schemes such as retrofitting**. The issue with these payments is that they are rarely high enough to generate the level of funding needed for extensive retrofit programs and below-target developments create another set of buildings that will need to be retrofitted in the future to meet the zero-carbon target.

7.3.3 Stockport

Currently, Stockport planning policy favours developments with higher sustainability standards. Emission reductions beyond those set in Part L of the building regulations were required of:

- At least 40% beyond 2006 TER requirements for domestic buildings
- At least 30% for non-domestic buildings

There were additional requirements based on any carbon reduction opportunities identified for a particular site. Where low-carbon opportunities had been identified, the Council could require emissions rates up to 100% lower than the TER (effectively zero-carbon) for new developments where developers would be expected to meet the energy demand from renewable sources. These policies only applied to developments of 11 or more dwellings or non-domestic developments over 1,000 m^2.

Since the 2011 Core Strategy, the specific TER targets for non-residential developments have been superseded by increases in the Part L requirements for new developments. The domestic target still stands but reflects changes in Part L since Core Strategy adoption. In addition, the policy approach laid out in the Core Strategy still requires new developments to first consider opportunities for district heating and if this is not feasible, requires microgeneration capacity for the site, where technically feasible and financially viable are set out in an energy statement as part of the planning application process.

The energy policy in the 2011 Core Strategy was informed by a 2008 energy study commissioned by Stockport Council. **Since that energy study, the carbon intensity of the grid has roughly halved, meaning electric heating options now have much lower emissions than a gas boiler** and will become even lower emission technologies as the electricity grid continues to decarbonise.

7.4 Energy Efficiency Recommendations

7.4.1 Strategies for New Developments

There are a number of methods for maximising the energy efficiency that can be built into new developments:

- Orientation for winter heating and summer cooling/avoiding of heating
- Natural lighting
- Natural cooling using green roofs
- Insulation
- Heat recovery ventilation

The incorporation of renewable energy technologies should not be treated as a tick-box exercise but optimised to ensure maximum gain. A solar panel on a north facing roof or with heavy shading cannot be expected to generate the same amount of energy as an optimised system.

While energy efficiency measures can reduce emissions from buildings, only electric heating (accompanied by the decarbonisation) of the electricity grid can eliminate them. The CCC report '*The costs and benefits of tighter standards for new buildings*' lays out the case for the early incorporation of low-carbon heating into new developments:[19]

1. **Low-carbon heat supply makes very big carbon savings**, 90% lower than the equivalent gas-heated home.
2. **Photovoltaics are not a substitute for low-carbon heat.** Heating systems are most heavily used in winter, peaking in winter evenings; the time when photovoltaic panels are producing no energy. The electricity grid is decarbonising reducing carbon savings from using PV compared to the grid.

3. **Building efficiency is not a substitute for low-carbon heat.** Even the most energy-efficient homes will produce far greater carbon emissions with a gas boiler than with low-carbon heating. This is partly due to the heat demand for hot water.
4. **Low-carbon heat is cost-effective when built in new homes from 2021 and need not increase running costs.** Running costs with as air-source heat pump could be higher if not fitted properly; good design and construction are important. Ultra-high efficiency buildings will definitely have lower heating costs.
5. **The carbon penalty for delayed action is significant**. A detached home built in 2020 then retrofitted in 2030 will emit over three times as much as CO_2 as a home that had been directly fitted with low-carbon heating. In addition to the carbon savings, retrofitting is expensive, wastes materials and is intrusive on homes.

7.4.2 Passive House

Passive House Design

Passive house (or Passivhaus) is a method for designing and constructing buildings that minimises their energy usage.

The energy requirements for a passive house are specified per square meter of a building:

- Primary energy demand ≤120 kWh/m^2 per year
- Space heating ≤15 kWh/m^2 per year
- Space cooling ≤15 kWh/m^2 per year

For reference, a standard new build home would require around 100 kWh/m^2 per year, while an old home could be double that again at 200 kWh/m^2 per year.[96]

Passive house achieves such high energy standards by implementing:

- **High thermal performance**
  - The buildings are very well insulated with high-performance windows
  - Buildings have 'thermal bridge free' construction which means that heat cannot move between the inner and outer layers of the walls
- **High air tightness**
  - The buildings are free of draughts through floors, windows and doors
- **Mechanical ventilation with heat recovery**
  - Fresh air is brought into the house heated by humid outgoing air.

In addition to these construction features, passive house design makes use of sunlight in the winter by having windows directed south and, where there are multiple buildings on a site, ensuring that each building does not shadow the windows of the next. Above the windows, shade is added to prevent overheating in the warmer summer months and reduce cooling demand.

Passive House and the Performance Gap

Passive house is not just about the more efficient design of building or the use of materials; the passive house certification system means that buildings must meet the passive house standards in use. A major issue with the TER scheme has been the *performance gap* where the eventual energy efficiency of the building is considerably lower than that indicated in the building plans.[97] The behaviour of the occupiers cannot be overcome by the building standards (although education and guidance can be given) but discrepancies between the design specification and the as-built works, however, can be mitigated by proper monitoring and

[96] OVO Energy: How much energy do you use to heat your home? https://www.ovoenergy.com/guides/energy-guides/how-much-heating-energy-do-you-use.html
[97] More information in the performance gap is provided in Appendix 3: The Performance Gap.

certification. **As passive house involves independent testing of the building performance, this aspect of the performance gap is effectively eliminated.**

Passive house standards offer an established means of meeting the CCC's recommendations that new build homes should be ultra-energy efficient (heat demand 15-20 kWh/m^2 per year) and that compliance is based on the real-world performance of a building.

Passive House Construction

Passive house design and construction has previously been viewed as prohibitively expensive by both local authorities and private developers. This view may be arising from the attitude where developers attempt to impose passive house requirements on established designs. Attempting to bring buildings to passive house standard purely through insulation and sealant will result in significantly higher costs. **Passive house design needs to be a consideration in all aspects of a buildings design including things like the orientation and shape of buildings to maximise solar gain.**

The idea of designing an entire housing development with passive homes in mind from the beginning was demonstrated in the **Goldsmith Street project by Norwich City Council**. The development brought much publicity to passive house design in winning the Stirling architecture prize. The site of just over 100 dwellings is the largest passive house, social housing scheme in the UK. The overall cost of the project was £2,440 /m^2, considered reasonable in the south of England, or low for London, but still high for areas in the north of England.

Like with any technology, the costs associated with passive house design and construction will decrease with time and experience. Exeter City Council has led the way in the UK with respect to passive house construction. By the end of 2019, with over 9 projects, **Exeter City Council had brought down the build costs associated with passive house construction by 20%,** 25% when accounting for inflation. Exeter Council is considered an early adopter and will have paid a premium for passive house developments, however, they are set to reap the rewards for decades to come.

The additional benefits of passive housing in social housing are shared between occupants and housing providers:

- Reduced energy usage leads to reduced household bills for occupants
    - Fuel poverty is reduced
    - Social housing providers see reduction in rent arrears
- High levels of workmanship during construction mean that maintenance costs are reduced
    - Passive houses have significantly reduced levels of mould and damp again reducing maintenance costs
    - Health issues associated with mould and damp in housing are reduced in occupants.

For homeowners, houses with higher energy efficiency ratings could benefit from '*green mortgages'* in which mortgage rates are reduced for homes with higher energy-efficiency ratings.[98] These reductions are based on analysis by the Bank of England that showed mortgages for energy-efficient homes are less frequently in payment arrears than those in less efficient homes, even when controlling for other parameters such as household income.[99] Mortgages on energy-efficient homes are deemed to be lower risk and can therefore incur lower rates. The logic for this correlation was that occupiers of highly efficient homes will have reduced

[98] World Green Building Council: Green Mortgages https://www.worldgbc.org/green-mortgages
[99] Bank of England: Does energy efficiency predict mortgage performance? https://www.bankofengland.co.uk/working-paper/2020/does-energy-efficiency-predict-mortgage-performance

outgoings from reduced energy bills and are therefore less likely to default on mortgage payments.

Local Authorities

As of December 2019, Passivhaus Trust (the UK Passive House Organisation) had compiled a list of UK local authorities that had local planning policies that specified Passivhaus or equivalent standards.[100] There are 22 local authorities listed, including Greater London and Greater Manchester that each cover a number of smaller authorities. For some Councils, these requirements are specifically for residential buildings, non-residential buildings, schools, or developments over a certain size.

Only Brighton & Hove, Glasgow and Norwich are noted as having specified targets for passive house design with only **Glasgow setting the specific intention all new residential developments are to be passive house homes**. Other Councils, such as Fareham Borough Council, have set requirements for specific developments. For the Welborne Garden Village development in Fareham, a requirement of 10% of houses to be passive house standard was set. Targets such as these ease pressure on the development as a whole but generate local knowledge around the passive house building requirements.

Many of the Councils set targets of 19%-20% beyond 2013 building regulations as an interim (which work out at a similar level to Stockport's requirements in the previous Core Strategy for requirements above the 2006 building regulations) with some Councils then setting additional targets to come in at a later date, such as Greater Manchester's zero-carbon new homes by 2028 policy.

Stockport

There are currently at least 3 private homes in Stockport that have been constructed to passive house standards. That passive houses have already been built in Stockport bodes well for the borough and wider city region as some local knowledge will have been gained in the delivery of these projects; skills uplift has been identified as an ongoing issue in passive house design becoming mainstream.

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[100] Passivhaus Trust: Local Authority Energy Policies
https://www.passivhaustrust.org.uk/UserFiles/File/PH%20planning/2019.12.03_UK%20Local%20Planning%20Policies_Passivhaus.pdf

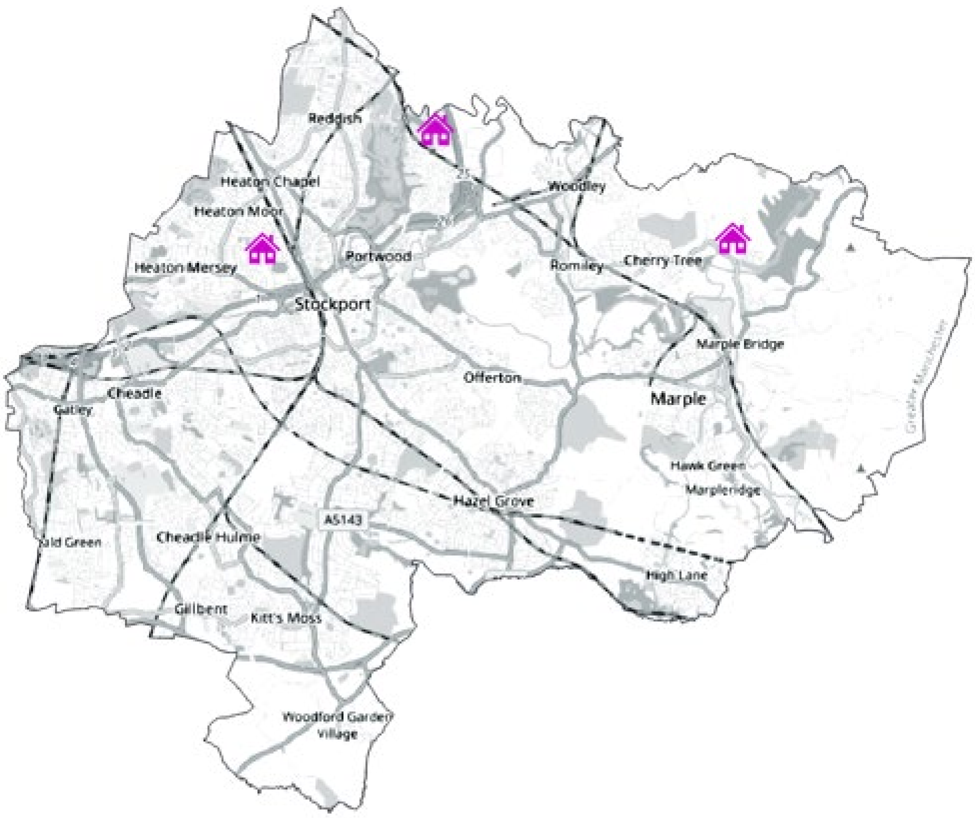

Figure 7.6: Locations of passive homes in Stockport.

Policy

It is not within Stockport Council's power to overhaul how building regulations are set. However, Stockport will be living with the effect of these policies for decades to come. Passive house construction may offer Stockport a means of addressing the concerns expressed by the CCC, among others, to parliament concerning the performance gap.

- The advantage of **specifying passive house construction** in policies and targets, as opposed to equivalent standards, is the certification scheme and the resulting impact on the **performance gap**. Where equivalent standards are set based on the TER, the as-built building are very likely to have energy demands significantly higher than those calculated for the TER.
- Setting a **requirement where a portion of buildings in any new development must be built to passive house standards allows for the introduction of passive house skills** and knowledge without putting developers off. As Exeter City Council has shown, costs for passive houses will come down with time and experience, guiding developers towards the zero-carbon developments of 2028.

7.5 Policy Recommendations

Policy on new developments is informed by current Stockport policy, GM and GMSF targets, best practice elsewhere and recommendations from organisations such as the CCC, Innovate UK and the Zero-Carbon Hub.

A number of policy recommendations relating to new development are provided with some being mandatory in nature and others promotional. Stockport Council should consider all of them for inclusion in the Local Plan (separately or bundled together) but also to inform policy implementation work. The following covers a range of ease of application, associated cost and resources and expected levels of impact on the uptake of low carbon measures in new developments:

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td rowspan="3">Mandate</td><td colspan="4">Objective: Increase the proportion of developments to which carbon reduction targets apply.</td></tr>
<tr><td></td><td>ND Policy 1: Widen the catchment of planning polices relating to energy efficiency, emissions and renewable energy to include smaller developments.</td><td>Could reduce the viability of some smaller sites subject to an understanding of how to capture build costs in sale value uplift.

Lack of appropriate knowledge and skills among workforce.</td><td>Skills uplift.</td></tr>
<tr><td colspan="4">Justification: No project is too small to not matter now.

Single dwelling projects often have greater desire to achieve high energy standards.

Stockport Local Planning Authority historically has had high levels of small scale development applications (see Annual Monitoring Reports)[101].

The preference for redeveloping existing sites (brownfield preference) makes it likely that multiple commercial developments will be under the current requirement of 11 dwellings - may miss opportunities to create low-emission redevelopment sites.</td></tr>
<tr><td rowspan="2">Mandate</td><td colspan="4">Objective: Increase energy efficiency of new developments.</td></tr>
<tr><td>Zero-carbon new developments by 2028.

Two/three step policy process to</td><td>ND Policy 2: Subject to GMSF eventual policy: 31% reduction in emissions beyond current (2016) Part L building regulations (in line with Future Homes Standards option favoured by the government)</td><td>May deter developers or increase house prices.</td><td>Skills uplift and forming of supply chains.

Residents can benefit from green</td></tr>
</table>

[101] https://www.stockport.gov.uk/authoritys-monitoring-report-amr

	Target	Policy	Risks and Barriers	Associated Benefits
	take Stockport towards this target.	***Or*** Go beyond updated regulations, subject to local authority permissions being preserved.		mortgages where lower mortgage rates are given to homes with lower energy demands. Reduced bills and fuel poverty.
		ND Policy 3: Second step in emission reduction requirements in line with Future Homes Standards Plans in 2025 but also including non-domestic.		
		ND Policy 4: Zero-carbon new developments 2028.		
	Other Recommendations: Strong monitoring framework is required to reduce the future workload associated with retrofitting buildings built over the next few years to zero-carbon standards. **Justification**: The Future Homes Standards is likely to bring in a requirement for 31% reduction in emissions compared to 2016 Part L regulations. The aim is to reduce emissions from new developments to 75%-80% of 2006 levels in 2025. However, the previous policy for zero-emission homes from 2016 was scrapped therefore Stockport should ensure that their Local Plan addresses the aims of these standards and GM net-zero 2038 regardless of when the Future Homes Standards come into force.			
Mandate	**Objective:** Reduce the performance gap associated with new developments.			
	Eliminate the performance gap associated with discrepancies between the design specifications and the **as-built** building.	**ND Policy 5:** Set a requirement for new developments to be delivered to Passivhaus standards. This requirement could be introduced as a proportion of houses to be Passivhaus with the proportion increasing over time. ***or***	Passivhaus requirements may be off putting to developers and may raise house prices.	Residents can benefit from green mortgages where lower mortgage rates are given to homes with lower energy demands. Passivhaus homes are reported to be noticeably more comfortable to inhabit in addition to the reduced bills. Reduction in fuel poverty. Skills uplift.
		Explore options for testing the as-built performance of a new development with the view to setting requirements on as-built performance.		
	Other recommendation: Develop a means of independent testing for emissions rate of a building that can be used locally and certified.			

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td></td><td colspan="4">Justification: The performance gap can result in large differences between the projected emissions for a designed building and those from the building in use.

The Passive House Trust provides independent certification for Passivhaus buildings.

Glasgow City Council already has policy in place that requires all new residential buildings to be built to Passivhaus standards. Exeter City Council has completed 9 Passivhaus projects to date. Norwich City Council has completed the Goldsmith Street project, the largest Passivhaus, social housing scheme in the UK.

If the Council does not feel it can effectively monitor the as-built emissions then the onus can be placed on developers to prove the emissions rate to an external body.</td></tr>
<tr><td rowspan="3">Mandate</td><td colspan="4">Objective: Encourage the use of heat pumps</td></tr>
<tr><td>Phase out gas boilers ahead of the government plans to do so by 2025. Stockport may choose to aim for 2022.</td><td>ND Policy 6: Ban gas boilers from new developments from 2022.

ND Policy 7: Require very special circumstances to be put forward for the use of direct electric heating instead of heat pumps or connection to a low-carbon heat network.</td><td>Use of direct electric heating is very expensive for occupier to run.

Poorly fitted heat pumps can increase running costs for occupier.</td><td>Skills uplift.

Normalises heat pumps.</td></tr>
<tr><td colspan="4">Other recommendations: Policy wording to strongly support the use of heat pumps and discourage the use of direct electric heating.

Justification: The grid has now decarbonised to the point where it is significantly less carbon intensive to provide heating from electric sources than gas boilers.

Using heat pumps reduces the carbon intensity of heating beyond that of direct electric heating.

While heat pumps have similar running costs to gas boilers, direct electric heating is much more expensive for occupiers (although cheap to install).

Direct electric heating places much higher demands on the electricity grid.</td></tr>
<tr><td rowspan="2">Mandate</td><td colspan="4">Objective: Understand the feasibility for district heating within Stockport.</td></tr>
<tr><td>Implement a number of district heating networks in Stockport.</td><td>ND Policy 8: Subject to GMSF eventual district heating policy: Retain the current policy (Development Management Policy SD-4) requiring new developments to connect to existing, or develop new, district heating network, to design the development to maximise opportunities for district heating and to consider inclusion of</td><td>Installing heat networks is disruptive to individual household and the general area.

The Council would need to take on a lot of the risk</td><td>Low carbon heat provision that efficiently uses any fuel source.</td></tr>
</table>

	Target	Policy	Risks and Barriers	Associated Benefits
		adjacent public buildings as anchor heat loads	and expense associated with the project.	
	Other recommendations: Conduct an updated feasibility study on district heating plans with the considerations of future planned developments and new technology preferences. **Justification:** The Committee on Climate Change projects that district heating networks will have a major role to play in a low-carbon future. Heat pumps, particularly ground source heat pumps, are now considered the best low-carbon option for large scale heating. With areas of development identified and site appraisals taking place, Stockport is in a strong position to predict future heat demand.			
Mandate	**Objective:** Promote the incorporation of renewable energy into new developments			
	20% of projected energy demand to come from renewable energy sources as part of the development.	**ND Policy 9: Subject to GMSF eventual policy:** New developments to include renewable energy projects that will cover at least 20% of projected demand. This may be set higher if a site has been identified as having significant renewable potential.	Requires monitoring with some level of technical knowledge.	Reduced bills for occupiers. Increased prevalence and awareness of renewable energy.
	Other recommendations: Require reasonable consideration to be given to optimisation of renewable energy systems on site including orientation of PV and incorporation of storage. **Justification:** In line with GM and GMSF plans. Increase in use of low / zero carbon technologies with associated uplift in skills and certainty for the market through policy requirements. New developments should not be able to use a flat rate of energy generation per PV panel as their predictions for electricity generation without consideration of orientation, angle and shading. A panel facing north or hidden behind trees cannot be expected to generate the same amount of energy as an optimised system.			
P r	**Objective:** Promote the benefits of low-carbon homes.			

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td rowspan="2"></td><td>Work with developers to promote low-carbon technologies they can promote to home buyers</td><td>ND Policy 10: Provide material for developers on advantages of low-emission homes – Appendix 4</td><td></td><td>Increases demand for low-carbon homes.

Lower fuel costs for occupiers.</td></tr>
<tr><td colspan="4">Justification: A lack of awareness of low-carbon measures and their financial opportunities has been identified as a barrier to the implementation of low-carbon measures in new-developments.

Increased knowledge of low carbon finance and marketing and associated skills uplift in the building sector

Improved uptake of low carbon design and technologies in new build reducing the levels of retrofit requirement in the future.</td></tr>
<tr><td rowspan="3">Promote</td><td colspan="4">Objective: Promote the incorporation of energy storage and smart systems into new developments</td></tr>
<tr><td>Introduce energy storage to Stockport buildings.</td><td>ND Policy 11: Consideration to be given to energy storage and smart systems.</td><td>Storage prices are still falling rapidly, installing now risks paying a premium for storage services.</td><td>Reduced bills for occupiers.

Reduced demand on the energy grid.

Increased security of energy supply.</td></tr>
<tr><td colspan="4">Justification: Energy storage systems will allow occupiers to use more of the free energy generated from solar panels or to store energy at times when demand on the grid is low.

Distributed energy storage will be important for managing demand on the electricity grid, especially with the transition to electric heating and transport.</td></tr>
<tr><td rowspan="2">Promote</td><td colspan="4">Objective: Promote the use of recycled and low-carbon materials in construction</td></tr>
<tr><td>Reduce emissions associated with construction of new developments
.</td><td>ND Policy 12: Preference to be given to developments that demonstrate greater use of recycled materials and materials with low embodied carbon.</td><td>Potential for increased costs.</td><td></td></tr>
</table>

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td></td><td colspan="4">Justification: A large portion of the CO_2 associated with any building is in the material extraction, production and transport. The manufacture of steel and concrete is very carbon intensive whereas the use of materials like sustainable timber locks away carbon in buildings. Alternative green technologies such as CO_2. Concrete can also be included.</td></tr>
<tr><td rowspan="3">Lead by Example</td><td colspan="4">Objective: Demonstrate the methods and technologies that can be used to achieve low-emission domestic and non-domestic buildings.</td></tr>
<tr><td></td><td>ND Policy 13: Publicise detailed case studies of carbon reduction projects undertaken in Stockport to developers and the public.</td><td>Council staffing time.</td><td>Raise awareness of projects within Council and wider Stockport community.</td></tr>
<tr><td colspan="4">Other recommendations: Make information related to the energy-efficiency and low-carbon technologies used in developments easily available, use examples such as Stockport Homes (for domestic) and non-domestic (Fred Perry House).

Justification: Easily available information makes it easier for others to know if they are in a position to follow suit.

These case studies can also be used as an educational resource (Stockport Hydro has strong community engagement and education links).

Retrofit Scotland current provides case studies on their website http://www.retrofitscotland.org/case-studies/.</td></tr>
<tr><td rowspan="2">Support</td><td colspan="4">Objective: Support the skills uplift required for all developments in 2028 to be zero carbon.</td></tr>
<tr><td></td><td>ND Policy 14: Provide information, support funding applications and co-ordinate low cost training for tradespeople who wish to develop skills in emission reduction technologies.</td><td></td><td>Increased future employment opportunities for local tradespeople.

Improved local low carbon economy with opportunities to serve neighbouring districts and boroughs.</td></tr>
</table>

	Target	Policy	Risks and Barriers	Associated Benefits
	Other recommendations: Favour the use of certified and trusted tradespeople and suppliers (as opposed to the cheapest) to ensure quality installation and encourage skills uplift. **Justification:** These tradespeople become a portfolio of skilled tradespeople. Poorly installed measures risk devaluing carbon saving measures in both energy terms and in public opinion.			

8. Economic Assessment for Developers

8.1 Introduction

The aims of the 'Economic Assessment for Developers' within this Study were to:

- First, understand the potential cost savings a low carbon technology in a new build property might offer homeowners, compared to using a conventional alternative.
- Second, to communicate these financial savings through a cost comparison tool and a piece of persuasive marketing copy, aimed at planners and property developers.

This section aims to help colleagues and developers understand the economic benefits and opportunities of low carbon development and how to maximise that within development budgets.

Adopting new technologies within homes that generate electricity on site, or materially alter heating demand (e.g. Passivhaus, air source heat pumps) can lead to financial savings for homeowners when compared to conventional alternatives. A homeowner may enjoy reduced energy bills and, over the lifetime of the low carbon technology, reduced maintenance and replacement costs.

Promoting the benefits of a property with low carbon features to prospective home buyers is important to planners and developers. The costs incurred when installing low carbon technologies are typically higher than conventional alternatives, leading to higher construction costs overall for a given property, and ultimately, can be reflected in a higher sale price. Therefore, promoting the annual financial savings which can be enjoyed by the homeowner can justify potentially higher sale or rental prices for developers.

8.2 Approach and key outputs

8.2.1 Approach

The annual operating and maintenance costs faced by homeowners were calculated and directly compared for the following three low carbon features and their conventional alternative technologies:

- solar panels compared to receiving electricity solely from the grid
- air-source heat pumps compared to a gas combi-boiler heating system
- Passivhaus design, including an air-source heat pump, compared to a typical new build home using a gas combi-boiler system

The calculations are set out within a user-friendly 'cost comparison' Excel tool, which allows users to determine various inputs such as heating or electricity demand (with typical heating and electricity demand values provided for specific property types), unit prices of gas and electricity and whether Renewable Heat Incentive payments are received.

The costs of installing a given low carbon technology within a new property are also of interest to property developers. While it is likely that most developers will already have a good understanding of these financial costs, for completeness, the cost comparison tool produces estimates of the increase in construction costs associated with installing each of the above low carbon features.

8.2.2 Outputs for property developers and how to use them

The analysis produced the following key resources for property developers and planners:

- an Excel cost comparison tool, with accompanying user guide
- a one-page infographic flyer for each low carbon feature

This innovative tool and the flyers are the first of their kind produced for a Planning Department in a Local Authority. Both resources are designed to produce information which property developers can use within their marketing of new build properties with low carbon features:

Cost comparison tool

- The cost comparison tool allows users to input the expected heating or electricity demand of the new property (with typical heating and electricity demand values provided for specific property types, e.g. semi-detached home)
- The tool then produces average annual cost savings homeowners can enjoy from occupying a home which features a low carbon technology (compared to a conventional alternative).
    - For example, for a semi-detached new build home, the tool estimates homeowners could save £322 a year from having solar panels as a feature of their home
    - Property developers could use this figure in a statement such as *'An energy efficient new [insert name of property developer] home could reduce your energy costs by up to £322 a year'*.
- Should they wish to, users can change various other inputs such as the unit cost of gas or electricity, whether Renewable Heat Incentive (RHI) payments are received etc., and the tool generates revised cost savings.
- The cost comparison tool also produces the expected uplift in construction costs developers can expect to incur (according to property type) from installing a low carbon feature.

Infographic flyers

- Three infographic flyers are available, one per low carbon technology. The flyers are accessible and visually appealing, using summary text, charts and infographics to clearly present information.
- Each infographic flyer summarises the potential benefits of installing low carbon features within a new build property, both for the homeowner and the property developer.
- As well as the financial savings which are calculated in the cost comparison tool, the flyer summarises the wider benefits which can be enjoyed by the homeowner to inform marketing.
- Developers can use the simple, visually appealing infographics within their own marketing materials, to summarise benefits.
- Developers can lift summary text directly from the flyer to describe the benefits of a low carbon property;
    - for example when marketing a Passivhaus build, developers could use the following text from the flyer: *'A comfortable temperature is maintained throughout the year, and home occupiers can enjoy health and wellbeing benefits due to warm surfaces, a lack of draughts and improved air quality'*.

It is the intention of Stockport Council to provide access to these resources via its website, or by contacting the Council directly.

8.3 Summary of findings

The following table summarises the annual cost savings per property type, for each low carbon feature assessed.

Table 1: Average annual cost savings to homeowners

Property type:	Air source heat pump	Solar panels	Passivhaus design
Apartment	£326	NA	£374
Terrace	£323	£236	£469
Semi-detached	£322	£236	£491
Detached	£317	£342	£674

The following table summarises the expected increase in construction costs faced by the property developer.

Table 2: Average increase in construction costs

Property type:	Air source heat pump	Solar panels	Passivhaus design
Apartment	£2,823	NA	£5,861 plus an additional 5-10% of usual construction costs
Terrace	£2,823	£7,000	£5,861 plus an additional 5-10% of usual construction costs
Semi-detached	£2,823	£7,000	£5,861 plus an additional 5-10% of usual construction costs
Detached	£4,923	£8,000	£5,861 plus an additional 5-10% of usual construction costs

The infographic flyers for each low carbon feature provide full details of all benefits the feature offers the homeowner and the property developer.

8.4 Potential improvements to the cost comparison tool

The cost comparison tool has been designed to be relatively future-proof, allowing users to amend elements of the calculations which are expected to change in future, such as the unit cost of gas or electricity and whether a homeowner can expect to receive RHI payments or not. However, there are various future extensions which could be considered:

- including the cost comparison analysis of an additional low carbon technology
- updating the tool in future to account for changes in all values used in the calculations
- including the additional option of battery storage/no battery storage for the solar panels cost comparison calculations[102].

[102] Currently, solar panel systems are rarely being installed with battery storage due to the high costs incurred. However, in future the costs of batteries are expected to fall, and it may become more commonplace for batteries to be installed alongside the solar panel system.

9. Retrofitting of Existing Buildings

9.1 Review existing policy approaches and best practise

9.1.1 National Policy

In the Clean Growth Strategy, the UK Government set a target that **all domestic properties should be brought up to EPC band C standard** "*where practical, cost-effective and affordable"* but it has remained unclear what these terms mean practically. The target for bringing domestic properties up to EPC band C level is consistent with advice from the CCC but falls into the *'policy gap'* highlighted by the CCC where policies are not in place to achieve the targets. In the Future Homes Standards consultation there is reference to retrofitting; the consultation states *"we intend to consult on standards when work is carried out in existing dwellings, with a view to uplifting the standards where there are cost-effective, safe and practical opportunities to do so".* It is not clear when this consultation might happen or what options it might contain.

9.1.2 Greater Manchester

The 5-Year Environment Plan for Greater Manchester sets specific and ambitious targets for retrofitting the current building stock, recognising the importance of retrofitting for achieving carbon emissions:

"Retrofitting of existing residential properties is the most significant issue in achieving our aims for carbon neutrality." 5-Year Environment Plan for Greater Manchester

The plan sets a target of retrofitting 61,000 homes per year in Greater Manchester, which would equate to over 6,000 retrofits a year in Stockport. It should be noted that this target is based on the how many homes will need to be retrofitted in Greater Manchester per year to achieve carbon neutrality as opposed to a being based on current data for retrofit numbers.

A 2019 report from Greater Manchester Combined Authority (GMCA) on '*Decarbonising Greater Manchester's Existing Buildings'* provided the evidence base for the policies laid out in the 5-Year Environment Plan.[103] The report indicates that **currently in Greater Manchester, deep retrofit projects are generally pilots on the scale of 10s of properties or at most 100-200 homes, with other retrofit schemes not of the required depth**. The report highlights the need for a whole-house approach to retrofits to realise the full potential of retrofitting a property. There is also recognition of the need to upskill the local workforce and develop trusted supply chains.

The barriers for commercial buildings are largely similar to those of domestic buildings. The GMCA retrofitting report recommends building in a mechanism for measuring and reporting on the energy efficiency of commercial buildings. Understanding the energy usage of a building would bring value to energy-efficiency measures in commercial buildings that is recognised by the market.

9.1.3. Stockport current policy

National and Greater Manchester policy recognises the difficulty of addressing emissions from current building stock. Stockport Council currently has planning policy in place that requires homeowners applying to extend their property to complete an energy checklist to understand the options for emission-reduction measures that would be appropriate for the property. If any of the measures identified **have payback periods of less than seven years and their combined cost does not exceed 10% of the cost of the building works** then the measures are required to be implemented as part of the works.

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[103] Greater Manchester Combined Authority: Decarbonising Greater Manchester's Existing Buildings https://democracy.greatermanchester-ca.gov.uk/documents/s2203/Decarbonising%20Buildings%20Report%20Cover%20Paper.pdf

The planning office has reported that no planning applications for home improvements have been denied based on failure to meet these criteria. There has been limited reviewing and monitoring of this policy such that it is not clear how many applications may not have met the targets.

9.2 Stockport Housing

According to the GMSF Energy Plan, only **28% of Stockport's domestic buildings that have been issued with an EPC certificate since 2008 have achieved a rating of A, B or C**, the lowest out of all the regions within Greater Manchester. Stockport also has the highest number of domestic buildings with F or G ratings with around 6% of dwellings being assigned these lowest ratings. The MSOA region in the far east of Stockport that includes Marple Bridge had less than 10% of properties with an EPC rating of C or better, making in the lowest in Greater Manchester. This statistic should be caveated with the knowledge that the built-up area of Marple Bridge is largely covered by a conservation zone.

Figure 9.1: Stockport conservation areas.

Figure 2.9 in Section 0 shows the current levels of insulation in Stockport dwellings according to BRE data. The data indicates that Stockport has:

- over 10,000 lofts requiring loft insulation to be installed
- nearly 52,000 lofts that would benefit from loft insulation being topped up to various degrees (currently have <200 mm)
- nearly 72,000 uninsulated cavity walls requiring insulation
- some portion of 18,000 solid walls that could benefits from external insulation.

If loft and cavity-wall insulation were installed in all of the properties identified as requiring them between 2020 and 2050, heat demand from domestic dwellings in Stockport would fall by around 16% leaving 84% of current demand. More extensive energy-efficiency measures could further reduce this but these measures only reduce space heating demand, not hot water demand. If gas boilers are left to provide the remaining heating and hot water demand it is not possible to eliminate emissions associated with buildings.

"Fabric efficiency is not a substitute for low-carbon heating" CCC

More information on low-carbon heating technologies is provided in section 0.

According to statistics that track installations registered for the renewable heat incentive, as of March 2020, Stockport had 62 accredited domestic installations and 20 non-domestic installations.[104] It is not clear how many of these are heat pumps and how many are biomass-based systems. Stockport Homes has installed heat pumps in a number of properties; as with solar PV installations, it may be that Stockport Homes is responsible for a large fraction of the low-carbon heating currently installed in Stockport.

9.3 Retrofitting in Stockport

The current policy in Stockport with regards to retrofitting has not had the desired impact. Consultation with the section of the planning office that deals with householder extension applications indicated that there was not the technical knowledge, confidence or capacity within their team to assess the proposed energy-efficiency measures set out as part of the energy checklist or indeed to monitor whether the proposed measures had been put in place. Although a Planning Policy officer has supported this policy with advice and guidance to applicants and officers, that officer's capacity is limited and monitoring has been through checking of submitted energy checklists rather than on site checks where capacity allows. For applications concerning commercial properties (of which there are fewer), the plans can be passed on to individuals outside the team with greater understanding of measures for emission reduction.

Planning policy with regards to retrofitting is one of the few levers available for Councils to influence the energy efficiency of owner-occupied dwellings. However, the planning team felt that adhering to the energy-efficiency checklist comes too late in the process of home improvement, past the point when many of the design and budgeting decisions had already been taken. Research from elsewhere indicates that retrofitting is most effective when planned in from the project inception and carried out on a whole-house scale. The planning policy team felt education and encouragement earlier in the planning of home improvements would have more impact that stricter planning policy requirements that are problematic to enforce.

In summary, the planning team within Stockport Council, through consultation with Element Energy, agreed that the most effective methods for increasing energy-efficiency uplift during home improvements were:

- **Education**
  - Homeowners should be provided with information on carbon reduction measures that can (and should) be taken as part of home improvements.
- **Encouragement**
  - Some financial aid may be required to help households implement carbon-reduction measures although encouragement should also take the form of showing homeowners the financial and comfort benefits of a more efficient home.
- **Increased capacity**
  - The planning team and Building Control function of the Council lack capacity to fully assess applications. If this issue cannot be addressed with training then an **increase in capacity** is required for Stockport Council to be able to able to implement this planning policy.
- **Monitoring**
  - In order to ensure the policy is enforced and that measures are actually implemented when renovations are carried out, monitoring and a series of site visits will be required (possibly in collaboration with Building Control colleagues).

[104] Renewable Heat Incentive Statistics https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

The planning page of the Stockport Council website is visited thousands of times per week making it an ideal place to host information relating to retrofitting where homeowners can find it early in the home-improvement process. Local authorities are considered trusted local sources of information making people more confident in undertaking measures recommended by a Council. As part of this study, guidance material was produced for incorporation of carbon saving measures into new developments, a similar set of materials for the retrofitting process could be beneficial for providing information to homeowners. The Housing Strategy Team at the Council leads on energy-efficiency advice to residents and is willing to work with planning colleagues to inform this work.

9.3.1 One-Stop Shop

One means of providing education on retrofitting to homeowners is through **the establishment of a *'one-stop shop'* for carbon reduction measures**. This service could provide guidance for homeowners interested in carbon reduction and a client base for certified and trusted installers. A study by the European Commission showed how a **one-stop shop helps to overcome fragmentation on both the supply and demand sides of retrofitting**. A homeowner interested in retrofitting currently has to assess various methods for reducing emissions and suppliers have to target many individuals; a one-stop shop can bring providers and interested parties together in one place.

As part of the one-stop shop guidance for homeowners can be provided for:

- Installing insulation
- Draught exclusion
- Installing heat pumps
- Finding certified local tradespeople
- Financial aid available

By bringing together success stories from previous projects, the one-stop shop can instil confidence in homeowners to carry out a more extensive retrofit across. In being local, the one-stop shop can provide Stockport (or GM) specific information on technologies best for the climate of the North of England and the kind of homes found in Stockport; the same technologies may not be appropriate for a house built in the 1960 versus one built in the 1800s. Retrofit Scotland has compiled a set of case studies on retrofit projects including the lessons learned in each project and a similar initiative could be a useful means of disseminating information within Stockport and Greater Manchester.[105]

It would also be important to include a section within the one-stop shop dedicated to non-domestic buildings. Annual energy demand, energy demand profiles and the opportunities for financial aid are all different for commercial buildings as are the opportunities for installing carbon-reduction measures.

A link is provided in the footnote to a document giving case studies of a series of one-stop shop initiatives across Europe.[106]

9.3.2 EnerPHit

A separate set of requirements has been developed in the wake of passive house design for retrofits to recognise the fact that a limited number of changes can be made to a building that is already standing. A large portion of the carbon emissions associated with any

[105] Retrofit Scotland: Case Studies http://www.retrofitscotland.org/case-studies/
[106] European Commission: One-stop-shops for energy renovations of buildings https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc113301_jrc113301_reportononestopshop_2017_v12_pubsy_science_for_policy_.pdf

building is in the materials and construction, so a well retrofitted existing dwelling is generally favourable, from an environmental point of view, to a new build even with higher energy-efficiency standards. The passive house retrofit scheme, EnerPHit, has the option of deep retrofit that takes place during a complete modernisation or using a phased approach spread over many years. Green mortgages may also be available to homeowners who upgrade the energy efficiency of their homes**.**

Edinburgh City Council is the only council listed to mention passive house standards in relation to retrofitting. They are currently exploring the feasibility of "a deep retrofit to building regulation gold or Passivhaus standard" for at least one local Council building each year. The passive house retrofit standard, EnerPHit, is considered as an option for setting the retrofit standards.[107] Edinburgh's council buildings are largely in the city's historic old town with typically hard-to-treat building stock; these projects will offer insights into the retrofitting options of such buildings.

9.3.3 Local Initiatives

Carbon Co-op

The Carbon Co-op is an initiative based in Greater Manchester to help people carry out deep retrofits on their homes. In being local, the Carbon Co-op is familiar with the building stock in Greater Manchester which in turn givers homeowners greater confidence that the measures will be suitable for their home. The group has provided a set of materials that are high level and accessible to non-experts with calculations on energy savings laid out. There is also guidance provided on how to access funding as well as agreements with local suppliers.

The Carbon Co-op acts as a one-stop shop for retrofitting in Greater Manchester. SMBC could establish a separate entity for Stockport or could engage with the Carbon Co-op to provide specific guidance and funding for projects within Stockport. A Stockport Planning Policy Officer is on the Steering Group for the People Powered Retrofit[108] project and could easily pursue this option.

Stockport-Based Groups

There are two community groups within Stockport that provide education and support for local residents on energy-saving measures:

- Marple, Mellor and Marple Bridge Energy Saving Strategy (MESS)
- Sustainable Living in the Heatons (SLH).

Stockport Council has already provided funding to MESS for loft and cavity-wall insulation that benefitted 246 local homes. The group also organised a showcase to bring together suppliers and potential customers, in much the same way as a one-stop shop is intended to work.

Sustainable Living in the Heatons has a broader outlook with initiatives relating to many aspects of improving life within the local area; with sections of its website dedicated to energy and addressing climate change. The group does not explicitly state its involvement in retrofit projects but has sent two of its members on a course for 'Retrofit Advocates' provided by the Carbon Co-op and provides energy advice from stalls at local events. The group also publicises the presence of a Passivhaus in Heaton Norris that was open to the public as part of an open day.

[107] Edinburgh City Council: Feasibility of Deep Energy Retrofit of Operational Council Buildings https://democracy.edinburgh.gov.uk/documents/s11668/Item%207.11%20-%20Feasibility%20of%20Deep%20Energy%20Retrofit%20of%20Operational%20Council%20Buildings.pdf

[108] https://carbon.coop/portfolio/people-powered-retrofit/

Initiatives such as the Carbon Co-op and MESS already act as a one-stop shop for retrofitting in Greater Manchester. The Council could establish its own separate entity for Stockport or could engage with and support established local groups to provide specific guidance and funding for projects within Stockport. Promotion of these initiatives through the Council website and the Local Plan could increase awareness throughout the borough. Working with such initiatives requires a dedicated officer resource with capacity to liaise and manage such activities. The Housing Strategy Team already liaise with these groups and could be ensured the capacity to do so.

9.4 Planning policy recommendations

The following policy recommendations on retrofitting are informed by current Stockport policy, GM targets, best practice elsewhere and the recommendations from the CCC.

A number of policy recommendations relating to retrofitting are provided with some being mandatory in nature and others project focussed. Stockport Council should consider relevant elements for inclusion in the Local Plan but also to inform policy implementation work. The following covers a range of ease of application, associated cost and resources and expected levels of impact on the uptake of retrofit measures:

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td rowspan="3">Undertake</td><td colspan="4">Objective: Reduce direct emissions from council buildings.</td></tr>
<tr><td>Retrofit local authority owned homes and public buildings to at least EPC band C and explore potential to achieve EPC band A or B where cost effective.</td><td>RF Policy 1: Undertake retrofitting of all Council buildings to bring them to at least EPC band C standard.</td><td>Availability of skills and suitable supply chains.

Disruption to Council offices (office capacity requirements may be permanently reduced by more people working from home).</td><td>Skills uplift in retrofitting energy-efficiency measures and low-carbon heating.</td></tr>
<tr><td colspan="4">Other Recommendations:
► Establish a fully funded action plan of works over the next five years building on the work of the Council’s Estates Team to consider carbon reduction
► First starting with the easiest buildings to tackle, to gain knowledge, then those with the lowest energy ratings.
► Investigate whether other nearby buildings would be interested in being part of a retrofit program. By carrying out retrofits together costs can be reduced in labour, equipment and bulk purchases.
Justification:
► In line with the policy recommendations laid out in the GM 5-Year Environment Plan.
► Council should lead by example.</td></tr>
</table>

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td></td><td colspan="4"></td></tr>
<tr><td rowspan="4">Support</td><td colspan="4">Objective: Establish the best methods for retrofitting historic buildings.</td></tr>
<tr><td>Undertake the retrofit of five historic buildings in Stockport by 2025.</td><td>RF Policy 2: Identify a number of historic buildings (preferably Council buildings) to retrofit high energy-efficiency standards.</td><td rowspan="2">The realisation of a biogas or hydrogen grid may mean that not all buildings on the gas grid will have to be retrofitted.

A fossil-free gas grid is unlikely to be realised before 2040, after the GM net-zero target. Additionally, retrofitting now rather than waiting for a fossil fuel free gas grid will have significant carbon savings overall.

Time and resource required to prepare and run the courses.</td><td rowspan="2">Specific skills uplift in retrofit of historic buildings.

Through educating people about the energy-saving options that may apply to their homes, people are more likely to feel they have the knowledge to plan retrofit works.</td></tr>
<tr><td>Run two courses per year on retrofitting historic buildings.</td><td>RF Policy 3: Support a local knowledge base in retrofitting of historic buildings.</td></tr>
<tr><td colspan="4">

Other Recommendations: Spread these pilot buildings across Stockport to provide local demonstration of retrofitting projects.
Examine opportunities for working within GM on this agenda, sharing costs, funding applications and ideas to tackle the loss of assets through the low carbon agenda.
Publicising successful processes and technologies. Use expertise gained from other regions such as York, Bath and Edinburgh that are carrying out retrofits of historic buildings.
Justification: These buildings will still be around in 2038/2050 so will need to be retrofitted. Showing that successful retrofits can take place on historic buildings will be an important demonstration for owners of historic assets. Using pilots, the Council takes on much of the risk of being the pioneer.

</td></tr>
<tr><td rowspan="2">Mandate + Support</td><td colspan="4">Objective: Reduce emissions from the current Stockport building stock.</td></tr>
<tr><td>Strengthen and enforce current planning policy on energy requirements.</td><td>RF Policy 4: Tighten policy (Development Management Policy SD-2) on home renovations to require energy saving measures to be included during renovations, even when payback is greater than 7 years and or cost is greater</td><td>May restrict ability of homeowners to make improvements to their homes but could be affordability based.</td><td>Contributes to the task of retrofitting more than 6,000 houses per year to achieve zero carbon targets</td></tr>
</table>

	Target	Policy	Risks and Barriers	Associated Benefits
		than 10% of renovation cost.	Ability of Council to enforce policies.	Increased comfort for homeowners in well retrofitted homes.
		RF Policy 5: Increase the capacity of the planning office to allow for enforcement and monitoring of retrofit planning policies.	Availability of funding to create new staffing position.	

Other recommendations:

- Provide the planning office with information and training on low-carbon options and technical specifications, possibly through increasing capacity within the office.
- Investigate the possibility of using building control to help with monitoring of energy-efficiency measures in homes.
- Publicise that enforcement is being stepped up.

Justification:

- The current policy aims to use one of the few levers available to bring about energy improvements in owner-occupied dwellings but is not currently enforced.
- Discussion with the planning office indicated that they did not feel they had the expertise or capacity to enforce or monitor the current policy. Building control has historically been unable to support monitoring due to capacity issues.
- Staff Carbon literacy training is underway but there is not yet confidence within the planning team to assess applications for carbon saving measures. This would require specific technical training.

Objective: Accelerate the transition to low-carbon heating

	Target	Policy	Risks and Barriers	Associated Benefits
Mandate + Support	Increase the readiness of the existing building stock for the transition to low-carbon heating.	**RF Policy 6:** Change the energy checklist for retrofitting to include consideration of heat pumps. **RF Policy 7:** Provide a list of heat pump installers locally. **RF Policy 8:** Remove the promotion of new gas boilers.	Misconceptions around electric heating must be overcome, particularly those based on storage heaters or the running expense of direct electric heating.	Avoids expensive and disruptive retrofitting in the future.
Mandate	Set a target number of low-carbon heating installations, increasing	**RF Policy 9:** Require extensions to new developments to be ready for low carbon heating (e.g. able to provide thermal comfort at a lower operating temperature, through oversized radiators, UFH, and /		

	Target	Policy	Risks and Barriers	Associated Benefits
	in ambition to 2030.	or high level of building fabric energy efficiency)		

Other recommendations:

- Publicise the outcome of the government consultation on low-carbon heat (likely to include an up-front grant).

Justification:

- The current energy checklist promotes the replacement of old boilers with new more-efficient boilers, this misses the opportunity for retrofitting low-carbon heating at this stage and new boilers are likely to remain in operation for an average of 15 years.
- Examine the opportunity to promote hydrogen-based solutions as and when the market emerges.
- The update to the Renewable Heat Incentive is likely to include an up-front grant to help cover the costs of transitioning to a low-carbon heating technology.

Educate

Objective: Educate homeowners and building owners on retrofit options.

Target	Policy	Risks and Barriers	Associated Benefits
Increase awareness of retrofit options	**RF Policy 10:** Establish a one-stop shop for retrofitting measures including: • Energy efficiency measures • Low-carbon heating options • Certified and trusted local tradespeople and suppliers • Financing options including loans and grants available.	Services must be well advertised. Careful establishment of certified/trusted tradespeople/suppliers. Overcoming misconceptions e.g. around electric heating.	Increased comfort for homeowners in well retrofitted homes. Easy access to trusted information for homeowners who genuinely wish to make emission reductions.

Other recommendations:

- Strongly publicise one-stop shop service.
- Advertise one-stop shop service on the planning portal and with local trades people.
- Direct homeowners to the one-stop shop at the top of the energy checklist for home improvements.
- Liaise with other Councils that have established such set ups.
- Involve Stockport Homes in the set-up as there is already local knowledge relating to these measures within Stockport Homes.
- Have a designated section for non-domestic properties.
- Examine the opportunities offered by existing retrofit projects for promotion to applicants

<table>
<tr><th></th><th>Target</th><th>Policy</th><th>Risks and Barriers</th><th>Associated Benefits</th></tr>
<tr><td></td><td colspan="4">Justification:
• The planning office feels that the public needs more education in retrofitting measures than the planning office can currently offer.
• Most decisions have been made by the time the planning office receives an application.
► The planning website receives a high number of weekly visits and could be a good mechanism for targeting homeowners in the early stages of planning home improvements.
► Local authorities are considered a trusted source of information.</td></tr>
<tr><td rowspan="3">Support</td><td colspan="4">Objective: Encourage local businesses to make contributions to reducing emissions/waste</td></tr>
<tr><td>Aid local businesses to reduce carbon emissions.</td><td>RF Policy 11: Reduce rates for businesses that:
• Have undergone extensive retrofitting
• Install renewable energy capacity to cover their demand
• Distribute locally grown produce
• Zero-waste shops</td><td>Loss of revenue for Council.</td><td>During the Covid-19 pandemic local supply chains have been much more resilient than the global supply chains.

Small businesses such as milk delivery, fruit and veg boxes have seen upsurges in demand.

Stronger local economy due to reduced fuel costs</td></tr>
<tr><td colspan="4">Other recommendations:
► Set a gold-star (or equivalent) scheme for local businesses that are recognised as actively reducing emissions/waste to recognise and publicise businesses that are reducing their environmental impact.
Justification:
► Local newspaper offices receive relief rates on local premises, this scheme could be expanded to encourage businesses to investigate emission/waste reduction measures.
► Stockport Council is examining carbon literacy training provision for local businesses that could support this.</td></tr>
</table>

	Target	Policy	Risks and Barriers	Associated Benefits
Support	**Objective:** Draw on peer support between other local authorities and city regions.			
		RF Policy 12: Work with ‘Accelerator Cities’ home retrofit project to develop home retrofit programmes and to co-ordinate with other cities and central government		Faster dissemination of information. Take advantage of lessons learned elsewhere. Staff development.
	Other recommendations: Share best practise amongst other local authorities. Continue to educate council staff on best practice and new developments in retrofit policy and procedures. **Justification**: Progress is faster when knowledge is shared. Major retrofit policies and support must come from central government.			

10. Summary of Planning Policies

This appendix brings together the planning policies described in the main report text and groups them according to four categories:

- Policy retention
- Changing policies
- Additional policies
- Supporting policy measures.

10.1 Renewable and Community Energy

Retention of Existing Policies

RE Policy 1*: Keep the current policy (Development Management Policy SD-5) in place that promotes local renewable energy generation from commercial, individual and community projects.*

Development Management Policy SD-5 supports the development of renewable energy resources in Stockport. This policy should be retained and supported by a number of measures described below.

Additional Policies

RE Policy 2: *Add requirement for local diversity and flexibility of electricity supply to be considered in all renewable energy planning applications.*

RE Policy 3: *Require local benefits to be included in all renewable planning applications, for example carbon savings, reduced fuel prices, community benefit scheme, reinvestment of revenues into local schemes.*

Supporting Policy Measures

RE Policy 4: *Identify potential sites for wind energy.*

RE Policy 5: *Carry out feasibility studies on Council owned sites within Stockport.*

RE Policy 6: *Publicise options for wind energy in the borough.*

RE Policy 7: *Encourage the establishment of a GM collective solar PV/battery purchase to drive up residential uptake.*

RE Policy 8: *Carry out a feasibility study of Council owned land for solar energy generation.*

RE Policy 9: *Establish a staff position within the Council that has responsibility for supporting community energy projects.*

RE Policy 10: *Establish a set agreement that can be applied to multiple renewable energy projects.*

RE Policy 11: *Carry out feasibility studies on sites to assess their potential renewable energy.*

RE Policy 12: *Share the findings of feasibility studies with community groups with an environmental interest within Stockport and Greater Manchester.*

RE Policy 13: *Provide grants or short-term loans to reduce up-front costs, particularly those that will be recovered such as VAT.*

These recommendations are based on recommendations laid out in the 5-Year Environment Plan for Greater Manchester and engagement with renewable energy stakeholders. The 5-Year

Environment Plan for Greater Manchester encourages local authorities to assess their assets for renewable energy potential and encourages the establishment of a GM collective solar/battery purchase scheme. Discussion with local and national community groups highlighted identification of sites, minimising bureaucratic costs and financial aid as the areas in which local authorities could be most helpful to community energy groups.

10.2 New Developments

Retention of Existing Policies

ND Policy 8: Subject to GMSF eventual district heating policy: *Retain the current policy (Development Management Policy SD-4) requiring new developments to connect to existing, or develop new, district heating network, to design the development to maximise opportunities for district heating and to consider inclusion of adjacent public buildings as anchor heat loads.*

Changes to Existing Policies

ND Policy 1: *Widen the catchment of planning polices relating to energy efficiency, emissions and renewable energy to include smaller developments.*

ND Policy 2: Subject to GMSF eventual policy *31% reduction in emissions beyond current (2016) Part L building regulations (in line with Future Homes Standards option favoured by the government)*

or

Go beyond updated regulations, subject to local authority permissions being preserved.

ND Policy 3: *Second step in emission reduction requirements in line with Future Homes Standards Plans in 2025 but also including non-domestic.*

ND Policy 4: *Zero-carbon new developments 2028*

Greater Manchester Combined Authority intends for all new developments to be net-zero by 2028. The Future Homes Standard should have one decrease in TER values in 2020 then another in 2025 but this is uncertain and therefore SMBC should have its own policies to effect change in the absence of national legislation.

Additional Policies

ND Policy 5: *Set a requirement for new developments to be delivered to Passivhaus standards. This requirement could be introduced as a proportion of houses to be Passivhaus with the proportion increasing over time.*

Or

Explore options for testing the as-built performance of a new development with the view to setting requirements on as-built performance.

The performance gap, the difference between the designed energy demand of a building and its as-built energy demand, means that setting targets and policies that require lower designed emissions without reference to the as-built emissions are not sufficient to address emission levels from new developments. Changing the monitoring process to measure as-built emissions levels is likely to be a process that requires national legislation. Passivhaus construction offers a means of eliminating the performance gap by requiring independent certification of a building's performance.

Currently Glasgow City Council has a requirement for new residential buildings to be Passivhaus as part of their requirements for 'gold compliance' that developers now have to adhere to: "*Passivhaus offered as a route to achieve Gold Level compliance (Option 2). Gold level* *compliance is required for new developments from 1 Sep 18 onwards. The alternative is a 27% reduction in TER plus a minimum 20% abatement in emissions from low/zero carbon renewables."*[109]

ND Policy 6: *Ban gas boilers from new developments from 2022.*

Energy-efficiency measures can reduce emissions but cannot eliminate them in buildings whose heating and hot water is provided by a gas boiler. The UK Government currently has plans to phase out gas boilers in new developments by 2025; the Committee on Climate Change is pushing for that date to be brought forward based on the cost of electric heating systems now being on par financially.

ND Policy 7: *Require very special circumstances to be put forward for the use of direct electric heating instead of heat pumps or connection to a low-carbon heat network.*

Direct electric heating is cheap to install and, as it runs on electricity, lower carbon than gas heating. However, direct electric heating is considerably more energy intensive to run increasing costs for the occupier and demand on the electricity grid.

ND Policy 9: Subject to GMSF eventual policy: *New developments to include renewable energy projects that will cover at least 20% of projected demand. This may be set higher if a site has been identified as having significant renewable potential.*

In line with the GMSF policies.

ND Policy 12: *Preference to be given to developments that demonstrate greater use of recycled materials and materials with low embodied carbon.*

Some building materials, such as steel and traditionally produced concrete, are very carbon intensive to produce; other building materials, such as timber or eco-friendly cement, can store carbon. The Committee on Climate Change has stated using timber for buildings is a good use of limited biomass resource due to the locking away of carbon, as opposed to cycling it as is the case for burning biomass.

Supporting Policy Measures

ND Policy 10: *Provide material for developers on advantages of low-emission homes – Appendix 4.*

Lack of knowledge within the construction industry has been identified as a barrier to reducing carbon emissions from new developments. As part of this study, Cambridge Econometrics has provided a set of infographic materials on energy-efficiency and low-carbon measures for new developments.

ND Policy 11: *Consideration to be given to energy storage and smart systems.*

The use of battery storage and smart energy systems is not yet fully established and therefore mandating the incorporation of these technologies is not yet recommended. However, there will be situations in which battery storage and smart technology will be sensible inclusions in new developments and these situations will increase with time. It is therefore advised that consideration is given to these technologies such that developers and policy makers remain aware of changes in the field.

[109] Glasgow City Council SG5 Resource Management https://www.glasgow.gov.uk/CHttpHandler.ashx?id=40325&p=0

10.3 Retrofitting

Changes to Existing Policy

RF Policy 4: *Tighten policy (Development Management Policy SD-2) on home renovations to require energy saving measures to be included during renovations, even when payback is greater than 7 years and or cost is greater than 10% of renovation cost.*

The current policy SMBC has in place with regards to energy-efficiency of existing buildings is innovative but has proved difficult to monitor. Additional measures are suggested below to address this issue.

RF Policy 6: *Change the energy checklist for retrofitting to include consideration of heat pumps.*

RF Policy 8: *Remove the promotion of new gas boilers.*

The transition to low-carbon heating is necessary to facilitate the reduction of emissions in existing buildings. The replacement of old gas boilers with newer gas boilers misses the opportunity to move to low-carbon heating options that will not come around again for the 10-15 year lifetime of the boiler.

Additional Policies

RF Policy 9: *Require extensions to new developments to be ready for low carbon heating (e.g. able to provide thermal comfort at a lower operating temperature, through oversized radiators, UFH, and / or high level of building fabric energy efficiency).*

Retrofitting heating systems suitable for low-carbon heating is expensive and intrusive. These costs can be minimised by ensuring as much of the building stock as possible is ready for low-carbon heating.

Supporting Policy Measures

RF Policy 1: *Undertake retrofitting of all Council buildings to bring them to at least EPC band C standard. For buildings where it has been identified to be feasible, buildings should be retrofitted to EPC band A or B standard.*

The 5-Year Environment Plan for Greater Manchester encourages all local authorities to undertake retrofitting of their own buildings to EPC band C standard. However, while retrofits are underway it is sensible to raise standards to as high a level as is feasible.

RF Policy 2: *Identify a number of historic buildings (preferably Council buildings) to retrofit high energy-efficiency standards.*

RF Policy 3: *Support a local knowledge base in retrofitting of historic buildings.*

Knowledge and skills in the local workforce have been identified as a barrier to extensive, high quality retrofits. Historic buildings are particularly challenging to retrofit so a specific focus should be placed on them.

RF Policy 5: *Increase the capacity of the planning office to allow for enforcement and monitoring of retrofit planning policies.*

The planning office has stated that there is not the capacity to monitor and enforce the current policy (Development Management Policy SD-2). Planning policy is one of the few levers available to effect change in privately-owned properties.

RF Policy 7: *Provide a list of heat pump installers locally.*

RF Policy 10: *Establish a one-stop shop for retrofitting measures including:*

- *Energy efficiency measures*

- *Low-carbon heating options*
- *Certified and trusted local tradespeople and suppliers*

Financing options including loans and grants available.

A lack of knowledge and confidence around the best ways of reducing energy demand and carbon emissions has been identified as a barrier to homeowners improving the performance of their homes. Low-carob heating options are particularly poorly understood.

RF Policy 11: *Reduce rates for businesses that:*

- *Have undergone extensive retrofitting*
- *Install renewable energy capacity to cover their demand*
- *Distribute locally grown produce*
- *Zero-waste shops.*

RF Policy 12: *Work with 'Accelerator Cities' home retrofit project to develop home retrofit programmes and to co-ordinate with other cities and central government.*

Appendix 1: Data Information

Information on Data

The maps for the MSOA regions were provided by Stockport Metropolitan Borough Council.

The consumption data used is taken from publicly available government statistics provided by the Department for Business, Energy & Industrial Strategy found at

- https://www.gov.uk/government/collections/sub-national-electricity-consumption-data
- https://www.gov.uk/government/collections/sub-national-gas-consumption-data

The gas data provided is weather corrected, however, the electricity data is not. As gas is largely used for space heating, the outside temperature has a greater effect on gas consumption than electricity consumption.

A property is designated as domestic on non-domestic largely based on the consumption level. For electricity, the automatic cut-off point for the property to be defined as non-domestic consumption is above 100,000 kWh per year. The designation of a property with consumption between 50,000 kWh and 100,000 kWh per year is assessed depending on the address (for example, if an address contains ‘plc.’ Or ‘ltd’).

For gas, the automatic cut off above which a property is classified as non-domestic is 73,200 kWh per year. It is estimated that around 2 million small businesses across the UK are incorrectly classified as domestic consumption.

Half-Hourly Data

Half-hourly data includes the largest non-domestic users but does not assign them to a MSOA. This creates a discrepancy between the plotted data in the historic energy figures, which show the non-domestic consumption as higher than the domestic consumption, while the maps show higher consumption values for domestic electricity values for most MSOAs.

Gas consumption does not have the same issues with half-hourly data, such that the issue does not affect any suggestions for district heating. However, it may make it difficult to identify regions of high demand on the grid.

Appendix 2: Solar Photovoltaic Technologies

The National Renewable Energy Laboratory (NREL) in the USA keeps an updated list of the highest performing solar panels in each technology and is commonly known as the NREL Efficiency Chart.[110] The top performing cells shown in the NREL chart are solar concentrator system and tandem cells.

Solar concentrator system use an array of mirrors to focus sunlight onto a small but highly efficient solar cell, in the same way as satellite dishes concentrate radio waves. The efficiency of a cell (not just the output) increases with the intensity of light incident on it. Using this system means that a highly efficient cell can by used to convert light collected from a large area using cheap mirrors as opposed to a large area of expensive photovoltaic panels. These systems are usually accompanied by solar tracking technology that adjusts to always point towards the sun as it tracks across the sky. The extra equipment cost and energy used for tracking must be met by additional gains from increased sunlight absorbed. **Concentrator systems are suited to areas with a large amount of direct sunlight such as desert regions**. Regions where direct sunlight is low, such as cloudy areas are not suited to concentrator systems as **light from a cloudy sky is diffuse and cannot be easily concentrated onto a cell**. As a result, solar concentrator systems are rarely seen in the UK outside research.

The other leading group of technologies are tandem cells; these cells use multiple absorbing materials to capture more of the solar spectrum and to use that light more efficiently. Tandem cells have typically been prohibitively expensive and their use largely confined to space applications. The high costs on tandem cells is the result of materials costs and fabrication costs.

Recent progress in PV research has seen rapid development of a technology called perovskites. **Perovskites have received a huge amount of attention in academic circles in recent years with efficiencies improving far faster than any solar technology has previously**. These materials are highly absorbing, make very efficient photovoltaic cells and are significantly easier to process than silicon or other typical PV materials. There were initial reservations around perovskite deployment due to the presence of lead in the perovskite material, however, the amounts used have been small enough to overcome this concern.

Several companies, including Oxford PV, have been developing a perovskite-silicon tandem cell. An additional benefit of perovskites (as well as other new materials) is their efficiency under low light conditions. The basic material properties of silicon make it a relatively poor absorber of light and silicon solar cells perform best under conditions of strong direct sunlight. Solar panels made from silicon have relatively thick layers to allow most of the sunlight to be absorbed. Many new technologies have far superior absorption properties meaning thinner layers can be used reducing the weight and material cost of making the panels. The superior absorption is especially noticeable in low light conditions or when light is diffuse (rather than direct) such as on cloudy days, an attractive quality for panels in the UK.

New technologies, however, have yet to demonstrate the stability of silicon solar panels over years in outdoor use. Having been used for decades in computers, silicon is very mature technology in terms of manufacturing and new technologies have some way to catch up. There have been recent developments in solar cell technology where lightweight, easy to process materials have been combined with silicon to form a multilayer panel. This technology takes the manufacturing maturity and market familiarity of silicon but brings in the added efficiency and low light properties of perovskites.

To be commercially ready, solar panels must undergo *accelerated lifetime testing*. To mimic many years in an outdoor environment these tests cycle panels through extreme heat, extreme cold and high humidity hundreds of times to predict their lifetime in the real world. When perovskite

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[110] NREL Efficiency Chart https://www.nrel.gov/pv/cell-efficiency.html

materials first became popular in research they were notoriously unstable and would disintegrate upon exposure to oxygen or water. However, material stabilities have vastly improved and Oxford PV panels have now passed accelerated lifetime tests. These technologies are in their infancy with low-volume production plants only being set up in 2020 but efficiency improvements in solar PV look set to continue.

It is important to note that, **while technologies are always improving, the manufacturing maturity, stability and current market dominance of silicon means that it is likely to be keep a very high share of the market for the foreseeable future**. There are other more established technologies in the solar PV market: cadmium telluride (CdTe, commonly referred to as 'cad-tel') and copper indium gallium arsenide (CIGS) panels also have advantages of manufacturing simplicity over silicon but have not realised their potential of lower manufacturing costs due to a low share of the global market.

CdTe and CIGS solar panels are generally blacker in appearance that silicon solar cells, which can be an advantage particularly in conservation areas or on listed buildings. Where these cells are integrated into a roof (as opposed to being attached onto the roof) they can be relatively subtle. For areas where aesthetics are particularly important, solar roof tiles have come on the market in recent years where each roof tile is its own small solar panel. These tiles are less efficient than standard panels and can only be installed as part of a whole roof replacement.

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Appendix 3: The Performance Gap

The *performance gap* is the term given to the difference between the projected emissions associated with a building in use and the real emissions from the as-built building. While some aspect of the performance gap is due to occupier behaviour meaning more energy is used than was expected, differences between the design and actual construction are a major factor. There have been several studies taking place to measure the performance gap in buildings. A study published **by Innovate UK found that energy usage in domestic buildings to be more than double that predicted by the SAP calculations**.[111] Moreover, there appeared to be **no correlation between the predicted values from SAP and the total annual emissions** (R^2 of 0.04) leading the report to state that

"It should not be assumed that actual carbon emissions link in any way to emission estimates needed for planning consents (also used in EPCs)." Innovate UK

While the Innovate UK study compared SAP values to energy consumption of the building *in-use*, and it is therefore subject to effects related to occupier behaviour, another study considered only the measurable characteristics of *as-built* buildings. The study, *"Magnitude and extent of building fabric thermal performance gap in UK low energy housing*", **compared 188 low-energy dwellings** in the UK of which 50 were passive house.[112] In terms of airtightness, the study found that **heat losses from non-passive house dwellings were around three times higher than those of the passive house**. While some of the non-passive house dwellings did have measured overall heat loss rates below the predicted values, 70% did not, with the heat loss rate of some dwellings nearly three times higher than the predictions. **As with the Innovate UK study, this study found no correlation between the measured space heating requirements of a dwelling and its SAP score for non-passive house dwellings** (R^2 of 0.07, passive house dwellings showed a good correlation, R^2 of 0.65).

A separate Innovate UK study was undertaken specifically for non-domestic buildings.[113] On average, carbon emissions were 3.8 times higher than those in the design estimate. The worst performing buildings were found to have performance gaps in the range of 6-10 times the predicted emissions. Common issues were associated with operation and maintenance issues associated with the **renewable energy technologies used, optimistic assumptions around usage hours and construction skills being lower than required to fully realise designed airtightness**. The best performing buildings incorporated ground-source heat pumps, natural ventilation and solar PV panels, although even the best performing buildings still had emission levels above those predicted. The results of this study highlighted issues relating to poor design, installation and understanding with regards to low-carbon technologies, the recurring issue of the skills gap.

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[111] Innovate UK: Building Performance Evaluation Program – Findings from Domestic projects https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/497758/Domestic_Building_Performance_full_report_2016.pdf

[112] Gupta & Kotopouleas, *Magnitude and extent of building fabric thermal performance gap in UK low energy housing*, Applied Energy, **2018**
https://www.sciencedirect.com/science/article/pii/S0306261918304343#b0220

[113] Innovate UK: Building Performance Evaluation Program – Findings from Non-Domestic projects
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/497761/Non-Domestic_Building_performance_full_report_2016.pdf

To better understand where issues are arising, an evidence study was conducted by the **Zero-Carbon Hub** relating to new development standards. [114] The study found that the main issues that contribute to the performance gap were

- Design teams lacking awareness and understanding of low-carbon measures and how to implement them
- Poor construction and integration of different aspects of the design on site
- Switching of products to less enegy efficient options
- Verification process applied inconsistently and prioritising aspects other than energy efficiency

Based on the evidence presented in the report, the Zero-Carbon Hub recommended that future Part L emission requirements be based on the as built rather than the designed performance. This option was not put forward in the Future Homes Standard Consultation although the consultation does discuss means of reducing the perfomance gap such as reforms to the regulatory system and increased guidance on the as-built specifications.

The reports discussed above relate to some of the more recent studies into the relationship between SAP ratings and real-life emissions but similar findings appear in reports stretching much further back. It is clear that, while TER and SAP ratings could be a useful tool in reducing the carbon emissions from new developments, without some form of monitoring the quality of the as-built buildings, tightening regulation on the TER ratings is unlikely to bring the gradual change to a zero-carbon 2038 envisaged by Greater Manchester.

In the Committee on Climate Changes report UK Housing: Fit for the Future, published in February 2019, many of the issues highlighted are discussed in the Zero-Carbon Hub's report. In line with the recommendations from the Zero-Carbon Hub study, the **first recommedation the CCC makes is that building standards compliance should be linked to the as-built buiding as opposed to the designed one.**

"1. Overhaul the compliance and enforcement framework so that it is outcomes-based (focussing on performance of homes once built), places risk with those able to control it, and provides transparent information and a clear audit trail, with effective oversight and sanctions. Fund local authorities to enforce standards properly across the country.

2. Reform monitoring metrics and certification to reflect real-world performance, rather than modelled data (e.g. SAP). Accurate performance testing and reporting must be made widespread, committing developers to the standards they advertise."

CCC UK Housing: Fit for the Future?

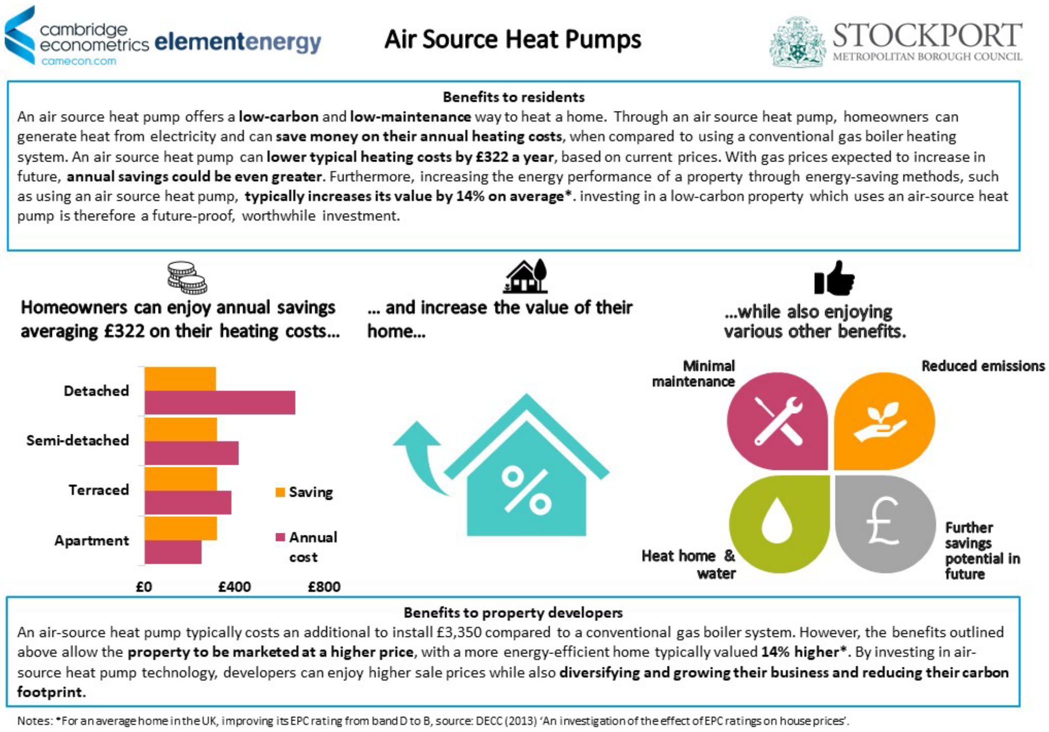
The CCC go on to say that, by 2025 at the latest, new-build homes should deliver ultra-high levels of energy efficiency, consistent with a space heating demand of 15-20 kWh/m^2 per year. It is notable that these standards are roughly in line with Passivhaus certified standards which are discussed in the following section.

These recommendations from the CCC, along with best practice policy from elsewhere, are used to inform the planning policy recommendations at the end of this section. Stockport Council has already implemented some of the suggestions from the CCC related to transport with the recommendation that new developments should be sustainably assessable to the urban area and that the electrics in a new homes should be capable of supporting EV charging.

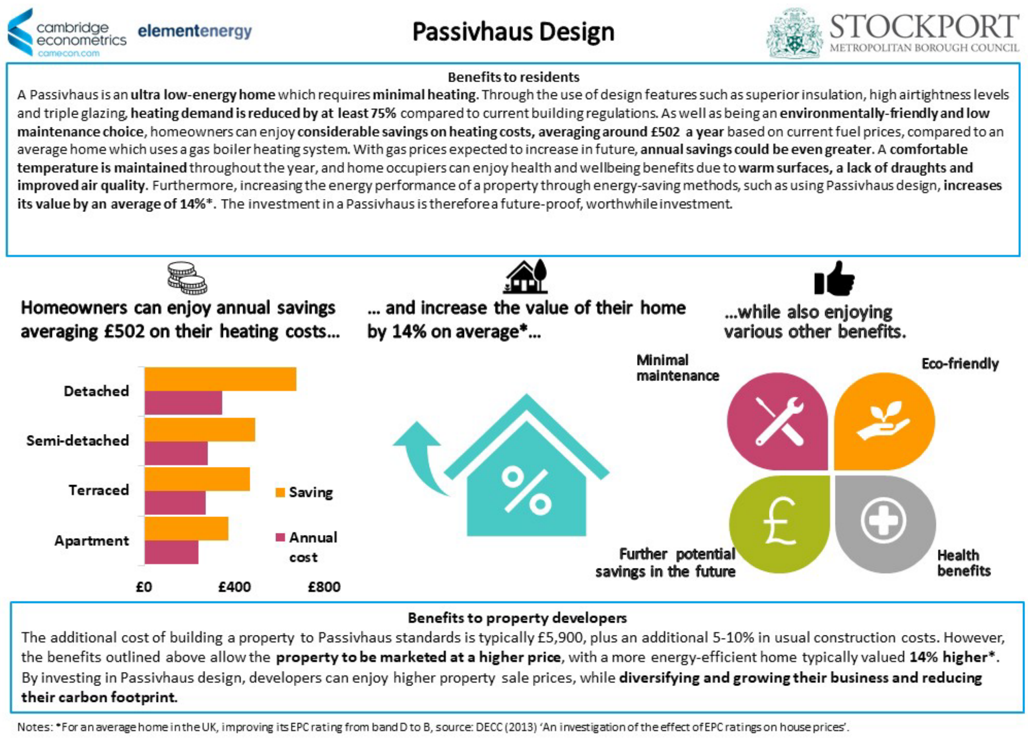
[114] Zero-Carbon Hub: Closing the Gap Between Design & As-Built Performance http://www.zerocarbonhub.org/sites/default/files/resources/reports/Closing_the_Gap_Between_Design_and_As-Built_Performance-Evidence_Review_Report_0.pdf

Appendix 4: Infographics for low-carbon measures

Air Source Heat Pumps



Passivhaus Design



Solar Photovoltaics