Leicester City Council

Energy and Sustainable Design & Construction Study

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Quality information

Prepared by	Checked by	Verified by	Approved by
Harper Robertson Senior Consultant	Alex Duckworth Principal Consultant	Matthew Turner Regional Director	Matthew Turner Regional Director
Isabelle Francis Consultant	Matthew Turner Regional Director		
Alex Duckworth Principal Consultant			

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Prepared for:

Leicester City Council

Prepared by:

AECOM Limited
Aldgate Tower
2 Leman Street
London E1 8FA
United Kingdom
aecom.com

Table of Contents

Figures

Tables

Executive Summary

Leicester City Council (LCC) has commissioned AECOM to provide technical support and justification for clear, deliverable and ambitious energy and sustainable design and construction policies within the forthcoming new Leicester Local Plan. This report builds on the 2015 Climate Change Evidence Base Study and describes the current situation with regards to energy and the sustainable design and construction of developments in Leicester. It discusses some of the anticipated changes that may arise in the coming years because of the development proposed in the emerging new Local Plan, national policy and wider changes, and presents a variety of options for responding to and delivering these through planning policy.

The aim of this report is to support Leicester City Council in ensuring Leicester's new Local Plan will adopt a proactive strategy to mitigate and adapt to climate change, to meet the requirements of legislation and the national planning policies framework, as well as contributing to the City's response to both the national and local 'climate emergencies'.

The report is split into the following key outputs and analysis:

- Carbon emissions baseline reporting
- Carbon scenario modelling
- Opportunities assessment
- Policy recommendations

A summary of each is as follows.

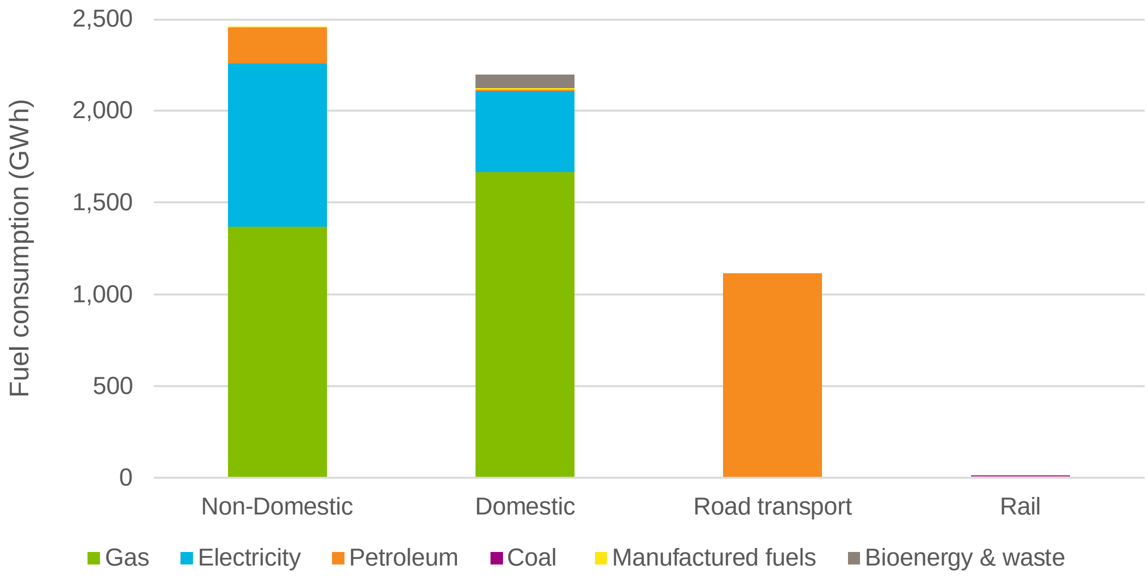
Baseline Reporting

To provide context for the assessment of the assessment of future low and zero carbon (LZC) opportunities, the current baseline fuel consumption and CO_2 emissions for Leicester is presented. The reference data is sourced from the Department of Business, Energy & Industrial Strategy (BEIS). The current gas and electricity consumption level and current Energy Performance Certificate (EPC) ratings in the built environment is also estimated, as well as the current level of ultra-low emission vehicles (ULEVs) uptake and charge point provision across Leicester city, and finally the deployment of Low or Zero Carbon (LZC) energy technologies that provide electricity and those that provide heat.

Fuel consumption in 2018

The fuel consumption within Leicester was analysed by sector and type (Figure A). The fuel consumption is led first by the non-domestic (43%) and domestic sectors (38%). Non-domestic and domestic fuel consumptions are dominated by gas which is predominantly for heating, hot water and cooking in the domestic sector. Road transportation accounts for 19% of fuel consumption in Leicester, almost completely fuelled by petroleum products, while rail transportation contribution to fuel consumption is minimal. Decarbonising the heating and transportation sectors are thus critical to lower Leicester's greenhouse gases (GHG) emissions, highlighting the large opportunity for decarbonisation of heat.

Figure A. Leicester fuel consumption by sector and fuel type (2018 BEIS dataset)



Recent trends and 2018 breakdown of CO_2 emissions

As well as fuel consumption, BEIS also provides an emissions breakdown and past trends data set for the city of Leicester. This data is presented in Table A and Figure B. The data has been analysed to locate areas and identify opportunities for emissions reduction.

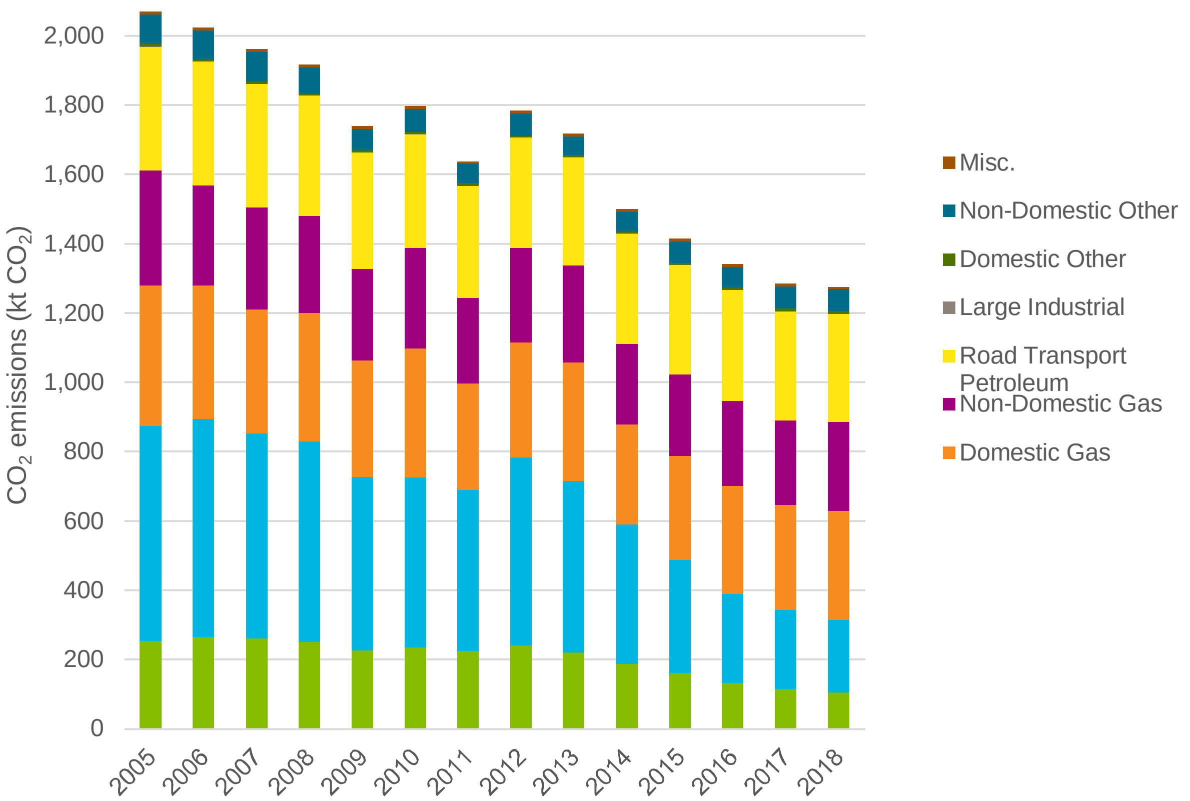
Table A. Leicester CO_2 emissions (2018 data)

	Emissions - Non-Domestic ($ktCO_2$)	Emissions – Domestic ($ktCO_2$)	Emissions – Transport ($ktCO_2$)	Removals - LULUCF* ($ktCO_2$)	Total ($ktCO_2$)	% of total emissions (excl. removals)
Gas	258.1	314.0	-	-	572.2	*45%*
Electricity	209.5	104.8	-	-	314.3	*25%*
Large Industrial Installations	0.5	-	-	-	0.5	*<1%*
Agriculture	0.7	-	-	-	0.7	*<1%*
Road Transport	-	-	311.8	-	311.8	*24%*
Other / Not Specified	63.6	6.8	5.7	(-2.5)	76.1	*6%*
TOTAL	**532**	**426**	**318**		**1,276**	
% of total emissions (excl. removals)	*42%*	*33%*	*25%*	*n/a*		

* See section 3.2 for note.

Figure B shows the recent trends in CO_2 emissions by sector and fuel type as reported by BEIS. Since 2005 there has been an overall 38% decrease in emissions, which is slightly larger than the UK average (which saw a 35% decrease). There has been year-on-year decreasing emissions for 11 of the 13 years reported. Nationally, most of this decrease is not due to lessening electricity consumption but is rather associated with decarbonisation of the electricity supply which has contributed to the large reduction of emissions associated with non-domestic electricity usage. Other emissions sources have reduced over time, however, change is not as significant as that of electricity; CO_2 emissions from gas have for example remained largely the same, whereas emissions from electricity have decreased by more than half.

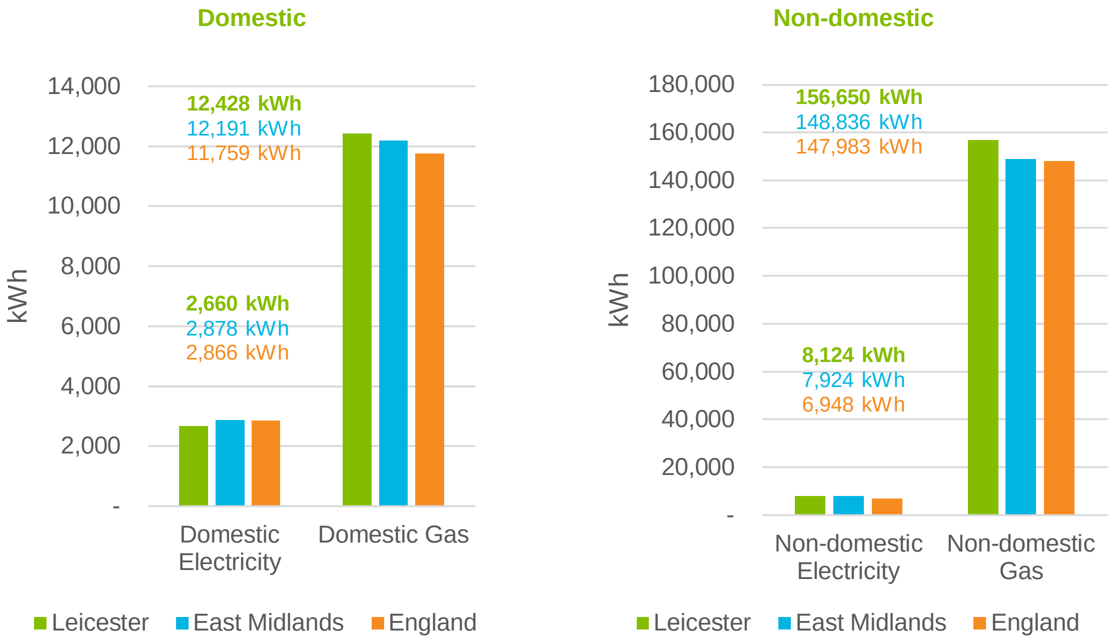
Figure B. Trends in Leicester CO_2 emissions from 2005 to 2018



Gas and electricity consumption level in the built environment

As stated previously, gas and electricity use in buildings account for a large proportion of fuel use and CO_2 emissions in Leicester. Figure C illustrates that domestic electricity consumption in Leicester is slightly lower than both the regional and national average, whereas domestic gas consumption is slightly higher. For non-domestic buildings, electricity consumption and gas consumption are both above the regional and national average.

Figure C. Median Gas and Electricity Consumption in Buildings (2018)



*No. of non-domestic energy meters:
Electricity – 13,077 and Gas – 1,676

Energy consumption in domestic buildings can vary based on a wide variety of factors, including but not limited to physical features affecting energy efficiency, such as the type of building (detached, semi-detached, flats, etc.), its age, location and construction type; technological factors such as the type of appliances and heating systems used; and social factors such as the number of occupants, household income levels, etc. These factors are likely to explain the variation between domestic fuel consumption in Leicester compared with other locations.

In the case of non-domestic buildings, all of these factors can play a role, but energy use also depends more strongly on the types and sizes of buildings – recalling that this category includes everything from large manufacturing facilities to small tourist information kiosks. Fuel consumption in non-domestic buildings is therefore linked to the types of industries within Leicester in addition to the energy efficiency of its fabric and services.

Energy Performance Certificate (EPC) ratings in the built environment

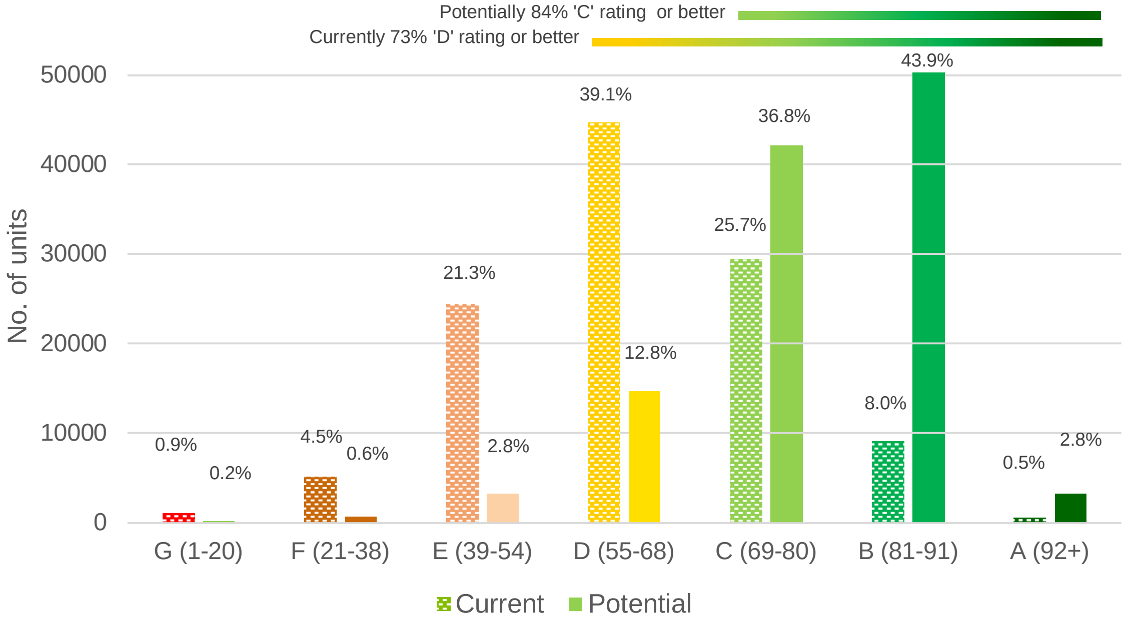
Energy Performance Certificate (EPC) ratings provide a normalised means of comparing the energy efficiency of different buildings. Here, EPC data is used as a rough indication of the relative performance of existing buildings in Leicester. Although the EPC database does not capture the entire building stock perfectly, it does provide helpful insight into the differences between building types, ages, and tenures. It also indicates the potential scale of improvement that might be achieved through retrofitting measures. This is particularly relevant because the main mechanism for UK Local Authorities to drive improvements in the energy efficiency of the existing stock, the Minimum Energy Efficiency Standards (MEES), relies on EPC ratings.

Domestic buildings are rated on a scale of 1 (worst) to 100 (best), and these scores correspond to 'bands' from A to G. Ratings are split into two scores, 'current' and 'potential' ratings. 'Potential' ratings are those that could be achieved subject to energy efficiency measures being carried out.

Below, Figure D shows the range of current and potential EPC ratings registered for existing domestic properties in Leicester. The highest number of current SAP ratings are in the range of 60-70 out of 100, which equates to a 'D' rating – in line with the average for England. The highest numbers of potential SAP ratings are in the range of 80-90, equivalent to a 'B' rating. The majority (73%) of dwellings in Leicester currently achieve an EPC rating of 'D' or better. The 'potential' results also indicate that, for a majority (84%) of existing properties, it would be possible to achieve an EPC rating of 'C' or better; if they implement a range of energy efficiency improvements. Although these ratings do not directly correlate to changes in CO_2 emissions, this confirms that there is significant scope to improve the energy efficiency of the existing domestic building stock.

Although it is not possible to predict the level of energy efficiency based solely on a building's age, in the UK older buildings tend to have higher heat demands and less efficient building services. This results in higher energy bills as well as CO_2 emissions.

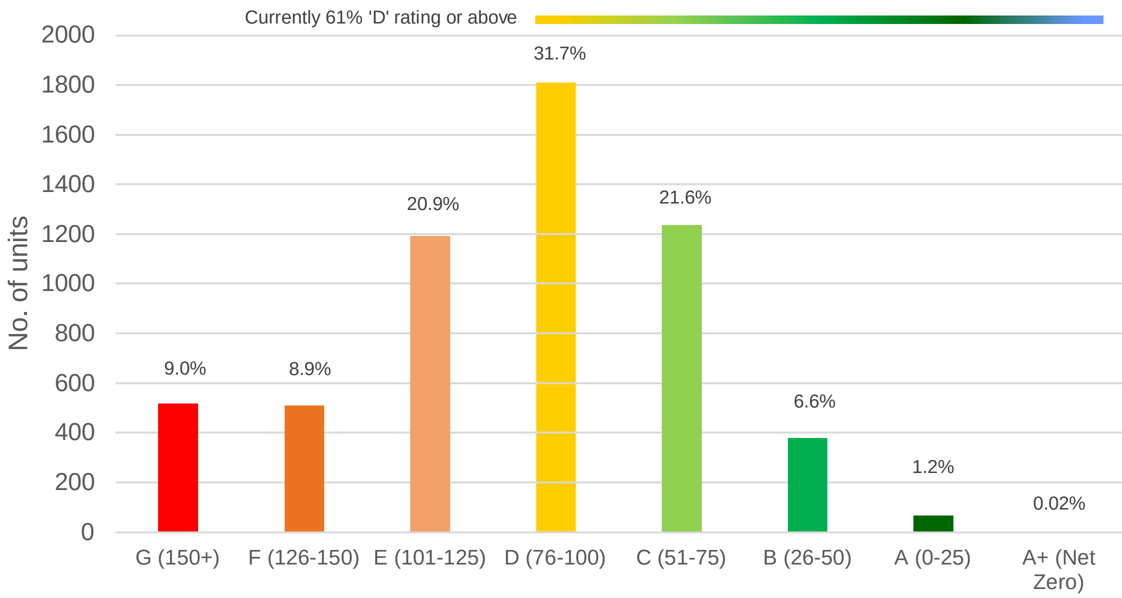
Figure D. EPC and SAP bands of existing buildings in Leicester City



A different rating system is used for **non-domestic buildings** and the public dataset includes less information than is provided for domestic EPCs. Rating 'bands' range from A+ to G, but numerical scores are not bounded; higher numerical scores indicate worse performance; and scores below zero indicate that the building is Net Zero carbon or carbon negative.

Figure E shows the distribution of EPC ratings for existing non-domestic buildings. It shows that the highest number of current ratings are 'D', with roughly 61% of properties achieving a 'D' rating or above. Note that there is a high number of 'G' rated properties due to a long 'tail' in the data; unlike for domestic properties, there is no upper end of the rating scale for non-domestic buildings. No information about potential ratings is provided in the dataset; therefore, it is difficult to ascertain the potential uplift that would be possible following a refurbishment or energy efficiency improvements. There are no potential figures given for non-domestic buildings at this point in time.

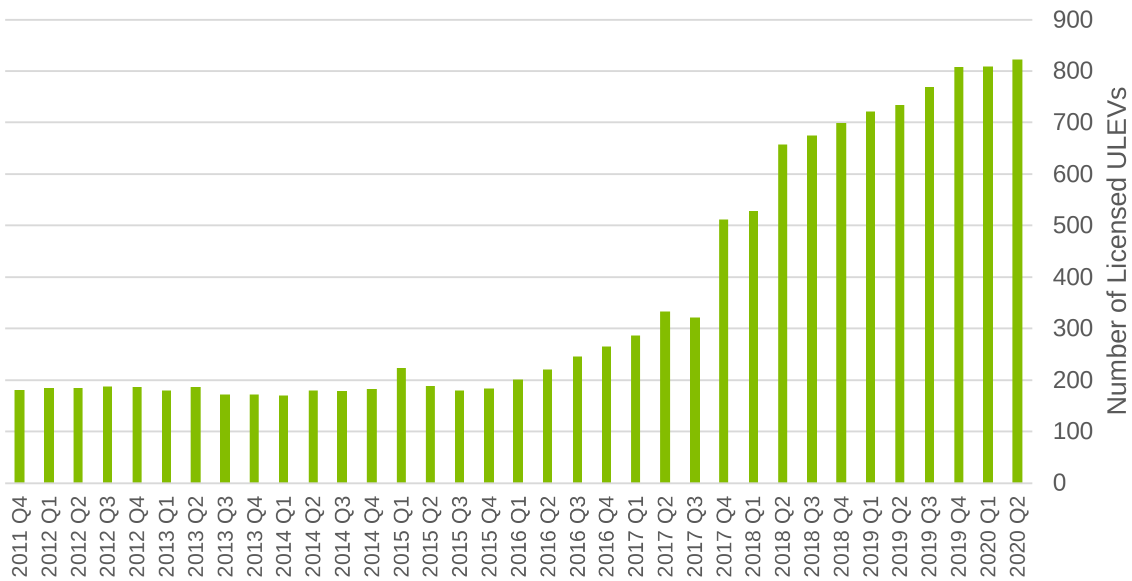
Figure E. EPC bands of existing non-domestic buildings in Leicester City



Recent trends for Ultra low emission vehicle (ULEV)

As shown in Figure F, there was a more than four-fold increase in the number of ULEVs registered in Leicester between 2011 and 2020, with 822 as of Q2 2020. Nonetheless, these represent a very small portion (<0.5%) of the more than 183,400 total vehicles licensed in the City. This is slightly below the proportion for the East Midlands (c. 0.6%) and for the United Kingdom as a whole (c. 0.8%).

Figure F. Ultra low emission vehicles (ULEVs) registrations in Leicester, 2011-2020

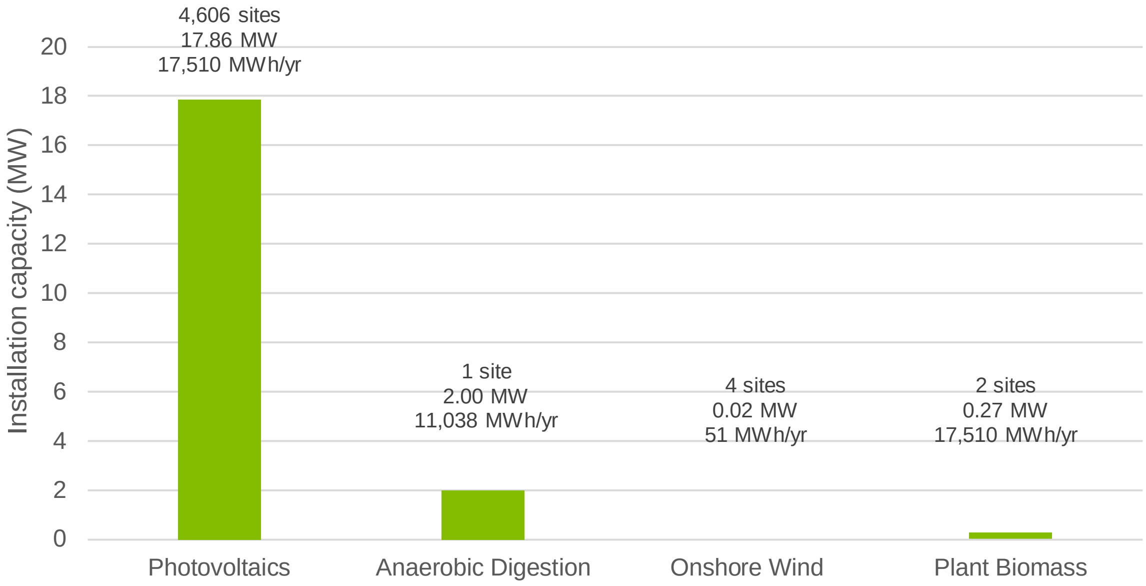


The national picture shows a big variation in the provision of chargepoints per head of population. On a regional basis, London (49), Scotland (32) and the (28) North East of England have the highest number of public chargepoints per 100,000 of population, while Yorkshire & the Humber (12), the West Midlands (14), East of England (15) and the East Midlands (15) having the lowest number per 100,00 of population.

Low and Zero Carbon (LZC) Energy Technologies in 2019

The total installed capacity of **low and zero carbon (LZC) electricity technologies** as at the end of 2019 was approximately 20.2 MWe, offering the potential to generate nearly 30,000 MWh of electricity per year. According to the REPD (accessed November 2020), there are currently no planning applications for any further renewables within Leicester. The largest number of installations are PV panels which also account for most of the renewable electricity that is generated (17,510 MWh per year). Most of these are small-scale roof-mounted arrays. There is one anaerobic digestion (AD) facility but due to the higher output of this technology, it accounts for most of the remaining electricity generated each year (11,038 MWh per year). There is also a small contribution from plant biomass and onshore wind. In total, technologies within Leicester City generate nearly 30 GWh of renewable electricity per year. These results are illustrated in Figure G.

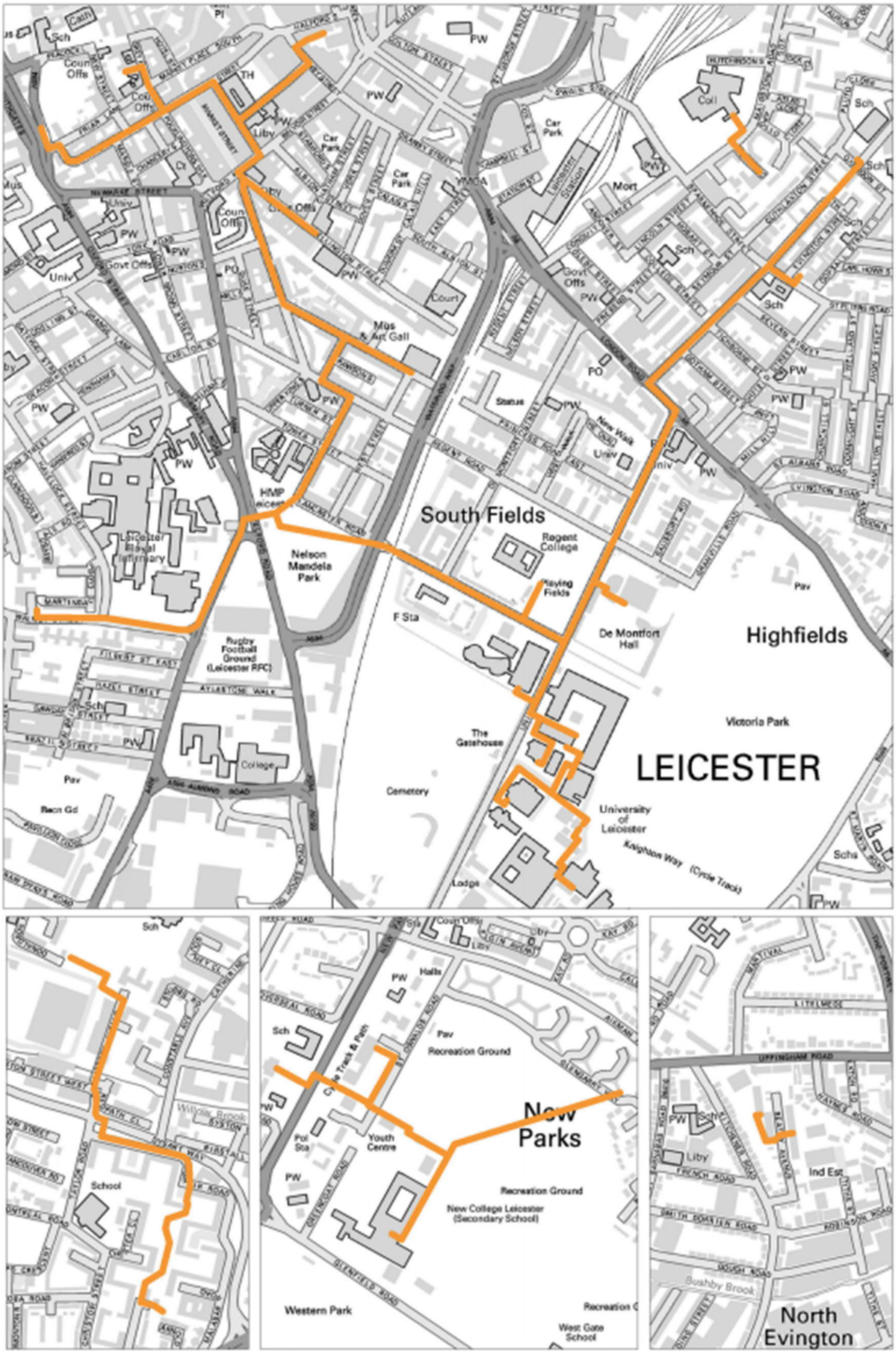
Figure G. Estimated capacity (MWh) and electricity generation (MWh/yr) of operational LZC electricity technologies at end of 2019



In addition, there are a variety of technologies in Leicester that provide **low and zero carbon (LZC) heat**. In 2012 ENGIE signed a 25-year contract with LCC agreeing to link and extend several existing heat networks around the City. These connect to a variety of university buildings, Council buildings, and residential homes. Figure H shows a map of the heat networks detailed in the City of Leicester Local Plan 2020-2036. Overall the scheme is estimated in the 2015 Climate Change Study to supply 10 MWe of energy generation from two gas fired CHP units and additional biomass boilers. The 2015 study further details the planned phasing for the expansion of the network, with the scope to increase capacity to 25-30 MWe of generation, although it is understood that the timing and scale of expansion is uncertain.

Aside from the heat network, the Renewable Heat Incentive (RHI) Database indicates that there are 6 accredited non-domestic RHI installations in Leicester with a capacity of roughly 1 MW in total, and 177 domestic RHI installations (capacity not listed). These could include heat pumps, solar thermal technologies, and technologies utilising biomass or biogas, but the RHI publication does not include a detailed breakdown.

Figure H. Existing District Heating Network. Source: City of Leicester Local Plan 2020-2036



Carbon Scenario Modelling

Using the baseline Leicester emissions data, a high-level CO_2 modelling exercise to assess the potential scale and direction of impacts from a range of anticipated future trends was completed. The range of future trends include:

- New housing and employment space to be constructed
- National electricity grid decarbonisation
- Energy demand reduction e.g. through energy efficiency measures and behaviour change
- Switching from the use of gas-fired heating to electric systems e.g. heat pumps; and
- Reducing demand for transport and increasing use of ULEVs.

We have developed two scenario models, for the purpose of illustrating the importance of the decarbonisation of the grid. The key findings of the scenario modelling are shown in Table B. In terms of emissions reduction the most substantial change is achieved by switching the fuel used for heating and transportation.

Table B. Key findings of the CO_2 emissions scenario modelling

By 2050… Potential change in carbon emissions from these measures…	Without grid decarbonisation	With grid decarbonisation
Electricity grid decarbonisation		
Decrease in line with BEIS trajectory (see Section 4.2)	n/a	-22%
New development		
New buildings constructed, no other changes	+7%	-22%
Demand reduction in existing buildings		
Reduce demand for electricity and heat*…	-7%	-1%
… and switch to electric heating systems (90% by 2050)	-14%	-38%
Low carbon transport		
Mileage reduction of 10%, no other changes	-1%	-1%
… and switch to ULEVs (excludes HGVs)	-16%	-22%
Total reductions		
All of the above measures implemented	-37%	-83%
Residual emissions ($ktCO_2$ p.a.)	**807**	**222**

* Conservative estimate of 10% demand reduction.

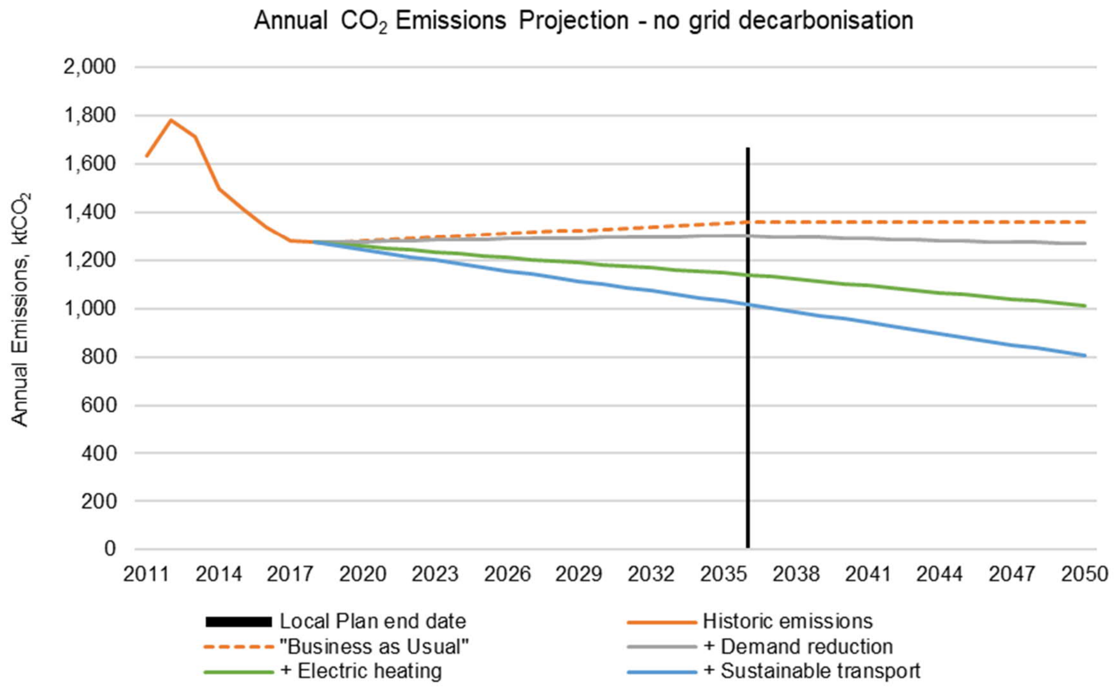
Figure I and Figure J show historic emissions for Leicester, along with a hypothetical 'Business as Usual' trajectory – which includes the provision for new development as LCC have outlined in its Draft Local Plan. The other lines show the cumulative impact of sequentially adopting reduction measures that:

1. Reduce energy demands in buildings (in grey); and then
2. Switch from gas boilers to efficient electric heating systems (in green); and then
3. Reduce vehicle mileage and switch from petrol and diesel vehicles to ULEV (electric or hydrogen) vehicles (in blue).

The measures are based on approximate changes and gradual role out of improvements. All are estimates based on unknown levels of change and adoption that will be different to that modelled but intended to illustrate the potential magnitude of the benefits that the measures can bring. The scale of the transition from gas to electric heating and fossil fuel to electric transportation in the model is conservative and there is certainly scope for this to increase and narrow the gap to zero carbon. What is difficult to determine is how successful national programmes for increasing uptake will be.

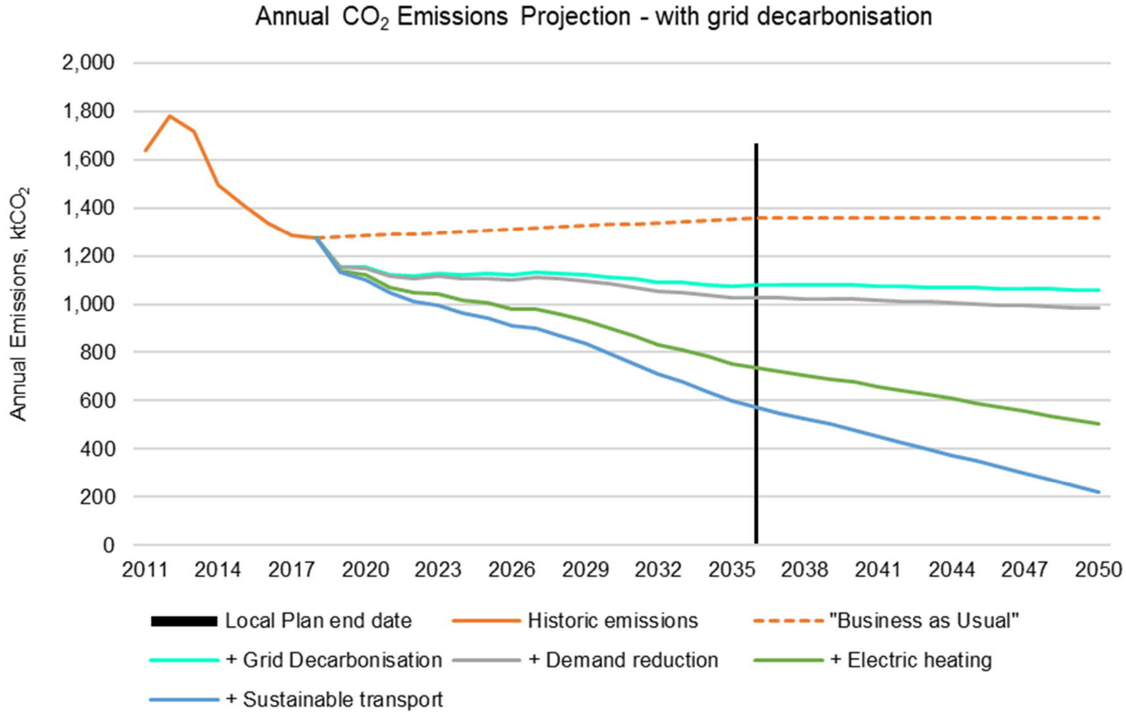
The carbon scenario models project how emissions in Leicester City will be affected by areas of policy and technology shifts, they are separated into ignoring the decarbonisation of the grid (Figure I) and accounting for the decarbonisation of the grid (Figure J).

Figure I. Annual CO_2 emissions scenarios for Leicester, no change in the electricity grid



Cumulatively, the changes would result in approximately 37% decrease in CO_2 emissions against the 2018 baseline. Total emissions would decrease from 1,273 $ktCO_2$ to 807 $ktCO_2$.

Figure J. Annual CO_2 emissions scenarios for Leicester, accounting for grid decarbonisation



This scenario essentially amplifies the effects of switching to electric heating systems and electric vehicles. In this scenario, if all of the above measures were adopted, this would reduce total CO_2 emissions by up to 83% by 2050, with residual emissions of 222 $ktCO_2$. This highlights how the impact of switching to electric heating systems and vehicles is highly dependent on whether or not they are supplied with low carbon, renewable electricity. Even if no intervention measures are adopted, emissions would still decrease by up to 22%.

It is important to note that these scenarios are *not* intended to predict actual fuel consumption or CO_2 emissions. However, the analysis is useful since it highlights the potential scale and direction of different trends, which provides insight into key priorities and risks when considering pathways and component actions required to deliver the decarbonisation target.

In both scenarios, the residual emissions would need to be addressed through additional measures such as tree planting, carbon removal technologies, and so on. However, as stated previously, the scale of offsetting required even in an optimistic scenario would require a huge amount of land and other resources and so is clearly not practical. This emphasises the fact that demand reduction and energy efficiency measures must be prioritised.

Opportunities Assessment

AECOM assessed various opportunities for introducing higher performance standards in planning policy and described sustainable design measures that could be implemented as best practice to contribute towards Leicester becoming a carbon neutral City.

Our assessment has considered measures that:

- Promote Sustainable Building Design – *discussing opportunities to set higher building design standards and sustainability-related assessments that go beyond Building Regulations*; and
- Increase Low and Zero Carbon (LZC) Energy Technology Provision – *with estimations of future LZC energy resources opportunities for Leicester such as wind energy, solar energy, heat pumps, hydroelectric power, biomass and district heat networks. AECOM also assessed the future deliverability of the generated power to customers via new or existing transmission and/or distribution network infrastructure*; and
- Promote sustainable transport – *such as encouraging sustainable modes of travel, supporting Ultra Low Emissions Vehicles and urban consolidation centres (hubs on the edge of cities that redistribute goods on 'last mile' deliveries to smaller electric vehicles)*; and
- Measures that benefit across multiple areas – *the cross-cutting measures are orientated towards long-term sustainability and wellbeing in a holistic manner. They address greenfield sites, overheating, retrofitting LZC technologies, green and blue infrastructure design, sustainable local material sourcing, lean design with circular economy and water efficiency*.

All these measures are discussed in further detail in the body of this report.

Policy Recommendations

The study draws out a series of policy recommendations outlined in Table C for Leicester City Council to take forward into the new Local Plan and its subsequent delivery. AECOM recommends Leicester City Council to revise the Climate Change and Flood Risk chapter of its Local Plan 2010-2026 with consideration of the following policy recommendations. The proposed revised policy is shown in Appendix F.

Table C. Series of policy recommendations for Leicester's new Local Plan

Ref	Policy recommendations	
1	Energy Hierarchy	Require all developments to follow a clear energy hierarchy.
2	Building Energy Efficiency Measures	Set a minimum target for carbon emissions reduction from building energy efficiency measures.
3	Heating/Cooling System Hierarchy	Require all developments to follow a clear heating/cooling system hierarchy.
4	Connection to Heat Networks	Include a requirement for all suitable developments near existing or planned heat networks to incorporate the necessary infrastructure to enable future connection.
5	Low and Zero Carbon Technologies	Require all development to provide details of the low and zero carbon energy technologies installed and the estimated reduction in CO_2 emissions these will deliver.
6	Cooling Hierarchy	Require all development to follow a clear cooling hierarchy.
7	Whole Life-Cycle Carbon Emissions	Introduce a requirement for development to minimise whole life-cycle emissions.
8	Existing Buildings	Positively support proposals that improve efficiencies and reduce emissions within the existing building stock.
9	Energy Statement	Include a requirement for all major developments to complete an energy statement to demonstrate compliance with the relevant policies.
10	Water Efficiency	All new developments should seek to maximise water efficiency on site
11	Sustainability Assessments	Encourage use of third-party assessments as an alternative approach to demonstrative compliance with the sustainable design and construction policies.
12	Policy Technical Guidance	Produce a technical guidance document to support developers in complying with the policy requirements.
13	Carbon Offset Scheme	Consider establishing a carbon offset scheme.

This study also provides evidence for informing technical notes and supplementary planning documents, as well as contributing to the quantitative understanding of future emissions and energy use.

1. Introduction

1.1 Purpose of this report

Leicester City Council (LCC) has commissioned AECOM to provide technical support and justification for clear, deliverable and ambitious energy and sustainable design and construction policies within the forthcoming new Leicester Local Plan.

Building on the Climate Change Evidence Base Study undertaken in 2015, this report describes the current state of affairs with regards to energy and the sustainable design and construction of developments in Leicester. It discusses some of the anticipated changes that may arise in the coming years as a result of the development proposed in the emerging new Local Plan, national policy and wider changes, and presents a variety of options for responding to and delivering these through planning policy.

The aim of this report is to support Leicester City Council in ensuring Leicester's new Local Plan will adopt a proactive strategy to mitigate and adapt to climate change, to meet the requirements of legislation and the national planning policies framework, as well as contributing to the City's response to both the national and local 'climate emergencies'.

The study provides an evidence base, and from this, a series of policy recommendations for Leicester City Council to take forward into the new Local Plan and its subsequent delivery. This study also provides evidence for informing technical notes and supplementary planning documents, as well as contributing to the quantitative understanding of future emissions and energy use.

1.2 Structure of this report

The report is structured as follows:

- **Section 1: Introduction**, purpose and structure of the report.
- **Section 2: Background and Regulatory Context** summarises the key drivers for sustainable design standards and LZC (low and zero carbon) energy deployment in Leicester.
- **Section 3: Establishing the Baseline** describes the current baseline and recent trends regarding fuel consumption, CO_2 emissions, ULEV (ultra-low emission vehicle) uptake and LZC deployment in Leicester. It also describes the energy efficiency and typical gas and electricity consumption of the existing building stock.
- **Section 4: Assessment of Future Changes** presents an overview of key trends that are expected to occur in the coming decades, including but not limited to new development, technological advances and regulatory changes. Where possible, the individual and cumulative impacts of these changes on Leicester's CO_2 emissions have been quantified.
- **Section 5: Assessment of Opportunities** outlines various options for introducing higher performance standards in planning policy and describes sustainable design measures that could be implemented as best practice to contribute towards Leicester becoming a carbon neutral City.
- **Section 6: Policy Recommendations** discusses the potential to establish a carbon offset fund for developers to make contributions in lieu of on-site carbon savings, outlining practical implications and potential next steps for LCC.
- Relevant supporting information is provided in the **Appendices**.

2. Background and Regulatory Context

Building on the 2015 study, this section provides a more up-to-date summary of the key existing and emerging legislation, policies and incentives relating to energy use and CO_2 emissions for the UK and Leicester built environments. These will inform the discussion throughout the report, and in particular, the policy recommendations presented in Section 6.

2.1 International Context

Climate change is one of the key challenges faced today, with its impact observed at global and local levels. The rise in average global temperatures is already recorded at 1.1°C above pre-industrial levels. The international consensus from climate experts and scientific organisations is that this rise must be limited to a maximum of 1.5°C to avoid causing irreparable impact upon the planet.

To this effect, in 2016 the UK signed the Paris Agreement on climate change, making a commitment to take steps to limit global temperature rise to well below 2°C and pursue efforts to keep it to 1.5°C. The urgency of achieving a united global response to combat the causes of climate change and mitigate its ongoing effects has been recognised nationally and locally, and in 2019 both the UK and Leicester declared climate emergencies.

Context: Leicester's Contribution towards meeting the Paris Agreement goals

A study produced by the Tyndall Centre for Climate Change Research[1] considered how much carbon could be emitted by each Local Authority in the UK while still being compatible with the targets set out in the Paris Agreement. The report authors found that, *'at 2017 CO_2 emission levels, Leicester would use this entire budget [8.5 million tonnes of CO_2] within 7 years from 2020'.* This emphasises the urgency of achieving rapid decarbonisation and supports LCC's aim of reaching Net Zero emissions in advance of the national deadline.

The UK is also committed to achieving the UN's Sustainable Development Goals (Figure 2-1) which were set out by the UN in 2015 to eradicate extreme poverty, fight inequality and injustice and leave no one behind. They cover a wide range of topics that are relevant to development in Leicester, including but not limited to:

- Goal 6. Ensure availability and sustainable management of water and sanitation for all.
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialisation, foster innovation.
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.
- Goal 13. Take urgent action to combat climate change and its impacts.
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Figure 2-1. UN Sustainable Development Goals. Image © United Nations

The following text lists out the 17 UN Sustainable Development Goals illustrated in Figure 2-1 in an accessible format:

Goal 1: No Poverty
Goal 2: Zero Hunger
Goal 3: Good Health and Well-being
Goal 4: Quality Education
Goal 5: Gender Equality
Goal 6: Clean Water and Sanitation
Goal 7: Affordable and Clean Energy
Goal 8: Decent Work and Economic Growth
Goal 9: Industry, Innovation, and Infrastructure
Goal 10: Reduced Inequality
Goal 11: Sustainable Cities and Communities
Goal 12: Responsible Consumption and Production
Goal 13: Climate Action
Goal 14: Life Below Water
Goal 15: Life on Land
Goal 16: Peace, Justice, and Strong Institutions
Goal 17: Partnerships to Achieve the Goal

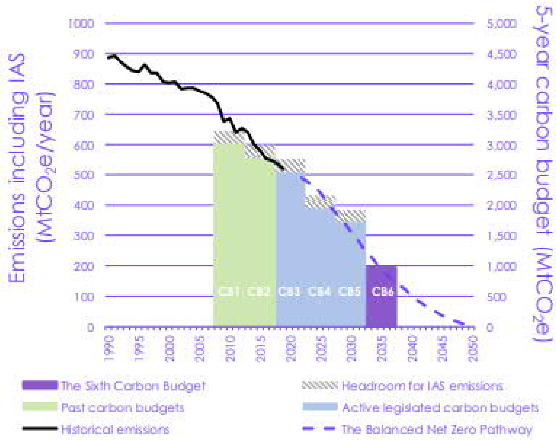
2.2 National legislation and policies

2.2.1 UK Climate Change Act

Through the Climate Change Act (2008), amended in 2019, the UK Government is legally committed to a 100% reduction in greenhouse gas (GHG) emissions by the year 2050, compared with a 1990 baseline. As part of this Act, the UK Government is also required to meet interim legally binding targets, known as carbon budgets, which act as steppingstones to 2050.

In December 2020, the Government announced that they would increase their 2030 GHG emissions reduction target, from achieving a 57% reduction relative to the 1990 baseline, to a 68% reduction[1]. Subsequently, the Committee on Climate Change has also recommended an additional reduction target of 78% by 2035, which will in effect, bring forward the UK's previous 80% target by nearly 15 years.

Figure 2-2. Illustration of the CCC's recommended 6th carbon budget. Image © CCC



Whist neither are yet legally binding, it does indicate the significant extent and pace of the intended decarbonisation trajectory for the UK occurring over Leicester's new Local Plan period (2020-2036), which Leicester and its built environment will be expected to contribute towards.

2.2.2 National Planning Policy Framework

The National Planning Policy Framework (NPPF), initially published in 2012, sets out Government planning policy for England and provides guidance for local planning authorities drawing up local plans and is a material consideration for those determining applications. The NPPF was most recently updated in 2021.[2]

The NPPF (2021) states that, *'the purpose of the planning system is to contribute to the achievement of sustainable development.'* It addresses topics that are relevant to the economic, environmental and social sustainability of development proposals, including but not limited to:

- Meeting the challenge of climate change, flooding and coastal change;
- Achieving well-designed places;
- Promoting sustainable transport and
- Conserving and enhancing the natural environment.

The key paragraphs within the NPPF relating to energy and sustainable design and construction are set out in Appendix A. The most relevant points for plan-making are that:

- Plans should take a proactive approach to mitigating and adapting to climate change in line with the objectives and provisions of the Climate Change Act 2008.

- New development should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change and can help to reduce greenhouse gas emissions.

- Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards. This is particularly relevant for water efficiency, and the national planning policy guidance clarifies 'where there is a clear local need, local planning authorities can

[1] HM Government press release, *'UK sets ambitious new climate targets ahead of summit'* (2020). Available at: https://www.gov.uk/government/news/uk-sets-ambitious-new-climate-target-ahead-of-un-summit
[2] Ministry of Housing, Communities & Local Government, '*National Planning Policy Framework'* (2021), Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

set out Local Plan policies requiring new dwellings to meet the tighter Building Regulations optional requirement of 110 litres/person/day.'

- National Planning Policy Guidance (NPPG) clarifies, 'In their development plan policies, local planning authorities: Can set energy performance standards for new housing or the adaptation of buildings to provide dwellings, that are higher than the building regulations, but only up to the equivalent of Level 4 of the Code for Sustainable Homes. Are not restricted or limited in setting energy performance standards above the building regulations for non-housing developments.
- To help increase the use and supply of renewable and low carbon energy and heat, plans should:

  a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

  b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

  c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.

- Proposed wind energy development involving one or more turbines should not be considered acceptable unless it is in an area identified as suitable for wind energy development in the development plan; and, following consultation, it can be demonstrated that the planning impacts identified by the affected local community have been fully addressed and the proposal has their backing.

2.2.2.1 'Planning for the Future' White Paper (2020)

The Planning for the Future consultation White Paper was published by the Ministry of Housing, Communities and Local Government on 6th August 2020. This consultation sets out a package of proposed measures that, if implemented, would comprehensively transform the current planning system in England. The stated aim is to streamline and modernise the planning process, including to improve design and sustainability outcomes.

The Consultation proposes the role of Local Plans to be simplified, with less repetition of national policy. Local Plans will instead focus on setting out clear rules limited to a core set of standards and requirements for development, including site-specific and area-specific requirements. It is also proposed that a National Model Design Code be introduced following the publication of the National Design Guide in October 2019, to be supplemented by local design guides and codes, although it is not clear what topics would be delegated to the latter.

Some of the proposed key changes in the consultation relevant to this study are outlined below.

- Local Plans would be significantly reduced in scope to include fewer policies. The majority of policies would be set nationally while Local Plans would primarily address development site allocations.
- Specifically, Local Plans would designate land as falling into the category of either 'protection', 'renewal' or 'growth'. Outline planning permission may automatically be granted for 'growth' areas and restricted in 'protection' areas, while areas suitable for 'renewal' would accommodate some forms of development such as infill / densification.
- Proposals would still need to adhere to locally specific Design Codes that set out more detailed requirements. The process for developing these would require significant community engagement and support, an issue that is strongly emphasised throughout the consultation document.
- The planning application system would be streamlined and digitised; in particular, the number of supporting application documents would be reduced.
- The current system of S106 contributions and the Community Infrastructure Levy would be replaced with a nationally standardised, flat-rate infrastructure levy based on development and land values.

The 'Planning for the Future' consultation closed on 29th October 2020. It is not clear when the government is intending to respond to the consultation or the timeline for implementation.

Nonetheless, it should be borne in mind when considering the policy recommendations set out in this report.

2.2.3 Building Regulations

The UK Building Regulations are a set of national building standards that provide guidance on how different elements of buildings must comply with safety and performance standards. They apply to the majority of new buildings that are constructed. In addition, certain forms of work and renovation to existing buildings may trigger a requirement for Building Regulations certification to be achieved.

Part L of Building Regulations is the key mechanism for implementing the Building Act (1984) with regard to the conservation of fuel and power in buildings. Part L has been progressively tightened, including updates in 2006, 2010 and 2013. The Government has recently (January 2021) released its consultation response to updates to Part L for residential buildings, proposing to introduce a nation-wide standard that is equivalent to a roughly 31% improvement against Part L 2013.[3] The Government is also currently consulting on uplifts to Part L for non-residential buildings, considering a 22% or 27% improvement on current performance standards.[4]

A key priority in previous updates to Building Regulations has been to maintain flexibility in how developers meet the required carbon reductions: enabling a choice between fabric and fixed services enhancements to reduce demands; investing in renewable technologies; or to supply energy demands through low carbon fuel sources. A notable change in the 2013 update was the introduction of a new Target Fabric Energy Efficiency (TFEE). This aims to increase the attention given by developers to reducing the intrinsic heating demands of new homes and addresses a concern that carbon reductions were increasingly being delivered through low carbon or renewable energy supply options without sufficient focus on reducing the underlying energy demands of homes. Meeting the TFEE is an additional requirement and developers are still required to achieve an overall CO_2 Target Emission Rate (TER). In other words, a distinction is made between fabric efficiency and total CO_2 emissions. Some Local Planning Authorities have chosen to make a similar distinction by setting separate targets for each of these in planning policy.

Parts F and G are also important aspects of the building regulations that impact the planning policy of Leicester City. Part F covers building ventilation, including building air quality and preventing condensation in a domestic or non-domestic structure. Part G includes regulation in regard to the supply of water to a property, including water safety, hot water supply, sanitation and water efficiency. As part of the Government's consultation on non-domestic buildings, updates are looking to be made to Part F. [4]

2.2.3.1 Setting Higher Local Standards

Provisions in the Planning and Energy Act (2008) allow local planning authorities to set energy efficiency standards in their development plan policies that exceed the energy efficiency requirements of the Building Regulations. It also allows Local Authorities to impose reasonable requirements for a proportion of energy used in development in their area to be energy from renewable and/or low carbon energy sources in the locality of the development (sometimes referred to as the 'Merton Rule').[5]

Since 2015 the UK Government has indicated that some of these powers might be removed in future, making it uncertain whether local planning authorities can continue to apply their existing or new planning policies. The Housing Standards Review undertaken in 2014/15 proposed to standardise performance requirements nationally, and this was codified by the Deregulation Act (2015), but the relevant provision was never enacted. In March 2019, new Planning Policy Guidance was issued, which confirmed that, for domestic buildings, Local Authorities can require new buildings to achieve up to a 19% improvement in CO_2 emissions compared with Part L 2013; and for non-domestic buildings, Local Authorities are 'not restricted or limited' in the standards they can set.[6]

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[3] For more information, see: The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings - GOV.UK (www.gov.uk)
[4] For more information, see: The Future Buildings Standard - GOV.UK (www.gov.uk)
[5] *Planning and Energy Act* (2008). Available at: https://www.legislation.gov.uk/ukpga/2008/21/pdfs/ukpga_20080021_en.pdf
[6] Ministry of Housing, Communities & Local Government and The Rt Hon Lord Pickles, *'Planning update'* (March 2015). Available at: https://www.gov.uk/government/speeches/planning-update-march-2015

In January 2021 the Government reiterated that, 'local planning authorities will retain powers to set local energy efficiency standards for new homes' for the time being, but reiterated that this could change in future.[7] According to the Government's Future Homes Standard (FHS) Consultation document:[8]

> *'As we move to the higher energy standards required by Part L 2020 and the Future Homes Standard, there may be no need for local authorities to seek higher standards and the power in the Planning and Energy Act 2008 may become redundant.'*

To summarise, although Local Authorities are currently able to set higher standards of building energy performance than those outlined in the Building Regulations, it is unclear whether this will remain the case.

2.2.3.2 Energy Performance Certificates

Since 2013, the majority of buildings newly constructed, sold or rented in the UK have been required to have an Energy Performance Certificate (EPC) that describes their energy performance standard. This is a duty under the Building Regulations and is necessary to show compliance with Part L.

2.2.4 Drivers of Energy Efficiency in Existing Buildings

As stated above, the Building Regulations typically apply to new buildings but do not impact the majority of the existing stock. However, there have been various pieces of legislation and other initiatives in the last ten years aimed at supporting further improvements in this area which include, but are not limited to, the following:

2.2.4.1 Energy Act (2011)

The Energy Act provides support for energy efficiency measures to homes and businesses through the introduction of the Energy Company Obligations and the Green Deal (now withdrawn).[9] The Act also lays out a requirement for energy efficiency improvements to be made in the private rented sector, which has been defined further in the Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2011 (see below).

2.2.4.2 Energy Efficiency (Private Rented Property) Regulations (2011)

This policy has introduced a Minimum Energy Efficiency Standard (MEES), which is based on the EPC rating of buildings existing buildings. The regulations are intended to drive progressive improvements in the existing building stock. Under the MEES regulations, as of 1st April 2018, any properties newly rented out in the private sector must have a minimum Energy Performance Certificate (EPC) rating of E (some exceptions apply). Owners of buildings with a lower EPC rating will be required to implement energy efficiency measures, though consideration will be given to financial viability, the anticipated payback time and impacts on property value. Local Authorities have the power to issue fines for non-compliance.

Over time, the Government intends to progressively increase the minimum EPC rating, meaning that buildings must become more efficient in order to be sold or rented. A consultation publication covering non-domestic buildings proposed that the minimum rating should be raised to B by 2030, subject to actions meeting a seven-year payback test.

2.2.4.3 The Home Energy Conservation Act (HECA)

In 2019, the Government provided new statutory guidance relating to the HECA (1995). HECA aims to encourage Local Authorities to plan for CO_2 emission reductions on a borough-wide basis. It required all English authorities with housing responsibilities to prepare an initial report by May 2019

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[7] Ministry of Housing, Communities & Local Government, *'The Future Homes Standard: Consultation on changes to Part L and Part F of the Building Regulations for new dwellings: Government response'* (2021). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf

[8] Ministry of Housing, Communities & Local Government, *'The Future Homes Standard: Consultation on changes to Part L and Part F of the Building Regulations for new dwellings'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/852605/Future_Homes_Standard_2019_Consultation.pdf

[9] *Energy Act* (2011) Aide Memoire. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48199/3211-energy-act-2011-aide-memoire.pdf

‘demonstrating what energy conservation measures they have adopted to improve the energy efficiency of residential accommodation within that LA’s area’

The guidance required Councils to consider how they will use Government initiatives such as the Renewable Heat Incentive (RHI) and Smart Energy Guarantee (SEG) (see below), and how they can facilitate improvements on a street-by-street or area basis.

2.2.5 Drivers of a Low Carbon Economy and Energy System

2.2.5.1 UK Clean Growth Strategy (2017)

The UK Clean Growth Strategy (CGS) was published in October 2017 and sets out the Government’s vision for achieving economic growth at the same time as decreasing carbon emissions[10]. It includes objectives for increasing the generation of energy from renewable sources, increasing the delivery of clean, smart and flexible power, and accelerating the shift to low carbon transport, smart grids and energy storage.

The delivery of low carbon heating is identified as a priority, indicating that heat pumps, district heating networks and a hydrogen gas grid could all support the scale of change required, while acknowledging the significant technical and financial obstacles.

The Clean Growth Strategy also discusses the need to improve energy efficiency in buildings, particularly the existing stock. This includes a strategy of progressively increasing the minimum Energy Performance Certificate (EPC) ratings that will be considered permissible to allow the sale or rental of buildings, as required by the Minimum Energy Efficiency Standards (MEES) regulations[11].

2.2.6 UK Industrial Strategy (2017)

The UK Industrial Strategy, published in November 2017, emphasises the themes of the CGS and describes a ‘Grand Challenge’ for maximising the advantages that the UK can gain from the global shift to a low carbon economy. Both documents note the potential for low carbon industries to deliver a high level of GDP growth compared with the current forecast.

2.2.6.1 The Ten Point Plan for a Green Industrial Revolution (2020)

In November 2020 the UK Government Prime Minister Boris Johnson published a ‘Ten Point Plan for a Green Industrial Revolution’.[12]
The document sets out the Government’s broad plan for investment and targets to reach Net Zero by 2050. Some of the key points from the Ten Point Plan relevant to this study are:

- Green public transport – investment into electrifying railways and buses and increasing active transport with an emphasis on cycling, through new cycle lanes and cycle training.
- Accelerating the shift to zero emission vehicles – a ban on the sales of petrol and diesel cars by 2030 with large investment into charging infrastructure roll out.
- Greener buildings – extending and funding the green homes grant, public sector decarbonisation scheme, homes upgrade grant and social housing decarbonisation scheme. There is a commitment to gradually move away from gas boilers over the next 15 years, with a goal of 600,000 heat pump installations a year by 2028.
- Protecting our natural environment – creating new national parks and Areas of Outstanding Natural Beauty.

[10] HM Government, *‘The Clean Growth Strategy’*, (2017). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf
[11] HM Government, ‘*Domestic private rented property: minimum energy efficiency standard - landlord guidance*’, (2018). Available at: https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance
[12] Prime Minister’s Office, *‘Ten Point Plan for a Green Industrial Revolution’* (2020). Available at: The ten point plan for a green industrial revolution - GOV.UK (www.gov.uk)

- Green finance and innovation – mandatory reporting of climate related financial information across the economy by 2025 and increasing research and development of a range on Net Zero initiatives.

2.2.6.2 Energy White Paper (2020)

Building on the energy-related measures in the Prime Minister's Ten Point Plan, in December 2020 the UK Government published its Energy White Paper.[13] This sets out the *'Government's policies and commitments to put the UK on course to Net Zero'.* Key sections of the White Paper cover:

- **Buildings** – there is a dual focus on "improved energy performance" and "clean heat technologies"
- **Power** – the White Paper's focus is on national opportunities, for example offshore wind, more so than renewable power opportunities of relevance to the Leicester City Local Plan.
- **Energy Systems** – there is an explanation of a major shift, from a centralised "electricity system of the past" to a decentralised and smart "electricity system of the future". This is an important consideration for Local Plans.
- **Transport** – the White Paper provides a very helpful holistic overview of priorities:
  - Modal shift to public and active transport
  - Place based solutions (consider "why emissions occur in certain locations")
  - Decarbonising how we get goods (including transforming "last mile deliveries")
  - Decarbonisation of vehicles, including charging infrastructure and energy system readiness

2.2.6.3 UK Clean Air Strategy (2019)

Published in January 2019, the UK Clean Air Strategy was launched, setting out the UK government's long-term target to reduce people's exposure to air pollution, especially particulate matter (PM), which came on top of a commitment to halve the number of people living in areas breaching WHO air quality guidelines on PM by 2025.

This document complements the Industrial Strategy, Clean Growth Strategy and the 25 Year Environmental Plan.

The UK Governments aim is to reduce emissions of $PM_{2.5}$ against the 2005 baseline by 30% by 2020, and 46% by 2030.

Energy

- Biomass burning will increase levels of air pollution and may be banned in urban areas connected to the gas grid.
- Phasing out coal-fired power stations, improving energy efficiency, and shifting to cleaner power sources will reduce emissions of air pollution, as well as carbon.
- Oil and coal heating will be phased out, reducing carbon emissions and air pollution

Transport

- No new cars & vans sold with internal combustion engines (ICEs) after 2040
- Hundreds of millions of pounds of funding have been allocated through various government schemes such as the Low Emission Bus Scheme, Clean Bus Technology Fund and Ultra-Low Emission Bus Scheme to retrofit buses.
- The HGV Road User Levy is designed to incentivise a move to cleaner fleets, and therefore increasingly improve air quality & reducing emissions.
- The Cycling and Walking Investment Strategy identifies £1.2 billion available for investment in cycling and walking from 2016-21 to double the level of cycling by 2025

[13] BEIS, *'Energy White Paper'* (2020), Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf

2.2.7 Government Policies on Sustainable Transport

The UK Government has set a target that all new vehicles will be ULEVs by 2040. This means that new internal combustion engine vehicles (which use traditional fuels such as petrol and diesel) will not be permitted for sale beyond this date. Since the passage of the Act in July 2018, the Government has expressed support for bringing forward, from 2040 to 2035, the date from which the sale of traditionally fuelled new vehicles will be banned. The Government has recently consulted[14] regarding this change, and the Government has indicated its support of an even earlier date (2030) for the ban to be introduced.[15]

In March 2020 the Government published the '*Decarbonising Transport: Setting the Challenge'*[16] document baselining the current policies and GHG emissions of transport within the UK and considering the challenge presented in decarbonising transport. The document is a precursor to the Transport Decarbonisation Plan set to be released in 2021.

The Government has set up the Office for Zero Emission Vehicles (OZEV) to help industry, local authorities, consumers and other stakeholders in their transition to ULEVs.[17] Examples of the support and resources that the OZEV provides include grants for new vehicles, grants for new workplace charging equipment and funding for ultra-low emission buses. Additionally, the OZEV provides guidance, latest news and research and statistics.

Definitions – Sustainable Transport

There are a variety of **sustainable transport** modes, and these can be defined by the transport hierarchy shown below:

- Reducing the need to travel
- Active travel (walking and cycling)
- Public transport
- Shared transport (ULEVs)
- Private vehicles (ULEVs) – least preferred option

According to the Department for Transport, ULEVs are currently defined as producing less than 75 gCO_2 from the tailpipe for every kilometre travelled. There are two main types of vehicle which qualify as ULEVs:

- **Battery Electric Vehicles** (BEV) – these run solely on electricity, and require regular recharging; and
- **Plug-in Hybrid Electric Vehicles** (PHEV) – these have both an internal combustion engine in addition to an onboard electric battery and motor which can be recharged from a chargepoint.

There are three main types of chargepoints:

- **Rapid** – these deliver the fastest rate of charge. Most of these chargers are Direct Current (DC), and deliver 50 kW, 100 kW or up to 350 kW for Ultra-Rapid chargers. There are some Alternating Current (AC) rapid chargers, with 43 kW AC being the most common size.
- **Fast** – these are AC only and commonly deliver power at 7 kW to 22 kW, depending on the unit.
- **Slow** – these AC units deliver the slowest rate of charge and deliver power at 3 kW to 6 kW.

In the context of this discussion, 'smart' charging refers to the ability of charge facilities to be flexible in the rate of charge that can be delivered, in response to the real-time capacity in the incoming supply.

[14] Department for Transport, *'Consulting on ending the sale of new petrol, diesel and hybrid cars and vans'* (2021). Available at: https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans
[15] HM Government press release, *'Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030'* (2020). Available at: https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030
[16] Department for Transport, '*Decarbonising Transport: Setting the Challenge*' (2020). Available at: Decarbonising Transport: Setting the Challenge (publishing.service.gov.uk)
[17] Office for Low Emission Vehicles. Available at: https://www.gov.uk/government/organisations/office-for-low-emission-vehicles

Although not only limited to transport, the Clean Air Strategy[18] released in 2019 sets out a variety of steps that will be taken to reduce the impact of all sources of air pollution. The strategy considers the sources of emissions from transport, the home, farming, industry and clean growth and innovation. Among other commitments, the strategy would give powers to local authorities to tackle high pollution in the worst-affected areas.

2.2.8 Financial Incentives

Below is a brief overview of some of the key financial incentive schemes for low and zero carbon energy in the UK. Note that the levels of Government incentives for these technologies have been adjusted repeatedly in recent years and it is reasonable to assume that further changes will occur.

2.2.8.1 Renewable Heat Incentive (RHI)

The Renewable Heat Incentive (RHI) provides a financial incentive to property owners for the uptake of the following heat generating technologies: Biomass boilers; air source heat pumps (ASHPs); ground source heat pumps (GSHPs); and solar thermal collectors which provide hot water.

Funding is available to support renewable heat delivered to new homes via heat networks, and for renewable heat installed to serve non-domestic buildings. Renewable heat installations serving single new homes are ineligible. Note that the Clean Growth Strategy identifies a need to strengthen and reform the RHI in recognition of the difficulty and urgency of decarbonising the UK heat supply.

2.2.8.2 Energy Company Obligations (ECO)

The 2011 Energy Bill, which made provision for the Green Deal, also provided for an Energy Company Obligation (ECO). The scheme has been updated several times with the latest update in 2017, known as ECO2t. Under the scheme energy companies are obligated to promote and support carbon emissions reductions to customers.

2.2.8.3 Smart Export Guarantee (SEG)

Launched in January 2020, the SEG provides a financial incentive for uptake of the following renewable electricity generating technologies: photovoltaics; wind; micro combined heat and power (CHP); hydroelectric power; and anaerobic digestion (AD). Essentially, it means that energy companies make payments to individuals or businesses that have installed renewable energy technologies, in exchange for the electricity that is exported to the grid. The SEG has been adopted to replace the Feed in Tariff (FiT) which ended in 2019.[19]

2.3 Local Policies and Drivers

Leicester's current development plan consists of a Core Strategy (adopted in 2010 and revised in 2014), a number of polices and proposals saved from the City of Leicester Local Plan (adopted in 2006), and the Leicestershire and Leicester Waste Development Framework (adopted in 2009); alongside a number of supplementary planning documents.

Since 2014, the Council have been preparing and consulting on a replacement of the City of Leicester Local Plan. The new Leicester Local Plan will eventually replace the Core Strategy, saved policies and proposals map. The Council expects this to be adopted in 2022.[20]

2.3.1 Adopted Leicester City Local Plan 2010-2026

The adopted Local Plan sets out the future development of the City from 2010 to 2026 and includes planning policies for new developments. Within the adopted Local Plan Policy CS2 is related to *'addressing climate change and flood risk.'* This policy requires new developments to:

[18] HM Government, *'Clean Air Strategy'* (2019). Available at: https://www.gov.uk/government/publications/clean-air-strategy-2019
[19] Ofgem, *'Smart Export Guarantee'*, Available at: https://www.ofgem.gov.uk/environmental-programmes/smart-export-guarantee-seg/about-smart-export-guarantee-seg
[20] LCC, '*Local Development Scheme 2020 to 2023*' (2020). Available at: https://www.leicester.gov.uk/media/c2jlcxpc/local-development-scheme-2020-to-2023-adopted.pdf

- Achieve Level 3 of the Code for Sustainable Homes where feasible. (Note: The Code has been suspended so this policy is no longer operational);
- Use best practice energy efficiency and sustainable construction methods, including waste management;
- Include or connect to a decentralised energy network where feasible;
- Provide for and enable commercial, community and domestic scale renewable energy generation schemes;
- Be directed to locations with the least impact on flooding or water resources;
- Ensure a shift to the use of sustainable low emissions transport to minimise the impact of vehicle emissions on air quality; and
- Wherever possible be adapted to climate change and help contribute to the reduction in carbon emissions, e.g. through use of green infrastructure.

The Climate Change Supplementary Planning Document (SPD), adopted in 2011, gives more details on how developers can meet the policies set out in the Local Plan.[21] The SPD provides information on reducing greenhouse gases through building layout and orientation and an energy hierarchy to be used in buildings; sustainable transport; reducing the impact of material, considering embodied carbon, minimising consumption and responsible sourcing; flooding and sustainable drainage; green infrastructure; and future proofing. There is also a special consideration for mitigating and adapting to climate change in relation to heritage buildings.

2.3.2 Draft Local Plan 2020-2036

In 2020, Leicester City Council again consulted on its draft Local Plan, the first local plan consultation since the City declared a climate emergency. The draft Local Plan set out the direction of the City for 2020 to 2036, including clearer development management policies that will guide planning applications, proposed site allocations, and an indication of how the plan will be delivered.

Chapter 6, *"Climate change and flood risk."* includes the following key policies relevant to climate change mitigation and adaptation:

- Policy CCFR01. Sustainable design and construction for new developments.
  Energy and carbon reduction: All developments must demonstrate how it will minimise energy demand and carbon emissions based on an energy hierarchy.
  Water and resources: All major developments should demonstrate how it will maximise an efficient use of resources, including minimising waste, and maximising sustainable recycling and the re-use of materials through both construction and use.
  Resilience to climate change: All major developments should demonstrate how the risks associated with future climate change have been planned for as part of the layout of the scheme and design of its buildings to ensure its longer-term resilience.
- Policy CCFR02. Delivering renewable and low carbon energy projects.
  Proposals for new renewable and low carbon energy projects will be supported subject to meeting the Council's requirements on a range of impacts to the local environment.
- Policy CCFR03. Managing flood risk and sustainable drainage systems (SuDs).
  The assessment criteria set out by the Council to ensure vulnerability to climate change is considered and flood risks are minimised.

2.3.2.1 Consultation Responses

As part of the Local plan process, the local planning authority is currently considering the responses received during the consultation on the draft local plan (2020). Some of the comments received from individuals, organisations, and key stakeholders were relevant to the council's emerging policies relating to the sustainable design and construction of development, and energy use and supply. Some of the most relevant comments for this study highlighted the importance of:

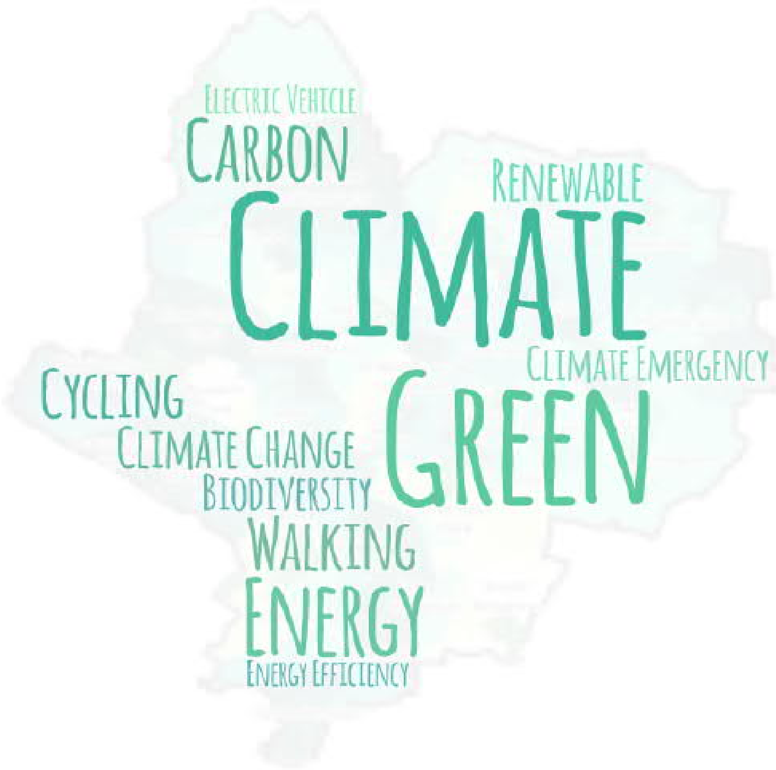
- Addressing climate change and the climate emergency including mitigation, adaptation and resilience.

[21] Leicester City Council , *'Leicester Climate Change SPD'* (2011). Available at: https://www.leicester.gov.uk/media/179107/climate-change-spd-january-2011.pdf

- Promoting sustainable and active forms of travel including walking, cycling and public transport.
- Supporting shifts towards low/zero carbon forms of transport such as electric vehicles.
- Support and promote reductions in energy use, increases in energy efficiencies, and increasing LZC supplies, for new and existing (retrofitting) developments, including introducing specific targets
- Protecting, enhancing and utilising green infrastructure (including biodiversity, trees and open spaces).
- Improving air quality.
- Other elements of sustainable design and construction e.g. embodied carbon, circular economies, modular homes, brownfield land, densities.

This is also illustrated in the word frequency map below, which shows a snapshot of some of the most common words used in some of the comments which seemed to be of most relevance to this study.

Figure 2-3. Word cloud diagram of sustainability-related keywords in the Local Plan consultation responses. Source: LCC



The following text lists out the keywords illustrated in Figure 2-3 in an accessible format. The words are listed from most frequent (tier 1) to least frequent (tier 5).

Tier 1: Climate, Green.
Tier 2: Carbon, Energy.
Tier 3: Cycling, Walking, Renewable
Tier 4: Climate change, Climate emergency.
Tier 5: Biodiversity, Energy efficiency, Electric vehicle.

2.3.3 Local Plan Evidence Base

2.3.3.1 Climate Change Evidence Base Study (2015)

In 2015, jointly with Oadby and Wigston Borough Council, Leicester City Council commissioned Amec Foster Wheeler to provide an evidence base that developed planning policies for climate change and renewable energy in the two Council's emerging new Local Plans.[22] The study conducted a baseline of energy use and CO_2 emissions within the City and assessed the current deployment of renewable

[22] Amec Foster Wheeler, *'Climate Change Evidence Base Study for Leicester and Oadby & Wigston'* (2015). Available at: https://www.leicester.gov.uk/media/183604/climate-change-evidence-base-study-final-report.pdf

and low carbon technologies. A resource assessment was undertaken to determine the future potential of further low and zero carbon (LZC) energy generation technology deployment. In this study we have sought to validate and update key results from the 2015 study and, where relevant, highlight changes that have occurred since it was published.

The study also provided draft Local Plan policy recommendations regarding wider sustainable design and construction topics. Leicester City Council took these recommendations forward into draft development management policies which have subsequently undergone several rounds of consultation (see below).

2.3.3.2 Other Supporting Documents

In addition to the Climate Change Evidence Base Study (2015) the draft Local Plan is supported by several other documents, including but not limited to the following: Strategic Flood Risk Assessment (2020), Water Cycle Study (2020), Utilities Infrastructure Capacity Study, (2017); and the Local Plan Sustainability Appraisal.

Where relevant, key findings from those studies have been referenced and incorporated into this report.

2.3.4 Local Transport Plan

Published in June 2021, the Draft Local Transport Plan (LTP) sets out a vision for a city that will be carbon neutral, healthy, well connected, with a good quality of life and which is economically vibrant and growing.

It sets out an ambitious programme of transport improvements for the next decade including transforming the railway station to provide an impressive new gateway into Leicester, delivering a new Greenlines electric express bus network and establishing a city-wide network of cycleways and paths, aiming for a '15 minute' city where people can access a large range of facilities in 15 minutes using sustainable transport.

The LTP will inform a consultation into the potential introduction of a Workplace Parking Levy to help the Council tackle traffic congestion and provide attractive sustainable transport choices which improve air quality and reduce carbon emissions.

2.3.5 Leicester Climate Emergency Strategy and Action Plan (2020-2023)

Leicester City Council made an individual climate emergency declaration in February 2019, setting out an intention to support the Government's Net Zero target to 2050, with the aim to achieve carbon neutrality for the City of Leicester as a whole by 2030. Subsequently, LCC has adopted both a Climate Emergency Strategy and a Climate Emergency Action Plan covering the period April 2020 to March 2023.[23]

The Climate Emergency Strategy will provide a vision for how both the City as a whole and the Council's own operations can become carbon neutral, and reiterates the Council's view that there is an urgent need for action and leadership on this issue. The document sets out a range of ambitious objectives for decarbonising all sectors in the city, and for improving resilience to the changes happening to the climate. Areas of focus include:

- **At home** – measures to reduce emissions from homes while addressing the issue of fuel poverty;
- **Travel and transport** – investing in infrastructure and promoting uptake of sustainable modes of transport;
- **Consumer choices and waste** – minimising waste and developing a new waste strategy;
- **At work** – creating green jobs and supporting local businesses to reduce their environmental impact;
- **Land use, green space and development** – ensuring that decisions about land use and new development address the Climate Emergency via the Local Plan; and

[23] Leicester City Council, *'Climate emergency'*. Available at: https://www.leicester.gov.uk/your-council/policies-plans-and-strategies/environment-and-sustainability/climate-emergency/

- **The Council** – measures to decarbonise LCC's own operations.

The Action Plan sets out details of specific measures to be delivered by the council as part of implementing the Strategy, including the preparation, adoption and implementation of the new Local Plan

2.3.6 Other Local Drivers and Initiatives

There are a range of other relevant strategies and plans that have been developed by Leicester City Council which inform the overarching development strategy and future trajectory for the City. Some notable examples include:

- **Anti-Poverty Strategy and Action Plan** – aims to address barriers caused by poverty, including fuel poverty, to ensure that Leicester achieves a socially just transition to a carbon-neutral City.
- **Biodiversity Action Plan 2011-2021** – current and new BAP (currently being developed) contribute to sustaining and enhancing Leicester's biodiversity in the face of challenges, including the threat posed by climate change.
- **COVID-19 Transport Recovery Plan (2020)** – indicates the key changes that will be made to transport infrastructure within Leicester to increase active transport and public transport usage in the recovery from COVID-19.[24]
- **Cycle Action Plan 2015-2024** – this sets out the method the Council will take in delivering the UK Government's Cycling Delivery Plan, including developing a strategic cycling infrastructure and expanding cycling and mechanic training alongside other measures to double everyday cycling numbers by 2018 and then again by 2024.
- **Healthier Air for Leicester** – Leicester's Air Quality Action Plan (2015-2026) sets out a programme of actions to reduce air pollution emissions, primarily from traffic. Also contributes to reducing carbon emissions from traffic through measures to reduce traffic levels, encourage walking and cycling and promote the introduction and increase of ultra-low emissions vehicles.[25]
- **Joint Health and Well-being Strategy and Action Plan (2018)** – The strategy involves five key themes: healthy places, healthy minds, healthy start, healthy lives and healthy ageing. Key objectives within this plan include improving air quality and increased opportunities for sustainable transport to aid the implementing the five key themes.[26]
- **Leicester Green Infrastructure Strategy 2015-2025** – sets out the strategic vision for green sites in Leicester and the ways in which they can be created, managed and maintained to provide maximum benefits to the people who live, work or visit Leicester.
- **Leicester's Local Transport Plan, 2011-2026 (2011)** – the overall focus of the plan is sustainable transport that will help grow the economy, protect and create jobs, whilst reducing carbon emissions and helping to improve air quality, encouraging active and safe travel and improving accessibility, with well-maintained assets.[27]
- **Leicester Street Design Guide (2020) –** guidance on how further changes should be made to Leicester's streets and roads to continue this process of favouring walking and cycling as the best way of moving across the City.[28]
- **Leicester Tree Strategy 2018-2023** – guides the Council in sustaining and increasing tree stock as well as helping to improve the quality of the City's trees, and realising these benefits in a changing climate.

[24] Leicester City Council, *'COVID-19 Transport Recovery Plan'*, (2020). Available at: https://leicester.gov.uk/media/186689/covid-19-transport-recovery-plan-may-2020.pdf
[25] Leicester City Council, *'Leicester's Air Quality Action Plan 2015-2026'*, (2015). Available at: https://www.leicester.gov.uk/media/180653/air-quality-action-plan.pdf
[26] Leicester City Council, '*Health and Wellbeing Strategy and Action Plan 2018-2023*', (2018). Available at: https://cabinet.leicester.gov.uk/documents/s95561/Health%20and%20wellbeing%20strategy%20action%20plan.pdf
[27] Leicester City Council, *'Leicester's Local Transport Plan 2011-2026',* (2011). Available at:https://www.leicester.gov.uk/media/178149/local-transport-plan-part-a.pdf
[28] Leicester City Council, '*Leicester Street Design Guide*' (2020). Available at: https://www.leicester.gov.uk/media/186708/leicester-street-design-guide-first-edition.pdf

- **Smart Leicester Strategy** – will include a theme around smart buildings and City infrastructure, which promotes the transition to sustainable buildings and transport, powered by clean, low-carbon energy.

Furthermore, Leicester City Council is, and has been, engaged in a number of CO_2 reduction initiatives, including but not limited to:

- Installing solar PV technologies on Council-owned buildings and schools;
- Encouraging adoption of energy efficiency measures and retrofitting homes and businesses through the Health Through Warmth scheme and the Green BELLE grant scheme;
- Use of electric buses at the Birstall Park and Ride; and
- Initiating a 'Climate Emergency Conversation' for City residents to inform local climate actions.

These have been taken into account when modelling future scenarios (Section 4), identifying future opportunities (Section 5) and providing recommendations (Section 6) for Leicester City Council.

2.4 Summary of Key Targets

Targets for energy use and CO_2 emissions in buildings are set at different levels of Government and with difference emphasis. Below is a summary of the various targets relevant to Leicester.

2.4.1 Mandatory targets:

- **Climate Change Act:** In June 2019, Parliament passed legislation requiring the Government to reduce the UK's net emissions of greenhouse gases by 100% relative to 1990 levels by 2050.[29] This target covers all sectors, activities and fuel types. The Government acknowledges that due to a variety of technical and practical reasons, decarbonisation may be easier or more difficult depending on the sector, activity or fuel type in question.

- **Building Regulations:** Energy use and CO_2 performance of new and existing buildings is determined by the UK Building Regulations. The Government has announced its intention for new buildings to emit 75-80% less CO_2 than those built to present standards. The target, which is expected to come into effect in 2025, primarily affects new buildings. For existing buildings undergoing major work or refurbishment, the Building Regulations provides alternative targets based on individual building elements.

- **Minimum Energy Efficiency Standards:** In order to promote energy efficiency in existing buildings, the Government intends to progressively increase the minimum Energy Performance Certificate (EPC) rating that must be achieved by any buildings being rented or sold. At present the minimum requirement is an 'E' rating but the Government has stated an ambition for all buildings to achieve a minimum EPC rating of 'C' where practical and viable by 2035. This does not directly equate to a CO_2 reduction target because EPC ratings are intended to reflect utility bills.

2.4.2 Other targets:

- In February 2019, Leicester City Council declared a climate emergency. As part of this, the Council has stated that *"[their] ambition is for Leicester to become 'carbon neutral' by 2030 or sooner."*

- The (CCC) advised Government that achieving Net Zero by 2050 would be the equitable role the UK would need to play in global efforts to limit average global emissions to 1.7 tCO_2e per person. For Leicester, where the average per capita emissions were 3.6 tCO_2 in 2018, this would reflect a more than 50% decrease.

- The Tyndall Centre has created a Carbon Budgeting Tool[30] which creates a budget for each Local Authority in the UK. It has estimated that, in order for Leicester City to make an equitable contribution towards the UK's commitment under the Paris Agreement, it should adhere to a total carbon budget of 8.5 $MtCO_2$ in the time period from 2020 through the year 2100. At current emission rates, that budget would be spent by 2027. Achieving the necessary reduction would require an average annual reduction of approximately 13%.

[29] HM Government, *'The Climate Change Act'* (2008). Available at: http://www.legislation.gov.uk/uksi/2019/1056/contents/made
[30] Carbon Budget, *'Setting Climate Commitments for Leicester'* (2022). Available at: https://carbonbudget.manchester.ac.uk/reports/E06000016/

- There are a variety of other aspirational targets set out by industry bodies and design codes which would involve reducing net energy demands and / or CO_2 emissions. Some of these are discussed in Section 5.1.1.

2.4.3 Context: How Might Climate Change Affect Leicester?

This brief overview details the potential impact of climate change on Leicester.

The main challenges that will be presented to the City of Leicester will be a result of rising temperatures, leading to heat related deaths, changes to rainfall intensity and frequency that could cause both flooding and water shortages depending on the time of year, as well as impacts on biodiversity in local terrestrial and freshwater ecosystems.

The UK Climate Projections (UKCP18) for Leicester predict that by the 2050s the annual mean temperatures will increase by 1.1ºC (low emissions scenario), but could increase by up to 1.9ºC (high emissions scenario).[31] The frequency of extreme weather events such as heatwaves is also expected to increase as a result of climate change.

One significant impact of temperature rises is the increased risk of overheating. High temperatures have been linked to mortality and wellbeing impacts. The UK Climate Change Risk Assessment 2017 projects that heat-related deaths could more than double by the 2050s from the 2,000-death per year baseline if there is no adaptation.[32] This would be a substantial human cost, and DEFRA predictions from 2012 estimate that the economic cost associated with heat-related deaths would rise by £15-100 million per year.[33]

Rising temperatures are also expected to increase evapotranspiration and summer aridity leading to water shortages and droughts. Predictions within the UK Climate Change Risk Assessment suggest that demand for water could be more than 150% of the available resource across much of the UK by the 2050s, which could lead to hosepipe bans and limits on water usage in the industrial and agricultural sectors. This then could then give rise to disruption in food production, which poses a risk to supply chains and could potentially lead to higher food prices. There will also be wider impacts to the natural environment and freshwater species with reduced water availability in the summer months likely to impact the ecology of rivers.

UKCP18 predicts that, while annual average precipitation may remain roughly equal, rainfall is likely to be more seasonal with winter precipitation rising by 6% to 18% and summer rainfall decreasing by 17% to 38% by the 2050s (from a 1981-2010 baseline). This suggests that summers will be hotter and drier, while winters are likely to be wetter and milder.

The frequency and intensity of extreme weather event leading to flooding will also increase. This poses a substantial increased flood risk for Leicester due to its position on the River Soar. Susceptibility to groundwater flooding in the City of Leicester area may increase as a result of more frequent high rainfall events. This could lead to further groundwater flooding in Leicester due to increased perched groundwater levels and associated spring flows[34]. Flooding can cause significant damage to human life and economic costs. Due to the expense of flood defences it may not be possible to provide adequate protection to all areas within Leicester and climate change may cause a greater disparity between protected and non-protected areas, as well as increasing the amount of area within the city that are at risk from flooding.

Due to the reliance of the UK on imported food, with approximately 40% of food imported, the impact of climate change on agriculture across the world and impacts to supply chains will have a direct impact to food consumed within Leicester. These effects could potentially lead to shortages in certain

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[31] The low emissions scenario is representative concentration pathway RCP2.6, which represents a 2.6ºC increase in global mean temperature by 2100. The high emissions scenario is RCP8.5 which would give a 4.3ºC global increase by 2100. Further information on the emissions scenario can be found here: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance---representative-concentration-pathways.pdf . UKCP18 data is available here: Product Form - UKCP (metoffice.gov.uk)

[32] Climate Change Committee, *'UK Climate Change Risk Assessment'* (2017). Available at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Synthesis-Report-Committee-on-Climate-Change.pdf

[33] Climate Change Committee, *'The hidden problem of overheating'* (2017). Available at: https://www.theccc.org.uk/2017/08/08/hidden-problem-overheating/

[34] Leicester City Council, *'Surface Water Management Plan'* (2012). Available at: https://www.leicester.gov.uk/media/178251/swmp-main-report.pdf

produce and increase the price of food which can have a significant impact on low-income households.

Leicester is home to a number of natural habitats that may be affected by climate change including neutral grasslands, wet meadows, parkland, woodland, rivers and streams[35]. Rising river water temperatures and altered water levels resulting from climate change will increase the risk of deoxygenation and may impact the habitat composition and distribution of river water species[36] (such as the rare White-Clawed Crayfish) especially in species rich, unpolluted (nonacidified) shallower rivers. Rising temperatures may also cause a further decline in abundance and distribution of butterflies, an increase in ground beetles and variations in abundance of other insect groups that could have knock on effects on other species that rely on insects for food, as well as potentially impacting the amount of crop-pollinating insects and crop-destroying pest insects, having potential knock-on effects on agricultural production and food-security[37].

[35] Leicester City Council, *'Leicester's Biodiversity Action Plan 2011 – 2021'*. Available at: https://www.leicester.gov.uk/media/113637/leicesters-biodiversity-action-plan-2011-21.pdf
[36] Joint Nature Conservation Committee, *'Biodiversity and Climate Change – a summary of impacts in the UK'* (2010). Available at: https://hub.jncc.gov.uk/assets/e2d77481-dcb2-4fb3-8fff-d8b1c0cfc97f
[37] *'The Impact of Climate Change on Agricultural Insect Pests'*, Skendžić et Al., 2021. https://doi.org/10.3390/insects12050440

3. Establishing the Baseline

This section summarises the current baseline fuel consumption and CO_2 emissions for Leicester. It also describes the energy efficiency of the building stock and provides an estimate of the current level of LZC deployment, ultra-low emission vehicles (ULEV) uptake and chargepoint provision across the City.

Where relevant, we have highlighted key changes that have occurred since the publication of the previous Climate Change Study in 2015.

3.1 Fuel Consumption

Fuel consumption figures are taken from the BEIS publication *'Sub-national total final energy consumption statistics: 2005-2018'* (published in 2020).[38] This is an updated version of the dataset that was used to provide the baseline fuel consumption figures in the Climate Change Study (2015), although at that time BEIS was known as the Department of Energy and Climate Change (DECC).

The dataset includes a breakdown of emissions by sector and fuel type where data is available and can be meaningfully disaggregated to a Local Authority level, i.e. it does not include aviation or national navigation. Further details of the methodology used to calculate these figures can be found in the *'Sub-national methodology and guidance booklet'* (BEIS, December 2018).[39] Results are shown in the table below.

Table 3-1. Leicester Fuel Consumption (2018 data)

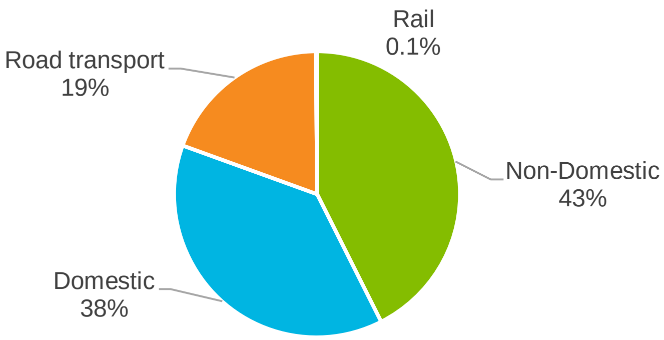
	Non-domestic (GWh)	Domestic (GWh)	Road transport (GWh)	Rail (GWh)	Total (GWh)	*% of total*
Gas	1,368.4	1,664.6	-	-	3,033.0	*52%*
Electricity	890.8	445.7	-	-	1,336.5	*23%*
Petroleum Products	195.3	5.8	1,115.4	6.1	1322.5	*23%*
Coal	-	5.7	-	0.2	6.0	*<1%*
Manufactured fuels	3.7	6.1	-	-	9.8	*<1%*
Bioenergy & waste	-	73.2	-	-	73.2	*1%*
Total by sector	**2,454.0**	**2,201.1**	**1,115.4**	**6.3**	**5,781.0**	
% of total	*43%*	*38%*	*19%*	*<1%*		

Note that it is not possible to differentiate between electricity use in buildings and electricity used for charging vehicles or public transport (such as electrified rail), as the public datasets do not capture this information. Therefore, fuel use for 'road transport' and 'rail' only include petroleum products. 'Road transport' includes all vehicle movements within the geographic boundary of Leicester regardless of origin or destination.

The non-domestic sector represents the highest portion of fuel consumption (43%), followed by the domestic sector which accounts for 38%. Road transportation accounts for 19% while there is a minimal contribution from rail. This is shown in Figure 3-1.

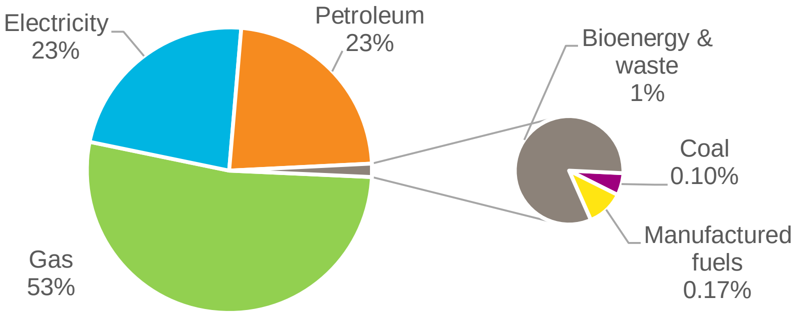
[38] BEIS, *'Total final energy consumption at regional and local authority level 2005 to 2017'* (2019). Available at: https://www.gov.uk/government/statistical-data-sets/total-final-energy-consumption-at-regional-and-local-authority-level
[39] Note that, for the purpose of this report, BEIS statistics for 'industrial & commercial' fuel consumption, 'public sector' fuel consumption and 'agriculture' fuel consumption are collectively referred to as 'non-domestic' uses. 'Bioenergy & waste' is not reported by sector. Electricity used for transport, (i.e. rail or ULEVs) is incorporated into the total figures for electricity. For further information see: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/771895/Sub-national_Methology_and_Guidance_Booklet_2018.pdf

Figure 3-1. Split of Leicester Fuel Consumption by Sector (2018 data)



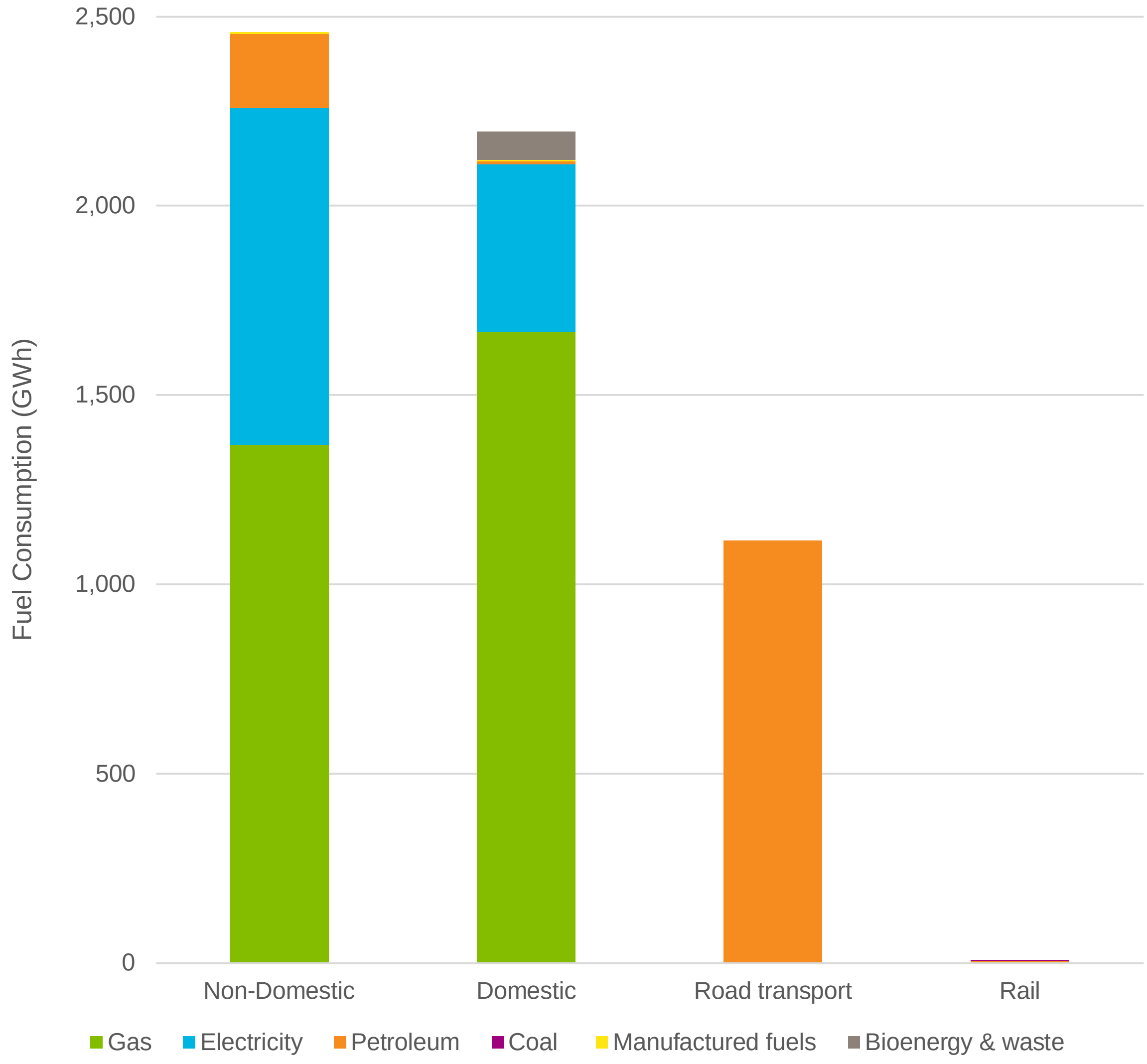
Gas represents the majority (52%) of fuel use in the City. The majority of this is used in domestic buildings for heating, hot water and cooking, although a significant portion is also used in industrial and commercial buildings. Electricity used in buildings accounts for 23% of total fuel use, while petroleum mainly from road transportation makes up 23%. The remaining fuel uses account for around 2%. This is illustrated in Figure 3-2 below.

Figure 3-2. Split of Leicester Fuel Consumption by Fuel Type (2018 data)



On the following page, Figure 3-3 shows a more detailed breakdown of fuel use by sector. This confirms that the majority of gas use is in domestic buildings. The next largest use is gas within non-domestic settings followed by road transportation.

Figure 3-3. Leicester Fuel Consumption by Sector and Fuel Type (2018 BEIS dataset)



Considering road transportation in more detail, the majority of fuel use is for petrol and diesel cars, which represents around 71% of the total within the 'road transport' category. A further 16% is used in light goods vehicles (LGVs) while the rest is composed of heavy goods vehicles (HGVs) and buses, 9% and 4% respectively.

Figure 3-4. Use of Petroleum Products in Road Transportation within Leicester (2018 BEIS dataset)

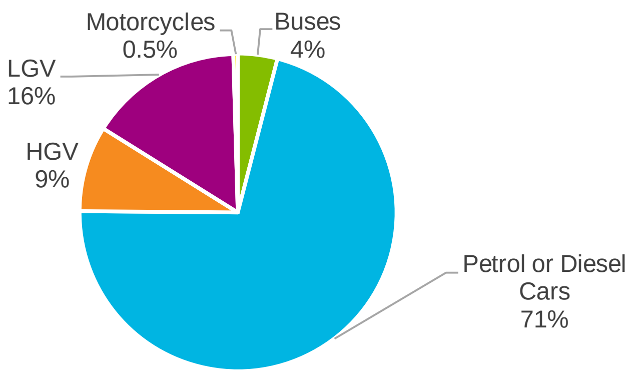
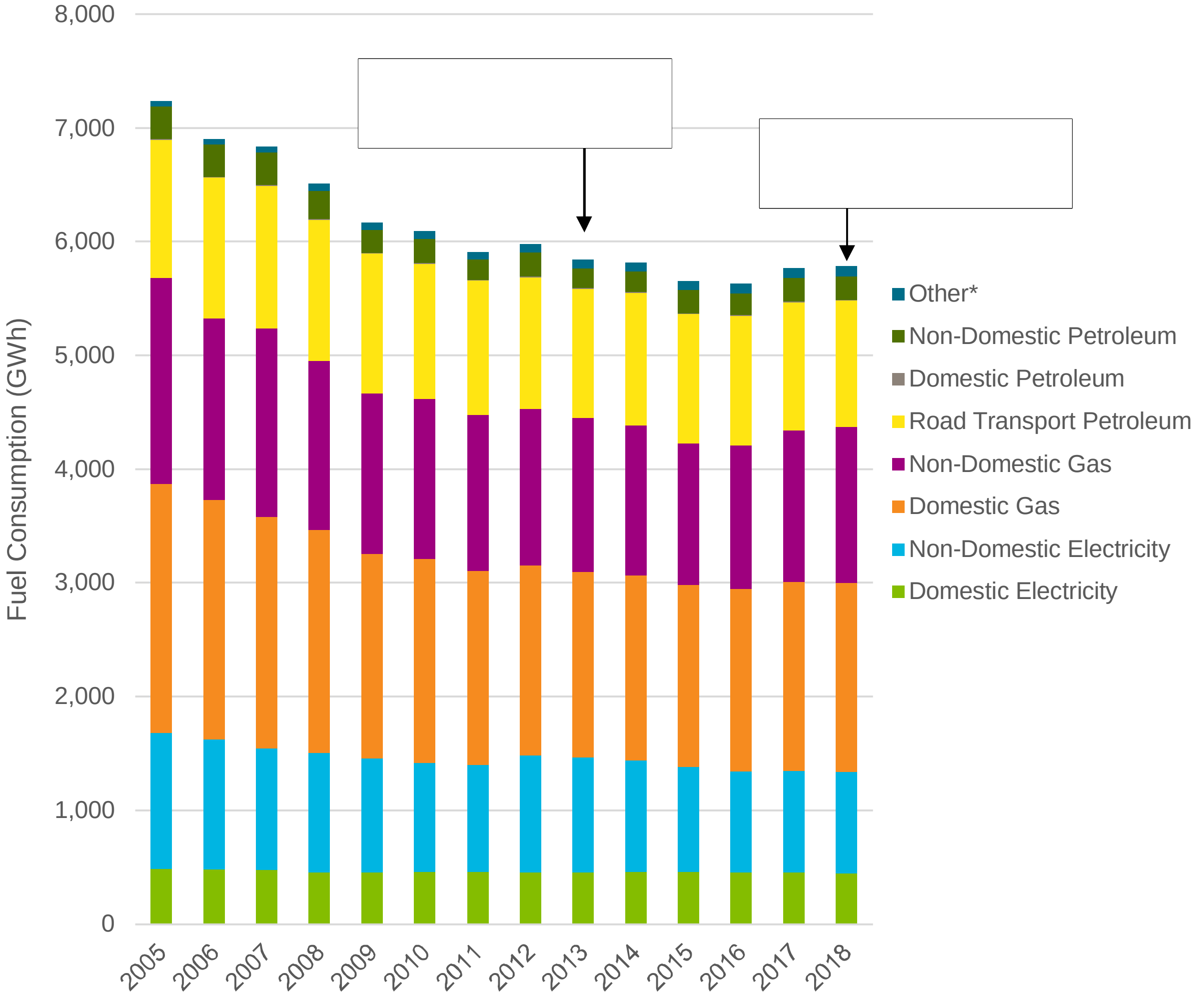


Figure 3-5 below shows trends in fuel consumption by sector since 2005. It can be seen that, although fuel use has fallen since 2005, it has been relatively stable since 2013. The previous Climate Change Study, although published in 2015, used 2013 data, so there has been little change since that report was issued.

Figure 3-5. Trends in Fuel Consumption within Leicester (2005-2018)



* Includes coal, manufactured fuels, bioenergy & waste, and petroleum products used for rail. These categories have been consolidated for clarity as they make up a small proportion (3-4%) of the total.

It is difficult to identify the main cause of the trends shown above because fuel use is linked to many factors, including weather, consumer behaviour, energy efficiency, and so on. However, in general, there is likely to be some decrease associated with improvements in the energy efficiency of buildings and appliances. The decrease may be partially or entirely offset by increases due to higher population, greater use of appliances, etc.

3.2 CO_2 Emissions

The Climate Change Study (2015) reported that, based on 2013 fuel consumption figures, the CO_2 emissions from gas and electricity use in buildings were 548.44 ktCO_2 and 706.01 ktCO_2 respectively.[40] BEIS publishes annual CO_2 emissions data for the entire UK at a Local Authority level, and that information has been used to provide an updated CO_2 emissions baseline for Leicester City.[41] Results are shown in Table 3-2 and further illustrated in Figure 3-6.

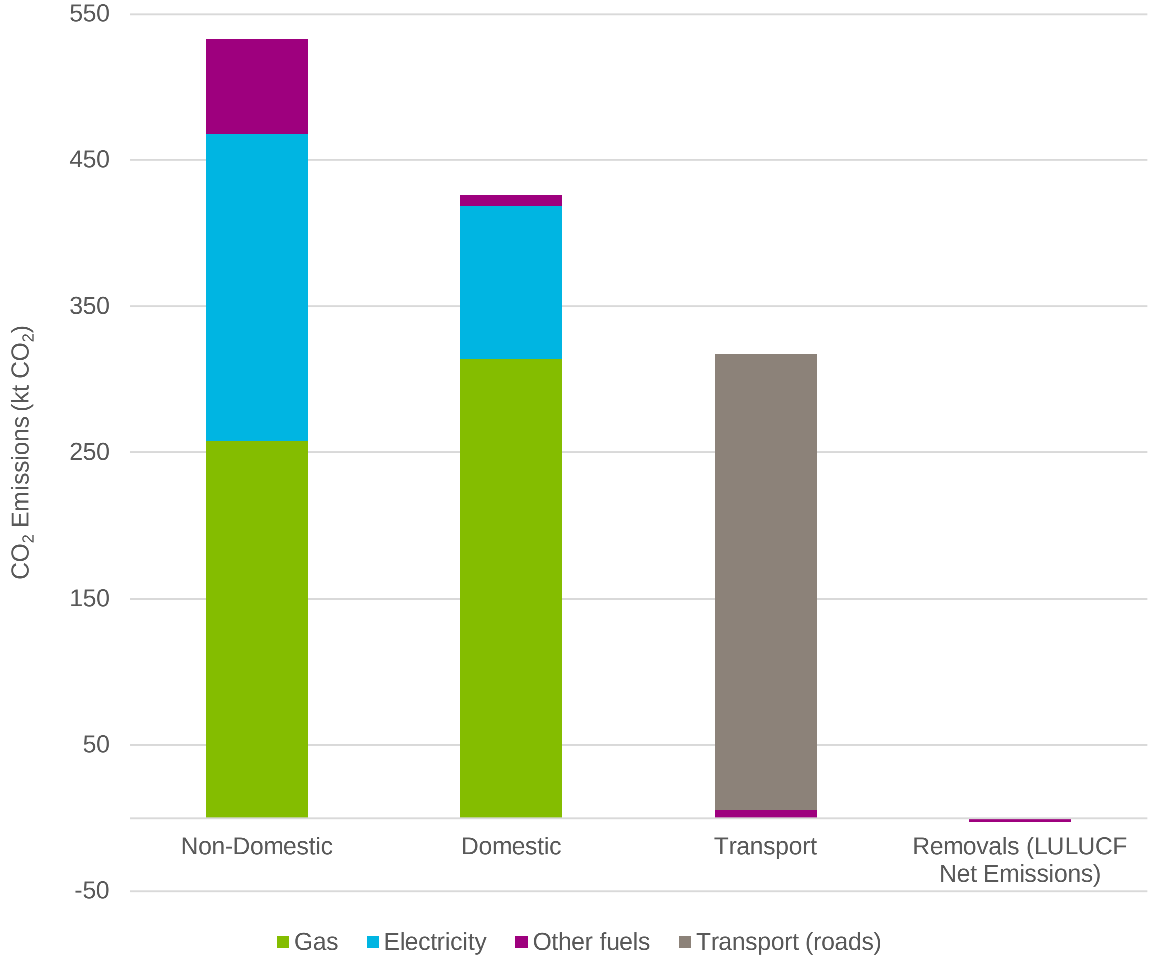
Table 3-2. Leicester CO_2 Emissions (2018 data)

	Emissions - Non-Domestic (ktCO_2)	Emissions – Domestic (ktCO_2)	Emissions – Transport (ktCO_2)	Removals - LULUCF* (ktCO_2)	Total (ktCO_2)	% of total emissions (excl. removals)
Gas	258.1	314.0	-	-	572.2	*45%*
Electricity	209.5	104.8	-	-	314.3	*25%*
Large Industrial Installations	0.5	-	-	-	0.5	*<1%*
Agriculture	0.7	-	-	-	0.7	*<1%*
Road Transport	-	-	311.8	-	311.8	*24%*
Other / Not Specified	63.6	6.8	5.7	(-2.5)	76.1	*6%*
TOTAL	**532**	**426**	**318**		**1,276**	
% of total emissions (excl. removals)	42%	33%	25%	n/a		

* Note: The adjustment for Land Use, Land Use Change and Forestry (LULUCF) reflects the fact that certain land use activities, such as cutting down or planting trees, result in CO_2 being added or removed from the atmosphere. In Leicester the net emissions from LULUCF are negative, i.e. more CO_2 is removed from the atmosphere than is emitted from these activities.

[40] Based on Table 3.1 of the Climate Change Study (2015), figures for Leicester only.
[41] BEIS, *'Emissions of Carbon Dioxide for Local Authority Areas 2005-2018'* (published 2020). Available at: https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas

Figure 3-6. Leicester CO_2 emissions by Sector and Source / Fuel Type (2018 data)

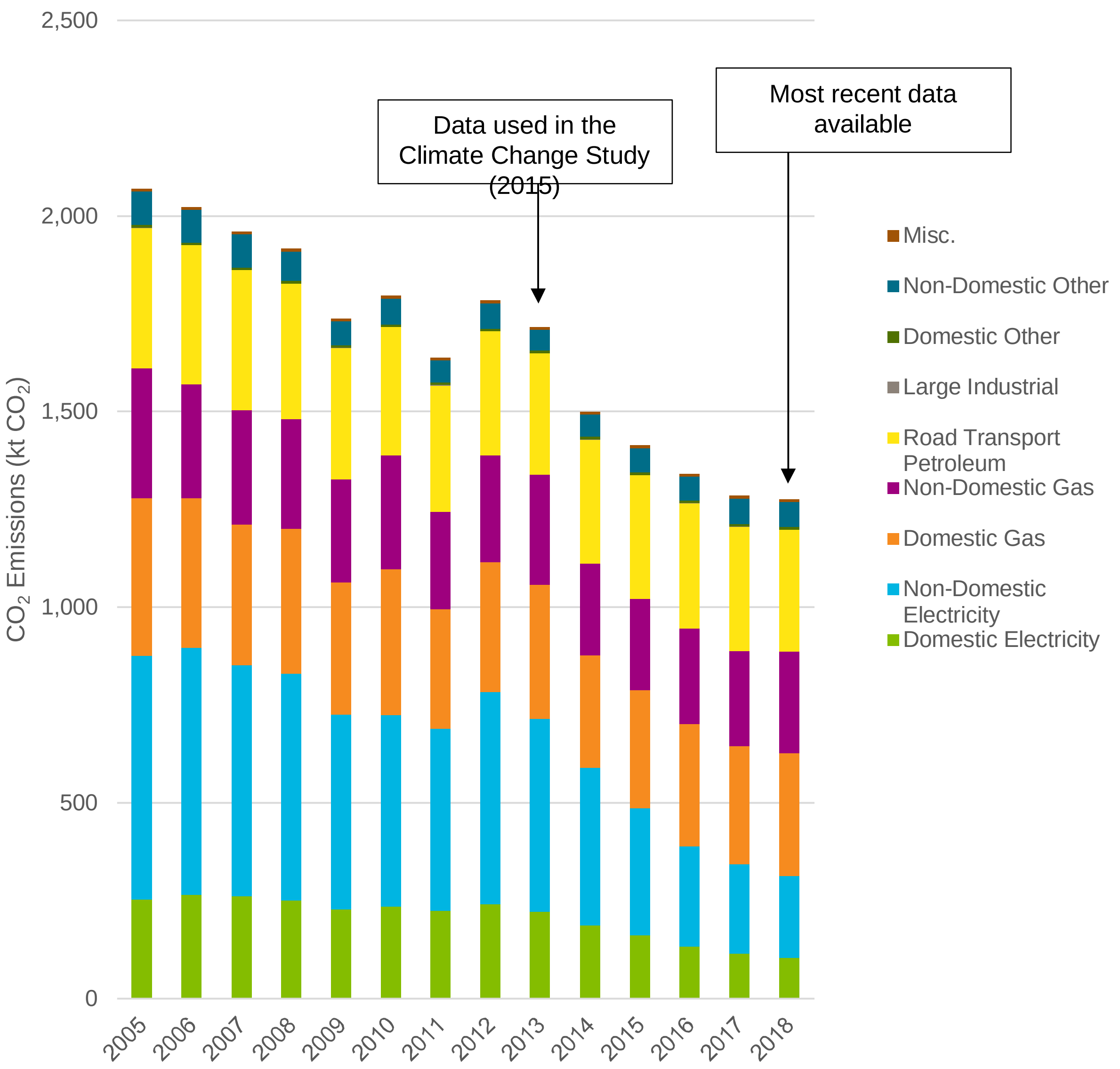


Among the sectors reported, as of 2018 the non-domestic sector accounts for the largest proportion of CO_2 emissions (42%). This includes emissions from fuels used in buildings, and therefore encompasses energy used for activities such as lighting, heating and cooling the space, but would also include fuels used for industrial processes themselves. Fuels used in domestic buildings account for around 33% of total emissions, mostly due to the use of gas for heating, hot water and cooking.

As noted previously, transport emissions include journeys that take place within Leicester regardless of where those journeys start and end, so it is not easy to assess the proportion that are likely due to the movements of occupants of (or organisations based in) Leicester compared with the overall total. However, as a rough proxy, it is worth considering that the split of transport fuel consumption is roughly 76% for personal travel and 24% freight, and 46% is used on A roads while 54% is used on minor roads. This suggests that a fairly significant portion of emissions could potentially be associated with journeys passing through the Leicester.

Figure 3-7 shows the recent trends in CO_2 emissions by sector and fuel type as reported by BEIS. Since 2005 there has been an overall 38% decrease in emissions, which is slightly larger than the UK average (which saw a 35% decrease). There has been year-on-year decreasing emissions for 11 of the 13 years reported. Nationally, most of this decrease is associated with decarbonisation of the electricity supply which has contributed to the large reduction of emissions associated with non-domestic electricity usage. This is the main reason why, compared with the previous baseline estimate, CO_2 emissions from gas have remained largely the same, whereas emissions from electricity have decreased by more than half.

Figure 3-7. Trends in Leicester CO_2 Emissions (2005-2018)



3.3 Built Environment

This section provides further details of the current energy performance of the building stock in Leicester.

3.3.1 Typical Gas and Electricity Consumption

As stated previously, gas and electricity use in buildings account for a large proportion of fuel use and CO_2 emissions in Leicester. Median annual gas and electricity consumption for both domestic and non-domestic buildings are published annually by BEIS; these can provide an indication of how buildings in Leicester compare to the regional (East Midlands) and national (England) average.[42,43]

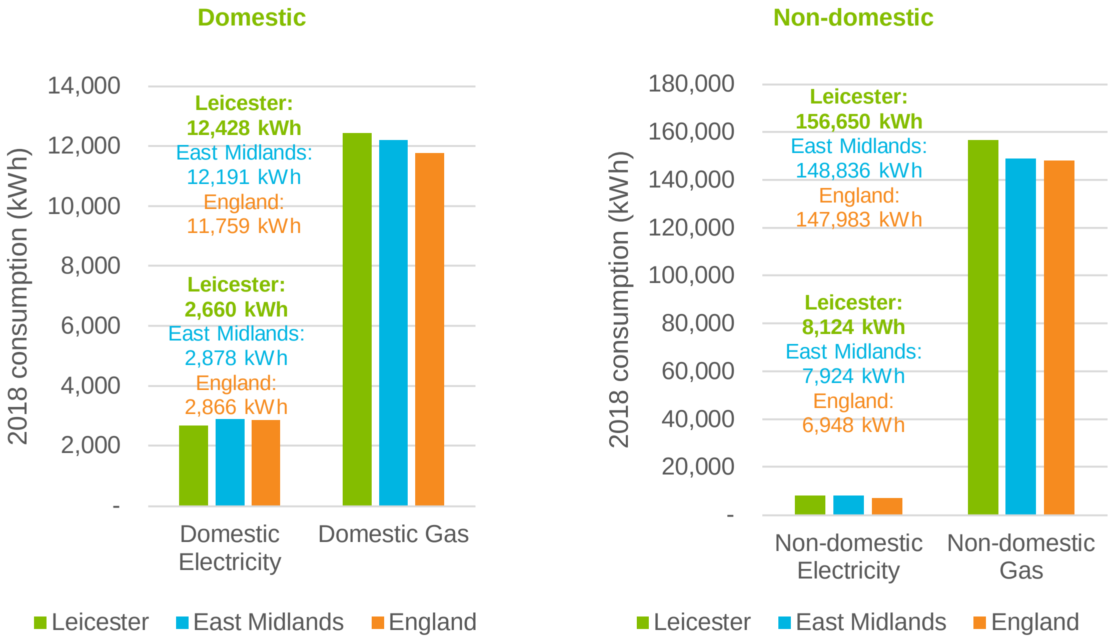
Table 3-3 shows that domestic electricity consumption in Leicester is slightly lower than both the regional and national average, at 2,660 kWh per year, whereas domestic gas consumption is slightly higher at 12,428 kWh per year. For non-domestic buildings, electricity consumption is 8,124 kWh per year and gas consumption is 156, 650 kWh per year, both of which are above the regional and national average. Results are illustrated in Figure 3-8.

Note the averages are of the data based on the number of meters for each energy source. Furthermore, the relatively high non-domestic gas consumption is potentially influenced by particularly high gas users such as a hospital rather than all non-domestic gas users having similar annual consumption. The spread is likely to be much smaller for the domestic sector.

Table 3-3. Median Gas and Electricity Consumption in Buildings (2018)

	Domestic Electricity	Domestic Gas	Non-domestic Electricity	Non-domestic Gas
Leicester	2,660	12,428	8,124	156,650
East Midlands	2,878	12,191	7,924	148,836
England	2,866	11,759	6,948	147,983

Figure 3-8. Median Gas and Electricity Consumption in Buildings (2018)



*No. of non-domestic energy meters:
Electricity – 13,077 and Gas – 1,676

[42] BEIS, *'Regional and local authority electricity consumption statistics'* (2021). Available at: https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics
[43] BEIS, *'Regional and local authority gas consumption statistics'* (2021). Available at: https://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority

Energy consumption in domestic buildings can vary based on a wide variety of factors, including but not limited to physical features affecting energy efficiency, such as the type of building (detached, semi-detached, flats, etc.), its age, location and construction type; technological factors such as the type of appliances and heating systems used; and social factors such as the number of occupants, household income levels, etc. These factors are likely to explain the variation between domestic fuel consumption in Leicester compared with other locations.

In the case of non-domestic buildings, all of these factors can play a role, but energy use also depends more strongly on the types and sizes of buildings – recalling that this category includes everything from large manufacturing facilities to small tourist information kiosks. Fuel consumption in non-domestic buildings is therefore linked to the types of industries within Leicester in addition to the energy efficiency of its fabric and services.

3.3.2 Energy Performance Certificate (EPC) Ratings

Energy Performance Certificate (EPC) ratings provide a normalised means of comparing the energy efficiency of different buildings. In this section, EPC data is used as a rough indication of the relative performance of existing buildings in Leicester. Records are freely available from DCLG unless the holder chooses to opt out.[44,45]

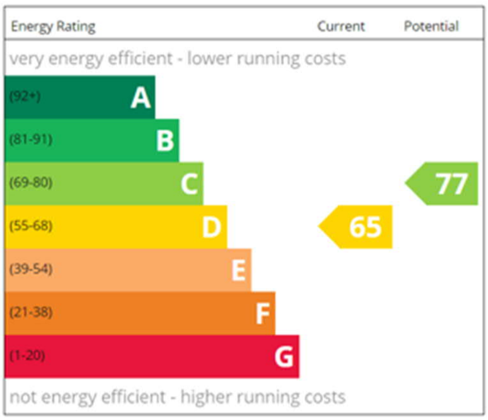
Although the EPC database does not capture the entire building stock perfectly – containing some omissions and duplicate entries[46] – it does provide helpful insight into the differences between building types, ages, and tenures. It also indicates the potential scale of improvement that might be achieved through retrofitting measures. This is particularly relevant because the main mechanism for UK Local Authorities to drive improvements in the energy efficiency of the existing stock, the Minimum Energy Efficiency Standards (MEES), relies on EPC ratings.

3.3.2.1 Domestic EPC Ratings

The rating system for domestic buildings is shown below. Buildings are rated on a scale of 1 (worst) to 100 (best), and these scores correspond to 'bands' of A-G. Ratings are split into two scores, 'current' and 'potential' ratings. 'Potential' ratings are those that could be achieved subject to energy efficiency measures being carried out.

Figure 3-9. Domestic EPC Rating bands (left) and sample domestic EPC rating (right)

Band	SAP rating
A	92 – 100
B	81 – 91
C	69 – 80
D	55 – 68
E	39 – 54
F	21 – 38
G	1 – 20



[44] Department for Levelling Up, Housing & Communities, *'Energy Performance of Buildings Data: England and Wales'* (2021). Available at: https://epc.opendatacommunities.org

[45] Except in circumstances where a property owner has sought an EPC voluntarily (e.g. for a Green Deal assessment), EPCs in the database will only include buildings rented, sold, or constructed since 2008. The dataset is updated continuously and was downloaded on 09/12/20.

[46] EPC data includes many duplicate assessments for the same property. AECOM have endeavoured to reduce any duplicates within the data set by removing duplicates with the same address (retaining the most recent assessment), reducing the data set for Leicester from 114,537 to 89,280. It is important to note, however, that any addresses incorrectly input would lead to duplicates being retained within our reduced data set. The 2011 Census indicated that there were 123,125 households in Leicester meaning our EPC dataset represents approximately 73% of the existing building stock. Although this does not cover the complete stock, it still represents a significant proportion and trends can be drawn from the dataset.

Below, Figure 3-10 shows the range of current and potential EPC ratings registered for existing domestic properties in Leicester, i.e. excluding EPCs that are registered for new dwellings upon construction. The highest number of current SAP ratings are in the range of 60-70 out of 100, which equates to a 'D' rating – in line with the average for England. The highest numbers of potential SAP ratings are in the range of 80-90, equivalent to a 'B' rating.

Figure 3-10. EPC and SAP bands of existing buildings in Leicester City

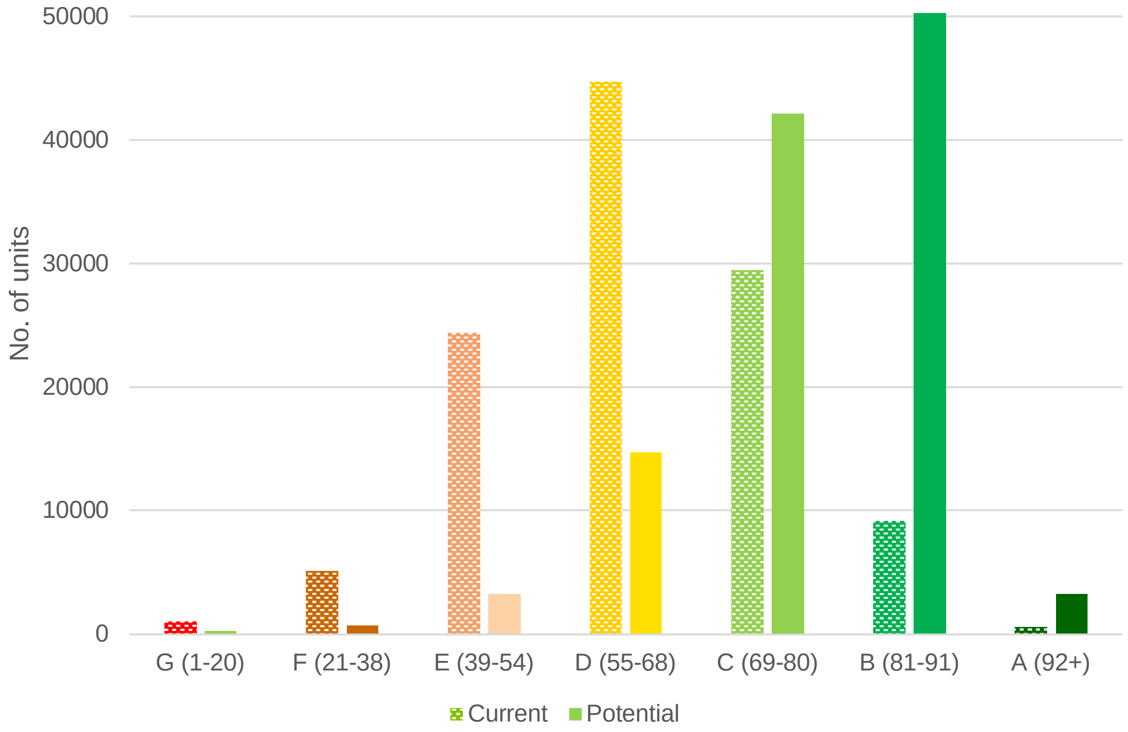


Table 3-4. Domestic EPC Ratings

% of properties with rating or above

Rating	Current	Potential
A	<1%	3%
B	8%	47%
C	34%	84%
D	73%	96%
E	95%	99%
F	99%	100%
G	100%	100%

Table 3-4 (left) shows that the majority (73%) of dwellings in Leicester currently achieve an EPC rating of 'D' or better. The 'potential' results also indicate that, for a majority (84%) of existing properties, it would be possible to achieve an EPC rating of 'C' or better; provided that they implement a range of energy efficiency improvements. Although these ratings do not directly correlate to changes in CO_2 emissions, this confirms that there is significant scope to improve the energy efficiency of the existing domestic building stock.

Below, Figure 3-11 presents the EPC data by age range of building construction and floor area. Unsurprisingly, this indicates that larger and older properties tend to have lower EPC ratings compared with newer, smaller properties. Although it is not possible to predict the level of energy efficiency based solely on a building's age, in the UK older buildings tend to have higher heat demands and less efficient building services.[47] This results in higher energy bills as well as CO_2 emissions.

[47] BEIS, *'National Energy Efficiency Database (NEED): Summary of Analysis 2017'* (published 2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/812561/National_Energy_Efficiency_Data_Framework__NEED__report_summary_of_analysis_2019.pdf

Figure 3-11. EPC rating of homes in Leicester by construction age and floor area

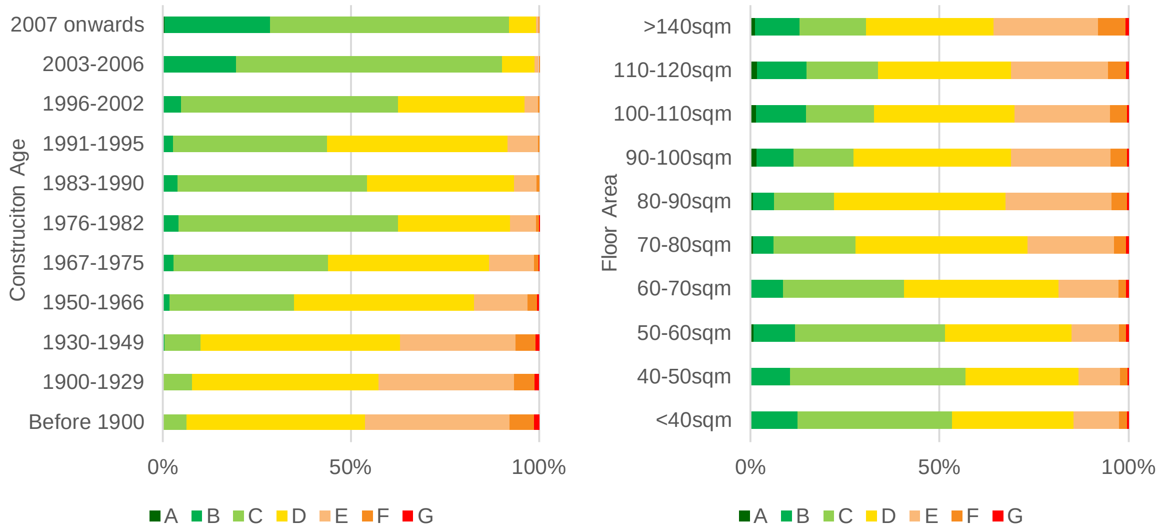
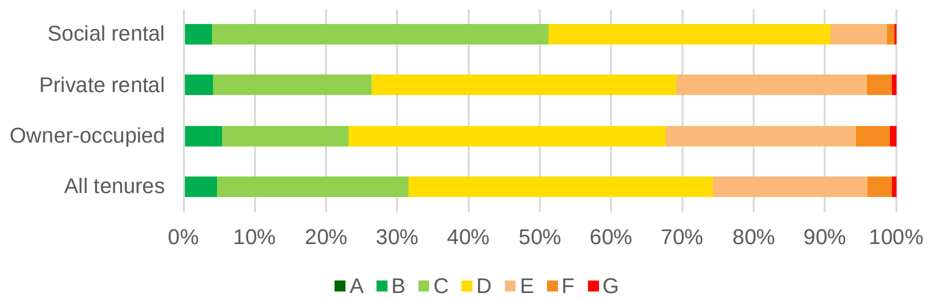


Figure 3-12 shows the EPC ratings of homes by tenure (social rented, private rented, and owner occupied). It shows that in general, socially rented housing in Leicester has higher EPC ratings than other tenures while owner occupied properties have lower ratings. This is different from the national picture; social housing in England tends to have lower EPC ratings than the stock as a whole.[48] It is difficult to comment on the reasons for this but it is likely to reflect the typical age, size and type of property in each tenure category, as well as the type of retrofitting improvements that have been undertaken.

Figure 3-12. EPC rating of homes in Leicester by tenure



These results show that there is scope for significant improvement in the energy performance of domestic buildings in Leicester. Section 5.1.2 will describe some of the options for LCC to continue promoting this.

3.3.2.2 Non-Domestic Buildings

A different rating system is used for non-domestic buildings and the public dataset includes less information than is provided for domestic EPCs. Rating 'bands' range from A+ to G, but numerical scores are not bounded; higher numerical scores indicate worse performance; and scores below zero indicate that the building is Net Zero carbon or carbon negative. This is shown in Figure 3-13 below.

[48] BEIS, *'Energy White Paper'* (2020), referring to the English Housing Survey 2018-19. Available at : https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf

Figure 3-13. Non-domestic EPC Rating bands, sample non-domestic EPC rating (right)

Band	SAP rating
A+	Below 0
A	0 – 25
B	26 – 50
C	51 – 75
D	76 – 100
E	101 – 125
F	126 – 150
G	Over 150

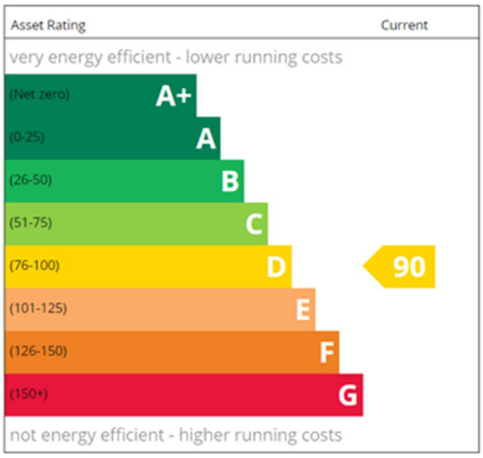


Figure 3-14 shows the distribution of EPC ratings for existing non-domestic buildings. It shows that the highest number of current ratings are ‘D’, with roughly 61% of properties achieving a ‘D’ rating or above. Note that there is a high number of ‘G’ rated properties due to a long ‘tail’ in the data; unlike for domestic properties, there is no upper end of the rating scale for non-domestic buildings.

No information about potential ratings is provided in the dataset; therefore, it is difficult to ascertain the potential uplift that would be possible following a refurbishment or energy efficiency improvements.

Figure 3-14. EPC bands of existing non-domestic buildings in Leicester City

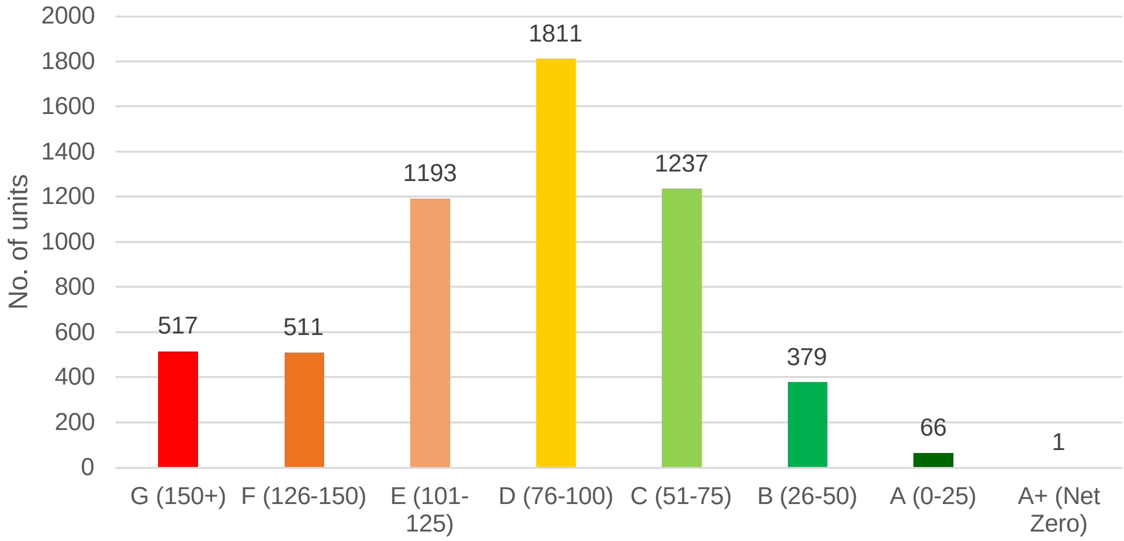


Table 3-5 (below) indicates that the majority (61%) of existing non-domestic properties in Leicester City achieve an EPC of ‘D’ or above. There are no potential figures given for non-domestic buildings at this point in time.

Table 3-5. Non-Domestic EPC Ratings

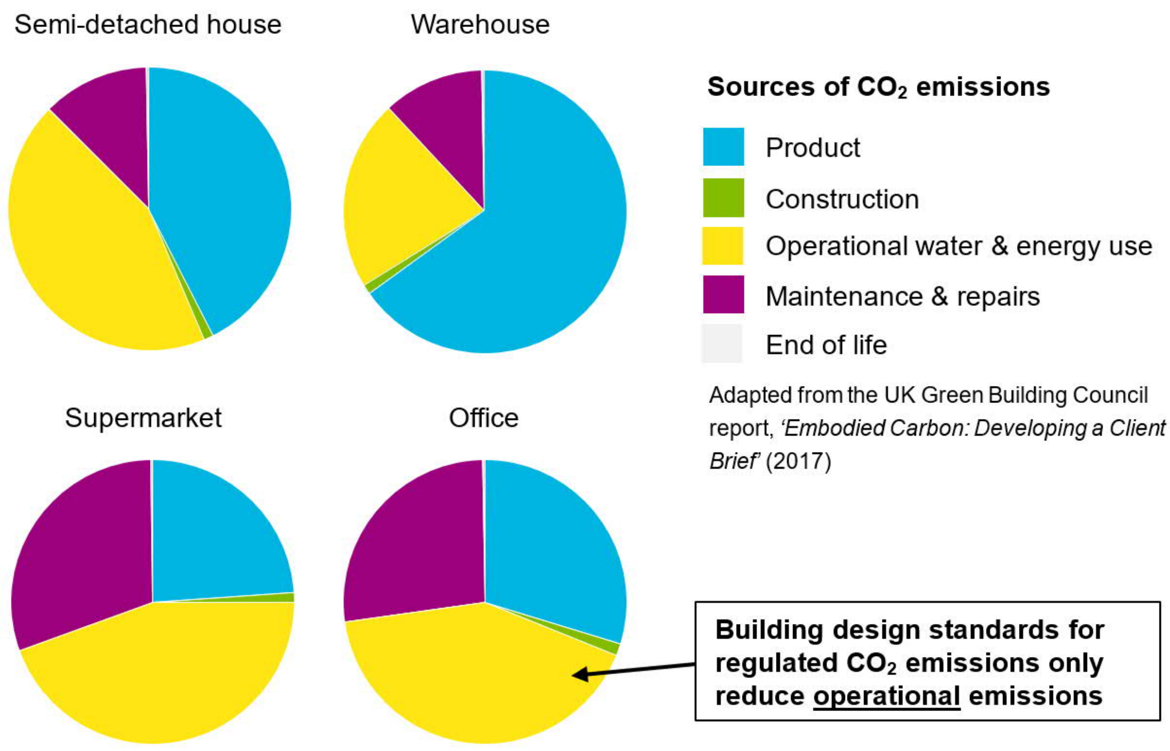
Rating	% of Properties achieving this rating or above
A+	<1%
A	1%
B	8%
C	29%
D	61%
E	82%
F	91%
G	100%

3.3.2.3 A note on 'Whole Life-Cycle' carbon emissions

The manufacture and construction of buildings results in a significant amount of energy use and CO_2 emissions. Further CO_2 emissions will be produced from these buildings due to the materials and equipment required for maintenance, renovations and demolition. This assessment has not considered the Whole Life-Cycle (WLC) carbon emissions of the building stock in Leicester, which is outside the scope of this report.

We can however demonstrate the significance of embodied carbon through housing averages. Embodied carbon can represent 30-70% of the total CO_2 emissions, as illustrated in Figure 3-15 below, which is adapted from the UK Green Building Council report.[49] To reach Net Zero across the whole of the UK, it will be necessary to implement policies that address a broader range of emissions that occur over the building's lifecycle, at all stages of the supply chain.

Figure 3-15. Illustration showing the relative proportion of CO_2 emissions from operational carbon (in yellow) compared with embodied carbon over a 30-year period. Source: UK-GBC (2017)



3.4 Sustainable Transport

This section provides information regarding transport usage within Leicester.

3.4.1 Transport Modes

The typical modal split of journeys, as last presented in LCC's Draft Local Transport Plan (2021-2036), is shown in Figure 3-16.[50] The sample was taken of people entering the City centre located within the inner ring road each weekday in the peak period of 7–10am, counted in a 2010 cordon survey. It shows that most people entering the City centre arrived by car (41.5%) while 3.4% arrived by car or LGV. Of the 34,500 people sampled; an extra 2,200 people entered the City Centre via rail, amounting to a 6.4% contribution which is not shown in Figure 3-16.

[49] UK Green Building Council, *'Embodied Carbon: Developing a Client Brief'* (2017). Available at: https://www.ukgbc.org/wp-content/uploads/2017/09/UK-GBC-EC-Developing-Client-Brief.pdf
[50] Leicester City Council, '*Leicester Transport Plan 2021-2036 (Draft)*', (2021). Available at: https://consultations.leicester.gov.uk/communications/ltp4/supporting_documents/Leicester%20Transport%20Plan.pdf

Figure 3-16. Modal share of transport entering central Leicester in 2019

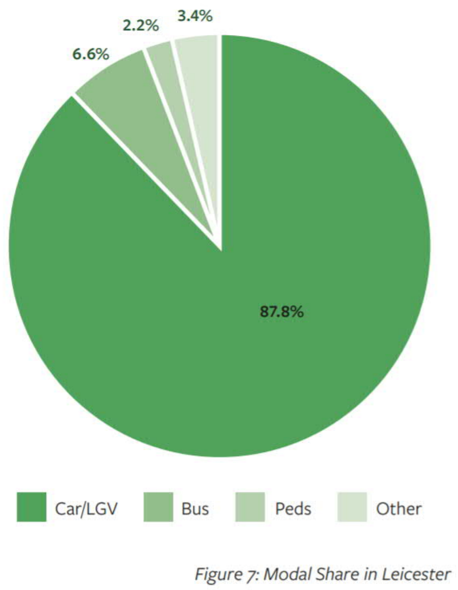
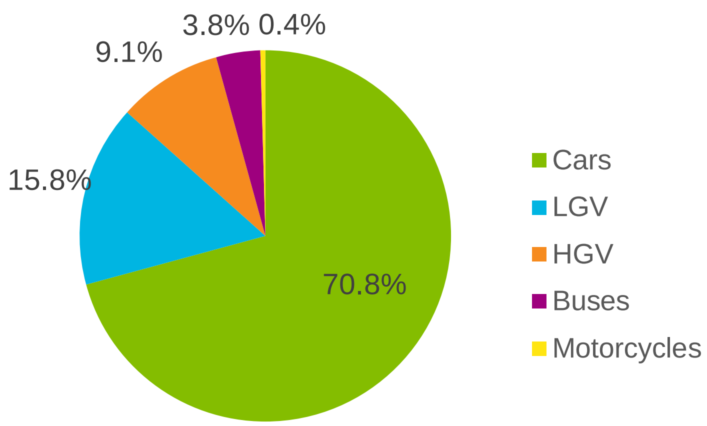


Figure 3-17. Leicester road transport energy consumption in 2019[51]



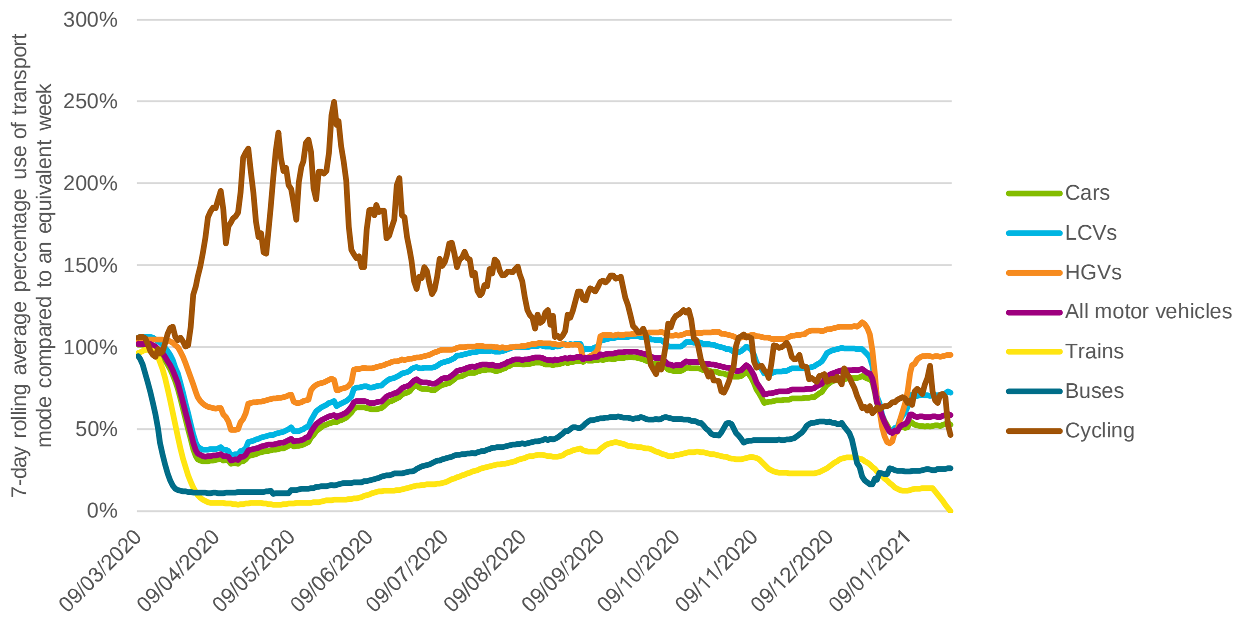
Whilst buses only use around 3.8% of the total transport fuel consumption in 2019 (5.6% in 2010), in a 2010 survey they accounted for 41.5% of passengers during morning peak hours [52]. Conversely cars and LGVs combined account for 86.6% of transport fuel consumption in 2019 (84.9% in 2010) but only 36.4% of passengers during peak hours. This is likely due to the difference in occupancy for cars and LGVS compared with buses: In the 2011 Leicester Network Management Plan 2011 2015, 80% of peak travel involves drivers with no passengers[53] which results in an average car occupancy of 1.34 persons per car, whereas for a bus the average capacity in peak hours is between 30-40 passengers per bus. This efficiency in moving people highlights again the importance of good public transport infrastructure and the role it can play in both reducing emissions and freeing up space for cycle lanes to be created.

The modes of transport chosen by individuals depends greatly on a number of factors including time, ease and weather. COVID-19 has played a significant role in dramatically changing the way people

[51] BEIS, *'Road transport energy consumption at regional and local authority level, 2005-2019'* (2021). Available at: https://www.gov.uk/government/statistics/road-transport-energy-consumption-at-regional-and-local-authority-level-2005-2019
[52] LCC, *Leicester's Local Transport Plan, 2011-2026* (2011). Available at: https://www.leicester.gov.uk/media/178149/local-transport-plan-part-a.pdf
[53] LCC, *Leicester Network Management Plan 2011-2015* (2011). Available at: https://cabinet.leicester.gov.uk/documents/s25431/

travel; during the first lockdown bus use in Leicester reduced to about 17% of normal levels and cycling and walking increased, doubling in some areas [54].

Figure 3-18. Transport use by mode for Great Britain since 1 March 2020



Source: Department for Transport.[55] The data regarding cycling is a percentage of the equivalent day in the first week of March rather than the equivalent day in a previous year. Cycling levels have been historically lower in colder, wetter months, which may influence lower cycle usage over the winter.

Figure 3-18 clearly shows the large reduction in the use of motor vehicles and public transport that coincided with the onset of COVID-19 within the UK and the lockdown that followed. There was however a large increase in the number of journeys taking place via bicycles. As lockdowns began to be eased over the summer months a rise in the use of motor vehicles grew more rapidly than the return to public transport, with vehicle usage levels returning to near normal by September.

Post pandemic, it will be important that travel is completed in accordance with the sustainable transport hierarchy presented in section 2.2.7 where non-emitting modes of travel are prioritised. LCC has produced the *'COVID-19 Transport Recovery Plan'* for Leicester in which the Council has detailed their plans as to how they will encourage the use of more sustainable modes of transport.[24]

3.4.2 Ultra Low Emission Vehicles (ULEVs)

This section summarises the current levels of uptake of ULEVs and electric vehicle (EV) charging provision. For the purpose of this report, we have used the DfT definition of 'ultra low emission vehicle' (ULEV) which refers to *'vehicles that emit less than 75g of carbon dioxide (CO_2) from the tailpipe for every kilometre travelled. In practice, the term typically refers to battery electric, plug-in hybrid electric and fuel cell electric vehicles.'*

3.4.2.1 Existing Provision

Estimates for the current number of vehicles (including ULEVs) in Leicester are taken from *'VEH0105: Licensed vehicles by body type and Local Authority'* and *'VEH0132: Licensed ultra low emission vehicles by Local Authority'* (2019) which are published by the Department for Transport (DfT). [56,57] These datasets record the number of vehicle registrations in each Local Authority from 2011 onwards.

[54] Leicester City Council, '*Leicester Transport Plan 2021-2036 (Draft)'*, (2021). Available at: https://consultations.leicester.gov.uk/communications/ltp4/supporting_documents/Leicester%20Transport%20Plan.pdf
[55] Department for Transport, *'Transport use by mode: Great Britain, since 1 March 2020'* (February 2021). Available at: Transport use during the coronavirus (COVID-19) pandemic - GOV.UK (www.gov.uk)
[56] Department for Transport, *'VEH0105: Licensed vehicles by body type and Local Authority'* (December 2019). Available at: https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#licensed-vehicles
[57] Department for Transport, *'VEH0132: Licensed ultra low emission vehicles by local authority'* (December 2019). Available at: https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#licensed-vehicles

Zap Map also publishes an online map of public charging points throughout the UK which has been used to estimate the current number in Leicester. [58]

Table 3-6 below shows the estimated number of ULEVs that are currently registered Leicester, along with the number of public EV charge points in the City.

Table 3-6. Uptake of ULEVs and estimated number of public charging points in Leicester

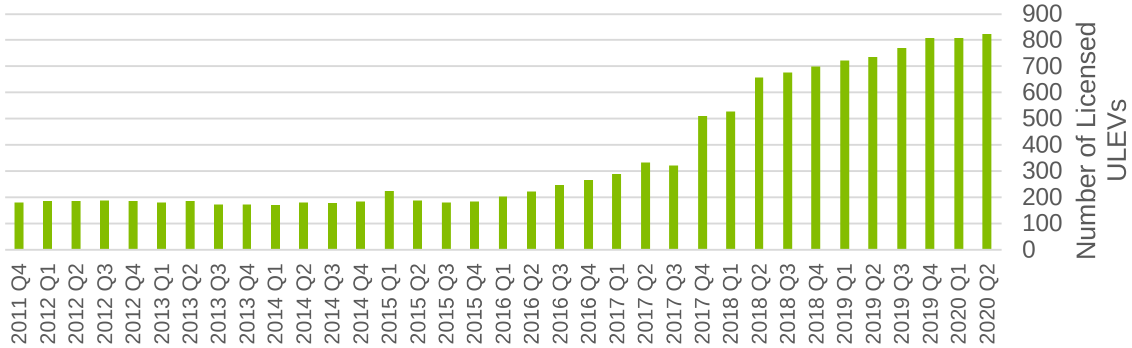
Description	Baseline Estimate	Expected new provision by end of 2021
Number of licensed ULEVs (as of Q2 2020)	822	-
ULEVs as % of total vehicles (at end of 2019)	<0.5%	-
Total public charging devices (No. sockets)	149	246
Total public rapid* charging devices (No. of sockets)	5	35
Charging devices per 100,000 population	21	35

* DfT statistics classify chargepoints of 43kW and above as 'rapid'.

3.4.2.2 Recent Trends

As shown in Figure 3-19, there was a more than four-fold increase in the number of ULEVs registered in Leicester between 2011 and 2020, with 822 as of Q2 2020. Nonetheless, these represent a very small portion (<0.5%) of the more than 183,400 total vehicles licensed in the City. This is slightly below the proportion for the East Midlands (c. 0.6%) and for the United Kingdom as a whole (c. 0.8%)

Figure 3-19. Ultra low emission vehicle (ULEV) registrations in Leicester, 2011-2020



The national picture shows a big variation in the provision of chargepoints per head of population. On a regional basis, London (49), Scotland (32) and the (28) North East of England have the highest number of public chargepoints per 100,000 of population, while Yorkshire & the Humber (12), the West Midlands (14), East of England (15) and the East Midlands (15) having the lowest number per 100,00 of population.[59]

3.5 Low and Zero Carbon (LZC) Energy Technologies

This section presents an estimate of the number, type and capacity of existing LZC technologies in Leicester. It covers technologies that provide electricity and / or heat, based on public datasets. In line with the NPPF, Local Plans are expected to identify opportunities for developments to include such technologies, and 'consider identifying suitable areas' for LZC technologies and infrastructure. Understanding the current uptake of these technologies will therefore help to inform our assessment of future opportunities and policy recommendations.

[58] Department for Transport, *'Table 1: Publicly available electric vehicle charging devices by Local Authority'* (October 2019). Available at: http://maps.dft.gov.uk/ev-charging-map/
[59] Department for Transport, *Electric Vehicle Charging Device Statistics October 2019*, December 2019. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850417/electric-vehicle-charging-device-statistics-october-2019.pdf

3.5.1 Data Sources

The total number and type of electricity-generating LZC technologies within Leicester is recorded in *'Regional Renewable Statistics: Renewable energy by Local Authority'* (henceforth referred to as RRS).[60] This was cross-checked against the Renewable Energy Planning Database[61] (REPD) which provides a quarterly record of all operational or planned LZC energy schemes that have been submitted for planning approval in the UK.

Regarding LZC technologies that generate only heat, there is less publicly available information. In order to provide an estimate of the number and type of these technologies, data was retrieved from the Renewable Heat Incentive (RHI) database.[62] It should be noted that these figures primarily focus on the total *number* of accredited installations; the figures are not disaggregated by technology type and figures for installed capacity are estimates based on nation-wide totals. Details were also cross-checked against the 2015 Climate Change Evidence Base (see Section 2.3.3).

Note that the amount of publicly available information varies depending on the technology in question, and therefore this information represents a 'best estimate' rather than a definitive list of every renewable energy installation in the City.[63]

3.5.2 Technologies that provide electricity

The total installed capacity of LZC electricity technologies as at the end of 2019 was approximately 20.2 MWe, offering the potential to generate nearly 30,000 MWh of electricity per year. According to the REPD (accessed November 2020), there are currently no planning applications for any further renewables within Leicester.

Table 3-7. LZC electricity installations in Leicester - as at end of 2019

	PV	Onshore Wind	Anaerobic Digestion	Plant Biomass	Total
Number of sites (#)	4,606	4	1	2	4,613
Installed capacity (MW)	17.9	0.02	2	0.27	20.2
Electricity generation (MWh/yr)	17,510	51	11,038	1,190	29,788

These results show that the largest number of installations are PV panels which also account for the majority of renewable electricity that is generated (17,510 MWh per year). Most of these are small-scale roof-mounted arrays. There is one anaerobic digestion (AD) facility but due to the higher output[64] of this technology, it accounts for most of the remaining electricity generated each year (11,038 MWh per year). There is also a small contribution from plant biomass and onshore wind. In total, technologies within Leicester City generate nearly 30 GWh of renewable electricity per year. These results are illustrated in the chart below.

[60] BEIS, *'Regional Renewable Statistics'* (2021). Available at: https://www.gov.uk/government/statistics/regional-renewable-statistics

[61] BEIS, *'Renewable Energy Planning Database: quarterly* extract' (2022). Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

[62] For non-domestic installations, see *'Table 1.4 - Number of accredited applications and installed capacity by Local Authority'* and *'Table 1.1 - Number of applications and total capacity by technology type'*. For domestic installations, see *'Table 2.1 - Number of applications and accreditations by technology type'* and *'Table 2.4 - Number of accreditations by Local Authority'*. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-february-2020

[63] Most of the data relating to renewable energy technologies is based on records of installations that have been registered under an accreditation scheme or similar measure. Technologies that are not supported by such schemes or that are not registered for some other reason are therefore likely to be underrepresented in this analysis. This includes renewable heat technologies that are not RHI accredited, and small scale electricity generating technologies (particularly PV) that would previously have been registered under the Feed-in Tariff incentive scheme, which closed to new registrations in 2019.

[64] Amount of electricity generated (in megawatt hours, MWh) per unit of installed capacity (in megawatts, MW).

Figure 3-20. Estimated capacity of operational LZC electricity technologies

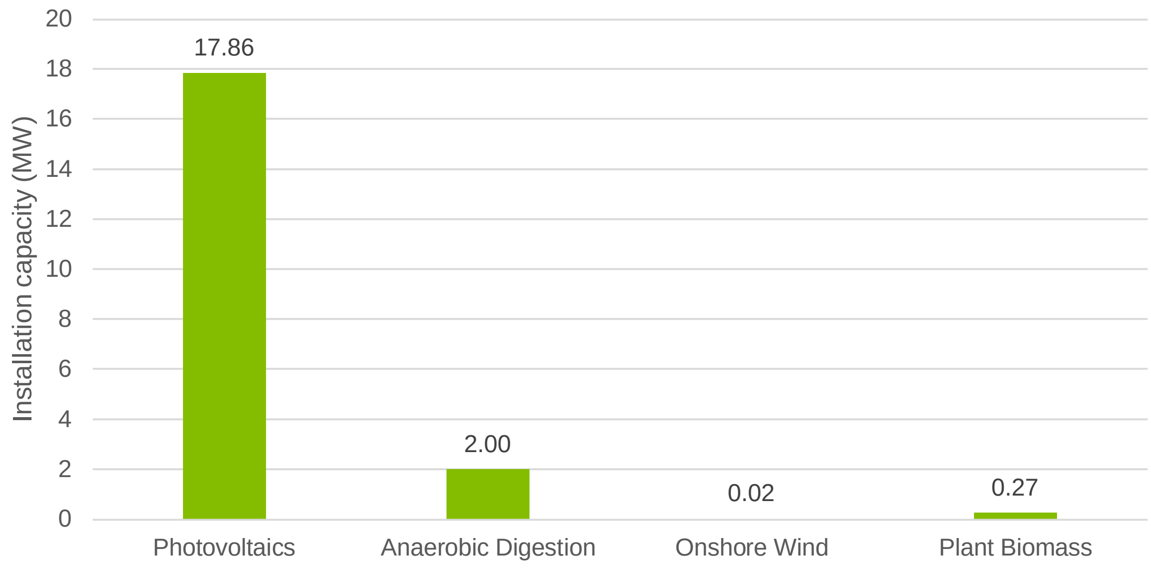
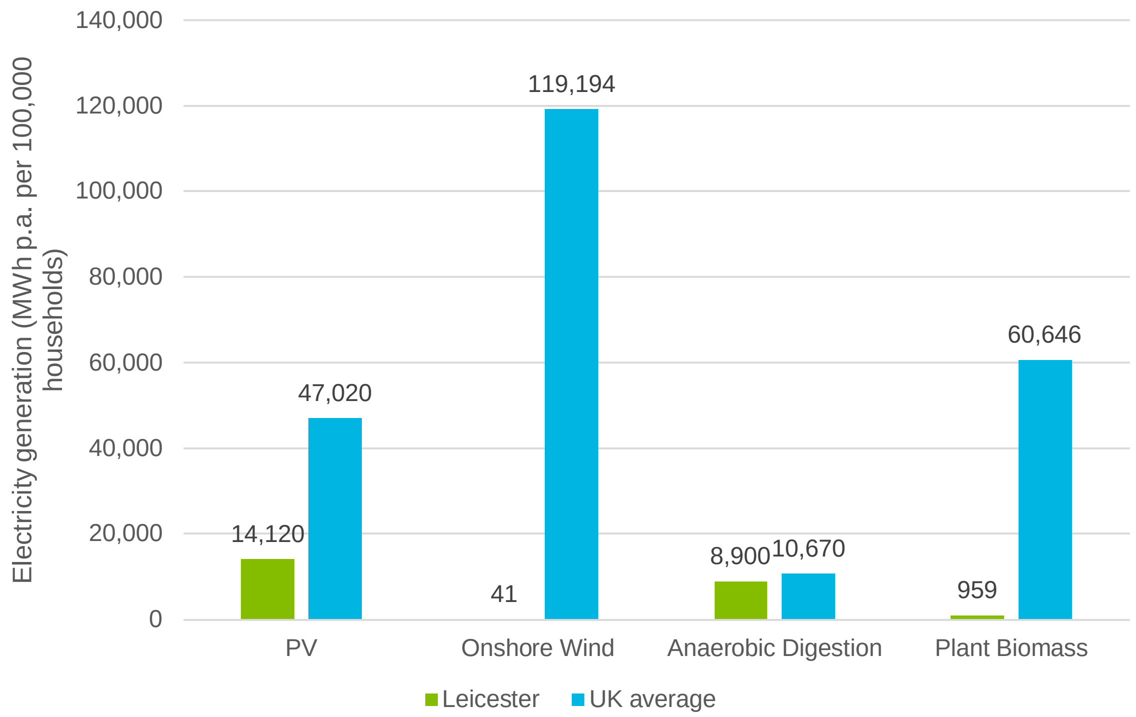


Figure 3-21 shows that the amount of renewable electricity generated per 100,000 households in Leicester is lower than the average for the UK as a whole. Given that the City occupies a small area and there is limited space available for large-scale renewable installations such as wind or solar farms, it is not surprising that there is less PV and wind energy in the area. Similarly, due to the availability of gas grid connections and concerns about air quality, it is also not surprising that there is less electricity generated from plant biomass.

Figure 3-21. Electricity generation per 100,000 households



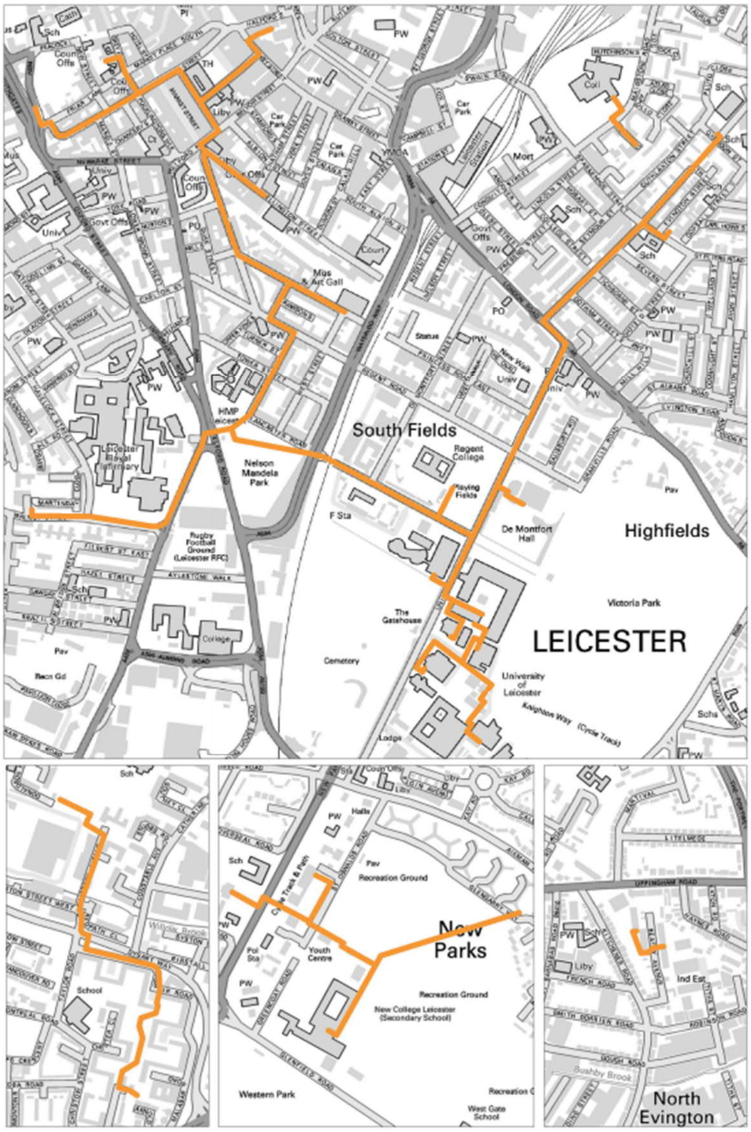
3.5.3 Technologies that provide heat

In addition to the renewable *electricity* technologies described above, there are a variety of technologies in Leicester that provide low and zero carbon heat.

In 2012 ENGIE signed a 25-year contract with LCC agreeing to link and extend several existing heat networks around the City. These connect to a variety of university buildings, Council buildings, and residential homes.[65] Figure 3-22 (below) shows a map of the heat networks detailed in the City of Leicester Local Plan 2020-2036. Overall the scheme is estimated in the 2015 Climate Change Study to supply 10MWe of energy generation from two gas fired CHP units and additional biomass boilers. The 2015 study further details the planned phasing for the expansion of the network, with the scope to increase capacity to 25-30MWe of generation, although it is understood that the timing and scale of expansion is uncertain.[66]

Aside from the heat network, the latest Renewable Heat Incentive (RHI) Database indicates that there are 10 accredited non-domestic RHI installations in Leicester with a capacity of roughly 1 MW in total, and 130 domestic RHI installations (capacity not listed). These could include heat pumps, solar thermal technologies, and technologies utilising biomass or biogas, but the RHI publication does not include a detailed breakdown.[67]

Figure 3-22. Existing District Heating Network. Source: City of Leicester Local Plan 2020-2036



[65] ENGIE, *'Leicester District Energy'* (2016). Available at: engie-leicesterv2.pdf

[66] LCC, *'Leicester District Energy Company: practical action to address carbon reduction'* (2019). Available at: https://www.nuclearpolicy.info/wp/wp-content/uploads/2019/06/Leicester_District_Heating_EC.pdf

[67] BEIS, *'Renewable Heat Incentive Monthly Deployment Statistics'* (February 2022), *'Table 1.4 - Number of accredited full applications and their installed capacity, and heat paid to any ever accredited application, by local authority'* and *'Table 2.4 - Number of accreditations by Local Authority'*. The RHI database does not provide a breakdown of installations for each Local Authority by technology type and installed capacity. Available at: https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

4. Assessment of Future Changes

There are a range of future trends which are expected to affect the trajectory of energy demand and CO_2 emissions, both in the UK as a whole and in Leicester specifically. This section briefly describes key trends and outlines what the implications may be for Leicester. It primarily focuses on topics that can be addressed via the Local Development Plan and will therefore be used to inform the policy recommendations.

The potential quantities and types of new development are described, and used to provide a rough estimate of future electricity and gas consumption based on a 'business as usual' scenario. Consideration is also given to the potential effects of trends such as grid decarbonisation, changes in heat delivery and transport electrification. Where possible, we have sought to quantify or describe the impacts of these trends individually. The potential cumulative impacts are then discussed in Section 4.7.

4.1 New Development

Based on information provided by LCC, an annual increase of around 1,712 new homes each year has been assumed, and a total increase in employment floorspace of 440,000 m^2 over the Local Plan period. This is based on the draft Local Plan (2020) and the Economic Development Needs Assessment for Leicester. **It is understood that these figures are subject to change and the actual level of delivery is uncertain, but this can be used as a starting point for understanding the relative impact that new buildings may have.**

Appendix A of the Draft Local Plan (2020) details the housing trajectory for Leicester from 2019-2036. It shows that there is a requirement of 1,712 new dwellings per year, based on standard methodology, totalling 29,104 new dwellings (21,362 within city) over the Local Plan period. The table below (extracted from the draft Local Plan) details how this housing provision is expected to be delivered via a mixture of committed major development sites, small sites / windfall allowance, and various new strategic allocations including some strategic greenfield sites and City centre areas. In general terms, it is anticipated that developments in the City centre are more likely to be higher density, with a higher proportion of flats and offices. Greenfield sites, meanwhile, are likely to comprise a broader range of houses, flats, and employment space.

Figure 4-1. Extract from the draft Local Plan for Leicester, showing housing provision through 2036

	Component	Dwellings
A	**Housing Need 2019-36 (Standard Method 2019)**	**29,104 (1,712 dwellings per annum)**
	Commitments	
B	Commitments major developments	9,827
D	Saved previous Local Plan allocations	0
E	Reserved matters applications with a resolution to grant subject to s106 agreements	0
H	Small sites allowance / windfalls based on past rate	2,550 (150dpa based on past delivery rate)
J	Allocations identified in the draft plan	1,486
K	City centre capacity work	4,905
L	Strategic sites	2,594
N	Total capacity within the city	21,362
O	Remainder need to be accommodated within the HMA (A-N)	7,742

The proposed increase in housing equates to nearly a 15% increase compared with the existing number of homes in Leicester, a change that is comparable in scale with population projections over that period. Due to land constraints, it is anticipated that approximately 7,742 dwellings will be delivered outside of the City boundary. However, it is possible that a further increase (up to 35%) may be required so these figures may change.

Assuming that new development in Leicester between now and 2036 will use roughly the same amount of gas and electricity as existing buildings, if all other variables hold constant, this will result in a roughly 7% *increase* in area-wide CO_2 emissions in Leicester over the Local Plan period, not counting emissions from any homes delivered outside the City boundary. (The trend would continue assuming that further housing and employment space is built up to 2050.)

In reality, the new development will be expected to meet higher energy and CO_2 performance standards than the existing stock (discussed in more detail in the following section), so this is likely to represent a worst-case scenario. However, some increase in both energy demand and CO_2 emissions will inevitably take place as a result of new development, which will have a range of negative environmental impacts while also placing pressure on existing infrastructure.

To mitigate these effects, it will be vital to ensure that all new buildings are constructed or retrofitted to be capable of becoming Net Zero in operation[68] and incorporate low and zero carbon technologies as standard. It will also be important to take steps towards reducing the whole life-cycle carbon emissions of new buildings.

Note that this calculation only accounts for the additional energy demands and CO_2 emissions associated with energy use in new buildings, and does not consider the wider effects of infrastructure, population growth, water use, waste management, and so on.

4.1.1 Changes in Building Regulations (Part L)

Part L of Building Regulations is the key mechanism that prescribes standards for the conservation of fuel and power in new and existing[69] buildings in England & Wales, based on metrics such as the estimated level of energy demands and CO_2 emissions. These standards are reviewed on a regular basis and are progressively strengthened to ensure that the emissions from new buildings will decrease over time.

At the time of writing, the Ministry of Housing, Communities and Local Government (MHCLG) had recently released a consultation on proposed future standards (see box below) that would significantly reduce emissions from new domestic buildings in the UK. The consultation also states that the Government will make further improvements to Building Regulations requirements for existing domestic buildings as well as new and existing non-domestic buildings.[70]

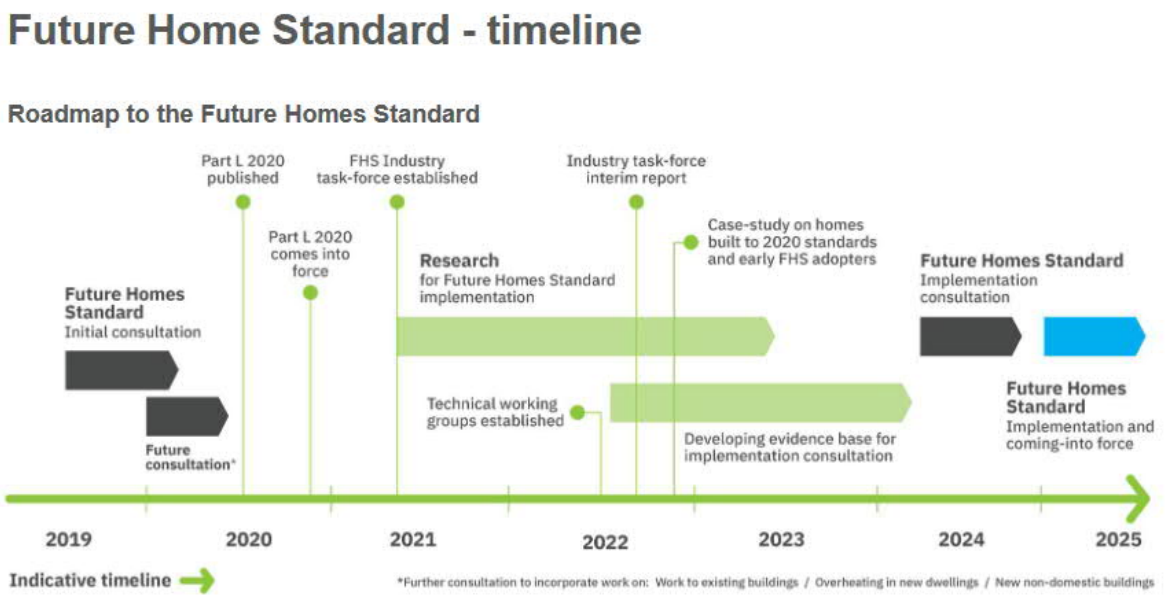
The Future Homes Standard

Under the Future Homes Standard (FHS), new buildings would be required to meet significantly higher targets for energy efficiency and carbon savings. The Government states that,

‘As part of the journey to 2050 we have committed to introducing the Future Homes Standard in 2025. This consultation sets out what we think a home built to the Future Homes Standard will be like. We expect that an average home built to it will have 75- 80% less carbon emissions than one built to current energy efficiency requirements (Approved Document L 2013). We expect this will be achieved through very high fabric standards and a low carbon heating system. This means a new home built to the Future Homes Standard might have a heat pump, triple glazing and standards for walls, floors and roofs that significantly limit any heat loss.’

- BEIS, *‘The Future Homes Standard Consultation’* (2019)

[68] Ministry of Housing, Communities & Local Government, *‘The Future Homes Standard: changes to Part L and Part F of the Building Regulations for new dwellings’* (2021). Available at: see https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings
[69] New buildings – Parts L1a and L2a. Existing buildings – Parts L1b and L2b.
[70] BEIS, *‘The Future Homes Standard Consultation’* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/852605/Future_Homes_Standard_2019_Consultation.pdf



The following text lists out the Future Home Standard timeline events illustrated in the figure above in an accessible format:

2019:
- Future Homes Standard – Initial consultation

2020:
- Future consultation (Further consultation to incorporate work on: Work to existing buildings / Overheating in new dwellings / New non-domestic buildings)
- Part L 2020 published
- Part L 2020 comes into force

2021:
- FHS Industry task-force established
- Research for Future Homes Standard implementation

2022:
- Technical working groups established
- Industry task-force interim report
- Case study on homes built to 2020 standards and early FHS adopters
- Developing evidence base for implementation consultation

2024:
- Future Homes Standard – Implementation consultation

2025:
- Future Homes Standard – Implementation and coming into force

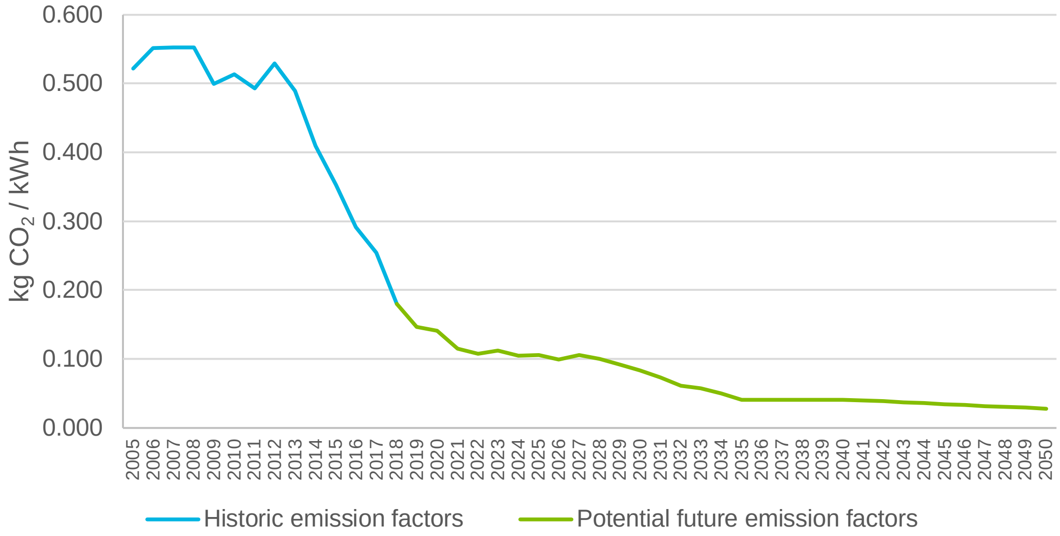
4.2 Electricity Grid Decarbonisation

The carbon emission factor for grid electricity is expected to fall progressively over time, as it will be generated using less coal and more renewable energy. The chart below shows the historic and potential future electricity carbon emission factors from 2010 to 2050, provided by BEIS.[71] The projections going forward are not certain but reflect the ambitions set by the Government and are seen as necessary to meet the UK's carbon reduction commitments.

[71] Data for 2005-2018 is based on the BEIS Sub-National CO_2 emissions dataset described previously. Data for 2018 onwards is from HM Treasury/BEIS *'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1 – Domestic Consumption-Based Emission Factors'* (2020). Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

- **Carbon Emission Factors: The amount of CO_2 emitted (usually measured in kg CO_2) per unit of fuel used or unit of electricity generated (usually measured in kWh).**

Figure 4-2. Historic and potential future carbon emission factors for grid electricity



Although the level of grid decarbonisation is uncertain, it is one of the most important variables that will determine whether the Net Zero target is achieved. This has both positive and negative implications. On one hand, if the BEIS decarbonisation scenario were to occur, area-wide emissions could decrease by up to 20% by 2036 and up to 22% by 2050, compared with 2018 emissions, even if no other actions were taken. On the other hand, this presents a key risk, because it means that much of the reliance on achieving the Net Zero target will rely on factors outside of the Council’s ability to influence.

To address and mitigate this risk, consideration must be given to how the Council can best facilitate the Government’s objectives in decarbonising the grid as well as what measures it can take to best insulate itself from the eventuality that grid decarbonisation does not happen as quickly and/or as deeply as the Government intends.

Although there has been significant progress in this area in recent years, future decarbonisation is anticipated to be much more difficult to achieve. To date, the decarbonisation of the national grid has been primarily achieved through the significant reduction in the use of coal fired power stations and the increase in the use of renewable technologies, particularly large-scale wind and biomass (where it is used for co-firing in power stations). However, the use of gas remains a significant component of the generation mix, and the timely replacement of the existing nuclear fleet is already proving to be challenging. Furthermore, significant additional pressures from the use of electricity to provide heating and power vehicles may incentivise power generation from fossil fuel sources to deal with greater peaks in demand.

4.3 Energy Use in Buildings

4.3.1 Retrofitting the Existing Building Stock

It is difficult to estimate the potential impacts of retrofitting buildings because, although it is technically possible to achieve deep reductions in both energy demand and CO_2 emissions, in practice the uptake of such measures is limited and often cost-prohibitive. Historically, uptake in the UK has been driven by Government initiatives (e.g. the Green Deal offered to the public) and Local Authority-led projects, but future funding levels are uncertain.[72]

To provide a rough indication of the potential impacts of retrofitting the existing building stock, we have considered a range of evidence relating to both basic retrofitting measures and more ambitious scenarios:

- **Domestic**: For domestic buildings, common cost-effective measures such as loft and cavity wall insulation can reduce heat demands by around 5-10%.[73] At the other end of the spectrum, case study evidence suggests that accredited Passivhaus or EnerPHit projects can result in a 75%-90% reduction in heating demands. The Energiesprong retrofit method goes even further, seeking to ensure that a house operates with Net Zero energy demands over the course of a year. The actual reduction is likely to fall somewhere within this – admittedly large – range. However, it is worth noting that many households and landlords of domestic properties may have already installed such measures, meaning that the *additional* improvement if these were installed in the entire domestic stock is likely to be lower.

- **Non-Domestic:** The level of improvement in energy performance that can be achieved in non-domestic properties varies tremendously, as this category encompasses typologies ranging from small corner shops, cafes and offices to large shopping centres, industrial facilities, hospitals, and so on. It is also worth noting that, whereas heat demand dominates fuel use in the domestic sector, this is not the case for the non-domestic sector where the use of lighting and appliances, which in many cases are not considered 'regulated' energy demands, tends to be higher[74]. A review of available evidence suggests that, for non-domestic buildings, it would be reasonable to assume that total energy savings of roughly 10-15% are achievable.[75,76,77]

Based on a conservative assumption that retrofitting can reduce energy use in existing buildings by 10% on average, this would result in a roughly 6% decrease in total CO_2 emissions compared with 2018 levels. In principle, it would be possible to achieve a greater reduction through a large-scale retrofitting initiative. However, the timescale and cost implications are extremely challenging and would require an ambitious programme of energy efficiency improvements.

One of the key obstacles would likely be the absence of a policy driver that requires energy efficiency upgrades to existing buildings. The Minimum Energy Efficiency Standards (MEES) regulations are intended to drive progressive improvements in the existing stock but the impact this will have is not yet clear; it will only apply to buildings that are being sold or rented and requires enforcement by the Local Authority. Furthermore, the Government's stated aim is for all buildings to achieve an EPC rating of 'C' or above where practical (recent Government Energy White Paper states: "All rented non-domestic buildings will be EPC B and by 2030, where cost-effective"), which although beneficial, will

[72] For example, the Green Homes Grant initiated in 2020.
[73] The National Energy Efficiency Database (NEED) collects data on improvements following installation of common, cost effective measures such as cavity or solid wall insulation, boiler replacement, loft insulation, and heat controls. For more information, see https://www.gov.uk/government/collections/national-energy-efficiency-data-need-framework
[74] BEIS, *'Business Energy Statistical Summary: How energy is used and by whom in the non-domestic sector'* (2018). Available at: https://www.gov.uk/government/publications/business-energy-statistical-summary . See also https://erpuk.org/wp-content/uploads/2017/01/ERP-Heating-Buildings-report-Oct-2016.pdf
[75] Carbon Trust, *'Building the Future, Today'* (2009). Available at: https://www.carbontrust.com/it/node/936 . Note that the impact of fabric efficiency is small compared with the benefits of better controls and monitors for heating, lighting and appliances. It should also be noted that the research is somewhat out of date and may not account for changes such as technological improvements, electricity grid decarbonisation, changing costs of PV, etc.
[76] BEIS, *'Consultation: The Non-Domestic Private Rented Sector Minimum Energy Efficiency Standards'* (2020). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/839362/future-trajectory-non-dom-prs-regulations-consultation.pdf
[77] BBP, *'Real Estate Environmental Benchmark: 2019 Energy Snapshot – Chart 6'* (2020). Available at: https://www.betterbuildingspartnership.co.uk/sites/default/files/media/attachment/BBP_REEB%202019%20Energy%20Snapshot.pdf

not provide the scale of energy demand reduction that is necessary to reach Net Zero. There are some potential opportunities to address this issue (discussed in Section 5.1.2).

It is worth noting that there are important reasons other than CO_2 savings that support refurbishing the existing stock. Fabric and building services efficiency improvements can help to protect consumers against changes in fuel prices, mitigate fuel poverty and improve health, wellbeing and comfort, all of which are highly important.

4.3.2 Low Carbon Heating Technologies

The majority of heating systems in the UK are individual gas boilers. Unlike electricity, which can be generated from a range of renewable technologies, natural gas is a fossil fuel which unavoidably emits CO_2 during combustion. In order to meet the Net Zero target, it will therefore be crucial to phase out the use of gas, along with all other fossil fuel-based heating systems.

The two main options for achieving this, based on currently available technologies, are to (1) reduce the total demand for heat and (2) switch to using electric heating systems such as direct electric heating (DEH) or heat pumps. Of these, heat pumps are the preferred option due to the lower running costs and smaller impact on the electrical grid. Within the Prime Minister's Ten Point Plan, heat pumps have been announced as the key provider of space heating. The plan introduced a target of 600,000 heat pump instillations per year by 2028, a significant increase from the current 30,000 install per year rate. The Government will also be consulting on banning the connection of new homes to the gas grid.

(Note: It may be possible to decarbonise the gas grid by injecting it with biomethane or hydrogen, but this would require a technological step-change and has therefore not been considered given the timeframe for the Council to reach Net Zero.)

A large-scale shift to the use of low carbon heating technologies would have the effect of reducing Leicester's emissions by around 11%, depending on the technology used, assuming there is no change in the electricity grid emissions and, crucially**,** the homes that were using these technologies were energy efficient – i.e. there was a demand reduction. As the grid decarbonises, the CO_2 savings would also increase.

These new electric heating systems could be provided to individual buildings (which is standard) or as part of communal or district heat networks.[78] The model used for analysis assumes that a mix of technologies is used. Heat networks offer an opportunity to switch multiple buildings on to lower carbon heating systems and use larger and more complex technologies to deliver higher carbon savings with lower overall capital and operational costs than addressing each building separately. However, by virtue of being larger projects, they can be more complex to deliver, although the Government is providing technical support and funding through the Heat Network Delivery Unit, Heat Network Investment Project and Green Heat Network Fund to assist local authorities in delivering and decarbonising these projects.

4.3.3 Smart Energy Controls

One of the key benefits of smart meters is improving transparency and user access to their own energy data, making it easier to identify areas of waste. Although it is not clear to what extent this affects user behaviour in the long term, the improved data collection could also facilitate the introduction of demand side response, and on a broader scale, help to balance energy demand and supply, which is particularly important at peak times. In principle, therefore, these have the potential to reduce energy consumption.

Initial studies on the success of smart meters in domestic properties indicate average savings of around 4% for customers fitted with smart meters compared to those without. It was seen in some cases that these savings could increase to 11% for homes installed with real-time display smart

[78] A heat network involves the centralised generation of heat to serve multiple buildings, which can enable the use of larger and more efficient equipment, thereby delivering higher carbon savings with lower capital and operational costs than solutions for each individual building. Although heat networks at present often utilise gas-fired Combined Heat and Power (CHP) systems, future heat networks will need to deliver low or zero carbon heat and therefore are likely to utilise large-scale heat pump technology or waste heat sources.

meters.[79] Assuming that a 4% reduction in domestic electricity demands is achieved in this way, overall CO_2 emissions would decrease by around <0.5% compared with 2018 levels.

The impact may be small, but smart metering can still offer wider benefits both to energy consumers and power companies, by providing a more detailed understanding of the quantity and timing of energy demands.

4.4 Low and Zero Carbon Energy Technologies

4.4.1 Electricity

As buildings and vehicles switch away from the use of fossil fuels and towards electricity, it becomes increasingly important to ensure that electricity is supplied from renewable sources. Reasons include:

- reducing pressure on grid infrastructure;
- ensuring security of supply, and
- protecting consumers from rising electricity prices.

Section 5.2 describes potential opportunities for increasing the amount of LZC technologies in Leicester, considering key constraints, opportunities and challenges in more detail.

Increasing LZC deployment would have an indirect effect on total CO_2 emissions because it would contribute to electricity grid decarbonisation and could help to decrease demands for other fuels. Therefore, it has not been quantified separately in the CO_2 scenario model. For context, however, consider that in new developments it is typically feasible to deliver at least 10% of electricity demands via on-site generation.[80] This would result in a small reduction in future energy demands compared with a scenario where no on-site generation occurs.

4.4.2 Battery Storage

There have been significant improvements in battery storage technology in recent years with implications for energy consumption across all sectors. Although batteries are likely to become crucial to future energy infrastructure, they do not offer CO_2e savings per se. Instead, they help to facilitate uptake of LZC technologies by moderating the intermittency of wind and solar energy generation. Combined with EV uptake and the introduction of vehicle-to-grid systems, this could have a transformative effect on the design of energy infrastructure and the built environment.

This technology has not been included in our quantitative analysis of CO_2 scenarios, but present further opportunities for LCC to reduce CO_2 emissions.

4.4.3 Hydrogen

Hydrogen usually exists in a compound state with other elements, for example in water (H_2O). In order to attain hydrogen for use in a fuel cell, the hydrogen needs to be separated from other elements in order to produce a pure elemental gas (H_2). One way of producing hydrogen is by splitting water, using a technique known as electrolysis (where an electric current is passed through water), into its component elements: hydrogen (H) and oxygen (O). Hydrogen is considered a low carbon and renewable fuel if this electrolysis is powered by renewable and low carbon electricity.

As an emerging technology, it is difficult to provide a quantitative assessment of the impact that hydrogen could have on total energy demand or CO_2 emissions in Leicester, so it has not been included in our calculations. The implications from a planning perspective are also unclear; it is likely that delivering hydrogen to buildings would involve repurposing the gas grid, but this might not have a big effect on spatial planning or development management. In terms of potential future Local Plan policies, it is possible that developments in close proximity to a hydrogen gas connection might be required or encouraged to connect to it, similar to the current requirements for district heat networks. It is more likely to be used within industry that requires high grade heat and, as discussed below, the transportation sector.

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[79] AECOM for Ofgem, *'Energy Demand Research Project: Final Analysis – Executive Summary'* (2011). Available at: energy-demand-research-project-executive-summary_0.pdf

[80] Note that this figure varies widely depending on the type of development and its energy demand intensity.

4.5 Sustainable Transport

4.5.1 Reducing Private Vehicle Journeys

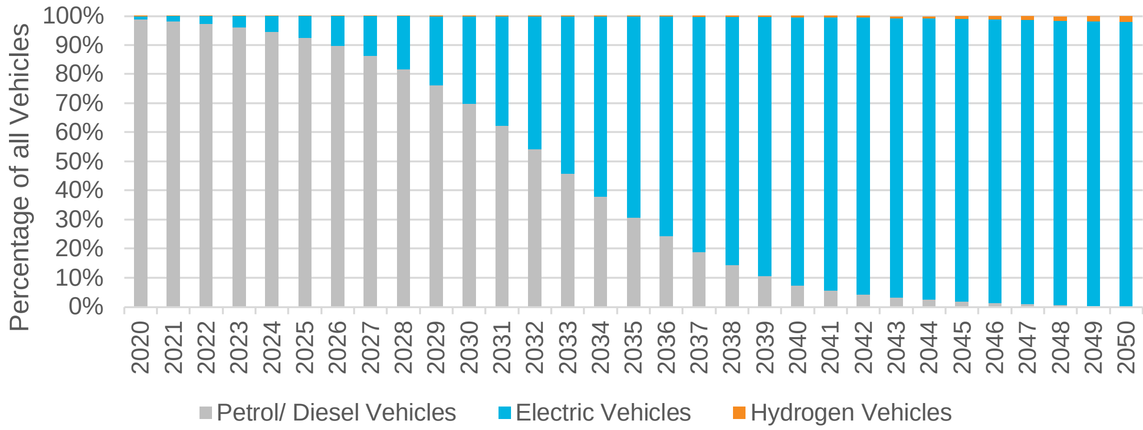
As discussed previously in Section 3.2, transport accounts for around a quarter of total emissions in Leicester, the majority of which (over 70%) is associated with petrol or diesel cars. Assuming that a reduction in the number of private vehicle journeys is roughly proportionate to a reduction in CO_2 emissions from transport, it might be possible to achieve a 1-2% decrease in CO_2 emissions for every 10% reduction in the number of journeys or mileage. The effect would be less if the journeys were made by buses, car shares, e-scooters, and so on.

4.5.2 Ultra Low Emission Vehicles

4.5.2.1 Switching to Ultra Low Emission Vehicles (ULEVs) – Cars and Vans

To reach Net Zero emissions in transport, petrol and diesel vehicles will have to be phased out entirely by 2050 at the latest, being replaced mostly by ULEVs. Figure 25 shows an illustrative scenario to achieving zero emission transport, which is based on the National Grid Future Energy Scenarios (FES). If the trends in Leicester mirror the FES nation-wide trends estimates, then by 2029, electric and hydrogen fuelled vehicles would make up around a quarter of all vehicles, by 2033 they would make up over half of all vehicles and by 2036 (the expected end period of the emerging Local Plan) they would make up over three quarters of all vehicles in the City. This would result in a significant decrease in the use of petroleum products and a significant increase in annual electricity demand. Peak electricity demand could also potentially increase although the benefits of interconnect energy storage on the Grid may help to mitigate this. In reality, the impacts will vary regionally, but this provides an indication of the scale of change that could occur in the coming decades.

Figure 4-3. Vehicle Fuel Sources 2020-2050 (National Grid FES: 'Community Renewables')



As shown in Section 3.4.2, there has been an increase in electric vehicle registrations in Leicester, and growth is expected to continue. It is estimated that the price of electric, hybrid and traditional fuel cars could converge within the next decade,[81] which would help to facilitate the shift towards sustainable transport. Switching to ULEVs would reduce total CO_2 emissions by around 15% if they were charged using current national grid electricity. The savings would increase as the electricity grid decarbonises, or if the vehicles were charged using 100% renewable energy – for instance, generated by PV on the roof of a Council-owned car park. In that instance, the savings could be up to 22% compared with 2018 CO_2 emissions.

Although switching to ULEVs will be an important part of reaching the decarbonisation target, even if this goal is achieved, it creates additional challenges. For instance, achieving the area-wide Net Zero target will depend more on the rate of national electricity grid decarbonisation. It will also present a broad-ranging challenge across all areas of electricity infrastructure.[82] Increasing LZC energy

[81] Cambridge Econometrics and Element Energy, *'Fuelling Europe's Future: How the transition from oil strengthens the economy'* (2018). Available at: https://europeanclimate.org/wp-content/uploads/2018/02/FEF_transition.pdf
[82] National Grid, *'Future Energy Scenarios 2021'* (2021). Available at: https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021

generation, the use of smart EV charging and, potentially, vehicle-to-grid systems could mitigate some of the effects on peak demand and help to alleviate some of this pressure.

A large-scale shift to the use of electric vehicles must also be accompanied by a significant modal shift towards walking, cycling, ridesharing, and an increase in the use of public transport. This is necessary to reduce electricity demand – with added benefits in terms of air quality and, potentially, improving people's health.

4.5.2.2 Reducing Emissions from Heavy Goods Vehicles (HGVs)

At the time of writing, ultra-low emission HGVs are not widely commercially available. In the short-term the Government has suggested a target of reducing emissions from HGVs by 15% through efficiency measures such as driver training and better route planning. Because HGVs represent a small portion of the total emissions in Leicester,[83] this would have a small (<2%) impact. (Note that conversion to hydrogen or electric HGVs is anticipated in the medium to long term.)

4.5.2.3 Hydrogen-Fuelled Vehicles

A potential alternative to EVs is the development of a hydrogen-fuelled vehicle industry. Hydrogen potentially has an important role to play in decarbonising the transportation sector, while it also assists with progress against other key environmental priorities, such as improving local air quality.

While the EV market is expanding quickly and is considered further along its development than the hydrogen vehicle market, there are important advantages which hydrogen vehicles possess when compared to EVs. These include, most significantly, the ability to cover long distances with a 'tank' of fuel and refill the vehicle rapidly. The refilling infrastructure would also be comparable to that used at existing centralised gasoline refilling stations. However, there remain only a small handful of hydrogen refilling stations in the UK[84], and a very significant expansion of this infrastructure would be needed to support a hydrogen vehicle market.

Currently in the UK, there are hydrogen-fuelled vehicles being used in the London bus fleet (ten in total) and in Aberdeen (six)[85]. However, there are many more planned across the country. While it remains to be seen whether a hydrogen vehicle market will compete fully with the EV market, there may be a selective requirement for hydrogen vehicles in niche uses (potentially for heavy goods vehicles, haulage as well as buses). It is therefore recommended that LCC continue to note the hydrogen vehicle markets as they continue to develop.

4.6 Water Efficiency

Note: Water efficiency is a cross-cutting issue relevant to a variety of environmental topics. As the population rises, water demands are also expected to rise, with associated increases in energy use, CO_2 emissions, and wastewater production. Insufficient data is available to estimate the impact this would have on fuel consumption and CO_2 emissions in Leicester because it is difficult to disaggregate water use from other activities. Some of the impacts would take place outside of the City boundary and are therefore outside the scope of this report. Therefore, this section of the report will consider water efficiency from a resource conservation perspective.

The 2017 UK Climate Change Risk Assessment considered the risks associated with climate change for a number of areas. The risk of shortages in the public water supply, and the associated impacts for agriculture, energy generation, industry, and ecology were found to be high and requiring further action. The assessment suggested that the demand for water could be more than 150% of the available resources for many regions of the UK by 2050. The 2017 Water Cycle Study for Leicestershire found that the County is currently classified as an area with 'moderate' water stress, an issue that is expected to increase as a result of climate change, and will be exacerbated by population growth. The image below, taken from the Severn Trent Water (STW) Climate Change Adaptation

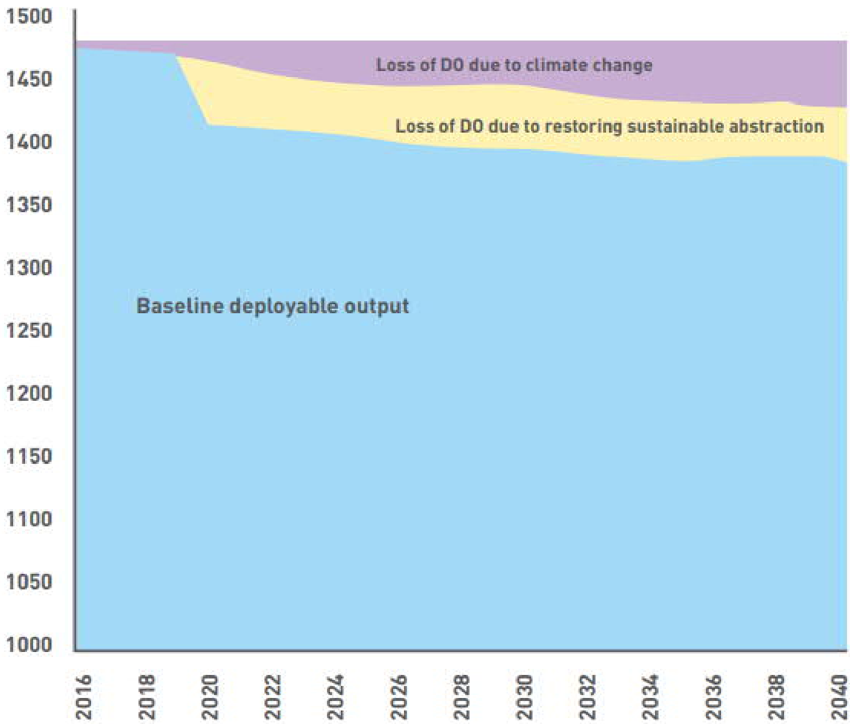
[83] Although not reported separately in the BEIS CO_2 dataset, HGVs account for less than 10% of all fuel used for transportation. See BEIS, '*Sub-national road transport fuel consumption 2005-2018*' (published 2020). Available at: https://www.gov.uk/government/collections/road-transport-consumption-at-regional-and-local-level

[84] Ellis Hyde, '*Where can I buy hydrogen and where is my nearest hydrogen filling station?*' (2022). Available at: https://www.drivingelectric.com/your-questions-answered/1363/where-can-i-buy-hydrogen-and-where-my-nearest-hydrogen-filling-station

[85] See more about Fuel Cell electric buses at: https://fuelcellbuses.eu/

Report, indicates the potential decrease in deployable output of water over the coming decades that could occur due to climate change.[86] It confirms the potential impacts on local supply.

Figure 4-4. Potential future changes in deployable output (DO) from STW. Image © STW



The following text is the legend from Figure 4-4 in an accessible format:

- Baseline deployable output (DO)
- Loss of DO due to restoring sustainable abstraction
- Loss of DO due to climate change

[86] Severn Trent, *'Future proofing: Water's climate adaptation report'* (2015). Available at: https://www.stwater.co.uk/content/dam/stw/about_us/documents/Full-Climate-change-adaptation-report-2015-2020.pdf

4.7 Cumulative Impacts

4.7.1 Modelling Future Trends

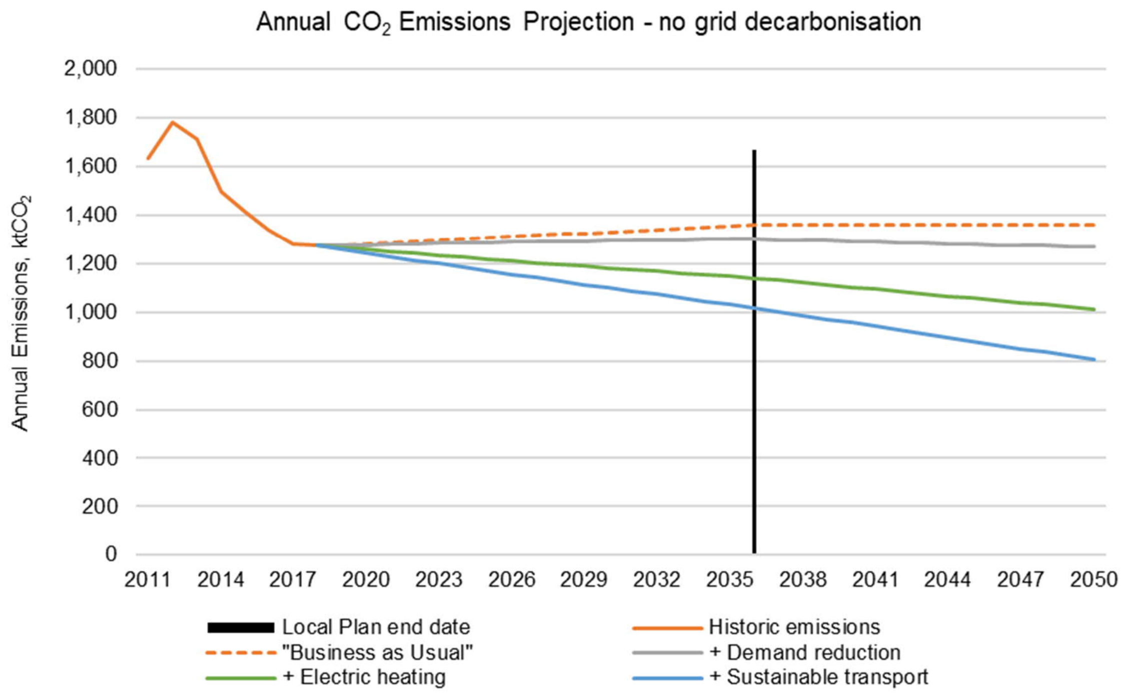
Figure 4-5 and Figure 4-6 show the relative impacts of the future trends described above, as follows:

- Historic emissions are shown based on BEIS statistics, as set out in Section 3.
- There is a small increase in CO_2 emissions, which reflects additional gas and electricity demand due to the operation of new buildings. This increases during the Local Plan period and then models no further energy demand associated with new development post 2036.

Then, the other lines show the cumulative impact of adopting a series of further intervention measures, in the following order:

- **Demand Reduction** – This assumes that energy efficiency retrofitting measures are adopted, resulting in a 10% reduction in emissions from existing buildings, i.e. the conservative assumption described in Section 4.3.1.
- **Electric Heating** – This assumes that, in addition to demand reduction measures, both existing (90%) and new buildings are fitted with electric heating systems by 2050, including a mixture of heat pumps and direct electric heating (DEH) systems, as described in Section 4.3.2.
- **Sustainable Transport** – This assumes that there is a 10% reduction in vehicle journeys for all vehicles, and furthermore, that all vehicles (excluding HGVs) are replaced with EVs where possible, as described in Section 4.5.

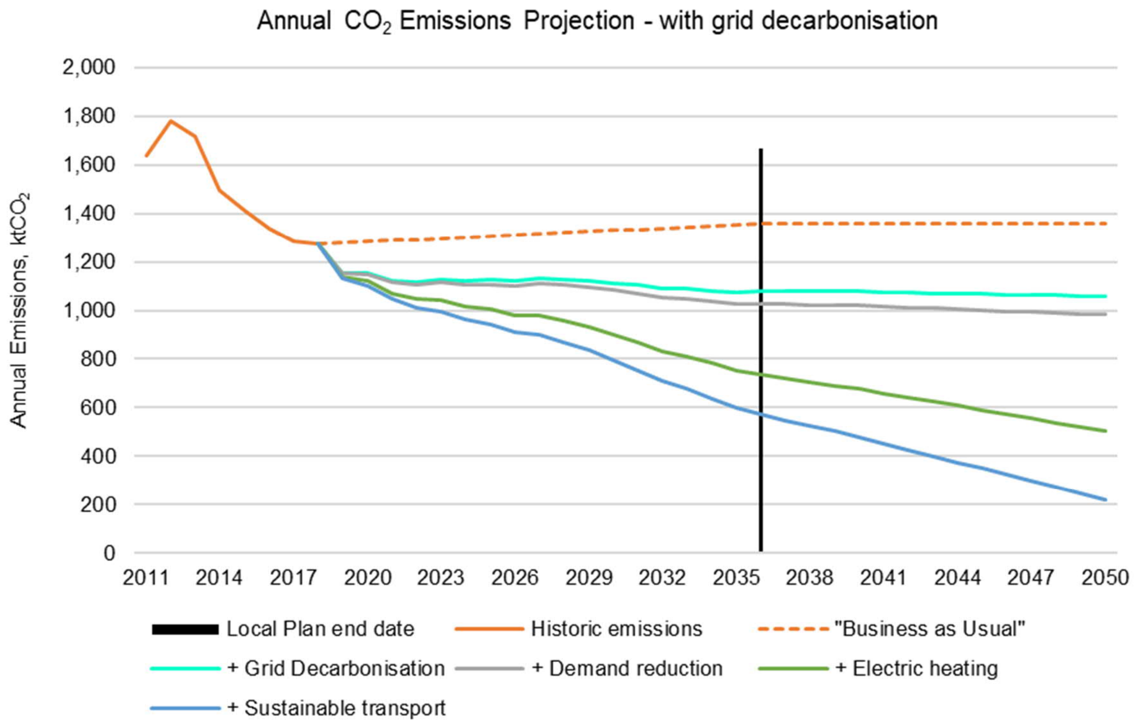
Figure 4-5. Annual CO_2 emissions scenarios for Leicester, no change in the electricity grid



Cumulatively, these changes would result in approximately 37% decrease in CO_2 emissions against the 2018 baseline. Total emissions would decrease from 1,273 ktCO_2 to 807 ktCO_2.

For comparison, Figure 4-6 shows the same results, but this time also accounting for decarbonisation of the national electricity grid, based on the BEIS trajectory described in Section 4.2.

Figure 4-6. Annual CO_2 emissions scenarios for Leicester, accounting for grid decarbonisation



This scenario essentially amplifies the effects of switching to electric heating systems and electric vehicles. In this scenario, if all of the above measures were adopted, this would reduce total CO_2 emissions by up to 83% by 2050, with residual emissions of 222 $ktCO_2$. This highlights how the impact of switching to electric heating systems and vehicles is highly dependent on whether or not they are supplied with low carbon, renewable electricity.

Even if no intervention measures are adopted, emissions would still decrease by up to 22% (this amount is 'capped' at the total proportion of CO_2 emissions that are due to electricity use).

It is important to note that these scenarios are *not* intended to predict actual fuel consumption or CO_2 emissions. However, the analysis is useful inasmuch as it highlights the potential scale and direction of different trends, which provides insight into key priorities and risks when considering pathways and component actions required to deliver the decarbonisation target.

In both scenarios, the residual emissions would need to be addressed through additional measures such as tree planting, carbon removal technologies, and so on. However, as stated previously, the scale of offsetting required even in an optimistic scenario would require a huge amount of land and other resources and so is clearly not practical. This emphasises the fact that demand reduction and energy efficiency measures must be prioritised.

The results of this analysis are summarised in Table 4-1. Note that figures may not sum due to rounding and/or the impact of adopting multiple measures at once.

Table 4-1. Key findings of the CO_2 emissions scenario modelling

By 2050… Potential change in carbon emissions from these measures…	Without grid decarbonisation	With grid decarbonisation
Electricity grid decarbonisation		
Decrease in line with BEIS trajectory (see Section 4.2)	n/a	-22%
New development		
New buildings constructed, no other changes	+7%	-22%
Demand reduction in existing buildings		
Reduce demand for electricity and heat*…	-7%	-1%
… and switch to electric heating systems (90% by 2050)	-14%	-38%
Low carbon transport		
Mileage reduction of 10%, no other changes	-1%	-1%
… and switch to ULEVs (excludes HGVs)	-16%	-22%
Total reductions		
All of the above measures implemented	-37%	-83%
Residual emissions (ktCO_2 p.a.)	**807**	**222**

* Conservative estimate of 10% demand reduction; see Section 4.3 for more details.

4.7.2 Key Implications for Local Planning Policies

Although CO_2 emissions have decreased in recent years, significant changes must take place across all sectors to achieve Net Zero emissions by 2050. Based on this analysis, the key priorities are to:

1. Reduce the demand for heat *and* phase out the use of natural gas by switching to heat pumps;
2. Reduce demand for transport *and* switch from petrol/diesel to ULEVs;
3. Reduce all other energy demands, in part to minimise pressure on grid infrastructure; and
4. Meet any remaining energy demands with renewable electricity.

Some of the ways that the Council could address these issues via the Local Plan would include:

- Setting targets for reducing energy demand and CO_2 emissions from new and existing buildings, for example:
    - Requiring applications to go beyond the requirements of Building Regulations Part L and demonstrate this via an Energy Statement.
    - Requiring major development applications to include a commitment to report energy consumption and compare this to estimated consumption at time of submission for a period of for example five years post occupancy.
    - Use of third-party assessment schemes or standards such as BREEAM, HQM, or Passivhaus.
    - Whole Life-Cycle Carbon Assessments (particularly for larger developments) to minimise the embodied energy of proposed schemes.
    - Introducing requirements relating to Circular Economy measures, which would have the effect of reducing embodied energy in the built environment by minimising demand for resources while also minimising the CO_2 emissions associated with the production and management of waste.
- Encouraging the use of low carbon heating systems such as air and ground source heat pumps, and promoting district heat networks where appropriate, particularly if there is an available source of waste heat. This could be done, for instance, by introducing an ‘Energy and Heat Hierarchy’.
- Ensuring that new development is, at the very least, ‘zero carbon ready’ i.e. designed with high levels of fabric efficiency, include systems that readily can transition from gas, and a building that

is optimised to maximise opportunities for LZC technologies such as roof-mounted PV and battery storage, to support the transition to Net Zero.

- Introducing policies that support holistic sustainable design measures that would have the effect of reducing energy demands, i.e. designing buildings, landscapes and communities to minimise demands for heating, avoid the risk of overheating, reduce waste, and use resources efficiently.
- Exploring avenues for improving the efficiency and reducing CO_2 emissions from the existing building stock. Among other issues, this would need to address the special considerations associated with alleviating fuel poverty. It is also important to ensure that the policy context supports appropriate retrofitting of historic buildings, including but not limited to some Listed buildings and those in Conservation Areas. This will need to be done a way that is sensitive to their heritage value and avoids unintended consequences such as moisture damage.
- Policies aimed at increasing the provision of high-quality cycle and pedestrian routes, EV infrastructure, car clubs, and other interventions aimed at modal shift – this would need to be reinforced via an approach to spatial planning that ensures all new development is located in areas with good provision of sustainable transport links. Requiring a mix of uses would also help to ensure that all residents are within walking distance of shops, schools, healthcare and other facilities.
- Actively encouraging increased uptake of standalone and building-integrated LZC energy technologies.
- Increasing carbon sequestration through land use policies and/or requirements to include green infrastructure in new developments. Note that contributing towards carbon offsetting schemes should be understood as a last resort for mitigating emissions that cannot be addressed via the above means.

5. Assessment of Opportunities

5.1 Promoting Sustainable Building Design

5.1.1 Energy and CO_2 Performance Standards

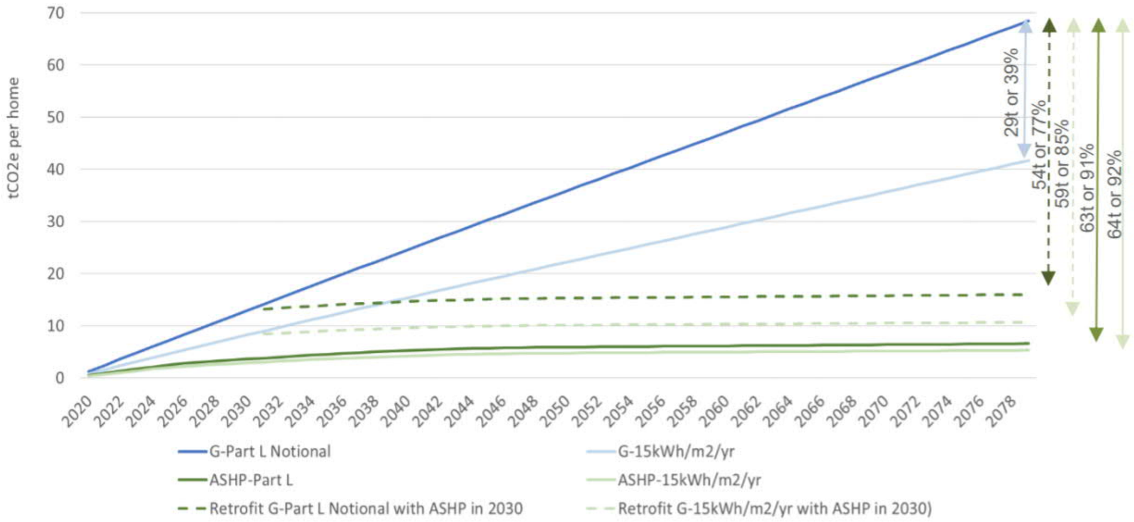
This section of the report considers the performance standards that could be set within Local Plan policy to reduce energy demand and CO_2 emissions in new domestic and non-domestic developments.

5.1.1.1 Overview of Key Issues

The UK has a legal commitment to reduce greenhouse gas emissions by 100% (i.e. achieve Net Zero emissions) by 2050. This goal cannot be met without a significant reduction in CO_2 emissions from all sectors. It is estimated that fuel use in buildings currently accounts for roughly 70% of total emissions in Leicester, and emissions from new development alone would be expected to result in up to an 9% increase compared with 2018 levels, which will make the decarbonisation target more difficult to achieve. The best way to mitigate this increase will be to introduce ambitious energy and CO_2 performance standards for new buildings in the City.

The environmental and financial cost of delay is significant, even if standards are increased progressively over time. For example, a study conducted on behalf of the Committee on Climate Change found that the lifetime carbon emissions (over 60 years) of a house built with a gas boiler in 2020 and then retrofitted with a heat pump in 2030 would be around three times higher than if a heat pump was fitted at the outset.[87] This is illustrated in Figure 5-1 (source: Figure E.1 of the CCC report). At a national level, the report found that, *'each year of delay in adopting lower-carbon heat technologies could result in several million tonnes of avoidable carbon emissions.'* Currently new homes are built to the upper most blue line with a gas boiler for heating meaning that in 15 years' time (2046) an ASHP alternative heating system would have emitted 3 times as much CO_2e.

Figure 5-1. Comparison of cumulative CO_2 emissions from a house built to different energy performance standards. Source: CCC (2019). [Blue lines are gas boiler heating and green lines are electric ASHPs]



Any new buildings that are *not* constructed to meet a Net Zero standard will also add a potential burden on the public purse in the future, as financial assistance may be needed to enable homeowners, occupants and landlords to implement sustainability measures.

The Council should therefore look to set the highest level of building performance standards for new buildings that can reasonably be implemented, and should do so as soon as possible. In addition,

[87] Currie Brown and AECOM on behalf of the Committee on Climate Change, *'The costs and benefits of tighter standards for new buildings'* (2019). Available at: https://www.theccc.org.uk/wp-content/uploads/2019/07/The-costs-and-benefits-of-tighter-standards-for-new-buildings-Currie-Brown-and-AECOM.pdf

LCC should consider opportunities to improve the performance of the existing building stock, as this represents a high share of total emissions.

It is important to understand that Building Regulations only address CO_2 emissions resulting from the use of fixed services and appliances, i.e. heating, cooling, ventilation, hot water, and lighting. These are referred to as 'regulated' CO_2 emissions. To reach Net Zero, it will be necessary to implement policies that address a broader range of emissions that occur over the building's lifecycle, at all stages of the supply chain:

- 'Unregulated' CO_2 emissions are those that result from the use of other (typically electrical) appliances (such as fridges, home entertainment systems, etc.).
- 'Embodied' CO_2 emissions are associated with the production, manufacture, construction, maintenance, repair and demolition of buildings.

Furthermore, it should be noted that most compliance calculations rely on modelled estimates of the building's energy demands and CO_2 emissions, but that, in real-world operation, these tend to be significantly higher than design estimates suggest. For example, research undertaken by Innovate UK, which examined the in-use performance of a selection of low carbon development schemes, found that, even though CO_2 emissions were lower than in typical buildings, in domestic buildings they were still 2-3 times higher than predicted, and in non-domestic buildings they were nearly 4 times higher.[88,89]

In addition to setting higher standards for *regulated* CO_2 emissions, therefore, LCC should consider requiring developers to:

- estimate unregulated and embodied CO_2 emissions;
- demonstrate how they have taken steps towards reducing these; and
- where possible, undertake post-construction monitoring.

This will be crucial in order to help bridge the 'performance gap' described above (between predicted or modelled emissions and those in-use emissions observed in the real world) and ensure that the levels of CO_2 reduction as indicated prior to construction are actually achieved.

5.1.1.2 Policy Context

In the 2015 Climate Change Study, it was understood that Local Authorities were unable to set energy and CO_2 performance targets that go above and beyond the requirements of UK Building Regulations. As described in Section 2 of this report, the policy context has changed significantly since that report was issued. At the time of writing (February 2021), Local Authorities *are* permitted to set higher energy and CO_2 performance targets for both domestic and non-domestic buildings. However, it is important to note that they **may not be enforceable in the future**. LCC should take this into account when considering the higher standards outlined below.

There are other measures that LCC can take to ensure that buildings are futureproofed and to ease the transition to a low carbon built environment. Those are discussed in the sub-section below titled 'Ensuring Compatibility with Net Zero Emissions' (p. 70).

5.1.1.3 Opportunities to Set Higher Standards

Mandatory standards for energy use and CO_2 emissions are set out in Part L of the Building Regulations. These are progressively updated and, despite the current policy uncertainty, will generally include more ambitious standards over time as the UK moves towards a Net Zero economy.

For domestic buildings, the Government intends to introduce a Future Homes Standard (FHS) in 2025 that would result in new homes having 75-80% lower CO_2 emissions compared with those constructed to the current Part L 2013 standards. In addition, in 2020 the Government proposed two possible interim uplifts to Part L, as follows:

[88] Innovate UK, *'Building Performance Evaluation Programme: Findings from domestic projects'* (2016). Available at: https://www.gov.uk/government/publications/low-carbon-homes-best-strategies-and-pitfalls
[89] Innovate UK, *'Building Performance Evaluation Programme: Findings from non-domestic projects'* (2016). Available at: https://www.gov.uk/government/publications/low-carbon-buildings-best-practices-and-what-to-avoid

- Option 1 – Equivalent to a 20% reduction in regulated CO_2 emissions. This standard was expected to be met primarily through energy efficiency measures e.g. triple glazing and high levels of insulation.

- Option 2 – Equivalent to a 31% reduction in regulated CO_2 emissions. This standard would have included a lower level of fabric energy efficiency, plus onsite renewable technologies e.g. rooftop PV.

In January 2021 it was announced that the Government would pursue Option 2, which is expected to take legal effect in terms of compliance from June 2022.

For non-domestic buildings, the Government is currently consulting on changes to Building Regulations that would result in either a 22% or 27% reduction in CO_2 emissions compared with Part L 2013. While the outcome of that consultation is yet to be published, in our view this confirms that a 20% improvement standard could reasonably be applied to all forms of new development, both domestic and non-domestic.

If LCC chooses to adopt a CO_2 performance target less than the proposed interim uplifts to Part L, then it may soon be superseded by changes to Building Regulations. LCC may therefore wish to consider either trying to set a more ambitious target or wording the policy so that the target is set to increase over time.

Options for developing a more ambitious policy could include:

- Requiring an additional reduction in CO_2 emissions to be achieved through use of on-site LZC energy technologies. LCC could either:
    - Require all developments to include LZCs unless, in exceptional circumstances, this is shown to be non-viable; or
    - Set a numerical target for the proportion of energy demands to be met via on-site generation. The proportion varies somewhat depending on the type and design of development.

- Requiring developers to calculate, and take steps to reduce, lifetime CO_2 emissions including both operational emissions and embodied carbon.

- Requiring developers to participate in a BREEAM, HQM or other environmental assessment scheme (discussed in more detail in the following section).

- Prohibiting the use heating systems that require onsite combustion of fossil fuels unless it can be shown that there is no viable alternative.

- Setting a higher CO_2 emissions reduction target with any shortfall to be met through contributions towards a carbon offsetting fund. For example, the Greater London Authority has, for some time, required all new developments to achieve a 35% CO_2 reduction and domestic developments must now offset all residual emissions (in effect achieving a 100% CO_2 reduction, i.e. Net Zero regulated emissions).
    - Appendix B contains a discussion of the potential to establish a Carbon Offset Fund.

5.1.1.4 Other Industry Standards and Assessment Methods

Separate to Part L of the Building Regulations, there are various voluntary industry standards and assessment methods that set higher energy and/or CO_2 performance targets. These include, for instance, the Building Research Establishment Environmental Assessment Method (BREEAM), which sets out a range of holistic environmental measures that can be implemented when designing non-residential buildings, and the Home Quality Mark (HQM) which is relevant to domestic buildings. Examples of voluntary energy standards include the Passivhaus Standard (predominantly applied to new buildings), EnerPHit and Energiesprong both of which are aimed at retrofit projects.

Table 5-1 (see overleaf) presents a brief overview and comparison of some of these standards, focusing on those that are most commonly in use in the UK.[90] The table also includes the current Part L 2013 requirements and those that are laid out in the FHS consultation for context. These standards vary significantly in scope, calculation methodology, and assessment / validation procedures.

[90] CIBSE, *'TM60: Good Practice in the Design of Homes'* (2018). Available at: https://www.cibsejournal.com/general/tm60-good-practice-in-the-design-of-homes/

Table 5-1. Comparison of building design standards

	Part L 2013	Future Homes Standard Option 1*	Future Homes Standard Option 2	BREEAM 'Outstanding'	Home Quality Mark (HQM)	Energiesprong	Passivhaus	Passivhaus Plus	EnerPHit
Description	Current performance standard of UK Building Regulations (2013).	Would equate to roughly a 20% improvement on Part L 2013, likely to be achieved through very high fabric efficiency standards.	Would equate to roughly a 31% improvement on Part L 2013 through fabric energy efficiency measures (not as high as in Option 1) plus the use of LZC technologies.	BREEAM 'Outstanding' requires a reduction in regulated CO_2 emissions, compared with Part L 2013 standards. Additional credits can be achieved for a 100% reduction (i.e. Net Zero) regulated emissions.	HQM was developed by the BRE as a rating system that can signal to householders how well the building performs based on various sustainability indicators, including energy use and CO_2 emissions.	Originally developed by the Dutch government to promote energy efficient retrofitting, this is a performance standard for new build and refurbishment.	Originally developed in Germany, this is a performance standard that aims to meet annual heating requirements with very low energy input.	Similar to the Passivhaus Standard, this scheme also requires renewable energy generation on-site or nearby, resulting in Net Zero emissions.	This is the Passivhaus Institute standard aimed at energy efficiency refurbishment schemes, which can achieve energy and CO_2 savings of 75-90%.
Relevant building types	Domestic and non-domestic	Domestic only	Domestic only	Non-domestic only [separate standards for domestic refurbishment]	Domestic only	Domestic only	Domestic and non-domestic	Domestic and non-domestic	Domestic and non-domestic retrofits
Scope	Regulated energy use only	Regulated energy use only	Regulated energy use only	Core requirements relate to regulated energy use, but additional credits can be achieved for reducing unregulated energy use. There is consideration of lifecycle CO_2 emissions from certain materials, but no set target.	Regulated and unregulated energy use .	Regulated and unregulated energy use	Regulated and unregulated energy use	Regulated and unregulated energy use	Regulated and unregulated energy use
Target values	Based on a notional building with a similar built form, targets are set for: • CO_2 emissions • Fabric energy efficiency • Minimum performance standards for building elements and fixed services	Typical 20% improvement on Part L 2013 CO_2 emission rates. New targets based on: • Primary energy • CO_2 emissions • Householder affordability • Minimum performance standards for building elements and fixed services	Typical 31% improvement on Part L 2013 CO_2 emission rates, or around a 22% improvement in typical flats (due to less roof space for LZCs) New targets as for Option 1 (see left)	A bespoke metric is used which accounts for its regulated operational heating and cooling energy demand, primary energy consumption and CO_2-eq emissions	A bespoke metric is used which accounts for fabric performance, system efficiency and Total resulting CO_2 emissions.	Space heating demand <30 kWh/m^2/yr Net Zero delivered energy over the course of the year	Space heating demand <15 kWh/m^2/yr Primary energy demand <60 kWh/m^2/yr	Space heating demand <15 kWh/m^2/yr Primary [renewable] energy demand <45 kWh/m^2/yr	Compliance can be achieved via a 'component' method which uses Passivhaus-certified products, or via the 'energy demand' method which sets a space heating target dependant on climate zone. In Leicester the target would be 25 kWh/m^2/yr
Fabric energy efficiency standard	Typically, 45-50 kWh/m^2/yr for flats and 55-60 kWh/m^2 /yr for houses	Fabric energy efficiency target to be replaced by those listed above	As for Option 1 (see left)	None	None	Minimum performance standards for building elements and fixed services	Space heating demand <15 kWh/m^2/yr	Space heating demand <15 kWh/m^2/yr	As for Passivhaus (see left) – but only if seeking compliance via the 'energy demand' method
Renewable energy requirement?	No	No	No, but this would typically be required to meet the targets	No	No	No	No, but this would typically be required to meet the targets	Yes, renewable energy generation >60 kWh/m2/yr of building footprint	No

If any of the above standards were to be introduced in Leicester, this would need to be tested through the normal Local Plan viability and consultation process. In practice, it is often the case that Local Authorities will only set higher energy and CO_2 performance targets (or BREEAM / HQM requirements) for major developments, or certain types of schemes that are known to have fewer technical and viability constraints (e.g. large developments on greenfield sites).

From a monitoring and enforcement perspective, third-party assessment schemes such as BREEAM, HQM and Passivhaus can be advantageous because developers can submit evidence that a scheme has undergone a pre-assessment and / or achieved accreditation, which reduces the amount of time that planning officers need to spend evaluating the details of each proposal.

5.1.1.5 Costs of Meeting Higher Standards

Analysis previously carried out by AECOM and Currie Brown on behalf of the Committee on Climate Change considered the cost implications of achieving energy performance standards roughly equivalent to those listed in Table 5-1 for a range of building types.[91] The study found that, for new buildings, the uplift in cost for achieving 'ultra-high energy' efficiency standards ranged from around 1%-4% of the total build cost. Note that, if certification is being sought from an independent scheme, there will be additional costs compared with achieving standard Part L compliance (e.g. design, assessment and validation).

An impact report produced as part of the Future Homes Standard Consultation[92] indicates that the proposed new standards would result in the following increase in build costs for new homes:

Table 5-2. Future Homes Standard Consultation – Uplift in typical build costs for different building types

	Option 1 (20% uplift)	Option 2 (31% uplift)
Detached house	£4,200	£6,520
Semi-detached house	£2,560	£4,850
Mid-terraced house	£2,200	£4,740
Flats	£2,070	£2,260
Average (based on build mix)	£2,870	£4,620

These costs should be weighed against the wider benefits of reducing energy demand and CO_2 emissions, including potential savings on energy bills. In the FHS Impact Assessment, the Government estimates that Option 1 would save occupants of a typical semi-detached home £60 per year on energy bills, compared with £260 savings with Option 2.

Consideration should also be given to the opportunity costs that may occur if new buildings are *not* capable of meeting these requirements. The costs of retrofitting buildings to an equivalent standard are significantly higher than those for new buildings (although still lower than the cost of demolishing and rebuilding a house).

For **domestic buildings**, the cost of installing energy efficiency measures and low carbon heating systems can be three to five times higher if they are retrofitted, compared with installing them in new homes. The cost depends on which measures are installed, but can range from around £16,000 per home (CCC, 2019) to upwards of £75,000 per home, as in the case of Energiesprong deep energy retrofitting projects.[93]

Non-domestic buildings exhibit a wider range of outcomes, but as a rough estimate, the costs of installing energy saving measures and technologies may be 3 to 10 times higher when they are retrofitted than when they are installed in a new building (CCC, 2019).

This indicates that some form of incentive scheme and regulatory change will almost certainly be required in order to improve the existing building stock to the level that would be required in order to reach Net Zero emissions.

5.1.1.6 Other Practical Considerations

Local Authority resources: Introducing standards that go beyond Building Regulations would require some Local Authority resources (i.e. officer time) to review additional planning submission documents. In some cases, it would also require a technical expert to act as a reviewer in order to be able to interpret and, where necessary, challenge the proposals that are made.

[91] AECOM and Currie Brown, 'The Costs and Benefits of Tighter Standards for New Buildings' (2019). Available at: https://www.theccc.org.uk/publication/the-costs-and-benefits-of-tighter-standards-for-new-buildings-currie-brown-and-aecom/
[92] See *'Table 5: Additional Capital Costs'* of the Future Homes Standard Consultation Impact Assessment (2019)
[93] Evidence gathered as part of the Energiesprong programme indicates that costs have decreased radically over time, and research by the Green Alliance suggests that these could come down to around £35,000 per home on average. Green Alliance, *'Reinventing Retrofit: How to scale up home energy efficiency in the UK'* (2019). Available at: https://www.green-alliance.org.uk/resources/reinventing_retrofit.pdf

Means of assessment: Typically, applicants are required to provide evidence of their sustainability claims in a dedicated Sustainability Statement and / or Energy Statement.[94] This can incur some costs to the developers / applicants who need to provide the report if they are describing the broad sustainability measures that are implemented. (An alternative option is to introduce a basic 'Sustainability Checklist' to be appended to the Design and Access Statement which demonstrates the measures that have been included.) The content of an Energy Statement and its level of technical detail will vary depending on the scheme in question.

Evidence of the level of CO_2 performance improvements (% reduction against Part L) can be demonstrated by submission of a Preliminary Energy Assessment (PEA) that would be carried out as a standard part of the Building Regulations certification process for any new schemes, but this would not explain the applicant's rationale for the proposed approach.

The benefit of third-party assessment schemes such as BREEAM and Passivhaus is that these are evaluated by the certifying body, so the Local Authority would only need to request proof of certification from the applicant rather than reviewing sustainability proposals in detail.

Enforcement: Typically, energy and CO_2 improvements that go beyond Building Regulations would be set as planning conditions and enforced as such. If LCC were to introduce a carbon offsetting fund and require developers to make payments in lieu of on-site savings, this would usually form part of an S106 agreement.

5.1.1.7 Ensuring Compatibility with Net Zero Emissions

In light of LCC's Climate Emergency Declaration, it is important to ensure that all new buildings are at least capable of *becoming* Net Zero carbon in operation, even if they are not constructed to that standard initially. Therefore, regardless of whether or not a CO_2 improvement target is set, the Council should strongly consider requiring developers to include futureproofing measures, such as:

- **High levels of fabric energy efficiency** – This is important for reducing energy demands and also to provide optimal operating conditions for heat pumps. The Government's FHS Consultation sets out an indicative fabric specification that would enable new homes to achieve a 20% CO_2 reduction primarily through energy efficiency measures.
- **Designing heating systems to be compatible with heat pumps**, if these are not installed at the outset – This would include use of underfloor heating or larger radiators, which can provide the same amount of space heating, but which require a lower distribution temperature improving the heat pump's efficiency. Additionally, it is beneficial to provide hot water cylinders, as these can be 'charged' at night when electricity prices and demand are lower. Further details are provided in Section 5.2.5.
- **Maximising potential for on-site renewable electricity generation**, for instance, by considering the position, orientation and shape of the building, and the site layout, to facilitate future installation of onsite LZC technology, and to maximise its effectiveness – This can help occupants to later more economically save on energy bills and reduce the quantum of additional LZC technologies off-site.

5.1.2 Retrofitting the Existing Building Stock

Existing buildings account for the majority of CO_2 emissions in Leicester and therefore represent a key challenge when it comes to reaching the decarbonisation target. LCC will inherently have less influence over existing buildings than new buildings. The Local Plan and associated guidance should emphasise the importance of carrying out energy efficiency upgrades and incorporating LZC technologies wherever possible, and make it explicitly clear that LCC considers this to be a priority. LCC should also ensure that the relevant Supplementary Planning Document (SPD) is kept up-to-date to reflect current policies and best practices.

Technical opportunities for installing energy efficiency measures in existing buildings will be dependent on the construction build-up. Generally, it is not considered practical for existing buildings to improve insulation levels to match performance of new build standards due to spatial limitations (e.g. insufficient gap in a cavity wall), and practical considerations (e.g. cost or disruption to

[94] The adopted Local Plan for Leicester requires major developments to submit a Sustainability Statement.

occupants). There is also a risk of retrofitting measures having unintended consequences, e.g. causing condensation and moisture issues, which may affect the types of measures that can be implemented. Nonetheless, it is always possible to improve the performance of the building *to some extent*, even if this simply means adopting low-cost, no-regret measures such as double or triple glazing, draughtproofing and loft insulation.

There are existing standards and approaches set out (e.g. BREEAM Domestic Refurbishment, Passivhaus / EnerPHit, or Energiesprong) that are applicable to existing buildings and could therefore be encouraged through planning policy or associated guidance. Although those generally represent best practice, they are often cost-prohibitive for individual property owners, and are unlikely to be widely adopted without significant Government incentives. However, LCC could consider requiring these for major refurbishment schemes where planning permission is required.

More broadly, while it may be difficult for the Council to actively promote uptake through its role as a Local Planning Authority, it can passively promote uptake by loosening restrictions on certain energy and CO_2 reduction measures where appropriate. One option would be to adopt a presumption in favour of certain measures such as roof-mounted PV, air source heat pumps and external wall insulation, which could be done e.g. by issuing a Local Development Order (LDO) or otherwise extending permitted development rights, or implementing a 'fast track' that reduces the burden on applicants of submitting a full planning application.

Other opportunities are to:

- Enforce the Minimum Energy Efficiency Standards;
- Continue to actively work to identify and secure funding for retrofitting measures; and
- Lobby the Government to promote further improvements in this area.

The UK Green Building Council (UKGB) has developed *'The Retrofit Playbook'* for Local Authorities to advise on different methods for supporting residents in increasing the energy performance of their homes.[95] LCC can refer to the Retrofit Playbook for further information.

5.1.2.1 Special Considerations for Historic Buildings and Conservation Areas

For historic buildings (including but not limited to Listed buildings and those in Conservation areas), it is important to strike a balance between CO_2 reduction and preserving the heritage significance of these assets. Due to the unique nature of these buildings, it is impossible to set a universal energy or CO_2 performance standard that must be achieved, or to define specific measures that must be implemented.

LCC should nonetheless seek to ensure that the Local Plan and associated guidance make it explicitly clear that sustainability measures are permitted in historic buildings and conservation areas, provided that they are carried out in line with best practice guidance, with consultation from appropriate stakeholders e.g. Historic England. LCC could also encourage applicants to follow the process set out in the Historic England report, *'How to Improve Energy Efficiency in Historic Buildings'* (2018) when identifying suitable intervention measures.

5.2 Increasing LZC Energy Technology Provision

As discussed previously, to reach Net Zero emissions, there must be a major increase in the deployment of LZC technologies across the UK. This section of the report considers opportunities to deliver additional LZC energy technologies within the Leicester City area.

5.2.1 Approach to Estimating Future LZC Energy Resources

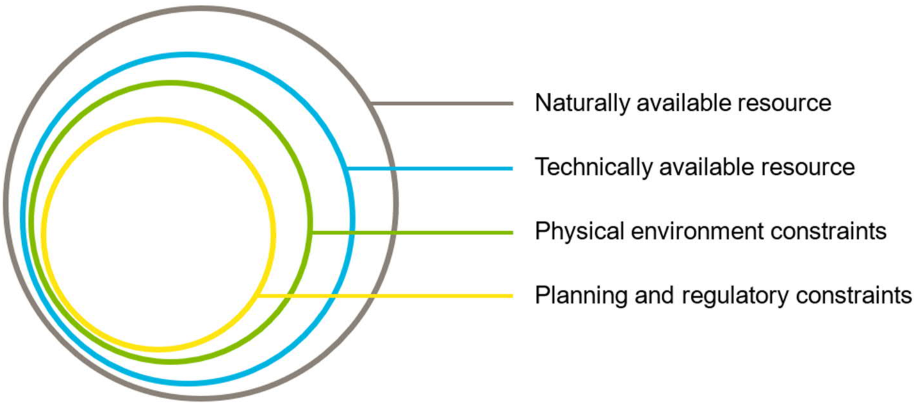
The Government acknowledges[96] that, *'there are no hard and fast rules about how suitable areas for renewable energy should be identified'* when developing an evidence base for local planning policies.

[95] UK Green Building Council, '*The Retrofit Playbook'* (2020). Available at: https://www.ukgbc.org/ukgbc-work/driving-retrofit-of-existing-homes/
[96] Department for Communities and Local Government, *'Planning practice guidance for renewable and low carbon energy'* (2013). Available at:

To assess future opportunities to deliver LZC energy technologies in Leicester City, a review and validation of previous analytical work carried out in the 'Climate Change Evidence Base Study'[22] (2015) has been undertaken, Reference has also been made to a study carried out by SQW and the Centre for Sustainable Energy in 2011, 'Low Carbon Energy Opportunities and Heat Mapping for Local Planning Areas Across the East Midlands'.[97] Where relevant, we have sought to update or supplement those earlier findings to reflect changes that have taken place since 2015, including policy and technological developments.

Our assessment is informed by the 'Renewable and Low-Carbon Energy Capacity Methodology' published in 2010 by the former Department of Energy and Climate Change (DECC).[98] This involves estimating the total naturally available energy resource in a given geographic area, which is narrowed down sequentially based on technical constraints, physical constraints, and planning or regulatory constraints, as illustrated in Figure 5-2. Where possible, an indicative quantitative estimate of capacity is provided. This was the approach used by SQW and CSE in the 2011 study (indeed, SQW was the company that wrote the DECC guidance).

Figure 5-2. Sequential approach to assessing LZC opportunities, based on DECC (2010)



The assessment has considered the following technologies:

- Wind turbines
- Solar photovoltaics (PV), roof-mounted and ground-mounted
- Hydroelectric power
- Biomass
- Ground, air and water source heat pumps (GSHPs, ASHPs and WSHPs) – Note that, although these do not generate renewable electricity or fuel, they can reduce CO_2 emissions by lowering primary energy demands and facilitating a switch towards less carbon-intensive fuels.
- Heat networks – As with heat pumps, this technology does not necessarily provide renewable electricity or heat but can offer greater efficiencies and facilitate a shift towards LZC heat sources where available.

Technologies that are not relevant to the geographic context of Leicester, such as tidal power, have been excluded from this analysis. Energy from waste incineration (EfW), landfill gas and sewage gas fall into this category because these are managed in facilities outside the geographic boundary of Leicester City.[99] Emerging technologies, such as hydrogen fuel cells, are also excluded due to uncertainty associated with their performance and limited information about practical constraints.

It is important to understand that not all opportunities will be captured using an area-wide assessment technique. In locations where constraints are identified, it may be possible to remove or mitigate these

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/225689/Planning_Practice_Guidance_for_Renewable_and_Low_Carbon_Energy.pdf

[97] SQW and CSE, *'Low Carbon Energy Opportunities and Heat Mapping for Local Planning Areas Across the East Midlands'* (2011) Available at: https://www.emcouncils.gov.uk/write/Emids-low-carbon-energy-opportunities-Final-Report-07-2011-update.pdf

[98] DECC, *'Renewable and low carbon energy capacity methodology'* (2010). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/226175/renewable_and_low_carbon_energy_capacity_methodology_jan2010.pdf

[99] Waste management services have been provided by Biffa since 2002 as part of a 25-year contract. Material is collected and processed to segregate recyclable and organic waste streams; this process diverts the majority of waste from landfill. The organic waste is then sent to an anaerobic digestion facility in Wanlip, co-located with a sewage treatment facility operated by Severn Trent Water, where it is used to produce biogas and fertiliser.

constraints through careful design and planning. Conversely, there may be practical barriers or other reasons why LZC development would be difficult even in areas that are identified as being ‘less constrained’.

5.2.2 Key Opportunities

5.2.2.1 Opportunities by Technology Type

Table 5-3 summarises the theoretical future LZC opportunities in Leicester City by technology type. Unless otherwise stated, results are reported in units of megawatts (MW) of electrical power capacity and megawatt hours (MWh) of energy. Additional details are provided in subsequent sections of this chapter.

Overall, due to the built-up nature of Leicester, the main technologies suitable for adoption are likely to be roof-mounted PV or solar thermal technologies. These can be located on any type of building and also installed on other built environment infrastructure such as car parks and bus shelters. There may be some sites within the City boundary that are suitable for larger-scale ground-mounted solar arrays, although there are likely to be competing land uses. It is considered unlikely that wind energy technologies can be accommodated (these are not recommended in built-up areas), although these cannot be ruled out entirely and would be subject to a site-specific feasibility assessment.

It is likely that most new buildings, and many existing buildings, will need to use electrically powered heating technologies in future. It is anticipated that most of these will be air source heat pumps which provide very high levels of efficiency and can be installed new or retrofitted into most properties. There may also be opportunities to use ground or water source heat pumps subject to further assessment of ground and environmental conditions. Leicester has previously been identified by the Government as having a comparatively high water heat resource.

It is understood that future expansion is planned for the existing heat network in Leicester. Other locations for additional heat networks are not proposed in this study, but high-level information about the types of developments where these might be suitable is provided.

Key opportunities are summarised in the table below, which also indicates the source of the estimate.

Table 5-3. Potential future LZC opportunities by technology type in Leicester City breakdown

Technology	Theoretical future added capacity, (MW)	Theoretical future added generation, (MWh p.a.)	Reference*
Large-scale wind	0	0	See Section 5.2.3 for details.
Small-scale wind	0.34	530	SQW (2011)
Building-mounted PV – Total			AECOM estimates; see Section 5.2.4 for details.
Domestic buildings	68.1	66,600	
Commercial buildings	23.6	23,100	
Industrial buildings	7.1	6,965	
New dwellings	34.2	33,400	
New non-domestic buildings			
Solar water heating	79.54	34,840	SQW (2011)
	13	5,697	Amec Foster Wheeler (2015)
Ground-mounted PV	5	4,500	Capacity is from Amec Foster Wheeler (2015); generation is an AECOM estimate.

ASHPs and GSHPs	Not quantified; see notes	n/a	Potential to retrofit one of these technologies into most existing buildings and all new buildings. See Section 5.2.5 for details.
WSHPs	Not quantified; see notes	n/a	Potential to use on sites adjacent to river subject to further assessment. See Section 5.2.5 for details.
Hydroelectric power	0.06	310	SQW (2011)
	0.10	600-900 depending on which sites are used	Amec Foster Wheeler (2015)
			See Section 5.2.5 for details.

*SQW (2011) refers to the East Midlands renewable energy study and Amec Foster Wheeler (2015) refers to the Climate Change Evidence Base study. A technical review of those studies is summarised in Appendix D.

Note that these estimates are based on the *current* technical performance of each technology and do not account for anticipated technological changes (e.g. efficiency improvements). These estimates also do not consider the available capacity of the electrical power network which could be a major barrier to deployment (see Section 5.2.9).

5.2.2.2 Opportunities by Development Type

Table 5-4. Potential future LZC opportunities by development type in Leicester City breakdown

Development Type	Example	Key opportunities for using LZC energy technologies
Conversion / refurbishment	Conversion of industrial or commercial building to flats	**Heat:** Consider ASHPs and GSHPs for space heating and hot water. GSHPs are likely to be boreholes unless extensive excavation works are being carried out in which case horizontal ground loops could be used. Roof-mounted solar hot water may be suitable for uses with high hot water demand. Some sites may be able to link with the city centre DHN if they are in close proximity and this should be assessed during early design phases. Similarly, some sites next to the river could potentially utilise WSHP. Electric heating can also be used which may decrease the amount of work needed to modify the existing heating system, but note the higher impact on electricity demands (placing pressure on electricity grid) and energy bills. **Electricity:** Consider roof-mounted PV although this will depend on roof geometry, overshading, orientation, etc.
City centre mixed use	Medium-density, commercial or retail use on ground floor with flats above	**Heat:** See 'Conversion / refurbishment'. Compared with a refurbishment scheme, it may be easier to use heat pumps because there would be no need to replace the existing heating system. Given the relatively high heating and cooling demand density heat networks should be considered. **Electricity:** Consider roof-mounted PV although this will depend on roof geometry, overshading, orientation, etc. Compared with a refurbishment scheme, a new build scheme may offer more opportunities to install roof-mounted PV through careful design of roof geometry, form, massing, etc.
Strategic greenfield urban extension	Major residential-led development	**Heat:** Heat pumps and solar hot water are all suitable for greenfield sites. GSHPs are more efficient than heat pumps so may be preferable from an energy demand and CO_2 emissions perspective; they are more expensive to install but offer much lower energy bills if installed and used correctly. If ASHPs are proposed then this should be considered in the design of the development from the outset to avoid visual impact and noise issues – this may be easier on a greenfield site where there will be fewer existing design constraints. Direct electric heating can be used if it is shown that heat pumps are not practical or feasible. However, this would result in higher electricity demands compared with heat pumps, and ultimately lead to much higher CO_2 emissions and energy bills for building occupants / owners. The site specifics will drive the type of heat pump arrangement for example, individual dwelling heat pumps vs site-wide interconnected system. This should be assessed. **Electricity:** Consider roof-mounted PV. Very large sites potentially offer opportunities to manage some waste/wastewater onsite, which could be used in an anaerobic digestor to provide biogas and potentially generate renewable electricity. However, in practice it may be more cost-effective to continue sending waste to the AD plant in Wanlip. Furthermore, some strategic greenfield sites close to the City boundaries might be able to utilise wind energy provided that turbines can be located away from any buildings, trees, etc.

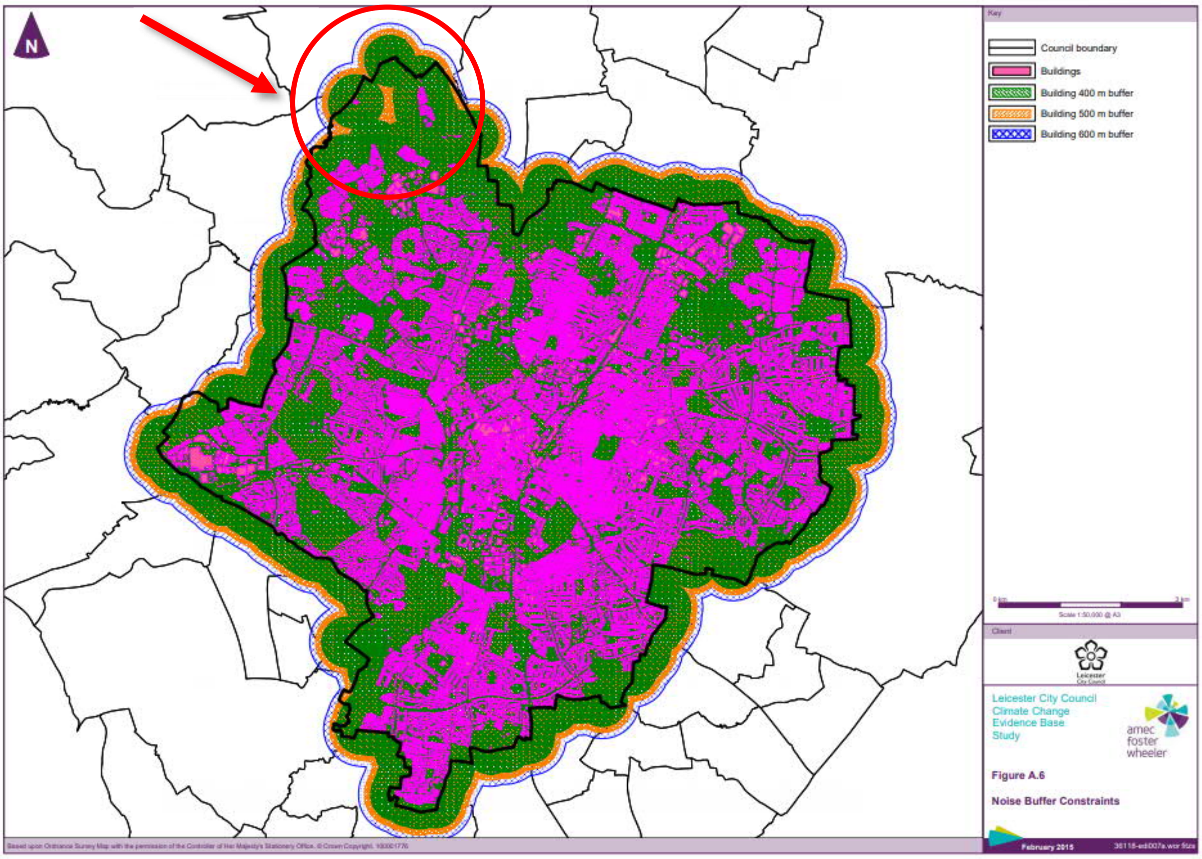
Mixed-use regeneration site	Mix of commercial and residential	**Heat:** See 'Conversion / refurbishment'. Some regeneration sites located near industrial sites or other facilities with high energy demands could also utilise sources of waste heat. **Electricity:** See 'City centre mixed use'.
Residential infill scheme	3-4 houses in the city centre	**Heat:** See 'Conversion / refurbishment'. Compared with a refurbishment scheme, it may be easier to use heat pumps because there would be no need to replace the existing heating system. Depending on the site layout, there may be potential difficulties in siting ASHPs to avoid noise and visual impacts although this obstacle can often be overcome. Direct electric heating may therefore be more straightforward to install but as stated previously, this is not a preferred option. **Electricity:** See 'City centre mixed use'.

5.2.3 Wind Energy

The 2015 Climate Change Study, found that, '*The analysis shows no potential for medium to large scale wind in Leicester given the combination of environmental designations, communication and radar issues and noise attenuation from buildings.'* The technical analysis of that report has been reviewed in detail and the findings from this review align with the authors' finding that medium to large scale turbines would be challenging to deliver. It is not possible to identify locations that would definitely be suitable in Leicester without undertaking site-specific feasibility assessments. While the 2015 study lists a wide variety of physical and environmental constraints, at a basic level, this is due to the urban setting; wind turbines are less effective in built-up areas due to interruptions in wind flow, and from a practical perspective there may be objections raised by the community.

However, in our view, there is one area that should not be ruled out; namely, the agricultural land located in the north of the City. This area is in relatively near proximity to high voltage electricity transmission lines, which skirt the north and western portions of the City. As shown in Figure 5-3 (taken from the 2015 Climate Change study; the red arrow points to the general area under discussion), there is more than a 400m distance from nearby residential buildings, which would help to reduce the risk of noise issues and visual impacts. Compared with the rest of Leicester, this area might have fewer factors negatively affecting wind speed. There are relatively few built-up areas to the southwest of this zone, which is where the prevailing winds are from, and it is at a slightly higher elevation than some of the surroundings.

Figure 5-3. Map showing buffer zones around residential properties for the purpose of a wind energy opportunity assessment. (Image © Amec Foster Wheeler, 2015 Climate Change Evidence Base Study)



To be clear, without a detailed feasibility assessment, it is not possible to confirm whether this location would necessarily be suitable for wind energy development, but equally it cannot be ruled out from a technical standpoint, so LCC could consider conducting further investigations. It is important to note that, based on NPPF guidance, to deliver large scale wind turbines on any site in Leicester, this would need to be allocated as a suitable area for wind energy development and receive local community backing.[100]

Regarding small-scale wind, turbines can be installed on or near buildings, although they tend not to perform very well in urban areas where there is more disruption to wind flow.[101] Therefore, it is usually assumed that these will be more suitable for rural locations where there are fewer obstacles and wind speeds are higher. They may also be suitable for industrial sites and business parks where there is less concern about visual impact.

Overall, although there could be opportunities highlighted by site-specific feasibility studies, wind energy is not expected to make a significant contribution to Leicester's renewable energy mix going forward.

5.2.4 Solar Energy

5.2.4.1 Roof-Mounted Photovoltaics (PV) and Solar Water Heating (SHW)

Both building mounted solar photovoltaics (PV) and solar water heating (SWH) depend largely on two site-specific factors: available roof space, and the solar exposure of the roof area (which relates to orientation, pitch, overshading, etc). SWH systems are typically sized to meet a certain proportion of

[100] UK Parliament, *'Local Planning'* (2015). Available at: https://www.parliament.uk/documents/commons-vote-office/June%202015/18%20June/1-DCLG-Planning.pdf

[101] DECC (2010) assumes that small scale turbines can in principle be located at any address point where the wind speed meets or exceeds 4.5 m/s at 10 m above ground level. In practice, site specific constraints vary considerably and include building height, roof shape, neighbouring buildings and other physical obstacles. These have a significant impact on viability because the power output varies cubically with relation to wind speed.

annual hot water demand, since the heat is used on site.[102] PV can be sized more flexibly, subject to the amount of available roof space, since electricity can be stored using batteries or exported to the grid.

From a planning perspective, the main considerations for roof-mounted solar technologies are due to the visual impacts and potential 'modernising effect' they may have. Therefore, their use is often restricted in sensitive locations such as Conservation Areas. However, these are policy constraints rather than technical barriers, and the impact can be minimised depending on factors such as whether they can be seen from the street and the size of the installation relative to the roof area. The Planning Authority could, in principle, adopt a more permissive stance when it comes to Conservation Areas.

Although roof-mounted PV is not the cheapest way to generate renewable electricity, it should be understood as a key opportunity for Leicester, both because it has a smaller visual impact on the wider landscape than wind turbines, and because the total amount of roof space, considered cumulatively, is relatively large.[103] Our estimates suggest that it would be possible to install up to 80 MW of roof-mounted PV on existing buildings and an additional 34 MW on new dwellings projected to be built during the Local Plan period.

The following types of sites may provide better opportunities to deliver roof-mounted solar technologies:

- In general, greenfield and large new development sites may offer greater potential for solar energy generation; the relative lack of design constraints provides more opportunities to maximise sustainable design measures from the outset.
- Industrial sites may be more suited to solar technologies as they tend to have large roof areas and there is generally less concern about the visual impacts of solar panels.
- Schools, hospitals, leisure centres and other public sector buildings also tend to have comparatively large roof areas. They can be particularly suitable for community energy projects as the Council might hold more influence compared with private commercial and industrial buildings.
- Another key opportunity would be to install PV canopies on structures such as car parks. If co-located with battery storage and EV chargepoints, this would provide a local source of renewable electricity while also helping to decarbonise transport.

5.2.4.2 Large-Scale / Ground-mounted PV

In principle, PV can be delivered anywhere where there is a suitable surface with adequate solar access (i.e. minimal overshading and favourable orientation and pitch). The 2015 Climate Change Study found that '*Land availability for such arrays will be restricted by constraints similar to those applied in the case of wind. Given the capacity constraints it is unlikely that single site multi-Megawatt schemes will be brought forward in the Leicester area.*' Ground-mounted PV can also be installed in locations that are difficult to develop, such as those located above historic landfills, in flood zones, etc.

5.2.4.3 Mapping Opportunities and Constraints for PV

The maps on the following page highlights some of the key opportunities and constraints, as follows:

Ground-Mounted PV

- Constraints – For ground-mounted PV, it is generally recommended to avoid high-grade agricultural land (ALC Grades 1 and 2) and areas with environmental designations; there is one SSSI in Leicester and several Registered Parks and Gardens. For roof-mounted PV, Conservation Areas may pose a constraint depending on what is permitted by the Local Planning Authority.

[102] For context, in domestic properties a typical SHW system size would be 4-5 m^2 according to the Energy Saving Trust; the system would not be compatible with combi boilers if there is no hot water tank. See https://energysavingtrust.org.uk/renewable-energy/heat/solar-water-heating
[103] Solargis, *'Download solar resource maps and GIS data for 200+ countries and regions'*. Available at: https://solargis.com/maps-and-gis-data/download/united-kingdom

- Opportunities – The map highlights historic landfills as potential opportunities (see above). Locations that are close to electricity transmission lines can sometimes be easier to deliver due to the lower cost of infrastructure needed to connect to the grid.

Roof-Mounted PV and Solar Hot Water

- Constraints – The main constraints will be related to historic and Listed buildings and Conservation Areas although this is not necessarily a barrier as stated on the previous page.
- Opportunities – The map highlights industrial sites as potential opportunity areas for larger roof-mounted solar arrays.

Figure 5-4. Opportunities and Constraints relevant to Ground-Mounted PV

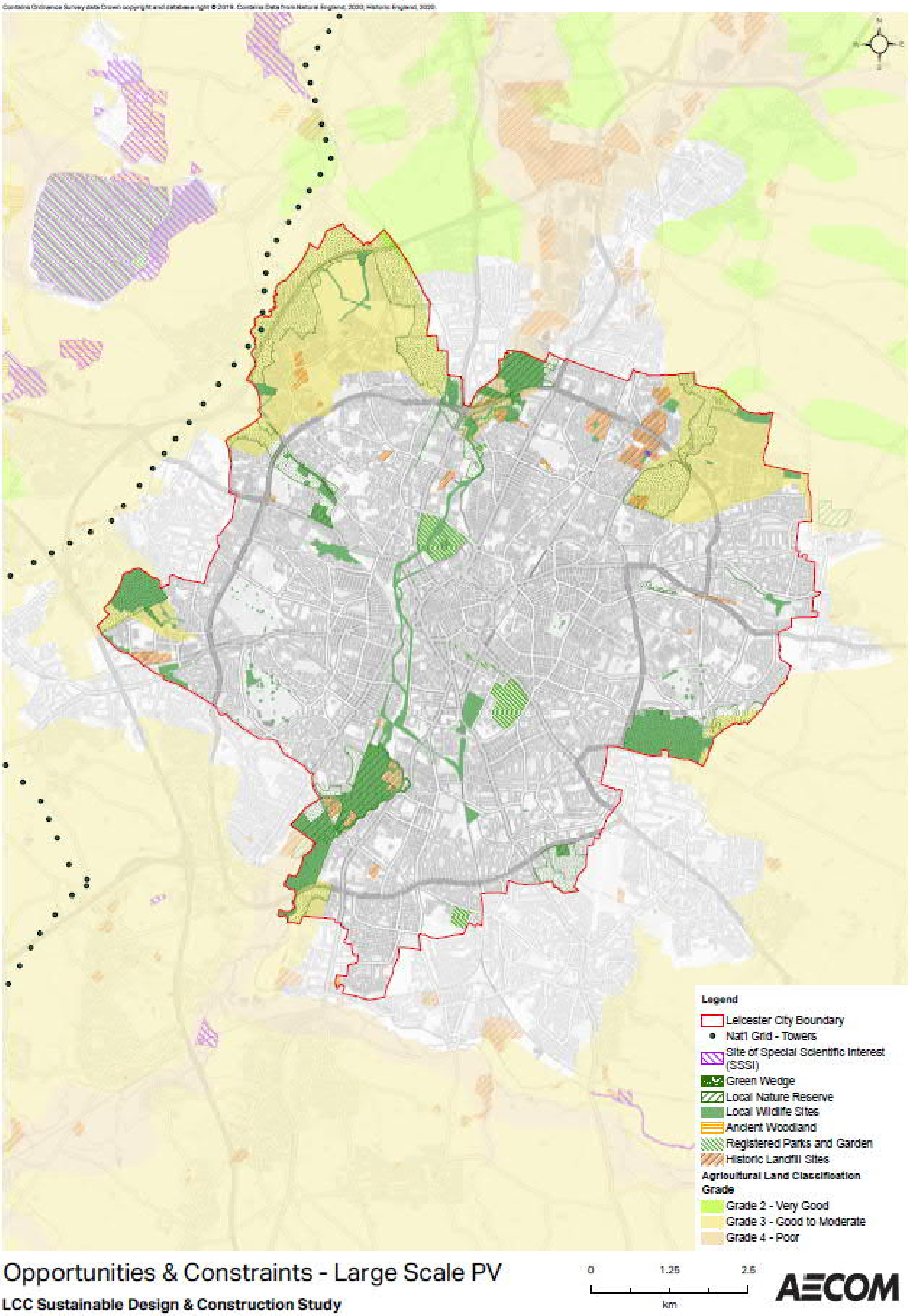
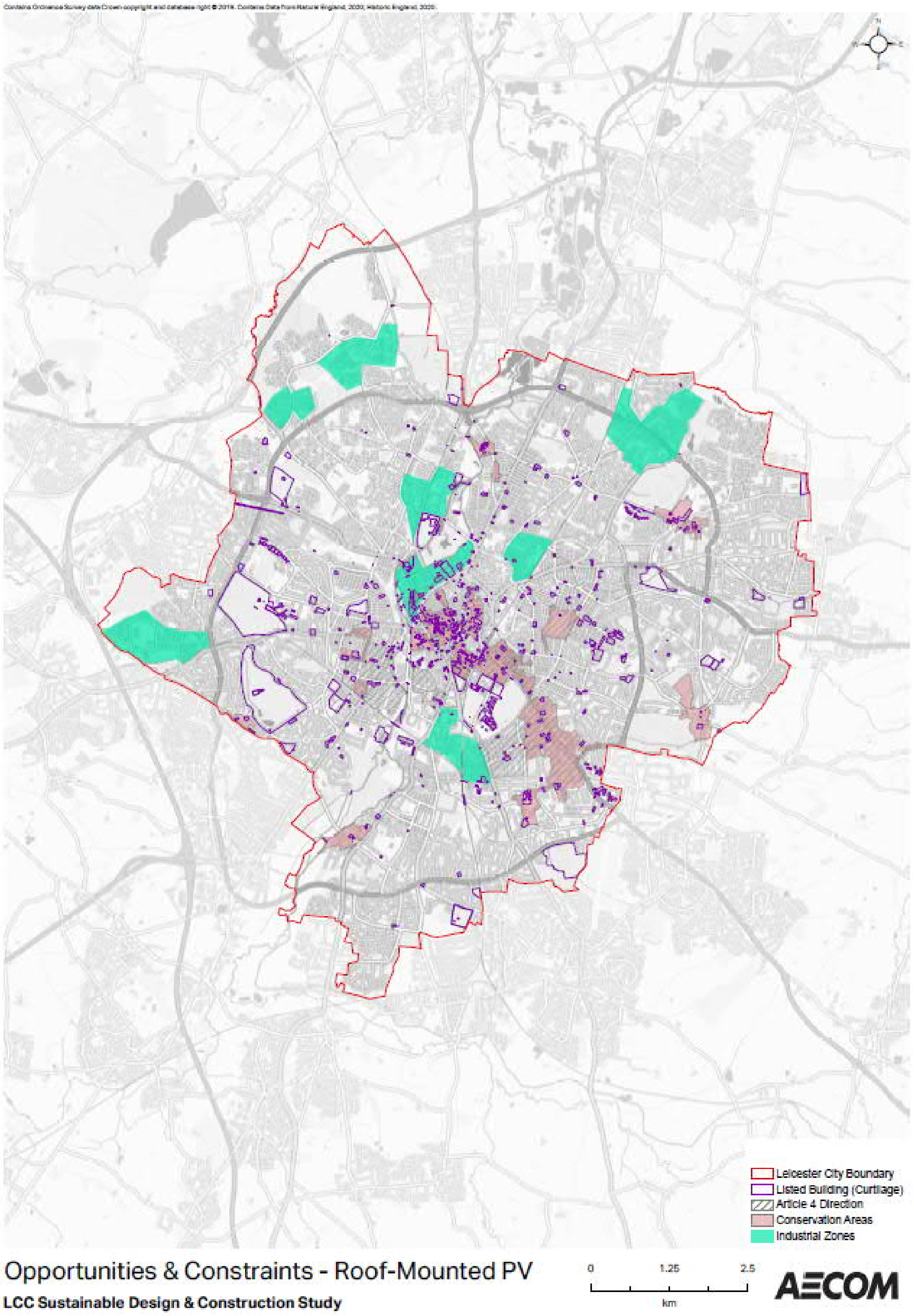


Figure 5-5. Opportunities and Constraints relevant to Roof-Mounted PV



5.2.5 **Heat Pumps**

DECC (2010) assumes that all buildings could, in principle, accommodate either a ground or air source heat pump (GSHP or ASHP). In practice, these tend to be more expensive to install than either gas boilers or direct electric heating (DEH), both due to the cost of the equipment itself and the need to upgrade the building fabric and services to ensure compatibility. At present, they are not commonly used, but as discussed in Section 4.7.1, they are expected to become significantly more common in the coming decades if there is a move to greater use of electricity for heating to replace gas boilers. This shift will be influenced by regulatory factors (i.e. changes to UK Building Regulations) and wider market trends including the capacity for the electrical infrastructure to accommodate the scale of transition required.

In broad terms, while all heat pumps are considerably more efficient than either gas boilers or DEH systems, ground and water source heat pumps generally have a higher coefficient of performance (COP) than ASHPs. However, these are more expensive to install, and rely on detailed feasibility work being carried out to ensure that the site is suitable. Therefore, in practice, ASHPs are likely to be more common, both in new buildings and retrofitted into existing ones. For context, national domestic RHI data indicates that there are more than four times as many accredited ASHP installations as there are GSHP installations.[104]

5.2.5.1 Air Source Heat Pumps

Because ASHPs need to be located outside of the building, they could be considered to have a negative visual impact, which would be particularly relevant in Conservation Areas. The design and siting of ASHPs should also consider the potential noise or vibrations from fans, although this depends to some extent on the precise model of heat pump that is installed. Further design challenges include sourcing the electrical capacity to introduce these technologies at scale. Provided that these issues are adequately addressed, ASHPs can in principle be integrated into many types of new development or retrofitted into existing buildings.

5.2.5.2 Ground Source Heat Pumps

In order to determine whether it is possible to install a GSHP on a specific site, detailed analysis must be undertaken, which is beyond the scope of this report. The assessment has therefore sought to map some of the major constraints on a City-wide basis, where GIS data was available.

Different constraints apply depending on the specific technology in question, i.e. whether the GSHP is horizontal or vertical, open or closed loop). In all cases, however, the most important considerations relate to excavations, drilling and ground conditions rather than visual impact.

According to the Environment Agency's *'Environmental good practice guide for ground source heating and cooling'* (2011), an environmental impact assessment should be carried out to assess whether the site is:

- Within a defined groundwater Source Protection Zone 1 (as per DEFRA's online mapping resource)[105] – Note there are none within the boundary of Leicester City
- Within 50m from a well, spring or borehole used for potable water supply
- On land affected by contamination e.g. historic landfill sites[106]
- Close to a designated wetland site – Note there are none within the boundary of Leicester City
- Within 10m of a watercourse
- Close to other GSHP schemes (depending on uptake, proximity to other open-loop GSHPs could become a constraint due to the potential for thermal interference)
- Adjacent to a septic tank or cesspit

These factors would indicate that the location is potentially sensitive to a GSHP installation. Additional factors that need to be taken into account include:

- Location of buried infrastructure e.g. gas pipelines, sewers, cables
- Other built heritage and environmental designations e.g. Archaeological Notification areas, Regionally Important Geological Sites, Sites of Special Scientific Interest, etc.

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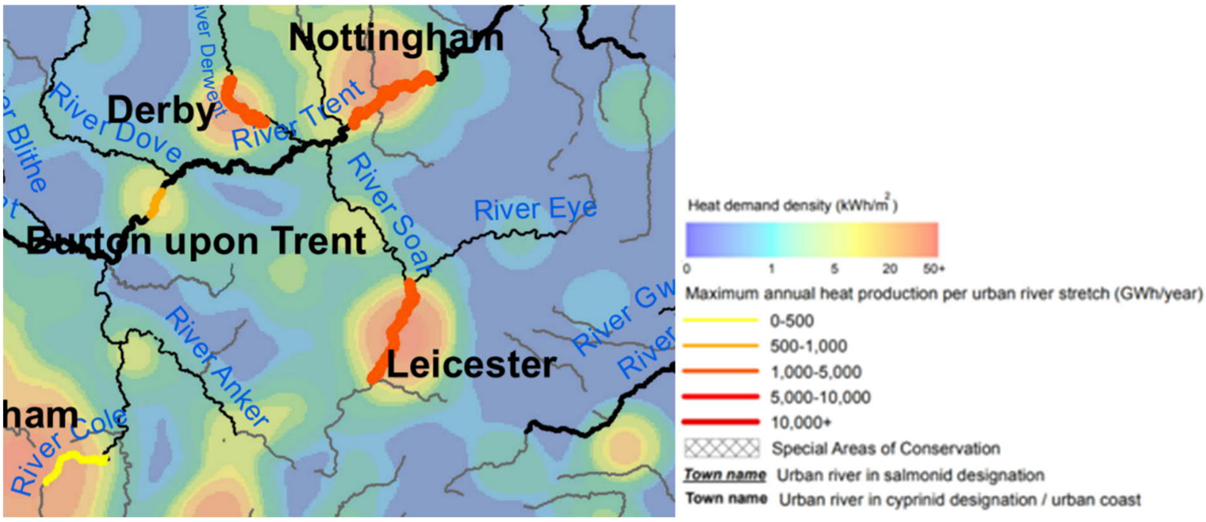
[104] Ofgem, *'Domestic Renewable Heat Incentive'*. Available at: https://www.ofgem.gov.uk/environmental-and-social-schemes/domestic-renewable-heat-incentive-domestic-rhi/contacts-guidance-and-resources
[105] UK government Environment Agency, *'Drinking Water Protected Areas (Surface Water)'*. Available at: https://data.gov.uk/dataset/3d136e9a-78cf-4452-824d-39d715ba5b69/drinking-water-protected-areas-surface-water and Department for Environment, Food and rural affairs, *'Defra spatial data download '*. Available at: https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/SourceProtectionZonesMerged&Mode=spatial
[106] Maps available at https://data.gov.uk/dataset/82ad1676-0f96-4dd3-b7e0-75678661a37b/contaminated-land

Water Source Heat Pumps

There are relatively few examples of water source heat pumps (WSHPs) in the UK at present. A report[107] published by DECC in 2015 identifies the River Soar as having a potential 13 MW heat capacity, meaning a significant portion of the City's heat could be drawn from there. Another map[108] published by DECC in 2014, which provided a high-level assessment of river heat capacity for all of England, suggests that the opportunities to utilise river source heat in Leicester City are high *on a national scale*.

Figure 5-6 (extracted from the DECC 2014 map) highlights urban areas that are adjacent to potential sources of river heat, colour coded based on the estimated river heat capacity. The areas highlighted around Leicester City are shown to be in the '10,000+' bracket (highest).

Figure 5-6. Total heat capacity from rivers in megawatts for urban areas. Source: DECC (2014)



WSHPs can be used as part of an energy centre feeding heat networks around the City, replacing old Combined Heat and Power (CHP) centres as they currently provide diminishing emissions savings for their delivered heat and electricity due to the decarbonisation of grid electricity. The heat capacity map suggests that the River Soar would be worth exploring as a potential source of heat but significant further work is required to confirm this. Avenues for utilising this resource for heat networks should be explored but it is likely to be best suited to larger developments or existing heat networks given the complexities of such systems.

As for GSHPs, detailed feasibility studies would be required to assess the potential for WSHPs on a given site, which would also require consultation with the Environment Agency. Environmental designations that could potentially act as constraints on the use of WSHPs include:

- Sites of Special Scientific Interest
- Special Protection Areas
- Special Areas of Conservation
- RAMSAR sites
- CAMS water resource status
- Freshwater fisheries status
- Water Framework Directive Waterbodies

5.2.5.3 Mapping Opportunities and Constraints for Heat Pumps

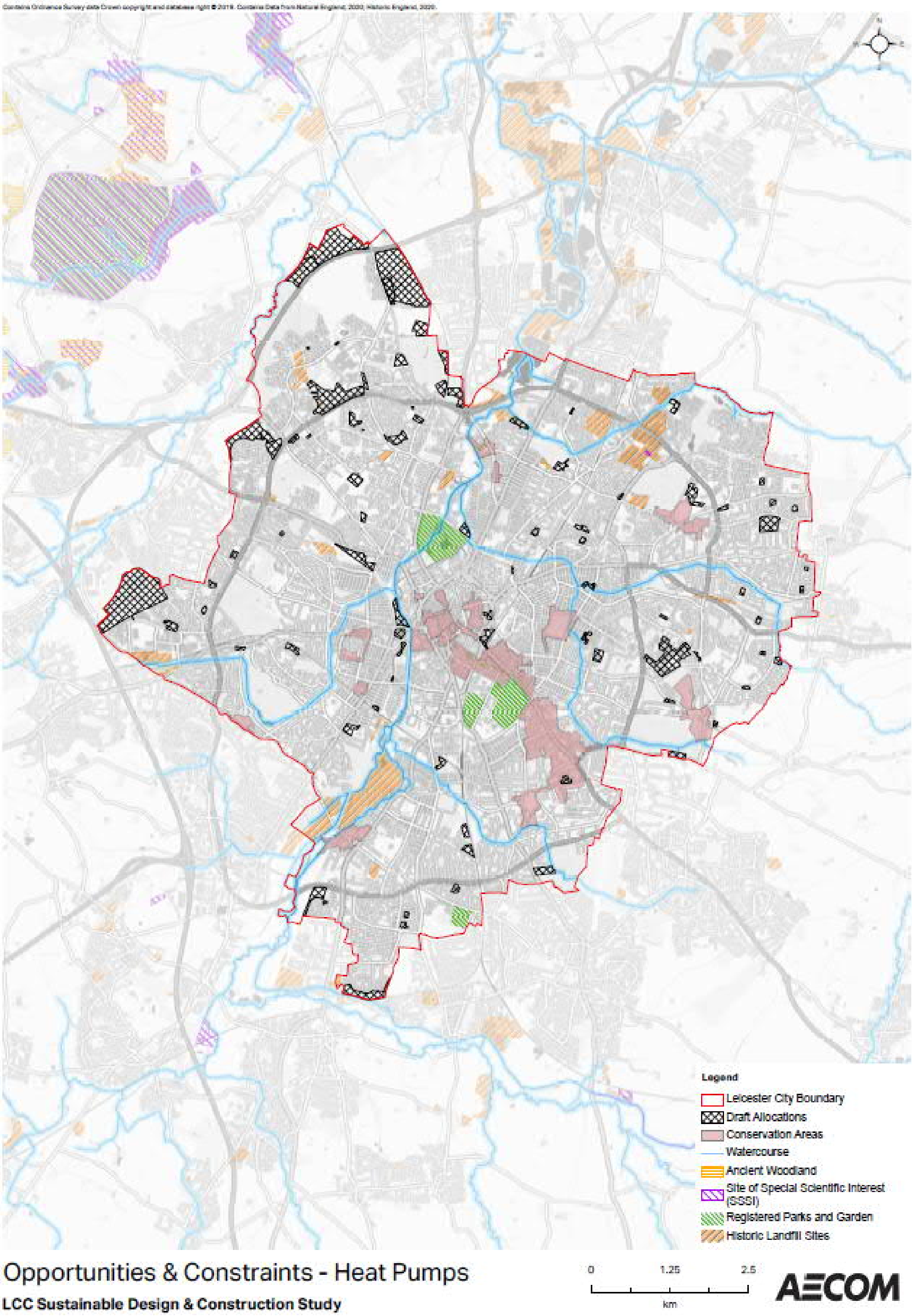
Figure 5-7 on the following page shows a map of some opportunities and constraints relevant to ground, air and water source heat pumps. However, not all of the data listed above was available during this study, so this is only a partial assessment. No data on wells, springs, boreholes, septic

[107] Department of Energy & Climate Change, *'National Heat Map: Water source heat map layer'*, (2015). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416660/water_source_heat_map.PDF
[108] For more information, see Department of Energy & Climate Change, *' Water Source Heat map'* (2014). Available at: https://www.gov.uk/government/publications/water-source-heat-map

tanks, cesspits and existing GSHP schemes was available at the time of writing. Additional feasibility studies would be needed to determine whether a GSHP is suitable on a given site.

- Opportunities – The main opportunity for horizontal loop GSHPs is on greenfield development sites where a ground loop can be installed during construction. Watercourses are also shown as these could potentially be used for WSHPs.
- Constraints – Listed above but **note that not all constraints were available in GIS format**. From a planning perspective the environmental constraints are the main issue. Unlike ASHPs, GSHPs do not require a fan and the 'kit' can be located indoors, thus avoiding issues with noise and visual impact.

Figure 5-7. Map of Opportunities and Constraints Relevant to Heat Pumps



5.2.5.4 General Comments on Heat Pumps

Retrofitting heat pumps incurs a variety of technical and practical challenges. For example:

- To ensure that the systems operate efficiently it is necessary to undertake energy efficiency upgrades to ensure that the building is well insulated and reasonably airtight.
- It may be necessary to upgrade the entire heating system to be compatible with a low temperature distribution system, which requires either larger radiators or underfloor heating, and the use of a hot water cylinder. (This presents a potential challenge particularly if there is no space for one.).
- In the case of GSHPs, the level of excavation or drilling work depends on the type of system that is installed, but it either requires boreholes or excavation of a large area if using horizontal trenches.
- ASHPs need to be located outside, which has a visual impact and can result in noise due to the fans used. The appearance is similar to a typical external air conditioning unit.

The challenges described further point to the case that heat pumps should be installed and integrated fully into the design where possible.

Where heat pumps have not been specified, to ensure that new buildings are able to accommodate heat pumps easily in future, the following design measures should be strongly encouraged as part of either a Local Plan policy or SPD:

- The space heating system must be capable of delivering required heat load with a flow temperature ≤45°C (e.g. underfloor heating or large radiators);
- Individual houses must have space for a hot water cylinder (apartments with a communal heating system the flow temperature must be ≤60°C);
- Houses should not include gas for cooking and instead electric induction hobs and ovens are required;
- External space must be allocated for an air source heat pump capable of providing space heating and hot water load required by property; and
- Allocated space for air source heat pumps must be shown to meet the noise planning requirements for neighbouring new and existing properties (this applies to new properties that are proposing to install new air source heat pumps).

It is important to understand that, even if new buildings are constructed with gas boilers and then retrofitted with heat pumps, the environmental and financial cost of delay is significant, even if standards are increased progressively over time. For example, a study conducted on behalf of the Committee on Climate Change found that the lifetime carbon emissions (over 60 years) of a house built with a gas boiler in 2020 and then retrofitted with a heat pump in 2030 would be around three times higher than if a heat pump was fitted at the outset.[109] This is illustrated in Figure 5-1 (see Section 5.1.1). At a national level, *'each year of delay in adopting lower-carbon heat technologies could result in several million tonnes of avoidable carbon emissions.'*

5.2.6 Hydroelectric Power

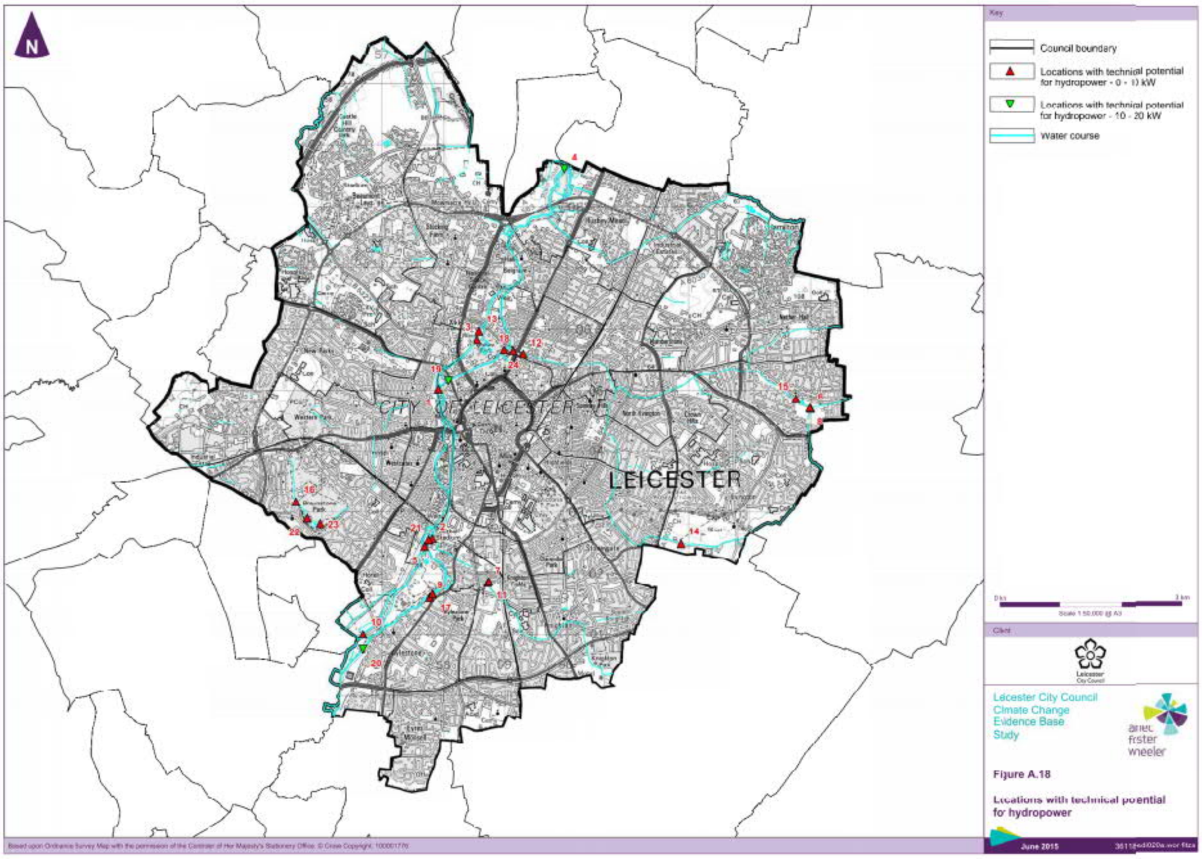
Hydroelectric power is generated by water flow through a turbine and depends on the volumetric flow rate and available head (i.e. the vertical distance of the water surface above the turbine).

A review of existing LZC installations in Leicester City (Section 3.5) found no operational or planned hydroelectric power installations. Due to the urban density of Leicester, it is highly unlikely any large hydroelectric scheme would be able to be built within the City's boundary. The 2015 report did find potential for an estimated 100 kW of small hydroelectric power, identifying 24 individual weirs and locks. These are shown on the map below (Figure 5-8 extracted from the 2015 study). For all these sites, their development sensitivity was medium to high; suggesting the likelihood of fulfilling the full

[109] Currie Brown and AECOM on behalf of the Committee on Climate Change, *'The costs and benefits of tighter standards for new buildings'* (2019). Available at: https://www.theccc.org.uk/wp-content/uploads/2019/07/The-costs-and-benefits-of-tighter-standards-for-new-buildings-Currie-Brown-and-AECOM.pdf

potential is small (see the 2015 study for further details). The Environment Agency would likely be averse to any additional barriers being created which would limit the availability of new sites.

Figure 5-8. Potential hydropower sites in Leicester. Image © Amec Foster Wheeler



For the purpose of this assessment it is assumed that hydroelectric power will not make a significant contribution to Leicester's electricity demands in future. However, this opportunity could be explored in more detail for sites situated in adjacent to a weir or lock.

5.2.7 Biomass

Biomass covers a diverse range of fuels derived from plants, animals or human activity. Biomass is usually converted to energy via combustion, pyrolysis, gasification or anaerobic digestion. Currently there is a 2 MW capacity anaerobic digestion facility in Leicester City, likely to be the Pepsico/Walkers site named in the 2015 Study. In terms of future potential, the 2015 Climate Change Study, which focused on energy crops and local woodland residues, found that there were limited biomass resources within the City; this is understandable given that it is an urban area and most green spaces will be parks, playing fields, wildlife sites, etc.

In the past decade, the UK Government has widely supported the use of biomass (particularly wood and other energy crops) as a source of renewable heat. However, it is difficult to quantify the overall environmental benefits using a broad-brush approach, in part because of questions about how the biomass is produced, transport implications and whether there is a more suitable end use for the material.

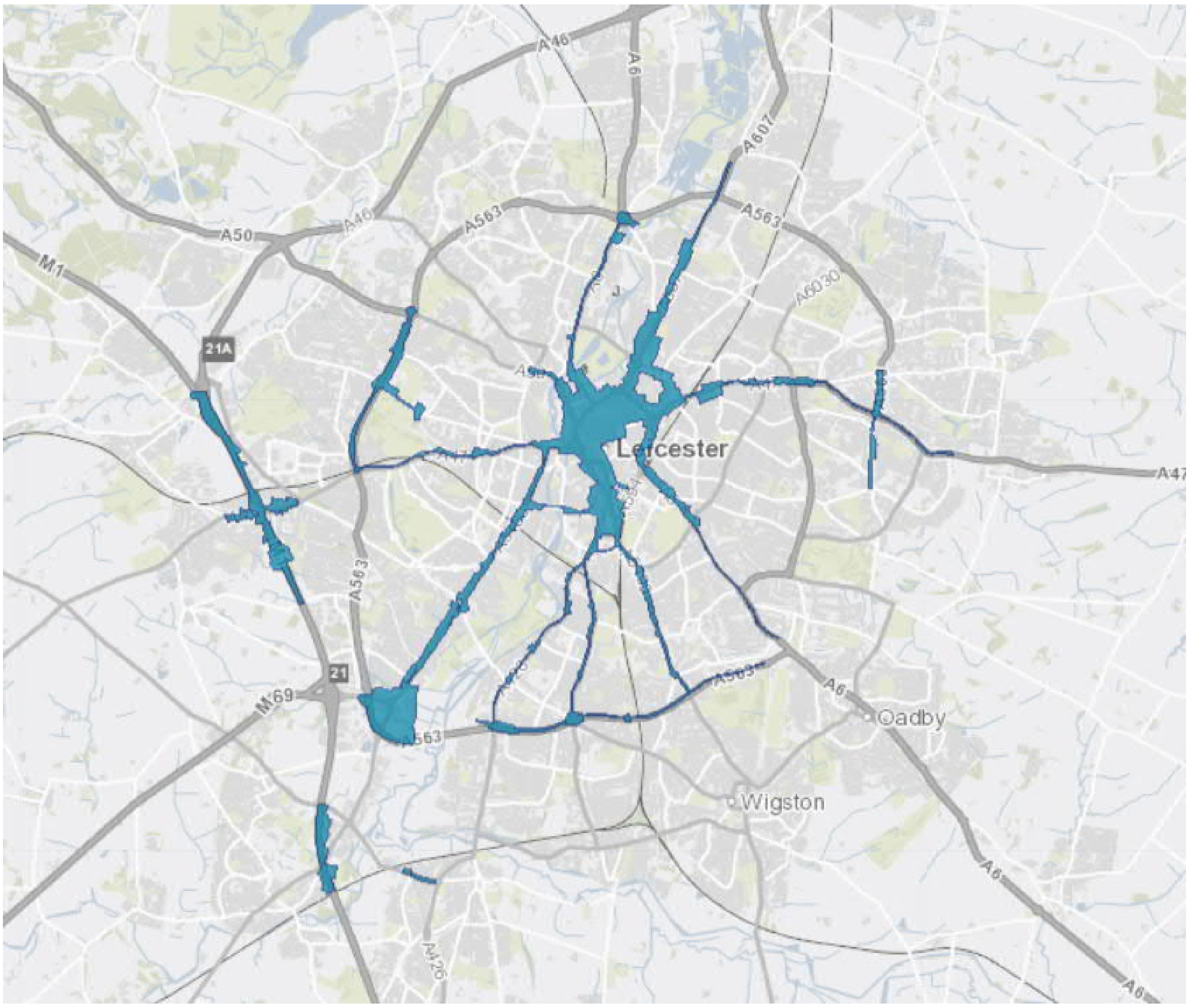
A 2018 report by the Committee on Climate Change[110] considered the role of biomass in supporting the UK's decarbonisation targets, and found that:

> *'Biomass can be produced and used in ways that are both low-carbon and sustainable. […] If this is not achieved, there are risks that biomass production and use could in some circumstances be worse for the climate than using fossil fuels.'*

[110] Committee on Climate Change, *'Biomass in a Low Carbon Economy'* (2018). Available at: https://www.theccc.org.uk/wp-content/uploads/2018/11/Biomass-in-a-low-carbon-economy-CCC-2018.pdf

There are additional issues related to air quality impacts. Direct combustion (burning) to produce electricity or heat is often the most viable approach to energy conversion from a technical and economic standpoint. However, biomass burning emits particulate matter (PMx) and therefore DEFRA's position is to not encourage this practice in or near urban areas or Air Quality Management Areas (AQMAs) due to air quality concerns.

Figure 5-9. AQMA boundaries in Leicester. Image © DEFRA

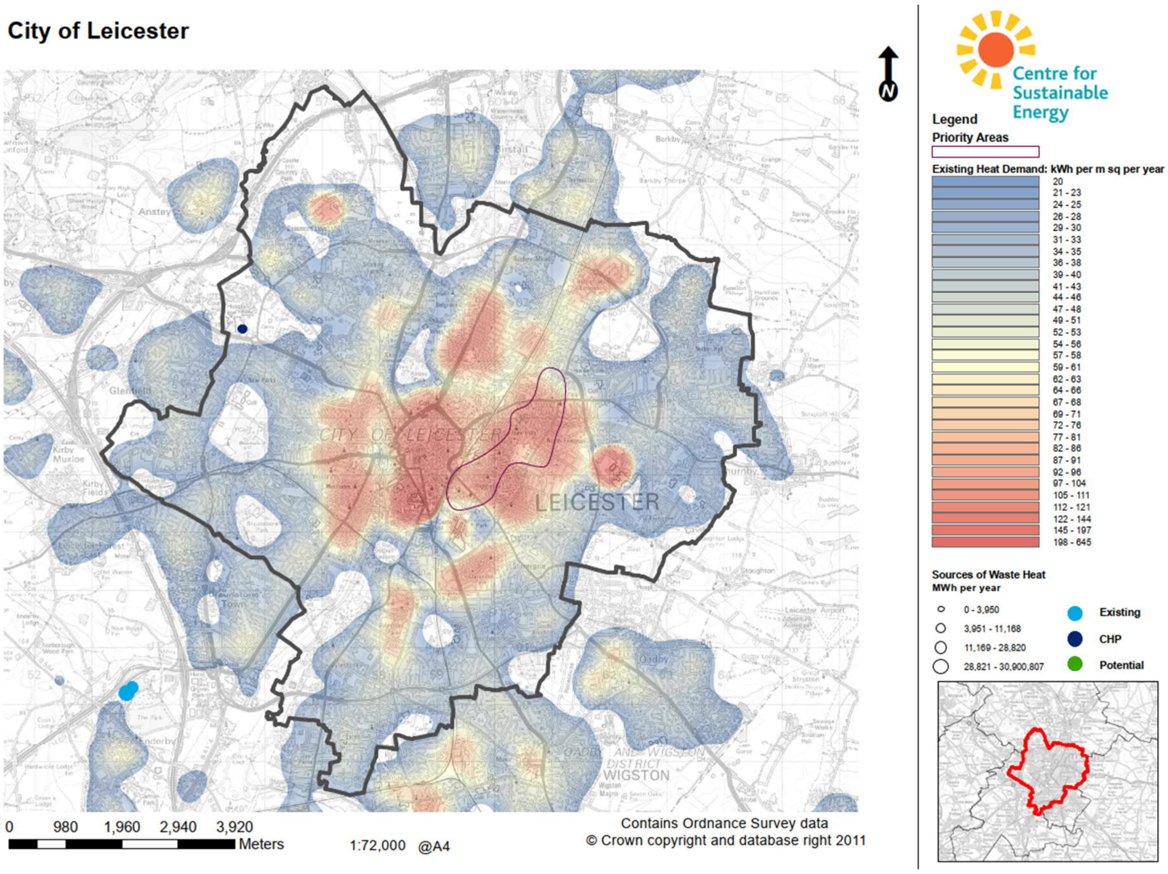


With this in mind, biomass combustion technologies are not recommended for widespread adoption in Leicester. The exception would be in cases where there is an existing source of sustainably and locally sourced waste biomass – provided that there is no other beneficial use for the material and that waste reduction measures are also in place. This could include, for example, anaerobic digestion plants that are co-located with agricultural facilities that have a high energy demand.

5.2.8 District Heat Networks

The delivery and expansion of heat networks relies upon the connectivity of potential heat loads. Heat mapping for Leicester was carried out by CSE in 2011 (see Figure 5-10 below). As discussed in Section 3, fuel consumption has remained relatively stable since that time, so it is assumed that, for existing buildings, the main opportunity areas will be largely the same. These are mainly focused on the City centre, although there are some localised areas of higher demand e.g. an industrial zone in the north-west and the Leicester General Hospital in the east.

Figure 5-10. Heat map of Leicester City. Image © CSE



As noted previously, there is currently a heat network in central Leicester and there are plans to expand it in future to 25-30MWe of generation. For the purpose of estimating future LZC provision, it is assumed that this expansion will take place but the number or size of additional heat networks has not been assessed.

In general, suitable developments will be those of mixed usage types and those with a sufficiently high density of heat demand. There are a range of factors that justify the use of a heat network and a feasibility study would be required for the individual scheme. Opportunities may arise in proximity to hospitals, prisons, leisure centres, crematoria, and other high energy users where waste heat is abundant and concentrated.

Another opportunity for Leicester might be to use WSHPs connected to a low-temperature heat network for developments situated close to the River Soar. LCC could consider requiring developers to assess this opportunity on sites shown that are directly adjacent.

Government assumption of 20% of heat could be from heat networks so in urban areas this could be much higher. Heat network zoning announced in recent white paper that could accelerate heat network development and expansion along with the funding provided.

5.2.9 Transmission and Distribution Network Capacity

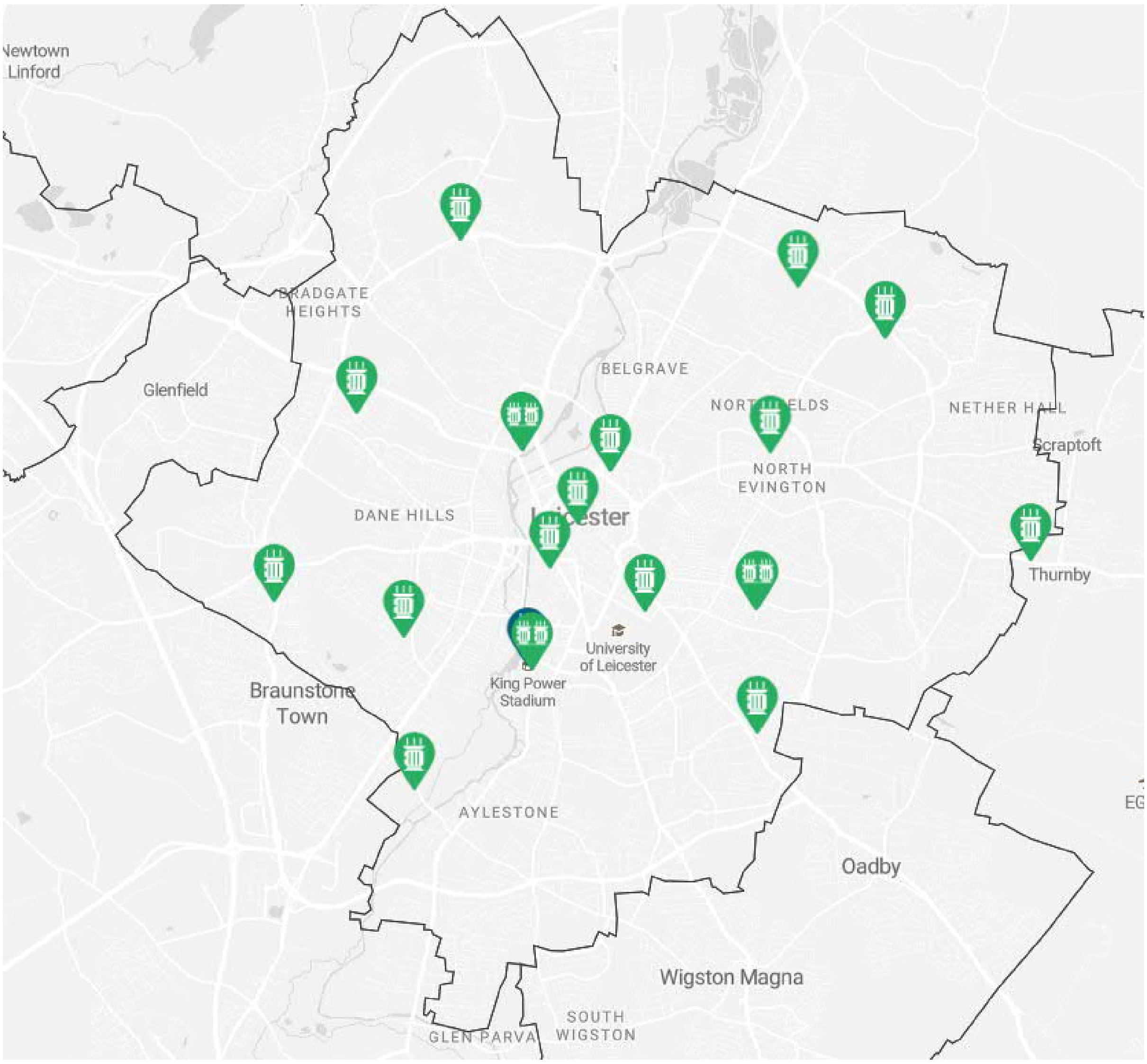
The viability of new LZC generation projects depends on the ability to be able to deliver the generated power to customers via new or existing transmission and/or distribution network infrastructure. The existing Distribution Network in Leicester is owned and operated by Western Power Distribution (WPD).

Figure 5-11 is an extract from the WPD Network Generation Capacity Map which *'provides an indication of the network's capability to connect large-scale developments to major substations.'* Each WPD substation is colour-coded to represent whether a connection could potentially be achieved without significant reinforcement; green indicates 25% or more capacity is available, amber indicates limited additional capacity (10-25%), and red indicates that there is very limited additional capacity

(<10%), as advised by WPD. The map indicates that most substations in Leicester have a 'high' level of capacity to accommodate large-scale (5 to 20+ MW) renewable energy installations.

Note that the data is updated continually by WPD and is therefore subject to change.

Figure 5-11. Existing substation generation capacity in Leicester. Image © WPD[111]



Whilst it is beyond the scope of this report to identify specific sites for large-scale LZCs, minimising the required network expansion to connect the LZC generator will increase the viability of the development. In particular, if LCC landholdings are in close proximity to existing infrastructure and lie within these opportunity areas, they could be considered potential candidates to deliver LZCs, thereby contributing towards the Council's Net Zero ambitions.

[111] WPD Network Capacity Map Data. Available at: https://www.westernpower.co.uk/our-network/network-capacity-map/

5.3 Promoting Sustainable Transport

5.3.1 Encouraging Sustainable Modes of Travel

The location and overall layout of a development should ensure that a mix of amenities are within easy walking or cycling distance of peoples' homes, to minimise the amount of travel required. In addition, wherever possible, developments should provide access to a range of public transport options such as bus and rail services.

The streetscape should provide safe and attractive pedestrian routes that link destinations both within, and between, neighbourhoods or developments. To this effect, it is also important to provide dedicated cycle lanes and bus routes, and consider limiting access for private vehicles in town or City centres. These measures improve safety for cyclists and pedestrians, in addition to offering air quality benefits.

Although design measures play a role in facilitating behaviour change, there are also questions of public perception / attitudes, consumer behaviour, and so on, which can have a significant impact on travel behaviours. This is particularly true in light of the COVID-19 pandemic. It is expected that the Local Authorities will need to undertake further research to understand how to capitalise on some of the positive changes that have taken place (e.g. less commuting and travel in general) and ensure that this is sustained as part of a longer term 'green recovery'. However, such an assessment is out of the scope of the present study.

As discussed in the following section, the shift to electric vehicles will rely on a significant increase in the availability of charging infrastructure, and will put additional pressure on electrical power networks. Therefore, integrating PV technologies into transport infrastructure (for instance, installing solar canopies above car parks) will help to maximise the use of renewable energy for such vehicles. The same principle applies to domestic buildings: new homes should offer the provision for EV charging, which could be linked with rooftop PV and (vehicle-to-grid) battery systems.

Changes in technology can contribute to reducing transport carbon emissions via measures that range from facilitating ridesharing and working from home, to smart logistics and traffic management. It is likely that intelligent traffic management systems will increasingly be used to optimise transport flow in ways that could reduce the need for parking spaces and multi-lane roads, although it is difficult to provide a quantitative estimate of the impacts these measures would have.[112]

5.3.2 Supporting Ultra Low Emission Vehicles

One of the key constraints to adoption of ULEVs, particularly plug-in electric vehicles, is the availability of suitable charging infrastructure. Although the Council cannot directly require the consumers to purchase ULEVs, they can help to support uptake through various means, such as:

- Requiring new developments to include provision for EV chargepoints, which could be co-located with renewable electricity technologies and battery storage;
- Requiring new or existing developments / neighbourhoods to limit access to traditionally-fuelled vehicles[113]; and
- Provision of EV chargepoints in Council-owned parking spaces.

Compared with traditionally fuelled vehicles, which can be refuelled relatively quickly at conventional filling stations, electric vehicles require a different approach. Depending on the chargepoint type and the size of the battery, these can take upwards of an hour for rapid chargepoints, and twelve hours or more for slow or trickle chargepoints. This has implications for travel planning, design of developments and siting of infrastructure. In addition, from LCC's perspective it is helpful to consider the different types of charging facilities that may be installed because these may have different implications from a planning perspective.

[112] Department for Transport, *'The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy'* (2018). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf
[113] It is understood that LCC has proposed the introduction of a Clean Air Zone that would impose charges on taxis, buses, and coaches. The Council should consider expanding this to other vehicle types, recognising that cars and vans represent a much higher proportion of fuel use in the area.

5.3.2.1 Journey charging

This is where the driver's primary purpose for being at the chargepoint is to charge the vehicle. These are typically public charging facilities. Chargepoints therefore need to be able to deliver rapid bursts of charge in a short space of time to ensure that the vehicle's 'dwell time' is minimised. This is important in order to ensure that both the delivered charge is of a meaningful quantity, and the throughput of vehicles is maximised (thereby reducing the risks of unwanted queueing at the facility). These types of facilities are likely to be sited in dedicated charge hubs, where rapid or ultra-rapid chargers deliver significant amounts of charge in a short space of time. This should be considered within the design of new developments and the broader spatial strategy for Leicester.

Charge hubs are likely to experience a relatively fast throughput of customers, meaning that site access and egress provision, their location in relation to and connectedness with the wider road network, and their impact on existing urban traffic patterns and capacity, will be key considerations in determining suitable locations. Examples of where journey charging facilities are likely to be located include at major nodes of transport interchange, such as at bus or train stations or park and ride hubs. They may also likely be installed at or near existing petrol/diesel filling stations.

Charge hubs may also place significant additional loads on the local electrical distribution networks. This may require upstream reinforcements of the local grid infrastructure (e.g. increasing the capacity of upstream substations and cabling), resulting in significant extra capital investment and ongoing management and maintenance costs.

5.3.2.2 Grazing charging

This is where the driver's reason for being at the chargepoint is primarily for a purpose other than for charging. For example, supermarkets and other major retail outlets, are expected to be prime locations for installing fast charging facilities. Leisure facilities, such as sports centres, cinemas, restaurants and museums, would also be suitable locations for the installation of fast chargepoints aimed at grazing charging. Chargepoints for this type of behaviour do not need to be able to deliver rapid bursts of charge, since the 'dwell time' for these vehicles is longer and does not need to result in a full charge. Public facilities aimed at grazing charging behaviour are likely to be much more widely distributed than those aimed at journey charging.

5.3.2.3 Workplaces

These may require a mix of different types of charging facilities that can accommodate both grazing and journey charging. Charging facilities may be needed for employees' personal vehicles, company vehicle fleets, etc.

5.3.2.4 Homes and residential areas

Chargers that deliver a slow trickle of charge are expected to dominate the home charger market due to the increased available plug-in time at home and reduced electrical infrastructure upgrade requirements for these types of chargers.

In new residential developments, one strategy for promoting sustainable transport might be to designate most streets as being primarily for use by pedestrians and cyclists, and then provide consolidated parking areas rather than on-street or driveway parking. The entire parking area could then be covered with a PV canopy, thus maximising the amount of LZC generation on-site – whereas this would not be suitable if each dwelling had a parking spot on the street.

5.3.2.5 General comments

For all charging facilities, there are opportunities to integrate and pair these with renewable energy and/or battery systems. Solar canopy arrays at car parks for example represent a well-aligned opportunity to maximise the use of solar power for the purpose of charging EVs. The generation profile of the solar installation will likely match the demand profile (i.e. highest occupation during the day when solar generation is at its peak) which reduces the demand on the distribution system and increases the penetration of renewable energy in the system. Were large-scale battery systems to be deployed on the same site, they would enable the storage of any excess energy for which there is insufficient real-time demand for later use by EV charge points. They may also be used to manage the loading of the electrical supply system to maximise utilisation and reduce network infrastructure upgrade requirements. Other considerations are to match charger speeds and numbers to the principal trip purposes a car park serves. Future proof with ducting & cabling provided to ease future, demand led provision.

Smart chargers can facilitate an optimised investment in electricity supply infrastructure. They enable the rate of charge to be controlled such that the electrical infrastructure's utilisation is maximised and not overloaded. The implementation of chargers offering variable rates need to be carefully managed to align with the customer's expectations of what charge rate they will receive when they plug in. This could be managed by varying price-points for different charge rates or offering a range of rates when the customer opts to use the unit.

Figure 5-12. Example of solar car park. Source: BRE, *'Solar Car Parks'* (2016)

With this in mind, the key recommendations for LCC are to ensure that adequate provision for EV charging is made from the outset, and where possible, ensure that this is co-located with renewable electricity technologies and battery storage. This should be done as part of a wider strategy to encourage sustainable travel modes, and to reduce demands on grid infrastructure.

In terms of viability implications, there would be some increase in development costs due to the provision of chargepoints. A rough indication of costs per chargepoint[114] is provided by BRE as follows:

- Slow (3.50-7kW): £500-1000
- Fast (7-22kW): £2,000-3,000 (AC) or £19,000 (DC)
- Rapid (up to 50kW): £20k-40k

There will be some additional costs depending on the level of additional infrastructure required, including electrical capacity reinforcements. It is also worth noting that the cost of retrofitting EV chargepoints is higher than installing them from the outset.[115]

The Distribution Network Operator (DNO) in the region, Western Power Distribution (WPD) has developed an EV strategy which outlines how they aim to facilitate the uptake of EV charging infrastructure[116]. As WPD is actively participating in the transition to EVs, engagement with them is recommended to gain their support and learn from the trials and existing installations they have implemented. Engagement with WPD is also recommended in order to gain understanding of where capacity exists on the network, and what plans WPD have for expanding capacity in the future.

[114] BRE, *'Solar Car Parks: A guide for owners and developers'* (2016). Available at: http://www.bre.co.uk/filelibrary/nsc/Documents%20Library/NSC%20Publications/BRE_solar-carpark-guide.pdf
[115] Energy Saving Trust, *'Guide to chargepoint infrastructure for business users'* (2017). Available at: https://www.energysavingtrust.org.uk/sites/default/files/reports/6390%20EST%20A4%20Chargepoints%20guide_v10b.pdf
[116] WPD, *'EV Strategy'* (March 2019). Available at: https://www.westernpower.co.uk/downloads-view/29293

5.3.3 Urban Consolidation Centres

Urban consolidation centres represent opportunities to reduce emissions as a result of minimising the miles driven by HGVs. They act as hubs located on the edge of cities in which goods would be delivered in via heavy vehicles and 'last mile' deliveries can then be made via smaller electric vehicles such (including e-bikes). In recommendations made by the CCC in the Sixth Carbon Budget charting the path to Net Zero, consolidation centres play a key role in not only reducing emissions but also supporting increased air quality in city centres.

LCC can help to facilitate the shift towards the utilisation of urban consolidation centres by identifying appropriate locations and allocating them via the Local Plan. This would potentially be controversial with freight and logistics companies and may need to be accompanied with restrictions on access for such vehicles.

5.4 Cross-Cutting Measures

This section of the report describes other types of sustainability interventions that can be made to reduce energy demand in the built environment and transportation in a holistic manner. Recognising that this is a broad topic area which has been the subject of significant previous research, this study has sought to highlight key considerations at an urban planning level, as well as at a building level, with reference to published studies and industry guidance.

5.4.1 Measures to Reduce Overheating

At a masterplanning level, incorporating areas of green and blue infrastructure into the urban landscape can help to reduce the urban heat island (UHI) effect, in addition to providing attractive routes for pedestrians and cyclists, habitats for a variety of species, and helping to control surface water run-off. (Note: Measures such as green roofs and walls, are discussed in more detail in Section 5.4.3, recognising that there is significant overlap with climate adaptation measures.) Reducing energy use in buildings overall will also reduce the amount of waste heat that is generated and rejected to the local microclimate, which is particularly relevant to urban areas.[117]

At an individual building level, the priority should be to minimise unwanted heat gains before considering alternative cooling strategies.[118] The geometry, orientation and form of buildings can have a significant impact on overheating risk. For example, single aspect units are at higher risk of overheating than other buildings, due to the lack of natural cross-ventilation. It is also important to ensure that, if natural ventilation is to be used to cool a building, this will not compromise its indoor air quality, noise levels, or security. The transition to EVs will be useful in this regard, because EVs are less noisy and have a significantly lower impact on air quality than traditional fuel vehicles, which means people may feel more comfortable opening windows.

In addition to building orientation, glazing area, and glazing specification, external shading devices are among the most effective means of reducing overheating risk.[119] This could also potentially be achieved through the use of balconies, external walkways or corridors and / or locating deciduous trees along the south, east or west facades of buildings. In the public realm, structures that provide shade (such as canopies and bus shelters) can be integrated with solar PV to generate renewable

[117] Although it is difficult to determine the impact this would have on local temperatures in Leicester, research indicates that switching to Net Zero energy use buildings would reduce the average summer UHI magnitude in London by around 15%. See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7604/2185850.pdf

[118] For example, the GLA London Plan (Policy 5.9) includes the following 'Cooling Hierarchy':

1 minimise internal heat generation through energy efficient design
2 reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
3 manage the heat within the building through exposed internal thermal mass and high ceilings
4 passive ventilation
5 mechanical ventilation
6 active cooling systems (ensuring they are the lowest carbon options).

For more information, see https://www.london.gov.uk/sites/default/files/energy_assessment_guidance_2018.pdf

[119] Report produced by AECOM on behalf of the Department for Communities and Local Government, *'Investigation into Overheating in Homes: Literature Review'* (2012). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7604/2185850.pdf

energy, thus serving a dual purpose. Materials that are lighter in colour have higher albedo (sun reflecting properties) and can therefore help to reduce heat gains.[120]

There are some sustainable design measures that can potentially conflict with measures aimed at reducing overheating and therefore must be given careful consideration. For example:

- Over the course of a year, there is a trade-off that will occur between reducing solar gains in summer (to minimise overheating) while also maximising solar gains in winter (to minimise heating demand).
- Although materials with a high thermal mass such as concrete, brick or stone can help to reduce fluctuations in temperature, some of these products – concrete in particular – have a high embodied energy and carbon content. This can be minimised, for instance through the use of cement replacements such as ground granulated blast furnace slag (GGBS).

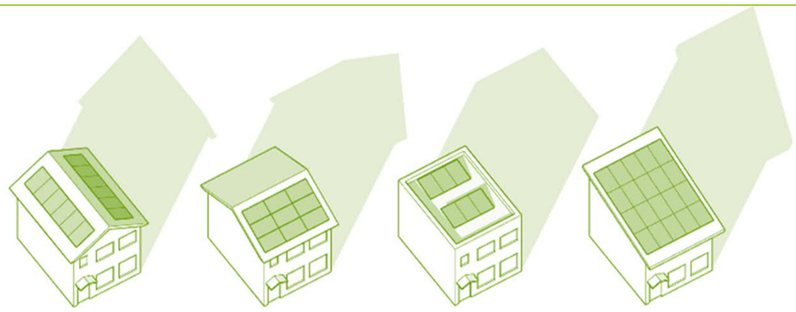
5.4.2 Futureproofing to Enable Retrofitting LZC Technologies

As discussed in Section 5.2, in order to reach Net Zero emissions, there must be a major increase in the deployment of LZC technologies across the UK. Although this is an issue that is likely to be addressed in part through future changes in UK Building Regulations, in the interim period, it is important to ensure that new developments, along with extensions or refurbishment schemes, maximise opportunities to install such technologies – if not at the outset, then at a future date.

Although some technologies that are not yet widely available could become widespread in future (e.g. hydrogen gas and fuel cells), at the time of writing the key opportunities are likely to include:

- **Maximising opportunities for renewable energy generation** – The amount of electricity generated by PV depends on multiple factors, including annual solar irradiation, panel orientation, tilt and efficiency. Therefore, the design and geometry of a building, and the overall layout of the development, are important factors that determine how much PV can be installed.

  To illustrate this point, the diagram below shows the difference in the amount of PV that could potentially be retrofitted onto buildings with the same footprint, but different roof geometries. The aim is not simply to compare the output of arrays with different orientations, but to highlight how multiple factors including array size, tilt and orientation have a combined impact on how much renewable electricity is generated, thus emphasising the need for sustainable design measures to be considered holistically.



	House 1	House 2	House 3	House 4
Description	Dual pitch	Dual pitch	Flat roof + parapet	Monopitch
Orientation	East/West	South	South	South
Electricity (kWh p.a.)	2,190	1,910	1,150	4,080

In this example, House 4, which has a south-facing monopitch roof, would be expected to generate roughly three and a half times more electricity per year than House 3, where panels

[120] More information can be found in the following publications:
- CIBSE *'TM60: Good practice in the design of homes'* (2018)
- CIBSE *'TM52: Limits of thermal comfort – Avoiding overheating in European buildings'* (2013)
- CIBSE *'TM54: Evaluating operational energy performance of buildings at the design stage'* (2013)

have been installed on a flat roof and arranged in order to avoid being overshadowed by the parapet or adjacent panels.[121]

- **Use of low temperature heating systems that can be more easily replaced with ASHPs** – As stated in Section 4.3.2, in the future, the most carbon efficient form of heating is likely to involve heat pumps, which operate most efficiently when used with low-temperature heating systems. Installing radiators and pipework that are compatible with low-temperature heating systems can both reduce the cost of retrofitting a heat pump (because the pipework and radiators can be retained), and in the meantime can potentially improve the performance of a gas boiler (resulting in an increase in boiler efficiency of around 3%).[109] For example, this would likely involve underfloor heating or specifying larger radiators than would be typically used for a traditional gas boiler system.

- **Allowing space for LZC technologies and battery/thermal storage** – ASHPs must be placed in an accessible outdoor location adjacent to the property, ideally in the open air (i.e. not within a shed or similar structure). Similarly, the design of new buildings should include space to accommodate battery systems, inverters, and other associated hardware (although it is acknowledged that the spatial requirements are likely to change over time due to technological improvements). Note that the increasing use of electric heating systems, EVs, battery storage and onsite renewable electricity generation would place significant demands on existing power infrastructure which may require upstream reinforcements of the local grid (e.g. increasing the capacity of upstream substations and cabling).

- **Allowing access for maintenance and replacement of heating / cooling systems and other building services** – This issue is more likely to arise in non-domestic buildings with designated plant rooms and ventilation systems. It is important to ensure that the design allows for easy access to all building services (e.g. door dimensions and lift facilities allowing access to plant rooms in the basement or on the roof). Designing to facilitate maintenance can also help to reduce the amount of material needed to maintain a building over its lifespan and facilitate deconstruction, aligning with Circular Economy design principles (see Section 5.4.5).

- **Ensuring that buildings meet a high standard of fabric efficiency, including insulation and airtightness** – Reaching Net Zero will rely on reducing energy demands and switching towards the use of technologies that are powered by renewable electricity, including heat pumps and heat recovery systems. A high standard of fabric efficiency is necessary to ensure that these technologies operate at maximum efficiency. Furthermore, given that electricity is a more expensive fuel than natural gas, demand reduction is necessary to ensure that this transition does not result in higher energy bills.

It is recommended that these measures could be addressed in a future SPD.

5.4.3 Green and Blue Infrastructure Design

Guidance from Natural England states[122] that a holistic approach to green infrastructure design should produce *'a strategic and linked, multifunctional network of spaces with benefits for people and wildlife.'* An obvious example is to co-locate green corridors (including trees, parks, gardens, and other areas of landscaping) with pedestrian and cycle routes, and to integrate these with sustainable drainage systems (SuDS) or other blue infrastructure such as canals, ponds and river networks.[123,124]

This approach offers multiple benefits, including but not limited to:

- **Recreation and amenity space** for people to enjoy, with associated positive health and social impacts, along with opportunities to provide outdoor education;
- **Habitats** for a range of wildlife, which can have a positive effect on biodiversity and ecosystems;

[121] Based on standard 250W / 1.6 m^2 panels with a maximum annual output of 850 kWh/kWp, shown with a minimum 300mm gap between the panel and roof edge.
[122] Natural England, *'Green Infrastructure Guidance'* (2009). Available at: http://publications.naturalengland.org.uk/file/94026
[123] CIRIA, *'C753: The SuDS Manual'* (2015)
[124] CIRIA, *'C768: Guidance on the Construction of SuDS'* (2018)

- **Reduction of the UHI effect** and, therefore, reduction in the risk of overheating and associated health impacts and cooling energy demands; and
- **Reducing surface water runoff** and providing flood attenuation / storage, which helps to alleviate pressure on drainage systems, reducing the risk of flooding and watercourse pollution.

Other forms of green infrastructure that should be integrated into new and existing built environments include:

- **Planting trees** that can (among other benefits) help to provide shade, thus offering comfortable outdoor space for amenity and recreation, reducing heat gains in buildings, and sequestering carbon from the atmosphere.
- **Green roofs and walls**, which can form part of a holistic SuDS strategy whilst offering beneficial outdoor space for building occupants. The design of these features should take into consideration the embodied carbon impacts of any additional structural support that they will need, along with the water use / irrigation requirements of any plant species.

- **Space for individual or communal food growing** such as allotments, orchards and edible gardens.[125]

The design of green and blue infrastructure must also consider:

- Proximity to buildings, infrastructure, or sources of disturbance such as noise or light pollution – these factors can have a significant impact on the actual ecosystem benefits that are realised.
- The water requirements of any plants – this would include selecting species that are drought resistant and can thrive with minimal or no supplementary irrigation.

Recognising that Leicester is already classified as an area with 'moderate' water stress,[126] and that this is likely to increase in future, design features that have an impact on water use or water management must consider opportunities to conserve this important resource.[127] For example:

- SuDS features (e.g. water gardens and reed ponds) could be integrated with greywater recycling systems.
- If irrigation is provided to green roofs or walls or other landscaping features, this must include rainwater harvesting to minimise the pressure on the public water supply.

One way of ensuring that these features are not constrained to narrow corridors, but are integrated within the wider landscaping scheme, would be to provide multi-function SuDS – for instance, spaces that are designed to flood under certain circumstances but otherwise offer natural play areas. (Areas that are designed to flood are not classed as 'developable' land but would count as open space which may also be publicly accessible, so there is a trade-off in this regard.) A range of further guidance has been produced by the Construction Industry Research and Information Association (CIRIA).[128]

Finally, it is worth noting that there is a potential tension between the need to increase the amount of development in areas that are already served by transport links and other infrastructure – which will generally be in more urban areas – and the need to ensure that those same areas have a high level of green and blue infrastructure provision.

5.4.4 Sustainable, Locally Sourced Materials

Although there is no set definition of what constitutes 'sustainable sourcing' of materials, the term is commonly used to refer to a process that takes into account issues such as material traceability, health and safety, and environmental management through all stages of the supply chain. This could include consideration of energy, resource and water use, greenhouse gas emissions, deforestation,

[125] A report that examined urban food growing in London noted that, *'Almost any site, irrespective of size, location or soil conditions can be used for food growing operations by making use of raised beds, skips and builders' bags filled with good quality soil.'* London Assembly, *'Cultivating the Capital'* (2010). Available at: https://www.london.gov.uk/
[126] Environment Agency, *'Areas of water stress: Final classification'* (2013). Available at: https://www.iow.gov.uk/azservices/documents/2782-FE1-Areas-of-Water-Stress.pdf
[127] CCC, *'Net Zero: The UK's Contribution to stopping global warming'* (2019). Available at: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/
[128] For example, the CIRIA *'Suds Manual'* (2015) or *'Water Sensitive Urban Design in the UK: Ideas for Built Environment Practitioners'* (2013). Available at: https://www.susdrain.org/files/resources/ciria_guidance/wsud_ideas_book.pdf

circular economy and ecotoxicity. Local Authorities should support developments that seek to use materials that are sustainably sourced.

There are a variety of established standards and certification schemes that can be used to demonstrate responsible sourcing, some of which are recognised within the BREEAM or HQM environmental assessment standards (see Section 5.1.1). In the UK, the Building Research Establishment (BRE) has developed a *'Framework for Responsible Sourcing'* (BES 6001) which *'provides manufacturers with a means by which their products can be independently assessed and certified as being responsibly sourced'* through appropriate governance and supply chain management.[129] More broadly, organisations can implement environmental management systems (EMS) in line with ISO 14001 standards to demonstrate that they have taken steps to reduce their environmental impacts.

Other certification schemes exist for specific construction products or materials, including timber, aluminium, structural steel, and concrete.[130] For example, with regards to timber products, certification schemes are run by the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC).[131,132]

A range of potential benefits can be obtained by using materials and construction products that are produced near to the construction site. In particular, this can help to provide benefits to the local economy, providing jobs and skills training opportunities. It can also help to reduce the embodied carbon emissions of the development, for example if the material is transported a shorter distance – although distance is only one of many factors affecting the embodied carbon.

An obvious example of sustainable, local sourcing would be to utilise construction materials that have been reclaimed or recycled from existing buildings on or near the proposed development site, provided that these can be processed locally with minimal environmental impact. There are also examples of local reuse organisations that can provide furniture, appliances, and IT equipment. However, in many cases, the most sustainable method of meeting the demand for construction materials will be to avoid the need for them in the first place. This requires a design approach that maximises the retention and reuse of existing buildings, infrastructure, and other products. (i.e. a 'circular economy' approach – see below).

5.4.5 Lean Design and Circular Economy Measures

Designing for flexibility and adaptability, and following 'circular economy' principles, can contribute towards reducing the lifecycle energy demands and carbon emissions of buildings, while offering a range of co-benefits for sustainability and human health. According to the Ellen MacArthur Foundation:[133]

> *'A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration […] and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.'*

A 'circular economy' therefore stands in contrast to the current 'linear' system of extracting materials, using them, and then throwing them away – which is inherently unsustainable when considering finite natural resources.

By reducing the material demands up front ('lean design') and implementing waste reduction measures during construction, it is possible to reduce the embodied carbon and broader environmental impacts of new development. Designers should also consider ways to minimise the additional material demands and waste produced over the course of a building's lifecycle, by ensuring that buildings are durable, easy to adapt, repurpose, and deconstruct. In addition to the environmental

[129] Green Book Live, 'Responsible Sourcing BES 6001'.Available at: https://www.greenbooklive.com/search/scheme.jsp?id=153
[130] For a list of schemes eligible for BREEAM and HQM credits, see BREEAM*, 'Guidance note GN18: Recognised Responsible Sourcing Certification Schemes'* (2020). Available at: https://files.bregroup.com/breeam/GN18_BREEAM-NC_Guidance-Note.pdf
[131] Forest Stewardship Council, *'What is FSC?'*. Available at: https://www.fsc-uk.org/en-uk/about-fsc
[132] Programme for the Endorsement of Forest Certification, *'What is certification?*'. Available at: https://www.pefc.org/what-we-do/our-approach/what-is-certification
[133] Ellen MacArthur Foundation, *'Towards the Circular Economy: Volume 1'* (2013). Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf

benefits, this can result in social benefits (e.g. making it easier for families to reconfigure their living spaces over time, or making it easier for changes in use of commercial properties) and associated cost savings.[134]

5.4.6 Water Efficiency

Severn Trent Water (STW) provides water and wastewater services to Leicester and the surrounding area. In its 2015 Climate Change Adaptation Report, STW analysis found that, *'The combination of increased demand and decreased availability means that unless action is taken, climate change could severely impact our ability to supply customers with water whenever they need it.'*[135] In the STW Resource Management Plan (2019), the company lists three key strategic responses:[136]

- *'Reducing leakage on our network;*
- *Helping customers to use less water through water efficiency activities and education; and*
- *Increasing the coverage of water meters across our network to further reduce consumption and to improve our understanding of water demand patterns.'*

LCC can contribute towards the latter two goals by requiring developments to implement water efficiency measures and water meters as standard. Potential responses therefore include:

- **Requiring all developments to include rainwater collection where there are external landscaping features, private gardens, etc.** – This could be a simple water butt or a more sophisticated commercial rainwater collection system. The water can be used for irrigation purposes directly (without treatment), or can be incorporated into non-potable systems within the building e.g. for toilet flushing. The cost impacts of rainwater butts are minimal whereas non-potable water systems would incur higher costs.
- **Requiring all developments to include smart water meters –** This should be adopted as standard. It will allow the occupants to track their usage more easily, and also assist in leak detection. At the time of writing, STW does not offer this to customers[137] so developers would need to install them.
- **Requiring developments to meet the optional standard for water use in the Building Regulations** – Typical per capita water consumption in the STW operating area is around 130 L/p/d which is broadly in line with the rest of the UK.[138] Part G of Building Regulations, which sets out standards related to water efficiency, includes a set of basic requirements that all developments must achieve (a water consumption limit of 125 L/p/d) and also a set of more ambitious, optional requirements (110 L/p/d) that Local Authorities can request Local Authorities e.g. if they are within a water stressed area. It is recommended that LCC adopt the 110 L/p/d target as a minimum level of ambition. The optional standard can typically be achieved through introduction of water efficient taps and fittings (Part G also describes appropriate flow rates). Adopting these measures can often be achieved with low or no additional costs during construction, and can help occupants save money on water bills.
- **Setting a higher target for water use that goes beyond Building Regulations** – From an environmental standpoint, LCC would be justified in pushing this target further. The CCC reports that, in order to address future water supply risks, average consumption across the UK needs to be 'well below' 100 L/p/d by 2050, and should ideally be closer to 80-90 L/p/d.[139] Achieving such low levels of water consumption is often challenging in existing buildings because it may require the use of separate distribution systems for non-potable water. To lower the average consumption, LCC should consider adopting water efficiency standards for new developments that are below 100 L/p/d. This is more difficult to achieve and would likely require rainwater

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[134] David Cheshire, *'Building Revolutions: Applying the Circular Economy in the Built Environment'* (RIBA Publishing, 2016)
[135] Severn Trent, *'Future proofing: Water's climate adaptation report'* (2015). Available at: https://www.stwater.co.uk/content/dam/stw/about_us/documents/Full-Climate-change-adaptation-report-2015-2020.pdf
[136] Severn Trent, *'Water Resources Management Plan 2019'* (2019). Available at: https://www.severntrent.com/content/dam/stw-plc/our-plans/severn-trent-water-resource-management-plan.pdf
[137] See Severn Trent's Legal information: https://www.stwater.co.uk/help-and-contact/legal/terms-and-conditions/water-meters/
[138] Severn Trent, *'Water conservation report'* (2018). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766894/water-conservation-report-2018.pdf
[139] Committee on Climate Change, *'UK housing: Fit for the future?'* (2019). Available at: https://www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf

collection or greywater recycling. Therefore, this standard might be encouraged for major new developments where there are fewer constraints on the design of new infrastructure.

- **Encouraging developers to assess opportunities for rainwater or greywater recycling** – Even if higher quantitative targets are not adopted (see above), developers could still be asked to undertake a feasibility assessment.
- **Where relevant, requiring applicants to achieve a set number of credits within the Wat 01 category of a BREEAM or HQM assessment** – This would only apply to developers undertaking such an assessment.

6. Policy Recommendations

All policy options discussed in this section of the report are summarised in Table 6-1. Each policy theme has a corresponding reference number to the relevant policy recommendations section. This section contains details describing the rationale and impacts on deliverability to help guide the Council in selecting the preferred policies for further development and/or integration into the new Local Plan. Each policy area that is recommended for inclusion in the Local Plan policy highlights a sample policy wording that can be integrated into the revised Local Plan. Appendix F details the proposed revised Leicester City Local Plan Climate Change policy set against the previous consulted upon policy for reference.

The following section includes a range of planning policy options in Table 6-1 that could be implemented to address carbon reduction in line with the key themes identified in the evidence provided in the previous sections. The options include measures that:

- Promote sustainable building design;
- Increase LZC energy technology provision; and
- Consider policy areas that crosscut and may well be incorporated into other policy areas.

The measures specifically targeting the promotion of Sustainable Transport are intentionally not mentioned in the following section as they are not relevant to building planning policy and would instead be addressed by the transport plan.

Table 6-1. Policy options and the energy hierarchy

Ref	Policy recommendations	
1	Energy Hierarchy	Require all developments to follow a clear energy hierarchy.
2	Building Energy Efficiency Measures	Set a minimum target for carbon emissions reduction from building energy efficiency measures.
3	Heating/Cooling System Hierarchy	Require all developments to follow a clear heating/cooling system hierarchy.
4	Connection to Heat Networks	Include a requirement for all suitable developments near existing or planned heat networks to incorporate the necessary infrastructure to enable future connection.
5	Low and Zero Carbon Technologies	Require all development to provide details of the low and zero carbon energy technologies installed and the estimated reduction in CO_2 emissions these will deliver.
6	Cooling Hierarchy	Require all development to follow a clear cooling hierarchy.
7	Whole Life-Cycle Carbon Emissions	Introduce a requirement for development to minimise whole life-cycle emissions.
8	Existing Buildings	Positively support proposals that improve efficiencies and reduce emissions within the existing building stock.
9	Energy Statement	Include a requirement for all major developments to complete an energy statement to demonstrate compliance with the relevant policies.
10	Water Efficiency	All new developments should seek to maximise water efficiency on site
11	Sustainability Assessments	Encourage use of third-party assessments as an alternative approach to demonstrative compliance with the sustainable design and construction policies.
12	Policy Technical Guidance	Produce a technical guidance document to support developers in complying with the policy requirements.

13	Carbon Offset Scheme	Consider establishing a carbon offset scheme.

6.1 [1] Energy Hierarchy

Require all developments to follow a clear energy hierarchy.

6.1.1 Basis

As demonstrated in Section 4, for the UK to feasibly reach the 2050 target, and for Leicester to move closer to becoming carbon neutral by 2030, a switch towards renewable energy sources needs to be accompanied by a radical reduction in energy demand across all sectors. Any increase in carbon emissions will make these targets more difficult to achieve.

Leicester City Council has outlined an emerging hierarchy so that development can minimise energy demand and carbon emissions including consideration of heating and cooling. In order to support a practical and viable transition for the city to become carbon neutral as quickly as possible, the local planning authority can amend the emerging hierarchies in line with best practice to ensure a clear and consistent approach to energy use, carbon emissions, heating and cooling of existing and new development.

Recommendation 1 focuses on setting out a clear energy hierarchy for existing and new development. This includes a greater emphasis on ensuring improvements are clearly demonstrated and achieved, through the 'be seen' principle, as well as ensuring opportunities are identified and pursued at the earliest stages of the design process and future proofing of development is maximised. This would be accompanied by a heating hierarchy, as detailed in Recommendation 3, and a cooling hierarchy, as detailed in Recommendation 6.

6.1.2 Proposed Approach

All developments should be carbon neutral in operation by 2030. This requires reducing greenhouse gas emissions, minimising both annual and peak energy demand, and future proofing development in accordance with the following energy hierarchy.

- Be Lean: Minimise energy use and manage demand during operation. This should be achieved through passive design measures including optimised site layout, building orientation, form factor, massing, daylighting and control of solar gain, minimised heat loss from the building fabric through reduced U-values and thermal bridges, and increased air tightness; followed by utilising energy efficient lighting and services, including consideration of passive ventilation, heat recovery and demand management technologies; and,
- Be Clean: Further reduce carbon emissions through the use of zero and/or low emission decentralised energy, prioritising connection to district heating and cooling networks and utilising secondary heat sources; and,
- Be Green: Further reduce carbon emissions by maximising opportunities to produce ad use renewable energy on site, utilising storage technologies; and,
- Be Seen: Verify and report on energy performance.

Measures should be incorporated at the earliest design stage of a development and maintained throughout the design, construction and operation of a proposal. All opportunities to maximise compatibility with current and future use of local and onsite zero and low carbon energy technologies must be identified and pursued.

6.1.3 Evidence and Viability

To commit fully to the Council zero carbon ambitions a more ambitious target would be preferable. There is precedence where this has been adopted successfully, most notably by Greater London Authority (GLA) with a minimum on-site carbon reduction target of 35% assuming the baseline is a building using a gas boiler for heating and hot water. In recent years the viability of such a target has proved to not be excessively challenged particularly if the carbon intensity of grid electricity is updated.

More information about the viability implications of these options can be found in the UK-GBC Policy Playbook and the Future Homes Standard Impact Assessment. Increasing the ambition to zero carbon for example will certainly test the viability and is very likely to be challenged. It may be more realistic to consider policy that embeds known strategies to enable a transition to zero carbon as highlighted later.

6.1.4 Implications for Implementation and Compliance

Current (2013) Part L of Building Regulations typically equates to a range of building specifications that do not align with net-zero carbon future aspirations. Seeking better performance is appropriate and would align with the evidence that this is a key policy for LCC to promote.

The level of reduction contained in the policy will depend on a balance between Council ambition and viability. Recommendation 2 describes the approach to minimum performance.

The ability of local planning authorities to set energy efficiency requirements may be revised in the future following the implementation of the Future Homes Standard and the Future Buildings Standard, planned for 2025. Currently it is allowable to set standards that exceed the England Building Regulations.

Part L 2013 is due to be updated in the next year therefore any targets set in relation to Part L, would need to include wording that addresses this planned update. Consideration should be made for the scenario that the Local Plan and its policies are adopted after Building Regulations have been updated and therefore it might be more appropriate to reference the Regulations at that time.

The Government response to the Part L consultation has resulted in the likely adoption of a housing specification that would typically equate to a 31% carbon reduction compared to Part L 2013 specification. The magnitude and potential impact of extending this to, for example, 35% is limited when compared to these proposals. The value that such a policy brings and the additional work by developers and the Council to demonstrate, test and check compliance should be questioned. It may be more valuable to focus on the measures that have the longest lifecycle, for example, wall construction with a lifecycle equivalent to that of the building's life. This compared to the heating system which would likely be replaced within 15 years and therefore multiple times during the building's life. This is not to say that policy cannot influence specifics related to the heating system but more that embedding a focus on what will be present in 2050 and beyond is crucial.

The evidence in this report paints a clear picture that there is value is setting a clear heating hierarchy that promotes systems that don't use fossil fuels such as gas. The UK construction industry hasn't fully transitioned away from the most common approach of installing each new home with a new gas boiler. An option could be to embed this in policy and specifically exclude such systems. There is good evidence to support this, however, 2025 regulations will likely see this transition occur nationally without the need to add a further viability consideration.

6.1.5 Recommendation

Incorporate the four hierarchy stages into the policy and require proposed developments to follow the hierarchy reporting these in the Energy Statement referenced in Recommendation 9. Be Seen is left relatively open and initially it is expected that this will require the developer to provide an updated Energy Statement upon project completion. This can be detailed in the accompanying SPD. In future, where more evidence is available of how post completion energy monitoring schemes work in other local authorities, this policy could be expanded to included annually reported building energy consumption.

6.1.6 Proposed Policy Wording

All development must:

a) Be Lean: Minimise energy use and manage demand during operation. This should be achieved through passive design measures including optimised site layout, building orientation, form factor, massing, daylighting and control of solar gain, minimised heat loss from the building fabric through reduced U-values and thermal bridges, and increased air tightness; followed by utilising energy efficient lighting and services, including consideration of passive ventilation, heat recovery and demand management technologies; and,

b) Be Clean: Further reduce carbon emissions through the use of zero and/or low emission decentralised energy, prioritising connection to district heating and cooling networks and utilising secondary heat sources; and,

c) Be Green: Further reduce carbon emissions by maximising opportunities to produce and use renewable energy on site, utilising storage technologies; and,

d) Be Seen: Verify and report on energy performance.

6.2 [2] Building Energy Efficiency Measures

Set a minimum target for carbon emissions reduction from building energy efficiency measures.

6.2.1 Basis

The evidence provided in this report demonstrates there is a need for buildings to transition away from fossil fuels and towards electrical systems. To best support this it is essential to lower demand and limit strain on the electrical infrastructure locally and nationally. Fabric and energy efficiency measures are the most effective way to reduce energy demands, as well as lower CO_2 emissions and costs for occupants of new buildings.

6.2.2 Proposed Approach

All developments should be required to meet a minimum level of fabric and energy efficiency. It is therefore recommended to consider a dedicated target that is delivered by fabric and energy efficiency measures only. A 10% reduction from fabric and energy efficiency (Be Lean) for new homes and 20% for most non-domestic buildings compared to Part L 2013 is typically feasible.

The Government has indicated in the Future Homes Standard consultation that it’s preferred option (Option 2) would see a 27% improvement in CO_2 emissions per building (across the build-mix of non-domestic buildings – uplifts vary by building type), compared to the current Part L standard, through fabric & energy efficiency measures and low carbon technologies such as heat pumps or photovoltaic panels.

This focused approach to carbon reduction also ensures planning policies will continue to work with future updates to the building regulations, which is expected to elevate total savings through further fabric and energy efficiency measures and/or the use of decentralised, low and zero carbon energy technologies.

6.2.3 Evidence and Viability

The targets set in Part L (2013) are devised in a way that it is possible to deliver compliance through reasonable fabric and energy efficiency measures alone, with no additional requirement to provide additional carbon saving technologies such as solar PV. Similarly, the Government has indicated that the Future Homes Standard Option 1 (20% uplift) could be achieved through increased fabric efficiency measures alone.

The fabric cost will be higher for developers but would likely mean less photovoltaic panels, for example, installed to meet the minimum regulated performance and impacting the viability assessment less. This policy would be supported by the viability and impacts assessments associated with Building Regulations Part L (2013), the Future Homes Standard and the Future Building Standard.

GLA adopts a minimum target of 10% and 15% for new domestic and non-domestic buildings from fabric and energy efficiency measures only. The balance to their 35% or greater carbon saving can include measures such as connecting to low carbon heat networks and renewable technologies.

The GLA's recent energy monitoring report[140] compares the Be Lean carbon saving from the previous year's planning applications for both domestic and non-domestic. The distribution curves suggest that 10% saving for new dwellings is achievable and that the non-domestic buildings have a much wider range given the different building uses and energy demand profiles. It may be appropriate to adopt specific exemptions for certain non-domestic buildings and this should be detailed in technical guidance. For many new non-domestic building uses it is possible to achieve a reduction of 20%.

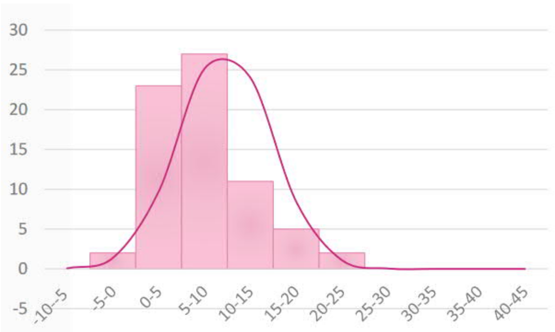

Figure 7: Carbon savings (per cent) achieved from 'be lean' measures for residential developments (y axis represents the number of referable developments)

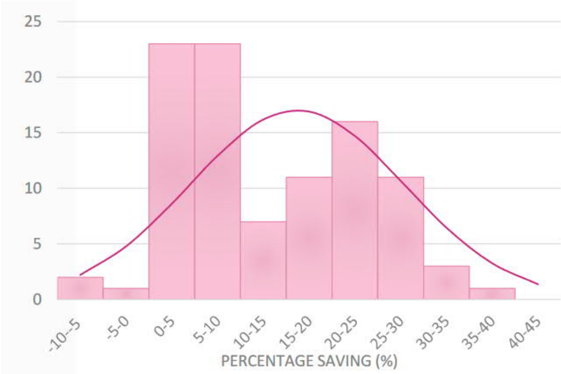

Figure 8: Carbon savings (per cent) achieved from 'be lean' measures for non-residential developments (y axis represents the number of referable developments)

In the case of residential buildings, the technical appendix for SAP (the approved calculation methodology), sets out a detailed recipe for delivering compliance, referred to as the 'Reference Values'. Similarly, in the case of non-domestic buildings the notional building performance provides a guide to the specification required to achieve compliance, this can be found in the National Calculation Methodology (NCM) modelling guide.

Alternative approaches include setting an energy intensity target. There are merits to this approach, however, to minimise the number of differing assessments and allow clearer direct comparison it is likely to be preferable to be consistent and use carbon emissions as a proxy for energy demand. The lead criterion tested as part of Part L is carbon emissions. It is useful to pitch the benefit from efficiency measures against the same scale as the total saving.

The Government has decided that its preferred Future Homes Standard for the next iteration of Building Regulations is Option 2 of its two options provided in the 2019/20 consultation[141]. The two options are briefly described by MHCLG as follows:

Option 1: 20% reduction in carbon emissions compared to the current standard for an average home. We anticipate this could be delivered by very high fabric standards (typically with triple glazing and minimal heat loss from walls, ceilings and roofs).	*Option 2: 31% reduction in carbon emissions compared to the current standard. We anticipate this could be delivered based on the installation of 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).*

To require new developments in Leicester City to target higher performance than the Regulations may be possible but to avoid substantial challenges it could be approached strategically. We understand

[140] GLA, *'Towards a net zero carbon London: Energy Monitoring report 2019'* (2020). Available at: https://www.london.gov.uk/sites/default/files/planning_energy_monitoring_report_final.pdf
[141] Ministry of Housing, Communities & Local Government, *'The Future Homes Standard 2019 Consultation on changes to Part L and Part F of the Building Regulations for new dwellings'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/852605/Future_Homes_Standard_2019_Consultation.pdf

from the evidence provided in this report that there is a need to transition away from fossil fuels to electrical systems. To make this viable as a long-term objective it is essential to lower demand and limit strain on the electrical infrastructure locally and nationally. It is therefore of value to consider a dedicated target that equates approximately to Option 1 delivered by fabric and energy efficiency measures only. Building Regulations would elevate the total saving required to 31% and higher.

6.2.4 Implications for Implementation and Compliance

The policy would require developers to provide an additional set of calculations to help disaggregate the carbon saving from fabric and energy efficiency alone. It is, however, possible to apply the appropriate inputs to the same assessment undertaken for Building Regulations and is therefore a relatively small additional work item for a developer and their consultants.

In the case of residential buildings, the technical appendix for SAP (the approved calculation methodology), sets out a detailed recipe for delivering compliance, referred to as the 'Reference Values'. Similarly, in the case of non-domestic buildings the national building performance provides a guide to the specification required to achieve compliance, this can be found in the National Calculation Methodology (NCM) modelling guide.

To ensure a consistent approach to reporting the council may need to detail an agreed methodology in the form of a guidance document. This should be updated in line with changes to the building regulations.

The policy would require developers to provide an additional set of calculations to help disaggregate the carbon saving from fabric and energy efficiency alone. It is, however, possible to apply the appropriate inputs to the same assessment undertaken for Building Regulations and is therefore a relatively small additional work item for a developer and their consultants. For the Council, a methodology will be needed to ensure a consistent approach to reporting. Technical guidance provided by the Council will be necessary and it may be necessary to update the guidance in line with Regulation updates to reflect changes to approved calculation methods and stay relevant.

Although Option 1 refers to a 20% saving this is compared to Part L 2013 specification. New Regulations may apply during the new Local Plan period. It may be more appropriate to identify the uplift required from Option 2 excluding renewable technologies noting that the methodology will need to account for assessing the baseline as well as the saving from fabric and energy efficiency.

The fabric cost will be higher for developers but would likely mean less photovoltaic panels, for example, installed to meet the minimum regulated performance and therefore impact the viability assessment less.

6.2.5 Proposed Policy Wording

All new dwellings should achieve a minimum 10% reduction in carbon emissions beyond the requirement of Part L 2013* of the Building Regulations through 'Be Lean' passive, fabric and energy efficient design measures alone. For non-dwellings the target is 20% with some exceptions such as those building types with high occupant hot water demand, here the focus is shifted to a target space heating demand. Calculation methodology details are included in the Supplementary Planning Documents.

*an alternative target will be provided when new national Regulations are adopted.

6.3 [3] Heating/Cooling System Hierarchy

Require all developments to follow a clear heating/cooling system hierarchy.

6.3.1 Basis

The evidence in this report paints a clear picture that there is value in setting a clear heating hierarchy that prioritises the city-wide uptake of low and zero carbon heating systems. There is also a need to ensure heating technologies do not contribute towards worsening air pollution. An option would be to embed this into policy. This would support the Be Clean and Be Green measures in the energy hierarchy.

6.3.2 Proposed Approach

To ensure that a heating or cooling system with the lowest possible carbon emissions is selected the following systems and technology hierarchy (ordered from highest to lowest preference) could be proposed:

<table>
<tr><td rowspan="4">System</td><td colspan="3">1. Connect to existing heat/cooling networks; - where the network has a decarbonisation plan</td></tr>
<tr><td>2. Establish a site wide heat/cooling network;</td><td rowspan="3">Technology</td><td>1. Systems using renewable/waste energy sources</td></tr>
<tr><td>3. Use building scale heat/cooling network;</td><td>2. Low carbon and low emission technologies</td></tr>
<tr><td>4 Use individual heating/cooling systems.</td><td>3. Conventional systems e.g. gas or direct electric</td></tr>
</table>

Measures should be incorporated at the earliest design stage of a development and maintained throughout the design, construction and operation of a proposal. All opportunities to maximise compatibility with future use of local and/or onsite low to zero carbon heating technologies must be identified and pursued.

A priority is to avoid installation of new gas heating systems in favour of systems that are compatible with a decarbonised future.

6.3.3 Evidence and Viability

A key step in being able to achieve net zero emissions across Leicester City will be the ability to satisfy its heating and cooling needs using low or zero carbon energy. To do this, it will be critical to increase the amount of decentralised and renewable energy technologies within the city. Providing on-site and decentralised energy systems can help to improve the resilience of an energy network and decrease pressures on grid infrastructure.

Having a hierarchy in policy ensures that developers revisit approaches to heating and cooling systems opening up the options to better integrate future-proofed systems and technologies. This policy doesn't mandate a specific outcome and therefore should not have an impact on viability yet helps to minimise the times a strategy is proposed without considering the wider context of a low carbon future.

The following recommendation (4) connection to heat networks links into this hierarchy by recognising that well thought out district networks offer a cost-effective route to decarbonisation with options to better levy a range of heat sources not typically available to individual developments.

To reach net zero carbon it is essential to remove fossil fuels as far as is possible. Alternative heating systems to gas boilers is possible and therefore there is a priority to avoid installing new boilers. ASHPs for example not only reduce emissions in the future, acting now can result in a whole life-cycle carbon reduction of 3x less than an equivalent gas boiler. Currently, however, the life-cycle cost benefits of gas boilers and the fact that regulations do not yet prevent their use, viability issues would prevent policy from definitively stating that they can't be used. It should, however, be made clear that gas heating is at the bottom of the hierarchy and alternatives will be received positively by the Council.

Direct electric resistance heating is compatible with a low carbon future, but the relatively high operating costs and wider impact on the electrical grid make it only appropriate for very low heat demand applications. Removing it as an option entirely may not be appropriate as for some applications the availability of very small capacity heat pumps on the market is limited and the payback periods far too long to be suitable given the relatively small benefit.

6.3.4 Implications for Implementation and Compliance

Guidance should be provided within an SPD to advise applicants as to how they can achieve this. Like previous recommendations, guidance documents detailing the methodology are helpful to achieving consistency across applications. Being clear as to how the policy should be achieved will make it easier for the Council to monitor and minimise the challenges on interpretation.

It is understood from discussing with the Council that there are some building typologies that have standardised approaches to heating that potentially do not align well with the hierarchy, e.g. student accommodation. We believe that the best way to address this will be in accompanying guidance, and whilst there are likely to be certain exceptions there are options to target measures at, in the case of student accommodation, domestic hot water consumption for example.

Reference to the heating and cooling networks is covered in more detail in the following recommendation.

6.3.5 Proposed Policy Wording

Low Carbon Heating and Cooling

To ensure that the most appropriate selection of a heating/ cooling system for a development, targeting the lowest CO_2 emissions possible, all major developments must incorporate low- or zero-carbon heating in accordance with the following system and technology hierarchy (ordered from highest to lowest preference):

<table>
<tr><td rowspan="4">System</td><td colspan="3">1. Connect to existing heat/cooling networks; - where the network has a decarbonisation plan and within 500m of the new development or LCC preidentified network connection zone.</td></tr>
<tr><td>2. Establish a site wide heat/cooling network;</td><td rowspan="3">Technology</td><td>1. Systems using renewable/waste energy sources</td></tr>
<tr><td>3. Use building scale heat/cooling network;</td><td>2. Low carbon and low emission technologies</td></tr>
<tr><td>4 Use individual heating/cooling systems.</td><td>3. Conventional systems e.g. gas or direct electric</td></tr>
</table>

Fossil fuels are not a compatible source of energy in a zero-carbon economy, for this reason avoiding installation of gas heating is preferred and such proposals will be well received by the Council. The whole life-cycle carbon emissions of gas boilers is much higher than an equivalent electric heat pumps. Efficient electric heating brings added benefits in the form of improved air quality, compliance with forthcoming regulations and avoids the need for future wholesale system changes.

Direct electric heating is compatible with a low carbon future, but the relatively high operating costs make it only appropriate for very low heat demand applications. Applicants should provide justification for its use instead of more energy efficient systems such as electric heat pumps.

6.4 [4] Connection to Heat Networks

Include a requirement for all suitable development near existing or planned heat networks to incorporate the necessary infrastructure to enable future connection.

6.4.1 Basis

The delivery and expansion of heat networks relies upon maximising the economies of scale and making use of available heating and cooling sources. New developments too can facilitate this through the design of new buildings to connect or tap into useful sources of energy for distribution and integration into wider heat networks. This can enable future connection and thereby support the creation and expansion of networks in the city.

6.4.2 Proposed Approach

Connecting to heating and cooling networks may not be viable as a new scheme is brought forward. This would be explored when responding to policy recommendation 3. Market forces, changes to legislation and availability of energy options all can, over time, vary the preferred solution within the heating and cooling system hierarchy. For this reason, it is important that developments are sufficiently flexible to accommodate future solutions, key of which is the potential to connect to expanding heat networks.

Policy will require that systems proposed can accommodate a degree of flexibility and adopt some of the key features required to make a future network connection viable. Specifically, we expect as a minimum, developments near existing or planned heat networks should be designed to allow for the cost-effective connection at a later date including the following features:

- Provision of a centralised heating/ cooling distribution in the form of a single energy centre/ plant room
- Suitable distribution, control systems and temperatures of operation
- Safeguarded access for external pipework through the site and into the energy centre/ plant room
- Space within the energy centre/ plant room for a future heat substation
- Compliance with CIBSE CP1: Heat networks: Code of Practice (latest revision)

6.4.3 Evidence and Viability

For commercial buildings the costs for designing a building to enable future connection to a heat network should be no greater than the alternative approach. The likely requirements include the location of the plant room, provision of space within the plant room for a heat exchanger, capped off connections to the flow and return pipework, lower temperature heating systems and the choice of control systems.

For residential buildings there could be additional costs associated with the communal heating network within blocks of flats if compared to individual heating systems such as gas boilers. As the shift towards electrified heat and transportation increases the demand on local infrastructure the impact on the cost of electrical connection is expected to come under pressure. The cost benefits of creating communal systems will likely therefore rebalance and become more viable.

Considering the national picture, the Government are committed to the expansion of heat networks take the existing Heat Network Investment Project (HNIP) and proposed Green Heat Network Fund (GHNF). This should provide confidence that it is appropriate to include policy that seeks greater accommodation for future connection.

The Government have recently published a consultation[142] on proposals to develop heat network zones across England. Having policy already incorporating the features to integrate simpler network expansion will allow more effective implementation of any future zones identified within the city for the wider national exercise.

6.4.4 Implications for Implementation and Compliance

Minimum and good practice standards are specified in the CIBSE Heat Network Code of Practice. Details on how developers could be expected to demonstrate compliance would need to be provided in the policy wording and/or associated technical guidance document.

Heating and cooling networks are not appropriate in all cases, hence the Government proposals to develop a national heat network zoning tool to priorities their expansion where it is the most effective solution. An initial simple approach of setting a 500m radius zone around existing or planned heating and cooling networks could eventually be replaced by future to be determined zones which will likely be more specific to local opportunities and constraints. These are to be included in the policy wording.

6.4.5 Proposed Policy Wording

Where it has been clearly demonstrated that connection to existing heating/ cooling networks are not feasible and/or viable (e.g. due to lack of heat & hot water demand and/ or lack of heat network capacity), development near (within 500m or a LCC preidentified network priority zone) existing or planned heat networks should be designed to allow for cost-effective connection at a later date by including the following features:

a) Provision of centralised heating/ cooling distribution in the form of a single accessible energy centre/ plant room

b) Suitable distribution, control systems and operating temperatures

c) Safeguarded access routes for future external pipework through the site and into the energy centre/ plant room

d) Space within the energy centre/ plant room for a future heat substation

e) Building system compliance with CIBSE CP1: Heat networks: Code of Practice (latest revision)

6.5 [5] Low and Zero Carbon Technologies

Require all development to provide details of the low and zero carbon energy technologies installed and the estimated reduction in CO_2 emissions these will deliver.

6.5.1 Basis

Leicester City Council is seeking to maximise the delivery of low and zero carbon (LZC) energy technologies associated with new development in the city. It is anticipated that developers will use LZCs to meet the elevated requirements expected from updates to the building regulations. Understanding what has been proposed will be important to support the Council in recording the types of technologies used and the scale of installations within Leicester. These records will help to verify the installation of the proposed systems and will also be important for supporting higher targets in the future by providing evidence of what has been achieved on delivered schemes.

6.5.2 Proposed Approach

All development should be required to provide specific details of the low and zero carbon energy technologies installed as part of the development. This should include details of the type of

[142] BEIS, *'Proposals for heat network zoning'* (2021). Available at: https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning

technology, the nature of the installation, the size/capacity of system installed and the estimated reduction in CO_2 emissions as well as providing evidence to substantiate the commitments.

The carbon reduction targets for new buildings will likely result in the installation of renewable energy generation technologies. There is an opportunity to seek better performance by requiring all new developments to demonstrate how the layout, orientation and massing has been designed to maximise energy efficiency opportunities including installation of on-site renewable and low carbon technologies. An Energy Statement would be required to contain a review of the potential to integrate and maximise renewable technologies.

The design and layout of new developments, and in particular the geometry and orientation of a building, can have a significant impact on the potential amount of renewable energy that can be generated on development sites. Furthermore, existing developments are often subject to structural constraints which limit the potential for the building to accommodate additional structural loadings. It is essential that developers maximise opportunities to incorporate LZC technologies.

6.5.3 Evidence and Viability

Building Regulations 25A already requires developers to assess the potential for using LZC technologies and specifically refers to investigating cogeneration, district heating/cooling, heat pumps and renewable energy technologies. It is anticipated that the additional requirements for details of the CO_2 savings, drawing/specifications and evidence of installation are unlikely to require significant additional work.

6.5.4 Implications for Implementation and Compliance

Developers should be required to clearly demonstrate the details of the LZC technologies being installed which can then be conditioned and checked before start on site and at practical completion, if required. A further step that could be taken in the future would be to ask for actual outputs of the systems over the first years of operation. As with the previous recommendations, for the Council this approach is likely to require some additional resource within the planning department to undertake the necessary compliance checking and monitoring and would require developers to provide additional details to demonstrate compliance, both of which could be mitigated by providing the technical guidance to show how compliance can be achieved and help to standardise the reporting.

6.5.5 Proposed Policy Wording

All major developments* will be required to provide an Energy Statement as described in the supporting technical guidance. The Statement will include details of the energy reduction measures proposed and details of the low and zero carbon energy technologies included. CO_2 reduction achieved from each stage of the energy hierarchy must be reported.

*all other applications can opt to submit an Energy Statement or include a relevant section in the Design and Access Statement addressing the relevant policy areas.

6.6 [6] Cooling Hierarchy

Require all developments to follow a clear cooling hierarchy.

6.6.1 Basis

It is well recognised that new homes and buildings are prone to overheat, particularly where the ventilation strategies have not been adequately considered. It is preferable to avoid installing cooling systems for several reasons including increased energy and carbon emissions during the summer and higher operational, maintenance and installation costs. There are many advantages to promoting natural, simple and resilient designs; including this in policy not only will benefit building occupants' thermal comfort but it also aligns with aims to reduce energy and carbon emissions.

Climate change is predicted to increase the risk of heat wave events. New homes and buildings can address this now and adopt strategies that are resilient to these changes. If robust approaches are taken, this lessens the need for future occupants to feel the need to retrofit cooling systems that increase energy demand.

A cooling hierarchy should be defined in a similar fashion to the energy hierarchy with natural and passive cooling options promoted above active energy intensive solutions. Not all proposals or applications warrant the sole reliance on natural or passive solutions, however, options to avoid or minimise active cooling solutions should be prioritised.

6.6.2 Proposed Approach

All development proposals should reduce the potential for internal overheating and reliance on air conditioning systems in accordance with a hierarchy that prioritises natural and passive measures over active cooling systems. Where active systems are necessary recover useful heat for other uses such as heat for domestic hot water.

6.6.3 Evidence and Viability

The policy does not specify a particular outcome or target performance and therefore should not have viability implications. Guidance within SPDs will likely require developers and their consultants to provide additional evidence that the hierarchy has been considered and explain how identified risks to future occupants have been addressed.

It should be noted that future Building Regulations in England are likely to include requirements to assess overheating risk in new homes. It is expected that the assessment will be more challenging to demonstrate compliance than past Regulations and careful consideration for the passive shading and natural ventilation measures included will be needed.

6.6.4 Implications for Implementation and Compliance

There are several guidance documents published to allow designers and developers to effectively assess their proposals including CIBSE TM52[143] and 59[144]. The assessment could be part of the Energy Statement as it is intrinsically linked to the wider energy and heat management strategy. Requirements for what analysis to undertake should be included in the policy guidance documents.

The Good Homes Alliance (GHA)[145] tool is an effective way for residential developers to understand the level of overheating risk and demonstrate where there is a need to undertake more detailed analysis. This approach has the benefit of highlighting key principles that are known to elevate or reduce risk such as size of windows and proximity of the site to sources of noise that could impact the practical use of window openings for ventilation. It would be relatively straightforward for the Council to review the GHA tool assumptions made by the developer and challenge these where necessary to ensure constraints are considered and mitigated.

There may well be conflict in Local Plan policy that promotes development of brownfield sites over greenfield. The latter is likely to have fewer ventilation constraints and therefore brownfield sites may need some degree of active cooling to mitigate ventilation limits. Cooling, although less preferrable and will increase energy demand, could be considered as a useful technology to enable greater use of brownfield sites and minimise development on virgin land. Using cooling heat recovery solutions to convert waste heat into energy for domestic hot water services can help to mitigate some of the issues that cooling systems bring.

[143] CIBSE TM52: The Limits of Thermal Comfort: Avoiding Overheating in European Buildings (2013)
[144] CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017)
[145] Good Homes Alliance, *'Overheating tool and guidance'*. Available at: https://goodhomes.org.uk/overheating-in-new-homes

6.6.5 Proposed Policy Wording

Minimise potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy (ordered from highest to lowest priority):

1) reducing the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure;
2) minimising internal heat generation through energy efficient design;
3) managing the heat within the building through exposed internal thermal mass (where appropriate) and high ceilings;
4) providing passive and cross ventilation;
5) providing mechanical ventilation;
6) providing active cooling systems and where possible recover waste heat.

6.7 [7] Whole Life-Cycle Carbon Emissions

Require developments to minimise whole life-cycle carbon emissions.

6.7.1 Basis

To reach net zero across the whole of the UK, it will be necessary to implement policies that address a broader range of emissions that occur over the building's lifecycle and at all stages of the supply chain. As well as regulated emissions, whole life-cycle carbon emissions include unregulated emissions, embodied emissions and emissions associated with maintenance, repair, replacement, demolition and disposal. Achieving significant improvements requires a cross-disciplinary approach (including planners, architects and engineers) and the greatest gains require intervention at the very start of the design lifecycle.

The need to address the whole-life cycle emissions associated with new development should therefore be considered at a policy level and encouraged for all new development.

6.7.2 Proposed Approach

It is worth noting that calculating whole life-cycle carbon emissions remains somewhat difficult and in its infancy. Whilst all development can take actions to minimise whole life-cycle carbon emissions, it may be worth providing a degree of flexibility in how different scales of development should demonstrate compliance with this policy, with larger scale development using a nationally recognised whole life-cycle carbon assessment. A threshold of 1,000sqm or 100 dwellings would be appropriate.

This could be used as evidence to support more specific whole life cycle carbon emission targets expected from new development in subsequent updates to the local plan.

6.7.3 Evidence and Viability

As regulated energy demands in buildings are driven down through more efficient fabric and services, the unregulated and 'embodied' emissions become a much higher proportion of the lifetime emissions, making it increasingly important to reduce these to meet the net zero target.

It is estimated that of the global cumulative carbon emissions associated with new development that will occur between now and 2050, around half will result from the embodied emissions that have occurred prior to operation.

To help reduce unregulated carbon emissions, several techniques could be adopted. These include:

- Requiring applicants to predict and report operational energy demands (including unregulated emissions) using a modelling methodology (e.g. CIBSE TM54) or monitored data from comparable buildings and putting measures in place to reduce these demands.

- Encouraging the use of industry performance standards such as those detailed previously, which set targets for operational energy as a whole, including unregulated emissions.

To help reduce lifetime carbon emissions, including embodied emissions, LCC could introduce a requirement for developments to undertake Lifecycle Carbon Assessment (LCA), which could help to determine the most effective approaches to reducing these emissions. This approach would tend to favour retrofitting and repurposing existing buildings rather than demolishing and rebuilding and would ensure that operational energy use is not the sole factor when considering carbon emissions. A range of guidance has been prepared to help practitioners undertake LCAs and reduce embodied carbon, including:

- RICS Professional Statement: Whole Life Carbon assessment for the built environment[146]
- UK Green Building Council, 'Embodied Carbon: Developing a Client Brief' (2017)[147]
- LETI Embodied Carbon Primer Supplementary Guidance to the Climate Emergency Design Guide (2020)[148]

There are also several industry tools that are being used by building practitioners to help appraise embodied and lifecycle emissions. These include but are not limited to eTool, One Click LCA and IES VE. These use libraries of embodied carbon data for standard building materials, products and building elements to derive an estimate of a building's embodied carbon from the quantum of materials and products used. These enable early comparison of design options.

In terms of viability the proposed approach is to only require assessment and consideration for measures to lower whole life-cycle carbon emissions. A target is not set, although future local plans or updates could include this policy change as the industry becomes more familiar with the carbon reduction options available.

6.7.4 **Implications for Implementation and Compliance**

The benefits of using operational energy demand modelling tools and undertaking life-cycle carbon assessments will only be realised if these tools are used at the very early stages of a project. It is expected that these assessments will not be required as part of Regulation in England and will therefore result in an additional planning cost to the developer. To avoid the use of these tools becoming a 'tick box' exercise, LCC should accompany any requirements for these assessments alongside guidance on the stage at which the assessments should be undertaken. LCC should also consider reviewing the outcomes of these assessments prior to planning application submissions.

Guidance should be provided within the SPD to advise applicants of the methodology required to demonstrate compliance with a policy. This will help to ensure consistency across applications and will make it easier for the Council to monitor and minimise the challenges on interpretation.

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[146] RICS, *'RICS Professional Statement: Whole Life Carbon assessment for the built environment*'. 1st edition. RICS. November 2017. Available at: https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf
[147] UKGBC, *'Embodied Carbon: developing a client brief'* (2017). Available at: https://www.ukgbc.org/wp-content/uploads/2017/09/UK-GBC-EC-Developing-Client-Brief.pdf
[148] LETI, *'Embodied Carbon Primer'* (2020). Available at: https://www.leti.london/ecp

6.7.5 Proposed Policy Wording

Whole Life-Cycle Carbon

All developments shall identify and pursue opportunities to minimise whole life cycle carbon emissions. The follow criteria should be considered when aiming to minimise whole life-cycle carbon:

a) Operational energy – Developments should achieve high levels of energy efficiency, use low-carbon heating sources and be powered by renewable energy to minimise operational carbon emissions

b) Embodied carbon – Developments should meet best practice targets for upfront embodied carbon. Its materials should be made from re-used materials and be designed to be disassembled (rather than demolished) in accordance with circular economy principles.

c) Developments above 1,000sqm or 100 dwellings must calculate and demonstrate methodology compliance through a nationally recognised Whole Life-Cycle Carbon Emissions assessment e.g. BS EN 15978.

6.8 [8] Existing Buildings

Positively support proposals that improve efficiencies and reduce emissions within the existing building stock.

6.8.1 Basis

Existing buildings account for a large proportion of carbon emissions in Leicester and is an area with huge scope to achieve carbon reductions. It is also likely that the promotion of minimising whole life cycle carbon will likely favour refurbishment, providing increasing opportunity for LCC to reduce emissions within this area. Some development proposals may also trigger a requirement for consequential improvements to be made under building regulations.

Therefore, the Local Plan and associated guidance should emphasise the importance of carrying out energy efficiency upgrades and incorporating LZC technologies in existing buildings, wherever possible, and make it explicitly clear that the local planning authority will positively support these measures. LCC should also ensure that the relevant supporting materials are kept up to date to reflect current policies and best practices.

It is worth noting that some retrofitting measures, such as external wall insultation, may affect the appearance of existing buildings and sometimes lead to unintended consequences, such as increasing likelihood of moisture damage. This is particularly acute when considering the impacts of retrofitting on heritage assets and developments in conservation areas. Therefore, it is important for applicants to ensure retrofitting measures are introduced in ways that are that are sensitive to amenity, heritage, and avoids unintended consequences for occupants.

6.8.2 Proposed Approach

Instead of requiring specific targets the intention is to promote measures to reduce energy demand and carbon emissions where it is appropriate to do so. The range of hierarchy's described in policy are usually appropriate to refurbishment projects as well as new developments. SPD guidance can reinforce this point and expand on any specific details that should be considered for existing Leicester City buildings.

6.8.3 Evidence and Viability

Unlikely to have viability implications as this only outlines a positive framework for applicants to improve the existing building stock. Refurbishment projects will like new developments benefit from the range of hierarchy approaches included in policy.

There are existing standards and approaches, such as EnerPHit and Energiesprong that are applicable to existing buildings and could therefore be encouraged through planning policy or associated guidance (see section 5.1 for further details). Although those generally represent best practice, they are often cost-prohibitive for individual property owners and are unlikely to be widely adopted without significant Government incentives. However, LCC could consider requiring these for major refurbishment schemes, where planning permission is required.

More broadly, while it may be difficult for the Council to actively promote uptake through its role as a Local Planning Authority, it can passively promote uptake by loosening restrictions on certain energy and carbon reduction measures where appropriate. One option would be to adopt a presumption in favour of certain measures such as roof-mounted PV, air source heat pumps and external wall insulation, which could be done, for example, by issuing a Local Development Order (LDO) or otherwise extending permitted development rights, or implementing a 'fast track' that reduces the burden on applicants of submitting a full planning application.

LCC should review opportunities to promote energy efficiency measures and LZC uptake in existing buildings and ensure that any existing or planned initiatives / areas of influence are consistent with the net zero targets. This could include the following:

- **Existing or planned initiatives aimed at reducing fuel poverty** – It is important that any advice given, or measures implemented, as part of these initiatives either directly contribute towards reducing energy demands and facilitating a switch towards the use of renewable fuels or, at least, are futureproofed to ensure that this can happen at a later date while avoiding unintended negative consequences. For example, this would mean providing funding for electric heating systems (especially heat pumps) and rooftop PV instead of new gas boilers.
- **Existing or planned initiatives aimed at helping local organisations and businesses to reduce energy use** – For instance, if the Council provides subsidised energy audits or other advice. Similar considerations apply as for fuel poverty initiatives (see previous bullet point).
- **Enforcement of the Minimum Energy Efficiency Standards** (MEES)[149] – Since 1st April 2018, any properties newly rented out in the private sector have been required to have a minimum Energy Performance Certificate (EPC) rating of E (some exceptions apply, for example in the case of Listed buildings). Owners of buildings with a lower EPC rating will be required to implement energy efficiency measures, though consideration will be given to financial viability, the anticipated payback time and impacts on property value. Over time, the Government intends to progressively increase the minimum EPC rating, meaning that buildings must become more efficient in order to be sold or rented.[150] Local Authorities are responsible for enforcing MEES and fines can be issued for non-compliance.
- **Enforcement of Building Regulations Part L2B** – This regulation stipulates that, when undertaking certain types of work on existing non-domestic buildings over 1,000 m^2 in floor area, energy efficiency measures must be introduced to improve the performance of the building, known as a 'consequential improvements' policy.

It is advised that LCC should also continue to actively work to identify and secure funding for retrofitting measures and lobby the Government to promote further improvements in this area.

6.8.4 Implications for Implementation and Compliance

The Local Plan and associated guidance should emphasise the importance of carrying out energy efficiency upgrades and incorporating LZC technologies in existing buildings, wherever possible, and make it explicitly clear that LCC considers this to be a priority. LCC should also ensure that the relevant Supplementary Planning Document (SPD) is kept up-to-date to reflect current policies and best practices. Where the benefits of retaining buildings and reducing embodied carbon emissions are considered as part of carbon reduction targets a methodology must be established for this approach to be applied consistently.

149 The *'Energy Efficiency (Private Rented Property) (England and Wales)'* Regulations 2015 introduced the Minimum Energy Efficiency Standard (MEES) for buildings across the UK. For further information, see https://www.gov.uk/government/publications/the-private-rented-property-minimum-standard-landlord-guidance-documents
150 BEIS, *'The Non-Domestic Private Sector Minimum Energy Efficiency Standards: The Future Trajectory to 2030'* (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/839362/future-trajectory-non-dom-prs-regulations-consultation.pdf

The UK Green Building Council (UKGB) has developed *'The Retrofit Playbook'* for Local Authorities to advise on different methods for supporting residents in increasing the energy performance of their homes.[151] LCC can refer to the Retrofit Playbook for further information.

LCC should ensure that the Local Plan and associated guidance make it explicitly clear that sustainability measures are permitted in historic buildings and conservation areas, provided that they are carried out in line with best practice guidance, with consultation from appropriate stakeholders e.g. Historic England. LCC could also encourage applicants to follow the process set out in the Historic England report, *'How to Improve Energy Efficiency in Historic Buildings'* (2018) when identifying suitable intervention measures.

For buildings that are either owned and / or operated by LCC, it is recommended that the Council takes a leadership role in reducing carbon emissions through actions such as the following (if these have not already been adopted):

- Carrying out an assessment of the energy demands and carbon emissions from existing buildings, if this information is not already held, and then developing an appropriate carbon management and reduction strategy.
- Reviewing leasing / tenancy arrangements to understand what interventions could be implemented in properties that are owned, but not operated, by the Council, and vice-versa.
- Based on the findings of those assessments, the Council should then adopt targets for existing buildings, any future developments and any refurbishment schemes, e.g. net zero operational carbon emissions, potentially as part of a Sustainable Design Code for Council assets.
- Initiate a dialogue with occupants of Council-owned buildings to build support for, and communicate the benefits of, energy and carbon saving measures that will require their engagement.
- Implement the energy and carbon saving measures across all Council-owned buildings, monitor the outcomes and publicise any lessons learned to help promote uptake of such measures across the wider stock.

6.9 [9] Energy Statement

Include a requirement for all major developments to complete an energy statement to demonstrate compliance with the relevant policies.

6.9.1 Basis

Requiring all new development to submit an Energy Statement and providing clear guidance of the required format and content of this document, will better ensure that all new development complies with the requirements of policy.

To reduce carbon emissions effectively, policy should require that energy strategies are developed using the energy hierarchy, which classifies energy options to reduces demand before using energy efficient technologies and LZCs to meet residual demand.

Energy Statements can be used to demonstrate that developments comply with energy related policies, including the energy hierarchy, and help to ensure that energy is an integral part of the development's design and evolution. A checklist is an option, but it is better reserved for smaller schemes where additional design fees are less viable; for larger schemes it is appropriate to have a fuller response to the policy.

To achieve better consistency of responses from developers and clarify the Council's expectations for the level of detail and content, the policy should be accompanied by guidance on how to prepare the statements. Where LCC has details on existing opportunities in the District such as existing or

[151] UK Green Building Council, '*The Retrofit Playbook*' (2020). Available at: https://www.ukgbc.org/ukgbc-work/driving-retrofit-of-existing-homes/

planned heat networks and sources of waste or renewable heat this can be shared and an evidenced investigation provided.

6.9.2 Proposed Approach

As a minimum, energy statements should contain the following information:

- Calculation of the energy demand and carbon emissions covered by Building Regulations.
- Proposals to reduce carbon emissions beyond Building Regulations through the energy efficient design of the site, buildings and services, including passive heating and cooling measures, and a calculation of carbon emission reductions from these actions.
- Proposals to further reduce carbon emissions through the use of zero or low-emission decentralised energy where feasible, prioritising connection to district heating and cooling networks and utilising local secondary heat sources. Proposals that connect to or create new heat networks should include details of the design and specification criteria and standards for their systems
- Proposals to further reduce carbon emissions by maximising opportunities to produce and use renewable energy on-site, utilising storage technologies where appropriate, including details of the size/capacity of the systems and the estimated CO_2 savings that will be achieved.
- Proposals for demand-side response, such as the installation of smart meters, minimising peak energy demand and promoting short-term energy storage, as well as consideration of smart grids and local micro grids where feasible.
- Cumulative estimated carbon emissions savings from Be Lean, Be Clean and Be Green measures.
- Proposals explaining how the site has been future proofed to achieve carbon neutrality by 2030 wherever possible.
- Actions to reduce life-cycle carbon emissions. Larger scale development should calculate and demonstrate compliance through the use of a whole life-cycle carbon emissions assessment.

6.9.3 Evidence and Viability

Developments reduce emissions most effectively where the energy hierarchy is followed. Energy Statements are an effective way to ensure new developments follow the energy hierarchy and respond to any other energy related policy set by LCC. Making the Energy Statement (or checklist) a planning application validation document will encourage the developer to consider, early in the design process, the policy responses and potential to integrate good strategies to reduce energy and carbon emissions.

The Energy Statement guidance provided to developers can help to encourage consideration of surrounding opportunities for a given site and offers a good platform for communicating this to prospective developers before designs have been finalised. This process helps to minimise missed viable opportunities from being locked out through lack of information and knowledge during the early design phases.

6.9.4 Implications for Implementation and Compliance

The requirement for an Energy Statement or a checklist with supporting information could be used to ensure developments achieve policy compliance from an energy/carbon perspective. This would require applicants to provide details of how each step of the energy hierarchy had been addressed and the estimated carbon emission reductions delivered at each of these steps. It is recommended that the energy hierarchy should apply directly to all new development, both domestic and non-domestic, so that all proposals follow a similar approach in achieving energy and carbon reductions.

Guidance on the Energy Statement calculation methodology and structure expected should be provided either within the Local Plan or SPD. Providing this detail will help ensure consistency across applications, making it easier for the Council to monitor, review and compare submissions. For an example, see the GLA's 'Energy Assessment Guidance' document[152].

6.9.5 Proposed Policy Wording

All major developments* will be required to provide an Energy Statement as described in the supporting technical guidance. The Statement will include details of the energy reduction measures proposed and details of the low and zero carbon energy technologies included. CO_2 reduction achieved from each stage of the energy hierarchy must be reported.

*all other applications can opt to submit an Energy Statement or include a relevant section in the Design and Access Statement addressing the relevant policy areas.

6.10 [10] Water Efficiency

All new developments should seek to maximise water efficiency on site.

6.10.1 Basis

Leicester is currently classed as an area with 'moderate' water stress. In future, it is anticipated that demand for water will increase while supply decreases. It is not only important to conserve water due to the expected effects of climate change to water availability, but also due to the energy use and carbon emissions associated with its treatment and supply. The CCC suggests that, on average, the UK should aim to reduce household water consumption to 'well below' 100 L/p/d, so this policy aims to ensure that all new developments align with that recommendation.

LCC has an existing policy that seeks to minimise water demand and maximise water efficiencies. There is an opportunity for the council to incorporate specific standards to support the emerging policy. We would recommend LCC require all new domestic developments to reach the optional numerical targets in Part G of Building Regulations (110 L/p/d) and include rainwater collection as standard if the proposed development includes landscaped areas.

6.10.2 Proposed Approach

All development proposals should seek to minimise the use of mains water through adoption of water saving measures (e.g. smart meters), fittings and appliances. Refurbishment schemes will be expected to retrofit such measures.

Many of these features are adopted as standard on new developments given Part G of Building Regulations but setting it in policy and providing relevant SPD guidance will help it to be more successfully integrated into design. It will increase the potential for opportunities such as water recycling and rainwater harvesting to be considered earlier in the design process and thus be more feasible.

6.10.3 Evidence and Viability

The viability implications of requiring the optional Part G standards for new dwellings is likely to be limited.

6.10.4 Implications for Implementation and Compliance

New dwellings will be required to submit a Part G calculation and therefore a predefined methodology is set to determine the numerical value for water consumption. It is possible for a developer to agree an informed and tested water efficiency target such as 110 L/p/d and subsequently provide LCC planners with the evidence submitted as part of the Building Control approvals.

[152] GLA, Energy Planning Guidance. Available at: https://www.london.gov.uk/what-we-do/planning/planning-applications-and-decisions/pre-planning-application-meeting-service-0

Planning officers would likely need to set this as a condition to be met however then evidence will need to be completed regardless of the planning application and therefore does not reflect a significant additional resource burden on the developer or planning authority.

6.10.5 Proposed Policy Wording

Minimised use of mains water through adoption of water saving measures, fittings and appliances.

- Domestic developments should be designed to achieve a maximum of 110 litres per person per day, in line with the Optional Standard of Building Regulations Part G.
- Non-domestic developments should be designed to achieve the maximum available credits under BREEAM Wat 01 or an equivalent best practice standard.

6.11 [11] Sustainability Assessments

Encourage use of third-party assessments as an alternative approach to demonstrative compliance with the sustainable design and construction policies.

6.11.1 Basis

Many local authorities include environmental assessment scheme requirements, such as BREEAM, in Local Plan policies. Relevant schemes for new build include BREEAM (non-domestic) and Home Quality Mark (domestic). The Home Quality Mark (HQM) was developed as a replacement for the Code for Sustainable Homes (CSH), however, has not been adopted widely as a mandatory requirement. BREEAM mandatory assessments and certification on the other hand is regularly included in planning policy.

The objectives of the building assessment methods are to improve the sustainability of new developments and minimise their environmental impact. This aligns well with many of LCC's ambitions, including reducing energy and carbon emissions. As a third-party assessment procedure, it offers an accredited and industry recognised approach to verifying the standard achieved and minimises the resources required for the local planning authority to evaluate submissions. Using third party certification schemes can also help to narrow the performance gap.

It is worth noting there are some disadvantages to using third party assessments as less focus can be placed on targeting measures that fully align with net zero carbon than desired by the Council and secondly, the assessments will result in greater development cost.

The use of industry standards and assessment methods with a focus to demonstrate carbon reductions beyond the requirement of Building Regulations is widely supported, as there is the potential for these to help deliver buildings where energy efficiency is a key driver for the design and where as-built performance is more likely to align with the design intent.

Developers of new build and refurbishment projects can be encouraged to use performance standards, such as Passivhaus, Passivhaus Plus, EnerPHit, Energiesprong and AECB Silver Standard to achieve carbon reductions in both domestic and non-domestic development. This would be in addition the Building Regulations compliance.

Passivhaus

The Passivhaus standard involves a focus on taking steps to ensure very high thermal efficiency and comfort, particularly through 'passive' measures relating to building form and fabric, and therefore very low energy inputs for heating. The standard includes an annual space heating target of 15 kWh/m^2. It is recognised as an approach that is effective at delivering very low energy demand in practice, assuming full certification is achieved. The method is based on energy demand rather than carbon emissions so does not focus on low carbon heating sources. However, the Passivhaus Institute has also developed the Passivhaus Plus standard; this scheme requires renewable energy generation on-site or nearby, resulting in net zero emissions.

The Passivhaus standard is designed for new build developments (domestic or non-domestic). EnerPHit is the Passivhaus Trust's standard which can be applied to refurbishment schemes. This standard allows a slight relaxation in the space heating targets (20-25 kWh/m^2 depending on location), recognising that the form of the building cannot easily be changed in refurbishment, and improvements to some building elements may not be possible.

Energiesprong

Originally developed by the Dutch government, this assessment method is designed to be used as part of either new build or building refurbishment schemes, although it is designed for residential schemes only. The methodology involves a focus on achieving minimum performance standards for building elements and fixed services and, like the Passivhaus methodologies, both regulated and unregulated emissions are taken into account.

AECB Silver Standard

An alternative approach to applying quality assurance to the design process and helping eliminate the performance gap is the Association of Energy Conscious Builders' Silver Standard. AECB encourages its members to adopt this standard for their projects. AECB estimates that applying to the standard will reduce overall carbon emissions by around 70% for most building types. Unlike Passivhaus there is no third-party assurance process. Member consultants self-certify and take responsibility for underwriting the Silver Standard claim. The AECB provides a form of declaration for completion by the certifying consultant but will deliberately not audit or take responsibility for the certification.

The AECB Silver Standard uses a similar approach to the Passivhaus methodology but is not as rigorous as Passivhaus or EnerPHit certification, in terms of approvals and third-party certification.

6.11.2 Proposed Approach

The Council will encourage use of third-party assessments to demonstrate compliance with the sustainable design and construction policies. Further details of acceptable alternative assessments and equivalent standards will be provided in supporting guidance.

6.11.3 Evidence and Viability

The approach, which is optional, offers developers flexibility to use third-party assessments to demonstrate compliance and therefore the addition is therefore unlikely to have viability implications.

The Committee on Climate Change (CCC) recommends that space heating demand is reduced to 15 kWh/m^2/year and the LETI Design Guide considers how to achieve this for both domestic and non-domestic buildings. However, there is limited guidance on what modelling methodologies should be used to demonstrate that the targets are met at design stage. For instance, it has been found that the current planning requirement of using the Building Regulations Part L modelling methodologies to demonstrate energy performance would broadly show a 15 kWh/m^2 for buildings meeting the London Plan energy efficiency requirements without some of the more stretching requirements, such as triple glazed windows or very low air permeability rates. It is, therefore, not recommended to set such a target unless a more accurate modelling methodology is agreed.

The Passivhaus Planning Package (PHPP) modelling software could be encouraged to be adopted by applicants to estimate energy demand more accurately. For non-domestic buildings, either the PHPP software or CIBSE TM54 methodology could be followed to more accurately predict the space heating demand and develop a strategy for meeting the 15 kWh/m^2 target. A more stringent target would be to set requirements to deliver homes (and non-domestic buildings) to meet the Passivhaus Standards. The key benefit would be the closely checked design and construction process which would reliably bring annual space heating demands down to less than 15 kWh/m^2.

6.11.4 Implications for Implementation and Compliance

Clear guidance must be provided by the local authority for acceptable alternative assessments, standards and any specific ratings that must be achieved. The intention is that the approach is voluntary as an alternative to specifically addressing some of the local plan policy. Once committed adherence with the proposal should normally be conditioned with the expectation that the developer will provide the relevant certification upon completion of the project.

At present there are relatively few qualified and experienced Passivhaus assessors so setting Passivhaus as a blanket requirement for all new development may not be realistic. Passivhaus uses its own calculation (the PHPP) so two sets of calculations would need to be run, one to meet Building Regulations and one for Passivhaus. Instead LCC could include information highlighting the benefits that Passivhaus offers in terms of a quality assured outcome, low energy demand and low running costs, and encourage voluntary adoption of Passivhaus Standards.

The, now retracted, GLA SPD on Sustainable Design and Construction took the approach of setting requirements at two levels: the Mayor's Priority and the Mayor's Best Practice. LCC could take a similar approach with the option of requiring Passivhaus (or one of the alternative performance standards mentioned above) for certain schemes.

6.11.5 Recommendation

Within supplementary guidance that accompanies the local plan and its policies it is recommended that a range of third-party assessments and an acceptable rating level for each are proposed as alternatives to some of the policy targets such as carbon reduction and water efficiency. Areas of policy excluded should be addressing the heating system and energy hierarchies, for example.

BRE has produced a set of guidance documents[153] to support policymakers in understanding how BREEAM and HQM can be incorporated into planning policy, along with sample policy wording and guidance on the different target ratings and schemes typically applied to various development types. Local Authorities would need to decide what target rating to set.

6.12 [12] Policy Technical Guidance

Produce a technical guidance document to support developers in complying with the policy requirements.

6.12.1 Basis

As noted in several of the previous recommendations, a technical guidance document would support developers in better understanding the requirements complying with the policies, approaches to take and how to demonstrate this in their planning applications. It would also help to standardise the energy and sustainability statements submitted at planning to enable LCC to verify compliance more easily.

A technical guidance note could also be updated more easily than the policy itself in order to reflect changes in national policy or revisions to calculation methodologies and assessment, such as the proposed updates to SAP and BREEAM.

6.12.2 Proposed approach

We would recommend producing a technical guidance document alongside the climate change and flooding chapters to clearly show how developments are required to demonstrate compliance with the relevant planning policies in relation to energy and sustainability. As noted in the previous recommendations, the adopted policy itself could then refer to this document.

As a minimum, the technical guidance should include the following:

- A more detailed description of the policy requirements (providing more specific details and clarifications than can be presented in the policy wording);
- Guidance on measures to deliver compliance with the Be Lean carbon emissions targets;

[153] BREEAM, *'Local Planning and BREEAM'*. Available at: https://www.breeam.com/engage/research-and-development/consultation-engagement/local-government/

- Detailed description of the approach to carrying out the energy and carbon calculations (based on compliance models and methods), specifying the process required, modelling and calculations to be undertaken and clarifying the assumptions to be used;
- Detailed description of the specific outputs of the energy and carbon calculations including templates of the results tables to be completed;
- Details of the supporting information required to verify the proposed approach, including tables showing the proposed performance specification, relevant drawings and outputs of the modelling (SAP/BRUKL documents);
- More detailed description of the sustainable design and construction requirements and guidance on measures to deliver compliance; and
- An updated checklist/proforma for developers to complete to demonstrate the approach being taken and performance against the sustainable design and construction requirements.

6.12.3 Evidence and Viability

As noted in the previous recommendations it is hoped that a clear and informative technical guidance document would support developers in providing details of measures that can be adopted to deliver compliance and standardise the required outputs to demonstrate compliance has been achieved.

The basis for the energy and carbon calculations referenced above will be the compliance assessments required in England with the intention that the burden of additional analysis reduces adherence with policy and extends planning determination periods.

As the guidance will supplement the policy it will need to be reviewed to ensure that new viability implications that could be challenged are not identified once implemented.

6.12.4 Implications for Implementation and Compliance

The technical guidance is intended to make both compliance and verification more straightforward to assist both developers and LCC in delivering the policies in the adopted local plan. This could also be provided in the form of an online tool for developers to use.

6.12.5 Recommendation

LCC should prepare a suitable technical guidance document to accompany the new local plan. It should align with the policy requirements and include clear descriptions of what information to provide. It is anticipated the information needed will align with existing calculations that developers are required to do such as Building Regulation calculations.

6.13 [13] Carbon Offset Scheme

Consider establishing a carbon offset scheme.

6.13.1 Basis

The carbon reduction targets are considered to be feasible for most building types and in most locations, there may be exceptional cases where for technical or financial reasons the target is difficult to achieve. In these cases, a carbon offset arrangement could be used to assist developers in demonstrating compliance.

Setting a carbon price could also assist in supporting a trajectory for future carbon reduction in all sectors in the city towards very low/zero carbon including:

- Energy efficiency measures in the local building stock;
- Projects that help to shift towards the use of sustainable transport;

- Local renewable energy projects; and
- Tree planting and other forms of land management to promote carbon sequestration.

LCC would need to ensure that any projects align with defined carbon reduction priorities for the City and develop project evaluation criteria that account for e.g. carbon cost effectiveness (£/t CO_2) and co-benefits. Further detail is included in Appendix B.

6.13.2 Proposed Approach

The recommendation is to consider setting up a carbon offset scheme but do not include in this local plan policy given the uncertainties of the investment needed to set up and manage the scheme. It should continue to be considered for future policy and potentially where carbon reduction targets push further, and on-site measures become more challenging to achieve these.

6.13.3 Evidence and Viability

It is widely recognised that offsetting carbon emissions will play an important role in the short, medium, and long-term strategies to reach net zero carbon. It is also understood that offsetting should not be the preferred option to reduce emissions.

As carbon reduction targets for new developments become more onerous inevitably there will be occasions that a particular site or building type constraint will mean the target cannot practically be reached within the measures proposed for the site. An offset fund provides developers with the mechanism to achieve policy compliance whilst providing local investment to reduce the City's emissions. The fund would need to be ring fenced for carbon reduction projects.

6.13.4 Implications for Implementation and Compliance

If LCC was to establish a Carbon Offset Fund, it would need to set a price per tCO_2 emitted by new development. This payment would be made to cover the remaining balance over a set lifetime of any development which fails to meet the Council's emissions reduction target. The Greater London Authority (GLA) has suggested a carbon price of £95/tCO_2 for a 30-year lifetime of new build be imposed by London Councils, and this may be suitable for LCC. The council would need to ensure that the carbon offset price covered the cost of offsetting the required quantity of carbon and additionality.

Managing the fund and seeking suitable projects for investment is a resource intensive task and would need dedicated input to ensure its success. It will also need to ensure that it is transparent and that the investments appropriately record reductions and that the carbon quantity has additionality.

Although the funds will be ring fenced and the price set at a level that should have the potential to deliver an equivalent carbon reduction, the local projects that receive investment may not be able to deliver the same reduction. The price will need to be considered carefully including recognising that developers may consider paying an offset rather than investigating the potential on-site options fully. There is therefore a balance to be considered between providing the opportunity for all sites to be policy compliant and having the unintended consequence that some developments don't maximise their potential.

A further consideration is whether the policy will seek to address the emissions other than those regulated. This and other details will need to be included in guidance document providing the methodology for developers to follow.

Appendix A – Key Paragraphs of the NPPF

The key paragraphs relevant to this study are from the National Planning Policy Framework are taken from chapter 14 about meeting the challenge of climate change, flooding and coastal change

152. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

153. […], taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

154. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

155. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.

156. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

157. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

158. When determining planning applications for renewable and low carbon development, local planning authorities should:

a) 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; and

b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Appendix B – Carbon Offset Funds

This Appendix describes the potential to establish a carbon offset fund for the City of Leicester. It includes an overview of best practices in carbon offsetting, describes the types of projects that could be undertaken and their typical costs, and then presents a rough estimate of the scale of fund that might be generated from implementing a Net Zero target for all new development in the City. Then, it describes some of the practical implications and policy context that should be considered by LCC when setting up such a fund.

What is Carbon Offsetting?

Definition

'Carbon offsetting' refers to compensating for carbon dioxide (CO_2) or other greenhouse gas (GHG) emissions in one area by taking actions that reduce emissions elsewhere. In the words of the Carbon Trust: [154]

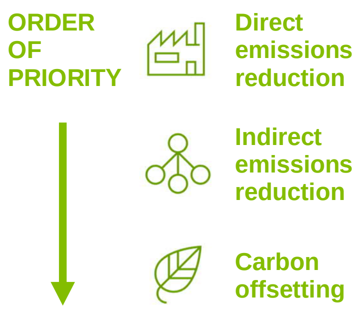
> *"Carbon offsets are generated from projects that avoid or absorb/sequester carbon dioxide, or any of the other main greenhouse gases […] These projects can take various forms, including renewable power, energy efficiency, fuel switching [e.g. from natural gas to electricity], reforestation, or destruction of greenhouse gases."*

The key benefit of carbon offsetting is that it provides an opportunity to reduce the global warming impacts of human activities that would otherwise be difficult to abate, such as CO_2 emissions from aviation or methane (CH_4) emissions from livestock. For this reason, carbon offsetting is recognised as an important step towards delivering the UK's target of achieving Net Zero emissions by 2050.[155]

Best Practices in Carbon Offsetting

Although carbon offsetting can be beneficial where these funds are used for energy efficiency and carbon reduction projects that are actually delivered, and where the savings can be proven, the practice has also been criticised for diverting resources away from projects or measures that avoid carbon emissions in the first place, such as demand reduction.

When developing a strategy for carbon offsetting, the most important guiding principle is that *it should be a last resort where other opportunities for reducing direct and indirect CO_2 emissions have been prioritised*. This hierarchy, illustrated in the diagram to the right, is crucial for developing a cost effective, socially responsible and robust carbon management plan.[156]



With that in mind, any carbon offsetting strategy should adhere to the following best practice principles, which are based on guidance from the Carbon Trust and the International Carbon Reduction and Offset Alliance (IOCA).[154,157] Carbon offsetting projects should be:

- *Additional* – To qualify as an offset, the reductions achieved by a project need to be additional to what would have happened in the absence of the project.
- *Permanent* – The offset should have a lasting, permanent effect.
- *Real* – The offset must be possible to implement and the impact of the offset quantifiable.
- *Verifiable* – In order to provide assurance on the quality and credibility of the offsetting project, ideally the project should be verified through a viable standard or offsetting scheme.

[154] Carbon Trust, *'The Carbon Trust three stage approach to developing a robust offsetting strategy'* (2006). Available at: https://www.carbontrust.com/resources/developing-a-robust-carbon-offsetting-strategy
[155] Committee on Climate Change, *'Net Zero – The UK's contribution to stopping global warming'* (2019). Available at: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/ Note a difference in terminology: the CCC report describes biological solutions in the section on 'reducing emissions in the land use sector' and technological solutions as 'greenhouse gas removal' or GGR, rather than 'carbon offsetting'.
[156] Adapted from *'Figure 1: The Carbon Trust three stage approach to developing a robust carbon management strategy'* (2006).
[157] International Caron Reduction & Offset Alliance, *'Code of Best Practices'* (Established in 2008). Available at: https://www.icroa.org/code

- *Traceable* – The offset must be transparent and provide proof of the offset through monitoring and regular reporting, ensuring traceable progress and commitment to offsetting best practices.
- *Designed to minimise leakage* – The project must be designed to ensure that there are no increases in emissions beyond the project boundary attributable to the project activity, a phenomenon known as 'leakage'.

Although the primary focus is on reducing emissions, where possible, projects should maximise co-benefits that address broader sustainable development goals. Examples include but are not limited to: Improving air quality and biodiversity, reducing fuel poverty, and supporting the local economy through jobs and investment.

Rationale for Establishing a Carbon Offset Fund

Depending on the type of development in question, it may not be feasible to deliver the requisite level of CO_2 emissions reduction onsite. In this instance, some jurisdictions allow developers to make a financial contribution towards a carbon offset fund. The money can then be used to pay for interventions off site that would result in an equivalent amount of CO_2 being avoided (e.g. through energy efficiency measures or LZC projects) or removed from the atmosphere (e.g. through afforestation).

For example, the Greater London Authority (GLA) requires all new domestic developments to achieve a CO_2 saving of 100% compared with the CO_2 emission standards set out in Part L (2013) of the Building Regulations. A minimum 35% saving must be achieved through onsite measures, while the remainder can be offset via a financial settlement known as a Carbon Offset Payment. Payments to the GLA are currently based on a carbon price of £60 per tonne of CO_2[158] over thirty years. The soon to be adopted draft new London Plan will increase this to £95 per tonne of CO_2 over thirty years. All payments need to be completed prior to occupancy. The fund itself is ringfenced and can only be used for the purposes of funding carbon offset projects elsewhere in the respective borough.

Opportunities for LCC

Potential Carbon Offsetting Projects

There are a wide range of potential projects that a carbon offsetting fund could support. These could include:

- Energy efficiency measures in the local building stock;
- Projects that help to shift towards the use of sustainable transport;
- Local renewable energy projects; and
- Tree planting and other forms of land management to promote carbon sequestration.

LCC would need to ensure that any projects align with defined carbon reduction priorities for the City and develop project evaluation criteria that account for e.g. carbon cost effectiveness (£/t CO_2), co-benefits, and so on.

Tree saplings in protective sleeves planted as part of a new woodland.

[158] GLA, *'Carbon Offset Funds: Guidance for London's Local Planning Authorities'* (2018). Available at: https://www.london.gov.uk/sites/default/files/carbon_offsett_funds_guidance_2018.pdf

Projects should be carried out locally where possible, and there may be an opportunity to deliver some of them on Council-owned land or buildings (such as roof-mounted PV or tree planting). Other public-sector buildings and land, such as schools and hospitals, could also be used.

For context, the table below shows indicative costs for a range of domestic energy efficiency measures and projects that could be carried out using carbon offsetting funds.[159] It also shows typical carbon savings (based on estimates provided in the reference documents) per typical dwelling. Note that costs and carbon savings depend on the project in question, and carbon savings also vary over time depending on factors such as electricity grid decarbonisation, so these figures are compiled from a number of sources and are provided for information only.

Indicative costs of domestic energy efficiency retrofitting measures and LZC installations

	Installation cost (£)	Annual carbon savings ($kgCO_2$)	Lifetime of installation (years)	Lifetime carbon savings (tCO_2)	Lifetime cost of carbon (£/tCO_2)	Ref.
Individual measures						
Cavity wall insulation	£595	577	42	24	£25	[a]
	£345-£610	335-1,150	-	-	-	[b]
Internal solid wall insulation	£5,300	1,187	36	43	£124	[a]
	£7,400	510-1,720	-	-	-	[b]
External solid wall insulation	£8,100	1,187	36	43	£190	[a]
	£13,000	510-1,720	-	-	-	[b]
Loft insulation	£300	108	42	5	£66	[a]
Loft insulation (add 270mm insulation to uninsulated loft)	£285-£395	550-1,030	-	-	-	[b]
Loft insulation (top up from 120mm to 270mm insulation)	£230-£290	50-95	-	-	-	[b]
Double glazing	£4,500	492	20	10	£457	[a]
Flat roof insulation	£1,050	594	20	12	£88	[a]
Floor insulation	£520-£1,300	120-310	-	-	-	[b]
Draughtproofing	£100	140	10	1	£71	[a]
	£200	-	-	-	-	[b]
Whole house refurbishment (see notes below)	£6,895-£14,400	1,215	30	36	£269	[a]
Whole house refurbishment (Energiesprong standard)	£35,000-£75,000	-	30	-	-	[c]
Whole house refurbishment (CCC, 2019)	£16,000-£25,000	-	30	-	-	[d]
Whole house refurbishment (EnerPHit case study)	Approx. £39,000	-	30	-	-	[e]

[159] AECOM on behalf of Greater London Authority, *'London Carbon Offset Price'* (2017). Available at: https://www.london.gov.uk/sites/default/files/london_carbon_offset_price_-_aecom_.pdf

Renewable energy technologies						
1MW wind turbine	£1,000,000	317,355	25	7,934	£126	[f]
1MW ground-mounted PV	£600,000	117,283	25	2,932	£205	[f]
1MW roof-mounted PV	£1,000,000	117,283	25	2,932	£341	[g]
Domestic solar water heating (approx. 3kW)	£4,615	289	20	6	£798	[a]

References

[a] AECOM, *'London Carbon Offset Price'* (2017). Figures are based on the Green Deal impact assessment carried out by the Department of Energy and Climate Change in 2012. In this instance, 'Whole house refurbishment' includes wall, loft and floor insulation, new double glazing, doors and draughtproofing.

[b] Energy Saving Trust estimate 2020. Available at: https://energysavingtrust.org.uk/

[c] Green Alliance, *'Reinventing Retrofit: How to scale up home energy efficiency in the UK'* (2019)

[d] Committee on Climate Change, *'Costs and benefits of tighter standards for new buildings'* (2019)

[e] Based on a case study reported by Passivhaus Trust, *'UK's first pre-certified step-by-step EnerPHit'* (2018)

[f] AECOM estimate 2020

[g] BEIS, *'MCS Installation Database - Small scale solar PV cost data'* (2019)

Potential Scale of the Carbon Offset Fund

Based on the new development figures provided by LCC, it is possible to make a rough estimate of the scale of carbon offset fund that could be generated annually via developer payments. In this illustrative example, key assumptions are as follows:

- It is assumed that LCC will set a target of Net Zero regulated emissions for all new developments, recognising that the Council has voted to declare a Climate Emergency. The calculation assumes that 100% of new dwellings are required to meet the Net Zero target, i.e. there is no size threshold for the scale of development that the policy applies to.
- The annual, regulated CO_2 emissions for a new home built to Part L 2013 standards are assumed to be 1.31 tCO_2 per year per dwelling, based on analysis of Energy Performance Certificate (EPC) data for all new buildings completed in Leicester since 2013.[160] In addition, to reflect potential future changes in Building Regulations, figures are provided for the improved standards outlined in the FHS Consultation:
    - Option 1: 20% improvement on Part L 2013 → 1.04 t CO_2 per dwelling per year
    - Option 2: 31% improvement on Part L 2013 → 0.90 t CO_2 per dwelling per year
- The cost of carbon is set at £60/tCO_2, which is based on the carbon offsetting requirements of the Greater London Authority (GLA). (Whilst there are other examples where Local Authorities have set up a carbon offset fund, for example Milton Keynes Council, the one covering London is the most ambitious.) In practice, LCC could choose to set a higher carbon price; for example, as noted above the draft new London Plan suggests a price of £95/tCO_2.
- The cost is calculated over a 30-year period, so the total cost paid by the developer is £1,800/tCO_2, assuming £60/tCO_2.
- The number of new dwellings constructed per year is based on typical annual figures set out in the draft Local Plan (2020), although **it is recognised that this figure is uncertain and subject to change**. The calculation shown below is therefore only an example.

The table below shows the amount of regulated CO_2 that each new dwelling would be expected to produce, *after* taking into account onsite energy efficiency and CO_2 saving measures. Then, it shows the amount of money that developers would need to pay in order to offset those residual CO_2 emissions – in other words, the size of the resulting illustrative carbon offset fund.

[160] Ministry of Housing, Communities & Local Government, *'Live EPC statistics: Table NB3 - Floor Area, Size, Energy Use, Carbon Dioxide Emissions and Fuel Costs of New Dwellings'* (2020). Available at: https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates

Estimated annual carbon offset fund that could be generated from a Net Zero regulated CO_2 emissions target

Assumption	Units	Average Regulated CO_2 per dwelling (Part L 2013)	Average Regulated CO_2 per dwelling (FHS Option 1)	Average Regulated CO_2 per dwelling (FHS Option 2)
CO_2 emissions	tCO_2 / dwelling per year	1.31	1.04	0.90
Cost of carbon	£/ tCO_2	£60	£60	£60
Number of years	years	30	30	30
CO_2 offset generated	£ / dwelling	£2,358	£1,890	£1,620
Annual number of new dwellings	# of new dwellings	1,712	1,712	1,712
Total offset fund	**£ per year**	**£ 4,036,896**	**£ 3,235,680**	**£ 2,773,440**

Note that these payments into the carbon offset fund would be expected to occur in all years for which new development continues to be come forward as illustrated here.

Overall, this calculation suggests that the carbon offset fund could generate ££ per year depending on development rates and how the policy is applied. This figure is purely illustrative; in this example, the scale of the carbon offset fund is directly proportional to the number of new dwellings that are delivered in a given year.

Practical Considerations

Some key practical considerations are set out below. For more details about how to set up a carbon offsetting fund, refer to *'Carbon Offset Funds: Guidance for London's Local Planning Authorities'* (2018) which was produced by the Greater London Authority but is also relevant to other locations.[161]

Setting targets

The requirement for developers to contribute towards a carbon offsetting fund would arise from a carbon reduction target set in a future Local Plan policy. Some key considerations would therefore include:

- What level of carbon reduction is required? – For example, the GLA requires domestic developments to achieve at least a 35% carbon reduction onsite and offset the remainder up to 100% (i.e. achieving Net Zero). More typically, Local Authorities tend to set 10-20% carbon reduction targets.
- Which developments does this apply to? – The target could apply to all developments or only certain types, e.g. major developments or those in certain strategic locations.
- What is the scope of the carbon offsetting calculation? – Will this refer to regulated emissions only, or total emissions? Will it be based on design stage predictions or operational energy use?

These issues would need to be tested through the Local Plan viability and consultation process.

Deciding how to administer the fund

Carbon offset funds can either be administered through Section 106 processes or set up as a separate fund. It is recommended that existing processes should be used, if possible, to avoid a situation where some of the fund is needed for administration, enforcement and monitoring.

Setting a carbon price

Guidance produced by the GLA states that Local Planning Authorities (LPAs) *'should develop and publish a price for offsetting carbon based on either (a) a nationally recognised carbon pricing mechanism or (b) the cost of offsetting carbon emissions across the LPA.'* A range of examples and guidance are provided in the GLA document, but the most commonly cited figure is £60/tCO_2

[161] Greater London Authority, *'Carbon Offset Funds'* (2018). Available at: https://www.london.gov.uk/sites/default/files/carbon_offsett_funds_guidance_2018.pdf

Identifying suitable projects

Many Local Authorities begin by undertaking projects on their own housing stock or other Council-owned buildings. For energy efficiency retrofitting and associated projects, the Council may wish to begin by identifying properties that would benefit based on a variety of factors such as the type and age of buildings, along with neighbourhood and household characteristics. This could link with existing projects, for instance those aimed at reducing fuel poverty. For renewable energy or tree planting projects, LCC could begin by assessing its current landholdings and their uses to see whether there are any locations where these projects could be delivered, provided that this is done in line with the best practice principles outlined above.

Note: Impact of the 'Planning for the Future' White Paper (2020)

As stated in Section 2.2, the Government recently proposed that the current system of S106 contributions and the Community Infrastructure Levy be replaced with a nationally standardised, flat-rate infrastructure levy. Since carbon offset contributions are typically secured through S106 arrangements, this could impact Local Authorities' ability to use carbon offsetting funds. However, at the time of writing, the outcome of the consultation is unknown.

Appendix C – Methodology for Assessing Additional LZC Capacity

Solar PV and Solar Hot Water

An estimate of the potential for roof-mounted PV and SWH on domestic and commercial buildings is based on rules of thumb set out in the DECC (2010) guidance document, which describes the percentage of different buildings assumed to be suitable for solar energy systems, along with average capacity of domestic systems (2kW) and non-domestic systems (5kW). For industrial buildings, AECOM has used satellite imagery to measure the roof area of existing industrial sites in Leicester City and used a rule of thumb to determine the potential amount of roof area available for PV.[162]

The DECC (2010) suggested parameters for estimating potential solar PV and hot water installations at regional scale are shown below:

Table 3-8: Detailed assessment of opportunities and constraints for solar energy

No	Parameter	Description	Assessment requirement	Where to source data from
Opportunity assessment - natural and technically accessible resource				
1	Existing roof space	Number of roofs suitable for solar systems	Apply the following assumptions for number of suitable roofs: • Domestic properties - 25% of all properties (including flats) • Commercial properties - 40% of all hereditaments • Industrial buildings - 80% of the stock	CLG Statistics English Housing Survey (EHS) ONS data
2	New developments	Number of new roofs suitable for solar systems	Assume that 50% of all new domestic roofs will be suitable for solar systems	RSS new housing provisions
3	System capacity	Average generation capacity of an individual system kW	Apply the following assumptions for average system capacity: • Domestic - 2kW (thermal or electric) • Commercial - 5kW (electric only) • Industrial - each region use their own assumption	no data required
Constraints assessment - physically accessible and practically viable resource				
	n/a		No specific parameters have been defined as most constraints have already been taken into account in the assumptions applied for the parameters above.	no data required

Source: SQW Energy and Land Use Consultants

The table below shows the calculation used to estimate the potential number and capacity of roof-mounted solar systems in Leicester City.

162 Assuming that 3/8ths of roofs have an orientation of SE, S or SW, and that 10 m^2 of roof area is required per kWp of PV, we found that on average, industrial sites could accommodate approximately 375 kWp of PV in total.

Dwelling type	No. units	Percentage (%) of roofs suitable for solar systems	Number of suitable roofs	Total potential capacity (kW)*
Detached house	14,538	25%	3,635	7,270
Semi-detached house	48,945	25%	12,236	24,472
Terraced house	43,418	25%	10,855	21,710
Flat, maisonette or apartment	29,269	25%	7,317	14,634
Other domestic (e.g. caravans)	945	Not in DECC methodology; excluded from analysis	0	0
All domestic	137,116	-	34,043	68,086
Commercial	11,810	40%	4,724	23,620
Industrial	890	(Calculated separately)	712	7,120
TOTAL – Existing buildings	**149,816**	**-**	**39,479**	**91,705**
New dwellings	21,362	80%	17,090	34,179
TOTAL – New and existing	**-**	**-**	**56,569**	**125,884**

*Average domestic system capacity of 2kW and average non-domestic system capacity of 5kW.

Air and Ground Source Heat Pumps (ASHPs and GSHPs)

The DECC Methodology (2010) states: *'The regional assessment of the potential for heat pumps is […] based on the premise that most buildings (existing stock and new build) are suitable for the deployment of at least one of the heat pump options.' – Paragraph 3.25*

The suggested parameters for estimating potential heat pump installations at regional scale are shown below:

Table 3-9: Detailed assessment of opportunities and constraints for heat pumps

No	Parameter	Description	Assessment requirement	Where to source data from
Opportunity assessment - natural and technically accessible resource				
1	Existing building stock	Number of buildings suitable for heat pumps	Domestic - 100% of all of-grid properties; for the remaining stock - 75% of detached and semi-detached properties, 50% of terraced properties and 25% of flats Commercial -	CLG Statistics English Housing Survey (EHS) ONS data
2	New developments	Number of new buildings suitable for heat pumps	50% of all new build domestic properties	RSS new housing provisions
3	System capacity	Average generation capacity of an individual system kW	Domestic - 5kW Commercial - 100kW	no data required
Constraints assessment - physically accessible and practically viable resource				
	n/a		No significant specific parameters have been defined as most constraints have already been taken into account in the assumptions applied for the parameters above.	no data required

Source: SQW Energy and Land Use Consultants

The table below shows the estimated potential number and capacity of domestic heat pumps in Leicester, based on the above methodology.

Building type	No. units	Percentage (%) of buildings suitable for heat pumps	Potential number of buildings suitable for heat pumps	Total potential capacity (kW)*
Domestic buildings				
Off gas grid	15,897	100%	15,897	79,486
Detached house	12,853	75%	9,640	48,198
Semi-detached house	43,271	75%	32,453	162,265
Terraced house	38,384	50%	19,192	95,961
Flat, maisonette or apartment	25,875	25%	6,469	32,344
Other (e.g. caravans)	836	Not in DECC methodology; excluded from analysis	0	0
All domestic	137,116	-	83,651	418,254
All non-domestic	12,700	60%	7,085	708,584
TOTAL	**149,816**		**90,736**	**1,126,838**

*Note: Average domestic system capacity of 5kW and non-domestic system capacity of 100kW.

It should be noted that this methodology focuses on developing a universal approach to ASHPs assessments at Local Authority level. This means that these assumptions are broad and do not take into consideration local constraints for heat pump deployment.

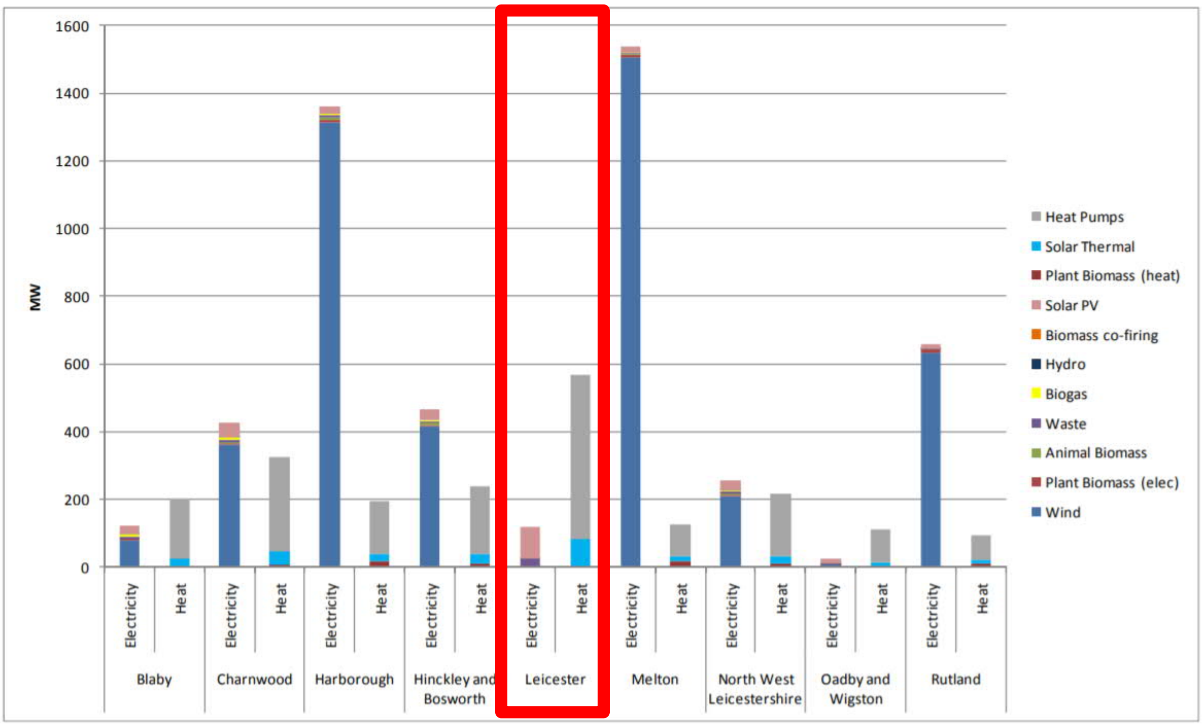
Appendix D – Previous Energy Studies

SQW 'Low Carbon Energy Opportunities and Heat Mapping for Local Planning Areas Across the East Midlands: Final Report' (2011)

This report assessed renewable energy opportunities for various Local Planning Authorities across the East Midlands. The authors estimated that, in total, there would be nearly 120 MW of renewable electricity capacity in Leicester by 2020, and over 560 MW of renewable heat capacity. Almost all of the resource was expected to come from solar and heat pump technologies. A detailed breakdown of results is provided below:

	Hinckley and Bosworth				Leicester				Melton			
Technology	2020 (MW)	2020 (GWh)	2030 (MW)	2030 (GWh)	2020 (MW)	2020 (GWh)	2030 (MW)	2030 (GWh)	2020 (MW)	2020 (GWh)	2030 (MW)	2030 (GWh)
Large Wind	178.97	282.21	178.97	282.21	0.00	0.00	0.00	0.00	977.39	1,541.16	977.39	1,541.16
Medium Wind	3.88	6.11	3.88	6.11	0.00	0.00	0.00	0.00	14.79	23.32	14.79	23.32
Small Wind	198.62	313.19	198.62	313.19	0.34	0.53	0.34	0.53	468.84	739.26	468.84	739.26
Small Scale Wind <6kW	34.65	48.57	34.65	48.57	0.00	0.00	0.00	0.00	42.58	59.68	42.58	59.68
Managed Woodland (heat)	1.41	5.56	1.41	5.56	0.04	0.16	0.04	0.16	2.03	8.00	2.03	8.00
Managed Woodland (elec)	0.23	1.73	0.23	1.73	0.01	0.08	0.01	0.08	0.33	2.49	0.33	2.49
Energy Crops (heat) Medium	7.25	28.58	7.98	31.46	0.45	1.77	0.49	1.93	15.90	62.68	17.49	68.95
Energy Crops (elec) Medium	1.25	9.42	1.37	10.32	0.08	0.60	0.08	0.60	2.73	20.57	3.01	22.68
Agricultural Arisings	1.86	9.75	1.86	9.75	0.05	0.25	0.05	0.25	3.90	20.52	3.90	20.52
Waste Wood (heat)	0.48	2.51	0.53	2.77	1.95	10.26	2.16	11.33	0.25	1.33	0.28	1.47
Waste Wood (elec)	0.56	2.93	0.61	3.23	2.28	11.97	2.52	13.22	0.30	1.55	0.33	1.72
Poultry Litter	0.08	0.40	0.08	0.40	0.00	0.00	0.00	0.00	0.34	1.79	0.34	1.79
Wet Organic Waste	4.62	24.29	4.62	24.29	0.27	1.44	0.27	1.44	5.91	31.07	5.91	31.07
Biomass Co-firing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Municipal Solid Waste (MSW)	3.27	17.20	3.60	18.92	9.76	51.31	10.74	56.44	1.70	8.94	1.87	9.84
Commercial and Industrial	2.62	13.75	2.75	14.45	12.42	65.29	13.06	68.63	1.39	7.31	1.46	7.68
Landfill Gas	1.94	10.18	0.53	2.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sewage Gas	0.29	1.25	0.31	1.34	0.00	0.00	0.00	0.00	0.77	3.35	0.82	3.60
Hydro	0.00	0.00	0.00	0.00	0.06	0.31	0.06	0.31	0.00	0.00	0.00	0.00
Solar PV	32.80	25.86	37.66	29.69	93.69	73.87	107.67	84.89	15.20	11.98	16.74	13.20
Solar Thermal	28.44	12.46	33.30	14.59	79.54	34.84	93.52	40.96	12.77	5.59	14.31	6.27
Heat Pumps	199.04	453.33	211.19	481.01	486.00	1,106.91	520.93	1,186.47	96.05	218.76	99.88	227.49
Total (electricity)	465.62	766.82	469.73	766.98	118.96	205.64	134.79	226.38	1,536.17	2,472.98	1,538.32	2,477.99
Total (heat)	236.62	502.43	254.41	535.38	567.98	1,153.94	617.14	1,240.85	127.00	296.37	133.99	312.17

Figure 4.5: Technical Renewable Energy Resource Potential for Leicester, Leicestershire and Rutland for 2020 in MW



Note: In the 2011 study, wind energy definitions were as follows:

- Large (commercial scale)– tip height 135m, 2.5 MW capacity
- Medium (commercial scale) – tip height 90m, 1 MW capacity
- Small (commercial scale) – tip height 65m, 0.5 MW capacity
- Small (domestic scale) – tip height not specified; any size up to 6kW

The assessment was carried out in compliance with DECC (2010) guidance, which although now slightly out of date, is understood to be the only Government-approved area-wide renewable energy assessment methodology for the UK. The main findings and assumptions are outlined below, along with high-level comments on any changes that may have occurred since 2011.

Technology	Key findings	AECOM comments
Wind energy	The report found that there are likely to be few or no opportunities for wind energy of any scale. While detailed mapping results for each Local Authority were not provided, in our view it is likely that the key constraint for Leicester is the application of buffer zones around residential properties which results in the majority of land area being considered unsuitable.	It is important to note that while rules of thumb are used to determine buffer zones based on turbine height, this is primarily a practical constraint rather than a technical one and is intended to provide a rough estimate of the area in which issues such as noise and shadow flicker may potentially occur. In an area-wide assessment, therefore, it is possible that some sites will be excluded from consideration that could actually support wind energy deployment, while conversely, it is possible that some sites would be considered potentially suitable but could later be found unsuitable following a site-specific feasibility assessment.
Biomass	The assessment indicates a small amount of biomass resource within Leicester. This is predominantly based on estimates of the amount of available wood fuel and an assumption that all abandoned land and pasture is used for energy crops.	In practice it is now considered unlikely that abandoned land would be used for energy crops without significant Government incentives, recognising the low uptake of previous incentive schemes in the past ten years. For air quality reasons, it is also no longer recommended to use biomass combustion, particularly in or near AQMAs.
Energy from Waste	The assessment assumed that waste would be burned in an incinerator. The resource estimate was based on the amount of waste generated within the Local Authority Area. Future potential resource was based on population growth projections.	The 2011 report does not seem to account for LCC's waste management contract with Biffa. A large portion of waste from the City is diverted from landfill for recycling, and organic material is processed in an AD plant. However, this takes place outside of the City boundary. To the best of our understanding, in order to maintain consistency with the BEIS Regional Renewable Statistics, the renewable energy resource should be allocated to the area where the waste is
Landfill and Sewage Gas	The report found that there was no current or future potential landfill or sewage gas resource.	This aligns with our own findings. Management of waste and wastewater takes place outside the City boundaries.
Hydropower	Hydropower opportunities were identified by referring to an earlier study carried out by the Environment Agency in 2009.	It is assumed that there would be no significant change in the general location, flow, etc. of waterbodies since 2009. However, the information is now more than ten years out of date; a site-specific feasibility

		assessment would be required to confirm whether any particular location is suitable.
Solar Technologies	These are one of the key opportunities for Leicester, recognising that it is a built-up area. The report only assessed roof-mounted solar technologies rather than ground-mounted technologies. It is based on rules of thumb for the number of suitable roofs, with assumptions about standard installation size and capacity. The authors note that this does not account for locally specific factors such as overshading and therefore may represent an overestimate. DECC (2010) does not provide a means of estimating ground-mounted solar opportunities which is excluded from the 2011 report.	We have provided separate comments related to roof-mounted versus ground-mounted solar technologies. Roof-mounted: Our report has provided updated estimates of roof-mounted solar opportunities based on the same rules of thumb provided in DECC (2010). Any difference will be due to differences in the assumed number and type of properties. Ground-mounted: The cost of PV has decreased dramatically in the last decade, which has contributed to the increased popularity and economic feasibility of solar farms. For most Local Authorities we would now expect this to offer significant additional resource so this might be considered a 'gap' in the assessment. On the other hand, for Leicester we would expect there to be comparatively few opportunities given the constrained land availability within the City.
Heat Pumps	Heat pumps comprise the main low carbon heating opportunity for Leicester. The report provides capacity and generation figures for heat pumps, based on rules of thumb about the number of properties that would be suitable (10% of commercial properties, 25-75% of domestic properties on the gas grid, 100% of domestic properties off the gas grid, and 50% of domestic new builds).	Our assessment concurs that heat pumps are a significant opportunity for Leicester. Since the report was published there is greater understanding of the role that heat pumps are likely to play in a zero carbon Britain and it is now expected that close to 100% of buildings will need to have some sort of LZC heating system installed. Therefore, compared with the results of the 2011 study, we would anticipate the number of heat pumps to be significantly higher. We have also provided evidence based on other studies that suggest there could be WSHP opportunities in the City.

Amec Foster Wheeler, 'Climate Change Evidence Base Study: Leicester City Council and Oadby & Wigston Borough Council' (2015)

This report was intended as part of an evidence base to support local planning policies in Leicester City and Oadby & Wigston Borough. It is broad in scope and covers a wide variety of topics related to renewable energy and sustainable design and construction. The table below summarises the potential future deployment by technology type as set out in the 2015 study.

Technology	Potential Capacity (MW)
Wind	NA
Solar PV (Domestic Buildings)	64
Solar PV (Non-Domestic Buildings)	100
Solar PV (Ground Mounted)	5
Solar Thermal	13
Biomass*	4.8
Hydro	0.1
District Heating	25 – 30
Heat Pumps	45
Micro-CHP	< 0.05
Geothermal	NA
Anaerobic Digestion	NA

* Energy available from local biomass resource

Appendix E – CO_2 Modelling Assumptions

Existing buildings

The modelling assumes that existing buildings will continue to have the same gas and electricity consumption in a 'BAU' scenario. Reductions to fuel consumption are then applied to test the relative impact of different intervention measures (described below) as part of the carbon projection modelling.

New buildings

Based on discussions with LCC and review of the draft Local Plan (2020) and Economic Development Needs Assessment, we have input the yearly housing trajectory proposed of 1,712 new homes, and a total increase in employment floorspace of 440,000 m^2 over the Local Plan period.

The amount of proposed new development (number of dwellings and m^2 of employment floorspace) is multiplied by benchmarks to provide an estimate of energy demand.

In order to estimate the impact of new construction / development within the District as a whole, benchmarks were used to estimate the fuel consumption of new buildings. For domestic buildings, benchmarks were derived from median consumption figures for Leicester as reported in NEED. For non-domestic buildings, CIBSE Guide F benchmarks were used to estimate gas and electricity demand. In both cases, the heat / gas demand figures were reduced by 50% to reflect higher fabric performance standards set by proposed policy of the draft Local Plan. The level of heating demand reduction was informed by the recently published consultation documents related to Parts L and F of the Building Regulations, and the introduction of a Future Homes Standard.

Grid decarbonisation pathway

Carbon emission factors (CEFs) for electricity were taken from HM Treasury/BEIS 'Green Book Supplementary Guidance: Toolkit for valuing changes in greenhouse gas emissions, Table 1' (2019) which is intended for use by organisations reporting on their greenhouse gas emissions. Note that this trajectory reflects the level of decarbonisation that would be necessary for the UK to meet its current decarbonisation targets. It is not a projection of the likely emissions from grid electricity.

Electricity demand reduction

Evidence suggests that reductions of around 5% can be achieved through measures such as behavioural changes, smart metering, and zone lighting. Case studies suggest that greater reductions are possible for some organisations. However, in recognition of the fact that electricity use has increased in the past decade due to factors such as increasing use of electronic appliances, 5% has been used as a conservative estimate.

The model assumes that total electricity consumption will decrease linearly through to the year 2030, at which point this reduction will be achieved.

Heating demand reduction from energy efficiency measures

Evidence from NEED indicates that installing multiple energy saving measures (such as cavity wall or loft insulation) can reduce heating bills by around 5-12%. From a technical standpoint, higher savings (over 75% in some properties) could be achieved with more ambitious retrofitting strategies,[163] but 10% has been used as a conservative estimate.

This would not necessarily require all buildings to undergo a retrofit – it represents an average across the entire stock. In other words, some buildings could be retrofitted to a higher standard, while others (such as Listed buildings) receive no upgrades.

The model assumes that total gas consumption will decrease linearly through to the year 2050, at which point this reduction will be achieved.

[163] Passipedia, *'EnerPHit – the Passive House Certificate for retrofits'*. Available at: https://passipedia.org/certification/enerphit

Impact of fuel switching

This calculation assumes that the metered gas consumption is delivered by individual gas boilers (80% efficiency). The total metered gas consumption data is used to provide a rough estimate of the amount of electricity that would be required if this level of demand was instead met using direct electric heating (DEH) with 100% efficiency or heat pumps with COP of 2.5 (this is intended as a conservative estimate that reflects the performance of air source heat pumps (ASHPs) in situ).

The model assumes that 90% of existing buildings will switch to an electric heating system by 2050. This would require an ambitious programme of heating system replacement with significant cost implications. Therefore, the calculation also assumes that 50% of the new heating systems will be DEH and 50% will be ASHP as an illustrative scenario, in recognition of the fact that DEH may be cheaper and more practical to install. Additional carbon reductions could potentially be achieved if more systems were replaced with ASHPs.

The model assumes that gas heating systems will be replaced with electric heating systems at a consistent rate (i.e. linearly) to 2050.

Vehicle mileage reduction

In the baseline scenario, it is assumed that demand for transport remains stable. This will likely tend to increase over time due to factors such as population growth. A stable trajectory would imply that measures are being implemented to mitigate this demand through encouraging other forms of travel such as walking, cycling or public transport.

According to the 'Road to Zero' report: 'Evidence from 60,000 fleet drivers receiving training through the Energy Saving Trust (EST), a key partner supporting the efficient motoring agenda, gave an average 15% saving of fuel and CO_2 […] Organisations that have incorporated a wider package of behavioural and procedural measures in managing their fleets (see the case study below) have delivered typical emission savings of between 10-30%.'

The model assumes that a 10% reduction in either journeys, vehicles, or miles travelled will result in a 10% reduction in CO_2e emissions from those vehicles. A travel strategy aimed at reducing emissions would likely seek to target certain types of trips, vehicles, or users, so this approach should be understood as an estimate. However, for the purpose of this analysis, it is considered enough to show a simple proportional reduction to highlight the relative scale of impact such a measure could have, relative to other interventions.

The model assumes that total mileage will decrease linearly through to the year 2050, at which point this reduction will be achieved.

Impact of switching to Ultra Low Emission Vehicles (ULEVs)

Based on the estimated mileage for each vehicle type, we have re-calculated CO_2e emissions using BEIS Green Guide figures for electric vehicles. All vehicles except for HGVs are modelled to have switched by 2050.

Carbon savings from Low or Zero Carbon (LZC) technology energy generation

Excluded from the scenario projections shown in this report. Future analysis updates where greater detail is known of what could be installed could include the following estimates. Given the spatial limitation of a city urban environment it may be more appropriate for discussions in this regard to be had with the wider Leicestershire County Council who are also considering decarbonisation plans.

Carbon savings from Low or Zero Carbon (LZC) energy generation are based on the amount of National Grid electricity that would be offset by renewable electricity. A total figure for the amount of LZC capacity that will be installed by 2050 is inputted into the model, and the model assumes that the total savings will increase linearly up to that point.

An estimate is then made of the potential amount of renewable electricity that could be generated by those technologies (large-scale PV or wind). The electricity generation figure is multiplied by the CEF for a given year to provide an estimate of the total CO_2e savings in a given year.

Large-scale PV: Assumed output of 827 kWh/kWp based on typical performance in the UK.

Large-scale onshore wind: Capacity factor of 2,081kWh/kWp.

Note that, as the electricity grid decarbonises, more LZC energy generation is required to offset any residual emissions. Therefore, although the amount of LZC capacity is assumed to increase linearly, the savings per MW decrease as the grid decarbonises over time.

Carbon reductions from woodland creation and tree planting

Excluded from the scenario projections shown in this report. Future analysis updates where greater detail is known of what could be installed could include the following estimates. Given the spatial limitation of a city urban environment it may be more appropriate for discussions in this regard to be had with the wider Leicestershire County Council who are also considering decarbonisation plans.

Based on nation-wide statistics from the Woodland Carbon Code, new woodlands created from low-grade agricultural land have the potential to sequester around 356 tCO_2e per hectare over 100 years, or 3.56 tCO_2e per hectare per year on average. In practice, this depends heavily on the type of woodland and its maturity level.

The scale of offsetting has been input in order to target net zero carbon by 2050 assuming all previous measures and changes in market come to pass. This allows LCC to understand the approximate scale of investment in offsetting required to overcome the likely gap shown by our projection modelling. Proposals would need to be backed up with detailed modelling / evidence and supported by a long-term management plan. Therefore, these figures are intended only to provide a rough sense of scale.

Limitations

As stated previously, this study has only considered sources of CO_2e emissions that are listed for Leicester City within the published BEIS dataset. Due to lack of information about other GHG emissions at a Local Authority level, therefore, the baseline presented in this report is likely to be an underestimate of the total.

A key overarching limitation of this approach is that any changes modelled would need to be backed up by policies, funding, changes in technology, and user / consumer behaviour which are uncertain.

The analysis does not account for other changes e.g. population growth, energy prices, weather, economic growth, and the many other trends that would impact energy demand – it is primarily focused on built environment measures with consideration given to changes in transportation technology.

Appendix F – Proposed Policy Wording

Previous policy detailed in Draft Leicester Local Plan 2020[164]

Policy CCFR01. Sustainable design and construction for new developments

Energy and carbon reduction

All development must demonstrate how it will minimise energy demand and carbon emissions based on the following energy hierarchy:

a) Minimising energy use through, and maximising the opportunities for, on-site or near-to-site renewable or low carbon energy supply through passive design measures including: site layout, building orientation, form and massing, daylighting levels, passive ventilation: shading, solar control glazing, and landscaping;
b) Further minimising energy demand through a high thermal performance of the building fabric and highly energy efficient systems including for heating, hot water, ventilation and lighting;
c) Meeting as much as possible of the heating, hot water, electricity and, where necessary, cooling demand from renewable energy sources, low carbon generation on-site or supply from a decentralised generation scheme;
d) Where on-site generation can provide renewable or low carbon energy that is surplus to the immediate needs of the development, making provision for any surplus to be stored for later use or supplied for use elsewhere.

Waste and resources

All major development should demonstrate how it will maximise an efficient use of resources, including minimising waste and maximising sustainable recycling and the reuse of materials through both construction and use.

Resilience to climate change

All major development should demonstrate how the risks associated with future climate change have been planned for as part of the layout of the scheme and design of its buildings to ensure its longer-term resilience through measures which shall include:

a) Use of sustainable drainage systems (SuDS);
b) Design of new buildings to minimise water demand and promote water efficiency;
c) Green roofs and walls;
d) Flood resilience measures for buildings, and not causing flooding elsewhere; and
e) Designing new buildings to avoid overheating and cooling.

[164] LCC, *'Draft Leicester Local Plan 2020'* (2020). Available at: https://consultations.leicester.gov.uk/sec/draft-local-plan/

This report recommends policies to be incorporated into the adopted Leicester City Local Plan 2010-2026. Outlined below is an edited version of the previously consulted local plan and includes the recommended policies building on the previously proposed policy (above).

Policy CCFR01. Sustainable design and construction for new developments

Energy and carbon reduction

The built environment should be carbon neutral in operation by 2030. This requires reduced greenhouse gas emissions, minimised annual and peak energy demand, and carbon neutral futureproofed development in accordance with the following energy hierarchy.

All development must:

a) Be Lean: Minimise energy use and manage demand during operation. This should be achieved through passive design measures including optimised site layout, building orientation, form factor, massing, daylighting and control of solar gain, minimised heat loss from the building fabric through reduced U-values and thermal bridges, and increased air tightness; followed by utilising energy efficient lighting and services, including consideration of passive ventilation, heat recovery and demand management technologies; and,

b) Be Clean: Further reduce carbon emissions through the use of zero and/or low emission decentralised energy, prioritising connection to district heating and cooling networks and utilising secondary heat sources; and,

c) Be Green: Further reduce carbon emissions by maximising opportunities to produce and use renewable energy on site, utilising storage technologies; and,

d) Be Seen: Verify and report on energy performance.

All new dwellings should achieve a minimum 10% reduction in carbon emissions beyond the requirement of Part L 2013[1] of the Building Regulations through 'Be Lean' passive, fabric and energy efficient design measures alone. For non-dwellings the target is 20% with some exceptions such as those building types with high occupant hot water demand, here the focus is shifted to a target space heating demand. Calculation methodology details are included in the Supplementary Planning Documents.

Measures to address the energy hierarchy and CO_2 reduction target should be incorporated at the earliest stage of a development and maintained throughout its design, construction and operation.

All major developments[2] will be required to provide an Energy Statement as described in the supporting technical guidance. The Statement will include details of the energy reduction measures proposed and details of the low and zero carbon energy technologies included. CO_2 reduction achieved from each stage of the energy hierarchy must be reported.

[1]*an alternative target will be provided when new national Regulations are adopted.*
[2]*all other applications can opt to submit an Energy Statement or include a relevant section in the Design and Access Statement addressing the relevant policy areas.*

Whole Life-Cycle Carbon

All developments shall identify and pursue opportunities to minimise whole life cycle carbon emissions. The follow criteria should be considered when aiming to minimise whole life-cycle carbon:

a) Operational energy – Developments should achieve high levels of energy efficiency, use low-carbon heating sources and be powered by renewable energy to minimise operational carbon emissions

b) Embodied carbon – Developments should meet best practice targets for upfront embodied carbon. Its materials should be made from re-used materials and be designed to be disassembled (rather than demolished) in accordance with circular economy principles.

c) Developments above 1,000sqm or 100 dwellings must calculate and demonstrate methodology compliance through a nationally recognised Whole Life-Cycle Carbon Emissions assessment e.g. BS EN 15978.

Low Carbon Heating and Cooling

To ensure that the most appropriate selection of a heating/ cooling system for a development, targeting the lowest CO_2 emissions possible, all major developments must incorporate low- or zero-carbon heating in accordance with the following system and technology hierarchy (ordered from highest to lowest preference):

<table>
<tr><td rowspan="4">System</td><td colspan="3">1. Connect to existing heat/cooling networks; - where the network has a decarbonisation plan and within 500m of the new development or LCC preidentified network connection zone.</td></tr>
<tr><td>2. Establish a site wide heat/cooling network;</td><td rowspan="3">Technology</td><td>1. Systems using renewable/waste energy sources</td></tr>
<tr><td>3. Use building scale heat/cooling network;</td><td>2. Low carbon and low emission technologies</td></tr>
<tr><td>4 Use individual heating/cooling systems.</td><td>3. Conventional systems e.g. gas or direct electric</td></tr>
</table>

Fossil fuels are not a compatible source of energy in a zero-carbon economy, for this reason avoiding installation of gas heating is preferred and such proposals will be well received by the Council. The whole life-cycle carbon emissions of gas boilers is much higher than an equivalent electric heat pumps. Efficient electric heating brings added benefits in the form of improved air quality, compliance with forthcoming regulations and avoids the need for future wholesale system changes.

Direct electric heating is compatible with a low carbon future, but the relatively high operating costs make it only appropriate for very low heat demand applications. Applicants should provide justification for its use instead of more energy efficient systems such as electric heat pumps.

Where it has been clearly demonstrated that connection to existing heating/ cooling networks are not feasible and/or viable (e.g. due to lack of heat & hot water demand and/ or lack of heat network capacity), development near (within 500m or a LCC preidentified network priority zone) existing or planned heat networks should be designed to allow for cost-effective connection at a later date by including the following features:

a) Provision of centralised heating/ cooling distribution in the form of a single accessible energy centre/ plant room

b) Suitable distribution, control systems and operating temperatures

c) Safeguarded access routes for future external pipework through the site and into the energy centre/ plant room

d) Space within the energy centre/ plant room for a future heat substation

e) Building system compliance with CIBSE CP1: Heat networks: Code of Practice (latest revision)

Resilience to climate change

All major developments should demonstrate how the risks associated with future climate change have been planned for as part of the layout of the scheme and design of its buildings to ensure its longer-term resilience through measures which shall include:

a) Use of sustainable drainage systems (SuDS);

b) Minimised use of mains water through adoption of water saving measures, fittings and appliances.

   - Domestic developments should be designed to achieve a maximum of 110 litres per person per day, in line with the Optional Standard of Building Regulations Part G.
   - Non-domestic developments should be designed to achieve the maximum available credits under BREEAM Wat 01 or an equivalent best practice standard.

c) Promote the use of green roofs and walls where suitable;

d) Flood resilience measures for buildings, and not cause flooding elsewhere; and

e) Minimise potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy (ordered from highest to lowest priority):

   1) reducing the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure;
   2) minimising internal heat generation through energy efficient design;
   3) managing the heat within the building through exposed internal thermal mass (where appropriate) and high ceilings;
   4) providing passive and cross ventilation;
   5) providing mechanical ventilation;
   6) providing active cooling systems and where possible recover waste heat.