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Leicester Carbon Neutral Roadmap

Recommendations for achieving carbon neutrality

Report for Leicester City Council

Final report for Leicester City Council

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Contact:

James Harries, Bright Building, Manchester Science Park, Pencroft Way, Manchester M15 6GZ, UK

T: +44 (0) 1235 753 3272

E: james.harries@ricardo.com

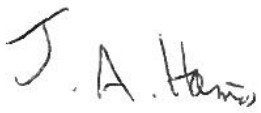
Author:

James Harries, Harper Robertson, Katharina Schmitt

Approved by:

James Harries

Signed



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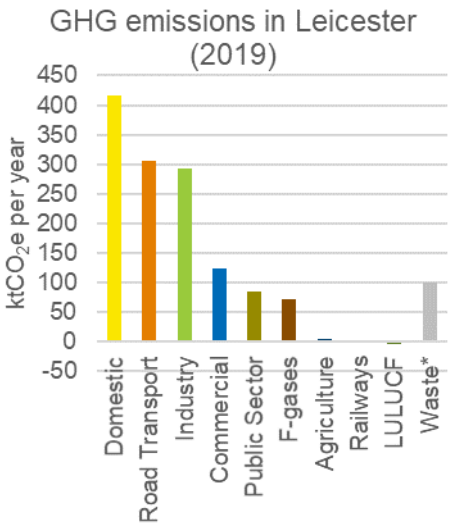
Executive summary



The scale and urgency of the challenge

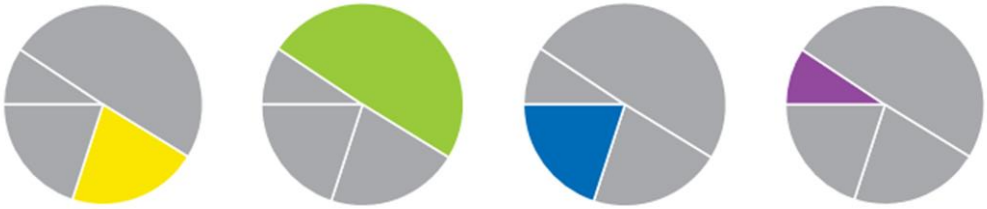
The need for climate action is clear and unequivocal. Leicester is in the vanguard of local authorities that are aspiring to achieve carbon neutrality before 2050, having set the ambition for the city to become carbon neutral by 2030 or sooner.

As of 2019, Leicester's total greenhouse gas (GHG) emissions were c. 1,300 $ktCO_2e$ – having fallen by approximately 40% since 2005. Although this is a positive sign, if emissions continue at this rate, according to the Tyndall Centre for Climate Change, Leicester's entire 'Paris Agreement compliant' carbon budget for the next 80 years would be used up by the mid-2020s.[1]

Aiming for carbon neutrality by 2030 will require a step change in the mindset of the Council and other stakeholders, to an emergency footing more akin to the response to the Covid-19 pandemic, both in terms of scale and urgency. It will require carbon neutrality to be embedded in everything that the Council does, but more importantly, everyone in Leicester will need to engage with the process.

The pathway to carbon neutrality

Taking Leicester's baseline emissions as a starting point, in broad terms, the main priorities are:



Electricity | Heat | Cars & Vans | … and everything else.

Leicester's strategic route to carbon neutrality:

Demand reduction

Minimising energy use and emissions at source

+

Electrification

Switching away from fossil fuels, towards renewable electricity – particularly for heat and transport

Recognising that there are limits to the scale of technological change that will take place between now and 2030, Leicester's strategic route to carbon neutrality will need to make use of existing, proven technologies.

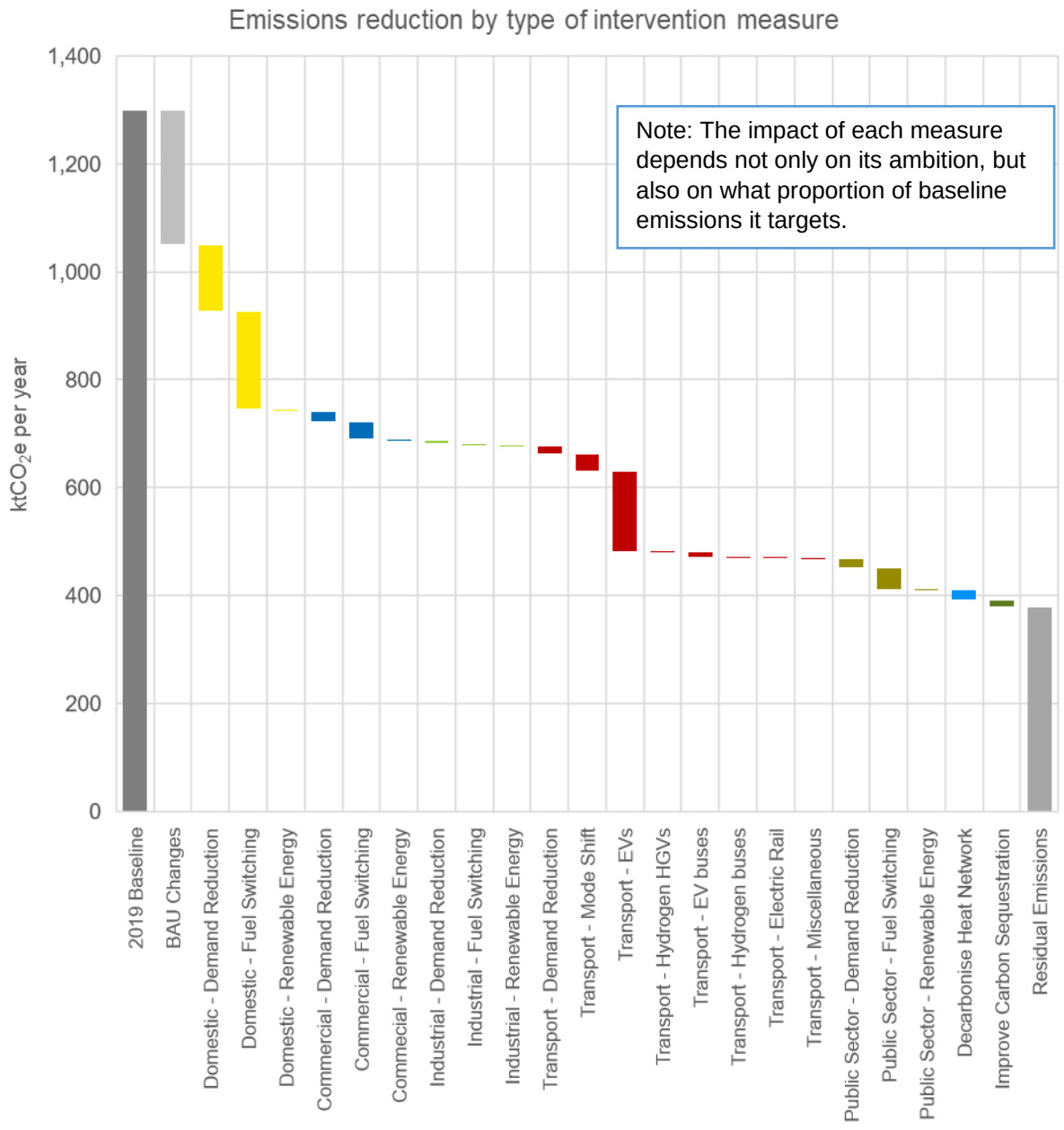
Because of that constraint, none of the scenarios modelled as part of this study reach zero emissions by 2030.

[1] This refers to the cumulative emissions that could occur in Leicester between now and 2100 if the City plays its part in helping the UK meet its commitments under the Paris Agreement. Source: Tyndall Centre for Climate Change Research

Impact of GHG reduction measures

The biggest carbon savings will come from efficiency improvements in buildings, switching from fossil fuel to electric heating systems, and roll-out of electric vehicles in transport. This will need to be facilitated by an upgrade to the electricity grid to accommodate the increased demand, and demand reduction measures to make the increase manageable.

Figure 1. Emissions reduction by type of intervention measure for Scenario 3

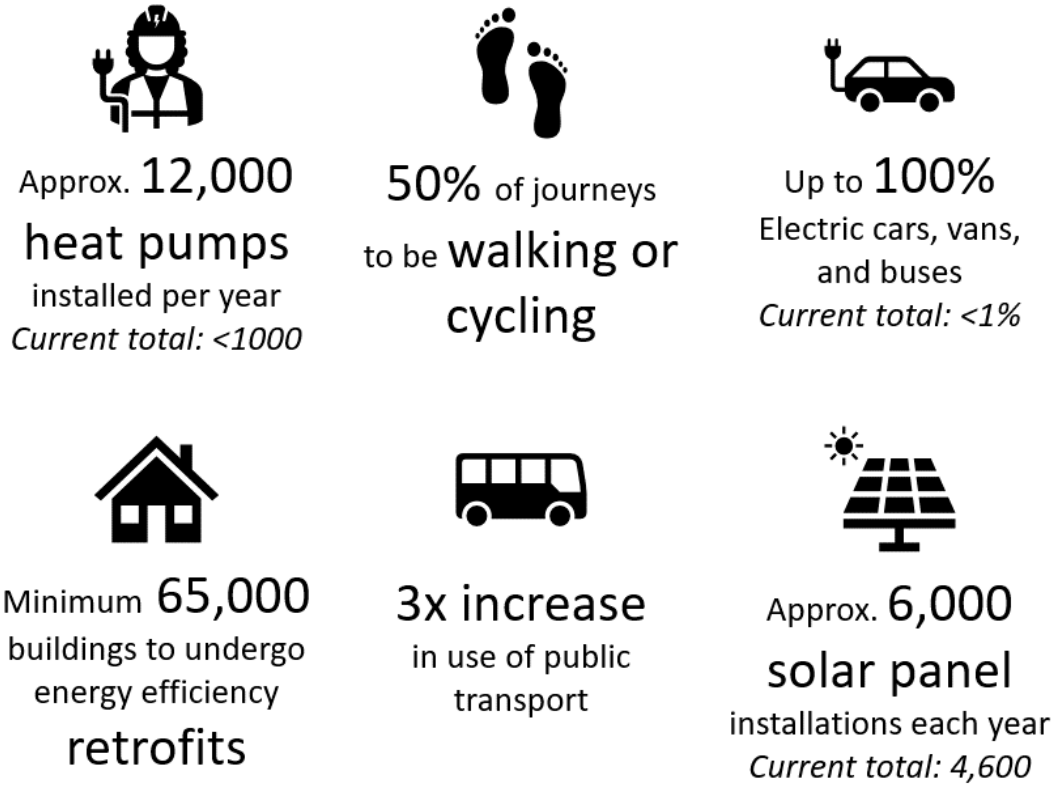


There are also several key strategic decisions that will need to be made in coming years, including the role of and approach to offsetting, the decarbonisation and expansion of the city centre district energy scheme and the approach to renewable energy generation (for example, whether to prioritise rooftop solar or large scale renewables outside of the city).

One of the most important findings from the carbon neutral pathways analysis is that in many cases, the same level of emissions reduction can be achieved through different combinations of demand reduction and electrification. However, this is not an excuse for complacency – if the electricity grid decarbonises more slowly than anticipated, there will need to be an even bigger push for demand reduction to make up the difference.

More broadly, demand reduction is also a 'common good' – with benefits that reach far beyond Leicester – because it minimises the quantity of finite resources, including materials, infrastructure, and renewable energy, that would be needed to meet demand.

The scale and pace of change needed to achieve this is significant. In the next 8 years, for Leicester to match the most ambitious scenario modelled would require measures such as:



Delivering carbon neutrality

The cost of delivering the intervention measures modelled as part of this study ranges from £950m to £5.3bn between now and 2030 (see the Evidence Report for further details of what this estimate includes).

Although these numbers are significant, the green economy offers huge opportunities for Leicester, including the potential for 5,000-10,000 jobs by 2030. According to the Climate Change Committee (CCC): *"The UK's low carbon economy could grow at around 11 per cent a year between 2015 and 2030, some four times faster than the average growth rate for the UK economy overall."*

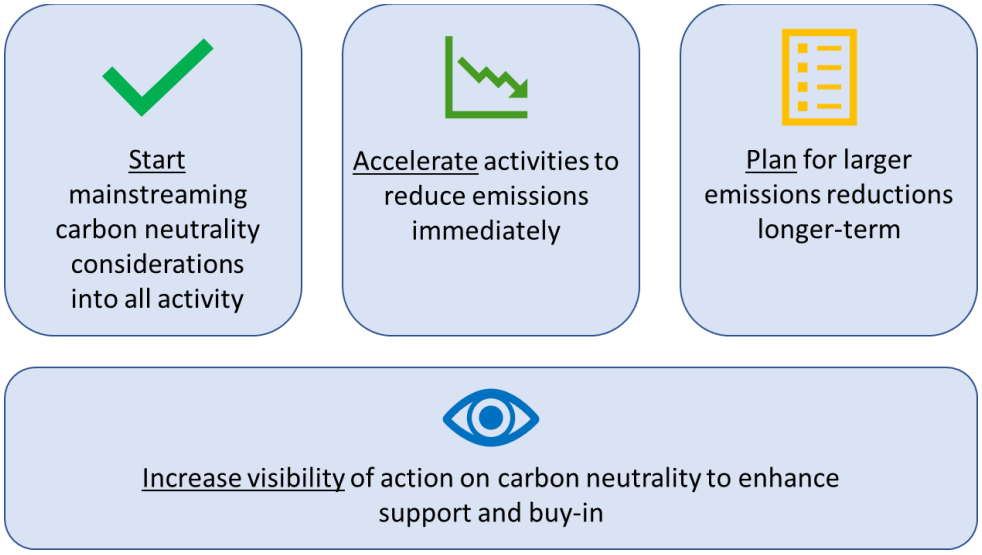
GHG reduction measures can also deliver a wide range of other environmental, social, and economic co-benefits, including but not limited to:

Table 1. Co-benefits associated with key climate mitigation measures

	Economy	Health	Society	Resilience	Resources
Retrofitting buildings	Creates jobs (construction, manufacturing installers, designers)	Reduced risk of cold, mouldy homes; improved thermal comfort	Can help to alleviate fuel poverty if done correctly	Housing stock less susceptible to weather extremes (cold or heatwaves)	Reduces the need for either demolition or new build
Active travel	Reduced congestion, fuel cost savings, increased property values	Physical and mental benefits of exercise, significant reduction in air and noise pollution	Facilitates access to jobs/services for residents with no car	Change to reclaim road space for social space and green space	Less demand for materials/ resources (fuel, motor vehicles) and infrastructure
Renewable energy	Generate revenue, e.g., through community-owned installations	Reduction in noise pollution, some reduction in air pollution	New employment opportunities	Diversified and localised renewable energy systems	Lower lifecycle carbon emissions than fossil-fuelled alternatives

Conclusions

Whilst there are a huge number of actions that will need to be taken to transition to carbon neutrality, they can be simplified into four main areas:



Emissions reductions need to accelerate over the very short term and planning needs to take place now for much greater cuts later in the decade. Everyone in Leicester will have a role to play, but the Council in particular has a strategic role in demonstrating leadership, driving change through its planning powers and facilitating collaboration with and action by others.

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1 Introduction and background

1.1 General introduction

The need for urgent action to reduce harmful greenhouse gas (GHG) emissions has never been clearer. The Glasgow Climate Pact, agreed at the COP26 climate conference in Scotland in November, resolved to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. The Pact recognises that doing so would require a reduction in global GHG emissions of 45% below 2010 levels by 2030 and to net zero around 2050. It is positive that around 90% of global emissions are now covered by net zero targets[2], many of them for 2050. However, some countries will not be expected to reach net zero emissions until after 2050. It is therefore only right that more developed countries like the UK consider acting even faster. In this context, large numbers of local authorities in the UK have declared a climate emergency and some are aiming to reach net zero before 2050.

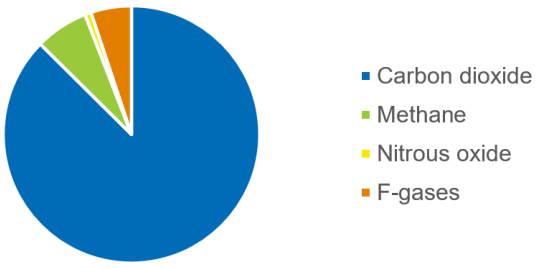
Leicester was one of these local authorities, declaring a climate emergency in February 2019[3] and setting an ambition to become a carbon neutral and climate adapted city by 2030 or sooner. This was followed by the Climate Emergency Strategy[4] published in October 2020. The latter sets out a high-level vision of what is needed to deliver carbon neutrality but does not quantify what needs to happen and how quickly. This roadmap builds on that strategy by providing a clearer idea of exactly what is needed to deliver carbon neutrality and who would need to do what to achieve it. The council also published a Climate Emergency Action Plan in October 2020, which sets out a raft of near-term actions to reduce GHG emissions across the city. The roadmap will be used to inform future updates of the action plan, to help ensure that the near-term actions are the right ones and are being done at the right pace to deliver carbon neutrality.

1.2 Definitions and scope

Carbon neutrality, also known as net zero, simply means achieving a balance between emissions of GHGs to the atmosphere and removals of carbon dioxide (the most widespread GHG) from the atmosphere, for example by nature-based solutions such as tree planting or by technological means such as carbon capture and storage. If the emissions and removals balance out, carbon neutrality has been achieved.

In addition to carbon dioxide, emissions include other GHGs, with the approximate breakdown shown below. Note that the methane emissions are almost entirely associated with waste, which is not included in the 1,300 $ktCO_2e$ total because these occur outside of the area boundary.

Figure 2. GHG emissions in Leicester in 2019



[2] https://climateactiontracker.org/publications/glasgows-2030-credibility-gap-net-zeros-lip-service-to-climate-action/
[3] https://cabinet.leicester.gov.uk/ieDecisionDetails.aspx?ID=1024
[4] https://www.leicester.gov.uk/media/dbxlmrxw/leicester-climate-emergency-full-strategy-2020-2023.pdf

This roadmap only covers emissions that occur within the geographic boundary of Leicester or are caused by energy used within Leicester, such as:

- Fuel combustion in cars, gas boilers, industrial processes, etc.
- Electricity consumption – although the emissions to generate the electricity largely take place outside of Leicester, they are considered part of the emissions baseline based on where the electricity is used
- Emissions from fluorinated gases (f-gases), which are primarily associated with refrigerants and cooling systems
- Emissions from land use, land use changes, agricultural activities, and so on – which are small compared with the overall total.

Emissions taking place outside of the city boundary, but which may be created by activity in Leicester, are not covered (with the exception of emissions caused by electricity generation at power stations), even though they are likely to represent a large portion, if not the majority, of total emissions. Examples include:

- Waste, which is managed outside of the area boundary
- Journeys or commutes taking place outside the city (by any travel mode)
- Production and transportation of goods purchased and consumed within Leicester.

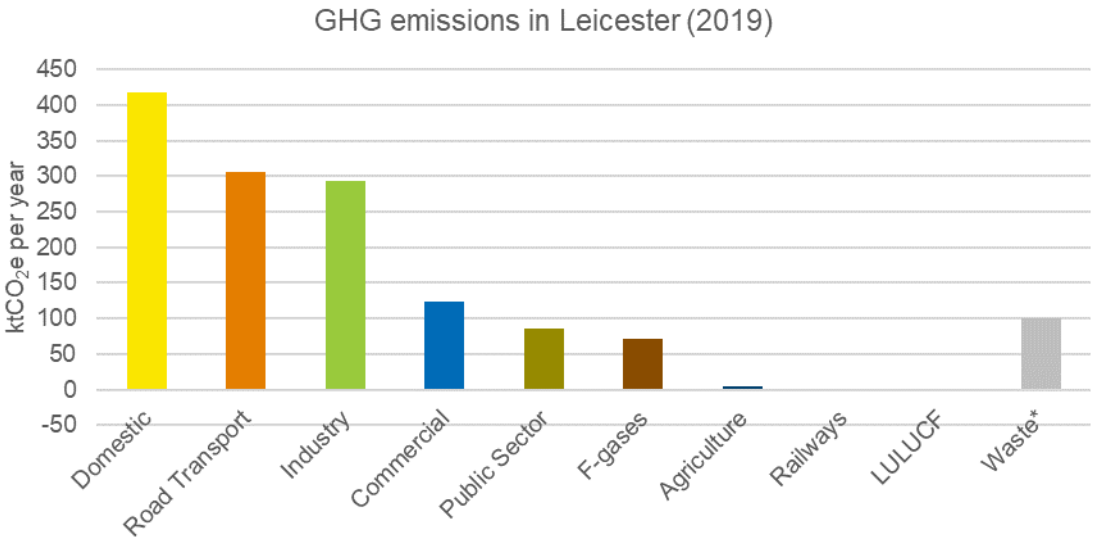
Tackling these sources of emissions is important but will be dealt with through other work streams.

On the other hand, whilst the scope of this work is the city itself, joined-up working will clearly be important to tackle the climate emergency, for example working with Leicestershire County Council and its district and borough councils.

2 Current sources of emissions in Leicester

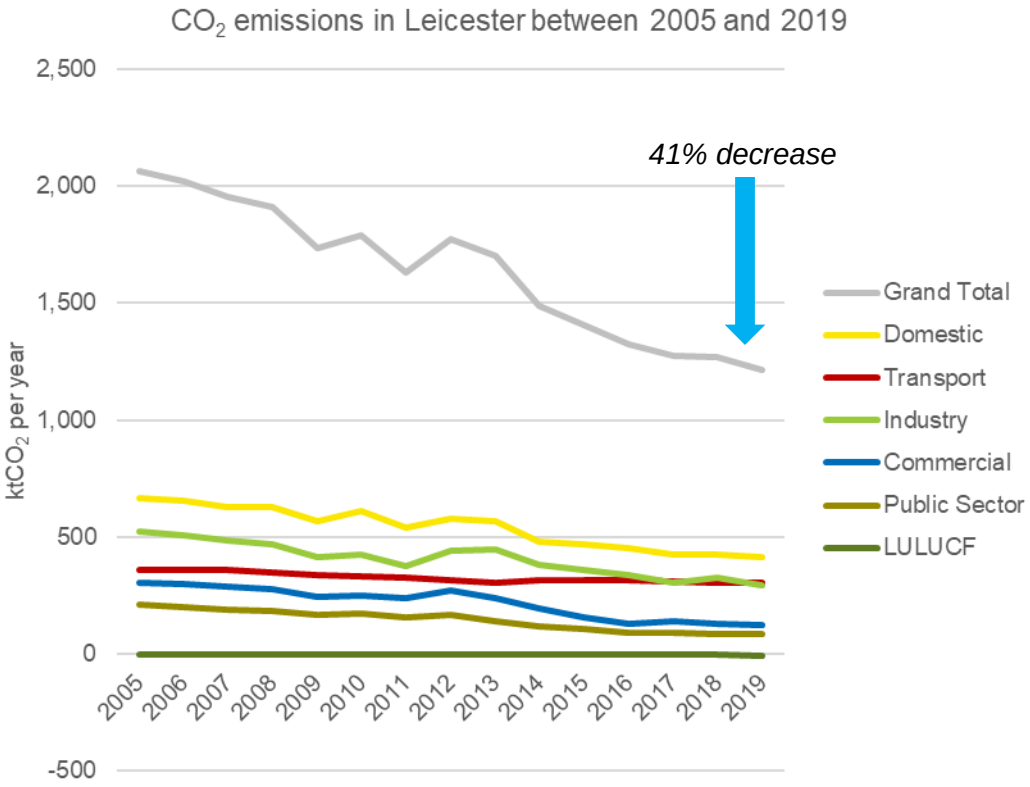
2.1 GHG emissions

An assessment has been made of overall GHG emissions in Leicester by using the UK Government statistics on local authority CO_2 emissions, and adding non-CO_2 emissions such as methane and nitrous oxide. Doing this shows overall GHG emissions in 2019 (the latest year for which there is data) to be approximately 1,300 $ktCO_2e$. This number does not include emissions from waste, but for context, these are estimated to be approximately 100 $ktCO_2e$ per year.



** Waste is reported for information but is outside the scope of this Roadmap.*

CO_2 emissions in Leicester have fallen by 41% between 2005 and 2019, which is more than the national average. All sectors have seen steady reductions in CO_2 emissions apart from transport, which has broadly remained steady.



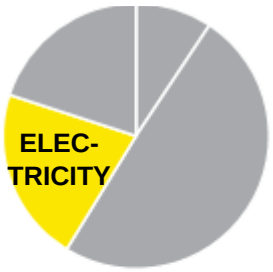
When interpreting trends in emissions, it is important to understand that:

- There have been decreases in energy use, but that is likely to be more influenced by economic trends than energy efficiency measures; and
- Most of the change in emissions is due to decarbonisation of the national electricity grid, which means that emissions have reduced even when electricity use remains the same.

Therefore, although the reduction in emissions is a good sign, if this trend is to continue/accelerate, much greater efforts will be needed – the remaining emissions are much harder to mitigate.

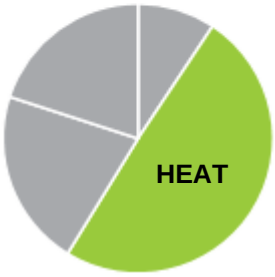
The emissions baseline immediately highlights some of the key challenges for Leicester. Heat and electricity use in buildings, plus emissions from cars and vans, together account for nearly 95% of Leicester's emissions, so these are the major areas requiring intervention.

Buildings & Industry

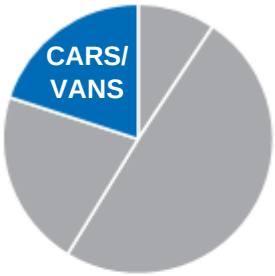


Electricity use in buildings accounts for roughly 21% of GHG emissions in Leicester. Electricity demand is expected to increase in future, so a major priority will be upgrading grid infrastructure.

However, given that electricity has decarbonised rapidly, and the Government has announced an ambition for the grid to be net zero by 2035, these emissions will decrease – to some extent – even if no further action is taken. Therefore, the main challenge for buildings will be addressing the use of fossil fuels to supply heat, which accounts for just under half of emissions.



Some of this heat is simply used to keep buildings at a comfortable temperature, so there needs to be a major push on replacing heating systems. This needs to be accompanied by high levels of retrofitting and behaviour change to reduce heat demand. However, some heat is used in industry-specific applications, such as manufacturing, where (a) there is less information about the processes using heat and (b) there might not yet be technological alternatives that can use renewable energy. These emissions (around 15% of the overall total for Leicester) might be hard to mitigate using current technologies.



Emissions from cars and vans account for around 20% of the total. The shift to EVs is already underway as the costs of battery technologies have come down, so this is likely to be primarily market-led. The challenges in Leicester will be to accelerate uptake and provide supporting infrastructure (charging points and renewable electricity). However, this will still not result in zero emission transport until electricity is fully decarbonised, so to address that risk while minimising impacts on infrastructure and resources, the city also needs to take radical steps to reduce demand for private car travel.

MISC.

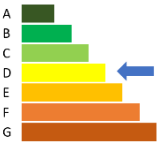
Most of the remaining GHG emissions will be hard to mitigate without technological advances or wider changes outside Leicester's control. For example:

- HGVs could run on biofuels or hydrogen, but renewable supplies of these fuels are very limited.
- Reducing f-gas emissions will rely primarily on the introduction of new cooling technologies and refrigerants.
- Emissions from railways are small, and electrification of the rail network requires major infrastructure projects beyond Leicester.

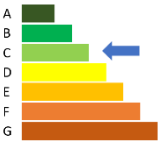
The GHG baseline therefore tells us that, in a best-case scenario, as of 2022 we only have solutions to address around 85-90% of Leicester's current emissions. To get to net zero, any residual emissions would need to be dealt with via some form of carbon removals or offsetting (discussed further in Section 3.3).

2.2 How is Leicester doing so far?

Housing



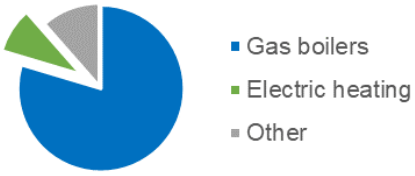
The energy efficiency of domestic buildings in Leicester is the same as the national average.



Council-owned housing in Leicester, however, is generally more energy efficient than the average.

On the plus side, this means that the Council has made some good progress – but the real challenge lies with improving the non-council housing stock.

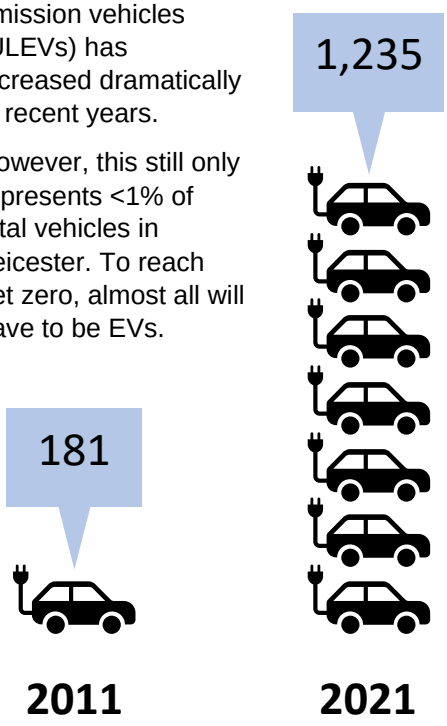
Furthermore, more than 80% of homes use fossil fuel heating systems – and all of them will need to be replaced.



Electric Vehicles

Uptake of ultra-low emission vehicles (ULEVs) has increased dramatically in recent years.

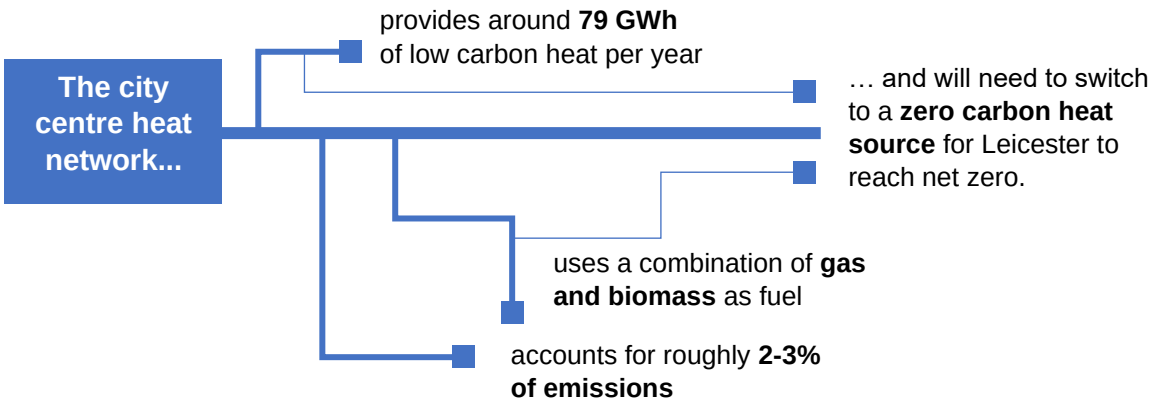
However, this still only represents <1% of total vehicles in Leicester. To reach net zero, almost all will have to be EVs.



Charging Infrastructure

Leicester has a relatively high number of EV charging points compared with most other UK local authorities, but when adjusted for population it is below average. The shift to EVs will only happen if there is adequate charging infrastructure to support them, so Leicester will need to both:

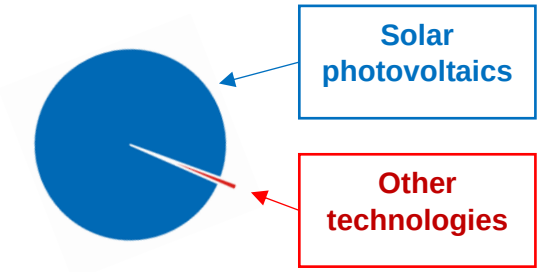
- **reduce demand for trips, particularly car and van journeys, and**
- **radically increase the number of charging points.**



Renewable electricity

As of 2019, there were **4,613** renewable electricity-producing installations in Leicester. Almost all are roof-mounted solar PV.

Collectively, these produce **30 GWh** of electricity per year, which is equivalent to **roughly 2%** of the city's electricity use.



Leicester will need to produce as much of its own renewable electricity as possible to mitigate against the possibility that the UK grid does not decarbonise sufficiently to reach net zero.

LCC has already taken significant steps towards reducing emissions, many of which are set out in the Climate Emergency Strategy and Action Plan 2020-2023. Some of the notable examples include:

- Proposing to introduce a Workplace Parking Levy and Local Transport Plan measures to generate funding for a dramatically enhanced electric bus network with integrated London-style ticketing, along with an expanded cycle route network
- Using money from the Salix Public Sector Decarbonisation Fund to deliver a programme of demand reduction and electrification measures in schools and corporate operational buildings
- Participating in the Green Homes Grants Local Authority Delivery programme which helps to improve the energy efficiency of homes for low income households
- Voluntarily setting a standard for all new council housing to be 'carbon neutral compatible', i.e. capable of operating with net zero emissions once the grid decarbonises, via high levels of energy efficiency and electric heating

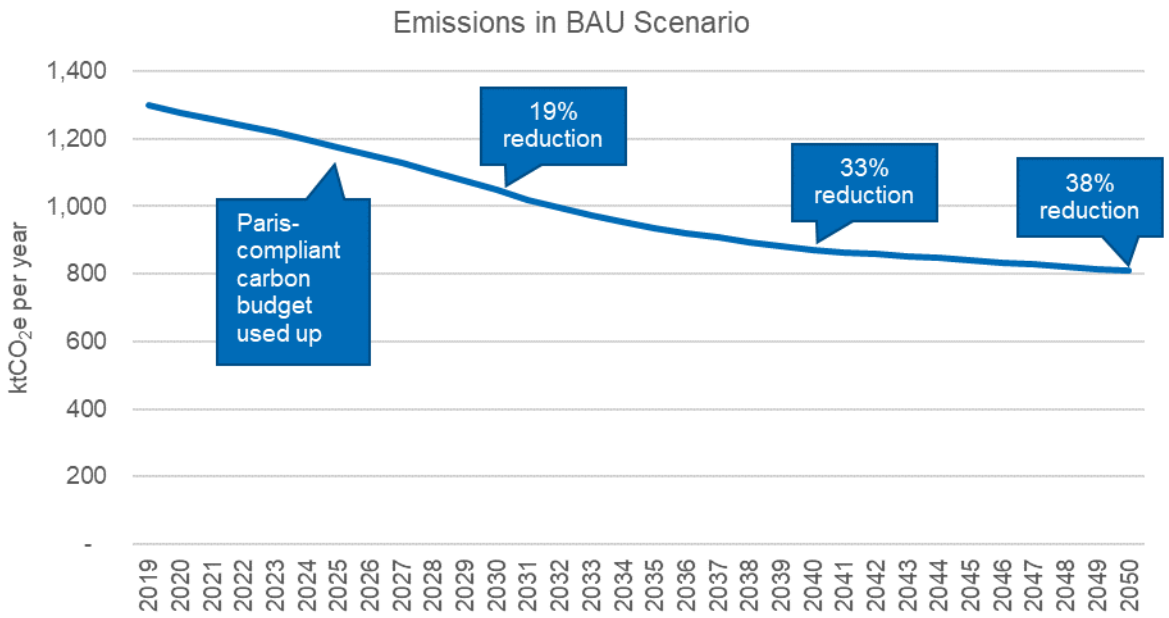
3 Potential future emissions pathways

3.1 The ‘Business as Usual’ scenario

This project used GHG scenario modelling to evaluate the impacts of changes the Government considers most likely to occur between now and 2050:

population growth	economic trends	national policy	technological changes

This is referred to as the ‘Business as Usual’ (BAU) scenario.



In the BAU scenario, although there are some changes in fuel consumption, the main driver of emissions reduction is due to electricity grid decarbonisation. It is clear that the 2030 ambition is not met – in fact, according to the CCC, the UK as a whole does not have sufficient policies in place to reach net zero by 2050.

This, combined with the fact that Leicester’s ambition is 20 years ahead of the national target, means that, like other local authorities have set ambitious decarbonisation goals, Leicester will face special challenges:

- There are fewer technological solutions available, so there is very little room to pick and choose measures. The focus has to be on reducing demand and making use of existing technologies.
- The scale and timing of changes must be vastly accelerated. There is probably no precedent in the UK for the type of transformative change that is required, other than COVID or wartime-era measures.

- For most of the priority interventions, there is currently little or no funding, and few levers of influence for the Council. Leicester will need to find innovative ways to effect change.

3.2 Carbon neutral scenarios

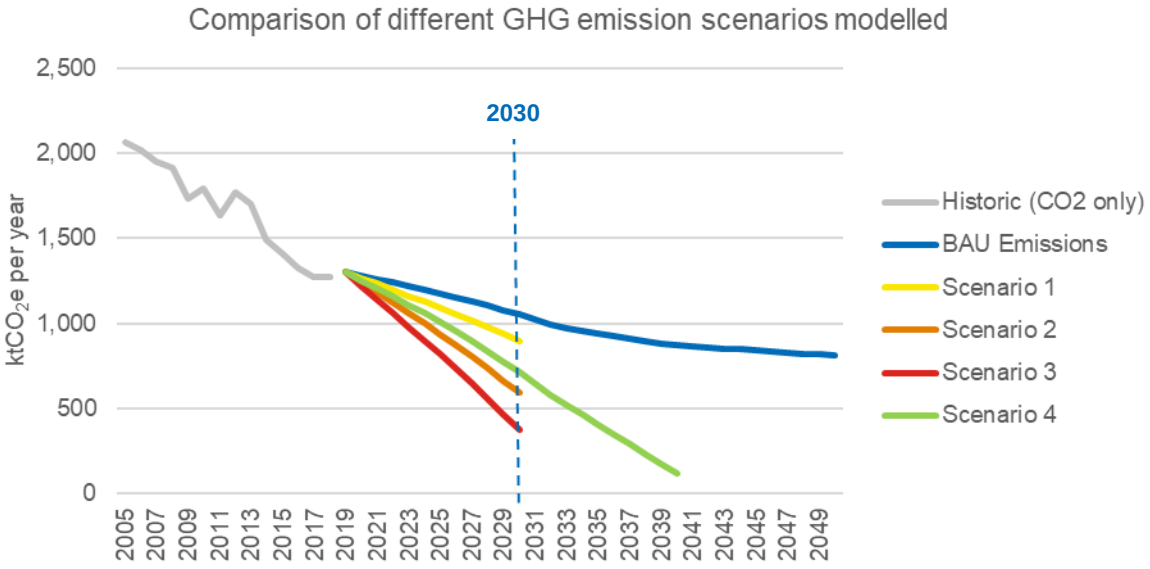
With the BAU as a starting point, additional mitigation measures were modelled to represent a series of alternative pathways with increasing levels of ambition.

Scenarios 1 and 2 are based in large part on the CCC's assumptions about changes in each sector that could happen in the coming decades. Scenario 1 reflects the level of change that would need to occur by 2030 for the UK to be broadly on track to reach net zero by 2050. Scenario 2 takes the major changes that could occur by 2050 under the CCC's assumptions, and brings them forward to 2030, 20 years ahead of schedule.

Scenario 3, meanwhile, is meant to represent a 'best case' scenario that pushes the boundaries of what is technically achievable. Of the scenarios modelled, Scenario 3 gets closest to net zero by 2030.

Scenario 4 sees broadly the same types of changes occurring as are modelled in Scenario 2, but they happen by 2040 instead of 2030. It also looks at the impacts of a few measures that are not likely to occur until the 2030s, namely the introduction of hydrogen for HGVs and certain industrial uses, plus decarbonisation of the city centre heat network.

Note: The emissions pathways are not predictions, but can be used to help identify key priorities, risks, and opportunities for Leicester, because they indicate the scale and direction of changes that each intervention could produce.

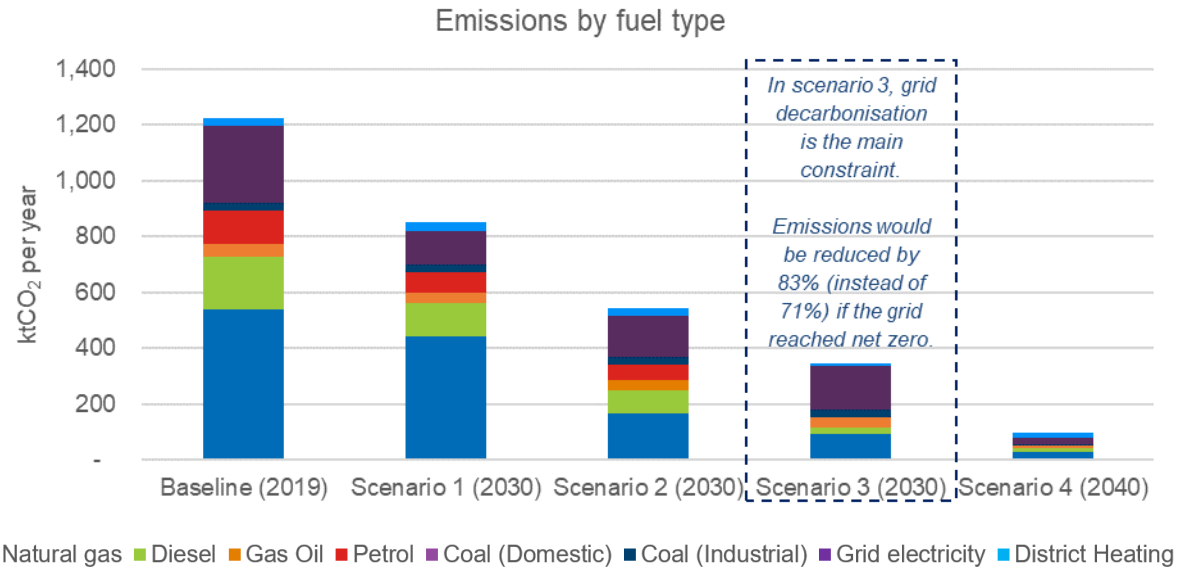


SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4
31% REDUCTION BY 2030	55% REDUCTION BY 2030	71% REDUCTION BY 2030	91% REDUCTION BY 2040

The headline finding is that none of the pathways reach zero emissions by 2030. All of them require some form of carbon offsetting or removals from outside the city boundary. This is due to two main factors:

1. As mentioned in Section 2.1, some sources of emissions are difficult or impossible to mitigate in this timeframe based on available technologies; and
2. The best option for decarbonising heat and transport is to switch to electricity, since this can be supplied with renewables – but the UK grid will not be zero carbon by 2030.

Scenario 3 is the pathway that Leicester should aspire to if the focus is on achieving carbon neutrality by 2030 with minimal residual emissions. It relies heavily on demand reduction and electrification.



3.3 Impacts of GHG mitigation measures

The table below shows the scale of emission reduction from each measure modelled in Scenario 3. It is important to understand that Scenario 3 is largely illustrative and, in some instances, represents the maximum theoretical changes that could occur. The numbers are helpful for understanding the *relative* scale of change, taking into account both the differences between measures/sectors as well as the other scenarios modelled.

Also note that the impact of each measure depends not only on its ambition, but also on what proportion of baseline emissions it affects. Hence, reductions in the domestic sector are the largest because that is the single largest-emitting sector.

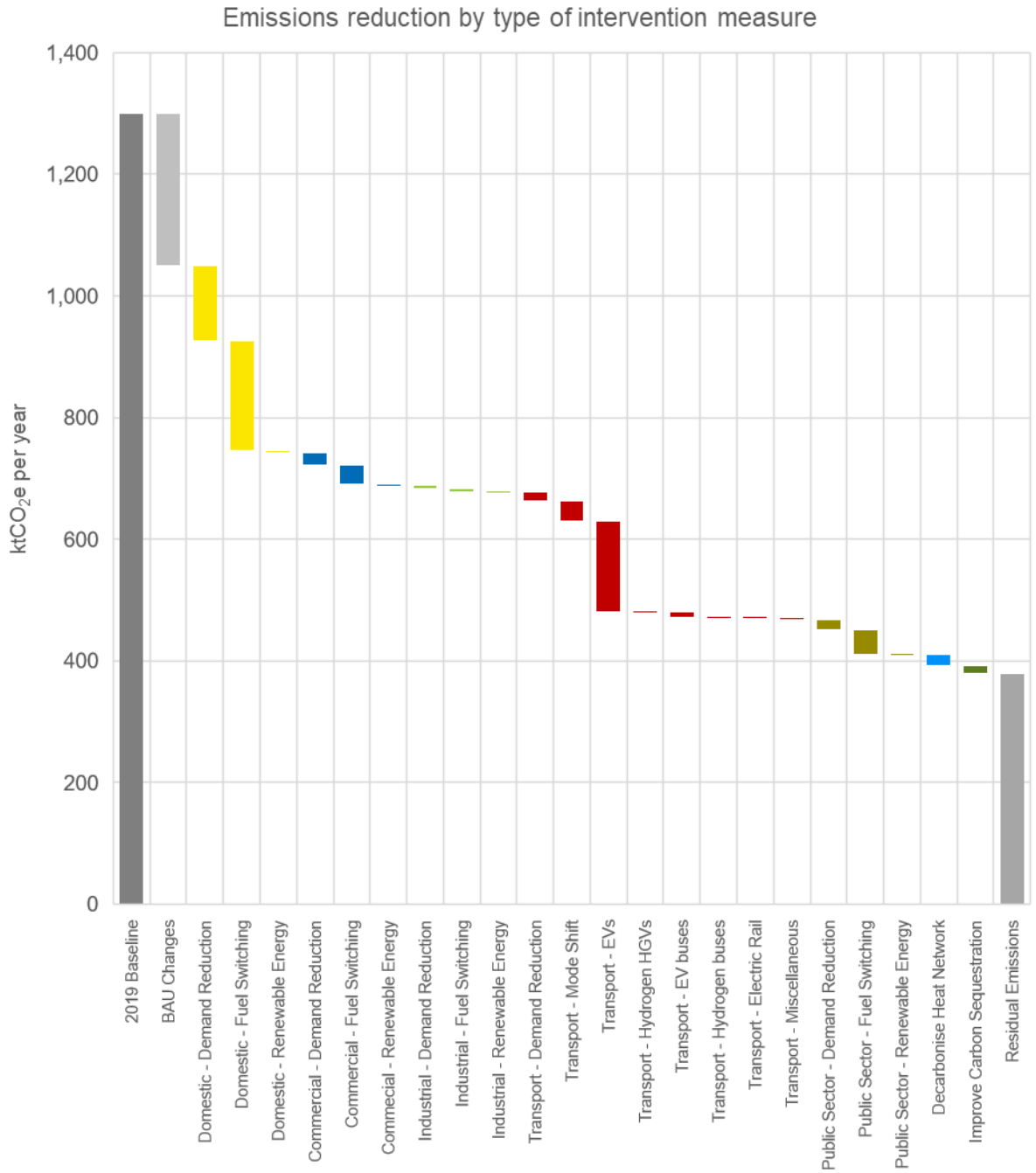
Values may not sum due to rounding.

Sector	**Mitigation measure**	**Potential impact on emissions for each…**	
		Measure	Sector
BAU	BAU Changes	-19%	-19%
Domestic	Domestic - Demand Reduction	-10%	-24%
	Domestic - Fuel Switching	-14%	
	Domestic - Renewable Energy	-0.4%	
Commercial	Commercial - Demand Reduction	-1.5%	-4%
	Commercial - Fuel Switching	-2.4%	
	Commercial - Renewable Energy	-0.1%	
Industrial	Industrial - Demand Reduction	-0.5%	-1%
	Industrial - Fuel Switching	-0.3%	
	Industrial - Renewable Energy	-0.04%	
Transport	Transport - Demand Reduction	-1.2%	-16%
	Transport - Mode Shift	-2.5%	
	Transport – EV cars and vans	-11%	
	Transport - Hydrogen HGVs	n/a	
	Transport - EV buses	-0.8%	
	Transport - Hydrogen buses	n/a	
	Transport - Electric Rail	n/a	

	Transport - Miscellaneous	-0.2%	
Public Sector	Public Sector - Demand Reduction	-1.3%	-4%
	Public Sector - Fuel Switching	-3.1%	
	Public Sector - Renewable Energy	*	
Heat Network	Decarbonise Heat Network	-1.4%	-1%
Land Use	Improve Carbon Sequestration	-1.0%	-1%

n/a = not modelled in Scenario 3; see Evidence Report for more details

** = included in the total for 'Commercial renewable electricity' due to estimation methodology*



In practical terms, achieving Scenario 3 would require actions across all sectors, with a level of ambition enough to achieve at least the following scale of changes:

In buildings:

- Making the building stock as efficient as possible, with at least half of all buildings (65,000) being retrofitted to a very high energy performance standard by 2030 – equating to roughly 7,000-8,000 retrofits each year, on average
- Decarbonising heat by installing an average of 11,000-12,000 heat pumps per year, switching the heat network from gas CHP and biomass to heat pumps, and ensuring all new buildings are electrically heated
- Switching to 100% LED lighting, compared with around 50% at present (estimated)

In the transport sector:

- Nearly 100% of cars, vans and buses being replaced with EVs by 2030. On average, that would involve replacing roughly 20,000 vehicles per year based on current numbers – however, measures should also be taken to reduce reliance on private vehicles which could reduce the number required.
- Achieving a 5% reduction in demand for transport through new ways of working and living (e.g. working from home and online shopping).
- An increase from 30% to 50% of all journeys being walking or cycling, in line with the ambition set out in the Government's road transport decarbonisation strategy.
- Shifting up to 10% of car journeys to public transport – this would more than triple the proportion of trips that are made by bus.
- A 10% reduction in emissions from commercial vehicles through consolidation and logistics.
- A further reduction in emissions from HGVs, from "eco driving" training and vehicle efficiency.

In the energy sector:

- Emissions from grid electricity dropping to less than half their current levels by 2030, which would require a massive increase in large-scale renewables across the UK
- Installing PV on roughly 40% of roofs, equivalent to 52,000 total or 5,800-6,500 annual installations – more than the current total of approximately 4,600

And furthermore:

- Using all available land within the city boundary to maximise carbon sequestration, potentially switching some agricultural land on the perimeter to woodland, and avoiding development on greenfield sites

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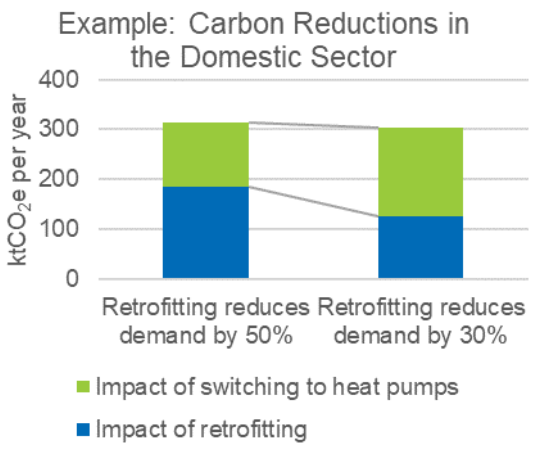
An important finding from the carbon neutral pathways analysis is that in some cases, the same level of emissions reduction can be achieved through different combinations of demand reduction and electrification. Therefore, it is not possible to say that a certain level of demand reduction ***must*** be achieved, either in buildings or transport.
However – if the electricity grid decarbonises more slowly than anticipated, there will need to be an even bigger push for demand reduction to make up the difference.

It is therefore crucial to prioritise demand reduction as the most certain way to reduce emissions by 2030 with the least reliance on grid decarbonisation.

More broadly, demand reduction is also a 'common good' – with benefits that reach far beyond Leicester – because it minimises the quantity of finite resources, including materials, infrastructure, and renewable energy, that would be needed to meet demand.



As mentioned previously, in order to reach net zero, any remaining emissions would need to be addressed through some form of carbon offsetting, comprising permanent removal of CO_2 from the atmosphere, even if that takes place outside Leicester. However, offsetting should be seen as a last resort for a variety of reasons, including the fact that it is open to criticism as potentially being a clever 'carbon accounting' mechanism that does not deliver real GHG reductions.

Even if, somehow, there were sufficient resources to purchase enough carbon offset credits for any residual emissions in Leicester by 2030, consideration needs to be given to whether it would be a worthwhile use of resources. Focusing on direct emission reductions would provide more immediate, realistic, local benefits. On the other hand, this would almost certainly put the 2030 ambition out of reach, unless there is a major shift in UK government policy, funding, and implementation, and/or technological breakthroughs.

KEY STRATEGIC DECISION:

Decide whether to put effort and resources towards offsetting the residual emissions, or whether to focus on emissions reductions within the City itself (which would almost certainly make reaching net zero by 2030 impossible).

4 The carbon neutral roadmap

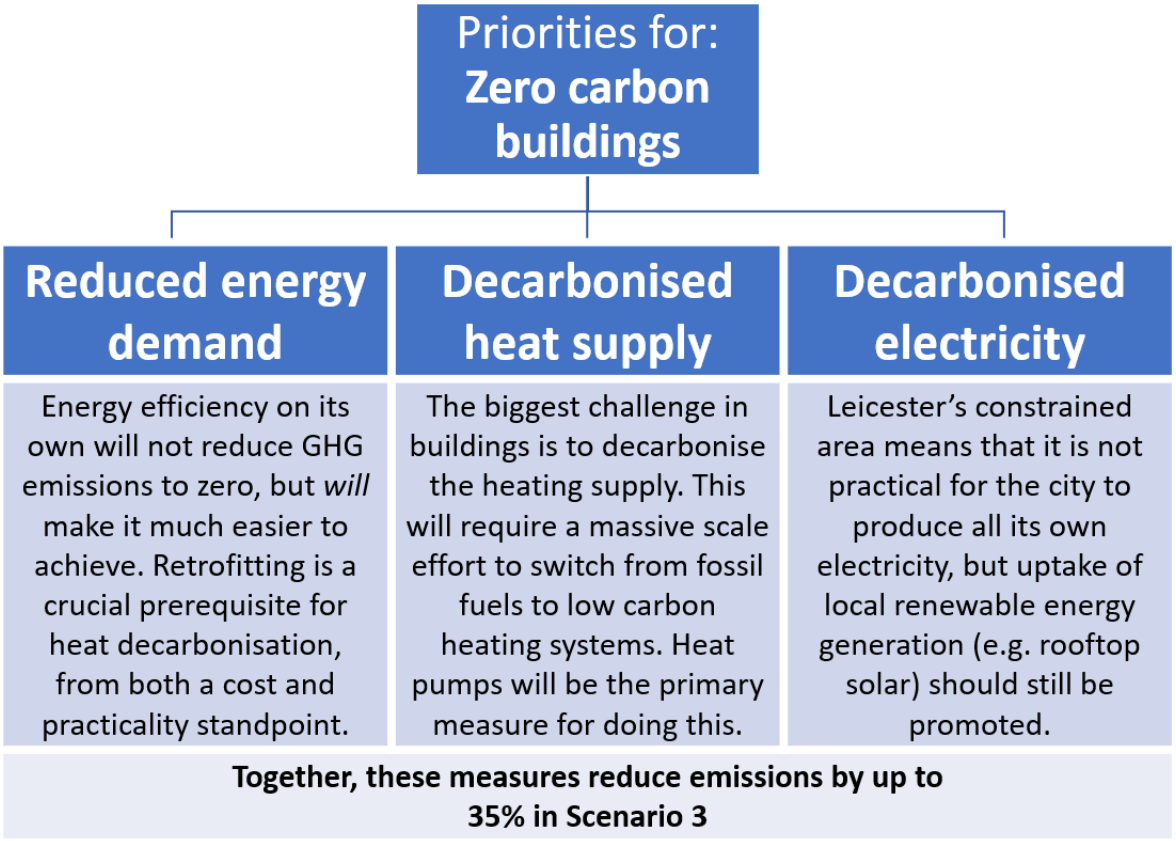
This section looks at major sources of emissions in turn and considers:

- What the main mitigation priorities are
- Key sectoral changes that need to occur
- Risks, barriers, and opportunities

4.1 Buildings

To achieve carbon neutrality in Leicester, CO_2 emissions from all buildings (domestic and non-domestic) will need to be reduced to zero. There are three sectoral goals to achieve this – decarbonising heat, reducing energy demand, and contributing to decarbonising electricity.

Headline messages for achieving zero carbon buildings in Leicester



4.1.1 Reducing energy demand

Behavioural change represents important easy wins to take advantage of and to support immediate emissions reductions. However, evidence to date suggests that it would only have a limited impact on overall emissions. Reduced energy demand therefore needs to be driven more by improved thermal efficiency of buildings.

Such efficiency measures are generally more cost-effective than heat decarbonisation measures and are also needed to enable heat pump uptake (as heat pumps only operate effectively in well-insulated buildings). They are also likely to benefit households, especially fuel poor low-income ones, by reducing fuel bills and increasing levels of comfort.

It is not possible to insulate your way to carbon neutrality – but energy efficiency is a key prerequisite for other necessary changes.

It therefore would make sense to push particularly hard on thermal efficiency in the next few years, with a more concerted push on heat decarbonisation (see below) in the latter half of the decade.

Opportunities should be sought to implement whole house retrofits that cover both thermal efficiency and heat decarbonisation measures, to minimise upheaval for residents and businesses, and avoid a situation where occupants are too worried about energy bills to make a switch to electric heat pumps.

4.1.2 Heat decarbonisation

The focus for heat decarbonisation will need to be on heat pumps, in particular in existing buildings. Whilst numbers of installations are only likely to ramp up later in the decade, action is still needed in the next few years. Firstly, it is suggested that the installation of heat pumps in coming years be driven by a small number of stakeholders that have significant property portfolios, for example the Council, social housing providers and key commercial landlords.

Alongside this, the Council should work with other relevant stakeholders to plan now for greater levels of low carbon heat uptake in later years, by addressing skills gaps to make sure there are enough qualified installers (e.g. working with schools and colleges) and scoping innovative financing options.

Hydrogen is not expected to play a significant role in heating buildings – there will be limited supply of renewable hydrogen by 2030 and it will be needed to tackle emissions from other sectors that are less able to switch to electricity (e.g., some heavy industry and HGVs). Furthermore, the Government will only take a decision in 2026 on the future role of hydrogen in heating, leaving little time for it to have an impact on emissions in Leicester by 2030.

Given that the average lifespan of a boiler is 15 years, reaching carbon neutrality by 2030 would require some systems to be replaced before the end of their natural life.

District heating, which accounts for 2-3% of current emissions, is only compatible with carbon neutrality if the heat comes from renewable sources. But any expansion of the existing network and switching to low carbon sources is only likely to happen after 2030. If the heat network is not expanded or switched to a low carbon heat source, these will form part of the residual emissions that would need to be offset in order to meet the ambition.

KEY STRATEGIC DECISION:

Decide what the role of district heating will be in the route to carbon neutrality, and whether it is worth expanding, given that it is unlikely that the heat network can decarbonise by 2030.

4.1.3 Decarbonised electricity – within Leicester

Although it is not necessary for each local authority area to meet all of its own electricity needs via technologies that are installed within the local authority boundary, supporting increased local renewable energy generation is important for many reasons:

- Reducing reliance on grid electricity will reduce the emissions associated with electricity use
- As a way for Leicester to play its part in the energy transition
- Helps to ensure a diverse energy supply which contributes to resilience
- Protects against rising energy prices
- In addition, making use of existing infrastructure (i.e., building roofs) reduces the land take from installing renewables elsewhere

As the grid decarbonises, the carbon savings from local renewables will decrease, since they are calculated based on the amount of grid electricity that they offset. Given Leicester's urban environment, the main opportunity is for increased installation of rooftop solar on buildings, which reduces emissions by around 0.5% in Scenario 3.

Large industrial roofs in particular offer a significant surface area for solar power generation, and some new developments (if designed correctly) could get most or all of their energy from PV.

As this is not a critical element of achieving carbon neutrality in Leicester, it could be decided to focus more on thermal efficiency and heat decarbonisation in buildings and carry out less resource intensive activities to help encourage some uptake of rooftop solar, for example ensuring informational materials are available for those that may wish to install.

On the other hand, local renewable energy can help residents and businesses save on energy bills, help form part of a diverse renewable power system, and helps reduce reliance on national-level grid decarbonisation. Moreover, given the challenge of reaching carbon neutrality and lack of land for other types of large-scale renewables, it should not be overlooked as an opportunity.

Another key consideration is whether resources should go towards roof-mounted PV, when onshore wind and PV farms are much more cost-effective; see Section 4.3.2 for details.

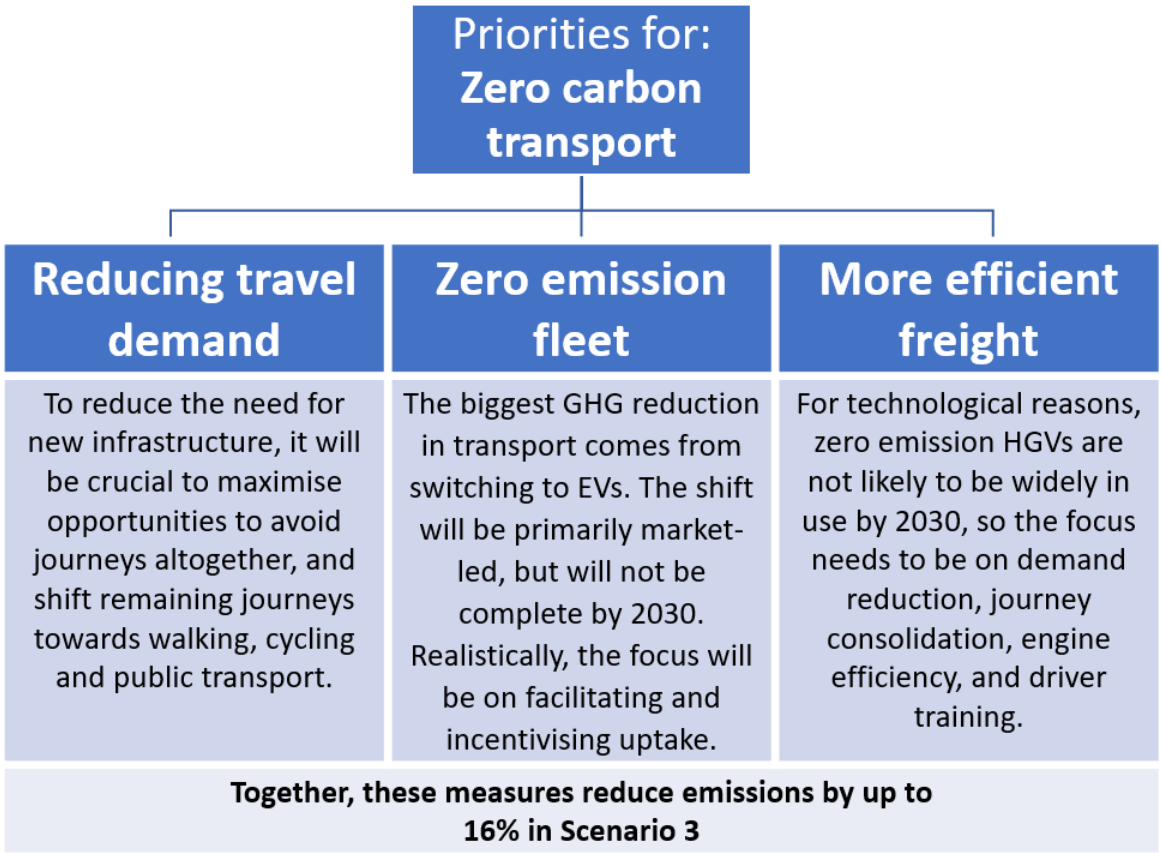
4.1.4 Uncertainties, constraints, barriers, risks and opportunities

Potential challenges or opportunities	Potential responses
Uncertainties: • Price of heat pumps is expected to come down and could even become price comparable with boilers – but how quickly? • Minimal national policy framework for driving heat pump uptake • Lack of information on industrial uses of heat and whether/when technological alternatives will become available	Work to make sure that available funding (heat pumps grant) is targeted at properties that are best suited for heat pumps Engage with businesses to understand more about energy end uses and identify industry-specific mitigation measures
Constraints/barriers/risks: • As heat pumps only work effectively in well-insulated buildings, if an insulation programme is not rolled out quickly then this could become a constraint to heat pump uptake • Potential to increase heating bills, if not done at the same time as energy efficiency measures • Lack of trained workforce to specify, install, and maintain the systems • Public perception could be damaged due to early examples of poorly installed or wrongly specified heat pumps • Lack of tried-and-tested local policy mechanisms or incentives for driving uptake • District heat network could be expanded but may not deliver substantial emissions savings in 2030 timeframe	Pilot projects to demonstrate best practice for retrofitting and heat pumps, to build up local supply chains and skilled trades An early decision will be needed on the role that expanding the heat network, and switching to low carbon sources, should play in achieving carbon neutrality in Leicester
Opportunities: • There is already an established heat network with potential to expand, which could help to switch more buildings to low carbon heat all at once	LCC can make immediate use of available studies that have already looked at options for decarbonising the heat network

4.2 Transport

To achieve carbon neutrality in Leicester, CO_2 emissions from transport will need to be reduced to zero. There are three sectoral goals to achieve this: reducing demand for trips (especially car use), moving to a zero-emission fleet, and encouraging more efficient freight.

Headline messages for achieving zero carbon transport in Leicester



4.2.1 Reducing demand for travel, and especially car usage

Leicester should aim to push as hard as possible on minimising the need to travel. Given that a very significant proportion of emissions comes from the use of private cars, this should be a particular area of focus. This is crucial for reducing emissions from transport, given that it is unlikely that the entire vehicle fleet will switch to being electric by 2030.

As a compact urban area, Leicester has an opportunity to strongly promote non-car options, i.e., walking, cycling and public transport. The Local Plan can be used to encourage a '15 minute city' approach which would ensure that would facilitate this. LCC can further support digital access to services and raise awareness among businesses and employers about the need to reduce trips. Doing so, building on many of the good initiatives already being taken, will help manage the impact on the grid of increased demand for electricity, as well as having numerous other benefits, such as reduced air pollution, improved health, better safety, reduced congestion and so on.

Previous initiatives have had a strong focus on air quality impacts.

Going forward, transport planning, strategies and funding all need to be re-focused to aim for carbon neutrality.

However, reaching carbon neutrality will require more than the "typical" measures that local authorities generally use to manage transport demand. The most certain way of reducing emissions from transport, recognising that LCC has relatively little control over private vehicle purchases, is to minimise demand for trips. LCC should consider further constraints on car and van travel/access, but it is acknowledged that these would be very controversial.

The Council should therefore use all its powers within the Local Transport Plan and in its role as a Local Planning Authority to ensure that walking, cycling, and public transport are the preferred modes for journeys and actively disincentivise unsustainable alternatives. The Council is already planning to introduce a Workplace Parking Levy, which is one option for rebalancing the relative attractiveness of private car travel. According to LCC estimates, the WPL could bring in £450 million to invest over 10 years (including the matched funding it could attract), which is more in line with the scale of investment required to deliver on the Council's ambition. Another example of the types of measures within the Council's remit would be establishing a Clean Air Zone.[5]

Major investments will be needed in order to reconfigure the public realm and transport network to prioritise sustainable travel. Road space that is reclaimed from cars can be used to provide high-quality walking, cycling and bus routes. An example of this already exists in Leicester, where a car park has been converted into a new public social space, Jubilee Square, as part of the Mayor's Connecting Leicester programme. Such interventions would also fundamentally change the look and feel of the city. In addition to the GHG and air quality benefits, doing so will also benefit the c. 40% of the population in Leicester who do not have a car or cannot afford an EV – but there will also be potential economic implications that need to be explored in consultation with local residents and businesses.

4.2.2 Zero emission vehicles

Although as much emissions reduction as possible will need to be achieved by reducing car travel (for the reasons explained above), switching to electric vehicles will have an even larger impact – and both are necessary to reach net zero.

Shifting the entire passenger car fleet to electric will be extremely challenging as it would mean effectively phasing out sales of new petrol and diesel cars immediately – and even then, scrapping some cars early. LCC has very little influence over private purchases of EVs and the carbon intensity of the electricity grid, but *can* take steps to facilitate and incentivise uptake, such as:

- Physical infrastructure – making charging facilities more easily available (including by using planning powers to make sure charging points are provided) and co-locating these with renewables where possible (e.g., PV with battery storage on car parks)
- Other incentives – such as preferential parking charges, perks for employees or preferential access
- Providing or signposting information about the benefits of EVs and showcasing them in the Council's own vehicle fleet

[5] It is understood that this was being considered until recently (2021) to meet air quality regulations, but that Leicester has now come in line with these regulations; however, those same powers can be used to lower carbon emissions from transport.

Transport infrastructure: How much is enough?

The provision of charging points (particularly in new housing) needs to carefully weigh up how much power would be needed in a carbon neutral future where most journeys happen on foot, cycle, or public transport.

The bus fleet will need to be fully zero carbon by 2030. Leicester has funding to electrify part of the bus fleet and are hoping for more funding for a 100% electric fleet by 2030. However, the network must also be expanded to enable modal shift, so additional funding will be required.

Any road improvement projects need to assess whether the project would be necessary if demand reduction measures have been fully implemented. They should also consider the embodied carbon of the materials and construction process.

4.2.3 More efficient freight

Based on current technologies, electric vehicles (EVs) are likely to be the first choice for cars, vans, and most other vehicles – with the exception of heavy goods vehicles (HGVs), which are more likely to run on biofuels or hydrogen. This is due to a range of issues, notably the challenge of developing batteries that can cope with the vehicles' weight and range requirements. Since renewable biofuels and hydrogen are not currently widely available, it is very likely that some residual emissions will remain for HGVs by 2030 – so this is one of the few areas where some form of offsetting or carbon removal would need to be considered to reach net zero by 2030.

Options for addressing freight emissions will therefore rely more on incremental efficiency improvements in the vehicle technologies, along with changes in logistics, driver training, and so on. There is also the potential to consider freight consolidation centres, provided that the risk of induced demand was carefully managed. This would need to be done in close collaboration with local businesses. Case study evidence suggests that combinations of these measures can reduce fuel use and emissions by more than 15%. The UK government has previously announced its support for a voluntary industry-wide target of achieving this reduction by 2025 (compared with 2015 levels).

4.2.4 Uncertainties, constraints, barriers, risks and opportunities

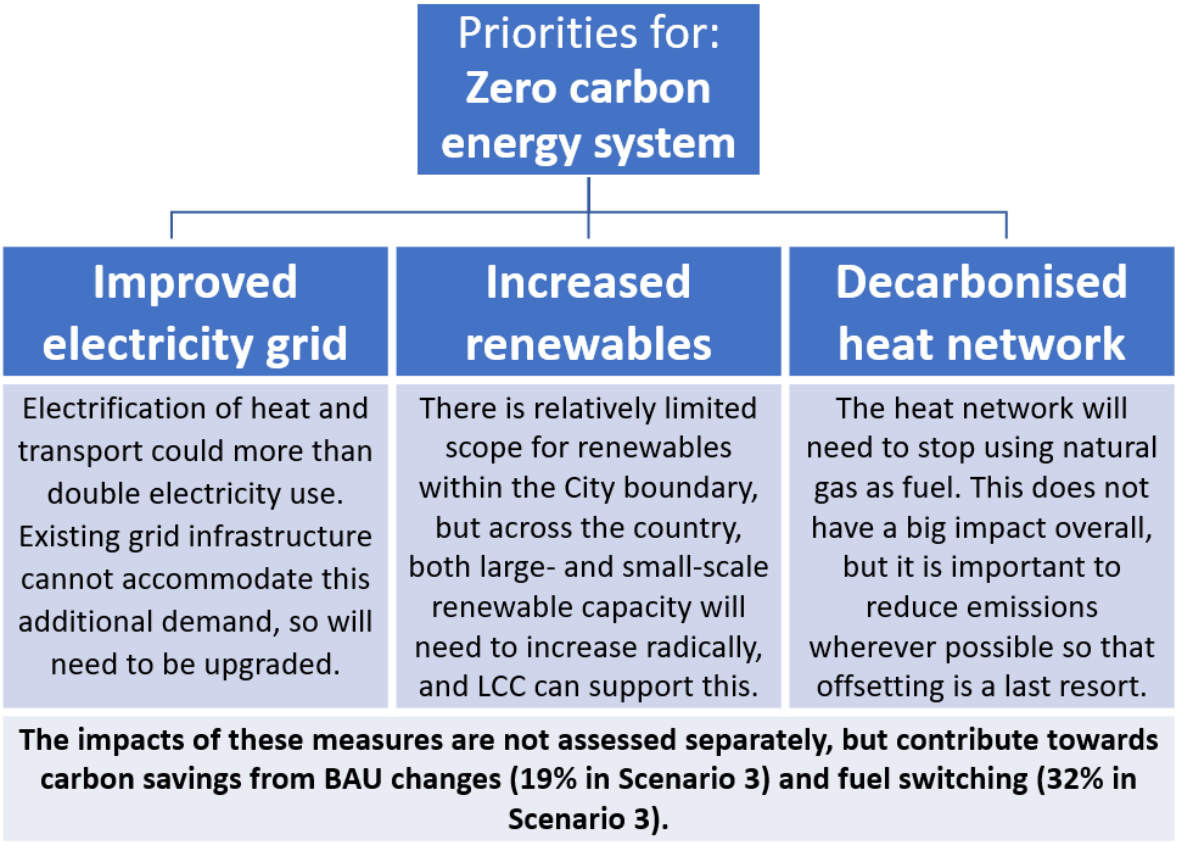
Potential challenges or opportunities	Potential responses
Uncertainties: • Ongoing impact of Covid-19 and the potential impact on travel choices – could support low carbon objectives (such as greater levels of working from home) or work against them (for example, reduced appetite for shared public transport)	Seek to understand the beneficial travel reductions from COVID while addressing issues such as reluctance to use public transport
Constraints/barriers/risks: • Potential unpopularity of measures to limit car usage • Cost differential of electric cars putting them out of reach for parts of the population of Leicester • National framework for low carbon vehicles not sufficiently ambitious (phasing out petrol and diesel vehicles by 2030)	To ensure buy-in, need to develop a public and business engagement programme that highlights the co-benefits of modal shift Businesses may need support for switching to electric cargo bikes or vans, for example capitalising on funding such as the Government's plug-in grant

Opportunities: • Due to compact urban nature of the city, more scope than some local authorities to maximise transport demand reduction and modal shift • Synergies between carbon neutrality measures and wider public benefits, such as health, cleaner air, road safety, etc.	Ensure clear links between the climate emergency, air quality, public health, and road safety agendas Coordinate with other cities that have delivered, or are delivering, large-scale modal shift programmes, to learn lessons and share best practice

4.3 Energy system

Decarbonisation and reinforcement of the wider energy system are needed to support the implementation of other measures in the buildings and transport sectors.

Headline messages for achieving zero carbon energy systems in Leicester



4.3.1 Improved electricity grid

Upgrading grid infrastructure is potentially the most important enabling activity for Leicester, given that the strategic pathway to reach carbon neutrality by 2030 relies on high levels of electrification. The other most important actions all relate to demand reduction (see previous sections), which is crucial for mitigating pressure on the grid.

LCC and other stakeholders will need to collaboratively push for an accelerated upgrade programme for the distribution network. This will require engagement with Western Power Distribution (WPD), the National Grid and Ofgem to ensure that they plan, design, and approve investment plans. In the meantime, ongoing/upcoming local improvement work and maintenance should consider future energy demands and futureproofing as much as possible – recognising that the current grid cannot support the scale of future electricity demand (which could more than double).

Where relevant, LCC should also seek to support and facilitate grid balancing projects such as renewable energy storage, vehicle-to-grid technologies and demand flexibility services.

Why the focus on electrification?

At present, electricity is the most readily available source of energy that can be made using renewable technologies. There are several other fuels that could potentially be zero carbon, including hydrogen gas and biofuels, but those rely on technological developments that are uncertain within the timescale to 2030 or even 2040.

Hydrogen in particular has been cited by the Government as a potential solution, particularly for applications that cannot use electricity.

What is the likely role for hydrogen in Leicester?

Hydrogen gas can be made using a variety of techniques. When made using renewable electricity, it is known as 'green hydrogen', and offers a low emission alternative to burning fossil fuels. Green hydrogen could help us to heat buildings, power HGVs, or be used in manufacturing and industry. 'Blue hydrogen' is derived from natural gas, but still emits CO_2, meaning that it will not offer a zero carbon energy source until and unless carbon capture and storage technologies become commercially available.

It is unclear when green hydrogen will become widely available, but the CCC does not expect this to happen by 2030. Therefore, it does not provide a viable option for Leicester to meet its carbon neutral ambition.

To the extent that hydrogen is considered as a solution, it will need to be reserved as an option for applications where electrification is not possible. This is likely to be limited to HGVs and certain energy-intensive industries such as steel, glass, brickworks, cement, from the 2030s onwards.

KEY STRATEGIC DECISION:

Decide to what extent the city wishes to invest in continuing to upgrade the gas grid, given that it will be necessary to phase out fossil fuels.

This is subject to a decision first being made on the role of hydrogen, which could potentially utilise the existing gas grid.

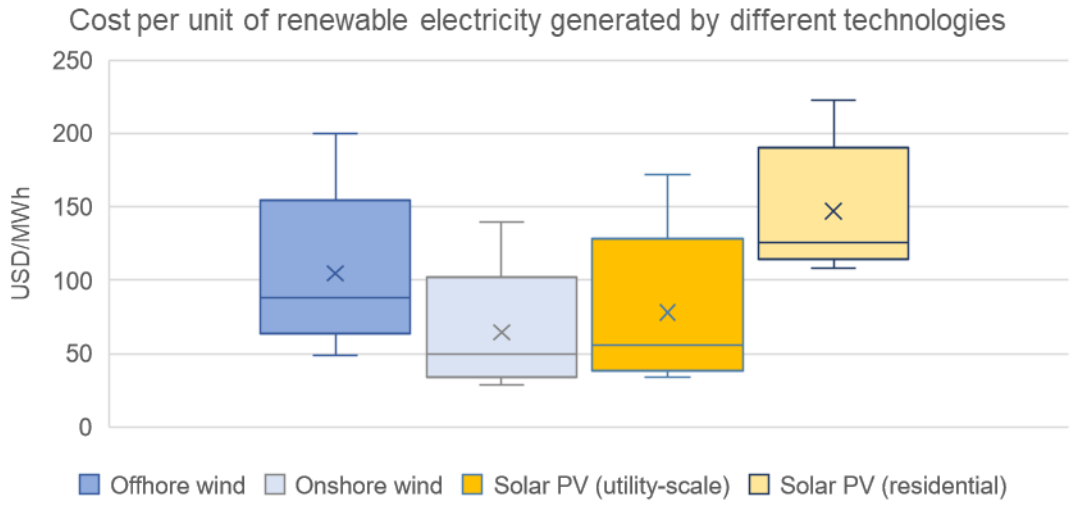
The Government has announced that they will decide on the role of hydrogen to heat buildings in/around 2026, so it may be necessary to wait until the national picture is clearer.

4.3.2 Decarbonised electricity – beyond Leicester

If, theoretically, all buildings and vehicles switched to electricity, and the infrastructure could support this, then the carbon emissions from grid electricity would be the biggest constraint on achieving carbon neutrality. Grid electricity is not expected to be zero carbon by 2030 – the Government has recently announced an ambition for this to happen by 2035 – so Leicester will need to 'do its part' to accelerate this shift.

Without grid decarbonisation, emissions in Scenario 3 would drop by -56% (instead of -71%) and emissions in Scenario 4 would drop by -56% (instead of -91%).

As mentioned previously, although the main opportunity within Leicester is roof-mounted PV, currently the cheapest option (in terms of £ invested per unit of electricity produced) is large-scale onshore wind, followed by ground-mounted solar, which would need to be located outside the City boundary.



Source: IEA[6]

KEY STRATEGIC DECISION:

If there are limited resources available to deliver or promote renewable energy projects, decide on the balance between focusing resources on renewables within Leicester or outside of the City. Onshore wind and large-scale PV are the cheapest options, although they have a larger impact on the landscape. This would require cooperation with the County Council and neighbouring local authorities.

Subject to the outcome of that decision, the main areas of focus are likely to include:

- Lobbying Government for more funding/subsidies, changes to planning law and energy regulations, and more legal powers to deliver local renewable energy systems; and
- LCC and relevant local stakeholders coordinating with the County Council and other local authorities to plan for large-scale renewable installations, including PV and wind.

At a local level, businesses, households, public and voluntary sector organisations can also help to stimulate demand for renewables by selecting 100% renewable tariffs and engaging with peak demand reduction initiatives. Again, these have not been modelled as separate mitigation measures and the impacts cannot be directly linked to emissions in Leicester, but they represent ways that people and organisations in Leicester can help to promote grid decarbonisation.

4.3.3 Decarbonised heat network

The existing heat network in Leicester is estimated to account for around 2-3% of annual emissions. It is currently partly served by gas boilers, which (along with all other fossil fuel heating systems) would need to be replaced with an alternative technology in order to reach net zero by 2030. It is understood that there are ongoing conversations between LCC and the operator; although it does not represent a large portion of total emissions, as stated previously there is no scope for picking and choosing when it comes to net zero. Therefore, LCC should continue to engage in finding an appropriate solution, bearing in mind both the technical and practical constraints.

Note: Due to the global warming potential (GWP) of refrigerants, it is important that any large scale heat pump system (like those that would be suitable for use in the heat network) use low-GWP refrigerants, and also include refrigerant leakage alarms and other leakage prevention measures. This issue applies to all heat pumps but is particularly important for large-scale systems.

[6] Projected Costs of Generating Electricity 2020 – Analysis - IEA

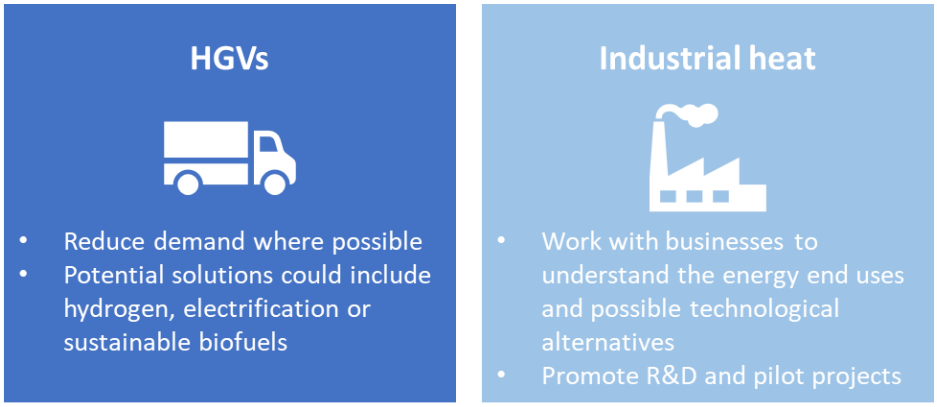
4.3.4 Uncertainties, constraints, barriers, risks and opportunities

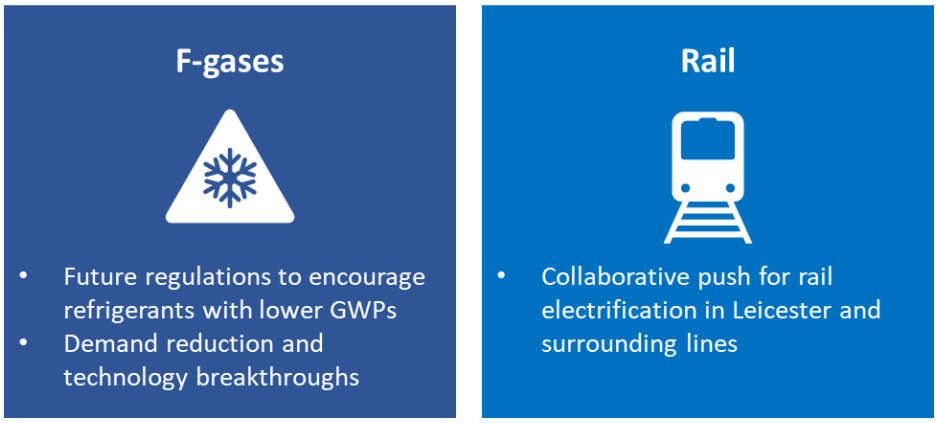
Potential challenges or opportunities	Potential responses
Uncertainties: • The capacity that the grid will need to cope with will depend on the levels of demand reduction in sectors such as buildings and transport	Aim to reduce demand as much as possible, but when engaging with WPD and other stakeholders, plan for a range of scenarios
Constraints/barriers/risks: • The rate of decarbonisation in the national grid. This has been rapid to date, and the Government has committed to fully decarbonised electricity by 2035 but has not yet outlined the policy mechanisms it intends to use to drive this. • Restrictions on anticipatory network investment by Ofgem • Cancellation of FiT subsidies	Prioritise local renewable energy generation to mitigate these risks Lobby for regulatory changes to allow for anticipatory network upgrades Consider innovative sources of funding e.g., green bonds
Opportunities: • Make use of LCC-owned land to free up space for renewables • Co-locate renewable energy on Council-owned car parks, linked with batteries and EV charging infrastructure • Undertake a more detailed feasibility study of roof-mounted solar to identify suitable large-scale industrial roofs for PV • Potential to influence decarbonization of existing heat network	Assess Council-owned landholdings and engage with large industrial organisations/landowners Continue to engage with stakeholders to facilitate use of alternative technologies for the heat network e.g., water source heat pumps

4.4 Tackling residual emissions

As shown in Section 3, even in the most ambitious scenario modelled, there will be some emissions that cannot be eliminated by 2030 using present technologies. The CCC acknowledges that, even by 2050, there will be some types of emissions that are hard to abate, which would need to be dealt with via some form of carbon removal, whether technological or nature-based.

The following diagrams show some of the main sources of what these emissions are likely to be for Leicester, and how they can realistically be addressed by LCC and other local stakeholders:





Even then, some emissions would remain. Theoretically, carbon removal technologies could help to mitigate these emissions – but such technologies are not expected to be widely available by 2030, if at all. Therefore, the main option for Leicester to reach carbon neutrality would be to explore nature-based solutions such as tree planting or peatland restoration.

In an urban environment like Leicester, it is to be expected that carbon sequestration will play a limited role in delivering carbon neutrality. Nevertheless, due to the ambitious decarbonisation goal, it is vital that existing carbon sinks and greenfield sites are protected and continue to be enhanced in line with biodiversity considerations. Therefore, LCC should continue to realise and expand biodiversity and green infrastructure efforts such as the ones outlined in the Biodiversity Action Plan, the Green Infrastructure Strategy and Tree Strategy. Within Leicester, LCC and other local landowners should work to adopt best practices in land management such as letting grass grow in parks, reducing fertiliser use, and so on.

As this alone will not bring Leicester's emission to net zero, actions outside of the city boundaries would potentially need to be considered as an additional action alongside within-city mitigation efforts. This would likely be done on council-owned land outside of the city boundary if suitable sites are under council ownership. Some of the actions may involve converting land into woodland (potentially seeking Woodland Carbon Code accreditation) and working with farmers to develop and implement best practices, such as minimum tillage (or no-till), reducing fertiliser use, and diversifying crop rotations.[7] The environmental benefits go beyond GHG emissions and should not be underestimated.

It is important to acknowledge that carbon offsetting is highly controversial. For a variety of reasons, participation in carbon offsetting schemes does not guarantee that CO_2 has been removed from the atmosphere. As mentioned previously, a strategic decision must be made on whether it is worth putting resources towards solutions outside of Leicester. There is also the question of who would be paying for offsetting measures – issues that are outside the scope of this roadmap.

The key take-home point is that the amount of land that would be required to offset Leicester's emissions through tree planting is vast – hundreds, more likely thousands, of hectares – which again emphasises the importance of reducing emissions at source.

[7] Liu et al., 2016: Farming tactics to reduce the carbon footprint of crop cultivation in semiarid areas. A review. Available at: Farming tactics to reduce the carbon footprint of crop cultivation in semiarid areas. A review | SpringerLink

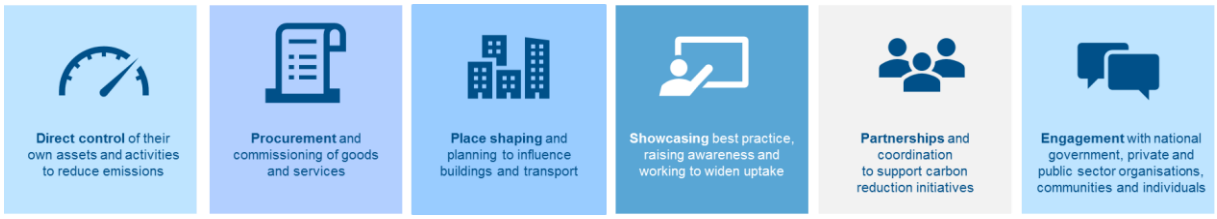
5 Delivering carbon neutrality

5.1 Roles and responsibilities

LCC's climate emergency declaration aspires to achieve carbon neutrality for the entire city – not just the Council. However, it cannot deliver on this target alone. Much of the Council's influence will be more reliant on engagement with stakeholders to promote carbon reduction projects, showcasing best practice, raising awareness, partnerships and lobbying for change.

Local authority influence over GHG emissions in their area

Adapted from CCC, '*Local Authorities and the Sixth Carbon Budget' (*2020)



The Council will need to take a leadership role in this process, by:

- Taking immediate action to drive down its own emissions
- Showing leadership to others and to inspire action
- Creating a conducive policy framework to drive climate action
- Developing coordination mechanisms and platforms for sharing information and collaboration.

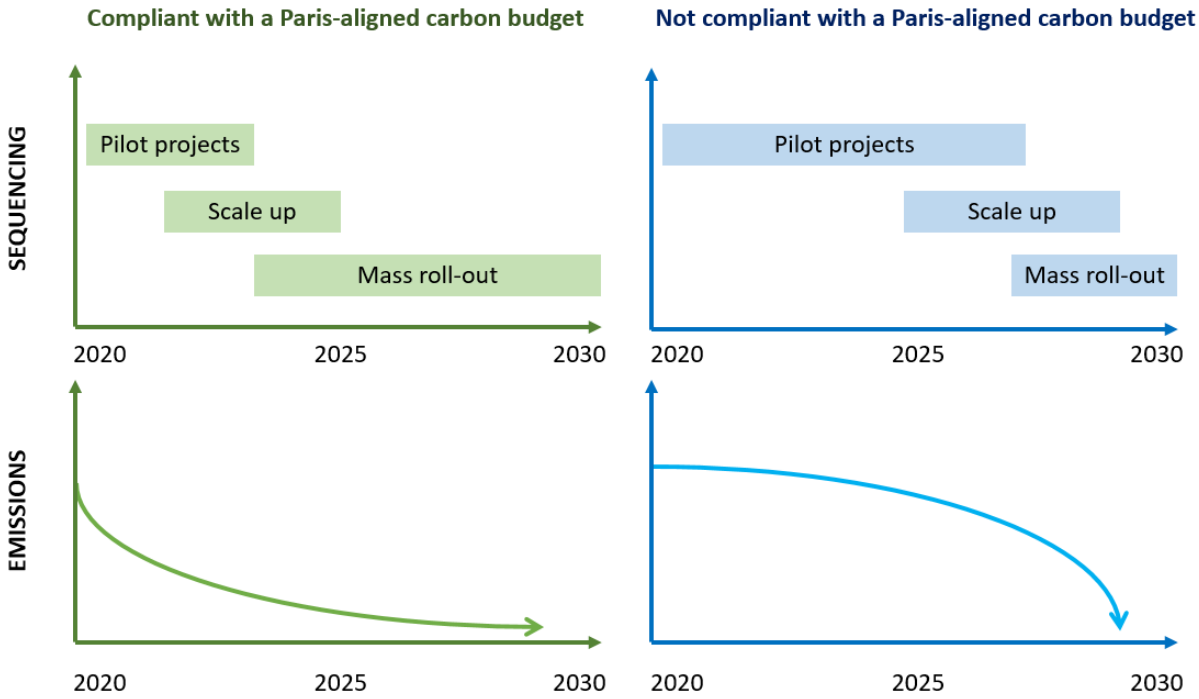
But they will need to work with a range of stakeholders to tackle GHG emissions across the city, with some key stakeholders being:

- Other councils, specifically Leicestershire County Council and neighbouring district councils.
- Business stakeholders, such as the Leicester and Leicestershire Enterprise Partnership.
- Energy stakeholders, such as Western Power Distribution and Cadent.
- Housing providers, such as housing associations.
- Major energy users, such as the universities, the NHS and major landlords.
- National-level stakeholders, including key Government departments, Ofgem, National Grid etc.

5.2 Key actions: Timescales, sequencing and stakeholders

From a legal standpoint, the UK is committed to reaching net zero by 2050, but there are not (yet) any mandates for specific actions to take place in Leicester, nor any set dates for them to be achieved. **From an environmental standpoint however, the urgency cannot be overstated – and the deadline is 'as soon as possible'.**

None of the pathways modelled show a credible emissions trajectory that is within a Paris Agreement-compliant carbon budget. As illustrated below, it is more likely that intervention measures will ramp up over time, resulting in greater carbon savings later in the 2020s, and higher cumulative emissions. But the faster these measures can be achieved, the better our chances of limiting global warming to well below 2°C.



With that said, the table below shows indicative timings for different types of decisions and interventions. These timings are intended to be more realistic but clearly all actions should be brought forward as much as possible.

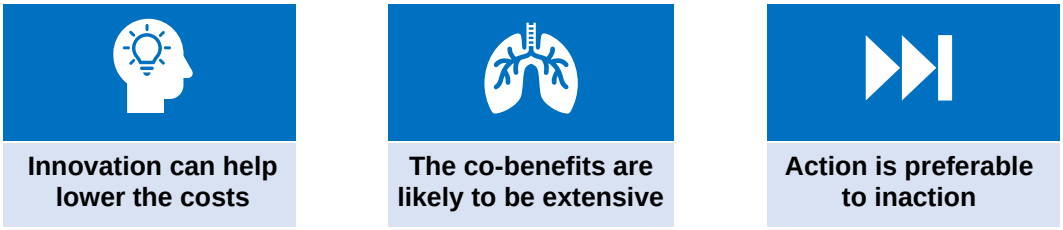
Note: Interventions prefaced by → are dependent on one or more prior measure(s) being introduced.

	Now	2025	2030	Major stakeholders
Strategic decisions				
Approach to offsetting				LCC
Decarbonisation of heat network				LCC, Engie
Local vs. large-scale renewables				LCC, County Council + other nearby Local Authorities
Role of hydrogen		*Gov't decision*		LCC
Gas grid upgrades (subject to decision on hydrogen)				
Ask of Government				
Push central Government for more support (funding, legislation, etc.)				LCC
Buildings & Industry				
Take all available steps to promote efficiency retrofits and secure access to funds				LCC
Plan, deliver and promote pilot/flagship retrofitting and heat pump projects				LCC, social housing providers, landlords, public sector bodies
Large-scale retrofitting rollout				LCC + everyone in Leicester
→ Large-scale heat pump rollout				LCC, Gov't (funding), landlords, homeowners, businesses, community groups
Engage businesses on options for reducing fossil fuel use in industrial applications				LCC, local businesses, industry bodies, DMU/UoL
→ Implement solutions for hard-to-abate industrial emissions when available				LCC, LLEP, local businesses, industry bodies
Transport				
Incorporate net zero thinking into routine road network upgrades and maintenance				LCC, National Highways
Develop an EV charging strategy for Leicester				LCC
→ Electrify buses (Note: Some funding already secured)				LCC, County Council, Arriva Leicester, First Bus
→ Large-scale shift to use of EVs				LCC, businesses, residents, LLEP
Potential shift to hydrogen/other zero emission HGVs				LCC, logistics companies, local businesses
Engage with National Highways to plan for infrastructure changes to prioritise active travel and public transport and EV charging				LCC, National Highways
→ Deliver large-scale changes (as above)				LCC, National Highways, local residents and businesses
Engage community on car travel demand reduction measures				LCC, residents, community groups, businesses, DMU/UoL
→ Pilot any additional demand reduction measures beyond those already proposed (e.g. Workplace Parking Levy)				LCC, neighbourhood groups
→ Larger scale roll-out of successful demand reduction measures				LCC + everyone in Leicester
Energy				
Incorporate net zero thinking into routine infrastructure upgrades and maintenance				WPD
Engage with WPD, National Grid, Ofgem, etc. to plan for upgrades				LCC, WPD, National Grid, Ofgem
→ Deliver large-scale infrastructure upgrades to accommodate future demand/generation				WPD, National Grid
Engage with neighbouring LAs and County to plan for renewables				LCC and neighbouring planning authorities, County Council
Deliver (and promote) pilot/flagship renewable projects				As above
→ Deliver (and promote) larger renewable projects out of boundary				As above + renewable energy developers, community energy groups
Decarbonise heat network				LCC, Engie, residents and heat network customers
Land Use				
Engage with landowners to identify and plan for carbon sequestration initiatives				LCC, local landowners
→ Adopt best practices across all landholdings (parks, agricultural land, etc.)				LCC, local landowners and other public sector bodies
Develop a carbon offsetting strategy (if applicable)				LCC
→ Deliver carbon offsetting projects out of boundary (if applicable)				LCC plus developers, investors, etc.

5.3 Costs and benefits of carbon neutrality

5.3.1 Potential investment required

Achieving carbon neutrality will require significant resources. The CCC estimates that, for the UK as a whole, the cost of net zero by 2050 could be 1-2% of GDP – although they also note that:

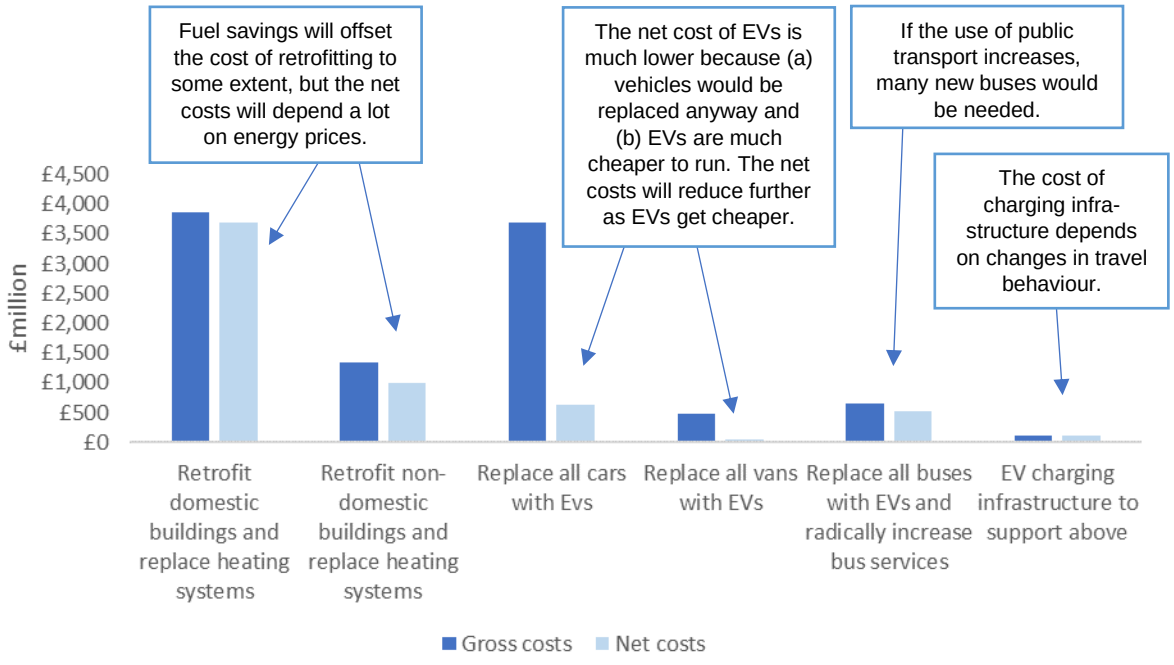


Overall, the total cost[8] of delivering the intervention measures modelled as part of this study ranges from £950m to £5.3bn. The most ambitious scenario (#3), which gets closest to carbon neutrality by 2030, is understandably the most expensive. Divided equally over 9 years, the annual costs of aligning with Scenario 3 would be between £550-600m, which is approximately 5% of Leicester's forecast GDP and 6% of current GDP.[9]

Those are the estimated 'net costs', i.e. the additional cost over and above what would otherwise have been spent; they also include cost savings, for example from reduced fuel bills.[10] If these are removed, we get an overall gross capital investment cost of £2-9bn across the scenarios modelled.

It is important to recognise that these costs are highly uncertain and intended only to illustrate the potential magnitude of investment that is required; refer to the Evidence Report for details.

Estimated costs for some of the 'big ticket' items are shown below:



[8] The net present value, i.e. future costs discounted to reflect the fact that costs and benefits in future years are valued less than nearer term costs and benefits. The figures include intervention measures taking place within Leicester but do not include the wider costs of changing the UK energy system or road network, or the cost of any initiatives/campaigns that would be needed in order to promote or administer the measures.
[9] ONS, 2021
[10] Based on current energy prices.

Although these numbers are large, there are some important factors to note:

First, these figures are high-level estimates intended to illustrate the order of magnitude of the funding required. There is huge uncertainty around future costs and the speed with which they can come down. As it stands, at present many of the individual measures can vary by up to 50% in cost.

It is possible – perhaps likely – that meeting carbon neutrality after 2030 would lower some of these costs, whether due to market maturity, or additional Government funding. Clearly, it would also reduce the annual investment needed. But such an approach would not be consistent with the city's desire to be a leader on the climate emergency, as evidenced by its ambition to achieve carbon neutrality by 2030 or sooner.

Due to "rapid cost reductions for key technologies like offshore wind and batteries for electric vehicles", the CCC now estimates that the cost of reaching net zero by 2050 is the same as previous cost estimates for reducing emissions by just 80%.

Second, some of the costs will not be truly new or additional – they would require reassignment of investments that would otherwise be spent on 'business as usual' measures such as: replacing gas boilers with new ones, refurbishing buildings without improving their energy performance, purchasing new petrol and diesel vehicles, and expanding roads to accommodate traffic growth.

Third, not all of these costs would fall on the Council – most will need to be met by other stakeholders, including businesses, householders, landlords, and other public sector bodies. One of the major challenges will therefore be to ensure that 'conventional' investments by all these stakeholders are reassigned towards measures that help Leicester along the path to carbon neutrality.

For carbon neutral solutions to become the default choice, a mix of strategies will be required:

- Regulatory requirements and enforcement, for example, minimum energy efficiency standards in existing buildings
- Initiatives aimed at re-training, developing new skills and trades
- Large-scale public engagement programmes aimed at securing buy-in and promoting behaviour change and sustainable consumer choices

However, realistically, for some of the measures that are needed, private sector investment is not likely to be forthcoming until and unless new regulatory requirements are brought into place, or there is a major shift in carbon pricing – so that the 'polluter pays'.

Finally, some of the most important benefits of investing in carbon neutrality – such as 'helping to avert climate catastrophe' – are critical to achieve, but do not necessarily generate streams of income for any particular investor. Others are classified as co-benefits, which may have a range of positive, but indirect, financial impacts as well as environmental and social ones. These factors are not reflected in the numbers above.

5.3.2 Co-benefits and wider impacts

The co-benefits of these climate actions are varied and cross-cutting. Some examples include:

	Economy	Health	Society	Resilience	Resources
Retrofitting buildings	Creates jobs (construction, manufacturing installers, designers)	Reduced risk of cold, mouldy homes; improved thermal comfort	Can help to alleviate fuel poverty if done correctly	Housing stock less susceptible to weather extremes (cold or heatwaves)	Reduces the need for either demolition or new build
Active travel	Reduced congestion, fuel cost savings, increased property values	Physical and mental benefits of exercise, significant reduction in air and noise pollution	Facilitates access to jobs/services for residents with no car	Change to reclaim road space for social space and green space	Less demand for materials/resources (fuel, motor vehicles) and infrastructure
Renewable energy	Generate revenue, e.g., through community-owned installations	Reduction in noise pollution, some reduction in air pollution	New employment opportunities	Diversified and localised renewable energy systems	Lower lifecycle carbon emissions than fossil-fuelled alternatives[11]

It is important to note that the scale of some of the co-benefits will depend on policy choices and how specific interventions are implemented.

Boosting the local economy

The Government has set up a Green Jobs Taskforce that envisions 2 million green jobs being created across the UK by 2030.[12] For Leicester, this could mean 5,000-10,000 new jobs spanning sectors such as construction, manufacturing, renewable energy and heating system installers/engineers, and innovative or community-led initiatives.

Leicester would also be attractive to new talent; a survey carried out in 2018 found that 65% of young people are interested in a career in the 'green economy'.[13]

In addition to local employment, several carbon reduction measures have cost-saving co-benefits, such as less money spent on fuel through a switch to active travel and EVs, as well as revenue generated directly for communities through local renewable energy installations. Figures from 2018 further show that congestion currently costs Leicester over £1,000 per driver per year[14] – amounting to over £104 million per annum (number of cars adjusted for vehicle occupancy). The reduction in congestion further results in health benefits through reduced air pollution.

> *"The UK's low carbon economy could grow at around 11 per cent a year between 2015 and 2030, some four times faster than the average growth rate for the UK economy overall."*
>
> *Source: UK Clean Growth Strategy*

[11] Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling | Nature Energy
[12] UK government launches taskforce to support drive for 2 million green jobs by 2030 - GOV.UK (www.gov.uk)
[13] Views on the green economy: survey of young people - GOV.UK (www.gov.uk)
[14] Congestion Costs U.K. Nearly £8 Billion in 2018 - INRIX

Shift to active travel

There are a wide range of health benefits from walking and cycling. Regular physical activity has been shown to reduce the risk of conditions such as:

Cardiovascular disease:	Type 2 diabetes:	Cancer:	Depression:
20-35% lower risk (comparing 'most active' vs. 'least active' people)	**30-40% lower risk** (comparing 'moderately active' vs. 'sedentary' people)	**30% lower risk of colon cancer** **20% lower risk of breast cancer**	**20-30% lower risk** (among people participating in daily physical activity)

Source: Sustrans[15]

Reducing air and noise pollution

In 2010 it was estimated that air pollution in Leicester might contribute to more than 160 deaths per year. A study of GHG reductions and air quality improvements in Bristol found that measures taken to decarbonise transport could have a major positive impact on air pollution, reducing NOx emissions by 92% and PM 2.5s by 37%.[16] If similar improvements could be achieved in Leicester, this would be expected to deliver public health benefits, with the potential to save dozens of lives per year. The costs to Leicester's economy previously estimated at around £7m per year, would also be reduced. [17]

In addition to air quality, a shift away from combustion engines would also decrease noise pollution – although, for safety reasons, EVs are unlikely to be silent.[18]

Tackling cold homes and alleviating fuel poverty

According to the Building Research Establishment, poor housing costs the NHS around £1.4bn each year.

Roughly 19% of households in Leicester experience fuel poverty. An ambitious retrofitting programme would help to reduce space heating demands which, for some households, could reduce energy bills by £50-£300 per year. (The picture is more complicated for households switching from gas to electric heating systems due to differences in the price of fuel, but they too can benefit from lower fuel bills provided that the standard of retrofitting is high.)

In addition, cold homes also come with significant health impacts. Nationally, almost 1/3rd of excess winter deaths are directly or indirectly linked to fuel poverty or cold housing conditions.[19] In Leicester, that would translate to roughly 50-60 deaths per year. Some of these could be avoided by introducing more energy efficient housing.

In addition to causing respiratory ailments, mould and condensation in cold buildings can also cause physical damage to buildings over the long term. When done correctly, retrofitting measures can therefore help to alleviate this problem, leading to lower property maintenance costs.

Local renewable energy systems

Community-owned energy installations can bring great benefits to the city beyond supporting the decarbonisation of the energy grid. Diversified local installations (e.g., wind *and* solar power) increase

[15] 4471.pdf (sustrans.org.uk)
[16] https://www.bristolonecity.com/wp-content/uploads/2020/02/Bristol-net-zero-for-direct-emissions.pdf
[17] air-quality-action-plan.pdf (leicester.gov.uk)
[18] New noise systems to stop 'silent' electric cars and improve safety - GOV.UK (www.gov.uk)
[19] e3g-nea-cold-homes-and-excess-winter-deaths.pdf (precarite-energie.org)

resilience to fluctuations in energy prices which are influenced by overseas imports and weather changes.[20] This effect is strongest when these can be coupled with energy storage solutions.

Care will need to be taken to ensure that the actions to deliver carbon neutrality do not worsen social inequality by hitting certain groups harder. For example:

- Electricity is currently more expensive than natural gas, so to avoid occupants facing higher fuel bills, retrofitting and specification of heating systems must be done carefully.
- Steps taken to reduce car travel can be disruptive to businesses and vulnerable individuals. It is important to ensure that the expanded public transport system is the cheapest option for travel, and businesses may need support to switch.
- There is evidence that improving the energy efficiency of homes and buildings, alongside public realm improvements, will increase property prices and rental values – but this could 'price out' lower income communities or smaller businesses.

It is crucial that Leicester implements its decarbonisation actions while ensuring that the benefits of this journey will be shared equally with all residents and be done through close community consultation to maximise the benefits for everyone.

5.4 What support will LCC need from the Government?

Considering the scale of ambition, and the scale of costs involved, it is clear that LCC cannot achieve net zero alone. It is crucial that policy at the national level is supportive of local authorities like Leicester that are aiming to achieve carbon neutrality ahead of the national 2050 target. Examples of key 'asks' are provided below. However, this list is not exhaustive and is subject to change over time in light of a fast-moving policy landscape.

Ensure that national-level programmes and funding are sustained and stable

- Recent cuts to public transport, and the cancellation of the Feed-in Tariff, Renewable Heat Incentive and Green Homes Grant have not helped support net zero ambitions at the local level.
- On issues such as public transport and heat decarbonisation, consider changing the way that national funding pots are allocated, recognising that they often have a very short turnaround and strict restrictions, in addition to being highly uncertain/variable which makes it extremely difficult for operators and authorities to plan services.
- The Government should elaborate concrete plans as soon as possible for implementation of recent net zero ambitions. For example, a clear mechanism to support the petrol and diesel car phase out.

Provide additional funding to support new actions

- Building retrofits remain a key priority, recognising that multiple schemes have been implemented unsuccessfully in recent years. In addition to funding for energy efficiency measures, also provide more support for local authorities in enforcing the Minimum Energy Efficiency Standards regulations.
- Continue to support the Boiler Upgrade grant while reinstating or introducing new incentive schemes that target heat decarbonisation and renewable energy.

[20] CAC-Chapters-all_new-brand.pdf (ashden.org)

- Provide additional funding for electric buses (already under consideration in Leicester) along with support for bus services outside of Leicester, to reduce the need for people to commute using private cars.

Remove barriers to further ambition

- Regarding energy policy, reform the existing system of planning for future demand for electricity and gas. As part of any reform, DNOs could be given a duty to prepare forward plans for supporting net zero, with a duty to work with the local authority – and a duty on the local authority to work with them.
- Change the requirements for viability testing of planning policies to consider the future costs of retrofitting (likely to be borne by the occupants/homeowners and potentially the public purse) and the wider cost of failing to reach net zero, not just the up-front cost of development.
- Develop and implement long-term recovery plans to address the impacts that the COVID-19 pandemic has had on public transport.

Re-allocate funding away from projects that increase emissions

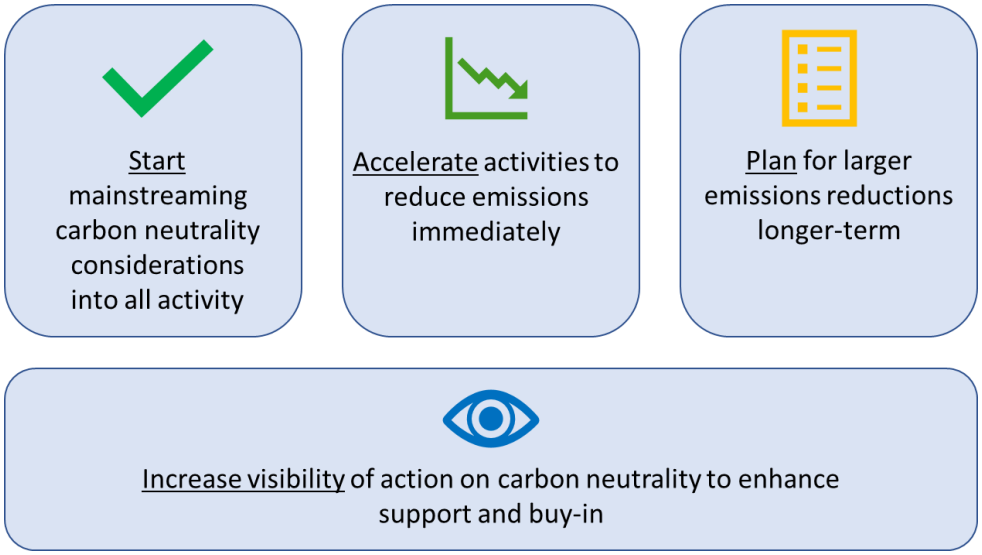
- For example, re-focus Government spending away from large road infrastructure projects, towards projects that enable car-free lifestyles.

Promote jobs and training in low carbon sectors

- Address skills gaps in the workforce by introducing training schemes for renewable energy and heat installers, along with re-training opportunities for gas boiler installers.
- Fund more research and development, and promote low carbon jobs, especially related to:
    - Energy storage and grid balancing (to facilitate the shift towards renewables)
    - Heat pumps (to help lower costs and improve performance)
    - Cooling technologies (to reduce the impact of refrigerants)
    - Green hydrogen (for sectors that cannot switch to electricity)
    - Carbon capture and storage technologies (to mitigate residual emissions)

6 Conclusions

Whilst there are a huge number of actions that will need to be taken to transition to carbon neutrality, they can be simplified into four main areas:



- **Start** mainstreaming carbon neutrality considerations into all activity. All actions that are not compatible with carbon neutrality, such as installing more gas boilers or building more road infrastructure, should be challenged, and economic and social policies need to be 'carbon-proofed'.
- **Accelerate** activities to reduce emissions immediately. Even continuing the recent pace of emissions reductions for a few more years could put the 2030 ambition out of reach. Activities that can get the market moving, working with key stakeholders that have significant influence, such as social housing providers and key commercial landlords, are needed to speed up the rate of emissions reductions over the next few years.
- **Plan** for larger emissions reductions in the longer-term. In the meantime, work needs to be done in the next few years to prepare the ground for much greater scale of change later in the decade, for example addressing skills gaps, or developing innovative local policy and financing mechanisms.
- **Increase visibility** of action on carbon neutrality to enhance support and buy-in. All of the above needs to be done in a way that demonstrates what is happening and inspires others to act.

Delivering carbon neutrality is a huge challenge. But Leicester has many advantages and opportunities – for example good work has already been started on walking and cycling, and the nature of the city means there is considerable scope for moving away from private car usage. Consideration of the pathway to carbon neutrality shows that the urgency of action is very high. Emissions reductions need to accelerate over the very short term and planning needs to take place now for much greater cuts later in the decade. Everyone in Leicester will have a role to play, but the Council in particular has a strategic role in demonstrating leadership, driving change through its planning powers and facilitating collaboration and action in others.

This roadmap, and the accompanying evidence report, aims to provide a clear framework for future discussions and work in Leicester. By outlining the scale and pace of change needed, and the strategic priorities, risks and opportunities, it is hoped it will support decision-making over the coming years, including any updates to the Council's Climate Emergency Action Plan.

T: +44 (0) 1235 753000

E: enquiry@ricardo.com

W: ee.ricardo.com