BURO HAPPOLD

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Work Package 1

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Date	09/11/2021

Contents

Glossary

- **Carbon offsets** – action to reduce greenhouse gas emissions in order to compensate for emissions made elsewhere.
- **Consumption emissions** – when goods and services are consumed inside a geographical area, these are the greenhouse gas emissions associated with creating and handling these goods and services outside the geographical area.
- **Decarbonisation pathway** – a model of projected greenhouse gas emissions in future years, including interventions to reduce them to zero.
- **District heat network** – a distribution system of insulated pipes that takes heat from a central source and delivers it to a number of buildings.
- **Domestic emissions** – greenhouse gas emissions associated with the energy use of homes inside Leicestershire.
- **Embodied emissions** – consumption emissions associated with materials extraction and construction processes.
- **Greenhouse gas emissions (GHG) (or 'emissions')** – atmospheric gas emitted from all activities that involve burning fossil fuels. GHGs accumulate in the atmosphere and trap heat from the Earth's surface, increasing warming.
- **Grid carbon factor** – greenhouse gas emissions associated with each kWh of electricity generated on the National Grid.
- **Heat pump** – device used to heat and cool buildings by transferring thermal energy from a cooler space to a warmer space, powered by electricity.
- **LULUCF –** the greenhouse gas emissions associated with loss of green habitats or change of land use classification.
- **$MtCO_2e$ (or $ktCO_2e$, tCO_2e) –** unit representing an the amount of greenhouse gasses emitted during a given period, measured in metric tons of carbon dioxide equivalent.
- **Net Zero** – no net overall contribution of greenhouse gas emissions to the atmosphere by activities being considered.
- **Non-domestic emissions –** greenhouse gas emissions associated with the energy use of business and commercial buildings from gas and electricity inside Leicestershire.
- **Operational emissions** – greenhouse gas emissions related to the use of buildings during their life span, primarily from heating and electricity usage.
- **Other GHGs** – territorial emissions data for Leicestershire is only modelled for CO_2. 'Other GHGs' is an additional emissions category included in this study to account for the impact of non-CO_2 greenhouse gases (methane, nitrous oxide and F-gases) for territorial emissions.
- **Residual emissions** – remaining greenhouse gas emissions at the end of a decarbonisation pathway. See also: decarbonisation pathway.
- **Retrofit** – upgrading and altering buildings or systems to reduce greenhouse gas emissions. This might include improving energy efficiency, adding renewable heat sources or removing fossil fuels.
- **Removals and negative emissions technologies** – process of capturing CO_2 from the atmosphere and locking it away for decades or centuries in plants, soils, oceans, rocks, saline aquifers, depleted oil wells, or long-lived products like cement.
- **Sequestration** – form of removal, relating to the capture of CO_2 from the atmosphere by trees and vegetation.
- **Territorial emissions** – greenhouse gas emissions from energy consumption and activities inside a geographical area.

Abbreviations

- BEIS – Department for Business, Energy and Industrial Strategy
- CCC – Climate Change Committee
- CEAP – Climate Emergency Action Plan
- Defra – Department for Business, Energy and Industrial Strategy
- DfT – Department for Transport
- GHG – Greenhouse gas
- LCC – Leicestershire County Council
- LETI – London Energy Transformation Initiative
- LULUCF – Land use, land-use change, and forestry
- PV – Photo Voltaic

EXECUTIVE SUMMARY

Executive Summary: Overview

Summary

This study was commissioned by Leicestershire County Council (LCC). It explores the emissions associated with activities across Leicestershire, and the possible impact of different decarbonisation interventions. The study is intended to inform the future development of coordinated climate action by all citizens, businesses, public authorities and other stakeholders across Leicestershire.

The study indicates that current local and national trajectories and policies are insufficient to decarbonise Leicestershire. It highlights that, even with radical action to decarbonise, the targets of the Paris Agreement will be extremely difficult to achieve. However, ambitious and extensive cross sector, regional and national action – at pace and backed by strong engagement and investment – can significantly reduce carbon emissions in Leicestershire, as well as delivering a wider range of social, economic and environmental benefits for local and regional residents and businesses.

Study overview

This study considers:

- A baseline inventory of emissions across Leicestershire for 2019; and
- Future emissions projections for Leicestershire based on different policies and interventions.
- High-level supplementary analysis of costs, impacts, co-benefits and stakeholder activities.

Baseline inventory (p29)

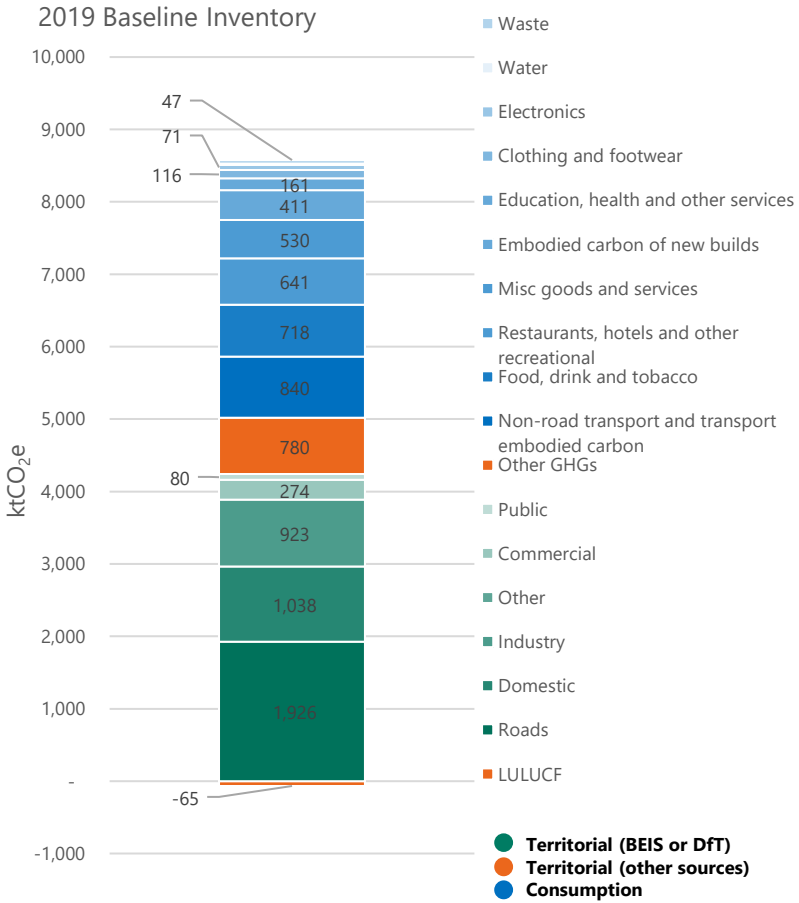
In 2019, consumption and territorial emissions categories from activities in Leicestershire amounted to 8.5 $MtCO_2e$. Of this, 59% were linked to territorial emissions, and the remainder to consumption. Consumption emissions have been estimated to acknowledge the carbon impact outside the area from activities within the county.

Modelling pathways (p35)

The study models four emission scenarios:

- Current Policy: to show what might be achieved with existing policy commitments across Leicestershire;
- Council Influenced: to show what could be achieved by LCC, working with partners across public buildings and services; and
- Balanced and Tailwinds: two approaches with a combination of decarbonising technologies and actions by all citizens, businesses and stakeholders across Leicestershire. Tailwinds represents the most ambitious scenario.

Within the pathways, all territorial emissions in Leicestershire were modelled, as were consumption emissions from systems over which LCC have a relatively high (though not complete) influence: waste disposed of by LCC, water, new building embodied carbon, food and drink. This combination of territorial and some consumption emissions amounted to 5.6 $MtCO_2e$ in 2019.



Executive Summary: Pathways

Urgent action is needed (p46)

The Current Policy pathway highlights that emissions in Leicestershire are only expected to reduce by 33% under current policies and trajectories (2020-2045). The majority of this reduction is due to national grid decarbonisation projections. The Council-Influenced pathway indicates that ambitious action to retrofit and remove fossil fuels from social housing and public buildings – such as schools and hospitals – will help reduce emissions by a further 4% only (2020-2045).

Ambitious policies and actions to reduce demand and eliminate the use of fossil fuels are urgently needed across all buildings, roads and systems in Leicestershire, with the participation of both public and private sectors.

Harnessing the benefits (p59)

The Balanced and Tailwinds pathways show demand reduction interventions, fuel switching and renewables installation can reduce emissions in Leicestershire by 91-95% between 2020-2045.

The Tailwinds Pathway achieves the highest, fastest rates of emissions reductions through a more ambitious approach to reducing vehicle mileage and building energy demand. It also enables the highest future fuel cost savings and benefits to the health, finances and environmental conditions of Leicestershire communities.

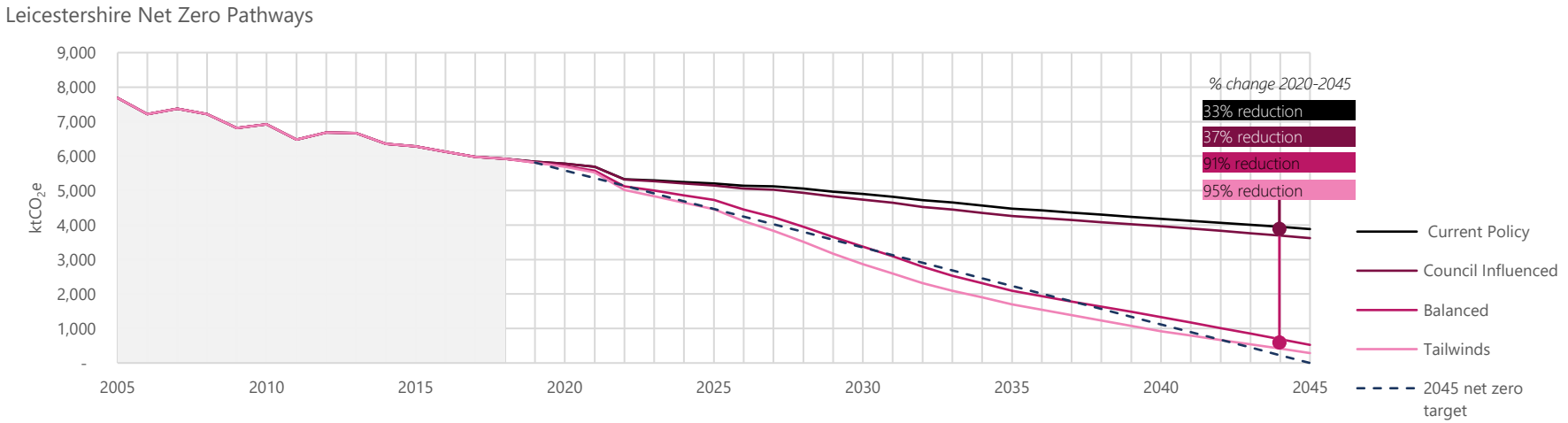
Just and affordable decarbonisation, with a focus on energy saving as well as fuel switching is essential to harness the full range of benefits of a green transition.

Pace of change is paramount (p45)

Although by 2045 annual emissions in Leicestershire can be significantly lower than today, a great deal of carbon will be emitted in the meantime.

Under the Tailwinds Pathway, Leicestershire will emit 43 $MtCO_2e$ of territorial emissions between 2020-2045. This is double the emissions budget allocated to Leicestershire in Tyndall Centre modelling for Paris Agreement compliant emissions for this time period (22 $MtCO_2e$).

Even with the ambitious targets modelled, Leicestershire risks producing a significant amount of emissions in the next decades, contributing to catastrophic climate change globally. No pace of change is too fast to decarbonise.



Executive Summary: High Level Action Plan

The recommendations for a high level action plan (p69-70) is intended to identify key themes, short-term actions (1-5 years) and lead partners for Leicestershire in achieving net zero by 2045.

Theme 1 – Road transport

Reduce vehicle mileage and switch fuel type

Road transport emissions account for a significant proportion of Leicestershire's total emissions. Reducing transport emissions is vital to achieving net zero, as well as providing additional co-benefits such as reduced air and noise pollution. While the decarbonisation of HGVs is of national significance, it is also a relevant focus area for Leicestershire given the significance of the logistics sector to the regional and national economy.

Theme 2 – Buildings

Retrofit buildings and switch heat sources

Heat switching is essential to decarbonisation and will occur in line with national guidance, gas phase-out targets and industry changes. However, the infrastructure needed for this transition, and the high cost of electricity at the time of writing, requires Leicestershire to accelerate retrofit across the county to ensure a just transition. A wide-ranging programme of building retrofit will reduce energy demand and help save fuel costs, as well as extending building lifespans and improving quality of life.

Theme 3 – Energy infrastructure

Deliver low carbon infrastructure across the region

Achieving net zero and the goals of Themes 1 and 2 will require a regional-scale energy transition. Not only will new electricity supplies be needed, renewable energy to contribute to national grid decarbonisation must be built. Coordinating the planning and delivery of regional low carbon infrastructure will enable Leicestershire to transition regionally, in collaboration with surrounding counties.

Theme 4 – Consumption emissions

Drive national decarbonisation efforts to decarbonise consumption emissions

Industry, agriculture, water treatment, and the embodied carbon of manufacturing are all high carbon emitters, both within Leicestershire and nationally. Leicestershire can engage with, and contribute to, national decarbonisation and circular economy efforts, supporting the county's decarbonisation whilst driving national efforts.

Theme 5 – A green Leicestershire

Enhance ecosystems and create accessible and inclusive green spaces

Ecosystem enhancement, increasing biodiversity and natural conservation projects are all essential to protecting Leicestershire's ecosystems and ensuring natural areas in the county can flourish. These spaces are essential for air quality, carbon sequestration and climate resilience.

Theme 6 – A just transition

Raise awareness of decarbonisation and its co-benefits and ensure equitable and inclusive climate action

Raising awareness of the benefits of decarbonisation will help establish a common vision across Leicestershire. Consultation carried out in the study indicated that there was a desire for collaboration between groups to enable inclusive and equitable climate action planning in Leicestershire.

Theme 7 – Council actions

Develop a LCC Action Plan

LCC has the opportunity to lead by example by ensuring that it is taking action to meet its own net zero target of 2030. LCC's place-leadership can support the piloting of new decarbonisation activities throughout the county, actively driving collaboration across sectors and scales to accelerate action and promote joined-up thinking.

INTRODUCTION

Purpose

Context

In May 2019, the UK Climate Change Committee (CCC) recommended that the UK increase ambition under the Climate Change Act to require Greenhouse Gas (GHG) emissions to reach Net Zero by 2050. The Government accepted this advice and legislated in June 2019 to make Net Zero 2050 a legal requirement.

In line with these national declarations, industry groups, local authorities and other actors are preparing strategies to decarbonise their activities.

Accordingly, Leicestershire County Council (LCC) recently declared a climate emergency, committing to net zero emissions across council functions by 2030 and county-wide by 2045. This is five years sooner than the legally binding national target for net zero by 2050, and as such is a goal that requires significant policy development, technological transformation and behavioural change.

LCC is in the process of preparing a strategy for delivering net zero across its own functions and buildings. This study precedes the council functions strategy, exploring county-wide decarbonisation. This includes emissions created by Leicestershire's residents and businesses, and consumption-based emissions from goods and services used within Leicestershire.

Purpose of the report

The study aims to provide a clear understanding of where emissions are concentrated within Leicestershire, and the themes for intervention needed to eliminate GHG emissions in the county.

The purpose of this report is to:

- Provide an overview of Climate Emergency Action Plan strategies and modelling undertaken by other public authorities;
- Identify main sources of emissions from Leicestershire's residents and businesses;
- Scope and baseline key emissions categories for Leicestershire to monitor in future years;
- Model policy interventions and decarbonisation interventions needed to achieve net zero, considering the suitability of existing policies and targets to meet the net zero 2045 targets and the Paris Agreement; and
- Provide LCC with a clear and concise evidence base that can be used to engage with a range of relevant stakeholders on this issue (including community stakeholders, industry bodies, service providers and Government ministries).

Image: Market Harborough / Adobe Stock / Nicola

Key Concepts

Greenhouse gas emissions

GHGs (or 'emissions') are emitted from all activities that involve the burning of fossil fuels. Long-lived GHG emissions (such as carbon dioxide – CO_2) accumulate in the atmosphere, trapping heat from the Earth's surface. Continued emission of these gases leads to continually increasing warming.

As a result, the CCC report that this warming has impacts on 'crop yields, shrinking glaciers and changing rainfall patterns affecting water availability, along with changing geographic ranges of species on land and ocean' (source, p355). These impacts are already felt today: 'there is no 'safe' level of global warming at which significant climate impacts can be avoided entirely.'

Note that in this study we use 'emissions' as a shorthand for 'greenhouse gas emissions'. These mean CO_2e emissions unless otherwise stated.

Greenhouse gas emissions categories

In this study, we differentiate between 'territorial' and 'consumption' emissions to help distinguish emissions categories and to align with national terminology and datasets.

'Territorial' emissions can occur when fuel is burnt, or electricity used, within Leicestershire, releasing 'territorial' emissions. Greenhouse gases emitted outside of Leicestershire for the creation of goods and services used within Leicestershire are 'consumption' emissions.

In this study, we consider all territorial emissions, resulting from the burning of fossil fuels and use of electricity within Leicestershire – for example heating in homes, use of vehicle fuels and power consumption for industrial activities.

Territorial emissions are reported by BEIS for all local authorities in the UK. BEIS reports only CO_2 emissions, however, while in reality other GHGs are released from these activities too – including methane, nitrous oxide and F-gases. As such, we model an additional 'Other GHGs' category of territorial emissions that represents the release of GHGs other than CO_2. See more on p25.

Alongside territorial emissions, we look at the 'Consumption' emissions created by residents and businesses in Leicestershire. Consumption emissions are the emissions produced outside of Leicestershire to create, transport and manage goods and services consumed within Leicestershire. Many groups do not report consumption emissions on the basis that consumption emissions should be reported as territorial emissions in the locations where goods and services are produced. However, accountability for emissions across the supply chain is useful to ensure full decarbonisation of all systems and avoid 'outsourcing' (source).

Consumption emissions are reported nationally on a per capita basis, and include all GHG, not just CO_2.

Units

We use metric units kWh and tCO_2 in this report:

- kWh – unit of energy demand – kilo-Watt hours;
- tCO_2 – tonnes of Carbon Dioxide emitted from an activity, where 1 tonne is 1,000 kg. 1 tCO_2 is equivalent to driving 6,000km in a diesel car (source);
- tCO_2e – tonnes of Carbon Dioxide equivalent emitted, a unit for all greenhouse gases, not just CO_2. 'Equivalent' means 'tonnes of greenhouse gas emitted that would have the same warming effect as carbon dioxide over 100 years';
- $ktCO_2$ or $ktCO_2e$ – 1,000 tonnes of CO_2 or CO_2e; and
- $MtCO_2$ or $MtCO_2e$ – 1,000,0000 tonnes of CO_2 or CO_2e.

Method

The approach to this study has been to undertake two strands of research: a literature review and detailed pathways modelling.

Literature review

Buro Happold, with guidance from LCC, undertook a review of Climate Emergency Action Plans (CEAPs) by other UK public authorities to identify:

- Typical emissions scoping and inclusion in CEAPs and associated modelling;
- Any notable benchmarks or effective strategies for decarbonisation that could be constructive for use in Leicestershire;
- How emissions reporting frameworks and accounting strategies, such as distinctions between consumption and territorial emissions, have been considered by different public authorities; and
- Modelling approaches taken by other public authorities.

Detailed pathways modelling

Following the CEAP review, modelling was undertaken for Leicestershire's own emissions. This was carried out in several steps:

1. Scoping and reference breakdown exercise – using the CEAP review findings, all emissions categories of relevance to Leicestershire were explored and sized for 2019, the most recently available data. These were then prioritised based on discussions with LCC staff, with all emissions with sufficient council influence and ability to monitor scoped into the Leicestershire Net Zero Pathways.
2. Pathway design and selection – a longlist of pathway options was prepared, based on locally specific questions identified by the project team, and versions of Committee on Climate Change (CCC) national decarbonisation pathways applied to the Leicestershire context. The project team selected four pathways to be modelled: the Current Policy Pathway to understand Leicestershire's future emissions pathway under existing targets and commitments; the Council-Influenced Pathway to demonstrate the influence that the council alone can have on Leicestershire's future emissions; the Balanced Pathway, to understand Leicestershire's future emissions following the CCC's headline dataset and UK government advice; and the Tailwinds Pathway, to understand Leicestershire's future emissions in a 'highly optimistic' scenario.
3. Pathways modelling – future emissions trajectories for Leicestershire were modelled, based on existing emissions data scaled to accommodate future new build and demand increase projections. These emissions are presented on an annual basis for all scoped emissions under the net zero target. Where regionally-specific data did not exist, best available data from national sources was used. Targets set within the pathways were determined based on the project team's best understanding of the existing policy landscape in Leicestershire and CCC pathways.
4. Post-analysis – the final pathways were reviewed and compared. This considered the modelled efficacy of current policy targets in meeting net zero targets, offsetting required to meet residual emissions, and challenging emissions categories were identified. A high level action plan was also prepared, identifying key themes, short-term actions and lead partners for Leicestershire in achieving net zero by 2045.

Policy updates

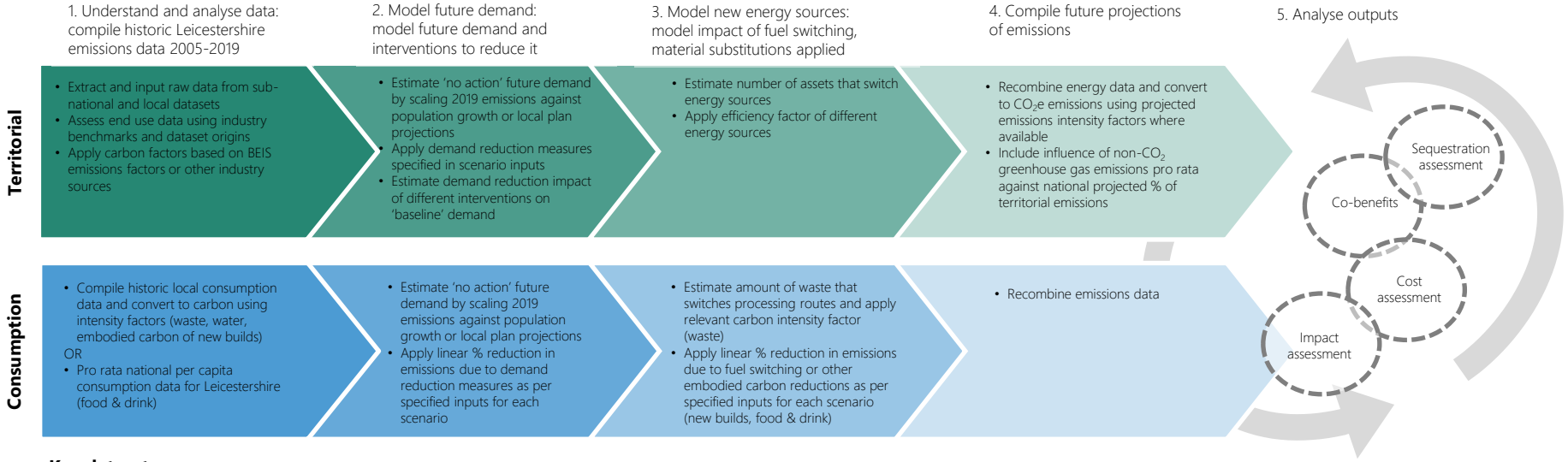
This report was prepared in the run up to COP26, when there was a great deal of policy updates and public commitments to climate action. This included a new UK Net Zero Strategy and the government Heat and Buildings strategy (source). These two publications where released after the analysis undertaken for this study was completed.

The project team reviewed these documents to understand how these aligned with the modelling undertaken. For the most part targets were not firm policy declarations (rather, ambitions or aims) or these changes are already incorporated in our modelling (as a result of the alignment with the CCC Balanced and Tailwinds pathway).

Appendix A sets out key policy commitments which are not captured in this study. Largely it is believed that these would not have significant impacts on the trends and conclusions of this study.

Pathways modelling

This study has involved quantitative modelling of Leicestershire Net Zero Pathways. These were prepared for a number of emissions categories for the period 2005-2045 using the following method:



Key datasets

- BEIS and industry carbon intensity factors for energy sources, embodied carbon and processing
- BEIS and DfT sub-national CO_2 emissions inventories
- Local waste and water data
- National per capita consumption emission data

- Local plan and subnational projections for population growth, waste arisings, water demand etc
- Industry data on achievable demand reduction rates from modelled interventions

- BEIS and industry carbon intensity factors for energy sources, embodied carbon and processing
- Industry data on achievable carbon reduction rates from modelled interventions

SECTION 1

CLIMATE EMERGENCY ACTION PLAN REVIEW

UK Net Zero Carbon Context

In 2019, the UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. The target will require the UK to bring all emissions to net zero by 2050, compared with the previous target of at least 80% reduction from 1990 levels.

UK decarbonisation progress

According to the Department of Businesses, Energy & industrial Strategy (BEIS) UK emissions were 44% below 1990 levels in 2018. The CCC suggests these reductions were largely due to progress made in reducing emissions in electricity generation, waste and the industrial sector. The first (2008-12) and the second carbon budget (2013-17) have been met and the UK is on track to meet the third (2018-22) carbon budget, but is not on track to meet the fourth, which covers the period 2023-27 or the fifth, which covers 2028-32.

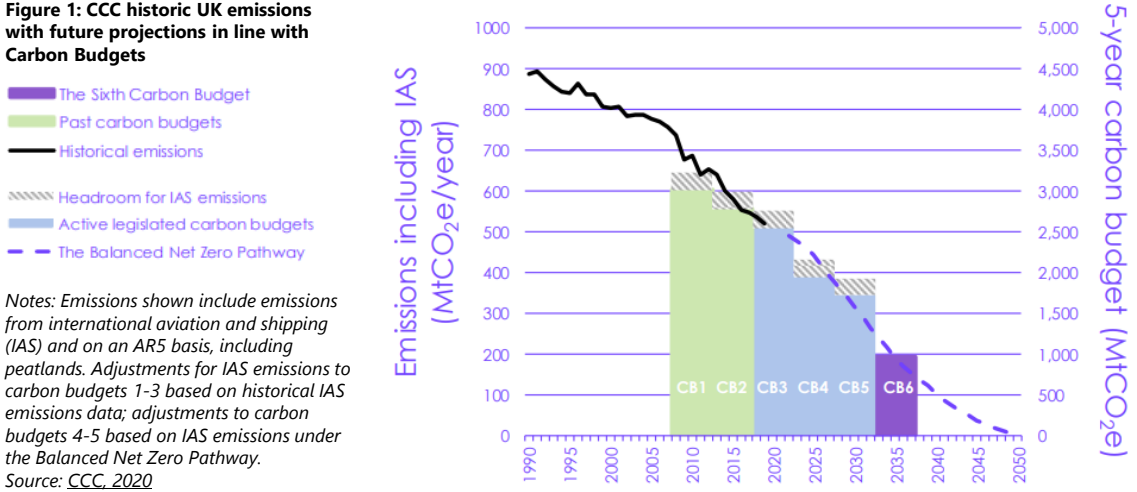
Crucially, these budgets were set against the previous target of an 80% reduction in emissions by 2050. The new net zero target (100% reduction by 2050) means that progress will need to be accelerated and ambitions raised, see figure 1.

Key policy levers for decarbonisation in the UK

The CCC, a non-departmental public body that advises the government on the climate, publishes progress and advisory reports for the Government. In the Committee's December 2020 Path to Net Zero report, there is new advice to the UK Government on securing a green and resilient recovery following the COVID-19 pandemic. The report highlights five clear investment priorities in the months ahead, all of which will be essential for Leicestershire and LCC to consider in its efforts to decarbonise:

1. Low-carbon retrofits and buildings that are fit for the future;
2. Tree planting, peatland restoration, and green infrastructure;
3. Energy networks must be strengthened;
4. Infrastructure to make it easy for people to walk, cycle, and work remotely; and
5. Moving towards a circular economy.

Figure 1: CCC historic UK emissions with future projections in line with Carbon Budgets



Notes: Emissions shown include emissions from international aviation and shipping (IAS) and on an AR5 basis, including peatlands. Adjustments for IAS emissions to carbon budgets 1-3 based on historical IAS emissions data; adjustments to carbon budgets 4-5 based on IAS emissions under the Balanced Net Zero Pathway.
Source: CCC, 2020

National Electricity Supply

Electricity grid decarbonisation

The UK national electricity grid has gone through a period of rapid decarbonisation. This is due to the decommissioning of coal fired power stations and the increase of renewable contributions to the network. As the electricity grid decarbonises, heat pumps and other electric technologies will provide lower carbon solutions. Emissions associated with gas are not currently expected to decarbonise based on BEIS predictions.

A variety of carbon factors or fuel emission factors are currently used in carbon analyses. The UK BEIS factors are used here as they provide a detailed projection of future grid decarbonisation expectations (source).

BEIS Greenhouse Gas Conversion Factors (source) show that in 2021 grid averaged electricity emissions factors approached Natural Gas emissions factors. BEIS Energy and Emissions Factors 2018 (source) include projected grid carbon intensities, indicating that natural gas is predicted to maintain its current trajectory of ~0.18 kg CO_2/kWh whereas electricity, 0.21 kg CO_2/kWh in 2021, is expected to reduce to ~0.041 kgCO_2/kWh by 2035 (80% reduction in average emissions compared to 2021). Preliminary modelling to 2050 indicates a carbon intensity of 0.007 kgCO_2/kWh and 0.07 kgCO_2/kWh by 2050 to meet national net zero targets – 97% reduction in average intensity compared to 2021 (source).

Following completion of this modelling, the government committed to decarbonising the grid by 2035, but updated trajectories from BEIS have not yet been produced (source).

Public tension over future fossil fuel use

Although the UK has declared a climate emergency and committed to achieving net zero by 2050, the country is still investing in fossil fuels, such as the proposed deep coalmine in Cumbria and continued oil drilling in the North Sea. However, there is an increasing level of public opposition regarding planned future fossil fuel energy projects. The government has been criticised for a lack of joined-up thinking and failure to act in-line with its climate commitments, despite its legally binding target to end the UK's contribution to the climate crisis (source). The UK's climate action has been further criticised given that it the host of COP26, and in a year in which it should be demonstrating its climate leadership, it is failing to follow the actions of Denmark and France in banning new oil exploration licenses (source).

Leicestershire is well positioned to support the national transition to a fully renewable electricity supply. The technical potential of renewable electricity generation in Leicester and Leicestershire is estimated to be 6,100 GWh per year, with 86% of this coming from wind energy (source). If exploited to its full potential, wind energy in the county alone could meet 76-88% of Leicester and Leicestershire's electricity requirements by 2050 (source).

Note: wind power is not modelled in this study since it is assumed that the majority of wind power would be exported to the grid (source) and therefore carbon savings would be captured in national carbon intensity statistics rather than Leicestershire statistics.

Public Authority Climate Emergency Action Plan Review

Review process

To further understand the decarbonisation context for public authorities, a review of CEAPs was undertaken. This review has been undertaken by Buro Happold with guidance from LCC and considered CEAPs from a range of public authorities across the UK.

The review considered:

- Headline targets;
- Emissions scoping;
- Modelling approaches; and
- Future actions identified and / or adopted by public authorities.

Reference to other council CEAPs can be found here: https://data.climateemergency.uk/.

Key findings

Headline tables are outlined on the following pages regarding the CEAPs reviewed and the scoping they included for their net zero carbon reduction commitments.

The key findings are as follows:

1. Most public authorities include the BEIS/territorial emissions in their climate plans. Some emissions categories are excluded depending upon local geography; most typically industrial, agriculture or land use change (LULUCF is included by Suffolk).
2. Public authorities typically limit their baseline to territorial, some however have chosen to include additional consumption-based emissions, most commonly, waste. Decision-making on variation is not clear.
3. A number of public authorities have produced a baseline of their own emissions and reported these relative to territorial emissions; outlining the proportion of emissions that the council has greatest influence over, and the extent to which collaboration is required to achieve decarbonisation commitments.
4. Most public authorities have published a CEAP that sets out emission baseline and priority decarbonisation interventions. Typically, the detailed modelling behind the emissions pathways is not publicly available online.
5. Many public authorities have chosen to outline actions against consumption/territorial emissions that they may have some direct control over, even if they don't include emissions data. These most commonly include procurement, residential/domestic consumption and road transport.

Emissions category	Definition
Domestic	Emissions associated to the energy use of homes from gas and electricity inside Leicestershire
Business	Emissions associated to the energy use of non-domestic buildings and rail from gas and electricity inside Leicestershire
Road transport	All road transport inside Leicestershire
Agriculture	Emissions associated to fuel consumption in agricultural buildings and processes
Industrial processes	Emissions associated to large scale industrial process within the physical boundary of Leicestershire
Council's own operational emissions	Specific breakdown of the Council's own emissions, as a proportion of the wider county
LULUCF	Emission associated with loss of green habitats or change of land use classification
Water	Emissions associated with water consumption in the county (e.g. in buildings, infrastructure and agriculture)
Waste	Emissions associated to waste generation, recycling and disposal from residents and businesses in Leicestershire
Aviation	Emissions associated to the flights of Leicestershire's residents and businesses
Products/ other	Any other consumption based emissions. Notes to the side of the CEAP comparison (p19)

Figure 2: Public Authority CEAP review categories

CEAPs Scoping Comparison

Included in emissions scoping

Either part scoped or considered within action plan but not in scoping

Not considered

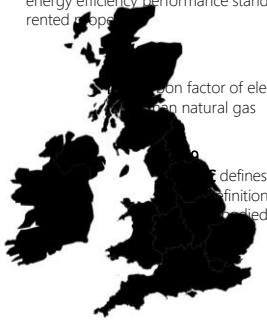
Scoping >	BEIS scoping or Territorial							Consumption based				
County Council	Domestic	Business	Road Transport	Agriculture	Industrial Processes	Council's own operational emissions	LULUCF	Water	Waste	Aviation	Products/ other	
Oxfordshire	◉	◉	◉	○	○	○	○	○	◉	○	○	
Kent	◉	◉	◉	○	○	◐	○	○	◐	○	◐	Shipping included
Suffolk	◉	◉	◉	◉	◐	◉	◐	○	◉	○	○	
Gloucestershire	◉	◉	◉	○	◉	◉	○	○	◉	○	○	Council procurement
Cornwall	◉	◐	◉	◉	○	◉	◉	◉	◉	○	○	Coastal included, shipping not

BEIS territorial emissions categories typically included for buildings and road transport

BEIS territorial agriculture, industrial and other emissions sometimes included, often not

Consumption emissions typically not included, apart from waste, for which most councils have responsibility for municipal disposal

UK and LCC Strategy Timeline



2018
Minimum Level of Energy Efficiency Minimum energy efficiency performance standards for all rented [illegible]

[illegible]on factor of electric grid averaged [illegible]n natural gas

[illegible] defines net-zero carbon, using the [illegible]finition for operational carbon and [illegible]ied carbon is to be considered.

2023
National Grid First year without Coal fired power stations

2025
Gas Boiler Ban No gas boilers to be installed in new homes

Mid-late 2020s
Retrofits Aim to retrofit all UK buildings to EPC B-C

2032
Heating Strategy Decision point for UK wide role out of heat pump /electrification or Hydrogen for buildings

2030
UK Hydrogen Strategy First low carbon Hydrogen clusters with carbon Capture and Storage operational

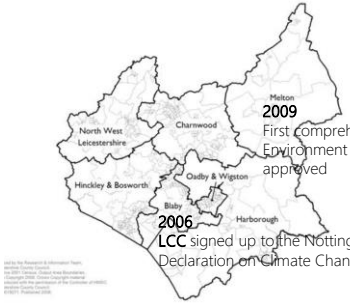
2030
Electric Vehicles Only Ultra Low Emission Vehicles (ULEV) sold as new

2035
National Grid The UK will be powered entirely by clean electricity

2035
Heat switching Ambition that by 2035, no new gas boilers will be sold.

2040
Net Zero Vehicles Government pledge to end the sale of new, non-zero emission road vehicles

2005 | Now | 2025 | 2030 | 2040 | 2050



2006
LCC signed up to the Nottingham Declaration on Climate Change

2009
First comprehensive Council-wide Environment Strategy and Action Plan approved

2019
LCC signed up for UK 100 pledge and declare a climate emergency

2020
LCC publishes updated environment strategy and commitment for 2030

2020
LCC set net zero targets for council's operations and to work with others to reach carbon neutrality across the county

2025
LCC reduces LCC operations emissions 64% (compared to 2016-17)

2030
LCC operations net zero

2045
Leicestershire county-wide net zero target

SECTION 2

SCOPING FOR LEICESTERSHIRE

Scoping Overview

Section overview

This section outlines the process of defining the scope of the Leicestershire Net Zero Pathways modelling, and in particular the decision-making process used to identify which emissions categories would be included in the modelling.

The section includes:

- Scoping method: the method used to scope emissions for the Leicestershire Net Zero Pathways;
- Scoping breakdown: a longlist of emissions categories with preliminary assessment for Leicestershire;
  - Territorial emissions assessment based on BEIS and DfT historic data;
  - Consumption emissions assessment pro-rata from national datasets, with certain emissions categories modified with regional datasets;
- Scoping outcomes: the final proposed scoping approach for the Leicestershire Net Zero Pathways.

Scoping method

Before modelling the Leicestershire Net Zero Pathways, Buro Happold and LCC undertook an exercise to identify which emissions categories would be included in the modelling.

To make this decision, Buro Happold initially prepared a longlist of possible emissions categories that might be included. This longlist was based on the CEAP peer review, available data in national emissions datasets, and emissions categories in the CCC Sixth Carbon Budget for the UK (source).

This longlist was then reviewed in collaboration with staff from across the council. A set of emissions to scope into the modelling was then agreed and finalised with attendees reflecting the council's ability to influence them, report progress and the size of each emissions category for Leicestershire.

Image: Melton Mowbray / Adobe Stock / Nicola

Scoping Breakdown: Territorial Emissions

BEIS territorial emissions

BEIS compiles territorial carbon dioxide emissions at local authority (sub-national) level every year. These track carbon dioxide emissions resulting from the use of electricity, gas and other fuels within the county.

In 2019, this indicated that 4,176 $ktCO_2$ of territorial emissions are emitted in Leicestershire. Significant categories are domestic and non-domestic use of electricity and gas, as well as road transport emissions.

Under scope of Local Authority influence

Though the full BEIS dataset is used as a starting point in this analysis, a reduced set of emissions data ('under scope of local authority influence') is sometimes used in government reporting. This excludes large industrial sites, railways, motorways and land-use change and forestry (LULUCF).

In 2019, Leicestershire territorial emissions under the scope of influence of LCC amounted to 3,375 $ktCO_2$, 81% of the full BEIS territorial dataset for Leicestershire.

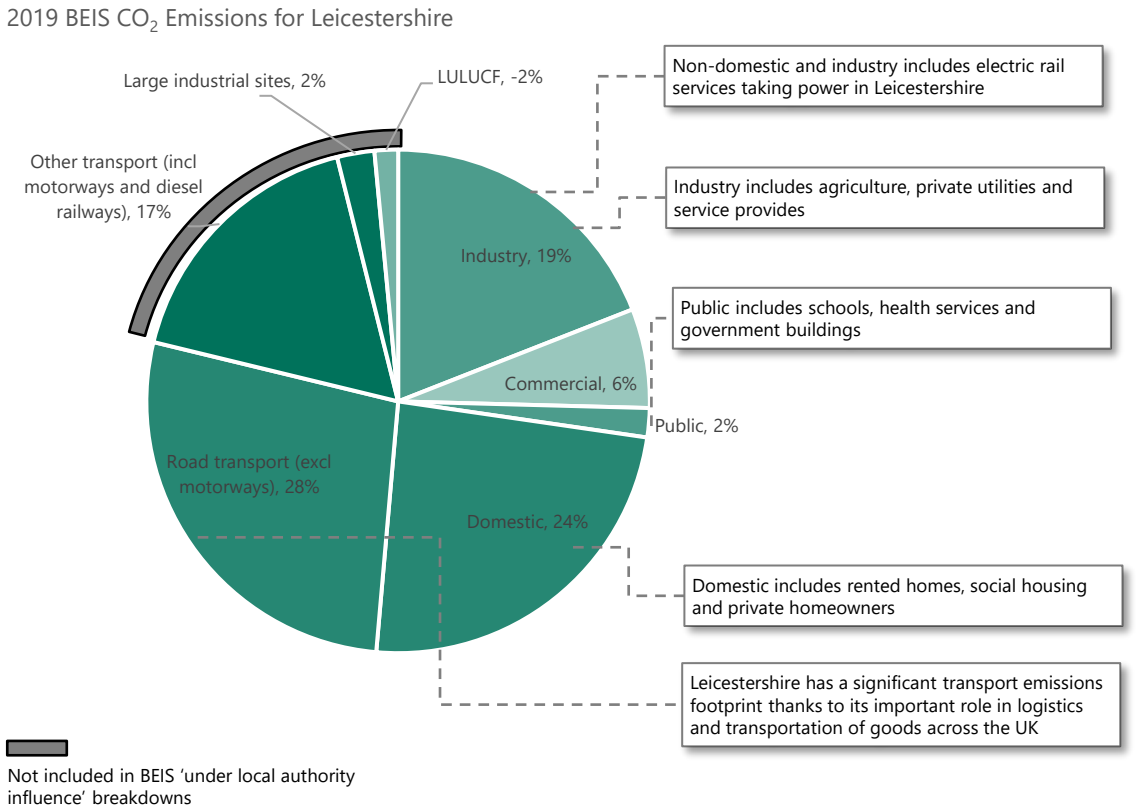


Figure 3: 2019 BEIS CO_2 Emissions for Leicestershire

Scoping Breakdown: Territorial Emissions

Spotlight: domestic emissions

Electricity and gas in the 264,000 homes (source) in Leicestershire contribute 25% of all of the county's territorial emissions, or 31% of emissions 'under scope of local authority influence'. Of these emissions, 78% are from gas or solid fuel consumption, and 22% from electricity.

Nearly half of homes in Leicestershire are owned outright (41% of households), with 36% owned with a mortgage or loan and 13% privately rented. The remainder are socially rented (10%) (ONS, 2019). Assuming a uniform distribution of energy demand and heat sources within these tenure types, this indicates that the vast majority of domestic emissions (90%, or 22.5% of all Leicestershire territorial carbon dioxide emissions) are privately owned or under mortgage/loan. Correspondingly, emissions from social rent are responsible for just 2.5% of Leicestershire's territorial emissions.

While emissions in different tenure types may vary, for example based on average household size, building age and energy provider, these results indicate that emissions in homes are overwhelmingly in private spaces where local authorities have considerably less influence. Policies to drive interventions in the domestic building stock will need to be sensitive to this balance: those in rented homes will require landlord involvement to retrofit properties, while 'homeowners' may be less inclined to adopt new measures if they are costly and potential co-benefits are not well communicated.

Spotlight: road transport emissions

Road transport emissions in Leicestershire, including A roads, minor roads and motorways, account for 46% of all Leicestershire's territorial emissions. This is a significant figure, resulting from the key role of Leicestershire roads as through-routes and interchanges in national logistics and distribution networks.

The Department for Transport (DfT) provides a detailed breakdown of fuel consumption based on vehicle typology at local authority level (source). This provides an accurate picture of how much fuel is being used by different vehicle typologies. Petrol and diesel vehicles emit a relatively similar amount of carbon per litre consumed (2.68 $kgCO_2$/litre for diesel compared to 2.31 $kgCO_2$/litre for petrol, source), so this breakdown also provides a relatively accurate assessment as to the amount of carbon dioxide emitted by each vehicle typology.

This indicates that the majority of fuel consumed is by petrol and diesel cars (54%). This means that cars make up approximately 25% of all Leicestershire's 2019 territorial carbon dioxide emissions. The second largest source is HGVs, which account for 26% of road transport energy consumption in Leicestershire, equating to approximately 12% of all Leicestershire's 2019 territorial carbon dioxide emissions.

Tenure type	% households in Leicestershire	% Leicestershire territorial CO_2 emissions
Social Rent	10%	2.5%
Private Rent	13%	3.3%
Owned with Mortgage or Loan	36%	9.0%
Owned Outright	41%	10.3%

Figure 4: 2019 housing tenure breakdown in LCC districts and corresponding proportion of Leicestershire emission
Assuming even rates of energy demand and heat sources across all tenure types
Source: ONS, 2019

Vehicle type	% 2019 road transport emissions
Buses	2%
Diesels Cars	28%
Petrol Cars	26%
HGV	26%
Diesel LGV	17%

Figure 5: 2019 road transport emissions breakdown in Leicestershire, based on % fuel consumption rates
Assuming relatively similar emissions intensity between diesel and petrol
Source: DfT, 2019

Scoping Breakdown: Territorial Emissions

Additional territorial scoping: other greenhouse gases

The BEIS territorial emissions consider carbon dioxide only. In reality, many greenhouse gas emissions are released with the consumption of energy, and the Kyoto Protocol requires reporting of several greenhouse gases, including methane, nitrous oxide and f-gases, which contribute to global heating.

In order to account for these additional gases, we can scope an approximate value based on the national estimates of carbon dioxide and other greenhouse gas emissions. In 2019, CO_2 was 80% of all greenhouse gases emitted in the UK, with f-gases and methane the remainder (source). For Leicestershire, we therefore model 'Other GHGs' as an additional 20% $ktCO_2e$ to the BEIS CO_2 emissions, in line with the relative proportions in the national database in 2019.

Additional territorial scoping: sequestration

According to the BEIS data, land use, land-use change, and forestry (LULUCF) emissions in Leicestershire amounted to -65 $ktCO_2$ in 2019, with 146 $ktCO_2e$ absorbed by forest and grassland offset by a net creation of emissions (82 $ktCO_2$) from expansion of cropland and settlements. 65 $ktCO_2$ is equivalent to ~2% of the total 2019 carbon dioxide territorial dataset for Leicestershire in 2019.

While this is a relatively low proportion of emissions in Leicestershire, the county has made ambitious tree planting goals (see Section 5). As such, it may be able to offset a more significant proportion of emissions in future.

Scoping Breakdown: Consumption Emissions

Modelling consumption emissions

Consumption-based emissions, emissions associated with the production of goods and services used in Leicestershire, are collected at national level, and are neither disaggregated at local authority or sub-national level nor split by end user (e.g. domestic, non-domestic and industrial). As such, understanding consumption emissions is challenging, and separating territorial emissions from consumption datasets accurately is not currently possible using publicly available data. However, interrogating high level data on UK consumption is a useful way to understand concentrations of consumption emissions associated with different activities, and to interrogate specific emissions of interest. This data can also be supplemented with more accurate data where benchmarks, national and regional datasets are available.

The most comprehensive consumption emissions dataset currently available for the UK is the University of Leeds UK Footprint Results (1990 - 2018) (source). We scale this national, per capita dataset based on Leicestershire 2019 population figures to approximate 2019 results. These results are then adjusted to remove territorial emissions where identifiable – i.e. electricity, gas and personal transport figures.

For more specific emissions categories that LCC wish to explore, it is possible to replace this emissions dataset benchmark figures with data specific to local processes – such as for water use, waste arisings and other areas. This is explored in later tables.

Scoping

LCC will have limited influence over the reduction of consumption emissions. Some processes, like waste disposal, they will have a higher degree of influence over.

For others, like personal consumption habits, that lead to waste arisings, they will only be able to support and encourage residents and businesses for example through behavioural change campaigns and financial (or other) incentives to encourage uptake of certain actions.

In this study, we highlight several categories of consumption emissions of relevance to LCC:

- Food, drink and tobacco;
- Road transport (excl. personal vehicles);
- New build embodied carbon;
- Waste;
- Water;
- Electronics;
- Clothing and textiles; and
- Other emissions – goods, services and investments.

Note that the 'other' emissions categories, as per the dataset, are organised by product typology and function, as illustrated in the figures on this page. This means that it is not currently possible to identify emissions associated with specific materials as these materials may appear in many categories – for example, plastics will appear in furnishings, clothing, health, communications etc.

Emissions category	$ktCO_2e$ in 2019	% of Leicestershire's consumption emissions
Food, drink and tobacco	772	23%
Clothing and footwear	116	4%
Housing and repairs	163	5%
Municipal-collected waste	46	1%
Domestic furnishings, fittings and appliances	152	5%
Health appliances and goods	105	3%
Vehicles	94	3%
Electronics	71	2%
Post and phone services	30	1%
Recreation and culture	291	9%
Newspapers, books and stationary	15	<1%
Education	25	1%
Restaurants and hotels	334	11%
Miscellaneous goods and services	215	7%
Transport services (including aviation)	746	24%

Figure 6: Leicestershire consumption emissions in 2019 ($ktCO_2e$)
Source: Buro Happold analysis of UK's carbon footprint - GOV.UK (www.gov.uk)

Territorial (BEIS or DfT)
Territorial (other sources)
Consumption

Scoping Outcome

In the final scoping, all territorial emissions categories were included, as were certain consumption emissions categories over which LCC have some scope of influence for: waste, water and embodied carbon of new builds. Food and drink was split into one category and included.

LCC chose not to exclude any categories from the study, in order to ensure that they are able to update future modelling with a wider scope of emissions if national guidance changes, and to ensure that these emissions are recognised in climate planning in Leicestershire.

	Emissions category	Emissions associated with...	Pathways	Baseline inventory
Territorial (BEIS/DfT)	**Industry energy**	*Electricity consumption by non-domestic entities within the boundaries of Leicestershire. Includes infrastructure.*	**Y**	**Y**
	Non-domestic energy *	*Electricity consumption by non-domestic entities within the boundaries of Leicestershire.*	**Y**	**Y**
	Domestic energy	*Electricity consumption in homes within the boundaries of Leicestershire.*	**Y**	**Y**
	Public sector energy	*Electricity consumption by public sector entities within the boundaries of Leicestershire.*	**Under ***	**Y**
	Road transport (all)	*Fuel usage by vehicle movement on roads other than motorways within Leicestershire.*	**Y**	**Y**
	Other	*Other territorial emissions in Leicestershire.*		**Y**
	LULUCF/Sequestration	*Land use, land-use change and forestry in Leicestershire.*	**Y**	**Y**
	Other GHGs	*Non-CO_2 emissions from territorial emissions categories above.*	**Y**	**Y**
	Renewables	*Electricity generation within the boundaries of Leicestershire. Excludes export to the grid.*	**Y**	**Y**
Consumption	**Food and drink**	*The production, delivery and disposal of all food, drink consumed within Leicestershire.*	**Y**	**Y**
	Water	*The treatment and processing of water within Leicestershire.*	**Y**	**Y**
	Waste	*The treatment and processing of waste disposed of by LCC.*	**Y**	**Y**
	Embodied carbon of new builds	*The construction of new buildings within Leicestershire.*	**Y**	**Y**
	Tobacco	*The production, delivery and disposal of tobacco consumed within Leicestershire.*		**Y**
	Clothing & footwear	*The production, delivery and disposal of all clothing and footwear bought within Leicestershire.*		**Y**
	Other transport	*Non-road transport, vehicle purchasing and transport ex-county.*		**Y**
	Electronics	*The production, delivery and disposal of electronics bought within Leicestershire.*		**Y**
	Education, health and other services	*Emissions associated with education, health and other services carried out within Leicestershire.*		**Y**
	Restaurants, hotels and recreational	*Restaurants, hotels and other recreational activities carried out within Leicestershire.*		**Y**
	Misc. goods and services [1]	*The production, delivery and disposal of all other goods, products and services bought and carried out within Leicestershire.*		**Y**

Scoping Comparison

Scoping in this study

In this study all emissions categories are baselined for 2019 to provide a comprehensive overview of both the territorial and consumption emissions associated with Leicestershire. Total consumption and territorial emissions in Leicestershire amounted to 8.5 $MtCO_2e$ in 2019.

In the Leicestershire Net Zero Pathways, this study models a bespoke scoping for Leicestershire, on the basis of local priorities and opportunities for reducing different territorial and consumption emissions (Section 3). This includes all territorial emissions in Leicestershire (including non-CO_2 GHGs), and a selection of consumption emissions based on existing policy commitments and the perceived council ability to influence and account for certain emission sources. Modelled consumption emission sources include embodied carbon of new builds, waste, water and food and drink consumption. This scoped emissions dataset amounts to 5.6 $MtCO_2e$ in 2019, 66% of the full 2019 baseline scope.

National emissions accounting

There is no national guidance on how different emissions categories might be included in local authority action plans. There is no requirement for local authorities to report or reduce consumption emissions.

However, BEIS reports territorial CO_2 emissions for local authorities on an annual basis. For Leicestershire, territorial CO_2 emissions totalled 4.5 $MtCO_2$ in 2019, 53% of the total territorial and consumption baseline inventory of this study.

BEIS provides guidance on a sub-set of territorial emissions that are classified 'within the scope of influence of local authorities.' These exclude large industrial sites, railways, motorways and land use, and amount to 3.4 $MtCO_2e$ in 2019, 40% of the full territorial and consumption emissions dataset of this study.

Paris Agreement compliance

A different scope of emissions is considered in the Tyndall Centre Paris Agreement compliant carbon budget referenced later in this report (p45). This mapping considers 'energy only' territorial CO_2 emissions in Leicestershire, amounting to 4.3 $MtCO_2$ in 2019, or 51% of the full territorial and consumption emissions dataset, and a smaller portion of emissions than in the main Leicestershire Net Zero Pathways. The Tyndall Centre Scoping is based on the BEIS territorial dataset for Leicestershire.

Key datasets and emissions categories

See Appendix A.

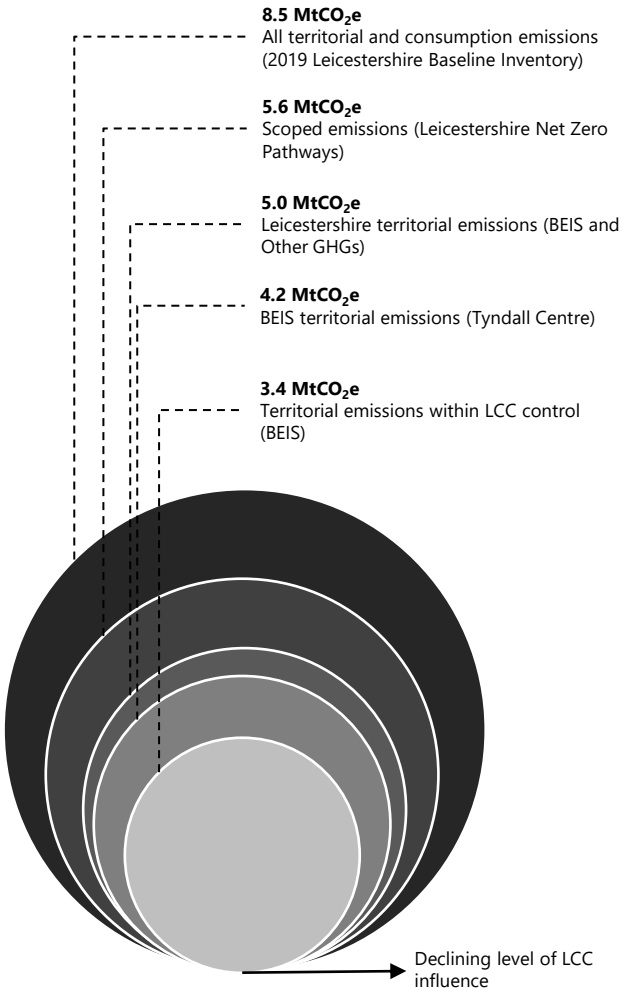


Figure 7: Scoping comparison for Leicestershire

SECTION 3

BASELINE INVENTORY AND CURRENT POLICY PATHWAY

Baseline Inventory

Topics in this section

The following pages set out the baseline inventory of this study for Leicestershire, and modelled pathway under the Current Policy Pathway, a mapping of the existing targets and interventions adopted for Leicestershire. We also compare these findings of this study to a Paris Agreement compliant pathway modelled by the Tyndall Centre.

Areas explored in this section include:

- Baseline Inventory for 2019 – understanding today's emissions in Leicestershire, as per the scoping categories set out in Section 2.
- Current Policy Pathway development – outlining the assumptions included in the Current Policy Pathway baseline modelled emissions scenario.
- Current Policy Pathway modelling results – discussion of the impacts of current policies in Leicestershire on decarbonisation.
- Paris Agreement compliant emissions comparison – comparing the Current Policy Pathway to a Paris Agreement compliant pathway (territorial emissions only).

Image: Crossroads At Bradgate / Adobe Stock / Peteholyoak

2019 Baseline Inventory

The previous section considered the scope of emissions to be studied to understand the baseline emissions from Leicestershire this study. In 2019, the last year of data available, these amounted to 8,497 $ktCO_2e$.

Territorial emissions

Of this, 50% relates to the territorial emissions reported for Leicestershire by BEIS every year (4,241 $ktCO_2$ in 2019). These include operational energy use in Leicestershire's buildings and by vehicles on Leicestershire's roads.

Significant greenhouse gases other than CO_2 (see Section 2) that arise from territorial emissions-creating activities, contribute a further 9% (780 $ktCO_2e$ in 2019) to the total consumption and territorial emissions emitted in Leicestershire. LULUCF removes 65 $ktCO_2e$, 1% of the total.

Consumption emissions

Other consumption emissions account for 41% of the total scoped baseline (3,535 $ktCO_2e$ in 2019). These relate to products and services undertaken in Leicestershire (or by Leicestershire's residents), but are accounted for as territorial emissions elsewhere. Notable emissions in this category include embodied emissions of food, non-road transport and restaurants, hotels and other recreational.

There is likely to be some double counting between the consumption and territorial data for Leicestershire. For example, waste from disposal of food is included in the food and drink consumption dataset and Leicestershire waste data. However, these overlaps are all relatively small, and accounting for them in any form is critical to taking action to reduce them.

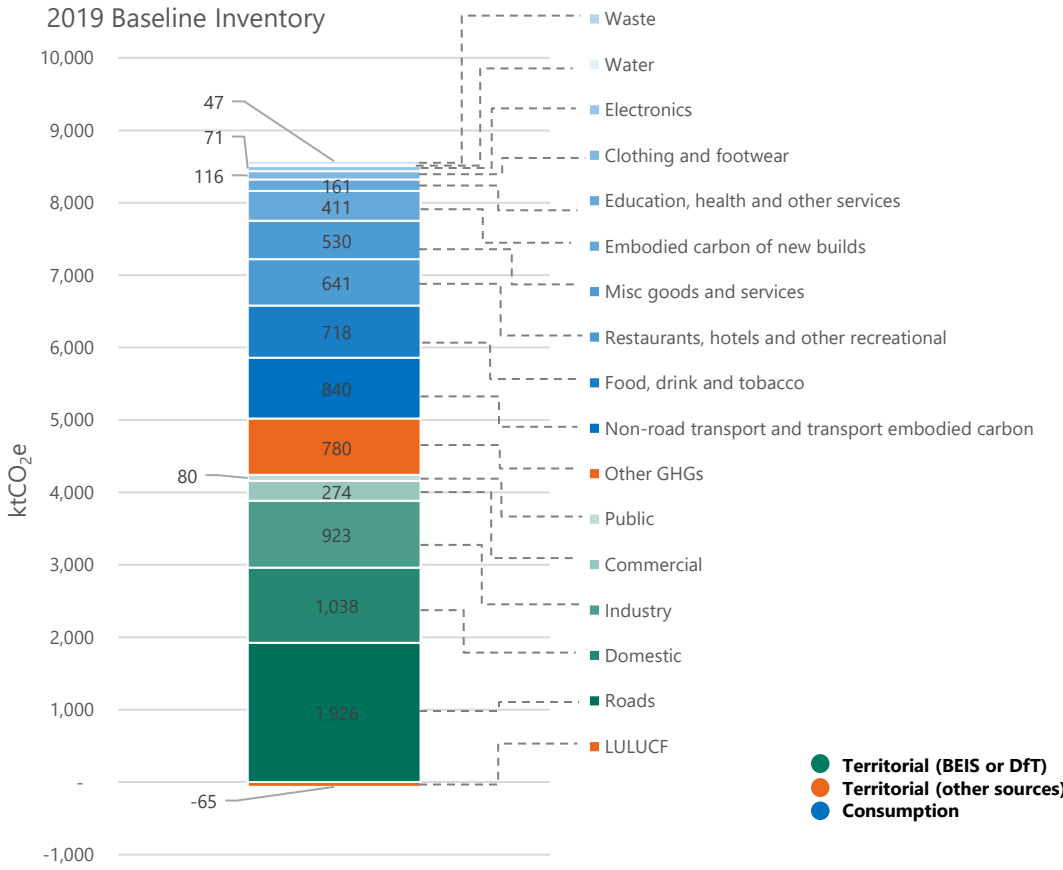


Figure 8: 2019 Baseline inventory

Modelling a Current Policy Emissions Pathway

The previous section outlined which emissions categories would be included in this study. This section looks at the how these emissions are modelled in the baseline Current Policy Pathway.

This will flow into the subsequent sections of this study, which model multiple scenarios – multiple combinations of assumptions – allowing LCC to understand the impacts of different approaches in the coming decades.

The Current Policy Pathway models the impact of growth trajectories, national projections and existing decarbonisation policies in Leicestershire. It does not however account for the decarbonisation commitments made by private sector organisations.

A more detailed breakdown of targets and interventions modelled under each pathway, including references, is available in Appendix B. Note that offsets, removals and sequestration are considered in Section 5.

Note: recent policy declarations linked to gas boiler bans in the UK have not been modelled, as the UK government has not, at the time of writing, committed to a target date for this policy (source).

	Current Policy
Reason for model	• To understand Leicestershire's future emissions pathway under existing targets and commitments.
What it shows	• Additional operational and embodied emissions demand from the construction of new builds. • Increased road transport, water and waste emissions. • Impact of grid decarbonisation. • Impact of retrofit and decarbonisation of a small portion of buildings as per schemes like the Green Homes Grant and other council trials. • Impact of petrol/diesel car national ban. • Effect of national recycling and waste processing targets.
Key targets and policies modelled	• 90,400 new dwellings, and an additional 3,000,000 m^2 commercial floor area by 2050, as per the 2018 Strategic Growth Plan. • Domestic and non-domestic retrofit, impacting an assumed 2% of buildings by 2045. • Electrification of cars and LGVs following national requirements to phase out diesel and petrol. • 40% increase in car mileage, and 90% increase in LGV mileage by 2050 (source). • 35% increase in waste arisings (source), and 20% increase in water demand to 2045. • 65% of LCC-collected waste recycled by 2030, with zero to landfill (source).

Current policy

Overall Emissions Pathways – Current Policy and Inventory

The 2019 (latest available data) baseline inventory of scoped emissions is mapped against the overall Current Policy Pathway.

The baseline inventory of this study gives a clear dataset to inform updates to the Leicestershire Net Zero Pathways and future policy changes. The Current Policy Pathway shows a 33% reduction in scoped emissions between 2020-2045 (1,897 $ktCO_2e$).

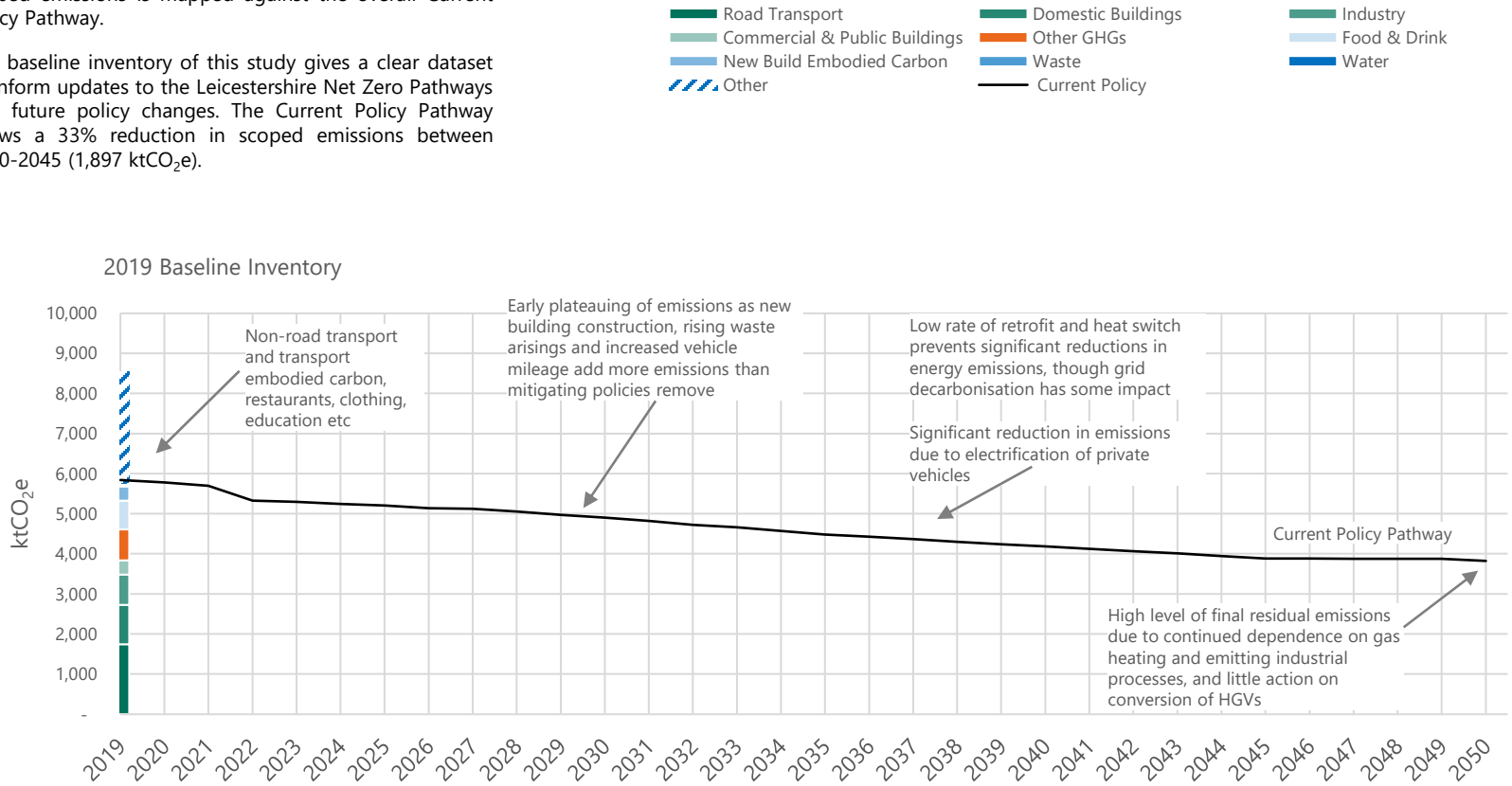


Figure 9: 2019 Baseline inventory

Current Policy

The Current Policy Pathway maps the emissions projected for Leicestershire under existing local and national policy commitments.

In these figures, emissions are mapped on an annual basis for each scoped emissions category in this scenario. This illustrates several key trends:

Territorial

- Emissions reductions of 26% have been achieved in recent decades (2005-2019), mainly through grid decarbonisation. A reduction of 33% is modelled between 2020-2045 (i.e. an overall decrease of 49% 2005-2045).
- With existing policy commitments, the rate of building emissions reductions declines as a result of grid decarbonisation, but since the majority of heat remains on the gas network this impact is limited.
- Planned retrofit and heat switching in public buildings have very little influence on county-wide decarbonisation, affecting <2% of demand.
- Despite increases in projected vehicle km, road transport continues to decarbonise. This is due to electrification of LGVs and cars following the 2030 (source) national phaseout.

Consumption

- Water and waste processing emissions (for waste disposed of by LCC, as per p31) are very small relative to other scoped categories, but increase slightly based on local plan and local water company projections;
- New build embodied carbon emissions remain significant in the coming decades. Notably, energy demand for new construction also contributes to the small rise in demand in the domestic and non-domestic buildings categories;
- Food and drink consumption emissions rise as a result of growing population projections for Leicestershire, with no modelled reduction in average emissions per person.

Unless otherwise stated, all % changes in emissions are modelled between 2020 and 2045.

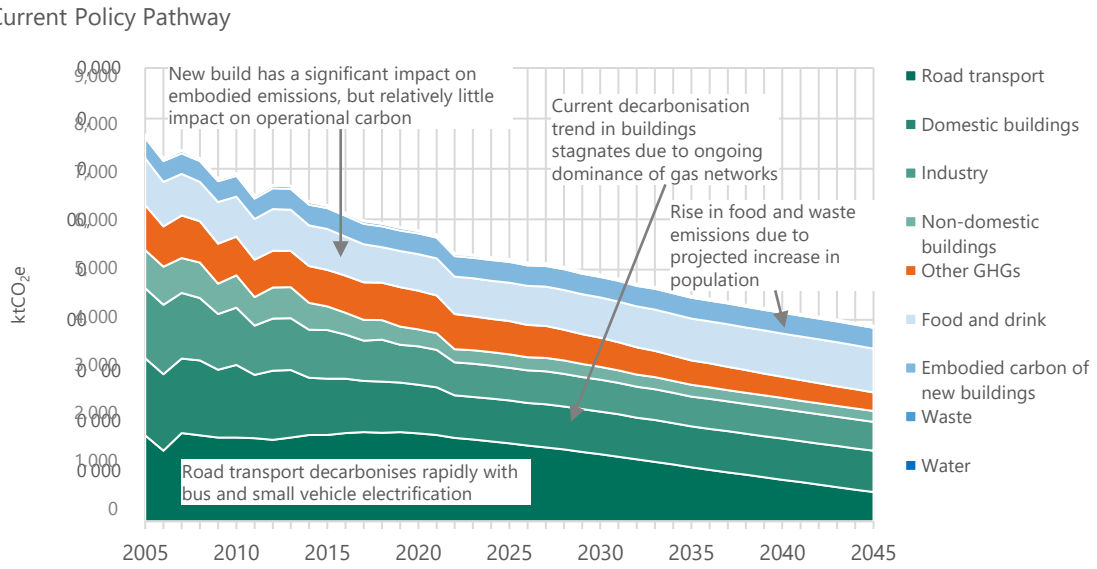


Figure 10: Current Policy Pathway for Leicestershire, 2005-2045

SECTION 4

EMISSIONS PATHWAY MODELLING

Pathways Overview

Topics in this section

The previous sections outlined which emissions categories would be included in this study and the baseline Current Policy Pathway. This section looks at the selection and modelling of additional pathway scenarios – multiple combinations of assumptions, targets and interventions.

Areas explored in this section include:

- Pathway development – outlining the assumptions included in each pathway.
- Emissions comparison – high-level comparison of pathway results.
- Detailed breakdown of modelled pathways, with discussion of the impacts of interventions on Leicestershire's decarbonisation.

Note that Appendix A-B list key model assumptions and scenarios, including a detailed breakdown of interventions and assumptions linked to each pathway.

Image: Signs in Harborough / Adobe Stock / CharnwoodPhoto

Scoping Multiple Emissions Pathways

Pathways longlist

Different pathway scenarios were considered. These included combinations of locally specific questions identified by the project team, and versions of CCC national decarbonisation pathways applied to the Leicestershire context.

CCC-influenced pathways follow the principles of pathways modelled in national carbon budget assessments undertaken by the CCC (source). Following these pathways may be useful for several reasons. Results will show the application of national target setting conversations at the Leicestershire-level, there is a wealth of background evidence and information to inform these targets, they are theoretically aligned with national net zero approaches, and they cover a range of scenarios and interventions.

The selected pathways look to understand:

- Profile of current policies;
- Influence of decarbonising public systems and spaces only;
- An approach aligned with CCC advice for national decarbonisation programmes; and
- A more ambitious scenario.

A more detailed breakdown of targets and interventions modelled under each pathway, including references, is available in Appendix A.

Note the CCC pathways involve matching high level targets and assumptions provided by CCC, and do not replicate national modelling. Where the CCC models do not include targets or information that this project seeks to consider, judgements are made by the project team to add targets in line with the approach sought by the CCC pathway – for example, in a 'technology-focussed' pathway, any gaps would be filled by targets prioritising a similarly 'technological' approach. These assumptions are clearly referenced, recorded and justified where necessary.

	Description	Why modelled
Current Policy	Models the impacts of current national and regional policies and targets on Leicestershire's decarbonisation.	To understand Leicestershire's future emissions pathway under existing targets and commitments.
Council-Influenced	Focuses on decarbonising social housing, public buildings, and public transport, with changes in the private sector as per 'current policy'.	To understand Leicestershire's future emissions pathway solely through council actions. The pathway is based on current policy, plus more ambitious action by LCC.
Balanced [CCC]	A whole-system approach to decarbonisation, with a relatively balanced mix of contributions from behaviour change, electrification, sequestration and fuel switching.	To understand what Leicestershire could achieve following the CCC's headline dataset for carbon budgeting and UK government advice. This pathway combines actions from LCC and all others.
Tailwinds [CCC modified]	The fastest route to net zero, with a high level of behavioural and demand change, and use of existing technologies like electric heating. However, it is highly optimistic, going beyond current evidence in places.	To understand what Leicestershire could achieve through a 'highly optimistic' level of behaviour change and innovation. This pathway combines actions from LCC and all others.

Final Scoped Emissions Pathways

	Current Policy	Council-Influenced	Balanced	Tailwinds
What it looks to show	• Additional operational and embodied emissions demand from new builds, as specified in local plans. • Increased road transport, water and waste emissions as a result of projections for the area. • Impact of grid decarbonisation. • Impact of major government gas boiler and petrol/diesel car ban. • Effect of national recycling and waste processing targets.	• Impact of operational emissions, waste and water demand reductions in social housing and public buildings through widespread retrofit campaign. • Solar PV installations on public buildings and social housing. • Impact of majority of buses switched to electricity or hydrogen. • Embodied carbon of new build social housing and public buildings reduced in line with LETI targets.	• Impact of widespread retrofit to EPC C, with electrification of heat prioritised and building-scale renewables rolled-out across the county. • Improvements in industrial energy demand, processes switched to hydrogen and electrification. • Decrease in vehicle milage, with full EV roll-out for small vehicles, and HGVs split between electrification and hydrogen • Impact of water and building embodied carbon decarbonised across the county. • Food and drink decarbonises through fuel switching and improved efficiencies.	• Impact of widespread retrofit to EPC A or B, with electrification of heat prioritised and building-scale renewables rolled-out across the county. • Significant improvements in industrial energy demand, processes switched to hydrogen and electrification. • High decrease in vehicle milage, with full EV roll-out for small vehicles, and HGVs split between electrification and hydrogen. • Food and drink decarbonises through fuel switching and improved efficiencies.
Key targets and policies modelled	• 90,400 new dwellings, and an additional 3,000,000 m^2 commercial floor area. • Domestic and non-domestic retrofit, impacting an assumed 2% of buildings. • Electrification of cars and LGVs following national requirements to phase out diesel and petrol. • 40% increase in car mileage, and 90% increase in LGV mileage. • 35% increase in waste arisings, and 20% increase in water demand • 65% of LCC-collected waste recycled, with zero to landfill.	• 90,400 new dwellings, and an additional 3,000,000 m^2 commercial floor area. • Retrofit of 9% of domestic buildings and 21% of non-domestic buildings. • Electrification of cars and LGVs following national requirements to phase out diesel and petrol, two-thirds of buses switch to electricity or hydrogen. • 70% of LCC-collected waste recycled, with zero to landfill. • 40% increase in car mileage, and 90% increase in LGV mileage. • Solar PV installations on 25% of social housing and 40% of public buildings.	• 90,400 new dwellings, and an additional 3,000,000 m^2 commercial floor area. • Retrofit of 66% of domestic buildings and 63% of non-domestic buildings. • Full EV roll-out and decreased in mileage across all vehicle types. • Industry heat source evenly split between hydrogen and electricity. • 145,000 domestic and non-domestic Solar PV installations. • 68% of LCC-collected waste recycled, with zero to landfill. • 98% reduction in embodied carbon of new builds.	• 90,400 new dwellings, and an additional 3,000,000 m^2 commercial floor area. • Retrofit of 100% of domestic buildings and 98% of non-domestic buildings to EPC A • Full EV roll-out and decreased in mileage across all vehicle types. • Industry heat source 64% electricity, 36% hydrogen. • 610,000 domestic and non-domestic Solar PV installations. • 79% of LCC-collected waste recycled, with zero to landfill. • 100% reduction in embodied carbon of new builds.
Reason for selection	To determine Leicestershire's future following current local and national policy, and demonstrate the need for urgent and wide-spread change in order to achieve net zero.	To demonstrate what the council can achieve, and outline the collective action require across the county to achieve net zero.	To demonstrate what Leicestershire could achieve following CCC and UK Government decarbonisation timeframes.	To demonstrate what Leicestershire could achieve if the county implements widespread, fast-paced change with leading technologies to meet industry best practices.

Overall Emissions Pathways

The 2019 (latest available data) baseline inventory of this study is mapped against the overall modelled emissions scenarios.

The Current Policy Pathway shows a steady decrease in the scoped emissions modelled in this study, 33% between 2020-2045. The Council-Influenced Pathway shows a small improvement in emissions reductions compared to the Current Policy Pathway (37%). The two CCC-aligned pathways both achieve a notable reduction in emissions by 2045 (91% and 95% for the Balanced and Tailwinds Pathways respectively).

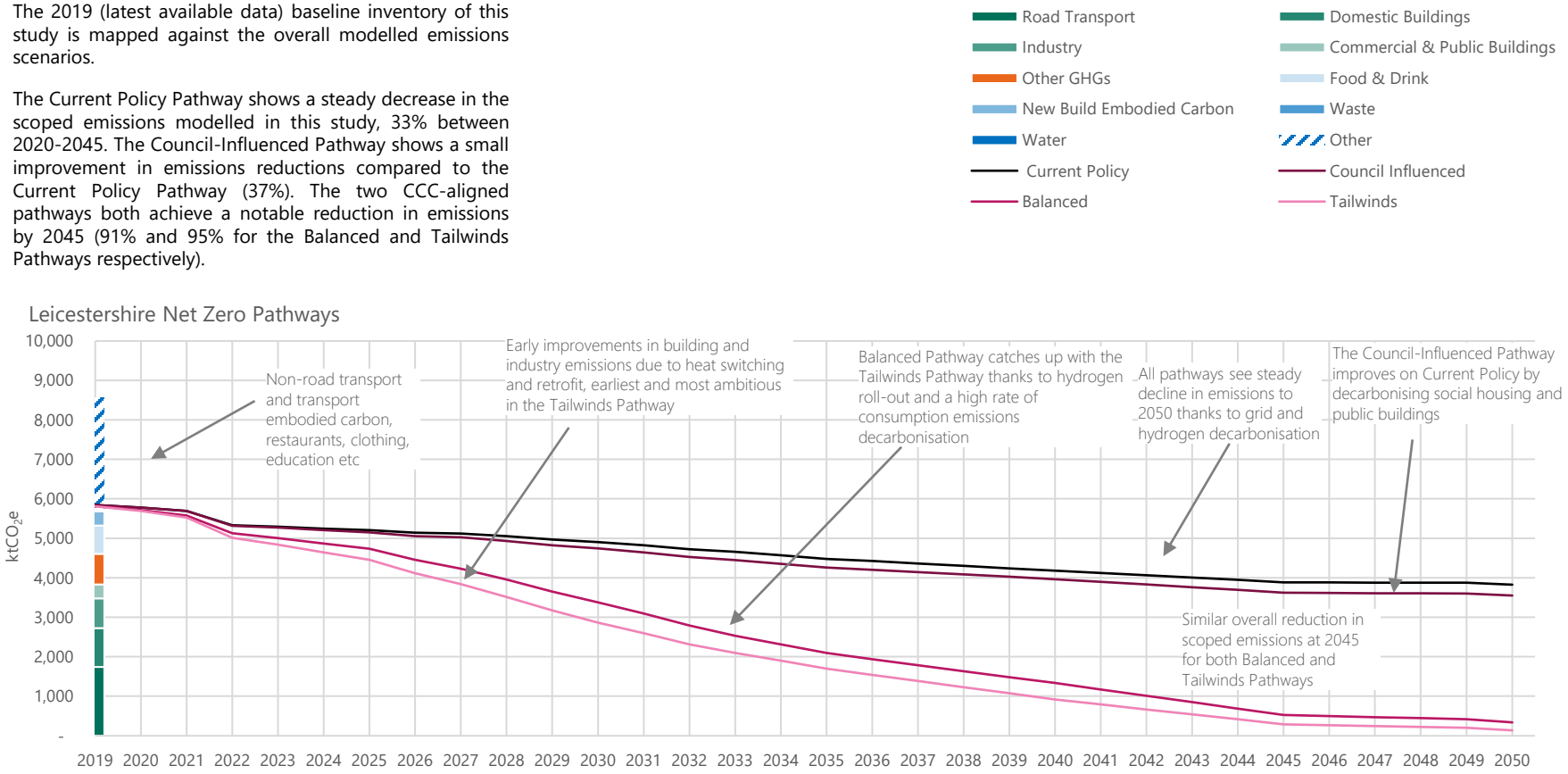


Figure 11: Leicestershire Net Zero Pathways

Overall Emissions Pathways

Findings from the Council-Influenced Pathway

The Council-Influenced Pathway shows a small improvement in emissions reductions compared to the Current Policy Pathway as a result of ambitious retrofits and heat switching in social housing and public buildings. However, the high level of residual emissions remaining under this pathway by 2045 (3,620 $ktCO_2e$) indicates that actions constrained only to assets under which LCC or public bodies have direct control will have a very small impact on overall emissions. It is essential that private stakeholders and assets are part of decarbonisation efforts in Leicestershire.

Findings from the Balanced and Tailwinds Pathways

The Balanced Pathway aims to meet net zero through a moderate roll-out of retrofit and demand reduction and an ambitious programme to reduce consumption emissions. The Tailwinds Pathway uses a slightly earlier and more ambitious programme of demand reduction, a heat switch campaign with higher rates of electrical heating but a smaller focus on consumption emissions.

Both pathways show Leicestershire achieving significant emissions reductions by 2045. This emphasises that it is eminently possible for Leicestershire to greatly reduce emissions with the cross-sector involvement of public and private stakeholders. However, residual emissions remain, highlighting that even more ambitious actions will be needed to fully align with the Paris Agreement, as explored in the following pages.

The two ambitious pathways also highlight that there are a diversity of routes available to LCC in developing net zero policies. There are strategic choices to be made about the deployment of low carbon heating, demand reduction initiatives and other policies. Deciding strategic direction for Leicestershire will require locally-specific decision-making, as well as engagement with national trends and plans.

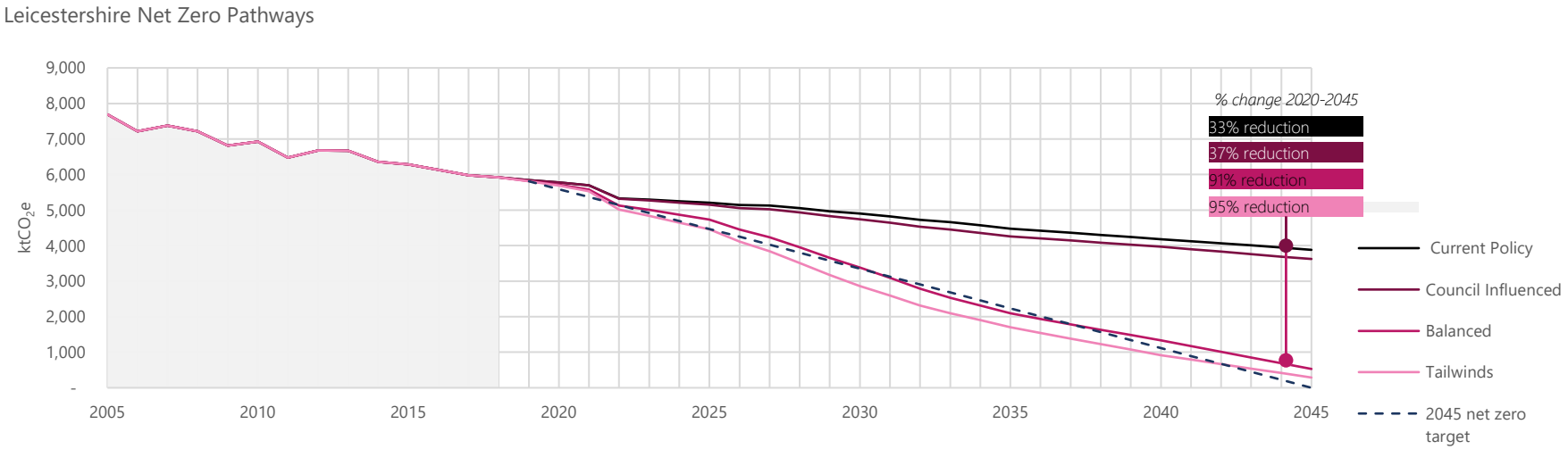


Figure 12: Leicestershire Net Zero Pathways

Council-Influenced Pathway

The Council-Influenced Pathway maps the emissions projected for Leicestershire when ambitious action is taken to decarbonise public buildings and social housing, in addition to the interventions in the Current Policy Pathway.

LCC does not have responsibility for social housing or public buildings, but this pathway demonstrates the relative contribution of these strategically important spaces against the full emissions portfolio. See more on stakeholder analysis in Section 6.

In these figures, emissions are mapped on an annual basis for each scoped emissions category for this pathway. This illustrates several key trends:

Territorial

- Emissions reductions of 26% have been achieved in recent decades (2005-2019), mainly achieved through grid decarbonisation. A reduction of 37% is modelled between 2020-2045 (i.e. an overall decrease of 53% 2005-2045).
- Heat switching, retrofit measures and Solar PV installations on social housing and public buildings enable the majority of the additional emissions reductions compared to the Current Policy Pathway.

Consumption

- A small reduction in scoped emissions is achieved through more ambitious water and waste policies than those modelled in the Current Policy Pathway. This comprises a 70% recycling rate for Leicestershire waste disposal (compared to the current 65% national 2035 target), and 20% reduction in water demand in social housing and public buildings. However, waste processing emissions are very small relative to other scoped categories, so the overall impact of these changes on the full pathway is low;
- New build embodied carbon emissions drop as a result of new social housing and public buildings meeting ambitious construction industries targets to eliminate embodied carbon in construction;
- Food and drink consumption emissions rise as a result of growing population projections for Leicestershire, with no modelled reduction in average emissions per person in this pathway.

Unless otherwise stated, all % changes in emissions are modelled between 2020 and 2045.

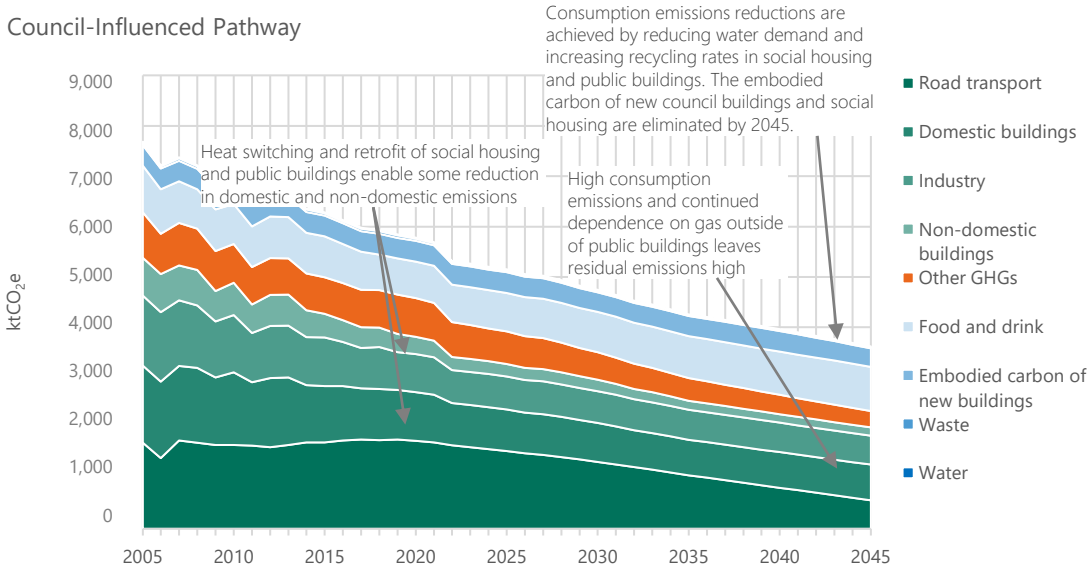


Figure 13: Council-Influenced Pathway for Leicestershire, 2005-2045

Balanced Pathway

The Balanced Pathway maps the emissions projected for Leicestershire when a mixture of actions to reduce demand, switch fuel sources and adopt hydrogen technologies is taken in Leicestershire, informed by targets in the CCC Balanced Net Zero Pathway.

In these figures, emissions are mapped on an annual basis for each scoped emissions category for this pathway. This illustrates several key trends:

Territorial

- Emissions reductions of 26% have been achieved in recent decades (2005-2019), mainly achieved through grid decarbonisation. A reduction of 91% is modelled between 2020-2045 (i.e. an overall decrease of 93% 2005-2045).
- Moving all buildings off gas to a mixture of heat pumps, hydrogen and electric heat sources, alongside retrofitting all buildings to EPC C or above enables a significant reduction in territorial building emissions.
- Reductions in vehicle mileage combined with fuel switching (cars and LGVs to electric, with HGVs and buses to a mixture of electric and hydrogen) enable a major reduction in road transport emissions.

Consumption

- A large reduction in scoped emissions for water is seen as a result of a 20% drop in demand for water at all sources. However, water emissions are small relative to other scoped categories, so the overall impact of these changes on the full pathway is low.
- Waste processing emissions reductions are comparable to the Current Policy pathway as targets are similar to national requirements.
- New build embodied carbon emissions drop as a result of all new buildings meeting ambitious construction industries targets to eliminate embodied carbon in construction (98% of new builds zero embodied carbon by 2045).
- Food and drink consumption emissions are eliminated as a result of switching manufacturing fuel to electricity or hydrogen (77% of emissions reductions) and the remainder of reductions achieved thanks to shifts in consumption patterns and process efficiencies.

Unless otherwise stated, all % changes in emissions are modelled between 2020 and 2045.

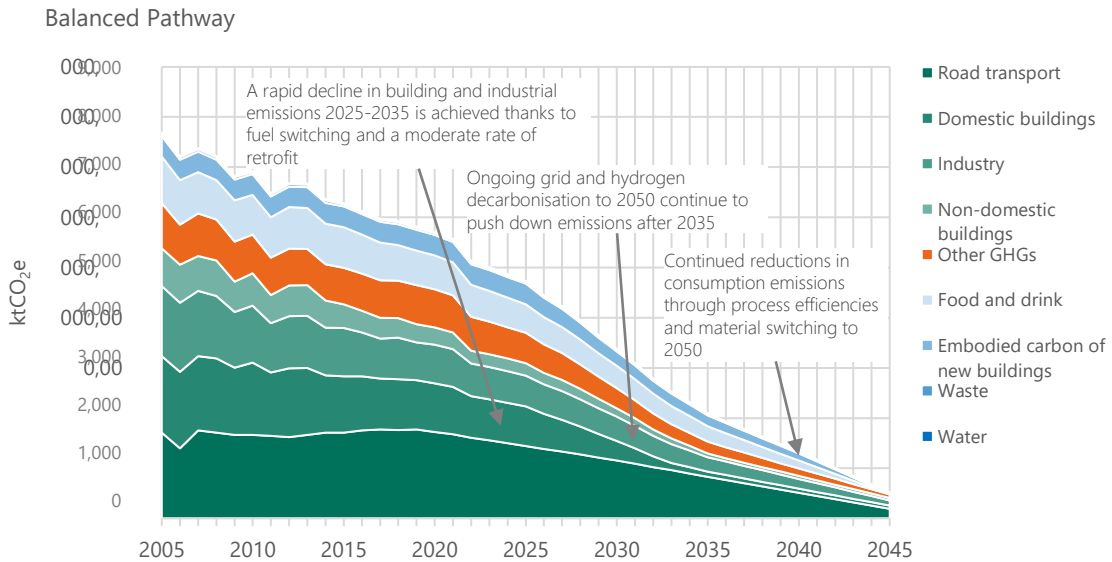


Figure 14: Balanced Pathway for Leicestershire, 2005-2045

Tailwinds

The Tailwinds Pathway maps the emissions projected for Leicestershire when ambitious, early action to reduce demand, switch fuel sources to existing technologies and adopt hydrogen technologies in hard-to-decarbonise areas is taken in Leicestershire, informed by targets set out in the CCC Tailwinds Pathway.

In these figures, emissions are mapped on an annual basis for each scoped emissions category for this pathway. This illustrates several key trends:

Territorial

- Emissions reductions of 26% have been achieved in recent decades (2005-2019), mainly achieved through grid decarbonisation. A reduction of 95% is modelled between 2020-2045 (i.e. an overall decrease of 96% 2005-2045).
- Moving all buildings off gas to heat pumps and electric heat sources, alongside retrofitting all buildings to better than EPC A enables a significant reduction in territorial building emissions.
- Substantial reductions in vehicle mileage combined with fuel switching (cars and LGVs to electric, with HGVs and buses to a mixture of electric and hydrogen) enable a major reduction in road transport emissions.

Consumption

- As in the Balanced Pathway, a large reduction in scoped emissions for water is seen as a result of a 20% drop in demand for water at all sources. However, water emissions are small relative to other scoped categories, so the overall impact of these changes on the full pathway is low.
- Waste processing emissions reductions are higher than the Current Policy Pathway thanks to a 79% recycling rate achieved for Leicestershire waste disposal.
- Food and drink consumption emissions eliminated as per the Balanced Pathway;
- New build embodied carbon emissions drop as a result of all new buildings meeting ambitious construction industries targets to eliminate embodied carbon in construction (100% of new builds zero embodied carbon by 2045).

Unless otherwise stated, all % changes in emissions are modelled between 2020 and 2045.

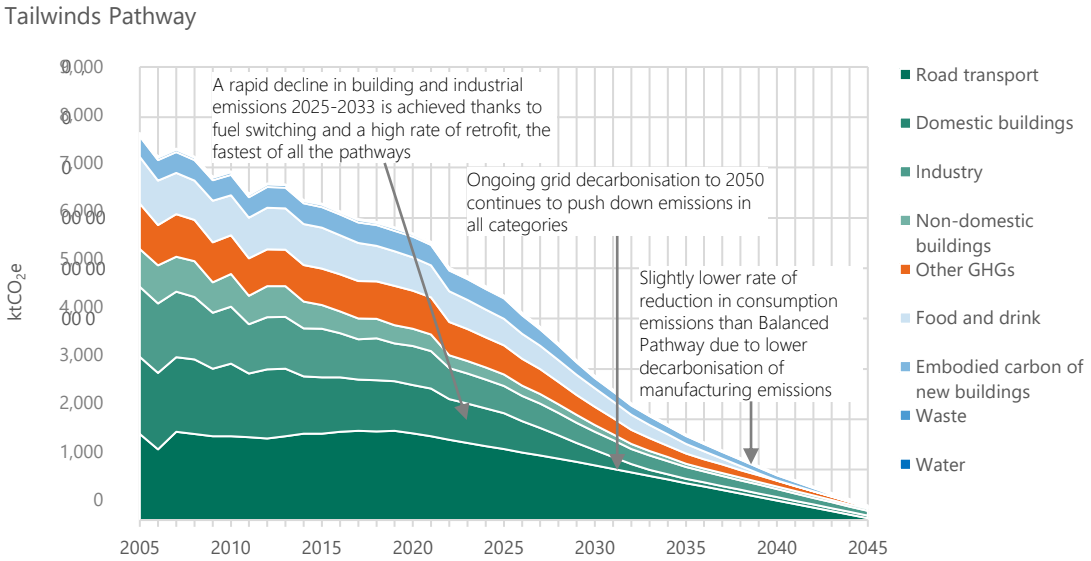


Figure 15: Tailwinds Pathway for Leicestershire, 2005-2045

Paris Agreement Compliant Pathways

The Paris Agreement

The United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement commits the global community to take action to 'hold the increase in global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C' (source). To do this, cumulative global carbon budgets are calculated to understand the amount of carbon which can be emitted in the coming decades while remaining within 1.5ºC-2ºC of planetary warming.

There is significant uncertainty in estimates of the future global cumulative CO_2 budgets consistent with the Paris Agreement long-term temperature goal (source, p368). However, the Intergovernmental Panel on Climate Change Special Report on 1.5ºC estimates that 900 billion tCO_2 can be emitted and still be consistent with keeping global temperatures well below 2ºC with an outside chance of stabilising at 1.5 ºC (source).

Shares of the global carbon budget are then allocated to countries based on historic emissions, and factors including additional considerations of common-but-differentiated responsibilities and respective capabilities in light of national circumstances. The process for the UK is described in detail by the CCC (source).

The Paris Agreement and Leicestershire

Alternative climate change targets for the majority of territorial emissions in Leicestershire (see scoping comparison on p28), can be derived from the commitments enshrined in the Paris Agreement.

The Tyndall Centre (source), has undertaken modelling for all UK local authorities based on the Paris Agreement global budget, applying the 'well below 2°C and pursuing 1.5°C' global temperature target and equity principles in the United Nations Paris Agreement to a national and sub-national UK carbon budget.

This looks at a reduced set of territorial emissions categories, as outlined on p28. This means it does not include the full scope of emissions considered in the Leicestershire Net Zero Pathways, but remains a useful comparison for assessing ambition.

For Leicestershire to make its 'fair' contribution towards the Paris Agreement, the Tyndall Centre recommends:

- A maximum cumulative carbon dioxide emissions budget of 26.7 $MtCO_2$ for the period of 2020 to 2100. At 2017 CO_2 emission levels, Leicestershire would use this entire budget within 6 years from 2020.
- An immediate programme of CO_2 mitigation to deliver cuts in emissions averaging a minimum of -13.9% per year (630 $ktCO_2$) to deliver a Paris aligned carbon budget. This scale of emissions is approximately equivalent to all the food and drink emissions in Leicestershire in 2019 (718 $ktCO_2$). These annual reductions in emissions require national and local action.
- Very low levels of residual CO_2 emissions by mid-century, with just 5% of the budget remaining in 2040 according to Tyndall Centre modelling.

Annual emissions in 2040

The Current Policy Pathway in this study does not achieve a level of decarbonisation that is compliant with the Paris Agreement.

In 2045, the year of the Leicestershire net zero target, the Current Policy Pathway models territorial emissions that are 17 times the annual emissions recommended in the Tyndall Centre's Paris Agreement compliant pathway. While a Paris-aligned pathway requires 98% reductions, the Current Policy and Council-Influenced Pathways reduce territorial emissions by only 36% and 42% between 2020-2045 (emitting a total of 79.9 $MtCO_2$, 76.2 $MtCO_2$).

Our modelling indicates that both the Balanced and Tailwinds Pathways approach this target by 2045, achieving 92% and 99% reductions in territorial emissions respectively (emitting 49.2 $MtCO_2$, 43.4 $MtCO_2$). This means that by 2045 the pathways show an annual emissions rate that is compliant with the Paris Agreement.

	% emissions reduction 2020 - 2045	Total carbon emitted $MtCO_2$ 2020-2045
Paris-aligned	98%	22.4
Current Policy	**36%**	**79.9**
Council-Influenced	**42%**	**76.2**
Balanced	**92%**	**49.2**
Tailwinds	**99%**	**43.4**

Figure 16: Emissions breakdown across all modelled pathways

Paris Agreement Compliant Pathways

Carbon budget

Although the modelled Balanced and Tailwind pathways project a rate of annual emissions that is compatible with the Tyndall Centre Paris Aligned budgets at 2045, it is important to consider the carbon emitted before that date, between 2020-2045.

As detailed on p44, the Tyndall Centre recommends a maximum cumulative carbon dioxide emissions budget for Leicestershire of 26.7 $MtCO_2$ for the period of 2020 to 2100. The Tyndall Centre projects that 95% of this budget (22.4 $MtCO_2$) would be spent between 2020-2045.

Under Leicestershire's Current Policy Pathway, a total of 79.9 $MtCO_2$ is emitted between 2020 and 2045, 357% higher than the 22.4 $MtCO_2$ budget the Tyndall Centre propose in the same timeframe. This is a clear indicator that current policies, in Leicestershire and nationally, are insufficient to deliver decarbonisation in line with the Paris Agreement.

The modelling for Leicestershire indicates that all of the pathways emit substantially more territorial CO_2 than the Tyndall Centre Paris Agreement compliant budget allows. The Current Policy and Council-Influenced Pathways emit 357% and 341% more carbon than the budget; and the Balanced and Tailwinds Pathways 220% and 194% respectively.

The inability of even the most ambitious policy pathways to align with a Paris Agreement compliant pathway highlights the major policy gap between current targets and the required pace of action, including in national guidance like CCC modelling, and the dependence of CCC budgets and targets on removals and negative emissions technologies, which are not modelled in these Leicestershire Net Zero Pathways, to meet Paris Agreement goals.

Note: CCC modelling nationally contains Paris compliant carbon budgets, thanks to a full portfolio of emissions categories and interventions, including removals technologies and other negative emissions strategies. The impact of these approaches and technologies is explored for Leicestershire in the following section.

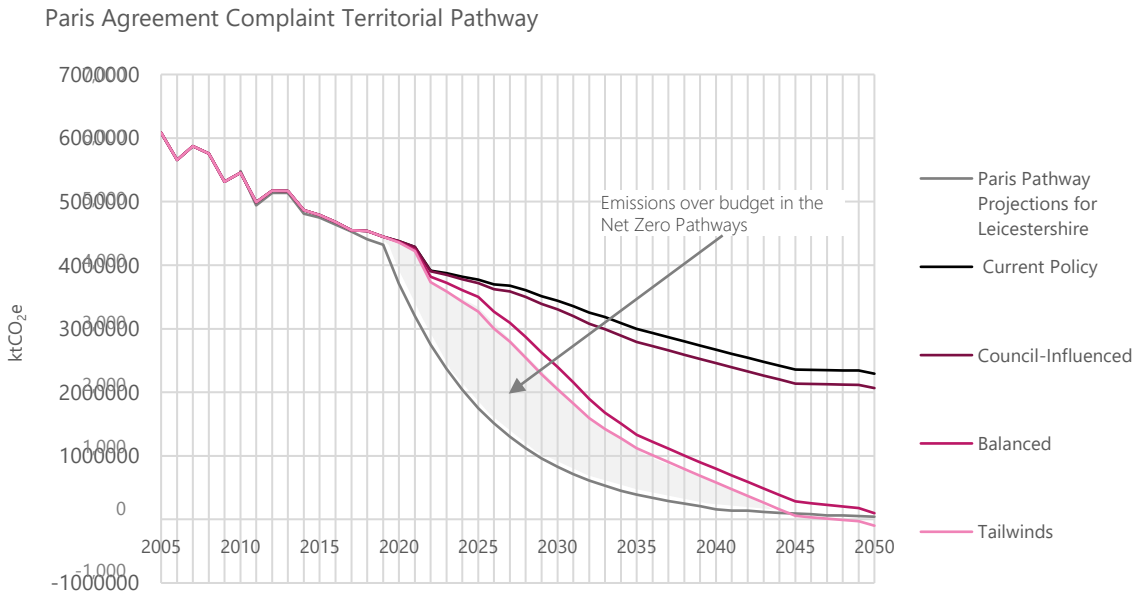


Figure 17: Paris Agreement compliant territorial pathway, 2005-2045

SECTION 5
SUPPLEMENTARY ANALYSIS

Supplementary Analysis

The following section presents a high level assessment of costs, key partners and co-benefits to delivering a Net Zero by 2045 Roadmap for Leicestershire.

This includes the following analysis:

- Residual emissions analysis, highlighting remaining sources of emissions and the potential for carbon sequestration and offsetting in the county;
- High level impact assessment of different interventions in reducing carbon;
- Indicative cost assessments for delivering the change required; and
- High level assessment of co-benefits of delivering net zero for health, economy, society and the environment.

Image: John O'Gaunt Disused Railway Viaduct / Adobe Stock / David Green/EyeEm

Residual Emissions

Residual emissions in 2045

Under all emissions pathways, Leicestershire is left with some annual residual emissions. The largest residual emissions categories in both the Balanced and Tailwinds Pathways are:

- Road transport – a small amount of residual emissions resulting from HGV vehicles that have not switched to electric or hydrogen fuel by 2045;
- Industry and building emissions – as a result of latent carbon in the electric grid and hydrogen sources. Industry emissions categories also include agricultural emissions, which may prove hard to reduce; and
- Other GHGs – non-CO_2 emissions linked to the territorial emissions categories are modelled to reduce in line with CO_2 territorial emissions reductions (source). As a result a fraction of residual Other GHGs emissions remain, as per the proportion of remaining CO_2 territorial emissions.

Removals

As such, if net zero is to be achieved in any pathway, carbon removals or offsetting would be required in 2045. Similarly, the CCC Sixth Carbon Budget anticipates a certain amount of carbon removal technology and net emissions reductions activity to meet net zero in the UK.

Under CCC Balanced Net Zero Pathway modelling, 77 $MtCO_2e$ carbon is modelled as 'removed' at its net zero deadline of 2050, from a combination of sources [1]. This amounts to 15% of the 2020 UK emissions (485 $MtCO_2e$).

Under Leicestershire modelling, the Balanced Pathway and Tailwinds Pathway leave residual emissions in 2045 that are 9%, and 5% of 2020 emissions. This is less than the 15% removals proportion under the CCC modelling, suggesting decarbonisation ambition in Leicestershire proportionate to national efforts.

[1] LULUCF, BECCS, DACCS, and timber in construction. Read more at CCC, 2021, p197

Pricing offsets

All offsetting allows some carbon to enter the atmosphere, contributing to global warming. However, in the absence of commercially viable removals technology, pricing the scale of offsets that might be required gives a sense of the scale of the challenge.

Using the median offset price of £43 £/tCO_2e in the BEIS projected price range of £19-85 £/tCO_2e for offsets (source, 2035 prices, latest available data), Leicestershire annual residual scoped emissions in 2045 can be valued:

- Current Policy – 3,884 $ktCO_2e/y$ – £166m/y
- Council-Influenced– 3,620 $ktCO_2e/y$ – £154m/y
- Balanced – 526 $ktCO_2e/y$ – £22m/y
- Tailwinds – 290 $ktCO_2e/y$ – £12m/y

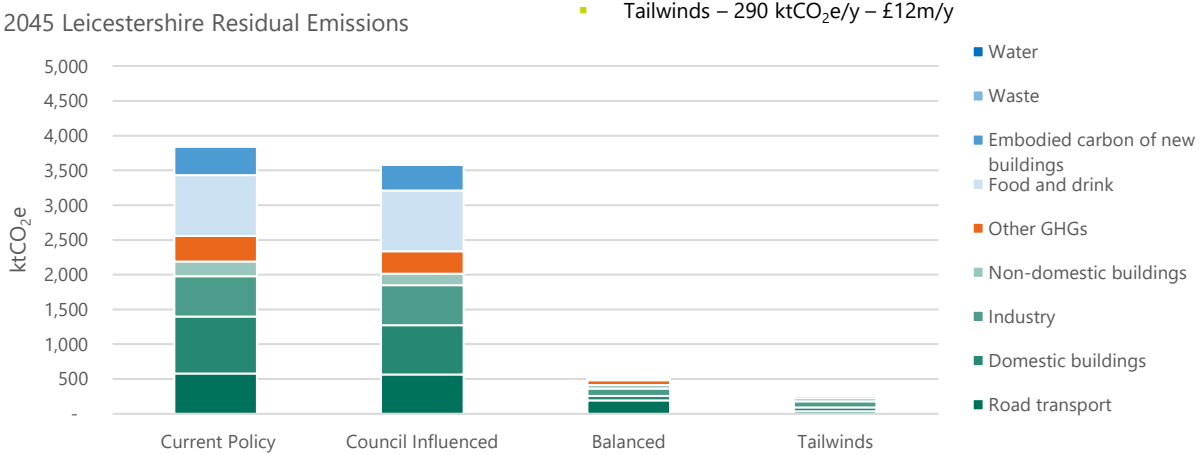


Figure 18: Residual emissions across Leicestershire Net Zero Pathways, 2045

Sequestration

Sequestration in Leicestershire today

Recent studies for Leicestershire [1] indicate that only 6% of the county is 'built'. The majority (65%) is farmland, while 8% is 'potentially valuable grassland', 5% is garden and 5% is woodland. The study indicates that ecosystems in Leicestershire and Leicester City sequester 40 $ktCO_2$ every year. Given the urban density of the Leicester City area, it can be assumed that a large proportion of this sequestration occurs outside of the city. 40 $ktCO_2$ is equivalent to 1% of Leicestershire territorial emissions in 2019, or 14% of 2045 territorial emissions projected in Leicestershire under the Tailwinds Pathway.

Within this dataset, the council manages 321,000 trees, of which 37% are in country parks, 35% on highways, and the rest in farms, schools or other properties.[2] Council-managed trees sequester 2,400 tCO_2e/y, [3] less than 0.02% of Leicestershire territorial emissions in 2019.

Tree planting commitments

Leicestershire has committed to planting 700,000 trees by the 2030s – 'a tree for every resident' (source). This will go some way to replace the decline in the tree population in Leicestershire since the 1970s, when Dutch elm disease accounted for the loss of more than 200,000 mature trees in the County.[2]

Assuming all planted trees sequester carbon at a similar rate as today's mix of council trees, the current tree planting commitment will enable 5,300 tCO_2e/y to be sequestered by 2045, or 0.125% of Leicestershire territorial emissions in 2019.

Though this figure is likely to be conservative, since younger trees tend to sequester greater volumes of carbon than their mature counterparts, it demonstrates that the current tree planting commitment is not at the order of magnitude required for tree planting to remove a significant proportion of Leicestershire's emissions.

Strategies to increase sequestration

Under the Tailwinds Pathway, residual territorial emissions amount to 290 $ktCO_2/y$ in 2045. To indicate the scale of tree planting, we considered the emissions associated with domestic building energy use, which comprises 19% of the scoped total in 2045 (54 $ktCO_2$).

To offset these emissions, 7 million trees would need to be planted – 10x the current commitment.

Alternatively, BEIS data indicated that change in land use in Leicestershire absorbed a net 65 $ktCO_2$ in Leicestershire in 2019 (see p25). This was equivalent to 1.4% of Leicestershire territorial emissions in 2019, or 22% in 2045 under the Tailwinds Pathway.

Continuing this trend, for example by enhancing areas and planting biodiverse, carbon-absorbing ecosystems, would therefore perhaps be a more effective strategy to increase the annual rate of sequestration in the county than tree planting. However, this process depends on constant improvements in the sequestration capacity capacity of large areas of Leicestershire every year, so may be challenging to sustain long-term. While planting is essential and brings many co-benefits (p59), this stresses the importance of coupling planting efforts with ambitious mitigation actions across all systems and activities.

[1] High-level strategic assessment of the natural capital assets of Leicester and Leicestershire (Holt et al, 2021).

[2] LCC Tree Management Strategy 2020-2025

[3] An i-Tree survey of 82,599 trees in Leicestershire found they sequestered 625 tCO_2e/y, as outlined in [2]. Assuming a comparable biodiversity and maturity mix across the county, a rate of 7.6 $kgCO_2e/y$/tree is applied.

[4] Assuming 14.5 tCO_2e/hectare/year sequestered according to Natural England (source, p30)

Tree planting commitment	Carbon sequestered annually $ktCO_2/y$	% of total Leicestershire territorial emissions in 2045 (Tailwinds)
Current commitment: 700,000 trees planted	5.3	1.8%
10x current commitment – 7 million trees planted	50.3	17.4%
3,000 hectares of mixed native broadleaved woodland (average age 30y) planted in areas where no carbon is currently sequestered	43.5	15.0%

Figure 19: Leicestershire sequestration potential

Emission Savings Impact Assessment

The Leicestershire Net Zero Pathways modelling includes a number of emissions categories and interventions to reduce them. This Impact Assessment considers the amount by which different emissions categories are reduced in each pathway, including the relative impact of some different interventions. We present the results of the Tailwinds Pathway here.

As shown in the image below, savings are achieved in all emissions categories modelled. The greatest absolute emissions savings are modelled in the Tailwinds pathway, in which fuel switching in the road transport and domestic/non-domestic buildings categories achieve savings of around 2,000 $ktCO_2e$. Demand reductions through retrofit and reduced mileage save a further 1,000 $ktCO_2e$ in the same categories. Though Solar PV installation is associated with a relatively small amount of emissions savings in this pathway (78 $ktCO_2e$), renewables are a critical precursor to decarbonising the grid, have fuel saving benefits and create resilience across the county (see more p59). They should therefore not be overlooked.

High levels of savings are achieved through industrial demand reductions and heat switching (665 $ktCO_2e$), while the majority of the rest of emissions savings are the industry-wide reductions in consumption emissions in manufacturing and construction (new build embodied carbon and food & drink; over 1,000 $ktCO_2e$).

Unless otherwise stated, all % changes in emissions are modelled between 2020 and 2045.

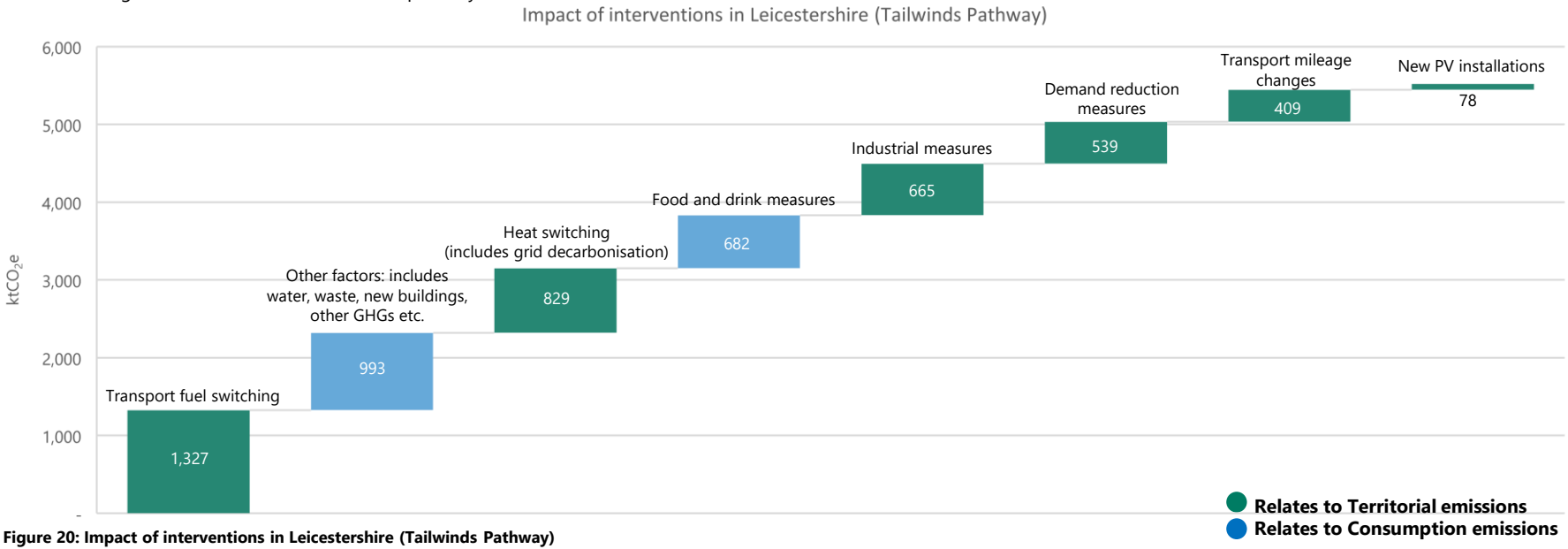


Figure 20: Impact of interventions in Leicestershire (Tailwinds Pathway)

Impact Assessment

Spotlight: transport

Under the Current Policy and Council-Influenced Pathways, emissions from vehicles increase thanks to the rising vehicle mileage modelled.

Road transport emissions are reduced 89-97% (1,531-1,682 $ktCO_2e$) in both the Balanced and the Tailwinds Pathways. These savings are achieved primarily through fuel switching (1,364/1,327 $ktCO_2e$), with the remainder from changes in vehicle mileage (215/409 $ktCO_2e$).

Note that the Balanced Pathway achieves greater emissions savings from fuel switching than Tailwinds because the higher reduction in average vehicle mileage modelled in the Tailwinds Pathway means there is a smaller energy demand for which fuel switching is applied.

Spotlight: industry

Overall, industry emissions are reduced 86% (669 $ktCO_2e$) in the Balanced Pathway, and 89% (684 $ktCO_2e$) in the Tailwinds Pathway. These reductions are primarily achieved through fuel switching, though we also model a 5-10% reduction in industrial energy demand through resource efficiencies, material substitutions and process efficiencies.

Spotlight: buildings

Under the Current Policy and Council-Influenced Pathways, building emissions only reduce in Leicestershire by 21% and 33% respectively (273-435 $ktCO_2e$).

For the more ambitious pathways, buildings emissions are reduced 91% (1,193 $ktCO_2e$) in the Balanced Pathway, and 92% (1,208 $ktCO_2e$) in the Tailwinds Pathway.

These savings are achieved primarily through heat switching (1,055/829 $ktCO_2e$), with additional contributions from retrofits (297/539 $ktCO_2e$) and Solar PV (69/78 $ktCO_2e$). The combination of heat switching and demand reduction efforts radically change the profile of energy consumption in buildings in Leicestershire by 2045, as shown in Figure 21 for the Tailwinds Pathway, where average demand drops 53% between 2020 and 2035.

In both scenarios heat switching is an underlying requirement for decarbonisation, demonstrating that there are a diversity of routes available to achieve county-wide decarbonisation of heat.

Spotlight: food and drink

Overall, food and drink emissions are reduced 98% (691 $ktCO_2e$) in the Balanced Pathway, and 99% (682 $ktCO_2e$) in the Tailwinds.

This reduction is in line with CCC guidance for food and drink, which indicates that emissions from the industry can be fully eliminated without negative emissions technologies or offsetting. This is due to electrification or fuel switching of processes (70-75%) and energy/resource efficiencies (20-30%), including a 50% reduction in all meat and dairy consumption.

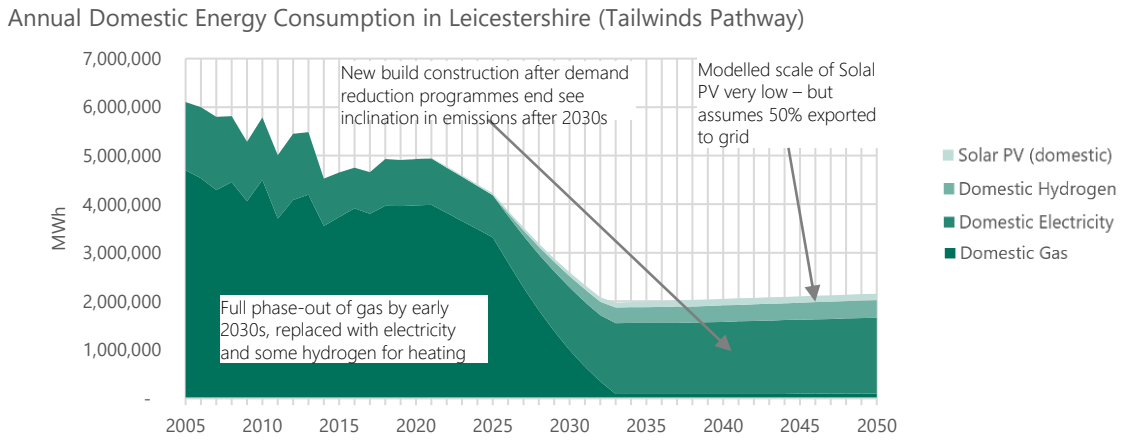


Figure 21: Annual domestic energy consumption in Leicestershire (Tailwinds Pathway)

Impact Assessment

Conclusion

This assessment highlights several key trends:

- The greatest single emissions saving activities in the Tailwinds pathway are from fuel switching in vehicles and building heating (>2,000 $ktCO_2e$ in the Tailwinds pathway), with additional significant savings from demand reduction measures, and reductions in embodied carbon of Food & Drink and new builds;
- Territorial emissions from buildings, road transport and industry are reduced by 80-90% in the Balanced and Tailwinds pathways thanks to fuel switching and demand reduction measures. Consumption emissions are decarbonised by 95%+ in line with CCC assumptions around UK-wide resource and process efficiencies, and fuel switching;
- Interventions to reduce carbon are necessary across all emissions categories, and include both demand reduction efforts and fuel switching; and
- The most significant carbon savings come from fuel switching: electrifying road transport emissions (24% of savings in the Tailwinds Pathway) and removing gas from buildings (15% in the Tailwinds Pathway).

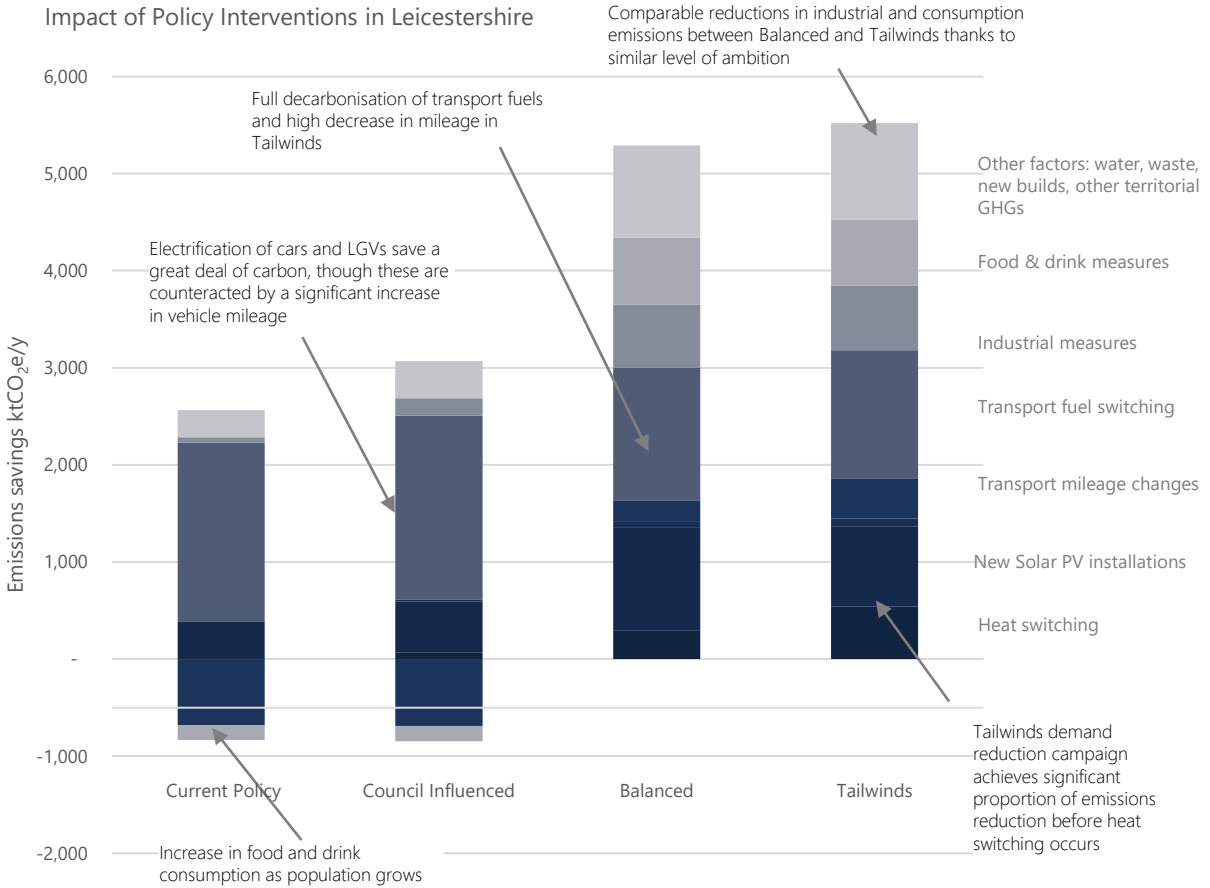


Figure 22: Impact of policy interventions in Leicestershire

High Level Costing

National costing models

Costing decarbonisation pathways requires a detailed understanding of the costs associated with major technological and behavioural change nation-wide. For example, this means understanding the scale of uptake of new technologies needed to deliver decarbonisation, outlining the extent of supporting infrastructure needed to deliver and sustain new technologies, and estimating operational activities necessary to maintain the new system. Moreover, costs for many of these areas are unknown, and will depend heavily on the scale at which new systems are delivered, investor confidence and 'learning-by-doing' during deployment (source, p20).

The CCC provides the most detailed set of cost projection models for UK-wide decarbonisation currently available. They find that the capital cost of a Balanced Net Zero Pathway nationally would cost £1,415b (2020-2050), and that of a Tailwinds Pathway would cost £1,440b (2020-2050) (excluding removals).

They find that costs to make these changes equates to below 1% of GDP throughout the next 30 years (source, p5). This stands in stark contrast to reports that the economic cost of inaction on climate could be of the order of 20% of GDP (source).

What does this mean for Leicestershire?

Leicestershire territorial emissions in 2019 amounted to 4.5 $MtCO_2e$, 1.3% of national emissions (345 $MtCO_2e$). Pro rata, this indicates that decarbonisation efforts in Leicestershire could require a combination of public and private investment in the region of £18b under either Balanced or Tailwinds Pathways.

However, this figure is indicative only. It is not accurate to disaggregate or pro rata costs directly between national cost models and Leicestershire requirements for several reasons: the scoping of the CCC and Leicestershire Net Zero Pathways varies for consumption emissions, CCC modelling is dependent on a uniform national strategy for decarbonisation and there are geographic variations in targets, costs and uptake rates within CCC models that make some high-level cost estimates inapplicable to the Leicestershire context.

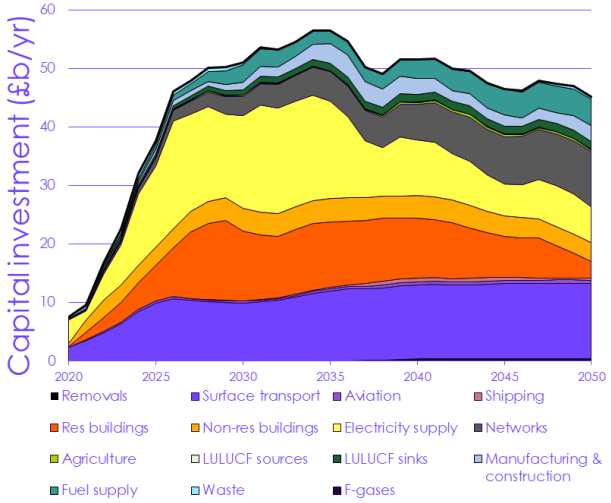


Figure 23: CCC modelling of UK capital investment 2020-2050 (Balanced Net Zero Pathway)
Source: CCC, 2021, p245

Additional insights

CCC costing assessments provide general insights into cost breakdowns and trends that may hold true in the Leicestershire context, particularly where Leicestershire Net Zero Pathways align with national strategies. We outline a few such trends:

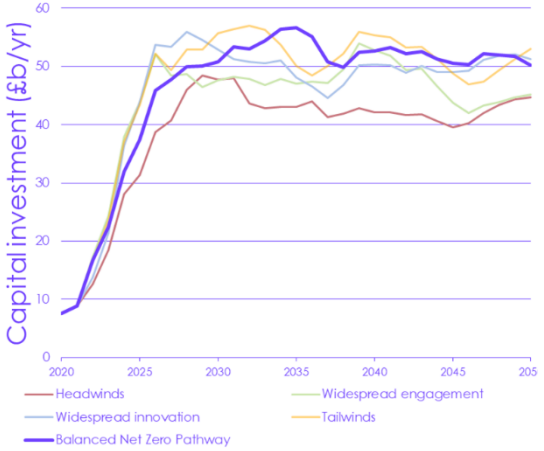


Figure 24: CCC modelling of UK capital investment 2020-2050 required to deliver a Balanced Net Zero and Tailwinds Pathway
Source: CCC, 2021, p248

High Level Costing

1. A constant annual capital investment programme will be required to mid-century under all scenarios. The CCC models an increase in the rate of annual capital investment to 2035 under a Balanced Net Zero Pathway, peaking at over £55 b/y, and a continued high rate of annual capital investment 2035-2050 (£45-55 b/y).

2. The five most expensive areas of decarbonisation, under a national decarbonisation Balanced Net Zero Pathway (2020-2050), are (source, p244):
   - Electricity supply (including wind farm construction and infrastructure roll-out to decarbonise the national grid), (£334b).
   - Surface (road) transport (£331b) – additional investment in this sector mainly refers to the higher upfront purchase price of zero-emissions vehicles and the costs of the supporting charging/refuelling infrastructure.
   - Domestic buildings (£253b) and non-domestic buildings (£107b) – investment in energy efficiency measures, such as insulation, are prioritised between 2020 and 2030; from 2030 onwards, the primary driver of additional capital investment is the deployment of low-carbon heating.
   - Networks (£147b) – the infrastructure investment required to enable pathways, including electricity transmission and distribution networks, but also development of Carbon Capture and Storage (CCS) infrastructure (which is not modelled in Leicestershire Net Zero Pathways, see p58).

3. Capital investment costs under a Tailwinds and Balanced Net Zero Pathway are comparable. Overall, the CCC model indicates national investment of around £1,400b under both the Balanced Net Zero Pathway, and Tailwinds (2020-2050).

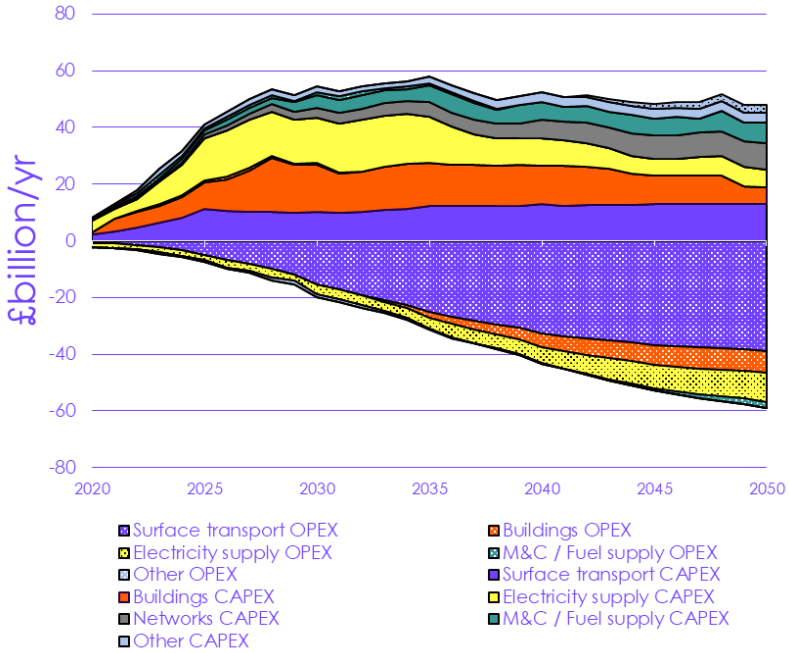


Figure 25: Capital and investment costs and operating cost savings in the CCC national Balanced Net Zero Pathway
Source: CCC, 2021, p250

High Level Costing

Return on investment

Capital investment costs dominate in the first 10-15 years of implementation of a national Balanced Net Zero Pathway. However, operational costs savings accumulate over time as low-carbon technologies are rolled out across the entire stock of vehicles, buildings and other capital stock. By 2050, aggregate operating cost savings are similar to the annual capital investment requirement. Total operational cost savings (2020-2050) modelled in the national CCC Balanced Net Zero Pathway include (source, p249):

- Surface (road) transport (-£684b) – electrified surface transport is far more efficient than high-carbon alternatives and has significantly lower maintenance costs. Overall, new transport infrastructure can deliver national annual operating cost savings of over £30b/y by 2050.
- Electricity supply (-£150b) – low-carbon electricity generation can have high upfront costs but achieves low costs in operation, in particular by avoiding fuel costs. The complete decarbonisation of the electricity sector by 2035 in the national Balanced Pathway reduces operating costs by around £10b/y, even allowing for the operational costs of meeting the extra demand from electrification.
- Buildings (-£84b) – energy efficiency improvements and switches to low-carbon heating deliver reductions in operating costs for buildings, estimated at around £8b/y by 2050.

Cost and impact

CCC modelling considers the average abatement potential of a variety of decarbonisation interventions, aligning CAPEX, OPEX and cost of fuel. It should be noted that this analysis is assuming national scale roll-out, looks at technologies in isolation when in reality energy infrastructure operates as a system, and does not consider co-benefits (for example, the health impacts of emissions). However, these figures provide a rough insight into the relative cost efficiency of different decarbonisation interventions.

This indicates that fabric efficiency is relatively expensive, at £638 / tCO_2e saved. This is most significant for domestic buildings given the high cost of domestic energy (see p56).

While heat switching costs are disaggregated in CCC analysis, their study also finds that most heat switching has costs, particularly for district heat (£166/tCO_2e) and hydrogen grid (£77/tCO_2e) development. Electricity grid investment brings returns on savings (-£16/tCO_2e) because investment in electricity generation helps avoid operational costs in other sectors, as those sectors electrify (source, p145).

For road transport, investment in electrifying cars and vans is significantly cheaper than for HGVs (£2/tCO_2e compared to £31/tCO_2e) because of the existing technology available for small electric vehicles.

Measure	£/tCO_2e
Domestic, fabric efficiency	638
Domestic, low carbon heat	220
Non-domestic, energy efficiency and behaviour change	185
Non-domestic, district heat	166
Road transport, cars and vans	2
Road transport, HGVs	31
Energy from waste	56
Hydrogen (grid)	77
Electricity (grid)	-16

Figure 26: High level estimation of average costs per tonne of emissions saved under different interventions. Based on average CCC Tailwinds Pathways figures 2020-2045.

Spotlight Costing: Leicestershire Building Decarbonisation

CCC modelling described on the previous pages sets out a full range of costs for the delivery of decarbonisation pathways, including full transformation of supporting infrastructure nation-wide. This is useful to understand the scale of costs required to deliver a full net zero carbon pathway.

To explore a more in depth breakdown of costing at Leicestershire-level, this study calculated costs for building decarbonisation in detail. This used the real modelled uptake rates of interventions and energy demand figures calculated in the Leicestershire Net Zero Pathways, with cost estimates applied based on industry and CCC figures (Appendix A-B).

All costs are modelled over the period 2020-2045.

Capital investment

We model a total capital investment into Leicestershire by public and private stakeholders of £47m, £548m, £3,057m and £3,792m to undertake building retrofits, Solar PV installation and heat switching in the four pathways.

Under Current Policy and Council-Influenced Pathways, focussing interventions only on 2-10% of buildings results in relatively moderate capital costs. For Council-Influenced (social housing and public buildings), we model a cost of £236m on installing demand reduction measures and £146m on heat switching (primarily installation of heat pumps).

Under the Tailwinds Pathway, 98-100% domestic and non-domestic buildings in Leicestershire are retrofit at a cost of £1,770m, and Solar PV is installed on 25% of domestic buildings and 40% of non-domestic buildings at a cost of £754m. The programme of heat switching is focussed on heat pumps (46%), with a balance of district, electric and hydrogen making up the remainder, costing £1,268m.

In the Balanced Pathway, a moderate programme of retrofits (63-66% of buildings) costs £1,127m, and a slightly lower rate of Solar PV roll-out costs £734m. Heat switching is more expensive than the Tailwinds Pathway, due to a higher reliance on heat pumps and hydrogen over electric heating, at £1,349m.

Solar PV

Solar PV installation costs are high in the Balanced Pathway, amounting to 23% of capital investment costs for buildings. It should be noted that some of this investment will be recouped by owners through energy exported to the grid (50% of electricity generated, source). This amounts to payback costs of £1,155m and £1,663m between 2020-2045 under the Balanced and Tailwinds Pathways, 36% of overall capital investment. Further operational cost savings on energy bills are explored in the following pages.

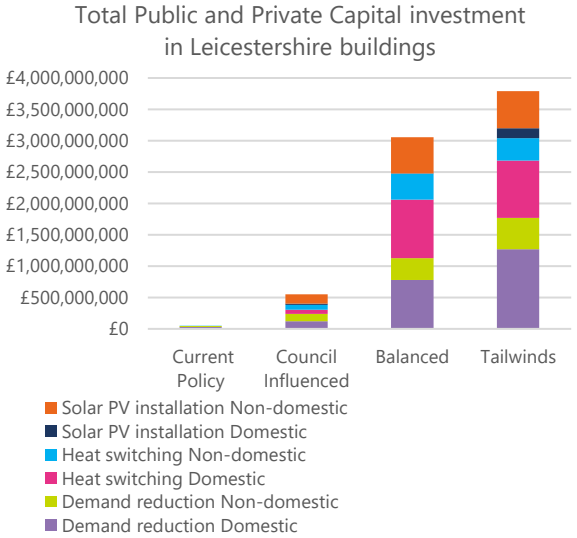


Figure 27: Total public and private capital investment in Leicestershire buildings

Item	£/unit	Fuel savings	Item	£/unit	Fuel savings
Fabric retrofit + water saving	£6,500	High	District heating	£8,060	None
Heat pump	£6,750	High	Gas boiler	£2,860	Losses
Solar PV (1kWp)	£1,628	High	Hydrogen boiler	£2,960	Losses
Electric heating	£780	None			

Figure 28: Typical modelled costings
Source: See Appendix A

Spotlight Costing: Leicestershire Building Decarbonisation

Fuel spending

Under the Balanced and Tailwinds Pathways, programmes of retrofits, Solar PV installation and heat switches are modelled. This results in a drop in energy demand across Leicestershire – even accounting for new builds. As a result of this drop, and the shift in fuel use, the cost of fuel for buildings is anticipated to change in coming decades.

Under the Balanced Pathway, reduction in energy demand combined with the relatively low cost of commercial electricity enables annual fuel savings of £40m/y in the non-domestic sector. This rises to £65m/y under the Tailwinds Pathway, thanks to its greater modelled demand reduction.

Savings in domestic buildings are relatively modest. This is a result of the relatively high cost charges for domestic electricity under current utility rate structures: the furthest BEIS projections indicate that domestic electricity consumption will be 17.2 p/kWh in 2035 much higher than gas (2.9 p/kWh). This results in a net increase in costs for domestic energy under the Balanced Pathway (£16m/y; ~£50 /y/household), despite reductions in energy consumption of 47%. For the Tailwinds Pathway, savings of £73m/y are predicted, thanks to a bigger drop in energy consumption of 57%.

However, this costing is extremely sensitive, as discussed on p58.

Fuel	p/kWh 2020	p/kWh 2035
Electricity (domestic)	19.7	17.2
Electricity (services)	13.7	12.4
Gas (domestic)	4.2	4.9
Gas (services)	2.8	3.8
Hydrogen (grid)	18.0	15.2

Figure 29: Energy retail price projections
Source: BEIS, 2019, Annex M; Hydrogen from BEIS, 2021. 2035 is the last available year of data, estimates are based on central estimates of economic growth and fossil fuel prices. Note the government has committed to working to reduce electricity cost to achieve parity between electricity and gas, as discussed in detail on p58.[1]

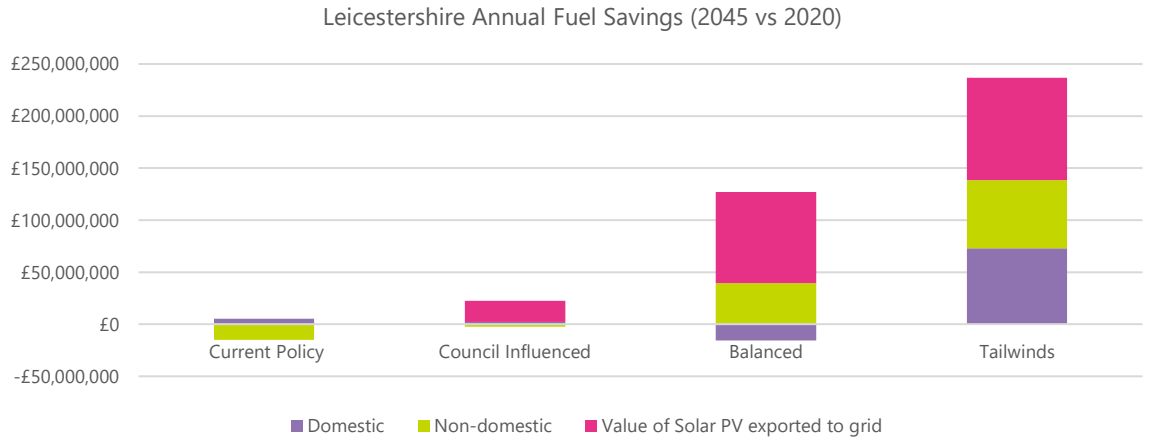


Figure 30: Leicestershire annual fuel savings, 2045 vs 2020
All costs and demand reduction figures are modelled over the period 2020-2045, unless otherwise stated..

Spotlight Costing: Leicestershire Building Decarbonisation

Whole life costing

Comparing capital investment into building retrofit, Solar PV installation and heat switching with fuel savings would indicate a relatively long pay-back time in this study: an investment of £3,792m (Tailwinds, 2020-2045) would be recouped by fuel savings and Solar PV grid sales of £250m/y (2045) over 15 years.

However, it is important to note that this costing is extremely sensitive, and may be conservative:

- Cost savings will be accrued before the full capital investment has been made;
- Additional avoided costs have not been included, such as routine replacement costs for existing gas boilers and fabric repairs;
- The efficiency of heat sources varies considerably, with heat pumps being more expensive than hydrogen boilers or direct electric sources, but resulting in significant energy savings thanks to high seasonal coefficients of performance. This means that future energy savings are sensitive to national heat strategies, technological developments and fiscal measures;
- There is an expectation that technologies such as heat pumps will become cheaper as they are rolled out on national scale (by up to 30%, according to CCC modelling, source, p247), with the government recently committing to reduce the costs of heat pumps 25-50% by 2025 (source);
- The cost of electrification is highly sensitive to wider trends, as evidenced by steep gas prices in 2021. Currently, tax rates and subsidies favour gas, but the government has committed to working to reduce electricity cost to achieve parity between electricity and gas (source). Moreover, mass electrification nationally, along with carbon pricing and other policies to disincentivise the use of gas, could help further reduce electricity costs (source, p297). As a result, the 2019 BEIS energy price projections used in this study could be overly conservative for electricity pricing, making fuel savings modelled in this study appear overly high; and
- The non-financial co-benefits of decarbonising buildings are significant, as explored in p59-63. Some of these, such as improved health and climate resilience have associated cost savings that are not reflected in these calculations.

The findings of this study highlight that cost savings can be expected in Leicestershire buildings as a result of a combination of retrofit, heat switching and Solar PV uptake. However, savings could be considerably higher where electricity prices fall, and as technologies such as heat pumps become more affordable. It is also essential to stress that the co-benefits of decarbonising buildings extend far beyond immediate changes to fuel spending.

Conclusion

This spotlight costing indicates several key trends:

- Capital investment costs amount to between £3,057m and £3,792m to undertake building retrofits, Solar PV installation and heat switching (Balanced, Tailwinds Pathway).
- Of building decarbonisation capital costs, demand reduction measures make up 35%, heat switching 42% and Solar PV installation 23% (Balanced Pathway).
- While the cost of electricity remains higher than gas, particularly for domestic buildings, electrification of heat increases the p/kWh paid by building owners. However, current policy signals and market predictions indicate future fuel prices are highly uncertain and the current expense of electricity relative to gas may shift. Energy retrofits and Solar PV installation can also reduce energy demand and avoid rising bills, among numerous other co-benefits.
- We calculate that retrofitting 98% of the Leicestershire building stock creates savings of £73m/y by 2045 (Tailwinds).
- Solar PV installation reduces energy bills, and enables building owners to recoup investment costs by feeding energy back to the grid, amounting to £1,634m/y in Leicestershire (Tailwinds).

Co-benefits

Co-benefits

Benefits that occur as a result of emissions reduction are known as 'co-benefits'. Co-benefits are important to take into account in considering the overall costs and benefits of abatement. In many cases, co-benefits can be greater than the main benefits, and can considerably reduce the costs associated with higher-cost technologies (source). LCC should look for synergies in these opportunities with other policy interventions and aspirations such as health, social care, fuel poverty, town-centre regeneration and connectivity.

Environmental

Decarbonisation initiatives may lead to a range of environmental co-benefits beyond reducing emissions. Environmental co-benefits may include reduced air and noise pollution, improved soil quality, biodiversity benefits and reduced water demand. Decarbonisation activities would also contribute to climate change adaptation and mitigation to the inevitable consequences of climate change making the county more resilient to the effects of climate change. Interventions such as tree planting for sequestration could have particularly significant environmental benefits, improving Leicestershire's flood resilience and relieving pressure on the county's drainage system.

Economic

Cutting emissions may lead to economic co-benefits for the county's residents, businesses and the council. Residents will save on electricity costs, reducing the number of people in the county living in fuel poverty. Retrofit measures will also reduce maintenance costs and can increase asset value. Businesses and LCC will also see savings in running costs and retrofit and heat switching will help businesses comply with energy consumption legislation. Other economic co-benefits include job creation, a reduction in long-term health costs, and reduce operational costs for water and waste management providers. Leading the way in decarbonisation will also make Leicestershire more attractive to forward-thinking businesses.

Whilst the macroeconomic change from net zero is likely to be small, the structural changes to Leicestershire and the UK's economy will be significant. Entirely new economic sectors will be created, and carbon intensive sectors of the economy will shut down, requiring much of Leicestershire's workforce to be re-trained.

Achieving a fully built and operational low carbon energy infrastructure will require substantial development and deployment of low carbon technologies and associated infrastructures. Over this period, depending on how these technologies and infrastructures are financed, energy prices may rise to pay for this (source).

Social

Interventions to reduce emissions may lead social co-benefits improving the quality of life of Leicestershire's residents. Social co-benefits may include improved overall health and wellbeing outcomes and reducing health inequalities as a result of housing retrofit, increased active travel, reduced air pollution and plant-based diets. Decarbonisation activities could also reduce food and fuel poverty in the long-run, and decarbonisation efforts that can involve the community, such as tree planting or community energy schemes, support social cohesion and community resilience. However, during the transition period, the impact of decarbonisation of prices may increase financial pressure on Leicestershire's households.

Co-benefits

CLEAN TRANSPORT, BUILDINGS AND INDUSTRY HAVE MAJOR CLIMATE, AIR QUALITY AND HEALTH BENEFITS

By taking these priority actions on climate change and air pollution, cities can work towards clean transport, buildings and industry, all underpinned by a decarbonised grid.

Achieving these goals represents a massive opportunity to improve climate, air quality and health but ambitious, city-wide action is required. Cities, and others, are already leading the way, for example through committing to Fossil Fuel Free Streets, Net Zero Carbon Buildings and 100% renewable energy.

Due to constraints in data availability, clean buildings and industry are grouped together (see methodology report). The benefits of curbing climate change, although not quantified, will be massive and will also impact health through reduced frequency of extreme weather conditions and floods.

However, the path to get there won't be easy and cities can't do this alone - we need national and regional governments, business and civil society, alongside cities, to take bold action.

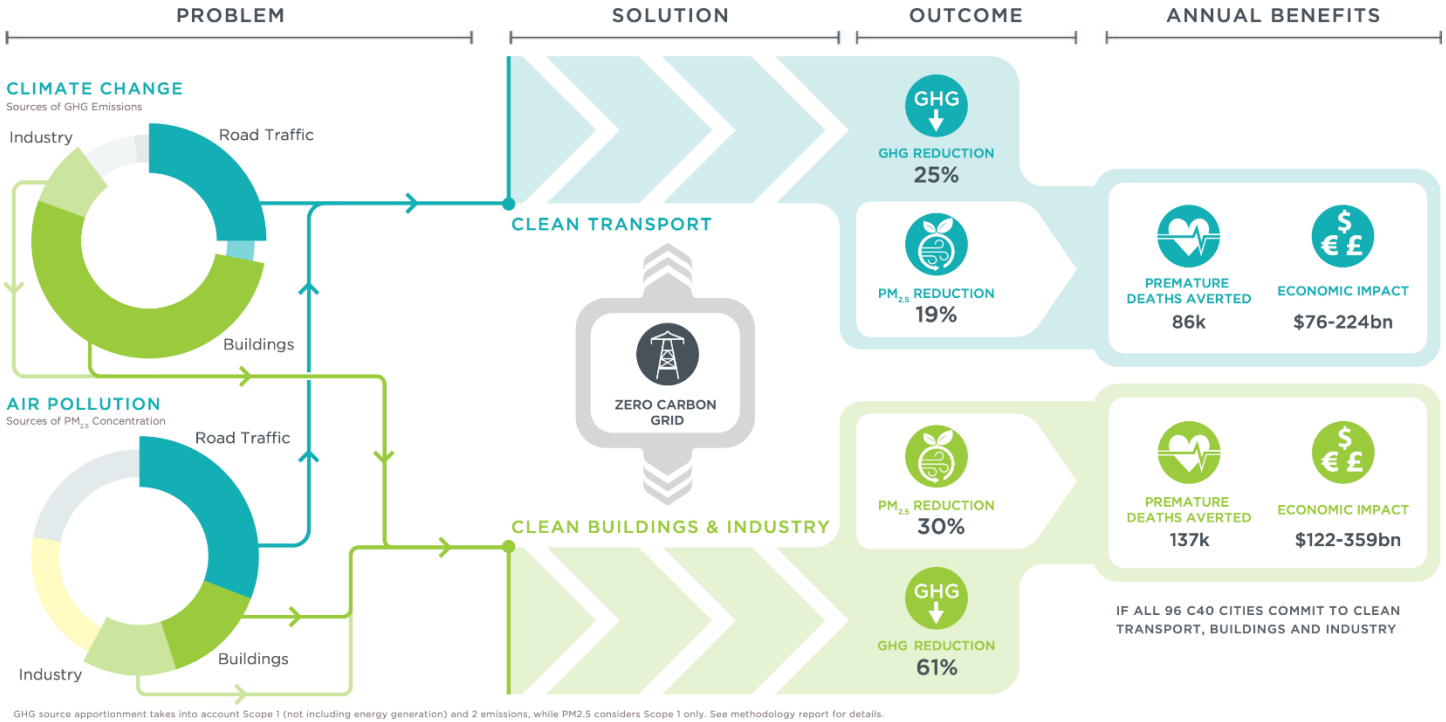


Figure 31: Towards a Healthier World
Co-benefits of decarbonisation actions, as discussed on p59-62, are diverse, interlinking and wide ranging. This graphic shows some of the ways in which decarbonisation activities can bring positive changes to the environment, the economy and to people, and gives examples of some of the metrics that can be used to track these changes.
'Cities' is used as a reference to a local government area.
Source: C40 Cities and Buro Happold

Co-benefits

Intervention	Environmental	Economic	Social
Building retrofit 	• Improving energy efficiency of buildings will reduce overall energy use and water demand (source). • Retrofitting existing structures avoids carbon-intensive demolition and rebuild. • Retrofitting can also increase the climate resilience of properties (source). • Opportunities for biodiversity, e.g. swift/bat boxes.	• Residents and businesses will benefit from significant energy savings due to increased efficiencies. This will particularly benefit those in the county currently living in fuel poverty (source, source). • Retrofit measures can also reduce asset maintenance costs through more efficient equipment and high-quality material (source). • Retrofit will also enhance the asset values of buildings (source). • Improved indoor environments can benefit staff productivity and wellbeing (source). • Help businesses comply with government energy consumption legislation (source).	• Improved energy efficiency and insulation will lead to better thermal comfort and reduce the risk of damp and mould, reducing the risk of developing respiratory and cardiovascular disease and other cold-related illnesses (source, source). • Improved thermal comfort will reduce the number of heat related deaths. • Contribute to Corporate Social Responsibility goals (source). • Retrofit will support the resilience and independence of households (source).
Heat switching 	• Switching from gas heating will significantly reduce building emissions, contributing to climate change mitigation. • Heat switching will improve air quality.	• Heat networks can provide heat more efficiently than individual building technologies, benefiting from economies of scale (source). • Switching from gas will reduce heating costs due to the greater efficiencies of new technologies (source). • Renewable electricity prices are more stable than gas.	• Reduced combustion of fossil fuels will reduce emissions of other air pollutants, with significant health benefits (source).
Solar PV installation 	• Energy generated from solar PVs does not produce air pollution or emissions (source).	• Increased demand for solar PVs in the county could lead to job creation in the renewables sector (source), nearly 700,000 direct jobs could be created in England's low-carbon and renewable economy by 2030, rising to more than 1.18 million by 2050 (source).	• Feed-in-tariffs could benefit low-income households (source). • Community-led renewable energy schemes could will support community resilience (source).

Co-benefits

Intervention	Environmental	Economic	Social
Food and drink 	• Agricultural emissions will be reduced by reducing over-consumption of red meat (source). • Improving efficiencies in food and drink production will save water, improve soil quality and minimise waste (source). • Changes to land use will support biodiversity resilience and increase carbon sequestration (source).	• Improving food and drink production efficiencies could pass on savings to consumers. • Health benefits pass on national cost saving to NHS (source). • Opportunity for regenerative agriculture to provide public good and food production (source).	• Health benefits of reducing red meat consumption (source). • Support Leicestershire's thriving local food sector.
Embodied energy of new buildings 	• Minimising the embodied carbon of new builds will reduce construction sector emissions, creating additional benefits throughout the supply chain (source). • Clean construction will reduce air and noise pollution, decrease damage to ecosystems, protect green spaces and minimise the level of construction and demolition waste that goes to landfill (source).	• Using less and re-using materials to achieve low embodied carbon also often result in reduced project costs (source). • Investing in materials that will last longer and can be recycled can also reduce maintenance costs (source). • Those who act now will take a leadership position in the transition to a decarbonised built environment (source). • Growing the market for sustainable timber.	• Timber has wellbeing benefits (source). • Whole life carbon analysis is valuable in reducing negative social impacts of manufacturing and transport (source). • Improved health and wellbeing and quality of life due to: improved living conditions; reduced community disturbance; reduced air and noise pollution; and reduced risk of road traffic accidents (source).
Vehicle fuel switching 	• EVs emit considerably lower emissions over their lifetime than internal combustion engine vehicles (source).	• EVs are expected to cost less over the course of ownership than internal combustion engine vehicles (source). • Potential opportunity for LCC revenue generation through EV charging.	• Improved health as a result of lower air pollution in towns and cities (source, source).
Active travel 	• Replacing vehicle miles with active travel will significantly reduce emissions, and air and noise pollution (source). • Incorporating green and blue infrastructure into improved active travel routes will support biodiversity (source).	• Savings in health costs in long-term (source).	• Health will be improved through encouraging active lifestyles over private-vehicle use (source). • Supports high street vitality and social cohesion (source).

Co-benefits

Intervention	Environmental	Economic	Social
Waste management 	• Reduced waste going to landfill will alleviate pressures on soil, water, groundwater and air pollution (source, source).	• New business opportunities for sustainable waste management (source). • Circular economy principles and re-use of materials can lead to a reduction in costs (source). • Reducing waste generation reduces costs of waste management (source).	• Reducing food waste helps mitigate food poverty and hunger by enabling surplus food to be distributed through food banks (source). • Sharing economy activities such as community composting and repair shops reduce waste whilst bringing communities together (source).
Water demand 	• Reducing water demand reduces electrical energy consumption and emissions (source). • Reducing water demand reduces environmental strain on region's water system (source).	• Reduction in operation and maintenance expenses due to lower energy for pumping and less chemical use in water acquisition, treatment and disposal (source). • Reducing leakage will reduce costs (source).	• Water security. • Reducing water demand will minimise the periods when restrictions are placed on supply (source).
Sequestration 	• Sequestration removes CO_2 from the atmosphere, mitigating climate change, as well as other air pollutants (source). • Increased green space and permeable surfaces will improved floor resilience and relieve pressure urban drainage systems (source). • Increased green space can support Leicestershire's biodiversity (source).	• Tree planting reduces green space maintenance costs (source). • Tree planting and woodland restoration will create jobs in Leicestershire (source).	• Increased green space provides mental and physical health and wellbeing benefits (source). • Increased access to green space and wildlife increases environmental awareness and support for climate action. • Tree planting provides an opportunity to engage the local community with educational and social benefits (source).

SECTION 6

HIGH LEVEL ACTION PLAN

Recommendations for Action Plan

The following section presents recommendations for a high level action plan to deliver the interventions highlighted in the Leicestershire Net Zero Pathways.

This includes the following analysis:

- Policy gap analysis – a comparison of current LCC and national policy with the interventions necessary to deliver net zero in Leicestershire, and identification of possible subsequent council policies;
- Stakeholder analysis – an assessment of stakeholder and collaborator activities needed to complement LCC decarbonisation interventions for Leicestershire; and
- High level action plan – a high level set of short, medium and long-term actions to support the decarbonisation of Leicestershire.

Image: Loughborough / Adobe Stock / Marcin

Net Zero Policy

Summary of current policy

As outlined in this study, the Current Policy Pathway shows a 33% reduction in scoped emissions in Leicestershire in the period 2020-2045.

This is achieved primarily through ongoing decarbonisation of the national grid and electrification of the car and LGV fleet following national petrol/diesel phase-out policies. Supporting policy in Leicestershire includes efforts to decarbonise public buildings and support homeowners with retrofit, as well as activities to improve walking and cycling rates in the county and encourage healthy eating.

Policy gap

Leicestershire has a target to decarbonise by 2045, which will require clear targets and further commitments at scale and pace to decarbonise the county. Some efforts have been made around building retrofit and heat switching, particularly in public buildings, but these need to be rolled-out on a mass scale across the county.

In order to meet Leicestershire's 2045 target, policies and programmes must cover:

- **Massive reduction in energy demand** through building retrofits, Solar PV installation, reduced vehicle mileage, and industrial and manufacturing process efficiencies;
- **County-wide switch to low carbon fuel** including building heat sources, vehicle electrification and switching industrial and manufacturing fuels to low carbon equivalents – such as biomass and hydrogen where electrification is not possible;
- **Significant reduction in material demand** including waste arisings, water demand, water supply leakage, reduced material consumption and material substitution in construction and manufacturing to lower embodied carbon of goods and services;
- **A just transition** to ensure that all interventions are implemented with equitable policies and co-benefits harnessed to support local flourishing.
- A coherent **programme to enhance biodiversity** across Leicestershire, restoring existing spaces, maximising carbon sinks and protecting endangered species.

Bridging the gap

In order to tackle building emissions, a coordinated program of building retrofit, Solar PV installation and heat switching must be prepared with district councils, with an accompanying suite of policies to drive uptake – such as financial incentives, hardships funds, workforce upskilling, pilot schemes, drawdown of national funds and more. Leicestershire could explore community-led renewable energy schemes, with pilot schemes on council assets.

For the decarbonisation of Leicestershire's road transport, coordinating the roll-out of EV infrastructure, active travel routes and public transport upgrades with neighbouring authorities will be necessary. Additional funding may be available through Section 106 agreements or central government's On-Street Residential Chargepoint Scheme, and future funding sources. Interventions outlined in Leicestershire's Local Transport Plan 3 should also continue to be implemented. Department for Transport strategy for HGV decarbonisation will need to be monitored and actioned.

For waste disposed of by LCC, LCC could improve monitoring of private waste disposal rates and methods, roll-out food collection across the districts and support research and development into circular economy initiatives and educational campaigns. Behaviour change campaigns may also be valuable, including experimenting with waste collection timings and water use educational initiatives.

Building retrofit and heat switching policy should connect industrial decarbonisation strategy, which will need to be developed alongside with local industry and national plans. In particular, food and drink emissions reductions can be supported by improved monitoring of food and drink manufacturing in the county and sector pilot projects to improve efficiencies and reduce waste. LCC could also coordinate district council actions to raise awareness of low-carbon, plant-based diets to reduce consumption emissions.

Stakeholder Analysis

Stakeholder input

As demonstrated on p41, LCC cannot achieve net zero carbon by 2045 without support from and collaboration with external stakeholders across Leicestershire and the UK.

In order to meet Leicestershire's 2045 target, the following stakeholder relationships and activities can support new policy:

- Support from and engagement with national Government, public bodies and industry groups. This may include lobbying for funds and strategic direction to enable a just transition to a net zero Leicestershire, identification of cross-county infrastructure needs, connecting Leicestershire residents and groups with national campaigns and research streams.
- Universities in and around Leicestershire are a valuable source of local knowledge on decarbonisation activities, and provide a forum for educational initiatives linked to behavioural change and systems change.
- There are a variety of tiers of local government which will have a role to play in delivering net zero carbon in Leicestershire. Councils within Leicestershire and neighbouring authorities are likely to be key partners for delivering decarbonisation through planning, waste management, housing and road transport.
- Parish councils can help drive behaviour change and the uptake of retrofit through providing advice to the public on financial support and technology available to them.
- Leicestershire's local businesses will play a significant role in achieving the net zero target. Further engagement with local business, particularly large carbon emitters and representative organisation, through accreditation schemes and awards, supporting pilot projects, financial incentives and planning requirements may further leverage the influence of local business in decarbonisation activities.
- Local services providers will also play a key role in achieving Leicestershire's net zero target:
  - Collaboration with private waste collection groups, with additional guidance from WRAP, can support the net zero transition through improved waste management and communication campaigns to raise awareness.
  - Local energy providers, supported by district network operators, can drive fuel switching and retrofit by promoting the opportunities of decarbonisation, as well as supporting community energy schemes. Rail and bus operators electrifying the county's public transport fleet.
  - Severn Trent can help reduce water demand through improving awareness of the importance of responsible water consumption, and improving network maintenance to reduce leaks.
  - To reduce territorial road transport emissions, Leicestershire's local transport providers can improve the accessibility, affordability and connectivity of the local public transport network.
  - Leicestershire's health partners can raise awareness of the health and wellbeing benefits of decarbonisation.
  - Other environmental, community sector and land based organisations in Leicestershire can also play a key role in achieving net zero.

Recommendations for Action Plan

The high level action plan is intended to identify key themes, short-term actions (1-5 years) and lead partners for Leicestershire in achieving net zero by 2045.

These actions provide the basis for the development of a longer term Climate Action Plan for Leicestershire, which could be informed through a Citizens' Assembly and further technical studies.

Theme 1 – Road transport

Reduce vehicle mileage and switch fuel type

Road transport emissions account for a significant proportion of Leicestershire's total emissions. Reducing transport emissions is vital to achieving net zero, as well as providing additional co-benefits such as reduced air and noise pollution. While the decarbonisation of HGVs is of national significance, it is also a relevant focus area for Leicestershire given the significance of the logistics sector to the regional and national economy.

Theme 2 – Buildings

Retrofit buildings and switch heat sources

Heat switching is essential to decarbonisation and will occur in line with national guidance, gas phase-out targets and industry changes. However, the infrastructure needed for this transition, and the high cost of electricity at the time of writing, requires Leicestershire to accelerate retrofit across the county to ensure a just transition. A wide-ranging programme of building retrofit will reduce energy demand and help save fuel costs, as well as extending building lifespans and improving quality of life.

Theme 3 – Energy infrastructure

Deliver low carbon infrastructure across the region

Achieving net zero and the goals of Themes 1 and 2 will require a regional-scale energy transition. Not only will new electricity supplies be needed, renewable energy to contribute to national grid decarbonisation must be built. Coordinating the planning and delivery of regional low carbon infrastructure will enable Leicestershire to transition regionally, in collaboration with surrounding counties.

Theme 4 – Consumption emissions

Drive national decarbonisation efforts to decarbonise consumption emissions

Industry, agriculture, water treatment, and the embodied carbon of manufacturing are all high carbon emitters, both within Leicestershire and nationally. Leicestershire can engage with, and contribute to, national decarbonisation and circular economy efforts, supporting the county's decarbonisation whilst driving national efforts.

Theme 5 – A green Leicestershire

Enhance ecosystems and create accessible and inclusive green spaces

Ecosystem enhancement, increasing biodiversity and natural conservation projects are all essential to protecting Leicestershire's ecosystems and ensuring natural areas in the county can flourish. These spaces are essential for air quality, carbon sequestration and climate resilience.

Theme 6 – A just transition

Raise awareness of decarbonisation and its co-benefits and ensure equitable and inclusive climate action

Raising awareness of the benefits of decarbonisation will help establish a common vision across Leicestershire. Consultation carried out in the study indicated that there was a desire for collaboration between groups to enable inclusive and equitable climate action planning in Leicestershire.

Theme 7 – Council actions

Develop a LCC Action Plan

LCC has the opportunity to lead by example by ensuring that it is taking action to meet its net zero target of 2030. LCC's leadership can support the piloting of new decarbonisation activities throughout the county, actively driving collaboration across sectors and scales to accelerate action and promote joined-up thinking.

Recommendations for Action Plan

THEME	DECARBONISING LEICESTERSHIRE MEANS...	CROSS-COUNTY SHORT-TERM ACTIONS	LEAD PARTNERS
ROAD TRANSPORT	• Reducing vehicle mileage through increased public transport, maximising efficiency of logistics sector and promotion of active travel • Mass electrification of vehicles, with hydrogen for hard-to-decarbonise vehicles	• Convene key players • Develop a low carbon transport plan • Pilot projects for decarbonisation of HGVs and reduced mileage strategies	• Midlands Connect • Logistics, haulier and road network industry groups • Energy companies
BUILDINGS	• Retrofitting buildings across the county • Rolling out renewables, including mass uptake of rooftop Solar PV • Switching all oil and gas-powered heating to low carbon alternatives	• Develop ambitious, coordinated targets • Prepare training and skills development for local retrofit companies • Understand building stock and prepare retrofit guidance	• District and parish councils • National government • Energy companies • Local engineering businesses
ENERGY INFRASTRUCTURE	• Delivering low carbon power supplies across the East Midlands to enable fuel switching in buildings and on the road, and contributing to national grid decarbonisation efforts through renewables construction	• Develop regional strategy for low carbon heat • Develop regional infrastructure plan	• National Government • District network operator • Universities • Industry • Commerce
CONSUMPTION EMISSIONS	• Increasing the efficiency of industrial and agricultural processes in Leicestershire and surrounding areas • Swapping fuels, processes and materials in manufacturing and construction to zero carbon alternatives	• Engage with national industry groups • Develop behaviour change campaigns • Pilot projects with local industries	• District and parish councils • National government • Industry leaders

Figure 32: High level recommendations for action plan

Recommendations for Action Plan

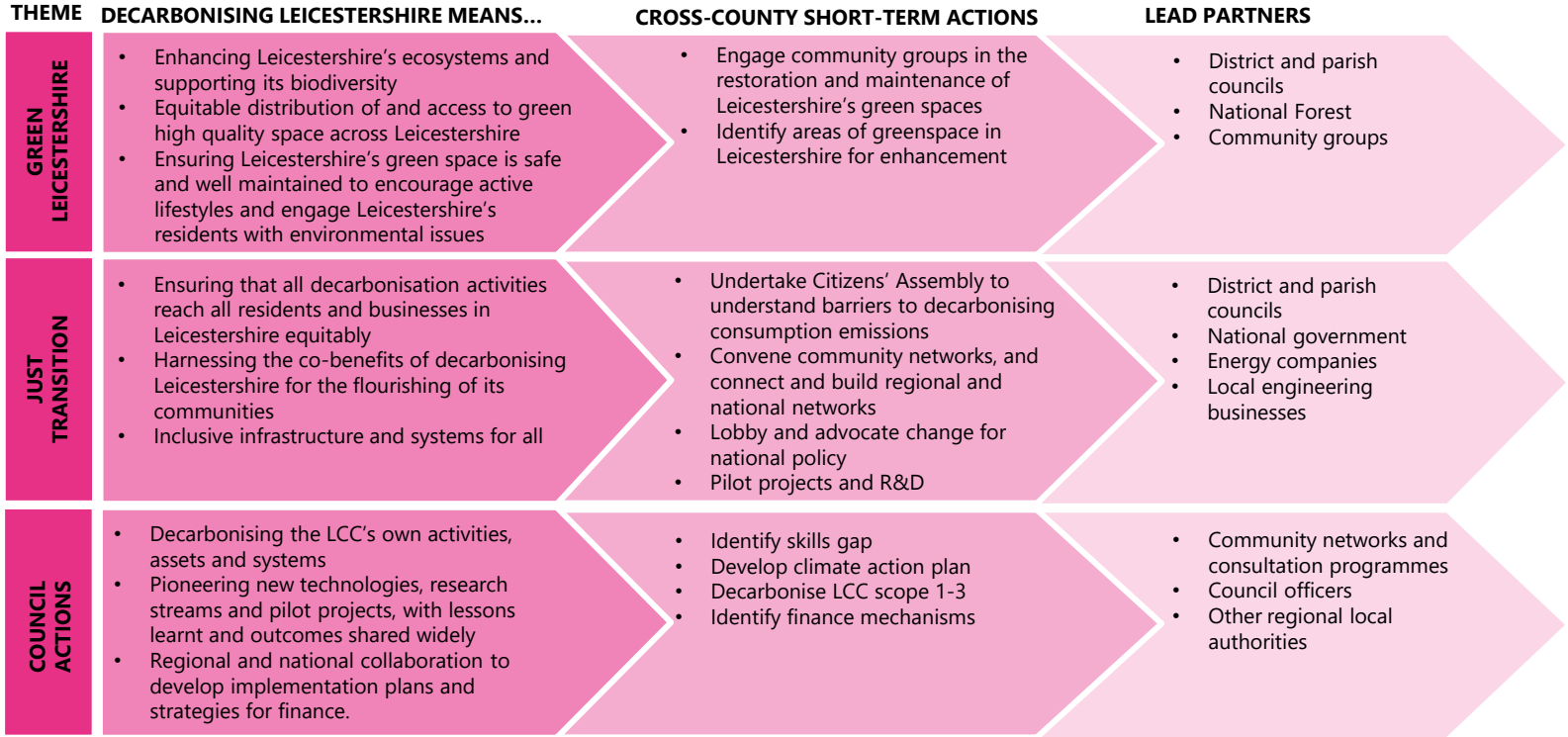


Figure 32: High level recommendations for action plan (continued)

APPENDICES

Appendix Overview

The following documents are provided as Appendices:

- Appendix A – technical overview of modelling notes and caveats. Includes key model backend data, assumptions and caveats.
- Appendix B – detailed technical model pathway inputs, assumptions and references (separate excel file).

Appendix A: Modelling Notes

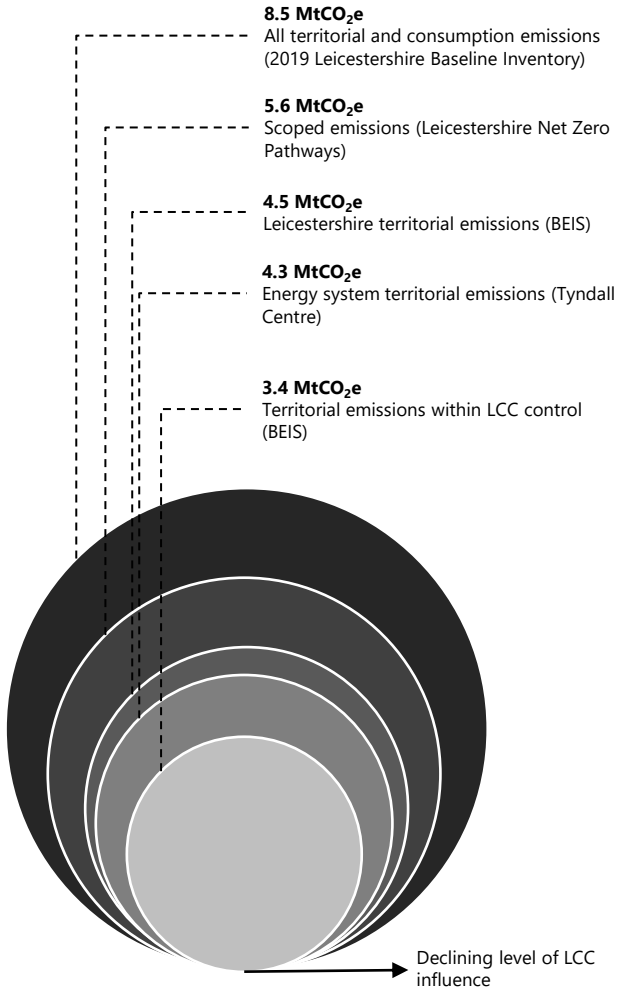
Emissions category in this study	Source	Exclusions and adjustments	Link to public data
Domestic, industry and non-domestic (territorial)	BEIS sub-national CO_2 emissions	Exclusions: - Road transport – replaced with below - LULUCF – sequestration considered in separate supplementary analysis	• UK local authority and regional carbon dioxide emissions national statistics: 2005 to 2019 - GOV.UK (www.gov.uk)
Road transport (territorial)	BEIS Sub-national road transport consumption data	Converted to kWh and then distance travelled using BEIS conversion factors	• Sub-national road transport consumption data - GOV.UK (www.gov.uk) • Greenhouse gas reporting: conversion factors 2021 - GOV.UK (www.gov.uk)
Other GHGs	Updated energy and emissions projections: 2019: Annex A	National ratio of carbon dioxide to other greenhouse gases derived annually using national historic data and projections, and applied pro rata to Leicestershire territorial emissions	• Updated energy and emissions projections: 2019 - GOV.UK (www.gov.uk)
Waste	Local authority collected waste: annual results tables	Converted to emissions using Eunomia and BEIS data Baseline waste arisings as per Waste Disposal Authority Plan 2018	• ENV18 - Local authority collected waste: annual results tables - GOV.UK (www.gov.uk) • Greenhouse Gas and Air Quality Impacts of Incineration and Landfill – Eunomia • Greenhouse gas reporting: conversion factors 2021 - GOV.UK (www.gov.uk)
Water	Severn Trent data	Converted to emissions using BEIS conversion factors. Future baseline demand based on population growth projections	• https://www.severntrent.com/content/dam/stw-plc/water-resource-zones/2019/FWRMP19-Appendix-B.pdf • Greenhouse gas reporting: conversion factors 2021 - GOV.UK (www.gov.uk) • Subnational population projections for England - Office for National Statistics
Embodied carbon of new buildings	Annual local planning data and industry benchmarks	Strategic Growth Plan 2018 figures scaled based on LETI embodied carbon benchmarks /m^2	• Embodied Carbon Primer | LETI
Other consumption emissions	University of Leeds UK Footprint Results (1990 - 2018)	Scaled pro rata based on Leicestershire population figures (historic and projections) Waste and water figures removed to avoid double counting.	• UK's carbon footprint - GOV.UK (www.gov.uk)

Table A: Data sources for historic and future baseline emissions

Appendix A: Modelling Notes

Scoping	Size in 2019 ($MTCO_2e$)	Includes
All territorial and consumption emissions (2019 Leicestershire Baseline Inventory)	8.5	• All emissions categories on p72
Scoped emissions (Leicestershire Net Zero Pathways)	5.6	• All territorial data • Consumption data: waste, water, embodied carbon of new buildings, Food & Drink
Leicestershire territorial emissions (BEIS)	4.5	• All territorial data on p72 • No consumption data
Energy system territorial emissions (Tyndall Centre)	4.3	• BEIS territorial data, excluding large industrial sites, railways, motorways and land-use change and forestry (LULUCF). • No consumption data
Territorial emissions within LCC control (BEIS)	3.4	• BEIS territorial data, with modifications to exclude aviation, shipping, process CO_2 emissions from cement production. • No consumption data

Table B: emissions category scoping breakdown



Scoping comparison for Leicestershire

Appendix A: Modelling Notes

Emissions category in this study	Key background model data	Link to data, where publicly available
Energy carbon intensity factors: grid	• Historic: BEIS GHG Domestic Grid average Electricity emissions factors historic archives • 2021-2035: Future projections based on BEIS projections • 2035+: linear decrease to BEIS net zero target	• https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2012 • https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794590/updated-energy-and-emissions-projections-2018.pdf • https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/947439/energy-emissions-projections-2019-annex-o-net-zero-power-sector-scenarios.pdf • See also: Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal - GOV.UK (www.gov.uk)
Energy carbon intensity factors: fuel	BEIS conversion factors	• https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021
Energy carbon intensity factors: hydrogen	CCC projections for 2050 – hydrogen from electrolysis	• https://www.theccc.org.uk/publication/hydrogen-in-a-low-carbon-economy/
Vehicle transport efficiencies (km/kWh)	Assumed constant and based on BEIS conversion factors	• https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021
Building energy demand	• Demand disaggregated between energy source and heating type as per national statistics (End Use Table U2) • New builds: adapted from CIBSE Part F table 20.1 with reduction factor applied based on CRREM Energy reduction pathways (average 21% achieved 2020-2045 for domestic, 20%) for offices	• Energy consumption in the UK 2021 - GOV.UK (www.gov.uk)
Carbon prices	BEIS 2019 Updated Energy & Emissions Projections	• Updated energy and emissions projections: 2019 - GOV.UK (www.gov.uk)
Fuel retail price projections	BEIS 2019 Updated Energy & Emissions Projections With additional BEIS analysis for hydrogen costs	• Updated energy and emissions projections: 2019 - GOV.UK (www.gov.uk) • https://www.gov.uk/government/publications/hydrogen-production-costs-2021

Table C: key background data sources within model projections

Appendix A: Modelling Notes

Emissions category in this study	Key assumptions	Source	Costs (where modelled)	Source
Fabric retrofits	• 40% reduction in space heat demand modelled (fabric retrofits)	• Average finding from Retrofit for the Future p50 (source)	• £1,000-10,000	• p37, Development of trajectories for residential heat decarbonisation to inform the Sixth Carbon Budget (Element Energy) - Climate Change Committee (theccc.org.uk)
Water heat savings	• 15-50% reduction in hot water heat demand modelled (waste water heat recovery, flow constrictors, etc)	• BH engineer recommendation	• £1,000	• https://www.thegreenage.co.uk/tech/waste-water-heat-recovery-systems/
Behaviour Change	• 3-10% total heat demand savings modelled (behaviour change, smart meters)	• https://www.which.co.uk/news/2019/09/new-government-report-reveals-whether-smart-meters-will-save-you-time-and-money/	• N/A	• N/A
Solar PV	• 50% energy generated exported to grid	• Export Tariff for Solar PV (spiritenergy.co.uk)	• £1,600-1,700 /kWp	• https://www.gov.uk/government/statistics/solar-pv-cost-data

Table D: modelled impact and cost of different building interventions. Where ranges are provided we use average data or specific data as per source level of detail.

Heat source	SCOP	Costs
Heat pumps	300%	£4,400-9,000
Hybrid heat pumps	250%	£6,200-6,700
District heat	100%	£8,000 (BH Engineer recommendation for 1x connection)
Direct electric heat	100%	£780
Hydrogen boiler	80%	£2,960
Gas boiler	87%	£2,860

Table E: modelled impact and cost of different building interventions. Where ranges are provided we use average data or specific data as per source level of detail. Source, p14.

Appendix A: Modelling Notes

Key Assumptions: baseline model

The modelling of these pathways aim to balance a challenging range of trends, factors and emissions areas in the Leicestershire context. Key assumptions and sensitivities inherent in this process are listed in this table, and may be useful context to those making policies and plans linked to this study.

Table F: key modelling assumptions and sensitivities

Risk	Description	Impact on model results	Impact
Constant capital investment costs in spotlight costing assumed	Flat rate costs are assumed for Solar PV installation, heat sources and fabric retrofits. In reality, these are all subject to change, and may well reduce as they are rolled out nationally under UK-wide decarbonisation efforts. Conversely, high demand without adequate supply may cause prices to rise.	Low	• Spotlight costing may prove inaccurate, and cost of implementation may prove higher or lower than planned for.
Constant carbon intensity for gas, petrol and diesel assumed	The carbon intensity of gas ($kgCO_2e/kWh$) and liquid vehicle fuels (km/kWh) is assumed to remain constant. In reality, it may be that machinery and process changes change efficiencies, but this is unlikely to substantially affect the pathways modelling unless significant changes in gas and fuel blends occur.	Low	• Territorial emissions projections may deviate where fossil fuels remain used, but this is likely to be small
Current Policy pathway assumptions superseded	New national and industry commitments are fast emerging, and may rapidly change the 'current policy' pathway assumptions from the time of writing.	Low	• Current Policy Pathway no longer a useful comparison
Impact of COVID-19 pandemic not captured	The COVID-19 pandemic may change commercial and domestic energy use, road transport and waste arisings. For example, it may be that long-term changes to working and commuting have significant impacts on future emissions splits as people work from home or commute differently.	Medium	• Shifts in emissions profiles and step change increases or reductions to different categories may occur 2020-2021. However, general emissions trends and observations around decarbonisation are likely to remain relevant.
Demand interventions do not have desired impact	There is a risk that modelled interventions to reduce emissions do not have the desired effect in practice. For example, we model that retrofits will achieve an average reduction in emissions of 40%, or that heat pumps perform with a SCOP of 300%. Many of these technologies are under development and performance will vary in practice.	Medium	• Performance gap between planned and implementation results in additional efforts needed to meet targets e.g. further retrofits and higher number of assets changed • Any costing estimates and infrastructure planning may prove outdated
Technological changes not captured	A range of technologies are modelled as per current best understanding. However, it is likely that future technological advances and changes will supersede these assumptions.	High	• Implementation strategies may deviate significantly from pathways in future, preventing detailed monitoring of progress against pathways
BEIS and public future projections inaccurate	Much of the underlying model assumptions are based on BEIS projections related to grid decarbonisation, and baseline future demand or population modelling in local plans and by water companies etc. Deviations from these projections are highly likely and are fundamental to these pathway assumptions.	High	• All emissions pathways and supplementary analyses sensitive to underlying baseline projections for demand, carbon intensity and prices

Appendix A: modelling notes

Policy updates

This report was prepared in the run up to COP26, when there was a great deal of policy updates and public commitments to climate action. This included a new UK Net Zero Strategy and the government Heat and Buildings strategy (source).

We reviewed these documents to understand how these aligned with our modelling. For the most part targets were not firm policy declarations (rather, ambitions or aims) or these changes are already incorporated in our modelling.

Table G sets out key policy commitments which are not captured in this study. Largely these would not have significant impacts on the trends and conclusions of this study. A full breakdown is available in Appendix A.

Policy Declaration	Source	Impact on Study
By 2035 the UK will be powered entirely by clean electricity, subject to security of supply.	Net Zero Strategy	Our analysis is based on older BEIS projections, that assume a rapid decline in carbon intensity to 2035, then gradual decreases to 2050. The new declaration would suggest a faster rate of decarbonisation. However, our model includes a significant drop in intensity over the same timeframe, so the general conclusions and trends remain accurate.
*Our commitment to reduce fuel poverty by ensuring as many fuel poor homes in England, as reasonably practicable, achieve a minimum energy efficiency rating of band C by the end of 2030. P18 *We will.. ensure the UK housing stock is on track to meet EPC band C by 2035 where practical, cost-effective and affordable. P19 *Setting privately-rented commercial buildings a minimum efficiency standard of EPC band B by 2030 in England and Wales, p20	Heat and Buildings	While the 'Current Policy' pathway does not reflect these rates, retrofit is explored in detail in the other pathways. Overall, the need for urgent retrofit of all buildings is well reflected in the findings of the study.
*Half of journeys in towns and cities to be cycled or walked by 2030 *Net zero rail network by 2050, with the ambition to remove all diesel-only trains by 2040	Net Zero Strategy	Walking and cycling are not modelled in the strategy, and it is not yet clear how these would affect vehicle mileage. Diesel railways are not captured in our modelling, and make up a small portion of emissions.

Table G: new policy updates in the