Draft – January 2026

York and North Yorkshire's Strategy for a Sustainable Future

Technical Report

New, green jobs | Affordable energy | Cleaner air | Warmer homes | Better, safer, more affordable transport




Thriving communities | More competitive businesses | Fresher, local food | Greener, more resilient landscapes

YORK & NORTH YORKSHIRE COMBINED AUTHORITY

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1. Introduction and Context

Introduction and Context. Background

2019

Paris aligned carbon budget for the region

Work began with the Tyndall Centre to establish a carbon budget for the region that ensures we make our "fair" contribution to the Paris Climate Change Agreement.

2021

Carbon Abatements Pathways (CAP 2021) Study

The Carbon Abatements Pathways study provided a baseline of GHG emissions and a series of potential pathways to get York and North Yorkshire to carbon negative.

2022

York and North Yorkshire's Routemap to Carbon Negative

The Carbon Abatements Pathways study provided an evidence-based, ambitious pathway to develop a co-owned strategy to enable the region to reach carbon negative by 2040, officially launched in October 2022.

City of York Climate Change Strategy

In December 2022, City of York Council publish their "York Climate Change Strategy 2022 to 2032".

2023

North Yorkshire Climate Change Strategy

In July 2023, North Yorkshire Council publish their "Climate Change Strategy 2023 to 2030".

2025

New Regional Strategy

Research was commissioned to re-baseline emissions and adapt our carbon reduction pathways, alongside extensive stakeholder engagement, to develop our new Strategy for a Sustainable Future. The findings of this are outlined in this report.

This report presents the evidence base which has supported the development of the Strategy for a Sustainable Future, building on previous work.

The first CAP study, referred to in this report as CAP Study (2021), aimed to assess the interventions that could enable the region to address the climate emergency. It identifies potential futures for the operation of energy systems (meeting power, heat, and transport demand) through the use of scenarios. The scenarios of emissions reduction pathways were modelled for a study region covering West Yorkshire, York and North Yorkshire (YNY) and Leeds City Region.

The emissions in scope included Carbon Dioxide equivalent (CO_2e) emissions from transport, buildings, industry, Land Use, Land Use Change and Forestry (LULUCF) and agriculture sectors and high-level inclusion of emissions from domestic and international aviation and waste (for completeness but not modelled in detail). Negative emissions were assessed from Bioenergy Carbon Capture and Storage (BECCS) and new forest planting within the region.

The study allowed comparison of the scenarios in terms of emissions, energy consumption and risks; it did not intend to enable a decision to be made on which scenario to pursue. It emphasises the need for key evidence that must be gathered in the next few years around remaining uncertainties. For example, on the viability, feasibility and consumer perception of hydrogen for heat.

Since 2021, further work to better understand our pathway to carbon negative has taken place, including the development of four Local Area Energy Plans (LAEPs). Beginning in 2024, YNYCA commissioned the CAP Study Refresh, which forms the basis of this report alongside more recent data.

Introduction and Context. Aims and Objectives

Given changes in national policy, emerging technologies, and significant lessons learnt, we feel that now is an opportune time to refresh our plans to reach carbon negative and become a truly sustainable region. Critically, York and North Yorkshire now have an elected Mayor and Combined Authority, with new powers and funding that can be used to accelerate the journey to becoming England's first carbon negative region and lead the way to a sustainable future. Refreshing our evidence base was the first step for this.

This technical report covers the York and North Yorkshire Combined Authority (YNYCA) geography and the emissions in scope include CO2e emissions from transport, buildings, industry, LULUCF, waste and agriculture sectors. Emissions from power are embedded within these sectors. The objectives of the project are summarised in Figure 1.

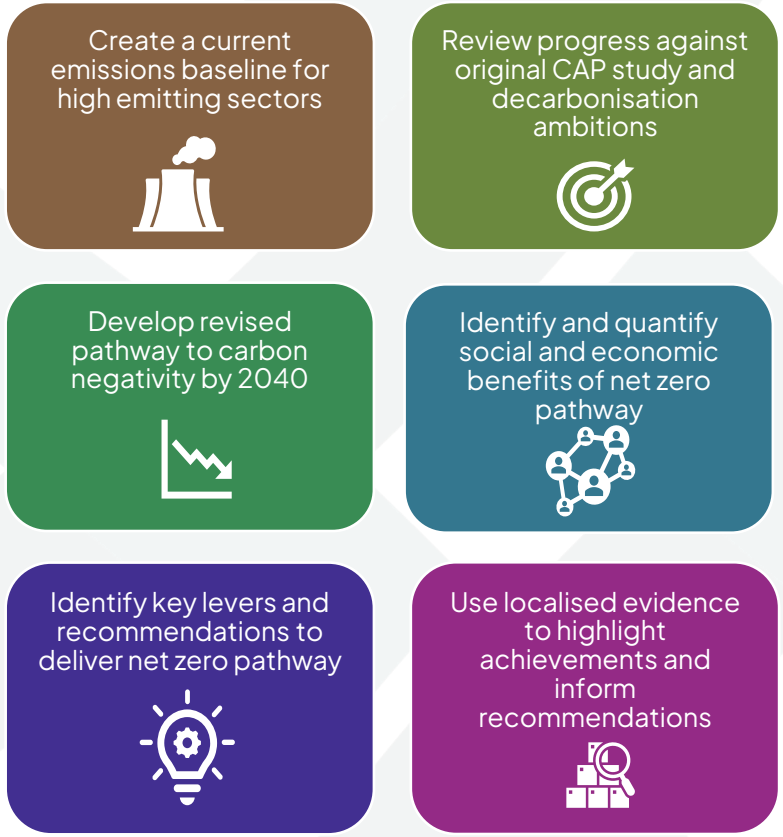
The report is comprised of the following sections that detail the findings:

- Current Emissions: These greenhouse gas (GHG) emissions estimates are for the latest year for which data are available for North Yorkshire and the City of York, which was 2023. They represent a single point in time.
- Business as Usual Projection: This section summarises the projection resulting from the implementation of current national policies and a set of assumptions to reflect potential growth in the region. The projection is presented across time from the present day to the year 2050.
- Pathways to Carbon Negative: These are scenario pathways used to explore possible long-term trajectories to reducing emissions and to help understand key uncertainties about the future. Scenarios are not predictions or forecasts.
- Benefits of Decarbonisation Pathways and the cost of inaction: Co-benefits are defined as added benefits to the mitigation of GHG emissions that could result from the implementation of scenario pathways. This section also explores the costs of delaying climate action.

This technical document is a combination of:

- The Carbon Abatement Pathway (CAP) Study refresh, completed by WSP in 2025;
- Internal work using the most recent Department for Energy Security and Net Zero (DESNZ) data (2023); and
- The Climate Adaptation Study, completed in February 2026.

Figure 1. Project Aims and Objectives



Introduction and Context. Defining Net Zero and Carbon Negative

Defining Net Zero and Carbon Negative

The CAP Study (2021) defined net zero as the point where emissions reach zero, which can be delivered through both absolute emissions reduction and emissions removal. The study included four net zero pathways, including a baseline scenario (the likely scenario based on policies at the time), and three scenarios based on reductions in emissions by 2034 in the Maximum Ambition, High Hydrogen and Balanced Scenarios respectively, with Bioenergy with Carbon Capture and Storage (BECCS) incorporated to remove remaining emissions.

The Science Based Targets Initiative (SBTi) Corporate Net Zero Standard, published in 2021, provides an industry-recognised approach for defining net zero and developing net zero targets. The SBTi definition of **net zero requires an absolute emissions reduction of at least 90%, excluding emissions removals from BECCS** but including removals from Land Use, Land Use Change and Forestry (LULUCF).

The CAP Study (2021) net zero definition therefore does not align with the SBTi net zero definition, meaning the scale of reduction required to meet the SBTi definition of net zero by 2034 is greater than the scale of reduction required to meet the CAP Study (2021) definition of net zero. Table 1 sets out the SBTi and CAP Study (2021) definitions of net zero. Whilst the SBTi Corporate Standard definition of net zero is not directly applicable to local authorities, it is widely considered to be best practice. This is the definition which has been used for this evidence base.

Carbon negative is defined as a point at which regional CO_2 removals and permanent storage (sequestration) are greater than the GHG emissions from activities within the region. This would involve removing more than the equivalent amount of our residual GHG emissions (i.e. unavoidable emissions that cannot be reduced further) within the region

Table 1. Net Zero definitions.

	Definition
CAP Study (2021) Net Zero	The point where emissions reach zero, delivered through absolute emissions reduction and/or emissions removal through LULUCF and BECCS.
Science Based Targets Initiative (SBTi) Aligned Net Zero	An absolute emissions reduction of at least 90%, including emissions from LULUCF but excluding emissions removals from BECCS.

Absolute emissions reduction focuses solely on cutting the overall quantity of emissions, actively lowering the total greenhouse gases emitted, rather than offsetting or balancing them with removals.

2. Current Emissions

Current Emissions. Sector Emissions

Since 2005, there has been an overall decrease in Greenhouse Gas (GHG) emissions across York and North Yorkshire. The COVID-19 pandemic led to a notable decrease in emissions in 2020 due to reduced road transport and industrial activity. However, as restrictions eased in 2021, emissions began to rise again.

This section shows how emissions have changed in the region's highest-emitting sectors, comparing actual 2023 data with the projected figures from the "max ambition" pathway from the CAP study (2021), which reaches carbon negative by 2040.

Buildings

Progress lagging

Emissions reduction from 2005: The Buildings Sector shows the highest fall in emissions since 2005, a 1.89 mega-tonnes of carbon dioxide equivalent (MtCO2e) reduction, equating to over a 50% reduction. Changes in fuel mix for electricity generation and above average temperatures are associated with this reduction in emissions.

Are we on track? Emissions from buildings are higher than those projected in the "max ambition" pathway. While this is expected to be partially due to an increase in the number of buildings, it is assumed that the required pace of decarbonisation in the pathway has not been achieved.

Transport

On Track

Emissions reduction from 2005: The Transport Sector also shows a reduction in emissions at 0.36 MtCO2e, equating to a reduction of around 15%, which is largely due to improvements in new car fuel efficiency.

Are we on track? Current emissions from the transport sector are lower than estimated in the "max ambition" pathway. This is partially due to the change in data sources and the exclusion of aviation emissions from domestic and international aviation (the latter accounts for only 1% of total emissions). Emissions have also been reduced due to lower petrol consumption by passenger cars, and improvements in fuel efficiency of both petrol and diesel cars.

Industry

Progress lagging

Emissions reduction from 2005: The Industry sector has seen an overall decrease in emissions from 2005, reduced from 1.23 MtCO2e to 0.78 MtCO2e in 2023, primarily due to grid decarbonisation and a reduction in fuel consumption in processes.

Are we on track? Emissions from Industry are higher than emissions forecast under the "max ambition" pathway.

Agriculture, Land Use, Land Use Change & Forestry

On Track

Emissions reduction from 2005: Combined emissions from Land Use, Land Use Change and Forestry (LULUCF) show a net increase in carbon sequestration from 2005 to 2023, from -0.07 to -0.19 MtCO2e. The Agriculture Sector shows a minor decline in emissions with a difference of 0.22 MtCO2e between 2005 and 2023 emissions.

Are we on track? The differences observed in the LULUCF estimates, in particular the fact that the sector functions as a sink in current emissions in 2023, are mainly due to the use of a different methodology and data sources. 2022 agriculture emissions are higher than projected in the "max ambition" pathway.

Waste

Progress lagging

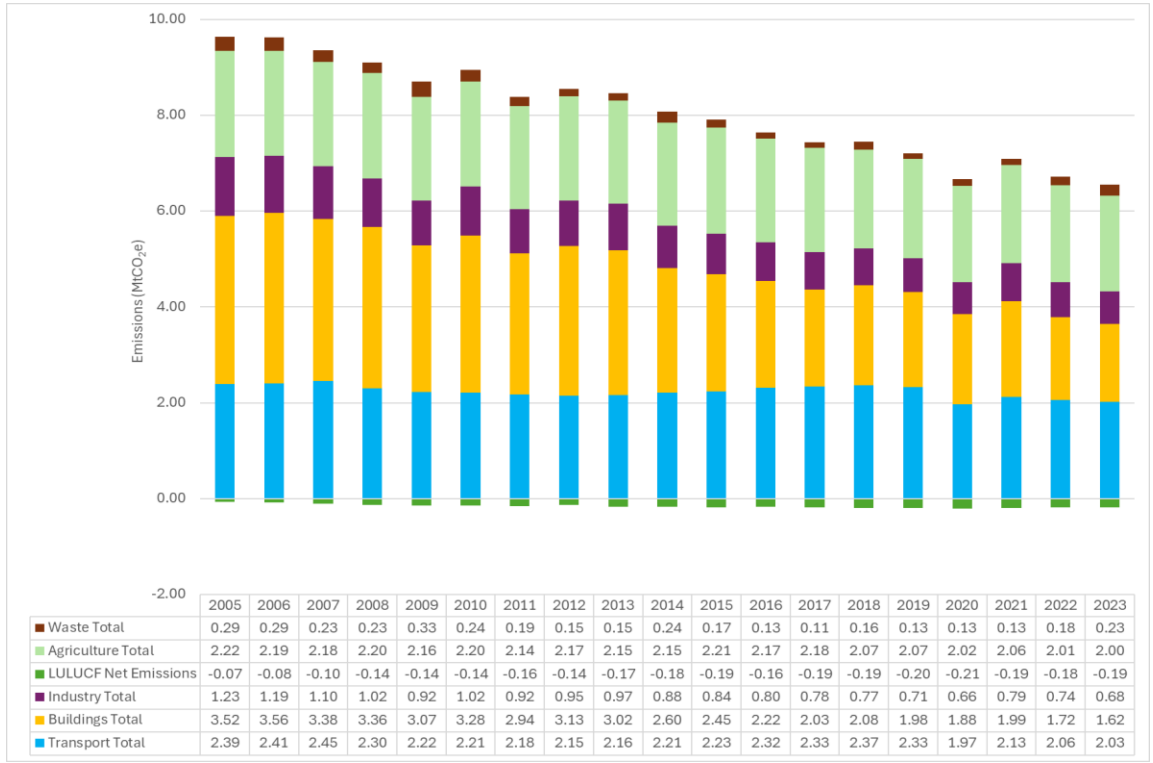
Emissions reduction from 2005: The Waste Sector shows a decline in emissions, with a difference of 0.23 MtCO2e between 2005 and 2023 emissions.

Are we on track? 2022 emissions from waste are higher than projected in the "max ambition" pathway and have been increasing year on year since 2021.

Current Emissions. Are we on track to reach carbon negative by 2040?

Figure 2. shows the trajectory of emissions reductions since 2005, whilst Figure 3. provides a comparison between 2023 emissions data and projected emissions under the "max ambition" scenario (which results in York and North Yorkshire reaching carbon negative by 2040).

Overall, the data shows a mixed picture, with the region on track for reductions in transport and LULUCF emissions, but lagging in reductions for buildings, industry, agriculture, and waste. Given the data lag, with the most recent data being available from 2023, it is somewhat difficult to draw robust conclusions and gain confidence that we are on track to reach our carbon negative ambition. However, this mixed picture does highlight that a step change in decarbonisation is needed to deliver carbon negative.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Waste Total	0.29	0.29	0.23	0.23	0.33	0.24	0.19	0.15	0.15	0.24	0.17	0.13	0.11	0.16	0.13	0.13	0.13	0.18	0.23
Agriculture Total	2.22	2.19	2.18	2.20	2.16	2.20	2.14	2.17	2.15	2.15	2.21	2.17	2.18	2.07	2.07	2.02	2.06	2.01	2.00
LULUCF Net Emissions	-0.07	-0.08	-0.10	-0.14	-0.14	-0.14	-0.16	-0.14	-0.17	-0.18	-0.19	-0.16	-0.19	-0.19	-0.20	-0.21	-0.19	-0.18	-0.19
Industry Total	1.23	1.19	1.10	1.02	0.92	1.02	0.92	0.95	0.97	0.88	0.84	0.80	0.78	0.77	0.71	0.66	0.79	0.74	0.68
Buildings Total	3.52	3.56	3.38	3.36	3.07	3.28	2.94	3.13	3.02	2.60	2.45	2.22	2.03	2.08	1.98	1.88	1.99	1.72	1.62
Transport Total	2.39	2.41	2.45	2.30	2.22	2.21	2.18	2.15	2.16	2.21	2.23	2.32	2.33	2.37	2.33	1.97	2.13	2.06	2.03

Figure 2. DESNZ Historical Emissions from 2005 to 2023 in York and North Yorkshire. Source: DESNZ (2025) UK local authority and regional greenhouse gas emissions statistics, 2005 to 2023.

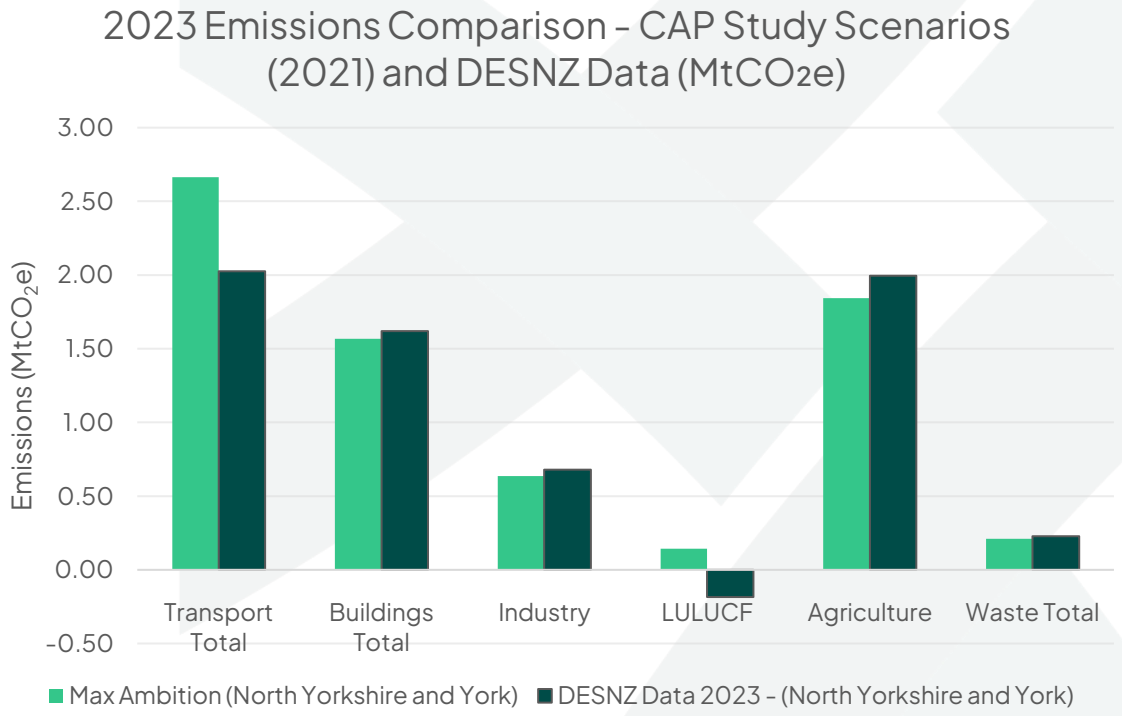


Figure 3. Comparison between York and North Yorkshire actual emissions in 2023 and projected emissions in "max ambition" scenario (to reach carbon negative by 2040)

Current Emissions. Regional Differences

York and North Yorkshire's Strategy for a Sustainable Future focuses on the whole region, but it is important to understand the differences between York, and North Yorkshire in terms of emissions.

North Yorkshire

The current carbon emissions for North Yorkshire are shown in Figure 4. The total carbon emissions in the North Yorkshire region for 2023 are 5.6 MtCO2e.

The Transport sector is the joint largest source of emissions at 31% (at 1.8 MtCO2e): road transport accounts for the majority of these emissions. The rural nature of the area means that the motorways and major roads contribute large proportion of emissions via 'through traffic' and reliance on internal combustion engine (ICE) vehicles, which is likely driven by perception of reliability of alternatives due to challenges associated with the rurality and topography of North Yorkshire, and a disparate electric vehicle charging network.

This is followed by the combined emissions from the LULUCF and Agriculture Sectors which together also make up 31% of the total emissions. LULUCF emissions function as a sink (predominantly from forestry); however, agricultural emissions are net emitters. The impact of reported methane and nitrous oxide emissions is a significant factor in reporting. The GHG emissions associated with livestock (enteric fermentation causing methane release and both methane and nitrous oxide release from animal manure) and soils (nitrous oxide emissions from fertiliser use and manure application) contributed around 75% of the agricultural sector emissions.

The emissions from the Buildings Sector and Industry Sector constitute 23% and 11% of the total emissions, respectively. Most building emissions (69%) come from domestic buildings.

City of York

Current emissions for the City of York are shown in Figure 5. Total emissions in the City of York region for 2023 are 0.76 MtCO2e.

The largest source of emissions is the Buildings sector representing 46% of all emissions (0.35 MtCO2e) with the majority of emissions from domestic buildings.

This is followed by the transport sector contributing around 34% of the total emissions and the industry sector contributing 9% of the total emissions. The vast majority of transport sector emissions come from road transport; as is the case in North Yorkshire, they are due to the consumption of fuels such as diesel and petrol in private ICE vehicles.

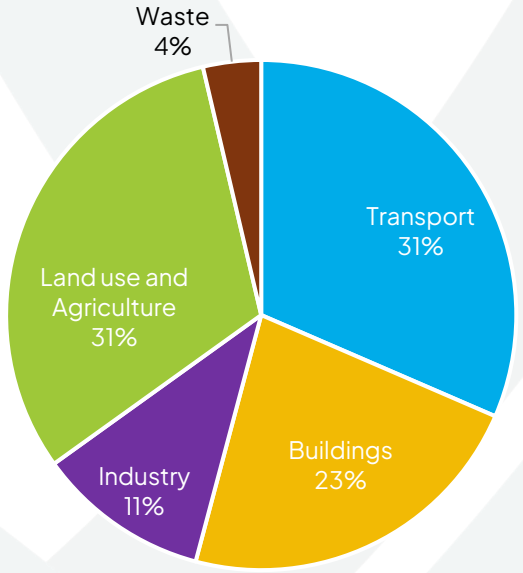


Figure 4. Current emissions North Yorkshire (2023 DESNZ – MtCO2e)

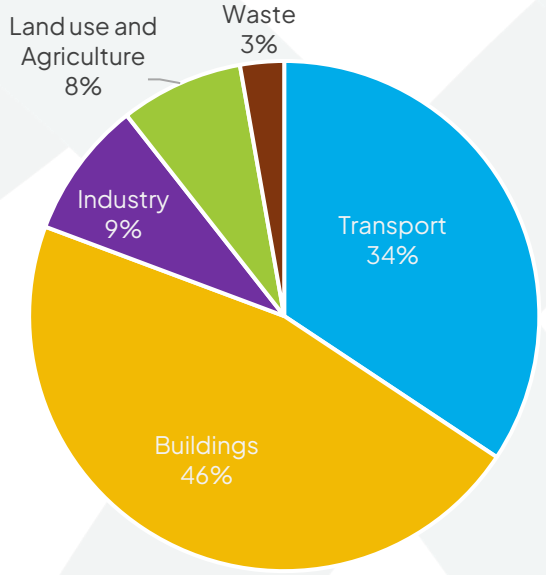


Figure 5. Current emissions City of York (2023 DESNZ – MtCO2e)

3. Business As Usual Projections

Business As Usual Projections. What is a BAU scenario?

A Business As Usual (BAU) scenario describes future greenhouse-gas emissions levels in the absence of future additional mitigation efforts and policies. It provides a guide to the pace of change that will occur without any additions to existing policies and regulation at national and regional level that support the transition to net zero. It is a reference point against which more ambitious action can be evaluated.

The scenario relies on a number of working assumptions. These are aligned with UK Government modelling work that supports assessment of existing national policies across each of the sectors, known as the UK Energy demand and Emissions Projections (EEP). It excludes any carbon sequestration, such as Bioenergy with Carbon Capture and Storage (BECCS) for example. The modelling also assumes no net change in Land Use, Land Use Change and Forestry (LULUCF) contributions.

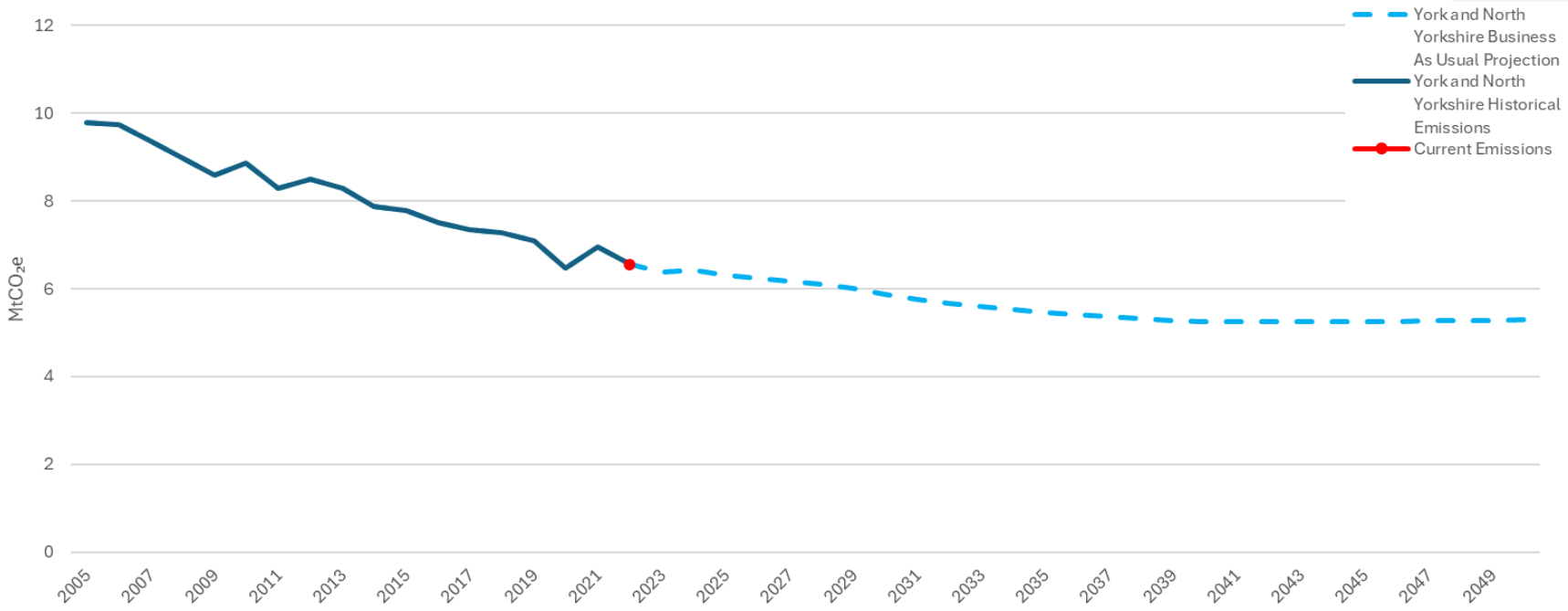


Figure 6. Historical and Business as Usual Projection YNY from 2005-2050

Business As Usual Projection results

In the BAU Scenario YNYCA GHG Emissions fall to 5.25 MtCO2e by 2040, representing around a 20% reduction against the current baseline of 6.55 MtCO2e.

Figure 6 shows the result of the business as usual projections modelling for York and North Yorkshire. The dark blue line shows the region's combined historical emissions from 2005-2022, estimated using the DESNZ Local Authority dataset with current emissions represented as a red dot. The dotted blue line is the business as usual projection

In this scenario therefore, York and North Yorkshire aligns policy with national-level commitments and the projection reflects further GHG reductions. It only models mitigation actions that reduce GHG emissions, since there is no national modelling of engineered carbon removal such as via BECCS. The Pathways to Carbon Negative section explains in detail the study's approach to carbon negative emissions.

Business As Usual Projections. Emissions trends

Overall, the DESNZ EEP data and annual percentage changes show:

- **Industry and agriculture emissions decline to 2030 and then increase slightly (≤1% annual change) to 2050**. Relevant policies aim to reduce emissions through a range of resource-efficiency and land management measures. In the case of business this includes the Streamlined Energy and Carbon Reporting for business (SECR). In the case of Agriculture, it includes a group of English, Scottish and Welsh policies and programmes: the Agricultural Action Plan (England), the Climate Change Plan (Scotland), and the Climate Smart Agriculture (Wales).

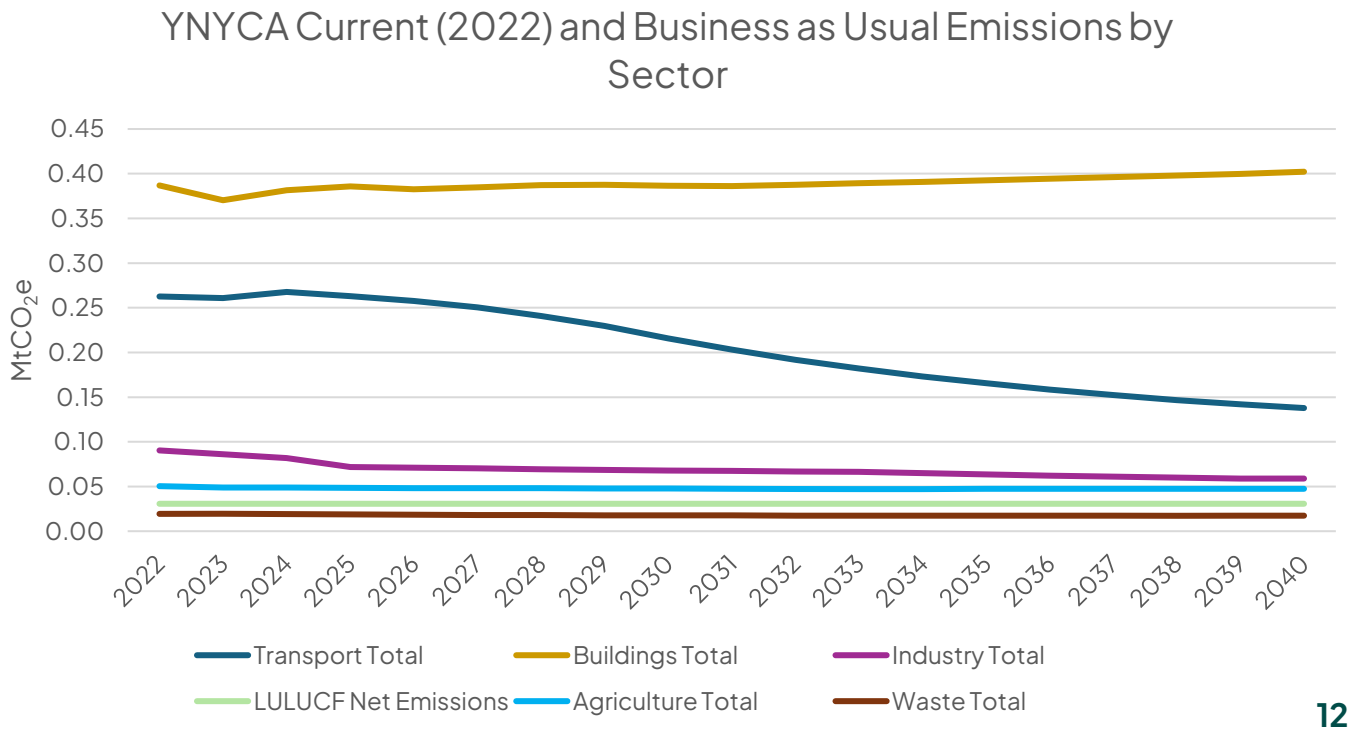
- **Public and Residential buildings show an increase in emissions from the current year**. The policy drivers for increasing energy efficiency include the implementation of the Building Regulations Part L and the Boiler Upgrade Scheme (BUS). The Future Buildings Standard and Future Homes Standard (2025+) will drive future energy efficiency. However, further action in decarbonising heat will be needed in the 2030s.

- **Industrial Processes and Waste show an annual reduction every year to 2040 from 2023**, flatlining or marginally increasing (≤1% annual change) from 2040 to 2050. Industry policy measures include the UK Emissions Trading Scheme (UK ETS), Energy Savings Opportunity Scheme (ESOS) - Improvements (Industrial Processes), the Industrial Energy Transformation Fund (IETF) Phase 3 Extension and the Pilot Energy Advice Service.

- **Transport emissions show an annual reduction every year to 2050,** showing a projected 52% reduction in 2050 compared to 2022. This is mostly due to road transport policy savings via the implementation of the Vehicle Emissions Trading Schemes (VETS) Order 2023, commonly known as the ZEV (Zero Emission Vehicle) Mandate.

The Business As Usual projection is shown below, divided up by sector. As shown in Figures 6 and 7, relying on current policy alone will not reduce our regional emissions to anywhere near carbon negative by 2040. Failing to meet our emissions reduction commitments will have significant social, economic, and environmental impacts for YNY and beyond. We therefore need to take significant, proactive action beyond current levels to reduce our emissions, as demonstrated in the following modelled pathways.

Figure 7. Business as Usual Projection by sector



4. Pathways to Carbon Negative

Pathways to Carbon Negative. What are scenario pathways?

What are scenario pathways?

Scenarios are a qualitative narrative and/or a quantitative projection of global changes in greenhouse gas emissions resulting from the combination of implementation of policy, changes in behaviour, and deployment of technology. Scenario pathways are therefore a plausible description of how the future might unfold.

An emission pathway is a modelled trajectory of GHG emissions and, therefore, forms a part of these scenarios. **The pathways to net zero identified for YNY are not forecasts but rather show the scale of possible changes given a set of assumptions and underpinning estimates**. For this reason, this report describes them as emissions projections instead of forecasts.

While underlying modelling assumptions are aligned with national policy direction, as in the original CAP Study (2021), there is a regional context provided by the Scale of Transformation figures. Whilst individually they may be unlikely to register a significant reduction in the sector GHG emissions for the region, these figures help provide a guide as to the impact of individual programmes of action.

For example, a programme of retrofitting that delivers heat pumps within 50 properties will not, in itself, register a noticeable change in the Buildings sector emissions total for the region. The Scale of Transformation indicator therefore helps to show this number in context (in this case as part of a cumulative count of the total number of heat pumps installed in the region). This provides transparency in terms of a positive step to reducing overall GHG emissions.

Modelled scenario pathways

For the CAP Study (2025), several scenarios were examined for reaching carbon negative. The Balanced Scenario, Policy-driven Scenario and Technology-driven Scenario are based on the Climate Change Committee's (CCC's) Sixth Carbon Budget*. Whilst these scenarios are useful for understanding the rate of change required under different approaches, the following two scenarios are what has been used to support the development of the Strategy for a Sustainable Future as they see the region reach carbon negative by our 2040 ambition:

- **The York and North Yorkshire Leading the Way Scenario** (CAP 2021 Study): Based on the previously adopted maximum ambition scenario included in the CAP Study (2021) and the Routemap to Carbon Negative published in 2022, this pathway implies a significant electrification of heating, transport and industry, as well as a significant increase in low-carbon power generation and high rates of forest planting. Further details regarding the basis of the York and North Yorkshire Leading the Way scenario can be referenced within the Maximum Ambition Scenario set out in the previous CAP Study (2021).
- **Higher Confidence Scenario:** Considering progress to date, the status of national policy drivers, stakeholder feedback and alignment to best practice, a higher confidence pathway to net zero (SBTi definition) has been developed. This SBTi aligned scenario pathway delivers net zero and carbon negative targets by 2040, contingent on a number of local and regional factors. The pathway is similar to the Leading the Way Scenario, but with more flexibility for changing policies, and acknowledgement that some of the changes needed to reach carbon negative are challenging in terms of feasibility.

The scenario pathways are underpinned by the scale of transformation indicators in Section 5 of this report.

*For further information on these scenarios, please refer to the CCC's Sixth Carbon Budget .

York & North Yorkshire Leading The Way. A refreshed pathway to reach carbon negative by 2040

Based on progress to date, changes in national policy and stakeholder feedback, we have revised our carbon reduction pathway. This is the York and North Yorkshire "Leading the Way" Scenario; the pathway requires significant electrification of heating, transport, and industry, as well as a substantial increase in renewable energy generation and high rates of forest planting. The trajectory of this pathway is shown below in figure 8. In reality, progress is not linear, and our actual emissions pathway is unlikely to perfectly align with this graph. It is possible we might go further and faster in some sectors, and slower in others. The graph also shows the negative emissions potential for the region and how through a combination of natural carbon sequestration and technological solutions, we can reach carbon negative by 2040. Without an unprecedented level of acceleration, nature-based carbon capture alone is unlikely to reach the required levels to achieve carbon negative by 2040, necessitating the need to explore technological solutions alongside progressing nature-based ones. The 2025 North York Moors fires have also highlighted the vulnerability of nature-based solutions, and with wildfire and storm frequency expected to increase throughout the century[1] there is additional risk to relying only on nature-based carbon capture.

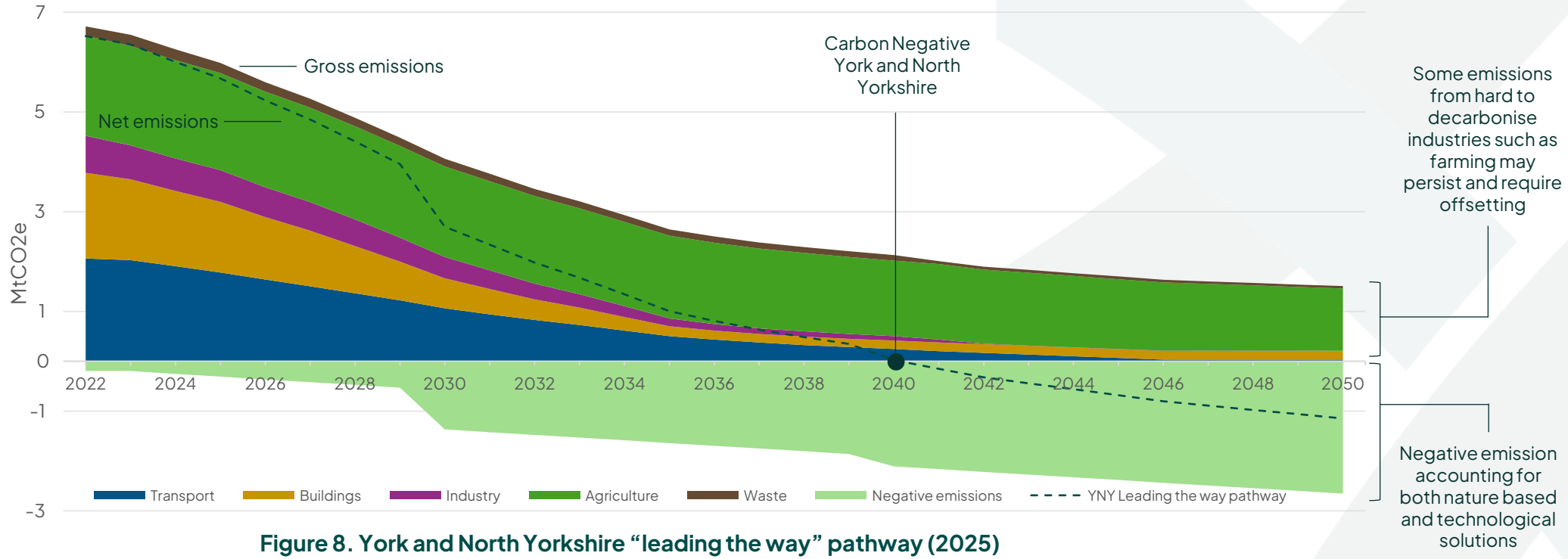


Figure 8. York and North Yorkshire "leading the way" pathway (2025)

Linked to this pathway are the series of "Scale of Transformation" indicators for each of the high emitting sectors, which can be found in Section 5 of this report. These figures are designed to provide an indication of the scale of change required to reach our carbon negative ambition. They highlight the level of ambition needed for this pathway but should not be viewed as prescriptive. For example, planting one less tree than specified in the Scale of Transformation does not mean that we will not reach carbon negative.

Pathways to Carbon Negative. Carbon Negative Emissions

York and North Yorkshire's Strategy for a Sustainable Future includes the ambition to be England's first carbon negative region. This means a 90% reduction in our greenhouse gas emissions, and sequestering more carbon than we emit.

To sequester carbon, nature-based solutions such as tree planting, regenerative agriculture and seaweed farming, will be prioritised. To meet the pace and scale required we will aim to take an innovative approach to carbon removal, including the exploration of technological solutions and transition technologies such as Carbon Capture and Storage (CCS).

Carbon Capture and Storage (CCS)

The increase in negative emissions from 2030 represents the contribution of carbon capture and storage projects primarily located at Drax Power Station. Though Drax have stated the timing of this is contingent on the construction of the Humber Carbon Capture Pipeline and a negative emissions policy and investment framework from government, 2030 is the current published date for the project to come online. While the pathway to Carbon Negative by 2040 is influenced by technological carbon capture and the sooner this technology is available the more effectively we can reach our ambitions, there is some flexibility in the pathway for when technological carbon capture is available to achieve regional carbon negativity by 2040. Additionally, continued climate action beyond 2040 as part of the UK's overall 2050 Net Zero Target has the potential to remove reliance on technological carbon capture in YNY altogether.

Marine and Coastal

Though not currently subject to direct Scale of Transformation indicators there is potential for wider contributions to GHG emission reduction through work in the marine and coastal sector. Marine ecosystems help to buffer human societies from the impacts of climate change, such as rising sea levels, enabling more resilient designed solutions. They also offer a means of harnessing the carbon sequestration functions of algal and invertebrate species and their aggregations. For example, the Yorkshire Marine Nature Partnership, with the University of Hull and East Riding of Yorkshire Council, conducted a survey of kelp forests along the Yorkshire coastline ('the Great Yorkshire Kelp Project'). Through this project it was estimated that the kelp along the Yorkshire coast holds a carbon stock of approximately 2,000 tonnes[2].

5. Scale of Transformation Indicators

Scale of Transformation Indicators.

What are Scale of Transformation Indicators?

Scale of Transformation indicators provide a means of understanding the range of transformation required to meet carbon negative and progress of individual programmes of work within wider sector GHG emissions totals for the region. Understanding the likely impact of each action on GHG emissions reduction, progress made to date, and the feasibility of achieving each action provides an insight into the viability of delivering each of the modelled pathways.

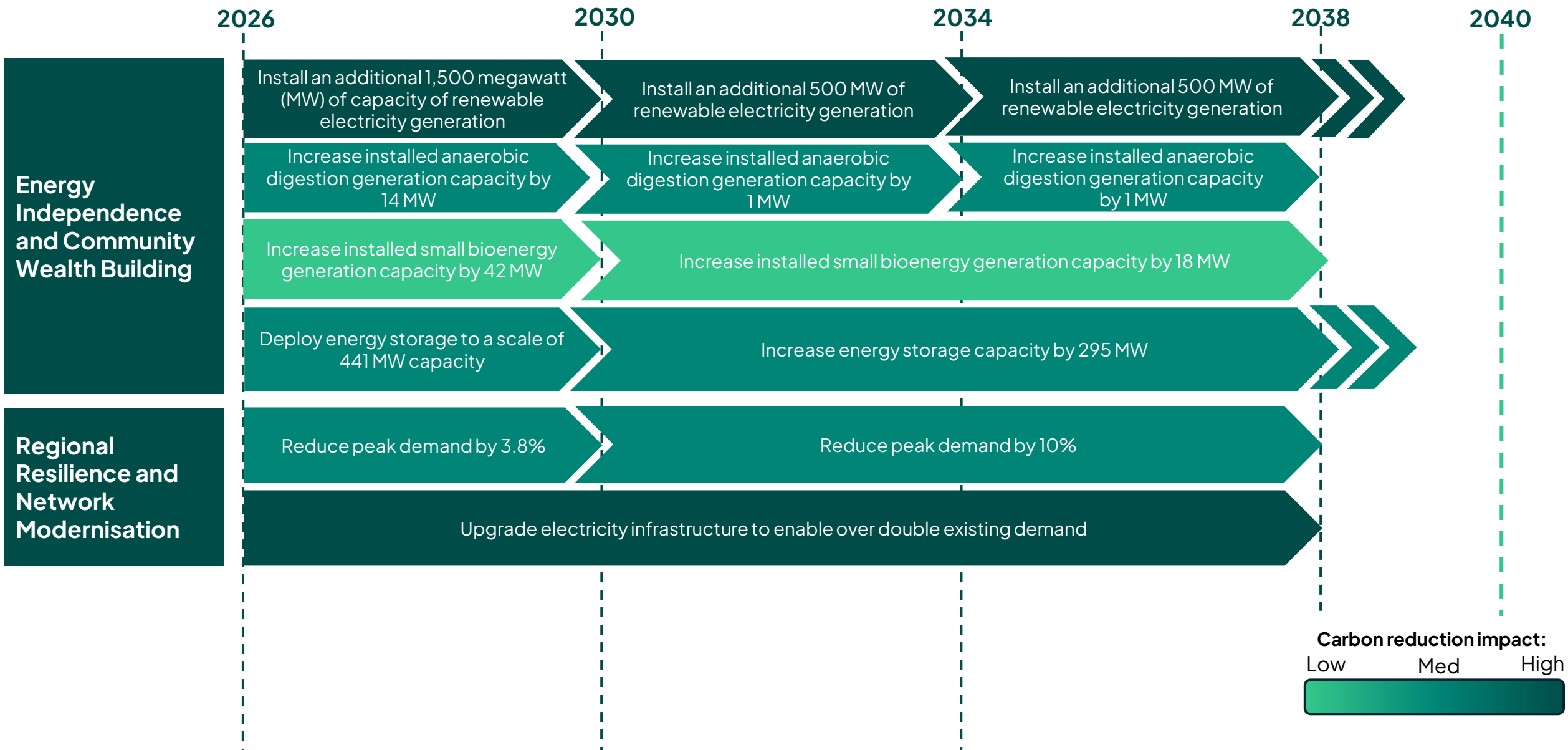
Some of the indicators are readily quantifiable. For example, one of the Power sector indicators tracks the scale of renewable generation installed in the region (measured by capacity in Megawatts (MW)). This is a dataset published as part of national statistics. However, there are a number of indicators where quantitative datasets are limited. This therefore means that a simple overview of progress will always include some qualitative measures.

These figures are designed to provide an indication of the scale of change required to reach our carbon negative ambition. They highlight the level of ambition needed for this pathway but should not be viewed as prescriptive. For example, planting one less tree than specified in the Scale of Transformation does not mean that we will not reach carbon negative.

Note that 'Marine and Coastal' indicators were not created or incorporated into the CAP study pathways, but quantitative indicators are included in the main Strategy for a Sustainable Future document.

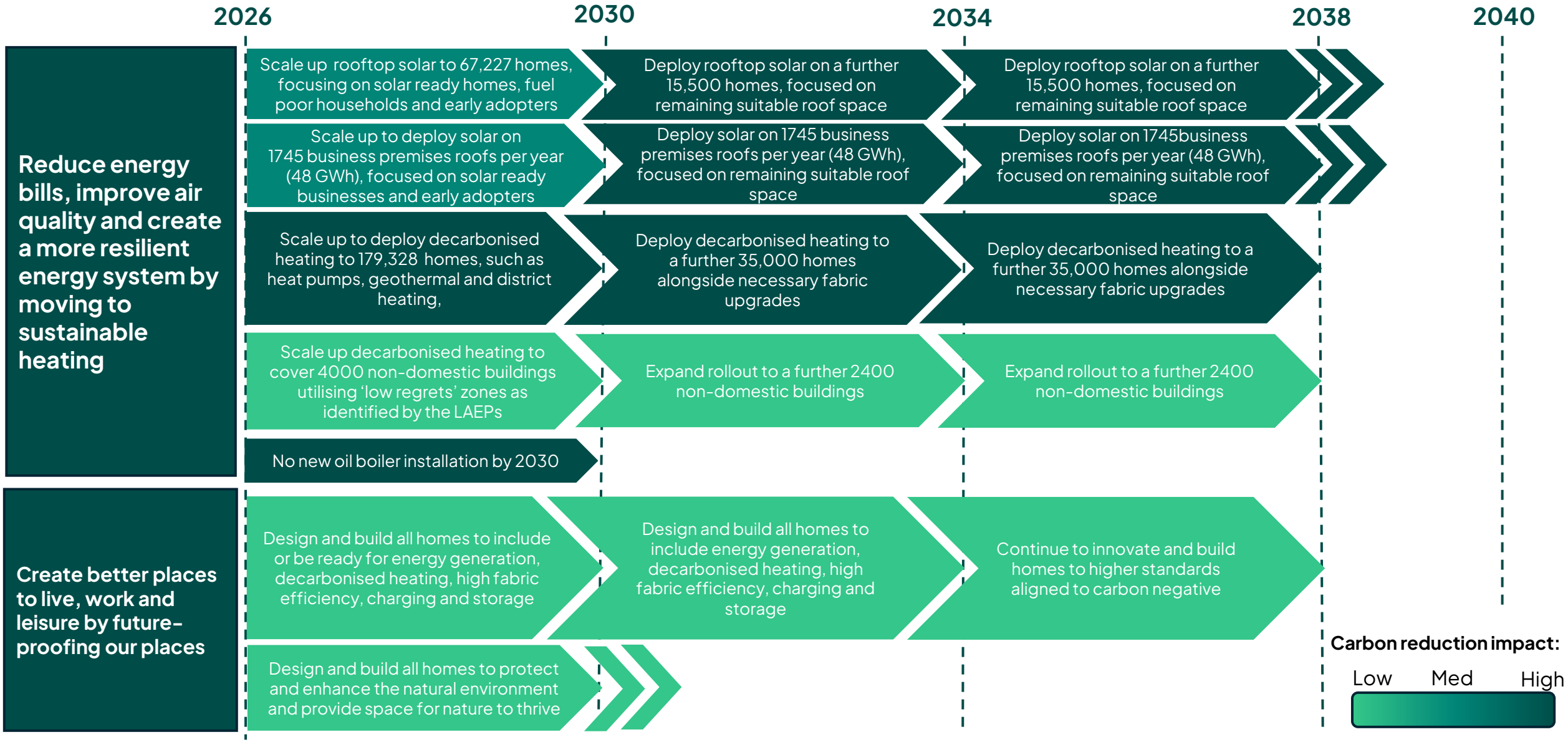
Clean, Affordable & Reliable Power: Scale of Transformation Indicators

Underpinned by research and guided by stakeholder engagement, these indicators demonstrate the level of change required to reach carbon negative by 2040 and inform the 'York and North Yorkshire Leading the Way' scenario.

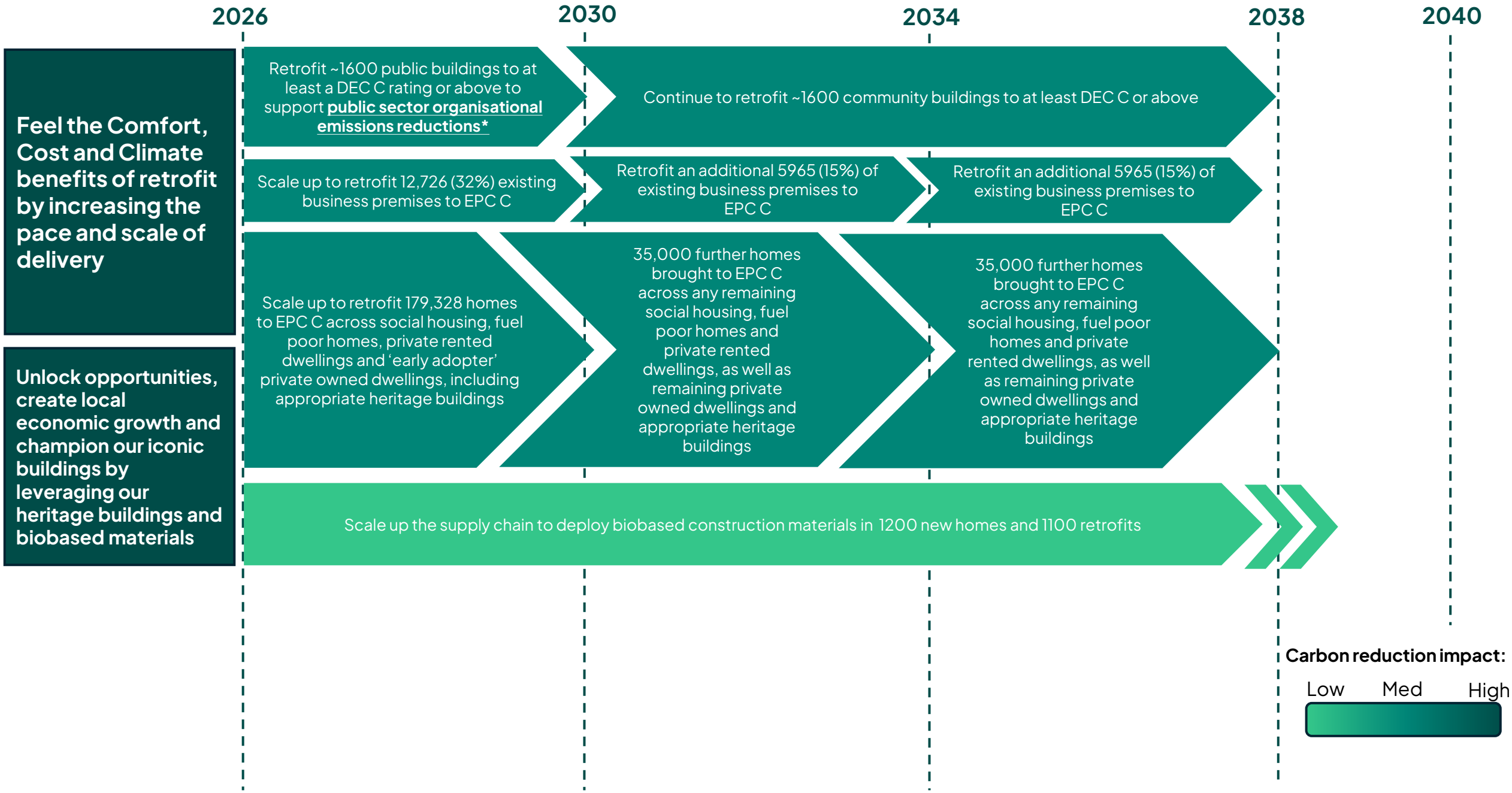


Warm, Comfortable Homes: Scale of Transformation Indicators

Underpinned by research and guided by stakeholder engagement, these indicators demonstrate the level of change required to reach carbon negative by 2040 and inform the 'York and North Yorkshire Leading the Way' scenario.

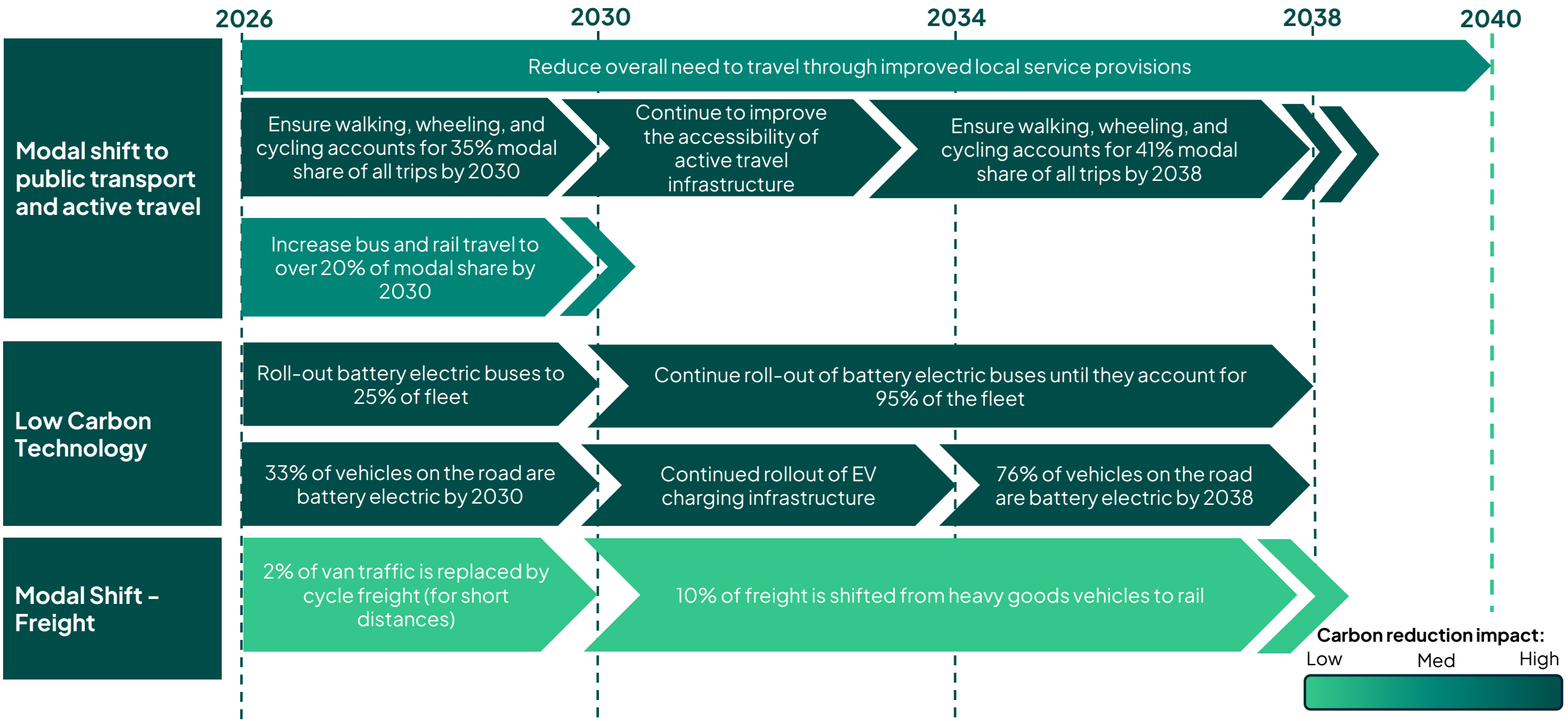


Warm, Comfortable Homes: Scale of Transformation Indicators



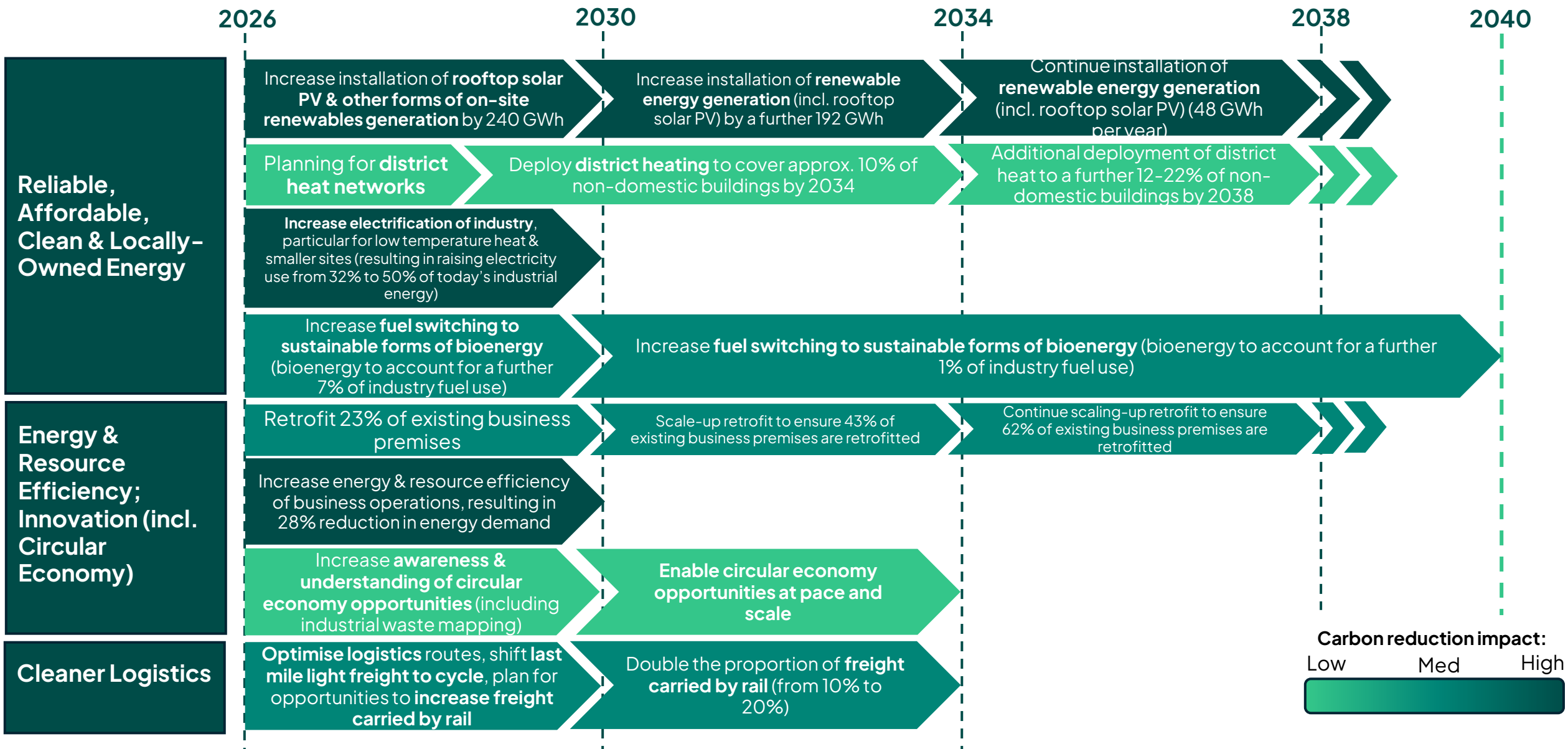
Accessible, Convenient Transport: Scale of Transformation Indicators

Underpinned by research and guided by stakeholder engagement, these indicators demonstrate the level of change required to reach carbon negative by 2040 and inform the 'York and North Yorkshire Leading the Way' scenario.



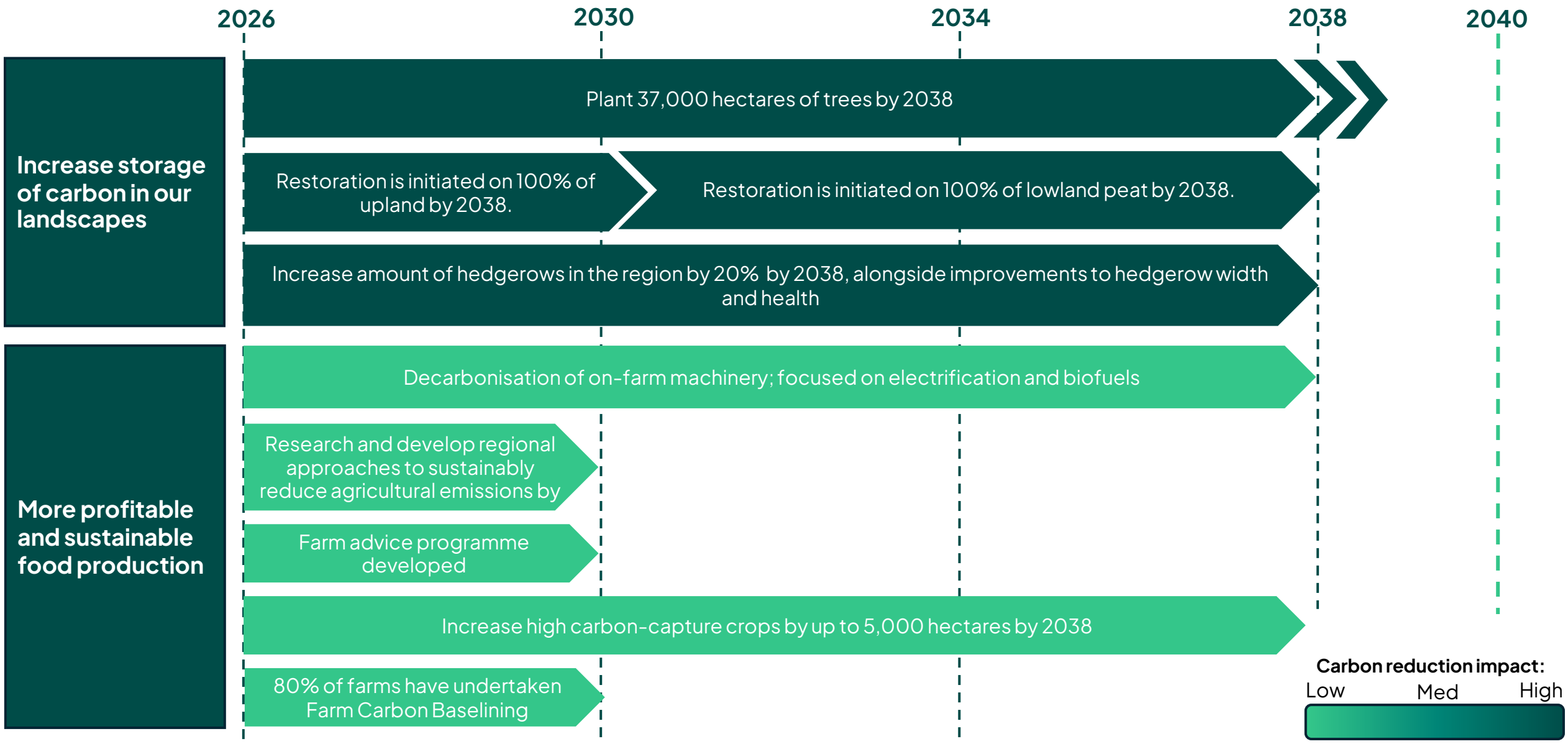
Innovative, Sustainable Businesses: Scale of Transformation Indicators

Underpinned by research and guided by stakeholder engagement, these indicators demonstrate the level of change required to reach carbon negative by 2040 and inform the 'York and North Yorkshire Leading the Way' scenario.



Resilient Landscapes, Sustainable Food & Farming: Scale of Transformation Indicators

Underpinned by research and guided by stakeholder engagement, these indicators demonstrate the level of change required to reach carbon negative by 2040 and inform the 'York and North Yorkshire Leading the Way' scenario.



6. Benefits of Decarbonisation Pathways and the Cost of Inaction

Benefits of decarbonisation.

Benefits of decarbonisation

It is important to assess the benefits of delivering the decarbonisation ambitions for each sector, to understand the wider benefits of delivering climate action for York and North Yorkshire. Understanding co-benefits will also support business cases to secure buy-in and funding for delivery of decarbonisation ambitions. The key co-benefits expected to result from decarbonisation action include:

- **Health benefits:** Switching to low carbon or zero emission vehicles and tree planting for carbon sequestration improves air quality, which can improve the health and wellbeing of local communities. Uptake of active travel and exposure to green infrastructure can also be linked to stress reduction and improved cognitive function.
- **Benefits to the local economy**: Investment in decarbonisation supports green economic growth and creates green jobs for local people. Investing in renewable power will also provide long-term energy security for the region and support the stability of energy bills for households and businesses.
- **Benefits to biodiversity:** Sustainable land management to support carbon sequestration including woodland creation and peat restoration can restore natural cycles and regenerate natural habitats to support biodiversity and water quality improvements.
- **Benefits to local places:** Tree planting for carbon sequestration supports climate change resilience by providing natural flood risk management, water security and shading benefits. Investing in sustainable and active travel improves local connectivity, reduces traffic congestion and brings cleaner air for local places.

These benefits have been considered and incorporated into the Strategy for a Sustainable Future.

What does this mean for York and North Yorkshire?

For every £1 invested in keeping homes warm, an NHS saving of 42p in direct healthcare costs is estimated[3].

A 2019 study found that tree cover in York and North Yorkshire and West Yorkshire saves £44 million in health costs associated with respiratory issues[4].

The average economic benefits of cycling have been found to be £590 per year per cyclist[5]. A 10% increase in the number of cyclists in the region could bring annual economic benefits of £48,427,200.

Properties with an EPC rating below band E cost an average of £1000 more per year to heat than a typical home. Retrofitting 250,000 homes to EPC C or above could therefore save up to £250 million per year in energy bills in the region[6].

Healthy peatlands, whilst also providing a carbon sink, provide a habitat for diverse plant and animal species, such as Sphagnum mosses and cottongrasses[7].

Reducing oil boiler use in York and North Yorkshire will support biodiversity improvements by reducing sulphur dioxide, nitrogen oxides and particulate matter pollution and oil spills, which can have a significant impact on soil health and water quality[8].

Switching short freight journeys to cycling or e-cargo bikes supports reduced traffic congestion, pollution and noise in local places. Investment into sustainable active travel also provides improved mobility and connectivity benefits.

25,000 jobs in the region have the potential to transition into retrofit roles through green skills upskilling[9].

The Cost of Inaction.

The Cost of Inaction

Delaying climate action will inevitably increase the negative impacts that our region and the world will experience due to climate change - this is known as the 'cost of inaction'.

Under current policies, the total cost of climate change damages to the UK are projected to increase from 1.1% of GDP at present to 3.3% by 2050 and 7.4% by 2100[10]. The Gross Domestic Product (GDP) in North Yorkshire was worth an estimated £18 billion in 2021; **damage costs would equate to somewhere in the region of £0.5 billion in 2050 on this basis**.

Combined, the net-zero transition (estimated to cost a maximum of 2% of UK GDP) is expected to have a net benefit of around 4% of GDP[10]. This net benefit would also include York and North Yorkshire economy (at around £0.7 billion at 2021 GDP figures).

Even a temperature rise of 1.5°C is projected to reduce global working hours by 2.2% worldwide by 2030[11], and already cost Great Britain £5.3 billion in 2020[12]. York and North Yorkshire are already experiencing heat waves impacting the population, including alerts of over 30 ℃.

The number of people experiencing high or extreme water stress will increase from 2.6 billion to 5.4 billion by 2040. In 2025, after the driest spring in over 130 years and record-breaking summer temperatures, reservoir levels within the Yorkshire Water area dropped to only 40% capacity, leading to the introduction of widespread hosepipe bans and other water saving measures[13]. This dry weather also led to the wildfire on the North York Moors, which resulted in the destruction of 10 square miles of the natural landscape, with estimates of up to £26 million in economic damages[14].

The number of people with uncertain access to food will increase from 2 billion to 3.5 billion by 2050[15] – the threat of climate change and biodiversity loss to UK food supply chains is now a national security issue. The UK Food Security Report 2024 notes a reduction in food secure households (those households that have access to food for all household members to sustain an active and healthy life). Up to 10% of households are determined as food insecure; if replicated in the region this would equate to around 8,500 households in City of York and 27,500 households in North Yorkshire. While there are several factors contributing to this, climate change, nature loss and water insecurity remain significant risks.

An Adaptation Study for York and North Yorkshire has recently taken place to better understand the impact of climate change on the region, which will be published as an evidence base alongside this report once completed.

Aside from the increasing costs associated with the impacts of a changing climate, there will be savings in operational costs in the medium to long term. While the scale of investment to achieve these is large, delaying this investment (or reducing the scale of investment) directly reduces the effectiveness of decarbonisation actions and the associated operational cost savings.

The CCC Advice to the Government on the Seventh Carbon Budget[16] highlights that investment will be offset by savings in operating costs. It is up to the public sector to decide on its share of contribution to the levels of investment required, but the Seventh Carbon Budget report expects that the private sector can provide the majority of the required investment. The scale of public investment is still significant. For example, support for low carbon heating for homes across the UK is estimated to average £6 billion per year over the period between 2025 – 2035 **(this equates to around £80 million per year for the YNY region).**

7. Next Steps

Next Steps. Summary

The findings from the research within this technical report has been incorporated into the development of York and North Yorkshire's Strategy for a Sustainable Future.

The baseline and projections for decarbonisation will be used to measure progress. Further detail on this can be found in the Strategy for a Sustainable Future, and the relevant implementation plans which are being developed. However, this may include:

- An ongoing review of progress against pathways and scale of transformation;
- Exploration of data sources that aren't subject to a 2-year time lag to provide earlier indication of progress levels, and more local level data;
- With lessons learnt and new data sources, strive to continuously improve the evidence base, e.g. to re-evaluate if scale of transformation indicators are still the correct actions.

8. References

References.

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9. Methodology

Methodology. Current Emissions

WSP completed a review of the CAP Study (2021) model and concluded that the best approach to updating the CAP Study's current emissions was to use the UK local authority and regional greenhouse gas emissions statistics published by the Department for Energy Security and Net Zero (DESNZ).

WSP completed a data review and desktop study of territorial greenhouse gas (GHG) emissions for York and North Yorkshire (YNY) using the UK local authority and regional greenhouse gas emissions statistics, 2005 to 2022 dataset referred to as the 'DESNZ LA dataset' in this report. The latest available year, 2022, was selected to extract current emissions for the study region. **YNYCA subsequently used the 2023 dataset to supplement this work.**

The DESNZ LA dataset defines the following reporting sectors:

- Domestic Sector (including all primary energy and electricity related emissions)
- Public Sector (including all primary energy and electricity related emissions)
- Commercial Sector (including all primary energy and electricity related emissions)
- Industry Sector (including all primary energy and electricity-related emissions)
- Transport Sector (road transport and rail related emissions – as applicable by local authority region)
- Agriculture Sector (including all primary energy and electricity-related emissions)
- Waste Sector (based on the waste arising and disposal methods within each local authority)
- Land use, land use change and forestry (LULUCF Sector) (including removals of carbon dioxide from the atmosphere)

The main emission sources included in each of the above sectors are listed in the table below (continued overleaf).

Sector Title	Inclusions (as per DESNZ Methodology)
Domestic Sector	• Domestic Electricity Consumption • Domestic Gas Consumption • Domestic oil and solid fuel use • Recreational use of N_2O and Other food
Non-Domestic Sector (Industrial, Commercial and Public Sector split)	• Non-Domestic Electricity Consumption • Non-Domestic Gas Consumption • Large industrial installations (for Industrial Sector) • Non-Domestic Other (Area source emissions for Industrial Sector)

Methodology. Current Emissions

Sector Title	Inclusions (as per DESNZ Methodology)
Agriculture Sector	• Electricity and gas consumption in the agriculture sector • Soils and Livestock • Consumption of solid and liquid fuels • Off-road mobile machinery emissions associated with activity in the agriculture sector
Transport	• Road Transport (A Roads, Motorways, Minor Roads) • Other Transport: • Road Transport – LPG • Road Transport – Lubricants • Road Transport – Urea • Railways – Coal • Inland Waterways / Domestic Navigation
Land Use, Land-Use Change and Forestry Emissions	• Forestry • Peatland • Cropland mineral soils under LUC • Grassland mineral soils under LUC • Settlement • Bioenergy crops • Other LULUCF
Waste	• Landfill Emissions • Other Waste Emissions (Total emissions from waste water treatment, sewage sludge decomposition, composting and anaerobic digestion)

Methodology. Current Emissions

Assumptions and Limitations

Emissions from the domestic, commercial and public sectors have been combined into the "Buildings Sector" to make this work comparable with the CAP study (2021). These emissions relate to the energy used in the operation of buildings; it excludes any GHG emissions arising from the construction or renovation of new or existing buildings. The remaining sectors have been presented with the same categorisation as DESNZ.

In addition to emissions from road transport and railways emissions, the CAP study (2021) also included aviation emissions from domestic and international aviation sectors. As stated in the CAP Study 2021 document, these were modelled based on a national aviation dataset (UK Aviation Forecasts 2017), which describes forecast UK National air passenger demand and aviation carbon dioxide emissions to 2050. The information in this dataset was pro-ratad in order to calculate an estimate of domestic and international aviation emissions from the Local Authority area. UK aviation emissions are reported separately from territorial GHG emissions and are subject to a sector specific net zero plan. For this reason, specific aviation details are excluded from the current study.

Emissions from the energy supply and fuel production sectors are not included at the point of emissions in the DESNZ LA dataset. These emissions have been redistributed to the relevant fuel consumption.

For the Land Use, Land-Use Change, and Forestry (LULUCF) sector, the DESNZ LA dataset considers a more comprehensive list of emission sources and sinks as compared to the CAP study (2021) and thus offers a more robust calculation methodology. The Marine and Coastal sector was included in the York and North Yorkshire's Routemap to Carbon Negative, in the form of interventions; however, this sector was not included in the previous CAP Study (2021) and the Councils do not currently collect activity data (e.g. marine fishery, aquaculture, tidal/wave power renewables and other relevant sources), which could be converted into tonnes of GHG emissions. While the region is working to understand their capacity to collect data on this sector, opportunities for decarbonisation have been described qualitatively in the Strategy for a Sustainable Future.

In the UK, domestic shipping, including fishing, is reported within transport data from the Department of Transport, but at UK level only. For the region, nearshore renewables in the form of wave or tidal energy generation could be an opportunity for the marine and coastal sector. A review of the Renewables UK database of wave and tidal energy generating sites shows no existing sites within the area of the North Yorkshire coast.

Additionally, there may be other more local data to support measurement of GHG emissions that was not available at the time of the study, and local action is unlikely to be well reflected in national datasets. This does not mean that local action has not had an impact.

Methodology. Business As Usual

A review of the CAP Study (2021) model concluded that the best approach to updating the business as usual (baseline) emissions was to use the Department for Energy Security & Net Zero (DESNZ) UK Energy demand and Emissions Projections (EEP). This dataset is updated annually.

At the time of writing, the latest available data was published in Nov 2023 – for 2023 to 2050 .

The EEP provides projections of greenhouse gas emissions. These projections take account of any national-level policies that, as of June 2024, have either been implemented or those that are planned where the level of funding has been agreed and the policy design is near final. These are referred to as EEP-ready policies. Policies at an earlier stage of development are not included. EEP-ready policies therefore do not take into account any measures announced by the current government . As an example, the Clean Power 2030 Action Plan was published in December 2024, therefore it is not included in the business as usual analysis.

The datasets for all the analysis are available as Annexes; for the business as usual modelling for YNYCA, Annex A (GHG by National Communication category) and the 'Reference' scenario has been used. This provides a GHG total for each National Communication sector in $MtCO_2e$.

To develop the business as usual projections for YNYCA, absolute numbers for each sector were used to calculate the annual percent change. A mapping of sectors in the EEP onto the relevant DESNZ Local Authority (DESNZ LA) sector total was then carried out so as to ensure that the annual percent changes were applied to the corresponding emissions source. The table below summarises this mapping.

DESNZ LA sectors (Current Emissions)	DESNZ EEP Sectors (Business as Usual Projections)
Industry Total	Industrial Processes
Commercial Total	Business
Public Sector Total	Public
Domestic Total	Residential
Transport Total	Transport
LULUCF Net Emissions	LULUCF
Agriculture Total	Agriculture
Waste Total	Waste Management
Excluded	*Energy Supply* *International Aviation & Shipping (IAS)*

Methodology. Scenario Pathways

Carbon negative

There is potential for wider contributions to GHG emission reduction through work in the marine and coastal sector. Marine ecosystems help to buffer human societies from the impacts of climate change, such as rising sea levels, enabling more resilient designed solutions. They also offer a means of harnessing the carbon sequestration functions of algal and invertebrate species and their aggregations. Marine biodiversity, from the priority species and their habitats to the common communities that characterise different coastal environments, are all an essential component in this necessarily unified view of ecological health, biotic integrity and cultural wellbeing on the built and urban coast.

The CCC's pathways analysis does not allocate specific levels of greenhouse gas removals that are used in UK scenarios to regions. This includes the combustion of biomass to generate electricity with CCS (BECCS power) or the use of direct air capture with carbon capture and storage (DACCS). The original CAP Study (2021) Max Ambition scenario assumed that 20% of Drax's generated energy is consumed in York and North Yorkshire and therefore applied 20% of the Drax BECCS savings to YNYCA's Max Ambition scenario. The basis of this figure was not articulated in the original CAP Study (2021). Since the CAP modelling was completed, the Drax BECCS Development Consent Order (DCO) was developed and made publicly available. This provides a means of updating the working assumptions regarding negative emissions for York and North Yorkshire.

Methodology for LULUCF inclusion

For all the pathways using the CCC's Sixth Carbon Budget scenarios, i.e. the Balanced Scenario, Policy-driven Scenario and Technology-driven Scenario, the relative percentage change was calculated against the reference year of 2022 for each year out to 2040. These percentages were then applied to the YNYCA data from DESNZ also relative to the current year (2022).

For the York and North Yorkshire Leading the Way Scenario, the Land Use emissions total from the original Max Ambition Pathway for 2040 was included in the modelling. To calculate the emissions for the years in between 2022 and 2040, the difference in emissions between 2040 and 2022 was calculated and then divided by the number of years between 2040 and 2022 to provide the annual change in emissions for land use. This approach results in linear interpolation between the years 2022 and 2040 from the DESNZ current emissions data to the original CAP study LULUCF emissions in 2040, to estimate LULUCF emissions over the period.

Methodology. Scale of Transformation

York and North Yorkshire's Routemap to Carbon Negative set a series of Scale of Transformation Indicators for each sector against a 2020 baseline. These provide a means of understanding the range of actions led by the YNYCA and progress of individual programmes of work within wider sector GHG emissions totals for the region. Section 5 of this report shows the estimated impact of each ambition on GHG emissions reduction. The process of determining the feasibility of delivering each indicator is set out below.

1. Original Routemap Ambition Indicators rated 'Major', 'Moderate' or 'Minor' based on their likely impact on GHG emissions reduction → 2. Progress against each indicator assessed using publically accessible data and stakeholder workshop → 3. Each indicator assigned a feasibility Red Amber Green (RAG) rating based on progress to date and stakeholder feedback

Each of the Scale of Transformation indicators have been allocated an Impact Rating based on their relative potential impact in reducing GHG emissions. The impact categories—major, moderate, and minor (definitions below)—were assigned to each carbon reduction action based on a combination of professional judgement and an assessment of the action's estimated contribution to reducing overall sectoral emissions, ensuring context-specific relevance. Progress against these indicators set out in the original Routemap has been assessed using publicly accessible data for the baseline year (2020) and present year (2022), or whichever year latest data is available for. The progress assessment is limited to the publicly available data collected at the time of this study; there may be other, more local or granular data that was not publicly available or made available before the end of this study. This has been taken into account to reach the Scale of Transformation figures in this technical report, and the draft Strategy for a Sustainable Future.

Major Impact	This action is expected to deliver a substantial reduction in carbon emissions relative to other interventions in this sector, making it a critical lever for achieving the carbon reduction goals.
Moderate Impact	This action offers a meaningful but not dominant reduction in carbon emissions compared to other sectoral options, playing an important supporting role in the overall mitigation strategy.
Minor Impact	This action is projected to contribute only a small decrease in carbon emissions within the sector and serves as a complementary or supplementary approach to higher-impact actions.

Methodology. Cost of Inaction

The Department for Energy Security and Net Zero's (DESNZ) traded carbon values for modelling purposes are used to estimate the financial cost of purchasing allowances in the United Kingdom Emissions Trading Scheme (UK ETS) under different scenarios. The 2024 traded carbon values range from 37 to 46 £/tCO2e; values are expected to triple by 2050 making purchasing allowances to achieve net zero targets more expensive over time, as shown in the table below.

Year	Market Traded Carbon Values (2024 GBP)	Low Sensitivity – High Fossil Fuel Prices and Low Economic Growth (2024 GBP)	Net Zero Strategy Aligned (2024 GBP)	High Sensitivity – Low Fossil Fuel Prices and High Economic Growth (2024 GBP)
2024	37	28	40	46
2040	128	94	128	151
2050	124	85	124	154