Calderdale Emission Reduction Pathways

A report for Calderdale Metropolitan Borough Council

Final report

21st May 2021

With minor amendments 21st June 2021

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Contents

Executive Summary iii
1 Introduction 1
1.1 Context and approach 1
1.2 Objectives and scope 1
1.3 Structure of the report 3
2 Calderdale emissions and generation profile 4
2.1 Current emissions 4
2.2 Electricity generation 5
3 Emissions trajectories 7
3.1 Introduction 7
3.2 Emissions reduction pathway 7
3.3 Hydrogen in the pathways 13
3.4 Reaching net zero 14
4 Roadmaps 17
5 Policy recommendations 21
5.1 Introduction 21
5.2 Cross-cutting action 22
5.3 Transport 23
5.4 Buildings & technology 26
5.5 Land & biodiversity 28
5.6 Waste 30
6 Wider actions to support the climate ambition 31
6.1 Supporting local food initiatives 31
6.2 Addressing embedded emissions 32
7 Action plan and recommendations 35
8 Appendix 39
8.1 Calderdale data 39
8.2 Baseline emissions trajectory 44
8.3 Additional supporting information 48
Appendix 2 1

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Element Energy is a leading low carbon energy consultancy working in a range of sectors including carbon capture and storage, low carbon transport, low carbon buildings, renewable power generation, energy networks, and energy storage. Element Energy works with a broad range of private and public sector clients to address challenges across the low carbon energy sector.

Acknowledgments

Element Energy were supported by the UK Centre for Ecology and Hydrology (CEH) in adapting the modelling of land use and agriculture emissions from the parent WYCA study to the local context.

Disclaimer

Executive Summary

Background and context

In January 2019 Calderdale Metropolitan Borough Council (CMBC) declared a Climate Emergency and committed to becoming a net zero emitter of carbon dioxide (CO_2) by 2038 with substantial progress by 2030. The Council has begun drafting a Climate Emergency Action Plan Tool Kit to set out how this target can be met, with action divided across the themes of: Buildings & Technology, Transport, Land & Biodiversity, Food, and People & Communities.

The pace of decarbonisation required by a 2038 target is significantly faster compared to the UK national target of 2050. This study aims to identify relevant technology options and interventions required to deliver this target through development of an emission reduction pathway (ERP) for Calderdale.

The accelerated timeline of decarbonisation by 2038 means that progress towards this target must begin immediately. A set of recommended actions that CMBC can take have been identified, defined across the short (out to 2025), medium (2025-2030) and long (2030-2038) term. This work will support CMBC to transition the existing toolkit into a robust action plan and to develop work on an ongoing basis alongside wider WYCA and Leeds City Region delivery plans to ensure that regional activities support and complement local actions.

Key findings

The major emissions sources in Calderdale are from road transport and from energy use in buildings and industry (Figure 1). Current (2020) emissions are estimated to be 1,059 $ktCO_2e$ and, without targeted action, emissions are likely to only reduce by 34% (696 $ktCO_2e/yr$) by 2038.[1] Local electricity production within the borough currently meets 15% of electricity consumption within Calderdale and has a very low carbon intensity since the majority of generation is from onshore wind.

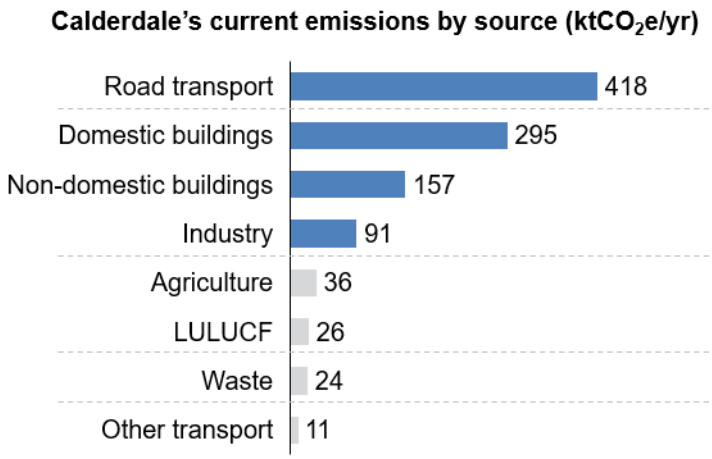


Figure 1 Calderdale's current emissions profile (modelled emissions for 2020).

The emissions reduction pathway represents an ambitious but technically feasible pathway to significant emissions reduction. Under this pathway, Calderdale can achieve 82% emissions reduction

[1] Following a "business as usual" pathway.

by 2038 (195 $ktCO_2e/yr$; Figure 2). This emissions reduction is achieved through a combination of ambitious behaviour change and technology shift (summarised in Figure 3).

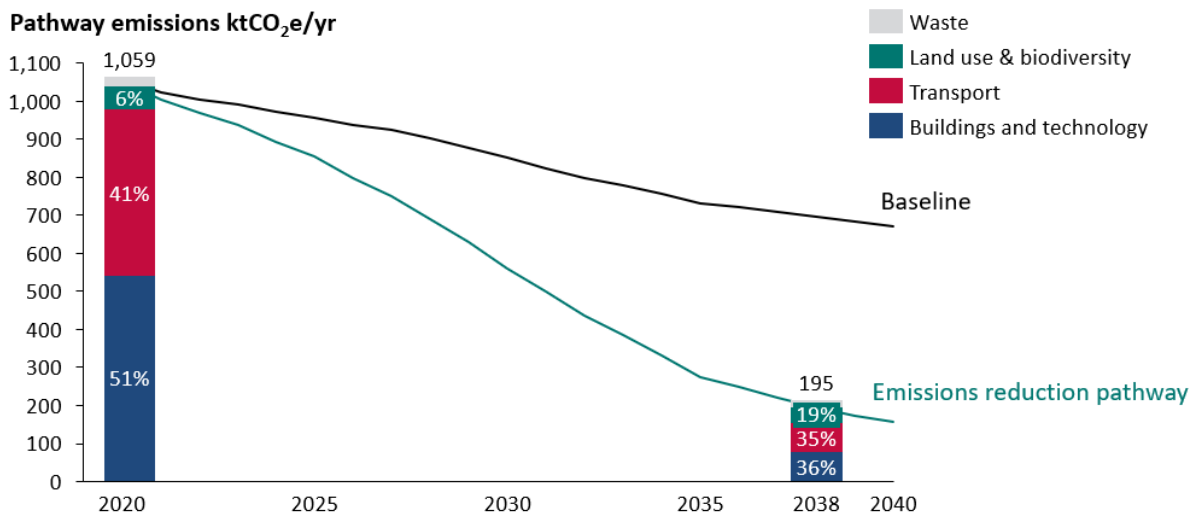


Figure 2 Emissions trajectory under the emissions reduction pathway compared to a baseline scenario

Transport

- Sales of zero emissions cars reach ca. 4,300/yr by 2038 (86% sales)
- Walking increases by 80% & cycling increases 22x compared to today
- Public transport travel increases by 50% compared to today

Buildings & Technology

- Retrofit of 69,000 homes to reach EPC C or better
- 49,000 heat pumps & hybrid heat pumps installed, or ca. 9/day from 2025-2035
- hydrogen equipment developed and deployed for select industry and buildings by mid-2030s
- Solar PV and onshore wind reach 143 MW (4.8 MW/yr from 2020-2030
- Electricity infrastructure investment enabling 51% higher annual demand

Land Use & Biodiversity

- 100% lowland and 60% upland peatland restored
- 450 hectares of new forest planting
- Diet change to reduce red meat and dairy consumption by 32%, leading to 24% reduction in sheep & cattle

Waste

- 35% reduction in avoidable food waste and increase recycling of municipal waste

Figure 3 The scale of the challenge - what needs to be achieved to reach 82% emissions reduction by 2038

The main emissions reductions come through actions in transport and buildings, with biggest wins coming from actions to address emissions from car travel and energy use in domestic households.

Within transport, just under half of emissions savings from car travel are due to changes in travel behaviour[2] while the remainder are due to the shifting to ultra-low and zero emissions cars (primarily battery electric). Behaviour change reduces the distance travelled by car by over a quarter compared to today, which must be met by increased public transport capacity and improved active and shared transport infrastructure.

For domestic buildings, just under three quarters of emissions savings come from rollout of low carbon heating (73%), with 2 in every 5 homes fitted with a heat pump or hybrid heat pump by 2038. The rollout of low carbon heating is supported by accelerated building energy efficiency retrofit in the 2020s, bringing 69,000 homes to EPC or above (reaching 100% of homes at this standard in the borough).

Peatland restoration is the largest contributor to emissions reductions in land use, with further emissions savings schieved through tree and energy crop planting and agricultural change. Behaviour change to achieve a 32% reduction in red meat and dairy consumption and 35% decrease in food waste are the largest contributors to emissions reduction in agriculture. Alongside on-farm measures, behaviour change also plays an important role in helping to free up land for other mitigation.

Local power generation doubles to reach 269 GWh/yr by 2038, with the majority of growth in onshore wind and large-scale solar.

Despite ambitious action, Calderdale does not reach net zero by 2038. The main sources of emissions in 2038 are from remaining fossil fuelled vehicles (conventional petrol and diesel, as well as hybrids) and emissions from electricity use in buildings, vehicles, and industry. Key challenges to reaching net zero include:

- **Stock turnover rates** limit how fast technology can be replaced even with strong incentives, meaning that some fossil fuel options (particularly vehicles) remain in 2038
- **Electrification of heat and transport relies on decarbonisation of the national grid** to reach net zero
- **Calderdale has limited options for negative emissions** within the borough boundaries – with no opportunity for bioenergy with carbon capture and storage within power or industry, and limited land availability for natural solutions

Some of the gap to zero could be closed through investing in further renewable electricity generation to offset national grid emissions, or through increased land use measures to sequester carbon; however, the impact of these measures is expected to be small (reaching 88% reduction overall) and comes with trade-offs with other land uses. Reaching net zero will therefore require further, largely speculative, measures such as negative emissions technologies, or carbon offsetting outside the borough. These must be explored at local level and the optimal mix of these options will be determined by developing evidence and agreed local priorities.

Policy recommendations and action plan

The emissions pathway modelling defined the scale of action required to reduce emissions in Calderdale under an ambitious emissions reduction pathway. Many of these actions must be taken by People & Communities, since many of the measures rely on change in private homes and businesses as well as personal travel and lifestyle choices. However, CMBC has a significant and critical role to play in supporting the net zero transition. This role ranges from planning, communication, and coordination, to direct delivery of measures and demonstrator projects. CMBC therefore needs to take

[2] Through absolute demand reduction (avoiding travel) and shifting journeys from private cars to active, public and shared transport.

a proactive role in both leading local delivery and in working to put the borough in a strong position to take advantage of opportunities as they arise (at national or regional level).

It is important to note that:

- **CMBC will be reliant on strong national policies** to achieve its goals
- **CMBC will need significant additional resource** (designated staff) and funding to deploy these policies and take crucial actions; this funding is not currently available and therefore further funding will therefore need to be secured in order to achieve the borough (and region's) climate ambition
- **Some actions are outside the remit of CMBC** and rely on action by stakeholders, private sector and individuals to fully achieve; in addition, many aspects of the ERP are reliant on external decisions (e.g. the role of hydrogen).

It is recognised that WYCA is in the process of developing its own, region-level, net zero strategies and CMBC's action will need to align with regional work where feasible. However, there are many actions CMBC can take to drive local emissions reduction alongside supporting regional ambitions.

A long-list of policy actions that CMBC can take for each Theme has been drawn up based on best practice examples and established reports, with a focus on action in the short-to-medium term**.** In addition to Theme-specific actions, there are a number of actions that support emissions reduction measures across all sectors. These actions are necessarily cross-sectoral in that they either target common objectives (such as encouraging behaviour change, developing local skills), enable necessary infrastructure development, or coordinate action across sectors to align priorities.

The top priorities and actions in the short-to-medium term are summarised in Figure 4. It should be noted that while these are selected as priority actions due to their importance in delivering key measures for emissions reductions, there are other essential actions outside these that must be taken to deliver the pathway.

	Transport	Buildings & Technology	Land Use & biodiversity
Top Priority	Reduce car use through modal shift and demand reduction	Reduce energy demand through energy efficiency	Ensure local land use priorities are set through gathering evidence while accelerating mitigation
Short term action	• Improve cycling and walking infrastructure • Reallocate road space and restrict parking • Expand electric vehicle charging network • Work with partners to expand bus offering and decarbonise rail • Decarbonise the public fleet and reduce emissions from staff travel	• Retrofit Existing public buildings • Map relevant features in the wider a stock to support retrofit under funded schemes • Use local planning policy to incentivise mitigation measures • Implement heat networks • Install renewables on public land and buildings	• Gather data and evidence on potential for land use emission reductions • Accelerate delivery of measures on public land • Use local plans to incentivise mitigation • Develop food waste strategy • Implement food purchasing policies for the public sector
Medium term action	• Role of freight consolidation • Role of traffic control measures	• Extent of district heat rollout and need for heat zoning policy • Role of H_2 for heat	• Focus of the messaging and local support for agriculture and land use measures, in line with evidence on optimal local solutions

Figure 4 Summary of key recommendations for action to deliver the emissions reduction pathway.

The long-list of policy recommendations are summarised in Figure 5, Figure 6 and Figure 7 to give a high-level action plan for each sector. While these action plans give indicative timelines and likely actions, the emissions reduction pathway will need to be reviewed regularly to adapt in response to the success of early actions, external decisions, and emerging evidence (such as technology learning and cost reduction). Key review points will be between phases (short, medium and long-term time periods); however, national and regional policy is rapidly evolving and CMBC's plan will need to be flexible to smaller, more regular adjustments as the policy landscape changes

Short Term (2020-2025)	Medium Term (2025-2030)	Long Term (2030-2038)
Priority Action • Use local planning policy to incentivise and support delivery of measures • Develop local strategy for road space reallocation • Develop and implement parking control measures, including reducing on-street, banded parking charges and workplace parking levies • Deliver currently funded cycle routes and continue to deliver cycling strategy measures • Expand cycle parking provisions across the borough • Assess CMBC staff travel needs and implement sustainable policies • Encourage local employers to assess staff travel • Develop a local electric vehicle charging infrastructure strategy, following regional strategy, and begin implementation • Work with partners to ensure delivery of expanded and improved bus services, limit road building and electrify rail **Evidence gathering (in parallel with priority actions)** • Assess local suitability of implementing traffic control measures such as zero emissions zones, strategic road closures and 20mph limits • Assess local feasibility of freight consolidation and cycle freight in key delivery locations • Support and deliver trials of innovation services and shared mobility • Engage with local fleets to understand their plans and raise awareness • Engage with key stakeholders to understand plans for gas in transport • Assess National Government support, priorities, and regulation **Review evidence and adjust pathway**	**Max implementation of policy** • High rate of expansion of active travel infrastructure, public transport services and electric vehicle charging infrastructure • Rapid conversion of public fleets to zero emission vehicles • Implementation of supportive measures to address commuter travel, as appropriate (e.g shared services) • Implementation of more ambitious traffic control measures such as zero emissions zones • Implementation of freight measures such as consolidation, dependent on feasibility and trials • Communication of available financial incentives at regional level, and assess need for further local support • Ongoing engagement with HGV fleets to encourage technology shift • Engagement with NGN to align targeted H2 refuelling rollout, and NPg to ensure targeted electricity upgrades **Review progress and adjust pathway**	**Adjustment and enhancement** Evaluate progress and implement further measures where necessary, for example: • Adjustment of strategies based on achieved level of deployment and changes in National Policy • Stronger regulatory measures to encourage uptake such as through local planning requirements (if possible) • Encouraging or directly implementing stronger financial incentives for technology uptake (e.g scrappage schemes) including support for HGV fleets • Support for rollout of innovative technologies and techniques • Adjustment of training programmes to meet skills shortages

Figure 5 Recommended action plan for measures to address Transport emissions

Short Term (2020-2025)	Medium Term (2025-2030)	Long Term (2030-2038)
Priority Action • Use local planning policy to incentivise and support delivery of measures • Accelerate retrofit of Council-owned buildings and social rented homes • Deliver Halifax district heat network • Initiate new low carbon heat network schemes • Accelerate installation of solar PV and flexibility technologies on Council owned land and buildings • Implement training programmes in energy efficiency retrofit and low carbon heating technologies • Work with WYCA to ensure development of actions to attract private investment in renewables • Provide guidance and support to community renewables projects • Influence government to deliver policy and support that supports climate ambition **Evidence gathering (in parallel with priority action)** • Initiate exemplar and demonstrator projects for high energy efficiency buildings and low carbon heating technology to better understand viability in the local context • Map hard-to-decarbonise homes in the region • Explore options for new low carbon heat networks • Engage with key stakeholders to stay informed of H_2 developments • Facilitate with engagement industry • Assess National Government support, priorities, and Regulation **Review evidence and adjust pathway**	**Max implementation of policy** • Maximum retrofit of public sector buildings • Deployment of new and/or expand district heat networks • Communication of available support and financial incentives at regional level, and assess need for further local support • Assess opportunities to link local homes with wider funding, particularly in private rented and owner occupier sectors • Ensure supportive planning for large scale renewables projects and continue to deliver on Council-owned land where appropriate • Engagement with NGN to align targeted H_2 rollout, and NPg to ensure targeted electricity upgrades **Review progress and adjust pathway**	**Adjustment and enhancement** Evaluate progress and implement further measures where necessary, for example: • Adjustment of strategies based on achieved level of deployment and changes in National Policy • Adjust approach to hydrogen based on likely deployment • Stronger regulatory measures to encourage uptake, such as through local planning requirements (is possible) • Encouraging or directly implementing stronger financial incentives for technology uptake (e.g scrappage schemes) and energy efficiency • Support for rollout of innovative technologies and techniques, such as battery-to-grid and smart system • Development of public-led business models for communal and district heating • Adjustment of training programmes to meet skill shortages

Figure 6 Recommended action plan for measures to address buildings & technology emissions

Short Term (2020-2025)	Medium Term (2025-2030)	Long Term (2030-2038)
Priority Action • Define local spatial land use priorities to ensure that Calderdale's data and priorities are included in any WYCA-level spatial land use strategy • Accelerate delivery of land use measures on suitable Council-owned land • Adopt a local food waste reduction strategy • Implement public procurement policies to reduce food waste and to reduce red meat and dairy in public sector catering • Use local plans to deliver climate ambitions • Support community schemes • Work with WYCA to ensure markets for end products of land management practices • Influence Government for funding to support climate mitigation measures, development of ELMs to ensure it supports locally-relevant measures, efficient processes for assessing funding **Evidence gathering (in parallel with priority action)** • Data collection and target-setting for land use measures, including peatland restoration potential (though existing Moors for the Future project), tree planting (building on/aligned with White Rose Forest targets), bioenergy crop production, and other changes in land use and/or land management techniques • Encourage local farmers to participate in Defra ELM Pilots • Support development and participate in trials of private investment models • Encourage local farmers to participate in trials of private investment models • Explore potential markets for end-products of land management practices • Assess National Government support, priorities, and regulation and details of ELMs **Review evidence and adjust pathway**	**Max implementation of policy** • Maximum delivery of measures on Council-owned land • Ongoing strong leadership and public messaging for diet change and food waste reduction • Communication of available support and financial incentives at regional level, and assess need for further local support • Ongoing engagement with farmers and landowners • Ongoing support for community projects • Strong markets bioenergy and afforestation end-products in place **Review progress and adjust pathway**	**Adjustment and enhancement** Evaluate progress and implement further measures where necessary, for example: • Adjustment of spatial land strategy targets based on effectiveness of implemented measures, extent of behaviour change and developments in National Policy • Stronger regulatory measures such as banning peatland burning or new/stronger local planning requirements for land use • Encouraging or directly implementing stronger financial incentives for climate mitigation measures • Support for rollout of innovative technologies and techniques • Public incentives for behaviour change • Adjustment of training programmes to meet skill shortages

Figure 7 Recommended action plan for measures to address Land use & biodiversity emission

Acronyms

Term	Definition
AD	Anaerobic digestion
BEV	Battery electric vehicle
BioCNG	Compressed natural gas, 100% biomethane
CCS	Carbon capture and storage
CHP	Combined heat and power
$CO_{2(e)}$	Carbon dioxide (equivalent)
DAC	Direct Air Capture
DSR	Demand side response
EfW	Energy from waste
ERP	Emissions reduction pathway
EVCP	Electric vehicle charge point
FCEV	(Hydrogen) Fuel Cell Electric vehicle
H_2	Hydrogen (as a fuel)
Ha (kha)	Hectares (land area)
HGV	Heavy goods vehicle
HP	Heat pump
HHP	Hybrid heat pump
kW (MW, GW)	Kilowatt – unit of power
kWh (MWh etc)	Kilowatt hour – unit of energy
LA	Local Authority
LEP	Local Enterprise Partnership
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land Use Change and Forestry
MBT	Mechanical biological treatment (of waste)
Passenger km	Passenger travel activity (number of passengers x average distance travelled)
PHEV	Plug in hybrid electric vehicle
(Solar) PV	Solar Photovoltaic (electricity generation)

Vehicle km, vkm	Vehicle transport activity (number of vehicles x average distance travelled)
WYCA	West Yorkshire Combined Authority
£m	£ million

1 Introduction

1.1 Context and approach

Following the UK government's commitment to reducing greenhouse gas (GHG) emissions to net zero by 2050,[3] local and regional authorities across the UK, including West Yorkshire, have strengthened their climate ambitions. In January 2019 Calderdale Metropolitan Borough Council (CMBC) declared a Climate Emergency and committed to becoming a net zero emitter of carbon dioxide (CO_2) by 2038 with substantial progress by 2030. The Council has begun drafting a Climate Emergency Action Plan Tool Kit to set out how this target can be met, with action divided across the themes of: Buildings & Technology, Transport, Land & Biodiversity, Food, and People & Communities.

This study aims to identify relevant technology options and interventions required to deliver this target through development of an emission reduction pathway (ERP) for Calderdale. This work builds upon work that Element Energy previously carried out for the West Yorkshire Combined Authority (WYCA), which developed fully integrated emissions reductions pathways for the power, buildings, industry, transport, and land use, land use change and forestry (LULUCF) sectors to enable the region to meet its 2038 climate target.[4] These pathways were used to identify key milestones, decision points, policies and interventions that can drive the transition toward these outcomes.[5]

This project takes the scenarios and actions developed in the WYCA study and translates them to the Calderdale context. The study uses local data to generate a locally-relevant picture of emissions and emissions reduction in Calderdale. Additionally, the project translates the findings and recommended actions from the wider study to the local context, taking into account all relevant policies and strategies to fully understand local plans and priorities.

This work will support CMBC to transition the existing toolkit into a robust action plan and to develop work on an ongoing basis alongside wider WYCA and Leeds City Region delivery plans to ensure that regional activities support and compliment local actions.

Definition of net zero

Reaching net zero means that any emissions of GHGs are balanced by removal of an equivalent amount of CO_2 from the atmosphere (sequestration) or by preventing emissions which otherwise would have occurred elsewhere (offsetting). For local authorities, in practice this means reducing emissions that arise within the borough as far as possible and to very low levels, and either balancing with sequestration within the borough or offsetting through action outside the borough.

1.2 Objectives and scope

The main objectives of the project are:

- To develop a robust emission reduction pathway for the Buildings & Technology, Transport and Land & Biodiversity themes
- To set out actions that must be taken by people and communities to enable the Borough to meet its emission reduction targets

[3] The Climate Change Act 2008 (2050 Target Amendment) Order 2019
[4] Draft results of the technical modelling were published alongside public consultation in July 2020: https://www.westyorks-ca.gov.uk/media/4277/west-yorkshire-carbon-emission-reduction-pathways-technical-report-draft-v7-1.pdf
[5] Full report expected to be published in 2021

- To explore good practice in considering the carbon impact of food, and present information and research which can inform local food projects and their development

This study maps the sectors in the WYCA study (parent study) to the CMBC Action Plan Tool Kit themes as set out in Table 1. Note that Food and People & Communities were not considered quantitatively in this study; Food is considered qualitatively (see section 6.1) whereas People & Communities is a cross-cutting theme. Emissions from waste were included at a high-level in the parent study and were also included in this study, for completeness.

Table 1 Mapping of WYCA study sectors to CMBC Themes in the modelling and actions.

WYCA Study sectors	Power	Buildings	Industry	Transport	Land, Land Use & Agriculture	-	-
CMBC Theme	Buildings & Technology			Transport	Land & Biodiversity	Food	People & Communities

The scope of emissions considered matches that of the parent study, as outlined in Table 2 except for emissions from aviation (excluded in this study but included in the parent study). The net zero target includes all emissions arising from activity within the region and from production of energy used within the region.

Table 2 Scope of emissions considered in this study

In scope	Out of scope
✓ Fuel combustion for heat in industry and buildings, including district heating	× Scope 3 emissions such as embedded emissions in product/service imports
✓ Transport emissions from road kms travelled in the region on a well-to-wheel basis. Inclusion of rail, aviation at a high-level.	× Travel activity of residents taking place outside the region (including aviation)
✓ Electricity used in the region for: Heating buildings; Appliances; Electric vehicles; Industrial uses (at regional carbon intensity)	× CO_2 emissions associated with electricity export (surplus power)[2].
✓ Energy & emissions for producing hydrogen (for hydrogen consumed in the borough)	× Non-CO_2 emissions other than from agriculture and fuel combustion (e.g., methane leakage from supply chain not included)
✓ Emissions associated with land use in the region, including CO_2, N_2O, CH_4.	× Detailed assessment of emissions offsetting outside region – considered qualitatively only

This work benefitted from six working group consultations in which members of the Calderdale Climate Emergency working group and Calderdale Council Cabinet Working Party provided feedback that helped to shape the local actions and interventions.

1.3 Structure of the report

Following this section, the report is structured as follows:

- Section 2 sets out the current emissions and electricity generation profile in Calderdale
- Section 3 describes the emissions pathways modelling, covering likely emissions under an ambitious emissions reduction pathway
- Section 4 sets out the key decision points, activities and milestones in delivering the emissions reduction pathway, presented as roadmaps for each Theme
- Section 5 sets out the recommended policies and actions that CMBC can take towards delivering the pathway outcomes
- Section 6 assesses wider actions to support the climate ambition, including evidence of the impact of local growing and actions to address embedded emissions
- Section 7 summarises the key findings of the study and presents the policy recommendations in high-level plans for action across Short term (2020-2025), Medium-term (2025-2030) and Long-term (2030-2038).
- Section 8 includes additional supporting information

2 Calderdale emissions and generation profile

2.1 Current emissions

Calderdale's current emissions were estimated using detailed bottom-up modelling and were calculated to be 1,059 $ktCO_2e$ in 2020 (see Appendix section 8.1 for details of approach and local data sources).[6] This represents just under 10% of West Yorkshire's emissions (10,732 $ktCO_2e$ in 2020)[7].

Calderdale's current emissions profile is very similar to that of the rest of West Yorkshire, with road transport and energy use in buildings as the largest sources of emissions (Figure). Around half (51%) of emissions come from the buildings & technology sector (comprising domestic buildings, non-domestic buildings, and industry), and the majority of the remaining emissions come from transport (41% of total emissions). With the exception of land use (see below), emissions from each sector are close to 10% of those in West Yorkshire, which is broadly in line with Calderdale's relative population share.

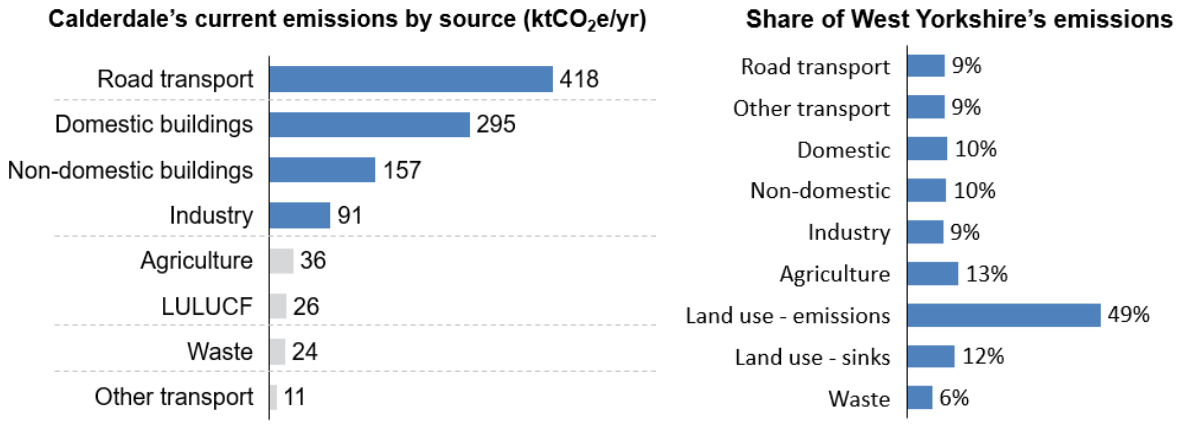


Figure 8 Modelled current emissions by source in Calderdale (left) and emissions as a share of West Yorkshire's emissions by source (right; NE = negative emissions, primarily from existing woodland)

Much of the emissions from buildings are due to heat generation, primarily due to natural gas use (93% of homes in Calderdale on natural gas, in line with West Yorkshire; 86% in England and Wales)[8]. Homes in the borough have a slightly higher energy demand than the rest of West Yorkshire, in part due to the high share of very old properties that are less well insulated (36% pre-1919 compared to 23% in West Yorkshire) and a low overall share of homes with EPC rating C or above (28% relative to 38% nationally).

Within transport, the vast majority of emissions come from road transport (97%), of which, 60% are from car use. Calderdale is assumed to have similar travel patterns to the rest of West Yorkshire,[9] with high car use (69% of all trips by car, 65% of commuter trips[10]) and a below average proportion of journeys using rail (6% of distance travelled, relative to 10% for England). More than 99% of road vehicles have conventional fossil fuel engines and all rail travel through the borough is diesel-powered.

[6] Note that the scope of emissions included in this estimate is larger than that included in the BEIS Local Authority CO_2 dataset, see section 1.2 for details
[7] From parent study modelling, not including emissions from aviation
[8] https://www.gov.uk/government/statistics/lsoa-estimates-of-households-not-connected-to-the-gas-network Note that there are uncertainties in the official dataset and the number connected to the grid may be higher
[9] Analysis of National Travel Survey data was carried out for the parent study but is not reliable at smaller (local authority) level due to small sample sizes
[10] Calderdale-specific data, from ONS Census 2011

More than half of industry emissions come from small industry (58%,relative to 38% for West Yorkshire). Little information is known about small industry, and the breakdown of business activities is assumed to be similar to the rest of West Yorkshire. There is limited large industry in the borough, with the two largest industrial sites making up 40% of industrial emissions – the Sonoco plant (paper) and its on-site combined heat and power (CHP) plant, and Nestlé Halifax (food and drink).

Calderdale has a large share of West Yorkshire's land use emissions since 50% of West Yorkshire's peatland area is in Calderdale.[11, 12] However, only 15% of West Yorkshire's woodland is in Calderdale,[12] meaning that a lower proportion of land use emissions are offset by natural carbon sequestration in Calderdale compared to West Yorkshire. Emissions from agriculture are primarily due to enteric fermentation (sheep and cattle) but are low overall as agriculture is a relatively small sector in Calderdale (<1% of England's farm holdings in Calderdale).[13]

Emissions from waste are small, as the majority of Calderdale's waste is already recycled or composted. The largest component of waste emissions (51%) is due to wastewater treatment.

2.2 Electricity generation

Calderdale has nearly three-quarters of West Yorkshire's installed onshore wind capacity (51.5 MWe; 73% of West Yorkshire's capacity; 9) but currently produces only ~10% of electricity generated in West Yorkshire (128 GWh/year). Currently, local large-scale generation produces 15% of local electricity consumption (compared to 25% across West Yorkshire; Table 3) which means that Calderdale imports the majority of its electricity from the national grid. Rooftop solar generates a further 9 GWh/year that is assumed to be used directly in buildings.

Calderdale's local electricity generation has very low carbon intensity since the majority of installed capacity is from onshore wind (compared to West Yorkshire that also has small fossil generation, energy from waste and other emitting power generation); however, this analysis does not consider Calderdale's contribution to power generation at energy from waste plants outside the borough (Calderdale's waste is currently treated at an energy from waste facility in Leeds).

Note that power generation emissions are not included in the emissions inventory and national grid intensity is used in the emissions pathways

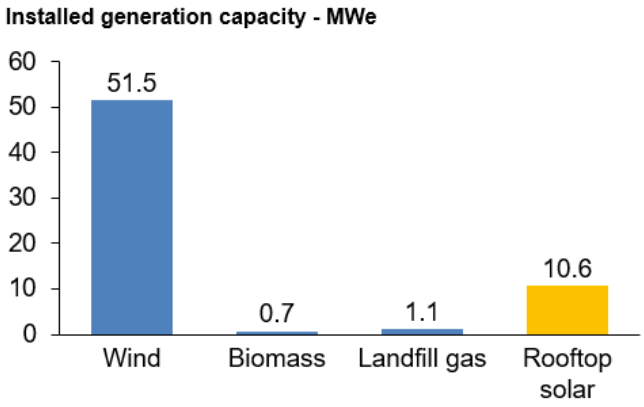


Figure 9 Breakdown of current electricity generation in Calderdale

[11] Rae, Alasdair (2017): A Land Cover Atlas of the United Kingdom (Maps). The University of Sheffield. Dataset. https://doi.org/10.15131/shef.data.5219956.v1.
[12] Evans et al. 2017 https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1904111135_UK_peatland_GHG_emissions.pdf
[13] Defra Local Authority breakdown for key crops areas and livestock numbers on agricultural holdings

Table 3 Generation carbon intensity of local large-scale electricity generation, and reliance on imports from the national grid

Area	Generation carbon intensity	Power imports
Calderdale	**1 gCO_2/kWh**	**84.7%**
West Yorkshire	**217 gCO_2/kWh**	**75.7%**
UK	128 gCO_2/kWh	–

3 Emissions trajectories

3.1 Introduction

This study considers two scenarios for Calderdale's emissions:

1. **Baseline:** The baseline represents the likely outcome if no additional policies are put in place beyond those in place today – as a result, this scenario sees slow progress due to low technology uptake and low behaviour change; however, considering the UK's commitments to emissions reduction, it is unlikely that this will be the case and, as such, this scenario should be considered to represent a realistic lower bound of possible future trajectories that is far from reaching national targets.

2. **Emissions reduction pathway (ERP)**: The ERP achieves significant emissions reduction in Calderdale through ambitious technology uptake and behaviour change, relying on a balanced technology mix across sectors (both electrification and hydrogen). The scenario targets ambitious but technically feasible change by 2038 with technology that is either currently mature or expected to become mature within the timeframe of the study.

The Emissions reduction pathway was based on the Balanced scenario from the WYCA study, with two main changes:

- Higher ambition for car and van decarbonisation, in line with current Government ambition[14]
- Higher ambition for land use change and agriculture to reflect local priorities for peatland restoration and tree planting

The results of the Baseline scenario are summarised in Section 8.2 in the Appendix; the ERP is summarised in the following section.

3.2 Emissions reduction pathway

Overview

The emissions reduction pathway represents an ambitious but technically feasible pathway to significant emissions reduction. Under this pathway, Calderdale can achieve 82% emissions reduction by 2038 (Figure 10). This emissions reduction is achieved through a combination of ambitious behaviour change and technology shift (summarised in Figure 11).

The main emissions reductions come through actions in transport and buildings, with biggest wins coming from actions to address emissions from car travel and domestic households. The key remaining emissions sources are from remaining fossil fuelled vehicles (conventional petrol and diesel, as well as hybrids) and emissions from electricity use in buildings, vehicles, and industry.

Reaching net zero will require further, largely speculative measures, which must be explored at local level and the mix of these will be determined by developing evidence and local priorities.

[14] Targeting an end to conventional petrol and diesel car and van sales by 2030

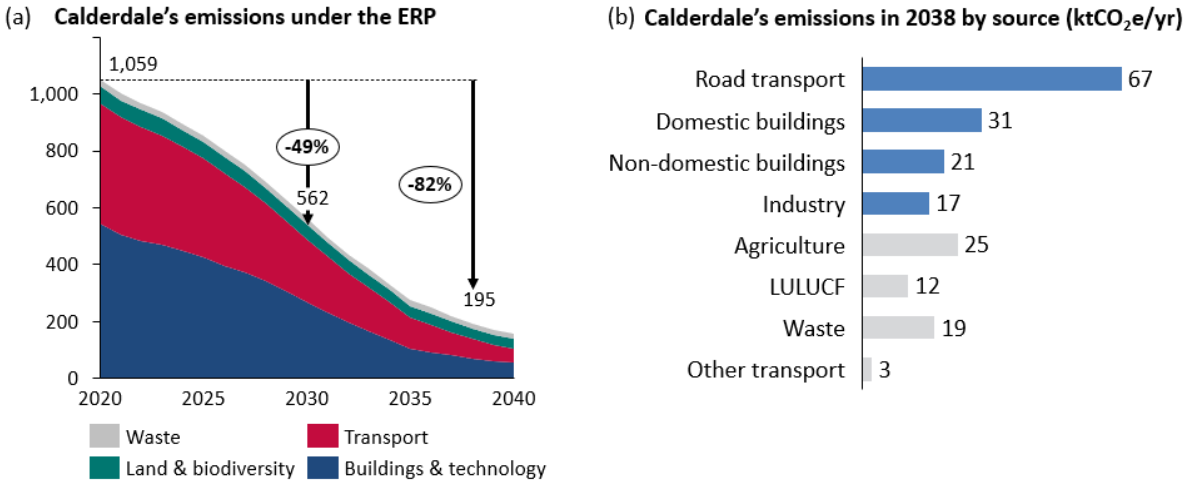


Figure 10 (a) Trajectory of emissions under the emissions reduction pathway (ERP) and (b) breakdown of emissions in 2038 by source

Transport
Sales of zero emissions cars reach ca. 4,300/yr by 2038 (86% sales)
Walking increases by 80% & cycling increases 22x compared to today
Public transport travel increases by 50% compared to today
Buildings & Technology
Retrofit of 69,000 homes to reach EPC C or better
49,000 heat pumps & hybrid heat pumps installed, or ca. 9/day from 2025-2035
hydrogen equipment developed and deployed for select industry and buildings by mid-2030s
Solar PV and onshore wind reach 143 MW (4.8 MW/yr from 2020-2030
Electricity infrastructure investment enabling 51% higher annual demand
Land Use & Biodiversity
100% lowland and 60% upland peatland restored
450 hectares of new forest planting
Diet change to reduce red meat and dairy consumption by 32%, leading to 24% reduction in sheep & cattle
Waste
35% reduction in avoidable food waste and increase recycling of municipal waste

Figure 11 The scale of the challenge - what needs to be achieved to reach 82% emissions reduction by 2038

Transport

The emissions reduction pathway represents a trajectory in which both hydrogen and battery electric technologies are strong options across transport sectors.

Under this scenario, transport emissions decrease by 84% by 2038, driven by high levels of technology shift and ambitious behaviour change (Figure 12). Of the emissions savings, close to half are due to actions to address car emissions. Of these, just under half are due to behaviour change while the remainder are due to shifting remaining travel demand to ultra-low and zero emissions cars.

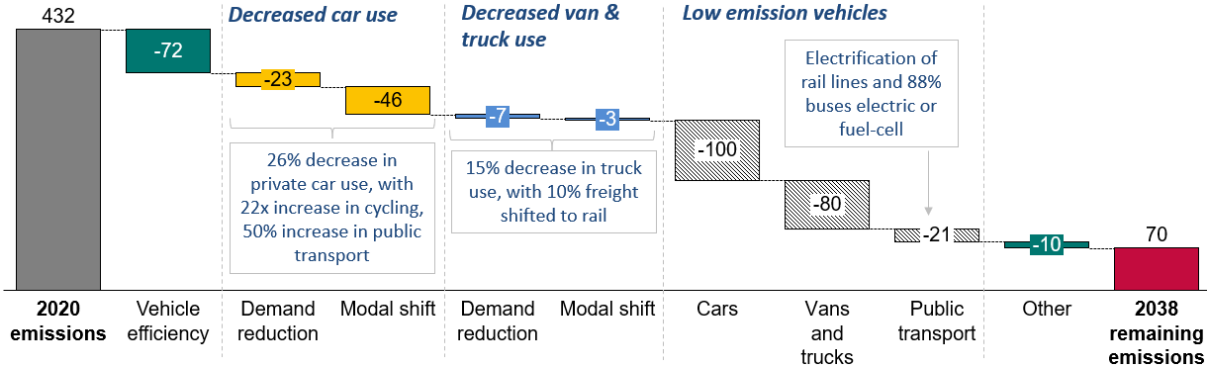


Figure 12 Contribution of modelled measures to emissions reduction between 2020 and 2038 in the Transport sector

Behaviour change is important not only for direct emissions savings but for reducing the number of low emissions vehicles that need to be sold in Calderdale to meet the climate goals,[15] reducing supply chain emissions and making the most of limited supply chains (especially early in the timeframe). Behaviour change measures comprise:

- **Absolute demand reduction**: a 12% reduction in passenger kilometres travelled relative to the Baseline is assumed to be achieved by 2038 through measures such as increased home working, teleconferencing, and closer proximity of housing to workplaces and amenities
- **Modal shift:** Of the remaining passenger travel demand, 36% of private car use (vehicle kilometres, vkm) is shifted to public, shared and active travel by 2038, requiring:
  - 8% of car vehicle km shift to **shared cars** by 2038 (either car clubs or car sharing)
  - Active travel to increase by 80% for walking trips and by a factor of 22 for cycling (reaching 12% of total travel distance)
  - Public transport: passenger km increase of 60% for trains by (by 2038) and 36% by 2038 for buses

Overall, compared to the Baseline scenario (see Section 8.2, Appendix), private car use decreases by 38% by 2038 (26% compared to today). Meeting the required increase in public transport will require an increase in capacity for both rail and buses. While some of the required rail capacity may be met using current infrastructure (e.g. by lengthening current trains), track capacity may be limiting and increases in infrastructure may also be required.[16]

Behaviour change is also assumed for heavy goods vehicles and vans, with van activity decreasing by 1% and heavy goods vehicle activity decreasing by 15% through measures including: consolidation,

[15] Without reducing private car use, 2,900 more zero emission cars (67% more) would need to be sold each year to reach the same share of zero emissions vehicles on the road (77% of cars either battery electric or hydrogen fuel cell)

[16] Based on Leeds City Region Capacity analysis draft report

shift to rail freight and cycle freight, and reductions in waste resulting in decreased freight travel demand.

For cars and vans, low emissions technology rollout follows the fastest rate considered feasible, requiring an end to conventional petrol and diesel vehicle sales by 2030 for cars and vans. Plug-in hybrids are removed from sale by 2035. This is in-line with current Government ambition. Sales of diesel buses end in 2031, but sales of hybrid diesel buses are allowed to continue until 2040.

Heavy goods vehicles are the hardest sector to decarbonise and sales of combustion engine vehicles continue until 2040; however, a switch to biomethane-fuelled vehicles (bio-compressed natural gas, BioCNG)[17] enables faster emissions reduction and can help to end the sales of diesel engines in the late 2030s.

For Calderdale, reaching this level of technology deployment (see Figure , Appendix page 49 for fleet share) requires:

- **Sales on the order of 2,000 zero emissions cars per year by 2025** in the region, going up to 4,300 per year by 2038, of which more than 90% are battery electric vehicles
- **Sales of zero emissions heavy goods vehicles** reach around 115 per year in 2038, of which close to 76% will be battery electric vehicles

For rail, all local lines, including the Calder Valley line, are assumed to be electrified early in the next National Rail Control Period (2024-2029), with all passenger and freight journeys fully electric by 2029.

Buildings & technology

Buildings & technology emissions reduce by 87% by 2038 under the emissions reduction pathway (Figure 13). Half of the emissions savings are due to measures in domestic buildings, of which, just under three quarters are due to low carbon heating rollout (73%).

A high level of energy efficiency retrofit is assumed across all buildings, with 69,000 homes brought to EPC C or higher (to reach 100% of homes at or above EPC C). Energy efficiency delivers emissions savings through reducing energy demand but is also essential to enable rollout of low carbon technology such as heat pumps. Over all building types, fuel consumption reduces by 47% by 2038 due to both high rollout of building efficiency measures and improved efficiency of electric heating technologies.

By 2038, there are around 49,000 heat pumps (including hybrids) and 17,000 hydrogen boilers in domestic homes. Hybrid heat pumps will primarily use either hydrogen or natural gas (with a high mix of biomethane) as their supplementary fuel. The non-domestic sector sees 11% heat supplied by hydrogen, 16% by hybrid heat pumps (using hydrogen) and 23% through full heat pumps by 2038. See Figure , Appendix page 50 for full breakdown.

District & communal heating increases to 17,000 (15%) and 4,000 (3%) homes, respectively, and 13% non-domestic buildings by 2038, focused in heat dense areas. The energy supply primarily utilises heat pumps, supplemented by gas technologies for peaking (times of high demand).; this supplementary heating is assumed to be predominantly natural gas CHP in the 2020s but transitions to hydrogen boilers by the early 2030s.

[17] BioCNG vehicles use an internal combustion engine but use compressed natural gas as a fuel; if the gas is 100% sourced from biomass, well-to-wheel emissions can be 85% lower than diesel

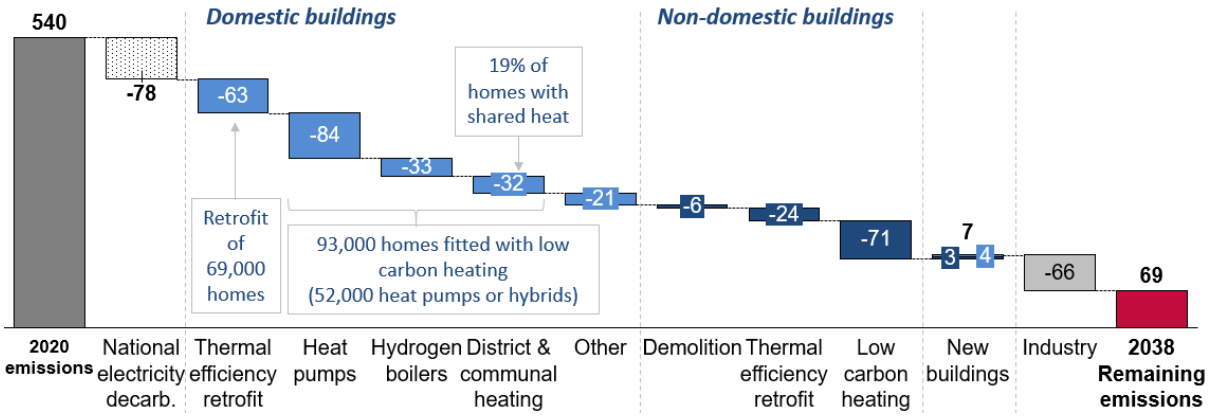


Figure 13 Contribution of modelled measures to emissions reduction between 2020 and 2038 in the buildings & technology sector. National electricity decarb. represents the impact of decarbonisation of the national electricity grid, ahead of any technology changes; Heat pumps includes hybrids heat pumps; Other includes gas grid decarbonisation, Solar PV, lighting and appliance efficiency, biomass boilers and electric heating.

Direct electric heating is deployed in buildings which are not suitable for heat pumps (14,500 homes; 12%).

Building scale solar PV reaches 18,000 domestic installations and 7 GWh/yr non-domestic generation by 2038.

In industry, the majority of emissions reductions in the 2020s come from energy efficiency and decarbonisation of the electricity grid. Small industries are assumed to use a mix of of electricity, bioenergy, hydrogen and significant gas by 2038; the gas from the gas grid has low carbon intensity due to biomethane blending. The Sonoco gas CHP plant is assumed to switch to hydrogen in the 2030s as the least disruptive option for decarbonisation[1]

Power

By 2038, total local generation is expected to double to reach 269 GWh/yr (Figure 14). The majority of growth is in onshore wind and large-scale solar, with landfill gas generation decreasing. Generation emissions increase slightly due to a small amount of deployment of dedicated bioenergy capacity in line with the wider West Yorkshire region and the UK; however overall emissions from power generation remain very low (2 gCO_2/kWh) in absolute terms since bioenergy is a very small contributor to local power generation and is a low emissions form of power generation.

Local generation will produce 22% of local grid electricity consumption (not including rooftop solar)[18] meaning that Calderdale will become slightly less dependent on imports than it is currently (compared to West Yorkshire which will become slightly more dependent on imports; Table 4). However, power generation is still insufficient to fully meet the borough's consumption needs, so electricity imports are still needed.

[18] Electricity generated by rooftop solar is assumed to be used directly by buildings and therefore reduces the requirement for electricity sourced from the grid.

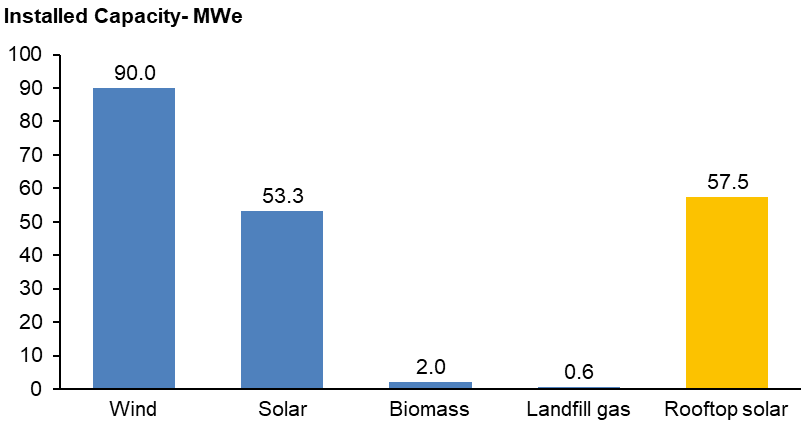


Figure 14 Calderdale electricity generation capacity in 2038 under the emissions reduction pathway

Table 4 Generation carbon intensity of local large-scale electricity generation, and reliance on imports from the national grid in 2038 under the emissions reduction pathway

Area	Generation carbon intensity	Power imports
Calderdale	**2 gCO_2/kWh**	**78%**
West Yorkshire	**42 gCO_2/kWh**	**79%**
UK	40 gCO_2/kWh	–

Land & biodiversity

Emissions from the Land & biodiversity sector decrease by 40% by 2038 relative to today, with emissions reductions from peatland restoration, tree and energy crop planting, sequestration and agricultural change offsetting increased emissions from urban expansion (Figure 15). However, due to constraints on land availability in Calderdale, emissions reductions are not sufficient to bring emissions to zero or net negative.

Peatland restoration is the largest contributor to emissions reduction in land use, with 100% lowland and 60% upland peatland restored by 2038. Forest area increases by ~450 ha 2020 – 2038, in line with the planting level included in the Baseline.[19] Bioenergy crops reach 530 ha by 2038, contributing to carbon sequestration as well as providing a source of fuel to decarbonise other sectors (e.g. biomethane for injection to the grid, bioenergy with carbon capture and storage in other regions of the UK).

Behaviour change to achieve a 32% reduction in red meat and dairy consumption and 35% decrease in food waste are the largest contributors to emissions reduction in agriculture. Alongside on-farm measures,[20] these measures also help to free up land for other mitigation measures.

However, although the diet change assumptions are ambitious, the modelling assumes that red meat reduction is replaced by increased pork and poultry consumption[21] – if the reduction in red meat protein is met through solely plant protein (as in the Climate Change Committee's latest 6th Carbon Budget

[19] Note that this is higher than the level of planting assumed in the parent WYCA study and necessarily requires trade-offs in land use for other purposes (other mitigation, climate resilience, biodiversity).
[20] Including increased stocking density, improved crop yields, and nitrogen use efficiency
[21] In line with the parent study, based on *Quantifying the impact of future land use scenarios to 2050 and beyond* (2018) UKCEH for CCC

scenarios), emissions from agriculture may reduce further and more land may be spared for additional land-based mitigation.[22]

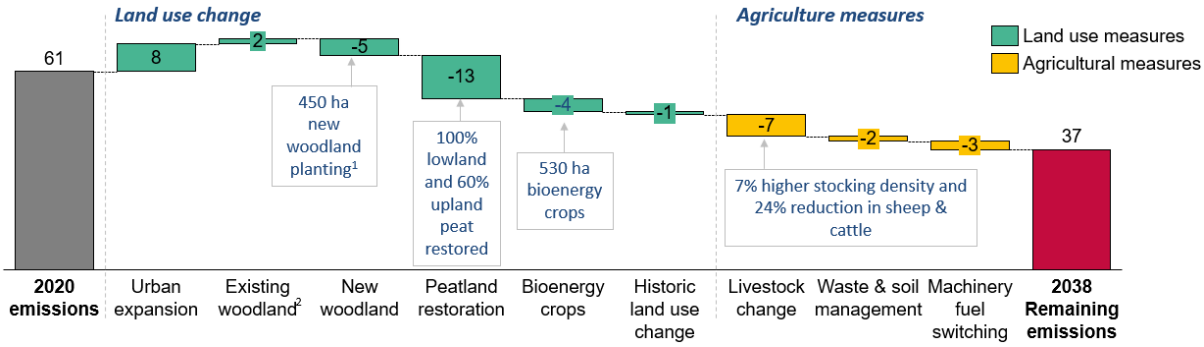


Figure 15 Contribution of modelled measures to emissions reduction between 2020 and 2038 in the Land & biodiversity sector

Waste

The waste decarbonisation pathway is based on the Further Ambition Scenario from the CCC's Net Zero Report (2019). Given the low emissions due to Waste in Calderdale, only a modest emissions reduction is seen by 2038 (26%; 14% compared to Baseline; see Figure 30, Appendix page 48). The largest emissions savings come from efficiency and process improvements in wastewater treatment and reduction in the remaining landfill emissions.

Landfill emissions reduce due to the England-level targets set by CCC's Further Ambition Scenarios: 20% reduction in avoidable food waste, eliminating 5 key biodegradable waste streams sent to landfill and increasing recycling of municipal waste to 70% by 2025.

3.3 Hydrogen in the pathways

The emissions reduction pathway requires deployment of hydrogen in selected buildings, industry, and transport types but there is uncertainty over its delivery in Calderdale.

Based on Northern Gas Network's current progress and plans,[23] as well as Government recent announcements for hydrogen and CCS strategy,[24,25] it is technically feasible that hydrogen could reach Calderdale by the mid-2030s. However, there is a great deal of uncertainty over the future role of hydrogen in the energy system and the timeframe for rollout will depend on national-level decisions and funding.

As Calderdale is likely to be one of the later areas in West Yorkshire to receive hydrogen under current plans,[23] the Council will need to monitor and review the role of hydrogen in the local decarbonisation pathway regularly to minimise the risk of delays or non-delivery. In practice, this would likely involve accelerating the electrification of heat and industrial processes.

[22] Including more forest planting, hedgerow planting, and agroforestry
[23] The H21 North of England places hydrogen in Calderdale (Halifax) by 2033
[24] *The Ten Point Plan for a Green Industrial Revolution* (2020) BEIS
[25] Open consultation for rollout of Carbon Capture and Storage in industrial clusters

Hydrogen in the Emission Reduction Pathway

By 2038, 527 GWh/yr of hydrogen is required in Calderdale, but this is a relatively small proportion of total fuel demand (22% of all fuel used):

- **In transport**: 4% of road vehicles use fuel cells, primarily buses and trucks but use of hydrogen in transport does not rely on local grid conversion
- **In buildings & technology:** 17,000 homes (15%) and 2% of businesses use hydrogen boilers, with additional hydrogen demand from the 24,000 homes (20%) and 17% of businesses that use hybrid heat pumps. Industrial use is higher, with 42% of fuel demand from hydrogen,[26] however, industrial hydrogen use does not necessarily rely on wider grid conversion since single (large) sites can be connected to dedicated pipelines where feasible.

In the worst-case, if hydrogen does not reach Calderdale by 2038 and all hydrogen appliances projected to be installed in Calderdale by 2038 instead ran on natural gas, emissions would increase by 30-60 $ktCO_2e/yr$.[27] In practice, CMBC should aim to mitigate this impact if hydrogen does not become available in the borough in time; for example, by increasing rollout of heat pumps or hybrid heat pumps in place of hydrogen boilers in the 17,000 homes that use this technology in the ERP. The extent to which alternative low carbon heating solutions are need (i.e. what share of the 17,000 homes need to receive heat pumps) will be determined by the extent of the delay in hydrogen reaching Calderdale. Therefore, it will be important for CMBC to regularly review progress of local hydrogen deployment and adjust its approach (and the pathway) to minimise emissions.

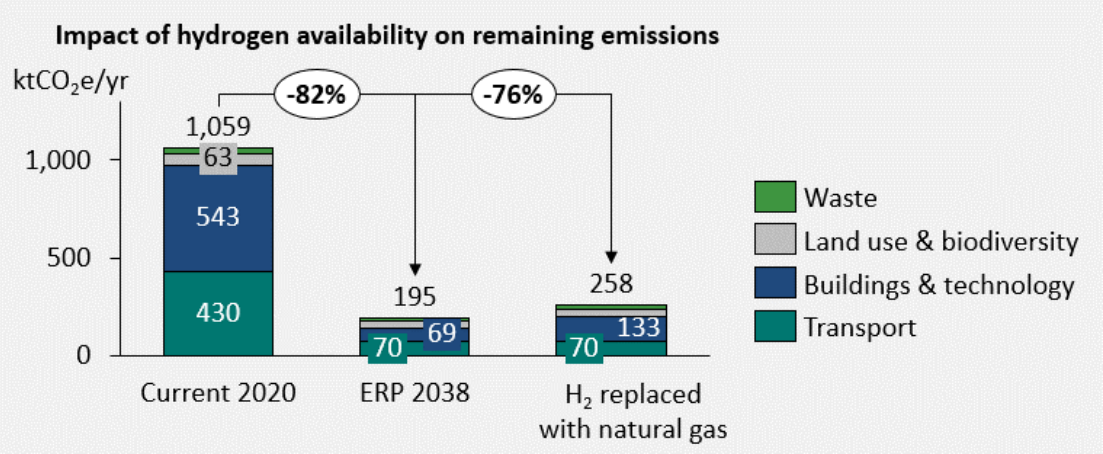


Figure 16 Impact of hydrogen availability on remaining emissions. The emission difference between incorporating hydrogen into ERP compared to natural gas.

3.4 Reaching net zero

Reaching net zero means that any remaining emissions in the Borough are offset by carbon sequestration, or offsetting. While some natural solutions for carbon sequestration are included in the ERP under the land use & biodiversity sector, these are not sufficient for Calderdale to reach net zero emissions by 2038 under the measures modelled. This is largely due to the high contribution of buildings and transport emissions.

Key challenges to reaching net zero include:

- **Stock turnover rates** limit how fast technology can be replaced even with strong incentives, meaning that some fossil fuel options (particularly vehicles) remain in 2038
- **Electrification of heat and transport relies on decarbonisation of the national grid** to reach net zero

- **Calderdale has limited options for negative emissions** within the borough boundaries – with no opportunity for bioenergy with carbon capture and storage within power or industry, and limited land availability for natural solutions

Further options to close the gap in Calderdale include:

- **Investing in renewable energy** to fully offset national grid carbon intensity would reduce emissions by a further 6% (to 87% reduction; Figure 17)
  - Doing this within the borough would require ~4 kha total land area if the additional demand (1 TWh) is met using solar PV, but ~10 kha land area if it is predominantly met using onshore wind (~30% of total land in the borough)
  - Alternatively, this could be achieved by investing in renewables outside the borough (e.g. through a Power Purchase Agreement[26]
- **Increasing the level of new forest planting** to increase local sequestration, but with required further trade-offs with other land uses**:**
  - If forest planting is increased to meet the target recently set by the White Rose Forest (2.5 kha by 2050) can reduce emissions but only by a further 1% (Figure 17)[27]
  - Fully addressing emissions through tree planting would require over 16 kha land (50% of land in the borough)

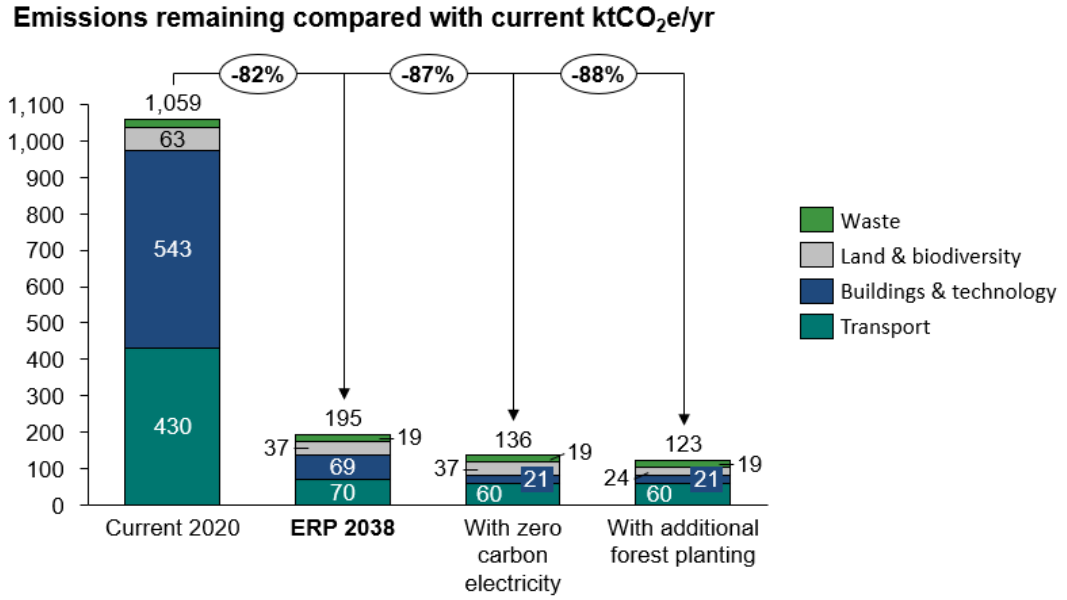


Figure 17 Illustrative impact on emissions of selected measures beyond those modelled in the ERP. Additional forest planting represents levels of planting recently committed to with the White Rose Forest.

[26] City of London recently secured a PPA for a solar farm in Dorset https://news.cityoflondon.gov.uk/citys-pioneering-green-energy-deal-could-be-blueprint-for-local-authorities/ (accessed March 2021)

[27] Based on emissions reduction in Woodland Carbon Code carbon calculator, assuming mix of Conifer (Yield class 14) and Broad leaf (Yield class 6)

As set out in section 3.2, more ambitious land use measures could be considered if more land could be spared however it is likely that more speculative technologies or system changes will also be needed, such as:

- **Negative emissions** methods (e.g. direct air capture with CO_2 capture and storage or utilisation)
- **Circular economy system changes** for example to reduce material consumption, processing and disposal (see also section 6.2)
- **Carbon offsetting outside the borough** – this could include a range of options such as: Afforestation, avoided deforestation or other land use change outside the borough, destruction of industrial pollutants such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), containment or combustion of methane generated by landfills or farm animals (using an anaerobic digestion plant), direct purchase and subsequent retirement of emissions allowances within trading schemes such as the EU Emissions Trading Scheme. Any offset used must represent real, additional, verifiable and permanent emission reductions.

However, many of these options are low maturity and will require detailed assessment to fully understand the impact, scale and wider implications as well as to determine the best mix to align with local priorities. Further research is recommended over the next few years to determine which of these options are feasible and preferrable.

4 Roadmaps

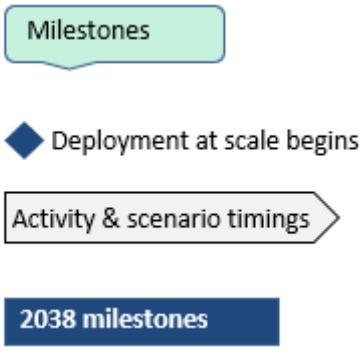
Overview

The emissions pathway modelling defined the scale of action required to reduce emissions in Calderdale under a Balanced emissions reduction pathway. Many of these actions must be taken by People & Communities, since many of the measures rely on change in private homes and businesses as well as personal travel and lifestyle choices.

To empower the Borough to take appropriate, targeted action to deliver their climate ambitions, implementation roadmaps have been constructed to detail the rate of change, key implementation timescales and activities to support delivery of the pathways, and milestones by which to monitor progress. The roadmaps aim to provide a clear picture of the required progress along the ERP.

Key information is represented on the roadmaps using the following indicators:

- Key milestones are represented by bubbles assigned to a fixed date
- Start dates for deployment at scale are marked
- The duration and expected end date of large-scale action is indicated by arrows
- Final 2038 milestones (maximum achievement in the modelled scenarios) are highlighted in blue



Sector roadmaps are provided on the following pages for transport, buildings & technology, and land & biodiversity. The roadmaps start in 2020 to highlight that some actions are already underway (at local or regional level); however, it is recognised that the majority of action will commence from 2021.

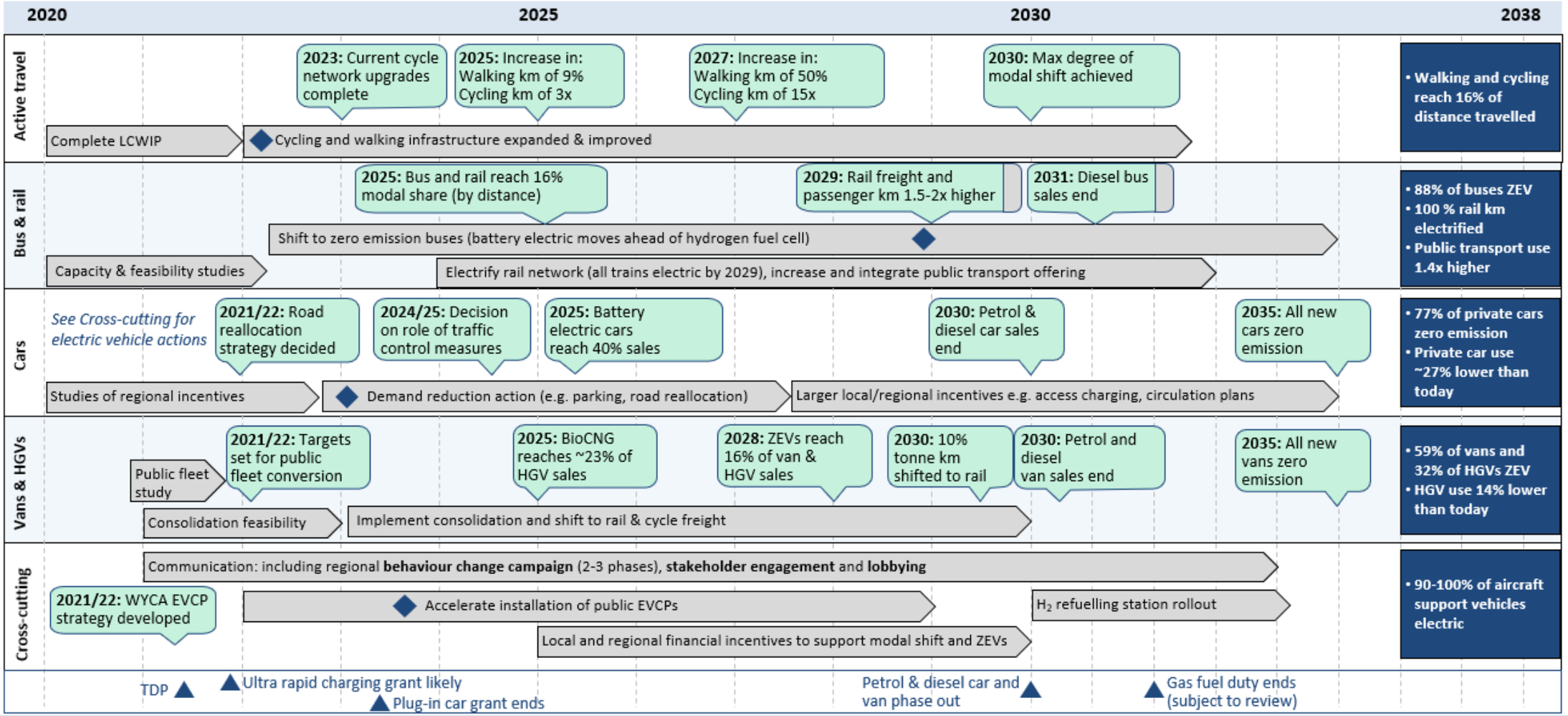


Figure 18 Transport roadmap. EVCP = electric vehicle charge point; BioCNG = biomethane, supplied as compressed natural gas; ZEV = zero emission vehicle; HGV = heavy goods vehicle; TDP = Transport decarbonisation plan

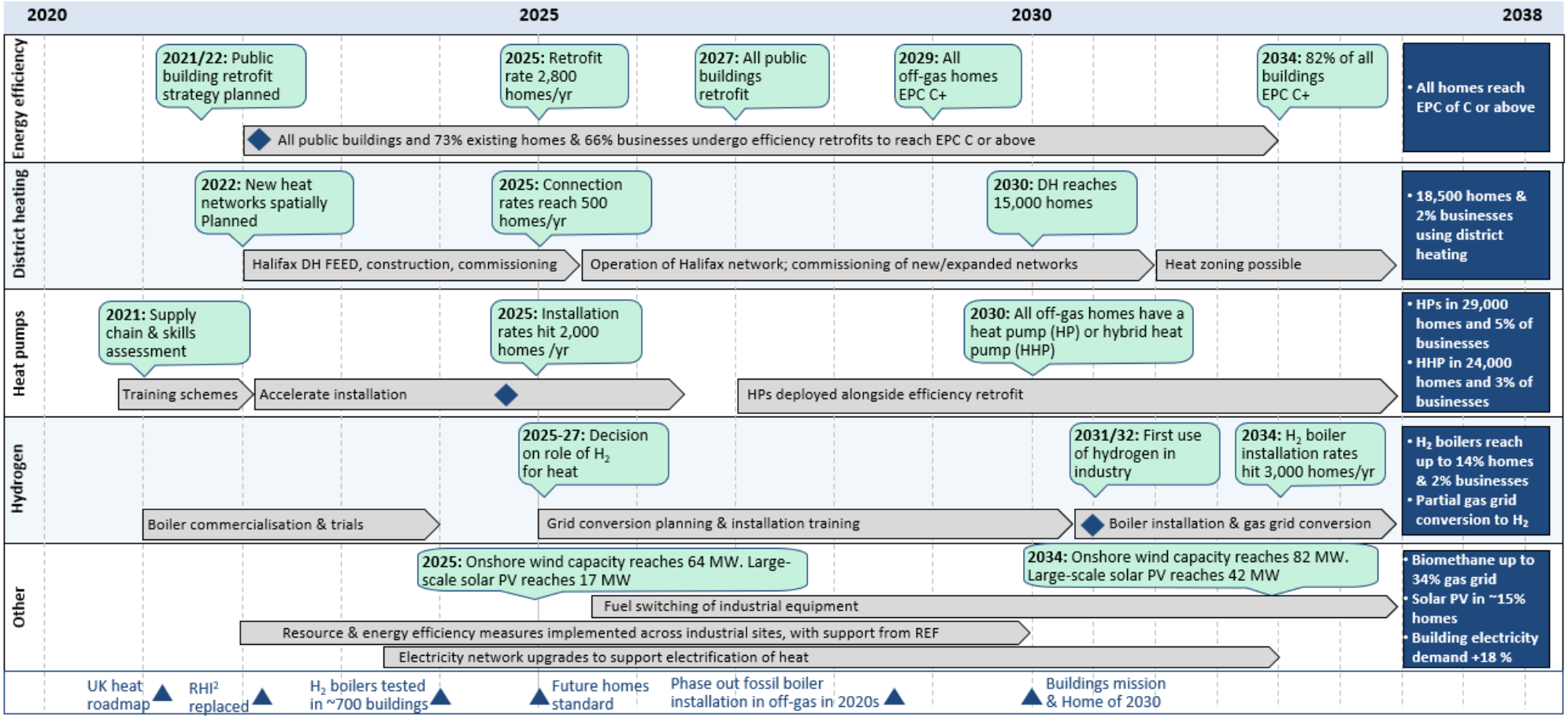


Figure 19 Buildings & technology roadmap. RHI = Renewable Heat Incentive; HP = Heat pump; HHP = hybrid heat pump. Note that the first use of hydrogen in industry is assumed to be earlier than the date at which hydrogen becomes widely available through the gas grid since larger sites can be served by dedicated pipelines.

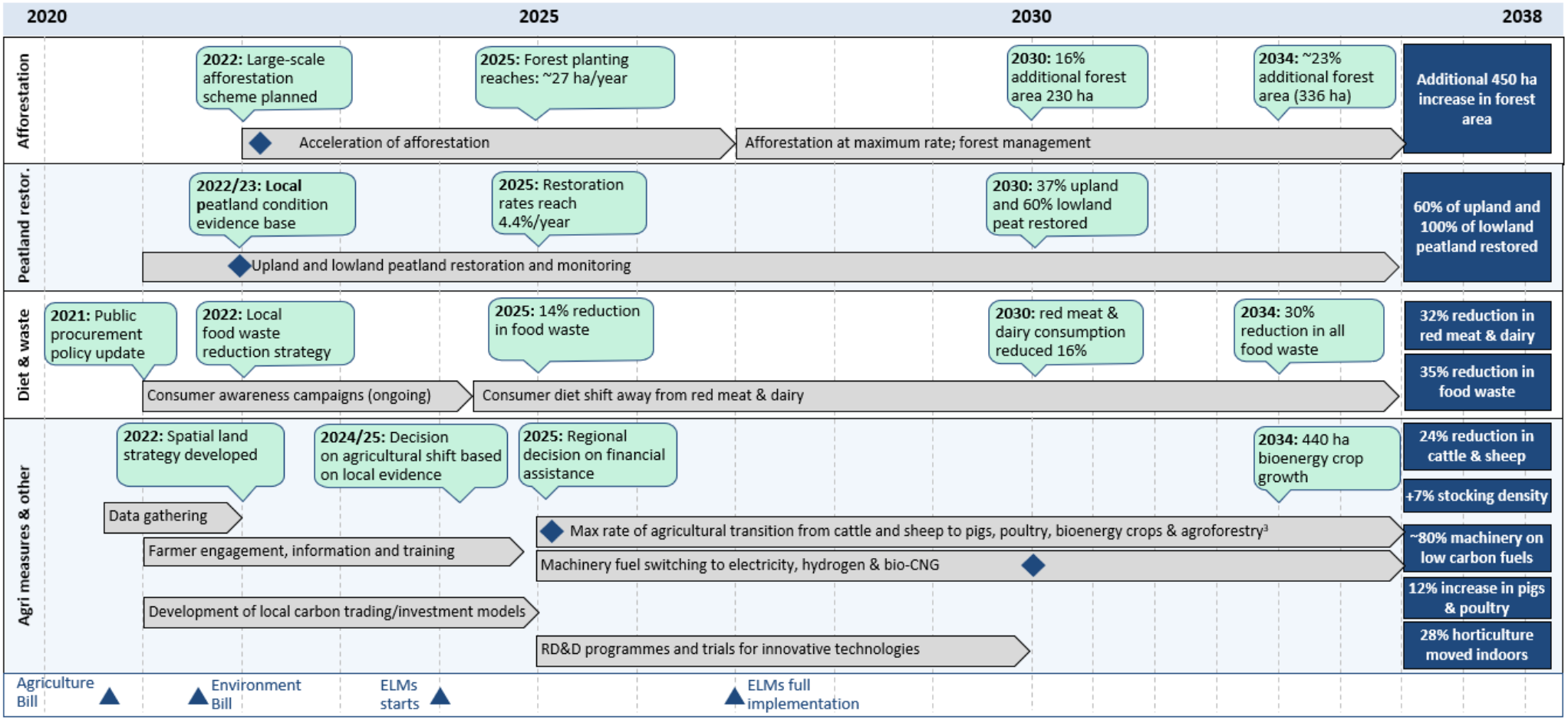


Figure 20 Land & biodiversity roadmap. ELMs = Environmental land management scheme.

5 Policy recommendations

5.1 Introduction

Calderdale's net zero target represents a substantially accelerated timeline for emissions reduction relative to the UK Government's target of net zero by 2050. Meeting these targets will require a wide range of ambitious actions that go beyond current policy and likely entail higher risk and cost to the Borough.

While it is acknowledged that WYCA is developing its own net zero strategies, and some measures will be best delivered at regional level, CMBC has a significant and critical role to play in supporting the net zero transition. This role ranges from planning, communication, and coordination to direct delivery of measures and demonstrator projects. CMBC therefore needs to take a proactive role in both leading local delivery and in working to put the borough in a strong position to take advantage of opportunities as they arise (at national or regional level) while aligning with regional work where feasible.

It is important to note that:

- **Both CMBC and WYCA will still be reliant on strong national policies** to achieve their goals
- **CMBC will need significant additional resource** (designated staff) and funding to deploy these policies and take crucial actions; this funding is not currently available and therefore further funding will therefore need to be secured in order to achieve the borough (and region's) climate ambition
- **Some actions are outside the remit of CMBC** and rely on action by stakeholders, private sector and individuals to fully achieve; in addition, many aspects of the ERP are reliant on external decisions (e.g. the role of hydrogen).

A long-list of policy actions that CMBC can take for each Theme has been drawn up based on best practice examples, and established reports, with a focus on action in the short-to-medium term. These actions align with those recommended at WYCA-level in the parent study but are tailored to the local context. The scale and pace of change in many sectors is unprecedented, so not every policy has a prior example of successful implementation at this scale. Note that the policies are written from the perspective of CMBC and the actions it can take; many of these actions are supporting action by the private sector.

The actions were appraised according to the following criteria:

- **Cost & resources:** high-level (indicative) estimate of the number of full-time equivalents (FTEs) needed to run the program and, where appropriate, the cost (e.g. of direct financial support), based on best practice examples, where available, or modelled costs
- **Risk and barriers:** Key risks and expected barriers to delivery of the project or achieving the project aims e.g. around engagement and uptake, national policy support, overspend etc
- **Role of stakeholder:** Summary of the different roles at each level of governance (i.e. CMBC vs WYCA). Other key stakeholders to interact with or that are crucial to delivery.
- **(Co) benefits:** significant additional benefits beyond carbon savings that support other Council aims
- **Key impact:** primary aim of the action and key links to other actions

The detailed appraisal tables are provided in a separate Annex to this report.The actions are summarised in the following sections. They are further summarised into action plans for each sector according to short (2020-2025), medium (2025-2030) and long (2030-2038) term in section 7.

5.2 Cross-cutting action

There are a number of actions that support emissions reduction measures across all sectors, either through targeting common objectives (such as encouraging behaviour change, developing local skills), enabling necessary infrastructure development, or through coordinating action across sectors to align priorities. These actions are summarised in Table 5.

Table 5 Summary of recommended cross-cutting policy actions

No	Policy Description	Role of CMBC
C1	Continue to **promote behaviour change** in line with climate ambition through: • **Aligning existing and future behaviour change campaigns with climate objectives** – e.g. Public Health initiatives, Active Calderdale • Linking to and **promoting wider WYCA behaviour change initiatives** in communications with residents and businesses **Immediate, with ongoing activities and review** **Wider WYCA campaign recommended to start in 2021**	• **Local engagement**, led through existing channels • Wider scheme led and delivered by WYCA
C2	Support **development of a spatial development strategy** for the WYCA region by ensuring that: • Local strategic priorities have been defined and data is available; for example, areas of land designated for each use, such as land use mitigation potential and nature recovery network future needs, power generation, and housing development • Calderdale's data and priorities are incorporated • Region-level strategy is reflected in Local Plan and planning decisions **Wider strategy recommended to be delivered by 2022/23, with ongoing review** **CMBC preparation to begin from 2021/22 to feed into that strategy**	• **Define own priorities** across sectors • **Coordination** of local departments
C3	Support **development of hydrogen and electricity infrastructure**, through engaging with necessary parties to share data, stay informed of plans, and ensure planning permission and land are granted/available where needed for larger schemes (e.g. bringing H_2 to Halifax and industrial sites). **2024 onward**	• **Engagement** (alone or via WYCA)
C4	**RD&D: Explore speculative options to reach net zero including:** • development of an **offsetting strategy** • supporting **local trials of innovative technologies** such as direct air capture • potential for **greater land use solutions** (inside and outside the Borough) • options for achieving **fully renewable electricity** supply **2025 - early 2030s**	• **Lead in defining own net zero strategy** but with strong links to any WYCA-level regional strategy
C5	**Skills & training:** Work with local education providers and projects to develop climate action training programmes across transport, heat, industry, and land use sectors. **Build on existing engagement, with programmes delivered from 2022/23**	• **Engagement and facilitation**
C6	**Influence & support:** Work with WYCA to **ensure region-wide investment in digital infrastructure** to enable working from home and transport technology rollout **By 2022**	• **Engagement**
C7	**Planning & regulatory:** Increase the capacity of the planning office to allow for enforcement and monitoring of climate mitigation actions	• **Implemented by CMBC**
C8	**Communication & information:** Use local communication channels to highlight available incentives for climate change action and raise awareness of climate change options. Calderdale could consider **participating in local trials of incentives** ahead of wider rollout in the region.	• **Local engagement** led through existing channels

No	Policy Description	Role of CMBC
	Participation in trials 2021-2025 **Wider scheme promotion from 2025** (or in line with developments at WYCA-level)	

5.3 Transport

Overview

Reducing private car use is a top priority for emissions reduction in transport. Encouraging residents to reduce their reliance on private cars requires them to be confident that they can meet all their travel needs by other, sustainable means. As such, achieving modal shift will require a combination of measures that aim to discourage car use and provide a comprehensive offering of shared, active and public transport.

As set out in the roadmap (Figure 18, page 18), measures to enable the transition of remaining vehicles to fully zero emission are expected to be deployed at scale in the medium-term but action to lay the foundations and to accelerate delivery must start now.

Calderdale work-to-date

Calderdale has already set ambitions for active travel within the borough through its Transport Strategy and Cycling Strategy, and the backbone of a comprehensive cycling network is already funded through the Transforming Cities Fund and West Yorkshire-plus Transport Fund. Additionally, Calderdale is supported by wider strategies, including the developing WYCA Connectivity Infrastructure Plan, which includes Calderdale in two priority areas and identifies Halifax as a priority Gateway for future travel.

The Council has also begun the process of transitioning to electric vehicles within its own fleet, with 35 battery electric and plug-in hybrid vans deployed in 2020. Calderdale currently has a lower charge point provision per capita compared to the UK average[28] but sets out ambitions to install charging facilities at taxi ranks and for public use in its Transport Strategy.

Recommended actions

Recommended actions to support the delivery of the ERP in Transport are summarised in Table 6.

Table 6 Summary of recommended Transport policy actions

No	Policy Description	Role of CMBC
Overarching		
T1	**Use local planning policy** to incentivise and support delivery of measures. Likely levers include: • Requiring **minimum standards for new developments** • targeting **mixed use developments** (e.g. **'15 minute neighbourhoods**') • **Establishing a framework** that ensures all strategic decisions, plans and policies consider transport emissions reduction ambitions and Healthy Streets considerations • **Introducing and enforcing Supplementary Planning Document** requirements for new developments **2020-2025**	• **Deliver policy**

[28] 16 per 100,000 population compared to 31 for UK, source: http://maps.dft.gov.uk/ev-charging-map/

No	Policy Description	Role of CMBC
Demand management		
T2	Develop **local strategy for road space reallocation** to cycling, walking and public transport to ensure that individual transport mode strategies are aligned and complementary. Limit new road building along local routes. **By 2023 (in parallel with other strategies)**	• **Lead assessment** of local roads and ensure link with strategies at WYCA-level
T3	Develop and implement **parking control measures** that discourage private car use and encourage low emissions technology uptake. This should include: • **reducing on-street parking** and reallocating to other uses • Implementing **banded parking charges** that vary with vehicle emissions, • **I**ntroducing **workplace parking levies** where appropriate and assessing implementing a cap on business parking permits. **Parking strategy already underway** **2021-2022**	• **Develop and implement local strategy** and ensure link with strategies at WYCA-level where appropriate
T4	Implement **traffic control measures** such as: • **zero emissions zones (ZEZs**) in town centres. • **Strategic road closures and/or modal filters** for town centre routes • **20mph limits** on all residential roads and appropriate major roads • **Access charging** (linked to ZEZs, circulation plans etc) and road user charging where appropriate **Feasibility by 2023** **Implementation 2025-2030**	• **Deliver measures**
Modal shift		
T5	Expand **cycling and walking infrastructure** beyond already funded routes, including delivery of full network outlined in current Cycling Strategy. Support infrastructure delivery by continuing to provide measures such as cycle training, cycle repair, maps etc. Link to behaviour change campaign. **Plan development by 2022/23** **Full implementation 2024-2030**	• **Direct delivery of infrastructure**
T6	Expand **cycle parking** provision across the borough, including hubs at major rail and bus stations and secure storage in residential areas, and catering for a range of bike types (including ebikes and cargo bikes) **By 2025**	• **Deliver in partnership with WYCA** and transport providers
T7	Work with WYCA **to ensure delivery of expanded and improved bus services** that meet the needs of all user groups and are fully integrated into the future transport network to ensure optimum connectivity. **Engagement immediately, delivery of improved network by mid-2020s**	• **Engage with WYCA** to determine routes
T8	Continue to support **trials of innovative services,** such as on-demand shared transport to support public transport provision, to integrate into wider strategy **From 2022/23**	• **Deliver in partnership with WYCA**
T9	**Assess CMBC staff travel needs** to set targets and implement targeted sustainable travel policies including: • **Addressing grey fleet emissions** through: Strengthening travel policies, partnership with car clubs and purchasing low emission pool vehicles • **Encouraging shared and public transport for commuting**, including through inviting innovative services into area to serve common routes **By 2022**	• **Lead assessment**

No	Policy Description	Role of CMBC
T10	**Encourage local employers to assess staff travel needs** and to implement sustainable policies and to address grey fleet emissions. **From 2022/23**	• **Lead or facilitate engagement** if wider WYCA initiatives if in place
T11	Explore opportunities for **Council-supported shared mobility,** such as bike sharing and increasing the car club offering **Feasibility and trials by 2025**	• **Lead delivery** in partnership with mobility providers
Decrease van and truck use		
T12	Assess feasibility and implement trials of **freight modal shift, consolidation and sustainable last mile delivery (**including cycle freight and electric road vehicles). **Feasibility and trials by 2025** **Full implementation in feasible areas by 2030**	• **Lead feasibility and delivery** but engage with WYCA to stay informed of wider opportunities
Zero emissions vehicles		
T13	Fully convert CMBC **fleet to zero emission vehicles** (including waste vehicles). Strategy will need to consider appropriate options for all vehicle types as well as constraints, such as fuel availability and grid constraints at fleet depot. **Fleet conversion strategy by 2021/22** **Fully convert car and van fleet by 2030; Minibuses and HGVs as soon as feasible.**	• **Deliver**
T14	**Financial:** Expand **public electric vehicle charge point provision** throughout the borough and trial both innovative on-street solutions and demonstrator rapid charging hubs. **Begin implementation by 2022/23** **Full implementation by 2030**	• **Delivery will be combination of CMBC-led and Private sector-led**
T15	**Regulatory & planning:** Use **taxi licencing** to require new vehicles to be zero emission capable and transition to zero emission**.** **From 2022 (zero-emission capable); from 2025 for zero emission**	• **Implemented by CMBC**
T16	**Coordination, information, facilitation: Engage with local van and HGV fleets** to understand their plans and to ensure that refuelling infrastructure is in place to support them, and to encourage them to participate in zero emissions trials. **Ongoing from 2021/22**	• **Engagement**
T17	**RD&D:** Work with WYCA to **stay informed of stakeholder plans for gas in transport** (Northern Gas Networks, HGV fleets, bioCNG refuelling station providers and AD plant developers) and the potential role of the Council in facilitating rollout (e.g. providing land, partnership etc) **Ongoing from 2021/22**	• **Engagement**
T18	**Influence & support:** Work with WYCA to **ensure decarbonisation of the bus fleet and future mass transit**, including through continued engagement with bus operators and strategic introduction of zero emission requirements in tendered services**.** **Ongoing from 2021**	• **Support and encourage** acceleration of decarbonisation plans
Key asks of others		
T19	**Influence and support:** Work with WYCA and key stakeholders to **accelerate decarbonisation of transport** including: • **Halt or limit increases in highway capacity** primarily aimed at enhancing capacity for private cars, and redistribute funds to active and public transport (*with TfN and Highways England*)	• Support WYCA and help to drive key asks

No	Policy Description	Role of CMBC
	• Ensure electrification of rail lines in Calderdale remain high priority (with WYCA, TfN, Network ***Rail and rail operators***) **Ongoing from 2021/22**	

5.4 Buildings & technology

Overview

Action across buildings & technology requires both energy demand reduction through energy efficiency measures and large-scale shift to low carbon technology.

For buildings, CMBC has the greatest influence over public buildings and new buildings and, as such, early action should target change in these sectors to lead by example, build evidence, and support supply chain development. Recommended actions to support private-rented and owner-occupier homes primarily focus on engagement, communication, and gathering evidence to put CMBC in a strong position to target interventions as funding opportunities arise.

Electricity generation technologies are already mature and therefore direct delivery can begin now. This will include direct delivery on Council-owned land and support for community projects to deliver schemes.

Calderdale work to date

CMBC has already carried out projects to assess local needs, including 'Hard-to-Treat' (or expensive-to-decarbonise) homes in the borough,[29] and to support delivery of energy efficiency measures, such as the Safe & Warm project and Affordable Warmth Partnership. Calderdale is also supported by wider initiatives such as Scaling Up Better Homes Yorkshire,[30] led at WYCA-level.

For power generation, CMBC has already assessed the opportunity for deployment of onshore wind within the borough[31] and defines suitable areas in the Local Plan.[32] However, the Plan only highlights areas where the impact on landscape sensitivity is between "Low" and "Moderate", and favours small turbines, which may limit local generation potential going forward.

Recommended actions

Recommended actions to support the delivery of the ERP in buildings & technology are summarised in Table 7.

Table 7 Summary of recommended buildings & technology policy actions

No	Policy Description	Role of CMBC
Overarching		
B1	**Use local planning policy** to incentivise delivery of measures. Likely levers include: • Adopting **high energy efficiency standards and low carbon technology requirements for new builds** ahead of the Future Homes Standard • Allowing low carbon alternatives to be permitted development • Exploring **relaxation of conservation area planning restrictions** to enable older house retrofit • Implementing a heat network connection policy through **'heat zoning'**	• **Implement policy**

[29] *Hard to Treat or Hard to Fund* (2011). The term "expensive-to-decarbonise" has been used here to reflect that decarbonisation is typically cost-prohibitive rather than technically unfeasible
[30] https://shap.uk.com/shap-projects-page/scaling-up-better-homes-yorkshire/
[31] *Renewable and Low Carbon Energy Study* (2010) Maslen Environmental
[32] Map available at this link

No	Policy Description	Role of CMBC
	• Consider implementing a **hydrogen zoning plan** (dependent on wider developments around hydrogen in the region) **Most measures considered from 2021; heat zoning and hydrogen zoning likely implemented later (mid-2020s and 2030s, respectively)**	
B2	Work with WYCA to engage with key stakeholders to **stay informed of H_2 developments and plans.** **From 2021**	• **Engagement**
Buildings retrofit		
B3	Work with WYCA to **ensure that a 'One-stop** shop' for energy efficiency and low carbon heating is set up to support residents, private landlords and businesses to install these measures. Promote the 'One-stop shop' through local channels and communications. Encourage local suppliers to upskill to be included on any recommended suppliers lists. **Immediate, delivery of One-stop Shop recommended by 2021/22**	• **Influence WYCA and promote wider scheme**
B4	Accelerate **retrofit of Council-owned buildings and social-rented homes with energy efficiency measures and low carbon heating.** The first step should include assessment of all buildings to set appropriate targets and inform delivery. **Assessment by 2021; Begin implementation latest 2023**	• **Delivered by CMBC and housing associations**
B5	Map incidence of **expensive-to-decarbonise homes** in the borough to support identification of appropriate measures and incentives for retrofit energy efficiency and low carbon heating for private home-owners. **By 2021/22**	• **Mapping led by CMBC**
Heat networks		
B6	**Deliver Halifax district heat network and explore options for new low carbon heat network schemes** in cost-effective and heat density-appropriate areas, either directly, through joint venture or through granting concessions to private sector schemes. **Project completion as early as practicable within the 2020s**	• **Delivery and initial investment may be by CMBC or through public-private partnership.**
Innovation and trials		
B7	Initiate **exemplar and demonstrator projects** of new build high energy efficiency standards, and whole house retrofits (energy efficiency and low carbon technology) in social housing, with the aim of assessing effectiveness and consumer acceptance of different measures in the local context. **By 2025**	• **Lead** in identifying sites and initiating projects; **deliver** in partnership with housing associations
Local generation		
B8	**Install solar PV, battery storage, demand side response or other related small scale generation and flexibility technologies on council owned land & buildings** **2021 onward**	• **Lead delivery,** in partnership with housing associations
B9	Work with WYCA to **ensure development of a package of policies/actions to attract larger-scale private investment** in solar, wind and flexibility technologies. Actions for CMBC include: • Ensuring supportive local planning policy • Identifying and communicating pre-designated areas for project development • Linking with communication and awareness-raising activities	• **Support wider action** through local policy and engagement **.**

No	Policy Description	Role of CMBC
	• Co-investment. **2023 onward**	
B10	**Coordination, facilitation, finance:** Provide **guidance and support to community renewable projects.** **2021 onward**	• Support wider delivery through local engagement and application support
Supporting industrial decarbonisation		
B11	**Communication & information:** Support wider WYCA-level initiatives by **facilitating engagement with local industry,** encouraging local industry to participate in trials, and communicating available support. **2022/23 onward**	• Support wider delivery through local engagement
Key asks of others		
B12	**Influence & support:** Work with WYCA **to influence Government** to deliver policy and support that supports climate ambition, including for example: • Clear policy direction on future of heat • Revise Minimum Energy Efficiency Standards for private rented sector • Either retain local control or set high national standards in National Planning Policy Framework Part L revision • Provide national funding with longer-term certainty and timeframes for completion • Support early deployment of CCUS infrastructure in Yorkshire & Humber **From 2021**	• Ensure local needs are reflected in regional position, and to provide weight/strength to the key asks

5.5 Land & biodiversity

Overview

Actions to mitigate emissions from Land use & biodiversity will require a place-based approach, and to be informed by local data. While this study has given a high-level assessment of potential emissions reduction, further evidence and analysis will need to be taken at a local and regional level to set targets and priorities. However, CMBC does not need to wait for strategies to be set to take positive action as mitigation measures can be delivered now to deliver strong benefits.

Work to date

CMBC has a Tree and Woodland Strategy in place and recently defined commitments to increase tree canopy cover to over 18% in the borough by 2050 in partnership with the White Rose Forest. CMBC is also taking a leading role in addressing peatland restoration by commissioning a condition survey and wildfire mitigation strategy (delivered by Moors for the Future), and through establishing a Sphagnum nursery to support peatland recovery efforts.

Recommended actions

Recommended actions to support the delivery of the ERP in Land use & biodiversity are summarised in Table 8.

Table 8 Summary of recommended Land & biodiversity policy actions

No	Policy Description	Role of CMBC
L1	Contribute to a wider WYCA-level **spatial land use strategy for the region,** by ensuring that: • Local strategic priorities have been defined and data and evidence has been collected (without duplicating effort) • Calderdale's data and priorities are incorporated **By 2022**	• **Lead in local assessment and support local data collection**
L2	**Accelerate delivery of measures on Council-owned land,** where identified as suitable – e.g. for peatland restoration, tree planting – and continue to look for opportunities to support mitigation **From 2021, to be aligned with developing strategy**	• **Lead delivery** with support from key partners
L3	**Engage with farmers and landowners** to understand local characteristics and needs, and to encourage climate action. This will include: • Encouraging sustainable practices and projects e.g. opportunities for peatland restoration • Encouraging participation in trials: • Communicating support measures available at regional and national level, **From 2021**	• **Engagement**
L4	Adopt a **food waste reduction strategy,** which sets informed targets and explores locally-relevant measures to deliver them Engage with WYCA to understand plans for region-level strategy develop in order to align and avoid duplication of effort **By 2022**	• **Lead on local strategy**
L5	Implement **food purchasing policies for the public sector** that reduce red meat and dairy, and reduce waste. **By 2021**	• **Implement policies** where possible, and engage with third party providers
L6	**Use local plans to deliver climate ambitions.** This can include: • Ensuring local plans are aligned with the wider regional strategy • Using net gain requirements to support and deliver natural solutions • Reviewing local regulations as appropriate, for example to enhance protection for hedgerows **By 2024**	• **Implement policies**
L7	Support **development and trials of private investment models** to attract funding for land use solutions, such as a carbon trading scheme. **Study options by 2023** **Rollout by 2025**	• **Support delivery in partnership with landowners** and existing schemes
L8	Work with WYCA to **ensure markets for end-products** of agriculture and land management practices are established, including: • Bioenergy crops • Harvested material from new woodland – such as in construction **By 2025**	• **Support wider delivery**
L9	**Promote and support community schemes** that contribute to net zero aims, such as: • Community food growth in urban areas	• **Lead** in partnership with WYCA, as appropriate

No	Policy Description	Role of CMBC
	• Community tree and hedgerow planting • Outlets for produce that does not meet supermarket standards **From 2023**	
L10	Work with WYCA **to influence Government** to deliver policy and support that supports climate ambition: • Funding for tree planting, hedgerow planting, agro-forestry and peatland restoration – nationally and/or as part of devolution deal • Ensure that ELMs adequately supports measures targeted for delivering net zero • Streamlining application process for afforestation **Ongoing from 2021**	• **Support** and strengthen key asks

5.6 Waste

Some actions related to waste are incorporated in other sectors (e.g. reduction in food waste, decarbonisation of fleet vehicles, and communication around behaviour change). Waste emissions are already low in the borough and further action should aim to encourage and maximise best practice across other local authorities, residents and waste facilities.

The recommended actions are summarised in Table 9.

Table 9 Summary of recommended Waste actions

No	Policy Description	Role of CMBC
W1	**Share best practice** with WYCA and other Local Authorities for implementation of separate food waste collection **By 2021/22**	• **Share best practice**
W2	Implement policies to **encourage separation of food waste and recyclables.** This could include: • Reducing general waste collection frequency – e.g. to three-weekly, without reducing frequency of recycling and food waste collection • Introducing 'pay-as-you-throw' incentives to reduce general waste **By 2021/22**	• **Implement policy**
W3	Use waste contract renewal to encourage existing or new (future) energy from waste (EfW) facilities to: • Develop decarbonisation strategies • Maintain sustainable practices – e.g. continue to recycle plastics where possible rather than incinerate Engagement with facilities should begin now to communicate plans **Contract renewal in 2024**	• **Implemented contract requirements**

6 Wider actions to support the climate ambition

6.1 Supporting local food initiatives

A shift to a sustainable food system can bring environmental, health and social benefits and is the cause for growing farm-to-fork initiatives. A Farm to Fork[33] strategy sits at the heart of the European Green Deal and highlights the importance of sustainable food and its links to healthy people, healthy societies and a healthy planet. As part of the strategy, the European commission is supporting the reduction of long-haul food transportation and sees that local food initiatives can help facilitate a more resilient and efficient supply chain. The UK's Climate Change Committee recommends that local authorities promote local procurement of food, develop sustainable food production and support local veg box schemes[34] that provide food with reduced packaging to minimise waste emissions. This was further echoed by the UK climate assembly[35] that notes its key recommendations the importance of more local and seasonal food.

The benefits of local produce (local growing and local buying) can be seen at both an individual and wider community level. Contrary to popular belief, transport is only a small contributor to emissions from food products. For beef from beef herds, for example, transport only accounts for around 0.5% of its emissions[36]. A significant part of the remaining emissions arises through farming methods such as the feed type, soils and fertilisers used, land use change, and the heavy machinery used in farming. However, the emissions from different food types vary widely depending on where they are produced; for example British beef has an estimated carbon footprint of 17.12 kgCO_2e/kg compared to a global average of 46kg CO_2e/kg[37]. Studies suggest that the reason beef and sheep farms in the UK are amongst the lowest in the world is due to its ideal landscape and weather conditions – the water-rich grasslands mean farming can be less intensive and less reliant on artificial fertilisers[38]. By buying locally, UK consumers can have greater confidence in the farming measures used to produce their food and therefore their own carbon footprint.

Furthermore, there are several factors that suggest local produce can also be healthier. Buying locally can often mean buying seasonally, and researchers at Montclair State University have found evidence that seasonally produced food can contain more nutrients[39]. Additionally, local produce is allowed to ripen naturally while food that travels long distances is often picked before it is ripe further affecting its nutrient contents.

Local food enterprises can also help support employment in local economies. Analysis was undertaken[40] to compare the ratio of jobs to turnover in outlets which sell significant to high percentages of local food with national supermarket chains. It was found that pound for pound, local food outlets support three times the number of jobs.

There is already good support for local growing within Calderdale. This is predominantly through Community Supported Agriculture (CSA), whereby a partnership is formed between farmers and consumers in which the responsibilities, risks and rewards of farming are shared. There are different approaches to CSA but two exist in Calderdale: Sagar Lane Market Gardens runs a producer-led approach, having their own veg box scheme; and Incredible Farm, which is a community-led project run by local volunteers who grow and campaign for local food. There is also support resulting from the

[33] https://ec.europa.eu/food/sites/food/files/safety/docs/f2f_action-plan_2020_strategy-info_en.pdf
[34] 2020, Climate Change Committee, Local Authorities and the Sixth Carbon Budget
[35] https://www.climateassembly.uk/report/read/final-report-exec-summary.pdf
[36] https://ourworldindata.org/food-choice-vs-eating-local
[37] NFU CYMRU, The facts about British red meat and milk
[38] https://meatpromotion.wales/images/resources/Welsh_Way_Final_Eng.pdf
[39] https://pubmed.ncbi.nlm.nih.gov/17852499/
[40] From field to fork https://www.cpre.org.uk/wp-content/uploads/2019/11/From_field_to_fork___The_value_of_Englands_local_food_webs_interactive.pdf

Calderdale Food Workshop[41] which help develop a draft food strategy for Calderdale and help establish the Calderdale Food Partnership. Actions required to support local produce were drafted, amongst which include: increasing presence of local food in markets and supermarkets; the council making more land available for food growing; introducing growing and cooking skills in the school curriculum; and facilitating localised food procurement through projects such as Incredible Edible and the Halifax Food Assembly.

There are further actions Calderdale can take to strengthen local produce networks as seen in other cities and local authorities. The coronavirus outbreak has exacerbated food insecurity and disrupted normal food and growing supply chains and as a result has seen an increase in homegrown food. Cardiff, for example, has launched a city-wide campaign distributing plants, seeds and growing kits to encourage home growing and uses Edible Cardiff[42], a local network connecting small scale growers, allotment holders and community gardens, to promote and help capitalise on the trend. There are further initiatives, such as the Sustainable Food Places[43] project – a programme led by the Soil Association, Food Matters and Sustain: the alliance for better food and farming – that supports food partnerships between local authorities, other public bodies and community groups, by encouraging peer-to-peer networking, events and conferences, and grant and campaign opportunities to support the creation of food partnerships and programmes.

6.2 Addressing embedded emissions

Scope 3 emissions include all greenhouse gas emissions associated with products and services supplied to the borough – often referred to as 'consumption-based emissions' – as well as travel outside the borough by residents and employees, and investments held by the council. These emissions were excluded from the scope of the current study due to their complex nature and the limited influence of local and regional authorities over these emissions. However, it is recognised that these emissions can make up a significant proportion of the carbon footprint of local areas[44] and actions to address these emissions therefore have great importance. While the embedded emissions in products and services consumed by residents and businesses are largely out of CMBC's control, there are a range of actions that CMBC can take to reduce embedded emissions in the products and services the council procures, and some supporting actions that it can take to influence embedded emissions more widely.

Green procurement

CMBC spends approximately £140m on procurement activity[45] and, as such, procurement represents a significant opportunity to demonstrate leadership in influencing embedded emissions within its own supply chains.

Green procurement aims to include green requirements in public tender documents to encourage the use of goods and services which demonstrate a better environmental performance relative to alternatives. The mechanisms by which public procurement can reduce GHG emissions are multiple, e.g. green procurement aims to use products with lower carbon intensity, which can last longer, or which foster the circular economy.

This can include action to address emissions in transportation of goods (e.g. by favouring low carbon transport in suppliers and supply chains) and in industry (e.g. by targeting goods or materials with lower carbon intensity and/or which can last longer). Actions that address industrial emissions are strongly linked to circular economy principles where they encourage improved resource efficiency and reduce waste (see box below).

[41] June 2017, Calderdale Food Workshop: Developing a borough-wide approach to food and building momentum locally
[42] https://foodcardiff.com/blog/growingtogether/
[43] https://www.sustainablefoodplaces.org/
[44] For example, in cities, Scope 3 emissions can contribute in the range of 50-70% of all city emissions Source: *City consumption: The new opportunity for climate action* (2018) Green Alliance
[45] *Toward a Plastics Strategy for Calderdale Metropolitan Council* (2019) Eunomia for CMBC

Initiatives are already underway regionally and locally that support carbon reduction through procurement. The York & North Yorkshire LEP has commissioned a project to develop a Carbon Procurement Toolkit and training workshops to support local authorities (including in West Yorkshire) to embed low carbon and circular economy principles within procurement and commissioning strategies.[46] Locally, Calderdale has already considered strategies to reduce plastics use within the borough,[45] including through procurement and reuse/refill initiatives, which align with and support the climate ambition.

Circular Economy

Circular economy principles emphasise a shift towards better use and reuse of materials that already exist in the economy. These measures inherently reduce emissions from industry, by reducing the demand for products and reducing consumption of resources, as well as reducing waste. Shifting to a more circular economy has been estimated to have the potential to cut EU industrial emissions by just over half by 2050[49] and the EU 's Circular Economy Action Plan[50] states the EU's interest in applying circular economy principles across sectors.

Actions that can be taken at local and/or regional level to support circular economy principles include:

- Adopting green public procurement practices relating to industrial products such as glass, chemicals, food and drinks, cement, asphalt, ceramics, lime, etc
- Coordinating schemes to increase circular economy through industrial recycling, especially close-loop recycling for glass, plastics, aggregates, etc.
- Developing additional capacity in waste services and working in partnership with businesses to link those who have the waste with those who can use them

Buildings

Low carbon construction practices that focus on the use of timber and recycled materials can reduce the embedded emissions of buildings by 10-20% with no additional cost, but have been demonstrated to achieve up to 80% reductions for individual projects.[44] In addition to reducing embedded carbon, procurement that supports low carbon construction for local projects can also deliver co-benefits of driving the supply chain, influencing land use (for timber supply) and reducing transport and construction-based direct emissions within the borough.

Divestment of pension funds

Divestment of pension funds away from fossil fuels and towards clean energy projects represents an opportunity to support industries necessary to meet national and local climate ambitions. A number of cities[47] local authorities, and pension providers have declared their intention to divest – including London and London Boroughs,[48] and South Yorkshire Pension Authority[49] - and there are calls for pension authorities in West Yorkshire and Greater Manchester to follow suit.

[46] *Building Carbon Reduction into Local Authority Procurement Processes*, carried out by Eunomia on behalf of York and North Yorkshire LEP, due to be complete in April 2021.
[47] https://www.c40.org/press_releases/fossil-fuel-divestment-city-partnership-network
[48] https://www.london.gov.uk/what-we-do/environment/climate-change/zero-carbon-london/divestment-and-green-investment
[49] South Yorkshire Pensions Authority Climate Change Policy 2020 https://www.sypensions.org.uk/Investments/Responsible-Investment/Investment-Policies-and-statements

Influencing wider change

Public engagement and supporting local initiatives to raise awareness and encourage behaviour change towards reducing waste and reusing products is an important lever in influencing wider embedded emissions. For example, Zero Waste Leeds[50] encourages recycling of clothing (including school uniforms) to promote waste reduction; CMBC can draw on learning from projects such as these in designing local initiatives.

[50] https://www.zerowasteleeds.org.uk/

7 Action plan and recommendations

Timeline

The accelerated timeline necessary to achieve significant decarbonisation by 2038 means that progress towards this target must start immediately. However, further information regarding technology performance, developments in national policy and consumer response to policies and technologies is needed to support an informed decision on CMBC's long-term strategy. Recommended actions for CMBC to take are defined across three broad phases:

- **Short-term action (2020-2025):** Early action should focus on driving ambitious change while keeping options open and gathering the evidence needed to support longer-term decisions. This encompasses:
  - **Priority actions –** actions that are relatively low-cost, deliver large co-benefits, and/or lay the foundation for larger-scale, long-term change. For example, accelerating decarbonisation of Council assets, supporting behaviour change, and setting local priorities/targets
  - **Evidence gathering –** delivering trials and studies, collecting local data, and engaging with stakeholders to help the Council understand local feasibility of technologies and measures
- **Medium term action (2025-2030)** should implement local action to ensure maximum delivery of measures and interventions in-line with agreed ambition and priorities (informed by evidence gathered in the short-term). These actions may require more substantial trade-offs to implement, such as between carbon savings, cost, consumer choice etc.
- **Long-term action (2030-2038)** should be informed by ongoing monitoring of progress and aim to adjust CMBC's approach based on the outcome of earlier measures and wider, regional and national, developments. For Calderdale, a key decision in this time period will centre around the role of hydrogen, driven by the emerging information about likelihood of delivery to the area.

The emissions reduction pathway will need to be reviewed regularly to adapt in response to the success of early actions, external decisions, and emerging evidence (such as technology learning and cost reduction). Key review points will be between phases (short, medium and long-term time periods); however, national and regional policy is rapidly evolving and CMBC's plan will need to be flexible to smaller, more regular adjustments as the policy landscape changes. For example, a number of Government strategies are due in 2021 ahead of COP26 which may influence sector strategies and/or reduce uncertainty.

Action plans

The long-list of policy recommendations detailed in section 5 are summarised here in line with timeframes outlined above to give a high-level action plan for each sector: Transport (Figure 21), buildings & technology (Figure 22), and Land use & biodiversity (Figure 23).

Cross-cutting actions (section 5.2) and actions to address Waste are not explicitly captured in these plans but it is crucial that these actions are also carried out alongside those in other sectors.

Short Term (2020-2025)	Medium Term (2025-2030)	Long Term (2030-2038)
Priority Action • Use local planning policy to incentivise and support delivery of measures • Develop local strategy for road space reallocation • Develop and implement parking control measures, including reducing on-street, banded parking charges and workplace parking levies • Deliver currently funded cycle routes and continue to deliver cycling strategy measures • Expand cycle parking provisions across the borough • Assess CMBC staff travel needs and implement sustainable policies • Encourage local employers to assess staff travel • Develop a local electric vehicle charging infrastructure strategy, following regional strategy, and begin implementation • Work with partners to ensure delivery of expanded and improved bus services, limit road building and electrify rail **Evidence gathering (in parallel with priority actions)** • Assess local suitability of implementing traffic control measures such as zero emissions zones, strategic road closures and 20mph limits • Assess local feasibility of freight consolidation and cycle freight in key delivery locations • Support and deliver trials of innovation services and shared mobility • Engage with local fleets to understand their plans and raise awareness • Engage with key stakeholders to understand plans for gas in transport • Assess National Government support, priorities, and regulation **Review evidence and adjust pathway**	**Max implementation of policy** • High rate of expansion of active travel infrastructure, public transport services and electric vehicle charging infrastructure • Rapid conversion of public fleets to zero emission vehicles • Implementation of supportive measures to address commuter travel, as appropriate (e.g shared services) • Implementation of more ambitious traffic control measures such as zero emissions zones • Implementation of freight measures such as consolidation, dependent on feasibility and trials • Communication of available financial incentives at regional level, and assess need for further local support • Ongoing engagement with HGV fleets to encourage technology shift • Engagement with NGN to align targeted H2 refuelling rollout, and NPg to ensure targeted electricity upgrades **Review progress and adjust pathway**	**Adjustment and enhancement** Evaluate progress and implement further measures where necessary, for example: • Adjustment of strategies based on achieved level of deployment and changes in National Policy • Stronger regulatory measures to encourage uptake such as through local planning requirements (if possible) • Encouraging or directly implementing stronger financial incentives for technology uptake (e.g scrappage schemes) including support for HGV fleets • Support for rollout of innovative technologies and techniques • Adjustment of training programmes to meet skills shortages

Figure 21 Recommended action plan for measures to address Transport emissions

Short Term (2020-2025)	Medium Term (2025-2030)	Long Term (2030-2038)
Priority Action • Use local planning policy to incentivise and support delivery of measures • Accelerate retrofit of Council-owned buildings and social rented homes • Deliver Halifax district heat network • Initiate new low carbon heat network schemes • Accelerate installation of solar PV and flexibility technologies on Council owned land and buildings • Implement training programmes in energy efficiency retrofit and low carbon heating technologies • Work with WYCA to ensure development of actions to attract private investment in renewables • Provide guidance and support to community renewables projects • Influence government to deliver policy and support that supports climate ambition **Evidence gathering (in parallel with priority action)** • Initiate exemplar and demonstrator projects for high energy efficiency buildings and low carbon heating technology to better understand viability in the local context • Map hard-to-decarbonise homes in the region • Explore options for new low carbon heat networks • Engage with key stakeholders to stay informed of H_2 developments • Facilitate with engagement industry • Assess National Government support, priorities, and Regulation **Review evidence and adjust pathway**	**Max implementation of policy** • Maximum retrofit of public sector buildings • Deployment of new and/or expand district heat networks • Communication of available support and financial incentives at regional level, and assess need for further local support • Assess opportunities to link local homes with wider funding, particularly in private rented and owner occupier sectors • Ensure supportive planning for large scale renewables projects and continue to deliver on Council-owned land where appropriate • Engagement with NGN to align targeted H_2 rollout, and NPg to ensure targeted electricity upgrades **Review progress and adjust pathway**	**Adjustment and enhancement** Evaluate progress and implement further measures where necessary, for example: • Adjustment of strategies based on achieved level of deployment and changes in National Policy • Adjust approach to hydrogen based on likely deployment • Stronger regulatory measures to encourage uptake, such as through local planning requirements (is possible) • Encouraging or directly implementing stronger financial incentives for technology uptake (e.g scrappage schemes) and energy efficiency • Support for rollout of innovative technologies and techniques, such as battery-to-grid and smart system • Development of public-led business models for communal and district heating • Adjustment of training programmes to meet skill shortages

Figure 22 Recommended action plan for measures to address buildings & technology emissions

Short Term (2020-2025)	Medium Term (2025-2030)	Long Term (2030-2038)
Priority Action • Define local spatial land use priorities to ensure that Calderdale's data and priorities are included in any WYCA-level spatial land use strategy • Accelerate delivery of land use measures on suitable Council-owned land • Adopt a local food waste reduction strategy • Implement public procurement policies to reduce food waste and to reduce red meat and dairy in public sector catering • Use local plans to deliver climate ambitions • Support community schemes • Work with WYCA to ensure markets for end products of land management practices • Influence Government for funding to support climate mitigation measures, development of ELMs to ensure it supports locally-relevant measures, efficient processes for assessing funding **Evidence gathering (in parallel with priority action)** • Data collection and target-setting for land use measures, including peatland restoration potential (though existing Moors for the Future project), tree planting (building on/aligned with White Rose Forest targets), bioenergy crop production, and other changes in land use and/or land management techniques • Encourage local farmers to participate in Defra ELM Pilots • Support development and participate in trials of private investment models • Encourage local farmers to participate in trials of private investment models • Explore potential markets for end-products of land management practices • Assess National Government support, priorities, and regulation and details of ELMs **Review evidence and adjust pathway**	**Max implementation of policy** • Maximum delivery of measures on Council-owned land • Ongoing strong leadership and public messaging for diet change and food waste reduction • Communication of available support and financial incentives at regional level, and assess need for further local support • Ongoing engagement with farmers and landowners • Ongoing support for community projects • Strong markets bioenergy and afforestation end-products in place **Review progress and adjust pathway**	**Adjustment and enhancement** Evaluate progress and implement further measures where necessary, for example: • Adjustment of spatial land strategy targets based on effectiveness of implemented measures, extent of behaviour change and developments in National Policy • Stronger regulatory measures such as banning peatland burning or new/stronger local planning requirements for land use • Encouraging or directly implementing stronger financial incentives for climate mitigation measures • Support for rollout of innovative technologies and techniques • Public incentives for behaviour change • Adjustment of training programmes to meet skill shortages

Figure 23 Recommended action plan for measures to address Land use & biodiversity emissions

8 Appendix

8.1 Calderdale data

8.1.1 Transport

Significant information is publicly available regarding road vehicle activity at local authority level, and this was used as a basis for modelling travel activity within Calderdale. Baseline growth forecasts were assumed to be the same as for the parent study unless locally-relevant data was available (e.g. population growth forecasts, rail freight forecasts). Modal share, modal shift, and technology uptake assumptions from the parent study were then applied to this baseline. Rail and Other transport emissions trajectories deviated from the parent study and were tailored to the local context.

Sector	Approach	Source data
Road vehicle activity (cars, buses, motorcycles, HGVs, vans)	Local data for vkm used to estimate passenger and road freight km, in line with approach in parent study	Government road traffic statistics
Rail and Other transport emissions	Local data for historic diesel rail emissions	Local Authority CO_2 dataset, adjusted to CO_2e based on UK GHG conversion factors
Road vehicle Baseline growth assumptions	As parent study – in line with DfT growth projections	DfT Road Traffic Forecasts (2018)
Passenger rail Baseline growth assumptions	As parent study – 60% growth	Government Office for Science analysis (2018)
Freight rail Baseline growth assumptions	No growth	Network Rail North of England Freight Study (2018)
Modal shift assumptions	As parent study – based on analysis of National Travel Survey data	See parent study[51]
Technology uptake trajectories	As parent study – based on Element Energy modelling for DfT (cars and vans), WYCA (buses), and CCC (heavy goods vehicles)	See parent study[51]
Rail decarbonisation trajectory	Derived assuming conversion of lines within the next Network Rail Control Period, with full conversion of all trains by 2029.	Assumption
Other transport decarbonisation trajectory	Scaled from parent study trajectory for proportion of Other transport associated with oils and lubricants[52]	See parent study[51]

[51] Published version not available at time of writing. A draft of the evidence base report with full Technical Appendix is available at the following link: https://www.westyorks-ca.gov.uk/media/4277/west-yorkshire-carbon-emission-reduction-pathways-technical-report-draft-v7-1.pdf

[52] Other transport comprises aircraft support vehicles in addition to oils and lubricant combustion; however, aircraft support vehicles are not a relevant emissions source for Calderdale

8.1.2 Buildings & technology

Domestic buildings

Significant information is publicly available on domestic building stock at local authority (LA) level, such as the number, type and age of buildings. This data was used to build a starting point stock model of domestic buildings in Calderdale. Then the parents study assumptions were applied to each stock segment on energy efficiency and heating system uptake.

Data type	Approach	Source data
Existing stock	Local data for: 1. Housing numbers 2. Split by EPC 3. House type 4. Age 5. Gas grid connection	NEED LA level data tables Government statistics on energy performance of buildings Government estimates of properties on gas network National BEES and NIC data for building stock
Existing building-level heat demand and heating system	1. Heat demand – archetype estimates scaled to local authority fuel use 2. Heating system – estimates based on local data	1 Gov subnational LA level energy consumption statistics Gov LA electricity consumption statistics Gov LA subnational gas consumption data 2 Plumplot data
New buildings	Local housing growth projections	Local Plan, Information provided by CMBC
New building heat demand	As parent study – based on new building statistics	Energy consumption statistics
Energy efficiency uptake	As parent study – based on Element Energy analysis for the National Infrastructure Commission and CCC. Projections are linked to house type, age and EPC rating so degree of local specificity	See parent study[51]
Technology uptake	As parent study – based on Element Energy analysis for the CCC but accelerated to decarbonise more rapidly. Projections are linked to house type, so degree of local specificity District heating uptake adjusted to account for proportion of local heat demand that lies within the heat density (minimum kWh/km^2) threshold of parent study	See parent study[51] Heat density by MSOA from Gov gas consumption data
Solar PV	Local projections for Calderdale from NPg	LA Level Northern PowerGrid Distribution FES

Non-domestic buildings

Limited information is available publicly on non-domestic / commercial buildings, so scaling of national and WYCA figures was completed based on the local authority (LA) level ONS business workbook and non-domestic floorspace statistics. Heating system breakdowns were based on national data by non-domestic building subsector / archetype. Solar PV estimates were based on local FiT data.

Data type	Approach	Source data
Existing stock	Local data for: 1. Business units and floorspace in LA by subsector (e.g. education, offices) 2. Split by EPC	1 ONS UK business workbook and non-domestic business floorspace 2 Government statistics on energy performance of buildings
Existing building-level heat demand and heating system	As parent study, scaled by LA business units and floorspace by subsector (5.2-7.1% of study region) as above.	
New buildings	As parent study. Growth – based on data provided by the WYCA Team Heat demand – based on national statistics by building type/subsector	Growth - WYCA Team Regional Econometric Model on GVA and employment forecasts for the Leeds City Region ECUK national statistics by building type/subsector
Energy efficiency uptake	As parent study – based on Element Energy analysis for the National Infrastructure Commission. Projections are linked to subsector so degree of local specificity	See parent study[51]
Technology uptake	As parent study – based on Clean Growth strategy targets, CCC Net Zero modelling and Element Energy in-house modelling. Projections are linked to subsector, so degree of local specificity District heating uptake adjusted to account for proportion of local heat demand that lies within the heat density (minimum kWh/km^2) threshold of parent study	See parent study[51] Heat density by MSOA from Gov gas consumption data
Solar PV	Local estimates based on FiT data for Calderdale	Gov sub-regional feed-in-tariff statistics

Industry

Large industrial sites are recorded with their geographic location in NAEI, so were mapped to Calderdale, although there are only 3 entries as Calderdale has a small amount of heavy industry.

Limited information is available publicly on small industrial sites, so the energy demand is estimated from the local authority (LA) energy consumption statistics by subtracting the heavy industry and non-domestic buildings from the "Industry and Commercial" category.

Data type	Approach	Source data
Large industrial sites stock	• Geographic data on emissions and location of 3 large sites in Calderdale (Sonoco + Sonoco CHP, Nestle Halifax) from NEAI • Energy consumption fuel split data same as parent study for each subsector ('food and drink', 'other industry'), but adjusted for Sonoco facility energy usage & CHP	NAEI Point source database Number of sources on Sonoco, including National grid ESO, site permit, EU ETS data and Sonoco website.
Small industrial sites stock	• Energy consumption of small sites at LA level after accounting for large industry (above) and commercial (non-domestic) from national LA level dataset.	BEIS subnational energy consumption statistics I&C
Decarbonisation technologies and trajectories (energy efficiency and low carbon fuel switching)	• Industrial subsector assumptions same as parent study (with minor tweaks for Sonoco CHP). Assumptions linked to the industrial subsector present and the relevant decarbonisation options, so degree of local specificity.	See sources in parent study. [51]

Power

Local generation data is publicly available and was used to create the current generation profile. Technology deployment was scaled from the parent study in proportion with relative land area of Calderdale compared to West Yorkshire. Energy from Waste and Anaerobic Digestion were excluded from the modelling in line with current status and local priorities.

Data type	Approach	Source data
Current solar PV	Local deployment data	December 2019 Renewable Energy Planning Database
Onshore wind, biomass, landfill gas	Local deployment data	Renewable electricity by local authority, BEIS 2019:

8.1.3 Land use & biodiversity

Emissions and emissions savings were scaled from West Yorkshire modelled results according to relative land areas and livestock types in Calderdale, as detailed in Table 10.

Table 10 Approach and scaling factors for land use & biodiversity emissions sources and mitigation measures

Emission source/sink	Basis for scaling	Scaling factor relative to West Yorkshire	Source data
Existing forests	Share of WY existing woodland	15.4%	• *A Land Cover Atlas of the UK* (2017)
New forest planting	Share of WY land types required for new forest planting in parent study (	30%	
Bioenergy crops	Share of WY land types required for bioenergy crop planting (	9%	
Peatlands – existing emissions	Share of WY existing peatland	50%	
Peatlands – emissions reduction due to mitigation	Share of WY land types required for peatland restoration (permanent grassland, rough grazing and cropland)	43%	
Urban expansion	Share of WY land required for urban expansion, based on projected housing growth and historic share of land required for development that is on previously undeveloped land	5%	Ministry of Housing, Communities & Local Government: • Land use change statistics • House building statistics
Enteric fermentation	Share of WY enteric fermentation emissions, estimated based on average UK emissions per head of livestock (cattle, sheep and pigs) and total livestock of each type.	18%	• Defra Local Authority breakdown for key crop areas and livestock • BEIS Final UK Greenhouse gas emissions national statistics (2018)
Waste and manure management	Share of WY waste and manure management emissions, estimated based on average UK waste emissions per head of livestock (cattle, sheep, pigs and poultry) and total livestock of each type.	13%	
Agricultural soils	Share of WY arable land	0.5%	*A Land Cover Atlas of the UK* (2017)
Stationary and mobile machinery	Share of WY CO_2 emissions associated with agriculture	14%	BEIS Local Authority CO_2 dataset

8.2 Baseline emissions trajectory

Overview

The baseline scenario sees a 34% reduction in emissions by 2038, with 696 $ktCO_2e/yr$ remaining in 2038 (Figure 24). All sectors see slow change due to a lack of strong incentives for consumers and businesses to switch to low carbon heat, transport and other practices. The remaining emissions in 2038 are still primarily from buildings and road transport.

Transport

The transport sector sees the most progress due to the faster development of technically ready and cost-effective solutions, leading to uptake of electric vehicles. Travel demand grows across all transport types and private cars remain the dominant mode of passenger travel.

Total transport emissions decrease by 43% by 2038**,** primarily due to increased efficiency of internal combustion engine vehicles and (limited) uptake of low emissions technologies in road transport. In the absence of strong national or local policy to drive uptake, the shift to low emissions vehicles is primarily driven by manufacturer emissions targets, reductions in battery costs and improvements in vehicle range.

Rail lines in the borough are assumed to not electrify within the timeframe and therefore rail experiences increased emissions due to growth in passenger numbers.

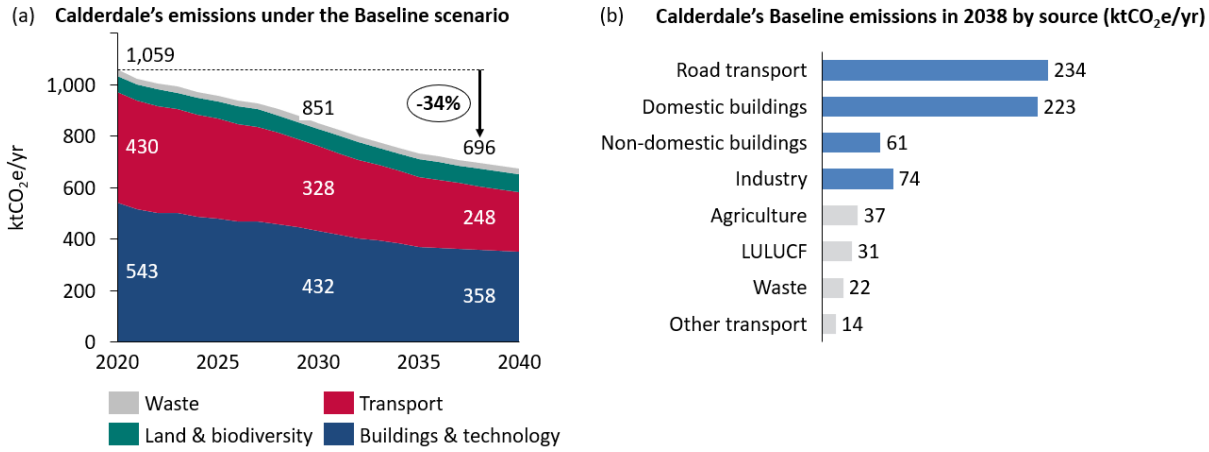


Figure 24 (a) Trajectory of emissions under the Baseline scenario and (b) breakdown of emissions in 2038 by source

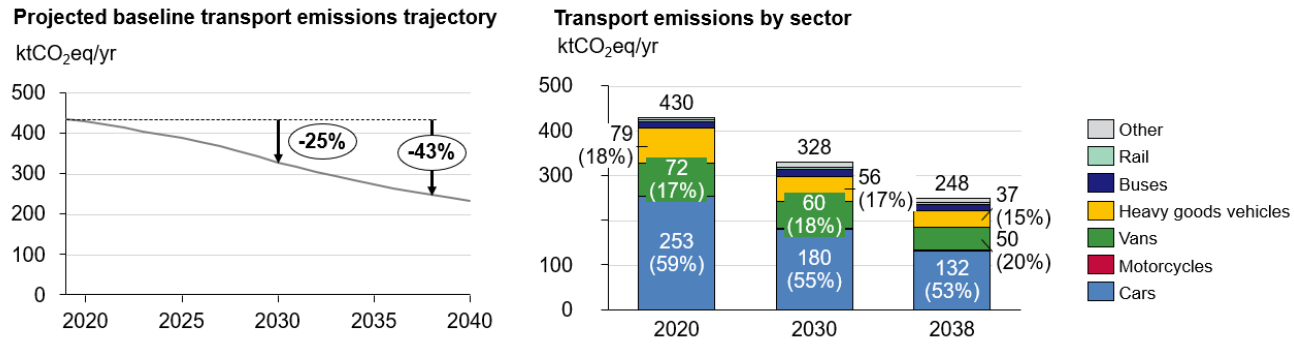


Figure 25 Emissions trajectory for transport in the Baseline scenario (left) and breakdown by subsector (right)

Buildings & technology

The majority of the emissions reduction in buildings and industry is due to decarbonisation of national renewable electricity alongside a small uptake of energy efficiency measures. There is slow uptake of low carbon heat due to high cost, low awareness and consumer behaviour challenges.

Buildings

Total buildings emissions decrease by around 37% in the baseline scenario (Figure 26). Fuel consumption reduces by 11% by 2038, due primarily to efficiency measures, but remains predominantly natural gas and electricity; oil is phased out but only slow uptake of further electric heating is seen. For non-heat energy, all applications which currently use electricity remain on electricity (as this will decarbonise). It is assumed that there is an increase of 20% in non-domestic cooling demand[3].

In domestic buildings, heat pump installations continue at a slow rate, increasing only a little from current rates under the Renewable Heat Incentive (RHI).[53] District and communal heating increases to 6% buildings by 2038 under current government support schemes.

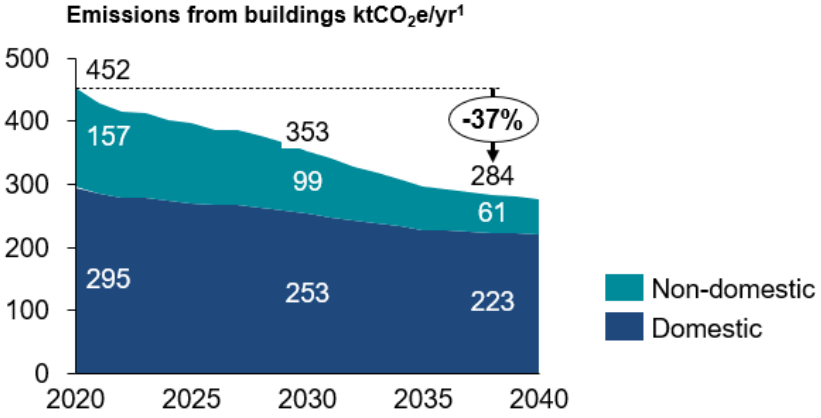


Figure 26 Emissions trajectory for Buildings in the Baseline scenario

The non-domestic sector sees more progress due to the higher frequency of retrofit and new build. By 2038, the non-domestic sector exhibits a more diverse heating mix than the domestic sector, with a greater proportion of warm air heating systems (e.g. air-to-air heat pumps).

For both domestic and non-domestic sectors, new buildings have considerably lower emissions due to high energy efficiency standards and installation of only low carbon heating technologies from 2025

[53] Approximately 0.04% of households per year (based on average installations in GB 2014-2019) https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-october-2019

(electric heating, heat pumps and district heating). As a result, the contribution of new buildings to emissions is small (~4% by 2038).

Rooftop solar installations make a small contribution to offsetting electricity emissions in buildings. Domestic solar PV installations increase from 2,600 to 4,600 by 2038,[54] and non-domestic solar PV reaches 4 GWh/yr by 2038.

Industry

Fuel switching to low carbon fuels in industry is limited in the Baseline and focused primarily on phasing out coal/oil and a small amount of electrification of heat. Energy consumption remains primarily natural gas and electricity.

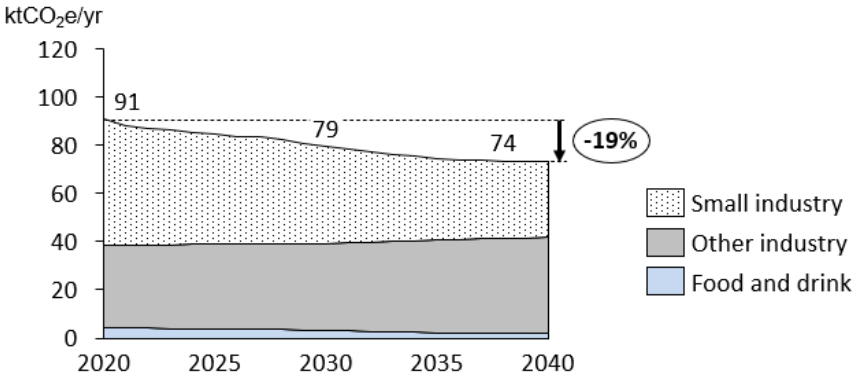


Figure 27 Emissions trajectory for local industry in the Baseline scenario

Power

Power generation in Calderdale increases 65% from 2020 to 2038, with slow uptake of onshore wind but a decrease in generation from landfill. No large-scale solar is assumed to be deployed. Over the same period, local generation emissions remain relatively constant as the majority of the increase in capacity is from renewable sources.

Baseline electricity consumption in Calderdale is 1 TWh/year in 2038, which implies that 80% of demand must be met by net imports from the national grid and region becomes slightly less dependent on outside sources.

[54] following Northern Powergrid's 'Steady Progression scenario as set out in the Distribution Future Energy Scenarios (DFES)

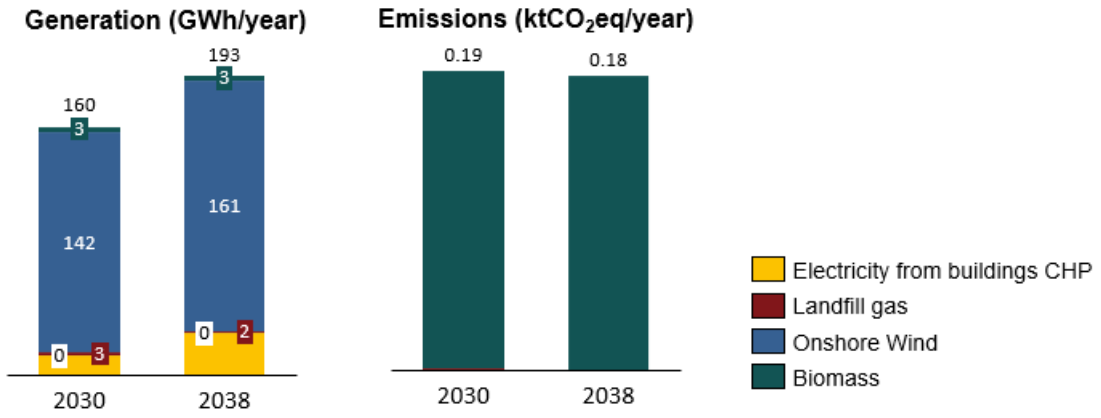


Figure 28 Local large-scale electricity generation (left) and generation carbon intensity (right) of local large-scale electricity generation in the Baseline scenario

Land & biodiversity

Emissions in the Land & biodiversity sector increase by 9% overall in the Baseline scenario. This is primarily due to the projected increase in population growth which results in increased land use emissions from urban expansion and increased agriculture emissions from food production (Figure 29).[55] While some peatland restoration activities are ongoing in Calderdale which are likely to improve the emissions associated with peatlands, there is limited quantitative evidence as to the magnitude of the impact, so the baseline scenario assumes no change in the associated emissions.

Some emissions are offset by forest planting (set to be in-line with White Rose Forest targets, as of 2019), which reaches 450 ha new woodland in Calderdale by 2038.[56] Additional emissions reductions come from machinery fuel switching but, overall, emissions reductions are insufficient to offset emissions growth.

Waste

Waste emissions are assumed to decrease in line with the Climate Change Committee Net Zero report "Core" scenario trajectories. Landfill emissions are assumed to decrease by 60% while wastewater treatment emissions are assumed to increase in line with population growth. Overall, waste emissions decrease by 14% (see Figure 30, Appendix page 48).

[55] Per capita food production is assumed to remain the same over time
[56] Based on WY planting rates from parent study, allocated to Calderdale in line with suitable land area for afforestation (30%; close to historic planting share)

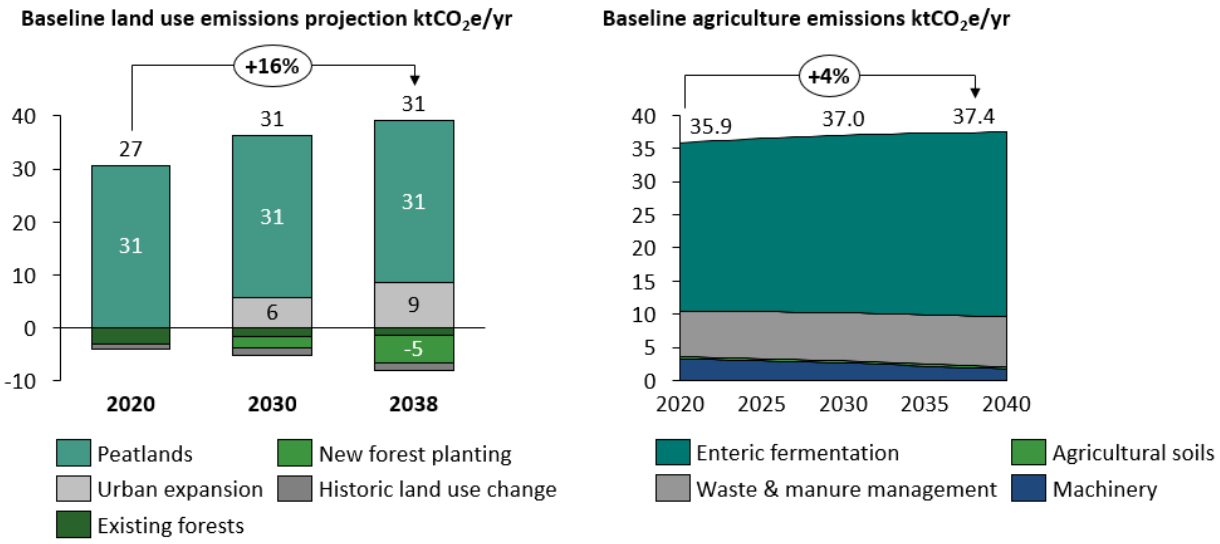


Figure 29 Emissions trajectories for the Land & biodiversity sector: (left) Land use, land use change and forestry, and (right) agriculture

8.3 Additional supporting information

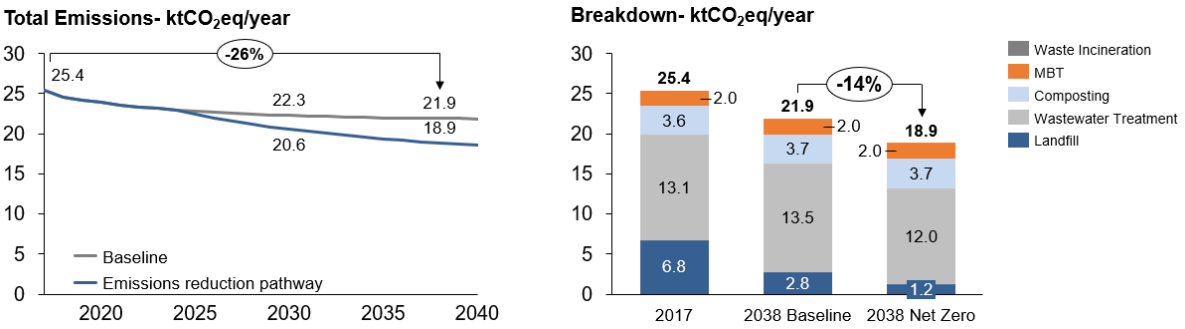


Figure 30 Waste sector emissions under the Baseline scenario and emissions reduction pathway (ERP)

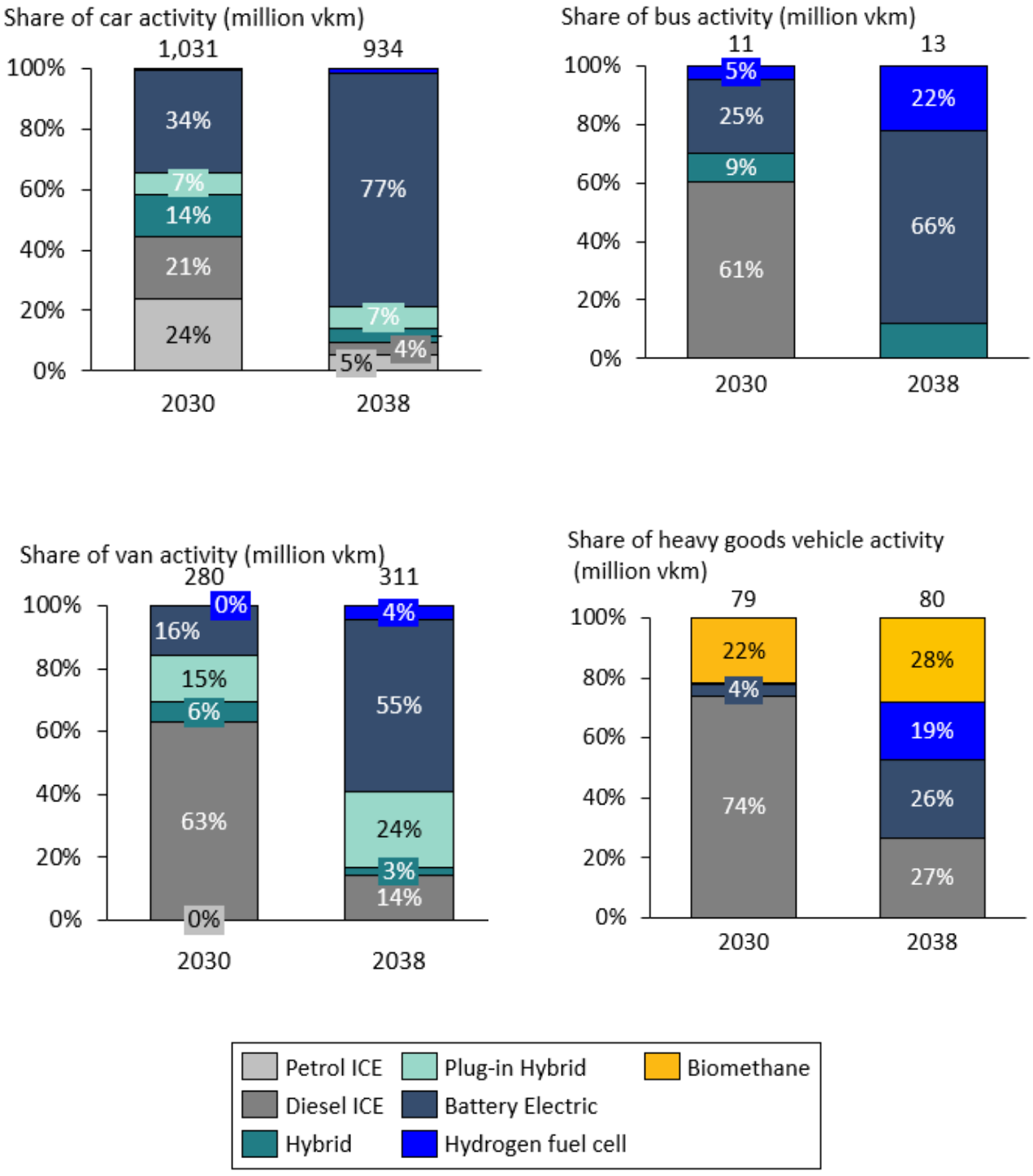


Figure 31 (top left, top right, bottom left, bottom right) Share of vehicle activity by vehicle fuel type under the emissions reduction pathway

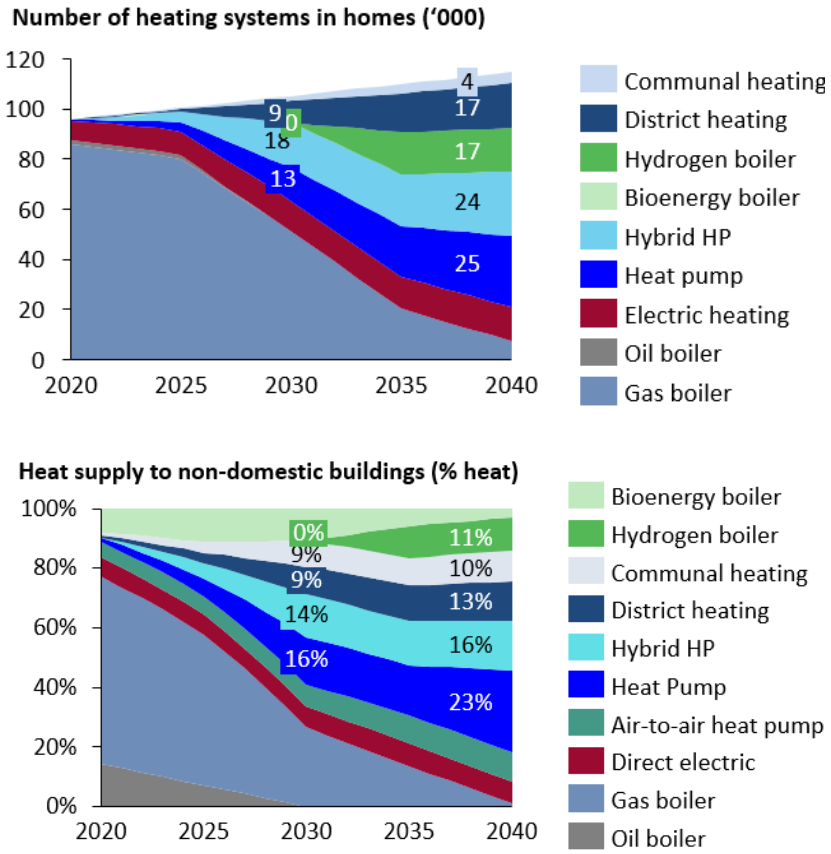


Figure 32 Heating system breakdown for (top) domestic buildings and (bottom) non-domestic buildings under the emissions reduction pathway. Note that the numbers within the top graph are number of thousand homes with each heating type (for selected heating types) by 2038.

Appendix 2

Transcript added for the roadmaps related to Figure 18, 19, 20.

Figure 18 is a roadmap image which shows various actions for the transport sector to undertake.

Acronyms:

- EVCP = electric vehicle charge point
- BioCNG = biomethane, supplied as compressed natural gas
- ZEV = zero emission vehicle
- HGV = heavy goods vehicle
- TDP = Transport decarbonisation plan

Activity	Milestones	Deployment at scale begins	Activity & Scenario timings	2038 milestones
Active Travel	• 2023: Current cycle network upgrades complete • 2025: Increase in: Waling km of 9% and cycling km of 3x • 2027: Increase in: Walking km of 50% and cycling km of 15x • 2030: Max degree of modal shift achieved	• 2022 to 2032: Cycling and walking infrastructure expanded & improved	Complete LCWIP	• Walking and cycling reach 16% of distance travelled
Bus & Rail	• 2025: Bus and rail reach 16% modal share (by distance) • 2029: Rail freight and passenger km 1.5-2x higher • 2031: Diesel bus sales end	2029: shifting to zero emission buses	• 2020 to 2022: capacity & feasibility studies • 2022 to 2035: shift to zero emission buses (battery electric moves ahead of hydrogen fuel cell) • 2024 to 2033: Electrify rail network (all trains electric by 2029), increase and integrate public transport offering	• 88% of buses ZEV • 100% of rail km electrified • Public transport use 1.4x higher
Cars	• 2021/22: Road reallocation strategy decided	2023: Demand reduction action (e.g parking, road reallocation)	• 2020 to 2023: Studies of regional incentives • 2023 to 2027: Demand reduction	• 77% of private cars zero emission

	• 2024/25: Decision on role of traffic control measures • 2025: Battery electric cars reach 40% sales • 2030: Petrol & diesel car sales end • 2035: All new cars zero emission		action (e.g. parking, road reallocation • 2027 to 2035: Larger local/regional incentives e.g. access charging, circulation plans	• Private car use ~27% lower than today
Vans & HGVs	• 2021/22: Targets set for public fleet conversion • 2025: BioCNG reaches ~23% of HGV sales • 2028: ZEVs reach 16% of van & HGV sales • 2030: 10% tonne km shifted to rail • 2030: Petrol and diesel van sales end • 2035: All new vans zero emissions		• 2020/21 to 2022: Public fleet study • 2021 to 2023: Consolidation feasibility • 2023 to 2030: implement consolidation and shift to rail & cycle freight	• 59% of vans and 32% of HGCs ZEV • HGV use 14% lower than today
Cross-cutting	• 2021/22: WYCA EVCP strategy developed	2023/24: Accelerate installation of public EVCPs	• 2021 to 2034: Communication: including regional behaviour change campaign (2-3 phases), stakeholder engagement and lobbying • 2022 to 2029: Accelerate installation of public EVCPs • 2025 to 2030: local and regional financial incentives to support modal shift and ZEVs • 2030: H_2 refuelling station rollout	• 90-100% of aircraft support vehicles electric

Other Key Actions:

- 2021/22: TDP
- 2021/22: Ultra rapid charging grant likely
- 2023/24: Plug-in car grants ends
- 2030: Petrol & diesel car and van phase out

Figure 19 is a roadmap image which shows various actions for the Buildings & Technology sector to undertake.

Acronyms:

- RHI = Renewable Heat Incentive
- HP = Heat pump; HHP = hybrid heat pump.

Note that the first use of hydrogen in industry is assumed to be earlier than the date at which hydrogen becomes widely available through the gas grid since larger sites can be served by dedicated pipelines.

Activity	Milestones	Deployment at scale begins	Activity & Scenario timings	2038 milestones
Energy Efficiency	• 2021/22: Public building retrofit strategy planned • 2025: Retrofit rate 2,800 homes/yr • 2027: All public buildings retrofit • 2029: All off-gas homes EPC C+	2022: All public buildings and 73% existing homes & 66% businesses undergo efficiency retrofits to reach EPC C or above	2022 to 2034: All public buildings and 73% existing homes & 66% businesses undergo efficiency retrofits to reach EPC C or above	• All homes reach EPC of C or above
District heating	• 2022: New heat networks spatially planed • 2025: Connection rates reach 500 homes/yr • 2030: DH reaches 15,000 homes		• 2022 to 2025/26: Halifax DH FEED, construction, commissioning • 2025/26 to 2032: Operation of Halifax network, commissioning of new/expanded networks • 2032 to 2036: Heat zoning possible	• 18,500 homes & 2% businesses using district heating
Heat pumps	• 2021: Supply chain & skills assessment • 2025: installation rates hit 2,000 homes/yr • 2030: All off-gas homes have a heat pump (HP) or hybrid heat pump (HHP)	2024/25: Accelerate installation	• 2021/22 to 2022/32: Training schemes • 2022 to 2025/26: Accelerate installation • 2026 to 2036: HPs deployed alongside efficiency retrofit	• HPs in 29,000 homes and 5% of businesses • HHP in 24,000 homes and 3% of businesses
Hydrogen	• 2025-27: Decision on role of H2 for heat • 2031/32: First use of hydrogen in industry	2031: Boiler installation & gas grid conversion	• 2021 to 2024: Boiler commercialisation & trials • 2025 to 2030/31: Grid conversion planning & installation training	• H_2 boilers reach up to 14% homes & 2% businesses • Partial gas grid conversion to H_2

	• 2034: H_2 boiler installation rates hit 3,000 homes/yr		• 2031 to 2036: Boiler installation & gas grid conversion	
Other	• 2025: Onshore wind capacity reaches 64 MW. Large-scale solar PV reaches 17MW • 2034: Onshore wind capacity reaches 82 MW. Large-scale solar PV reaches 42 MW		• 2022 to 2030: Resource & energy efficiency measures implemented across industrial sites with support from REF • 2023/24 to 2034: Electricity network upgraders to support electrification of heat • 2025/26 to 2036: Fuel switching of industrial equipment	• Biomethane up to 34% gas grid • Solar PV in~15% homes • Building electricity demand +18%

Other key dates and actions:

- 2021/22: UK heat roadmap
- 2022/23: RHI[2] replaced
- 2024: H_2 boilers tested in ~700 buildings
- 2025: Future homes standard
- 2028/29: Phase out of fossil boiler installation in off-gas in 2020s
- 2030: Building's mission & Home of 2030

Figure 20 is a roadmap image which shows various actions for the Land & Biodiversity sector to undertake.

Acronyms:

- ELMs = Environmental land management scheme

Activity	Milestones	Deployment at scale begins	Activity & Scenario timings	2038 milestones
Afforestation	• 2022: Large-scale afforestation scheme planned • 2025: Forest planting reaches ~27ha/yr • 2030: 16% additional forest area 230 ha • 2034: ~23% additional forest area (336 ha)	2022: Acceleration of afforestation	• 2022 to 2027: Acceleration of afforestation • 2027 to 2036: Afforestation at maximum rate; forest management	• Additional 450 ha increase in forest area
Peatland restoration	• 2022/23: Local peatland condition evidence base • 2025: Restoration rates reach 4.4%/yr • 2030: 37% upland and 60% lowland peat restored	2022: upland and lowland peatland restoration and monitoring	2021 to 2036: upland and lowland peatland restoration and monitoring	• 60% of upland and 100% of lowland peatland restored
Diet & waste	• 2021: Public procurement policy update • 2022: Local food waste reduction strategy • 2025: 14% reduction in food waste • 2030: red meat & diary consumption reduced 16% • 2034: 30% reduction in food waste		• 2021 to 2024: consumer awareness campaigns (ongoing) • 2024/25 to 2036: Consumer diet shift away from red meat & dairy	• 32% reduction in red meat and dairy • 35% reduction in food waste
Agri measures & other	• 2022: Spatial land strategy developed • 2024/25: decision on agricultural shift based local evidence • 2025: Regional decision on financial assistance • 2034: 440 ha bioenergy crop growth	• 2025: Max rate of agricultural transition from cattle and sheep to pigs, poultry, bioenergy crops & agroforestry[3] • 2030: Machinery fuel switching to electricity, hydrogen & bio-CNG	• 2020/21 to 2022: Data gathering • 2021 to 2024/25: Farmer engagement, information and training • 2021 to 2025: Development of local carbon trading/investment models • 2025 to 2036: Max rate of agricultural transition from cattle and sheep to pigs, poultry, bioenergy crops & agroforestry[3]	• 24% reduction in cattle & sheep • +7% stocking density • ~80% machinery on low carbon fuels • 12% increase in pigs & poultry • 28% horticulture moved indoors

			• 2025 to 2036: Machinery fuel switching to electricity, hydrogen & bio-CNG • 2025 to 2030: RD&D programmes and trials for innovative technologies	

Other key dates and actions:

- 2020/21: Agriculture Bill
- 2021/22: Environment Bill
- 2024: ELMs starts
- 2027: ELMs full implementation