England's Economic Heartland

DECARBONISATION ROADMAP – PHASE ONE REPORT

CITY SCIENCE
endless possibilities

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Prepared by:

Dr Bob Hickish	Senior Consultant, City Science
Grace Solsby	Principal Consultant, City Science
Tom Veale	Intern, City Science
Elliot Reid	Associate Director, City Science
Heather Watkinson	Associate Director, City Science

Approved by:

Laurence Oakes-Ash	CEO, City Science

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1 Executive Summary

1.1.1 In light of human-driven global warming, England's Economic Heartland (EEH) and many of its constituent local authorities have set ambitious targets to decarbonise transport within the area. Key to achieving this is understanding the current sources of carbon emissions, their contribution, and what the rate of decarbonisation should be for each. City Science has been commissioned to conduct analysis and translate national level emissions data, and guidance on the rate of decarbonisation, into a picture that is specific to the EEH and its local authorities – whilst taking into account any local variation in targets. This report describes the derivation of possible pathways and key findings. Key findings include:

- There has been little transport decarbonisation within EEH since 2005. This is consistent with the UK-wide situation and indicates the scale of the challenge remaining.
- EEH accounts for approximately 10% of the UK's carbon emissions. This gives it an emissions per capita value that is approximately 30% greater than the UK.
- Cars are by far the greatest contributor to transport emissions within EEH. They account for 59% of emissions and should be the focus of decarbonisation efforts.
- The road freight system also contributes substantially. HGVs and Vans account for 38% of transport emissions and, given the technical difficulties associated with decarbonising these, should also be prioritised.
- The majority of road emissions occur on roads which are controlled by EEH and its local authorities. This means there is a significant opportunity for policy to encourage decarbonisation of road transport in the area.
- There are substantial variations in the emissions, and their sources, across the authorities within EEH. This reinforces the need for localised analysis and targets.
- Recent rates of decarbonisation prior to the COVID-19 pandemic will be insufficient to reach most decarbonisation targets. Continuing the 2017 to 2019 trend means transport would only by approximately 50% decarbonised by 2050.
- The decarbonisation brought about by the COVID-19 pandemic indicates the scale of change needed. The 2019 to 2020 reduction in carbon emissions is similar to the pre-pandemic target for 2019 to 2025.
- No nationally published emission pathways will align with the EEH's target for a fully decarbonised transport system by 2040. Approximately 10% of carbon emissions will remain, and so these targets will need to be accelerated.
- To determine policy which will align with EEH's target, it will be crucial to understand the use of Electric Vehicles. Modelling the distance travelled by vehicles of different propulsion types will allow fleet uptake targets to be set.

2 Introduction

2.1.1 The UK government has made commitments to pursue 'net zero emissions by 2050' (hereafter referred to as 'Net Zero 2050'). Nationally, the transport sector is the current largest emitter of carbon emissions and so must be decarbonised in order to achieve Net Zero 2050. In alignment with this, EEH have set the ambition of achieving a transport system with zero carbon emissions by 2040 (hereafter referred to as 'Zero Carbon 2040'), with constituent local authorities having set a range of local targets. Two crucial items of information which can assist with the strategic planning for these decarbonisation targets are:

1. Understanding the scale of current carbon emissions and the distribution between different sources, e.g. road or rail.
2. Understanding the rate of decarbonisation required and hence setting future year emission targets

2.1.2 Fortunately, there are national-level data sets which can inform both of these. City Science has been commissioned to disaggregate this data to the EEH region and different emission sources. The result is a localised, source specific, picture of current transport emissions and associated future emission targets. These can be viewed in the case of alignment with Net Zero 2050, Zero Carbon 2040, or any other local target. This report discusses the derivation of this data and key findings.

2.2 Key Definitions

Net Zero Emissions
Emissions are at 'net zero' when the quantity of emissions created is less than or equal to the quantity recaptured. This means that carbon emissions can still be at 'net zero' if they are offset by carbon capture. The UK-wide Net Zero 2050 target recognises that it might not be possible to fully decarbonise some sectors, e.g. Agriculture, and therefore emissions can be offset by recapture in others, e.g. Land Use, Land Use Change and Forestry.

Emission Pathway
A series of future emission quantities, either predictions or targets.

Zero Carbon Transport
In contrast to Net Zero, **Zero Carbon** measures do not allow for carbon offsetting, therefore the sector needs to reach absolute zero carbon emissions. To arrive at zero carbon from a transport perspective, this would mean that no carbon is emitted 'at the tailpipe' and that any fuels used are also fully decarbonised.

Carbon Budget
A limit on the total carbon emitted (either net or absolute) over a set period.

2.2.1 The remainder of this report is structured as follows:

- **Section 3** – Describes the policy context and emission pathways published by a range of bodies including the Climate Change Committee (CCC) and Department for Transport
- **Section 4** – Presents key findings on the current emissions in EEH, and the methodology to

determine these.

- Section 5 – Presents key findings on the emissions pathways for EEH, and the methodology to determine these.
- Section 6 – Provides conclusions and recommendations for next steps.

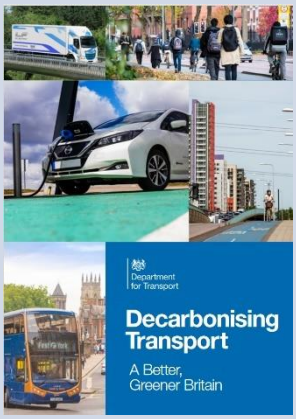
3 Key Policy and Emission Pathways

3.1 Key Policy

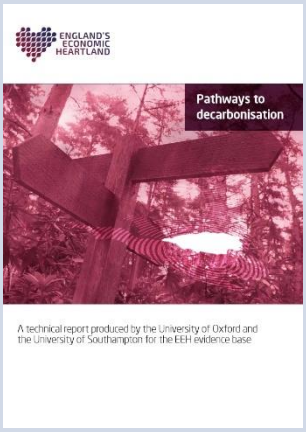
3.1.1 The Climate Change Act (2008) committed the UK government to an 80% reduction (relative to 1990 levels) of greenhouse gas emissions by the year 2050, i.e. 'Net Twenty'. The act also established the Climate Change Committee (CCC) – an independent, statutory body to advise the UK and devolved governments on emissions targets. Following advice from the CCC, the UK government subsequently amended the Climate Change Act in 2019, resulting in the current Net Zero 2050 target. This strengthens the previous commitment from an emissions reduction of 80% relative to 1990 levels, to a 100% reduction. Further enhancement is also provided by The Carbon Budget Order (2021), which sets a carbon budget equivalent to an emissions reduction of 78% (relative to 1990 levels) by 2035.

3.2 Proposed Emission Pathways

3.2.1 In response to these targets, and the wider need to decarbonise, various organisations have published proposed emission pathways. Table 3-1 notes the key features of the emission pathways considered in this report, Table 3-2 compares the emission sources for which specific pathways exist, and Table 3-3 compares the modes which the published pathways can be disaggregated to.

Pathway Source	Key features	Report Emission Pathway Name
Transport Decarbonisation Plan (Department for Transport, 2021a) 	• Sets out the net zero pathway for the UK's transport system to 2050 • The plan acknowledges (but does not define) several targets including mode share, car mileage, motoring taxes, vehicle occupancy • Provides specific targets for freight, rail, shipping and aviation (subject to consultation) • The 2035 target, set through The Carbon Budget Order (2021), is unlikely to be met within transport on its own and will instead rely on contributions from other sectors • Does include carbon offsetting / removal • Considers 'Tailpipe' emissions only with grid carbon, for example, addressed through other strategies	TDP
The Sixth Carbon Budget:	• Calculates the annual emissions of hypothetical scenarios which align with Net Zero 2050 • Six scenarios (including one baseline) are considered resulting in six pathways • Pathways are UK wide with no geographic breakdown	CCC

The UK's path to Net Zero (CCC, 2020)
 
	• Each scenario has pathways for specific transport-related emission sources, including:
	  ○ Surface transport (Road and Rail)
	  ○ Shipping
	  ○ Aviation
	• Does include carbon offsetting / removal
	• 'End user' emissions, i.e. the emissions created to produce electricity for electric cars are included	

Pathways to Decarbonisation (EEH, 2020)
 
	• Calculates the annual emissions of hypothetical scenarios which align with Net Zero 2050 – using the NISMOD model
	• Five scenarios (including one baseline) are considered resulting in five pathways
	• Pathways are EEH specific, but with no further geographic breakdown
	• Each scenario has pathways for:
	  ○ Passenger Transport (Road and Rail)
	  ○ Freight Transport (Road and Rail)
	• Scenarios include population and housing growth
	• Does not include carbon offsetting / removal
	• Considers 'Tailpipe' emissions only
		NISMOD

Setting Climate Commitments for EEH: Quantifying the implications of the United Nations Paris Agreement for EEH (Tyndall Centre, 2020)	• Determines a Carbon Budget to 2100
	• Derived from a global carbon budget of 900 $GtCO_2$ (extracted from IPCC reports)
	• Disaggregates to sub-national regions through one of three methods
	• Three disaggregation methods resulting three pathways for each geographic area
	• Includes emissions from all industry sectors other than:
	  ○ International Aviation and Shipping
	  ○ Land Use, Land Use Change and Forestry
	• Does not include carbon offsetting / removal
	• Because all industry sectors are included, cannot be classified as 'tailpipe' or 'end user'
		Tyndall Centre

Table 3-1: Comparison of published pathway sources

Emission Source Pathway	Transport Decarbonisation Plan (Department for Transport)	The Sixth Carbon Budget (CCC)	Pathways to Decarbonisation (EEH)	Setting Climate Commitments for EEH (Tyndall Centre)
Specific road vehicles, e.g. Car, Van, or HGV	X	X	X	X
Passenger Road and Rail	X	X	X	X
Freight Road and Rail	X	X	✓	X
Road and Rail	X	✓	✓	X
Domestic and International Aviation	X	✓	X	X
Domestic and International Shipping	X	✓	X	X
Road, Rail, and Domestic Shipping and Aviation	✓	✓	X	X
Road, Rail, Domestic and International Shipping and Aviation	✓	X	X	X
All energy use	X	X	X	✓

Table 3-2: The emission source pathways explicitly included in each of the publications considered in this report

Pathway Source (Organisation)	Car	Van	HGV	Rail	Domestic Aviation	Domestic Shipping	International Aviation	International Shipping
Transport Decarbonisation Plan (Department for Transport)	✓	✓	✓	✓	✓	✓	✓	✓
The Sixth Carbon Budget (CCC)	✓	✓	✓	✓	✓	✓	✓	✓
Pathways to Decarbonisation (EEH)	✓	✓	✓	✓	X	X	X	X
Setting Climate Commitments for EEH (Tyndall Centre)	✓	✓	✓	✓	✓	✓	X	X

Table 3-3: Mode disaggregation possible from each published emission pathway

3.3 Other Notable Carbon Calculations

3.3.1 The Centre for Research into Energy Demand Solutions (CREDS) Carbon Calculator is a place-based calculator that calculates the carbon footprint of neighbourhoods in England (CREDS, 2021). This geospatial data is displayed alongside contextual information such as bus stop locations or cycling propensity, to help understand these relationships. Different to aforementioned carbon calculations, the tool doesn't provide a pathway but focuses instead on existing emissions. This bottom-up model provides useful context into relative emissions between regions and some of the core drivers (e.g. car and van movements from MOT data and an independent assessment of flight emissions), but doesn't provide a reconciliation to the full regional transport carbon emissions.

4 Current Emissions

4.1 City Science Methodology for Disaggregating Current Emissions

4.1.1 To determine the quantity of emissions from transport-related sources, at the level of EEH and its constituent local authorities, we combine multiple data sets and processes – shown in Table 4-1 and Table 4-2, respectively. Our finalised data set is consistent with national level government published data, and allows equitable comparison between locations, emission sources, and over time. Note that the emissions shown are 'tailpipe' emissions, meaning that the emissions created to produce electricity for Electric Vehicles is not included.

Data	Source	Purpose
UK local authority and regional carbon dioxide emissions national statistics	(Department for Business, Energy & Industrial Strategy, 2021a)	• Emission per LA for Motorways, and Major and Minor roads • Emission per LA for Diesel Rail • Disaggregating emissions to vehicle types
UK greenhouse gas national emission statistics	(Department for Business, Energy & Industrial Strategy, 2021b)	• Scaling 'end user' emissions to 'tailpipe' emissions • Disaggregating emissions to vehicle types
UK greenhouse gas national emission statistics (provisional)	(Department for Business, Energy & Industrial Strategy, 2021c)	• Determining 2020 values
Vehicle kilometers by vehicle type	(Department for Transport, 2021b)	• Disaggregating emissions to vehicle types
Road kilometers by road type		• Disaggregating emissions to Strategic, Major, and Minor Roads
UK Population	(Office for National Statistics, 2021)	• Determining per capita values
Rail Emissions	(Office of Rail and Road, 2020)	• Disaggregating emissions to freight and passenger trains
UK Airport Aviation Movements	(Civil Aviation Authority, 2021)	• Disaggregate UK Aviation emissions to EEH

Table 4-1: Data and use within the City Science methodology

Disaggregation	Process
Geography	Data is provided at the UK local authority level
Mode	Multiply the LA-level vehicle kilometres for each vehicle type, with UK-wide emissions per vehicle kilometre for each vehicle type
Road type	Allocate emissions according to the length of A roads and Motorway that are in the Strategic Road Network within the authority. Owing to the data available, district-level authorities are assumed to have the same ratio as their containing county
Rail – Passenger and Freight	Allocate LA-level diesel rail emissions according to the national ratio between diesel passenger rail and diesel freight rail emissions
Aviation – International and Domestic	Disaggregate UK-wide aviation emissions for domestic and international travel according to annual plane movements

Table 4-2: The processes used to disaggregate emissions data to different sources

4.2 Key Findings

4.2.1 **Finding 1: Historic emission trends are variable:** Figure 4-1 illustrates the annual emissions of Road and Rail Tailpipe Emissions within the EEH, during the period from 2005 to 2020. The EEH contribution to the annual UK total varies between 9.9 and 10.2%, with an average of

10.0% as illustrated in Figure 4-1 also. The reduction in emissions in 2008 coincides with the Climate Change Act (2008) and also the worldwide financial crash. By 2017 emissions have returned to near pre-2008 levels, before reducing again. There is a 20% reduction from 2019 to 2020 levels, likely owing to the reduction in travel caused by restrictions during the COVID-19 pandemic.

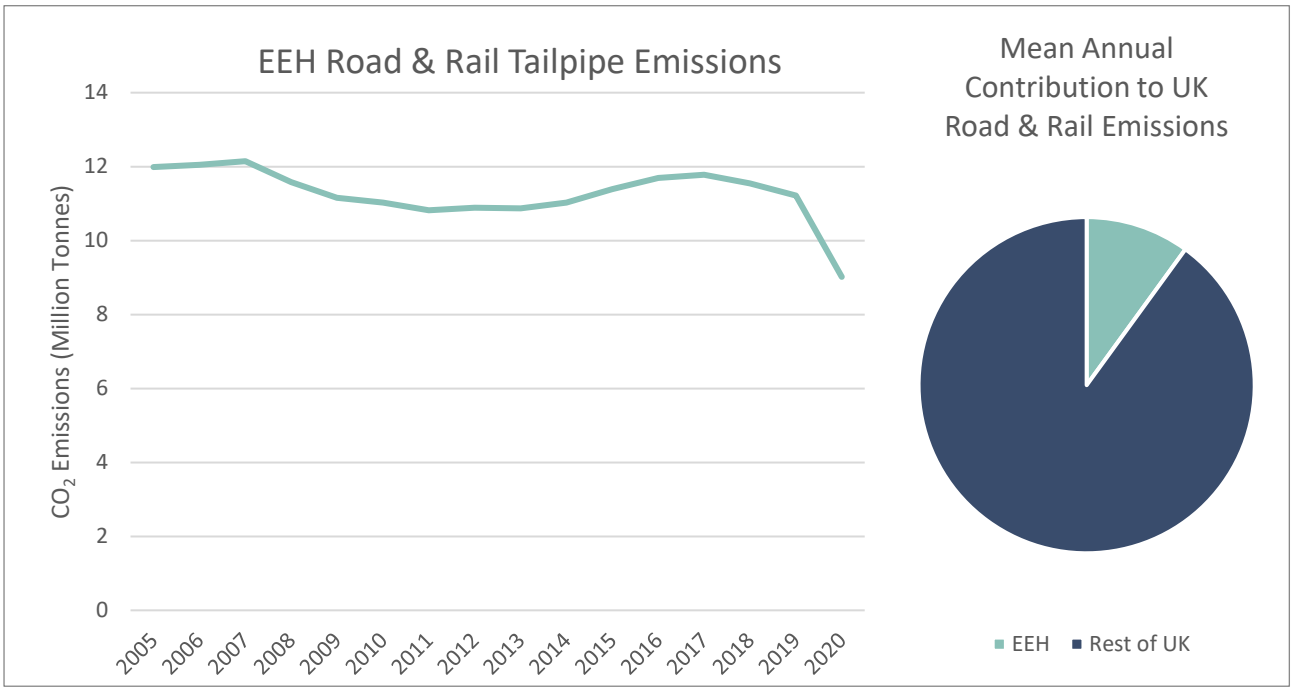


Figure 4-1: EEH historic Road & Rail Tailpipe Emissions per capita (tonnes per person) and EEH's mean contribution to the UK's Road & Rail CO_2 emissions over the same time period

4.2.2 **Finding 2: EEH has higher-than-average emissions per capita:** Figure 4-2 compares the Road and Rail Tailpipe Emissions of EEH and the UK on a per capita basis, between the years 2005 and 2020. For this period average per capita emissions within the EEH are 30% greater than the UK average. This aligns with the known high economic productivity of the area but could also indicate higher emission lifestyles than the national average. It is important to note that per capita emissions may look different if using a disaggregation method based on resident activity only (i.e. not considering traffic that passes through the region from other areas).

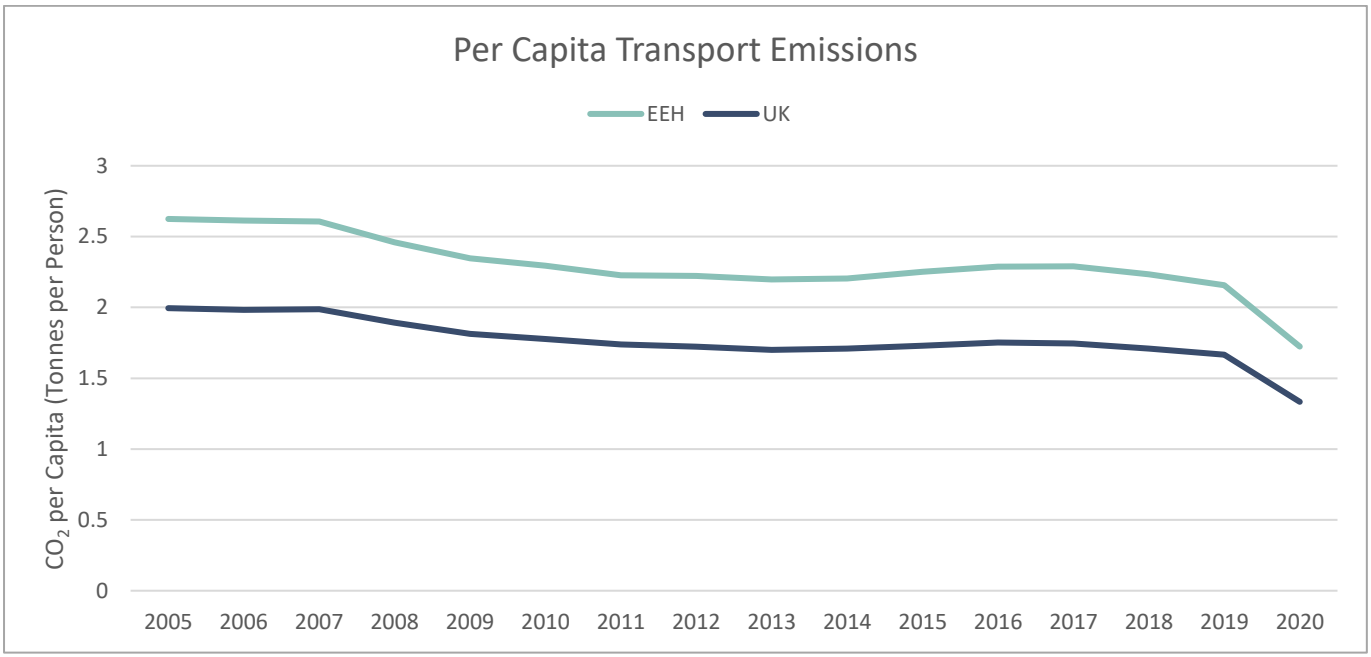


Figure 4-2: Comparison of EEH and UK historic transport CO_2 emissions per capita (tonnes per person)

4.2.3 **Finding 3: Car emissions dominate but individual HGV emission values are greater:** Figure 4-3 illustrates the relative contribution of different sources to EEH's surface transport emissions in 2019. Car emissions dominate (59%), with HGVs (22%) and Vans (16%) also contributing substantially. The contribution from Other Road Vehicles (1%), such as busses and motorbikes, and Rail (2%) is minimal. This picture is consistent with our understanding of frequent car-use nationwide, and the high emission values of individual HGVs. Across the constituent local authorities of EEH, there is variation in the relative contribution of these sources. However, their ranking remains largely unchanged. It is a similar situation when comparing over time, with the only substantial trend being the steady increase in the contribution of Vans from 12% in 2005.

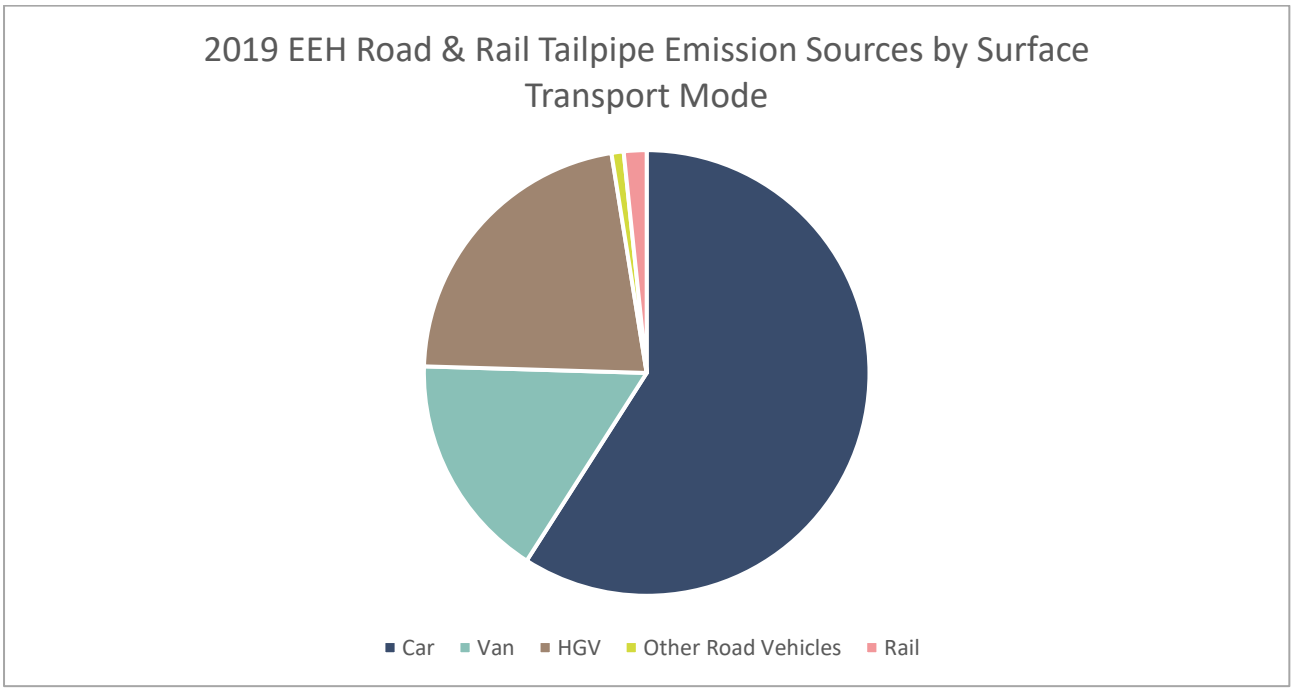


Figure 4-3: EEH Road & Rail Tailpipe Emission Sources by surface transport mode (2019)

4.2.4 **Finding 4: The SRN contributes the greatest to road emissions:** Figure 4-4 further investigates road emission sources by comparing the relative contribution from different networks. As can be seen, the largest single source within EEH is the Strategic Road Network (44%). However, in combination, the Major (26%) and Minor (30%) road networks have a greater contribution.

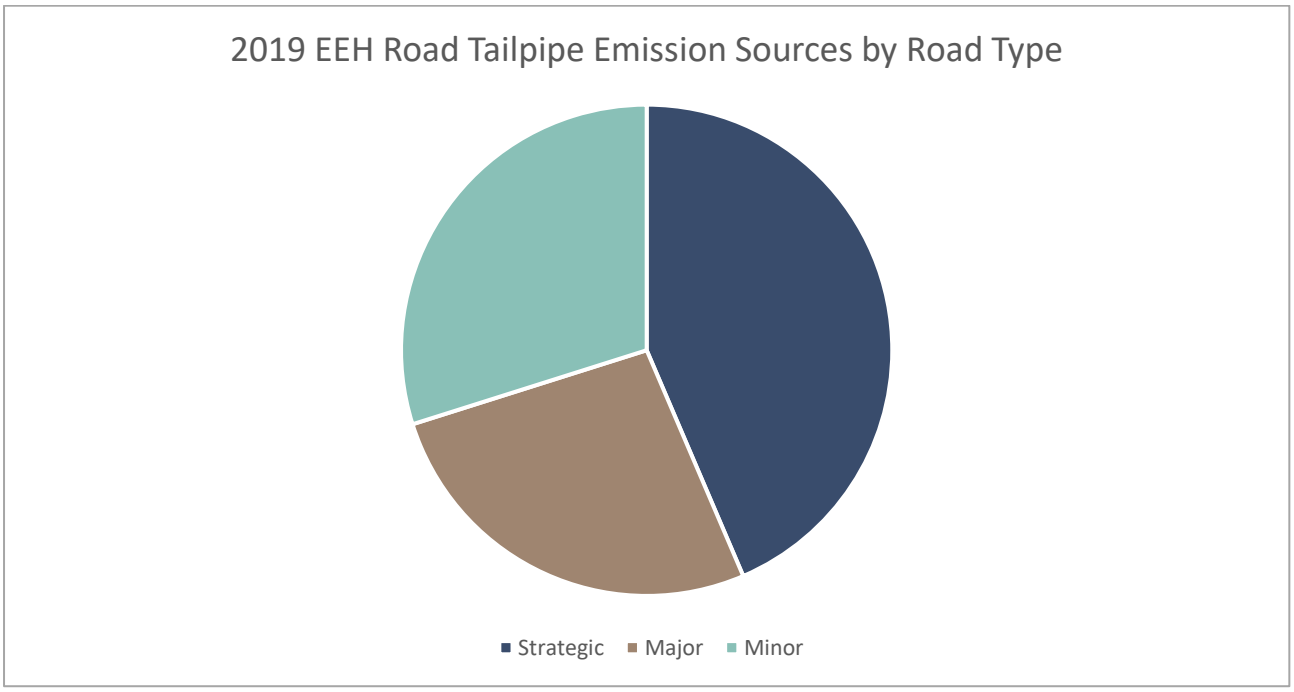


Figure 4-4: EEH Road Tailpipe Emission Sources by road type (2019)

4.2.5 **Finding 5: Carbon emissions vary greatly between EEH's local authorities:** For individual local authorities within EEH, the Road and Rail Tailpipe Emissions are illustrated on an absolute (Figure 4-5) and per capita (Figure 4-6) basis. Across the authorities there is substantial variation in the quantity of carbon emissions produced. Those authorities reporting the highest emissions are home to movements that generate up to 15 times more carbon than the lowest emitting authorities. Localised variation in emissions are expected given the different characteristics of the authorities, e.g. population, presence of Strategic Road Network, availability of low-emission modes. However, this does reinforce the need for individualised, local assessment of emissions and pathways, taking due consideration of the role of different networks.

4.2.6 Plotting the same data on a per capita basis removes the effect of population upon the emissions (Figure 4-6). It can be seen that the authorities reporting the highest per capita emissions are home to movements that generated up to six times more carbon than the lowest emitting authorities. Again, these differences could be owing to geographic factors, e.g. the presence of the Strategic Road Network but may also indicate differences in lifestyles. This indicates the importance of further analysis using alternative disaggregation methods to remove the effect of through traffic on a local authority's emissions, as discussed below.

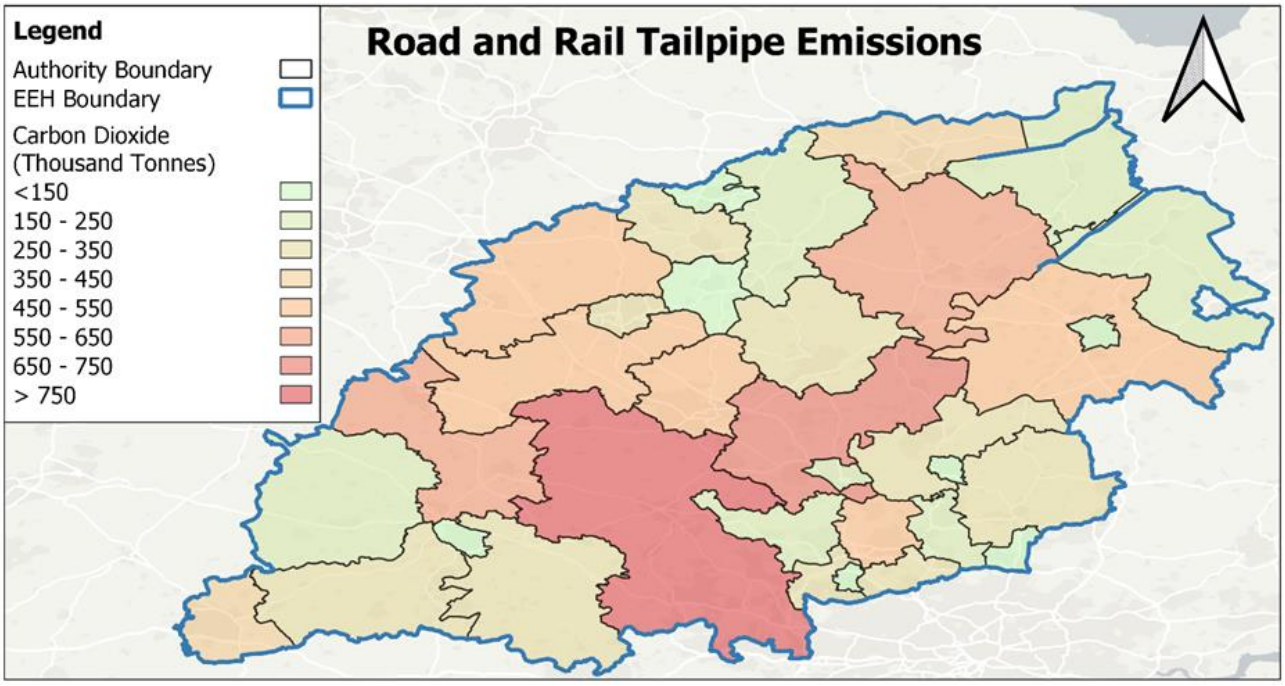


Figure 4-5: Absolute Road & Rail Tailpipe Emissions in EEH. OS data © Crown copyright and database right 2021

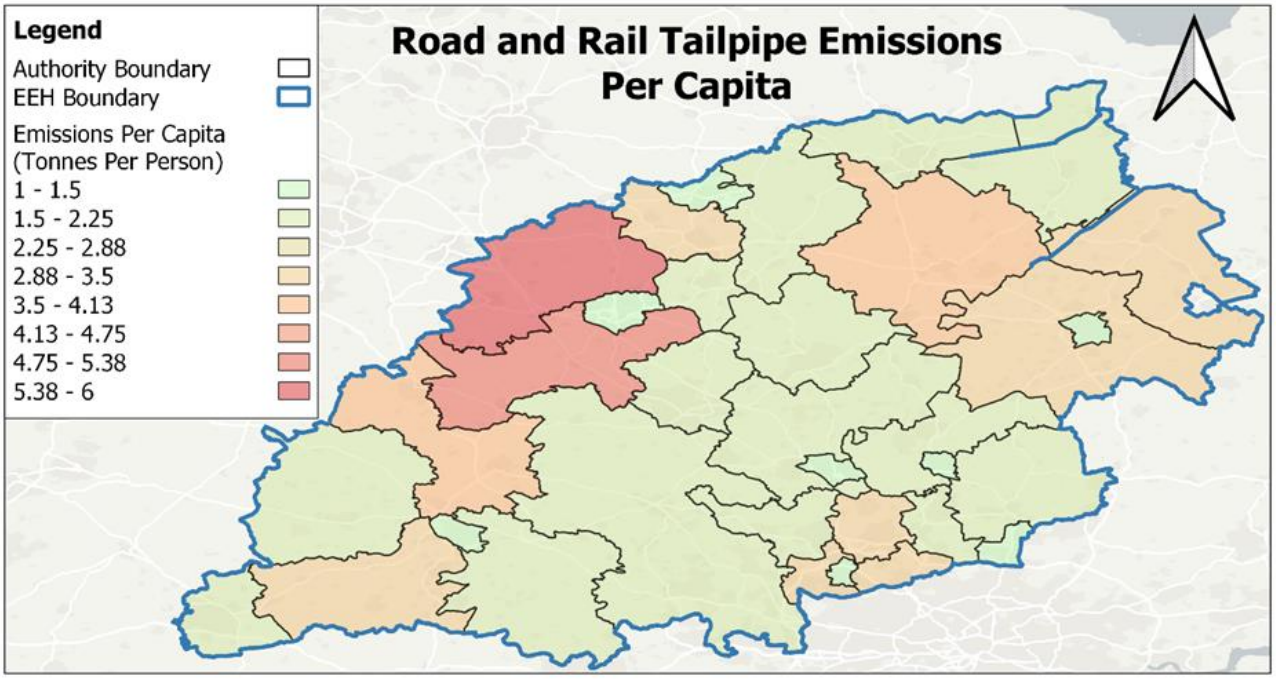


Figure 4-6: Road & Rail Tailpipe Emissions in EEH using CO_2 tonnes per person per capita. Contains OS data © Crown copyright and database right 2021

4.2.7 **Finding 6: The contribution of commuting to emissions varies greatly between EEH's local authorities:** For individual local authorities within EEH, Figure 4-7 illustrates the contribution of commuting to Passenger Road and Rail Tailpipe Emissions. This data has been determined considering the commuting patterns of residents, i.e. excluding traffic 'passing through' the authority. It relates to the year 2011 – the latest for which input data was available. In general, the contribution of commuting is greater in highly urbanised authorities than larger, more rural, authorities. This is likely owing to the employment hubs within urbanised authorities attracting many trips and hence concentrating travel from surrounding areas.

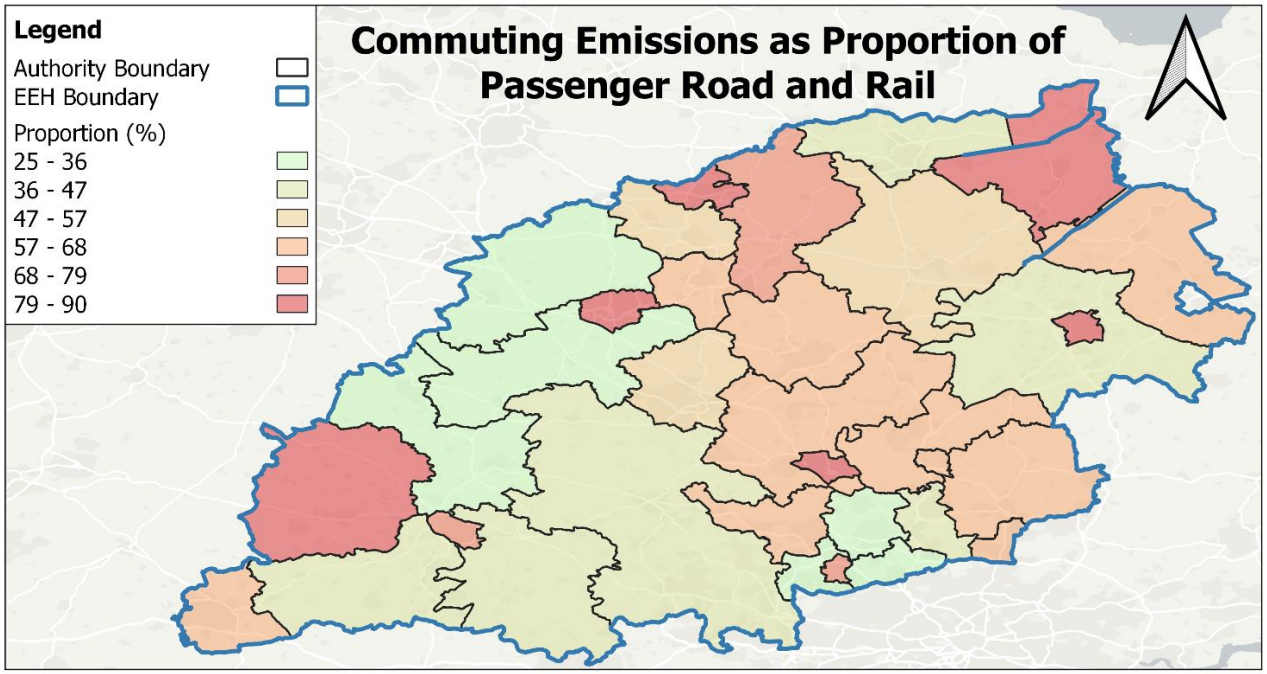


Figure 4-7: CO_2 Emissions from Commuting in EEH as a proportion of Passenger Road and Rail Tailpipe Emissions. Contains OS data © Crown copyright and database right 2021

4.2.8 **Finding 7: The contribution of commercial vehicle emissions varies greatly between EEH's local authorities:** For individual local authorities within EEH, Figure 4-8 illustrates the contribution of HGVs and Vans to Road and Rail Tailpipe Emissions. The grouping of high-contribution authorities is likely owing to factors such as: freight traffic from HGVs travelling to and from Felixstowe – the UK's busiest container port (Department for Transport, 2020); and high concentrations of logistics and warehousing companies, e.g. in Northamptonshire.

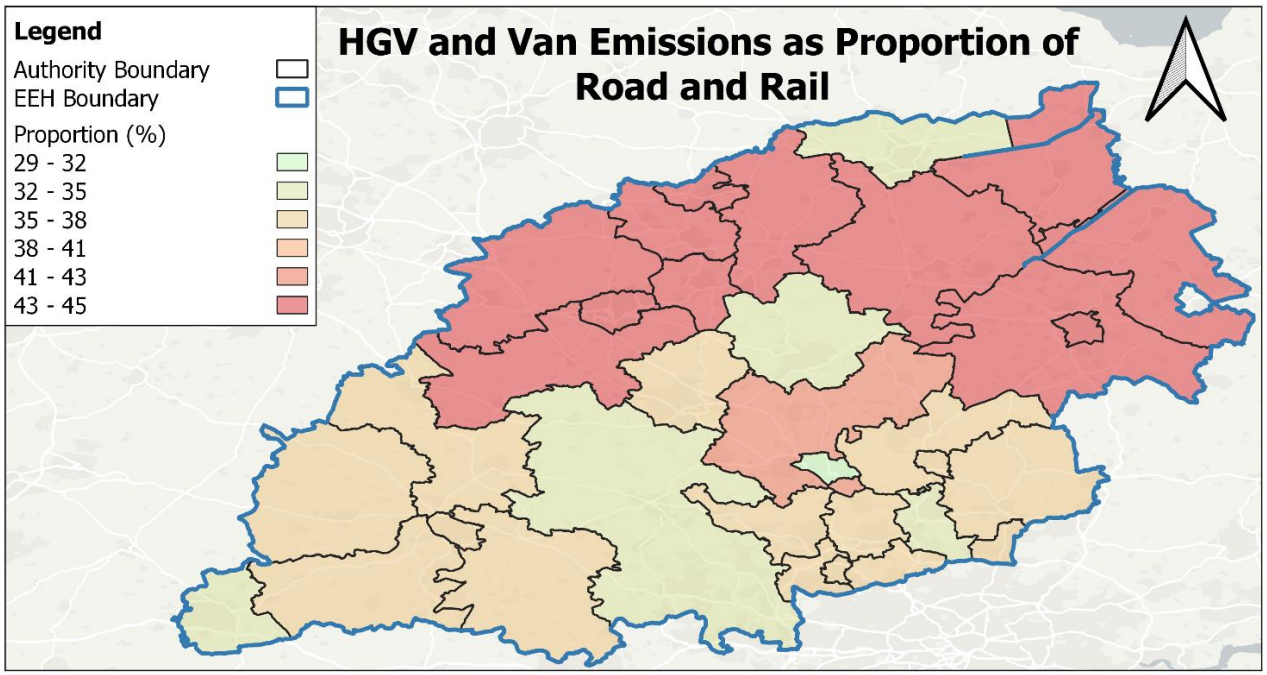


Figure 4-8: CO_2 Emissions from HGVs and Vans as a proportion of Passenger Road and Rail Tailpipe Emissions. Contains OS data © Crown copyright and database right 2021

4.2.9 **Finding 8: Emissions from international aviation are not on track to align with the UK government's Sixth Carbon Budget.** Figure 4-9 illustrates the change in emissions from Luton

Airport (the only substantial airport within EEH) relative to their 2015 value. It can be seen that, whilst emissions from both sources have increased since 2015, emissions from domestic aviation have started to reduce yet emissions from international aviation continue to grow. This does not align with the Sixth Carbon Budget which, as set out in The Carbon Budget Order (2021), includes international aviation emissions. Note, this analysis does not take account of use of other airports by EEH residents, nor use of Luton airport by residents from outside EEH.

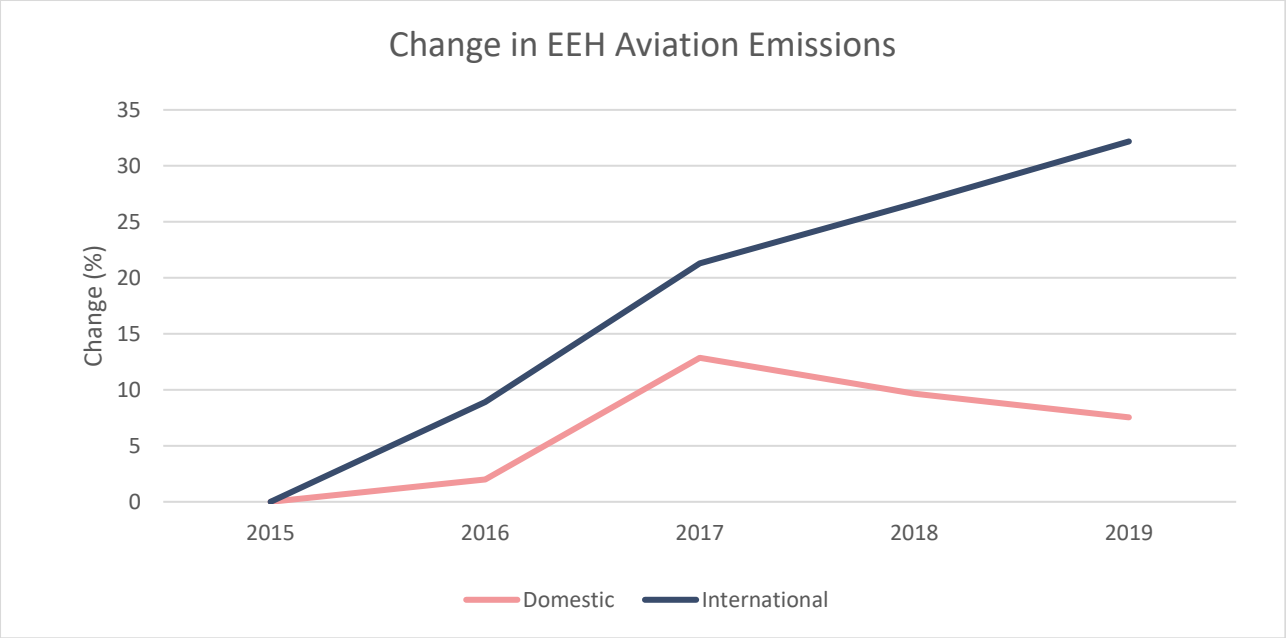


Figure 4-9: The change in emissions from aviation within EEH, relative to their 2015 value

4.2.10 **Finding 9: Net zero targets vary greatly between EEH's local authorities:** Table 4-3 lists the 2019 emissions from all transport within each local authority of EEH, and the local Net Zero target year. The amount of emissions that occurred on the road network outside of the Strategic Road Network is also shown, i.e. transport emissions controllable by the local authority. Target years have only been quoted for local authorities where the net zero target is associated with carbon emissions for the entire local authority area. Targets for net zero emissions for solely the council's 'estate' have been excluded.

Local Authority	All Transport Emissions ($ktCO_2$)	Controllable Transport Emissions ($ktCO_2$)	Local Net Zero Target	Source
Cherwell	590	330	No data available	N/A
Oxford	120	42	2040	(Oxford City Council, 2021)
South Oxfordshire	380	220	2030	(South Oxfordshire District Council, 2021)
Vale of White Horse	370	80	2045	(Vale of White Horse District Council, 2019)
West Oxfordshire	190	84	No data available	N/A

Oxfordshire	*1600*	*760*	*2050*	(Oxfordshire County Council, 2020)
Cambridge	88	45	2030	(Cambridge City Council, No date)
East Cambridgeshire	250	68	2050	(East Cambridgeshire District Council, 2020)
Fenland	170	87	No data available	N/A
Huntingdonshire	650	230	No data available	N/A
South Cambridgeshire	550	170	2050	(South Cambridgeshire District Council, 2020)
Cambridgeshire	*1700*	*600*	*2050*	(Cambridgeshire County Council, 2019)
Corby	78	36	2030	(Corby Borough Council, 2020)
Daventry	480	240	2050	(Daventry District Council, 2020)
East Northamptonshire	230	65	No data available	N/A
Kettering	260	55	2030	(Northamptonshire County Council, 2020)
Northampton	260	93	2030	(Northampton Borough Council, 2020)
South Northamptonshire	510	250	No data available	N/A
Wellingborough	150	41	2050	(Borough Council of Wellingborough, 2019)
Northamptonshire	*2000*	*790*	*No data available*	*N/A*
Broxbourne	120	59	No data available	N/A
Dacorum	250	140	2050	(Dacorum Borough Council, 2020)
East Hertfordshire	250	120	2050	(Hertfordshire County Council, 2020)
Hertsmere	320	260	2050	(Hertsmere District Council, 2020)
North Hertfordshire	260	170	No data available	N/A
St Albans	490	390	2030	(St Albans City and District Council, 2020)
Stevenage	120	79	2030	(Stevenage Borough Council, 2020)
Three Rivers	280	240	No data available	N/A
Watford	87	46	2030	(Watford Borough Council, 2020)
Welwyn Hatfield	230	170	2050	(Welwyn Hatfield Distict Council, 2020)

Hertfordshire	*2400*	*1700*	*2050*	(Hertfordshire County Council, 2020)
Buckinghamshire	*1200*	*840*	*2050*	(Buckinghamshire Council, 2021)
Swindon	*400*	*250*	*2050*	(Swindon Borough Council, 2020)
Luton	*200*	*130*	*2040*	(Luton Council, 2021)
Peterborough	*400*	*150*	*2030*	(Peterborough City Council, No date)
Milton Keynes	*530*	*340*	*2030*	(Milton Keynes Council, 2018)
Bedford	*290*	*86*	*No data available*	*N/A*
Central Bedfordshire	*710*	*380*	*2030*	(Central Bedfordshire Council, 2020)

Table 4-3: Summary of local authority net zero targets and 2019 carbon emissions from transport

5 Emission Pathways

5.1 City Science Methodology for Disaggregating Emission Pathways

5.1.1 To make equitable comparison of the pathways from different sources, we have disaggregated each pathway to EEH Road and Rail Tailpipe Emissions. The same disaggregation process can be applied to all pathways published by the same source, as described in Table 5-1.

Pathway source	Disaggregation Method
TDP	• Disaggregated to EEH and local authorities according to their contribution to the UK's Road and Rail Tailpipe Emissions in 2019 • No disaggregation by source required
CCC	• Disaggregated to EEH and local authorities according to their contribution to the UK's Road and Rail Tailpipe Emissions in 2019 • No disaggregation by source required • Scaled to 'tailpipe' emissions (rather than 'end user') according to 2019 proportions
NISMOD	• Published at EEH level. Lower-level geographical disaggregation made proportionally to a local authority's contribution to EEH's Road and Rail Tailpipe Emissions in 2019 • Already published at the 'Road' level. Scaled according to ratio between Road and Rail Tailpipe Emissions in EEH in 2019
Tyndall Centre	• No geographical disaggregation needed (published by local authority) • Sector disaggregation necessary to Road and Rail Tailpipe Emissions proportionally according to that sector's contribution to 'Energy Only' emissions in 2019.

Table 5-1: Disaggregation processes applied to each of the three pathway groups

5.2 City Science Methodology for Accelerating Pathways to 2040

5.2.1 The published CCC and NISMOD pathways have been calculated to align with Net Zero 2050, however, as shown in Table 4-3, some constituent councils within EEH have set a target for Net Zero by 2040 or earlier. EEH as a whole have set the ambition of achieving a transport system with zero carbon emissions by 2040. To view the pathways in the case of Net Zero 2040, we have 'compressed' the timescale to represent an 'accelerated' pathway to 2040. Note that this approach assumes that all milestones within a future scenario are accelerated, e.g. the end of new internal combustion engine car sales is brought forward to pre-2030.

5.3 Key Findings

5.3.1 **Finding 10: EEH's existing underlying emission reduction rate is insufficient for Net Zero 2050:** Figure 5-1 combines the past Road and Rail Tailpipe Emissions with three emission pathways to 2050. The 2017 – 2019 emission reduction rate has been extrapolated to 2050 shown as a dashed brown line in this figure. Under this "pre-COVID" trend pathway, emissions would still be substantial by 2050 and therefore this pathway does not align with Net Zero 2050.

5.3.2 **Finding 11: Reductions due to the COVID-19 pandemic indicate the scale of change needed:** The CCC 'Balanced Net Zero' pathway is shown in Figure 5-1, as is the 'Accelerated' version which aligns with Net Zero 2040. Both have been reconciled to the 2019 emissions value. Comparing the 2020 value against the CCC pathways shows that the level in emissions reduction brought about by the COVID-19 pandemic is similar to the change expected by approximately 2025 under these pathways. Locking in positive behavioural change resulting from the pandemic is likely to be key to ensuring those pathways can be met over the short-term in particular.

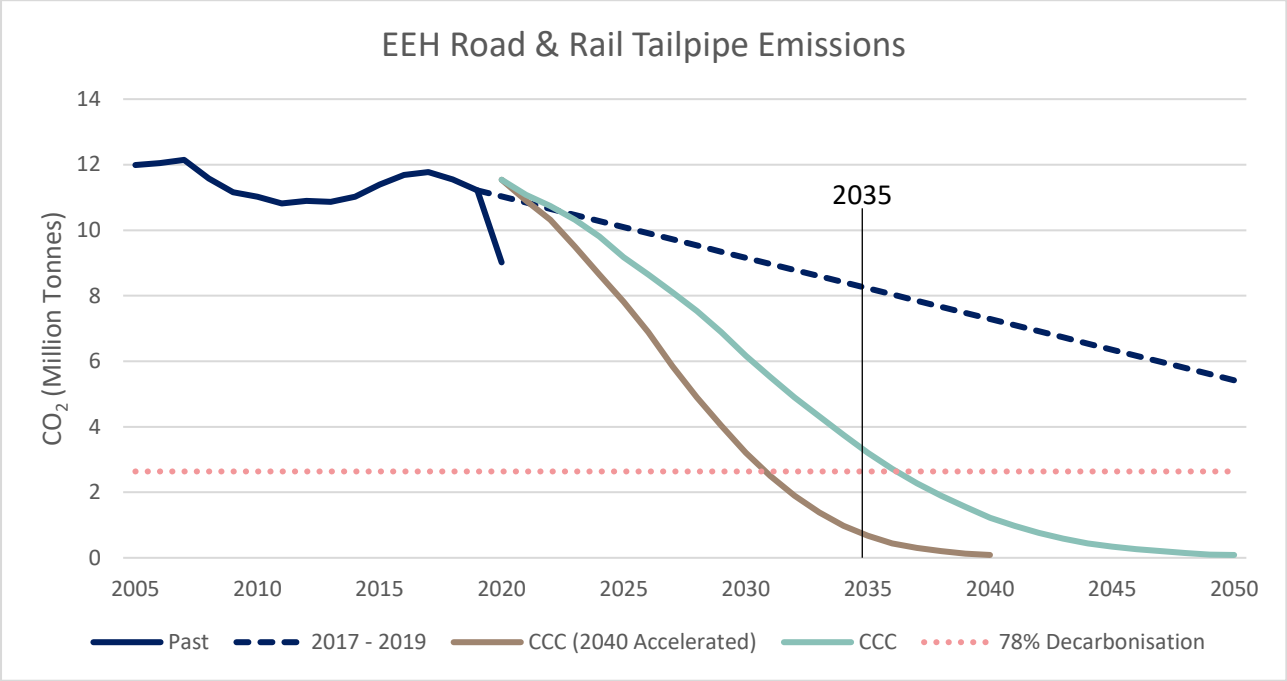


Figure 5-1: EEH Road & Rail Tailpipe Emissions, comparing historic emissions, extrapolated reductions and net zero pathways

5.3.3 **Finding 12: The "starting points" of different pathways are significantly different:** Figure 5-2 makes a comparison of the key features of the published emission pathways, on the basis of Road and Rail Tailpipe Emissions within the EEH. For clarity, the Net Zero 2050 aligning pathways of NISMOD and CCC have been combined and the values plotted here are the median of each pathway group. Values have been plotted for 2020 onwards since this is the earliest year for which all pathway values were available. There are substantial differences in the pathway predictions for the year 2020 owing to the difference in methodology used to calculate the published pathway. That the CCC and Tyndall Centre 2020 values are different is expected, owing to the Tyndall Centre's more rapid decarbonisation (13.6% reduction from 2019 to 2020). Note that the difference between 'NISMOD' and 'NISMOD – Business as Usual' is because the pathway was calculated from an initial year of 2019 and therefore by 2020 the pathways are diverging. This also accounts for the difference between 'CCC' and 'CCC – Baseline'

5.3.4 **Finding 13: Meeting Net Zero Targets by 2050:** The NISMOD, CCC, and Tyndall Centre decarbonisation emission pathways all lead to near zero emissions by 2050, and therefore align with Net Zero 2050. The NISMOD pathway indicates a near constant rate of decarbonisation during that period, whereas the CCC rate is variable (with a peak rate of decarbonisation in the period 2025 to 2035). The CCC pathway relates to 13.6% reduction

year-on-year, meaning that absolute reductions are large at first but become increasingly smaller.

5.3.5 **Finding 14: Focused decarbonisation efforts need to be made**: The 'NISMOD – Business as Usual' pathway reflects a scenario where the shift to Electric Vehicles continues at the historical rate, therefore emissions do reduce in the future, but substantial emissions remain in 2050, i.e. not aligning with Net Zero 2050. The 'CCC – Baseline' pathway reflects a scenario where no decarbonisation efforts are made, and therefore emissions increase with population growth.

5.3.6 Both these scenarios reflect the need for focused decarbonisation efforts to be made; historical trends prove that we cannot continue as we are and without decarbonisation efforts that have not been made before, we will not reach Net Zero 2050.

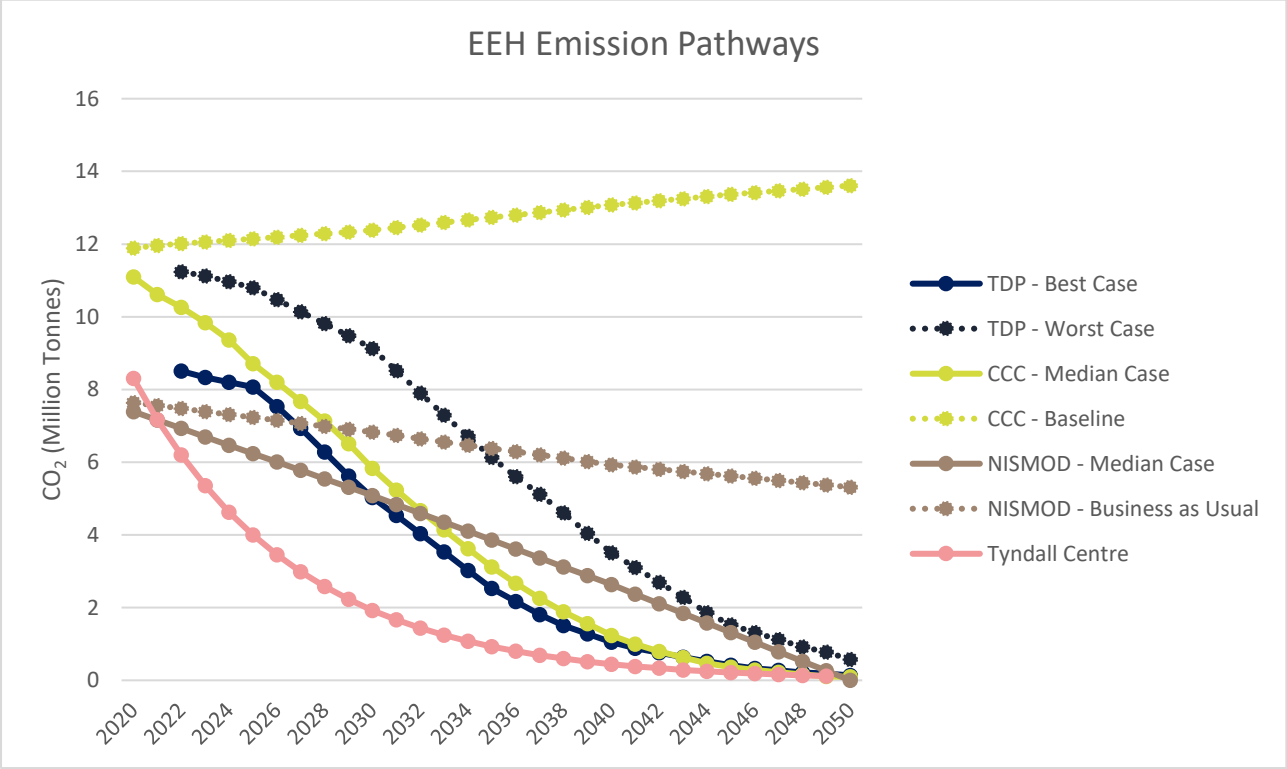


Figure 5-2: Carbon emission pathways comparison between sources for EEH

5.3.7 **Finding 15: The roll out of Electric Vehicles across EEH will need to rapidly up-scale:** Figure 5-3 illustrates the Electric Vehicle pathway for the EEH, in the case of the CCC's Balanced Net Zero scenario. Both Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are shown. It can be seen that there is rapid increase in the number of BEVs from approximately the year 2024. Like internal combustion engine cars, PHEVs will need to be phased out by 2050 in order to align with Zero Carbon Transport. This means that whilst PHEVs will contribute to the electrification of car travel until approximately 2028, the substantial increase in BEVs will dominate thereafter. This takeover is necessary as PHEVs have a zero-emission range of approximately only 30 miles (The AA, 2021). Although expected to increase, it means many long-distance journeys (which are less likely to be made by sustainable modes such as bus, walking or cycling) will not be zero carbon.

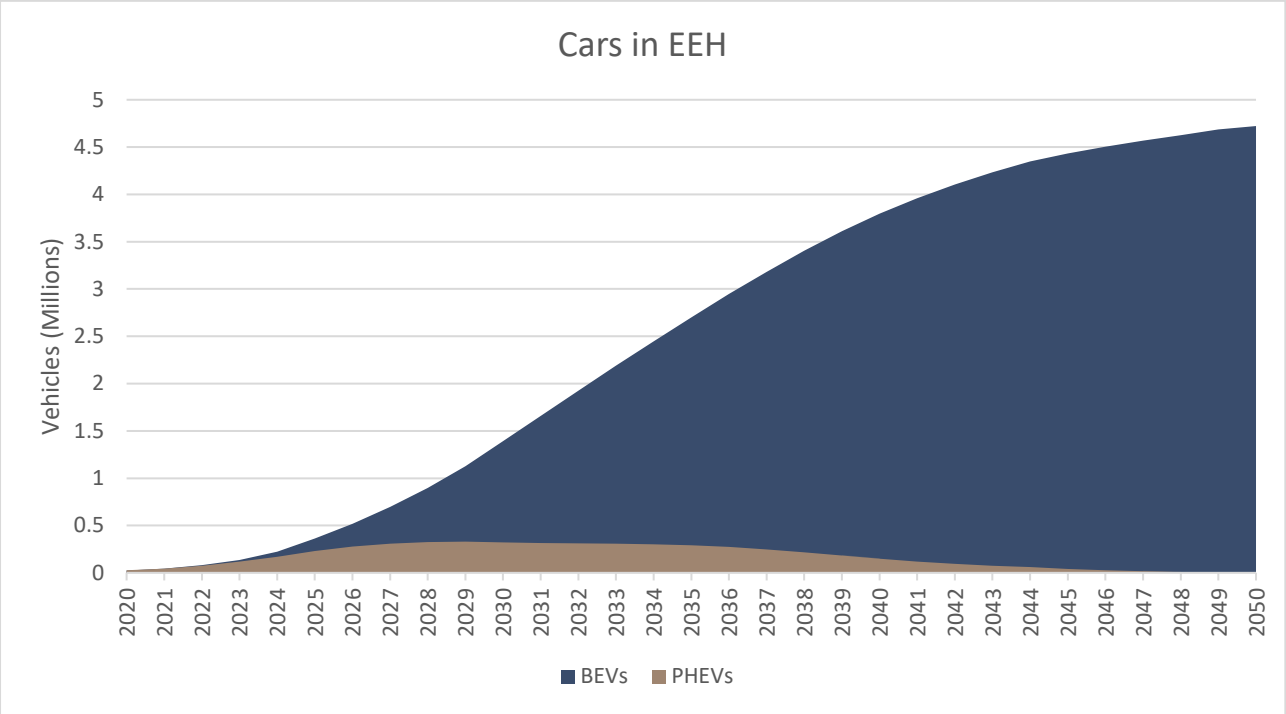


Figure 5-3: The CCC pathway for the number of Electric Vehicles within the EEH

6 Conclusions

6.1.1 The Road and Rail Tailpipe Emissions of EEH are substantial, accounting for approximately one tenth of all UK emissions, and being approximately one third greater than the average equivalent UK emissions per capita. This confirms the strong need for EEH to decarbonise transport if the UK is to reach Net Zero 2050.

6.1.2 **Recommendation 1: Separate strategic and place-based initiatives.**
Each authority should understand the quantity of emissions coming from local-level and strategic-level movements, and consider reducing both separately. Between the local authorities of EEH there is substantial variation in emission rates. Naturally this reflects differing geographic, place and demographic contexts as well as strategic through movements linked to the SRN and national freight flows. It will be important to analyse these differences further to develop responses appropriate to both strategic flows and provide place-based solutions that enable sharing of best-practice between similar typologies of settlements.

6.1.3 **Recommendation 2: Focus on decarbonisation of the car and road freight.**
The emissions owing to both can and must be reduced by a combination of vehicle electrification and a reduction in the number of vehicle movements, e.g. through greater use of public transport and active travel for passengers, and use of consolidation centres for freight. Outside of the effects of the COVID-19 pandemic in 2020, there has been little decarbonisation of EEH Road and Rail transport since 2005. This is similar to UK-wide patterns and reflects the inherent challenges of decarbonising road transport. Going forward, **cars contribute the overwhelming majority of emissions within EEH and decarbonising these is therefore imperative**. However, the contribution from Vans and HGVs is also substantial and will be vital to decarbonise. This is a particular challenge given the greater technological difficulties in electrifying road freight transport. In comparison to cars, Vans and HGVs, the emissions from other road vehicles and rail transport is relatively minor. A Net Zero 2040 objective could be reached without focus on these residual sectors in scenarios that assume carbon recapture technologies are developed and available to offset these. The majority of decarbonisation efforts should be focussed upon car, van, and HGV vehicles. Within the EEH, most of these emissions occur whilst travelling on the Strategic Road Network therefore there is significant scope for EEH and local authorities to identify interventions which will assist decarbonisation of these sources.

6.1.4 **Recommendation 3: Start decarbonisation at the earliest opportunity.**
The earlier emissions are reduced, e.g. through reduction of car emissions as described above, the greater the benefit and less drastic action is required later. While the published reducing emission pathways analysed in this project have different estimates of the current emissions or "starting point" for decarbonisation, all indicate a rate of decarbonisation greater than achieved in historic periods prior to the COVID-19 pandemic. Multiple pathways predict that if action is not increased, Road and Rail Tailpipe Emissions within EEH will remain substantial by 2050 and not align with Net Zero 2040. Whilst the pathways published by the CCC and Tyndall Centre have differing changes in emission rate, both predict a period of more rapid decarbonisation with the rate of change slowing in the period 2040 – 2050. This

indicates the urgency of decarbonisation now, if the pathways are to be followed.

6.1.5 Recommendation 4: Align with the CCC or Tyndall Centre pathways to give best chance of achieving Net Zero 2040.

EEH and its constituent local authorities will be best placed, with currently available information, to achieve Net Zero 2040 by translating the CCC scenario assumptions in to local targets and associated policy interventions. None of the published emission pathways achieve Net Zero 2040, and to do so will be a substantial challenge. The pathways closest to achieving this are that of the Tyndall Centre, CCC, and TDP – Best Case, all with approximately 1 million tonnes of CO_2 emissions remaining in 2040. Given that the TDP - Best Case pathway relates to a 'best case scenario' with the possibility for substantially more emissions by 2040, this should be considered a high-risk pathway to follow. The CCC and TDP pathways have less variation in their 2040 value and hence are lower risk. Nonetheless, the ambition of these would need to be increased further in order to reach Net Zero 2040. It should also be noted that the Tyndall Centre pathway does not correlate to a scenario pathway which can be used to guide policy. Accelerating the scenario pathway described by the CCC, including the roll out of Electric Vehicles, could lead to Net Zero 2040.

6.1.6 Recommendation 5: Understand the benefit of Electric Vehicle sales.

EEH and its constituent local authorities should gather data to quantify the reduction in tailpipe emissions brought about by Electric Vehicle sales. The magnitude of reduction in fleet-wide tailpipe emissions owing to Electric Vehicle sales is unknown. It will be necessary to quantify this in order to confirm whether Net Zero 2040 can be achieved by accelerating the CCC scenario pathway. Furthermore, this will allow actionable targets to be set for local authorities to influence the number of electric vehicles registered within them, and hence their tailpipe emissions. To determine the benefit of Electric Vehicle sales, it will be necessary to understand the distances travelled by the current electric and internal combustion fleets.

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