TECHNICAL METHODOLOGY NOTE

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SUBJECT:	Phase 3 Technical Methodology Note		
PROJECT:	CPCA Quantified Carbon Reduction Strategy	**AUTHOR:**	Sajitha Sasidharan, Aditya Sohoni
CHECKED:	Alex Thomas	**APPROVED:**	James Moore

1 INTRODUCTION

1.1 Background

WSP have been commissioned by Cambridge and Peterborough Combined Authority (CPCA) to undertake a three-phase decarbonisation study to support the Local Transport & Connectivity Plan (LTCP) which is currently being developed. CPCA and its constituent authorities have made a commitment to reduce vehicle km by 15% (from a 2019 baseline) through their LTCP.

The phasing of the study has been designed to align with the emerging Department for Transport (DfT) Quantified Carbon Reduction (QCR) guidance. Firstly, to provide the evidence required to support a compliant LTCP and secondly, to inform the scale and rate of carbon reduction which is required to support net zero objectives.

1.2 WSP Commission

In response to the background described above WSP has been commissioned to undertake a three-phase decarbonisation study to support the LTCP which is currently being developed. The phases include:

Phase 1: Estimation of current and future user emissions.
Phase 1 of the study set out the base year emissions on the transport network and forecast the emissions gap under a “business as usual” and “accelerated electric vehicle” scenario using a high-level link-based methodology. The results showed that a business as usual or do minimum approach reliant on technology change will leave a huge residual gap in carbon compared to the desired trajectory up to 2050.

Phase 2: Carbon assessment of current commitments identified in LTCP.
Phase 2 developed a more sophisticated baseline emissions model, adopting the most detailed method recommended by the upcoming DfT guidance. The network-based model allows us to disaggregate the results by journey purpose, vehicle type, trip length and road type to gain a better understanding of where emissions are coming from. This evidence is used to tailor interventions more effectively to target the carbon “worst offenders”. Once policy measures and specific interventions have been identified, the emissions model is then used to test their impact at varying scales and intensities.

Phase 2 of the study quantified the carbon impact of the current commitments identified in the LTCP. The results highlight that the current commitments shortlisted in the LTCP will not be sufficient to achieve the scale of reduction in vehicle km travelled required to bridge the emissions gap identified in Phase 1. The extent of committed infrastructure that will change travel behaviour (i.e., reduce demand or switch to sustainable modes) or accelerate electric vehicle uptake is not expected to create the transformational change required to reach the Government's net zero by 2050 target.

The results of phase 2 demonstrated that infrastructure alone is not enough to reduce the emissions gap (identified in phase 1) without additional policy measures that seek to influence travel behaviour on a greater scale.

Phase 3: Option appraisal and carbon assessment of interventions required.
Phase 3 seeks to provide evidence on the range and potential impact of additional policy measures that might be suitable for inclusion in the LTCP in order to achieve the combined authority's policy commitments. The carbon model developed in phase 2 will be used to test the full range of measures which are required to exert a greater influence on travel demand, including spatial strategy, demand management and shared transport solutions.

The key deliverables of this study include:

- **QCR Scoping Study Findings Presentation** – a slide deck summarizing the findings of the study. This has been designed to be suitable for both presentation and review as a standalone document. Task 1 findings were presented in December and Task 2 findings in January. The final slide deck includes findings from both.
- **Technical methodology note** – this document. The purpose is described in Section 1.3 and structure in 1.4.

1.3 Purpose of this Methodology Note

The purpose of this methodology note is to:

- Document the technical methodology (including key assumptions and sources) that have informed the analysis and recommendations presented in the slide-deck
- Set out methodological requirements and recommendations for future stages of carbon analysis in support of LTP4's development in line with the QCR guidance.

The intended audience of this methodology note is officers looking to understand the methodology that has informed this analysis and methodological advice and recommendations for future stages of LTP development.

The slide-deck should be used as the primary deliverable for communicating the findings and recommendations from this commission. This methodology note therefore does not repeat this content from the slide-deck and instead cross-references to content in the slide-deck.

1.4 Structure of this Note

The structure of this note is aligned to that used in the slide-deck as follows:

- Section 2: Carbon budgets and pathways (slides 5-8)
- Section 3: Identify the implementation gap (slide 7-8)
- Section 4: Identify transport outcomes (slides 10-12)
- Section 5: Identify interventions (slides 14 – 18)
- Section 6: Assessment of interventions (18 – 35)
- Section 7: Linking interventions to outcomes (36 – 51)
- Section 8: QCR gap analysis (52 – 53)

2 CARBON BUDGETS AND PATHWAYS

2.1 Transport decarbonisation pathways

Different national and regional pathways represent different interpretations of the pace of which emissions must fall to mitigate climate change. For a more detailed breakdown please refer to phase 1 and 2 deliverables.

The following pathways have been used in this analysis.

CCCs The Sixth Carbon Budget: The UK's path to Net Zero

Three 'explanatory scenarios' developed to identify a 'Balanced Pathway' towards Net Zero. The balanced pathway puts the UK on track for Net Zero by 2050 and supports the required global path for decarbonisation. For the purpose of calculating transport decarbonisation pathways the data is extracted from 'surface transport' under the Scenario Key Metrics tab of the CCC dataset. Key assumptions underpinning the pathway can be found in the methodology report.

Net Zero Strategy: Build Back Greener (2021)

The Net Zero Strategy contains three illustrative 2050 net zero scenarios and an indicative delivery pathway for each sector including domestic transport. The indicative delivery pathway for domestic transport reflects uncertainty in future macroeconomic trends from which a central pathway can be determined.

The central pathway and consistent carbon budgets, if delivered successfully, would meet statutory whole economy carbon budgets set by the UK (assuming that other sectors achieve their relevant delivery pathways). The Net Zero delivery pathway is informed by CCC's analysis but reflect Government policy decisions of how best to achieve targets. Further information on how this pathway has been developed can be found in pages 74-83 of the Net Zero Strategy.

Data is extracted from the NZS Dataset under the Transport tab; NZS Delivery Pathway (Upper and Lower range).

Tyndall Centre

The Tyndall Centre pathway is the most ambitious of the pathways analysed with emission reductions throughout the 2020's equivalent to those seen in 2020 under COVID-19 travel restrictions. The method used by Tyndall Centre adopts a different interpretation of what is a 'fair' contribution by the UK to the Paris Agreement, providing the UK a smaller whole economy carbon budget than committed to nationally. Local authorities are then apportioned to a share of the budget.

The data reports can be used to calculate carbon budgets for any part of the United Kingdom from local authority area scale up to regions and devolved administrations. As such, whole-economy decarbonisation pathway annual data is extracted manually from the report by selecting the relevant LA's and summing these.

The Tyndall Centre provides a whole-economy decarbonisation pathway for each local authority. It does not however disaggregate by sector. To provide a transport specific pathway the 2019 proportions of emissions from each sector have therefore been used. This assumes the proportions remain the same in future years (i.e. each sector decarbonises at the same pace) which is a limitation.

2.2 Method for scaling to CPCA using Carbon Tool

The tool has a bottom-up approach to provide the baseline carbon emission till 2050 for transport in the CPCA area with 2019 as baseline. The tool provides details of carbon emissions on a link-based level, with the ability to analyse emissions in each local authority area based on road type. The results of the baseline are also broken down into categories (for example journey purpose, mode type etc.) and aligned to historical carbon data by local highway authority available from the Department for Business, Energy & Industrial Strategy (BEIS).

The link-based assessment used outputs from different strategic models (Cambridge Sub Regional Model (CSRM2), Peterborough transport model (PTM3), March Area Transport Study Model (MATS), Wisbech Area Transport Study Model (WATS15) and the Southeast Regional Transport Model (SERTM2)). SERTM2 model was developed for National Highways and covers the whole of the south-east of England including the whole of the CPCA area.

The outputs of the link-based data produced in phase one of this project have been combined with the trip genesis and trip length distribution outputs into a more detailed carbon baseline model. The spreadsheet developed does not forecast nor manipulate data to see the effect of different interventions/measures. However, it is considered the starting point for forecasting and sensitivity testing.

The data is provided on a row-by-row basis with each row providing a record of data e.g. sector, attribute, vehicle type kilometres, vehicle type speed. The attribute on each record was journey purpose, journey length bandwidth, road type and so on. The outputs are used separately in the dashboard analysis to avoid double counting.

2.3 Carbon Budgets Methodology

In response to the Paris Agreement, the UK Government has set ambitious Nationally Determined Contributions (NDCs) to reduce greenhouse gases in line with a trajectory to limit global average temperature increases to 1.5°C and to keep global temperatures less than 2°C above pre-industrial levels.

Through the Climate Change Act these NDCs have been translated into UK law in the form of five-year carbon budgets, which set legally binding limits on the total amount of greenhouse gas emissions the UK can emit over five-year periods. These limits reduce with each successive budgetary period. Achieving these budgets will put the UK on a trajectory to achieve Net Zero by 2050.

Slide 15 details indicative transport carbon budgets for each of pathways. For each pathway these have been calculated by summing the results (as documented in the data spreadsheet) for each carbon budget period, as defined through the Climate Change Act.

3 IDENTIFY THE IMPLEMENTATION GAP (SLIDE 7 TO 8)

3.1 Future Emission Scenarios

Three scenarios have been used to test what impact no further intervention as well as accelerated EV uptake would have on transport emissions in CPCA, depicted on Slides 5, 7 and 24 respectively.

The three scenarios used are:

Business as Usual (TAG) Forecast

The Business as Usual (BaU) scenario highlights how transport emissions in CPCA may change up to 2050 without further intervention.

This represents firm and funded policies in line with current TAG datasets and recognised growth forecasts (National Road Traffic Projections (NRTP) 2022 Core scenario).

Fleet assumptions are based on the latest version of the TAG Databook (A1.3.9) which does not account for national bans on the sale of new Internal Combustion Engine Vehicles (ICEVs): a national intervention that is not yet legislated for but is expected to have a significant influence on future emissions.

Accelerated ZEV uptake scenarios

The following scenarios of 'accelerated ZEV uptake' have been used to present possible scenarios of accelerated ZEV uptake driven primarily by the national bans on the sale of ICEVs.

EV:Ready / Localised Market Ready (High and Low)

EV:Ready is WSP's tool for informing transport authorities of future EV demand, supply and charging requirements. It has been used to prepare local authority forecasts of EV uptake that reflect local factors. The method utilises National Grid Future Energy Scenarios (FES) for UK based scenarios of EV uptake and weights these to reflect their relevance to the market today and forecast uptake rates until 2050. Local factors are then accounted for using data such as baseline EV ownership and sales trends, reliance on on-street parking, vehicle ownership, wider fleet and vehicle turnover trends and propensity to switch to an EV (based on socio-demographics and consumer attitude data).

This gives a High and Low forecast of percentage EV ownership as a proportion of total vehicle fleet on an annual basis up to 2050. These percentages have been used in place of TAG Unit A1.3.9 in the forecasting of emissions up to 2050 (see Figure 1). This assumes percentage ownership can be used in place of percentage mileage split, which may cause inaccuracies in some local circumstances (e.g., where an authority has low EV ownership but high EV mileage from trips originated in a neighbouring authority).

EV:Ready only provides EV forecasts for car. To reflect likely switches to zero emission technologies in LGVs and HGVs it has been assumed LGV ownership is the same as EV:Ready forecasts for car, and HGVs follow the same profile but 10 years behind.

The High and Low forecasts reflect the significant uncertainty that exists in future EV uptake but reflects EV uptake is likely to be higher than estimated in TAG.

Common Analytical Scenarios (CAS)

DfT released the Common Analytical Scenarios in August 2022 with a databook that included mileage split by fuel type for each scenario. Growth factors for each CAS scenario were released in December 2022 as part of the National Road Traffic Projections (NRTP) 2022.

The intention of CAS is to provide greater consistency in the treatment of uncertainty in the appraisal, and development of transport schemes, policies, and strategies. Six analytical scenarios have been developed including high economy, low economy, regional, behavioural change, technology and decarbonisation.

The decarbonisation scenarios include two variants:

- Mode Balanced (MB) Decarbonisation
- Vehicle Led (VL) Decarbonisation Scenario

These two scenarios include the same mileage split dataset that represent a potential future of ambitious ZEV uptake. Both are national datasets (not reflecting local differences) and are only scenarios intended to support planning for uncertainty – they are not forecasts. Since fleet assumptions is same for the two variants in decarbonisation scenarios and all other assumptions (e.g., traffic growth, fuel efficiency) remain same as per the Business-as-Usual (TAG) estimate in the carbon tool, only Vehicle Led scenario is considered in the analysis.

The accelerated EV uptake scenario should be used to inform the potential contribution that accelerated EV uptake driven by national policy could have. The scenario however must be enabled by local delivery of charging infrastructure and may fail to materialise if charging provision and other factors (e.g., grid supply) are not overcome.

The datasets used in each emission estimate scenario are summarised in Table 1 below. This includes the values for each key dataset in 2025, 2030, 2040 and 2050 to aid comparison between these datasets.

Table 1: Datasets used in each emission estimate scenario

		BaU (TAG A1.3.9)				EV:Ready-High				EV:Ready-Low				CAS -VL (CAS Mileage Split (VL1))			
Fleet composition		Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV
	2025	15%	2%	0%	16%	13%	13%	0%	13%	8%	8%	0%	8%	13%	4%	0%	16%
	2030	36%	5%	0%	28%	44%	44%	2%	44%	28%	28%	2%	28%	41%	28%	9%	36%
	2040	62%	29%	0%	31%	92%	92%	44%	92%	79%	79%	28%	79%	88%	81%	70%	82%
	2050	67%	45%	0%	33%	99%	99%	92%	99%	95%	95%	79%	95%	99%	95%	99%	98%
Traffic growth (Minor Roads)		NRTP Core				NRTP Core				NRTP Core				NRTP Core			
		Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV
	2025	1.03	1.13	1.01	0.93	1.03	1.13	1.01	0.93	1.03	1.13	1.01	0.93	1.03	1.13	1.01	0.93
	2030	1.08	1.09	1.01	0.93	1.08	1.09	1.01	0.93	1.08	1.09	1.01	0.93	1.08	1.09	1.01	0.93
	2040	1.15	1.22	1.03	0.93	1.15	1.22	1.03	0.93	1.15	1.22	1.03	0.93	1.15	1.22	1.03	0.93
	2050	1.18	1.34	1.04	0.93	1.18	1.34	1.04	0.93	1.18	1.34	1.04	0.93	1.18	1.34	1.04	0.93
Traffic growth (Motorways)		NRTP Core				NRTP Core				NRTP Core				NRTP Core			
		Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV
	2025	1.05	1.13	1.03	0.93	1.05	1.13	1.03	0.93	1.05	1.13	1.03	0.93	1.05	1.13	1.03	0.93
	2030	1.13	1.13	1.07	0.93	1.13	1.13	1.07	0.93	1.13	1.13	1.07	0.93	1.13	1.13	1.07	0.93
	2040	1.24	1.27	1.13	0.93	1.24	1.27	1.13	0.93	1.24	1.27	1.13	0.93	1.24	1.27	1.13	0.93
	2050	1.29	1.40	1.18	0.93	1.29	1.40	1.18	0.93	1.29	1.40	1.18	0.93	1.29	1.40	1.18	0.93
Traffic growth (A Roads)		NRTP Core				NRTP Core				NRTP Core				NRTP Core			
		Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	LGV	HGV	PSV
	2025	1.02	1.16	1.02	0.93	1.02	1.16	1.02	0.93	1.02	1.16	1.02	0.93	1.02	1.16	1.02	0.93
	2030	1.08	1.20	1.03	0.93	1.08	1.20	1.03	0.93	1.08	1.20	1.03	0.93	1.08	1.20	1.03	0.93
	2040	1.14	1.38	1.05	0.93	1.14	1.38	1.05	0.93	1.14	1.38	1.05	0.93	1.14	1.38	1.05	0.93
	2050	1.18	1.52	1.07	0.93	1.18	1.52	1.07	0.93	1.18	1.52	1.07	0.93	1.18	1.52	1.07	0.93
Fuel efficiency (Petrol) in l/km		TAG A1.3.11				TAG 1.3.11				TAG 1.3.11				TAG 1.3.11			
		Car	LGV			Car	LGV			Car	LGV			Car	LGV		
	2025	0.06	0.08			0.06	0.08			0.06	0.08			0.06	0.08		
	2030	0.06	0.07			0.06	0.07			0.06	0.07			0.06	0.07		
	2040	0.06	0.06			0.06	0.06			0.06	0.06			0.06	0.06		
	2050	0.07	0.05			0.07	0.05			0.07	0.05			0.07	0.05		
Fuel efficiency (Diesel) in l/km		TAG A1.3.11				TAG A1.3.11				TAG A1.3.11				TAG 1.3.11			
		Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	Car	LGV	HGV	PSV	LGV	HGV	PSV
	2025	0.06	0.07	0.17	0.26	0.06	0.07	0.17	0.26	0.06	0.06	0.07	0.17	0.26	0.09	0.31	0.41
	2030	0.06	0.06	0.16	0.26	0.06	0.06	0.16	0.26	0.06	0.06	0.06	0.16	0.26	0.08	0.28	0.39
	2040	0.06	0.06	0.14	0.25	0.06	0.06	0.14	0.25	0.06	0.06	0.06	0.14	0.25	0.08	0.24	0.36
	2050	0.06	0.05	0.14	0.25	0.06	0.05	0.14	0.25	0.06	0.06	0.05	0.14	0.25	0.08	0.23	0.34
Fuel efficiency (Electric) in kWh/km		TAG A1.3.11				TAG A1.3.11				TAG A1.3.11				TAG 1.3.11			
		Car	LGV	HGV	PSV	Car	LGV	HGV	PSV	Car	Car	LGV	HGV	PSV	LGV	HGV	PSV
	2025	0.19	0.26	1.15	1.19	0.19	0.26	1.15	1.19	0.19	0.19	0.26	1.15	1.19	0.27	1.19	1.08
	2030	0.18	0.25	1.09	1.18	0.18	0.25	1.09	1.18	0.18	0.18	0.25	1.09	1.18	0.27	1.14	1.00
	2040	0.17	0.28	1.12	1.15	0.17	0.28	1.12	1.15	0.17	0.17	0.28	1.12	1.15	0.28	1.12	0.92
	2050	0.16	0.27	1.12	1.12	0.16	0.27	1.12	1.12	0.16	0.16	0.27	1.12	1.12	0.27	1.12	0.88

3.2 Size of the Gap

The graph on slide 8 depicts the gap between estimates and carbon budgets based on the Common Analytical Scenario which presents the most ambitious EV uptake and the BaU Forecast. The gap for each pathway was determined by calculating the difference between the total carbon budget for each scenario and pathway as per each carbon budget period (CB4 to CB6).

4 IDENTIFY TRANSPORT OUTCOMES (SLIDE 10 - 12)

The Cambridge and Peterborough Independent Commission on Climate recommends a 15% reduction in vehicle km in 2030 (from a 2019 baseline). This was approved by the CA board in June 2021 and is now a commitment. Analysis has been done as to check if this commitment demonstrates a realistic and suitable level of ambition for the LTP to achieve. The BAU estimates were compared to the CCC pathway for this. The steps involved in the analysis are given below:

- To compute the target vehicle km reduction required by CPCA, a 15% reduction from 2019 baseline vehicle km was applied.
- The growth in vehicle km between 2019 and the forecast year (2031) under a business-as-usual scenario was then quantified.
- The 2019 required vehicle km was then subtracted by the 2031 base (which includes traffic growth) to quantify the required % reduction to achieve the policy objective.

To demonstrate how the local 15% objective aligns with the CCC pathway to net zero, the annual vehicle km per tCO2e was extracted from the carbon tool outputs (vehicle km and the corresponding emission estimates for the years 2019 to 2050). This annual vehicle km per tCO2e is used to calculate the corresponding annual vehicle km for CCC pathway emissions forecasted.

5 IDENTIFY INTERVENTIONS (SLIDES 14 – 18)

5.1 Carbon Assessment Framework (CAF)

To identify the decarbonisation potential of multiple interventions, a carbon assessment framework (CAF) has been developed. Please acknowledge the general guidance behind slide 17 results:

- The Carbon Assessment Framework (CAF) tool should be used as part of the optioneering stage of the QCR (Stage 3).
- The intervention list has been developed from the Midland Connect Playbook longlist. In advance of the Midlands Connect Decarbonisation Playbook which is not yet available for use, this study has sought to provide a proportionate estimate of the scale of impact different interventions could realistically achieve. This is intended to support early consideration of the nature and scale of measures required.
- Estimates are high-level and do not account for local circumstances within CPCA
- A range has been provided for user emissions to account for variability in intervention impact
- At this stage a quantitative range for infrastructure carbon is not available. This is largely due to the variability in impact and limited availability of suitable benchmarks.
- More detailed and bespoke carbon assessments of interventions is recommended should interventions be shortlisted.

Each of the scoring matrixes is provided below:

Role within Decarbonisation Framework (Avoid / Shift / Improve).

- Avoid (3): Interventions which reduce the need to travel
- Shift (2): Interventions which increase the proportion of trips that are taken by active, public and shared forms of transport. The reduction in vehicle travel (km) is converted to emissions to quantify the carbon impact.
- Improve (1): Interventions which improve the efficiency of transport.

User Emissions Impact

User emissions relates to the direct emissions generated from the use of the transport network (e.g., tailpipe emissions). Interventions which result in mode shift and a reduction in vehicle use will generate user emissions savings. A four-point scale has been applied to score each intervention:

- Neutral (0)
- Slight beneficial (1): typically, <1,000 tCO2e
- Moderate beneficial (2): typically, >1,000 tCO2e and <25,000 tCO2e
- Large beneficial (3): typically, >25,000 tCO2e

Scale of user emission savings has been quantified in tonnes of CO2e (results relate to cumulative impact in emissions up to 2050). A range has been provided to allow for variation in user savings between schemes of the same type. For example, a 1km of cycle infrastructure in one location, will not return the same user emission savings elsewhere. The tCO2e range is intended to support early consideration of the nature and scale of measures required.

Infrastructure carbon:
Infrastructure carbon relates to emissions associated with the construction, operation and maintenance of an infrastructure asset. A four-point scale has been used to quantify the infrastructure carbon impact of each intervention.

- Neutral (0): None or limited infrastructure carbon.
- Slight increase (-1): Small scale construction / materials involved.
- Moderate increase (-2): Moderate construction/materials and engineering involved.
- Adverse increase (-3): Major construction required.

Due to the variability of infrastructure emissions, dependent on scheme design, scale of materials, construction methods etc, it is not possible at this early stage to provide a quantitative range alongside the four-point scale. For this reason, we would recommend extra consideration is given to infrastructure carbon when shortlisting measures. PAS2080 principles should be applied throughout the LTP4 infrastructure plan, adopting the best practise of the carbon reduction hierarchy.

Whole-life Carbon assessment for schemes should be undertaken to quantify the carbon impact of an intervention across its lifecycle, including user emissions and infrastructure carbon. Interventions scored -3 have the potential to offset any user emissions savings from modal shift.

Net score

The sum of the three scores has been calculated to provide the net carbon score for each measure.

- 0: Limited to no impact on carbon emissions
- 1: Slight beneficial: User emissions savings offset by infrastructure carbon.
- 2: Slight beneficial: Schemes with low user emissions savings but no infrastructure carbon | schemes with moderate user emissions potential but moderate infrastructure carbon
- 3: Moderate beneficial: Shift schemes with moderate infrastructure carbon. To be prioritised in areas of poor sustainable travel choice
- 4: Moderate beneficial: Shift / avoid schemes with moderate user emissions savings and limited infrastructure carbon
- 5: Large beneficial: Shift / avoid schemes with large user emissions savings and limited infrastructure carbon
- 6: Large beneficial: Avoid schemes with moderate user emissions savings and limited infrastructure carbon

6 ASSESSMENT OF INTERVENTIONS

6.1 Principles of Method

Phase 3 of the study builds on the transport decarbonisation model (TDCM) developed in Phase 2 and considers a range of measures that will impact the CPCA decarbonisation pathway. The results of this analysis will define what additional measures are required (over and above the schemes already identified in the LTCP) to achieve a 15% reduction in vehicle km travelled.

6.2 Emissions in the Combined Authority Influence

Through-trips (trips without a destination within the administrative boundary of the authority) and rail are outside the direct influence of authorities to address through the LTCP.

Method: Through trips are excluded from the trip genesis and the new reduced vehicle km is run through the carbon model tool to get the emissions in tCO2e.

Assumptions: Assumed to remove all the through trips for all time periods.

Limitations: Interventions which could target emissions from through trips have not been quantified as part of this commission.

6.3 Impact of Limiting Traffic Growth

The TDCM includes growth factors to account for housing projections and traffic growth. This assumes that new growth broadly replicates current travel patterns and that all new developments induce travel demand. To quantify the potential scale of emissions reductions which are achievable by limiting traffic growth, we have applied sensitivity tests to the growth factors used in the traffic model.

Method: First step is to get the annual growth in vehicle km travelled (~ 1% to 2% per year) from the carbon model outputs and then apply manual reductions to these growths. Then the reduced vehicle kms is estimated using the reduced growth factors and fed to the carbon tool to get the emissions (tco2e).

Assumptions: CPCA requires a Spatial Development Strategy (SDS) to apply a carbon lens to the Local Plan alongside the LTP measures to enable this reduction. The assumed reduction rates applied to the growths are 10%, 25% and 50%.

Limitations: Growth rate is aggregated across modes and regions before applying reduction factors. Depending on the spatial development strategy, its likely that traffic growth would look different across CPCA. For instance, urban areas with high access to sustainable travel choice and services offer the greatest potential to limit car growth.

6.4 Self-Containment Test (Spatial Planning)

Design codes for new developments advocate the 20-minute neighbourhood as best practise – allowing trips within a 20-minute journey time to be made by walk / cycle.

Method: First step is to identify responsive demand which would be analogous to car trips within a band of <5 miles in distance corresponding to a 20-minute journey. Trip reduction factor applied by trip purpose for internal, in-bound and out-bound trips. Through trips have been excluded. Reductions are applied for Personal Business, Leisure & Shopping for Other trip purpose. The reduced vehicle km is then fed to the carbon model to get the corresponding emissions (tCO2e).

Assumptions: This was only applied to Cambridge and Peterborough. Assumed reduction in car trips/vehicle kms by purpose keeping LGV / HGV movements as non-responsive. The following reduction rates were assumed for different trip purpose.

- Business: 10%
- Commute: 10%
- Other (personal business, leisure, shopping): 14%

Limitations: Other authorities (which include Fenland, Huntingdonshire, East Cambridgeshire and South Cambridgeshire) are not considered. Reductions rates have the potential to be variable dependent on location and scale of interventions (i.e., level of sustainable travel choice available and proximity of services within 20-minute catchment area).

6.5 Impact of Online Services

Increased provision of online services and opportunities provides the potential to reduce emissions by reducing travel as people work, attend meetings or appointments or shop virtually at home or at a local digital hubs, rather than making a journey.

Method: First step is to identify the responsive demand in Cars and LGVs (HGV Trips excluded) for all periods. Respective trip reduction factor is applied to all trip genesis by purpose of the trip. The reduced vehicle km is fed into the carbon tool to get the corresponding emissions (tCO2e).

Assumptions: Reduction in car trips/vehicle kms by purpose: Business: 10%, Commute: 10%, Other (personal business, leisure, shopping): 10%**.** Increase in Business LGV trips/vehicle kms = 5%

Limitations: The analysis applies reductions to a 2019 baseline and therefore does not fully account for the legacy of behavioural changes seen during and post covid. The latest evidence released from ONS[1] shows the scale of vehicle reduction could be significantly higher than the reduction factors listed under assumptions above. The data shows that 28% of people reported both working from home and travelling to work over the period September 2022 to January 2023 (whilst 16% reported working from home only) in comparison to the 2019 survey data[2] which shows 12% of working adults reported working from home at some point in the week before the interview. The scale of reduction could therefore be an underestimate.

However, there is also a risk of re-bound travel as other trips could be made with the time made available, so the reduction could be an overestimation. Also, worth noting that the online services might not be at the

[1]https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/characteristicsofhomeworkersgreatbritain/september2022tojanuary2023
[2] Coronavirus and homeworking in the UK labour market - Office for National Statistics (ons.gov.uk)

same level across all the Local authorities and there is a lack of empirical evidence to demonstrate long and short-term effect.

6.6 Impact of Alternative Fuel

Three EV uptake scenarios are tested

1. Business-as-Usual (TAG) scenario - based on latest version of TAG Databook A.1.3.9 (minimum requirement of EV uptake in QCR guidance).
2. DfT Common Analytical Scenario (CAS) - table VL1 from the vehicle led decarbonisation scenario (minimum requirement of EV uptake in QCR guidance).
3. Localised market forecast - derived from WSP's EV: Ready tool and processed from a range of forecasts (considered Optional by QCR guidance).

Method: The emissions corresponding to the scenarios are obtained from CPCA's carbon tool for all three scenarios.

Assumptions: Only the fleet assumptions change in the scenarios and all other assumptions (e.g., traffic growth, fuel efficiency) remain as per the Business-as-Usual estimate.

Limitations: The TAG and Common Analytical Scenario assumptions are national level. There is no consideration to the scale of infrastructure provision which is required to enable this scale of electric vehicle uptake. No allowance of constraints in electric supply have been made.

6.7 Impact of Achieving BSIP Targets

The Bus Service Improvement Plan (BSIP) has the potential to supplement measures identified in the LTCP to expediate the switch to public transport. Phase 3 will quantify the potential scale of impact of these changes. Our analysis will estimate the scale of reduction in car use could be expected if BSIP reaches its target for bus patronage. The impact of discounting fare prices across CPCA are also tested.

Method:

First step was to identify the rate of increase in bus patronage and then quantifying mode shift from car to bus (increase in bus passenger trips * TAG diversion factor). Next step was to estimate the total vehicle km saved by multiplying vehicle trips and average trip distance. The reduced vehicle km was then fed to the carbon tool to get the emissions in tCO2e.

Evidence Source: TAG Diversion Factor -TAG Table A5.4.6 Bus diversion factors by recipient/source mode; Average distance - DfT National Travel Survey NTS9912; Elasticities – TAG Unit M2.1 Variable Demand Modelling.

Assumptions: Growth in passenger trips is from a 2019 baseline. Tested for BSIP target growth of 15%, 30%, 50% and 100%. Mode shift from car to PT for fare discount (50% and 100% reduction) were tested.

Limitations: Applied elasticity values across the board. This may overestimate the vehicle km reduction for I-E, E-I and through trips to and from CPCA. It may also underestimate the vehicle km reduction for internal trips within CPCA. Emissions return is dependent upon Tag diversion factor and average trip distance.

6.8 Impact of Future Mobility Solutions for Freight

LGV / HGV movements make up 42% of emissions in CPCA. For short distance trips of less than 5 miles, they constitute 1% of vehicle km, but 3% of total emissions. Particularly with the rise of home deliveries, there is a need to provide first and last mile solutions to freight deliveries. This sensitivity test quantifies the potential scale of carbon reduction which can be achieved by reducing the vehicle km assigned to LGV / HGV movements within the urban areas of Cambridge and Peterborough.

Method:

First step is to Identify the responsive demand (trips <5miles) only for LGV/HGV trips within the Cambridge and Peterborough region. The trip reduction factor (20% for business purpose trips) to internal, in-bound and out-bound trips was applied to get the reduced vehicle km. The estimated reduced vehicle km is fed to the carbon tool to get the emissions in tCO2e.

Assumptions: Reduction factor only applied to Cambridge and Peterborough on trips less than 5 miles for LGVs and HGVs (Car trips are excluded). Assumes freight deliveries are shifted to zero emission vehicles or are removed through supply chain efficiencies i.e., consolidation centres and optimised delivery routing.

Limitations: No change in LGV / HGV movements outside of the urban areas. This test provides a top-down estimate of the potential scale of emissions reduction, however, there is limited evidence available to justify reduction factor applied. Analysis does not quantify the scale or intensity of measures which is required to achieve this scale of reduction. Analysis does not take account of rates of conversion of HGVs to ZEVs.

6.9 Impact of Physical Measures - Capacity Constraints

Vehicle capacity constraints are physical constraints deployed to restrict vehicle use in targeted locations to reduce vehicle numbers and emissions. For this study these will be for a cordon-based reduction, based on the city centre.

Method: Based on an input cordon analogous to the area of influence of any capacity constraint measure to be implemented (noting that the cordon would be big enough to contain the diversion route(s) as well), the cordon factor is calculated to derive responsive trips that are a subset of total LA vehicle kms. Reduction factor shall be applied to these responsive trips (decreased by 6%), and the reduced vehicle km is fed to carbon tool to get the emissions in tCO2e. The figure below shows the map showing city centre cordon for Cambridge.

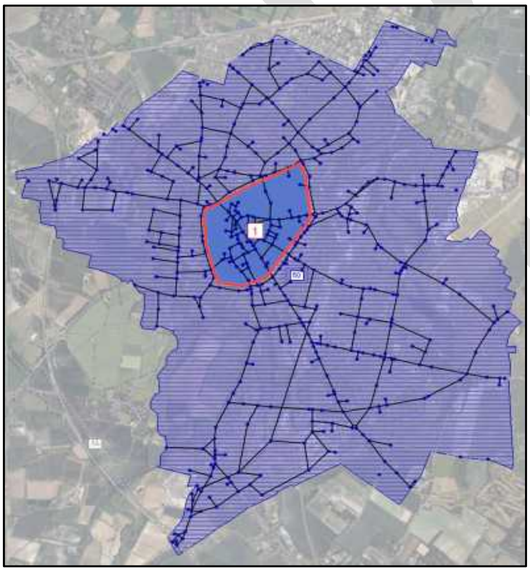

Figure 1: City Centre Cordon of Cambridge

Evidence Source: Literature (disappearing_traffic_cairns.pdf[3]) – Empirical data from multiple studies was collated, with the studies' data for trips before and after the implementation of capacity reduction (natural cause or planned measure) being used to calculate reduction.

[3] Cairns, S., Atkins, S.T., & Goodwin, P.B. (2002). DISAPPEARING TRAFFIC? THE STORY SO FAR.

Assumptions: Applied only to Cambridge & Peterborough. Reduction factor is assumed from the resultant median value in the range of 10-14% reduction in 50% of cases i.e., 5-7% reduction. Accordingly, an average 6% was taken as the reduction factor for this measure.

Limitations: There is lack of empirical evidence to demonstrate long and short-term effect of congestion. No information on sizes of study sites to choose selectively comparable to input cordon, to allow for modification in reduction factor. Scale of vehicle reduction is dependent on size of cordon. The test is high level in nature and does not clarify the exact number or intensity of vehicle constraints which are required in the cordon to achieve the reduction factor.

6.10 Impact of Physical Demand Management – Access Constraints

Physical constraints are now being deployed to restrict vehicle use in targeted locations to reach policy objectives. The study will provide a high-level indication of the potential impact of these demand management measures.

Method: Based on an input cordon analogous to the size of the area within which access would be restrained, the cordon factor is calculated to derive responsive trips that are a subset of total LA vehicle kms. Reduction factor shall be applied to these responsive trips (decreased by 32.7%), while the rest of the LAs trips would be increased by a factor (1.3%) to incorporate the diversion resulting from the access restraint. The total reduced vehicle km is fed to carbon tool to get the emissions in tCO_2e. Figure 2 shows the area where access constraint is applied in Cambridge and Peterborough.

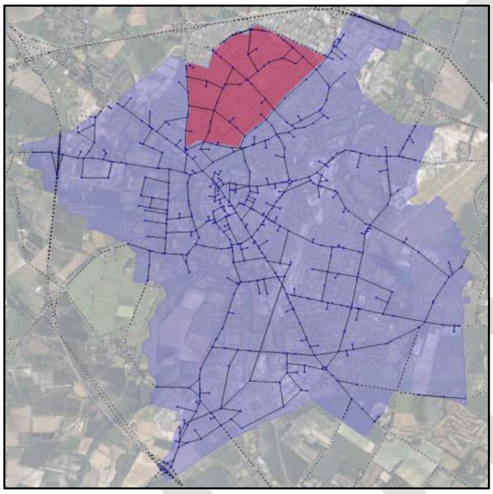

Figure 2:Map showing the Cordon Area where the scenario assumption is made for Cambridge

Evidence Source: Changes in motor traffic inside London's LTNs and on boundary roads[4]. Goodwin et al (2002) Disappearing Traffic? The story so far[5]

Assumptions: Based on Input Cordon, the proportion of Vehicle km for cordon is estimated as proportion of LA Vehicle km. Reduction Factors from empirical studies' data are applied to responsive Vehicle km.

Limitations: There is lack of empirical evidence to demonstrate long and short-term effect of congestion. No information on sizes of study sites to choose selectively comparable to input cordon, to allow for modification in Reduction Factor. Applied only to Cambridge & Peterborough**.** Not linked to specific interventions i.e., the policy does not guarantee what scale of restrictions are required to achieve the carbon reduction quoted.

[4] Changes in motor traffic inside London's LTNs and on boundary roads - Google Docs
[5] [PDF] DISAPPEARING TRAFFIC? THE STORY SO FAR | Semantic Scholar

6.11 Impact of Cordon Based Road User Charge

Cordon based road user charge schemes involve charging drivers a fee for driving within a specified charging zone. For this study, a flat fee has been assigned to any vehicle driving in the designated cordons within Cambridge and Peterborough. Sensitivity tests have then been applied to estimate the impact of a variable charge (peak period travel only).

Method: First step is to identify Monetary cost of travel/hr in forecast year (MCT) (Value of time (VOT) + Vehicle operating Cost (VOC) * Speed). Next step is to calculate total cost of travel/hr in forecast (TCT) by adding the Monetary cost of travel/hr with Cordon Based Charge (Pence/hr). Then the responsive vehicle km (trips entering cordon) are identified. The Elasticity values based on Traffic type and short term/long term effect is selected. The reduction in Vehicle km is computed. The last step is to run the reduced vehicle km through the Carbon Tool to estimate the emissions. Figure 3 show the study area for Cambridge and the map showing the cordon selected within the city centre of Peterborough.

The study area for Cambridge largely reflects the Making Connections scheme. However, the specific exemptions and scheme specifics of the Making Connection scheme are not all captured by this analysis. For example, this method assumes all vehicles are charges, whereas Making Connections includes exemptions for certain road users (taxis, blue badge holders etc).

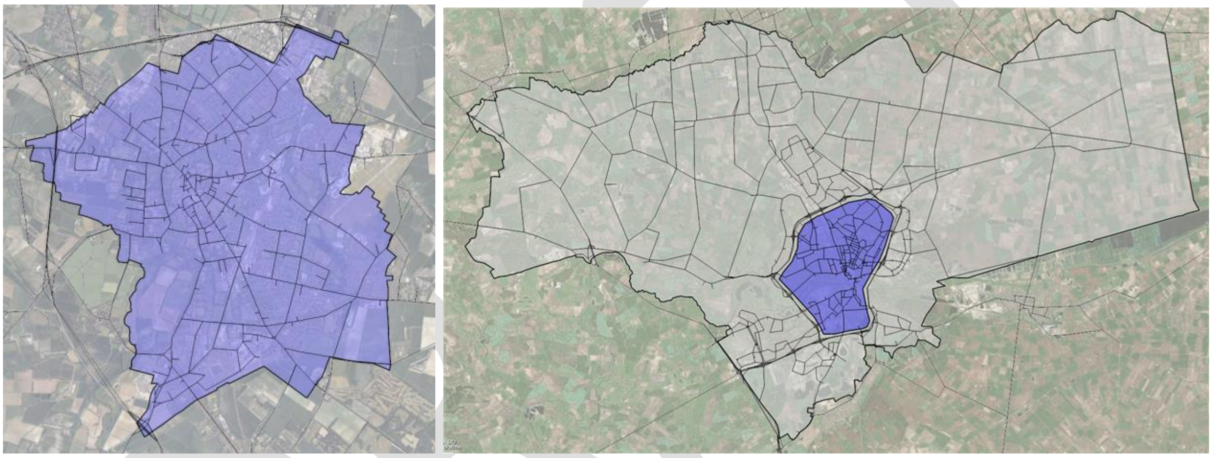

Figure 3: Map showing the study area for Cambridge and Peterborough

Evidence Source: TAG Data Book (VOT/VOC/GDP Deflator), Elasticities from Literature Potential distributional impacts of road pricing[6]:

Assumptions: Applied only to Cambridge & Peterborough for all periods. A flat fee is charged for any vehicle and for all purpose which travels within the cordon. £8 is considered a suitable starting intensity charge fee. Further impact of £10, £15 and £30 per day is also studied. These charges will need to increase in line with value of time increase to maintain the effectiveness i.e., a £10 charge will not have the same impact in 2040 unless it is the same proportional cost.

Limitations: Overestimation of the response for long distance trips is possible as dampening factors reflecting the length of total journey relative to journey within CPCA is not fully captured.

[6] A dozen effective interventions to reduce car use in European cities: Lessons learned from a meta-analysis and Transition Management - ScienceDirect
https://eeh-prod-media.s3.amazonaws.com/documents/Pathways_to_Decarbonisation_v2.pdf
Road user charging first principles assessment (leeds.ac.uk)

6.12 Impact of Cordon Based Road User Charge (Variable Charge)

Method: Same approach as 6.11 above but the responsive trips applies only to vkm travelled within the peak periods.

Evidence Source: TAG Data Book (VOT/VOC/GDP Deflator), Elasticities from TAG Unit M2.1- using Literature Potential distributional impacts of road pricing:

Assumptions: Same as 6.11 above. But charge only applies to AM and PM peak travel. Modelling does not consider the impact of peak spreading on travel demand.

Limitations: Peak spreading is assumed to not occur wherein some motorists may shift their travel departure times to slightly before or after the peak period in response to time-based charging. For example, drivers could avoid the morning peak periods (considered to be between 8 am– 10 am) so that they can still travel by car but not pay the charge. i.e., start work an hour earlier or finish an hour earlier. Limited case studies are available and there is again a general lack of empirical evidence to demonstrate long and short-term effect.

6.13 Impact of Area Wide Road User Charge

Area wide road user charge schemes involve charging drivers a fee for driving within a specified charging zone. Similar to cordon base charges, fees can be variable. For this study, three tests have been undertaken: 1) a flat fee per km travelled for every vehicle, 2) a variable fee, where per km travelled outside of the urban cordons (Cambridge and Peterborough) there is a 50% higher fee compared to vehicle km within these cordons, and 3) an electric vehicle subsidy, where 50% discount is applied for trips undertaken in an electric vehicle to account for the difference in user emissions per trip.

Method: First step is to identify Monetary cost of travel/hr in forecast year (MCT) (Value of time (VOT) + Vehicle operating Cost (VOC) * Speed). Next step is to calculate total cost of travel/hr in forecast (TCT) by adding the Monetary cost of travel/hr with Cordon Based Charge. The % increase in average travel cost is computed. Following step is to compute the reduction in Vehicle km. The last step is to run the reduced vehicle km through the Carbon Tool to estimate the emissions.

Evidence source: VOT/VOC/GDP Deflator was determined from TAG Data Book (v1.20.1) TAG Table 1.3.5, TAG Table 1.3.6 and TAG Table 1.3.7; Elasticities from TAG Unit M2.1 Variable Demand Modelling[7]

Assumptions: The charge applies at all time periods, for all journey purposes and on all road types (except SRN).

Limitations: Case studies conducted in the UK are not present and there is lack of empirical evidence to demonstrate long and short-term effect. The limited evidence available relates to foreign examples, and often only relates to tolling of HGV movements such as on Germans SRN.

Non-SRN traffic is calculated using the Vehicle km based on road type from the Carbon tool for Inbound, Outbound and Internal trips. For through trips, it is assumed to 10% Car and 5% Heavies for all Local Authorities. Forecasted speeds are used. Charge will need to increase in line with changes in value of time to maintain effectiveness.

6.14 National reform to Road Pricing?

Slide 31 presents the revenue raised by fuel duty in relation to different EV scenarios. The following method has been applied to estimate the change in revenue:

1. Forecast growth in vehicle mileage using NTEM – Yorkshire and Humber.

[7] TAG unit M2-1 variable demand modelling - GOV.UK (www.gov.uk)

2. Apply fuel duty rates to vehicle mileage data to calculate business as usual forecast for revenue gained (using TAG forecast of vehicle mix)
3. Apply accelerated EV forecast scenarios (CAS and EV ready) to estimate revenue loss as a result of higher uptake of electric vehicles.

Given the changes to legislation around vehicle tax duty (EV's no longer exempt from 2025), the impact of increased uptake of electric vehicles on vehicle tax duty is expected to be negligible in comparison to fuel duty.

6.15 Impact of Workplace Parking Levy (WPL)

Workplace parking levy's (WPL) is a charge which applies to businesses who provide a set number of parking spaces within a cordon. The employer has to pay the cost or pass the cost onto the employee. For this study, the cost is to the individual user.

Method: First step is to quantify Responsive trips which is the sum of all commute and business trips with a destination in Cambridge and Peterborough. Second step is to quantify WPL Traffic % by dividing No. of WPL spaces and total responsive trips Vehicle km. % Reduction in responsive trips Vehicle km is found by applying elasticity factor based on recent study findings. Inputting the reduced vehicle km in the carbon tool to get the corresponding emissions.

Evidence Source: WPP Spaces from online (ukbusinessworkbook2022); Reduction rate from Literature - Options for Fiscal Measures, West of England Joint Transport Study, 2017, Tour Proportion from DIADEM Manual, Elasticities from Literature - Hensher and King, 2001, Table 6[8]

Assumptions: WPL is only applicable to commute and business traffic. Each WPL space is assumed to create one single trip in a day (Two-way). Assumes WPL charge is a cost to the individual user. Linear relationship considered to estimate the reduction in commuting trips due to the charge.

Limitations: Limitation of method to calculate number of car park spaces. Not based on criteria of max spaces like Nottingham i.e., 11 spaces.

Lack of information on proportion of commuting trips which are chained with workplace business trips, or the number of business trips which are affected by a WPL. Hence, Car business vehicle km are reduced by the same percentage amount as commuting vkms.

6.16 Impact of Car Parking Strategies

Car park pricing strategies involve increased charges to discourage car-based travel by increasing the overall journey cost and providing a trip end constraint. For this study, only local authority owned car parks have been included, and the charge applies to any vehicle parking regardless of time period or journey purpose.

Method: First step is to quantify the total car park traffic demand which is multiplying No. of car park spaces, trip rate (car park surveys) and average trip length (NTS). Next step is to quantify change in demand by applying elasticity to responsive traffic. The estimated reduced vehicle km is then run through carbon tool to get the emissions.

Evidence Source: Car Park Spaces from Online (https://www.peterborough.gov.uk/residents/parking/car-park-locations; https://maps.cambridgeshire.gov.uk/?tab=maps), Elasticities from Literature (Hensher and King, 2001, Table 6); Arrival/Departure rate – benchmarked from WSP previous studies.

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[8] A dozen effective interventions to reduce car use in European cities: Lessons learned from a meta-analysis and Transition Management - ScienceDirect

Assumptions: Only applies to LA owned car park spaces. The charge applies to any vehicle that parks in the car park, regardless of time period or journey purpose. Average journey distance to be applied in emissions calculations

Limitations: Same arrival/departure rate is considered across the region. Limited to number of car park spaces. Doesn't include other authorities. Doesn't include residential parking zones or private parking spaces.

7 LINKING INTERVENTIONS TO OUTCOMES

7.1 2031 Analysis

To assess to what extent an ambitious LTP could close the emission gap in 2031, interventions have been aggregated into packages and tested against the CPCA Policy Target (15% reduction) and the CCC Sixth Carbon Budget. For both scenarios tests (slide 36 and 37), the most ambitious scenario of electric vehicle uptake (CAS) was taken from the BaU forecast (TAG) to quantify the cumulative gap in emissions for the LTP4 to target.

The intensity of measures has to be increased significantly to achieve a reduction in line with the CCC pathway. This is largely due to the proportion of vehicles on the network which are still ICE (petrol or diesel powered) and the scale of the emissions gap.

7.2 Pathway Analysis up to Carbon Budget 6 (2037) and 2050

To forecast the carbon impact of LTP at a programme level up to 2037, the analysis required assumptions around the implementation date for each intervention (refer to slide 38). Once assumptions around delivery dates had been agreed, the next step involved estimating the annual impact (user emissions saving) of each measure and then multiplying this by the corresponding forecast years.

The same methodology detailed above for slide 38 has been applied to estimate the scale of impact of an ambitious LTP programme up to 2050. Slide 39 shows that an ambitious LTP programme which includes a combination of all measures identified in Phase 3 of this commission is sufficient to comply with the CCC pathway for Net Zero by 2050 (<19.02 MtCO2e Cumulative Emissions). Please refer back to slide 8 and slide 38 for a data on cumulative emissions and carbon budget periods.

7.3 Limitations

- Each intervention impact will be variable depending on intensity, place type, levels of travel demand etc.
- This study reports the sum of individual scheme assessments – it does not account for expected in-combination benefits from delivery of the programme as a whole or with other current or future policies or interventions. <u>It is expected that the benefit would as a result be greater than the reported sum of the parts.</u>
- Cumulative impact analysis does not account for variation in emissions return due to changes in fuel efficiency. The implementation dates of measures identified therefore must match the implementation dates of the benchmark sources to maintain accuracy when converting cumulative impact to annual impact and vice versa. For example, removing 1 tCO2e in 2030 requires a reduction in vehicle km travelled of approximately 4,800, whereas the same reduction (1 tCO2e) in 2040 would require >8,500vkm due to the higher proportion of electric vehicles on the network.
- Analysis did not include a whole-life carbon approach and showed only the potential user emissions savings. Infrastructure carbon has the potential to run counter to these estimates.

- The intervention list assessed is not exclusive. Other influencing factors such as future mobility, technological changes and behavioural changes beyond that tested could all influence the CPCA emissions pathway.
- Geographical challenge (slide 40): data has been extracted from the TDCM model used in Phase 2 / 3 to highlight the scale of emissions challenge across CPCA. For instance, Cambridge only accounts for 5% of CPCA total emissions in 2031.

7.4 Infrastructure carbon (slide 50)

To capture the impact of resurfacing the existing highway a high-level indicative estimate of emissions was calculated using a simple methodology based on area-based benchmarks for highway maintenance (i.e., 1m^2 of resurfacing = 0.004 tCO_2e).

The data used included DfT road length statistics and DMRB D2M road type lane widths. The minimum single lane width was used (3.65m) and multiplied based on the number of lanes per road type i.e.,

- A Roads (single carriageway) = 7.3m
- Principal A Roads (dual carriageway) = 14.6m
- Trunk A Road (dual carriageway) = 14.6m
- All Minor Roads = 3.65m

An illustrative depiction of the method is presented below:

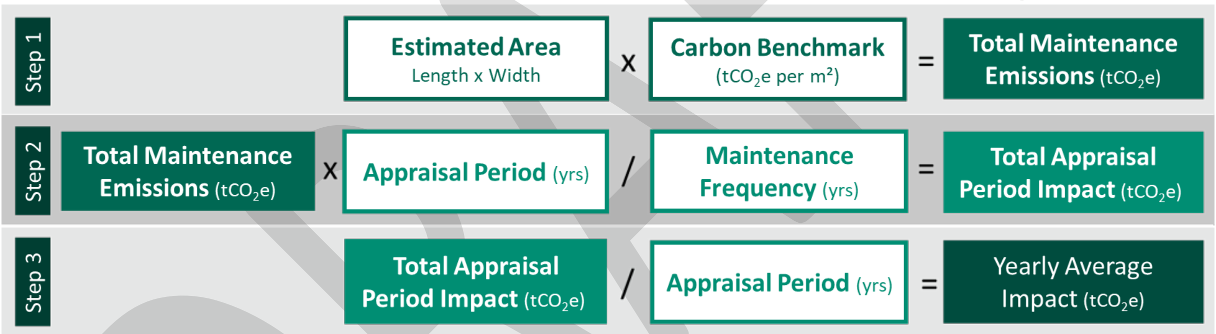

Figure 4: Method for calculating carbon impact of existing highway maintenance

It is emphasised that this is a very crude, high-level method that should be used only to infer an indication of the potential scale of annual emissions associated with highway maintenance. Key limitations are:

- Only captures resurfacing of carriageway asset
- Very crude benchmark used for resurfacing that doesn't reflect different types of surface treatment
- Associated activities (e.g., fuel use for plant) isn't included in the 1m^2 figure
- Does not consider road classification and use to determine 'Maintenance Frequency'
- Does not consider routine and reactive maintenance activities such as Inspections and defect repairs

8 QCR GAP ANALYSIS

The commission has provided CPCA a detailed evidence base to support their decarbonisation strategy development; however, it does not provide the full range of insights and conclusions that are needed to fulfil the requirements of the QCR guidance. A summary of the key recommended next steps to support LTP4 in fulfilling the requirement of the QCR guidance are presented on slide 53 of the presentation.

At the time of writing, the QCR guidance has not yet been finalised for its issue for public consultation. The guidance and its requirements may also change following public consultation. The requirements are therefore based on WSP's best understanding of the expected requirements of the guidance at this time.