Department for Transport

Local Transport Plan Quantifiable Carbon Reduction Guidance

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This publication is also available on our website at Department for Transport

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Contents

Terminology used

The following terms are used throughout this document:

- **Quantifiable Carbon Reduction (QCR) approach:** the approach advocated within this guidance to support an evidence-led, quantifiable assessment of carbon as part of the development and assessment of LTPs
- **Greenhouse Gases (GHGs)**: gases that by absorbing heat in our atmosphere contribute to global warming. The largest proportion of GHG emissions relate to carbon dioxide although they include methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride
- **Carbon**: carbon dioxide equivalent of all greenhouse gases, for which it is frequently used as shorthand throughout this document
- **Carbon Impact:** refers to the effect of proposed interventions and/or policies on carbon, either an increase or decrease in emissions
- **Carbon Budgets:** legally binding long-term emission reduction targets set at the national level
- **Net Zero:** total greenhouse gas emissions released are equal or less than the emissions removed from the atmosphere
- **Authorities:** used throughout this report to refer to local or regional authorities responsible for local transport planning (for example Local Transport Authorities)
- **User Emissions:** direct emissions generated from the use of the transport network (for example tailpipe emissions)
- **Infrastructure Carbon:** emissions associated with the construction, operation, and maintenance of an infrastructure asset. This includes capital and operational carbon
- **Capital Carbon:** emissions associated with the construction of an infrastructure asset
- **Operational Carbon:** emissions associated with the operation and maintenance of an infrastructure asset (for example carbon due to the power consumed by traffic lights, but not any change in carbon emitted by vehicles due to the working of the traffic lights)
- **Whole-life Carbon:** emissions associated with an infrastructure asset over its lifecycle. This includes user emissions and infrastructure carbon
- **Zero Emission Vehicles (ZEV):** a vehicle that produces no emissions from the on-board source of power (for example all-electric or hydrogen fuel cell vehicles)

1. Introduction

Background

1.1 Significant reductions in transport related emissions are needed to achieve legally binding carbon budgets and deliver net zero by 2050. For this reason, the Transport Decarbonisation Plan committed the Government to "drive decarbonisation and transport improvements at a local level by making quantifiable carbon reductions a fundamental part of local transport planning and funding".

1.2 Local Transport Plans (LTPs) therefore need to set out how local transport authorities will "deliver ambitious, quantifiable carbon reductions in transport, taking into account the different transport requirements of different areas." (Transport Decarbonisation Plan p.151).

1.3 This technical guidance provides practical advice on how authorities can best estimate local transport emissions and quantify the carbon impacts of their policies to inform the development of their LTPs. It is a companion document to the wider 'Local Transport Plan Guidance 2023', which explains how LTPs should be developed, and should be used alongside it.

Consultation Questions

We are seeking your feedback on questions presented throughout the document in boxes such as this and listed in full in Annex A. Responses to these questions will inform how this guidance can be improved prior to publication.

Responses to these questions should be provided through the online survey form.

Purpose of this guidance

1.4 This guidance will:

- Provide a framework approach for carbon analysis, with key steps that should be undertaken as part of the wider development of an LTP.

- Set out the evidence that is likely to be needed for authorities to develop their own credible analysis of the carbon reduction that the interventions set out in an LTP could achieve.
- Provide advice on various methods that can be used to assess carbon impacts and the methodologies and datasets that can be used in support of this.
- Begin to establish a more consistent analytical best practice for authorities, from which carbon analysis methods and data can continue to be developed by the Department for Transport (DfT) and the sector.

1.5 This guidance should help authorities to understand the scale and sources of local transport emissions in their area and what the potential carbon impacts of policy and infrastructure interventions outlined in their LTPs may be. This will drive a critical evolution towards more evidence-led decision making, where data on transport decarbonisation can be considered during the early stages of the planning process, alongside other strategic priorities.

1.6 DfT recognises that the analysis of carbon impacts in strategic transport planning can be challenging. Carbon quantification methods and tools are an evolving area across the sector and authority capacity and capability to apply these will vary depending on current local circumstance. Indeed, the methods presented within the guidance are new and we anticipate that these methods and others will continue to develop. The DfT will keep this guidance under review and update it as necessary. This should ensure that the quantified understanding of the carbon impact of local transport continues to develop at all tiers of government.

1.7 Carbon quantification has traditionally been applied during later stages of individual scheme business case development and has typically required specialist skills. However, considering carbon emissions impacts earlier, at the strategic planning stage, will equip authorities to influence carbon outcomes earlier and more easily. To support this, the guidance presents a tiered approach to carbon quantification to cater for a varying level of local analytical capability and DfT will continue to consider the level of support that is needed for authorities to deliver quantifiable carbon reductions through their LTP.

1.8 There is no ‘one size fits all’ solution to local transport decarbonisation. When using this guidance alongside the Local Transport Plan Guidance 2023, authorities will be able to understand more clearly where to focus their efforts and develop an LTP which reflects the specific needs of the place and contributes to national decarbonisation efforts.

1.9 For more information on local transport decarbonisation, and other local transport policies, please refer to the ‘Local Transport Plan Guidance 2023’.

1.10 This guidance is explicitly related to the development of an LTP and does not affect other existing business case processes or guidance.

Guidance at a glance

1.11 This guidance has been designed for a variety of users, from policy officers to analysts. It has been structured as follows:

- A high-level overview of the process is provided in Chapter 2;
- Technical guidance on the methods that authorities can use to generate the key outputs of this guidance is provided in Chapters 3 – 9; and
- Within each technical chapter an 'at a glance' non-technical summary is provided.

1.12 The analytical tasks referenced in this QCR guidance should be undertaken as part of developing a high-quality LTP and should correspond to the LTP development steps ('phases') as set out in the wider 'Local Transport Plan Guidance 2023' document. These are described in Table 1 below with further explanation of these QCR steps and overarching principles provided in Chapter 2.

Steps in developing an LTP	QCR Step	Relevant Chapter
Phase 4 - Evidence, analysis, and baseline creation	Estimate current and future emissions	Chapter 3
Phase 5 - Developing the LTP vision and objectives	Establish a local transport decarbonisation pathway	Chapter 4
Phase 6 - Strategy development: developing interventions and option appraisal	Consider carbon in the generation and appraisal of interventions and policy options for an LTP	Chapter 5
Phase 6 - Strategy development: evidence of impact of proposals	Estimate the potential impact of the pipeline of interventions	Chapter 6 and 7

Table 1: LTP development stages corresponding to QCR steps and guidance

1.13 Guidance on how to report the outputs of this analysis is provided in Chapter 8.

1.14 Chapter 9 explains how authorities should continue to quantify the carbon impacts of their policies after the initial scoping and development of an LTP.

1.15 Annex C provides a checklist of the key outputs that should be developed through this process. These outputs should be published by authorities as part of their LTP or supplementary LTP documents to allow the public and other stakeholders to engage with them.

Key steps and outputs

1.16 In order to generate a consistent 'minimum standard' of outputs in line with this guidance, authorities must undertake a number of analytical tasks, each of which contain an ‘essential’, ‘encouraged’ and ‘optional’ tier of analysis. Detail of these tiers

are identified for each of the core tasks in Table 2. The ‘essential’ tasks will provide a basic understanding of carbon impacts and require only the simpler forms of analysis such as benchmarking outlined in the guidance. Where this minimum standard has not been met, authorities should provide an explanation why.

1.17 For a more robust understanding and insight, authorities are encouraged to go further and undertake the ‘encouraged’ and ‘optional’ tasks, where able, to strengthen the quality of the analysis behind the LTP. In any future iterations of the guidance, the higher tiers of analysis identified may become encouraged or even essential, depending on what is judged to be proportionate in the future as authority capability, and decarbonisation policy develops.

1.18 The tiered approach to analysis set out in this guidance will support authorities in implementing carbon analysis by catering to different levels of analytical capability, in line with what is proportionate for authorities to achieve at the planning stage. Chapter 2 summarises how this guidance supports authorities in fulfilling these key steps.

QCR Step	Analysis tiers
1. Estimate current and future emissions (Chapter 3)	Essential: • Obtain outputs of analysis prepared by a Sub National Transport Body (STB), if available. • If not, apply Method A1: a simple method derived from the Government's Greenhouse Gas (GHG) inventory. No modelling is required. Encouraged: • Analysis to present a sub-set of emissions within 'direct authority influence’. Optional: • Additional scenario testing.

QCR Step	Analysis tiers
2. Establish a local transport decarbonisation pathway (Chapter 4)	Essential: • Scale the Net Zero Strategy domestic transport indicative delivery pathway to the local emission baseline to provide a context for local emissions. Identify the difference between forecast emissions in Step 1 and pathways for local decarbonisation. Encouraged: • 'Top-down' analysis to identify what local transport outcomes may help to further reduce emissions. • Prepare a graph showing the different scenarios of decarbonisation at a local level. Optional: • Prepare a Theory of Change model.
3. Consider carbon in the generation and appraisal of interventions and policy options for an LTP (Chapter 5)	Essential: • Consider outputs from Step 1 and Step 2 when establishing a longlist of interventions and policy options. • Within option appraisal (see Chapter 4 of the LTP Guidance) prepare a light-touch qualitative or risk-based appraisal of carbon that considers both user emissions and infrastructure carbon impacts and the strategic fit with the outputs of Step 1 and 2. Encouraged: • Quantitative analysis of interventions within the longlist, where needed to support decision-making (where possible).

QCR Step	Analysis tiers
4. Estimate the carbon impact of the intervention programme (Chapter 6 and 7)	Essential: • Where benchmarks (Method B1) or existing assessments (Method B2) are available, quantify user emission impacts of shortlisted interventions using benchmarking. Encouraged: • Quantify infrastructure carbon impacts of all shortlisted interventions using benchmarking (Method C1). • Prepare a high-level estimate of carbon impact of operational highway maintenance on the local authority's network (Method C3). • Analysis to quantify the impact of committed measures to reduce infrastructure carbon both for capital interventions and ongoing maintenance. • 'Bottom-up' methods to quantify user emission and infrastructure carbon impacts (Methods B2 and C2) where suitable benchmarks are not available.

Table 2: Tiering of analysis

2. LTP Carbon Analysis: An Overview

Context

2.1 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.

2.2 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.

2.3 Transport user emissions make up the largest share of current UK greenhouse gas emissions of any sector across the economy. The Net Zero Strategy sets out an indicative pathway for decarbonisation of domestic transport up to 2037, reflecting the different paces of decarbonisation that different sectors will take, but together contributing to economy wide decarbonisation in line with carbon budgets.

2.4 The Net Zero Strategy and Transport Decarbonisation Plan (TDP) set out the actions that need to be taken to achieve such a decarbonisation pathway for domestic transport. This includes legislation to phase out fossil fuel powered vehicles. The TDP recognises that the adoption of zero emission vehicles alone will not allow us to meet all our climate goals, particularly for the medium-term Sixth Carbon budget targets. As such, increasing the use of public and active transport for local journeys is a strategic priority of the TDP.

2.5 Local authorities are uniquely positioned to deliver the place-based solutions needed to support the accelerated uptake of zero emission vehicles (ZEVs) and encourage the use of public and active transport. This reflects the fact that there is no 'one size fits all' solution, and decarbonisation will need to be considered alongside wider strategic priorities.

2.6 To support decarbonisation of the economy as a whole towards Net Zero, authorities should begin to account for and manage emissions associated with the construction and maintenance of infrastructure. However, in this version of the guidance, quantification of these elements is ‘encouraged’ but not ‘essential’.

2.7 Local Transport Plans (LTPs) are intended to be holistic place-based strategies that identify projects for investment and detail how local and strategic objectives will be achieved through changes to the transport network. Tackling climate change by decarbonising transport must be a priority outcome of LTPs. To achieve this, authorities must make the carbon impacts of their policies a central consideration in the development of their LTP. This guidance provides practical advice on how best to do this.

Process outline

2.8 Figure 1 illustratively sets out a current best-practice process by which authorities are encouraged to consider carbon throughout the development of their LTP. Authorities may choose to apply the methods set out in this guidance flexibly subject to their local needs and circumstances or develop other innovative methods or solutions where this improves the quality of analysis. However, significant methodological differences should be clearly explained, including any new assumptions, to ensure that outputs are valid and comparable sub-nationally.

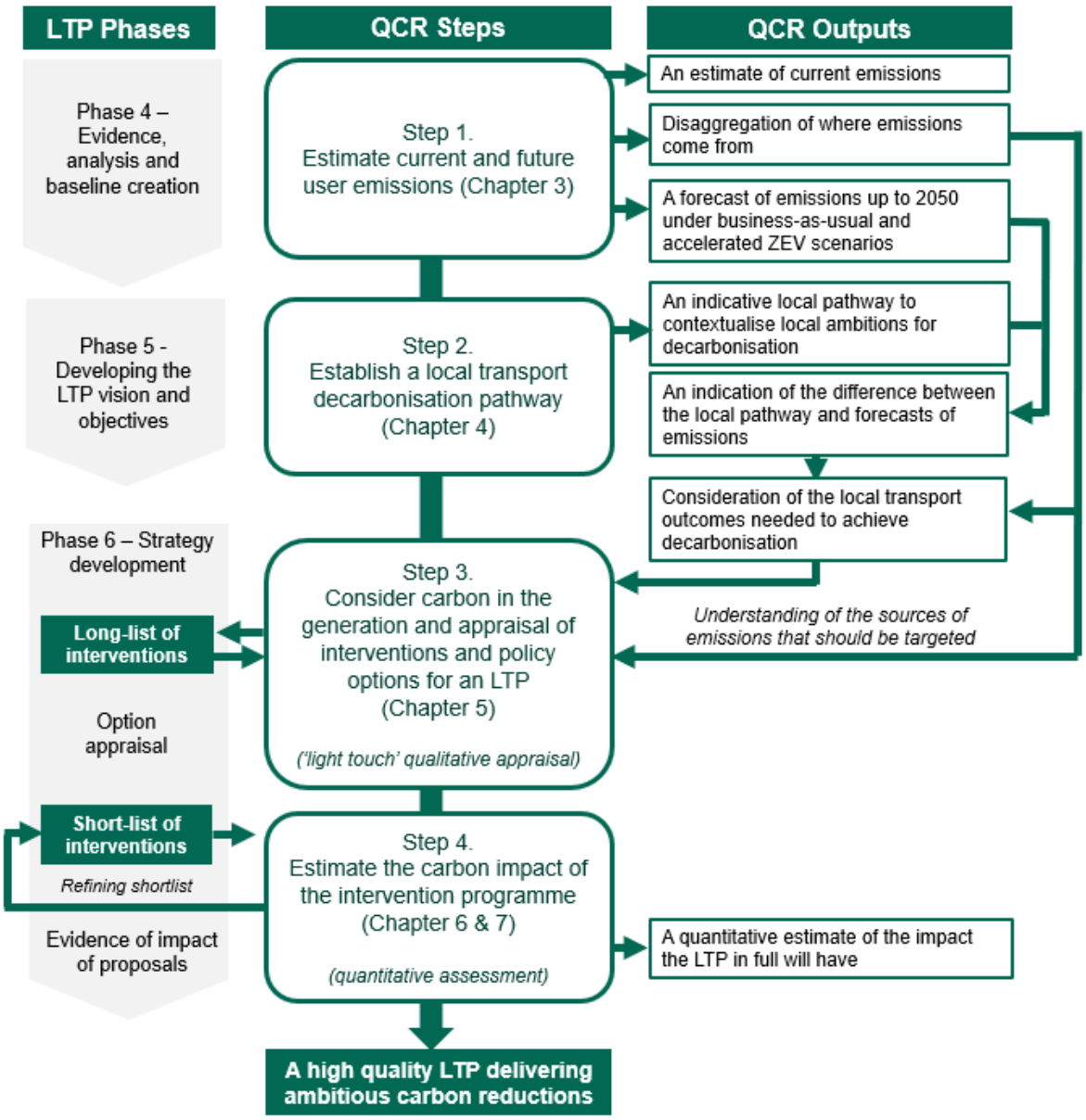

Figure 1: LTP Carbon Analysis Process Outline

2.9 Step 1 must report total user emissions within the relevant administrative geography of the LTP in order to provide a holistic and consistent understanding of all transport emissions. DfT acknowledges however that not all emissions counted within this total will be within the direct influence of authorities, such as emissions from through-trips or rail. LTPs should concentrate interventions on sources of transport emissions within their influence. Authorities can however use this analysis to identify where collaboration with others may be beneficial to support decarbonisation of total emissions within their geography and beyond. Such reductions that are predicted to occur as a result of the interventions set out in the LTP, where quantified, can count towards the outputs reported from this process. Further guidance is provided in Chapter 3.

2.10 All options generated and appraised as part of LTP development should be tested for their carbon impacts where possible in line with this guidance. These should be considered with other key strategic priorities, through option generation and appraisal (Step 3) as a minimum. All interventions must be qualitatively assessed at the

longlisting stage of the options assessment process, and this should be in a manner consistent with the advice provided in Chapter 5. Within the shortlist, the proposed pipeline of interventions should be subject to quantitative assessment (Step 4) where proportionate to do so, in a manner consistent with the advice provided in Chapters 6 and 7.

2.11 The quantitative carbon impact reported in the LTP should seek to account for all policies and interventions within the shortlisted pipeline of interventions included in the LTP strategy (typically a 10–15-year programme). Where an intervention has not been considered quantitatively (for example due to lack of a suitable benchmark) a justification should be provided as to why, and how its carbon impact has been considered within the overall LTP development process, including what assumptions and trade-offs have been made.

2.12 For the majority of interventions in the shortlisted pipeline of interventions it will be appropriate to apply simpler forms of quantitative analysis (for example benchmarking) that require only basic levels of information and do not require specialist skills. For example, to quantify user emission impacts Sub-National Transport Bodies (STBs) will provide a source of benchmark evidence and tools that assist authorities in conducting this simpler form of analysis. It is the responsibility of authorities however to ensure that their analysis is credible and provides suitable assurance. This may mean, that a more detailed level of analysis is considered for interventions included in the 2 – 5-year Implementation Plan (Phase 7 of the LTP guidance) or that high impact policies or interventions or those with reputational risks are subject to more advanced tiers of analysis.

Question Number	Consultation Question
Q1	In your view, does this high-level process for considering carbon make sense to you when considered with the wider Local Transport Plan guidance? ☐Yes ☐No ☐ Don't know If no, what part(s) of the process do you think could be improved, and how?

A proportionate tiered approach

2.13 DfT recognises that the analysis of carbon impacts in strategic transport planning can be challenging. Carbon quantification methods and tools are an evolving area and authority capacity and capability to apply these will vary depending on current local circumstance. Current methods have traditionally been applied during later stages of individual scheme development and typically require specialist skills.

2.14 This guidance has sought to cater for a range of local analytical capability by providing a proportionate, tiered approach that does not place an undue burden on

authorities who are not yet able to adopt more comprehensive analysis. The following considerations have been taken into account:

- **Tiering of methodologies** - for quantitative tasks covered in Chapters 3, 6 and 7 the guidance provides a tiering of methodologies. The lowest tier or 'minimum standard' consists of simpler forms of analysis (for example benchmarking) which produce the minimum outputs required for a meaningful understanding of carbon impact. The more advanced tiers are not required to achieve the key outputs of the guidance; however, these methods will provide additional or more robust evidence and insight to strengthen the quality of an LTP and the carbon reductions it might achieve. All the methodologies presented are designed to be delivered in-house by local authority officers, without the need for specialist contracted skills or additional resources, depending on an authority's current analytical capability.
- **Provision of new tools and datasets** - this guidance references new tools and datasets that are under development by DfT and partners to support authorities and provide the proportionate 'minimum standards' described.
- **Flexibility in methodologies** - guidance on the use of methodologies is not prescriptive and authorities have the flexibility to use other data, methods and tools that may be suitable to their situation as long as these still deliver the key outputs. Authorities should clearly report the assumptions and methodological differences used in their analysis, particularly where the methods used are not covered by this guidance.

2.15 Table 2 summarises the tiers of analysis. Authorities are also encouraged to refer to Annex C to understand further which outputs are essential to provide a minimum standard, which are encouraged to provide a more robust analysis, and which are currently entirely optional but will provide the most comprehensive level of understanding.

2.16 Some of the available methods for the quantification of carbon are relatively new and designed to a level of accuracy proportionate to strategic assessment such as this QCR process. We anticipate that the methods will evolve, and DfT will keep this guidance under review and update it as necessary. Through this consultation, views are also sought on what other tools are available and/or where additional guidance, data or tools may be needed. However, authorities will only be expected to adopt relevant changes to their approach to QCR when renewing their LTPs.

Question Number	Consultation Question
Q2	How confident are you that a local authority can apply the process described in this guidance? ☐ Very confident ☐ Confident ☐ Neither confident nor unconfident ☐ Unconfident ☐ Very unconfident

Question Number	Consultation Question
	If unconfident or very unconfident, please explain why, including any suggestions for improvement.

A whole-life carbon approach and scope

2.17 Whole-life carbon is the full carbon impact of a transport intervention across the project lifecycle (cradle to grave) and thereby represents its full contribution to climate change. This includes infrastructure related emissions that may be accounted for at a national level (for example the Net Zero Strategy and BEIS GHG inventory) under sectors such as industry as well as transport. Considering whole-life carbon is necessary to support decarbonisation of the economy as a whole towards Net Zero.

2.18 Whole-life carbon comprises of the key categories presented in Figure 2. A more granular breakdown can be found in whole-life carbon guidance such as PAS2080 and BS EN 17472. Review of these documents is however not required to conduct this LTP carbon analysis process, which adopts the key principles of PAS2080 and BS EN 17472. Chapters 5 and 6 provide a further breakdown of user emission and infrastructure carbon impacts.

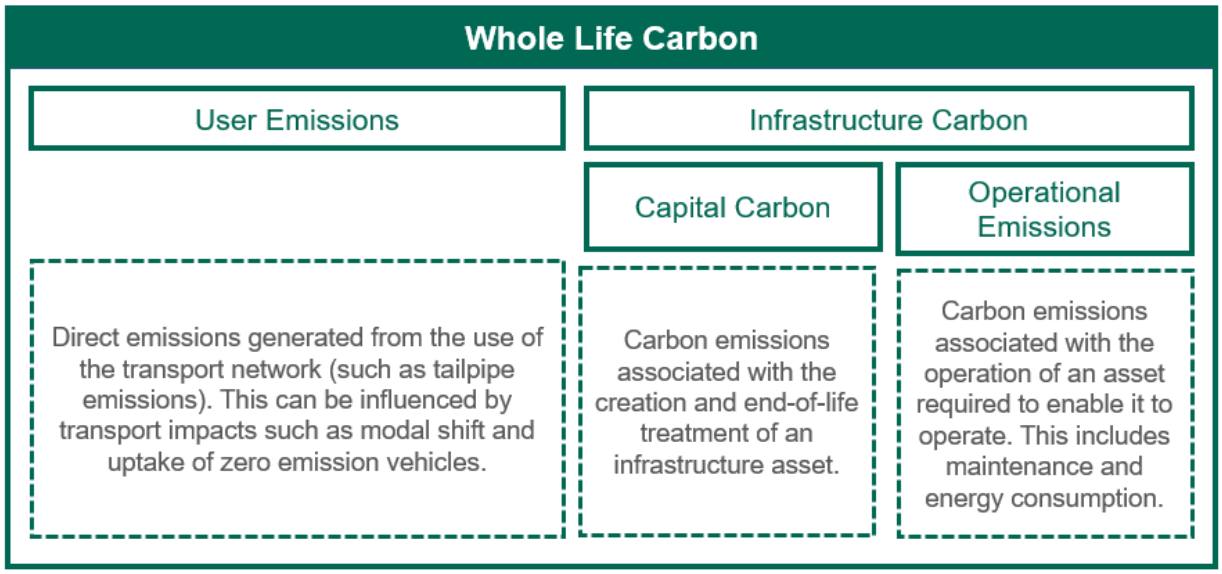

Figure 2: Whole Life Carbon and related carbon definitions

User emissions

2.19 Achieving Net Zero in transport requires intervention to reduce user emissions, carbon emissions generated from the operation and use of vehicles on the transport network. User emissions are therefore the primary consideration of the approach set out in this guidance.

Infrastructure carbon

2.20 The influence of an LTP on infrastructure carbon will include capital and operational carbon impacts. As with user emissions, there is a significant opportunity to influence infrastructure carbon outcomes if these are considered early in the development of an LTP. As well as helping to mitigate climate change, reducing and managing infrastructure carbon can reduce costs and drive resource efficiency as set out in the Infrastructure Carbon Review.

2.21 Authorities are encouraged to consider infrastructure carbon associated with both future interventions set out in the LTP (for example a proposed cycle lane) and the maintenance of existing infrastructure (for example resurfacing existing highways). As illustrated in Figure 2, this should involve consideration of infrastructure carbon alongside user emission impacts in qualitative option appraisal of a longlist of interventions, before quantitative assessment of a shortlist. Guidance on a proportionate approach to these steps is provided in Chapters 5 and 7.

2.22 It is not expected to be proportionate to quantify operational emissions associated with energy or water consumption (for example highway lighting) or end-of-life capital carbon (for example disposal of an asset) because the carbon impact of operational or end-of-life emissions is likely to be negligible in the context of tailpipe user emissions in most cases. Associated interventions (for example LED street lighting or sustainable energy generation) may give worthwhile carbon reductions and authorities can report such evidence where available. Further guidance is provided in Chapters 6 and 7.

Question Number	Consultation Question
Q3	In your view, is the proposed scope of emissions covered appropriate and proportionate for the development and assessment of an LTP? ☐ Yes ☐ No ☐ Don't know If no, what should be changed and why?

Intervention development and delivery stages

2.23 Interventions identified as part of an LTP will undergo subsequent appraisal, as they mature, to inform the investment decision-making process. The LTP carbon analysis, conducted as part of LTP development and assurance, should be considered the first step in what is an evolving and iterative process for the appraisal and management of carbon impacts. This should be recognised in the following ways:

- **Planning stage (Local Transport Plan)**: factoring in quantifiable carbon reductions in decision making in an LTP should be strategic in nature; primarily considering and influencing the types of interventions to be delivered and their fundamental principles, rather than how they are delivered (for example material choices in design). It is at this early, strategic stage that the opportunity to influence carbon outcomes is greatest. Methods and advice for undertaking this analysis to inform the planning stage is provided in this guidance document.
- **Business case and design development stage**: carbon should be considered in greater detail as appropriate at each business case and design development stage. This should involve appraisal in accordance with Transport Analysis Guidance (TAG) Unit A3 and evolving guidance and tools for managing carbon at an intervention level that may be released by DfT's Carbon Management Programme. Iterative assessment of carbon in intervention design stages should inform optioneering and design decisions to maximise whole-life carbon outcomes achieved by an intervention.
- **Construction and delivery stage**: good practice should involve the actioning of identified carbon management measures and monitoring and evaluation to improve the accuracy of future assessments.

2.24 As part of the development of the LTP, authorities should make estimates of intervention impacts through the tools set out in this guidance. As interventions progress to later stages of their lifecycle and further analysis is undertaken, the assessment of carbon impacts will improve in accuracy and precision. This should be reconciled with the fact that the ability to influence carbon outcomes diminishes as interventions progress through the project lifecycle.

2.25 Authorities should use the appropriate level of carbon assessment depending on the stage of development of the interventions under consideration at the LTP development stage. For example, where an intervention has detailed estimates of demand changes prepared as part of an Outline Business Case this should be used instead of benchmarking data. Where a scheme is only at concept design and no such existing analysis is available it is appropriate to use benchmarking data. This will enable local decisions to be made based on the most accurate or mature estimate of carbon impacts available. These principles are illustrated in Figure 3 below.

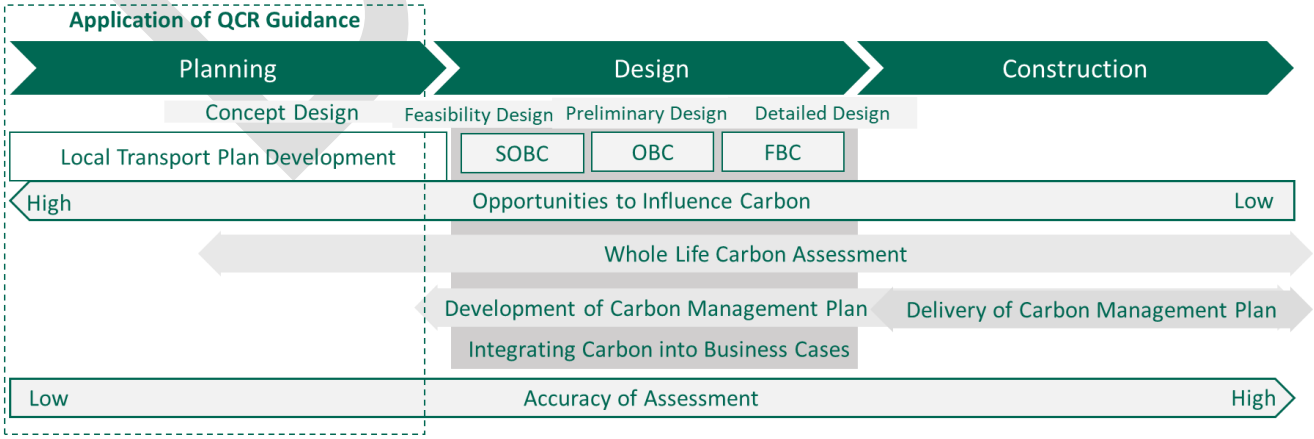

Figure 3: Overview of assessment evolution and remit of this LTP carbon analysis

2.26 Future iterations and assessments of LTP interventions will be needed to ensure an accurate understanding of authority emissions as quantification methods and interventions evolve. This guidance has been designed to facilitate and encourage this. Authorities should update QCR assessments as they report on implementation of their LTP as a minimum. For example, as a proposed intervention moves through the business case stages, more up-to-date assessment of carbon impacts should replace older ones.

Geographical scope

2.27 It is acknowledged that activities in one authority will influence emissions in others. For example, a Workplace Parking Levy instigated in an urban authority will likely reduce commuting trips and associated emissions that occur in a neighbouring rural authority. Alternatively, this urban authority's reported emissions may be influenced by improvements to bus services within the neighbouring authority. This highlights the importance of coordination of local transport planning at a regional level and insights from carbon analysis in LTPs will help to inform this.

2.28 Chapters 3, 6 and 7 provide topic specific guidance relating to the geographical scope of emissions to be quantified. Total surface transport emissions within the administrative boundary of the authority should be quantified in Step 1 to provide a holistic and consistent understanding of all transport emissions. In the absence of suitable methods to accurately distinguish cross-boundary effects however it is not required in Step 4 to distinguish emission impacts from LTP interventions by geography. This means emission impacts achieved outside of the geographical boundary of the authority delivering the intervention will be counted towards the impacts by the authority responsible for that intervention.

2.29 Where two or more authorities deliver an intervention jointly the emission impact should be split using appropriate analysis or assumptions. Any assumptions should be transparently set out in accordance with guidance in Chapter 8.

Question Number	Consultation Question
Q4	In your view, what, if any, implications with the approach proposed for geographical scope have been missed?

3. Step 1: Estimating Current and Future User Emissions

3.1 Each authority has a different baseline of emissions based on the individual characteristics of their area. Authorities also have different challenges and conditions that influence the scale and source of their emissions.

3.2 Step 1 of the LTP carbon analysis process (Figure 1) involves producing an estimate of current and future user emissions (in the absence of the interventions outlined in the updated LTP). This provides a 'baseline' against which the impact of an LTP can be measured. It can also provide an insight into the source of emissions to help authorities target interventions where they will have the greatest effect.

3.3 In most regions, authorities can obtain this stage of analysis from the relevant Sub-National Transport Body (STB) and may not need to undertake the analysis themselves. If this is not available, this guidance is intended to enable authorities to understand how to conduct the analysis or to inform further developments by STBs or others.

3.4 This chapter relates to user emissions only. The rationale for this is that infrastructure carbon falls under sectors other than transport (for example product manufacture relates to industry) as accounted at a national level by the Department of Business, Energy and Industrial Strategy (BEIS). The proportion of total emissions in these sectors that relates to infrastructure carbon within the control of transport authorities is not identified. Proportionate methods to determine a comprehensive baseline are therefore not available at this time. Guidance on the consideration of infrastructure carbon is provided in Chapter 7.

3.5 For consistent reporting between LTPs, the primary quantitative outputs of this step should be reported as the metrics defined in Table 9 of this Chapter. These reporting metrics are distinguished as 'user emissions on business as usual' (metric reference: UE-BaU) and 'user emissions on accelerated uptake of Zero Emission Vehicles' (UE-ZEV).

Process at a glance: Step 1 – estimating current and future user emissions
Quantification of the user emission impacts of an LTP should involve: • Obtaining the outputs of existing analysis (where available). • Where existing analysis isn't yet available at a regional level, quantify emissions from transport model outputs (Method A2) or apply a methodology based on BEIS Greenhouse Gas (GHG) inventory data (Method A1).
Enabling reporting of: • Current user emissions and how they will change up to 2050 under business-as-usual. • The extent to which an accelerated uptake of Zero Emission Vehicles (ZEV) at a national level can influence future emissions (assuming comprehensive Local EV Charging Strategies that will contribute to delivering accelerated uptake of ZEVs nationally). • Sources of emissions, such as proportions from different modes and trip types.
Informing decision making and DfT assurance in relation to: • The scale of additional emission reductions that need to be achieved nationally, and how LTPs can contribute to decarbonising transport towards Net Zero. • Where interventions can be focused to have the greatest influence on decarbonisation of local transport in an authority's influence.

Table 3: Step 1 'at a glance' non-technical summary

Scope of emissions

3.6 The geographical scope for an estimate of current and future user emissions should lie within the relevant administrative boundary of the LTP and should be prepared accordingly.

3.7 Authorities are only required to quantify domestic surface transport emissions. Quantification of aviation and shipping emissions are not expected as they are governed by policy outside of the control of the authority. Emissions associated with surface transport to and from airports and ports should however be included.

3.8 The scope of emissions quantified should be made clear when reporting. This should clarify which modes are included in the estimate of current and future emissions and provide a clear justification where sources of emissions are excluded.

3.9 The principles of proportionality should be applied, focusing the scope of quantification on the largest impacts. As a minimum, emissions associated with cars, Light Good Vehicles (LGVs) and Heavy Goods Vehicles (HGVs) should be quantified. Data on the relative emissions by mode at a national level can be found in Decarbonising Transport: Setting the Challenge.

3.10 Assessment of current and future bus emissions in Step 1 is encouraged but the feasibility of this and extent to which they can be quantified and disaggregated will be reliant on the tools and data available to authorities. The carbon impacts of any bus intervention put forward in an LTP should be considered as part of Steps 3 and 4 (see Chapters 5, 6 and 7).

3.11 Assessment of current and future rail emissions in Step 1 is not required. Quantifying rail emissions within a local authority is currently challenging; these emissions will not be captured in local transport models and national emission inventories only capture emissions from diesel railways. Rail emissions are also not entirely under local authority control. The carbon impacts of any rail intervention put forward in an LTP should be considered as part of Steps 3 and 4 (see Chapters 5, 6 and 7).

3.12 Emissions from bus and rail use, which account for both user emissions (tailpipe) and energy consumption (for example electric or hydrogen propulsion) are typically a small source of overall emissions in comparison to user emissions from cars, LGVs and HGVs. Available methods described in this Chapter do not all include bus or rail emissions by default, as set out in Table 5. To ensure a proportionate approach, the assessment of current and future emissions for public transport as part of Step 1 is therefore encouraged but not required (as described in Paragraphs 3.10 and 3.11).

Scenarios for assessment

3.13 Emissions should be estimated on a yearly basis from a recent baseline year up to at least 2050. It is acknowledged however, there are significant uncertainties in future trends that may influence user emissions over this time period.

3.14 As a minimum, authorities should develop an estimate of future emissions using a Business-as-Usual scenario that represents firm and funded policies in line with current TAG datasets and recognised growth forecasts such as the National Transport Model (NTM) / Road Traffic Forecasts (RTF) or National Road Traffic Projections (NRTP). Fleet assumptions for a Business-as-Usual (BaU) scenario should be based on the latest version of the TAG Databook. A1.3.9 provides fleet proportions of vehicle kilometres by fuel type.

3.15 This Business-as-Usual scenario using current TAG data will 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. As described in the Transport Decarbonisation Plan however DfT intend to introduce a ZEV mandate that will establish sales percentage targets that must be met by vehicle manufacturers, requiring to them to sell a certain proportion of zero emission vehicles. Once this becomes ‘firm and funded’, it is anticipated that TAG will incorporate higher levels of forecast ZEV uptake and the Business-as-Usual scenario will therefore reflect emission reductions closer to the range illustratively indicated in Figure 4.

3.16 Authorities should however test the impact that ambitious Zero Emission Vehicle (ZEV) uptake might have on future emissions. This should be reported as an ‘accelerated ZEV uptake’ forecast (Metric UE-ZEV). This forecast should be modelled using mileage split data from DfT’s Common Analytical Scenarios (CAS)

'vehicle-led decarbonisation' and 'mode-balanced decarbonisation'. These scenarios include the same mileage split dataset that represents ambitious ZEV uptake. This can be found in tabs VL1 and MB1 of the CAS Databook. This assumes a much more ambitious level of ZEV uptake post-2030 than the current TAG Databook, as illustrated in Table 4.

Scenario	2025	2030	2040	2050
Business as Usual (TAG Unit A1.3.9)	15%	36%	62%	67%
Accelerated ZEV uptake (Common Analytical Scenarios)	13%	40%	88%	99%

Table 4: The proportion of vehicle kms travelled under electric propulsion in TAG A1.3.9 and the Common Analytical Scenarios

3.17 This alternative future of ZEV uptake will have a significant influence on estimates of future emissions prepared as part of this LTP carbon analysis. This is illustrated as an example of local emission forecasts in Figure 4 including a comparison to a decarbonisation pathway derived from the Net Zero Strategy. Guidance on decarbonisation pathways is provided in Chapter 4.

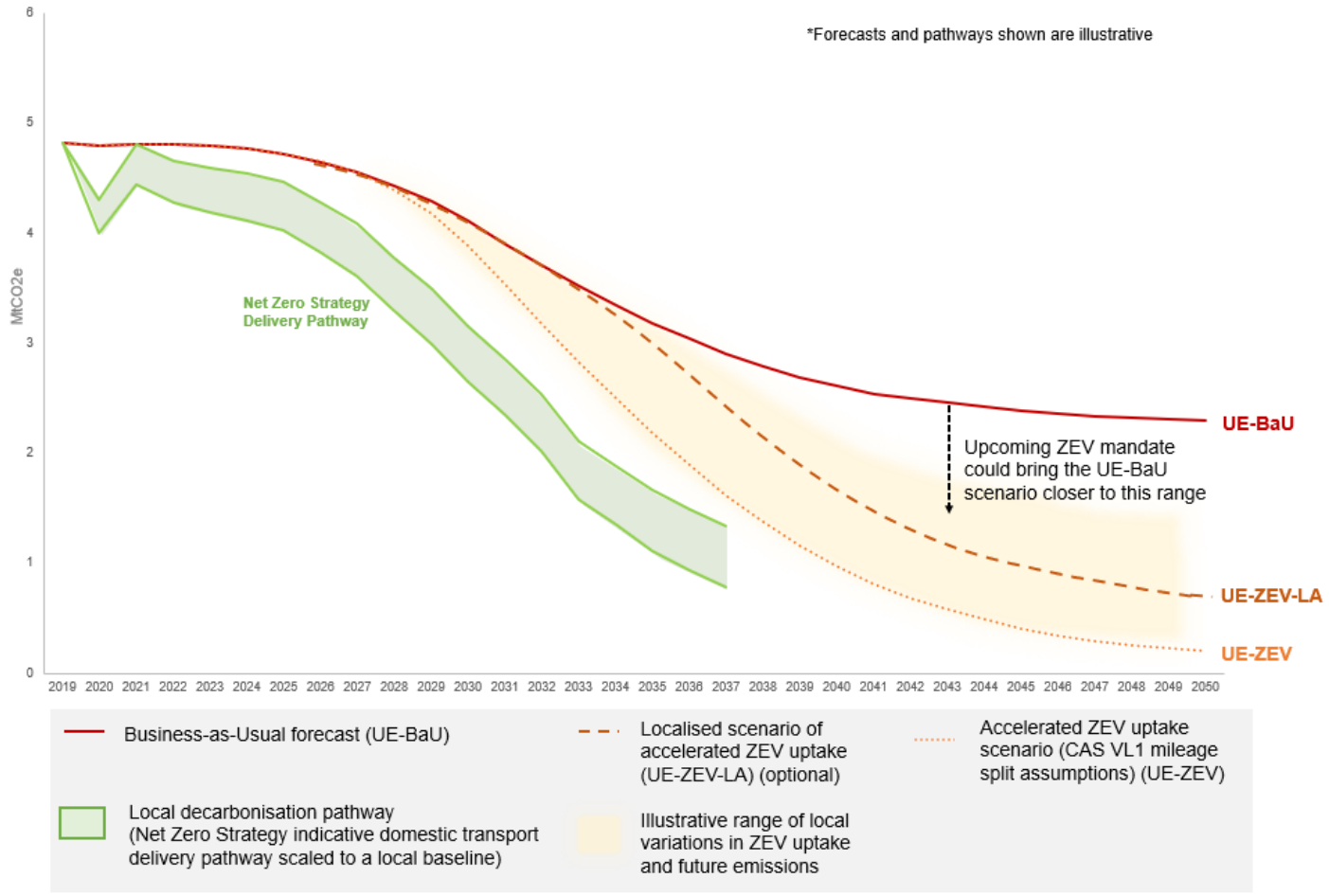

Figure 4: Illustrative example emission estimates

3.18 TAG A1.3.9 should be considered the lower limit and the **'**accelerated ZEV uptake' (CAS VL1 mileage split data) scenario the upper limit of potential ZEV uptake nationally. The former represents firm and funded policies while the latter dataset is a scenario of ambitious vehicle decarbonisation that should for this analysis represent a best-case scenario of ZEV uptake. The illustrative estimates presented in Figure 4 are not an official forecast but rather are provided to illustrate that the 'accelerated ZEV uptake' scenario based on the CAS assumptions is not anticipated to be sufficient to meet the Net Zero Strategy Delivery Pathway on its own. Therefore, not only is ambitious delivery of ZEV infrastructure and local ZEV policy required, but also other local interventions. Further guidance on how to apply the Net Zero Strategy as a local transport decarbonisation pathway is provided in Chapter 4.

3.19 Authorities have a critical role to play in planning and delivering the charging infrastructure that will enable ambitious uptake of ZEVs; particularly where the market may fail to do so. While national policy will likely drive higher uptake than currently modelled in TAG data, the ambitious levels of ZEV uptake included in the CAS can only be achieved with ambitious delivery of local charging infrastructure. Authorities must therefore have an effective local EV charging strategy to ensure sufficient charging infrastructure will be delivered in their area to achieve the national 'accelerated ZEV uptake' scenario. Further guidance is provided in the 'Local Transport Plan Guidance 2023' and UK electric vehicle infrastructure strategy.

3.20 The ambition and delivery of a local EV charging strategy will be a key determinant of future fleet composition. Local conditions will also influence the pace and scale of EV uptake between areas. Through the development of the LTP and EV charging strategy it is for the authority to decide, using the evidence of the QCR process, what mix, pace and scale of interventions, including EVs are required. Therefore, local EV uptake in some cases may present between the lower limit of current TAG data and upper limit of the CAS, as illustrated using the illustrative range and hypothetical example of a localised accelerated ZEV uptake scenario presented in Figure 4. Authorities are encouraged to use localised forecasts where available to establish a more realistic and locally specific scenario. This should be reported as metric UE-ZEV-LA and presented in comparison to metric UE-BaU and UE-ZEV.

3.21 Guidance on creating scenarios and conducting scenario analysis can be found in the TAG Uncertainty Toolkit. Sensitivity testing can also be prepared using alternative forecasts such as those provided by the National Grid or Society of Motor Manufacturers and Traders (SMMT).

3.22 Ambitious uptake of ZEVs such as that included in CAS is not expected to be enough to meet decarbonisation objectives. The use of an 'accelerated ZEV uptake' scenario based on CAS should therefore be used as part of this LTP carbon analysis to provide evidence of:

- The potential contribution of an ambitious scenario of ZEV uptake nationally if enabled by local charging infrastructure.
- Illustrate the scale of the challenge that remains even after a scenario of ambitious ZEV uptake. This will inform the level of ambition needed in other local interventions and what options places should consider to reduce emissions in their influence. Further guidance on establishing and using a decarbonisation pathway is provided in Chapter 4.

3.23 If they wish, authorities may conduct additional scenario testing to inform planning for uncertainty. This could include running one or multiple Common Analytical Scenarios in full (for example in addition to mileage splits also testing scenario assumptions for fuel efficiency, fuel costs etc) or estimating the impact of the Covid pandemic on future travel patterns. The basis of any assumptions should be clearly set out and justified. Guidance in TAG unit M4 (Forecasting and Uncertainty) and the TAG Uncertainty Toolkit should also be considered.

3.24 Chapter 6 provides further guidance on how these scenarios can be used as a baseline against which the impact of an LTP can be measured. Guidance is also provided on how the impact of local ZEV interventions can be accounted for.

3.25 Chapter 8 provides guidance on how these scenarios should be reported.

Question Number	Consultation Question
Q5a	To what extent do you agree or disagree that the Business-as-Usual and 'accelerated ZEV uptake' scenarios (as described) are a proportionate minimum standard by which authorities should estimate future emissions in the absence of an LTP?

	☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please explain why.
Q5b	To what extent do you agree or disagree that the Business-as-Usual and 'accelerated ZEV uptake' scenarios (as described) will provide a consistent approach (between LAs) for which they can estimate what future emissions might look like in the absence of an LTP? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree If you disagree, please explain why.
Q6	In your view, are there potential implications for this proposed approach to scenarios for assessment that have not been identified, if so, what are they?
Q7	In your view, to what extent would a detailed quantification of current and future emissions from bus and rail in your area be useful as part of QCR Step 1? ☐ Essential ☐ Useful but not essential ☐ Not proportionate ☐ Not useful ☐ Don't know If considered either essential or useful, to help improve the guidance, please describe what information you would find essential or useful and why. This might relate to the scope of quantification or level of disaggregation (for example breakdown of bus emissions by fuel type).

A tiered methodology

3.26 Authorities can estimate baseline and future emissions by relying on the tools STBs have created. In the absence of these tools, a method for disaggregating the emissions by authority is detailed below.

- **Method A1 - GHG Inventory:** estimates at local authority and regional level from the BEIS GHG inventory dataset with forecasts produced using nationally available datasets; and
- **Method A2a and A2b - Modelling based:** estimates typically derived from local transport model data (to cover the geography of the LTA as a minimum).

3.27 It is recommended all authorities seek to utilise Method A2a or A2b where available. A number of STBs have already developed methods that can provide results at a disaggregated level of constituent authorities.

3.28 For authorities without access to modelling-based methods, Method A1 provides a minimum standard for estimating current and future user emissions. Results from this methodology will not reflect local traffic conditions or support future monitoring and evaluation. It also provides only a basic level of disaggregation of emission sources. As such, authorities should seek to advance to modelling based methods at the earliest opportunity and update their estimates accordingly.

3.29 Traffic models provide a greater understanding of demand, using local data to disaggregate emissions by road user type, journey purpose and trip length. This evidence should better inform LTP development as it reflects an understanding of the source of emissions and where interventions should be prioritised.

3.30 Figure 5 summarises the available methods and circumstances in which each should be used. In this context, a Strategic Transport Model (STM) is defined as one that is capable of modelling alternative travel choices in response to changes in travel costs and is sufficiently detailed to provide medium to long term traffic forecasts over the LTP area.

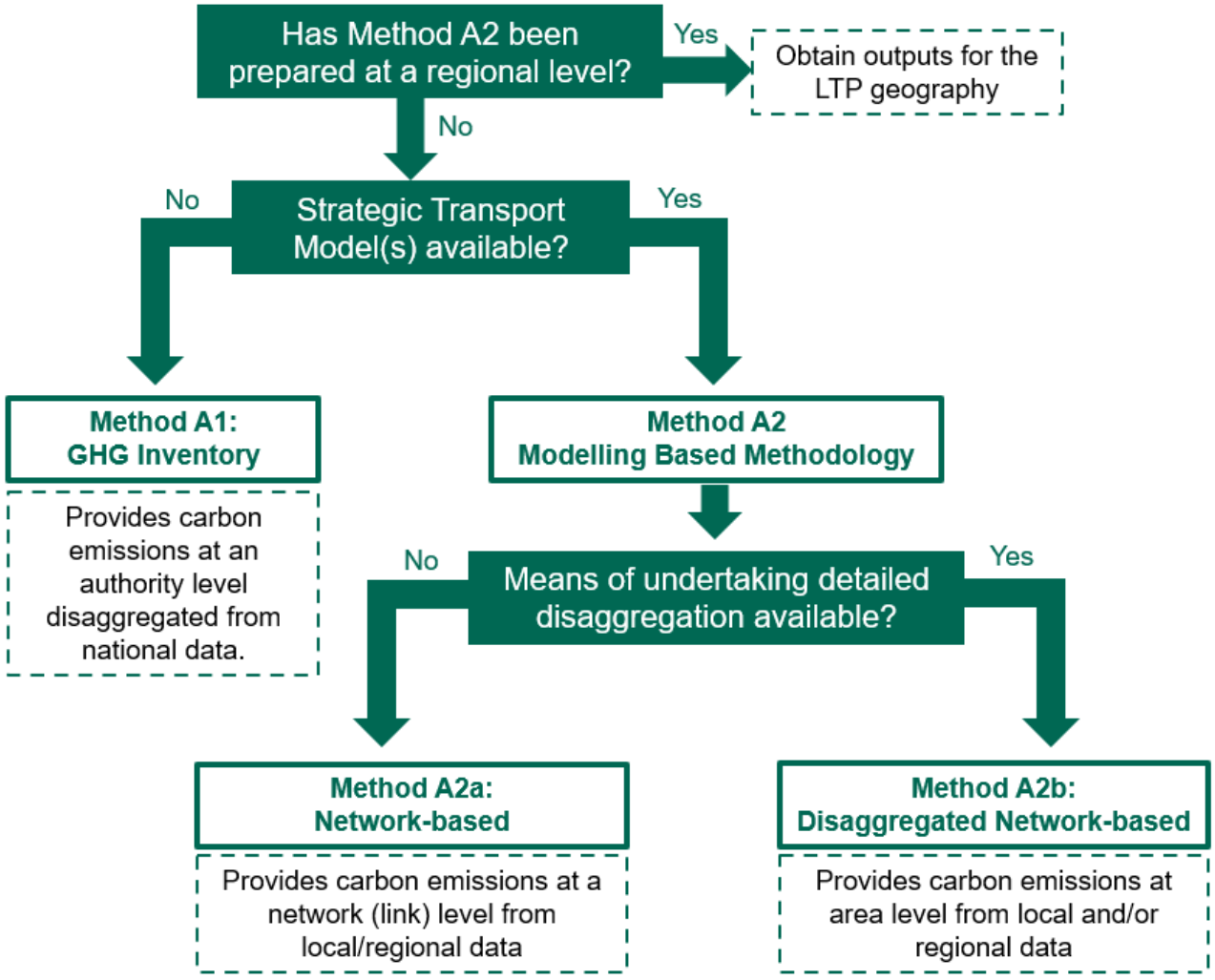

Figure 5: Circumstances for using methods A1, A2a and A2b

Question Number	Consultation Question
Q8	To what extent do you agree or disagree with the tiered methodology for estimating current and future emissions outlined and their application? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please explain why.

3.31 Methods A2a and A2b do not by default quantify bus and rail emissions whilst Method A1 includes some bus and rail emissions. Additional analysis would be required to include or identify / disaggregate bus and rail emissions within each method. This is summarised in Table 5 below.

Mode	Method A1	Method A2a	Method A2b
Cars, LGVs and HGVs	Quantified	Quantified	Quantified
Bus	Included within total emissions but not reported	Not quantified - requires additional analysis	Not quantified - requires additional analysis
Rail (passenger, freight, light rail and heavy rail)	Diesel railways included. Other rail types not identified.	Not quantified - requires additional analysis	Not quantified - requires additional analysis

Table 5: Inclusion of modes

3.32 Where bus and/or rail emissions are not explicitly modelled they can be quantified or disaggregated through further analysis using resources such as digitised timetables or MOIRA. This additional analysis, if needed, can be resource intensive so undertaking this at a regional level will therefore be more proportionate.

Method A1: GHG Inventory

3.33 Inventories of historic GHG emissions at a sub-national level have been prepared by The Department for Business, Energy and Industrial Strategy (BEIS) since 2005. The dataset provides total emissions by authority, split by BEIS default road type classification (Motorways, A Roads and Minor Roads).

3.34 The methodology used in developing the GHG Inventory can be found in this detailed technical methodology report. This method offers a comprehensive and nationally consistent estimate of local transport emissions; a dataset that when aggregated is used to monitor changes in emissions over time and informs national policy. The BEIS GHG Inventory can therefore be used as a reliable estimate of current (recent) emissions. Estimates of current emissions from modelling-based methods (Method A2) should be compared with the BEIS GHG Inventory to understand any differences.

Extracting current authority transport emission estimates from the BEIS GHG inventory

To identify an estimate of current (recent) transport emissions at an authority scale the following steps can be taken:

- Access the dataset on GOV.UK here: **UK Local Authority and Regional Greenhouse Gas Emissions National Statistics 2005-2020**
- Download the 'UK local and regional greenhouse gas emissions - data Tables' file in Excel.
- Table 1.1 provides a breakdown of authority GHG emissions 2005-2020. This includes all GHGs influenced by transport and that contribute to climate change. This data Table can be filtered by authority, year and sector. For each year in each authority it provides total transport emissions and a breakdown by road type classifications.
- Table 2.1 provides a dataset of CO_2 emissions within the scope of influence of authorities; defined for transport in this dataset as excluding motorways and diesel railways. These CO_2 estimates for road transport on A-roads and minor roads however may include through-trips (for example a trip on an A-road that has no origin or destination in that authority). It should also be noted that the exclusion of motorway CO_2 emissions may exclude trips that take place on a motorway but have an origin or destination in that authority and can therefore be influenced by that authority. Table 2.1 does not include transport influenced GHGs such as nitrous oxide: only CO_2. To understand total greenhouse gas emissions (MtCO2e) authorities should therefore use Table 1.1.

This dataset has also been visualised by the National Atmospheric Emissions Inventory as an interactive map available here: **Local Authority CO_2 Interactive Map**

Table 6: Steps to identify Local Authority Transport Emission Estimates

3.35 It is recommended to use 2019 as the base year since data from 2020 would reflect the change in travel patterns due to the Covid-19 pandemic.

3.36 The BEIS GHG Inventory only provides estimates of historic emissions, but it is possible to prepare forecasts of future emissions from the BEIS GHG Inventory and other datasets. Where modelling-based (Method A2) methods are not yet available to authorities this can provide a preliminary understanding of how emissions might change up to 2050, without the need for specialist skills or modelling data.

3.37 Local variations in forecasts will not be reflected by this method. Authorities should only use this approach when a suitable traffic model to cover the administrative boundary of the LTP is not available.

Method A2a - Network based estimation

3.38 Authorities should use this method when suitable local or regional strategic models are available, but bespoke modelling of carbon emissions (Method A2b) has not been completed by the STB.

3.39 This is the simplest form of a modelling-based approach using a suitable traffic model covering the LTP area. A traffic model can provide network-based outputs including:

- Link traffic flow by vehicle type and journey purpose.
- Link distances; and
- Average link speeds.

3.40 Using model outputs this method calculates vehicle kms travelled on a link-by-link basis. This can be processed to calculate vehicle kms travelled across the relevant network. Vehicle km values can be converted to carbon emissions to understand current and future emissions within the modelled geography.

3.41 The process for estimating vehicle kms and resulting emissions from traffic model outputs can be summarised into three key steps:

1. Extract traffic flow, link length and speeds from traffic model network;

2. Calculate vehicle kms (vkms) (AADT * link length) and average speeds; and

3. Convert vehicle kms to carbon emissions (using fuel consumption and emissions parameters from TAG Databook).

3.42 In order to disaggregate emissions by variables such as time period, vehicle type, journey purpose and road type, the process in Figure 6 can be used. Links within the model will need to be classified by these variables. For example, in order to understand emissions by road type (for example motorway, A road, B road, SRN or local) links within the model networks will need to be classified by these road type categories.

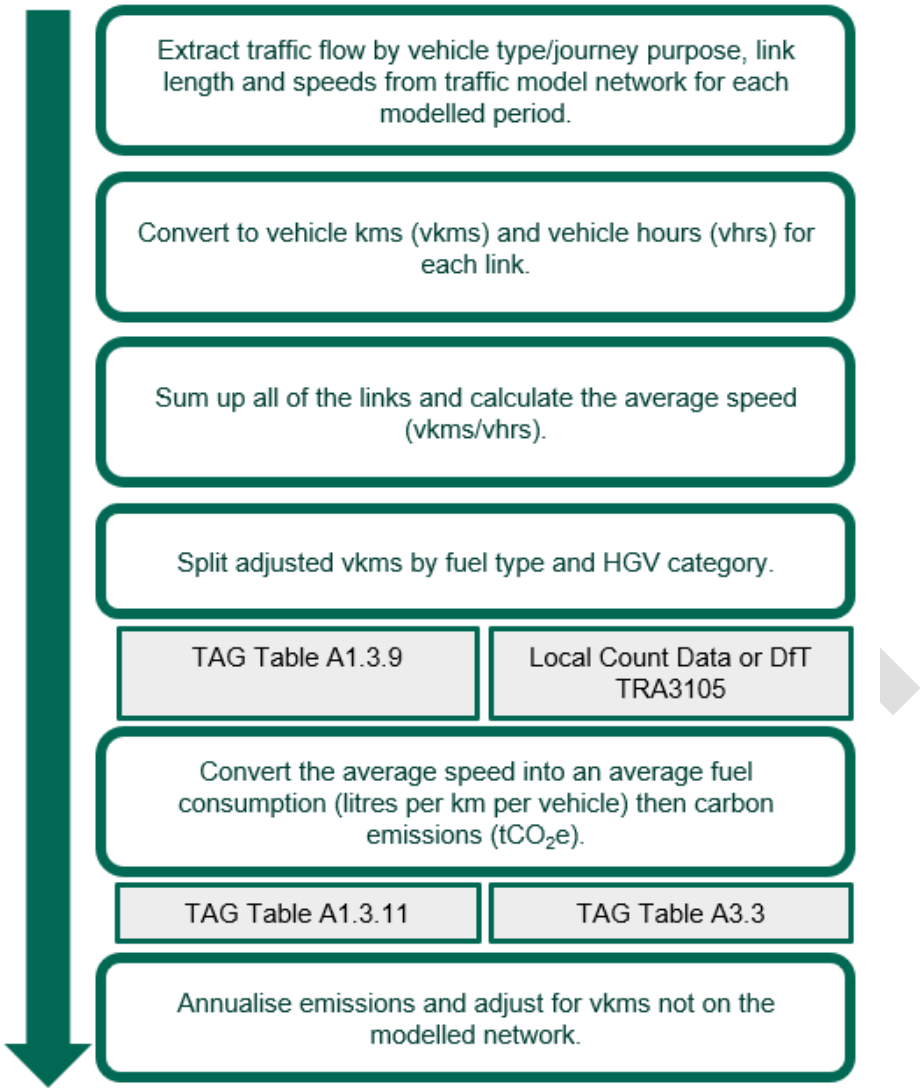

Figure 6: An example outline process of Method A2a

3.43 Figure 7 below provides an example output of emissions disaggregated by time period across an area. Within this theoretical example, the results indicate that a high proportion of emissions come from cars in the inter-peak period.

		2019			2030		
		Car	Van	HGV	Car	Van	HGV
Time Period	AM	12%	3%	4%	11%	4%	4%
	Inter-Peak	20%	6%	9%	19%	7%	9%
	PM	14%	3%	3%	13%	3%	4%
	Off-Peak	16%	4%	3%	15%	5%	6%

Figure 7: Method A2a example breakdown of emissions

3.44 A modelling practitioner will need to assess the suitability of the model and may need to undertake additional processing tasks to derive an accurate emissions estimate from Method A2a. The following paragraphs should be taken into consideration.

3.45 If the model used does not cover all traffic within the desired geography a factoring approach using DfT transport statistics can be applied. For example, to account for vehicle kms within the full LTP geography where the model does not cover that full geography.

3.46 TAG advice needs to be considered to take a view on the appropriateness of the model base year and forecast years. A modelling practitioner will need to assess if a 2019 base year and forecast year horizons can be derived by interpolation of existing model runs or whether additional runs will be required to feed into the baseline forecast. The reason behind the approach chosen, along with the issues considered, should be documented.

3.47 In order to quantify emissions on a yearly basis (for example report total emissions in 2019, 2030 and up to 2050) vehicle kms will need to be annualised. This can be done using data from local traffic counts. This process normalises the traffic model output and can be done at an authority level. The annualisation and other adjustment factors can be assumed to remain constant over the forecast period, unless there is clear reason to change (which should be documented). Emissions can be derived for years not represented by the traffic model by interpolation and extrapolation. Extrapolation should keep in line with RTF or NRTP growth.

3.48 To forecast the accelerated ZEV uptake scenario, authorities will need to apply adjustments to fuel type in the format of TAG Unit A1.3.9. Further sensitivity analysis can be undertaken by adjusting other variables such as vehicle km inputs.

3.49 In addition to the core outputs provided by the transport model and TAG data, supplementary data sources can also be applied for more detailed disaggregation and insight. For example, National Travel Survey (NTS) data can be used to apply more detailed journey purpose proportions to the results to provide additional insight (for example emissions by retail trips).

3.50 The inputs, variables and outputs of this method are detailed in the Table 7 below.

Variable	Definition
Input	• Link based traffic flows, road lengths and speeds derived from suitable local or regional strategic traffic model(s) in LTP area.
Growth forecast assumptions	• Detailed local growth assumptions. • At least one scenario based on TEMPRO.

Variable	Definition
Disaggregation	Added value: • Vehicle type (PSV). • Road type. • Trip purpose (for example commuting, business, other). • Other time period (off peak, weekend).
Supplementary data sources	• National Travel Survey (NTS) journey purpose. proportions and vehicle occupancy data. • DfT transport statistic datasets and forecasts.
Output	• Baseline and future emissions disaggregated based on model road network (links).

Table 7: Method A2a - Network Based Estimation

Method A2b - Disaggregated Network Based Estimation

3.51 This method uses additional data sources, data processing and a more advanced carbon tool than Method A2a and is more suitable to be undertaken at a higher level (typically across more than one authority; STB or Combined Authority level), with modelling tools which take account of the full extent of journeys (from origin to destination) and optionally other modes (for example rail, bus and coach).

3.52 An example of a Method A2b is shown in Figure 8 below. The method has the capacity to provide a breakdown of emissions by a more extensive range of variables than is possible with Method A2a. This includes variables such as journey length and distribution (for example whether a vehicle trip is outbound, inbound, internal or through an authority), owing to the use of model trip and cost matrices. Such additional insight about where emissions come from can be used by authorities to make better informed decisions in their LTP.

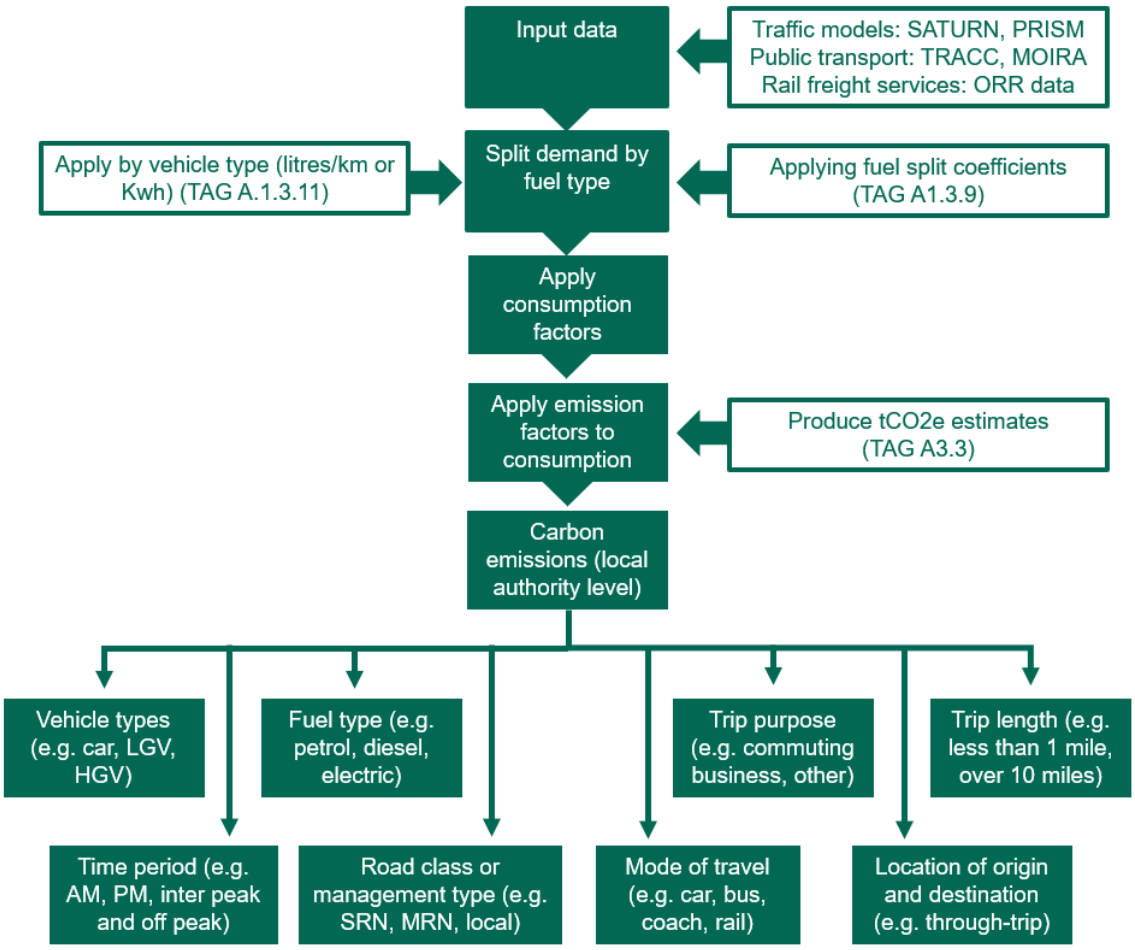

Figure 8: An example workflow of Method A2b

3.53 Figure 9 below provides an example output from Method A2b, in this case disaggregating emissions by journey purpose, vehicle type and trip length. Within this theoretical example, the results indicate that a high proportion of emissions come from journeys of more than 10 miles and so a more detailed breakdown of emissions in this bandwidth would provide more insight. Such evidence will help identify where best to target interventions.

		2019			2030		
		Car	Van	HGV	Car	Van	HGV
Business	<1 mile	0%	0%	0%	0%	0%	0%
	1-5 miles	0%	1%	0%	0%	1%	0%
	5-10 miles	1%	2%	0%	0%	2%	0%
	10+ miles	12%	13%	21%	11%	15%	23%
Commute	<1 mile	0%	0%	0%	0%	0%	0%
	1-5 miles	3%	0%	0%	2%	0%	0%
	5-10 miles	3%	0%	0%	3%	0%	0%
	10+ miles	15%	0%	0%	14%	0%	0%
Other	<1 mile	0%	0%	0%	0%	0%	0%
	1-5 miles	6%	0%	0%	5%	0%	0%
	5-10 miles	5%	0%	0%	4%	0%	0%
	10+ miles	18%	0%	0%	16%	0%	0%

Figure 9: Method A2b example breakdown of emissions

3.54 The evidence from this method can also be used to understand future emission trends and identify the influence that future interventions might have. As with Method A2a, in order to forecast the accelerated ZEV uptake scenario, authorities will need to apply adjustments to fuel type in the format of TAG Unit A1.3.9. The additional variables by which emissions are disaggregated in Method A2b can be used for more extensive and detailed scenario testing than Method A2a. For example, vehicle kms on specific network links could be adjusted in order to test the expected impact (as informed by evidence and analysis in Step 4a / Chapter 6) of a policy to reduce vehicle use in that area.

3.55 Method A2b has the capacity to use inputs from a wide range of sources, for example a combination of local and regional traffic models to improve the representation of both short distance and long-distance traffic and speeds.

3.56 The inputs, capabilities and outputs of this method are detailed in Table 8 below.

Variable	Definition
Input	Minimum requirement • Regional and local strategic traffic model(s).
Growth forecast assumptions	• Detailed local growth assumptions. • At least one scenario based on TEMPRO.

Variable	Definition
Disaggregation	Minimum requirement • Vehicle type (for example car, LGV, HGV etc.) • Fuel type (for example petrol, diesel, electric etc.) • Trip purpose (for example commuting, business, other). • Time period (for example AM, PM, inter peak and off peak). • Road class or management type (for example Strategic Road Network (SRN), Major Road Network (MRN) and local network). • Trip length (for example less than 1 mile, over 10 miles etc.) • By distribution of origin and destination for example start in area but travelling out; end in area coming from outside; both start and end in area; and pass straight through area. Optional • Public transport (for example local bus, tram and inter-city coach, fast and stopping services by time day by authority) by traction type. • Rail freight (regional total by traction type - disaggregated by trip genesis if possible).
Supplementary data sources (Optional)	In addition to Method A1 and Method A2a: • Office for National Statistics (ONS). • TRACC, MOIRA for public transport (paid services). • GBFM (paid service), ORR for rail freight.
Output	• Baseline and future emissions at authority level, disaggregated by vehicle type, by link management type, by mode, by trip length, time of day, trip distribution and journey purpose.

Table 8: Method A2b - Disaggregated Network Based Estimation

3.57 The A2b modelling-based method is beneficial as it captures the full measure of user emissions and segments of demand that an authority may not have control of at a local level (for example through-trips or emissions generated on the SRN). Authorities should utilise the results of this method wherever available from STB analysis or at the earliest opportunity that they can be obtained.

Question Number	Consultation Question
Q9	In your view, which of the methods do you anticipate that an authority would be able to apply using this guidance? Select all that apply. ☐ Method A1 GHG inventory ☐ Method A2a Network-based estimation ☐ Method A2b Disaggregated network-based estimation ☐ None of the above ☐ Don't know If you have selected none of the above, please explain why.
Q10	In your view, is there any further guidance or support that could be provided to help authorities to implement the methods proposed? ☐Yes ☐No ☐ Don't know If yes, what additional guidance or tools would be helpful?
Q11	Do you expect authorities to develop any of these methods 'in-house' at a sub-regional level to implement the recommendations of this guidance? ☐Yes ☐No – only expected to use locally disaggregated outputs of analysis conducted at a regional level (for example by STBs) ☐ Don't know If yes, please describe which methods you expect authorities to develop at a sub-regional level and for what reasons.

Quantifying emissions under LA influence

3.58 It is acknowledged that not all emissions counted under these methods will be within the direct influence of authorities. For example, through-trips (trips without a destination within the administrative boundary of the authority) and rail. Such emissions outside the direct influence of authorities may be higher where the Strategic Road Network falls within that authority.

3.59 Authorities must report total user emissions within their relevant administrative geography in order to provide a holistic and consistent understanding of all transport

emissions. Where an authority chooses to conduct analysis to present a sub-set of these emissions that are proposed to be under their influence, this should be reported separately, and the basis of this analysis clearly stated.

Reporting metrics

3.60 Quantitative outputs of this step of the LTP carbon analysis process, as described in this chapter, should provide the key metrics referenced in Table 9. For further guidance on the format within which these metrics are reported please refer to Chapter 8.

Reference	Scenario	Status	Description
UE-BaU	Business as Usual	Required	An estimate of total emissions under business-as-usual assumptions. <u>Reporting:</u> • Annual totals between the baseline year (recommended 2019) and 2050. • Total between the baseline year and 2050. <u>Applicable methods</u>: A1, A2a, A2b <u>What this includes:</u> • Total surface user emissions within the LTA administrative boundary (including emissions outside direct LA control). • Primary focus on modes with greatest impact such as emissions associated with cars, Light Good Vehicles (LGVs) & Heavy Goods Vehicles (HGVs). • Option to include public transport and rail freight. <u>What this excludes:</u> Aviation or shipping emissions

Reference	Scenario	Status	Description
UE-ZEV	Accelerated ZEV uptake	Required	An estimate of total emissions under an accelerated ZEV scenario based on the Common Analytical Scenarios. Reporting: • Annual totals between the baseline year (recommended 2019) and 2050. • Total between the baseline year and 2050. Applicable methods: A1, A2a, A2b What this includes: • Total surface user emissions within the LTA administrative boundary (including emissions outside direct LA control). • Primary focus on modes with greatest impact such as emissions associated with cars, LGVs and HGVs. • Option to include public transport and rail freight. What this excludes: Aviation or shipping emissions
UE-ZEV-LA	Localised scenario of accelerated ZEV uptake	Encouraged	An estimate of total emissions under an accelerated ZEV scenario based on a locally specific forecast of ZEV uptake. This should reflect the likely rate of ZEV uptake in an LTA based on key determinants of ZEV uptake rates (for example ownership trends, availability of off-street parking). This scenario should otherwise be treated the same as detailed for scenario UE-ZEV above.

Table 9: Estimating Current & Future User Emissions

3.61 These metrics should allow an authority to visualise the estimated change in emissions under these scenarios up to 2050. An illustrative example is presented in Figure 10 below.

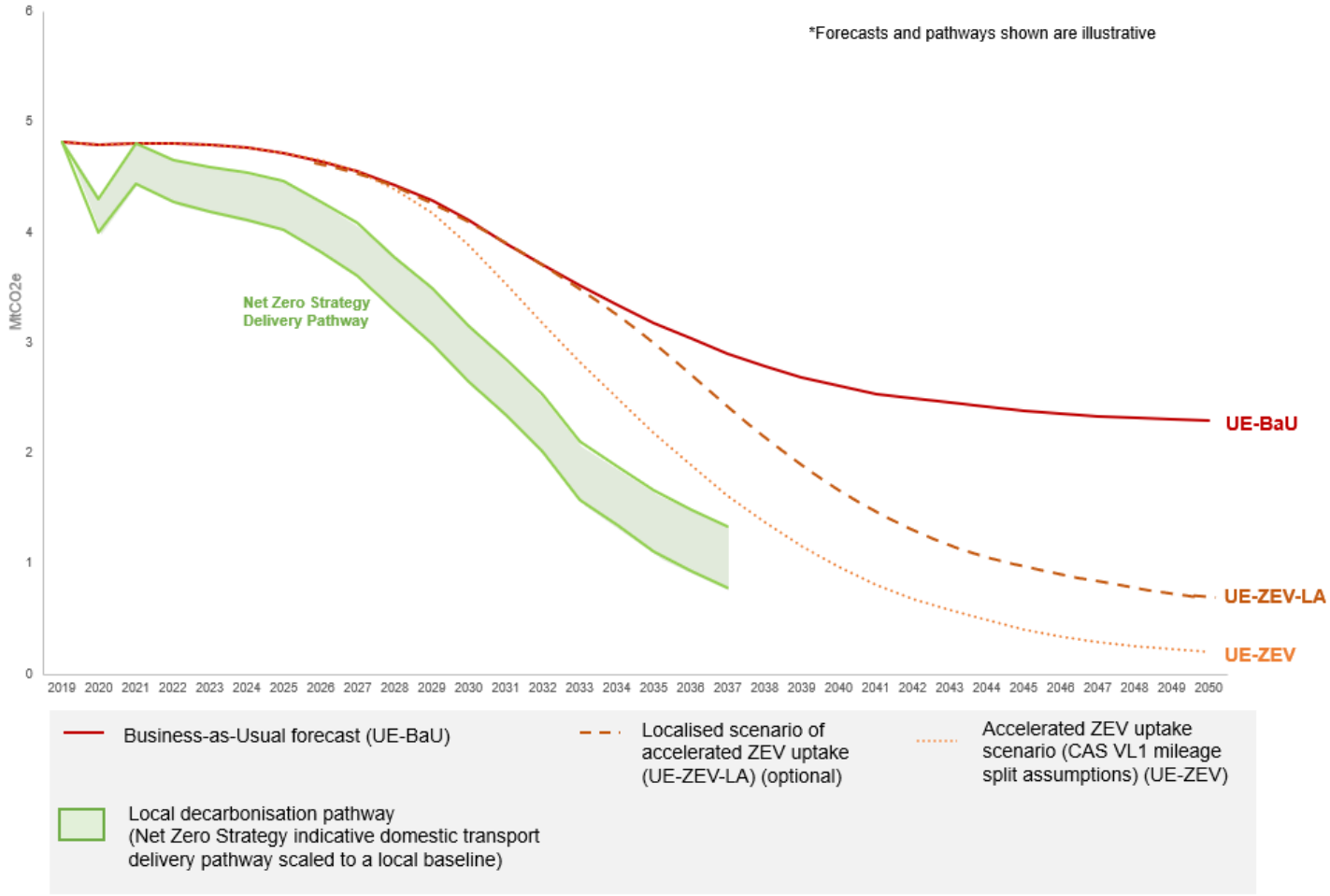

Figure 10: An example graph of emission forecasts prepared from analysis described in Chapter 3 (illustrative)

Question Number	Consultation Question
Q12	Do you anticipate any key challenges for an LTA in delivering the analysis set out in this chapter? ☐Yes ☐No ☐ Don't know If yes, please describe what these challenges could be.
Q13	In your view, what further guidance or support, if any, could be given to LTAs to carry out elements described in this chapter?

4. Step 2: Establishing a local transport decarbonisation pathway

4.1 Step 2 of the LTP carbon analysis process involves developing an indicative local transport decarbonisation pathway. This will help authorities to identify a level of decarbonisation ambition appropriate to the scale of carbon emissions in their area. For authorities without an existing, locally determined pathway, this Chapter provides guidance on how authorities can develop an indicative local decarbonisation pathway using existing pathways.

4.2 By comparing this pathway with baseline projections identified from Step 1, authorities will gain an insight to the scale of the challenge and to what extent successive LTPs may need to contribute to decarbonisation in future. This comparison can also inform consideration of what local transport outcomes would contribute to transport decarbonisation; thereby helping to shape the vision and objectives of the LTP.

Process at a glance: Step 2- establish a local transport decarbonisation pathway
Establishing how a carbon reduction can be achieved should involve: • Defining a local transport decarbonisation pathway that is in line with Net Zero • Identifying the difference between the Business as usual (UE-BaU) and accelerated ZEV uptake forecasts (and any other locally derived forecasts) and a local decarbonisation pathway. • Considering what local transport outcomes would contribute to local transport decarbonisation according to local circumstances (for example desirable mode splits or percentage increases in cycling demand).
Informing decision making in relation to: • The level of ambition required in a place. • What the vision and objectives of the LTP should be in the context of local needs and circumstances. • How those desired outcomes can be realised through the choice of interventions.

Table 10: Step 2 'at a glance' non-technical summary

Defining a local decarbonisation pathway

4.3 Each authority will decarbonise at a different pace subject to local capabilities, needs and circumstances; authorities are therefore encouraged to develop locally specific decarbonisation pathways. Localised pathways, budgets or targets are not provided by the Government in this guidance.

4.4 While encouraged, it is accepted it may not be possible or proportionate to develop a bespoke local decarbonisation pathway as part of this LTP carbon analysis. Alternatively, therefore it is acceptable to develop a local decarbonisation pathway by scaling an existing regional or national pathway. An example of a regional decarbonisation pathway is presented in Table 11.

Case study: Transport for the North's Decarbonisation Strategy and regional decarbonisation pathway
TfN's Decarbonisation Strategy provides a decarbonisation trajectory that would reduce the North of England's surface transport emissions to close to zero by 2045. This trajectory acknowledges that some areas within the region will decarbonise more quickly, while some may decarbonise more slowly. TfN's Decarbonisation Trajectory however provides a regionally specific pathway that authorities in the North of England can scale to local baselines and use to guide the level of ambition required.

Table 11: Example of regional decarbonisation pathway

4.5 As a minimum authorities should present a scaled version of the domestic transport delivery pathway published in the Net Zero Strategy as guiding context on transport decarbonisation ambition. This national pathway should be scaled to a local baseline emission estimate derived from Step 1, as described in Table 12. This scaled version of the Net Zero Strategy pathway should be presented alongside any other local decarbonisation pathway(s) or existing locally determined Net Zero commitments.

4.6 The Net Zero Strategy provides at a national level an indication of the pace of decarbonisation required by each sector in order to achieve Net Zero by 2050. It establishes indicative delivery pathways for each sector up to 2037; an indicative pathway of emissions reductions which meet targets up to the sixth carbon budget ending in 2037. These pathways reflect the different paces of decarbonisation that different sectors will take but are together intended to deliver on whole-economy emission targets.

4.7 The reductions required nationally in domestic transport emissions as indicated by the Net Zero Strategy's indicative transport delivery pathway are illustrated below. This indicates national emissions from domestic transport need to fall by 34-45% by 2030 and 65-77% by 2035, relative to 2019 levels, in order to achieve carbon budgets on a pathway to Net Zero by 2050.

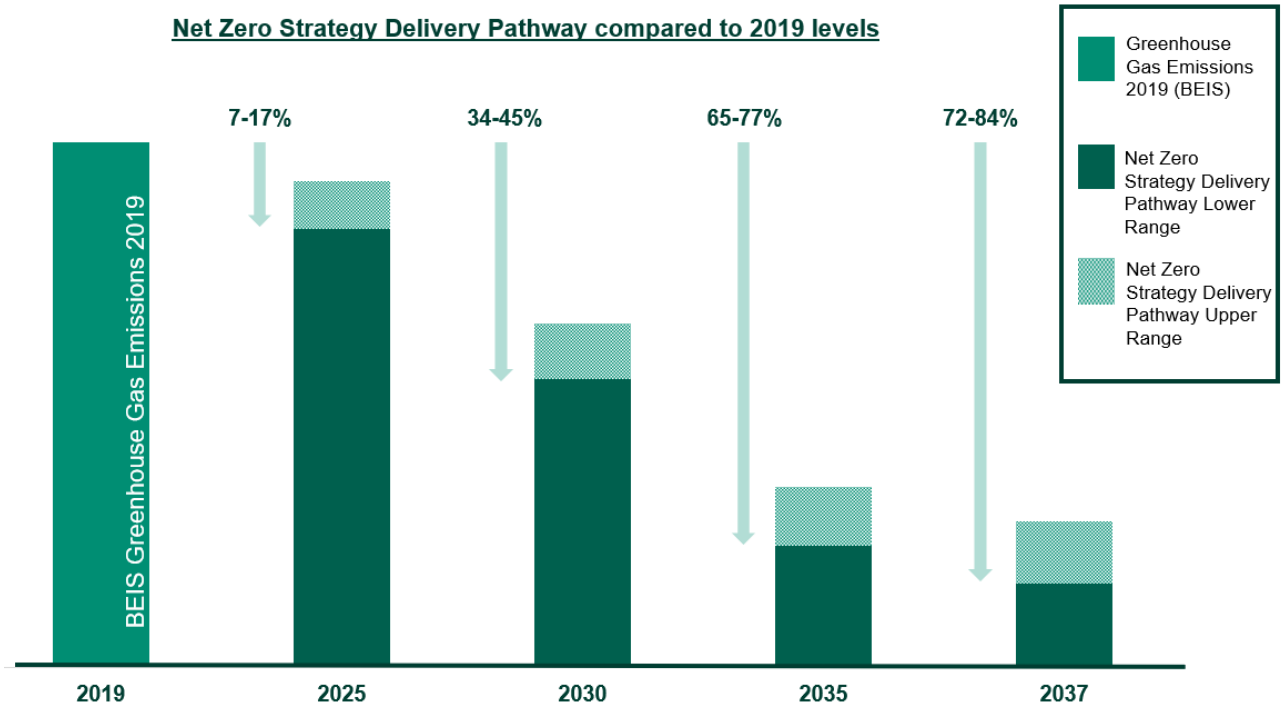

Figure 11: Net Zero Strategy Delivery Pathway Emission Reductions

Applying the Net Zero Strategy transport delivery pathway to a local baseline
The following steps can be taken to create a locally scaled version of the Net Zero Strategy's indicative transport delivery pathway: • Calculate the yearly percentage change needed at a national level in the Net Zero Strategy data table for domestic transport (Tab 3v, Figure 21). For each year from 2020 onwards the percentage change from the 2019 emission value should be calculated. This should be done for both the upper and lower limits. • Apply those percentage reductions to a local baseline emission estimate. This can be the baseline worked out through Step 1.

Table 12: Applying the Net Zero Strategy transport delivery pathway to a local baseline

4.8 This scaled pathway can serve as an indicative local transport decarbonisation pathway in the absence of a bespoke, locally developed pathway. It will also provide guiding context of how national ambition may compare to local commitments. It will not however reflect differing local capabilities or circumstances that affect the pace of possible decarbonisation. Where authorities have the capability to be more ambitious than this pathway they should do so.

4.9 Domestic transport pathways will only represent user emissions and therefore should only be applied to the user emission baseline determined in Step 1 (Chapter 3). To support decarbonisation of the economy as a whole towards Net Zero, authorities should consider that interventions included in an LTP will influence the decarbonisation of other sectors such as industry (for example through manufacturing of products for construction).

4.10 While the Net Zero Strategy provides indicative delivery pathways for other sectors including industry, these pathways do not distinguish the transport related emissions within them. Definition of an infrastructure carbon pathway is therefore not required, and authorities are encouraged to refer to the Net Zero Strategy for Industry. Further guidance on how infrastructure carbon can be considered in the development of an LTP intervention pipeline is provided in Chapter 5 and 7.

Question Number	Consultation Question
Q14	In your view, are there potential implications for this proposed approach to decarbonisation pathways that have not been identified, if so, what are they?
Q15	Do you anticipate there will be challenges for LTAs in establishing a local transport decarbonisation pathway following the approach set out in this chapter? ☐Yes ☐No ☐ Don't know If yes, what challenges do you anticipate?

4.11 A local transport decarbonisation pathway provides strong evidence of the challenge and helps to make the case for change. It can also be used to frame the ambition for analysis of what local transport outcomes would contribute to decarbonisation in a way most suitable to local conditions.

4.12 The decarbonisation pathway can be compared with a Business-as-Usual forecast (metric UE-BaU as developed in Step 1) and an 'accelerated ZEV uptake' scenario (UE-ZEV). This should be visualised as a graph such as Figure 4. As stated in Paragraph 3.16, this is an illustrative example and not an official forecast or target. The 'accelerated ZEV uptake' scenario which is based on the Common Analytical Scenarios should be treated as an ambitious upper limit of ZEV uptake enabled by ambitious delivery of a local EV charging strategy, as described in Paragraphs 3.16 to 3.20.

4.13 Problem identification and establishing the case for change can also be supported by analysis of where emissions come from now and in future years. Guidance on methods for disaggregation of emissions sources is provided in Chapter 5.

4.14 It is not intended that the local transport decarbonisation pathways should be treated as a sub-national apportionment of the national carbon budget. Nor is it intended that these are treated as a local decarbonisation target in the determination of planning applications for transport schemes or in applications for development consent for national and regionally significant transport infrastructure projects.

Consider the local transport outcomes needed to achieve decarbonisation

4.15 Having identified a decarbonisation pathway and considered the level of decarbonisation ambition needed, authorities should consider what transport outcomes will support carbon reductions. For example, what split of modes is necessary and desirable to reduce emissions at the pace and scale required, or what percentage increase in cycling demand will result in meaningful change. This should consider local conditions and the evidence base of emission sources provided in Step 1 (Chapter 3). This analysis should support the establishment of a vision and objectives and subsequently, the specific policies and interventions that will help achieve that, in line with the Local Transport Plan Guidance 2023 ('how' the desired changes will be realised through interventions, as informed by Steps 3 and 4).

4.16 While this task is not the primary focus of Step 2, the following forms of analysis may be useful to authorities in establishing what local transport outcomes are required to support decarbonisation. These options could be used as standalone options or together in a complementary manner.

'Top-down' analysis of speculative transport measures

4.17 There are a number of cases of 'top-down' analysis that have been undertaken to understand what transport outcomes are needed to decarbonise. In these studies, different measures, or outcomes (for example modal-share) are modelled in order to set out the realistic proportions of emission reductions that will be achieved by each. Such analysis however does not model the impact of interventions in specific locations but is intended to determine the likely scale of interventions needed to achieve a meaningful impact.

4.18 The methods outlined in Chapter 3 can be adapted to support analysis. For example, this might include building in ‘levers’ to a carbon tool that enable testing of different intensities of measures such as adjustments to traffic growth forecasts and ZEV forecasts. Such methods can also be used to test the carbon reductions achieved by different modal-splits. For example, testing what carbon reductions would be achieved if 50% of short journeys were undertaken by active travel.

4.19 The Royal Town Planning Institute (RTPI) research paper ‘Net Zero Transport: the role of spatial planning and place-based solutions’ utilises analysis such as this and provides guidance relevant to establishing the changes required to decarbonise transport.

Theory of Change

4.20 As an alternative or supplementary to the ‘top-down’ analysis described above, a Theory of Change approach can be used. This can provide a structured means to establish and engage on the cause and effect of changes that will deliver carbon reductions. The preparation of a decarbonisation focused Theory of Change map can also be used to inform the wider Theory of Change established for the LTP, in circumstances where this does not cover sufficient detail relating to decarbonisation.

4.21 In the absence of locally specific quantitative analysis such as the 'top down' analysis referenced previously, authorities are encouraged to use existing sources to inform and evidence the Theory of Change model. This may include regional decarbonisation strategies or national studies such as the Transport Decarbonisation Plan and analysis by the Committee for Climate Change.

4.22 Further guidance on the development of a Theory of Change model can be found in Chapter 3 of the LTP guidance.

Question Number	Consultation Question
Q16	To what extent do you agree or disagree with the approach to using a local transport decarbonisation pathway? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please provide an explanation for your answer, including suggestions for improvement if any.
Q17	In your view, is there sufficient guidance in this chapter to support LTAs in developing an understanding of the potential scale of local emissions reductions? ☐Yes ☐No ☐ Don't know If no, what additional information do you think is required?

5. Step 3: Appraising options

5.1 Step 3 of this LTP carbon analysis process involves meaningful and proportionate consideration of carbon as part of the process of establishing a longlist of potential interventions and policies and appraising these to produce a shortlist. This Chapter corresponds to the 'Developing Interventions (longlisting)' and 'Option Appraisal (shortlisting)' sections within Chapter 3 'Developing and Delivering the Local Transport Plan' of the Local Transport Plan Guidance 2023.

5.2 Through these stages of longlisting and shortlisting, it may not be proportionate for authorities to undertake a full quantitative assessment for every proposed intervention during early stages of option assessment. As such, the advice provided in this Chapter relates primarily to the use of 'lighter-touch' methods that are qualitative in nature. Advice is also provided on how insights gained from Step 1 and 2 of the QCR process can be used to arrive at a shortlist of interventions. This Chapter provides further advice on where quantitative assessment (Chapter 6 and 7) should support LTP development.

5.3 LTPs and intervention pipelines should not be developed without regard to their estimated carbon impact as this is unlikely to lead to quantifiable carbon reductions across the local authority's overall portfolio. As part of the wider options appraisal process there may be clear strategic reasons why specific interventions that increase carbon should be chosen for the LTP pipeline of interventions to achieve the wider vision and objectives of the LTP.

Process at a glance: Step 3 -: Consider carbon in the generation and appraisal of interventions and policy options for an LTP

Appraising options should involve:

- Considering outputs from Step 1 (Chapter 3) and Step 2 (Chapter 4) when establishing a longlist of interventions and policy options. Alongside other local transport priorities this may include responding to where emissions are greatest, and the level of ambition required.
- When refining a longlist of options down to a shortlist, undertaking a light-touch qualitative or risk-based appraisal of carbon that considers both user emissions and infrastructure carbon impacts and strategic fit with the outputs of Step 1 and 2 (Chapter 3 and 4 respectively).

Process at a glance: Step 3 -: Consider carbon in the generation and appraisal of interventions and policy options for an LTP
• Once arrived at a shortlist, undertaking a quantitative assessment using the methods set out in Chapters 6 and 7. The findings of this assessment should inform further revision of the shortlist if needed.
Enabling: • Arrival at a shortlist of interventions and policies that will effectively deliver decarbonisation objectives, without the need for quantitative assessment of the full longlist. • Demonstration of how a quantified understanding of potential carbon impacts have been an integral part of the development and decision-making process of the LTP.

Table 14: Step 3 'at a glance' non-technical summary

Developing interventions (longlisting)

5.4 The generation of a longlist of policy and infrastructure interventions should consider the outputs of Steps 1 and 2 of this LTP carbon analysis process (Chapters 3 and 4 respectively). The baseline analysis from those steps will inform authorities as to what types of interventions, at what scale, may be required to reduce emissions within their influence within the timeframe set out by a local transport decarbonisation pathway. Figure 12 includes some examples of these QCR considerations. There is no 'one size fits all' solution however and local authorities will have different levers to pull to effectively deliver decarbonisation, depending on the characteristics of place.

5.5 Through options assessment, authorities should draw their own conclusions on what these interventions will be based on outputs from Steps 1 and 2 and their own local circumstances. However, authorities should consider all possible options to deliver a sustainable transport future and their role in decarbonisation. For further guidance on the measures places can consider to decarbonise, please see the Local Transport Plan guidance 2023.

5.6 Benchmarking datasets (Method B1 in Chapter 6) can provide an indication of the carbon impact of interventions, including those that will deliver the most effective reductions in user emissions. When considered alongside the potential scale of infrastructure carbon as indicated by infrastructure carbon benchmarks (Method C1 in Chapter 7) this can inform the likely net-impact interventions may have. Additional resources to support authorities in designing and implementing interventions can be found in the Local Authority Toolkit.

Option appraisal (shortlisting)

5.7 It is expected that initial option appraisal to refine a longlist to a shortlist will be predominantly qualitative or risk based in nature. Annex F of the Local Transport Plan Guidance 2023 sets out some of basic methods of qualitative analysis such as Multi-Criteria analysis or the Option Framework Filter. Authorities can decide to include carbon as part of the wider qualitive options assessment of longlisted and

shortlisted interventions or use these tools to consider carbon subsequently. Further guidance on appraisal methodologies can be found in the Green Book.

5.8 Whichever appraisal methodology authorities choose to refine a longlist to an initial shortlist, it is encouraged that an appraisal of carbon impact is 'unpacked' to consider the following:

- The compatibility of the intervention with ambitious reductions in user emissions, considering local conditions and any other local and regional strategies. This should consider the evidence of emission sources provided by Step 1 (Chapter 3) and the logic and ambition context provided by Step 2 (Chapter 4); and
- The likely scale of infrastructure carbon that may result from the option.

5.9 Table 15 below presents some suggested considerations of whether an intervention will support a carbon reduction and Net Zero.

Sub-criteria	Suggested considerations
User emissions	• To what extent will the intervention affect the transition to Zero Emission Vehicles? • To what extent will the intervention affect the use of public transport, active travel, and/or private vehicles? • To what extent will the intervention affect the modal-share of vehicles? • When considered in-combination with other policies and interventions to what extent might the intervention have a greater impact than it would in isolation?
Infrastructure carbon	• To what extent will construction of the intervention involve quantities of new material, their transportation and other construction processes? • To what extent will the intervention increase operational maintenance requirements? • To what extent will the intervention change the carbon intensity of operational highway maintenance activities?

Table 15: Suggested considerations for qualitative option appraisal

5.10 Quantitative methods set out in Chapters 6 and 7 can be used to provide further evidence where required. For example, if there is uncertainty as to which of two options will give greater carbon savings, benchmarks for user emissions and infrastructure carbon could be applied and inform the qualitative scoring within the option appraisal.

5.11 Once a shortlist of options has been selected, authorities should apply a quantitative assessment using the methods set out in Chapters 6 and 7. This will fulfil the need to understand the impact of the LTP in full and the extent to which the shortlisted interventions will support decarbonisation. Outputs of this assessment may then inform further refinement of the shortlist that is progressed to the LTP's intervention pipeline.

5.12 Figure 12 presents an example, idealised workflow of this process by which QCR analysis should inform the development of the LTP Strategy and Implementation Plan. This is not prescriptive but intended to illustrate how QCR Step 3 should influence corresponding phases of LTP development.

5.13 Authorities may additionally choose to consider how the effects of climate change will impact the transport system. This may include the choice of interventions associated with maintenance or improvements to improve climate resilience related to identified risks. Green Book guidance on 'Accounting for the Effects of Climate Change' sets out a process for considering the effects of climate change when appraising options when developing policies, programmes, and projects.

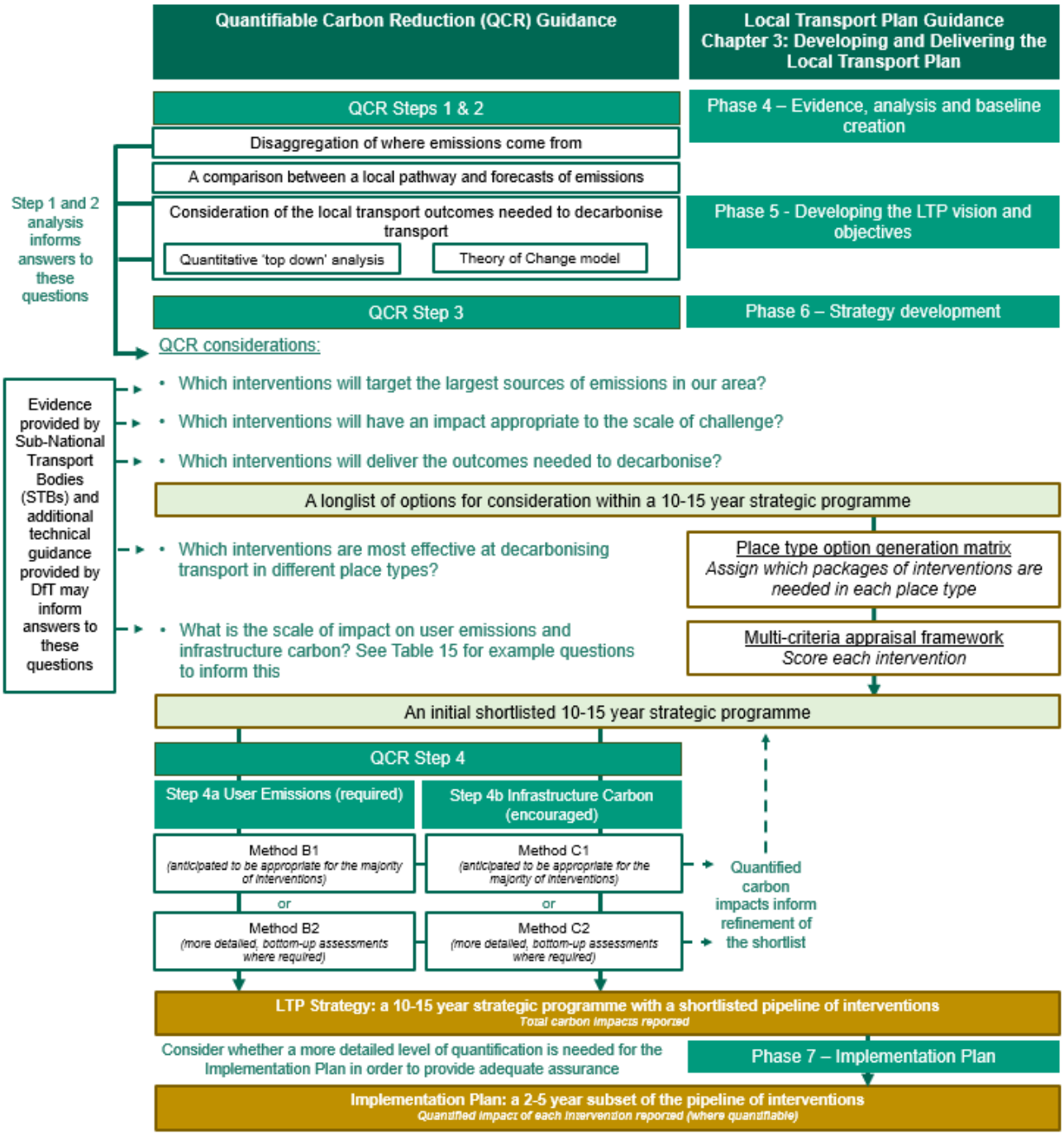

Figure 12: An example, idealised workflow for carbon analysis in LTP Strategy and Implementation Plan development

Question Number	Consultation Question
Q18	To what extent do you agree or disagree with the approach to considering carbon as part of the options assessment? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please provide an explanation for your answer including suggestions for improvement, if any.
Q19	What, if any, do you think are the main challenges for LTAs when considering carbon as part of the options assessment process?
Q20	In your view, does this Chapter effectively elaborate on the contents of the 'Local Transport Plan Guidance 2023' to provide further detail on factoring in QCR as a part of the LTP options appraisal process? ☐Yes ☐No ☐ Don't know If no, how could this chapter be improved?

6. Step 4a: Estimating Local Transport Plan Impact - User Emissions

6.1 Step 4 of the LTP carbon analysis process involves estimating the potential carbon impact of the LTP intervention programme. This step is split into two parts, 4a and 4b which relate to the estimation of user and infrastructure carbon impacts respectively. Primary to this should be understanding how interventions influence carbon emissions associated with transport users. This will inform the extent to which the LTP can deliver quantifiable carbon reductions overall across the local authority's portfolio, as established through Step 1 and 2 (Chapter 3 and 4 respectively).

6.2 This chapter describes Step 4a, setting out the methods that should be used to quantify the potential user emission impacts of LTP interventions. This involves quantification on a case-by-case basis of interventions included in the LTP strategic intervention pipeline/shortlist. These results can then be aggregated to understand the potential scale of impact of the LTP. Review of these results against a local decarbonisation pathway can support authorities in understanding whether the shortlist requires further refinement.

6.3 For consistent reporting between LTPs, the primary quantitative outputs of this Step should be reported as the metrics defined in Table 18 of this Chapter. These reporting metrics are distinguished as 'user emission impacts as a result of the LTP' (metric reference: UE-LTP), 'user emission impacts as a result of ZEV interventions' (UE-LTP-ZEV) and 'user emission impacts outside the scope of the guidance' (UE-OSG).

6.4 It is acknowledged that there are challenges and limitations associated with the estimation of user emission impacts of transport interventions at the LTP level. This Chapter provides guidance on how they can be overcome.

Process at a glance: Step 4a - estimating LTP impact on user emissions
Quantification of the user emission impacts of an LTP should involve: • In most cases, the use of simple benchmarks to estimate likely scale of user emission impacts from new interventions. • A focus on quantifying the changes in vehicle kms due to new interventions. • Conversion of vehicle kms to carbon emissions (tCO_2e) in a standardised way.
Enabling reporting of: • Quantifiable reductions in user emissions up to 2050 as a result of the LTP interventions. • To what extent LTP impacts contribute to decarbonisation of transport towards Net Zero.
Informing decision making and DfT assurance in relation to: • The choice of interventions put forward within an LTP and identification of which interventions will create a reduction in user emissions. • A final published LTP containing a pipeline of local interventions which have been planned, taking into account QCR as part of a wider set of priorities.

Table 16: Step 4a 'at a glance' non-technical summary

Scope of emissions

6.5 As set out in Chapter 3, quantified estimates of the impact of LTPs should consider resulting changes in user emissions. This impact may not be limited to the geographical boundary of the LTP in question: carbon impacts in other areas can be counted. Due to limitations in available methodologies, it is not expected that the proportions of carbon impacts resulting from an LTP can be disaggregated to geographical boundaries. It is accepted that this may result in some authorities over-estimating future emissions with the LTP in place, for example if the full impact of an intervention is spread over multiple authorities. It may also lead to some authorities under-estimating emissions, for example if an authority is unable to account for the impact of a relevant intervention delivered by a neighbouring authority. Where authorities can disaggregate such impacts, this can be reported and DfT will keep the evolution of methods under review and update this guidance as necessary.

6.6 Interventions delivered through an LTP will influence user emissions through several constituent transport impacts that affect carbon emissions. Those most likely to be relevant to an LTP are referenced in Table 17 with guidance on the proportionality of their quantification.

Transport Impact	Carbon effect	Guidance on scope
Changes in the composition of vehicle propulsion types	Changing carbon intensity per km travelled	Methods relating to ZEV uptake are currently being considered and further guidance will be provided at formal publication of this guidance.
Changes to modal-share by improving choice in travel options	Change in carbon through changes in vehicle kms	This will be a primary carbon effect of travel improvements delivered through an LTP (such as providing greater choice and encouraging the use of public and active transport). Proportionate methods to quantify this are set out in this guidance. As such it is expected this will be quantified where relevant.
Changes to vehicle occupancy	Change in carbon through changes in vehicle kms	Where relevant this should be quantified using available benchmarking data or bespoke calculations as appropriate.
Changes in traffic speeds, routeing, or journey lengths (construction and use stage)	Changing carbon intensity per km travelled; or Changing vehicle kms travelled	In most cases quantification will require traffic modelling to estimate carbon impacts of changing speeds, routeing or journey lengths. Quantification of this impact is likely to be applicable to interventions in the later stages of development where modelling outputs are available. It is acceptable not to quantify this impact as part of LTP development.
Induced demand to private vehicle	Increased carbon through change in vehicle kms	In most cases quantification will require traffic modelling to estimate carbon impacts due to induced demand. This would normally be expected to be accounted for in traffic forecasts where there is a change in travel cost (for example additional capacity allowing higher speeds) Quantification of this impact is likely to be applicable to interventions in the later stages of development where variable demand modelling outputs are available. It is acceptable not to quantify this impact as part of LTP development. Guidance in TAG Unit M2-1 should be considered where induced demand is calculated using variable demand modelling.

Table 17: Guidance on the scope of transport impacts

6.7 The scope of quantification of transport user emission impacts should focus on the transport impacts of relevance to the intervention in question, while considering proportionality. For example, the primary transport impact of interventions which

improve sustainable travel choices (for example by upgrading a cycle route) will be changes to the modal-share. Whereas for highway interventions, both changes in modal-share and induced demand should be quantified.

A tiered methodology

6.8 A tiered methodology has been provided to allow the assessment to be proportionate to the authority's capability and to reflect the data likely to be available at various stages of the intervention. The methods covered are:

- **Method B1** – Benchmarking; and
- **Method B2** – Bottom-up demand assessment.

6.9 For the majority of interventions, it is expected that Method B1 will be most appropriate when quantifying interventions at the earliest stages of development such as pre-SOBC or SOBC stage, owing to the lack of intervention-specific data at this level of maturity. Benchmarks can be applied across programmes without specific skills and with a negligible burden of time or cost. While the accuracy of a benchmarking method may be limited, it is considered appropriate for a strategic assessment of this nature; being primarily used to test options and understand the potential scale of reductions in user emissions.

6.10 Method B2 in contrast, requires authorities to quantify the carbon impact of an intervention via a bottom-up assessment using intervention specific data. Where an existing assessment of the transport impacts and/or the carbon effects of an intervention has been undertaken, this should be used. For example, analysis supporting an intervention business case, including assessment of carbon impacts, may be available in some cases.

6.11 For some intervention types there are existing tools that can be used to conduct this assessment. For more complex interventions, bespoke analysis may be required to estimate the carbon impact. The processes and data inputs however are similar.

6.12 Where suitable benchmarks are available authorities are required to apply Method B1, unless an existing and more accurate Method B2 assessment is already available and can be used instead. Authorities are encouraged where proportionate to apply Method B2 where Method B1 is not possible. Alternatively, Method B2 may be considered appropriate to apply to the Implementation Plan where a more detailed or accurate level of assessment is proportionate. Authorities may also choose to apply Method B2 or bespoke analysis to high impact interventions and policies or those with reputational risk. For interventions where the minimum standard is not met however, an explanation should be provided as to why. These circumstances are summarised in Table 18.

Circumstance	Required minimum standard	Advanced analysis (optional)
Benchmarking data or evidence is available for all interventions	Method B1 - apply the benchmark to basic scheme information Use outputs from existing Method B2 assessments where readily available	Method B2 where this is judged to be proportionate or necessary to provide a credible assessment or address a reputational or assurance risk Additional reporting mechanisms (Paragraph 6.37)
Not all interventions have a suitable benchmark or evidence base available	Apply Method B1 to interventions for which benchmarking evidence is available Use outputs from existing Method B2 assessments where readily available Describe the potential impact on the LTP wide reporting metrics of any interventions it has not been possible to quantify	Apply Method B2 to interventions where Method B1 is not possible or this is judged to be proportionate or necessary Additional reporting mechanisms (Paragraph 6.37)

Table 18: Quantifying LTP user emission impact: circumstances for applying Methods B1 and B2

Method B1 - Benchmarking

6.13 This benchmarking method uses existing evidence of the carbon impact of comparable interventions. Only a basic, concept level of information on the intervention to be quantified is needed to apply it to the benchmarks and estimate carbon impact.

6.14 This method should be used when data is limited or when the likely scale of impact does not justify an in-depth assessment. It is therefore anticipated this method will be most appropriate for the majority of interventions quantified as part of this QCR process. Its outputs however should be used as an order of magnitude estimate rather than a definitive change.

6.15 For formal publication of the guidance, Sub-National Transport Bodies (STBs) will provide a source of benchmark evidence that can be used by authorities to deliver this method. This work is currently in development and involves extensive reviews of available evidence on the impact different interventions might have on travel

demand. This evidence will be collated into a benchmarking resource provided to authorities as a tool.

6.16 An overview of the expected functionality of this tool is presented in Figure 13 below. The details of this method are subject to change.

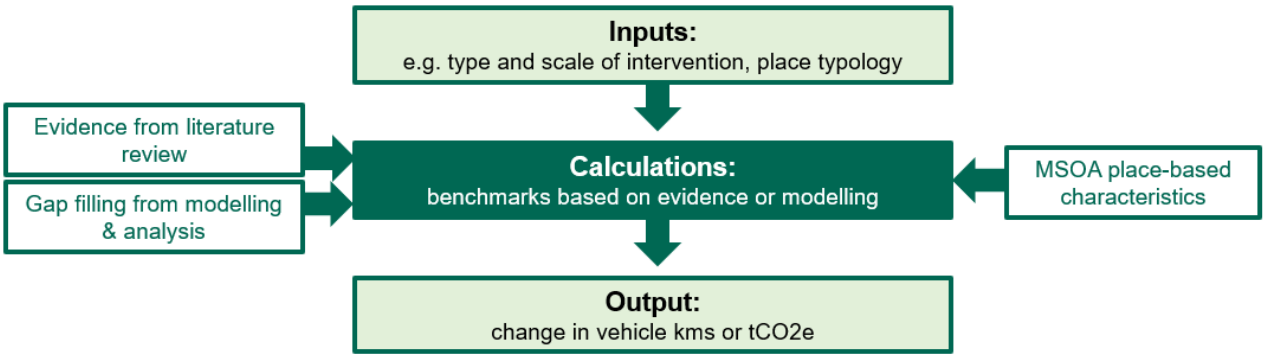

Figure 13: A conceptual overview of the Method B1 tool in development (details subject to change)

6.17 This resource / tool will be a first iteration when released with formal publication of this guidance. The quality and coverage of available evidence to develop these benchmarks is variable and benchmarks may therefore not be provided for all interventions and the quality of those benchmarks may not be suitable in all circumstances. Full functionality may also not be available in the first iteration (for example adjustments for impact by place type). The resource / tool will transparently reference the source and quality of evidence underpinning each benchmark and DfT and partners will seek to improve this evidence base in future iterations.

6.18 Authorities should evaluate the suitability of available benchmarks for quantifying the impact of their interventions. Other benchmarking sources (such as sources not formally promoted by DfT) where available can be used if authorities determine it will provide a more accurate assessment, but these sources should be clearly referenced. Where no suitable benchmark is available, authorities should consider applying Method B2.

6.19 Further details and guidance on Method B1 resources will be provided with formal publication of the guidance.

Method B2 - Bottom-up Assessment

6.20 Method B2 can only be employed for interventions where the impact on traffic use has been forecast at an appropriately disaggregate level, or where methods are available to forecast the change in emissions and it is proportionate to do so.

6.21 The four-phase process below can be used to quantify the carbon impact of an intervention. Phase 1 and 2 will only be required when no previous traffic assessment has been undertaken.

1. Estimate demand (without intervention)

2. Estimate change in demand (with intervention)

3. Quantify change in vehicle km (annual)

4. Convert change in vehicle km to carbon emissions (tCO_2e).

6.22 For interventions which have demand forecasts available in the form of an annual change in vehicle kms travelled, authorities only need to do Phase 4. Table 19 below shows the limited number of tools currently available which can be used to source this information.

Tool	Purpose	Output
Active Mode Appraisal Toolkit (AMAT) (TAG Unit A5-1)	The tool allows users to estimate the cost benefit ratio (BCR) of cycling or walking investment proposals	Carbon emissions (tCO_2e)
TUBA - Transport Users Benefit Appraisal	Cost - benefit analysis for multi-modal interventions with fixed or variable demand. Reliant on traffic model inputs to provide change in vehicle kms	Carbon emissions (tCO_2e) Estimate of change in vehicle kms

Table 19: Existing tools providing change in vehicle km as an output

6.23 A worked example using AMAT is provided in Table 20 below.

Worked Example: Delivery of a new cycle route (using existing tool)
• Base cycling demand is 5556 annual trips (derived from Census 2011 data). Comparative studies involving similar cycling infrastructure improvement measures have indicated the intervention could increase cycling trips by around 19%. This gives a future demand of 6612 trips. • The current and future number of trips, current and proposed cycling infrastructure for the intervention area, appraisal period, average length of a trip and other intervention details are input to DfT's AMAT. • The tool calculates the benefits of increased cycling trips, using Marginal External Costs (TAG Unit A5.4 - Marginal external costs). These decongestion benefits are presented in the Discounting worksheet of the AMAT. The reduction in car kilometres across the appraisal period (assumed 20 years) is calculated to be 5,743,000.

Worked Example: Delivery of a new cycle route (using existing tool)
• The total car kilometres removed are converted into carbon emissions (in tCO_2e) using emission factors from TAG data book (see Paragraph 6.30).

Table 20: Example of delivery of new cycle route

6.24 For interventions outside of the scope of these tools, authorities can draw upon bespoke analysis completed as part of an interventions business case where applicable. For example, an intervention providing cycling and bus improvements may have been assessed using an AMAT to calculate the changes in modal-share from car to cycling and bespoke calculations using TAG diversion factors to calculate the changes in modal-share from car to bus.

6.25 The number of tools which provide "vehicle km change" as an output is limited, so we encourage authorities to be innovative when coming up with ways to quantify interventions. Authorities should make best use of available tools, TAG dataset values and locally sourced empirical evidence to estimate an intervention's impact.

6.26 The Passenger Demand Forecasting Handbook (PDFH) or Moira modelling software can be used to estimate the change in demand for rail interventions whilst the Zero Emission Bus or Green Bus Model Spreadsheet can be used to estimate the carbon impacts of replacing diesel buses with zero emission buses. In some cases, data from transport operators such as public transport, car club or bike share providers can also be used to assess utilisation figures and evidence changes in the modal-share. For other transport interventions, elasticity factors will be required to represent the responsiveness of travel demand to delivery of the intervention.

6.27 This is not an exhaustive list, for some interventions it might be more appropriate to use a locally sourced benchmark to estimate the change in demand.

6.28 Bespoke calculations require a higher level of knowledge and time to carry out and, in some cases, might require specialist skills to ensure the outputs of the analysis are proportionate.

6.29 This level of bespoke analysis will only apply to a select number of LTP interventions, depending on the extent of development of that intervention or policy. The authority is not expected to complete this level of detailed assessment if existing studies are not available. An example of a bottom-up assessment using a bespoke method is provided in Table 21 below.

Worked Example - refurbishment of a bus station (bespoke method)
• The base demand is calculated using patronage data from bus operating companies. • A bespoke spreadsheet-based tool is developed to estimate the change in demand as a result of the upgrade to bus station facilities. The generalised journey time (GJT) on each bus service is determined. • GJT saving as a result of station improvements is calculated using Values of Time (VoT) from TAG Databook Table A1.3.1. Bus GJT elasticities provided by RAND in 'Bus fare and journey time elasticities and diversion factors for all

Worked Example - refurbishment of a bus station (bespoke method)
modes: a rapid evidence assessment' are used to estimate the change in demand. • The number of car kms removed as a result is calculated using Bus Diversion Factors from TAG Databook Table A5.4.6. This is projected to future years in the appraisal period using patronage growth assumptions. • The car kilometres removed per year are converted into carbon emissions (in tCO_2e) using emission factors from TAG Databook (see Paragraph 6.30).

Table 21: A worked example of a bespoke bottom-up assessment of a bus station refurbishment

Calculating carbon impact of changing vehicle kilometres travelled

6.30 Once an authority has estimated the change in vehicle kms (typically an annual change), this figure should be converted to carbon impact by the following methodology:

- Using proportions of car vehicle kilometres by fuel type (Table A1.3.9) and fuel consumption parameters (Table A1.3.11) expressed in litres/KWh per km from the TAG Databook the amount of petrol, diesel and electricity consumed for yearly v/km estimates can be calculated.
- The function $L = a/v + b + c.v + d.v^2$ used to estimate fuel consumption requires average speed (kms) per hour.
- Average speed can be obtained from Road Traffic Statistics, GPS derived data or transport model outputs. If a calculator tool is developed, the default average speed can be based on road statistics.
- Changes in tCO_2e (converted from kgs) can then be calculated using Table A3.3 Carbon dioxide emissions per litre of fuel burnt/kwh used).

6.31 This methodology allows annual changes in vehicle kms over the assessment period (Baseline to 2050) to be converted to tCO_2e using yearly TAG forecast fleet composition and fuel efficiency data. The methodology above refers to changes in vehicle kms from movements of people. Changes in vehicle kms associated with movements of goods can be calculated using LGV data forecasts.

6.32 For formal publication of the guidance, DfT will aim to provide a tool that delivers this process. As an input this will require only the yearly change in vehicle kms and as an output will provide yearly change in tCO_2e. Tools under development by STBs are also expected to include this functionality.

Question Number	Consultation Question
Q21	To what extent do you agree or disagree that the methods and approach presented will enable the quantification of the estimated user emissions impacts of the shortlisted LTP interventions? ☐ Strongly agree

	☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don’t know To help improve the guidance, please provide an explanation for your answer.
Q22	Which of the methods do you anticipate that an authority would be able to apply using this guidance? Select all the apply. ☐ Method B1 Benchmarking ☐ Method B2 Bottom-up assessment ☐ Neither ☐ Don’t know If ‘neither’, please provide an explanation for your answer.
Q23	Is there any further guidance or support that could be provided to help authorities to implement the user emission quantification methods proposed? ☐Yes ☐No ☐ Don’t know If yes, what additional guidance or tools would be helpful?

Additional reporting mechanisms

6.33 There are a number of challenges and limitations associated with the estimation of user emissions impacts of transport interventions at the LTP level as detailed below.

6.34 Methods presented in this guidance typically assess interventions in-isolation, from which it is expected they will be aggregated to indicate the impact of the whole intervention programme. This fails to account for interactions between interventions or policies. Quantitative estimates of intervention programmes may therefore not account for the full transport impacts and associated carbon effects. A transport model with the appropriate specification could, in principle, be used to assess an authority's whole programme and overcome this challenge. However, it is acknowledged that very few authorities will have access to such a model.

6.35 A large margin of error can be expected in some cases; particularly from Method B1 considering the variability in benchmark values from previous intervention assessments. It is expected this error margin will reduce in future assessments at the intervention level as the availability and quality of data improves. In accordance with the principle set out in PAS2080, the level of inaccuracy of assessment at an early

stage of strategy or an interventions development should not deter from its use to support decision-making, given it is at these early stages there is greatest potential to influence carbon outcomes.

6.36 The carbon impact of traffic flow changes (routing, congestion, speeds) cannot typically be captured at a strategic scale in the absence of traffic modelling. Similarly, where traffic outputs have been provided, the robustness of the carbon assessment is highly dependent on the validity of the traffic model.

6.37 Quantitative analysis may be supplemented by additional reporting mechanisms to address these challenges and limitations. This may include:

- An updated Theory of Change model - building on a model that may have been prepared in development of the LTP (see Chapter 4) to incorporate quantitative evidence and contextualise the influence of non-quantified factors on achieving a greater carbon reduction than quantified estimates may indicate; and
- Reporting against desired outcomes - where targets such as modal-splits are established, such as the examples set out in Chapter 4, and demonstrated to lead to quantifiable carbon reductions, the effectiveness of LTP interventions against these should be reported. It should be made explicit where interventions support these targeted outcomes and a quantitative assessment provided of whether these interventions are likely to be enough to achieve that outcome.

Reporting metrics

6.38 Quantitative outputs of this step of the LTP carbon analysis process should provide the key metrics referenced in Table 22. For further guidance on the format in which these metrics should be reported refer to Chapter 8.

Reference	Scenario	Status	Description
UE-LTP	Reductions in user emissions as a result of LTP	Required	An estimate of the reductions in user emissions that will occur because of the interventions put forward in the LTP. This does not include authorities influence on the uptake of ZEVs Reporting: • A total between the baseline year (2019) and 2050 • A yearly breakdown Applicable methods: B1, B2 What this includes: • The impact of interventions put forward in the LTP • Primary focus on carbon reductions achieved through changes to modal-share • Increased carbon emissions because of transport impacts such as induced demand, where relevant What this doesn't include: The impact of provision of ZEV charging infrastructure or other policies or interventions intended to enable or encourage ZEV uptake (to avoid double counting with Metric UE-LTP-ZEV)

Reference	Scenario	Status	Description
UE-LTP-ZEV	Reductions in user emissions as a result of ZEV interventions within LTP	Optional	An estimate of the reductions in user emissions that will occur because of interventions put forward in the LTP that enable or encourage ZEV uptake. This is to avoid any double counting of emission savings from national ZEV policies Reporting: • A total between the baseline year (2019) and 2050 • A yearly breakdown Applicable methods: benchmarks (Method B1) under development What this includes: • Interventions delivered as part of the LTP that enable or encourage the transition to ZEVs, such as provision of charging infrastructure What this doesn't include: A background pathway of ZEV uptake as influenced by national policies or market forces
UE-OSG	Reductions in user emissions outside scope of guidance	Optional	Estimated reductions in user emissions that have not been captured within another metric Reporting: • A total between the baseline year (2019) and 2050 • A yearly breakdown Applicable methods: any not referenced in this guidance

Table 22: User emission reporting metrics

6.39 As explained in Chapter 3 the Business-as-Usual forecast (UE-BaU), based on current TAG data, will not account for national bans on the sale of new ICEVs and is therefore likely to underestimate the pace of emission reductions resulting from ZEV uptake nationally. Therefore, to understand the extent to which the LTP can contribute to emissions reductions, the metric UE-LTP should be added to help visualise the distance to an illustrative decarbonisation pathway, as identified in QCR Step 2. Metric UE-LTP should be added to the 'accelerated ZEV uptake' scenario (UE-ZEV), based on CAS mileage split data, in order to illustrate the potential upper limit contribution that the LTP could deliver in-combination with ambitious ZEV uptake

supported by the successful delivery of local charging infrastructure and national policy. In order for this scenario of ZEV uptake to be credible, authorities must have a local EV charging strategy that supports the accelerated uptake of ZEVs.

6.40 Given the limitations of both the Business-as-Usual and 'accelerated ZEV uptake' (CAS) scenarios described above, authorities are encouraged where possible to present the impact of the LTP against a localised scenario of ZEV uptake. This can provide a more realistic and locally specific indication of emission reductions resulting from the LTP and national policies that accelerate the uptake of ZEVs. An illustrative example is presented as Figure 14 below.

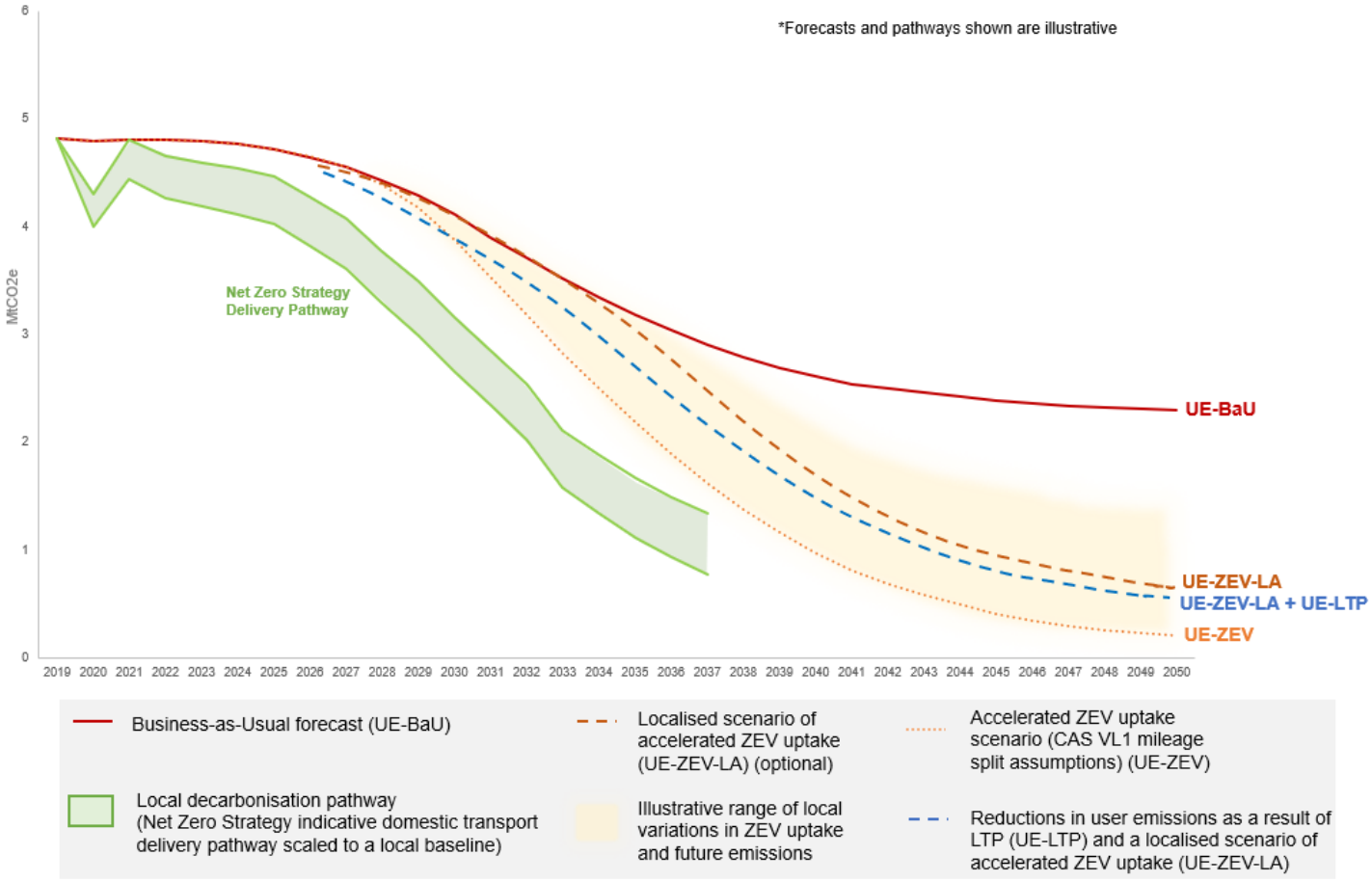

Figure 14: An example graph identifying the estimated impact of the LTP (illustrative)

6.41 The LTP's impact can also be measured against other scenario tests where prepared. As noted in Paragraph 3.23, the basis of any assumptions should be clearly set out and justified.

7. Step 4b: Estimating Local Transport Plan Impact - Infrastructure Carbon

7.1 As described in Paragraph 6.1, Step 4 of this LTP carbon analysis process involves estimating the potential carbon impact of the LTP intervention programme, split into two parts, 4a and 4b. This Chapter describes Step 4b and sets out the methods that should be used to quantify infrastructure carbon emissions. The infrastructure carbon of an intervention should be considered at the outset of the intervention's lifecycle when there is the greatest ability to influence carbon outcomes. This is illustrated in Chart 1C of the Infrastructure Carbon Review.

7.2 As stated in Chapter 2, authorities are encouraged, but not obliged, to quantify infrastructure carbon. However, doing so will enable LTPs to be shaped accordingly and thereby maximise the impact of an LTP on the decarbonisation of the economy as a whole towards Net Zero. Where infrastructure carbon has not been quantified, an explanation as to why should be provided.

7.3 The principles of this guidance align with the carbon management guidance provided in PAS 2080 (and associated carbon assessment standards BS EN 15978:2011 and BS EN17472:2022 and the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment, 2017).

7.4 The guidance provided in this Chapter is intended for the strategic / concept stage quantification of infrastructure carbon. For guidance on interventions at later development stages refer to the 'Guidance for the application of GHG Scope 1 & 2 in Local Highways Authorities' and 'Guidance for the application of GHG Scope 3 in Local Highways Authorities' (to be released in the second half of 2022/23) by ADEPT, and the guidance and standards referenced above.

7.5 For consistent reporting between LTPs, the primary quantitative outputs of this Step should be reported as the metrics defined in Table 24 of this Chapter. These reporting metrics are distinguished as 'infrastructure carbon impacts as a result of the LTP' (metric reference: IC-LTP), 'reductions in LTP infrastructure carbon impact as a result of carbon management' (IC-CM), 'highway maintenance emissions' (IC-HM), 'reductions in highway maintenance emissions as a result of the LTP' (IC-LTP-HM) and 'reductions in infrastructure carbon outside scope of this guidance' (IC-OSG).

Process at a glance: Step 4b - estimating LTP impact on infrastructure carbon
Quantification of infrastructure carbon should involve: • A focus on product, construction, and operational maintenance carbon emissions. • The use of simple benchmarks (under development by DfT) to estimate the likely scale of impact from proposed infrastructure interventions and baseline maintenance of existing infrastructure. • Where existing detailed assessments based on material quantities are available, these can be used instead of benchmarks. • Estimating how any portfolio wide carbon management initiatives will lower the carbon impact of construction and maintenance.
Enabling reporting of: • Infrastructure carbon impact of the LTP - at an intervention and portfolio level, separately to user emission impacts. • Total emissions from maintenance of existing infrastructure in current year and up to 2050. • Reductions in construction and/or maintenance carbon impacts because of committed measures and/or the LTP.
Informing decision making and DfT assurance in relation to: • The choice of interventions put forward within an LTP; considering the potential scale of infrastructure carbon impact and how it may compare to user emissions reductions. • The need to include measures within an LTP to reduce the infrastructure carbon impact of proposed interventions and maintenance.

Table 23: Step 4b 'at a glance' non-technical summary

Scope of emissions

7.6 A summary of the key infrastructure carbon categories referred to in this guidance is provided in Figure 15.

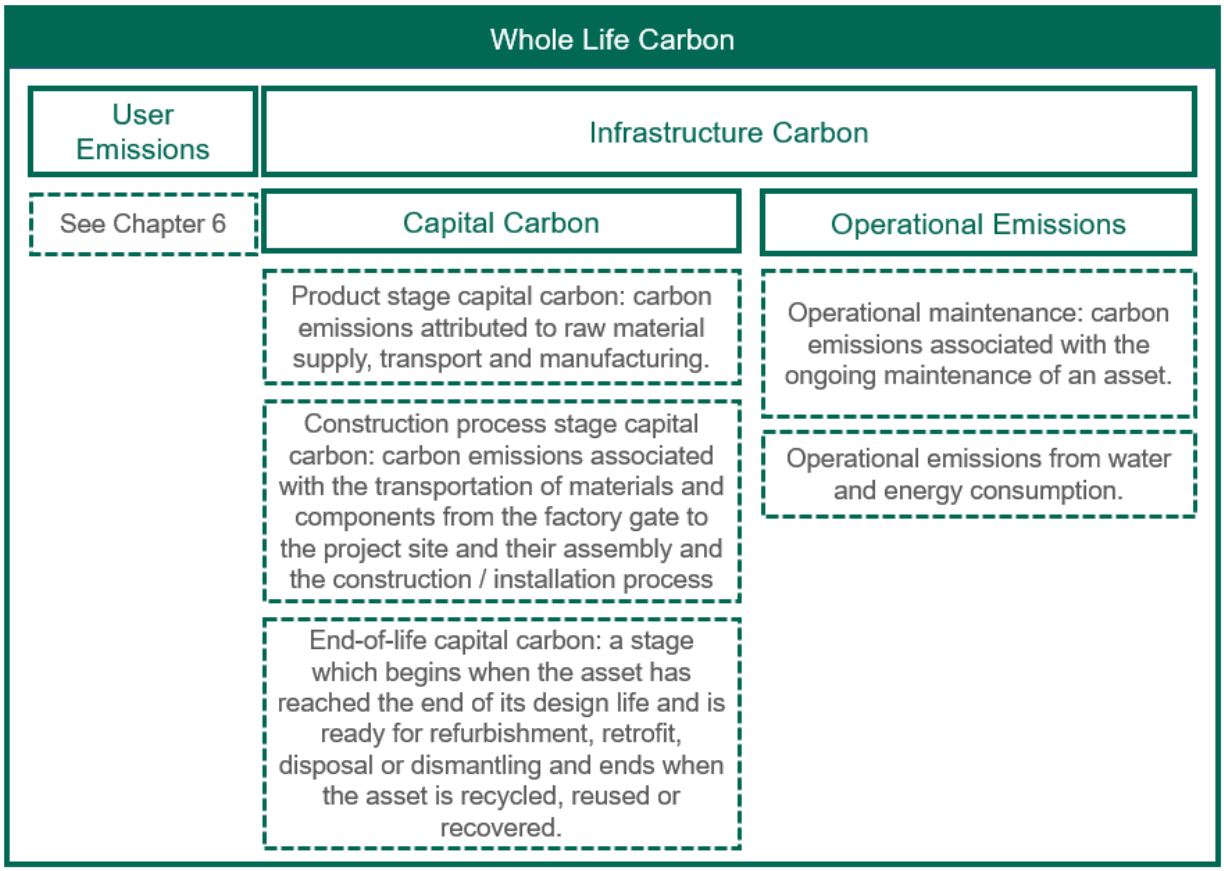

Figure 15: Categories and definitions of Infrastructure Carbon

7.7 It will not be possible to fully assess all sources of infrastructure carbon associated with an LTP, as, for example, many of the interventions will be at an early stage of development. The scope of the assessment should focus on those sources of greatest significance and a rationale reported where the scope deviates from the guidance in Table 24 below.

7.8 When considering the scope of infrastructure carbon quantification, a distinction is made between the following intervention typologies:

- **New interventions** - interventions that involve new infrastructure outside of the boundary of the existing highway or railway, or significant widening;
- **Improvements or refurbishment interventions** - alterations to existing infrastructure that is already subject to operational maintenance; and
- **Existing infrastructure** - existing infrastructure that is subject to maintenance under the authority's control.

7.9 Table 24 below sets guidance on the recommended scope of quantification for each of the intervention typologies.

Lifecycle Stage	Infrastructure Carbon Category	LTP Interventions - New Intervention	LTP Interventions - Improvements or Refurbishments	**Existing Infrastructure**
Construction	Product Stage	Encouraged	Encouraged	N/A
Construction	Construction Process Stage	Encouraged	Encouraged	N/A
Operation	Operational maintenance carbon	Encouraged	Optional	Encouraged
Operation	Operational consumption of water and energy carbon	Not Required	Not Required	Not Required
Operation	End of life carbon	Not Required	Not Required	Not Required

Table 24: Estimating Local Transport Plan Impact (Infrastructure Carbon) – scope of quantification

7.10 This recommended scope reflects that in most cases the construction stage is a significant source of carbon for all infrastructure interventions. For improvement or refurbishment interventions however, operational maintenance would largely occur in the absence of the intervention (a 'do-nothing' scenario), and improvements or refurbishments are therefore unlikely to result in a significant change in operational maintenance emissions. An example is provided in Table 25.

Type of intervention	**New intervention**	**Improvement or refurbishment**	**Existing infrastructure**	**Existing infrastructure**
Examples:	**Bypass**	**Segregated cycleway within existing highway**	**Baseline maintenance**	**Routine highway resurfacing switch to using low temperature asphalt**

Type of intervention	New intervention	Improvement or refurbishment	Existing infrastructure	Existing infrastructure
Carbon impacts in a 'do-nothing' scenario	No significant impacts	Operational maintenance carbon from existing highway	Operational maintenance carbon from existing highway	Operational maintenance carbon from existing highway
Carbon impacts in a 'do-something' scenario	Construction -product stage and construction process capital carbon Operational maintenance emissions	Construction - product stage and construction process capital carbon Change in operational maintenance (minimal)	Operational maintenance from existing highway (same as 'do-nothing' scenario)	Change in operational maintenance carbon (a lower carbon impact)
Recommended scope to quantify	Construction stage capital carbon Operational maintenance	Construction stage capital carbon	Operational maintenance carbon (baseline 'do-nothing')	Operational maintenance carbon (do-nothing) Operational maintenance carbon reduction (difference between do-nothing and do-something)

Table 25: An example of key impacts and a proportionate scope of quantification for each intervention typology

7.11 Guidance on methods for quantifying 'not required' categories listed in Table 24 (for example end of life and water and energy consumption) is not provided. Where these are quantified, the methods used should be reported in accordance with the guidance provided in Chapter 8.

7.12 A large proportion of the infrastructure carbon within this scope will, at source (for example energy generation or material manufacture), be emitted outside the geography of the authority. As emissions within the influence of the authority they should however be quantified as an impact of the LTP.

Quantifying the impact of LTP interventions

A tiered methodology

7.13 A tiered methodology for assessing proposed LTP interventions has been provided to allow for the assessment to be proportionate and to reflect the level of data likely to be available at various stages of intervention's development. The two methods covered are:

- Method C1. Benchmarking; and
- Method C2. Material estimate derived quantification (bottom-up).

7.14 As with Method B1 in Chapter 6, for the majority of interventions it is expected that a benchmarking method (Method C1) will be most appropriate when quantifying interventions at pre-SOBC or SOBC stage, owing to the lack of intervention-specific data of proposals at this level of maturity. Benchmarks can be applied across programmes without specific skills and with a negligible burden of time or cost. While the accuracy of a benchmarking method may be limited, and outputs may not identify a breakdown of emission sources, this method is considered sufficient to support analysis in developing the LTP (both in terms of option development and to assess the potential scale of impact of the programme).

7.15 Method C2 is typically adopted during later intervention development stages where greater definition of intervention's details is available. It requires bottom-up estimation of material quantities that can be obtained through the cost estimation process. Processing of such estimates for their use in carbon quantification tools (for example the National Highways carbon tool) can however be time consuming and may require specialist skills. As such, only high-level guidance on this method is provided here.

7.16 Where suitable benchmarks are available authorities are encouraged to apply Method C1. For interventions where no assessment has been prepared, an explanation should be provided as to why. Authorities are encouraged, where possible, to apply Method C2 where Method C1 is not possible. Alternatively, Method C2 may be considered appropriate to apply to the Implementation Plan where a more detailed or accurate level of assessment is proportionate or might support imminent scheme development activities. Authorities may also choose to apply Method C2 to high impact interventions and policies or those with reputational risk. These circumstances are summarised in Table 26.

Circumstance	Encouraged minimum standard	Advanced analysis (optional)
Benchmarking data or evidence is available for all interventions	Method C1 - apply the benchmark to basic scheme information Use outputs from existing Method C2 assessments where readily available	Method C2 where this is judged to be proportionate or necessary to provide a credible assessment or address a reputational or assurance risk Analysis of interventions to reduce infrastructure carbon
Not all interventions have a suitable benchmark or evidence base available	Apply Method C1 to interventions for which benchmarking evidence is available Use outputs from existing Method C2 assessments where readily available Describe the potential impact on the LTP wide reporting metrics of any interventions it has not been possible to quantify	Apply Method C2 to interventions where Method C1 is not possible or Method C2 is judged to be proportionate or necessary Analysis of interventions to reduce infrastructure carbon

Table 26: Quantifying LTP infrastructure carbon impact: circumstances for applying Methods C1 and C2

Method C1. Benchmarking

7.17 Benchmarks provide an indication of the carbon impact of an intervention against key metrics such as cost or functional unit (length, area etc). Benchmarks are based on high-level sector or industry average data and as such can be considered a 'top-down' method. Benchmarks provide a quick and simple method to estimate carbon impact with only basic intervention details.

7.18 The inputs required are suitable benchmarks and basic intervention information. DfT aims to work with local authorities and partners to develop benchmarks suitable for the context of Local Transport Plans. In addition to these benchmarks, authorities will require an estimated unit, such as intervention length or cost. Benchmarks will be developed to include construction and maintenance impacts to support the scope of quantification encouraged in Table 24.

7.19 The process for applying benchmarks involves multiplying the benchmark value by the intervention unit (for example length or cost) to provide an estimate of the infrastructure carbon impact. An illustration of this process is provided in Figure 16 below.

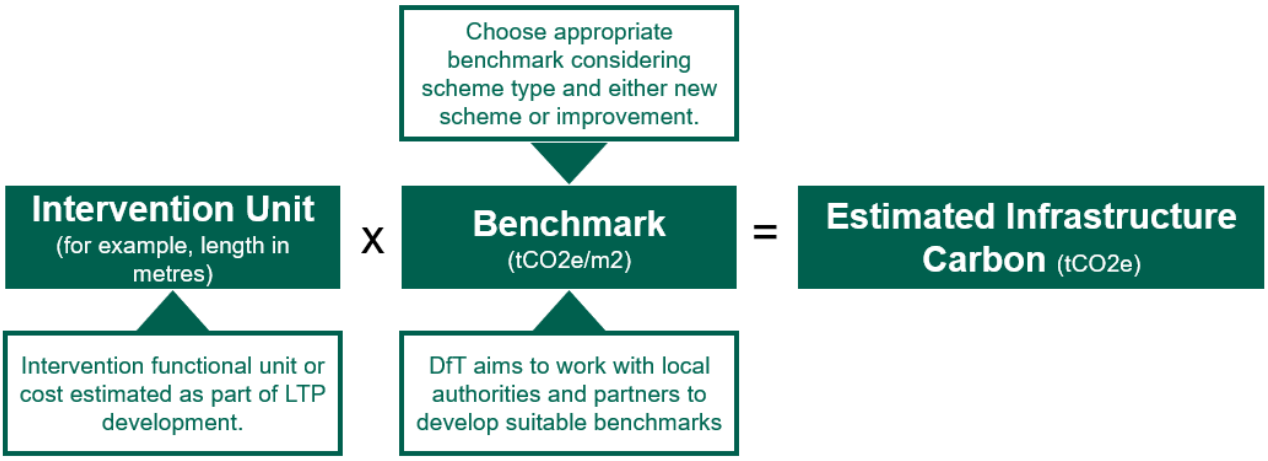

Figure 16: Illustrative process for applying infrastructure carbon benchmarks

7.20 The cost and benchmark used should be recorded in line with guidance provided in Chapter 8.

7.21 Benchmarking should be applied to estimate those impacts referred to as 'encouraged' in Table 24. Benchmarking (Method C1) is expected to provide sufficiently robust estimates in all circumstances, although Method C2 should be used if available.

Question Number	Consultation Question
Q24	In your view, would interventions be at a sufficient level of development as part of your LTP to establish the functional units (for example intervention length) needed to apply infrastructure carbon benchmarks? ☐All will ☐Some will ☐None will ☐ Don't know If you have selected 'none will', please explain why?

Method C2. Material estimate (bottom-up) derived quantification

7.22 Detailed estimates of infrastructure carbon can be derived from a breakdown of estimated material quantities and other intervention details (for example distances materials are transported) against which carbon factors are applied. This methodology provides an intervention-specific and more accurate estimate than is possible with benchmarking but requires more detailed information on materials and

activities. More detailed guidance can be found in BS EN 15978:2011 and BS EN17472:2022 and the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment, 2017.

7.23 The inputs required are estimates of material quantities and key activities required to deliver the infrastructure. This information is typically prepared for intervention cost plans / bills of quantities and should be consistent with these cost estimates.

7.24 The process for Method C2 involves applying carbon factors to material and activity data in order to calculate the carbon impact. This can be executed through tools such as the National Highways Carbon Tool and Rail Safety and Standards Board (RSSB) Rail Carbon Tool. These tools can consider construction stage capital carbon and can be used to quantify operational maintenance carbon where assumptions on maintenance requirements are available as an input. Separate calculations may be needed for impacts such as construction process emissions or operational impacts, such as energy consumption.

7.25 This method will provide an estimate of total infrastructure carbon emissions based on the scope of input data provided. For example, if only quantities of construction materials are used, the scope of quantification will be product stage capital carbon only. Additionally, this method can provide a breakdown of emissions against materials and activities.

7.26 Outputs should be provided in tCO_2e and a breakdown provided against the categories referenced in Figure 15. See Chapter 8 for further guidance on reporting.

7.27 Authorities may choose to utilise this method where a more accurate, intervention-specific assessment is required, and it is proportionate to do so. For example, for an intervention that is expected to have a large infrastructure carbon impact and where the required material estimates are already available. Outputs of this method can also support, and may have already been developed for, business case requirements and to provide a baseline for carbon management plans.

Quantifying maintenance of existing infrastructure

7.28 Ongoing maintenance of the existing road network can represent a significant source of operational carbon within an authority's control. An estimate of these emissions should be made to understand their scale and inform potential measures to reduce this impact. Where measures to reduce the carbon impact of maintenance are put forward in an LTP and can be quantified, these savings can be reported alongside a baseline estimate of maintenance emissions up to 2050.

Method C3. A baseline estimate of highway operational maintenance carbon

7.29 An indicative estimate of baseline maintenance emissions can be prepared using a simple methodology based on DfT road length statistics and area-based benchmarks for highway maintenance (for example 1m^2 of resurfacing = X tCO_2e). An illustrative example of this method is provided in Figure 17 below. Benchmarks and more detailed development of and guidance on this methodology will be provided in the final version of this guidance.

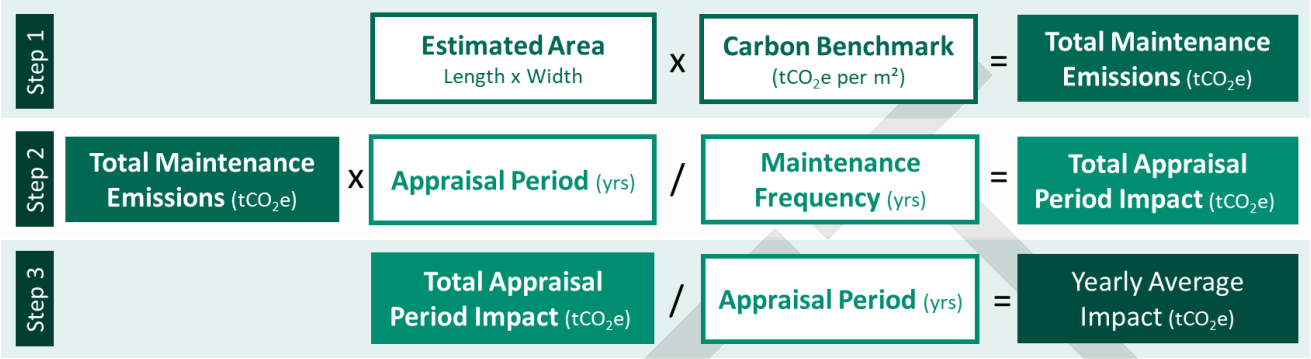

Figure 17: Method C3 using DfT road length statistics and benchmarking data

7.30 This methodology will capture the impact of resurfacing existing highway. It is acknowledged that the impact of operational maintenance within an authorities' control will include other works that will generate additional impact, such as bridge maintenance. Authorities are encouraged to estimate additional impacts where possible.

7.31 Methods to prepare this baseline estimate of infrastructure carbon associated with maintenance of the existing highway may also include:

- Carbon reporting provided by maintenance contractors; and
- Use of condition survey and data relating to the frequency of maintenance works.

7.32 Where such methods are used a summary of the methodology and any key assumptions should be provided in line with the reporting guidance in Chapter 8.

Accounting for reductions in infrastructure carbon

7.33 Benchmarks applied using Method C1 and C3 will assume conventional construction materials and techniques. The quantified estimate derived from these methods (or Method C2) and reported as Metric IC-LTP will therefore represent an early-stage, indicative estimate in the absence of any existing or proposed carbon management measures.

7.34 Where an authority's intervention will reduce infrastructure carbon impacts and can be evidenced, this reduction can be accounted for within Metric IC-CM. This will enable insight to the potential scale of infrastructure carbon with the LTP in place, including any measures that lower that impact. Potential carbon management measures and how they should be accounted for are set out in Table 27 below. A summary of the metrics referenced can be found in Table 29.

Measures or scenarios	Example	Can this be accounted for in reported metrics?
Alternative choices of intervention types of designs	Selection of a bus improvement intervention over a bypass intervention	**No** - such decisions should not be accounted for as a carbon management measure and associated carbon saving but will influence the overall reported emissions in Metric IC-LTP
Carbon reduction targets	A targeted 50% reduction in capital carbon, either for a specific intervention or across a portfolio	**No** - this is aspirational rather than a committed measure and should be dealt with in later development stages of the intervention
Intervention-specific carbon management measures	Commitment to use of low-carbon concrete in the design of a single cycle intervention	**Yes** - where this is a committed measure and can be quantified using Method C2
Existing portfolio-wide measures	Design standards have been updated to require use of recycled aggregates across all construction and maintenance	**Yes** - through Metric IC-LTP and IC-HM as applicable and where this can be evidenced
Portfolio wide measures proposed in the LTP	Proposed use of lower temperature asphalt in the construction of all LTP interventions	**Yes** - through Metric IC-CM and IC-LTP-HM as applicable and where this can be evidenced
Future scenarios	Background trends out of an authority's direct control, such as decarbonisation of the energy grid	**No** - these are measures outside of an authorities control and should therefore not be accounted for as reductions. They can be reported separately if desired

Table 27: Measures to reduce infrastructure carbon and where to account for these in reporting

Example - quantifying committed carbon management measures
The total infrastructure carbon impact of the LTP intervention programme has been estimated as 200,000 tCO_2e. For the majority of interventions this has been calculated predominantly using Method C1, while estimates for a small number of interventions are based on Method C2 where this method had already been applied during previous development of interventions. Benchmarks used as part of Method C1 assume 'standard' materials and techniques, including conventional hot mix asphalt. The authority has updated standards to require lower temperature asphalt across all construction and maintenance. Evidence shows it can be expected to reduce the carbon impact associated with use of asphalt by 10% on average (illustrative only). Calculations based on Method C1 benchmarks indicate hot rolled asphalt is responsible for 40% of emissions (varying for different intervention type benchmarks) - resulting in 80,000 tCO_2e across construction and maintenance associated with the LTP. A reduction of 10% from 80,000 tCO_2e equates to a carbon saving of 8,000 tCO_2e. This is recorded as metric IC-CM. This indicates that the likely scale of infrastructure carbon with the LTP in place will be 192,000 tCO_2e. ***Note: Figures used in this example are illustrative only.***

Table 28: Example of quantifying committed carbon management measures

Key considerations when interpreting results

7.35 The estimates of infrastructure carbon prepared as part of this analysis, particularly with Method C1, may have a high degree of uncertainty. In many cases it will present a worst-case picture in the absence of any later measures that might be utilised to reduce infrastructure carbon impacts (for example choice of low-carbon materials) or relevant background trends (for example decarbonisation of the energy grid). In other cases, it may present an under-estimate in the absence of full knowledge of all activities involved in the construction and maintenance of an intervention.

7.36 As such, the results should be reported separately to user emission estimates. Estimates of infrastructure carbon should be used to support an understanding of its potential scale in comparison to the estimated scale of reductions in user emissions and support identification of measures to minimise infrastructure carbon impacts. With this perspective, the choice of interventions put forward within an LTP should be reviewed with a view to minimise the scale of infrastructure carbon impacts while considering trade-offs with other strategic priorities.

7.37 It is not expected at this stage and for the reasons set out above, that all interventions will 'pay-back' construction stage capital carbon with operational user emission reductions. The estimated infrastructure carbon impact of individual interventions and the shortlisted programme as a whole should be treated as a baseline: an indication of the potential scale of impact which carbon management

measures in later stages of the intervention's development will seek to reduce. However, an increasing majority of interventions will need to make net positive contributions to decarbonisation in the near future.

Reporting metrics

7.38 Quantitative outputs of this step of the LTP carbon analysis process should provide the key metrics referenced in Table 29. For further guidance on the format in which these metrics should be reported refer to Chapter 8.

Reference	Scenario	Status	Description
IC-LTP	Infrastructure carbon impact of the LTP	Encouraged	A high-level estimate of the potential scale of infrastructure carbon resulting from the LTP Applicable methods: C1 and C2 What this includes: • Interventions put forward through the LTP • Construction and maintenance emissions as proportionate on an intervention basis (see Table 26) • Existing and committed carbon reduction measures where the impact can be evidenced What this doesn't include: • Maintenance of existing infrastructure • Historic interventions not included in the LTP • Carbon reduction targets • Carbon reduction measures proposed in the LTP • Operational energy consumption

Reference	Scenario	Status	Description
IC-CM	Reductions in LTP infrastructure carbon impact as a result of carbon management	Optional	The estimated reduction in the infrastructure carbon impact of proposed LTP interventions as a result of any carbon management interventions proposed in the LTP Applicable methods: C2 and bespoke methods What this includes: • Portfolio wide carbon management initiatives (for example use of lower temperature asphalt) included in the LTP that will be applied to the development of interventions. What this doesn't include: The difference between alternative intervention types or designs (for example the carbon saving from choosing a single lane carriageway bypass instead of two lane)

Reference	Scenario	Status	Description
IC-HM	Highway maintenance emissions	Encouraged	A high-level baseline estimates of current and future emissions associated with maintenance of the existing highway network within an authority's control Applicable methods: C3 and bespoke methods. This should be a proportionate, high-level estimate using readily available data What this includes: • The existing road network that the authority is responsible for maintaining • Routine resurfacing of the highway. Other maintenance activities can be included but this is not required What this doesn't include: • Carbon reduction measures proposed in the LTP • The influence of future scenarios such as energy grid decarbonisation or fleet decarbonisation • Maintenance of infrastructure other than local authority highways. This should be reported separately if quantified

Reference	Scenario	Status	Description
IC-LTP-HM	Reductions in highway maintenance emissions as a result of the LTP	Optional	The estimated reduction in the carbon impact of maintenance of the existing highway because of carbon management interventions proposed in the LTP Applicable methods: bespoke calculations What this includes: • Portfolio wide carbon management initiatives included in the LTP that will be applied to the maintenance of the existing highway network What this doesn't include: • Increases in maintenance emissions that might result from additional maintenance funding • Carbon reduction targets (such as a percentage target)
IC-OSG	Reductions in infrastructure carbon outside scope of guidance	Optional	Estimated reductions in infrastructure carbon that have not been captured within another metric. For example, reductions in operational energy consumption from upgrading highway lighting to LEDs Applicable methods: any not referenced in this guidance and/or that are not relevant to another metric

Table 29: Infrastructure carbon reporting metrics

7.39 All infrastructure carbon metrics referenced in Table 29 should be reported as a total impact between the baseline year (see Chapter 5) and 2050. Assumptions on construction start dates, durations and maintenance frequencies can be made to profile infrastructure carbon on a yearly basis if desired.

Question Number	Consultation Question:
Q25	To what extent do you agree or disagree with the recommended scope of infrastructure carbon analysis put forward in this chapter? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know To help improve the guidance, please provide an explanation for your answer.
Q26	Which of the methods do you anticipate that an authority would be able to apply using this guidance? Select all the apply. ☐ Method C1 Benchmarking (infrastructure carbon) ☐ Method C2 Material estimate derived quantification ☐ Neither ☐ Don't know If you have selected 'neither', please explain why.
Q27	Do you currently have access to any carbon infrastructure benchmarks that you could use when estimating the infrastructure carbon associated with proposed interventions in your LTP? ☐ Yes ☐ No ☐ Don't know If yes, what are these sources?
Q28	In your view, is there any further guidance or support that could be provided to help authorities to implement the infrastructure carbon quantification methods presented? ☐ Yes ☐ No ☐ Don't know If yes, what additional guidance or tools would be helpful?

8. Reporting

8.1 This Chapter provides guidance on how outputs from this LTP carbon analysis process should be reported. This reporting should be published in or alongside the Local Transport Plan and be made publicly available to be referenced in support of business cases or future funding opportunities.

Metric reporting requirements

8.2 The metrics that should / can be reported as an output of this LTP carbon analysis process are described in Chapters 5, 6 and 7. A summary is provided in Table 30 below.

Required	Encouraged	Optional
UE-BaU Business as Usual	**IC-LTP** Infrastructure Carbon impact of LTP	**UE-LTP-ZEV** Reductions in user emissions as a results of ZEV interventions within LTP
UE-ZEV Accelerated ZEV uptake based on the Common Analytical Scenarios	**IC-HM** Highway maintenance emissions	**UE-OSG** Reductions in user emissions outside scope of guidance
UE-LTP Reductions in user emissions as a result of LTP	***UE-LTP-LA*** Localised scenario of accelerated ZEV uptake	**IC-CM** Reductions in LTP infrastructure carbon impact as a result of carbon management
Empty cell	*Empty cell*	**IC-LTP-HM** Reductions in highway maintenance emissions as a result of LTP
Empty cell	*Empty cell*	**IC-OSG** Reductions in infrastructure carbon outside scope of this guidance.

Table 30: Summary of requirements for reporting metrics

8.3 A graph must be provided to visualise the predicted change in user emissions within the geography of the LTP. This should include metrics UE-BaU, UE-ZEV and UE-LTP (measured against UE-BaU). An example is provided as Figure 14 in Chapter 6.

8.4 Where additional scenarios or pathways have been prepared these should be presented on a separate graph. This may include alternative Business-as-Usual or accelerated ZEV uptake forecasts, local decarbonisation pathways or Net Zero commitments.

Reporting format

8.5 The outputs of the QCR process will have been a key factor in the decision-making for the LTP. As such, these outputs and conclusions should be presented in the final published plan documents in support of the vision of the LTP and a clear articulation of the quantifiable impacts of the plan. For further information for the wider content, considerations and presentation of the LTP and Implementation Plan, please refer to the Local Transport Plan Guidance 2023.

8.6 With respect to carbon authorities are encouraged to report QCR analysis and outputs within the four key documents summarised in Table 31. The recommended carbon detail to be included in each is provided in the paragraphs 8.6 to 8.9.

Document	Document purpose	Time period	When to update
LTP Strategy	A public facing integrated and sustainable transport strategy which articulates a clear vision and set of objectives drawn from a robust evidence base. Provides a clear strategic case for a shortlist of interventions (policies and infrastructure) published in the plan and spanning the period of the plan.	10-15 years	See LTP guidance
Implementation Plan	Presents a pipeline of interventions formed as a sub-set of the shortlist of interventions presented in the LTP Strategy. Interventions that can be delivered in the next 2-5 years (if funded) are broken down into greater detail.	2 – 5 years	After each plan period

QCR workbook	An Excel tool / template (in development by DfT) to assist authorities with collating and presenting core QCR outputs in a transparent and consistent format. This may also support any future assurance of LTPs.	Matching the LTP plan period (for example 10-15 years)	When the LTP is updated
QCR methodological statement	To provide sufficient transparency to assist the public, stakeholders and DfT to understand the process and methodology that has been followed, the extent to which results are considered credible and any implications this has for decision-making.	N/A	When the QCR workbook is updated

Table 31: Recommended formats to report QCR analysis

8.7 Authorities are strongly encouraged to report the headline findings of the QCR process within their LTP Strategy which presents the final vision for a place, including the strategic case for interventions. Decarbonisation should be a key priority in this case for change and, through the QCR process, have shaped decision-making and the shortlisted strategic pipeline of interventions included in the LTP. As a strategic document this need only include the highest tier of carbon outputs and narrative but as a minimum it is expected would include:

- LTAs should provide adequate carbon context where suitable in their LTP strategy, using the outputs developed through the QCR process. This should include key statistics, graphics and narrative relating to current and future emissions (Step 1) and a local transport decarbonisation pathway (Step 2). This should also include the graph referenced in paragraph 8.4. Where available, the disaggregation of emission sources in the geography of the LTP should also be presented.
- The estimated carbon impact of the shortlisted LTP interventions (where quantifiable), compared to the baseline estimates of future emissions. This impact should be reported in $MtCO_2e$ over a timescale at least over the LTP period (for example 10-15 years). It should also include an overall, aggregated estimate of the carbon impact of the LTP programme (assuming interventions were to be funded and delivered in full).
- A high-level summary of the QCR process that has been followed and how this has influenced the development of the LTP.

8.8 The Implementation Plan provides a more detailed breakdown of the intervention, policies and infrastructure that an authority would aim to deliver in the next 2-5 years. This will be a sub-set of the strategic programme set out in the LTP Strategy but provide further details for each intervention. For further guidance on content of the Implementation Plan, including a basic illustrative example, please refer to the Local Transport Plan Guidance. In the Implementation Plan, the estimated carbon impact of each intervention should be provided, for example by including an ‘estimated

carbon impact' column (or multiple if infrastructure carbon is also quantified). The estimated carbon impact should be reported up to the end of the Implementation Plan, over the LTP period and a speculative projection up to 2050.

8.9 For formal publication of the guidance DfT will provide a workbook to assist authorities with collating and presenting core QCR outputs. This is likely to include a consistent structure within which key outputs can be populated and functionality to auto-generate graphical outputs. Authorities are strongly encouraged to use this template and publish it

8.10 Authorities are also encouraged to prepare a supplementary QCR methodological note to record any divergence from the methodology or assumptions set out in this guidance. This statement will assist authorities if they wish to revisit their analysis or to inform future LTP development. As with the QCR workbook, authorities are encouraged to publish this note for transparency and as a contribution to a growing shared evidence base of data and methods for quantifying local transport carbon impacts at a strategic level. Authorities should work to assure their own data analysis, assumptions and methods.

Question Number	Consultation Questions
Q29	In your view, are there any issues with presenting the outputs of this LTP carbon analysis in the format described, if so, what are they?
Q30	In your view, what additional guidance, tools or templates would you find useful for reporting QCR analysis?

What does good look like?

8.11 Reporting outputs may be used to assess the degree of credibility and ambition in carbon reduction that an LTP can be expected to achieve. Quantified estimates of carbon reduction are a critical component to this, but it is recognised that such numerical estimates may not fully reflect the extent to which an LTP can offer a credible or ambitious carbon reduction.

8.12 For the UK to achieve the national carbon budgets, we will ultimately require a mixture of future national and local policy, and some authorities and sectors may decarbonise quicker than others. Therefore, DfT recognises that in some cases the quantified estimate of an LTP's impact may demonstrate in the first instance that current local ambition for transport decarbonisation may not be sufficient to achieve a decarbonisation pathways aligned to national efforts on Net Zero at this stage. What is key then, is that authorities will be equipped to make more evidence-led decisions which will have a greater impact on carbon outcomes in the future and recognise the pace and scale at which places may need to act. This may also inform future discussion between DfT and authorities on future policy and funding.

8.13 Outputs of carbon analysis that indicate an LTP will support ambitious and credible carbon reductions includes demonstration of the following:

- A robust quantitative understanding of the scale and pace of emissions reduction that need to be achieved nationally, and how LTPs can contribute to decarbonising the economy as a whole towards Net Zero;
- A clear articulation of how an ambitious local carbon reduction in line with Net Zero can be achieved. This may include reference to wider interventions and collaboration, in addition to the policies and interventions set out in an LTP;
- That a quantified understanding of potential carbon impacts has been an integral part of the development and decision-making process of the LTP and associated programme of interventions, and that this reflects local conditions and requirements;
- A comprehensive yet proportionate estimate of the user emissions reductions that will likely be achieved by the LTP, and the potential scale of infrastructure carbon that may result; and
- Articulation of what additional measures may be needed to get closer to a decarbonisation pathway illustrative of Net Zero.

8.14 It is the responsibility of authorities to ensure that their analysis is credible and that any limitations and its implications are made clear. It is acknowledged however that carbon quantification methods and tools are an evolving area. DfT will keep this guidance under review and continue to engage with the sectors on best practice, standards, and guidance.

9. QCR Actions Following LTP Publication

9.1 This Chapter provides guidance on the ongoing actions authorities should take to deliver and improve quantifiable carbon reduction outcomes following LTP publication. This includes when LTPs need to be amended and as interventions are taken forward from an LTP through their lifecycle.

LTP and implementation plan updates

9.2 If material amendments to an LTP Strategy or Implementation Plan are made, authorities should update QCR reporting so that an accurate picture of carbon emissions are presented in the plan, and these should be made publicly available.

9.3 When assessments of scheme interventions mature through the project lifecycle, these more up to date assessments should be integrated into any updates to QCR reporting. The authority should do this as they see fit but DfT would recommend aligning these with the locally determined period of implementation plan development. Authorities may also choose to use the framework and reporting tools provided to monitor carbon impacts of their intervention programmes and inform the business case development process.

Question Number	Consultation Questions
Q31	In your view, what challenges might a local authority face in updating QCR reporting with updates to the LTP and Implementation Plan?”

Monitoring and evaluation

9.4 To enable the monitoring and evaluation process, authorities need to consider how and when to set / update the baseline of current emissions (Step 1 as described in Chapter 3). Authorities should refer to monitoring and evaluation guidance as referenced in Chapter 4 of the LTP Guidance.

9.5 Further guidance on monitoring and evaluation will be considered with the aim to improve the accuracy of benchmarking data and assessment methods by establishing a feedback loop from detailed assessments and post-construction

monitoring. This will be considered in future iterations of this guidance and parallel initiatives, but authorities are encouraged to contact DfT where evidence can be provided that will support improvements to the methods referenced in this guidance.

Carbon management in development of interventions

9.6 In the development of interventions taken forward from an LTP, authorities are encouraged to adopt a best practice carbon management process in line with PAS2080. This should be applied iteratively at all major lifecycle stages; defined as the principal Business Case Stages (Strategic Outline Case, Outline Business Case and Full Business Case) as well as monitoring this estimation against measured figures during construction and operation. Management, Commercial and Economic Case guidance documents have been updated to better incorporate whole-life carbon considerations. Financial, and Strategic Case guidance documents will be updated in the coming months to also reflect this.

9.7 The early understanding of carbon impacts provided by this LTP carbon analysis process should support the carbon management process adopted at an intervention level. An early understanding of the significance of infrastructure carbon can be used to inform the level of ambition required in intervention level carbon reduction targets.

Question Number	Consultation Questions
Q32	If you have any final comments on the QCR guidance, please provide them below.

What will happen next

A summary of responses, including the next steps, will be published within three months of the consultation closing on [web address]. Paper copies will be available on request.

If you have questions about this consultation, please contact:

Name

Address

Phone Number

Email address

Further background information can be found at [web address]

Annex A: Full list of consultation questions

Question Number	Consultation Question
Q1	In your view, does this high-level process for considering carbon make sense to you when considered with the wider Local Transport Plan guidance? ☐Yes ☐No ☐ Don't know If no, what part(s) of the process do you think could be improved, and how?
Q2	How confident are you that a local authority can apply the process described in this guidance? ☐ Very confident ☐ Confident ☐ Neither confident nor unconfident ☐ Unconfident ☐ Very unconfident If Unconfident or Very Unconfident, please explain why, including any suggestions for improvement.
Q3	In your view, is the proposed scope of emissions covered appropriate and proportionate for the development and assessment of an LTP? ☐ Yes ☐ No ☐ Don't know If no, what should be changed and why?
Q4	In your view, what, if any, implications with the approach proposed for geographical scope have been missed?

Q5a	To what extent do you agree or disagree that the Business-as-Usual and 'accelerated ZEV uptake' scenarios (as described) are a proportionate minimum standard by which authorities should estimate future emissions in the absence of an LTP? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please explain why.
Q5b	To what extent do you agree or disagree that the Business-as-Usual and 'accelerated ZEV uptake' scenarios (as described) will provide a consistent approach (between Las) for which they can estimate what future emissions might look like in the absence of an LTP? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree If you disagree, please explain why.
Q6	In your view, are there potential implications for this proposed approach to scenarios for assessment that have not been identified, if so, what are they?
Q7	In your view, to what extent would a detailed quantification of current and future emissions from bus and rail in your area be useful as part of QCR Step 1? ☐ Essential ☐ Useful but not essential ☐ Not proportionate ☐ Not useful ☐ Don't know If considered either essential or useful, to help improve the guidance, please describe what information you would find essential or useful and why. This might relate to the scope of quantification or level of disaggregation (for example breakdown of bus emissions by fuel type).

Q8	To what extent do you agree or disagree with the tiered methodology for estimating current and future emissions outlined and their application? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please explain why.
Q9	In your view, which of the methods do you anticipate that an authority would be able to apply using this guidance? Select all that apply. ☐ Method A1 GHG inventory ☐ Method A2a Network-based estimation ☐ Method A2b Disaggregated network-based estimation ☐ None of the above ☐ Don't know If you have selected none of the above, please explain why.
Q10	In your view, is there any further guidance or support that could be provided to help authorities to implement the methods proposed? ☐Yes ☐No ☐ Don't know If yes, what additional guidance or tools would be helpful?
Q11	Do you expect authorities to develop any of these methods 'in-house' at a sub-regional level to implement the recommendations of this guidance? ☐Yes ☐No – only expected to use locally disaggregated outputs of analysis conducted at a regional level (for example by STBs) ☐ Don't know If yes, please describe which methods you expect authorities to develop at a sub-regional level and for what reasons.

Q12	Do you anticipate any key challenges for an LTA in delivering the analysis set out in this chapter? ☐Yes ☐No ☐ Don’t know If yes, please describe what these challenges could be.
Q13	In your view, what further guidance or support, if any, could be given to LTAs to carry out elements described in this chapter?
Q14	In your view, are there potential implications for this proposed approach to decarbonisation pathways that have not been identified, if so, what are they?
Q15	Do you anticipate there will be challenges for LTAs in establishing a local transport decarbonisation pathway following the approach set out in this chapter? ☐Yes ☐No ☐ Don’t know If yes, what challenges do you anticipate?
Q16	To what extent do you agree or disagree with the approach to using a local transport decarbonisation pathway? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don’t know If you disagree, please provide an explanation for your answer, including suggestions for improvement if any

Q17	In your view, is there sufficient guidance in this chapter to support LTAs in developing an understanding of the potential scale of local emissions reductions? ☐Yes ☐No ☐ Don't know If no, what additional information do you think is required?
Q18	To what extent do you agree or disagree with the approach to considering carbon as part of the options assessment? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know If you disagree, please provide an explanation for your answer including suggestions for improvement, if any.
Q19	What, if any, do you think are the main challenges for LTAs when considering carbon as part of the options assessment process?
Q20	In your view, does this Chapter effectively elaborate on the contents of the 'Local Transport Plan Guidance 2023' to provide further detail on factoring in QCR as a part of the LTP options appraisal process? ☐Yes ☐No ☐ Don't know If no, how could this chapter be improved?

Q21	To what extent do you agree or disagree that the methods and approach presented will enable the quantification of the estimated user emissions impacts of the shortlisted LTP interventions? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don’t know To help improve the guidance, please provide an explanation for your answer.
Q22	Which of the methods do you anticipate that an authority would be able to apply using this guidance? Select all the apply. ☐ Method B1 Benchmarking ☐ Method B2 Bottom-up assessment ☐ Neither ☐ Don’t know If ‘neither’, please provide an explanation for your answer.
Q23	Is there any further guidance or support that could be provided to help authorities to implement the user emission quantification methods proposed? ☐Yes ☐No ☐ Don’t know If yes, what additional guidance or tools would be helpful?

Q24	In your view, would interventions be at a sufficient level of development as part of your LTP to establish the functional units (for example intervention length) needed to apply infrastructure carbon benchmarks? ☐All will ☐Some will ☐None will ☐ Don't know If you have selected 'none will', please explain why?
Q25	To what extent do you agree or disagree with the recommended scope of infrastructure carbon analysis put forward in this chapter? ☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐ Don't know To help improve the guidance, please provide an explanation for your answer.
Q26	Which of the methods do you anticipate that an authority would be able to apply using this guidance? Select all the apply. ☐ Method C1 Benchmarking (infrastructure carbon) ☐ Method C2 Material estimate derived quantification ☐ Neither ☐ Don't know If you have selected 'neither', please explain why.
Q27	Do you currently have access to any carbon infrastructure benchmarks that you could use when estimating the infrastructure carbon associated with proposed interventions in your LTP? ☐ Yes ☐ No ☐ Don't know If yes, what are these sources?

Q28	In your view, is there any further guidance or support that could be provided to help authorities to implement the infrastructure carbon quantification methods presented? ☐ Yes ☐ No ☐ Don’t know If yes, what additional guidance or tools would be helpful?
Q29	In your view, are there any issues with presenting the outputs of this LTP carbon analysis in the format described, if so, what are they? In your view, is there any further guidance or support that could be provided to help authorities to implement the infrastructure carbon quantification methods presented? ☐Yes ☐No ☐ Don’t know If yes, what additional guidance or tools would be helpful?
Q30	In your view, are there any issues with presenting the outputs of this LTP carbon analysis in the format described, if so, what are they? In your view, what additional guidance, tools or templates would you find useful for reporting QCR analysis?
Q31	In your view, what challenges might a local authority face in updating QCR reporting with updates to the LTP and Implementation Plan?”
Q32	If you have any final comments on the QCR guidance, please provide them below.

Annex B: Consultation principles

The consultation is being conducted in line with the Government's key consultation principles which are listed below. Further information is available at Consultation Principles: Guidance

If you have any comments about the consultation process, please contact:

Consultation Co-ordinator
Department for Transport
Zone 1/29 Great Minster House
London SW1P 4DR
Email consultation@dft.gsi.gov.uk

Annex C QCR Checklist

This Annex summarises the key items that should be developed as an output of this LTP carbon analysis process. This is structured on the four overarching steps set out in Chapter 2 and references the key outputs from each.

As referenced in Chapter 8 the outputs of this LTP carbon analysis process are expected to be reported within a DfT supplied reporting template and a supporting technical report.

Where an item does not have a specified reporting metric it can be reported as the authority sees fit.

Step 1 - Estimate current and future user emissions (without LTP)

Item	Requirement	Guidance	Reporting metric
A rationale for the methodology used to estimate current and future emissions, including reference to the availability of any existing tools (for example STB baseline models)	Essential	Chapter 3	N/A
An estimate of current (baseline) user emissions in your authority area and how they will change up to 2050 without implementation of the LTP under business-as-usual assumptions	Essential	Chapter 3	UE-BaU
An estimate of current (baseline) user emissions in your authority area and how they will change up to 2050 without implementation of the LTP under an accelerated EV scenario based on the Common Analytical Scenario dataset VL1	Essential	Chapter 3	UE-ZEV
An estimate of current (baseline) user emissions in your authority area and how they will change up to 2050 without implementation of the LTP under an accelerated EV scenario based on a localised forecast of ZEV uptake	Encouraged	Chapter 3	UE-ZEV-LA

Item	Requirement	Guidance	Reporting metric
Additional scenario testing of current and future emissions.	Optional	Chapter 3	N/A
Disaggregation of current and future emissions to understand what the greatest sources of user emissions are now and, in the future	Encouraged	Chapter 3	N/A

Step 2 - Establish a local transport decarbonisation pathway

Item	Requirement	Guidance	Reporting metric
A graph illustrating up to 2050: • Estimated user emissions under BaU assumptions • Estimated user emissions under an 'accelerated ZEV uptake' scenario • A local decarbonisation pathway based on the Net Zero Strategy	Essential	Chapter 4	N/A
Analysis of impact of desired or required outcomes in local transport compared to illustrative decarbonisation pathways. Advice on possible methods is provided in Chapter 4	Optional	Chapter 4	N/A

Step 3 - Consider carbon in the generation and appraisal of interventions and policy options for an LTP

Item	Requirement	Guidance	Reporting metric
A summary of how carbon has been considered as part of the generation and appraisal of options	Encouraged	Chapter 5	N/A

Step 4 Estimate the carbon impact of your LTP

Item	**Requirement**	**Guidance**	**Reporting metric**
A breakdown of the estimated carbon impact of each intervention included within the LTP and the methods used. This should include user emissions, and (if quantified) infrastructure carbon	Essential (where benchmarks exist)	Chapter 6	N/A
The estimated reduction in user emissions as a result of the LTP	Essential	Chapter 6	UE-LTP
The estimated reduction in user emissions as a result of ZEV interventions within the LTP	Optional	Chapter 6	UE-LTP-ZEV
The estimated reduction in user emissions outside the scope of this guidance	Optional	Chapter 6	UE-OSG
The estimated infrastructure carbon impact of the LTP	Encouraged	Chapter 7	IC-LTP
The estimated reductions in infrastructure carbon as a result of carbon management measures	Optional	Chapter 7	IC-CM
Estimated baseline highway maintenance emissions	Encouraged	Chapter 7	IC-HM
Estimated reductions in highway maintenance emissions as a result of the LTP	Optional	Chapter 7	IC-LTP-HM
Supporting narrative or analysis of whether the quantified estimate of LTP impact is accurate and whether further intervention is required to achieve decarbonisation commitments	Essential	Chapter 6, 7 and 8	N/A

Annex D Supporting materials

This Annex provides a summary of initiatives of relevance to carbon reduction in local transport. This is not an exhaustive list and will be updated with other initiatives, tools, and resources for the formal publication of this guidance.

National Highways Carbon Tool

A tool used to calculate carbon emissions for operational, construction and maintenance activities undertaken on behalf of National Highways.

Local Authority Toolkit

This toolkit offers guidance to authorities on the actions they can take to reduce transport carbon emissions. The tool highlights the benefits of various interventions, shares best practice examples, and signposts other relevant guidance and methodologies.

Transport User Benefits Appraisal (TUBA)

A software used to undertake economic appraisal of transport schemes, in accordance with DfT's cost benefit analysis guidance. The software implements a 'willingness to pay' approach to economic appraisal for multi-modal schemes with either fixed or variable demand. Carbon impacts in monetary value and tonnes of CO_2e can be extracted from TUBA output files.

DEFRA Emission Factor Toolkit (EFT)

A tool that allows users to calculate road vehicle pollutant emission rates for oxides of nitrogen (NO_x) and particulate matter (PM - PM_{10} and $PM_{2.5}$), for a specified year, road type, vehicle speed and vehicle fleet composition. CO_2 exhaust emission rates can also be calculated for petrol, diesel and alternative fuelled vehicles, with additional output provided for calculation of non-exhaust CO_2e emissions related to the charging of electric and plug-in hybrid vehicles.

Active Mode Appraisal Toolkit (AMAT)

A spreadsheet-based tool published by DfT, used for assessing the overall costs and benefits of proposed walking and cycling interventions, ranging from capital investments to behaviour change programmes. Through its ability to quantify the key impacts of an intervention, the tool helps to provide decision-makers with a view of the impacts on transport users, the environment, society, and the economy. AMAT also provides a measure of the 'Value for Money' for the proposed intervention, in the form of a benefit-cost ratio (BCR). It also indicates a change in vehicle kms travelled as a result of an intervention, which can be converted to tCO_2e.

BEIS GHG Inventory

Inventories of historic GHG emissions at a sub-national level have been prepared by The Department for Business, Energy, and Industrial Strategy (BEIS) since 2005. The dataset provides total emissions by authority, split by BEIS default road type classification (Motorways, A Roads Minor Roads). See Chapter 3 for further guidance.

PAS2080 (not openly accessible)

A global standard for managing whole-life infrastructure carbon. The standard provides a consistent approach to delivering low-carbon infrastructure, aiming to reduce carbon and cost through innovative design principles.