Department for Environment Food & Rural Affairs

LAQM.TG(22) Supplementary Guidance England excl. London

Determining the impact of air quality improvement measures

September 2024

Table of Contents

List of Tables

List of Figures

List of Boxes

1 Introduction

Through the Environment Act 2021 (EA21) and updated Local Air Quality Management Statutory Policy Guidance 2022 (PG22), the Local Air Quality Management (LAQM) framework in England has been considerably strengthened in recent years.

Schedule 11 of EA21 came into force in May 2022 and amended Part IV of the Environment Act 1995, impacting action plans in England including London as follows:

- *Air Quality Action Plans (AQAPs) prepared in response to an exceedance or likely exceedance of an air quality objective must be prepared for the purpose of* ***securing that air quality objectives are achieved.***
- *AQAPs must set out the measures that will be taken to improve local air quality and* ***specify a date by when each measure will be carried out****.*
- *AQAPs must, as far as possible, demonstrate how adopted measures will secure required local air quality improvements within a* ***set timeframe*** *and ensure that they are* ***maintained thereafter****.*

The Local Air Quality Management Statutory Policy Guidance 2022 (LAQM.PG(22))[1] and Technical Guidance 2022 (LAQM.TG(22))[2] set out further detail on how the requirements of EA21 should be fulfilled. PG22 also set out that, from 2023, local authorities without an Air Quality Management Area (AQMA) should draw up a local Air Quality Strategy. The purpose of a local Air Quality Strategy is to encourage prevention and reduction of polluting activities in preference to only taking steps to reduce air pollution once exceedances have been identified.

In the air quality context, interventions cover a wide range of actions from 'deliberate' measures to reduce air pollution to those primarily aimed at other outcomes, but which can indirectly affect air pollution. Air quality interventions span a wide range of situations, spatial scales (e.g. from a single road through to city-wide and sub-regional scales) and temporal scales (e.g. from the short-term closure of a road to permanent change for which benefits may only arise over a number of years, or longer). The principal focus of this report is on local scale interventions, such as those that might reasonably be considered by local authorities in addressing their AQAPs, or in drawing up local Air Quality Strategies.

Understanding the impact that interventions have on air quality is highly desirable because of the need to quantify the outcome on air quality and health i.e. relate a policy aimed at improving air quality to a robust understanding of the outcome.

The assessment of interventions can be challenging for several reasons. A common challenge is that interventions rarely occur in isolation from other changes that affect air

[1] https://laqm.defra.gov.uk/wp-content/uploads/2023/11/LAQM-Policy-Guidance-2022.pdf
[2] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

quality, making it difficult to detect and quantify changes, especially if the interventions are small. Indeed, interventions may not be detectable or quantifiable in terms of changes in pollutant concentrations or health outcomes, even using sophisticated analysis techniques. Moreover, some interventions rely on behavioural change for both adoption and benefits to be realised, for which there remains considerable uncertainty regarding the extent to which such changes will be enacted.

This supplementary guidance aims to assist local authorities in fulfilling the strengthened requirements for AQAPs or drawing up a local Air Quality Strategy, and in prioritising strategy measures, by offering a structured methodology for determining the future impacts of air quality improvement measures.

2 Measure Categorisation

By 2024, 94.6% of AQMAs in England (excluding London) were declared on the basis of road transport sources, 1.7 % were declared for industrial sources, and 0.2% (only one AQMA) declared based on domestic sources. 3.3% were declared for a combination of transport and industrial source or transport, industrial and domestic sources. Therefore, this guidance is primarily focused on air quality measures targeting road transport sources. Other sources are mostly assessed via industrial permitting processes under local or national permitting schemes. Relevant resources and guidance for other sources is provided in section 3.4.2.

Measures can generally be categorised as “soft measures” and “hard measures”.

Soft measures are generally the interventions that focus on individual / group behavioural change and do not involve measures that directly impact infrastructure with physical changes. Soft measures are usually flexible, lower in cost, and wide-reaching in their focus. Soft measures can focus on reducing source contributions and/or exposure to air pollution, commonly involving raising awareness and/or encouraging or facilitating behavioural change. It is generally considered that soft measures are more acceptable to the public and capable of achieving their objectives and are therefore more politically feasible[3][4]. However, the impact of soft measures on emissions and concentrations can be difficult to quantify accurately. As such, the use of Qualitative Assessment methods to define their potential air quality impact is often adopted. If proxy data of air quality impacts from a soft measure can be estimated by qualitative assessment, the impact can then be calculated and quantified by an emission-based assessment or concentration-based assessment. An example of emission-based assessment using proxy data from qualitative assessment is present in Box 3-1 and Box 3-3.

[3] Thorpe, N. Hills, P. and Jaensirisak, S. (2000) Public attitudes to TDM measures: a comparative study. Transport Policy. Vol. 7 (4)

[4] Katie, C (2012) Why is it so hard to be soft? How Perceptions of Effectiveness and Acceptance of Measures Can Be Improved to Encourage Smarter Travel.

Some soft measures, such as campaigns and events, can be quantified in terms of contribution. Government Communication Service (GCS) Evaluation Cycle[5] is a useful guidance for evaluating campaigns and communication events. More information is provided in section 3.4.1.

Box 2-1 below provides some examples of soft measures. More details of the listed measures can be found on the Air Quality Hub [6] and LAQM Action Toolbox in LAQM.TG(22).

[5] Government Communication Service. The GCS Evaluation Cycle. Available at: https://gcs.civilservice.gov.uk/publications/gcs-evaluation-cycle/

[6] https://laqm.defra.gov.uk/air-quality-hub/

Box 2-1 – Examples of Soft Measures

Travel Planning

- **Personalised travel planning**
  Provision of personalised travel information to individuals to promote uptake and use of sustainable and lower emission transport options.
- **Residential travel planning**
  Developer-led provision of travel information and advice to new residents to promote uptake and use of sustainable and lower emission transport options on new developments.
- **Workplace travel planning**
  Encouraging the development and adoption of Workplace Travel Plans to improve the uptake and use of sustainable and lower emission transport in workplaces.
- **School travel planning**
  Encouraging the development and adoption of School Travel Plans to improve the uptake of sustainable and lower emission transport by school communities.

Car Sharing and Car Clubs

- **Car share schemes**
  Reduce individual car trips and emissions, through promotion of shared car journeys.
- **Car clubs**
  Reduce emissions from personal convenience trips and workplace journeys through provision and use of car club fleet vehicles.

Promotion of Public Transport

- **Cycling initiatives**
  Schemes to promote use of cycling.
- **Promotion of bus and coach use**
  Schemes to promote use of buses and coaches.
- **Rail initiatives**
  Schemes to promote use of rail or rail improvement.

Walking Initiatives

- **Walking events/groups**
  Provision of guided walks and walking support groups.
- **Pedestrian training**
  Provision of pedestrian training.
- **Park and Stride Scheme**
  Using Park & Stride sites to encourage completion of car journeys by foot.

Schools / Education

- Anti-idling initiatives in educational settings.
- Promoting sustainable travel to school.
- Education based monitoring projects.
- School based educational activities.

Public Information Campaigns / Events

- Sustainable transport-based campaigns.
- Health based campaigns.
- Events to provide air quality information and promote behavioural change.
- Social media-based campaigns.
- Air quality websites.

Fleet Management

- ECO driving/driver skills development.
- Fleet Recognition Schemes.

Hard measures generally encompass physical changes to infrastructure or adoption of technologies, often driven by clear changes in regulations. These measures are mostly targeted at specific pollutant sources and deliver defined outcomes based on reductions of emissions. However, implementation of hard measures will often require higher costs, and can be considered more disruptive, and can therefore sometimes be more politically challenging when compared to soft measures.

The impact of hard measures can often be quantified by emission-based assessments and concentration-based assessments (i.e. through a dispersion modelling assessment). To undertake the assessment for a measure, predicted emissions data under the impact scenario compared to the "as is" position is required. For road transport sources, data required includes changes to traffic flow, fleet composition or speed.

Box 2-2 below provides some examples of hard measures. More details of the listed measures can be found on the Air Quality Hub and the LAQM Action Toolbox in LAQM.TG(22).

Box 2-2 – Examples of Hard Measures

Public Transport Infrastructure

- Procurement of low emission buses and coaches.
- Retrofits/upgrades of abatement technologies.

Clean Air Zones / Low Emission Zones

- Traffic Regulation Conditions.
- Clean Air Zone (CAZ).
- Low Emission Zone (LEZ).

Electric Vehicle (EV) Charging

- Interactive EV charging points.
- EV charging and planning.

Traffic Management Initiatives

- Junction and road improvement schemes.
- Anti-idling enforcement.
- Speed management.
- Urban Traffic Management and Control.

Walking Initiatives

- Foot streets / pedestrianisation.

Please note that some measures may not fit neatly into one of these two categories and have the features of both soft measure and hard measure. For example, a walking infrastructure improvement is a measure delivering physical changes, e.g. widening a footpath or better lighting. This measure does not specifically target a direct change in traffic numbers, but promotes walking by improving infrastructure. An example of an assessment using a combination of methods is presented in Box 3-1 and Box 3-2.

3 Assessment Methods

The flow chart in Figure 3.1 below illustrates the types of measures that can be used for quantifying the future impacts of measures within AQAPs.

To determine the various assessment methods which can be used, action plan measures can be categorised as “soft” or “hard” measures, as specified in the Section 2, above. Whilst it is acknowledged that some measures will fall in the middle and may not fit neatly into one of these two categories, categorising the measures in this manner helps to determine how the various assessment methods can be applied.

This guidance document introduces three assessment methods to comprehensively evaluate the impact of measures included in an AQAP:

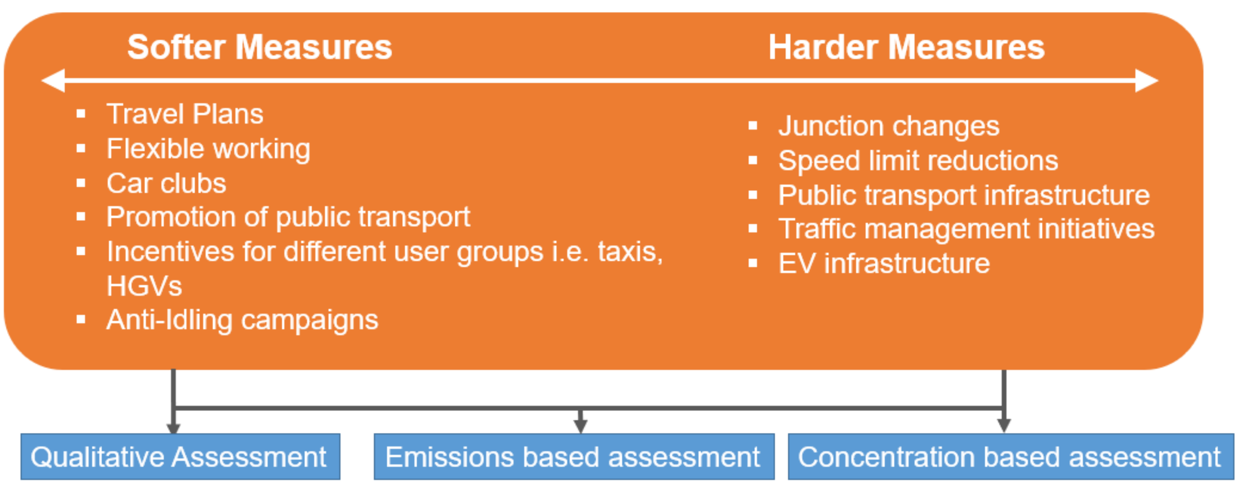
1. Qualitative assessment
2. Concentration-based assessment
3. Emission-based assessment

Local authorities should adopt the most appropriate assessment method, or a combination of assessment methods based on the categories of measures and data availability. The flowchart in Figure 3.1 demonstrates how to choose the assessment method for proposed measures.

Information on other assessment methods dealing with non-road transport emission sources are provided in section 3.4.

The outcomes of the assessments will collectively form the basis for a comprehensive Cost Benefit Analysis (CBA). This holistic approach ensures that decision-makers have a thorough understanding and consider the potential future impacts of proposed measures, aiding in the prioritisation of interventions that offer the greatest benefit to local air quality.

Figure 3.1 – Decision Tree for Measure Quantification



3.1 Qualitative Assessment

Soft measures, characterised by their influence on behavioural change and practices, often present a challenge in precise quantification. This chapter introduces the Qualitative Assessment method, offering a robust framework to assess the contribution that soft measures may have on air quality. In some cases, qualitative assessment can also help the estimation of proxy data which can then be used in emission-based assessment or concentration-based assessment. Examples include the predicted reduction in journeys travelled, changes in mileage travelled or vehicle speeds within the area to which the intervention is applied, and any peripheral impacts thereof.

The below methods are examples of how analysis of soft measures might be conducted.

3.1.1 Professional Judgment and Local Knowledge

This method relies on the expertise of professionals in specific relevant fields such as air quality management, urban planning, and behavioural science to provide nuanced insights into the potential impact of proposed measures. Engagement with local expertise gained from local environmental health officers, transport planners and urban planners, the combined approach provides for valuable insights on the formulation of ideas on which soft measures could be realistic to implement to reduce emissions in an area.

In the assessment of soft measures, the guidance recognises the need to gather opinions from a spectrum of professionals. This includes air quality experts, public health officers of local authorities, planning officers of local authorities, neighbouring/other local authorities, a designated relevant public authority, National Highways, the Environment Agency (EA), local businesses and interest groups and any other relevant Air Quality Partners. By engaging a diverse range of experts, as relevant to the specific soft measures being proposed, the assessment benefits from a comprehensive array of perspectives, ensuring a holistic understanding of the potential impacts, both positive and negative. Unintended consequences can also be explored, and therefore avoided.

3.1.2 Collaboration and Communication

Collaboration and communication with neighbouring or other local authorities implementing similar air quality measures can be a valuable resource to understand the impact of the measures, and any difficulties experienced in doing so. Local authorities can gain insight from others and evaluate the impact of their proposed measures through a number of available resources, including:

- **The Air Quality Hub**

The Air Quality Hub is a free, online information and knowledge sharing resource for local authority air quality professionals, seeking to deliver air quality benefits. In July 2024, the total number of users on the Air Quality Hub was 1,174 and a total of 26 case studies and 98 strategy measures were published. It is available to all local authorities via the link https://laqm.defra.gov.uk/air-quality-hub/ and features the following:

1. Strategy Measures

   The Air Quality Hub offers an overview of various measures that local authorities can adopt to improve air quality in their area, and the pollutants that they are most applicable to. Each strategy measure provides a summary of the steps needed to implement it, the likely air quality benefits and sign posting to relevant documents, guidance and case studies which can help a local authority with measures selection and impact assessment. The list of local authorities who implement this is also shown for each measure.

2. Case Studies

   The Case Studies section provides a comprehensive overview of an action taken by another local authority to improve air quality. These detail how the project was funded, steps for delivery, learning outcomes and key successes.

The Discussion Forum on the Air Quality Hub also provides an opportunity for local authorities to interact directly with each other for the purpose of sharing knowledge and experiences. Local authorities can ask for advice, discuss proposed measures and share outcomes and lessons learned.

- **Review of AQAP Good Practice Examples**

Good practice examples of air quality measures implemented through AQAPs are available on the LAQM webpage. These examples are shared based on the overall approach to the AQAP taken by the authority, or the endorsement of specific elements of the Plan, which may prove useful to other authorities embarking on the AQAP process.

Local authorities can refer to the assessment of similar soft measures in the published AQAPs to provisionally assess the impact of the measure proposed in their own AQAP. It is important to consider the unique local dynamics, demographics and environmental factors that shape the efficacy of the measures being compared.

- **Contacting the Relevant Local Authority Directly**

It is recommended to directly contact the relevant local authority who has implemented the proposed measures. This is likely to provide more detailed information, including the quantitative and monitored impact of the measures.

Notes

It should be noted that the impacts of measures undertaken by other local authorities must be contextualized to the specific circumstances and characteristics of the area of implementation. Consequently, the effectiveness of a given measure within one local authority may not necessarily replicate similar outcomes in another location.

For instance, the success of a school travel plan can vary according to local factors such as the location of the school, the size of the school, whether it is primary or secondary and the attitudes of the staff and parents. Therefore, it is important to consider the unique local dynamics, demographics, and environmental factors that shape the efficacy of the measure being compared.

3.1.3 Literature Review

Through a thorough examination of existing research, studies, and best practices related to the selected measures, a local authority can extract valuable insights and evidence. This information serves to inform the future impact and effectiveness of the proposed air quality measures proposed. Multiple sources of evidence should be reviewed, as it is possible that findings from a single study may have specific contextual circumstances, which impacted a project / measures success or lack thereof.

A well-structured literature review process is critical to ensuring the review is comprehensive and provides valuable insights to inform the assessment of air quality measures. Below outlines the general steps and methodology for conducting an effective literature review:

1. **Formulating the measure and assessment objectives**
   Begin by clearly defining the specific air quality improvement measures being assessed and the objectives of the literature review. This ensures the scope is focused on evaluating the potential impacts and effectiveness of the proposed measures.
2. **Searching the relevant literature**
   Identify relevant databases, journals, government studies, and other sources to systematically search for existing research and evidence related to the types of air quality improvement measures being considered. Use a combination of keyword searches and citation tracking[7] to find the most pertinent literature.
3. **Screening for inclusion**
   Establish clear criteria for including or excluding studies and articles in the review. This may be based on factors such as the measure type, geographic location, research methodology, and time frames relevant to assessing air quality impacts.
4. **Critical Appraisal of the Evidence**
   Critically evaluate the relevancy and robustness of the included studies to determine their suitability for the assessment of the proposed air quality measures.
5. **Synthesis of the Evidence**
   Describe the findings from the studies and conclude the implication of the findings on the potential impact of the proposed measures.

By following this structured approach, the literature review will provide a comprehensive, evidence-based foundation to support the assessment of the air quality improvement measures.

[7] Citation tracking involves using the references and citations within existing studies and articles to identify additional relevant literature on the topic.

For more detailed guidance on conducting rapid evidence assessments, local authorities may refer to the guidance – the production of quick scoping reviews and rapid evidence assessments[8].

Below provides some examples of the types of information sources that may form part of a literature review:

- Government Studies: Department of Transport Research[9], Air Quality Expert Group[10], UK-AIR Science and Research[11].
- Policy Research: Transport for Quality of Life[12].
- Academic Journals: Transport Policy[13]; Journal of Transport & Health[14]; Transactions on Ecology and the Environment[15]; Science of The Total Environment[16]; Journal of Cleaner Production[17]; Atmospheric Environment[18].
- Local Authority Case Studies: Air Quality Hub[19].

It is important to note that the robustness of the literature needs to be assessed before use as there are different metrics to select published materials based on their quality. These include the authors, study design, the quality of journals or platform of publication, and the relevance of the subject of the publication to the topic/subject to be reviewed.

Government studies are generally considered to be robust with objective and valid evidence. However, factors such as the design and scale of the study should always be considered in relation to the strength and robustness of any evidence

Academic journal quality can be based on Impact Factor (IF) rankings. The IF is a measure of the frequency with which the average article in a journal has been cited in a particular year. It is used to measure the importance or rank of a journal by calculating the times its articles are cited. Journal articles tend to be peer reviewed and scrutinised by academics prior to publication, and commonly report the limitations and generalisability of the findings.

Case studies provided by private companies are usually not peer-reviewed or validated / authorised to be object and accurate. Therefore, literature from such sources should be used with caution.

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[8] Environment Agency, Department for Environment, Food & Rural Affairs and Natural Environment Research Council. Published 2016. The production of quick scoping reviews and rapid evidence assessments. Available at: https://www.gov.uk/government/publications/the-production-of-quick-scoping-reviews-and-rapid-evidence-assessments

[9] https://www.gov.uk/transport#research_and_statistics

[10] https://uk-air.defra.gov.uk/research/aqeg/

[11] https://uk-air.defra.gov.uk/research/

[12] https://www.transportforqualityoflife.com/policyresearch/

[13] https://www.sciencedirect.com/journal/transport-policy

[14] https://www.sciencedirect.com/journal/journal-of-transport-and-health

[15] https://www.witpress.com/elibrary/wit-transactions-on-ecology-and-the-environment

[16] https://www.sciencedirect.com/journal/science-of-the-total-environment

[17] https://www.sciencedirect.com/journal/journal-of-cleaner-production

[18] https://www.sciencedirect.com/journal/atmospheric-environment

[19] https://www.airqualityhub.co.uk/case-study/

There is no strict minimum or maximum number of references recommended, as this will depend on the measure being assessed and the availability of relevant literature. However, it is essential to gather a diverse and representative set of evidence to assess a proposed measure.

In Box 3-1 below, an example of a literature review on the impact of a travel plan is provided.

Box 3-1 – Example of a Literature Review on Measure Impacts

Evidence-Based Assessment of Travel Plan

Example 1 – Workplace Travel Plan: effectiveness and cost

Article: Newson, C., Cairns, S. & Davis, A. (2002). *Making travel plans work: Lessons from UK case studies*.

Review: This research report concludes that following a detailed evaluation of the travel plans adopted by various organisations, car journey reductions in the range of 5% to 66%, were achieved (Table A below). Typical costs of different travel plan measures are also provided in the report (Table B below).

Table A – Changes in commuter car use at British organisations with travel plans[20]

Organisation	Cars per 100 staff*~		%-point shift	%change
	Before	After		
Orange (Temple Point)	79	27	52	-66
Bluewater	69	31	38	-55
Plymouth Hospitals NHS Trust	>78	<54	>24	>-31
Computer Associates	89	74	15	-17
Buckinghamshire County Council	71	56	15	-21
Addenbrooke's NHS Trust	<74	<60	>14	>-19
Wycombe District Council	77	65	12	-16
Orange (Almondsbury Park)	92	80	12	-13
Nottingham City Hospital NHS Trust	73	61	12	-16
Marks and Spencer Financial Services	<95	<83	>12	>-13
BP	84	72	12	-14
Vodafone	<84	<75	>9	>-11
University of Bristol	44	35	9	-20
Egg	62	53	9	-15
AstraZeneca	<90	<82	>8	>-9
Government Office for the East Midlands	<45	<38	>7	>-16
Pfizer	75	68	7	-9
Agilent Technologies	71	65	6	-8
Stockley Park	<88	<84	>4	>-5
Oxford Radcliffe Hospitals NHS Trust (JR site)	58	54	4	-7
Boots	65	62	3	-5
Average	74	61	> -14	> -18
National Travel Survey comparison	59			

Reproduced from Cairns et al. (2002)

* 'Cars per 100 staff' relates to the number of commuter cars arriving per 100 staff at the time of the earliest and latest monitoring at each organisation. Staff who were parking off-site were counted as bringing a car. Staff using Park-and-Ride services for commuting were not counted as bringing a car.

~ Where inequality signs have been used, changes in car numbers have usually been inferred from figures about the total proportion of staff commuting by car. This usually gives a conservative estimate of change, as it does not allow for reductions in the number of commuter cars arriving per 100 staff achieved by increased car sharing, or, in the case of Vodafone, increasing proportions of people who only commute by car for some days each week.

[20] Source: Cairns S, Sloman L, Newson C, Anable J, Kirkbride A & Goodwin P (2004) *'Smarter Choices – Changing the Way We Travel'*. Reproduced from Newson, C., Cairns, S. & Davis, A. (2002). Making travel plans work: Lessons from UK case studies.

Table B – Typical Costs for Travel Plan Measures[21]

Indicative sums spent by organisations on different measures*

Measure		Cost
Bus/rail measures	Private shuttle bus service (including vehicle and one year's running cost)	£70-100,000
	Annual subsidy for five commuter routes	£150,000
	Major pump priming of services across the area	£0.5-1 million
Cycling	10 lockers	£300-£1,000
	Two sets of shower and changing facilities	£3-8,000
	Area of lockable parking	£3-8,000
	Infrastructure of a new cycle route	£30-100,000
Walking	Promotion work	£500-1,000
	Significant improvements to infrastructure, such as traffic calming, pedestrian crossings, lighting and/or improved pavements.	£30-100,000
Car sharing	Setting up a database system	£5,000
	Guaranteed ride home and/or marking out dedicated car-share parking spaces	£50-500
Travel co-ordinator	Salary plus on-costs	£40,000
Surveys	Two staff travel surveys	£10,000
Publicity and promotion	Annual budget	£5-15,000
Incentives to staff	£500p.a. for 100 staff	£50,000

**Of course, actual costs depend on exactly what is being done, and local conditions. These figures provide an indication only. Your organisation may only need to make a contribution to some costs, as other partners, such as local authorities or public transport operators, may pay the majority.*

Conclusion: Local authorities can assess their proposed measures by comparing them with those in the travel plan case study. If the measures are similar, they can estimate the potential impact and implementation cost using the information provided within the case study. The assessment of the proposed work travel plan should also consider local knowledge and factors that will influence the plan's local impact, including the size of the organisation, parking spaces, business type, etc.

Example 2 – School Travel Plan: proxy data from literature review

Article 1: Newson, C., Cairns, S. & Davis, A. (2010). *Making school travel plans work: experience from English case studies.* Transport for Quality of Life.

Review: This research report concluded that 26 of the 30 case study schools in the report had reduced car use – two of them by more than half. On average, where reductions were achieved, car use had been cut car by almost a quarter.

Article 2: Department of Education. (2010) ***Evaluation of the 'Travelling to School Initiative' programme: final report.***

Review: The report conducted the School Census to collects data on schools and pupils in England and is administered by the Department for Children, Schools and Families. Despite various data limitation of the Census, a positive overall change is observed in travel modes with an increase in walk to school, car share and cycle and a decrease in car travel.

Article 3: House of Commons Transport Committee. (2009) School Travel: Government Response to the Committee's Second Report of Session 2008–09.

Review: Case study shows, on Merseyside the 2.4% reduction in car use in schools with a school travel plan over the past five years had been against an increase of 5% in other schools without a school travel plan.

Article 4: London Assembly Trasport Committee. (2007) ***Going to Plan? The London Assembly Transport Committee's review of School Travel Plans in London.***

Review: The report concluded fifty-four per cent of all schools in London have adopted travel plans, resulting in reported average reductions in car use for school travel of almost seven percent.

Conclusion: Based on the review of these studies, the school travel plan can effectively reduce car travel. However, the level of reduction varies depending on the scale of the study and location in which the travel plan is implemented.

Proxy Data Estimation Based on Review:

Baseline Scenario: A local authority proposes to promote school travel plans among 14 schools within its region. It is known there are 4,200 pupils and 210 staffs in total in these 14 schools. The schools provide information that around 50% of pupils travelling to school by car and around 80% of staff travelling to school by car. An average distance travel to school is 2.6 miles.

Estimated total car travel (drop off, pick up and staff trip): 4,536 Annual Average Daily Traffic (AADT)

Future Year No School Travel Plan Scenario: In five years' time, it is estimated to have an increase of 5% car use in pupils' drop off and pick up. All other conditions keep the same.

Estimated total car travel (drop off, pick up and staff trip): 4,746 Annual Average Daily Traffic (AADT)

Future Year with School Travel Plan Scenario: The assessment of the proposed school travel plan should consider local knowledge and factors that will influence the plan's local impact, including the size of the school, road conditions around the school, pick-up and drop-off hours, etc.

This local authority is a non-London English local authority. By comparing the size of local population and local school. The local authority decides to take a conservative estimation on the impact of school travel plan. An estimated 3% reduction in cars use is estimated which is lower than the average reduction in the review of London schools, but similar to the case study on Merseyside.

Estimated total car travel (drop off, pick up and staff trip): 4,400 AADT

Conclusion: The estimated proxy data can then be used in emission-based assessment to provide an estimated reduction in emission by implementing school travel plans. The following steps of emission-based assessment of this school travel plan example is presented in Box 3-3.

[21] Source: Newson, C., Cairns, S. & Davis, A. (2002). Making travel plans work: Lessons from UK case studies.

3.2 Emissions-Based Assessment – Road Traffic Measures

An emission-based assessment is a method used to calculate the impact of an air quality measure in terms of expected changes in emissions that are associated with the measure. Within such an assessment, the pollutant emissions are calculated in the scenarios before and after the implementation of the assessed measure. The change in emissions can then be calculated and assessed.

To fully understand the impact of the proposed measures on NO_2 concentrations, dispersion modelling is recommended, approaches and considerations of which are covered in LAQM.TG(22) Chapter 7 – 4 Dispersion Modelling of Emissions and elaborated on in section 3.3. However, an emissions-based assessment can be used when the availability of data is too limited to undertake full dispersion modelling or if there is insufficient funding, resources, time or technical understanding to do so.

An emissions-based assessment for road traffic can be undertaken by the local authority using the Emissions Factors Toolkit[22], without the need for additional software as it is a Microsoft Excel-based tool. The EFT can help local authorities to define the road NO_x reduction attributed to road transport measures to help compare the impact of measures against each other.

This method can only be used to assess measures aimed at improving road traffic emissions. The framework cannot be applied to the evaluation of measures for other source categories, e.g. industrial combustion. If you require further support on how best to proceed in such circumstances, you can refer to section 3.4.2 Non-Road Transport Source or please contact the LAQM Support Helpdesk[23].

An emissions-based assessment utilises the targeted changes in road traffic arising from a measure. For example, if a proposed measure targets a 50% reduction in total Heavy Duty Vehicles (HDVs) travelling through an AQMA, the estimated HDV traffic flow post-implementation can be calculated by applying a 50% reduction factor to the existing HDV traffic flow in AADT format. The post-implementation HDV traffic flow, along with other required information such as the fleet composition and average vehicle speed, can then be used as input to the EFT. Subsequently, the EFT will provide an estimate of the pollutant emissions following the implementation of the measure. Detailed examples of the assessment methodology are provided in Box 3-2 below.

An emissions-based assessment can also be used to assess impacts of multiple behavioural based measures at once by estimating the combined emission reduction of the measures as a result of the change in traffic flow/composition.

[22] Emission Factor Toolkit v12.0.1, published December 2023. Available at: https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

[23] LAQM Helpdesk. Available at: https://laqm.defra.gov.uk/helpdesk/

Box 3-2 – Examples of Emission Based Assessment – Calculation of NO_x Emission Reduction from Road Traffic

Calculation of NO_x Emission Reduction using the EFT

$$\begin{aligned} &Estimated\ Road\ NO_x\ Annual\ Emissions\ Reduction\ by\ Implementing\ Measure \\ &= Current\ Road\ NO_x\ Annual\ Emissions - Predicted\ Road\ NO_x\ Annual\ Emissions \end{aligned}$$

Where:

- Current Road NO_x Annual Emissions is calculated from existing traffic conditions without the proposed measure.
- Predicted Road NO_x Annual Emissions calculated from revised traffic conditions attributed to measure implementation.

Example 1: Emissions-based Assessment – Road Traffic Flows

Measure 1 will result in a 50% reduction in total HDVs travelling through an AQMA. Below are the steps to assess the reduction in annual emissions of road-NO_x by implementing Measure 1.

EFT Inputs – Selection

To generate the NO_x annual emission, the **Annual Link Emission** option needs to be selected as **Y** within the **Standard Outputs** section. The below example is using the **Basic Split** option for **Traffic Format** Input.

More detailed instructions on EFT input options are available in EFT User Guide[24].

EFT Inputs – Current Traffic Data (Source ID 1)

Assuming that:

- Current year is 2023
- The AQMA is located in an urban area in England, outside of London
- Current total traffic flow through AQMA = 65396 AADT
- Current HDVs travelling through AQMA = 4336 AADT
- Current percentage of HDVs travelling through AQMA = 4336 AADT / 65396 AADT = 6.6%
- Average speed in AQMA = 50 kph
- Total link length within the AQMA = 2 km

EFT Inputs – Predicted Traffic Data with Measure Implemented (Source ID 2)

With Measure 1 implemented in 2023 (if the implementation year is different, the EFT needs to be run separately with the year amended to the implementation year), the number of HDVs travelling through the AQMA will reduce by 50% to 2168 AADT and the traffic flow of non-HDVs remains the same:

- Reduce number of HDVs by 50% = 2168 AADT
- Future total traffic flow through AQMA with Measure 1 implemented = 63228 AADT

[24] EFT v12.0 User Guide. Available at: https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

- Future percentage of HDVs travelling through AQMA = 2168 AADT / 63228 AADT = 3.4%
- Speed and link length remain the same

Below shows the example EFT Inputs for Measure 1 Emissions-based Assessment.

Primary Inputs		Pollutants	Selected	Standard Outputs	Selected	Additonal Outputs	Selected
Area	England (not London)	NO_x	Y	Air Quality Modelling (g/km/s)		Breakdown by Vehicle	
Year	2023	PM_{10}		Emissions Rates (g/km)		Source Apportionment	
Traffic Format	Basic Split	$PM_{2.5}$		Annual Link Emissions	Y	PM by Source	
All must be selected		CO_2				Primary NO_2 Fraction	
						Export Outputs	

SourceID	Road Type	Traffic Flow	% HDV	Speed(kph)	No of Hours	Link Length (km)	% Gradient
1	Urban (not London)	65396	6.6	50	24	2	
2	Urban (not London)	63228	3.4	50	24	2	

EFT Outputs

Below shows the EFT outputs for Current Road NO_x Annual Emission (Source ID 1) and Predicted Road NO_x Annual Emissions attributed by the implementation of Measure 1 (Source ID 2).

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	12,538.21328
2	NOx	11,136.12710

- Current Road NO_x Annual Emissions (Source ID 1) = 12,538 kg/yr
- Predicted Road NO_x Annual Emissions (Source ID 2) = 11,136 kg/yr
- Estimated Road NO_x Annual Emissions Reduction by Implementing Measure 1 = Current Road NO_x Annual Emissions (Source ID 1) – Predicted Road NO_x Annual Emissions (Source ID 2) = 1,402 kg/yr
- Estimated percentage reduction of Road NO_x Annual Emissions by implementing Measure 1 = 11%

In conclusion, there is an estimated reduction of 11% on NO_x Annual Emissions from road traffic by implementing Measure 1.

Example 2: Emissions-based Assessment – Vehicle Fleet Composition

Measure 2 will result in a 5% change of conventional Internal Combustion Engine (ICE) Cars to Electric Cars passing through an AQMA.

EFT Inputs – Selection

To generate the NO_x annual emission, the **Annual Link Emission** option needs to be selected as **Y** within the **Standard Outputs** section. The below example is using the **Basic Split** option for **Traffic Format** Input.

More detailed instructions on EFT input options are available in EFT User Guide[25].

EFT Inputs – Current Traffic Data (Source ID 1)

Assuming that:

- Current year is 2023
- The AQMA is located in an urban area in England, outside of London
- Current total traffic flow through AQMA = 65396 AADT (HDV 6.6%)
- Average speed in AQMA = 50 kph
- Total link length within the AQMA = 2 km
- **Default NAEI Vehicle Fleet** is used for current traffic conditions without Measure 2. No options need to be selected in Advanced Options and the below default vehicle fleet is used for calculating Source ID 1 Current Road NO_x Annual Emission.

NAEI Vehicle Split		Default fleet - England (2023)		
		Urban	Rural	Motorway
Cars	Conventional Petrol	0.43	0.39	0.36
	Hybrid Petrol	0.02	0.02	0.02
	Plugin Hybrid Petrol	0.03	0.02	0.02
	Conventional Diesel	0.30	0.31	0.30
	Hybrid Diesel	0.01	0.01	0.01
	Electric	0.03	0.03	0.03
LGVs	Petrol	0.01	0.01	0.01
	Diesel	0.14	0.15	0.14
	Electric	0.00	0.00	0.00
Taxi		0.00	0.00	0.00
Rigid HGV		0.01	0.02	0.03
Articulated HGV		0.00	0.02	0.08
Buses & Coaches		0.01	0.00	0.00
Motorcycles		0.01	0.01	0.00

Default ICE Car fleet composition = Conventional Petrol + Conventional Diesel = 0.43 + 0.30 =0.73 (73%)

Default Electric Car fleet composition = 0.03 (3%)

Please note that the fleet composition needs to be changed to calculate Predicted Road NO_x Annual Emission attributed to the implementation of Measure 2 (Source ID 2). Therefore, the EFT needs to be run separately for Source ID 1 and Source ID 2.

25 EFT v12.0 User Guide. Available at: https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

EFT Inputs – Predicted Traffic Data with Measure Implemented (Source ID 2)

With Measure 2 implemented in 2023, 5% of ICE cars (Conventional Petrol and Conventional Diesel) will switch to electric cars:

- Total traffic flow through AQMA = 65396 (6.6% HDV)
- Speed and link length remain the same.
- Adjust default fleet based on shift in fleet composition. **Bespoke Base Fleets** need to be selected as **NAEI** within the **Advanced Options**. In the **NAEI Bespoke Fleet** Tab, first click **Populate with Defaults** button, then adjust the **User Defined Base Fleet**. Adjusted User Defined Base Fleet is shown in the figure below.
    - **Default ICE car fleet composition** = Conventional Petrol car fleet composition + Conventional Diesel car fleet composition = 43% + 30% = 73%
    - **ICE car fleet composition shifting to electric cars** = Default ICE car fleet composition x ICE car fleet change percentage = 73% × 5% = 4%
    - **Adjusted ICE car fleet composition** = Default ICE car fleet composition – ICE car fleet composition shifting to electric cars = 73% – 4% = 69%
    - **Adjusted electric car fleet composition** = Default electric car fleet composition + ICE car fleet composition shifting to electric cars = 3% + 4% = 7%
    - Proportionally, the changed Conventional Petrol car fleet and Conventional Diesel car fleet are:
        - **Adjusted Conventional Petrol car fleet** = Adjusted ICE car fleet composition × (Default Conventional Petrol car fleet composition ÷ Default ICE car fleet composition) = 69% × (43% ÷ 73%) = 41%
        - **Adjusted Conventional Diesel car fleet** = Adjusted ICE car fleet composition × (Default Conventional Diesel car fleet composition ÷ Default ICE car fleet composition) = 69% × (43% ÷ 30%) = 28%

Please be aware that the Default Fleet values in the EFT are displayed at two decimal places, but the values have more decimal places. Therefore, it is recommended to copy the values to a separate spreadsheet for accurate calculation and ensure that all post-adjustment the user defined total fleet proportions for each road type add up to 1.

NAEI Vehicle Split		User Defined Base Fleet - England (2023)		
		Urban	Rural	Motorway
Cars	Conventional Petrol	0.41	0.39	0.36
	Hybrid Petrol	0.02	0.02	0.02
	Plugin Hybrid Petrol	0.03	0.02	0.02
	Conventional Diesel	0.28	0.31	0.30
	Hybrid Diesel	0.01	0.01	0.01
	Electric	0.07	0.03	0.03
LGVs	Petrol	0.01	0.01	0.01
	Diesel	0.14	0.15	0.14
	Electric	0.00	0.00	0.00
	Taxi	0.00	0.00	0.00
	Rigid HGV	0.01	0.02	0.03
	Articulated HGV	0.00	0.02	0.08
	Buses & Coaches	0.01	0.00	0.00
	Motorcycles	0.01	0.01	0.00

Adjusted Conventional Petrol car fleet

Adjusted Conventional Diesel car fleet

Adjusted electric car fleet

EFT Outputs

Below shows the EFT outputs for Current Road NO_x Annual Emission (Source ID 1) and Predicted Road NO_x Annual Emissions attributed by the implementation of Measure 2 (Source ID 2).

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	12,538.21328

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	12,208.25410

- Current Road NO_x Annual Emissions (Source ID 1) = 12,538 kg/yr
- Predicted Road NO_x Annual Emissions (Source ID 2) = 12,208 kg/yr
- Estimated Road NO_x Annual Emissions Reduction by Implementing Measure 2 = Current Road NO_x Annual Emissions (Source ID 1) – Predicted NO_x Annual Emissions (Source ID 2) = 330 kg/yr
- Estimated percentage reduction of Road NO_x Annual Emissions by implementing Measure 2 = 3%

In conclusion, there is an estimated reduction of 3% on NO_x Annual Emissions from road traffic by implementing Measure 2.

Example 3: Emissions-based Assessment – Speed Change

Measure 3 will improve traffic congestion in an AQMA and result in the average speed increasing to 30kph from the current 20 kph.

EFT Inputs – Selection

To generate the NO_x annual emission, the **Annual Link Emission** option needs to be selected as **Y** within the **Standard Outputs** section. The below example is using the **Basic Split** option for **Traffic Format** Input.

More detailed instructions on EFT input options are available in EFT User Guide[26].

EFT Inputs – Current Traffic Data (Source ID 1)

Assuming that:

- Current year is 2023
- The AQMA is in an urban area in England, outside of London
- Current total traffic flow through AQMA = 65396 (6.6% HDV)
- Average speed in AQMA = 20 kph
- Total link length within the AQMA = 2 km

EFT Inputs – Predicted Traffic Data with Measure Implemented (Source ID 2)

- Implementation year is 2023
- Improved average speed = 30 kph
- Total traffic flow through AQMA, %HDV and link length remain the same.

Primary Inputs		Pollutants	Selected	Standard Outputs	Selected	Additonal Outputs	Selected
Area	England (not London)	NO_x	Y	Air Quality Modelling (g/km/s)		Breakdown by Vehicle	
Year	2023	PM_{10}		Emissions Rates (g/km)		Source Apportionment	
Traffic Format	Basic Split	$PM_{2.5}$		Annual Link Emissions	Y	PM by Source	
All must be selected		CO_2				Primary NO_2 Fraction	
						Export Outputs	

SourceID	Road Type	Traffic Flow	% HDV	Speed(kph)	No of Hours	Link Length (km)	% Gradient
1	Urban (not London)	65396	6.6	20	24	2	
2	Urban (not London)	65396	6.6	30	24	2	

EFT Outputs

Below shows the EFT outputs for Current Road NO_x Annual Emission (Source ID 1) and Predicted Road NO_x Annual Emissions attributed by the implementation of Measure 2 (Source ID 2).

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	19,341.77026
2	NOx	15,909.55768

- Current Road NO_x Annual Emissions (Source ID 1) = 19,341 kg/yr
- Predicted Road NO_x Annual Emissions (Source ID 2) = 15,909 kg/yr
- Estimated Road NO_x Annual Emissions Reduction by Implementing Measure 3 = Current Road NO_x Annual Emissions (Source ID 1) – Predicted Road NO_x Annual Emissions (Source ID 2) = 3,432 kg/yr
- Estimated percentage reduction of Road NO_x Annual Emissions by implementing Measure 3 = 18%

In conclusion, there is an estimated reduction of 18% on NO_x Annual Emissions from road traffic by implementing Measure 3.

[26] EFT v12.0 User Guide. Available at: https://laqm.defra.gov.uk/wp-content/uploads/2023/11/EFTv12.0-user-guide-v1.0.pdf

Example 4: Emissions-based Assessment – Euro Fleet Improvement

Measure 4 will upgrade all the existing bus fleet to Euro VI while the total number of buses remains the same.

EFT Inputs – Selection

To generate the NO_x annual emission, the **Annual Link Emission** option needs to be selected as **Y** within the **Standard Outputs** section. The below example is using the **Basic Split** option for **Traffic Format** Input.

More detailed instructions on EFT input options are available in EFT User Guide[27].

EFT Inputs – Current Traffic Data (Source ID 1)

Assuming that:

- Current year is 2023
- The AQMA is located in an urban area in England, outside of London
- Current total traffic flow through AQMA = 65396 AADT (HDV 6.6%)
- Average speed in AQMA = 50 kph
- Total link length within AQMA = 2 km

Default Euro Fleet is used for current traffic conditions without Measure 4. No options need to be selected in Advanced Options and the below default vehicle fleet is used for calculating Source ID 1 Current Road NO_x Annual Emission.

Default Euro Proportions 2023 - England (not London)

Cars	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6 a/b/c	Euro 6 d-temp	Euro 6 d
Conventional Petrol	-	-	-	0.02	0.10	0.23	0.31	0.16	0.19
Hybrid Petrol				0.00	0.02	0.11	0.23	0.21	0.43
Plugin Hybrid Petrol					0.00	0.02	0.16	0.14	0.68
Conventional Diesel	-	-	-	0.01	0.10	0.34	0.37	0.09	0.08
Hybrid Diesel				0.00	0.00	0.01	0.10	0.23	0.65

LGVs	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6_1	Euro 6_2	Euro 6_3
Petrol LGV	-	-	-	0.03	0.08	0.12	0.07	0.21	0.50
Diesel LGV	-	-	-	0.01	0.06	0.19	0.12	0.26	0.36
Petrol Taxi	-	-	-	0.03	0.08	0.12	0.07	0.21	0.50
Diesel Taxi	-	-	-	0.01	0.06	0.19	0.12	0.26	0.36

Heavy Duty Vehicles	Pre-Euro I	Euro I	Euro II	Euro III	Euro IV	Euro V_EGR	Euro V_SCR	Euro VI	Euro II SCRRF	Euro III SCRRF	Euro IV SCRRF	Euro V SCRRF to EGR
Rigid HGVs	-	-	0.01	0.03	0.02	0.03	0.08	0.84	-	-	-	-
Artic HGVs	-	-	0.00	0.00	0.00	0.01	0.03	0.96	-	-	-	-
Conventional Buses	-	-	0.01	0.03	0.04	0.05	0.15	0.72	-	-	-	-
Hybrid Buses					-	0.20	0.59	0.21				
Conventional Coaches	-	-	0.01	0.03	0.04	0.05	0.15	0.72	-	-	-	-
Hybrid Coaches					-	0.20	0.59	0.21				

EFT Inputs – Predicted Traffic Data with Measure Implemented (Source ID 2)

With Measure 4 implemented in 2023, al the buses will upgrade to Euro VI, resulting in an increase in the composition of the Euro VI bus fleet to 100%:

- Total traffic flow through AQMA = 65396 (6.6% HDV)
- Speed and link length remain the same.
- Adjust Euro proportions based on shift in fleet composition. **Bespoke Euro Fleets** need to be selected as **Y** within the **Advanced Options**. In the **Bespoke Euro Fleet** Tab, first click **Populate with Defaults** button, then adjust the **User Euro Proportions**. Adjusted User Euro Proportions is shown in the figure below.
    - Adjusted Conventional Buses Euro VI fleet composition = 100%
    - Adjusted Hybrid Buses Euro VI fleet composition = 100%
    - All other Euro standard bus fleet (below Euro VI) = 0%

Please be aware that the Default Fleet values in EFT are displayed with two decimal places, but they actually have more decimal places. Therefore, it is recommended to copy the value to a separate spreadsheet for accurate calculation and ensure that all post-adjustment the user defined Euro fleet proportions add up to 1 for each vehicle type.

User Euro Proportions 2023 - England (not London)

Cars	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6 a/b/c	Euro 6 d-temp	Euro 6 d
Conventional Petrol	-	-	-	0.02	0.10	0.23	0.31	0.16	0.19
Hybrid Petrol				0.00	0.02	0.11	0.23	0.21	0.43
Plugin Hybrid Petrol					0.00	0.02	0.16	0.14	0.68
Conventional Diesel	-	-	-	0.01	0.10	0.34	0.37	0.09	0.08
Hybrid Diesel				0.00	0.00	0.01	0.10	0.23	0.65

LGVs	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6_1	Euro 6_2	Euro 6_3
Petrol LGV	-	-	-	0.03	0.08	0.12	0.07	0.21	0.50
Diesel LGV	-	-	-	0.01	0.06	0.19	0.12	0.26	0.36
Petrol Taxi	-	-	-	0.03	0.08	0.12	0.07	0.21	0.50
Diesel Taxi	-	-	-	0.01	0.06	0.19	0.12	0.26	0.36

Heavy Duty Vehicles	Pre-Euro I	Euro I	Euro II	Euro III	Euro IV	Euro V_EGR	Euro V_SCR	Euro VI	Euro II SCRRF	Euro III SCRRF	Euro IV SCRRF	Euro V SCRRF to EGR
Rigid HGVs	-	-	0.01	0.03	0.02	0.03	0.08	0.84	-	-	-	-
Artic HGVs	-	-	0.00	0.00	0.00	0.01	0.03	0.96	-	-	-	-
Conventional Buses	-	-	-	-	-	-	-	1.00	-	-	-	-
Hybrid Buses					-	-	-	1.00				
Conventional Coaches	-	-	0.01	0.03	0.04	0.05	0.15	0.72	-	-	-	-
Hybrid Coaches					-	0.20	0.59	0.21				

Adjusted Conventional Buses Euro VI fleet

Adjusted Hybrid Buses Euro VI fleet

EFT Outputs

Below shows the EFT outputs for current Road NO_x Annual Emission (Source ID 1) and Predicted Road NO_x Annual Emissions attributed by the implementation of Measure 2 (Source ID 2).

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	12,538.21328

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	11,799.47392

- Current Road NO_x Annual Emissions (Source ID 1) = 12,538 kg/yr
- Predicted Road NO_x Annual Emissions (Source ID 2) = 11,799 kg/yr
- Estimated Road NO_x Annual Emissions Reduction by Implementing Measure 4 = Current Road NO_x Annual Emissions (Source ID 1) – Predicted Road NO_x Annual Emissions (Source ID 2) = 739 kg/yr
- Estimated percentage reduction of Road NO_x Annual Emissions by implementing Measure 4 = 6%

In conclusion, there is an estimated reduction of 6% on NO_x Annual Emissions from road traffic by implementing Measure 4.

If required, data can be estimated from the qualitative assessment of a proposed soft measure, and the soft measure can then be assessed by emission-based assessment using the proxy data. Below Box 3-3 is an example of an emission-based assessment on school travel plan using the proxy data estimated in the above Box 3-1.

Box 3-3 Example of Emission Based Assessment – Calculation of NO_x Emission Reduction from School Travel Plans

Example: Emissions-based Assessment – School Travel Plans

Proposed school travel plan measure is estimated to result in 3% reduction in car use in five years, meanwhile the school car use is estimated to increase by 5% if no travel plan is implemented. The proxy data are estimated in the above Box 3-1 Below are the steps to assess the reduction in annual emissions of road-NO_x by implementing the proposed school travel plans.

EFT Inputs – Selection

To generate the NO_x annual emission, the **Annual Link Emission** option needs to be selected as **Y** within the **Standard Outputs** section. The below example is using the **Basic Split** option for **Traffic Format** Input.

More detailed instructions on EFT input options are available in EFT User Guide[28].

EFT Inputs – Future Scenario No School Travel Plans (Source ID 1)

Assuming that:

- Current year is 2023 and the assessed year is five years later 2028
- The location is in an urban area in England, outside of London
- Estimated future total traffic flow (total school car use) = 4746 AADT
- Average speed = 32 kph
- Total link length (average distance travel to school) = 2.6 miles = 4.2 km

EFT Inputs – Future Scenario with School Travel Plans (Source ID 2)

With proposed travel plan implemented in 2023, the number of total car use will reduce by 3% to 4400 AADT:

- Estimated future total traffic flow (total school car use) = 4400 AADT
- Speed and link length remain the same

Below shows the example EFT Inputs for the proposed school travel plans Emissions-based Assessment.

Primary Inputs		Pollutants	Selected	Standard Outputs	Selected	Additional Outputs	Selected
Area	England (not London)	NO_x	Y	Air Quality Modelling (g/km/s)		Breakdown by Vehicle	
Year	2028	PM_{10}		Emissions Rates (g/km)		Source Apportionment	
Traffic Format	Basic Split	$PM_{2.5}$		Annual Link Emissions	Y	PM by Source	
All must be selected		CO_2				Primary NO_2 Fraction	
						Export Outputs	

SourceID	Road Type	Traffic Flow	% HDV	Speed(kph)	No of Hours	Link Length (km)	% Gradient
1	Urban (not London)	4746	0	32	24	4.2	
2	Urban (not London)	4400	0	32	24	4.2	

[28] EFT v12.0 User Guide. Available at: https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

EFT Outputs

Below shows the EFT outputs for Current Road NO_x Annual Emission (Source ID 1) and Predicted Road NO_x Annual Emissions attributed by the implementation of the school travel plans (Source ID 2).

Source Name	Pollutant Name	All Vehicles (Annual Emissions (kg/yr except CO2 tonnes/yr))
1	NOx	998.97323
2	NOx	926.14459

- Future Road NO_x Annual Emissions without School Travel Plans (Source ID 1) = 999 kg/yr
- Predicted Road NO_x Annual Emissions with School Travel Plans (Source ID 2) = 926 kg/yr
- Estimated Road NO_x Annual Emissions Reduction by Implementing School Travel Plans = Future Road NO_x Annual Emissions without School Travel Plans (Source ID 1) – Predicted Road NO_x Annual Emissions with School Travel Plans (Source ID 2) = 72 kg/yr
- Estimated percentage reduction of Road NO_x Annual Emissions by implementing School Travel Plans = 7%

In conclusion, there is an estimated reduction of 7% on NO_x Annual Emissions from road traffic by implementing School Travel Plans.

An emissions-based assessment can also be used to quantify the reduction in $PM_{2.5}$ and PM_{10} emissions by selecting the relevant output pollutant in the EFT.

3.3 Concentration-based Assessments (Dispersion Modelling) - Road Traffic Measures

A concentration-based assessment is a method used to assess an air quality measure by calculating the impacts on pollutant concentrations. Under this assessment, the pollutant concentrations are modelled in the scenarios before and after the implementation of the assessed measure. The change in concentration can then be calculated and assessed for the proposed measure.

Dispersion modelling is the most detailed way to quantify the reduction in concentrations resulting from proposed traffic-based measures in an AQAP. The use of dispersion modelling requires the availability of supporting traffic data in the assessed areas, which shows the change in traffic parameters including traffic flows, average speeds, road geometry and fleet composition.

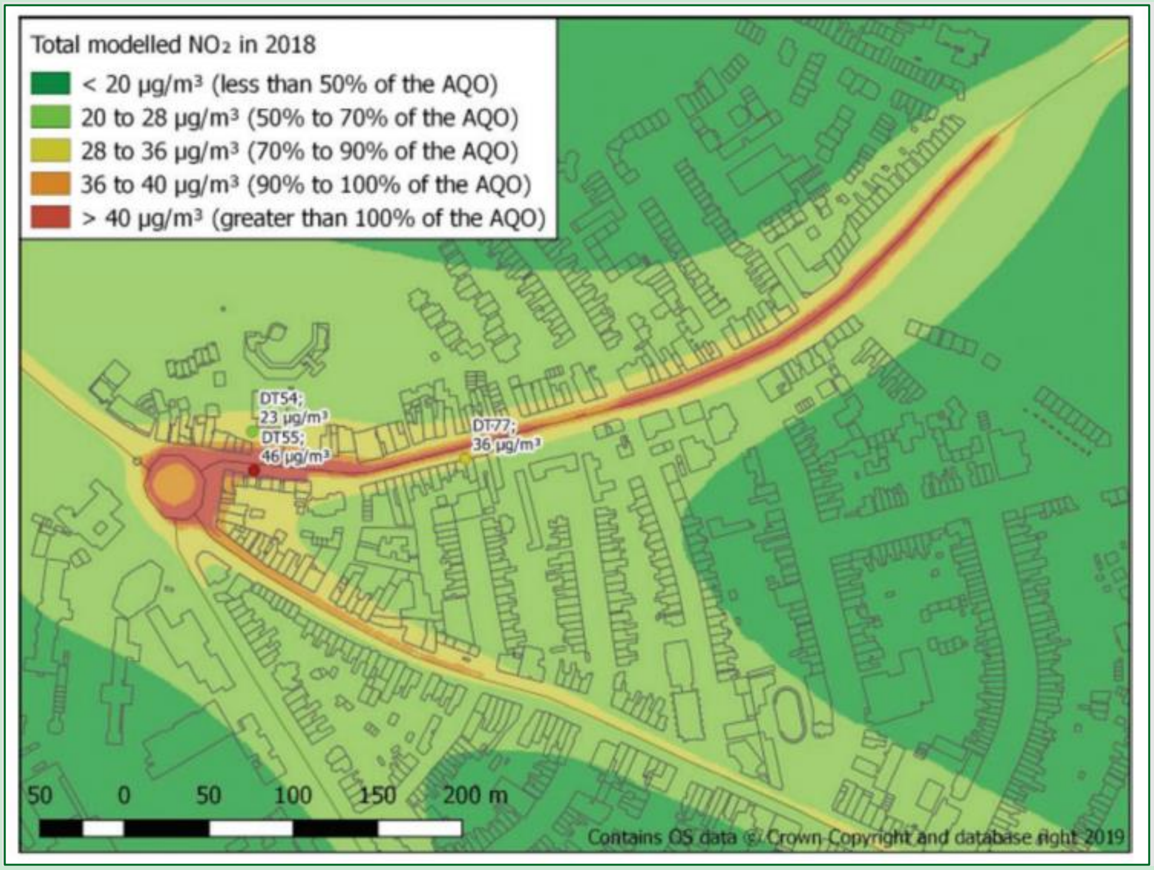
Where possible and appropriate, it is recommended to quantify the top 3 - 5 measures detailed in the AQAP by using dispersion modelling. In addition, it is possible to consider packages or combinations of measures as a singular model scenario, allowing for the determination of the cumulative impact of multiple proposed measures.

Comprehensive guidance on the use of dispersion modelling is provided in LAQM.TG(22) Chapter 7: Technical Supporting Information, Section 4: Dispersion Modelling of Emissions. The LAQM Support Helpdesk can also be contacted for further advice on related matters. Rather than duplicate these detailed instructions here, this section provides for an overview of the types of measures that can be assessed using such tools, the types of output that can be produced using such methods, and how these add value to the decision-making process when considering which measures to take forwards to implementation.

Figure 3.2 below presents three types of examples of concentration output maps generated from dispersion modelling exercises.

Figure 3.2 – Example Concentration Output Maps from Dispersion Modelling

Example 1: Contour Map for Modelled NO_2 Concentrations



Introduction

Example 1 presents a contour map for modelled annual mean NO_2 concentrations. As per the legend, the different coloured areas represent NO_2 concentrations within a defined range. For example, the yellow area on map shows the area where annual mean NO_2 concentrations are predicted to be between 28 µg/m^3 and 36 µg/m^3.

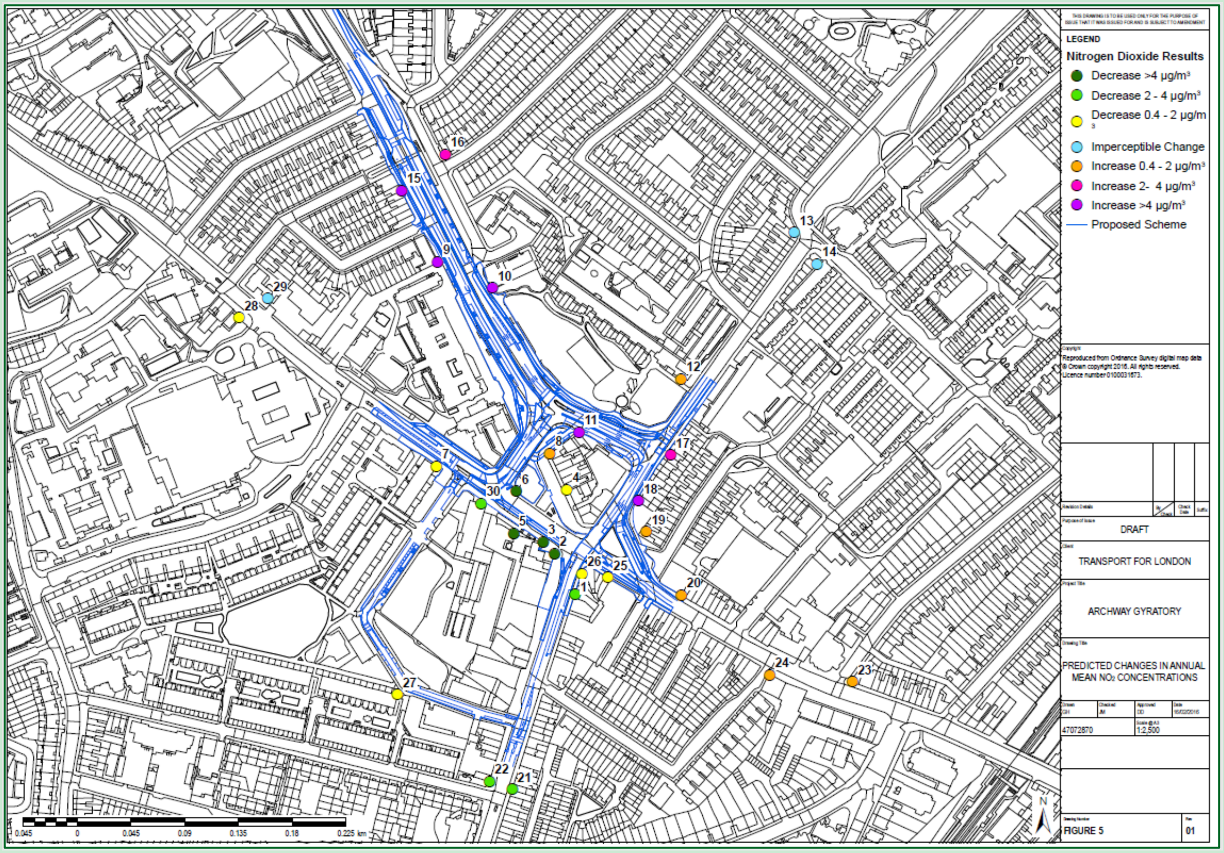
Benefits

The contour map can be used to identify 'hotspot' areas, i.e. where the highest pollutant concentrations occur and if any exceedances of the NO_2 annual mean objective are expected. Informed with this information, this can then help local authorities to determine the areas to be targeted for air pollution reduction measures, and the types of measures to consider implementing.

How to Produce

To generate a contour map, dispersion model concentration outputs are required to be output to either regular (e.g. 10 m × 10 m) or variable spaced (e.g. road source-oriented) gridded receptor points (or a combination of both). The pollutant concentrations at the various gridded receptor points can then be post-processed using a Geographic Information System (GIS) package or mapping software to generate a contour map as illustrated above.

Example 2: Map of Junction Improvement Impact on Selected Receptor Locations



Introduction

Example 2 presents a map for predicted annual mean NO_2 concentration changes at selected receptor locations, because of a junction improvement project. Each point represents a discrete receptor included within the modelling exercise. Different colours are used at each receptor location to represent different NO_2 concentration changes brought about by implementation of when the junction improvement project. For example, the green points on the map denote receptor locations where annual mean NO_2 concentrations are predicted to reduce between 2 µg/m³ and 4 µg/m³ attributed to the junction improvement project.

Benefits

The point map can be used to recognise the impact on specific receptors of concerns, and then to help local authorities to decide which measures to be used for specific sensitive receptors.

How to Produce

When carrying out detailed dispersion modelling, the pollutant concentrations need to be output at selected discrete specified receptor points, for both the current traffic condition scenario (i.e. without measure) and the scenario after the measure is implemented (i.e. with measure). The difference in pollutant concentrations at each common receptor point can then be calculated between the two scenarios; the difference being attributed to the measure being implemented. The predicted pollutant concentration differences can be input into a Geographic Information System (GIS) package or mapping software to generate a map as illustrated above.

3.4 Other Assessment Methods and Resources

3.4.1 GCS Evaluation Cycle

The Government Communication Service (GCS) Evaluation Cycle is a useful framework that local authorities can consider when assessing the potential impacts of air quality improvement campaigns and communications. The GCS Evaluation Cycle outlines a structured process for continuously evaluating communication activities and campaigns.

The key stages of the GCS Evaluation Cycle are:

1. Inputs - The planning and research that informs the communication activities.
2. Outputs - Measuring the audience reach and experience of the communications.
3. Outtakes - Assessing the audience's perceptions, beliefs and intentions.
4. Outcomes - Evaluating changes in audience behaviour.
5. Impact - Linking the communication outcomes to policy and organisational objectives.
6. Learning and Innovation - Capturing insights to inform future improvements.

The key factors that can be used to assess the impact include estimated total reach, direct contacts, events organised, volume of coverage, and partnerships secured.

By following this structured evaluation cycle, local authorities can ensure a comprehensive and evidence-based approach to assessing the potential impact of air quality improvement campaigns and communications.

Local authorities are encouraged to refer to the full GCS Evaluation Cycle guidance, available online, to inform their approach to evaluating the effectiveness of air quality campaigns. Applying a consistent evaluation framework can enhance the rigour, transparency and comparability of assessments across local authorities.

3.4.2 Non-Road Transport Sources

While the majority of AQMAs are related to road transport emissions, local authorities may also need to address non-road transport sources of air pollution when developing their AQAPs.

For power stations and industrial emission sources, these are typically regulated through the permitting process by the Environment Agency (EA). When an AQMA is declared due to concerns from these types of sources, the local authority should liaise closely with the operator to obtain a detailed assessment and mitigation plan.

The assessment and proposed measures provided by the operator can then be utilised by the local authority to inform the development of the AQAP. A good example of this collaborative approach is the Cheshire West and Chester - Thornton le Moors Air Quality Action Plan[29], where the local authority worked closely with the operator of an oil refinery to address the air quality issues in the area.

For other non-road transport sources, such as domestic, commercial or agricultural sources, the assessment and quantification of measures may need to follow different methodologies than those used for road transport. Local authorities can refer to LAQM.TG(22) Chapter 7-1 Screening Tools and Methodology for more technical information.

The key is for local authorities to take a holistic approach and engage with all relevant stakeholders, including emission source operators, to ensure a comprehensive understanding of the air quality issues and the appropriate mitigation measures to be included in the AQAP.

4 Cost Benefit Analysis

Cost Benefit Analysis is a systematic process used to illustrate the expected efficiency of the proposed measures and facilitate prioritisation. While conducting a full CBA is not mandatory for local authorities in the context of AQAPs and Air Quality Strategies, it can be a valuable tool for decision-making and resource allocation.

The purpose of conducting a CBA in the context of air quality improvement measures is to:

- Compare the potential benefits of different measures against their costs;
- Prioritize measures that offer the best value for money;
- Justify the allocation of resources to specific measures; and
- Provide a transparent basis for decision-making.

Local authorities may choose to conduct a CBA when:

- There are multiple potential measures to choose from and resources are limited;
- The costs or benefits of a measure are unclear or contentious;
- There is a need to justify the allocation of significant resources to a particular measure; or

[29] Cheshire West and Chester. Thornton le Moors Air Quality Action Plan, published December 2023. Available at: https://www.cheshirewestandchester.gov.uk/asset-library/aqap-thornton-le-moors-revised-2023-final.pdf

- Stakeholders require a clear, quantitative basis for decision-making.

It is important to note that whilst not all measures can be easily quantified, a form of cost benefit analysis can be applied to evaluate all measures. As a minimum, local authorities should rank the proposed measures based on their estimated costs and air quality impacts. This is an essential step to help prioritise measures to take forwards to implementation.

There is no defined approach for performing a CBA for the purposes of LAQM and AQAP measures development, and different methods of CBA can be adapted by local authorities depending on local factors. The Green Book[30] issued by HM treasury provides guidance on CBA for general policy and project assessment. This guidance note offers an example framework to undertake CBA for air quality improvement measures. In this example a simple multiplication of the score for the estimated cost and the score for the predicted air quality impact (in this case based on NO_2 concentration reduction), can provide an indication of the cost-effectiveness for each measure. This is represented by the formula:

Cost-Effectiveness Score = Cost Score × Impact Score

Where the Cost Score is a numerical representation of the monetary cost of the measure, and the Impact Score reflects the air quality impact. The Cost Score should also consider any revenue generated by the proposed measure, e.g. a charging CAZ will generate revenue to offset the initial costs.

Table 4.1 below presents a reference table for cost and impact scores. The scoring bands can be adjusted to fit local factors i.e. adjusting the approximate cost banding to be more appropriately in line with the specific measures that have been proposed.

The resultant Cost-Effectiveness Score can aid local authorities in the prioritisation of measures within the AQAP.

Table 4.1 – Reference Cost Scores and Impact Scores of Measures

Costs	
Score	**Approximate Cost (£)**
7	<10k
6	10k – 50k
5	50k – 100k
4	100k – 500k
3	500k – 1 million
2	1 million – 10 million
1	>10 million

[30] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020#valuation-of-costs-and-benefits

Air Quality Impacts	
Score	**Indicative Reduction in NO_2 Concentrations**
7	>5 µg/m^3
6	4-5 µg/m^3
5	3-4 µg/m^3
4	2-3 µg/m^3
3	1-2 µg/m^3
2	0.5-1 µg/m^3
1	<0.5 µg/m^3

To prioritise proposed measures in the AQAP, feasibility of a measure's implementation should also be considered. Feasibility of implementation may consider aspects such as the practicality of implementation, the feasibility of securing the necessary funding, time it will take to implement the measure and the alignment of each proposed measure relative to local/national politics and policies.

In this reference method, feasibility is scored on a scale from 1 to 7, aligning with the scoring range of the cost score and impact score. Here, 1 represents the least feasible, and 7 represents the most feasible. Table 4.2 below presents a reference feasibility score table. Local authorities can assign scores to each proposed measure based on these criteria.

Table 4.2 – Reference Feasibility Scores

Feasibility Score	Feasibility Description
7	Measure has already been started and just requires progressing
6	Very easy to implement, and political support, sufficient resources
5	Relatively easy to implement, resources available
4	Possible to implement but may require some learning/campaigning, moderately time intensive
3	Challenging but still feasible, may require additional support and resources
2	Difficult to implement, no political appetite, time and resource intensive
1	Very difficult to implement, no political appetite, time and resource intensive

The overall prioritisation score for each proposed measure can then be determined using the formula:

Prioritisation Score = Cost-Effectiveness Score × Feasibility Score

A higher prioritisation score represents those measures that generally have a lower cost, can generate greater air quality benefits, and are more feasible to implement. Therefore, the measures with the highest prioritisation scores should be typically prioritised by local authorities.

This comprehensive approach ensures that both the cost-effectiveness and feasibility of implementing a measure is taken into account when establishing priorities within the AQAP. By considering all of these factors together, local authorities can make informed decisions that balance air quality impacts, financial implications, and feasibility of implementation, whilst ensuring the Air Quality Objectives are met in the shortest possible time.

Box 4-1 below presents an example of a CBA on proposed air quality improvement measures, using the above framework.

Box 4-1 – Example of Cost Benefit Analysis

The table below presents an example of cost benefit analysis on four proposed measures where dispersion modelling has been undertaken to define the Air Quality Impact in NO_2 concentration reduction.

Measure	Approximate Cost (£)	Cost Score	Air Quality Impacts	Impact Score	Cost Effective Score	Feasibility Score	Prioritisation Score
Measure 1 – Junction Improvement Project	1 – 10 million	2	3.2 $\mu g/m^3$ NO_2 Reduction	5	10	4	40
Measure 2 – Car Share Scheme	50K - 100k	5	1.1 $\mu g/m^3$ NO_2 Reduction	3	15	8	120
Measure 3 – Urban Traffic Management and Control System	1 – 10 million	4	4.9 $\mu g/m^3$ NO_2 Reduction	6	24	4	112
Measure 4 – Taxi Financial Incentives	50K – 100k	5	0.9 $\mu g/m^3$ NO_2 Reduction	2	10	7	70

In conclusion, the priority of these four proposed measures should be ranked as follows:

- Measure 2 – Car Share Scheme
- Measure 3 – Urban Traffic Management and Control System
- Measure 4 – Taxi Financial Incentives
- Measure 1 – Junction Improvement Project

Measure 2 – Car Share Scheme should be prioritised by local authority as it presents the highest prioritisation score.

5 Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values’
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
LAQM	Local Air Quality Management
LAQM.PG(22)	Local Air Quality Management Policy Guidance 2022
LAQM.TG(22)	Local Air Quality Management Technical Guidance 2022
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
EA	Environment Agency
EV	Electric Vehicle
CAZ	Clean Air Zone
LEZ	Low Emission Zone
EFT	Emissions Factors Toolkit
HDV	Heavy Duty Vehicle
AADT	Annual Average Daily Traffic
IEC	Internal Combustion Engines
NAEI	National Atmospheric Emissions Inventory