CLEANER TRAVEL ACCESS FUND CAMPAIGN – ECONOMIC MODELLING RESEARCH

Summary Report

Report for: Asthma + Lung UK

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Ricardo, Gemini Building, Fermi Avenue, Harwell, Oxfordshire, OX11 0QR, UK | +44(0)1235 75 3000 | ee.ricardo.com
Registered company no. 08229264 | VAT no. GB 212 8365 24

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Contact:
Thomas Adams, Gemini Building, Fermi Avenue, Harwell, Didcot, OX11 0QR, UK

T: +44 (0) 1235 753 517
E: Thomas.Adams@ricardo.com

Author:
Thomas Adams, David Birchby, Charlotte Day, James Southgate, Joe Hague

Approved by:
David Birchby

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1. INTRODUCTION

Exposure to air pollutants can have a harmful effect on human and environmental health, in particular on the most vulnerable groups in society. Air pollution has been associated with a shortening of life and a range of morbidity effects – these effects present a cost to UK society, not just from the intrinsic loss of wellbeing and enjoyment of life (the utility effect) suffered by the individual, but also in terms of costs to health and social care services and lost productivity (e.g. where people participate in formal – i.e. paid employment – or informal – i.e. unpaid activities, such as caring – activities which provide a value for the economy and society as a whole). It is estimated that air pollution in the UK reduces the life expectancy of every person by an average of 7 – 8 months, with an associated cost of up to £20 billion each year.[1]

1.1 CLEAN AIR ZONES AND THE CLEANER TRAVEL ACCESS FUND CAMPAIGN

Road transport remains an important source of some of the most harmful air pollutants and is responsible for significant contributions to emissions of nitrogen oxides (NO_X) and particulate matter (PM), in particular in the centre of towns and cities.

In its 2017 NO_2 plan[2], UK government identified a number of cities and towns across the UK at risk of being in exceedance of legal limits of NO_2, and required them to assess and consider the introduction of a Clean Air Zone (CAZ) in order to reduce NO_2 to levels below legal limits as soon as possible. In the years since, many cities and towns have implemented CAZs, or are likely to do so in the near future. These city-level measures work alongside a range of national targets and measures to reduce air pollution: more recently the UK government has set targets to phase out the sale of new petrol and diesel vehicles by 2030.

There are currently nine CAZs (or equivalent charging measures) in England: Bath[3] (CAZ C), Birmingham[4] (CAZ D), Bradford[5] (CAZ C+), Bristol[6] (CAZ D), London[7] (Ultra-Low Emission Zone (ULEZ)), Tyneside[8] (CAZ C), Oxford[9] (Zero-Emission Zone (ZEZ)), Portsmouth[10] (CAZ B), and Sheffield (CAZ C) – three of these charge private passenger cars.

Although CAZs are relatively simple and low-cost for a local authority to put in place, the more significant costs of compliance fall on vehicle owners and operators. Furthermore, there is a risk of a strong, negative distributional effect, as older more polluting vehicles that would be non-compliant with a CAZ are more frequently owned by poorer individuals in society or smaller businesses (a risk often highlighted in the Distributional Analysis undertaken by Ricardo in its support to multiple CAZ feasibility studies, e.g. in Staffordshire[11] and Southampton[12]). However, little funding has been provided for private individuals to make the switch. Asthma + Lung UK estimate that only 20% of scrappage funding has been distributed to individuals, with most going to businesses and taxis. This has played a part in many CAZs being delayed or even shelved, as highlighted by Asthma + Lung UK's (referred to from here as A+LUK) 'Zoning in on Clean air' report[13].

In April 2023, A+LUK launched the 'Putting the brakes on toxic air' policy report[14], which set out the barriers and enablers to transitioning to cleaner modes of transport and demonstrated public support for a number of policy enablers to encourage the transition. One of the four recommendations resulting from this research was to establish a Cleaner Travel Access Fund (CTAF), a scrappage scheme for people on low incomes and people

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1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf

2 https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

3 https://beta.bathnes.gov.uk/bath-clean-air-zone

4 https://www.birmingham.gov.uk/info/20076/pollution/1763/a_clean_air_zone_for_birmingham

5 https://www.bradford.gov.uk/breathe-better-bradford/where-is-the-clean-air-zone/where-is-the-clean-air-zone/

6 https://www.bristol.gov.uk/residents/streets-travel/bristols-caz

7 https://tfl.gov.uk/modes/driving/ultra-low-emission-zone

8 https://www.newcastle.gov.uk/our-city/transport-improvements/transport-and-air-quality/newcastle-and-gateshead-clean-air-zone

9 https://www.oxford.gov.uk/zez

10 https://cleanerairportsmouth.co.uk/

11 https://moderngov.newcastle-staffs.gov.uk/documents/s34196/Appendix%2036%20-%20E3%20Distributional%20Analysis.pdf

12 https://www.southampton.gov.uk/moderngov/documents/s39084/E3%20Distributional%20Analysis.pdf

13 https://www.asthmaandlung.org.uk/zoning-in-on-clean-air

14 https://www.asthmaandlung.org.uk/putting-brakes-toxic-air

with long term health conditions. The intention is to target such funding particularly at those cities considering a CAZ (D). Although the CTAF directly targets the removal of older, more polluting vehicles, the intention is that this would sit as part of a wider push to encourage more sustainable and active travel. The CTAF offers targeted, financial support to those who would face the most difficulty in complying with the CAZ – namely the poorest households, who frequently rely on their vehicle as a means of travel to work, school, healthcare, and other critical activities. The CTAF therefore helps to overcome a potential unequal burden on these groups, but also mitigate the knock-on effects on the local society and economies (e.g. avoiding people cancelling trips to work and urban centres).

The key features of the proposed CTAF scheme, as outlined in A+LUK's 'Putting the brakes on toxic air' policy report, are:

- It is targeted towards people on lower incomes and people with long-term health conditions that affect their mobility;
- The funding would come from central government for communities that implement a Class D CAZ, to help with the financial cost of strong clean air policies;
- The scheme should support people to use the cleanest modes of transport that they can access; and
- Consumer choice should be a key principle, allowing those eligible to access a combination of grants for active travel, public transport, and electric vehicles.

1.2 AIMS AND OBJECTIVES OF THIS STUDY

Asthma + Lung UK (A+LUK) is the UK's lung charity with a vision for a world where everyone has healthy lungs. The key objective of this study is to develop a robust assessment of the health and economic benefits of the Cleaner Travel Access Fund. This will focus on the impacts on human health, exploring both the overall quantified and monetised impact which can be compared to the estimated costs of the scheme (£777million based on the eligibility criteria and the areas with illegal levels of pollution expected under a Class D CAZ), but also the varying contributing effects which may be of greater interest to different audiences – e.g. impacts on productivity, children, and educational attainment, on health inequalities, etc.

The scope of the appraisal is England-wide, but study provides additional detailed modelling for four focus areas: Liverpool City Region, Greater Manchester, West Yorkshire, and the West Midlands.

For the full methodology and results for all aspects of this study, please refer to the accompanying Technical Report.[15]

[15] CTAF Campaign – Economic Modelling Research Technical Report, Ricardo, October 2023

2. AIR QUALITY MODELLING

The potential air quality improvements that could be achieved as a result of implementing a CAZ D[16] vehicle scrappage scheme have been assessed in detail for four regions in England, and the impact of a wider uptake of the scheme across England has also been estimated. The modelling results are representative of implementation of the proposed CTAF in isolation, and therefore do not include the impact of implementing CAZ D restrictions in any city.

2.1.1 Methodology overview

To quantify the potential air quality improvements that could be achieved as a result of implementing the proposed CTAF, we have modelled two road transport emissions scenarios:

1. 2019 Baseline – Representative of road transport emissions in 2019 with no changes applied; this scenario is used to provide a baseline situation from which to assess the impact of the proposed CTAF.
2. 2019 CTAF – Representative of emissions in 2019 with the CTAF in place; this scenario is the same as the 'Baseline' scenario, but with assumptions applied to represent implementation of the CTAF.

The estimated impact of the CTAF scheme is therefore the difference between scenarios 1 and 2. The year 2019 was chosen for the study as this is the most recent year that the emissions maps are available for, that is not impacted by the COVID-19 pandemic.

Three CTAF uptake domains were developed to investigate the potential impacts of the CTAF scheme being applied across different numbers of cities in England:

- "Cost" uptake domain – to estimate the impacts of applying the CTAF scheme in four local authorities and representative of the CTAF scheme as costed in A+LUK's "Putting the brakes on toxic air" report.
- "Detailed model" domain – to estimate the impacts of applying the CTAF scheme in the 28 local authorities within Greater Manchester, Liverpool City Region, West Midlands, and West Yorkshire.
- "England-wide" domain – to estimate the impacts of applying the CTAF scheme in 89 local authorities exceeding the annual mean NO_2 standard in 2019, to represent the potential impacts of wider uptake of the CTAF.

For the "Detailed model" domain, the potential air quality improvements have been quantified in terms of both total annual emissions reductions of oxides of nitrogen (NO_X), particulate matter (PM_{10}, $PM_{2.5}$), and carbon dioxide (CO_2), and annual mean concentration improvements of nitrogen dioxide (NO_2), PM_{10}, and $PM_{2.5}$. For the "Cost" and "England-wide" domains, the potential air quality improvements have been quantified in terms of total annual emissions reductions only.

This Summary Report presents the key findings if the CTAF scheme were implemented across the "England-wide" domain, which focuses on reductions in annual emissions of NO_X, PM_{10}, $PM_{2.5}$, and CO_2 from the road transport sector. For the full set of results, including all three uptake scenarios, and changes in pollutant concentrations, please refer to the Technical Report.[17]

2.1.2 England-wide results – change in annual emissions from the road transport sector

Table 2-1 provides a summary of the reduction in total annual emissions (in tonnes) of NO_x, PM_{10}, $PM_{2.5}$, and CO_2 from the road transport sector as a result of the CTAF being applied across the "England-wide" domain. The reduction in emissions is the difference between the total emissions from road transport from all the 1 km grid squares within the CTAF uptake domain, under the Baseline and CTAF scenarios.

Total emissions of particulate matter from road transport are generally lower than emissions of NO_x, and emissions of CO_2 tend to be much greater than emissions of NO_x / PM; the scale of the emissions reductions in the modelling results also reflects this (i.e., smaller changes to PM emissions are observed compared to NO_x or CO_2).

[16] CAZ D restrictions apply to buses, coaches, taxis, private hire vehicles, heavy goods vehicles, vans, minibuses, cars, and the local authority has the option to include motorcycles.

[17] CTAF Campaign – Economic Modelling Research Technical Report, Ricardo, October 2023

Table 2-1 Summary of total annual emissions reductions (in tonnes) of NOx, PM_{10}, $PM_{2.5}$, and CO_2, from the road transport sector, for the England-wide CTAF uptake scenario, compared to baseline emissions

CTAF uptake domain	Annual emissions reduction (tonnes)			
	NOx	PM_{10}	$PM_{2.5}$	CO_2
England-wide (89 LAs)	1,670	158	99.9	802,000

Table 2-2 provides a summary of the reduction in total annual emissions as a proportion of the baseline emissions from the road transport sector, as a result of the CTAF being applied across England. Despite the differences in magnitude of emissions removed (in tonnes) as a result of CTAF implementation, the percentage reductions in emissions are broadly similar across all pollutants, in the range of 2-3%.

Table 2-2 Summary of total annual emissions reductions (%) of NOx, PM_{10}, $PM_{2.5}$, and CO_2, from the road transport sector, for the England-wide CTAF uptake scenario, compared to baseline emissions

CTAF uptake domain	Annual emissions reduction (%)			
	NOx	PM_{10}	$PM_{2.5}$	CO_2
England-wide (89 LAs)	2.20%	2.73%	2.70%	2.65%

The main emissions modelling using the NAEI 1 km emissions maps accounted for road transport emissions changes for the 1 km grid squares within the CTAF uptake domain; this can be considered to be the 'city emissions' removed as a result of CTAF implementation in those local authorities. However, there are also likely to be additional wider impacts of the CTAF from removal of vehicles travelling outside the domain boundary, i.e., 'all emissions' removed as a result of the CTAF. Additional emissions calculations were carried out to attempt to estimate the potential wider impact of the CTAF on emissions (i.e., from vehicles travelling outside the CTAF uptake domain boundary).

Table 2-3 presents the results of the emissions calculations based on a specified number of CAZ non-compliant petrol and diesel cars[18] travelling an assumed 13,000 km per annum[19]. For the England-wide CTAF uptake scenario, the estimated reduction in road transport emissions of NOx, PM_{10} and $PM_{2.5}$ are approximately eight times greater considering 'all emissions' than when 'city emissions' are considered. For CO_2, the reduction is around nine times greater considering 'all emissions' than when 'city emissions' are considered.

Table 2-3. Summary of total annual emissions reductions (in tonnes) of NOx, PM_{10}, $PM_{2.5}$, and CO_2, from removal of emissions from a specified number of CAZ non-compliant cars as a result of the CTAF being applied across England

Scenario	No. cars assumed	Annual emissions reduction (tonnes)			
		NOx	PM_{10}	$PM_{2.5}$	CO_2
England-wide (89 LAs)	3,020,000	14,200	1,290	782	7,070,000

[18] The proportion of petrol and diesel cars was taken as the national average for 2019, from NAEI data. To model CAZ non-compliant vehicles only, the non-compliant Euro standards from the default NAEI Euro standards for petrol/diesel cars for 2019 were normalised and applied in the EFT.

[19] Based on Ricardo study for TfL (2014): 'Environmental Support to the Development of a London Low Emission Vehicle Roadmap' (unpublished), and as deployed in multiple Clean Air Zone feasibility studies undertaken by Ricardo

3. HEALTH IMPACT ASSESSMENT

3.1.1 Methodology overview

The health impact analysis is split into four separate work-strands:

- Overall Health Impact Assessment (HIA) (following the Defra/IGCB approach);
- Assessment of impacts on productivity specifically;
- Assessment of impacts on children and education specifically; and
- Comparing costs and benefits of the CTAF.

To assess the impacts of the proposal on human health via changes in exposure to air pollution, we have undertaken a quantitative assessment following the latest, best-practice guidance around the appraisal of these effects issued by the UK-Government[20]. This includes taking into account recent changes as captured in the Damage Cost 2023 update. The output is a quantified effect of the proposal on the number of detrimental health outcomes associated with exposure to air pollution (e.g. change in hospital admissions), presenting the change in 'attributable' health outcomes. The health impacts are then monetised to present the 'economic' benefits – this captures a range of effects, such as the direct impact on the utility of the affected individual (commonly captured by the 'willingness-to-pay' of the individual to avoid the detrimental health outcome), impacts on productivity and a reduction in medical costs.

Air pollution can have a range of impacts on 'productivity' through its effects on human health, either removing people's ability to participate in formal (i.e. paid) or informal (i.e. unpaid – e.g. volunteering or caring) activities that provide a benefit for society. For this study, we produced three estimates of productivity effects for consideration: 1. Damage cost pathways, splitting out the productivity pathways in the Defra's appraisal guidance and damage costs (e.g. work-loss days); 2. More complete bottom-up assessment, where we also include other pathways considered in Ricardo's original productivity study for Defra, but not included in the damage costs; and 3. Top-down estimation, deploying the approach adopted by the EU to estimate overall productivity effects (for example, as was deployed in a study to support the impact assessment for proposal to revise the EU's Ambient Air Quality Directive[21]), but which is not widely applied in UK studies. By splitting out the pathways which are part of the 'formal' paid economy, we can also isolate an impact on gross domestic product (GDP).

Children and young people are particularly susceptible to the detrimental effects of air pollution, as exposure has a damaging effect during the development of their respiratory and cardiovascular systems. Defra's damage costs capture several impacts on children specifically – school days lost (SDL), and asthma in children. To explore the effects on children and educational attainment, we have split these out from the core health impact assessment.

A final work-strand draws together the quantification and monetisation of effects for comparison to the costs of the proposal, as estimated in Asthma + Lung UK's 'Putting the brakes on toxic air' report[22]. To complement to comparison, we have also produced a high-level estimate of the fuel saving and greenhouse gas (GHG) emission reduction benefits associated with removing these vehicles from the roads.

3.1.2 England-wide results

Health impacts have been quantified both in terms of a change in health outcome, but also as a monetised economic impact. Health outcomes in turn are also expressed in two ways, as a change in health outcome and health metric for monetisation. The results of the analysis are presented in the following tables (Table 3-1 and Table 3-2).

For the England-wide CTAF uptake domain, the changes in air pollution associated with the scheme are anticipated to deliver:

- A total economic benefit of £254m per year if the CTAF is rolled out across England (of which £50.2m per year is associated with reduction in emissions in urban areas).

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[20] Please see the Glossary in Appendix 1 for a definition of damage costs
[21] https://op.europa.eu/en/publication-detail/-/publication/a05c2e91-54db-11ed-92ed-01aa75ed71a1/language-en
[22] https://www.asthmaandlung.org.uk/putting-brakes-toxic-air

- Reducing the mortality impacts of air pollutant exposure across England by 2,637 life years lost (LYLs) – expressed another way, the CTAF will reduce deaths by 260 across England per annum.
- CTAF is also estimated to reduce the number of hospital admissions for respiratory conditions by around 174 per annum across England.

Table 3-1 Health and economic benefits of CTAF for the England-wide (damage costs) uptake domain

Domain	Mortality associated with long-term exposure	Respiratory hospital admission	IHD	Stroke	Lung cancer	Asthma (all children)	Asthma (small children)	Asthma (older children)	TOTAL Monetised impacts
Units	*Deaths*	*HA*	*#cases*	*#cases*	*#cases*	*#cases*	*#cases*	*#cases*	*£2022 prices m*
England-wide (89 LAs) – all emissions	260.00	174.00	24.80	30.30	14.60	44.30	95.50	32.50	254

Looking specifically at productivity, across the England-wide domain, the CTAF is estimated to deliver:

- A total economic productivity benefit of £3.0m, rising to £8.4m where a greater range of pathways are included (or £2.9m to £7.3m in terms of an impact on GDP).
- Each year, avoiding the loss of: 136 work years, 20,400 work days, 34,000 care hours, and 25,000 volunteer hours.

Table 3-2 Productivity impacts of CTAF for the England-wide (damage cost) uptake domain

Domain	Mortality associated with long-term exposure (all employed persons)	Chronic bronchitis (all employed persons)	Work days lost (all employed persons)	School days lost (all employed persons)	(minor) Restricted Activity Days (all employed persons)	Mortality associated with long-term exposure (carers)	Work days lost (carers)	Mortality associated with long-term exposure (volunteers)	Work days lost (volunteers)	TOTAL – APPROACH 1	*TOTAL – APPROACH 1 – GDP ONLY*	TOTAL – APPROACH 2	*TOTAL – APPROACH 2 (GDP)*
Units	*WYL*	*WYL*	*WDL*	*WDL*	*WDL*	*Care hours*	*Care hours*	*Volunteering hours*	*Volunteering hours*	*£2022 prices m*	*£2022 prices m*	*£2022 prices m*	*£2022 prices m*
England-wide (89 LAs)	104.26	31.45	14,458	995	4,988	29,774	3,902	23,716	1,630	2.97	2.86	8.44	7.33

Notes: *Pathways included in the damage costs are a subset of all pathways shown here. These are denoted by lighter blue in the header row. **m** = £million

The Defra approach captures pathways which quantify the impacts of air pollution on children. These are split out in the following table (Table 3-3). As can be seen in the table, the change in air pollution emissions and exposure as a consequence of the CTAF scheme can have a positive impact on child health and school attendance, and in turn on educational attainment. For the England-wide domain, the CTAF scheme is estimated to reduce the number of missed school days (SDL) by 6,600 per year, and reduce the number of new cases of asthma by around 172 per year. However, the Defra approach only captures two of an increasing list of impacts that air pollution can have on children, and subsequently on their educational attainment. A number of other effects on children have been linked to exposure to air pollution, for which robust methods of quantification do not yet exist – this includes negative impacts on a broader group of acute lower respiratory infections in children, leukaemia, growth, mental health and IQ.

Table 3-3 Impact of CTAF on children across England-wide (damage costs) uptake domain

	School days lost	Asthma (Small Children – 0-5)	Asthma (Older Children – 6-15)
England-wide domain (damage costs)			
Units	*SDL*	#cases	#cases
England-wide (89 LAs) – all emissions	6,620	95.50	76.8

The air pollution benefits delivered by the CTAF are only part of the story. The CTAF would also incur costs to deliver, and achieve additional benefits. Comparing costs and benefits provides an illustration of the merits of the CTAF scheme, as shown in Table 3-4.

Table 3-4 Summary of costs and benefits of the CTAF scheme

Impact	Estimated value
Grant for low-income households switching to AT/PT	-£144m
Blue-badge holders purchasing EVs	-£34m
TOTAL COSTS	**-£179m**
Fuel saving	£160m
Opex saving	£79m
GHG emission saving	£179m
AQ emission saving	£21.8m
TOTAL BENEFITS	**£440m**
NET PRESENT VALUE	**£261m**
BENEFIT-COST RATIO	***2.5***

The CTAF scheme is assessed to deliver a net benefit to society (i.e. it has a positive net present value) of around £261m per year. These benefits would persist over the period where behaviour change to switch to active travel or public transport is maintained, and/or over the lifetime of the EVs purchased. The scheme is estimated to deliver a benefit-to-cost ratio of 2.5 – i.e. for every £1 invested in the scheme, there is a payback of £2.50 for society (this ratio would be even higher when only considering costs incurred by the funder). There are costs to the scheme, including additional costs of EVs over and above the grant funding provided. However, the switch to active travel, public transport and EVs delivers significant benefits, in particular through fuel and GHG emissions savings which outweigh the costs of the scheme. Air pollution benefits in the urban centres deliver an additional important benefit for the scheme.

4. OVERVIEW OF DISTRIBUTIONAL IMPACT ASSESSMENT

The distributional impact assessment evaluates the relationship between the presence of different demographic groups in a given area and against the corresponding change in NO_2 concentrations. The change in annual average NO_2 pollutant was calculated by considering the average concentration of NO_2 across a spatial area from the modelling outputs for both the baseline and the CTAF scenarios. NO_2 was selected as the pollutant for analysis (as opposed to $PM_{2.5}$ which was also assessed in detail) as it was considered that given that the issues and impacts associated with NO_2 are more local to the source of emissions, it was considered that any distributional trends would be more significant (and hence more apparent) relative to those associated with $PM_{2.5}$. Lower Super Output Areas (LSOAs) were used to define the spatial regions applied to the analysis. These spatial regions were selected as it was the highest spatial resolution that could be used alongside publicly available demographic datasets.

Distributional impact assessments were carried out across the four detailed modelling regions – Greater Manchester, Liverpool City Region, West Midlands, and West Yorkshire. For all regions, there is a linear trend between areas with the largest change in modelled annual mean NO_2 concentrations and those with the highest level of deprivation.

Overall, the analysis suggests that the introduction of the CTAF scheme will benefit to a greater extent:

- Those living in more /the most deprived (Quintile 5) areas relative to those living in lesser/the lowest deprived areas.
- Areas with higher populations of children, relative to areas with lower populations of children (although the significance of the difference between areas is less than that for deprivation)
- Areas with lower proportions of elderly residents, relative to areas with higher proportions of elderly residents.

5. CONCLUSIONS

Emissions and air dispersion modelling were used to predict the air quality impacts of implementing the CTAF scheme for local authorities in England. Three CTAF uptake domains were developed to investigate the potential impacts of the scheme being implemented by different numbers of cities across England: a "Cost", "Detailed model", and "England-wide" domain to estimate the impacts of applying the CTAF scheme in increasingly larger areas of England and represent the potential impacts of wider uptake of the CTAF. The results showed that the modelled reductions in NO_2, particulate matter (PM_{10} and $PM_{2.5}$), and CO_2 emissions increased with increased uptake of the CTAF scheme.

Should the CTAF be rolled out England-wide, the scheme could deliver a total economic benefit of £254m per year. This represents a greater achievement of health benefits, equivalent to reducing the mortality impacts of air pollutant exposure by 2,640 LYLs (or in other words, reduce deaths by 260), and hospital admissions for respiratory conditions by 174 per annum. By way of comparison, an assessment of the proposed London-wide Ultra-Low Emission Zone (ULEZ) suggested that scheme could reduce LYLs associated with air pollution exposure by 59 LYLs each year, reduce respiratory hospital admissions by 1.4 per year, and deliver a total economic benefit of £13.0m per year (2020 prices) across Greater London.

One of the impacts captured in the comprehensive figures above is an important effect on productivity. If rolled out England-wide, the total boost to the economy could be around £8.4m benefit per year (following Defra's guidance for appraising such effects). That said, alternative approaches to assessing such effects produce much higher estimates – for example, adopting a 'top-down' approach as commonly used in European studies (but not widely applied in the UK), the overall productivity impacts could be significantly greater, estimated to be as large as a combined £35.7m benefit per year across the four cities in the detailed modelling domain alone.

CTAF could also importantly mitigate some of the negative impacts of air pollution on children, school attendance and educational attainment. England-wide, the scheme could reduce the number of missed school days (SDL) by 6,600 per year, and reduce the number of new cases of asthma by around 172 per year.

The analysis has also compared the costs and benefits of CTAF to provide an overall illustration of the merits of the CTAF scheme. The CTAF scheme is assessed to deliver a net benefit to society (i.e. it has a positive net present value) of around £261m per year. These benefits would persist over the period where behaviour change to switch to active travel or public transport is maintained, and/or over the lifetime of the EVs purchased. The scheme is estimated to deliver a benefit-to-cost ratio of 2.5 – i.e. by investing in a fair transition to cleaner modes of travel, the government are getting a 2.5-for-1 deal: for every £1 invested in the scheme, there is a payback of £2.50 for society (this ratio would be even higher when only considering costs incurred by the funder).

An additional benefit captured as part of the comparison of costs and benefits is an additional climate change benefit: CTAF is estimated to deliver 608 ktCO2e of GHGs avoided, helping to protect our planet from climate breakdown.

APPENDICES

APPENDIX 1 GLOSSARY AND ABBREVIATIONS

Term	Meaning
A+LUK	Asthma + Lung UK
AADT	Annual Average Daily Traffic
Air quality model	A mathematical simulation of how air pollutants disperse and react in the atmosphere to affect ambient air quality.
Air quality standard	A statutory limit, usually set as an airborne concentration which should not be exceeded in order to avoid unacceptable risks of air pollution impacts. The standard may be specified to allow a certain number of exceedances of the limit value.
Ambient air quality	The quality of the outside air that we breathe in terms of the amount of pollutants it contains.
Averaging period	The time over which a pollutant concentration is measured, modelled, and evaluated. Relevant averaging periods range from a few seconds for odours, through 15 minutes for sulphur dioxide, one to twenty-four hours (a wide range of pollutants), to a year (a wide range of pollutants).
BBH	Blue Badge Holder
CAZ	Clean Air Zone
CBA	Cost-Benefit Analysis
CO_2	Carbon dioxide (CO_2) is a greenhouse gas that traps heat in the atmosphere. It is commonly emitted from the extraction and burning of fossil fuels (such as coal, oil, and natural gas), from wildfires, and natural processes like volcanic eruptions.
CTAF	Cleaner Travel Access Fund
Damage costs	Damage costs are summary estimates of the monetized impacts of air pollution, summarised as a cost per tonne emitted.
DfT	Department for Transport
EFT	Emissions Factors Toolkit
EV	Electric vehicle
GDP	Gross Domestic Product, a measure of the monetary value of final goods and services (e.g., of a country).
GHG	Greenhouse gases (GHGs) are gases in the Earth's atmosphere that trap heat. Greenhouse gases cause the greenhouse effect by absorbing some of the heat a planet's surface radiates in response to light from its host star (e.g., the Sun for planet Earth).
GVA	Gross Value Added. Gross value added (GVA) is an economic productivity metric that measures the contribution of a corporate subsidiary, company, or municipality to an economy, producer, sector, or region. GVA is the output of the country less the intermediate consumption, which is the difference between gross output and net output.
HA	Hospital admission
ICE	Internal-combustion engine
IGCB	Interdepartmental Group on Costs and Benefits
IMD	Index of Multiple Deprivation
IPA	Impact Pathway Approach
JAQU	Joint Air Quality Unit

Term	Meaning
LSOA	Lower Super Output Area
LYLs	Life years lost is a summary measure of premature mortality. It estimates the years of potential life lost due to premature deaths.
Morbidity	The annual rate of ill health in a given population (e.g., hospital admissions per 100,000 people)
Mortality	The annual rate of death in a given population (e.g., deaths per 100,000 people)
MSOA	Medium Super Output Area
NAEI	National Atmospheric Emissions Inventory
NO	Nitric oxide
NO_2	Nitrogen dioxide (NO_2) is an air pollutant, typically emitted from combustion processes and road traffic. Nitrogen dioxide reacts reversibly to form nitric oxide and vice versa, by interaction with sunlight, ozone, and other oxidants in the atmosphere. At high levels, nitrogen dioxide can have acute effects on health, and long-term exposure can also result in an increase in respiratory and cardiovascular disease, and premature deaths. Deposition of nitrogen dioxide also contributes to acidification and eutrophication.
NO_x	For most practical purposes, oxides of nitrogen (NOx) comprise nitric oxide (NO) and nitrogen dioxide (NO_2).
OAP	Old Age Pensioner
OECD	Organization for Economic Co-operation and Development
Opex	Ongoing annual operating costs.
PM	Particulate matter (PM) is an air pollutant, emitted from a wide range of sources, including combustion processes, road traffic, agriculture, construction, and natural sources. Airborne particulate matter can cause a nuisance due to dust deposition, and finer fractions (PM_{10} and $PM_{2.5}$) can have effects on health.
PM_{10}	Particulate matter with a diameter of less than 10 microns (10×10^{-6} meters). At high levels, PM_{10} can have acute effects on health, and long-term exposure can also result in an increase in respiratory and cardiovascular disease, and premature deaths.
$PM_{2.5}$	Particulate matter with a diameter of less than 2.5 microns (2.5×10^{-6} meters). At high levels, $PM_{2.5}$ can have acute effects on health, and long-term exposure can also result in an increase in respiratory and cardiovascular disease, and premature deaths.
QALYs	Quality adjusted life year. The quality-adjusted life year (QALY) is a generic measure of disease burden, including both the quality and the quantity of life lived. One quality-adjusted life year (QALY) is equal to 1 year of life in perfect health.
SDL	School days lost
Spearman's Rank Correlation Coefficient	Spearman's Rank correlation coefficient is a technique which can be used to summarise the strength and direction (negative or positive) of a relationship between two variables. The result will always be between 1 and minus 1, where a result of 1 or -1 suggests that two variables are perfectly correlated, and a value of 0 where there is no correlation between two variables.
TAG	Transport Analysis Guidance
WHO	World Health Organization

APPENDIX 2 LOCAL AUTHORITIES INCLUDED IN ENGLAND-WIDE CTAF UPTAKE SCENARIO

Table A- 1. List of local authorities included in the "England-wide" CTAF uptake scenarios

Local authority		
Barking and Dagenham	Haringey	Rochdale
Barnet	Havant	Rochford
Basildon	Havering	Rotherham
Bexley	Hillingdon	Rushmoor
Birmingham	Hounslow	Salford
Bolsover	Islington	Sandwell
Bolton	Kensington and Chelsea	Sefton
Bournemouth, Christchurch and Poole	Kingston upon Thames	Sheffield
Bradford	Kirklees	Slough
Brent	Knowsley	Solihull
Bristol, City of	Lambeth	Southampton
Bury	Leeds	Southwark
Calderdale	Leicester	Spelthorne
Camden	Lewisham	St. Helens
City of London	Liverpool	Stockport
County Durham	Manchester	Stoke-on-Trent
Coventry	Merton	Surrey Heath
Crawley	Middlesbrough	Tameside
Croydon	New Forest	Tower Hamlets
Derby	Newcastle upon Tyne	Trafford
Dudley	Newcastle-under-Lyme	Wakefield
Ealing	Newham	Walsall
Enfield	North Tyneside	Waltham Forest
Fareham	Nottingham	Wandsworth
Gateshead	Oldham	West Northamptonshire
Greenwich	Plymouth	Westminster
Guildford	Portsmouth	Wigan
Hackney	Reading	Wirral
Halton	Redbridge	Wolverhampton
Hammersmith and Fulham	Richmond upon Thames	
Total		**89**

T: +44 (0) 1235 75 3000

E: enquiry-ee@ricardo.com

W: www.ricardo.com