CEPA

Benefits and costs of an enhanced Clean Air Fund

Report to UK100

August 2019

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Executive Summary

Requirement and scope

- **The UK is currently exceeding legal limits of NO$_2$ in the air**, with other pollutants (e.g. SO$_x$, PM$_x$) also causing health concerns. Exceedances of pollutants are particularly bad in urban areas with high levels of traffic, due to the emissions from diesel and petrol vehicles. This, combined with ambitious 2050 CO$_2$ targets, has brought the environmental impact of road transport to the forefront of UK environmental policy.

- **The government has called on 60 local authorities to create clean air plans, including requiring five cities to develop Clean Air Zones (CAZs) to deal with NO$_2$ pollution issues.**

- **The Clean Air Fund (CAF) makes available £220m of spending over the period 2018/19-2020/21.** The CAF's key objective is to:

  "support individuals and businesses affected by local nitrogen dioxide plans"

- **UK100 is seeking Government support for an enhanced CAF,** including for London which has historically been excluded from the CAF, which would enable the delivery of CAZs across the UK and support a national fleet renewal programme to deliver WHO air quality standards.

- **UK100 has requested CEPA undertake analysis to set out the benefits and costs of the delivery of CAZs, with the aim of demonstrating that an enhanced CAF has a positive economic case**

  - The outputs will be used as inputs to present the case for the scheme to Government. We have previously supported development of TfL's ULEZ scrappage scheme proposals.

  - UK100 has requested that we assess a theoretical/notional CAZ, which can be used as a reference point to compare actual cities to – as a quantitative assessment of multiple CAZs was not possible due to limited time available before UK100 will meet with government.

  - We make use of the Department for Transport's (DfT) WebTAG tool (and its wider statistics publications for inputs) and CEPA modelling to develop an initial 'economic' case as a feasibility-level study, as well as beginning to develop the strategic case for the scheme.

Executive Summary

The strategic case for an enhanced CAF is clear: The pursual of fleet renewal and supporting CAZs fits well with Government priorities – targeting air quality to reach compliance with European Commission requirements and address health concerns.

- It is important that cities consider carefully their choice of vehicles to include in the CAZ restrictions.
    - As private cars often account for a large proportion of NO_2 in the air (e.g. 40% in Bristol), their inclusion in the CAZ restrictions often strengthens the strategic (and economic) case for a CAZ supported by an enhanced CAF.
    - The effect on individuals (of including cars) may be high, which may weaken the strategic case for a Class D CAZ (which is the only class to include private cars).
    - **Where cities are struggling to achieve residents' support for including certain types of vehicles in the CAZ, the CAF can play an important role in mitigating the negative impact of the CAZ while assisting groups who might otherwise find it difficult to achieve compliance.**
- CAF-funded plans which provide a useful addition to the strategic case include: scrappage/retrofit incentives, more public transport to make non-car journeys easier, and the provision of more EV charging points.

There could be wider benefits from an enhanced CAF – improving general EV take-up

- From a strategic perspective, we consider that a 'national' fleet renewal scheme consists of a network of CAZs made up of major cities and towns across UK, NOT a scheme that all businesses and households are eligible for. A targeted scheme, assisting those less financially able to achieve compliance, would have additional benefits.
- An enhanced CAF will help to move EV penetration up the curve, improving nationwide take-up (and air quality).
- Typically, take-up of new technologies is slow until they reach a certain level of market penetration (above around 2.5-5%), after which point it speeds up. EVs are still approaching this phase. Encouraging the upgrade of vehicles to EV will bring the country as a whole closer to this critical level of market penetration and improve confidence in EVs and the charging network, increasing EV take-up.

Executive Summary

There is a net positive economic case (>1) for a Class D for our notional CAZ

- A benefit-cost ratio (BCR) is often used to demonstrate the return on each £1 of investment – a BCR of 1.5 means a 'value' of £1.5 is achieved for every £1 spent. The table demonstrates the value for money (VfM) typically implied by different BCR values. For air quality schemes, the strategic case is so important that a lower than normal BCR may be considered strong.

- **Using the assumptions as set out on the previous slides, we find that in our baseline case:**
  - **Our Class A-C CAZs achieve benefit-cost ratios (BCRs) of up to 0.8**
  - **Our Class D CAZ achieves a BCR of 1.7, with a wide range of 0.5-4.3**

- We highlight:
  - The BCR can be further boosted, for example by reducing the cost per vehicle to Government through industry contributions to the scrappage scheme. London has received commitment from third party organisations (e.g. car clubs) for additional funding to support its car scrappage scheme (e.g. match-funding) – some contribution to the 'mode shift' part of the modelled scrappage scheme here assumes some contribution.
  - Industry collaborations could also take the form of car clubs, which can be an effective way of encouraging lower usage private car owners onto public transport most of the time, as they would still have access to a car when they really need it.

- We emphasise that this is a 'feasibility' stage study, utilising assumptions rather than city-focused quantitative assessments to make the case. More detailed assessments, which demonstrate air quality compliance, will likely be required for applications to draw down from the fund that UK100 is looking to secure.

BCR	VfM
0.0 to 1.0	Poor
1.0 to 1.5	Low
1.5 to 2.0	Medium
2.0 to 4.0	High
4.0 +	Very high

Source: DfT (2015) VfM framework

Benefit-cost ratio of the four classes of CAZ (cumulative) (baseline, low, and high cases)

BCR
- Class A: 0.2
- Class B: 0.8
- Class C: 0.8
- Class D: 1.7
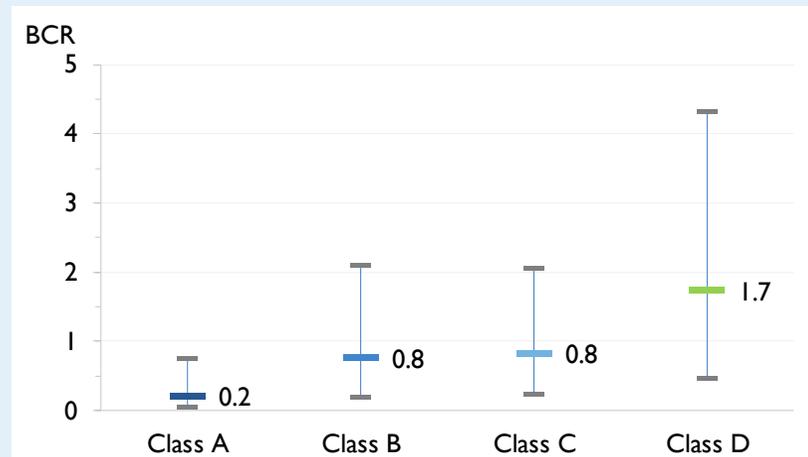
Executive Summary

Bringing the notional CAZ results to a Local Authority level

- UK100 have proposed an enhanced CAF involving an additional £1.5bn budget. The notional CAZ is a simplified case with many assumptions, and should be taken as demonstration that it is feasible that enhanced CAF spending to facilitate a CAZ could present a positive economic business case alongside the strong strategic case.

- UK100 requested that our assessment focus on a notional CAZ, rather than on any individual city or Local Authority. The assessment of the notional CAZ can be taken as an early-stage estimate which provides a reference point for the UK100 cities and Local Authorities.

- The assessment of specific CAZs will differ from that of the notional CAZ:

  - With the ~£50m cost in our notional CAZ base case, £1.0bn (plus private contributions) could cover approximately 20 comparable CAZs. In reality more CAZs can likely be supported, as many are smaller.

  - UK100 asked that when constructing our notional CAZ we should keep in mind the four cities considered in Section 4. The proposed CAZs we have looked at range in size from 20-25km^2 to 1,600km^2. The notional CAZ is 20-25km^2.

    - There is potential for even smaller CAZs than this, where there is an acute pollution issue in a single street or a few streets, and the assessment for such proposals may be different and focused more on the strategic case.

  - The chosen Class for a CAZ affects the net benefit, and in our notional CAZ it only achieves a net benefit at a Class D. But, this does not mean that all CAZ will need to be Class D to achieve a net benefit – a Class C CAZ could still balance out to a net benefit, once other factors are taken into account, for example the areas covered, levels of congestion, the volume of km driven by different vehicle types within the CAZ, etc.

1 Introduction

1. Introduction

Requirement and scope

- **The UK is currently exceeding legal limits of NO$_2$ in the air**, with other pollutants (e.g. SO$_x$, PM$_x$) also causing health concerns. Exceedances of pollutants are particularly bad in urban areas with high levels of traffic, due to emissions from diesel and petrol vehicles. This, combined with ambitious 2050 CO$_2$ targets, has brought the environmental impact of road transport to the forefront of UK environmental policy.

- **The government has called on five cities to create CAZs and 60 other local councils to draw up clean air plans.**

- **The CAF makes available £220m of spending over the period 2018/19-2020/21.** The CAF's key objective is to:

   "support individuals and businesses affected by local nitrogen dioxide plans"

- **UK100 is seeking Government support for an enhanced CAF,** including for London which has historically been excluded from the CAF, which would enable the delivery of CAZs across the UK and support a national fleet renewal programme to deliver WHO air quality standards.

- **UK100 has requested CEPA undertake analysis to set out the benefits and costs of the delivery of CAZs, with the aim of demonstrating that an enhanced CAF has a positive economic case**

   - The outputs will be used as inputs to present the case for the scheme to Government. We have previously supported development of TfL's ULEZ scrappage scheme proposals.

   - UK100 has requested that we assess a theoretical/notional CAZ, and then use this as a reference point to compare actual cities to – as a quantitative assessment of multiple CAZs was not possible due to limited time available before UK100 will meet with government.

   - We make use of the Department for Transport's (DfT) WebTAG tool (and its wider statistics publications for inputs) and CEPA modelling to develop an initial 'economic' case as a feasibility-level study, as well as beginning to develop the strategic case for the scheme.
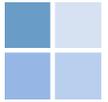
1. Introduction

Approach

- The aim is to demonstrate the economic case for an enhanced CAF, expecting a positive case.
- We consider how drivers are likely to respond to the introduction of a CAZ e.g. how drivers might respond to charges and the wider policy interventions which support it – mode-shift, scrappage schemes, use of car club etc. in order to assess the km no longer driven and therefore the emissions reduction that the CAZ delivers.
- We draw upon publicly available data and our previous work for TfL to develop a notional set of policy interventions for a UK city and assess whether a positive business case can be achieved for Category A-D CAZ schemes. We assume that HMT will be more receptive to requests for funding that have a positive business case.
- We understand that each city's CAZ and wider policy interventions will differ – the aim of this project is to calculate the costs and benefits for a notional CAZ and then indicate, at a high level, how these might differ for individual cities:

1. Case studies to inform notional CAZ

- We develop case studies of Birmingham, Manchester, and Bristol's CAZ plans, and another on London's ULEZ.
- These then inform the choice of policies for a 'notional' CAZ that we model in stage (2) of this project.

2. High-level assessment of economic and strategic cases

- We developed a WebTAG-based model, which assesses the costs and benefits of various CAZ measures. The results of this inform the economic and strategic cases for the policy – including the best approach to a 'national' scheme.

3. Implications for individual cities' CAZs

- At a high-level, we consider how the results from the assessment of the notional CAZ might change when assessing the UK100 cities' actual CAZ plans.

1. Introduction
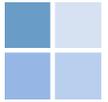
What is a CAZ?

- There are several key components to a CAZ:
  - Targeted interventions to improve air quality, to bring about health benefits and support economic growth.
  - Addressing all sources of pollution, including NO_2 and PM_x, but tailoring the measures to the location.
  - Accelerate the transition to a low emission economy.
- CAZ also involve restricting access to 'compliant' vehicles. It is important to have consistency in what counts as compliance across different CAZ, but to also recognise that there may be different local requirements. There are therefore four options for 'class' of CAZ, as in the table below.

These largest or highest frequency vehicles emit higher levels of pollution per vehicle – so are high priority for a CAZ.

Smaller, less polluting vehicles are included in the category D CAZ. Note that there is a significant volume driver for cars

Vehicle type (euro category)	Minimum EU Emission standard required in the CAZ classes			
	Class A	Class B	Class C	Class D
Buses and coaches (M2, M3)	Euro VI	Euro VI	Euro VI	Euro VI
HGV (N2, N3)	All permitted	Euro VI	Euro VI	Euro VI
Large van (N1, N2)	All permitted	All permitted	Euro VI	Euro VI
Taxi and private hire (M1, M2)	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)
Minibus (M2)	All permitted	All permitted	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)
Small van/light commercial (N1)	All permitted	All permitted	Euro 6 (diesel) Euro 4 (petrol)	Euro 6 (diesel) Euro 4 (petrol)
Cars (M1)	All permitted	All permitted	All permitted	Euro 6 (diesel) Euro 4 (petrol)
Motorcycles and mopeds (L)	All permitted	All permitted	All permitted	Euro 3 (optional)

Standards are in: Defra and DfT (2017) "Clean Air Zone Framework"
EU vehicle categories are described in: EAFO (accessed June 2019) "European classification for vehicle category, based in UNECE standards"
Euro standards are described in: RAC (accessed June 2019) "Euro emission standards"

2 **Strategic case**

2. Strategic case

- Establishing CAZs across the country is an important air quality policy– the 'strategic case' focuses on health concerns and compliance with European Commission requirements, given the contribution of road transport to pollutants in the air.

- As the current proposal being assessed here is for an enhanced CAF from government, it is important to keep in mind the overall aim of the CAF:

  "The Clean Air Fund's objective is to support individuals and businesses affected by local nitrogen dioxide plans."

- Defra suggests that this objective might be delivered in three ways:
  - Introduce measures to make compliance easier, more attractive or more affordable (e.g. if restricting vehicle access, provide additional mode-shift options).
  - Implement plans that impact on fewer people (e.g. if choose not to include LGVs in CAZ restriction, could instead create a freight consolidation zone to reduce 'last mile' emissions, and CAF can fund that).
  - Reduce transport costs for people (e.g. if including private cars in CAZ restriction, support local travel discounts for low income households).

- Suggested policy interventions that could be eligible for CAF support might include:
  - Provision of EV infrastructure to make compliance (through upgrading to an EV) easier.
  - Working with car clubs to assist installation of car club parking areas to encourage car owners to shift to public transport sometimes as they have the option of using a car club when a car is more necessary.
  - Increased provision of public transport to assist users that would otherwise use a non-compliant car, and subsidising transport passes for low-income families that give up their car.
  - Any wider scrappage/retrofit scheme would have scrappage grants or retrofit discounts specifically for more vulnerable groups – e.g. low income households and small businesses.

We consider that a strong strategic case is generated in two ways:

1. An enhanced CAF is important for facilitating the delivery of the CAZ, due to concerns about the impact on specific groups (including low-income households, charities, and micro businesses) if they do not receive assistance in achieving compliance.

2. A CAF that assists fleet renewal will further the take-up of EV nationwide, as we discuss on slide 14.

* These suggestions build on those presented by Defra in their March 2018 publication on the CAF.

2. Strategic case

The strategic case for a 'national' scheme

Because road transport is a key source of NO_2, cities and large towns, and the major roads linking them, experience the highest levels of pollution – see the red areas in the map below.

NO_2 levels across England and Wales

Lower NO_2 levels

Higher NO_2 levels

Source: BEIS, National Atmospheric Emissions Inventory
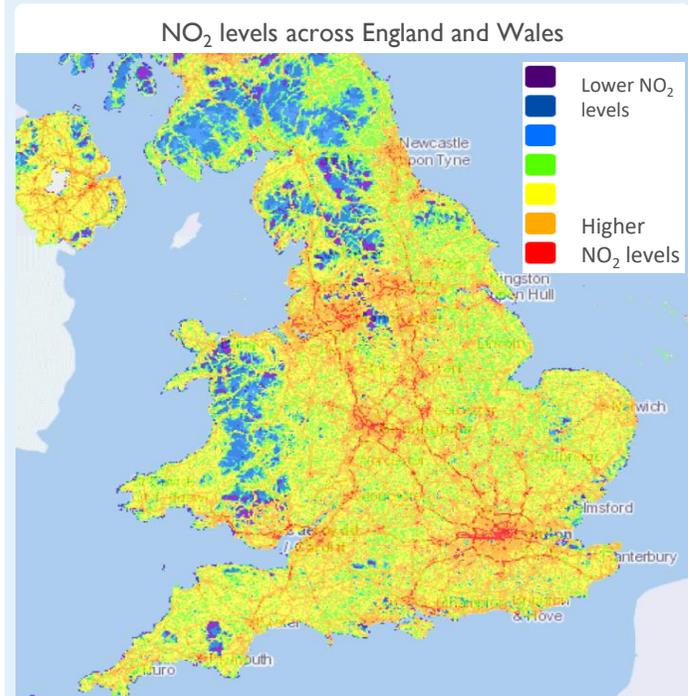
- Given the full range of negative impacts of high levels of road traffic in addition to harmful emissions (congestion, noise pollution, etc.) in built-up areas, the economic and strategic case is are strongest in urban areas. It is therefore most effective for policymaking and funding to focus on urban areas.

- The pursual of fleet renewal and supporting CAZs fits well with Government priorities – targeting air quality to reach compliance with European Commission targets and address health concerns.

- It is important that cities consider carefully their choice of vehicles to include in the CAZ restrictions. As private cars often account for a large proportion of NO_2 in the air (e.g. 40% in Bristol), their inclusion in the CAZ restrictions strengthens the strategic (and economic) case for a CAZ supported by an enhanced CAF.

- Where cities are struggling to achieve residents' support for including certain types of vehicles in the CAZ, the CAF can play an important role in mitigating the negative impact of the CAZ while assisting groups who might otherwise find it difficult to achieve compliance. Plans such as the following provide a useful strategic side: scrappage/retrofit incentives, more public transport to make non-car journeys easier, and the provision of more EV charging.

2. Strategic case

Rural areas WILL benefit from an enhanced CAF that improves take-up of ULEV/EV in urban areas but are not the focus of our work

- From a strategic perspective, we consider that a 'national' fleet renewal scheme consists of a network of CAZs made up of major cities and towns across UK, NOT a scheme that all businesses and households nationwide are eligible for.

- Targeted policy interventions that assist those (living and/or working in a relevant CAZ) who are less financially able to achieve compliance, has additional distributional benefits. Targeted groups could include micro businesses and sole traders, low-income households, and charities.

- An important driver of an enhanced CAF is to move EV penetration up the adoption curve, which is illustrated in the graph on the right, improving nationwide take-up (and thus air quality).

This graph shows the theory of 'diffusion of innovations' – typically, take-up of new technologies is slow until they reach a certain level of market penetration, at which point it speeds up. EVs are currently just at the start of the 'early adopters' phase. Encouraging the upgrade of vehicles to EV will bring the country as a whole further up this adoption curve and improve confidence in EVs and the charging network, increasing EV take-up.

Theory of diffusion of innovations*

Total market share achieved as each group of 'adopters' takes up the technology

Different groups of 'adopters' – some adopt early, most join in the middle, some join late

EVs accounted for 2.6% of car market share in December 2018*

Market share %

100

75

50

25

0

| Innovators 2.5 % | Early Adopters 13.5 % | Early Majority 34 % | Late Majority 34 % | Laggards 16 % |
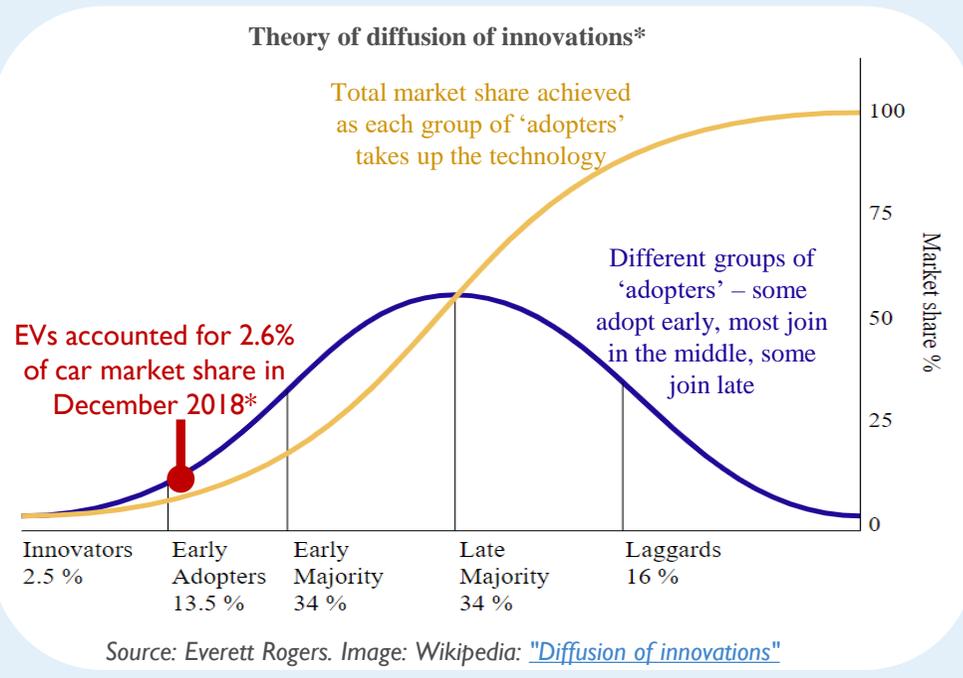
Source: Everett Rogers. Image: Wikipedia: "Diffusion of innovations"

2. Strategic case

We also highlight practical considerations relevant to the strategic case that cities will need to consider

Marketing the scheme

- **There could be industry contributions to covering the cost of the scheme**. In our TfL work we undertook stakeholder engagement which suggested that industry members may be willing to contribute (e.g. car club credit, contribution to the leasing). These companies may also assist with marketing the joint components of the scheme. This would improve the economic case, but in the absence of any agreements we have not assumed this in our notional CAZ.
  - **Car clubs may also be a useful addition to the scheme.** Users of cars may be able to mode-shift to public transport (or cycling) for a vast majority of journeys but may rely on using a car for specific purposes that are hard to transfer to another mode of transport. For these users, provision of car-club membership may be a useful incentive, as it can provide people with access to cars for occasional use (often at a lower cost than buying and maintaining a private car). London has received commitment from third-party organisations, including car clubs, to support their schemes (e.g. with match-funding).
  - **Flexibility in how to use the scrappage offer may aid take-up**, for example if applicants can choose whether to buy or lease a vehicle. This may help if drivers are anxious about using an EV for the first time as the financial risk is shared.

Operating CAZ charging schemes

- **Eligibility criteria** are important for ensuring that the scheme is able to be administered efficiently. This helps applicants and the administrator, and can also minimise fraud.
  - To minimise administrative costs, the simplest way to determine eligibility of a household is to base it on access to another benefit – e.g. low-income households may be able to present a recent housing benefit or Universal Credit form. Micro businesses and sole traders may be registered at Companies House or for VAT with evidence of levels of turnover.
  - Eligible vehicles should typically be registered to an address within the CAZ, but it may also be reasonable to apply a "frequency" criterion if data to support it is available. For example, in London ANPR provides evidence of how many times each vehicle has entered the current ULEZ in a given period. Without ANPR, other sources should be considered such as whether cars are currently registered for season tickets for parking within the CAZ.
- A budget for scrappage can be managed in a more sophisticated way than placing a blanket amount per type of vehicle – for example the scheme could target the oldest vehicles first, or earlier applicants could be eligible for a higher amount.

2. Strategic case

It is important that CAZ/CAF schemes addresses previous criticism aimed at scrappage schemes, e.g.:

Source	Concern	Discussion in the context of this scheme
RAC foundation (Mar 2017) "A diesel scrappage scheme – could it work?" raise three concerns about targeted schemes	With a lack of information on where/when/how much vehicles are used, it is difficult to ensure that the scheme targets the most polluting vehicles.	Strict eligibility criteria will be required to narrow the scope of applicants – in London the use of existing ANPR assisted this, but other data may be available (e.g. parking season tickets).
	Low-income households will be least able to afford to upgrade to a new zero-emission vehicle even with a publicly-funded financial incentive.	We would recommend that the scheme is open to leases rather than outright purchases, to assist low-income households. We also recommend the inclusion of a mode-shift option.
	Car clubs are still a nascent concept.	We have not included car clubs in our notional CAZ as they don't seem to be a large part of the CAZ conversation at the moment. That said, collaborations/assisting the growth of car clubs could be considered as a way to encourage users to mode-shift where possible while retaining access to a car when most needed. Car clubs are growing across the country, with Car Plus aiming to have a car club within a ten minute walk of all households.
House of Commons (Mar 2018) "Briefing paper: Vehicle scrappage schemes"	Concerns that a general scheme only brings forward new car purchases rather than increasing overall purchases (i.e. reduces future demand).	EV is still in its early days – additional successful purchases will contribute to normalising EV and is expected to have a positive effect on future take-up vs petrol/diesel. Furthermore, air quality is a time-sensitive issue and earlier purchases do bring greater benefits.
	Retrofitting buses provides more benefit to air quality than a scrappage scheme encouraging smaller vehicles to move to electric/Euro 6.	UK100's proposal includes retrofitting for buses alongside a scheme for smaller cars – with some cities seeing a high proportion of NO_2 from cars, their inclusion could be important in some cities.
Discussions with stakeholders.	Even some Euro 6 vehicles (particularly diesel) can be quite polluting.	UK100's proposal encourages EV wherever possible. Unfortunately EV is not feasible for all vehicle types yet, and in these cases the reduction from an upgrade to Euro 6 provides a useful contribution to improving air quality
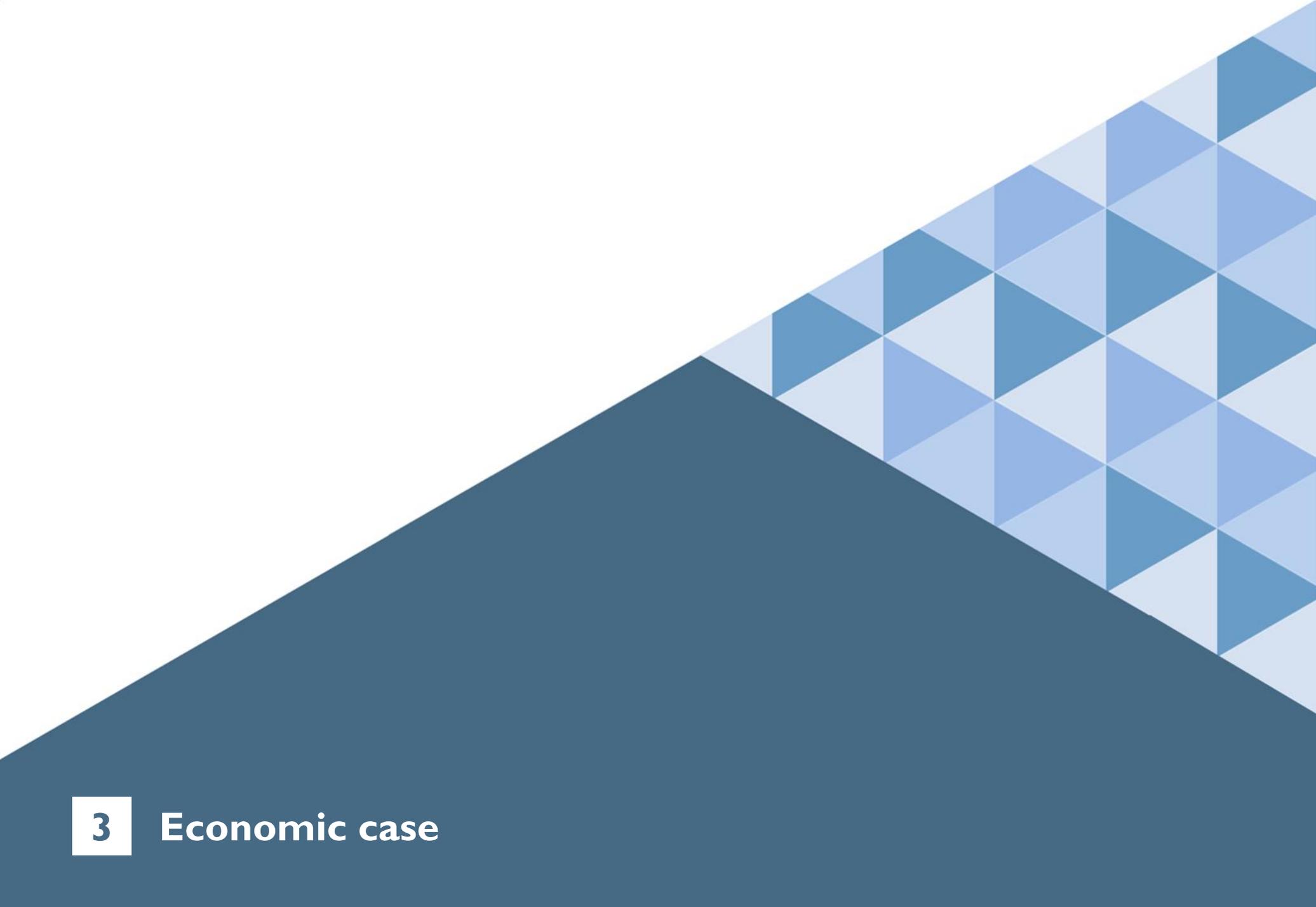
3 **Economic case**

3. Economic case

UK100 asked CEPA to consider the benefits and costs that an enhanced CAF might bring via support to the delivery of CAZ

- The economic case focuses on quantifying benefits and costs where possible. It assumes the benefits of the CAZ itself and the CAF, with the rationale that the policy interventions enabled by the CAF are required to facilitate the implementation of a CAZ, i.e. without the CAF, cities may struggle to implement a CAZ.

- UK100 regions introducing a CAZ have the same overarching objective – to reduce the level of ambient NO_2 due to its negative health effects, and they focus on road transport as a major source of these. But, there are many regions in the UK, each with a different plan, e.g.:

  - **The focus areas range in size.** The largest CAZ includes all of Greater London. The smallest are likely to focus on a very small area that contains one or a few problematic roads. This range means that there is a substantial variance in the number of vehicles (and volume of km driven) being targeted.

  - **There are different 'classes' of CAZ, targeting different vehicle types**. The 4 CAZ classes were described in the introduction, and range from focusing on only the most polluting 'per vehicle' (buses, coaches, taxis, PHVs) to including all motor vehicles (with potential exceptions for motorcycles).

  - **Supporting policy interventions may differ** according to the type of CAZ being introduced. Some may choose to offer scrappage, others may install EV charging infrastructure, some may improve public transport/car club provision, and many would like to offer a mix etc.

  - The similarities and differences are demonstrated through the summary of the London, Manchester, Birmingham and Bristol CAZ schemes discussed on the next slide.

- As a result, and to allow the assessment to take place in a short period, UK100 requested that CEPA develop the economic case for a notional CAZ, presenting a sample quantitative case that can be qualitatively assessed to understand the potential benefits and costs of an enhanced CAF that encompasses several cities.

3. Economic case

Summary of case studies

	Birmingham	Manchester	Bristol	London
Characteristics	Government-mandated requires a CAZ by 2020, focus is on reducing NO_x. Over half of current vehicles are not CAZ-compliant.	Government-mandated Clean Air Plan to reduce NO_2 levels.	NO_2 is the key issue in Bristol - ~40% of NO_2 in the air is from cars.	Already a LEZ (since 2008, strengthened in 2012 – heavy vehicles need to be Euro III) and the CCZ – now introduced ULEZ to target NO_x and PM_x.
CAZ proposed	Class D (excluding Motorbikes) Light vehicles: £8/day Heavy vehicles: £50/day Range of exemptions for local or vulnerable drivers. Awarded £14m for implementation. Size: ~20-25km^2	Class B 2021, Class C 2023. Light vehicles: £7.50/day Heavy vehicles: £100/day Range of exemptions to be developed through consultation. Size: large (~1,300km^2)	Considering Class C or D, and whether to make it medium or small. As yet undecided whether to charge and how much.	Central London Class D from 2019; "Inner London" from Oct 2021. Class B all-London in 2020. Light vehicles £12.50/day Heavy vehicles £100/day Size: ~20km^2 to ~300-400km^2 to ~1,600km^2
Support measures for compliant vehicles	£38m from CAFs to support those affected – 50% aimed at taxi/PHV.	Requested £116m from Clean Air schemes to aid compliance – and will not implement CAZ without it.	Plans still in progress.	Small business scrappage/retrofit scheme for LGVs/minibuses. Retrofit/LPG conversion available for taxis, buses.
Measures to discourage vehicle use	Planning to offer incentives e.g. discounted public transport tickets.		Plan to consult on measures to encourage public transport, cycling, and car clubs.	Investing in cycling, walking, and public transport to encourage fewer car journeys.

3. Economic case

Setting out our 'notional CAZ'

- The case studies on the previous slide demonstrate that affected UK cities are considering different forms of CAZ and supporting policy interventions – although they all face an NO_2 issue,

- **CAZ Class:** As cities are considering different classes of CAZ, we model all four classes. We do not include motorbikes in the Class D CAZ, but recognise that some cities may choose to (e.g. London).

- **Charging**: Although it is not mandatory for a CAZ to involve charging non-compliant vehicles, we include in our notional CAZ a charge for vehicles as a key contributor to reducing km driven inside the CAZ.

- **Provision of a scrappage/retrofit scheme**: To encourage compliance, we assume that there is financial support available for targeted groups of vehicle owners to upgrade or retrofit their vehicle to reach CAZ-compliance.

- **Installation of EV charging infrastructure**: Considering the CAF objectives, we have included costs for installation of EV charging as an input that brings about positive effects (i.e. users upgrade to EV because it is less inconvenient to charge their vehicle, range anxiety being a significant concern at present).

- **Size of CAZ:** The chosen CAZ is on the smaller end of charging CAZs considered by the 4 cities in Section 4 – there may be Local Authorities where the CAZ is focused on charging/other restrictions (i.e. bans) in much smaller areas, as Bristol are considering.

- To some extent, the choices have also been led by available data, for example there is an estimated cost of EV charging for a city of 1m.

Characteristics	Begin in 2020, focusing on reducing NO_x.
CAZ proposed	Vary from Class A to Class D (excluding motorbikes). Small region (~20-25km2) covering about 10% of the area of the city (with full city being ~1m people). Light vehicles: £10/day; Heavy vehicles: £75/day
Support measures for compliant vehicles	Installation of EV charging at a cost of £25m in our base case (£6m-£43m range). Scrappage/retrofit scheme, 50% to low-income households or micro businesses: cars, taxis, PHVs, £2k to upgrade (whether lease or buy); cars £1k to mode shift (to public transport); LGVs £6k to buy/lease EV; HGVs and bus/coach £6k to retrofit to achieve Euro 6 standards, total of £25m available. This leads to a total budget of £50m.
Measures to discourage vehicle use	Inclusion of a 'mode shift' option in the scrappage/retrofit scheme. We do not include any exemptions to the CAZ charge for non-compliant vehicles, and we assume the scheme is fully implemented in 2020.
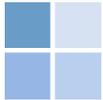
3. Economic case

The economic case considers the benefits and costs of the notional scheme

- To assess the benefits and costs of the '*notional CAZ*' we use the 'notional' set of policy interventions described above that broadly represent those that *might* be implemented by a UK100 city, we draw upon work by UK cities but we utilise interventions for illustrative city rather than an actual one.

- We then developed a simple excel tool that provides an early indication of the benefits and costs (represented as a Benefit-Cost Ratio, BCR) depending on the type of scheme (Class A-D CAZ). We highlight on slide 27 the difficulties of using WebTAG for a scheme of this type – it is not routinely used for analysis such as this, and there are some difficulties e.g. there is a 'cost' of lost tax (through fuel duty) when switching to cleaner vehicles.

- This model structure/contents are broadly:

Inputs
• Km/year by different types of vehicle.
• Costs and benefits per km driven.
• Scrappage/retrofit value offered and number of vehicles scrapped/retrofitted.
• Vehicle owners encouraged to upgrade to avoid paying the CAZ charge or due to other measures (e.g. EV infrastructure
• Km/year reduction inside the CAZ due to CAZ charges, public transport, etc.
• Cost of the CAZ minus charge revenue
• Cost of additional measures

Calculations				
Cars	Taxi/PHV	LGVs	HGVs	Bus/coach

- Benefits and costs from:
  - Km/year reduction by scrapped (for upgrade) and retrofitted vehicles.
  - Km/year reduction by upgraded vehicles (old vehicle sold not scrapped).
  - Km/year reduction by vehicles avoiding the CAZ.
  - Cost of scheme
- Discounting costs/benefits to consider fading benefits and the discount rate

Outputs
• Benefits and costs if implementing a:
• Class A CAZ
• Class B CAZ
• Class C CAZ
• Class D CAZ
• We also set out a range of results to demonstrate the effect of changing our assumptions: we present a baseline case, a low case, and a high case.

- The model is based heavily on our previous work for TfL, in assessing its proposed scrappage scheme, but we highlight that it has been updated due to the different parameters of the assessment required by UK100 (not focusing just on scrappage) and there have been updates to data available (including categories of data in WebTAG).

3. Economic case

Methodology

- WebTAG sets out best practice estimation methods and, where evidence is sufficient, values of benefits and costs to be used. Usefully, it provides the social costs of each additional km driven by different vehicle types (cars, LGVs, HGVs, and buses and coaches), which it calls "marginal external costs" (MECs):

MECs related to presence on the road (irrespective of fuel type/efficiency)				MECs related to fuel type/efficiency		
Traffic/ congestion	Accidents	Infrastructure wear and tear	Noise pollution	Local air quality	Greenhouse gas emissions	Income in tax paid on fuel

- **For changes in km through avoidance of journeys into the CAZ, or vehicles scrapped for a mode-shift to public transport**: we apply all of the above MECs, as there is a change in the presence on the road.

- **For changes in km through vehicles scrapped or retrofitted for an upgrade**: We assume that the driver will drive the same km in their new vehicle, so we cannot count benefits for a removed 'presence on the road' but we can count benefits (or costs) related to the fuel type or efficiency; we apply a proportion of the 'local air quality' and 'greenhouse gas emissions' to represent better fuel efficiency of newer vehicles.

- **For changes in km through vehicles sold or upgraded (a 10% increase on normal churn without scrappage):** We assume sold vehicles will continue to be used and so do not assume any 'presence on the road' MECs but can assume that there may be some 'local air quality' benefits if the old, non-compliant vehicle, is now used outside the CAZ.

- **Our BCR calculations are early stage estimates (feasibility stage). It is not a full, formal analysis with standard output tables populated, because:**
  - our requested scope involved assessing a notional CAZ, not actual cities or the full CAF being sought by UK100.
  - this is not a scheme of a type that WebTAG analysis has routinely been applied to, thus lacks precedent for how to approach some of the questions raised – best practice is not established in such areas; and
  - some of the important scheme effects are hard to forecast since there is no strong evidence base on which to make such a forecast, which is why we also calculate sensitivities, most with a 20% range.

3. Economic case

This slide sets out key assumptions for our notional CAZ.

The number of vehicles encouraged to upgrade to a compliant vehicle through the scrappage/retrofit scheme, and the km they drive each year. We assume a scrappage amount per vehicle and a number of vehicles being targeted. The offer for cars/taxis uses assumptions from UK100's initial proposal. The LGV/HGV/bus schemes use a higher value as in TfL's current scrappage/retrofit scheme, up to a third of the cost of buying a small EV van, or retrofitting a bus/HGV. Our base case requires a scrappage/retrofit budget of £25m.

This shows how many vehicles scrapped or retrofitted, cost per vehicle, and assumed km each vehicle would have driven each year.

The number of vehicles encouraged to upgrade to avoid the CAZ charge without needing a scrappage payment, and the km they would have driven (the same km/year as in the previous bullet point). We assume that there is a 10% addition to normal churn, based on 2018 sales data, and assume a higher proportion of owners switch to EV through the CAZ and installation of EV charging infrastructure.

This shows an assumption of how many vehicles are upgraded to avoid the CAZ charge, without the financial support required.

The percentage of vehicles encouraged to reduce journeys by CAZ charge. For ±km in the CAZ, we use the results from the first year of the London congestion charge (CC), except as follows. Taxis/PHVs we use results from our 2017 PHV study, because initially exempt from the CC. We assume a larger effect on HGVs (there was 9% seen in the CC, but we assume 20% assumed in our model) as the CAZ charges are higher than the CC.

Here we assume the number of journeys into the CAZ avoided (vs the status quo) – measured as a volume reduction. We only apply the reduction to non-compliant vehicles that pay the CAZ charge.

	Encouraged to upgrade to avoid CAZ charge via the scrappage scheme							Encouraged to upgrade to avoid CAZ charge				Encouraged to reduce journeys because of CAZ charge		
	Scrappage payment (£/vehicle)			Number to scrap for each type of upgrade			km/year per vehicle upgraded	km/year per vehicle upgraded	Encouraged to upgrade by CAZ		Total km/year inside CAZ	% compliant inside CAZ	% change in driving in CAZ
	Euro 6	EV	Mode shift	Euro 6	EV	Mode shift	Baseline	Baseline	Euro 6	To EV	Baseline		
Cars		2,000	1,000		3,000	3,000	12,553	12,553	3,642	1,214	400m	**31%**	-39%
Taxis and PHV		2,000			2,000		20,000	20,000	34	8	130m	31%	-6%
LGVs		6,000			1,000		20,449	20,449	947	105	80m	66%	-10%
HGVs	6,000			500			54,968	54,968	40		23m	63%	-20%
Buses	6,000			500			23,873	23,873	22		7m	78%	+7%

3. Economic case

Further key assumptions are set out below

Component	Baseline

Cost of implementation	• The net cost takes into account setting up the CAZ charging, operating the CAZ charging, and any CAZ charges received for non-compliant vehicles. We assume that these costs reach a net of £0.
	• We assume some expenditure on EV infrastructure, and highlight that sources suggest different levels required.*
	  • Our 'low' cost (in the 'high BCR' scenario) is based on TfL's 2019 EV infrastructure delivery plan. Rapid chargers cost £50,000 each, and slower chargers cost ~£5,000 each. We apply the same ratio of EVs:chargers as is currently found in London: 200 rapid and 2,200 slower chargers for 20,622 EVs. This is ~£6m.
	  • Our 'high' cost ('low BCR') is based on a 2018 report by Transport and Environment which sets out how much it may cost to provide infrastructure for a city of 1 million people – an average of its results gives ~£43m.
	  • Our baseline cost uses the average of the 'high' and 'low' scenarios.

Reduction of benefits and costs after the first year	• We assume that the scheme starts in 2020 and include costs and benefits until 2029. We bring down the benefits and costs included after the first year – to account for two main factors: in time, those encouraged to upgrade their vehicle may have done so anyway, and some may revert to old behaviour (e.g. journeys in the CAZ may rise again). *(see table below)*
Distributional impact	• We include a distributional impact for a proportion of the scheme that will be ring-fenced for low-income households and micro-businesses. As recommended by the Green Book, we weigh these benefits by the relative marginal utilities between low-income households and average-income households (i.e. see it as transfer through taxation). For this, we assume that 50% of the scrappage funds go to these types of businesses.
Sensitivity analysis	• For our sensitivity testing, we develop a 'high' and a 'low' scenario. For this we typically use a range of 20% higher or lower than the baseline numbers. The range is influenced most heavily by: the spending on EVs; how quickly benefits and costs are reduced after the first year of the scheme; the assumed reduced mileage within the CAZ from avoided journeys; and the change in traffic in the CAZ by non-compliant vehicles.

	Y1	Y2	Y3	Y4	Y5+
Baseline	100%	80%	60%	40%	20%
Low sensitivity	100%	75%	50%	25%	0%
High sensitivity	100%	85%	70%	55%	60%

3. Economic case

Our economic case is presented as a benefit-cost ratio (BCR)

- In assessing proposals for value for money, DfT use BCR to provide a high-level view of:

  "the expected impact of a proposal on public value and the extent to which it represents value for money once all potential impacts (monetised and non-monetised) have been considered"*

- A BCR of 1 means that for every £1 spent on the proposed intervention, £1 of 'value' will be delivered. A BCR higher than 1, e.g. of, 1.5 would mean that for every £1 spent on the proposed intervention there will be £1.50 of 'value'.

- The table below shows the value for money (VfM) typically implied by different BCR values, in DfT assessments.*

| BCR	0.0 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 to 4.0	4.0 +
Implied VfM	Poor	Low	Medium	High	Very high

- It is typically prudent to aim for at least a 'medium' BCR, not least because the estimated BCR will typically fall as a project progresses.

- For schemes such as CAZ and the CAF, the strategic case (and the requirement to meet air quality standards, for public health concerns and European Commission requirements) is so important that a 'low' or 'medium' BCR in the economic case may be considered tolerable.

- There may be other effects that cannot be quantified. These are best considered in the other dimensions of the 'five cases' of the business case, in particular the strategic case, e.g. health concerns, meeting compliance with EC or Government requirements,

3. Economic case
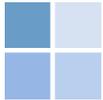
Results

- Using the assumptions as set out on the previous slides, we find that in our baseline case:

  - **Our Class A-C CAZs achieve benefit-cost ratios (BCRs) of up to 0.8 in the base case**

  - **Our Class D CAZ achieves a BCR of 1.7**, with a wide range of 0.5-4.3.

- We highlight that this is for the 'notional CAZ', which is designed to be a reference point for cities and LAs considering a CAZ. These results do not mean that every CAZ will achieve these BCR values, rather this is an early indication that suggests that a Class D CAZ is likely feasible and a Class B/C CAZ may be feasible depending on circumstances.

Benefit-cost ratio of the four classes of CAZ (cumulative) (baseline, low, and high cases)

- As suggested on the previous slide, BCR of 1.7 is good in this context, but we highlight:

  - There may be ways to boost this BCR, for example by encouraging industry contribution to the scrappage scheme (reducing the cost per vehicle to Government). Industry collaborations could also take the form of car clubs, which can be an effective way to encourage lower usage private car owners onto public transport most of the time, as they would still have access to a car when they really need it. This is taken account of in our economic case in which we assume a lower cost per user being encouraged into a car club (£1,000 instead of £2,000 as for those purchasing a new car) with the assumption that industry may be encouraged to match-fund this.

  - Earlier in this report we highlighted that WebTAG is not perfectly set up to assess a scheme like this – for example, we think it may undervalue local air quality improvements (we discuss this on the next slide).

- We emphasise that this is a 'feasibility' stage study, using assumptions rather than city-focused quantitative assessments to make the case. More detailed assessments will likely be required for applications to draw down from the £1.5bn fund that UK100 is looking to secure.
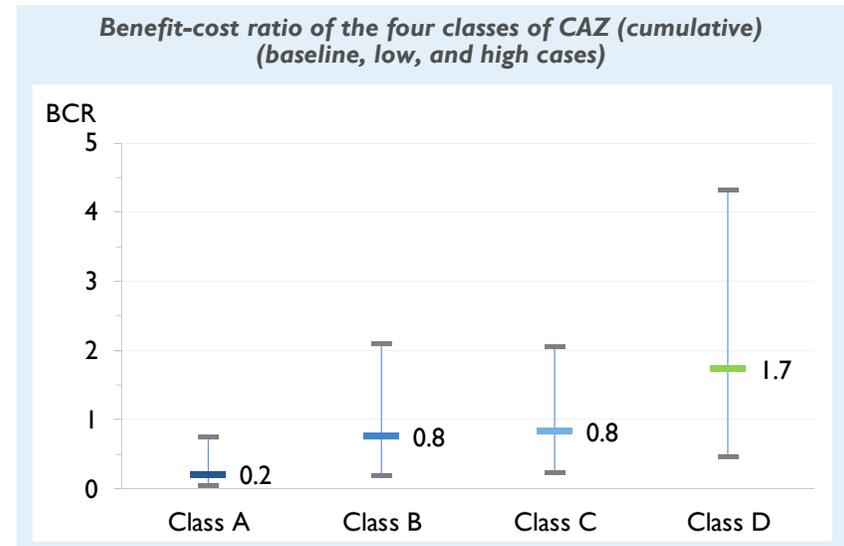
3. Economic case

We provide here a brief summary of the components that make up the BCR values on the previous slide

We consider that WebTAG is not particularly well set up to assess an investment of this sort – e.g. WebTAG currently values lost tax revenue from fuel (per km) several times higher than it values improvements to local air quality (per km).

	Benefit	Description	Contribution *
MECs related to presence on the road (irrespective of fuel type/ efficiency)	Congestion	This is the key benefit of the scheme, given the high value WebTAG places on congestion, particularly urban areas. It is linked to km driven, and type of roads. WebTAG provides values for congestion to reflect how close the relevant road is to its capacity (the congestion 'band') – we use DfT's provided weighted average.	55%-75% of benefits
	Accidents Infrastructure Noise	WebTAG provides monetised values per km of reduced mileage – as less driving is expected to reduce the number of accidents, to reduce noise pollution and to reduce the wear and tear on the roads.	10%-30% of benefits
MECs related to fuel type/efficiency	Local air quality	WebTAG provides values for improvements in these areas when overall mileage is reduced, and we account for an appropriate proportion of these for upgrades to cleaner vehicles. We consider that the **local air quality** values likely underestimate the true social value, particularly for proposals like CAZ. Ideally, in future WebTAG will provide local air quality values depending on the severity of the local air pollution problem, similar to its approach to congestion (where the highest 'band' has values hundreds of times higher than the lowest band).	Up to 5% of benefits
	Greenhouse gases		Up to 30% of benefits
	Indirect taxes	Less petrol/diesel used (fewer km or cleaner vehicles) results in lower tax revenue.	40% to 50% of costs
Other costs and benefits	Distributional impacts	Where the scrappage scheme focuses on micro-businesses and low-income household, it is possible to calculate distributional impacts. WebTAG does not monetise these in its current Databook, but has offered methodologies for doing so in previous versions. As distributional impacts are key to this scheme, we follow earlier methodologies to achieve an estimate.	Up to 5% of benefits
	Scrappage cost	The total cost of the scrappage payments.	40% to 45% of costs
	EV infrastructure	To represent policy interventions to encourage EV, we have included an estimate based on TfL's experience in London with some consideration of the potential need to provide more chargers per EV while trying to encourage take-up in the early days.	10% to 20% of costs

* The contribution varies depending on the Class of CAZ, and is affected by factors such as the relative MEC values for different vehicle types, and the type of vehicle upgrades available in different CAZ classes (e.g. we have not assumed any electric buses).
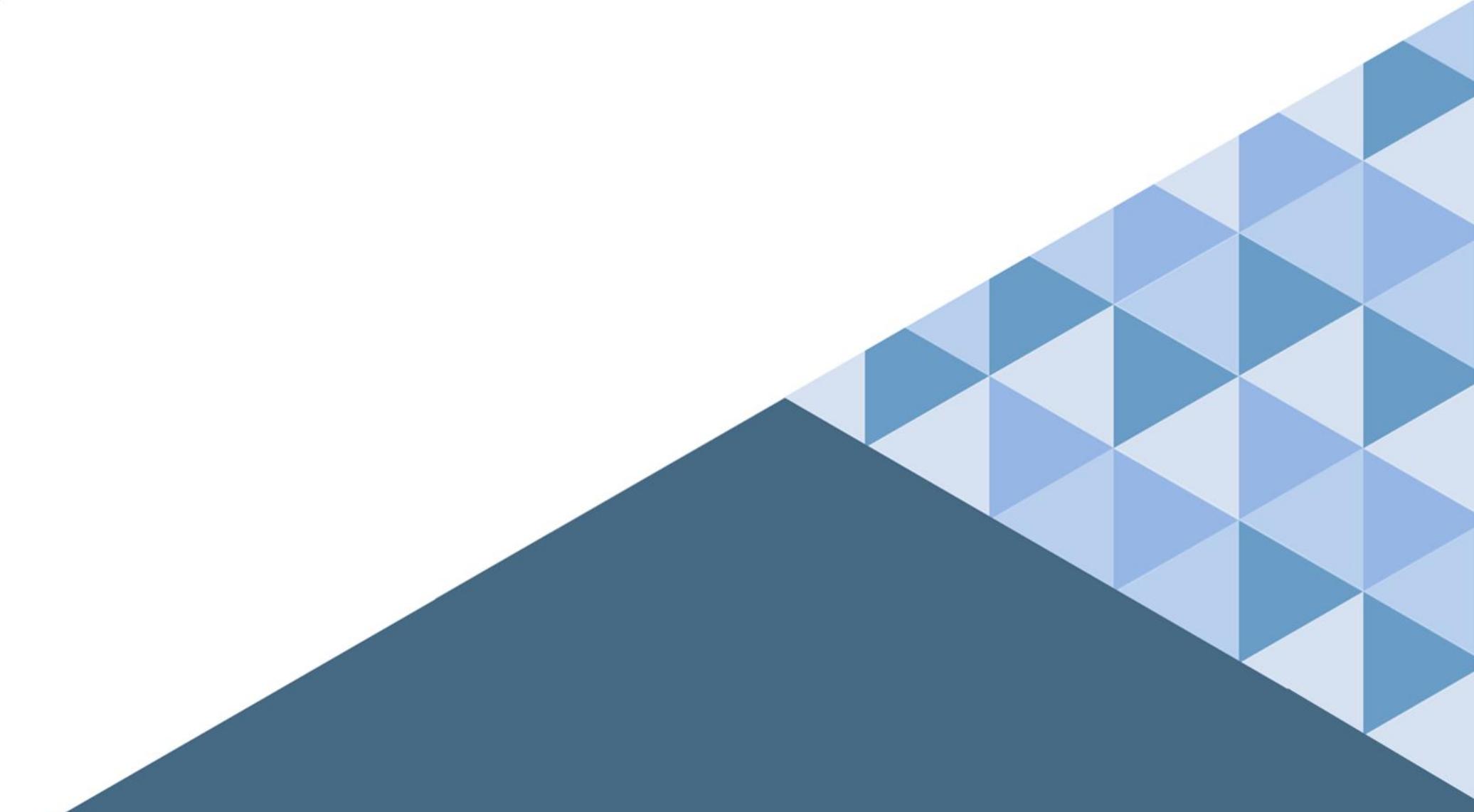
4 **Assessing actual proposed CAZs**

4. Assessing actual proposed CAZs

CAZs around the country are likely to vary from each other (and from our notional CAZ)

- UK100 has proposed an enhanced CAF involving an additional £1.5bn budget, of which it anticipates £0.5bn could come from private sector initiatives. This is taken account of in the scrappage scheme budget (e.g. where we have assumed a £1,000/car incentive for mode share, a car club might match-fund that £1,000 in car club credit).

- The notional CAZ is a simplified case with many assumptions, and should be taken as demonstration that it is feasible that enhanced CAF spending to facilitate a CAZ could present a positive economic business case alongside the already strong strategic case.

- Here, we consider how the assessment of specific CAZs might differ from that of the notional CAZ.

  – Assuming the £50m cost in our notional CAZ, £1.0bn could deliver 20 comparable CAZs; the average CAZ is smaller than our notional CAZ so this would likely cover more than 20 real CAZs.

  – The proposed CAZs we have looked at range in size from 1,600km^2 to 20-25km^2. The notional CAZ is 20-25km^2. There is potential for even smaller CAZs than this, where there is an acute pollution issue in a single street or string of streets, and the assessment for such proposals may be different and more strategic.

  – The notional CAZ achieves a net benefit at a Class D, but not a Class A-C – but this does not mean that all CAZ will need to be Class D to achieve a net benefit – a Class C CAZ covering a larger area may deliver a net benefit. The business case is also depends on the volume of km driven by different vehicle types within the CAZ.

  – Early notification of implementation allows users that can afford an upgrade to a cleaner vehicle time to comply with the CAZ requirements – temporary exemptions can extend this period for groups that need more time. This contributes positively to the strategic case, and may have mixed effects on the economic case: the economic case may improve through better local air quality in the CAZ, but may also be dampened by reducing the 'km avoided' by non-compliant vehicles seeking to avoid the charge (km avoided provides the largest net benefit to our notional CAZ).

4. Assessing actual proposed CAZs

Greater Manchester

- Initially Class B, increasing to Class C, for two main reasons:
  - Implementing a Class C CAZ by 2023 would be sufficient for Greater Manchester to reach compliance with air quality requirements by 2024, based on its own modelling.
  - Class D, including private cars, would have a strong socioeconomic impact on those households that cannot afford to pay the charge or upgrade to a compliant vehicle. In this context, and since a Class C CAZ is expected to deliver compliance, cars will not be included. These considerations are important areas for the strategic case that sits alongside the economic case as part of the overall business plan.
- Our analysis of a 'notional CAZ' demonstrates that a positive business case appears plausible for a Class D CAZ, but may be more tricky for a small Class A-C CAZ.
- We highlight that Manchester's proposed CAZ covers 1,276km^2, a much larger area than in our notional CAZ (20-25km^2).
  - This creates a wider area over which to achieve benefits, particularly avoided journeys (which provide the highest per-km benefit due to WebTAG placing high values on other factors alongside air quality effects (the effect of congestion, traffic accidents, etc).
    - There is a chance that the behavioural response to a larger CAZ could be less effective than assumed in our calculations, as greater percentage of journeys may be unavoidable (e.g. hospital appointments), which may mean that encouraging a switch to EV and providing additional public transport options is more important.
  - There would be a wider area over which to install EV charging, which will increase the cost – but it may be possible to install fewer chargers (at a lower overall cost) if the city is not actively encouraging EV cars or if residents/businesses will install their own.
  - Manchester proposes a much larger scrappage/retrofit budget than our notional CAZ.
    - There could be a strong strategic case for this, particularly if focusing on easing distributional impacts.
    - The economic case may be more difficult, as scrappage (for upgrades) does not bring as many benefits in the BCR as avoided journeys into the CAZ. This is due to the high value that WebTAG places on reductions in congestion, which is much higher than its value for local air quality and greenhouse gas emissions. Given the current strong focus in the UK on improving air quality it may be possible to challenge how WebTAG is valuing air quality improvements. Similar to how WebTAG offers much larger values for reducing congestion on roads that are operating above capacity, it seems reasonable to expect similar increases in value when looking at improving air quality in areas with a significant issue.
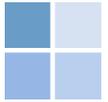
4. Assessing actual proposed CAZs

Birmingham

- Some of the data in our 'notional CAZ' is real-world data for the Local Authority of Birmingham and with a CAZ roughly the size of that proposed for Birmingham (20-25km^2). Nonetheless, there are several ways in which the current proposal for Birmingham's CAZ differs:

  - Birmingham offers a range of exemptions to the CAZ charge which are likely to effect the economic case:

    - They may dampen the behavioural response to implementation of the CAZ (i.e. avoided journeys, upgrades to EV/Euro 6 outside of the scrappage/retrofit scheme), reducing the benefits.

    - The majority of exemptions will be for at most two years, and there may be a strong socioeconomic case for allowing certain groups more time to achieve compliance. Permanent exemption is only proposed for the most vulnerable groups. This is an important consideration for the strategic case.

  - Birmingham has been awarded £38m from the CAF already which is aimed at assisting businesses and individuals affected by the CAZ – it appears that at least £33m of this is for scrappage or retrofit. This will enable a higher number of vehicles to be upgraded that we have assumed for the notional CAZ, bringing more air quality benefits.

    - A portion of this is for mobility schemes for individuals, which may help mode-shift to public transport (e.g. for commuting).

  - Birmingham also has separate funding for EV charging points, and so it is unclear whether the cost and benefit of EV charging points can be reasonably included in an assessment of the benefits and costs of a CAF aimed at facilitating the implementation and success of CAZ.

  - Birmingham may face a £60m fine if it does not reach compliance. It would not be common practice to consider this in the economic case, but it introduces an important imperative to the strategic case.

4. Assessing actual proposed CAZs

Bristol

- Bristol is currently assessing options to choose the best approach to its CAZ.
  - It is not certain that there will be a CAZ charge (CAZ do not by definition have to include a charge), there may be non-charging interventions solely, including a diesel ban for certain hours of the day (with a fine for entering during the ban hours) – in effect the fine replaces the charge, but attempts to increase the behavioural response without increasing the financial cost.
  - In our assessment of a notional CAZ, the strongest benefits came from km removed due to *journeys into the CAZ avoided to avoid paying the CAZ charge*. For this reason, a ban for the most problematic periods of the day may still provide a strong strategic case, and could bring a reasonable economic case.
- Bristol is also considering whether to choose a Class C or a Class D CAZ (Class D includes cars). With 40% of Bristol's NO_2 emissions being from diesel cars, there may be a strong case for implementing a Class D CAZ.
  - Bristol has previously found that there were strong socioeconomic concerns preventing it from including cars in the CAZ restrictions. If it is likely that Bristol needs to include cars to achieve compliance with air quality limits in the time period allowed, the best economic case may come from implementing a Class D CAZ with targeted support for the hardest hit groups (for upgrades and/or mode-shift, as is the case in our notional CAZ), and potentially exemptions to provide additional time for certain groups to achieve compliance.
  - With 23% of NO_2 emissions in Bristol being from diesel LGVs and 22% from buses and coaches, the case may be sufficiently strong for a Class C CAZ (which excludes cars), but should be taken into consideration alongside the strategic case (e.g. are there serious concerns about including cars? Can a Class C CAZ achieve air quality compliance?)

4. Assessing actual proposed CAZs

London

- London's initial CAZ, implemented as the ULEZ covers a 21km^2 area and applies to all vehicle types, is likely to bring benefits in line with or higher than the notional CAZ.
    - Results from the first month of the ULEZ* suggest that there has been a positive effect in terms of both reduced traffic from non-compliant vehicles and an increase in upgrading to compliant vehicles.
        - ULEZ was formally announced over 2 years prior to its introduction in April 2019. This allowed time for those who cannot reasonably avoid trips into the zone (e.g. PHV drivers) to plan and budget for an upgrade to a compliant vehicle.
    - The widening of the current Class D ULEZ to the north-south circular (at least 10 times the size of the current ULEZ) will increase the benefits, but also increases costs such as in public transport provision and requirements for supporting policy interventions such as scrappage/retrofit . The economic case might be expected to be slightly weaker than the initial small zone, but still net positive. There would be additional benefits from the Greater London (~1,600km^2) Class B CAZ, which add to the case.
- London would likely achieve a higher net benefit from each km removed (as opposed to upgraded) because of the generally high congestion experienced on its roads (as demonstrated through the WebTAG value per km driven on London vs other urban roads).

A Case studies

Appendix A: Case studies

	Case study: Birmingham (Slide 1/2)
Characteristics	• Government has said that Birmingham requires a CAZ by the start of 2020, including to reduce NO_2 levels to a maximum average of $40\mu g/m^3$ in the air. • In 2017, the city of Birmingham was given a final warning by the European Commission to reduce levels of pollutants in the air by 2020. Failure to do so could results in a £60m fine. • Analysis found that air pollution in Birmingham city was resulting in ~900 premature deaths a year. • Half of current cars are not CAZ-compliant, 55% of all vehicles.

CAZ proposal	• Charge vehicles to enter the centre of the city (similar to London's ULEZ) from January 2020.
	• Class D CAZ (not including motorbikes), covering an area ~20-25km^2:
	    • Charges: cars, taxis, LGVs: £8/day. HGVs, coaches, buses: £50/day
	• There are some exemptions, for example
	    • Vehicles registered within the zone get a 1y (commercial) or 2y (private) exemption
	    • Vehicles registered within Birmingham with car finance agreements get a 1y exemption.
	    • Commuters working in the zone and earning less than £30k get a 1y exemption.
	    • Visitors to hospitals, GPs and care homes within the zone (1 year)
	    • Vans/minibuses registered to provide school and community transport and for vehicles with disabled tax class (permanent)
	• Birmingham was awarded ~£14m for implementation.

Appendix A: Case studies

Case study: Birmingham (Slide 2/2)	

Support measures to encourage take-up of low-emission vehicles or retrofitting	• Government has granted £38m from the CAF to support businesses/individuals affected by CAZ. Of the £38m allocated from the CAF:
	 • £10.84m for mobility schemes for individuals working within the CAZ (50+% for scrappage)
	 • £15m will be for supporting taxi drivers affected;
	    • £7m used for upgrading private hire vehicles.
	      • £2.5k/vehicle towards running ULEV eligible for the Government plug-in car grant
	      • £2.0k/vehicle towards a vehicle not eligible for the grant
	      • £1.0k/vehicle towards purchasing a CAZ-compliant non-ULEV
	    • £5m used to support Hackney carriage drivers;
	      • Offering £5k/vehicle towards retrofit or buying a new compliant vehicle.
	    • £2.75m will fund a council-run Hackney carriage leasing scheme – 50 ULEV.
	 • £10.05m will facilitate HGV and coach compliance
	 • The remainder will support engagement and awareness, and administering the schemes.
	• Birmingham was awarded separate funding by OLEV for 197 EV charging points for taxis/PHVs.

Measures to discourage use or ownership of vehicles	• Birmingham hopes to offer incentives in the form of public transport tickets.

Appendix A: Case studies

Case study: Manchester (Slide 1/2)

Characteristics	• Greater Manchester has been instructed by Government to develop a Clean Air Plan in order to reduce levels of NO_2 on local roads - 152 roads in Greater Manchester exceed legal NO_2 levels • Estimates indicate that air pollution contributes to ~1,200 premature deaths per year in Greater Manchester, and Central Manchester has the highest number of emergency hospital admissions in England for asthma (double the national average). • The aim of the scheme is to bring reduce NO_2 emissions and bring air quality within legal limits. • There has been some opposition to the CAZ plans proposed by both environmental groups who want private cars to be included in the proposals, which they feel are a major part of the issue in Manchester, and local businesses against the plans.

CAZ proposal	• Greater Manchester is considering a range of measures to tackle air quality and has proposed a CAZ after suggestion from the Government. It will not however, be introduced unless government funding to help businesses obtain compliant vehicles was made available.
	• Proposing a Greater Manchester-wide (all 10 LAs; 1,276km^2) CAZ to be introduced in 2021, charging more polluting vehicles. Current proposals would not include privately owned cars.
	• It is proposed as two phases:
	   o Phase 1, 2021: Class B. HGVs, buses, coaches, (£100/day) taxis and PHVs (£7.50/day)
	   o Phase 2, 2023: Class C. Extended to LGVs and minibuses (£7.50/day)
	• In Greater Manchester as of March 2019, 90% of buses and 85% of taxis are non-compliant.
	• Exemptions/discounts will apply but will be developed through consultations.
	• What next? – the 10 local authorities have considered the proposal, which has been submitted to government, and a full business case is expected by the end of 2019.

Appendix A: Case studies

Case study: Manchester (Slide 2/2)

Support measures to encourage take-up of low-emission vehicles or retrofitting	• Greater Manchester has requested £116m for government-funded schemes to aid local businesses, HGVs, buses, coaches, taxis, and PHV operators in changing to cleaner vehicles: 　o Clean Freight Fund: £59m for HGVs 　o Clean Bus Fund: £29m for buses and coaches 　o Clean Taxi Fund: £28m for taxis and PHVs 　o Greater Manchester loan scheme: FSA-regulated loans at preferential rates for those taking advantage of the clean vehicle funds • Greater Manchester has said the CAZ will not be introduced unless the above funding from government is made available.
Measures to discourage use or ownership of vehicles	

Appendix A: Case studies

Characteristics (for real cities, not notional)	• In Bristol, air quality breaks the legal standards for NO_2, with estimates suggesting there are hundreds of premature deaths each year in the city associated with the air pollution. • The Government requires Bristol to set out a Clean Air Plan, originally by the end of 2018 but it has been delays due to balancing the issues of compliance with concerns about the effect on residents. • The council estimate ~40% of NO_2 emissions come from diesel cars, 23% from light goods vehicles that are diesel, and 22% from buses/coaches.

CAZ proposal	• Bristol is in the process of developing a clean air plan in line with the Government's guidance. They have stated that they do not think it can be implemented before 2021.
	• There are 2 options which went out to consultation on the 1st of July 2019; both are expected to achieve compliance by 2025:
	    • **Option 1: Medium (~20-25km²) Class C CAZ** with a local scrappage scheme. The light vehicle charge is £9/day, the heavy vehicle charge is £100/day (all day). There would also be a part-time ban on diesel cars on two roads, HGV weight restrictions, bus lanes, and controls on the volume of traffic entering congested areas with poor air quality.
	    • **Option 2: Ban on diesel vehicles in a small area (~5-8km²)** between 7am and 3pm. There is the potential to include other measures such as a scrappage scheme.
	    • **Both options** include a package of non-charging measures, such as improving buses and taxis, bus and local traffic interventions in the most severely polluted areas.
	• There are concerns around introducing a Class D CAZ, as Bristol's studies found that this would likely have a high impact on lower income households,

Appendix A: Case studies

Case study: Bristol (Slide 2/2)	
Support measures to encourage compliance	• The proposed scrappage scheme under the Class C CAZ proposal would provide up to £2,000 per vehicle for diesel cars, to encourage mode-shift (to public transport) or upgrade to a compliant vehicle.
Measures to discourage use or ownership of vehicles	• Bristol plan to consult on potential measures including: • Encouraging cycling, including new or improved cycle paths. • Changing parking systems. • Encouraging the use of public transport. • Expanding car clubs to areas of the city with high levels of uncompliant vehicles

Appendix A: Case studies

Case study: London (Slide 1/2)

Characteristics (for real cities, not notional)	• The Ultra-Low Emission Zone (ULEZ)* is being rolled out in phases:
	  • 2019: Central London (same as the Congestion Charging Zone, approx. 20km^2) for all vehicles.
	  • 2020: Expanding the ULEZ to London-wide (~1,600km^2) for buses, coaches and HGVs.
	  • October 2021: Extension to the North and South Circular roads (~300-400km^2)
	• They carried out studies which found that air pollution affects the health of all Londoners (with vulnerable communities suffering most). Half of the NO_x and PM_x emissions come from transport.
	• The scheme is aiming to cut pollution by 15% in central London and 4% more broadly.
	• A Low Emission Zone (LEZ) has been in place since 2008 for buses, coaches, and HGVs, which are required to be at least Euro III.
	• Enforcement uses the cameras already in place to enforce the congestion charge and the LEZ.
	• There has been a lot of controversy over the introduction of the ULEZ around the potential damage to businesses and even more is expected as it expands. TfL's van scrappage scheme aims to assist micro businesses, sole traders, and charities to acquire a compliant vehicle.
	• The small Class D scheme implemented in April 2019 has already shown a reduction in traffic flows and an increase in compliant vehicles since the ULEZ was announced. (See ULEZ - first month report)

CAZ proposal	• The well-established congestion charge infrastructure means that enforcement will be strict.
	• The ULEZ standards equal a Class D CAZ, including motorbikes.
	  • £12.50/day for motorbikes, cars, LGVs and other specialist vehicles.
	  • £100/day for HGVs.
	• There are discounts and exemptions available e.g. residents in the zone, vehicles for disabled peoples, taxis and PHVs, although most of these are to be phased out over time.

* In the UK, a CAZ focuses on Clean Air measures, and can choose to include charging the most polluting vehicles - LEZ and ULEZ do use charging (an area can be both a CAZ and a LEZ)

Appendix A: Case studies

Case study: London (Slide 2/2)	
Support measures to encourage take-up of low-emission vehicles or retrofitting	• For cars and motorbikes, TfL provides no explicit link for measures to encourage take-up of low emissions vehicles or retrofitting, other than general advice on upgrading to ULEZ-compliant vehicles or switching to electric vehicles. • For vans and minibuses the mayor's office provides a 'Cleaner Vehicle Checker' for second-hand vehicles, a scrappage scheme for small businesses, to retrofit with emissions reduction technology or retrofit/convert to LPG • For larger vehicles (lorries, buses etc.) there is the option to retrofit emissions reduction technology. • For black cabs, there is a 'delicensing' scheme in place to encourage upgrading Euro 3-5 cabs to a newer, cleaner vehicle before the existing ones reach their current 15-year age limit.*
Measures to discourage use or ownership of vehicles	• Encouraging the use of public transport: London has a strategy aimed at increasing the share of all trips that are by public transport from 64% in 2017 to 80% in 2041 – 3 million fewer car journeys in London each day. This involves investing in walking, cycling, and public transport improvements.

*The current delicensing scheme offers £6k-£10k for taxis younger than 13 years, and £1k for 13 or 14 year old taxis.