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# CLEAN AIR ZONES: PRACTICAL GUIDANCE FOR CITIES

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**Clean Air Fund** is a global philanthropic organisation that works with governments, funders, businesses and campaigners to create a future where everyone breathes clean air. We fund and partner with organisations across the globe that promote air quality data, build public demand for clean air and drive action. We also influence and support decision makers to act on air pollution.

**Arup** is an independent firm of designers, planners, engineers, consultants and technical specialists, working across every aspect of today's built environment. Together we help our clients solve their most complex challenges – turning exciting ideas into tangible reality as we strive to find a better way and shape a better world. Our experience of developing and delivering clean air zones along with our global presence helped us with this guidance.

**Kaleidoscope Health and Care** is a not-for-profit social enterprise with a mission to work with others to build a future that is kind, connected and joyful. As a consultancy, we meet this mission by working in partnership with our clients to support them to make health and care better. Our research and evaluation support enables our clients to reflect better, understand deeper, and prioritise with more energy.

The **ICCT** is an independent, nonprofit research organization founded to provide exceptional, objective, timely research and technical and scientific analysis to environmental regulators. Our work empowers policymakers and others worldwide to improve the environmental performance of road, marine, and air transportation to benefit public health and mitigate climate change.

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Authors include Sarah Legge, Tiffany Cheung, James Bellinger, Clare Sheffield and Tom King (Arup). Contributors include Yousef Majeed, Dominic Dattero Snell, James Edwards, Anne Parkes and Laura O'Leary (Arup), Kaylin Lee and Sandra Wappelhorst (ICCT), Sarah Moir and Andréa Taylor (Kaleidoscope Health and Care), Sietske van der Ploeg, Arindam Roy, Matt Whitney and Sue Wixley (Clean Air Fund).

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# EXECUTIVE SUMMARY

Air pollution is one of the leading causes of premature deaths worldwide, with a death toll of more than 8 million people each year, many in cities. It also has crippling economic consequences: the loss of productivity and health costs of treating conditions such as asthma, cancer and dementia runs into the trillions.

Vehicle emissions are often a major source of air pollution in cities. Clean Air Zones (CAZs), and similar schemes such as Low Emissions Zones and Zero Emission Zones, are one of the tools available to cities seeking to address this challenge. This guidance is for policy makers who are interested in CAZs, including elected leaders, Mayors and officials in local governments and city administrations.

The guidance aims to support cities around the world at whatever stage they are in their pathway to clean air. It aims to help cities navigate through the process of developing and delivering a CAZ. It sets out key questions to answer, building on existing resources and supporting with lessons from elsewhere, bringing the entire process together into this comprehensive guidance. The guidance has been developed from an expert review of the current best practice for CAZ, a detailed literature review and 10 interviews, workshops and roundtables with cities from the Global North and Global South to enable cities to learn from each other.

Introducing a CAZ can deliver a host of benefits for local people and for cities. These include cleaner air, improved health which can lead to increased workforce



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productivity, safer streets, contributions to city's net zero goals and sustainable urbanisation. CAZ, like any new policy can present challenges and, in some cases, their introduction has caused a higher-than-normal level of opposition. To help cities navigate these challenges, the guidance considers the wider regulatory and political context, among other issues. Also explored, is advice on how to ensure a CAZ has equity at the heart of its design and delivery, and the wider context, costs of implementation and complementary measures.

There is no “one-size-fits-all” approach to CAZs. Instead, every aspect needs to be tailored to the unique circumstances of each city. We have provided **case studies** which can be used to see different approaches or learn from others where they have faced similar challenges. Our guidance starts with helping cities to decide **if a CAZ could be the right solution for the city.**

With careful planning through each phase, CAZs can be a sustainable and beneficial option for many cities. Our guidance has the ‘golden thread’ of **communication/ stakeholder engagement**, along with a focus on data and understanding of the issues, running through the document. We set out the core considerations for effective management of the CAZ to ensure confidence and consideration are built through the **planning** and **design** and into **implementation** and **monitoring and evaluation**, to ensure that the CAZ are effective and aligned to the city's aims.

# 01

## INTRODUCTION



## INTRODUCTION

Air pollution is a major concern for cities around the world, and Clean Air Zones can be an effective tool for addressing pollution from road transport.

This report provides comprehensive guidance for policy makers who are interested in Clean Air Zones, including elected leaders, mayors and officials in local governments and city administrations. It takes cities through each stage of planning, design, implementation, and monitoring and evaluation, with insights from other cities.



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## WHY CONSIDER A CLEAN AIR ZONE?

Toxic air affects us all. According to the World Health Organization, 99% of the world's population breathes polluted air with devastating consequences to their health and wellbeing. Air pollution, now the second leading risk factor for death globally<sup>i</sup>, leads to millions suffering with diseases like asthma, strokes, heart attacks, cancer and dementia. In 2021 alone, air pollution led to more than 8 million premature deaths.

In addition to the human toll, air pollution has a debilitating economic cost. The World Bank estimates the cost of health damages from PM<sub>2.5</sub> air pollution at \$8.1 trillion a year in 2019, the equivalent of 6.1% of global GDP<sup>iii</sup>.

### Cities on the frontline

Rapid urbanisation means that, by 2050, nearly seven out of ten people worldwide (68 %) will be living in cities and breathing air that is harmful to their health and the environment<sup>iv</sup>. Some groups are especially vulnerable to the harmful effects of air pollution, including young children, expectant mothers, older people, and individuals with cardiac and respiratory conditions. Economically disadvantaged communities often experience higher exposure to harmful air pollutants and greater health risks as a result.

Because of the impacts of air pollution, cities often act as first responders and drivers of innovation and action. Taking action to control key sources of urban pollution such as traffic, industrial activities, waste burning, the burning of solid fuels like coal and wood in homes, and power plants, is an increasingly urgent priority for many city leaders and local people alike.

For cities seeking to address emissions from traffic and improve air quality and health outcomes, a Clean Air Zone (CAZ) is an important tool in the clean air toolbox. All cities must tailor their approach to designing and introducing a CAZ to ensure it is effective and aligns with the city's aims. CAZ are often introduced alongside a package of complementary measures to address vehicle related emissions, such as upgrading public transport. Measures to address other sources of emissions may consider a host of options depending on their circumstances. These include: replacing dirty domestic heating, introducing cleaner cookstoves, driving cleaner industrial technology, making waste management more environmentally friendly, among others.

### CAZs rely on tailored measures

While by no means the only option available, CAZs have proved effective in a number of cities and in a range of context. This guidance is aimed at supporting learning about what works and what does not and brings real-life insights for those cities considering a Clean Air Zone.

This report draws on an expert review of Clean Air Zone development including a detailed literature review; 10 structured interviews and workshops with city officials from around the globe, including those which have introduced a Clean Air Zone and those which are still weighing up their options.

When it comes to accelerating air quality improvements, there is no “one-size-fits-all”. Consequently, this report is not intended as a prescriptive set of rules but instead provides questions, checklists and real-world insights for consideration.

The effectiveness of a CAZ also relies on the scheme being well designed and carefully implemented, which is why we wanted to provide guidance to support cities and share lessons.

## WHAT IS A CLEAN AIR ZONE?

A Clean Air Zone or CAZ is a specified area in which vehicles are required to meet minimum emission standards. These zones are designed by an authority to improve air quality and public health and promote a shift to public transport and other active travel. These zones are often enforced through charges for driving more polluting vehicles.

CAZs primarily target vehicular emissions - especially nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) – but also carbon dioxide (CO<sub>2</sub>) emissions, to protect both health and the climate. As well as incentivising a transition to less polluting vehicles, a CAZ can encourage the use of other modes of travel, including public transport, and help improve mobility. CAZ can also tackle congestion and make streets safer for cyclists and pedestrians.

Some cities define their wider clean air programme as a CAZ, which could include a LEZ as a centrepiece. A CAZ can be a holistic programme and may include a wider set of interventions that are also aimed at addressing the harmful consequences of air pollution and tackling climate challenges. These might include improvements to public transport, including introducing cleaner bus and taxi fleets, new parking measures, among other solutions to addressing pollution hotspots. Some hyperlocal schemes, such as Low Traffic Neighbourhoods, School Streets or pedestrianised streets, may have similar goals to a CAZ and can be introduced alongside a CAZ, however they are not included within the scope of this guidance. Similarly, CAZ can also be linked to non-road transport measures, covering construction sites or shipping for example. In this report, these are highlighted under complementary measures, but not considered in the core CAZ guidance.

CAZs primarily target vehicular emissions - especially nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) – but also carbon dioxide (CO<sub>2</sub>) emissions, to protect both health and the climate. As well as incentivising a transition to less polluting vehicles, a CAZ can encourage the use of other modes of travel, including public transport, and help improve mobility. CAZ can also tackle congestion and make streets safer for cyclists and pedestrians.

In addition to delivering benefits for public health and addressing a key driver of global warming, CAZs can also help a city address the disproportionate impact of air pollution on lower-income and minority groups. Like other measures to clean the air, CAZs also underpin a thriving economy, by cutting the impacts of air pollution such as reduced workforce productivity and increased health costs.

There is no “one-size-fits-all” approach to CAZs and every aspect needs to be tailored to the unique circumstances of each city. While there are multiple benefits of introducing a CAZ, they are not without their challenges. It is important to understand and be clear about both elements.



## ABOUT THIS GUIDANCE

This guidance is for policy makers around the world who are interested in CAZs, including elected leaders, mayors and officials in local governments and city administrations. The aim is to help policy makers to weigh up a range of considerations to inform their decision on whether a CAZ is appropriate, and to guide them through key aspects of planning and delivering a CAZ.

To deliver this guidance we have undertaken the following activities:

- carried out an expert review of the current best practice for Clean Air Zone development including a detailed literature review,
- conducted 10 structured interviews with city officials from around the globe; these included policy makers and leaders who have already introduced a CAZ and those who are interested in developing one; and included cities from the Global North and the Global South.

While a CAZ is just one option amongst many available for cities to consider when tackling air pollution, their effectiveness depends on the scheme being well designed and carefully implemented. Our aim is to support anyone wanting to learn more about CAZs, especially those cities which may be considering whether a Clean Air Zone is right for their context. Rather than prescriptive guidelines, we therefore set out questions, checklists, and a potential framework for cities to consider as the work develops.

## HOW TO USE THIS GUIDANCE

From our research and interviews, it is clear that while there are many variables to consider, cities have applied a fairly consistent approach in planning and delivering their CAZs, regardless of the design, size and criteria of the scheme.

These insights are distilled down and each chapter will build on the last by starting on planning and ending on how to monitor and evaluate the performance of the CAZ.

For ease, the three stages of 1) planning for, 2) implementing and 3) monitoring and evaluating a CAZ are colour coded throughout, as summarised in Figure 1. Reference source not found. and shown in detail in Figure 2. This guidance can be used sequentially or be consulted for questions on specific stages.

Each chapter starts with a brief summary for decision-makers and ends with a checklist to identify what cities should be able to action using the information and examples in the chapter.

Rather than replicating existing resources, this guidance includes links and references within each chapter to aid cities' work.

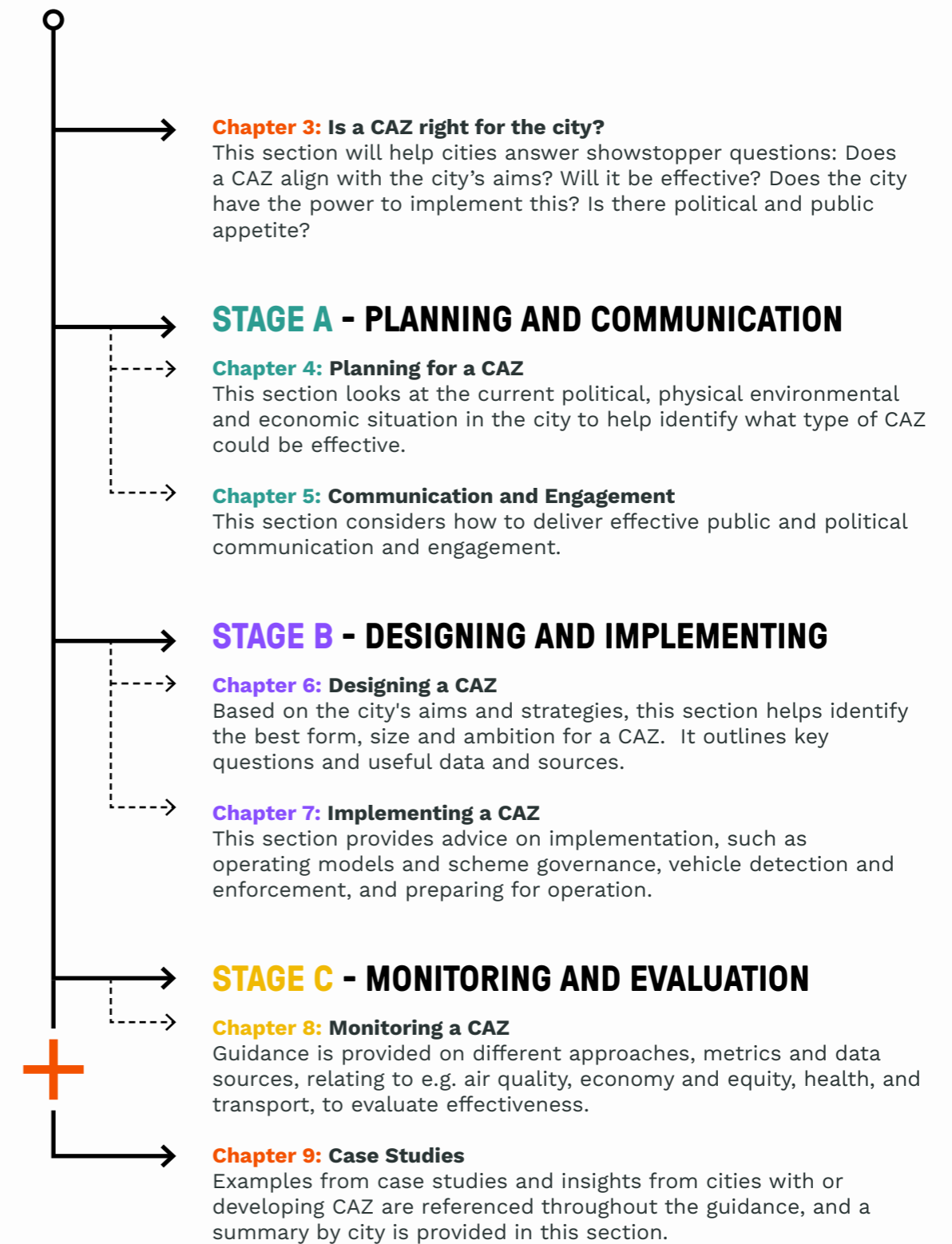


Figure 1 – How to use this guidance



# 02

## BENEFITS AND CHALLENGES OF CLEAN AIR ZONES



## BENEFITS AND CHALLENGES OF CLEAN AIR ZONES

A CAZ uses targeted action on transport in a specific area primarily to improve air quality through various methods such as traffic control, limited traffic zone, and emission standard controls. There are a variety of CAZs in use or under consideration, which target vehicular emissions to protect health and the climate, often using charges for those driving more polluting vehicles.

When designed well, a CAZ can deliver a wide range of benefits, on public health, climate, and equity issues. It can incentivise a transition to less polluting vehicles, encourage the use of public transport, tackle congestion and make streets safer, underpin a thriving economy and boosting a city's reputation.

However, there are also challenges for designing and implementing an effective CAZ, which have been highlighted in our research and interviews with cities, including political and public opposition, and cost. This guidance aims to help cities clearly understand both the opportunities and the challenges for CAZ and how to navigate them.



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## BENEFITS FOR LOCAL PEOPLE

There are numerous benefits for local people, including residents, visitors, commuters and local businesses and organisations (see Figure 3).

The improvements in air quality, reduction in air pollution-related health impacts as well as reductions in carbon emissions have been well documented and examples/statistics can be found in the C40 Clean Air Zone Toolbox<sup>v</sup>.



### Benefits of a CAZ for local people

- Cleaner air
- Improved health
- Reduced noise
- Safer streets
- Enhanced community
- Space for exercise and play
- Climate benefits

Figure 2 – CAZ benefits for local people

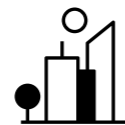
“Knowledge sharing with cities that have done similar projects would be very helpful. Hands-on experience of those who have already walked the path.”

- City representative, Global South

## BENEFITS FOR CITIES

The numerous benefits associated with cleaner, healthier cities, as summarised in Figure 4.

The benefits to the economy and how a CAZ can support and stimulate growth and make a city an attractive place for investors have been well documented and examples/statistics can be found in the C40 Clean Air Zone Toolbox<sup>v</sup>.



### Benefits of a CAZ for cities

- Stimulating the local economy
- Economic benefit of improved health
- Potential revenue generation for air quality initiatives
- Demonstrating leadership and innovation
- Improving reputation and city ranking
- Placemaking and urban regeneration
- Supporting net zero ambitions

Figure 3 – CAZ benefits for cities

“When we think about mobility management, increasing air quality or our convictions on climate change, for example, our goal of being carbon neutral, we had to implement some new strategies.”

- City representative, Global North

## CHALLENGES

- **Political and public pushback:** CAZs impose costs on drivers of more polluting vehicles and can limit the travel choices of residents. This has led to pushback from the public including those directly affected by a CAZ as well as from politicians and the media<sup>vi</sup>. This can be intense and lead to delays or rejection of a CAZ, and it has been linked to wider climate protests and political controversy. It is vital that cities consider how to make sure a CAZ fair and equitable by taking into account challenges such as a lack of affordable clean vehicles or public transport. Thorough planning, communication and engagement can help with addressing potential pushback, although this will remain a risk.
- **Time and costs for authorities:** The effort and costs associated with the planning, implementation and maintenance of a CAZ are significant. In addition to investing in establishing and maintaining the technology and infrastructure for a CAZ, cities need to factor the cost of stakeholder consultation and information campaigns. The upfront costs of implementation may be recouped through the collection of charge or penalty charge revenue over time, and in the longer-term scheme revenues may provide funding for investment in further initiatives, which are outlined in **Chapter 6: Designing a Clean Air Zone.**
- **Costs to local residents and businesses:** At the same time, individuals and businesses are faced with costs and inconvenience of transitioning to cleaner vehicles or changing their commuting habits, and the people most affected by CAZ implementation and compliance are not necessarily those who benefit most from its environmental, health, societal and wider economic impacts.
- **Challenge of adaptation:** the cost of upgrading a vehicle, the availability of affordable second-hand vehicles, the lack of accessible public transport may present a challenge for some individuals and groups, including people with certain disabilities, tradespeople who rely on vans to carry tools and equipment, and polluting public transport options such as mini vans in Global South cities. With the right support, cities can limit these potential burdens and support a smooth and equitable transition.



## LIMITATIONS

- **Availability of alternatives choices:** some cities are limited by what vehicles are available in the market, especially at scale at an acceptable price, or lack accessible public transport to replace some or all journeys. This will affect what restrictions a CAZ can set, as some groups may need to continue to drive their polluting vehicles in the zone.
- **Reduced impact over time:** Unless the scope changes or the vehicle standards become more stringent, the impact of a CAZ will gradually reduce over time as the general vehicle fleet becomes cleaner. However, even at this point, the zone will continue to make an impact by continuing to limit the most polluting vehicles.
- **Knock-on impact for neighbouring areas:** Sometimes a CAZ will result in high-emission vehicles diverting around the restricted zones, leading to increased pollution in adjacent areas, as well as increased impact, which can negate some of the intended benefits of the LEZ.
- **Regional pollution is not addressed:** A CAZ only targets emissions from local traffic, and other than the wider impact of vehicles choices affected by the CAZ (such as upgraded vehicles, or longer journeys which have their origin or destination within the zone), it cannot address pollution from outside the zone, such as from surrounding areas or further afield. Also it does not address other sources of pollution, for example from industrial emissions, domestic heating and cooking, waste or agricultural burning.



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## REAL-WORLD EMISSIONS

Many CAZ use regulatory emission standards as criteria for compliance, such as the European Vehicle Emission Standards (Euro standards). Historically, there have been differences in vehicle performance in a lab with how they perform in the real world, leading to potential difficulties of predicting future emission changes and underperformance of transport schemes designed to reduce air pollution.

Regulations which include real-world testing, also known as in-service testing, as part of the vehicle type approval process (such as Euro 6d standards onwards) can be a more reliable criteria for delivering real world benefits. It may also increase the benefits of a CAZ which moves from vehicles with an earlier emission standard to one with real-world testing, as the earlier vehicles may be more polluting than the modelled indicates.

Care may still need to be taken to ensure that the vehicles are well maintained and working effectively, as there have been examples of both systematic and individual tampering with the emission abatement technologies.



# 03

**IS A CLEAN AIR  
ZONE RIGHT FOR  
YOUR CITY?**

## IS A CLEAN AIR ZONE RIGHT FOR YOUR CITY?

Before diving into the planning process, it is important to understand cities' priorities, its transport and other infrastructure, and the regulatory, political and economic context in which it operates. Answers to these key questions will determine whether a Clean Air Zone could be the right scheme for your city.

## WHAT DO CITIES NEED TO CONSIDER BEFORE CHOOSING TO DEVELOP A CAZ?

There is no one approach to developing a CAZ and the enabling conditions will be different for each city. However, through research and feedback from cities around the world, some considerations have been identified that will help to inform this decision.

Consider the local context for the city:

- What are the city's key priorities and could a CAZ help deliver these?
- What are main sources of air pollution in the city?
- What air quality standards are in place?
- What impact could local politics have on the development of a CAZ?
- Does the city have the governance structures and authority required?
- Is there a political appetite to proceed?

- What existing infrastructure, such as public transport and enforcement framework, is already in place?
- Is the design and implementation of a CAZ scheme affordable?
- Is there sufficient time for implementation?
- How would a CAZ fit with existing local initiatives, and what can be learned from these?

The flowchart below (Figure 4) will help cities understand whether a CAZ would be appropriate for the city and to identify the cities' readiness for developing and implementing a CAZ. This flowchart is a summary overview of the process which can be followed, with further detail provided in subsequent subsections of this chapter.



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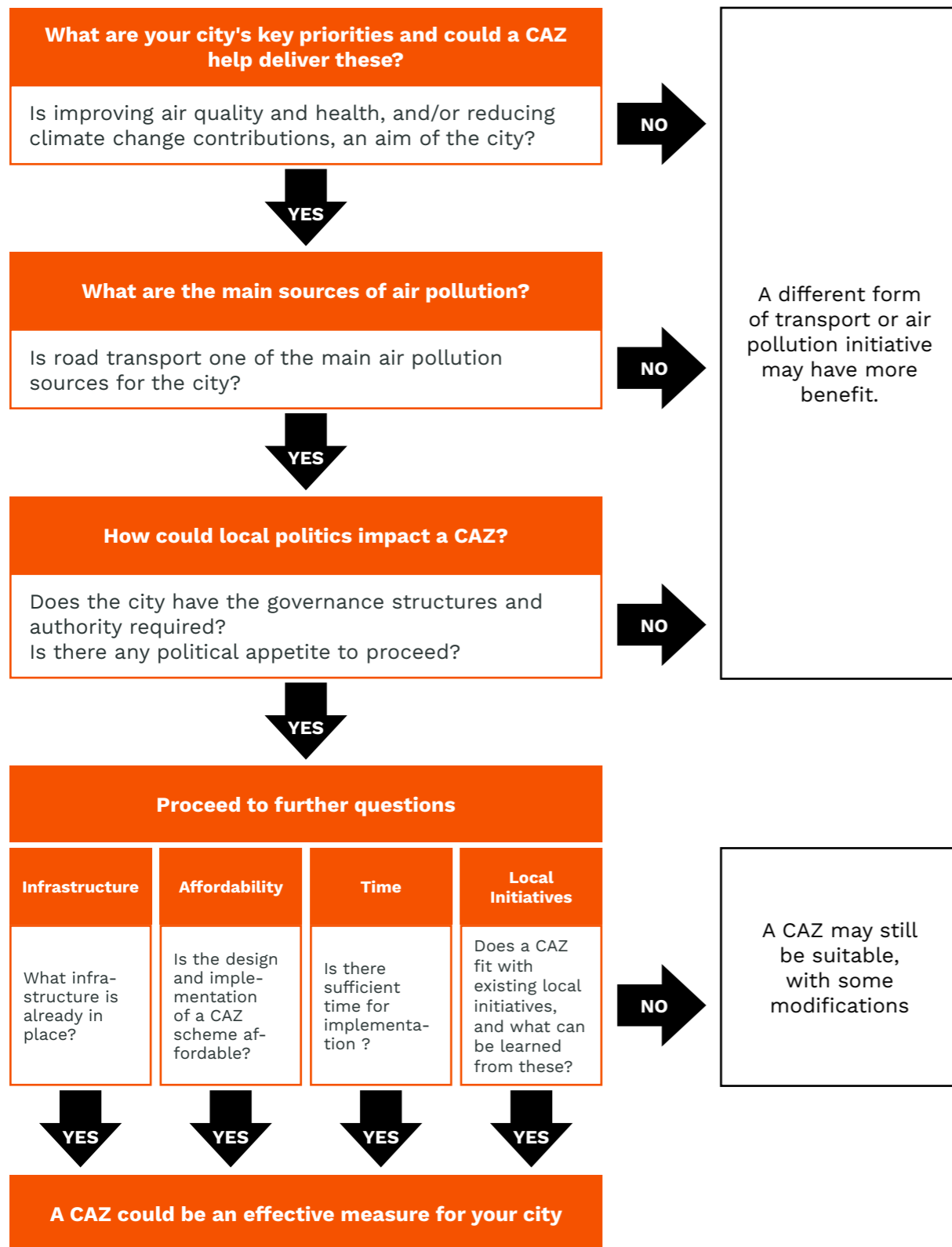


Figure 4 – Is a CAZ right for your city?

### WHAT ARE THE CITY'S KEY PRIORITIES AND COULD A CAZ HELP DELIVER THESE?

The first step when considering whether to implement a CAZ is to identify the city's policy priorities, to determine how important clean air is to the city in comparison with other priorities, and to what extent does delivering clean air initiatives help to deliver other priorities. For a CAZ to be effective, the key priorities for the city should align with at least one of the following:

- Improving public health and wellbeing through cleaner air;
- Meeting regulatory air pollution limits or criteria;
- Reducing traffic congestion;
- Addressing disproportionate impacts of air pollution;
- Developing a cleaner sustainable transport system;
- Encouraging active travel including walking and cycling;
- Achieving the World Health Organization (WHO) air quality guidelines or ambitious interim targets;
- Becoming a net zero city; and/or
- Urban regeneration or sustainable urbanisation.

### WHAT ARE THE MAIN SOURCES OF AIR POLLUTION?

To tackle air pollution effectively, there needs to be a clear understanding of the sources of air pollution and the regulatory environment. This can be identified through air pollution monitoring and emissions inventory work. Further information on this is provided in the **Clean Air Zones: Practical Guidance for Cities Annex.**

Understanding the contribution of emissions from the road transport sector is vital, since a CAZ is focused on reducing vehicle emissions. If road transport is a major source of emissions, a CAZ could be an appropriate measure.

Conversely, a CAZ may not be an appropriate first step for a city where the dominant sources of emissions are from non-road transport sectors. Some cities have significant pollution from sources such as industry, domestic heating and cooking, agriculture and waste burning, so it is vital to understand the relative impact of non-road transport sources. For example, in Ulaanbaater (Mongolia), the main sources pollution sources are from coal burning used for cooking and heating<sup>vii</sup>, in Dammam (Saudi Arabia), a large proportion of dust is from dust storms and construction activity, shipping and biomass burning<sup>viii</sup>.

#### What air quality standards are in place?

Consider the legal and regulatory context, including whether a regional directive, national legislation or other policy is in place. For example, are there relevant air quality standards, and is the city meeting them? Many cities have regulatory limits for air pollution concentrations, which suggests their CAZ prioritises improving air quality at the most polluted locations. Others may not have pollution concentration targets and therefore have the flexibility to focus on the maximising public health benefits across the wider population, adopt non-mandatory targets, or the dual aim of improving air quality and climate change.

## HOW COULD LOCAL POLITICS IMPACT A CAZ?

CAZ schemes are often controversial due to the costs to a city's budget, the behaviour changes required for individuals and the associated costs of vehicle upgrades. In addition, the direct impact on certain groups which cannot afford to change the vehicles and have to pay the charge instead can make these schemes unpopular. The vocal backing of the relevant political parties and champions – at a local, regional and national level – is therefore vital.

Two key questions to consider are: 'Does the city have the governance structures and authority required?' and 'Is there political appetite to proceed?'

### Does the city have the governance structures and authority required?

The city will need to have the power to restrict and control transport at a local level and the authority to enforce regulations and legislations.

A review of existing legal powers and administrative framework is useful to identify potential legal pathways for implementation and enforcement. The scope of this can include regulations on ambient air pollution, vehicle emissions or licensing, and controls on local roads. The ICCT carried out such a review for India<sup>ix</sup>.

The city may need to work closely with local, regional and national governments where each part of the government brings the necessary regulatory powers, resources and funding. Where there have been gaps in the legal framework, some cities have successfully worked with national government to create or amend laws and powers to enable the city to implement and enforce a CAZ.

## INTERVIEW INSIGHTS

Smooth implementation of a CAZ requires political support as well as having a supportive legal and legislative framework at both a local and national level. This legal backing gives cities the authority to enforce new regulations associated with the CAZ operation

"The legal, legislative framework was significant. It would have taken a lot longer to set up the LEZ without this."

- City representative, Global North



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Local government can play an important role both as potential barrier to implementation as well as a conduit for information. By sharing information and coordinating efforts within communities, local governments can amplify residents' voices so that concerns are heard and aligned with city, regional and national government actions.

### Is there a political appetite to proceed?

Securing political backing from the city authorities, including Mayors and other critical decision-makers in city councils is vital throughout the development and implementation of the CAZ. They will need to secure and allocate funding and resources, and authorise implementation and will need to lead public engagement, consistently making a positive case for the scheme.

Local political leadership will need to be reinforced by national government and/or political support.

Civil Society Organisations (CSO) might shore up support, and help connect with communities, for Mayors, politicians and other decision-makers, where the CAZ and its benefits aligns with their priorities.

## INTERVIEW INSIGHTS

A strong governance structure with political support, particularly from leadership like mayors and city councils, has been cited by interviewed cities as a key enabler for implementing a CAZ. This includes, but is not limited to, creating dedicated task forces and involving multiple government departments. In one city, support from mayors and vice-mayors was instrumental in pushing forward their Low Emission Zone. Similarly, in another city, the governance structure, from the governor down to the ministers, was identified as a key factor in enabling the implementation of air quality policies.

One of the key challenges noted by cities is the importance of maintaining consistent political support and a long-term vision despite changing administrations over time.

"Our upcoming challenge will be political transition, leadership transition. How will we keep the buy-in in the next administration?"

- City representative, Global North

"People with political power are really important. It cannot be just led by the traffic department. The city council needed to vote on the CAZ so they have to support the process and idea of the CAZ.

You need support from decision-makers, especially mayors. This is the most important thing. If you don't have the support of the decision-makers or mayor, it's not worth starting the process. You could collect data to baseline, but don't bother trying to implement a CAZ. Non-Governmental Organisation (NGO) influence isn't enough."

- City representative, Global North  
February 2025



## WHAT INFRASTRUCTURE IS ALREADY IN PLACE?

The existing physical and technological infrastructure, or the ability to introduce new infrastructure, is a major consideration. This should be reviewed, including an assessment of the existence of:

- a transport body with the powers, capacity, capability and resources to implement a CAZ scheme;
- a licencing system with sufficient information about vehicles and their owners;
- a financial structure to support funding the CAZ and complementary schemes;
- technological infrastructure such as air quality monitoring for the monitoring and evaluation of CAZ outcomes;
- accessible and well-distributed charging facilities and reliable electricity that is able to handle increased demand (if electric vehicles are being considered);
- technological and physical infrastructure, for example fixed signage for ongoing enforcement and maintenance, and Automatic Number Plate Recognition (ANPR) or an alternative suitable approach for enforcement;
- supporting technological infrastructure and personnel to support image processing and enforcement of vehicles entering CAZ;
- affordable options for vehicle replacement to lower emission vehicles; and
- adequate accessible public transport options and safe walking and cycling options to support the shift away from private vehicle usage.

The existence and extent of these infrastructure will determine the city's ambition and the type of CAZ that can be introduced. Cities which lack this infrastructure may need to be flexible when designing a CAZ, looking at modifications such as a non-charging scheme or manual enforcement rather than ANPR. For example, Paris's Zone à Faibles Émissions is enforced using stickers monitored by the police, which has lighter infrastructure requirements. **Chapter 4: Planning a Clean Air Zone** and **Chapter 6: Designing a Clean Air Zone** sets out more options for planning and implementation.

“[We] Already had cameras in place for congestion charge so we used this existing infrastructure and could save resource on this.”

- City representative, Global North



## INTERVIEW INSIGHTS

**Existing infrastructure and technology have been identified as important enablers when implementing a CAZ.** Cities with pre-existing systems, such as camera networks or traffic monitoring tools, find it easier to adapt these for CAZ purposes. One city utilised existing camera infrastructure and signage from a different scheme, significantly reducing setup costs and time. Another city highlighted the importance of having the right technological systems in place for effective implementation.

Piggybacking on existing infrastructure also allows for faster deployment and can increase public acceptance due to the use of familiar systems. However, cities lacking such infrastructure may face additional challenges and costs, or be flexible in their approach, in setting up a CAZ. However, cities lacking such infrastructure may face additional challenges and costs, or need to be flexible in their approach, in setting up a CAZ.

## IS THE DESIGN AND IMPLEMENTATION OF A CAZ SCHEME AFFORDABLE?

Implementing a CAZ requires significant up front funding, especially where additional physical and technological infrastructure is required. This will need to be considered as part of the process in determining whether a CAZ is right for the city.

Initial costs will include a feasibility study, data collection, and detailed design and evaluation. Further costs will include physical and technological infrastructure for monitoring, implementation and enforcement. Later chapters of this guidance provide more details on these steps and requirements, including a range of options.

Different cities use different funding models to support policy development work, including core or ring-fenced city budgets, some may supplement this with funding from external bodies, such as national government or non-profit organisations.

The development and implementation of the CAZ can be designed to minimise costs, but this can have implications for the approach, scope or ambition of the CAZ. Some of the costs of implementation can be recouped but an assessment of the price sensitivity of residents, businesses and visitors will need to be well understood. (See the [Clean Air Zones: Practical Guidance for Cities Annex](#) for more detail).

“There are financial challenges, which is a serious risk. You may get policy approved but not have the funding available to enact them.”

- City representative, Global South



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## INTERVIEW INSIGHTS

**Limited financial resources and inadequate infrastructure might create a barrier to implementing and maintaining CAZs.**

Even when policies are approved, many cities struggle to secure enough funding to install and maintain essential infrastructure, such as air quality monitoring stations and electric vehicle charging points. Insufficient budgets hinder efforts to expand or maintain monitoring across various zones, resulting in gaps in critical data needed for informed decision-making.

Collaboration between national and local governments is necessary to pool resources and ensure infrastructure is adequately supported. Moreover, cities need to mobilise political support across sectors like transportation to ensure these interventions are properly funded and sustained.

“Having to mobilise the political support to understand the long-term benefits of this intervention is still a grey area. There is a lot of investment that must happen and the budget doesn’t sit with the air quality department. How do we get the transport guys to play their role so these policies are implemented, so that they are budgeted and can support the policy?” - City representative, Global South



## IS THERE SUFFICIENT TIME FOR IMPLEMENTATION?

Planning and developing a CAZ can be a lengthy process which typically takes a few years<sup>x,xi</sup>, however the exact time will largely be dependent on context specific to the city, the existing infrastructure and the operational model chosen. This will be a lengthier process if road user charging infrastructure has yet to be installed.

If an ambitious CAZ is introduced too quickly it can have negative socioeconomic impacts on residents and businesses that do not have enough time to prepare. The implementation programme should be developed to provide sufficient time to minimise these impacts, while also ensuring the uptake of low or zero emission vehicles is achieved faster than the natural turnover of the fleet which would happen without a CAZ.

The purpose for your CAZ may change in the future depending on evolving factors including legislation and policy shifts, monitoring and evaluation outcomes, technological advancements, economic development, public reception and more. Phasing and piloting are important part of defining effective implementation timelines). It is important that the city continuously tailor its approach to respond to challenges and the opportunities that arise.

“If cities are able to lay out a 5 year road map what is happening with the CAZ, being really clear from the beginning. 10 year vision would be amazing but this usually needs to be the term of an administration.”

- City representative, Global North

## HOW WOULD A CAZ FIT WITH EXISTING LOCAL INITIATIVES, AND WHAT CAN BE LEARNED FROM THESE?

Aligning the CAZ with existing programmes and initiatives enables a cohesive and cost-effective approach to delivering benefits. It can be a key part of wider sustainability and/or transport improvements in a city.

Existing initiatives could complement, be a starting point for, or replace the need for a CAZ scheme. These could include, for example, focussed programmes to upgrade the city bus fleet, introduce emission standards through taxi licensing, electric vehicle charging networks and incentives, or urban renewal programmes.

It is also worth considering how other initiatives have been received e.g. public transport improvements, bicycle hire schemes or pedestrianisation measures.

There may be alternatives to introducing a CAZ and, as set out from the start of this process, it is important to consider all options and alternatives to reach the same goals.

## CHECKLIST - IS A CLEAN AIR ZONE RIGHT FOR YOUR CITY?

In deciding whether a CAZ could be the right approach for the city, the city should consider:

- The city's key priorities and whether could a CAZ help deliver these
- The main sources of air pollution in the city
- Relevant quality standards
- The impact local politics could have on the development of a CAZ
- Whether the city have the governance structures and authority required
- Whether there is political appetite to proceed
- The infrastructure already in place
- Whether the design and implementation of a CAZ scheme is affordable
- Whether there is sufficient time for implementation
- How a CAZ fit would with existing local initiatives, and what can be learned from these

## INTERVIEW INSIGHTS

Integrating CAZs with existing environmental or urban development initiatives has been found to increase acceptance and effectiveness of a scheme. This approach allows cities to align CAZ objectives with broader urban goals. For example, providing a bike sharing programme provides alternative ways for people to move around in CAZs. This requires careful planning and coordination across different departments and stakeholders.

“Currently [X city] already has a climate action plan which was helped by C40 as well, and they planned it last year. They formalised an air quality action plan up to 2030. On those two action plans there is a low emission zone as one of the action plans. So we want to integrate both of these different regulations into one guideline and road map towards a clean air zone.” - City representative, Global South

# 04

## PLANNING FOR A CLEAN AIR ZONE



## PLANNING FOR A CLEAN AIR ZONE

There are foundational questions to answer which will shape subsequent steps of designing and implementing a CAZ.

Data and evidence is a prominent theme in planning an effective CAZ. As each city has differing types and depth of data, this section provides a steer for data you might need, and how to plan for a CAZ where data gaps exist.



Data on air quality, traffic patterns, and public opinion is a key enabler for designing and implementing an effective CAZ, harnessing public support, and aiding compliance.

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Two vital elements of a Clean Air Zone - the geographical area it covers and the policy which will be applied - need to be carefully considered. Each of those questions entail several considerations and are addressed turn.

## WHAT IS THE APPROPRIATE AREA FOR A CAZ?

In many cities, the most pressing pollutant exposure concerns arise where the greatest pollutant concentrations coincide with the highest levels of on-street human activity. In most of the cities which have implemented CAZs, this has meant that the City Centre is often the chosen focal point, but exposure patterns in cities will vary significantly.

The key task is to evaluate where problematic levels of human exposure to

air pollution from road traffic are occurring, since this is likely where a CAZ intervention could have most impact.

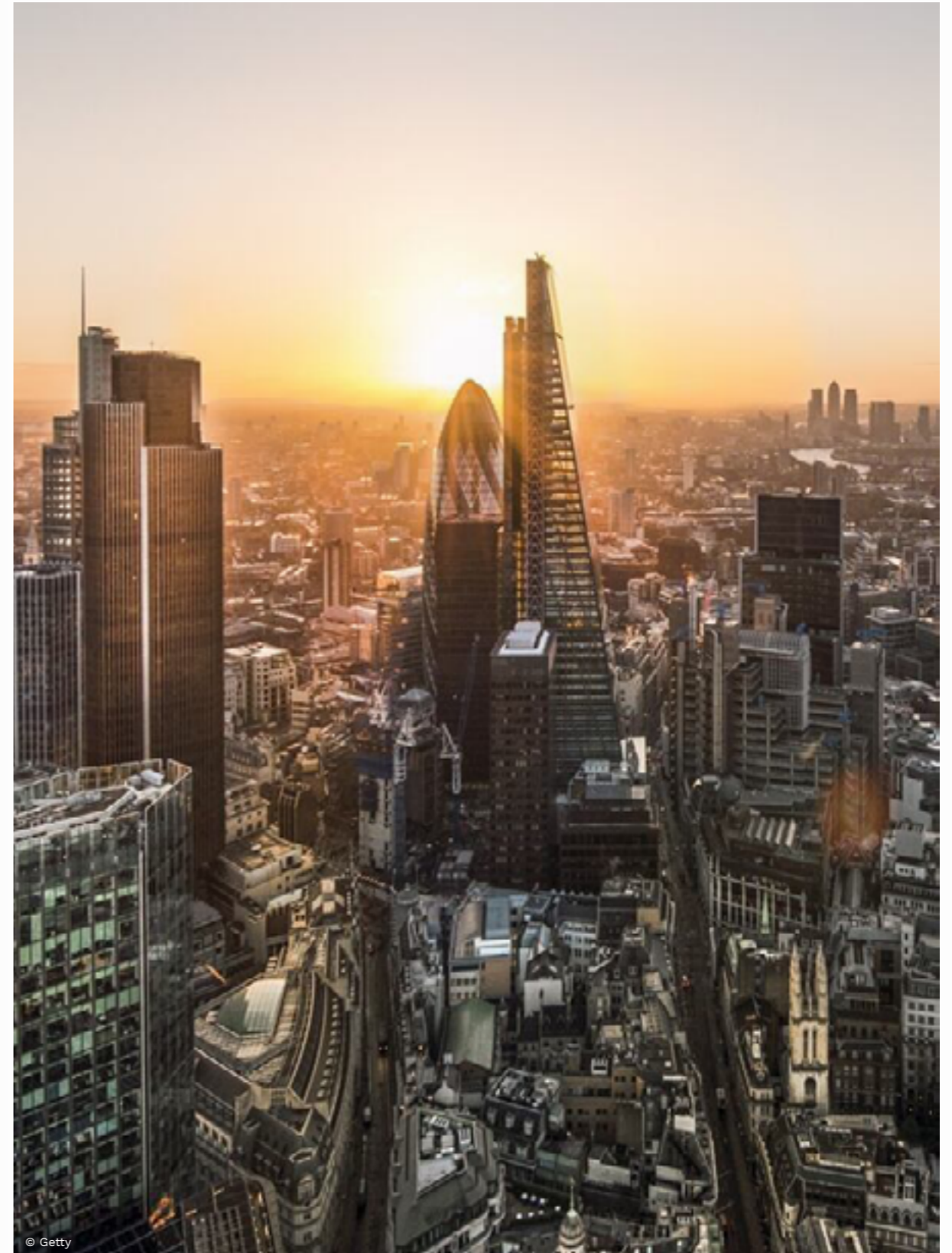
With a general understanding of the preferred CAZ area outlined, it is then necessary to identify a specific boundary within which the CAZ policy will apply.

“We have looked at low hanging fruits, sensitive zones, hospitals, schools, places of worship where you have places where vulnerable communities reside or go to work and you make sure that you correlate that to the data saying if these are pollution hotspots, can we start addressing that first..”

- City representative, Global South



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## HOW IS A SUITABLE CAZ BOUNDARY DETERMINED?

Alongside an understanding of where levels of exposure to air pollution are high, there might be other important considerations to take into account. The most effective CAZ is one that can be implemented – so sensitivity to what some have called ‘the art of the possible’ is vital. In this, there is no substitute for local expertise and stakeholder input.

Our analysis shows that, while CAZs are usually implemented in parts of a city which are heavily polluted, the boundaries do not necessarily map exactly onto the air quality context. So, there may be areas of relatively good air quality inside CAZs, while some polluted areas are outside the boundary.

Considerations include:

### A well-known area helps with public awareness

- Most CAZs occupy an area that already had some status in public awareness before the CAZ was introduced. That is, the area wasn’t defined by the CAZ, but rather, adopted for it.
- Zones are often easiest to communicate and operate if people can easily understand where they operate.
- Key examples: London’s Ultra Low Emissions Zone (ULEZ), Berlin’s Umweltzone, and Paris’s Zone à Faibles Émissions, all follow immediately recognisable boundaries that had an identity before a CAZ was considered.

### A clear boundary helps drivers comply

- CAZ boundaries very often follow natural boundaries of rivers, or major roads or railways.
- Key example: Berlin’s Umweltzone covers an 88km<sup>2</sup> area in the centre of Berlin inside the S-Bahn ring, a highly visible and well-known city landmark.

### A single continuous area is helpful

- Having one boundary to describe makes a policy easier to explain. This may mean including some areas where air pollution is lower, such as a park or a sparsely populated area, alongside areas of more intense pollution.
- One exception to this rule is that some CAZs exclude specific sections of certain roads where including them would cause major traffic management problems.
- Key examples: Brussels and Paris LEZs exclude sections of major road routes to assist in traffic management and avoid traffic displacement. To make it clear which sections are included or excluded, the CAZ usually requires extra signage and communications.

### Areas containing major destinations bring wider benefits

- Where CAZs incorporate major destinations, their beneficial influence extends well beyond their actual boundary as they help clean up the vehicles which travel to those places wherever they are travelling from.
- Implementing a CAZ in a location which can influence traffic across a wider area can therefore provide a higher return on investment.



Figure 5 – Berlin CAZ follows the ‘dog head’ of the S-Bahn, a local landmark.<sup>xiii</sup>

- Key examples: Amsterdam’s LEZ covers the central urban area, but has led to improvements in air quality along many radial routes into the centre<sup>xii</sup>, Kevadia has plans to convert the area of the Statue of Unity to be an electric vehicle-only area to reduce pollution on roads around the Statue of Unity.

### Context is key

- A CAZ could potentially create a ‘barrier’ between one part of a city and another. When defining a boundary, cities often avoid placing it where it would cut across community borders and areas of population or employment growth, to minimise economic disruption, and community severance.

### A suitable route for diverting traffic minimises traffic management issues

- Some vehicles will prefer to divert around a CAZ, rather than complying with the policy. This is why schemes typically aim to define a boundary where there is a nearby high-capacity route for diverting vehicles to which is out of scope for the CAZ.
- Sometimes these roads themselves constitute the CAZ boundary. What is essential is that these routes are not subject to the CAZ policy.
- E.g. London’s ULEZ makes use of the nearby orbital motorway around the city (M25) as the diversionary route.

“We used the same boundary as LEZ for heavy vehicles. As there were already signs and existing cameras to use the same infrastructure in place.”

– City representative, Global North

## THE SIZE OF A CAZ: A CAREFUL BALANCING ACT

If a CAZ is extremely small, for example an individual road, it may simply result in the displacement of vehicles to other areas, rather than the replacement of older vehicles with newer, cleaner alternatives. This may be good for the area inside the CAZ, but will not lead to better air quality outcomes more widely.

On the other hand, very large zones may also have drawbacks, requiring more enforcement and coordination to operate successfully.

But if it is well targeted, even a relatively small CAZ can have a significant wider impact. For example, the Zero Emission Zone in Oxford, England, initially covered just a few streets in the city centre, and only applied to buses. However, since it included one of the main hubs for bus routes, buses accessing that hub carried the benefit of low and zero emission capability across their entire routes.

In this way, a small zone at a strategic point in the transport network can have a far wider impact. A smaller zone can be more easily justified with a smaller impact on local residents and businesses on which they will impose a financial burden.

In some cities, like Lisbon, there is a relatively small CAZ with tighter restrictions located in the city centre where traffic and emissions are very high, surrounded by a much larger zone where the CAZ restrictions are less strict.

## HOW TO DEFINE AN EFFECTIVE CAZ POLICY

Assessing the effectiveness of a CAZ policy relies on an understanding of the choices a city is looking to influence and the options available to residents, visitors and businesses.

### Consider the choices people have available

A thoughtful analysis of the transport options available to people is critical in this process. Exploring the different responses people might make to different possible interventions will indicate which policies will be most effective in driving the desired outcomes.

Depending on the policy imposed, people might choose one or more of several different responses. For example, they might change how or whether they travel, where they travel, when they travel, or the vehicle they use – or they might sell the vehicle they currently own and replace it with one that complies with the CAZ policy. The outcomes will depend on the balance of choices available to them and the incentives that the CAZ policy provides.

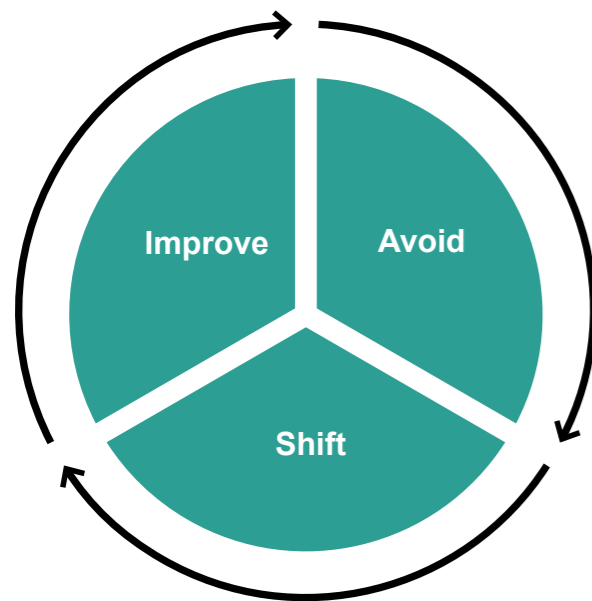


Figure 6 – Avoid-Shift-Improve approach

One useful model to inform cities decisions is the Avoid-Shift-Improve (ASI) approach, as shown in Figure 7. Some examples of specific policies that targeting each of these categories include:

- **Avoid:** Implementing pedestrian zones, incorporating parking restrictions, entry charges;
- **Shift:** Enhancing public transport services, encouraging active travel; and
- **Improve:** Specifying minimum vehicle emission standards, promoting the use of electric vehicles.

“Building a Clean Air Zone means that we need to push people to not use their own private vehicles so integration on how the city can provide satisfactory public transport facilities is also important.”

- City representative, Global South

Description	Implications for CAZ
Reduce or <b>avoid</b> the need for travel.	<b>Avoid</b> measures are usually widely used before a CAZ.
<b>Shift</b> to more sustainable and efficient modes of transport.	A CAZ can <b>shift</b> people to public transport, walking and cycling,
<b>Improve</b> sustainability and efficiency of transport modes and vehicle technology.	A CAZ can <b>improve</b> vehicles through the choice of compliance criteria

Increasing impact of CAZ

### Assessing policy options

The next step in the development of a suitable CAZ policy is to iteratively assess a variety of potential policy options.

This could entail variations on the key characteristics of the CAZ, for example, the vehicles it applies to, the standards it promotes, the charges applicable for non-compliant vehicles, or the times of day it operates.

Key questions to ask at each step would include:

- Considering the options available to people, and the measures provided by the CAZ policy, what behavioural response is likely (Avoid-Shift-Improve)?
- Is that response suitable to achieve the goals of the CAZ?
- If not, what would make it work better?

The tools that can be used to do this will vary depending on what is available at the location, ranging from sophisticated modelling tools to estimated traffic and air quality impacts on a spreadsheet.

**Section A.2** of the **Clean Air Zones: Practical Guidance for Cities Annex** provides an in-depth overview of data sources to consider.



## INTERVIEW INSIGHTS

A significant hurdle mentioned in the interviews is fostering long-term behavioural change and overcoming negative public perceptions of CAZs and alternative choices.

Cities report challenges in reducing reliance on private vehicles and motivating people to switch to sustainable transport options, despite offering improved infrastructure like e-bikes, bicycle lanes, and pedestrian spaces. In many cases, public transport alternatives are underutilised, which was identified as an issue particularly by cities in the Global South, or unsuitable.

Behaviour change communication is seen as essential for promoting the benefits of cleaner transportation and encouraging residents to shift their habits. Additionally, integrating clean air policies with enhanced public transport systems, supported by user-friendly applications, is considered key to overcoming this challenge.

“We need to encourage people to shift from cars to public transport. More focus on communication for behavioural change is needed in the Global South.” - City representative, Global South



## HOW TO MAKE SURE A CAZ IS EQUITABLE?

Planning a CAZ with equity in mind is vital both for cities which are considering implementing CAZs, as well as those which have already implemented them. Specific equity considerations (groups of particular concern, such as people with certain disabilities, for example) may be defined by local or national policy, or could be drawn from international reference points, such as the United Nations Sustainable Development Goals (UN SDGs)<sup>xiv</sup>.

Exploring the possible equity impacts of a CAZ requires a nuanced assessment, since disbenefits (additional financial costs, for example) are often much more immediately tangible than benefits (reduced mortality through air quality improvements).

### Considering equity issues

Addressing equity and establishing a sense of fairness are critical for effective CAZ schemes. Some groups of people may be less able to afford to comply with a CAZ than others, while also having fewer good alternative options to make use of to avoid it.

Conversely, high levels of air pollution are often correlated with areas where people on lower incomes live, for example close to busy roads, so their health is disproportionately impacted. These groups are also more likely to have poor health and therefore more vulnerable to the health impacts of pollution, and less likely to drive, so have less influence over sources of pollution.

Equity analyses seek to make a structured assessment of these kinds of impacts by considering whether their characteristics make them systematically more likely to be negatively or positively impacted than other groups, and in what ways. For example, do they have a particular need to travel at certain times in certain locations, or more difficulty than others in changing mode or destination.

Plans for a CAZ should align with the city's equity policy and framework. Cities without an existing equity policy must develop this alongside the CAZ, to ensure these benefits are captured and the risks mitigated.

Additional guidance on understanding the opportunities and challenges of including equity considerations in CAZs can be found in Part 2: How to create an inclusive and equitable Clean Air Zone of the C40 CAZ toolbox<sup>xv</sup>.



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## LONDON, EQUALITY ACT 2010

When developing the London LEZ and ULEZ, London assessed equity impacts in the context of the Equality Act 2010. The Act is a comprehensive piece of legislation that protects individuals from discrimination. The Equality Act 2010 identifies the following nine protected characteristics: Age, Disability, Gender reassignment, Marriage and civil partnership, Pregnancy and maternity, Race, Religion or belief, Sex and sexual orientation.

The Equality Impact Assessment (EqIA) undertaken as part of the planning for the ULEZ identified potential minor negative short to medium term effects due to increased cost and/or limited availability of transport services or purchase of compliant vehicles<sup>xvi</sup>. As mitigation, it was recommended that extensive marketing is used to increase public awareness of ULEZ requirements, developing the vehicle market further, and to provide financial support where needed.

## WHAT DATA IS NEEDED TO PLAN A CAZ?

Analysis of effective CAZ implementations show that there is no 'minimum requirement' as different cities have access to varying types of data, at different levels of sophistication, and each has made the best of what data it holds, sometimes strategically bolstering it where possible. The main types of data that cities draw on when developing CAZ proposals include data on:

-  **People and demographics**
-  **Vehicle fleets**
-  **Transport network**
-  **Air quality and the environment**
-  **Business and economy**
-  **Perceptions**

**Section A.2** of the **Clean Air Zones: Practical Guidance for Cities Annex** explores potential data needs, and considerations for each area, setting out the data priorities for key topics. It specifies for each of the main categories, the data for cities that are a must have, should have and are nice to have. This recognises that cities will have different types and level of data available, and for some, the development of a CAZ may be the start of a data collection journey on specific topics.

There are often differences in existing data and data collection frameworks between cities in the Global North and the Global South. For example, many European cities are required to collect certain consistent data under European Union (EU) and national law. In other cities, the availability of robust data will vary based on current and historic needs.

A lack of hard data need not be a barrier to commencing the planning for a CAZ. Local expertise and stakeholder input are equally valuable. More information can potentially be collected as part of the process of refining the CAZ design, which is further explored in **Chapter 6: Designing a Clean Air Zone**.



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## GATHERING AND USING DATA: INTERVIEW INSIGHTS

Several cities we spoke to identified **comprehensive data on air quality, traffic patterns, and public opinion as a key enabler**, not only for designing and implementing an effective CAZ, but also for **harnessing public support and aiding compliance**.

One city conducted surveys to understand public perceptions and used behavioural economics insights in their communication strategies and policies. This approach illustrates how cities are using data to tailor their CAZ strategies to public sentiment. Another explained how they had made use of data from air quality monitoring stations to identify pollution hotspots and support the public dialogue on the proposed CAZ boundary. This demonstrates the role of data in determining the geographical focus of CAZs.

**Our interviews revealed that cities considering and planning for CAZs value support to establish robust data collection systems.** In the earliest stages, this is focused on feasibility testing and setting up baseline measurements of air quality in various parts of the city. Another component noted as important at this stage is conducting a cost-benefit analysis, which can be instrumental in securing political and financial support.

"...when we were enacting policy, we would do...surveys to see what people were thinking, but also what wording and what things ticked their boxes. So a little bit of using behavioural economics to see what are the triggers that you can use to get people to change behaviour." - City representative, Global South

"you have to have the right data for us to be able to make the right decisions." - City representative, Global South



## CHECKLIST

### Planning for a Clean Air Zone

After undertaking a comprehensive planning exercise for a CAZ, the city should be a good understanding of:

- Where a CAZ could be located
- How to define an appropriate boundary
- What behaviour change will be effective in reducing emissions
- What policies will best deliver that change
- How to make sure the CAZ is equitable
- How to assess policy impacts
- What kind of data is available, and how it can be supplemented with local expertise and stakeholder input and collected at a later stage during the design process.



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# 05

## COMMUNICATION AND ENGAEMENT



## COMMUNICATION AND ENGAGEMENT

Once the city has a plan or proposal in place for the CAZ, the next step is to focus on communication and engagement.

Effective communication and engagement with decision-makers and stakeholders is essential for successfully delivering and implementing a CAZ scheme.

Experience highlighted in existing literature and from our interviews shows that CAZs often face opposition at a higher level than other transport policies.



“Public resistance is our main concern. People will ask us why they have to pay certain fees to enter certain areas or why there will be some limitations for vehicles, but then at the same time some other citizens are asking us to reduce traffic congestion and improve air quality.”

- City representative, Global North

© Image caption



## GUIDING QUESTIONS FOR COMMUNICATION AND ENGAGEMENT

All individuals or groups affected – from residents to commuters and businesses – have a key role in shaping the success of the scheme. Each city will need to tailor its approach to their context.

The following questions will help guide the plans for communication and engagement:

- What will people need to know?
- How can the city’s message reach everyone effectively?
- Why is equity important in engagement?

The C40 Cities Clean Air Zone Toolbox<sup>xvi</sup> provides a comprehensive guide to equip cities with the knowledge and tools for introducing an inclusive and equitable CAZ, with a focus on communication and engagement. As part of the Toolbox, C40 produced a Clean Air Wins playbook which provides a detailed case study and lessons learned during the air quality campaigning and advocacy in London during the city-wide ULEZ expansion<sup>xvii</sup>. These may be helpful resources for cities.

## INTERVIEW INSIGHTS

The development and implementation of CAZ strategies require support from, and coordination across, multiple sectors such as transportation, urban planning, health, social care and commerce. While transport and railway sectors are obvious partners as they are often responsible for the highest proportion of emissions, it is also critical to work with departments responsible for health and for social care to ensure an equitable approach that will not unfairly disadvantage the most vulnerable populations.

“in the zones we think will be our clean air zones, we [are looking at engaging] the business community, even the users. We are going to call the residence associations, and consider bringing them on board with a view of [consulting] with them on this kind of project. That is very, very critical.” – City representative, Global South

“The commercial association is very key to success. When the businesses were not involved in the process enough, there’s kind of a backlash. They would say ‘we were not involved, so your measure is not good enough’. While in other places the businesses association was involved...at the end, the city could say, ‘Well, we’ve been working with you, so you can’t say you weren’t at the table trying to put the different mitigation measures in’” – City representative, Global North

## WHAT WILL PEOPLE NEED TO KNOW?

People and businesses will need the right information about the CAZ so that they can understand how it works and what it will mean for them. Clear and accessible information will help them prepare and make it easier to comply with the policy, while also reducing misconceptions and misinformation.

Areas to focus on include:

- the health impacts of air pollution on local people and city businesses;
- how the scheme will work, its objectives and benefits, in a fair, clear and accessible way;
- easy to understand information on the vehicle standards required to drive in the CAZ, to enable compliance prior to implementation;

- targeted communications for businesses and local people owning or operating vehicles that are non-compliant explaining why and outlining the options and implications, including the charges and the availability of support to change to a cleaner vehicle (see **Chapter 6: Designing a Clean Air Zone** for more details on options for support);
- information on charging and penalties;
- for a charging scheme, mechanism to make payments prior to being charged; and
- opportunities for two-way communication regarding customer service, feedback and engagement.





## HOW CAN THE CITY'S MESSAGE REACH EVERYONE EFFECTIVELY?

Effective and tailored communication along with early and ongoing engagement with community groups, CSOs and affected sectors is vital for building support and addressing concerns for the successful implementation and operation of a CAZ. To achieve this, the city needs to craft a compelling narrative, select appropriate communication channels, identify and engage with the key audiences, take a proactive approach and recognise that this is an iterative process. This should ensure that equity is embedded in all communication and engagement, and in the wider work.

"Framing it as a health policy and highlighting the impact of pollution drove the most support."

- City representative, Global North

### INTERVIEW INSIGHTS

Framing the CAZs as pedestrian and cycle zones, rather than no-car zones was helpful in getting public support. This focus on protected spaces for pedestrians and cyclists was synergistic with other city-wide efforts to increase cycling safety. In addition, framing a CAZ as a health intervention rather than environmental policy as well as highlighting the health benefits of a CAZ has been cited as enablers for implementing a CAZ. This health framing was cited by cities as helping to drive support for a CAZ and contributing to a positive public perception.

Representatives from cities that have already implemented CAZs noted that developing champions, ambassadors and influencers within the community was an effective strategy to communicate the benefits and bring along a sceptical public. "The best support you get is from the community. When you have somebody that... has the credibility and the ability to get in front of policies...there's nothing that speaks louder than putting a face behind all this." - City representative, Global South

"Speaking about the daily impact on children and how it affects their schooling, their development, that was pretty important to the mayor."

- City representative, Global North

### Craft a compelling narrative

Creating a full narrative, from issue to solution, starts with identifying the key messages that the city wants to convey to all members of the community. This should also be reinforced with relevant facts and data that will resonate with the public or specific groups.

The specific details and points of emphasis within the narrative should also be tailored depending on the needs, interests and concerns of the target stakeholder groups. For example, for businesses, information on compliance and available support is higher priority than the health benefits; local placemaking and economy boosts may be of interest to local retailers; whereas the health impacts of air pollution, equity or climate, may be more important to the general public.

### Use multiple communication channels

To reach all segments of the population, the city will need to use multiple communication channels and a range of options are provided in **Clean Air Zones: Practical Guidance for Cities Annex**.

The key is selecting the ones which are most appropriate for the audience and their circumstances. It is also worth considering the existing channels that are already available as this will be familiar with the local audience. There will already be trust established and can often be a quicker and more cost-effective way to reach people.

### Identify and engage with the key stakeholders

To effectively engage with the different stakeholder groups, to deliver this message and receive feedback for an effective iteration on the scheme, the city needs to understand and map the key business and community groups, which reflect local interests and specific issues, and the wider public population.

To amplify the narrative, the city should identify trusted community champions such as leaders or experts to deliver the key messages, as they can help build trust and credibility whilst facilitating further reach within communities, therefore further increase public acceptance and buy-in.



### INTERVIEW INSIGHTS

Support at the national level is key to getting engagement across sectors. Having this political support can help to ensure that it will be considered a strategic priority and that funding for the planning, infrastructure development and ongoing operations needed for CAZ implementation are integrated into budgets across the relevant departments or ministries.

"If a clean air zone is implemented and championed by national government we would have extra support to be implemented within our city. Advocacy at a national level would give local level appreciation of the intervention when we roll out at a city level, and it might come with political, public and potentially financial support." - City representative, Global South

### Be proactive

For some stakeholder groups, there will need to be more proactive engagement with sector or community-specific outreach. Engagement should target whoever is important which – depending on where the city – might include licensed and unlicensed operators, small business owners, local community groups, residents with health conditions, local and national CSOs, amongst others. As the specific issues of concern will vary between cities, so will the groups affected by those impacts.

This engagement may involve consultation and workshops to gather input and feedback to address pushback or concerns on their specific circumstances to enable a CAZ design that is effective and equitable.

### Prepare for an iterative process

The entire engagement process should be iterative, with ample opportunities for ongoing feedback and responding to stakeholder needs to create ownership and partnership. It will have to evolve as the project progresses, new challenges arise and as the city receives feedback from the community. Be sure to regularly review and refine the approach so that the communication remains effective and relevant to the audience.



## INTERVIEW INSIGHTS

The support and skill sets of community partners and CSOs can be important to successful implementation of the CAZ. CSOs can represent the interest of local business and residents when thinking about how to redesign traffic routes, flag issues that will hinder compliance and provide complementary initiatives, such as improving urban spaces.

“Having people external to [the local transport authority] and [city government] willing to talk about why this was the most important support we had... Voices from health, faith, NGOs - organisations they might trust more than the mayor was the most helpful support that we got.” - City representative, Global North

## WHY IS EQUITY IMPORTANT IN ENGAGEMENT?

Equity is crucial in the engagement process of developing a CAZ because it ensures the voices, concerns, and needs of all community members are heard and considered. This includes those disproportionately affected, marginalised and vulnerable groups. Placing equity at the heart of this work ensures that all communication and engagement is based on a fair and transparent process.

Embedding equity into stakeholder engagement is important for:

- Inclusive representation – having diverse perspectives in the decision-making process will help create a CAZ that is reflective of the realities of all residents.
- Addressing disproportionate impacts – identifying and addressing potential disparities particularly for vulnerable groups at an early stage avoids exacerbating existing inequalities.
- Building trust and legitimacy – when people feel heard, it builds trust and demonstrates commitment to fairness and inclusivity, fostering public support.
- Enhancing compliance – when people see that their needs and concerns have been considered, they are more likely to comply with the CAZ regulations.
- Preventing unintended consequences – engaging equitably can identify potential negative impacts and address them before they materialise.

“We will need to do some communication work and that communication work should not only happen after the project is finished, it should be done at all points of the process in order to gain public support and change and shift the public view.”

- City representative, Global North



## CHECKLIST – COMMUNICATION AND ENGAGEMENT

After considering communication and engagement for a CAZ, the city should have:

- Set up a proactive and transparent plan for communication covering all key aspects of the CAZ
- Created a full narrative, identified communication channels, allowing for proactive and iterative engagement
- Considered equity to ensure a fair and transparent process is implemented for the consultation
- Completed the C40 equity checklist



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# 06

## DESIGNING A CLEAR AIR ZONE



## DESIGNING A CLEAN AIR ZONE

Building on **Chapter 4: Planning a Clean Air Zone** where we set out the foundational questions for planning a CAZ and **Chapter 5: Communication and Engagement** on the importance of a clear communication and engagement plan, the next step is to look at the details for CAZ design and delivery.

Designing a CAZ involves figuring out what policy to establish, and how to make the plan work for the stakeholders, while still achieving the aims of the CAZ. This might mean developing a proposal for supporting measures or targeted mitigation measures such as discounts, as well as considering phasing and pilot schemes. This chapter sets out key questions and how to answer these.



## THE KEY QUESTIONS TO GUIDE THE DESIGN OF A CAZ

### Primary questions:

- Where should the CAZ be located?
- When should the CAZ operate?
- Which vehicles should be targeted?
- How much should be charged?

### Secondary questions:

- How can equity impacts be addressed?
- What discounts are needed?
- What complementary measures are required?

### Tertiary questions to answer around scheme delivery:

- Will the CAZ be phased in?
- Will the city pilot it?

## DECIDING ON THE CORE SCHEME

### Where should the CAZ be located?

This has previously been discussed in Chapter 4: Planning a Clean Air Zone. It is a key consideration and having decided on the location, further details can be considered such as when it will operate, which vehicles to target and how much to charge.

### When should the CAZ operate?

CAZs will typically operate 24 hours per day, 7 days per week (24/7) whereas some will have variable hours of operation such as during business hours or on weekdays.

## VARIABLE HOURS OF OPERATION

Some schemes include more stringent restrictions on days where air quality is forecast to reach particularly dangerous levels, seeking to provide short-term response to severe pollution events.

This is a common design feature in French schemes, where during episodes of high pollution the minimum emissions standard is increased, and alternatives (such as public transport) are discounted.

Alternatively, CAZs may only be operational during air pollution events. In Bangkok, entry restrictions for trucks are in place during PM<sub>2.5</sub> pollution events<sup>xviii</sup>.

### Which vehicles should be targeted?

Most CAZs use vehicle emissions as the main criteria for setting vehicle standards, but there are different approaches that can be taken. These include:

- **Emissions rating:** Schemes based on emissions standards or vehicle age can be used where there are clear improvements in emission performance over time. The London ULEZ is tied to European emission standards where higher fees are charged for higher-polluting vehicle categories.
- **Fuel type and vehicle size:** Some schemes vary access rules or charges based on vehicle size and fuel type. Oslo charges higher rates for vehicles greater than 3.5 tonnes and apply different rates for vehicles based on fuel type.
- **Fleet composition:** Cities may consider targeting vehicles which are high-usage within the area (e.g. taxis, freight, commercial vehicles). In Shenzhen, the Green Logistics Zone targets light-duty logistic vehicles as they consist of 59% of the city's logistic vehicle fleet and accounted for approximately a fifth of the city's nitrogen oxides (NO<sub>x</sub>) and fine particulate matter (PM<sub>2.5</sub>) emissions<sup>xix</sup>.

## VEHICLES IN SCOPE

Some cities, such as in Bath, Helsinki and Amsterdam have focussed primarily on buses and Heavy Goods Vehicles (HGVs) on the basis that these vehicles are disproportionately polluting and the cost-benefit of upgrade is substantial.

However, depending on the area of the CAZ, HGVs may not be as common in smaller inner-city areas. This demonstrates the importance of understanding the commonly used road vehicles in the area.

## EMISSIONS FROM OTHER TYPES OF TRANSPORT

It is important to understand the context of the city when developing further options based on evidence gathered. In Amsterdam, the LEZ includes restrictions for boats in addition to vehicles. Boats used for recreational purposes must be zero emission.

In the Global South, public transport may be one of the most polluting forms of transport in the city due to the age of the fleet. CAZ policies may therefore bring forward the shift towards a cleaner or electric public transport fleet<sup>xxii</sup>.



## HOW MUCH SHOULD BE CHARGED?

### Charging schemes

For a charge-based scheme, determining an effective charge level is one of the most important aspects of developing a CAZ. International comparisons can be helpful as a starting point. The key things to consider are:

- If seeking to encourage people to upgrade to newer, cleaner vehicles, any charge must be high enough that it is more cost effective for a frequent traveller to upgrade than to simply pay the charge. (A charge that is too low risks acting as a revenue-raising measure without influencing behaviour change.)
- This trade-off varies between different segments of society and sectors, so understanding the driver population will help determine costs.
- It is also vital to understand to residents of upgrading. This might include an assessment of the availability of second-hand vehicles which are compliant.
- It is likely that an early view on possible charge levels is needed to develop options for assessment. This will then likely need to be revisited as part of the detailed policy design.

It is important to distinguish between a charge for entering a CAZ which allows vehicles which do not comply with the CAZ criteria to access the area, and a penalty fine which may be issued for non-compliance with the rules (such as failure to pay the charge or entering an area the vehicle is not permitted to enter). Penalty fines may be higher than the charge, and may be used in both charging and non-charging schemes, depending on the criteria and enforcement mechanisms.

## APPROACHES TO CHARGING

London's approach is heavily led by regulation and it has been adapted based on political, environmental, economic and societal pressures over time. For example, the daily Congestion Charge in London, which uses the same regulation as the London LEZ, has gradually increased both the charge and charging hours over time.

Oslo operates a congestion charging scheme but vary prices by emission level.

In Rio de Janeiro, there are also "voluntary" clean air zones which are being implemented through urban planning choices, promoting alternative transport.

A different approach may be to look at a range of metrics, with less focus on a single value to achieve.

### Non-charging schemes

Alternative strategies can be effective too and include constraint-based and incentive-based approaches.

Constraint-based approaches do not charge fees for entering the CAZ but focus on restricting vehicle access based on certain conditions. In Jakarta, there is an area where motor vehicles are prohibited from entry, except for those that belong to residents and business owners or are public transport vehicles<sup>xx</sup>.

Incentive-based approaches seek to encourage behaviour change by favouring cleaner vehicles. In Helsinki, for example, low emission vehicles receive a 50% discount on designated street parking prices<sup>xxi</sup>.

## USING MULTI-CRITERIA ASSESSMENT TO IDENTIFY THE BEST OPTION

Once some conceptual options comprising combinations of location, operational hours, targeted vehicles and charge levels have been identified, a core scheme that is most likely to meet the objectives should be identified.

Deciding on the core scheme can be achieved by undertaking a multi-criteria assessment. Depending on the data and tools available and on the decision-making processes, this assessment might include:

- Behavioural, traffic and air quality modelling of different scenarios<sup>xxii</sup> – noting to undertake this may require more data collection;
- Quantification of benefits and disbenefits for cost estimates and/or cost benefit analysis<sup>xxiii</sup> – understanding in monetary terms, what the net impact of the scheme is and can be used for comparison against other options;
- Qualitative assessment of different factors<sup>xxiv</sup> – including delivery against wider goals and impacts assessments.
- Even where detailed data are available, some aspects however will inevitably remain qualitative.

The criteria in the assessment will depend on local priorities, but should also build on those selected for the sifting stage. Examples of criteria to include are suggested in Figure 8.

“The baseline information is very crucial to see which sector can be measured in a clean air zone. And second, I will say that, the cost and benefit [calculation] of this clean air zone intervention is going to be ... very important to move forward with this solution.”

- City representative, Global South

Category	Example criteria
<b>Strategic alignment</b>	Location aligns with objectives, policy alignment, legal alignment, political acceptance, public acceptance
<b>Social</b>	Health and wellbeing, equity, public exposure to air pollution
<b>Environmental</b>	Changes to air pollutant emissions, air pollutant concentrations, greenhouse gas emissions, noise and vibration, biodiversity, climate resilience
<b>Financial</b>	Capital expenditure, operational expenditure, revenue
<b>Local economy</b>	Economic activity, visitor numbers
<b>Safety and security</b>	Road safety, security
<b>Mobility</b>	Traffic volumes, journey times, journey reliability, public transport use, active travel
<b>Implementation</b>	Supporting infrastructure, implementation timeline, fleet upgrades required

Figure 7 – Example assessment criteria

## SELECTING THE CORE SCHEME AND DECISION TO PROCEED

The multi-criteria assessment will help guide towards a preferred option, which is a major milestone in the project. It is probably about time to consider sharing the draft proposals more broadly to gather feedback (for example, a public consultation on the draft proposition).

It is also useful to ask again at this point whether a CAZ can still deliver what is needed for the city?

The information gathered during the process to date will have helped identify the issues facing the city and the characteristics of economic activity, transport demand patterns and its impact on air pollution and health.

This will help refine the most effective and appropriate option for the city, and can also be used to develop alternative or complementary measures.

Having carried out this process, it is possible that it might conclude that a CAZ is no longer considered an effective solution. If this has been fully explored and is supported, this is also an acceptable outcome.



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## REFINING THE SCHEME

Once a preferred option for the CAZ has been selected, the next step is to assess equity impacts and investigate the types of discounts and complementary measures to include so that impacts are optimised. This will allow for arriving at a preferred package.

### How can equity impacts be addressed?

For the core scheme, the potential and relative equity impacts need to be considered and this can be achieved by undertaking an equity assessment. Addressing equity and inequalities is also a priority for many organisations providing external funding to cities.

From the previous chapters, equity is a considerable part of the CAZ planning process and should be included at each stage of the planning and design. Building equity into the CAZ from the start will help with providing transparency and clarity for stakeholders and support the overall delivery of a successful CAZ.

The principle of equity in CAZ design emphasises that disadvantaged populations—often low-income communities who typically face higher exposure to pollution—should not bear additional economic burdens due to the introduction of such zones. The potential negative effects to be avoided are explored in further detail.

Figure 8 summarises the steps to undertake for addressing equity impacts.

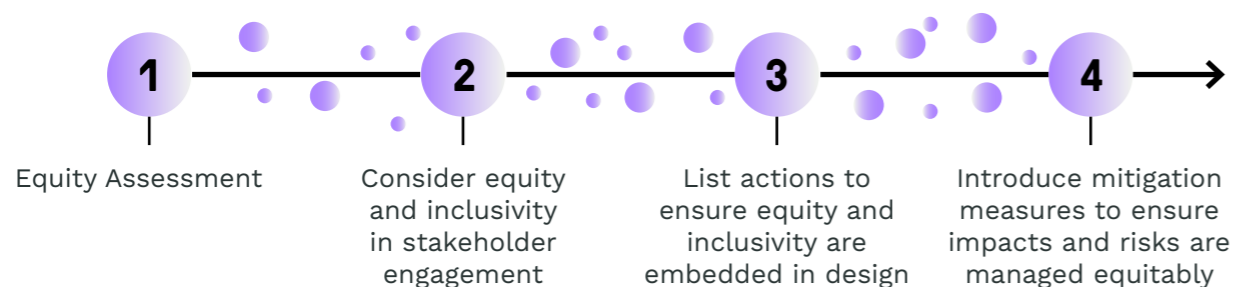


Figure 8 – Addressing equity impacts

### Equity Assessment

Cities should carry out a thorough impact assessment to identify groups that stand to gain or lose from the proposed CAZ option. This step helps ensure common understanding within city departments of key impacted groups before designing or implementing a CAZ.

The C40 Cities Clean Air Zone Toolbox<sup>v</sup> (p.44-47) provides detailed guidance on how to conduct an equity assessment.

“We have to prepare an inclusive strategy, keeping in mind our low-income citizens and small business owners, and the local and the central governments have to be prepared to tackle the situations.”

- City representative, Global North

### Negative impacts to consider

Throughout the design stage, the detailed design of the CAZ should be reviewed against potential negative impacts identified in the Equity Assessment, such as financial impacts and traffic displacement.

When people feel that the negative impacts are affecting some groups more than others, it can lead to public opposition and political pushback. Identifying and addressing potential equity issues up front in the process can reduce the risk of controversy.

### Financial impact on vulnerable populations

The cost implications of a charging CAZ will impact different groups in the population, depending on income levels and socio-economic situations, including those living and working in the area.

For some people, an increase in the cost of travel could make it materially harder for them to access friends, work or key services such as emergency healthcare, education and employment. However, this can be somewhat mitigated through discounts and exemptions. This still might not help everyone affected and it is acknowledged that there are trade-offs between impacts on individuals and overall scheme effectiveness.

### Vulnerable populations impacted by traffic displacement

The implementation of a CAZ can lead to traffic displacement, where vehicles divert to areas outside the CAZ to avoid restrictions or charges. There have been concerns that such impacts might disproportionately impact vulnerable populations through localised increases in air pollution, increased safety risks, reduced accessibility to essential services, or reduced economic opportunities in these neighbourhoods, deepening existing inequalities.

## FINANCIAL IMPACTS

In Edinburgh, Scotland, the local authority identified that public transport operators might increase the price of tickets as a result of increased costs from the need to replace or upgrade buses. For some passenger groups, the increase in price could potentially make the journey unaffordable. In response, the city implemented a Bus Emissions Abatement Retrofit Programme to support bus and coach operators on the costs of retrofitting to a newer engine with lower emissions or converting the fuel type to electric<sup>xxv</sup>.



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## WHAT DISCOUNTS ARE NEEDED?

Based on the multi-criteria assessment, equity assessment and stakeholder consultation, there should be consideration on incorporating discounts and exemptions as this can mitigate unacceptable negative impacts on people, communities and businesses.

The types of discounts and exemptions typically considered are:

- emergency service vehicles;
- specialist vehicles – e.g. mobile construction equipment;
- mobility requirements - vehicles driven by, carrying, or adapted for people with disabilities;
- vehicles driven by people from vulnerable or marginalised socio-economic groups, community organisations or businesses; and
- those waiting for a compliant replacement vehicle.

**"You have to balance exemptions against the impact you want the LEZ to have."**

- City representative, Global North

**"You have to be fair with people. We lacked fleet information in some places which would have been useful to inform what exemptions we introduced or how it would affect people."**

- City representative, Global North

The discounts and exemptions will need to be clearly defined so that they can be enforced effectively.

Care should be taken, however, to ensure introducing these do not erode the effectiveness of the scheme. Discounts and exemptions can be attractive politically and publicly to gain acceptance but while they solve one type of problem, they can affect the benefit that the scheme is looking to deliver. Cities should avoid the temptation of offering numerous, generous discounts and exemptions that erode the effectiveness of the scheme.

Temporary discounts and exemptions can be a good compromise between mitigating impacts whilst maintaining the integrity of the scheme in terms of achieving its core goals. These give vulnerable groups more time to upgrade and comply. Cities should consider the feasibility of implementing and enforcing any discounts and exemptions – noting that trip-based or income-based discounts and exemptions are typically more burdensome and complex to enforce.

## INTERVIEW INSIGHTS

One of the challenges is designing CAZ policy that balances exemptions with their intended environmental impact. Small businesses operating in busy economic zones may struggle to comply if the restrictions are too strict, leading to significant pushback. Cities have faced difficulties in implementing CAZs without adequate data on how different sectors, such as transportation fleets, will be affected. Exemptions and mitigations often need to be adjusted, sometimes after implementation, to accommodate local economic needs, making the process more complex. Cities have learned that building these considerations into CAZ policy from the start can simplify implementation and make the transition smoother for low-income communities and businesses.

## WHAT COMPLEMENTARY MEASURES ARE NEEDED?

Complementary measures can help to further improve air quality, encourage behaviour change and reduce negative impacts. Where a charge is being applied, the revenue may be able to fund these measures. Examples include:

- improvements to sustainable transport alternatives including public transport and active travel;
- provision of electric vehicle charging infrastructure to support upgrade to the cleanest vehicles;
- measures to improve the operations of the scheme. For example, parking controls in boundary areas or traffic management;
- leading by example to demonstrate confidence in a scheme. Some cities have chosen to upgrade their own operational vehicle fleets or bus fleets, or amended licensing systems for taxi and private hire vehicles;
- measures to mitigate the financial impact on vulnerable groups. For example, vehicle scrappage schemes supporting vehicle upgrades through grants/loans<sup>xxvi</sup> and
- subsidies and tax credits for low-emission vehicles such as bicycles, e-bikes and cargo bikes, which is important for equitable LEZ compliance.



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## ENSURING THERE ARE GOOD ALTERNATIVES TO DRIVING

Norway adopts both localised and general policies to improve the environmental impact of transport, including an extensive electric vehicle incentives, infrastructure investment, and emissions-targeted road tolls. Lisbon implemented its Zone 1 LEZ in the downtown area of Baixa. While over 80% of the population can reach the Baixa by bus or metro, the city added electric buses, extended tram lines, and expanded night services. In Brussels, the city implemented multiple incentive policies to encourage a shift toward public transport, walking, cycling and shared modes, through free public transit and car share programs for residents who scrapped a non-compliant vehicle. These are just some examples. Even if the complementary measures mentioned above are not feasible for the city, there are other ways to reduce car usage.



## HOW WILL THE CAZ BE DELIVERED?

### Will the CAZ be phased in?

CAZ schemes are typically rolled out in phases and refined over time, for example:

- schemes have expanded to a wider geographical area over time;
- charge levels have increased over time; or
- as vehicle fleets continue to become cleaner (a trend accelerated by CAZ implementation<sup>xxvii</sup>), restrictions tend to be tightened.

Consideration should be given to a realistic but effective first step, setting out a trajectory for implementation of a more stringent scheme over time. Amsterdam adopted the Clean Air Action Plan in 2019, setting a path towards zero-emission mobility for 2030<sup>xxviii</sup>.

Prior to full implementation, a temporary period where penalties or enforcement are waived, also known as a grace period, can allow residents time to prepare and plan ahead. A grace period was introduced for the London ULEZ expansion in 2021, where groups including disabled people and small businesses<sup>xxix</sup> were given up to 25 October 2027 to comply.

Deciding on phasing or full roll out will depend on the context of the CAZ such as the size, ambitions and political appetite. There is not a single 'correct' answer on how to proceed with roll out.

**“The biggest issue will be about changing vehicles for these clean air zones. We have to give a period of time for citizens to transition.”**

- City representative, Global North

## INTERVIEW INSIGHTS

Being flexible and considering a phased approach helps maximise acceptance. A phased approach allows cities to gradually introduce and expand their CAZ while building public support and addressing challenges. Consider starting with 'low-hanging fruits' by implementing CAZs around schools, hospitals, and places of worship. Cities can then demonstrate CAZ benefits in less controversial areas before expanding to other parts of the city.

A Global North city implemented a patchwork of small CAZs (framed as pedestrian and cycle zones). This helped build public support whilst maintaining transport links around the city. However, it has been difficult to measure air quality changes as there is not one geographically-defined zone.

Long-term planning and clear communication are important aspects of a phased approach. Cities that lay out a clear roadmap for CAZ implementation, ideally spanning 5-10 years, are better positioned for success. This long-term vision helps stakeholders understand and prepare for upcoming changes, though such plans often need to align with administrative terms.

“Being flexible enough to make concessions...may actually help it be better enforced...there are things that happen in their daily lives that... become a problem when you enforce a policy. If you really listen to their granular details, then you can shape it in a way that tries to impact them less.” - City representative, Global South

### Will the CAZ be piloted?

Pilot schemes are a useful tool for testing the implementation of a CAZ in a city where a small-scale zone is first introduced, before gradually expanding in scope and/or region.

Pilot studies can:

- provide insights into practical aspects – helping with option development, understanding practical implications;
- understand behavioural change, and help settle people's resistance;
- identify potential problems of weaknesses in design, acting as a form of risk mitigation; and
- support scaling to other cities, especially in countries or regions where there are limited examples of CAZs.

## SHENZHEN

In 2018, Shenzhen implemented a ZEZ pilot, focussing on light-duty trucks. Since then, the scheme has been continuously extended due to its ongoing success.

## OXFORD<sup>xxx</sup>

As part of the Oxford ZEZ pilot introduced in February 2022, consideration and flexibility was given to existing circumstances such as cost of living pressures. Changes were proposed during the pilot, for example, removing increases in daily charges and providing discounts for disabled people indefinitely.

## DENMARK<sup>xxxI</sup>

LEZ pilots were introduced in four Danish cities (Aalborg, Aarhus, Copenhagen & Frederiksberg and Odense) in October 2023. The Copenhagen & Frederiksberg LEZ have plans for expanding in 2025.

## HONG KONG<sup>xxxII</sup>

Although not a CAZ, Hong Kong ran a pilot of a congestion charging scheme in the 1980s. However, despite its success in reducing traffic, it was ultimately shelved due to high levels of public opposition.



## CHECKLIST – DESIGNING A CLEAN AIR ZONE

Having explored the designing of a CAZ, there should have a good understanding of:

- When the CAZ should operate to deliver on the objectives
- Which vehicles should be targeted to deliver on the objectives
- How much city needs to charge to deliver on the objectives
- How a multi-criteria assessment can be used to decide on your core scheme
- How to consider equity impacts
- What discounts will be needed to mitigate impacts and make it acceptable
- What complementary measures will be needed to mitigate impacts and make it acceptable
- Whether the CAZ will be phased in
- Whether a pilot scheme will be run





# 07

## IMPLEMENTING A CLEAN AIR ZONE

## IMPLEMENTING A CLEAN AIR ZONE

This section builds on the previous chapter on assessing, selecting and designing a CAZ and considers the practicalities of implementation.

It covers how different functions will be delivered and who they will be delivered by, including what systems will be used to detect vehicle trips, how the vehicle trips will be matched with payments and what enforcement processes will be put in place for non-compliance.

Some cities may be able to leverage and adapt existing assets and resources that are already in place, while others may need to develop some of these assets from scratch.



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## THE MAIN CONSIDERATIONS FOR IMPLEMENTING A CAZ

When looking to implement a CAZ, some key considerations include:

- What assets and systems are needed to implement a CAZ?
- How will the functions be delivered and who will be responsible?
- How will the city transition from design to operation?
- What organisation and governance does the city need for CAZ operation?
- What does the city need to manage a CAZ?

There is not much information available on how a CAZ transitions from design to implementation, and how all the different components of a CAZ fit together. This chapter aims to shed some light on the topic. Further details included in the [Clean Air Zones: Practical Guidance for Cities Annex](#).

“I believe the areas where we need support currently are more technical, regarding technical infrastructure.”

- City representative, Global North

## WHAT ASSETS AND SYSTEMS ARE NEEDED TO IMPLEMENT A CAZ?

Firstly, let's define what we mean by an 'assets and systems' for managing a CAZ. In the most basic sense, a CAZ needs a flow of data and interactions to all work together.

The main building blocks of which will be the vehicle trips in the CAZ and the method of management and enforcement. The 'operating model' is the set of processes (flow of data, charges, fines etc.) that work together to facilitate the CAZ. The 'governance structures' are the rules which manage how the operating model will function and deliver the outcomes of the CAZ. Figure 9 shows the key building blocks of a charging CAZ that all need to be linked by the operating model and governance structure.

Therefore, all assets and systems required are linked to the processes below which fit into the operating system and governance system. While this is set out for a charging CAZ, it can be modified to meet different city needs.

Having seen the assets and systems in the most basic form in Figure 9 we can now start to consider in more detail what functions are required to manage each of the separate elements.

We have set out in Figure 10 the components of a typical CAZ to demonstrate the range of roles, assets, systems and processes which need to work together. It highlights the complexity of data and expertise which needs to be developed and tested before a CAZ can 'go live'

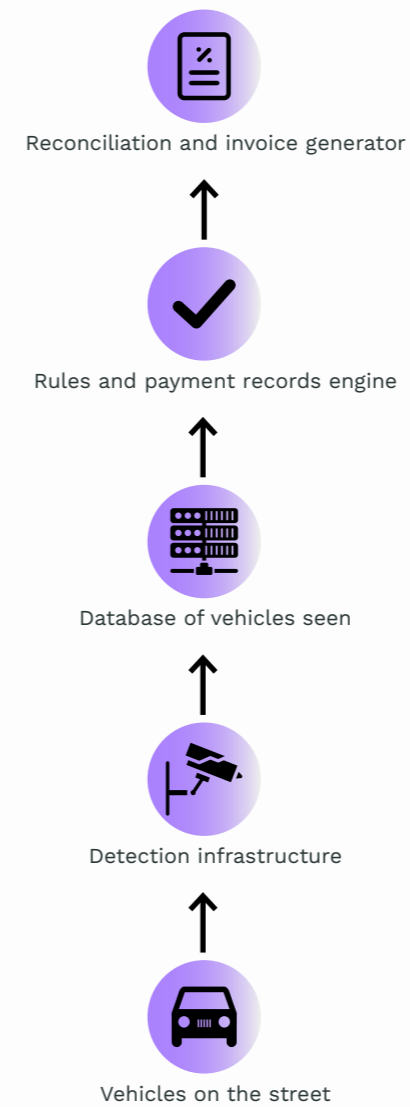


Figure 9: The building blocks of a charging CAZ

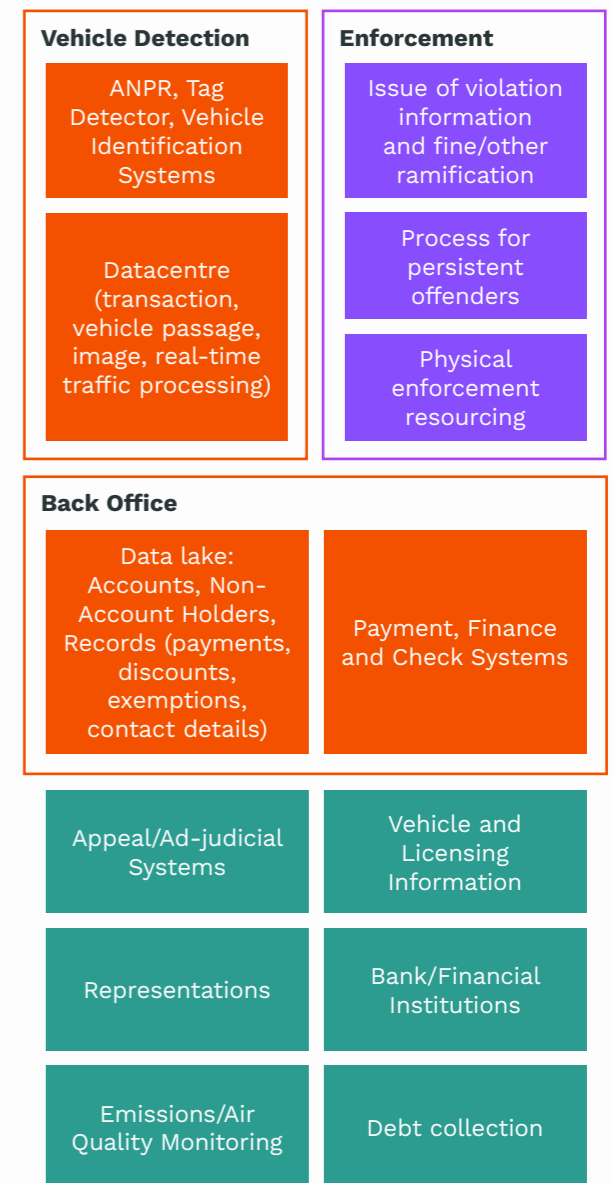


Figure 10: CAZ recommended services/inputs

## HOW WILL THE FUNCTIONS BE DELIVERED AND WHO WILL BE RESPONSIBLE?

An Operating Model determines the arrangements that need to be put in place to source the functions shown in Figure 10, whether using their own assets or through services from external suppliers. This forms an important part of being able to translate the CAZ policy into action.

A CAZ requires a wide range of stakeholders to be involved in the organisation and delivery. Typically, this involves a CAZ steering committee, project board, project/project directors and managers and stakeholder and communication managers. Where these groups are located within the city organisation can vary. Successful delivery of the CAZ often depends on their ability to work across a wide range of departments and technical areas.

Each city situation will be different, and will need assets and systems aligned to their needs and situation, therefore some of the key questions for the team setting up the operating model to answer will be:

- How will the CAZ infrastructure and operations be delivered?
- What functions are to be delivered in-house and what will be provided by external providers?
- How will responsibilities and risks be managed?
- How will the selected operating model affect project timeline, costs and flexibility?

## HOW WILL THE CITY TRANSITION FROM DESIGN TO OPERATION?

Before the city 'goes live' with a CAZ, the city needs to ensure that all stakeholders, facilities and systems are ready to work effectively. This will reduce the risk of operational issues, and the cost, schedule, and reputational impacts they bring with them.

To ensure a successful transition from design/implementation to operation, consider these five areas of readiness:

- **People** - Are staff fully trained, familiarised and equipped to manage the operation of the CAZ? A CAZ is likely to involve a large number of people, beyond those on a CAZ committee and those people will be working across departments and technical areas.
- **Process** - Have all processes been reviewed, renewed or adjusted to meet the objectives of the CAZ? Organisational responsibility will lie with the core CAZ delivery team but the operational testing and readiness will be managed across departments and technical areas.
- **Facilities** - Do the facilities support the management of CAZ operations and public experience? Through testing and engagement ensure the facilities will work for the public.
- **System** - Are CAZ systems aligned with the management of operations and are they are configured and proven to be reliable and sustainable?
- **Product** - Is the product and performance of the CAZ consistent with the city's aspirations?

“We work with the C40 cities, particularly in building the capacity of our technical staff in the air quality section to be able to know how to do emission analysis and dispersion models to be able to even understand the concentration of air pollution in the city.”

- City representative, Global South



### PLANNING FOR IMPLEMENTATION – CREATE AN EXPERT TEAM

**Having the right skills and expertise within the team involved in planning and implementing a CAZ has been identified as a key enabler for successful CAZ implementation.** Cities that invest in capacity building and skill development for their staff are better positioned to design, implement, and manage CAZs effectively. Evidence from multiple cities cites the importance of having knowledgeable personnel who understand both the technical aspects of CAZ operations and the broader policy implications.

“The right team who [are] well motivated is something which the city has right now. [The] team is well [versed] with the mandate which is ahead of them and...[if their] capacity [is] strengthened, then we will be ready for this kind of initiative. So when it comes...[we'll] be able to undertake it.” - City representative, Global South



## CAZ OPERATION: ORGANISATION AND GOVERNANCE

To ensure a smooth transition from the design and implementation stages to the mobilisation and operational stages, the CAZ project organisation needs to be well-structured. The city will need to consider the operational control of the CAZ through role fulfilment, technical and commercial sub-teams, as well as post-implementation transition. The exact expertise required, team sizes and departments to link with will differ for each CAZ. Therefore, we have focused on setting out the common elements which need to be considered for any CAZ being planned.

### Role Fulfilment

While the precise number of staff will vary, roles may be fulfilled in whole or part by a supplier organisation, depending on the chosen operating model. This will vary based on the extent to which:

- the CAZ solution can be built and operated in-house;
- existing communication channels such as community groups or forums can be used;
- existing systems and organisations can be used to support the CAZ, for example any traffic management systems or payment systems;
- a city needs new suppliers for any of the CAZ operational elements, for example legal support or payment systems.

### Technical and Commercial Sub-Teams

The Technical and Commercial teams will lead the specification of how the CAZ operates and delivers the implementation. They will need to be in place to start once the operating model decision has been made and procurement or contract negotiations have concluded.

### Post-Implementation Transition

After implementation and as the CAZ moves towards operation, the personnel will evolve where there will be a handover from design and implementation responsibilities to focus more on operational roles as they prepare for each go-live milestone. This can include Roadside Operations, Customer Operations, Back-Office Operations and Enforcement Operations roles.

“We will set up a project steering committee that will be multi-disciplinary that will focus on driving the policy development right up to policy innovation. We recognise that there will be a need for skills from other organisations.”

- City representative, Global South

“Cooperation with Clean Air Fund and other NGOs was helpful because they supported with the analysis of data. They completed some analysis within a month that would have taken us 9 months if we had done it through public channels.”

- City representative, Global South



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## ENCOURAGING COLLABORATION AND PARTNERSHIPS

Multiple cities have highlighted the benefits of collaboration and partnerships between governmental departments, external organizations, CSOs, universities, and other cities. These collaborations provide valuable support in terms of expertise, research capabilities, and access to best practices, making them a significant enabler for CAZ implementation.



## WHAT DOES THE CITY NEED TO MANAGE A CAZ?

The management of a CAZ scheme will vary depending on the specific context of each city. This guidance provides high-level recommendations for any city to consider when implementing a CAZ. The details provided in Section A.3 of the **Clean Air Zones: Practical Guidance for Cities Annex** cover the following key considerations:

- **Vehicle detection:** How will vehicles be detected within the CAZ? Consider the technology and processes required to accurately identify and monitor vehicles entering and exiting the zone.
- **Signage:** What signage will be necessary to inform drivers about the CAZ? Ensure that signage is clear, visible, and strategically placed to guide and inform the public effectively.
- **Enforcement:** How will the CAZ be enforced? Consider the enforcement notices, legal basis for enforcement and exemptions that may apply.

By addressing these considerations, cities can effectively manage their CAZ schemes and ensure successful implementation and operation.

## CHECKLIST – IMPLEMENTING A CLEAN AIR ZONE

Cities that are looking to implement a clean air zone should have an understanding of:

- The assets and systems needed to implement a CAZ
- How the different functions of the CAZ will be delivered and who will need to deliver them
- How the transition from design to operation will be planned
- How a CAZ operation will be organised and governed
- What the cities needs to manage a CAZ.



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# 08

## MONITORING THE IMPACT OF A CLEAN AIR ZONE

## MONITORING THE IMPACT OF A CLEAN AIR ZONE

Undertaking monitoring before and after a CAZ is implemented can help understand and evaluate its performance and effectiveness. It will also help to communicate the benefits to the public and other stakeholders all the way through.

The data and insights collected can form the evidence base for making future adjustments to the scheme, as well as supporting the development of additional CAZ stages or complementary measures.

There may also be unintended consequences that need mitigating or find evidence to allay concerns about negative socio-economic impacts.

This section provides advice on different approaches, metrics and data sources that can be used to monitor and evaluate the impact of the new CAZ.





### Monitoring the effectiveness of a CAZ

There are three questions which need to be considered to effectively monitor the impact of the CAZ which will be discussed in following sections:

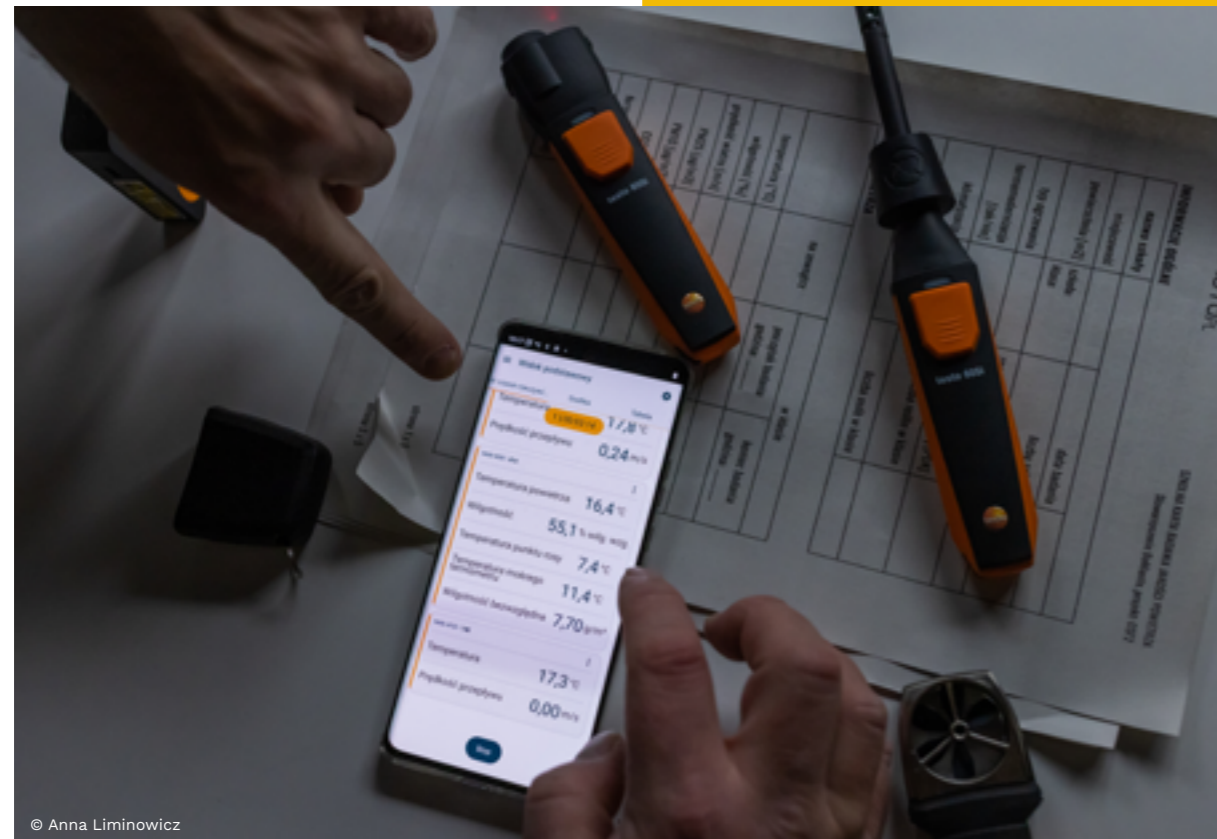
- Why is monitoring needed?
- What monitoring should be undertaken?
- How should monitoring be undertaken
- When should monitoring be undertaken?

There are a range of examples from existing CAZs on how to monitor the impacts and effectiveness, however many of these examples are from the global north and are specific to the challenges being faced by these specific cities. The monitoring for the CAZ should be tailored to the city and infrastructure and the questions to answer. This chapter summarises the steps required to do this. Additional detail can be found in **Section A.5 of Clean Air Zones: Practical Guidance for Cities Annex.**

### INTERVIEW INSIGHTS

As cities move into implementation, they need support to develop robust monitoring and evaluation frameworks to assess the effectiveness of CAZs. This included understanding the options for purchasing and setting up air quality monitoring infrastructure and technology that can measure and report air quality in real time and promote effective decision making.

Several city representatives noted that this was a significant need, as getting the monitoring infrastructure right was a technical challenge. Some cities mentioned they valued support from global partners such as the World Resources Institute (WRI) and C40 that helped them measure baseline data and set up monitoring stations.



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### WHY IS MONITORING NEEDED?

Monitoring is required to understand whether a CAZ is working to improve air quality and health in the city. The data can be used in comparing the trends within and outside the CAZ, and this would facilitate an understanding of any noticeable changes and resulting impacts due to the implementation of CAZ. In other words, to get a comprehensive picture of the wider benefits and unintended or negative consequences of the CAZ, it requires looking beyond air quality.

Collecting the monitoring and evaluation data is associated with capital investment and operational costs but it is an important part of the communication strategy around the CAZ. It helps to ensure transparency, accountability, credibility, and increase public awareness through regular reporting which helps to maintain stakeholder trust and engagement.

This can play an important role in tackling misinformation relating to the scheme as monitoring and evaluation can provide evidence to illustrate the performance of the scheme and be used to gain public acceptance and continue to secure political support.

In addition, monitoring and evaluation can provide feedback on what is working well, where things are not as expected and understand impacts from any changes in policy or context. This enables plans to continue adapting and evolving based on evidence to address any issues and ensure effectiveness.



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## WHAT MONITORING SHOULD BE UNDERTAKEN?

When deciding what monitoring should be carried out, it depends on the information that is being looked for in relation to the scheme, the motivations and objectives of the CAZ and the city context.

A strategy should be developed to undertake monitoring using a range of metrics with questions to consider which are summarised in Figure 9 and detailed in **Section A.5** of the **Clean Air Zones: Practical Guidance for Cities Annex**.

## INTERVIEW INSIGHTS

Cities often require support in developing the technical skills and capacity to design, implement and monitor CAZs effectively. This includes assistance with emission inventories, dispersion modelling, and air quality monitoring. An emission inventory quantifies the amount of pollutants being emitted from air emission sources. Air quality dispersion modelling is used to predict pollutant concentrations at specific locations based on these emissions.

Impact	Questions to ask
<b>Air quality</b>	How have vehicle air pollutant emissions for nitrogen oxides (NO <sub>x</sub> ) and particulate matter (PM <sub>10</sub> and PM <sub>2.5</sub> ) changed inside and outside the CAZ boundary since implementation?
	How have pollutant concentrations for nitrogen dioxide (NO <sub>2</sub> ), PM <sub>10</sub> and PM <sub>2.5</sub> changed since CAZ implementation? How does it vary spatially inside and outside the CAZ, are there any hotspots remaining?
<b>Climate</b>	How have vehicle emissions of carbon dioxide (CO <sub>2</sub> ) and other Greenhouse Gases (GHG) such as nitrous oxide (N <sub>2</sub> O) and black carbon (BC) changed since CAZ implementation?
<b>Economic and equity</b>	What is the impact of the CAZ on local businesses in relation to costs and revenue? Are small businesses more affected?
	Has the CAZ created job opportunities?
<b>Health and equity</b>	Are there any reductions in hospital admissions or mortality attributed to air pollution since CAZ implementation? Is there a difference depending on the location? How does it change over time?
	Have there been reductions in the number of road incidents?
<b>Transport</b>	How have traffic volumes, vehicle kilometres travelled and congestion changed inside and outside of the CAZ?
	Have there been changes to fleet composition and modal splits?
<b>Compliance and enforcement</b>	What is the proportion of vehicles that are compliant with the CAZ? Are these increasing over time?
	How effective is the existing compliance and enforcement process?
<b>Public perception and engagement</b>	How does the public perceive the CAZ and what is the level of support?
	What feedback has been gathered from all parts of society and how has it been incorporated into the CAZ policy?
<b>Socio-economic and equity</b>	How have public transportation costs changed for different income groups?
	How has the CAZ affected the local economy and footfall within its boundaries?
	Has there been a change in uptake of health and support services by vulnerable populations since CAZ implementation?
<b>Accessibility and mobility</b>	Has there been any impact on accessibility to key services and public transport options after CAZ implementation? Are certain communities worse affected?
<b>Behaviour change</b>	How have travel habits changed since CAZ implementation?
	How have consumer preferences and attitudes shifted towards cleaner vehicles and electric vehicles since CAZ introduction?



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Figure 9 – Monitoring metrics and key questions



## HOW SHOULD MONITORING BE UNDERTAKEN?

Any monitoring will build on existing data collected within the city, and any data collection framework set up as part of the CAZ development (see **Chapter 4: Planning a Clean Air Zone** and **Section A.2** of the **Clean Air Zones: Practical Guidance for Cities Annex** for further details).

The monitoring should be robust, fit for purpose, and aligned with the key metrics to ensure the CAZ is effective and achieving its aims. This applies both when starting a data collection programme or adapting and expanding an existing programme.

Table 9 in **Section A.5** of the **Clean Air Zones: Practical Guidance for Cities Annex** provides more detail on potential metrics and outcomes which could be useful in assessing and evaluating a CAZ. Many of these metrics are relevant to other types of projects and are well understood, others are less used and additional examples are provided in the Annex.

The impact of a CAZ on air pollution is a priority for many cities, and critical to ensuring effective development and implementation of a CAZ. Further information on different aspects of air pollution monitoring and evaluation is provided below.

### Emissions

The implementation of a CAZ would potentially disincentivise the use of older, more polluting non-compliant vehicles as well as the use of road transport, both could lead to potential reductions in vehicle emissions. Therefore, the changes in emissions over time should be estimated based upon the changing of fleet composition data (e.g. from vehicle licencing data), traffic volumes and estimates of vehicles kilometres of traffic within the CAZ.

This approach can also be used to assess the climate change impacts of the CAZ, by considering emissions of carbon dioxide or wider greenhouse gas emissions.

“The skills in the organisation, we have a unit which manages air quality. We have skills in air quality monitoring, understanding data and analysis, we have some modelling experience (air quality modelling, temporal resolution of emissions in the identified zones, social and economic models, so we understand the impact of the intervention).”

- City representative, Global South

### Air Pollution Concentrations

Understanding the pollutant concentrations within a CAZ is crucial for assessing how it can improve health by reducing air pollution. Air pollution concentrations are highly influenced by factors including meteorology, emission sources and the urban environment, therefore, site-specific pollution data should be collected via monitoring. Existing monitoring may be adequate, or additional monitoring sites can be introduced in advance of Go Live to supplement this.

“First is the ambient air quality monitoring and then the second is the regular emission inventory, for example, like how we want to evaluate every year or every six months.”

- City representative, Global South

“And then we are also looking forward to increasing the monitoring levels across various zones in the city. I know our budgets may not be adequate to be able to install monitors in those particular spaces, so we think that is an area in which we are also incapacitated.”

- City representative, Global South

### Air Quality Monitoring

For a road-based scheme such as a CAZ, roadside monitoring with a sampling height reflective of exposure (around 1.5 metres high) is useful in assessing the impacts. When designing an air quality monitoring network for CAZ evaluation, the following elements should be considered:

- Existing monitoring network - the locations and coverage of the current monitoring should be reviewed to determine the requirement of additional monitoring
- Key Pollutants - the key pollutants for a road transport scheme are nitrogen dioxide, NO<sub>2</sub> (or NO<sub>x</sub> for emissions, including NO<sub>2</sub> and its precursor nitric oxide, NO), and PM<sub>10</sub> and PM<sub>2.5</sub>. Monitoring these will allow for detailed analysis and evaluation of the CAZ impacts.
- Size of the monitoring network – determined by the size and location of the CAZ in addition to the elements below.
- Density of monitoring network - a denser network would be beneficial to the monitoring analysis, as more observations and comparisons could be made
- Type of monitors – air pollutants can be monitored using automatic monitoring sites to provide detailed short- and long-term data for all pollutants. This can be supplemented with passive monitoring, such as NO<sub>2</sub> diffusion tubes, which can provide a cost-effective indication of long-term trends. Low cost mobile monitors can also be used, especially where more extensive coverage is needed, but these can have limitations in data quality and comparison.
- Location of air quality monitors – monitors should ideally cover different environments such as location with relevant and/or high population exposure (e.g. residential properties/

schools/ hospitals), pollution hotspots, roadside (boundary roads, roads adjacent to the CAZ) and background locations.

- Monitoring period - it is recommended at least one full year of air quality monitoring data is collected prior to implementation, to provide useful annual average data, to support of the evaluation of the CAZ. A period shorter than a year can be distorted by seasonal trends and short term meteorology, and may not be suitable for long term trend or impact analysis.
- Sourcing of monitors – air quality monitors can be purchased or rented and the decision will need to be considered based on factors such as costs, length of monitoring period and maintenance. Buying the equipment would mean more upfront costs but may be more cost-effective in the longer term as no ongoing rental payments are required. However, renting equipment means maintenance and associated costs will likely be handled by the supplier, though in London, service level agreements (SLA) had to be established with all 31 local authorities which required additional cost and time.
- Proportionality should be considered when determining the air quality monitoring network for CAZ evaluation, balancing costs with the elements described above. Some cities may already have a well developed monitoring network which will be sufficient for CAZ evaluation whereas other cities, particularly those in the global south may have limited air quality sensors.

### Analysis and Further Studies

During analysis, it will be important to normalise for other factors including other transport policies, interventions and meteorological conditions to ensure that the results are reflective of the CAZ's true effect.

Atmospheric dispersion modelling can be carried out to understand the impact of the final implemented CAZ, to compare to any that was carried out during the detailed design stage. It can also assess the impact of changes and refinements introduced through the detailed design and implementation stages, additional mitigation measures, other sources of pollution and other changes to the city environment.

It can also be used to inform post-hoc health studies, reinforcing support and communicating the effectiveness of the CAZ, or developing the evidence-base for changes required where further improvements to the scheme can be made.

"I would say that [air quality] dispersion techniques is one of the areas which we think the city [needs] support in. It's a grey area and honestly I would say we would really appreciate a lot of support in this."

- City representative, Global South



## WHEN SHOULD MONITORING BE UNDERTAKEN?

With the understanding of what needs to be monitored, planning will need to be undertaken so that monitoring happens before and after implementation. Where possible, continuous data should be collected but often, snapshots or surveys will be just as beneficial for some types of data.

### Pre-implementation monitoring

The monitoring strategy should commence with pre-implementation monitoring. This will allow understand of the baseline trends and help distinguish the impact between the implementation of the CAZ scheme and other changes that may happen in the same time frame such as natural fleet transition, or the impact of complementary schemes or policies.

Pre-implementation monitoring would use similar monitoring techniques as described above and in the **Section A.5 of the Clean Air Zones: Practical Guidance for Cities Annex** to measure, e.g. the levels of pollution across the city. For example, a network of air quality monitors across the city pre- and post-implementation would help to understand the improvement in air quality to support communication and community engagement. These would ideally be operational for at least a year prior to Go Live.

### Post-implementation monitoring

Key Performance Indicators (KPIs) can be established to quantify the effectiveness of the CAZ and how the scheme is performing against the aims and objectives of the scheme at the post-implementation stage.

However, tracking KPIs is not the only method as they may not always provide the whole picture. The value of monitoring is in how it provides explanations for the how and why the impacts being measured have resulted.

The metrics can be categorised into:

- uptake metrics to measure near term changes regarding adoption and engagement of the scheme such as transport, compliance and enforcement, public perception and engagement; and,
- outcome and impact metrics to measure longer term changes to air quality, climate, economic and equity, health.

Where it is not possible to collect all the required data, if uptake metrics have been collected then the outcomes and impacts can be extracted by undertaking modelling and analysis activities.

To understand the wider impacts and any displacement generated by the CAZ it will be helpful to collect information for the metrics both within and outside of the CAZ implementation area.

Cities should consider the impact of the CAZ and the wider trends, to understand the impact of the scheme specifically, this may require further analysis for robust evaluation.

Sharing this data is an important part of the communication strategy around the CAZ. It helps to ensure transparency, accountability, credibility and increase public awareness through regular reporting which helps to maintain stakeholder trust and engagement. Real-time air quality and transport monitoring data should be made available to the public where possible to help maintain public trust and engagement whilst also allowing policy and decision makers to make informed decisions.



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## MONITORING MAJOR TRANSPORT POLICIES IN LONDON: CONGESTION CHARGE, LEZ AND ULEZ

The effectiveness of the Transport for London (TfL) congestion charge, Low Emission Zone and Ultra-Low Emission Zone schemes were measured by undertaking monitoring of air quality, congestion, and carbon emissions<sup>xxxiii,xxxiv</sup>. This allowed TfL to determine the area where air quality meets the relevant standards or guidelines across the study area to understand if the scheme was performing successfully.

TfL also monitor broader socio-economic factors, including local footfall, consumer and tourism spending, public transport usage, and changes in property values, as well as impacts on vulnerable groups, driver populations and business sectors<sup>xxxv</sup>. They have carried out a wide range of social surveys including customer satisfaction, attitudinal, behaviour change and social impacts surveys, using a range of quantitative and qualitative social survey techniques, depending on the population and the nature of the research question.

Considering these broader metrics are important for understanding the full impact of the CAZ. They can provide key insights for refining the CAZ over time and identifying areas for managing its impacts.



## CHECKLIST – MONITORING A CLEAN AIR ZONE

After exploring the monitoring and evaluation process for the CAZ, there should be a clearer idea of:

- Why undertaking monitoring is needed as part of the CAZ
- What monitoring should be undertaken
- How should the monitoring be undertaken
- When should the monitoring be undertaken



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# 09

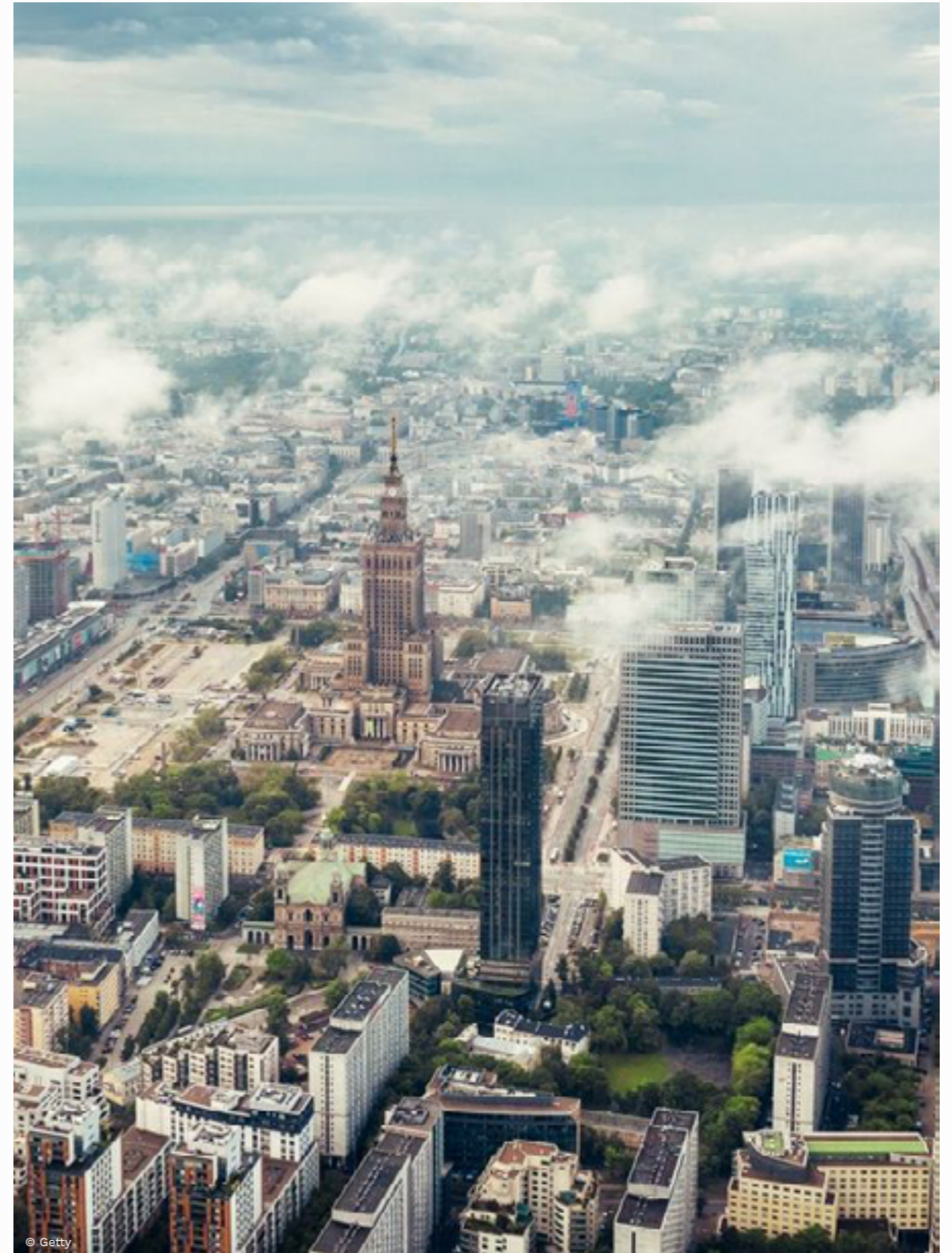
## CASE STUDIES

## CASE STUDIES

Learning from others and sharing experiences between cities and organisations is something we know cities find valuable.

In this chapter, we have selected four examples to highlight particular elements of CAZs which have been less explored in existing literature. Each tells a different story about how a city is navigating the opportunities and challenges of introducing a CAZ. These are:

1. Tackling legal challenges and working through an existing regulatory framework
2. Additional challenges for a growing city
3. Navigating political challenge and public opposition
4. Scaling up a CAZ





## TACKLING LEGAL CHALLENGES AND WORKING THROUGH AN EXISTING REGULATORY FRAMEWORK

**City:**  
Krakow, Poland's second largest city

**Status:**  
Piloted, updated and awaiting final approval for implementation

**CAZ overview:**  
The Krakow Clean Transport Zone or Strefa czystego transportu (SCT) is planned to be in force 1 July 2025 and will cover the administrative borders of the city of Krakow<sup>xxxv</sup> (Figure 1). Vehicles which have been registered before 1 March 2023 need to at least meet the Euro 1/Euro I (petrol) or Euro 2/Euro II (diesel) standards to be able to enter the zone. Vehicles registered after 1 March 2023 are subject to Euro 3/Euro III (petrol) or Euro 5/Euro V (diesel) standards. From 2026 onwards, these thresholds are tightened and all vehicles will need to meet the more stringent thresholds. Non-compliant vehicles will be fined, with exemptions, for example for disabled people and older people.

Transport-related emissions of nitrogen oxides (NO<sub>x</sub>) are one of the biggest contributors to air pollution in Poland due to the old fleet and high car ownership rate. Poor air quality is a major issue in Krakow, the city used to have one of the highest levels of pollution in the European Union. Local government efforts have helped to change that, in particular action to reduce emissions from household heating (by phasing out coal boilers)<sup>xxxvi</sup>. However, emissions from transport remains a challenge that needs addressing and a SCT was proposed with the aim of improving the city's air quality and the health and wellbeing of local people. Extensive consultations, which took place with local people, businesses and other stakeholders,

included an exploration of how best to limit the economic impact of the new policy.

**Tackling legal challenges and working through existing regulatory framework:**  
In 2019, Krakow implemented a pilot CAZ in the historic district of Kazimier. At the time, there was not sufficient legal basis in place and the scheme was unsuccessful<sup>xxxvii</sup>. However, the pilot contributed to setting relevant provisions in national law, enabling municipal officials to introduce plans for the SCT in 2021. The plans used provisions of the amended Electromobility and Alternative Fuels Act. While the Act does not mandate the establishment of CAZs, it provided the legal framework to enable local authorities to establish SCTs and set standards for vehicle entry<sup>xxxviii</sup>.

In November 2022, Krakow became the first city in Poland to approve a resolution to introduce the SCT. A regional representative of the government of Małopolska raised a complaint regarding the compliance of the local authority resolution with the Act<sup>xxxix</sup> and specifically a lack of clarity around the definition of the geographical boundary of the SCT and the lack of appropriate regulations on how traffic was to be re-organised in the zone. An additional complaint was raised by two private individuals who argued that the SCT amounted to an excessive interference in the sphere of constitutional rights and freedoms, such as personal liberty, freedom of movement, equality before the law or property, and violating the principle of proportionality.

Krakow City officials voted on the scheme and also argued for the dismissal of the complaints. The provincial administrative court, which was responsible for considering the claims, rejected the individuals' claims (although they are currently appealing this decision) but upheld Maloposka's claim, based on technical aspects and ultimately decided to annul Krakow's resolution in January 2024. Nevertheless, this delayed the original

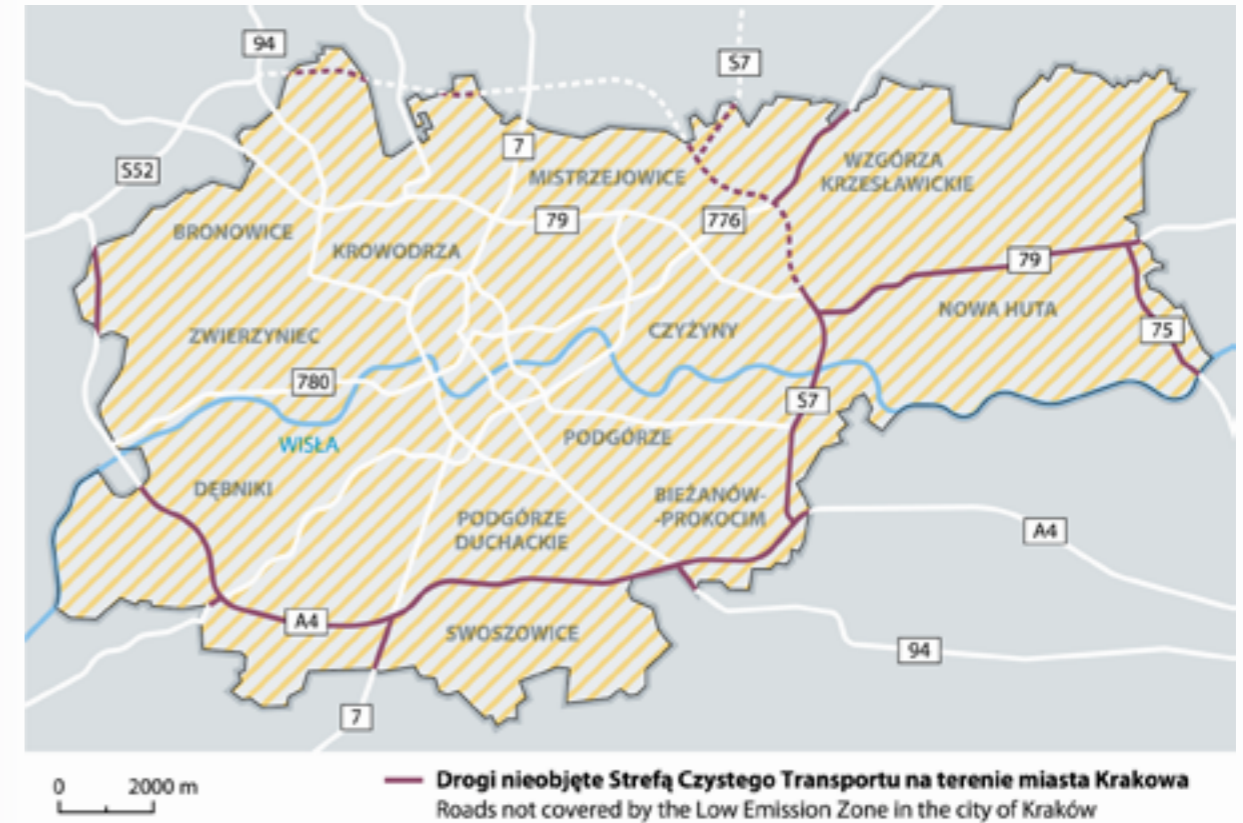


Figure 10 – Krakow Clean Transport Zone extent<sup>xxxvi</sup>

plan for the SCT to come into force 1 July 2024<sup>xl</sup>. Following that, an amended resolution on a SCT is being prepared which will directly address the court's concerns. Krakow has also continued with public engagement, including public consultation and information, to answer concerns about the scheme and build public support for it. The new, amended resolution<sup>xxxvi</sup> is due to be voted by the city council in early 2025.

## ADDITIONAL CHALLENGES FOR A GROWING CITY

### City:

Jakarta, Indonesia's capital and one of South East Asia's megacities

### Status:

Under consideration

### CAZ overview:

Jakarta currently has two ongoing CAZs. The Kota Tua LEZ is at the pilot stage and the Tebet Eco Park LEZ is operational.

The first is a pilot LEZ in Kota Tua, the city's old town, a tourist destination, which started in February 2021<sup>xlii</sup> (Figure 2). The LEZ has a total area of 0.14km<sup>2</sup> and prohibits most motor vehicles from entry, except for residents, business owners in the area and public transport vehicles.

This LEZ is accompanied by an odd-even restrictive driving policy in the surrounding area where a car with a license plate ending in an even number is only allowed to enter on even-numbered dates and vice versa.

It applies during certain time periods (6 to 10am and 4 to 9pm weekdays)<sup>xlii</sup>.

Some of the key findings from the pilot study<sup>xliii</sup> showed the importance of:

- understanding the needs of stakeholders;
- public engagement and communication at all stages;
- land-use planning for creating liveable areas;
- promoting non-motorised transport; and
- monitoring and evaluation for understanding impacts and make necessary adjustments.

The second LEZ around Tebet Eco Park was implemented in 2022. It prohibits motorised vehicles from entry, except for public transport and vehicles belonging to local residents. The restrictions are applied every weekend and on public holidays<sup>xliv</sup>.

The megacity is currently considering implementing a larger CAZ to improve air quality and reduce traffic congestion<sup>xlv</sup>.



Figure 11 – Kota Tua LEZ extent<sup>xli</sup>

“there is a huge buy-in or interest to start from the transit-oriented development side.”

- City representative, Jakarta

### Additional challenges for a growing city:

Jakarta is experiencing rapid urbanisation. This has led to the development of high-rise buildings adjacent low to middle income populations. While a CAZ can improve air quality for all, and will benefit many, including those who are medically vulnerable or live in more polluted areas, the potential negative impacts on the lower income populations requires careful consideration during design and implementation phase.

Like many cities in the Global South, the informal sector accounts for a considerable portion of jobs and livelihoods in Jakarta<sup>xlvi</sup>. These often requires the use of personal vehicles e.g. for delivery businesses, street vendors, Uber drivers and other small-scale businesses. Restrictions on vehicle use associated with a CAZ may impact these individuals and businesses who may experience more financial burden in upgrading vehicles.

Another challenge experienced by designing a CAZ in a rapidly growing city is lack of expertise across a range of areas. Jakarta has identified that they have gaps in data collection, policy development and technical knowledge, leading to reliance on external contractors. Having information on how cities similar to Jakarta are approaching the issue would also be valuable, as the vehicle fleet is different from Global North cities and therefore would be unable to use the designs as benchmark.

Designing a CAZ in a growing city also presents an opportunity to better integrate this into urban development, including public transport facilities to encourage behaviour change and shift away from private vehicle usage, and explore transit-oriented mixed-use development.



Figure 12 – Tebet Eco Park LEZ extent<sup>xlvii</sup>

“how we can provide an inclusive and equitable clean air zone?”

- City representative, Jakarta



## NAVIGATING POLITICAL CHALLENGE AND PUBLIC OPPOSITION

### City:

London, the capital of the United Kingdom

### Status:

Implemented

### CAZ overview:

The London-wide Ultra Low Emission Zone (ULEZ) currently operates across all London boroughs, covering 1,500km<sup>2</sup> and nine million people. It operates 24 hours a day, every day of the year except Christmas Day (25 December) as a measure to improve air quality and health<sup>xlviii</sup>. In 2019, when the ULEZ was first introduced for Central London. In 2021, it expanded to include the boundaries of North and South Circular Roads (Inner London), before being extended to cover all of Greater London in August 2023 (Figure 4).

As part of the ULEZ, all light duty vehicles (cars, motorcycles, vans and minibuses) entering the zone need to meet the minimum emission standards or pay a daily charge of £12.50. The minimum emission standards for cars and vans are Euro 6 for diesel and Euro 4 for petrol. Motorcycles must meet Euro 3 standards. Lorries, buses, coaches and larger vehicles over 3.5 tonnes need to meet the London-wide LEZ standards, introduced in 2008.

Some drivers and vehicles are eligible for discounts and exemptions which includes disabled people, taxis and others. A £110m scrappage scheme allowing people to claim up to £2,000 towards their old vehicles was introduced January 2023 in the lead-up to the implementation<sup>xlix</sup>. This support measure was expanded to £160m in the lead-up to the 'go live' day. It further increased to £210m in February 2024 when the ULEZ was already operational, and has now closed.

### Addressing political challenge and public opposition:

In the months leading up to the launch of the ULEZ expansion to the whole of Greater London, the scheme became highly politicised.

Several local authorities in outer London and a nearby area (Surrey County) initiated a legal challenge to the scheme. These councils were led by an opposition party to the Mayor's party<sup>l</sup>. The councils argued that implementation of the expanded scheme was beyond the Mayor of London's powers and that the public consultation and scrappage measures were flawed. However, as sufficient powers to introduce it were granted to the Mayor by the national government, and the consultation was considered "sufficient"<sup>li</sup>, ultimately, the High Court ruled that the expansion was lawful, giving the Mayor the green light to go ahead on 29 August 2023<sup>lii</sup>.

Adding to the politicisation of air pollution policies, there was "a misinformation campaign about London's Ultra Low Emission Zone", highlighted by the Institute for Government<sup>liii</sup>, where "...unscientific and unrepresentative views are ...being amplified by parts of the media".

London's ULEZ gained national prominence when it was seen as a factor influencing the result of a national by-election in July 2023<sup>liv</sup> and it was debated again in the subsequent Mayoral and London Assembly elections.

The public in London, while supportive of improving air quality, were more likely to oppose its expansion if they lived in Outer London<sup>lv</sup>. There were concerns raised about the lack of alternative transport in the area to be covered by the expansion. There were also concerns about the costs of replacing vehicles by individuals and businesses, particularly during a time of high inflation and cost of living crisis.

The political and public pushback demonstrated the importance of having the political will, strong backing and commitment from a Mayor to improve air quality and health. The ability to respond to public feedback, for example about the limitations of the scrappage scheme by expanding its eligibility criteria, is vital too for smooth implementation. The role of civil society and CSOs, such as campaign groups and environmental charities was also shown to be important. They were able to offer different perspectives to balance vociferous voices of opposition to the scheme.

Once the ULEZ expansion was implemented, its positive impacts became more apparent in relation to the increased number of compliant vehicles, reduction in vehicle emissions and improved air quality<sup>lvi</sup>. Outcomes of the London-wide ULEZ Six Month Report<sup>lvii</sup> showed the effectiveness of the scheme, included:

- 96% of vehicles driving in the zone are compliant and do not need to pay; and
- all phases of the ULEZ have led to roadside NO<sub>2</sub> concentrations being 53% lower in central London, 24% lower in inner London and 21% lower in outer London.

The incumbent London Mayor was re-elected for a third term in May 2024, following his implementation of the ULEZ. This suggests that ambitious air pollution policies which experience public and political pushback may not damage electoral prospects.

**“while public support for a scheme can dip close to its launch, we tend to see it increase in the months following”**

– City representative, London



Figure 13 – Map of London ULEZ<sup>lviii</sup>

## SCALING UP A CAZ

### City:

Bogotá, the capital of Colombia

### Status:

Active

### CAZ overview:

Bogotá is in a very early implementation stage of a 'Zonas Urbanas por un Mejor Aire' (ZUMA) as a way to improve air quality, protect public health and reduce greenhouse gas emissions in areas with high levels of pollution and socioeconomic vulnerability<sup>lix</sup>. It aims to reduce industrial and transport emissions through multiple interventions. This includes measures such as enhancing public transport, paving roads, creating green space and educational programmes to reduce air pollution exposure.

### Scaling up a CAZ:

The first ZUMA was declared in October 2023 in Bosa, a low income, high pollution neighbourhood. Some cross-sector actions to be implemented, include improving pedestrian areas, encouraging active travel, providing cleaner public transport as well as increasing air quality monitoring and control of mobile and fixed emission sources<sup>xxv</sup>.

A comprehensive roadmap has been prepared to provide a framework developing each ZUMA, including prioritising of zones, through to its design and implementation, where equity is considered throughout the process. After the initial declaration, a ZUMA undergoes three stages of implementation to gradually increase the positive air quality impact. In the first year, it goes through a period of planning and co-creation with the local community and other stakeholders to create an action plan. In the following six years, measures from the action plan are implemented. After this, further actions are undertaken to strengthen governance structures.

ZUMAs are currently part of the city's long term Strategic Plan for the Integral Management of Air Quality in Bogotá (Plan Aire 2030)<sup>lx</sup>. There is an implementation plan to establish two ZUMAs between 2023 and 2027, including the Bosa-Apogeo ZUMA, to allow for gradual expansion whilst ensuring that the necessary preparation, monitoring and evaluation are undertaken. In the long term, Bogotá aims to expand ZUMA across the entire southwest of the city, an area characterized by higher pollution levels and home to more vulnerable communities, reflecting its commitment to environmental justice.

The project is supported by partnerships with a number of not-for-profit organisations for technical expertise and funding, as well as local government departments.



Figure 14 – Bosa, Bogotá ZUMA extent<sup>lxii</sup>



# 10

## GLOSSARY AND REFERENCES

Term	Definition
<b>24/7</b>	24 hours a day, 7 days a week
<b>ANPR</b>	Automatic Number Plate Recognition
<b>ASI</b>	Avoid-Shift-Improve
<b>BC</b>	Black Carbon
<b>C40</b>	C40 Cities Climate Leadership Group
<b>CAZ</b>	Clean Air Zone
<b>CBO</b>	Commercial Back-Office
<b>CSO</b>	Civil Society Organisation which includes Non-Governmental Organisations (NGOs) as a subset
<b>CO2</b>	Carbon dioxide
<b>DSRC</b>	Dedicated Short-Range Communication
<b>EqIA</b>	Equality Impact Assessment
<b>EU</b>	European Union
<b>FAQs</b>	Frequently Asked Questions
<b>GHG</b>	Greenhouse gas
<b>GPS</b>	Global Positioning System
<b>HEV</b>	Hybrid-Electric Vehicle
<b>HGV</b>	Heavy Goods Vehicle
<b>KPI</b>	Key Performance Indicator
<b>LEZ</b>	Low Emission Zone
<b>Marginalised populations</b>	People who experience systemic social, political or economic exclusion, and likely to be disproportionately affected. Marginalised populations may be considered to be vulnerable, but are not mutually exclusive.
<b>NGO</b>	Non-Governmental Organisation

Term	Definition
<b>N<sub>2</sub>O</b>	Nitrous oxide
<b>NO<sub>2</sub></b>	Nitrogen dioxide
<b>NO<sub>x</sub></b>	Nitrogen oxides
<b>PM<sub>2.5</sub></b>	Airborne particles that have a diameter of less than 2.5 micrometres
<b>PM<sub>10</sub></b>	Airborne particles that have a diameter of less than 10 micrometres
<b>RFID</b>	Radio Frequency ID
<b>SCT</b>	Strefa czystego transport
<b>SLA</b>	Service Level Agreement
<b>TfL</b>	Transport for London
<b>UN SDG</b>	United Nations Sustainable Development Goal
<b>ULEZ</b>	Ultra Low Emission Zone
<b>VPR</b>	Vehicle Passage Record
<b>VRM</b>	Vehicle Registration Mark
<b>Vulnerable populations</b>	People who are at higher risk of adverse health effects. This includes people who are medically vulnerable due to physiological factors or health disparities, such as the elderly and children, people with existing long-term health conditions, disabled people, and pregnant people. People may also however be socioeconomically vulnerable who may be disproportionately affected by the environmental benefits of CAZ, or the implementation impacts, such as higher cost for compliance.
<b>WHO</b>	World Health Organization
<b>WRI</b>	World Resources Institute
<b>ZEA</b>	Zero Emission Areas
<b>ZEZ</b>	Zero Emission Zone
<b>ZUMA</b>	Zonas Urbanas por un Mejor Aire



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