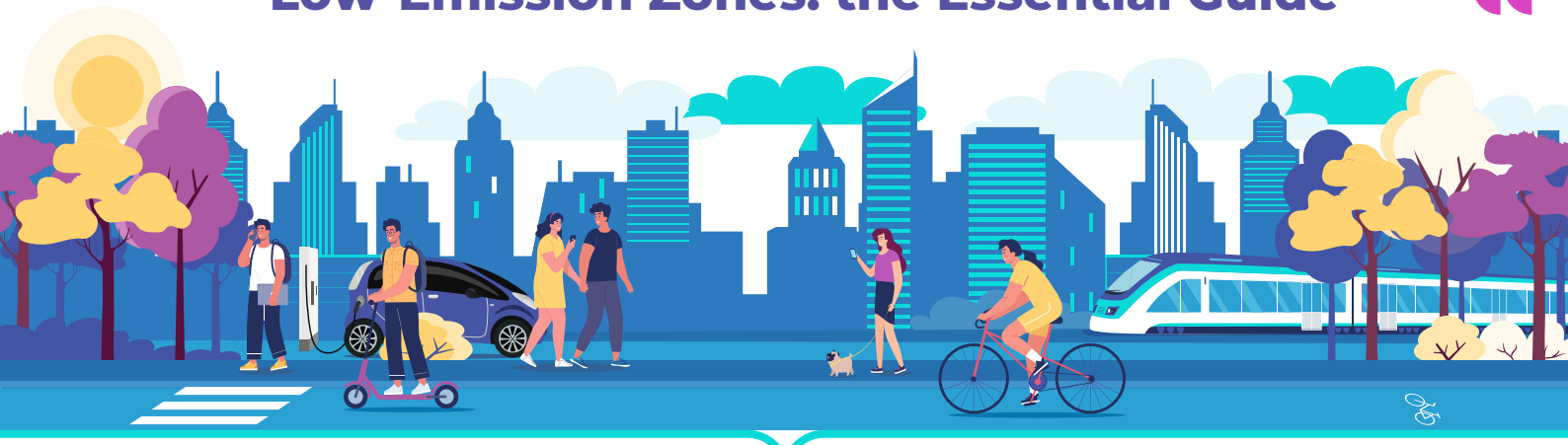
CleanCities

Low-Emission Zones: the Essential Guide

Practical solutions for city leaders

Low-Emission Zones: the Essential Guide



Why do cities need low-emission zones (LEZs)?

Low-emission zones are a tried and tested solution to curb air pollution, Europe's biggest environmental health risk. Well-designed LEZs can also reduce climate-damaging emissions, make cities more liveable and boost the local economy.

How successful are low-emission zones?

There is strong evidence for their positive impact

LEZs reduce nitrogen dioxide (NO_2) concentrations by **around 20%** in a wide range of conditions. In some cases, such as in central London, **reductions can reach up to 46%**.

There are also climate benefits: London's 'Ultra Low Emission Zone' reduced CO_2 emissions by **800,000 tons** between 2019 and 2022, which equals the annual emissions of more than **600,000 cars**. [1]

Additional benefits include accelerating fleet renewal and the shift to cleaner transport options. LEZs can also curb motorised traffic (e.g. by 3% to 9% in central London) and help reduce congestion, car ownership and noise.

LEZs can also have a positive impact on the local economy. Madrid's original zone was linked to an **8.6% rise in retail sales** in the city centre.

There are more than 320 low-emission zones in Europe...and counting

The number of active LEZs in Europe grew from **228 in 2019 to 320 in 2022 (+40%)**. Their number is expected to rise by **another 58% by 2025**.

By 2025, 27 cities are set to either expand or tighten existing LEZs, and **at least 35 cities** plan to introduce zero-emission zones by 2030.

The largest LEZ in the world is London's 'Ultra Low Emission Zone'. It covers all of London's boroughs and the City of London, with 9 million inhabitants.

More than 320 European cities have active LEZs. By 2030, at least 35 of these plan to advance their efforts by introducing zero-emission zones (ZEZs).

How to design low-emission zones?

There is no one-size-fits-all approach to LEZs, but proven recipes exist.

7 ingredients for success

The recipe for a successful LEZ includes seven basic ingredients:

- A clear definition of objectives, area, scope, and timeline
- A vision for zero-emission urban mobility
- Thorough and extensive communication
- Effective and fair enforcement strategies
- Monitoring schemes
- Targeted support for the most vulnerable
- Complementary measures to promote active and public transport

Win-Win: how to ensure a fast and fair transition

Cities must ensure a fast and fair transition to clean, healthy and inclusive mobility, especially for the most vulnerable groups.

Five policies have proven particularly successful:

- scrappage schemes for polluting vehicles
- reduced costs for bicycle purchases
- reduced public transport fares
- shared mobility hubs
- social leasing schemes for electric vehicles

Introduction

This factsheet provides a condensed overview of the knowledge base on low-emission zones, using both Clean Cities' own research as well as the most up to date scientific publications.

Low-emission zones (LEZs) are areas where the most polluting vehicles are regulated. [2] They have become a widespread measure in European cities, registering more than 320 active LEZs by 2022. [3] The main reason for this is that they have proven effective in reducing air pollution, the continent's most significant environmental health risk factor. [4] The most stringent zones have also contributed to reducing carbon emissions, mitigating congestion and incentivising the transition to zero-emission vehicles (ZEVs).

Well-designed LEZs usually require gradual implementation, accompanied by thorough stakeholder engagement, public communication, effective enforcement strategies and complementary measures to ensure fairness and acceptance. Clean Cities recommends that cities should immediately start introducing low-emission zones if no such measures are currently in place, and that all LEZs should have a clear path towards becoming zero-emission zones (ZEZs) by the 2030s at the latest to tackle the double challenges of air pollution and climate change.

Contents

1. Why cities need low-emission zones

Air pollution is Europe's most significant environmental health risk factor, especially in urban areas. [5] Toxic air has been linked to an increase in the occurrence of a wide range of illnesses that cause long-term suffering and significant costs to healthcare systems, including pulmonary diseases, diabetes mellitus and respiratory infections. [5] On average, air pollution costs each European city dweller more than €1,200 every year. [6] Road transport is one of the primary sources of toxic air pollution, and the main emitter (37%) of Nitrogen Oxides (NO_x), the 'dieselgate gas'. [7] Exposure to air pollution exceeding the World Health Organization (WHO) guideline levels resulted in at least 253,000 premature deaths in the EU-27. [8] More than 100 European cities are breaching EU air quality limits, which are less stringent than the current WHO guidelines. [9]

A 2021 pan-European city survey commissioned by Clean Cities showed that 71% of European city dwellers thought their leaders should do more to protect them from air pollution. [10] Air pollution adds to the cost-of-living crisis and the climate emergency. It also disproportionately affects the most disadvantaged people, although they often contribute the least to the problem, driving less and owning fewer cars. [11, 12] For example, according to the European Environment Agency, particulate matter ($PM_{2.5}$) concentrations are consistently higher by around a third in the poorest regions of the EU-27 compared to the richest ones. [13]

In this context, LEZs have emerged as a key urban vehicle access regulation (UVAR)* for improving air quality in European cities. Low-emission zones are explicitly recognized as a primary clean air measure in the EU's new Ambient Air Quality Directive. The directive requires authorities to assess the impact of LEZs when air pollution exceeds legal limits and to justify any decision not to implement them. [15]

This has contributed to the widespread adoption of LEZs across Europe. Clean Cities found that the number of active LEZs in Europe grew from 228 in 2019 to 320 in 2022 – an increase of 40%. [3] Their number is expected to rise by another 58% by 2025. Furthermore, by 2025, 27 cities are set to either expand or tighten existing LEZs, and at least 35 cities plan to introduce zero-emission zones (ZEZs) by 2030, barring the use of vehicles with internal combustion engines. [3, 15]

* Other examples of UVARs include, among others, car-free days, congestion charges, urban toll schemes, and limited traffic zones.

2. What are the effects of low-emission zones?

In line with the primary goal of reducing air pollution, the effects of LEZs are most evident when it comes to air quality. Low-emission zones are particularly successful at reducing nitrogen dioxide (NO_2) concentrations by around 20% in a wide range of conditions. [1, 16-18] As the table below shows, in some cases, such as in central London after the expansion of the city's Ultra Low Emission Zone (ULEZ), reductions can reach up to 46%. [18, 19]

Examples of the effects of LEZs on air quality and greenhouse gas emissions

Berlin, Germany	Berlin's LEZ, based on a ban of pre-Euro 4 diesel and Euro 1 petrol vehicles, contributed to a reduction of 10% in PM_{10} concentrations. [20]
Brussels, Belgium	Emissions of NO_x, $PM_{2.5}$ and black carbon from transport have fallen by 31%, 30% and 62% respectively since the LEZ was introduced in 2018. NO_2 concentrations have fallen by up to 30% in the city's main avenues. [17]
Lisbon, Portugal	An analysis of the LEZ in Lisbon reported a 22% reduction in NO_2 concentrations and 29% in PM_{10}. [21]
London, United Kingdom	Since 2019, the ULEZ has led to a decrease in nitrogen oxide (NOx) emissions by 23%. [1, 19]
	NO_2 concentrations in the air are estimated to be 21% lower in inner London and 46% in central London since 2017 compared to the scenario without the ULEZ. [22]
	Particulate matter ($PM_{2.5}$) levels have decreased by 41% in central and inner London since 2017. [22]
	London also reduced CO_2 emissions by as much as 800,000 tons between 2019 and 2022, which equals the annual emissions of more than 600,000 cars. [1]**
	The ULEZ also contributed to a reduction in traffic flows in central London of between 3% and 9%, depending on the time and the area. [24]
Madrid, Spain	The city's former LEZ, 'Madrid Central', was linked to a decrease in NO_2 concentration levels by between 23% and 34% compared to previous levels. [25, 26] The original LEZ has been replaced by a new, less stringent policy ('Madrid ZBE').

** Based on an average mileage of 12,000 km and CO2 emissions of 108 g/km. [23]

Beyond cleaner air and health improvements [27, 28], especially for children [29, 30], LEZs can also contribute to improving other dimensions of the quality of life in cities, including reducing motorised traffic, congestion and car ownership [25, 31] incentivising the shift to cleaner transport modes [32-36], curbing greenhouse gas emissions (see London data above) and cutting noise pollution [37, 38].

A 2021 evidence review by Clean Cities found that LEZs and other urban vehicle access regulations (UVARs) typically have a positive impact on a city's retail sector, given two reasons: car use plays a less important role for customers than shop owners think, and customers that walk, cycle, wheel or use public transport spend more overall as they visit local shops more frequently. [39] In Madrid, for instance, the city's former LEZ programme 'Madrid Central' was linked to an increase of 8.6% in retail sales in the city's central corridors. [40, 41] The evidence for the 'Good Move' traffic plan in Brussels, which complements the region's LEZ, comes to similar conclusions: An analysis of payments made with Belgian bank cards revealed that economic activity within the area of the traffic plan grew by nearly 10 per cent since the measures took effect in August 2022. [42] Studies from other cities confirm the potential positive impact of such policies on local businesses. [43-45]

LEZs have reduced nitrogen dioxide (NO_2) concentrations by around

20%

in a range of settings.

3. Are all low-emission zones the same?

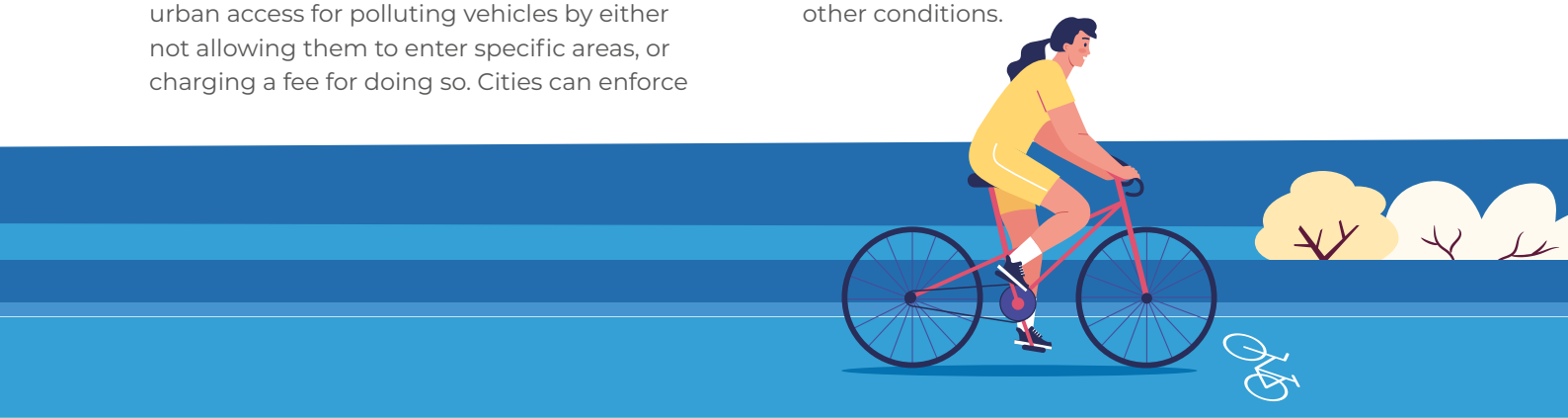
The general definition of LEZs refers to 'areas where the most polluting vehicles are regulated'. [2] However, these measures differ when it comes to variables such as: applicable emissions specifications, vehicle types that are allowed, exemptions, areas and timelines. For instance, the International Council on Clean Transportation (ICCT), classifies five categories of emission zones, from LEZ to ZEZ, depending on the type of vehicles allowed in the zone:

Classification of emission zones

Low-emission zone (LEZ)	Near-zero-emission zone for freight	Zero-emission zone for freight	Near-zero-emission zone	Zero-emission zone (ZEZ)
Certain vehicle types, such as diesel cars and vans, can be restricted. Access for vehicles is regulated based on emission standards.	BEV, FCEV and PHEV freight vehicles are allowed.	Only BEV and FCEV freight vehicles are allowed.	BEVs, FCEVs and PHEVs in general are allowed.	Only BEVs and FCEVs in general are allowed.

Note: BEV is a battery electric vehicle, FCEV is a fuel cell electric vehicle, and PHEV is a plug-in hybrid vehicle.
Source: Kok (2023), Planning and implementation of low- and zero-emission zones in cities [46]

Cities like Amsterdam are phasing their transition towards zero-emission urban transport following a path that is similar to the ICCT's classification. They have started to regulate the access of certain fossil-fuel vehicles through LEZs and are progressively moving to only allowing zero-emission vehicles in the city. [47] In general, emission zones regulate urban access for polluting vehicles by either not allowing them to enter specific areas, or charging a fee for doing so. Cities can enforce compliance using, for example, licence plate video recognition, manual enforcement options (e.g. via visual inspections), and, potentially, remote sensing technologies. [48] Table 3 illustrates the differences between the low-emission zones of Amsterdam, Brussels, London and Paris regarding area, vehicle restrictions and other conditions.



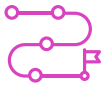
Examples of key characteristics of low-emission zones in selected European cities

City	LEZ area	Allowed vehicles	Enforcement type	Other conditions
 **Amsterdam, the Netherlands [47]**	Inner City (71 km² within the A10 ring, approx 400,000 inhabitants)	Currently, only the use of diesel vehicles is restricted. Diesel vans, buses and coaches must meet the Euro 6 norm. Diesel passenger cars and delivery vans must meet Euro 4 standards at least.	Automatic Number-Plate Recognition (ANPR)	Option to purchase daily passes for non-compliant delivery vehicles and trucks. Exemptions not only include certain vehicles used by authorities, but also people that are waiting for clean vehicles to be delivered.
 **Brussels, Belgium [49]**	Brussels Capital Region (161.4 km² and 1.2 million inhabitants)	Since 2023, for passenger cars: **Diesel:** Euro 5 or more recent **Petrol:** Euro 2 or more recent	Automatic Number-Plate Recognition (ANPR)	Option to purchase up to 24 day passes per year for non-compliant vehicles (ca. 35 EUR each). Exemptions apply, including: (people with disabilities, vintage cars, etc.).
 **London, United Kingdom [50]**	It was gradually expanded from 2019 until August 2023. The Ultra Low Emission Zone (ULEZ) covers the City of London and all London boroughs, 1,500 km², with 9 million inhabitants.	Since 2023: **Diesel:** Euro 6 or more recent **Petrol:** Euro 4 or more recent	Automatic Number-Plate Recognition (ANPR)	Operates 24 hours/7 days, except Christmas Day. Exemptions apply, including: people with disabilities, vintage cars, etc.
 **Paris, France [51]**	Grand Paris Metropolitan region: 79 municipalities with 5.61 million inhabitants, located mainly within the A86 motorway ring (use of motorway remains permitted)	Since 2021: **Diesel:** Euro 4 or more recent **Petrol:** Euro 2 or more recent	Automatic Number-Plate Recognition (ANPR)	Applies only from 08:00-20:00. Buses, heavy-duty vehicles: 7/7d, passenger cars, vans, powered two-wheelers: 5/7d Exemptions apply, including: ambulances, people with disabilities, police and government cars, etc.

4. What makes a good low-emission zone?

The wide variety of LEZs and their local contexts provide good opportunities to identify best practices. In 2022, Clean Cities identified the following seven steps [52] that cities should consider when designing and implementing a LEZ:

Seven steps to create effective low-emission zones

Step	Our recommendations	Guiding questions for policymakers
 **1. A clear definition of objectives, area, scope, and timeline**	▸ Have a clear and robust legal basis for establishing a LEZ ▸ Define clear objectives ▸ Define the area ▸ Define which vehicles are covered by the measure ▸ Define exemptions, if any ▸ Define the right, step by step timeline ▸ Rally allies and build support	▸ Is reducing air pollution the only aim of this measure? ▸ Is it going to be a large scheme? Does the city expect to expand the area gradually? ▸ Which vehicles are covered? Will there be any exemptions? Are those exemptions transparent, fair and limited? ▸ What's the city's vision towards zero-emission mobility? ▸ Who will implement the LEZ? What allies does the city have? How will action be coordinated? How can the city build support for the LEZ?
 **2. The right communication**	▸ Hold public consultations and make the information easily accessible through a dedicated platform ▸ Implement bespoke communication campaigns for specific groups, such as businesses and truck drivers ▸ Use as many communication channels as possible	▸ What is the public's opinion of LEZs? ▸ Has the city communicated the policy with different communities and interest groups? ▸ Has sufficient time been given from announcement till enforcement? Have stakeholders been given a long enough notice to be able to prepare for the changes? ▸ Is the city communicating the expected outcomes of the LEZ on air quality, public health and liveability?

3. The right enforcement	▸ Include a grace/trial period ▸ Use effective enforcement options (licence plate video recognition, remote sensing, manual enforcement) ▸ Use revenues from fines to fund public, shared, and active mobility	▸ Are drivers aware of the LEZ conditions? What time would be convenient for them to be fully informed? ▸ What enforcement option (licence plate video recognition, remote sensing, or manual enforcement) is preferred by the city? ▸ Is there a specific destination for revenues from fines?
4. The right complementary measures	▸ Set up complementary UVAR measures ▸ Ramp up alternatives to the private car	▸ What other measures should be considered in the city's mobility strategy? ▸ How does the LEZ complement investments in walking, cycling, micro-mobility and public transport?
5. The right targeted support	▸ Set up support schemes for vulnerable groups ▸ Plan for exemptions in specific cases ▸ Put in place support measures for financing the transition to cleaner cars	▸ What measures can the city implement to support the most vulnerable populations? ▸ What is the expected outcome of the exemptions program on the legitimacy and acceptance of the LEZ?
6. The right monitoring	▸ Ensure proper data collection ▸ Publish periodic evaluations and set up monitoring, evaluation and learning strategies	▸ Are the LEZ objectives being met? ▸ What's the LEZ's effect on air quality? ▸ Does the city have a specific platform to share the periodic results of the LEZ?
7. The right vision	▸ Foresee a pathway towards consolidating zero-emission zones	▸ Does the LEZ strategy anticipate different phases towards the consolidation of zero-emission cities?

What other measures should be considered in the city's mobility strategy?

5. Ensuring a fair and just transition

People in cities across Europe are currently facing multiple crises, including health impacts from illegal air pollution levels, the climate emergency and cost-of-living pressures. Each of these can disproportionately affect marginalised groups, i.e. low-income households, people living in poorly connected areas, racialised communities and people with disabilities. Evidence shows that these groups suffer most from the adverse health effects of polluting road transport, yet they often contribute the least to the problem. Therefore, urban transport policies should be designed in a way that pays special attention to the needs of these groups. This will help prevent them from being unfairly affected and secure strong public backing for political measures.

In a 2023 review, Clean Cities analysed best practices and highlighted five particularly effective ones, including scrappage schemes, reduced costs for bicycle purchases, reduced public transport fares, shared mobility hubs in poorly connected areas, and social leasing of electric vehicles. [53] The analysis showed that innovation appears when cities have a clear target for zero-emission urban transport and prioritise equity and justice in policymaking.

A win-win: five fast and fair solutions for cleaning urban transport

	MEASURE	Timeline	Equity			Cost-effectiveness
			Affordability	Connection	Accessibility	
	Scrappage schemes	Short term	⊕	⊕	⊕	○ neutral
	Reduced costs for bicycle purchase	Short term	⊕	⊕	?	⊕
	Public transport	Short term	⊕	⊕	?	⊕
	Shared mobility hubs	Medium term	⊕	⊕	⊕	?
	Social leasing of electric vehicles	Medium-long term	⊕	⊕	⊕	⊕

? = *depends on local infrastructure and affected vehicles*

A paper from the ICCT further analysed the measures that Brussels, London and Paris are taking to support the transition to zero-emission vehicles and alternative transport modes. [54] The study found that that in those cities, the financial aid provided for scrapping non-compliant vehicles, retrofitting vehicles with internal combustion engines to electric motors and for replacing polluting vehicles with cleaner alternatives helped those individuals and businesses that require support to transition. The study also found that authorities should target groups in most financial need and enhance the equitable outcomes of low- and zero-emission zones with the use of these supplementary measures.

6. The frontrunners

Clean Cities has analysed best practice examples from across Europe and considers the following cities as leading examples:

Frontrunner cities

CITY	BEST PRACTICE FEATURES
 Amsterdam	Since 2019, with the adoption of a 'Clean Air Plan' that was coordinated with the National Government, businesses and industries, this city has followed a gradual and detailed plan on how to transition from low-emission zones to zero-emission urban transport using an inclusive, well-communicated and forward-looking approach.
 Stockholm	The Swedish capital will introduce the country's first 'Environmental Zone 3' by 31 December 2024, a near-zero emission zone in the central business district. This milestone follows two previous low-emission zones in the city, and it is expected to be the first phase of the city's strategy towards a city-wide zero-emission zone by the 2030s.
 Brussels	The city has been tightening its LEZ over time, prompting significant shifts in overall mobility patterns. While there is room for increased promotion of zero-emission options, the Brussels LEZ represents an ambitious initiative that is meticulously monitored and complemented by financial support programmes and incentives to ensure fairness.
 Ghent	Although the Belgian city of Ghent is smaller, it is probably the most accomplished example of how to combine a LEZ with a general traffic plan that can reduce car use and ownership. The city has also successfully promoted active mobility.
 London	The world's largest LEZ has demonstrated its effectiveness in reducing emissions and traffic congestion. The city provides regular progress reports facilitated by enforcement technology, such as fixed and mobile cameras scanning vehicle licence plates. Additionally, the ULEZ incorporates a daily congestion charge, with exemptions for battery electric or hydrogen fuel cell vehicles until 2025.

Based on these **best practice examples** from all over Europe, a **well-designed LEZ should**:

- Be as **large, stringent**, and **well-enforced** as **London's** ULEZ
- Be as **inclusive, well-communicated** and **forward-looking** as **Amsterdam's** LEZ
- Provide at least as many **alternatives and support** measures as **Paris and Brussels**
- Combine it with a **general overhaul of traffic plans** like **Ghent**
- Still strike a flexible balance through capped daily passes like in **Brussels**

7. What's next for low-emission zones?

Zero-emission zones that are set to be introduced by the 2030s

Source: Clean Cities Campaign (2022), The development trends of low- and zero-emission zones in Europe. [3]

There are various approaches and speeds when it comes to the implementation of LEZs across Europe. It is expected that even more cities will adopt LEZs in the next few years, reaching a total number of more than 500 by 2025. [3] On the other hand, cities that already have LEZ schemes, like Amsterdam or Brussels, are moving towards setting up zero-emission zones by the 2030s, gradually expanding and/or tightening the existing emission zones. More than 30 European cities currently plan to introduce zero-emission zones by the 2030s. [3, 15, 35] Like low-emission zones, zero-emission zones are explicitly recognized as a primary clean air measure in the EU's new Ambient Air Quality Directive. The directive requires authorities to assess the impact of LEZs and ZEZs when air pollution exceeds legal limits and to justify any decision not to implement them.

Regarding the EU level, more effective and fair enforcement remains to be guaranteed. The EU should facilitate cross-border enforcement of low- and zero-emission zones to make sure that foreign drivers also comply with the policies. The recent reform of the Cross-Border Enforcement Directive failed to include this solution. [14]

Transitioning to zero-emission urban transport is not easy because it requires technological and behavioural change and adaptation involving many actors and authorities. If anything, the success of low-emission zones proves the power of cities in leading the way towards a sustainable, fair and fast transition.

8. Policy recommendations

Based on the research summarised above, Clean Cities recommends:

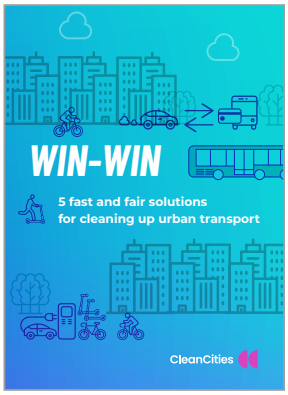
Cities: leadership, clarity and investments	▸ Introduce new or step up existing (ultra) low-emission zones to curb emissions and support modal shift, and announce a stepwise transition to zero-emission zones by the 2030s.
	▸ Review investment plans to prioritise the provision of reliable, affordable and climate-friendly alternatives to the use of cars, vans and trucks (e.g. walking and cycling infrastructure, public and shared transport, cargo bikes and logistics hubs).
National governments: the right regulatory framework	▸ Adopt a regulatory framework that sets stepwise, binding climate targets and enables cities to accelerate the transition to zero-emission transport, especially to allow local authorities to introduce low- and zero-emission zones.
	▸ Provide dedicated long-term funding for investments in clean urban transport solutions, including electric buses, shared mobility systems and infrastructure for walking and cycling.
European Union: Implement the Green Deal	▸ Continue to implement the EU Green Deal and, in particular, the 'Fit for 55' Package, which requires all new cars and vans to be zero-emission after 2035 and thereby also make a critical contribution to the cleaning up of urban transport.
	▸ Support the adoption of 'Sustainable Urban Mobility Plans' (SUMPs) that all urban nodes on the Trans-European Transport Networks (TEN-T) will have to adopt by 2027 as per a recent agreement reached by EU institutions.

Cities should introduce new or step up existing LEZs to curb emissions and support modal shift, and announce a stepwise transition to ZEZs by the 2030s'

9. Additional information

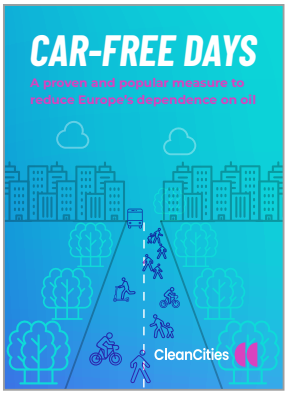
This factsheet provides a condensed overview of the knowledge base on low-emission zones, using both Clean Cities' own research as well as the state of scientific publications. Should you need more information on low-emission zones and our vision to clean up urban transport, please consult our reports:

When it comes to air pollution, how low can cities go?

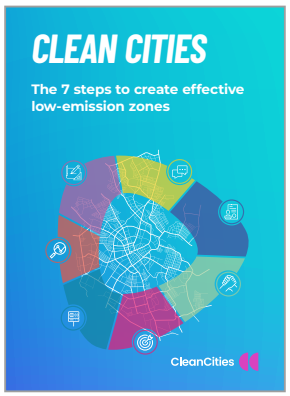


Five fast and fair solutions for cleaning up urban transport

Quantifying the impact of low- and zero-emission zones. An evidence review



Car-free days: A proven and popular measure to reduce oil demand



The 7 steps to create effective low-emission zones

The development trends of low- and zero-emission zones in Europe

Why fewer polluting cars in cities are good news for local shops

What European city-dwellers want from their mayors post-Covid

Low-emission Zones are a success – but they must move to zero-emission mobility

Blue Sky Recovery: How to keep lockdown low levels of air pollution in European Cities

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About the Clean Cities Campaign

Clean Cities is a European coalition of organisations hosted by Transport & Environment. We build public support for cities to shift from polluting cars to active, shared and electric mobility.

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