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Stakeholder dynamics in the implementation of Low Emission Zones

Abstract: Urban air pollution poses significant threats to public health, environmental sustainability, and economic stability, with vehicle emissions constituting the largest source of harmful contaminants in urban areas. Addressing these challenges and achieving climate neutrality requires a 90% reduction in transport-related emissions by 2050. As described in the article, Low Emission Zones (LEZs) and Zero Emission Zones (ZEZs) have emerged as key policy instruments aimed at restricting access for high-emission vehicles while promoting cleaner transport alternatives, including public transport, cycling, and walking. In the paper, LEZs are conceptualized as mechanisms designed to improve air quality, protect public health, advance climate objectives, and enhance social inclusion. The effective implementation of LEZs necessitates coordinated engagement among multiple stakeholders, including local authorities, motorists, businesses, environmental non-governmental organizations, public transport operators, residents, and vulnerable social groups. Case studies from London, Warsaw, and Cracow demonstrate diverse governance approaches and stakeholder dynamics, illustrating both the advantages and challenges associated with LEZ implementation. In the paper, the findings indicate that although LEZs contribute to measurable reductions in air pollutants, noise levels, and health risks, they also generate concerns related to equity, economic impacts, and public acceptance, thereby underscoring the need for transparent communication, phased implementation strategies, and targeted support measures to ensure long-term effectiveness and societal acceptance.

Keywords: stakeholder dynamics, Low Emission Zones, Zero Emission Zones, transport equity, social acceptance.

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1. INTRODUCTION

By guiding how urban spaces and amenities are developed, urban planning plays a key role in promoting or hindering the health and wellbeing of the people who live there [1]. While living in the densely populated cities, the people are exposed to more air pollution overall [2]. Bad air quality has caused millions of premature deaths and exacerbation of existing respiratory and cardiovascular diseases [3-5], and [6]. Urban air pollution refers to the accumulation of harmful contaminants-such as particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen oxides, sulphur dioxide, carbon monoxide, ozone, and volatile organic compounds - in the atmosphere of densely populated cities. Those pollutants originate mainly from vehicle emissions [7], industrial processes, energy production, construction activities, and waste burning, and are often intensified by urban design factors like limited green spaces and heat-trapping built environments. Increasing vehicle emissions are the single largest source of both nitrogen dioxide (NO_2) and particulate matter ($PM_{2.5}$) [8-9]. The impacts of urban air pollution are far-reaching. Human health is severely affected, with strong evidence linking exposure to respiratory diseases, cardiovascular problems, lung cancer, and increased mortality, particularly among vulnerable populations such as children and the elderly [10]. Environmentally, polluted air contributes to acid rain, vegetation damage, reduced visibility, and contamination of soil and water [11]. Economically, cities face higher healthcare costs, productivity losses, and damage to buildings and infrastructure. Additionally, certain pollutants-including black carbon and ozone-also act as climate forcers, exacerbating global warming and intensifying urban heat island effects [12]. Overall, urban air pollution [13] represents a significant threat to public health, environmental sustainability, and economic stability, necessitating coordinated policy and technological interventions [14-15].

To successfully achieve climate neutrality, the transport sector is mandated to deliver a substantial 90% reduction in emissions by 2050 [16]. Fundamentally, achieving sustainable mobility involves a user-first approach, focusing on providing people with more affordable, accessible, healthier, and cleaner alternatives to their established travel patterns, thereby facilitating a widespread shift in current mobility habits. Low Emission Zones (LEZs) are a practical solution to the problem of air pollution in urban

areas [17]. By restricting access for vehicles that produce high levels of emissions, LEZs help reduce the amount of harmful pollutants released into the air. This policy encourages the use of cleaner vehicles and promotes alternative modes of transport, such as public transit, cycling, and walking. As a result, LEZs contribute to better air quality, improved public health, and a more sustainable urban environment. In such context various stakeholders' engagement is essential while designing, implementing and sustaining LEZ.

Air quality standards at the European level are set by the Ambient Air Quality Directive [18]. Member states are required to meet those standards and limit pollutants like nitrogen dioxide, fine particles ($PM_{2.5}$), and particulate matter (PM_{10}).

In addition to improving air quality, Low Emission Zones (LEZs) and Zero Emission Zones (ZEEs) play a significant role in reducing urban noise pollution. Besides air pollution, urban environments are significantly affected by noise pollution, which is recognised as a major environmental and public health concern. Traffic and rail transport are primary sources of excessive urban noise, contributing to sleep disturbances, increased stress, and heightened risks of cardiovascular diseases. To mitigate these impacts, cities are increasingly adopting noise reduction measures alongside air quality initiatives. Notable examples include the installation of sound-absorbing porous concrete panels, such as those used on the Berlin S-Bahn, which have demonstrated effectiveness in reducing noise levels [19-20]. Additionally, rail dampers, devices designed to reduce vibrations and noise from railways, have been successfully implemented in various European cities [21-22]. Integrating such noise reduction [23] technologies into urban planning and transport policy is essential for creating healthier, more liveable cities and should be considered a key component of comprehensive environmental pollution control strategies.

Moreover, public transport plays a crucial role in shaping sustainable and liveable cities. Efficient tram, bus, and metro systems reduce dependence on private cars, lowering greenhouse gas emissions, traffic congestion, and noise pollution. When integrated with high-quality urban design, such as green tram corridors, safe pedestrian access, and cycling infrastructure, public transport becomes not only a mobility solution but also a tool for improving public health, social equity, and the overall

quality of urban life. Thus, ecological tram infrastructure, particularly green tracks with sedum or grass, transforms tram corridors into multifunctional urban spaces. Beyond reducing noise and improving air quality, these systems help mitigate urban heat, retain and filter stormwater, and create linear habitats that support urban biodiversity. Green tram tracks also enhance the visual quality of streets, increase public acceptance of tram projects, and contribute to climate-resilient transport networks by integrating mobility with nature-based solutions (NBS).

2. DEFINITION AND OBJECTIVES OF LOW EMISSION ZONES/ZERO EMISSIONS ZONES

A Low Emission Zone (LEZ) or Car-Free Zone, as defined by Institute of Transportation and Development Policy, is essentially a clearly bounded and continuous geographical area within a city where the use of the most polluting vehicles is actively restricted through either priced or non-priced strategies in order to significantly improve air quality and promote cleaner transportation. Priced LEZs function like a toll, charging drivers a fee—often a higher one for older, highly-polluting and a reduced fee for modern hybrid or electric vehicles—to gain entry. Conversely, non-priced LEZs operate by outright banning specific categories of high-emission vehicles, with enforcement relying on substantial fines for violators; this distinction means that isolated roads or corridors are excluded from this definition, as they can be easily circumvented, failing to spur the fundamental shift to cleaner vehicles that a full zone intends to achieve. Thus the LEZ is a flexible, multi-faceted policy tool - varying widely in size, fee structure, and specific terminology across different cities - designed to strategically cordon off an area to push polluting vehicles out and encourage sustainable mobility choices [24]. According to the City of Warsaw the LEZ is a designated area where only vehicles meeting the relevant emission standards (the so-called Euro standards, which are linked to the vehicle's manufacture date) may be driven.

All vehicles may enter the zone, regardless of the type of drive, including petrol, diesel, hybrids or those with LPG installations, provided that they meet a specific engine emission standard. However, there are exceptions to the requirements [25]. There are found a variety of LEZ (Table 1). Among them are Zero Emission Zones (ZEV), which are designated areas where, over time, only zero-emission

vehicles (ZEV) – alongside walking and cycling – are allowed. ZEVs are a key policy towards creating “Living Districts” – people-first urban areas that bring together [26].

A policy tool used by cities to reduce traffic volume, ease roadway congestion, and improve overall mobility by regulating or charging vehicles that enter a designated area are also congestion zones. They typically relies on pricing mechanisms such as daily entry fees, distance-based charges, or time-varying tariffs that increase during peak hours. They may also incorporate access restrictions, prioritising buses, cyclists, and emergency vehicles while limiting entry for certain vehicle types. Congestion zones and Low or Zero Emission Zones (LEZs/ZEVs) can sometimes appear similar depending on their design, but they differ in core purpose and regulatory approach. Congestion zones primarily aim to reduce traffic volume and improve mobility, often by restricting vehicle entry based on time of day or vehicle type and by charging a fee that encourages drivers to choose alternative routes or modes of transport. In contrast, LEZs and ZEVs focus on improving air quality and reducing emissions by requiring vehicles to meet specific pollution standards, though they can also be tailored to particular categories such as heavy-duty trucks. The Table 2 summarizes the differences between the various zones. Despite these differences, both types of zones must be carefully crafted with input from local stakeholders and aligned with the operational, social, and economic realities of the area to ensure their effectiveness and public acceptance.

The main objective of the Low Emission Zones and Zero Emission Zones are:

- **Improve Air Quality:** by reducing vehicle emissions, LEZs help lower concentrations of pollutants like nitrogen oxides and particulate matter, leading to cleaner air.
- **Protect Public Health:** better air quality reduces health risks, such as respiratory and cardiovascular diseases, especially among vulnerable groups.
- **Promote Sustainable Mobility:** LEZs encourage the use of public transport, cycling, walking, and other low-carbon mobility options.
- **Support Climate Goals:** these zones contribute to broader climate objectives, such as the European Green Deal, by helping cities move toward climate neutrality.
- **Foster Social Inclusion:** by improving access to clean and affordable transport, LEZs support equitable mobility for all residents.

Table 1. Classification of emission zones [27]

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: <i>Kok I.</i> , Planning and implementation of low- and zero-emission zones in cities. International council on clean transportation, 2023				

Table 2. Summary of congestion and emission zones [28]

Category	Zero-Emission Zone	Low-Emission Zone	Congestion Zone
Primary Benefits	Reduces global warming emissions Improves air quality	Reduces global warming emissions Improves air quality	Reduces traffic Raises revenue
Other Potential Benefits	Encourages zero-emissions vehicle (ZEV) infrastructure and adoption Raises revenue Reduces traffic Reduces noise Contributes to bike/pedestrian safety	Encourages ZEV infrastructure and adoption Raises revenue Reduces traffic Reduces noise Contributes to bike/pedestrian safety Emissions target can be lowered over time	Contributes to bike/pedestrian safety Reduces noise Improves air quality Reduces global warming emissions Can facilitate future land-use changes
Examples of Parameters	Only ZEVs can enter the zone	Can apply only to certain types of vehicles (for example, light-, medium-, heavy-duty) Can apply only during certain times Can require that vehicles meet certain pollution standards to enter	All vehicles may be subject to fee, permit, or fine to enter the zone Can be tailored to certain classes or types of vehicles
Enforcement Mechanism Options	Checkpoints and tolls Cameras, registrations, and ticketing Visual inspection and ticketing	Checkpoints and tolls Cameras, registrations, and ticketing Visual inspection and ticketing	Checkpoints and tolls Cameras, registrations, and ticketing Visual inspection and ticketing
Common Exceptions	Low-income drivers Those who live within the zone Public transit Vehicles for disabled persons Emergency vehicles	Nonregulated types of vehicles (for example, light-duty vehicles in a medium- or heavy-duty zone) Low-income drivers Those who live within the zone Public transit Vehicles for disabled persons Emergency vehicles	Low-income drivers People who live inside the zone People who pay for a permit to operate inside the zone Public transit Other shared mobility modes ZEVs for dual-purpose zone Vehicles for disabled persons Emergency vehicles
Source: Low- and Zero-Emissions Zones. Opportunities and Challenges in Designing Equitable Transportation Policies. 2021 (available: 21.11.2025)			

Cities can enforce compliance with emission-related regulations through a range of tools, including automated number plate recognition systems that track vehicle entry, manual enforcement such as on-street visual inspections by officials, and emerging remote-sensing technologies capable of detecting real-time emission levels from passing vehicles. Those mechanisms help ensure that only vehicles meeting the required standards enter the regulated zones and that violations can be accurately identified and penalised. Table 3 compares the low-emission

zones implemented in Amsterdam, Brussels, London, Paris, Warsaw and London highlighting key differences in aspects such as the geographic extent of the zone, the types of vehicles restricted, emissions standards applied, and additional conditions like grace periods, exemptions or financial support measures. Together, those variations demonstrate how each city adapts its LEZ to its specific mobility patterns, air quality challenges, and policy priorities, resulting in diverse approaches within a broadly similar regulatory framework.

Table. 3 Comparison of low emission zones in European countries

City	LEZ area	Allowed Vehicles	Enforcement type	Other conditions
Amsterdam, the Netherlands [29]	Within A10 and S100 ring roads	– Diesel passenger cars/vans: Euro 5 or higher – Diesel lorries: Euro 6 or higher – Fossil fuel vans/lorries registered after Jan 2025: zero-emission only – Petrol: no restrictions, except new zero-emission zones for taxis by 2025	Automatic Number Plate Recognition (ANPR)	Transitional period for older vehicles until 2030, exemptions for residents/entrepreneurs, incentive programs
Brussels, Belgium [30]	161.4 km ² , 1.2 million inhabitants (all 19 municipalities, Ring R0 excluded)	– Diesel: Euro 6 or newer (since Jan 2025, all Euro 5 and older banned) – Petrol/LPG/CNG: Euro 3 or newer – Heavy vehicles: Euro 6	Automatic NumberPlate Recognition (ANPR), police patrols	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 [31]	Greater London (covers all boroughs), ~9 million inhabitants	– Diesel: Euro 6 or newer – Petrol: Euro 4 or newer – Non-compliant: £12.50 daily charge – Lorries/HGVs: higher charges (£100/day)	Automatic Number Plate Recognition (ANPR), cameras (24/7, every day except Christmas)	Exemptions for disabled drivers, historic vehicles, emergency services, vintage cars. Fines for non-payment
Paris, France [32]	Grand Paris Metropolitan region, 79 municipalities (~5.61 million inhabitants inside A86 ring)	– Passenger cars/vans: Crit’Air emissions sticker required (effectively Euro 4 diesel and Euro 2 petrol or better) – Progressive bans for non-compliant vehicles	Automatic Number Plate Recognition (ANPR), police controls (8:00-20:00)	Exemptions for emergency vehicles, disabled drivers, government, vintage cars, specific time windows for operation
Warsaw, Poland [25]	Approx. 7% of the city area (city centre + central districts)	– Diesel: vehicles no older than 18 years (Euro 4 or newer); – Petrol/LPG: vehicles no older than 27 years (Euro 2 or newer)	ANPR might be used by the City Guard only as supporting tool (ANPR result must be always confirmed by the City Guard in the spot. Police is practically not involved in enforcement activities in the LEZ	Exemptions for: emergency vehicles, disabled drivers, classic/historic cars, school buses, transitional exemption for residents. Applications for waivers by criteria. Progressive tightening of restrictions until 2032.

Source: own elaboration based on the information provided in the references in the table

According to Transport & Environment, there are about 325 Low Emission Zones currently in place across the Europe and 35 Zero Emission Zones are expected to be introduced by 2030 [33]. Nevertheless, a wider lens is needed, since policies that limit driving bring more than just potential health gains [34]. They also carry trade-offs – curbing personal mobility, prompting shifts to other forms of transport, or requiring expensive upgrades or replacements of older vehicles.

3. LOW EMISSION ZONES – LONDON, WARSAW, CRACOW

3.1. LONDON

3.1.1. Air quality improvement – the case of ULEZ

Urban air pollution remains a critical public health and environmental challenge for many major cities. London, which has historically experienced elevated concentrations

of nitrogen dioxide (NO₂) and particulate matter (PM_{2.5}), has implemented a range of transport-related policies to address harmful emissions. Among those, the Ultra Low Emission Zone (ULEZ) represents one of the most ambitious large-scale emissions-control initiatives in Europe. The ULEZ aims to accelerate fleet modernization, reduce vehicular emissions, and improve air quality for London's residents [35]. The ULEZ was intended to supplement the Low Emission Zone which was introduced in London in February 2008 to charge heavy diesel vehicles that did not meet minimum standards for emissions of particulate matter.

The ULEZ builds upon previous transport-pricing measures such as the London Congestion Charge (introduced in 2003) and the Low Emission Zone (2008). Conceived as part of the Mayor of London's long-term air quality strategy, the ULEZ was formally launched in April 2019 within Central London, replacing the earlier T-Charge (Toxity Charge) [36]. Vehicles that fail to meet Euro 4 (petrol) or Euro 6 (diesel) standards are required to pay a daily fee of £12.50 to enter the zone.

The scheme expanded significantly in October 2021 to encompass the area bounded by the North and South Circular roads. In August 2023, ULEZ was extended further to cover all London boroughs (Fig. 1), making it the world's largest clean-air charging zone [37]. This expansion aligns with the city's broader climate-mitigation objectives and efforts to comply with national and EU air quality directives [38].

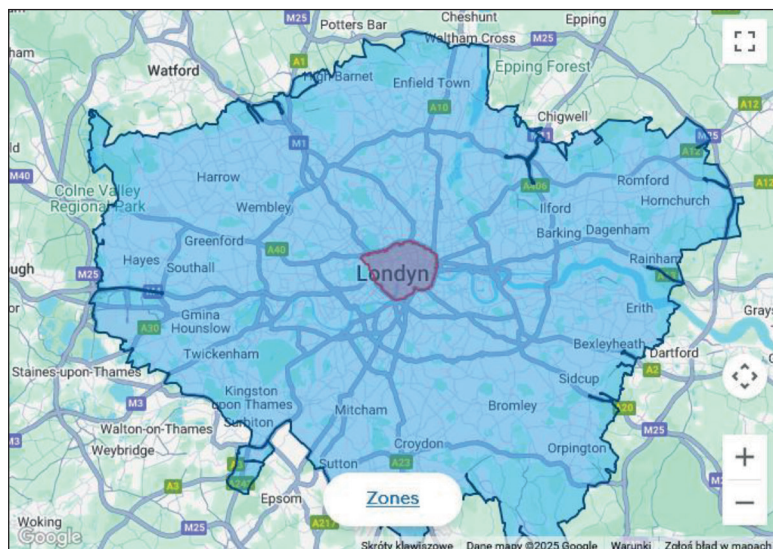


Fig. 1. The extend of the London's ULEZ; source: <https://tfl.gov.uk/modes/driving/ultra-low-emission-zone> (available: 10.12.2025)

Air pollution is unevenly distributed across London, with deprived communities often exposed to the worst air quality. Early evidence suggests that ULEZ has contributed to a notable reduction in exposure disparities, with some of the most deprived neighbourhoods experiencing up to 80% reductions in exposure to illegal pollution levels [35]. Given that air pollution is linked to approximately 4,000 premature deaths annually in London, the public health benefits are projected to be substantial [37].

Despite measurable environmental gains, the ULEZ has faced political and social resistance. Many politicians and media commentators were engaged in a propaganda campaign against air pollution policies, particularly the Ultra Low Emission Zone (ULEZ) in London [39]. Critics argue that the policy disproportionately impacts low-income drivers who cannot easily replace older vehicles, even with scrappage support. Concerns have also been raised about the economic effects on small businesses reliant on vehicle fleets [40]. Furthermore, public opposition intensified during the 2023 expansion into outer London, where public transport coverage is more limited.

Below are described the main stakeholder groups and the nature of opposition.

3.1.2. Local authorities

Outer London boroughs-including Bexley, Bromley, Harrow, and Hillingdon-expressed strong objections to the ULEZ expansion on the grounds that their residents experience higher car dependency and weaker public trans-

port connectivity compared with inner boroughs [41]. Councils argued that a uniform regulatory boundary does not sufficiently account for geographical differences in mobility patterns or socioeconomic vulnerability.

3.1.3. Motorists and advocacy organisations

Motorist groups, such as the Alliance of British Drivers, criticised the scheme for disproportionately affecting lower-income households who are less likely to own ULEZ-compliant vehicles [42]. Individuals dependent on older vehicles for daily mobility – particularly in outer London - identified the charge as regressive and insufficiently mitigated by scrappage schemes.

3.1.4. Small businesses, tradespeople, and charities

Small enterprises relying on vans or specialist vehicles reported substantial financial burdens relating to vehicle replacement or payment of the daily charge. Similar concerns emerged from charities using volunteer drivers or donated vehicles, many of which fall outside ULEZ compliance standards [43]. Stakeholders emphasised that limited capital and tight operating margins reduced their ability to adapt.

3.1.5. Political stakeholders

The ULEZ expansion has been politically contentious. Conservative London Assembly Members and several Members of Parliament framed the expansion as poorly timed during the cost-of-living crisis and inadequately supported by consultation [44]. Political narratives questioning the legitimacy of the consultation process amplified public scepticism.

3.1.6. Public and community groups

Public opposition reflects concerns over cost, fairness, and perceived government overreach. Increased media attention on enforcement-camera vandalism (e.g. “Blade Runners”) highlights a more radical segment of opposition, although such acts represent a minority of public sentiment [45].

3.2. WARSAW

Warsaw implemented its first Low Emission Zone (LEZ), the Clean Transport Zone (pol. Strefa Czystego Transportu, SCT) in 2024. The extend of the LEZ shows the Fig. 2. Warsaw’s LEZ aims to reduce emissions by restricting access for older, higher-polluting vehicles in central districts, representing a pioneering step in Eastern European cities [46-47]. While modelling predicts meaningful reductions in NO_x and health benefits, policy success depends on stakeholder acceptance, equity considerations, and effective enforcement. Modelling predicts reductions in NO_x emissions of up to 30-35% in hotspots, PM reductions of up to 57% from traffic sources, and potential avoidance of ~945 premature deaths annually due to air quality improvements [48-52]. The Table 4. shows the identified stakeholder groups and opposition or support for the LEZ in Warsaw.

The introduction of SCT has not been without criticism. For many Poles, especially those with lower incomes, the new regulations mean that they will have to replace older vehicles with newer ones that meet the standards. This is particularly problematic for people who cannot afford to buy more expensive cars. Critics point out that although the zone is promoted as pro-health, in practice it may burden the poorest, who often drive older, more polluting cars. The lack of financial support for vehicle replacement or insufficient development of alternative means of transport, such as public transport, raises additional concerns. The city is trying to respond to these allegations by offering exemptions from the entry ban for Warsaw residents. However, from 2028, new, more stringent rules will also apply to them, which may exacerbate discontent.

Moreover, the New Community Foundation decided to find out what Warsaw residents really think about the clean transport zone and how much they know about it, not through another opinion poll, but through its own (and independent of the city) social dialogues. Eight meetings were held at the turn of 2024 and 2025 on the subject of the LEZ in Warsaw. The participants were not experts in the field of transport and urban planning or urban activists, but “ordinary” people who travel the streets of Warsaw on a daily basis. The group discussions were facilitated by experienced facilitators, and their aim was not to

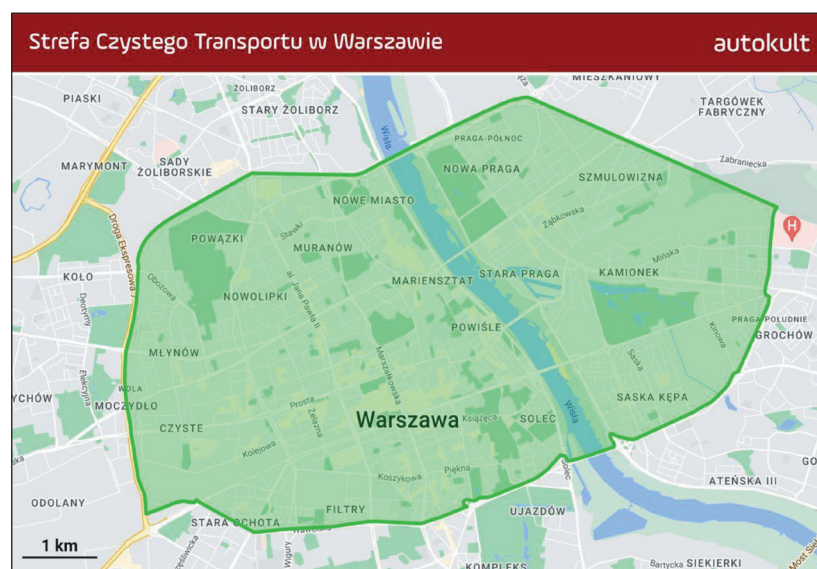


Fig. 2. The extend of the Warsaw’s LEZ; source: <https://autokult.pl/od-1-lipca-obowiazuje-w-warszawie-strefa-czystego-transportu-sprawdz-czy-mozesz-wjechac-i-na-jakich-zasadach,7044355349916480a> (available: 10.12.2025)

educate the participants, but to listen to them. The participants in the dialogues acknowledged that they lacked information about the clean transport zone – they rated their knowledge at an average of 5.4 on a 10-point scale (after the meetings, it rose to 7.2). The dialogues presented

a rather critical assessment of all entities responsible for SCT communication. The zone was perceived as an imposed solution rather than a jointly developed one, which weakened residents’ identification with its goals and drew attention to its negative effects [53].

Table 4. Stakeholder Groups and Nature of Opposition / Support

Stakeholder Group	Position	Nature of Opposition / Concerns	Notes / Mitigating Factors
City of Warsaw authorities	Supportive	n/a	Main driver of LEZ implementation; phased standards and exemptions for residents and seniors help manage equity concerns.
Masovian voivodeship (regional government)	Supportive	n/a	LEZ aligns with Air Protection Program; administrative cooperation supports enforcement.
Motorists / Private vehicle owners	Mixed; some opposition	Daily fees for non-compliant vehicles; cost burden for low-income drivers; limited availability of compliant vehicles in early phase	Exemptions for residents and seniors; sticker system; gradual tightening gives time to adapt.
Small businesses / / SMEs (delivery, logistics, tradespeople)	Opposed / / concerned	Financial strain from replacing non-compliant vehicles; operational disruption	Some support through exemptions for commercial vehicles in early phase; potential scrappage or incentive schemes.
Environmental NGOs / / Civil society (e.g. Clean Air Fund)	Supportive	n/a	Advocate for stricter enforcement and full compliance; focus on air quality and public health benefits.
Public transport operators	Supportive	Concern about congestion in some areas if motorists reroute	LEZ may increase use of public transport, potentially increasing revenue or ridership.
Residents in LEZ areas	Mixed	Financial burden on households with older cars; perception of inequity for residents near but outside the LEZ	Exemptions for residents paying local taxes; staged implementation reduces immediate impact.
Seniors / / Culnerable groups	Neutral / minimal opposition	Cost of compliance if exemptions not properly communicated	Explicit exemptions for those aged 70+ help mitigate concerns.
Media / / Political actors	Mixed	Opposition often framed around economic fairness, administrative complexity, or political gain	Public debates shape perception; media may amplify concerns of small businesses or motorists.
Commercial fleets / / Service vehicles	Some opposition	Cost and operational impacts if fleets are older	Gradual tightening and potential subsidies can reduce opposition; special-purpose vehicle exemptions.
n/a – not applicable; source: own elaboration			

3.3. CRACOW

In January 2024, the Provincial Administrative Court issued a ruling in case III SA/Kr 484/23, annulling the City Council’s original resolution establishing Cracow’s Low Emission Zone [54]. The judgment, formally announced on 12 January 2024, cited substantive legal deficiencies in the resolution, particularly regarding the clarity of the zone boundaries and the organisation of traffic within the LEZ. The court emphasised that drivers should be able to determine precisely from the resolution where the zone

begins and ends and how it will be marked and enforced. While the judgment did not reject the LEZ policy itself, it identified flaws that made the original resolution legally invalid.

The ruling also introduced uncertainty in the LEZ implementation timeline. Because the judgment annulled the resolution, Kraków could not proceed under the existing legal framework. In response, the city announced that a new resolution would be drafted to address the court’s objections [55]. Meanwhile, the judgment is not yet final,

as appeals have been filed with the Supreme Administrative Court further delaying the process and creating legal uncertainty.

The annulment also has social and political implications. Public communication suggests that delays may affect planning, enforcement, and information campaigns related to LEZ. Media reports highlight that some citizens are concerned about the potential financial burden of adapting to LEZ requirements, particularly if they need to replace or retrofit older vehicles [56-57] (WSA decision on Kraków Low Emission Zone – “We cannot afford it”). Administratively, the city must invest additional resources to draft a legally sound resolution that satisfies both the court’s requirements and practical enforceability. The extend of the LEZ shows the Fig. 3.

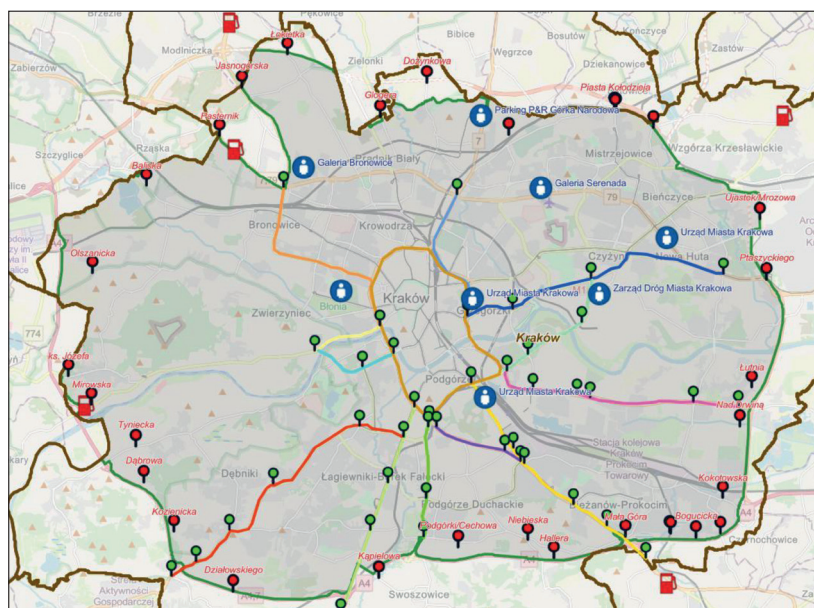


Fig. 3. The extend of the Cracow's LEZ; source: <https://krknews.pl/znamy-lokalizacje-kamer-strefy-czystego-transportu/>

To address these issues, in June 2024, Kraków's City Council adopted a modified resolution with an amended start date for SCT requirements set for 1 July 2025. This amendment is intended to correct the deficiencies highlighted by the WSA, including clearer demarcation of the LEZ and more precise traffic regulations. Despite these adjustments, the court's initial ruling demonstrates the complexity of implementing a low emission zone in an urban context, highlighting the need for precise legal drafting, effective administrative planning, and careful public communication to ensure both compliance and legitimacy.

Research suggests inadequate trust in the policy process. An analysis of Kraków's transport policy found ongoing public dissatisfaction despite consultations and infrastructure improvements, including SCT. In Kozicz's survey [58], Repository of Jagiellonian University (RUJ), respondents noted weak transport infrastructure (e.g., limited public transport alternatives), and highlighted a perceived lack of meaningful participation in decision-making. Some citizen voices (e.g., on social media) also criticise the consultation design and the perceived top-down nature of the policy.

Implementation of Cracow's SCT has been slowed by an intersection of legal challenges, administrative and technical readiness gaps, political contestation, and equity concerns. Although municipal authorities have maintained a planned start date (1 January 2026) and are advancing preparatory work, resolving outstanding court cases, completing digital enforcement systems, and securing public legitimacy remain essential to avoid further delays and to ensure the zone achieves its air-quality and public-health objectives.

4. STAKEHOLDERS DYNAMIC

The implementation of Low Emission Zones (LEZs) involves complex stakeholder dynamics shaped by differing interests, levels of influence, and perceptions of fairness. Local governments lead the process, aiming to improve air quality and meet climate targets, but they must coordinate across agencies and manage political risk. Businesses-especially logistics firms, small retailers, and taxi operators-often express concern about the financial burden of upgrading vehicles or changing operations, making them influential negotiators who can push for exemptions or delayed timelines. Residents and commuters form a diverse group whose support is crucial; while many value the health benefits and quieter streets, others may worry about increased travel costs or unequal impacts on low-income drivers. Environmental and health advocacy groups provide expert evidence and public pressure to maintain the integrity of LEZ standards, often counterbalancing industry lobbying. Public transport providers and technology companies also shape outcomes by offering alternatives and enabling enforcement mechanisms. Conflicts typically arise around cost distribution, equity concerns, and

potential economic disruptions, while cooperation emerges through transparent communication, inclusive consultation, phased implementation, and support schemes such as grants or scrappage programmes. Overall, stakeholder dynamics determine not only whether an LEZ is introduced but also its design, public acceptance, and long-term effectiveness.

In London, the Ultra Low Emission Zone (ULEZ) is managed by the Greater London Authority (GLA) and Transport for London (TfL). These institutions are responsible for policy design, enforcement, and stakeholder consultation. Residents, particularly those in inner and outer boroughs, are directly affected by vehicle restrictions and fees. While many support ULEZ for its public health benefits, low-income households reliant on older vehicles have voiced concerns regarding equity and affordability. Business stakeholders, including delivery companies and taxi drivers, negotiate the balance between compliance costs and operational continuity. Environmental and health advocacy groups, such as “Mums for Lungs”, play an active role in shaping policy discourse, emphasising the benefits of cleaner air. Finally, technology providers and mobility services contribute to the adoption of low-emission vehicles. The interaction among these stakeholders reflects a careful balancing act between environmental objectives, social equity, and economic impact, facilitated by extensive consultation processes and phased implementation strategies. The London experience demonstrates that clear governance structures, institutional capacity, and inclusive stakeholder engagement are key to achieving high compliance and legitimacy.

In Warsaw, the proposed Clean Transport Zone (CTZ) similarly involves multiple stakeholders. Municipal authorities design phased regulations, projected from 2024 to 2032, aiming to reduce emissions while mitigating social and economic costs. Residents’ responses vary with socio-demographics, with car owners expressing concerns about compliance costs, and public transport users generally supporting the scheme. Businesses and fleet operators are attentive to regulatory burdens, while environmental and public health groups advocate for stricter standards. Policy modelling supports the environmental rationale, but the translation of technical projections into socially acceptable policy requires negotiation with stakeholders. Phased implementation serves as a tool to balance

ambition with public acceptance, while equity mechanisms, such as exemptions and gradual tightening, aim to address potential social disparities.

In Cracow, the LEZ illustrates pronounced stakeholder tensions. Municipal authorities, led by the City Council and Public Transport Authority, have faced legal challenges, including the 2024 the Provincial Administrative Court Cracow ruling (III SA/Kr 484/23), which annulled the original SCT resolution due to unclear zone boundaries and traffic regulations. Residents are both beneficiaries and subjects of the regulation, with many expressing concern about the financial burden of retrofitting or replacing vehicles. Businesses, particularly those relying on older fleets, have raised objections regarding operational costs and potential economic losses. Civil society groups and environmental NGOs advocate for ambitious emission reductions, while surrounding municipalities have criticised the scheme as unfair for non-resident commuters. Consultation processes, conducted through surveys, workshops, and online platforms, have influenced amendments to the SCT, including phased application and exemptions for local residents. These dynamics highlight the need for careful legal drafting, institutional coordination, and transparent communication to maintain policy legitimacy.

Across the three cities, several common themes emerge. Equity versus environmental goals remains a central tension, with low-income or vehicle-dependent populations at risk of disproportionate impact. Public participation is critical for legitimacy, although consultation mechanisms and their perceived effectiveness vary. Phased implementation is commonly used to balance ambition with stakeholder adaptation, and businesses often exert significant influence over policy design. Access to funding and institutional capacity facilitates compliance and strengthens legitimacy, while advocacy groups provide moral and technical justification for stricter standards.

Stakeholder dynamics in LEZs demonstrate that achieving environmental objectives requires not only technical and legal design but also careful management of social, economic, and political interactions. The experiences of London, Warsaw, and Kraków underscore the importance of inclusive consultation, flexible implementation, and targeted support mechanisms to ensure that low emission zones are both effective and socially acceptable.

5. CONCLUSIONS

The implementation of Low Emission Zones (LEZs) in major European cities such as London, Warsaw, and Cracow demonstrates that achieving environmental objectives requires not only robust technical and legal frameworks but also careful management of social, economic, and political interactions. Key conclusions include:

1. **Stakeholder Engagement is Critical:** successful LEZs depend on coordinated involvement from local authorities, businesses, residents, advocacy groups, and public transport operators. Inclusive consultation and transparent communication help build legitimacy and public acceptance.
2. **Equity and Social Acceptance:** equity concerns – especially for low-income and vehicle-dependent populations – must be addressed through phased implementation, exemptions, and support schemes. Public participation and targeted support mechanisms are essential to ensure that LEZs do not disproportionately burden vulnerable groups.
3. **Phased Implementation and Flexibility:** gradual tightening of standards and staged rollouts allow stakeholders time to adapt, balancing environmental ambition with social and economic realities.

4. **Legal and Administrative Precision:** clear legal drafting, effective administrative planning, and precise enforcement mechanisms are necessary to avoid delays and ensure compliance, as illustrated by the challenges faced in Cracow.
5. **Public Trust and Legitimacy:** building trust through meaningful participation and responsive policy design is vital. Media and political actors play a significant role in shaping public perception and acceptance.
6. **Balancing Environmental and Economic Goals:** LEZs must reconcile the need for cleaner air and climate action with economic impacts on businesses and individuals. Support schemes, such as grants or scrappage programs, can help mitigate negative effects.
7. **Overall,** the experiences of London, Warsaw, and Cracow highlight that LEZs are most effective and sustainable when they are designed with flexibility, inclusivity, and a strong focus on equity and stakeholder dynamics.

By restricting access for high-emission and typically noisier vehicles, and encouraging the adoption of quieter alternatives such as electric vehicles, public transport, cycling, and walking, LEZs help create a calmer and healthier urban soundscape. The integration of noise reduction objectives into LEZ policy design further enhances social acceptance and supports the creation of more liveable urban environments.

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Dynamika interesariuszy we wdrażaniu Stref Czystego Transportu

Streszczenie: Zanieczyszczenie powietrza w miastach stanowi poważne zagrożenie dla zdrowia publicznego, zrównoważonego rozwoju środowiska i stabilności gospodarczej, a emisje z pojazdów są największym źródłem szkodliwych zanieczyszczeń na obszarach miejskich. Aby sprostać tym wyzwaniom i osiągnąć neutralność klimatyczną, konieczne jest ograniczenie emisji związanych z transportem o 90% do 2050 r. Opisane w pracy strefy niskiej emisji (LEZ) i strefy zerowej emisji (ZEZ) stały się kluczowymi instrumentami polityki mającymi na celu ograniczenie dostępu pojazdów o wysokiej emisji, przy jednoczesnym promowaniu czystszych alternatyw transportowych, w tym transportu publicznego, jazdy na rowerze i chodzenia pieszo. W artykule strefy LEZ są traktowane jako mechanizmy mające na celu poprawę jakości powietrza, ochronę zdrowia publicznego, realizację celów klimatycznych i zwiększenie integracji społecznej. Skuteczne wdrożenie LEZ wymaga skoordynowanego zaangażowania wielu zainteresowanych stron, w tym władz lokalnych, kierowców, przedsiębiorstw, pozarządowych organizacji ekologicznych, operatorów transportu publicznego, mieszkańców i wrażliwych grup społecznych. Studia przypadków z Londynu, Warszawy i Krakowa pokazują różnorodne podejścia do zarządzania i dynamikę relacji między zainteresowanymi stronami, ilustrując zarówno zalety, jak i wyzwania związane z wdrażaniem stref LEZ. Wyniki badań zawarte w artykule wskazują, że chociaż strefy LEZ przyczyniają się do wymiernego zmniejszenia poziomu zanieczyszczenia powietrza, hałasu i zagrożeń dla zdrowia budzą one również obawy związane z równością, skutkami gospodarczymi i akceptacją społeczną, co podkreśla potrzebę przejrzystej komunikacji, stopniowego wdrażania strategii i ukierunkowanych środków wsparcia w celu zapewnienia długoterminowej skuteczności i akceptacji społecznej.

Słowa kluczowe: dynamika interesariuszy, Strefy Czystego Transportu, transportowa sprawiedliwość, akceptacja społeczna, Strefy Zerowej Emisji.