UITP ADVANCING PUBLIC TRANSPORT

KNOWLEDGE BRIEF

LOW EMISSION ZONES - KEY TAKEAWAYS FROM THE EARLY ADAPTORS

FEBRUARY | 2024

INTRODUCTION

Deteriorating air quality poses a health hazard to the contemporary world. According to World Health Organization (WHO) 2019 report, 99% of the world's population live in areas where the air quality does not meet the levels recommended by WHO Air Quality Guidelines[1] (eg, annual $PM_{2.5}$- 5 microgram/m^3, PM_{10}–15 microgram/m^3, NO_2-10 microgram/m^3). Worldwide, air pollution cuts life expectancy by 1.8 years for an average person and causes nearly 8.8 million early deaths annually, with low- and middle-income countries paying the highest cost due to increased concentrations of $PM_{2.5}$, primarily generated by vehicular traffic[i].

Globally, road transport is responsible for about 27% of urban air pollution[ii] resulting in detrimental impact on public health. To promote greener mobility and tackle vehicular pollution, the Global Roadmap of Action towards Sustainable Mobility (GRA) produced by the Sustainable Mobility for All (SuM4AIITM) initiative[2] focusses on several measures. These include shifting more people to public transport, promoting walking, and cycling, reducing tail pipe emissions by requiring efficient filter systems and transitioning to electric vehicles, improving the management of on-road polluting vehicles, improving traffic flow through improved traffic engineering and street design, and introduction of Low Emission Zones (LEZ).

UITP's Better Urban Mobility Playbook[iii] also focuses on achieving sustainable mobility through three pillars – developing cities around public transport, optimise road and street management and adopting an innovative efficient public transport system. The playbook suggests introducing LEZ as one of the solutions to tackle the problems of congestion and improving air quality in cities.

The LEZ is defined as a designated area where an entity operating and managing the transport network "seeks to restrict or deter access by specific categories of high-polluting vehicles into the area to improve the air quality within the geographic area"[iv]. These highly regulated zones are supported by strong policies and robust data management, not only facilitating the improvement of air quality within the implementation area but also in its wider surrounding region. The concept promotes the usage of cleaner modes of mobility and public transportation.

To achieve carbon neutrality by 2070, India has undertaken taken several initiatives including shifting towards electric vehicles, especially in the public transport sector, through schemes such as Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) I and II, National Electric Bus Program (NEBP) and, the recently launched PM-eBus Sewa Scheme. Recognising the significance of LEZ concept to tackle the detrimental impact of vehicular pollution and its simultaneous role in combatting climate change, can be considered another step forward in achieving the objective of carbon neutrality.

Thus, UITP India is working on a project of two-year duration '**Enabling mechanisms for development of Low Emission Zones in India**'. This knowledge brief, a compilation of six international case cities, helps in understanding the concept of LEZ implementation in these Cities and their

[1] https://www.who.int/news-room/feature-stories/detail/what-are-the-who-air-quality-guidelines

[2] https://thedocs.worldbank.org/en/doc/350451571411004650-0090022019/original/GlobalRoadmapofActionTowardSustainableMobility.pdf

reasons for success that could be replicated in the Indian Context, as the first step towards the study. Initially, a list of 25 cities across the Globe was selected based on parameters such as area, types of interventions, and policy framework (Figure 1). From the list of 25 cities, focus was

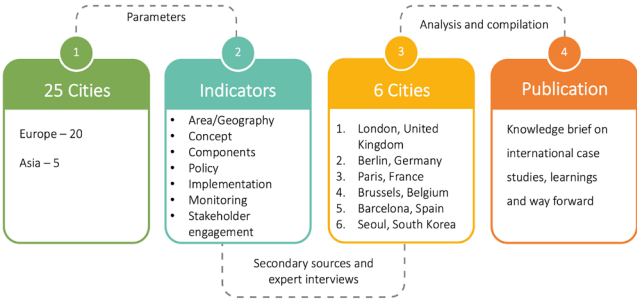

Figure 1: Methodology for the study (Source: Authors)

then laid on six cities for detailed study i.e., London, Berlin, Paris, Brussels, Barcelona and Seoul. These cities have not only been successful in implementing LEZ in their respective cities but also provide key take aways that could be replicated in Indian cities. Detailed literature reviews along with expert interviews from the six respective cities were conducted to present a detailed picture.

CASE STUDIES

Factors such as culture, demography, governance, technological advancement, and diverse determinants of human behaviour tend to differ from one city to another. Hence in this regard, it is important to closely study the factors that play crucial role in the holistic success of the initiative in these cities.

LONDON, UNITED KINGDOM

The capital city of United Kingdom (UK), London is one of the most cosmopolitan cities of the world. With a population of 8.8 million (2021)[v], London is the largest metropolis in the UK, serving as the country's cultural, economic and transportation hub.

London's pivotal role during the Industrial Revolution made smog a persistent problem in the city. However,

> Concerns regarding air pollution, climate change, traffic congestion and need for meeting European Union (EU) Air Quality (AQ) standards prompted London to be one of the first cities of the world to implement LEZ and then ULEZ.

the city's dynamic weather conditions prevented the development of complete photochemical smog. In fact, studies in the early 1960s reported a 30% reduction in winter sunshine hours in the smokier districts of east Inner London[vi].

With a strong political commitment under the leadership of the Mayor of London, Transport for London (TfL), introduced LEZ in a phased manner, following extensive consultations and outreach activities. This approach allowed sufficient time to become aware of and adapt to the new policy changes. In 2008, the LEZ was implemented with a focus on heavy vehicles, and then in 2019, an Ultra Low Emission Zone (ULEZ) was introduced, with an extended focus on cars and vans.

Figure 2: LEZ and ULEZ boundary in London as of 2019 (Source: Transport for London)

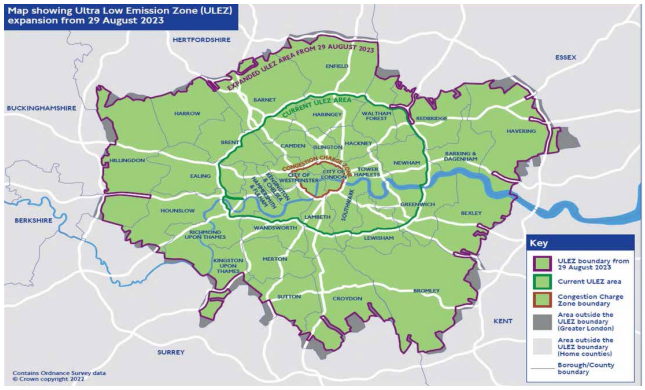

Figure 3: Present ULEZ boundary in London (Source: Transport for London)

INTERVENTIONS

- The Greater London area, spanning over 1,580 square kilometres, requires vehicles entering to either meet the specified emission standard or pay a daily charge for driving in the zone, or pay a fine for violation, depending on the type of vehicle used.
- The current minimum emission standard in the LEZ is Euro VI (NOx and PM) and in the ULEZ, Euro IV (NOx) for petrol cars and Euro VI (NOx and PM) for diesel cars.
- While ULEZ operates 24 hours a day, every day of the year (except Christmas Day - 25 December), the

TIMELINE	INTERVENTIONS
LEZ Phase I 4th Feb. 2008	LEZ launched with restrictions for Heavy Goods Vehicles (HGVs) over 12 tonnes
LEZ Phase II 7th July 2008	Restrictions on HGVs of 3.5 – 12 tonnes along with buses and coaches over 5 tonnes
LEZ Phase III 2012	Restrictions on large vans and mini-buses
LEZ Phase IV 3rd Jan. 2012	Tougher Particulate Matter (PM) standards for Phase I and II vehicles
Feb. 2013	Announcement for introduction of ULEZ in Central London by 2020
Nov. 2013	Stakeholder engagement for ULEZ emerging approach
Oct. 2014 – Jan. 2015	Public consultation on ULEZ implementation
23rd March 2015	Mayor of London announced launch of the world's first ULEZ in Central London from Sep. 2020
July 2016	Consultation on air quality measures began
Oct. 2016	Consultation on Toxicity Charge (Congestion Charge extension) and policy interventions for ULEZ changes
Feb. 2017	Announcement of T-Charge
Apr. – Jun. 2017	Consultation on introducing ULEZ in Central London in 2019
Oct. 2017	T-Charge launched in Central London
Nov. 2017	Announcement on ULEZ being brought forward to 2019
Dec. 2017 – Feb. 2018	Consultation on ULEZ expansion to inner London and tighter LEZ norms
June 2018	Announcement on ULEZ expansion and stricter LEZ norms
LEZ Phase V March 2021	Tougher NOx and PM standards for HGVs over 3.5 tonnes and for coaches/buses over 5 tonnes Euro VI standards required
Oct. 2021	ULEZ expansion to inner London
May – July 2022	Consultation on ULEZ expansion London-wide
Nov. 2022	Announcement of ULEZ expansion London-wide
Aug. 2023	ULEZ expanded London-wide

[3] A scheme is a plan of action / policy that ensures implementation of the strategy adopted

LEZ operates 24 hours a day, every day of the year, including weekends and all public and bank holidays.

- Automatic Number Plate Recognition (ANPR) cameras are used for enforcement.
- Exemptions are in place for military vehicles, specialist agricultural vehicles, non-road going vehicles such as excavators, mobile cranes, historic vehicles and London licensed taxis (depending on taxi age limits).
- Special agreements allow grace periods for emergency services to upgrade their specialist vehicles. Similar grace periods are provided for vehicles used by differently abled people, businesses and charities, London licensed wheelchair accessible vehicles and minibuses for community transport.

Study report claims that **London's LEZ benefitted an additional 18 million people outside London** as the lower emission vehicles that drive through London also drive through 95% of the major towns and cities in England and Wales[vii].

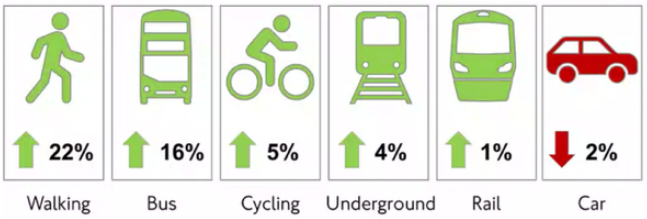

Figure 4: Impact of ULEZ Car and Motor Cycle Scrappage Scheme (Source: Transport for London 2023)

Vehemently establishing the problem through publishing reports and data on air pollution, introducing a Scrappage Scheme[3], promoting retrofit and the use of cleaner modes of transport, conducting large scale awareness programmes, mapping stakeholder, constant stakeholder engagement and consultations, launching strong public information campaigns, and strong political will have served as key enablers in the effective implementation of the LEZ and ULEZ norms. Additionally, initiatives such as providing a cleaner bus fleet with improved bus service, investing in walking and cycling, setting up electric vehicle (EV) charging infrastructure and deploying zero emission capable taxis were the approaches that acted as catalysts to address and improve air quality.

BERLIN, GERMANY

Berlin, with a metro area population of approximately 3.87 million in 2023[viii], is the capital and largest city of Germany, both in terms of area and population. With stricter, legally binding air quality (AQ) standards coming into force across the European Union (EU) in 1999, Berlin faced exceedances of the AQ limit values for PM_{10} and NO_2,

mainly in many roads concentrated in central areas of the city. This necessitated an accelerated improvement of the growing vehicular fleet and the application of existing filter technology to control toxic diesel emissions.

In 2005, Berlin became the first German city to adopt an LEZ, with plans for implementation in two stages in 2008 and 2010.

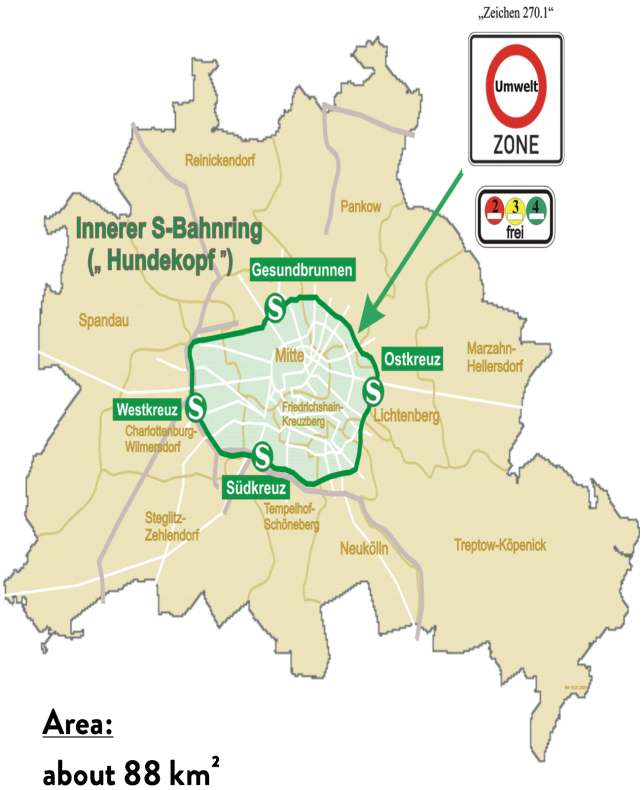

Figure 5: LEZ map for Berlin (Source: Senate Department for Environment, Transport and Climate Protection, Berlin)

EU's Air Quality Directive with legally binding AQ standards served as a driver for the LEZ, not only for Berlin but 60 other German cities, underpinned by a National sticker regulation for vehicles based on the EU norms for controlling emissions.

Stage 1 aimed to replace the most polluting fleet of vehicles, which were more than 12 years old, with modern and cleaner vehicles. In stage 2, the then new Euro 4 emission standards were required, but older diesel vehicles could be upgraded through retrofitting with a particle trap.

LEZ encompasses the busy central city area, covering 85 square kilometre delimited by the local railway ring, where almost one third of Berlin's population resides. The LEZ operates all 365 days a year and is permanent in nature.

INTERVENTIONS

- The German Government adopted a national labelling scheme with three categories that closely align with the Euro vehicle emission standard for diesel vehicles. These categories are represented by a number on a sticker, which is to be affixed to the vehicle's window screen.

Emissions class	1	2	3	4
Sticker	No Sticker existent			
Requirement for diesel vehicles	Euro 1 or worse	Euro 2 or Euro1 with particulate filter	Euro 3 or Euro 2 with particulate filter	Euro 4, Euro 5, Euro 6 or Euro 3 with particulate filter
Requirement for petrol vehicles	Without a catalytic converter			Euro 1 or better pre Euro 1 with a catalytic converter fitted

Figure 6: Sticker system in Berlin (Source: Urban Access Regulations in Europe)

- The labelling scheme was backed by a Regulatory and Technical Framework for the type-approval of particulate filters allowed for retrofitting in diesel vehicles. Supported by a funding scheme, this framework was later extended to cover the retrofitting of diesel vehicles with Selective Catalytic Reduction (SCR) catalysts to reduce NO_X emissions.
- Diesel passenger cars (14,000 PC with red sticker and 60,000 PC with yellow sticker) and diesel commercial vehicles (10,000 LDV/HDV with red sticker and 25,000 LDV/HDV with yellow sticker) that were affected after Stage 2 implementation by the end of 2009 faced regulation, unless retrofitted.
- Exemptions were initially granted for vehicles that could not be retrofitted for technical reasons and for small businesses facing proven economic troubles. From 1st January 2015 onwards, these exemptions were limited to differently abled people and special vehicles with a unique business idea or elaborate special equipment, along with low environmental zone performance.
- Cost-efficient Diesel Particle Filter (DPF) technology became an important element of Berlin's strategy to meet particle pollution standards. DPF became mandatory in new diesel engine applications in trucks and buses from 2014 and non-road machinery and vessels since 2019.

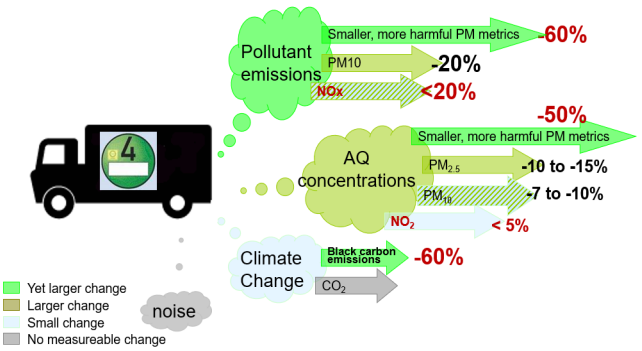

Figure 7: Impacts of LEZ in Berlin (Source: Senate Department for Environment, Transport and Climate Protection)

- Since it is a mandatory requirement, the Stakeholders' Working Group was consulted before drafting any new scheme along with conducting public consultation.
- The penalty for driving in a LEZ without the required sticker is €80, plus an administrative fee that varies.
- Foreign vehicles are also affected and are required to buy a sticker, with the details available on the website of the Senate Department for Urban Mobility, Transport, Climate Action, and the Environment. The emissions standard of foreign vehicles primarily depends on the vehicle's age.
- Berlin's Strategic Urban Mobility Plan (SUMP) outlined other important measures leading to an improvement in air quality, including a shift from private vehicles towards public transport, cycling, and pedestrianisation traffic. In fact, a 15% reduction in traffic volume has been observed in the whole city since 2002, owing to the traffic planning measures accompanying the launch of the LEZ.

The DPF retrofit programme, launched in 1999 for 1,499 buses, resulted in more than 90% reduction of soot emissions per vehicle. Berlin's focus on DPF retrofitting, especially through the low emission zone, reduced the traffic-generated black carbon concentration by more than half. Even though PM_{10} levels fell by less than 10%, it was still considered a success with regard to health protection and control of short-lived climate forcing compounds.

Given the relatively slow renewal of vehicle / machinery stock, the provision for retrofitting with particle filter proved an attractive, efficient and cost-effective solution, which substantially reduced black carbon levels in Berlin by nearly 50%. While retrofitting with NOx filter retrofit (SCR) proved to be technically feasible, efficient, and cost-effective for buses, DPF retrofitting proved to be a cost-efficient solution for older machinery. Thus, a robust policy framework, coupled with rewarding vehicle owners who invested in clean vehicles, acted as major factors behind the successful implementation of the LEZ in the city.

PARIS, FRANCE

Paris, with a population of nearly 2.2 million (2023) and forming the heart of France's commerce, education, art and culture, serves as the capital city. The population of the metropolitan region is 12 million[x]. The city is strategically located at the crossroads of both land and water routes, significant not only to France but also to Europe, and has played a significant role in its growth and prosperity.

In response to the rising concern among citizens regarding deteriorating air quality and to meet the Air Quality Standards set by European Union (EU), Paris initiated the **LEZ Legal Framework in 2015, locally known as La Zone a faibles emissions (ZFE)**. Since 2019, it has been a part of the metropolitan framework[xi].

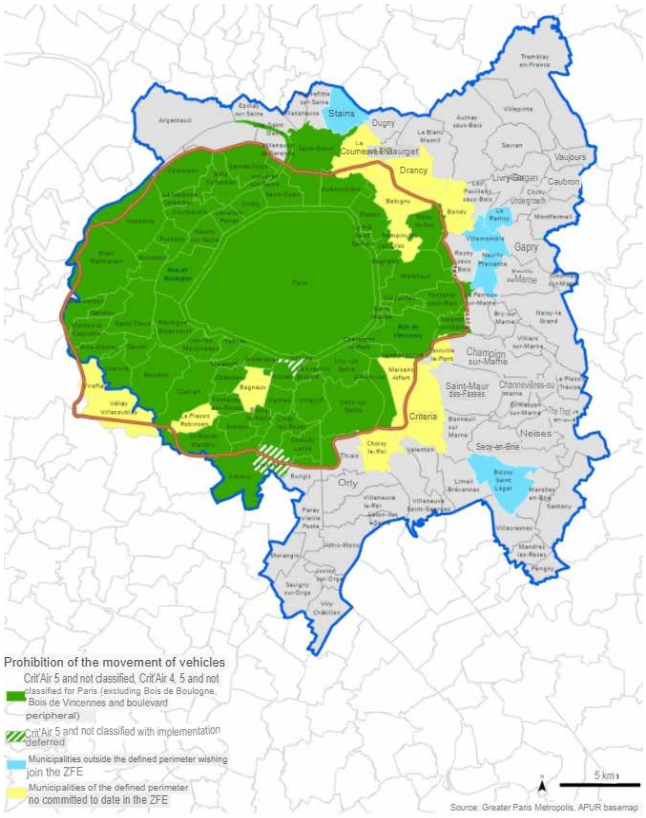

Figure 8: ZFE boundary in Paris (Source: Urban Access Regulations in Europe)

INTERVENTIONS

- Several studies conducted by the City of Paris, along with an NGO entrusted by the State and public authorities to measure and model air quality in the Greater Paris agglomeration, studied more than 400 scenarios and conducted sensitivity tests. Out of these, eight scenarios were studied in detail to understand traffic scenarios. This helped in identification of polluting light and heavy-duty vehicles, and motorised 2-wheelers that need restriction to improve air quality.

- A national sticker system known as Crit'Air, where stickers representing different Euro Emission Norms[4] are placed on vehicle windshield. According to national regulation, it is mandatory for all vehicles entering the LEZ to have the Crit'Air sticker issued by the State; otherwise, fines would be levied.

Figure 9: Different categories of Crit'Air stickers (Source: Official website of Crit'Air sticker)

- Since 01 June 2021, vehicles categorised as Unclassified, Crit'Air 5 and Crit'Air 4 (for cars Euro 3 and older) are restricted from driving in the ZFE and the A86 motorway, excluding the following days and times:
  - For buses, coaches and heavy goods vehicles, this restriction applies 7 days a week, between 8 a.m. to 8 p.m.
  - For private vehicles, light utility vehicles, two-wheelers, tricycles and motor quadricycles, the restriction applies from Monday to Friday from 8 a.m. to 8 p.m. – except public holidays.
- Laws such as the Mobility Orientation Law (2019) and Climate and Resilience Law (2021) played major roles in enforcement of the ZFE norms.
- Public consultations and coordinated consultations with all the municipalities across Greater Paris Metropolis were held between March to April 2021, along with a citizen opinion poll in March 2021 before the implementation of June 2021 stage of ZFE norms across the Parisian metropolitan region.
- An ANPR system is proposed to be implemented by the end of 2024 or beginning of 2025 for better vigilance and creation of a robust database on riders / vehicles.
- Exemptions exist for certain types of vehicles such as police vehicles, mobile hospital, emergency medical aid service, vehicles of the Ministry of Defence, vehicles displaying "mobility inclusion" that are used by differently abled people.
- The City of Paris has provided several financial aids for both individuals and professionals, including subsidies on e-bikes, to help them transition to cleaner modes of mobility.
- To increase compliance among citizens and acceptance of the LEZ norms, improvements in walkability, increasing bike lanes and formulation of policies to enhance accessibility have played key roles.

In case of Paris, active people's movements played a crucial role in prompting the government to consider implementing LEZ. Non-Governmental Organisations working in the field of air pollution measured air quality in different schools in the city and exerted pressure on the city authorities to better manage air quality in the city.

BRUSSELS, BELGIUM

Brussels, the capital city of Belgium and the administrative centre of the European Union, home to several headquarter of EU institutions, has a high density of population in the city center. With increase in vehicular traffic, the NO_2 levels in 2017 exceeded the prescribed EU AQ limits. Air pollution was reported as the biggest environmental threat to health, causing 300 deaths per million per year in Belgium. The transport sector was responsible for 55% of NO_2 emissions and 23% for $PM_{2.5}$ emissions in 2020. The city of Brussels introduced an LEZ in January 2018, due to pressure from the EU to control air pollution levels and in response to citizens' campaigns demanding clean air.

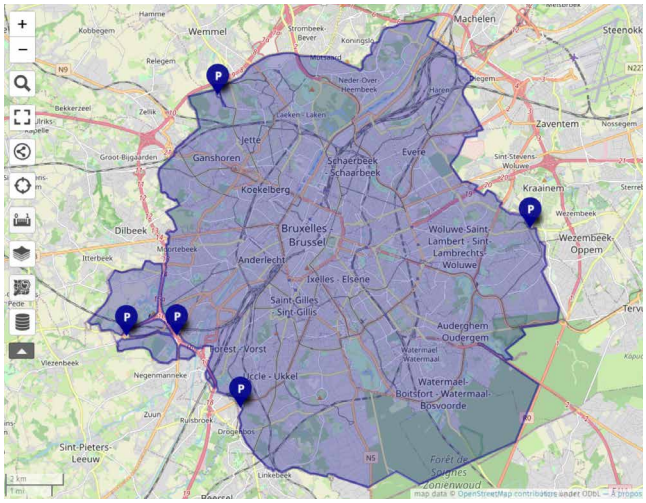

Figure 10: Map of LEZ in Brussels covering 19 municipalities with 'P' in the map showing points of Park / Park & Ride facility (Source: Brussels Environment Department)

INTERVENTIONS

- Since 01 January 2018, the Brussels capital region implemented a LEZ covering 19 municipalities spread over an area of 161 square kilometre, with the ring road

[4] Contrary to the German scheme, in the French one the number does not coincide with the Euro-norm.

selected as the natural boundary for demarcation. The current requirements are Euro 5 for Diesel and Euro 2 for petrol passenger vehicles, including vans and coaches.

Brussels conducted an opportunity study in year 2011 on LEZ and the decision to implement LEZ in 2018 was finalised in 2016. A comprehensive operational study was conducted between 2016-2017 and a legal framework designed for 2018-2025.

- Under the Scrappage Scheme, residents of the Brussels region, were provided with a €500-900 mobility budget to be used for public transport passes or to purchase bicycle. The rationale was to make people shift towards public transport, instead of compelling them to buy private electric cars .
- Using Digital cross-connect (DXC) technology, the city installed 300 cameras equipped with Automated Number Plate Recognition (ANPR) technology, capable of capturing 4-million license plate photos per day. These cameras could also be accessed by the city police for security purposes.

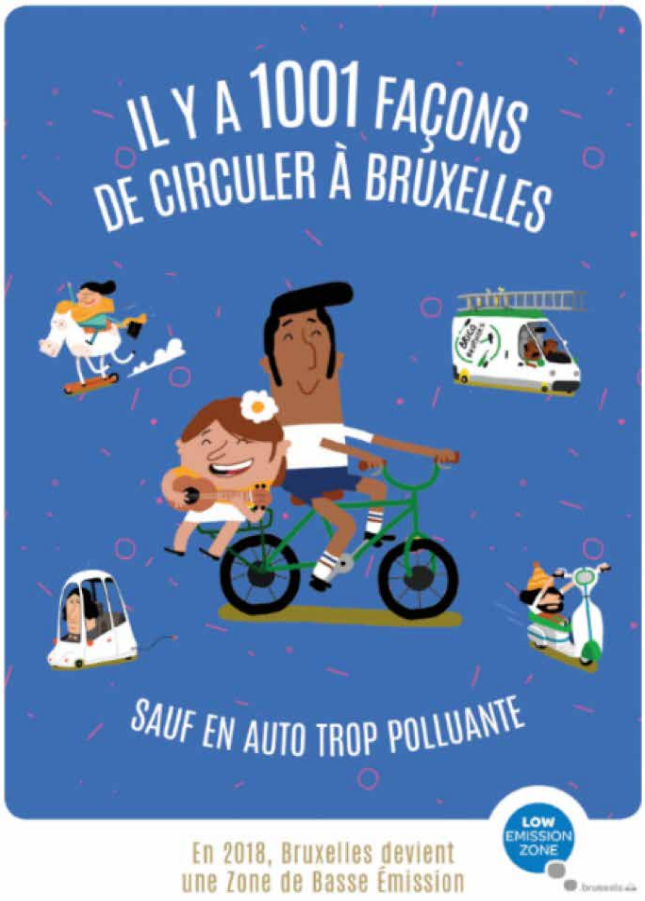

Figure 11: Communication strategy adopted to spread awareness on LEZ (Source: Brussels Environment Department)

- Park and ride facilities and transit car parks were established on the periphery of Brussels-capital region, along with the introduction of car sharing platforms in the city.
- People also have the option to buy 24 days passes per year for entering LEZ area of €35 per pass, as an exemption.
- Special exemptions are provided for emergency vehicles such as fire brigade, ambulance, military, police cars, vehicle used by differently abled people (registration / application necessary), and vintage cars older than 30 years (registration / application necessary).
- A high penalty for violating norms amounts to €350 per illegal entry, applicable for 3 months.
- A comprehensive communication strategy was adopted, including distribution of leaflets providing basic information about LEZ, dedicated website, campaigns, warning letters to car owners, and information kits for stakeholders were developed to spread awareness.
- Brussels Mobility initiated a campaign called 'Mobility Poverty' to address concerns raised by NGOs working with impacted citizens.
- Concept of Mobility Coach – a dedicated call centre for individual queries that provides various alternate commute options was established.
- A collaborative effort involving multiple organisations such as Brussels Regional Public Service, Bruxelles Environment, Fiscalite Brussels, Cirb.brussels and DXC technology, took place for effective implementation.
- The implementation of a strong Mobility Plan, with investments in public transport, cycling, and shared mobility, was a crucial approach that worked in favour of LEZ implementation.
- A Low Emission Mobility Roadmap is under development for 2025-2035, with extensive stakeholder consultation and a study of the legal framework. The goal is to phase out diesel vehicles by 2030 and petrol vehicles by 2035.

In Brussels capital region, on road it is estimated that between June 2018 and October 2020, the number of old diesel vehicles circulating significantly decreased, leading to reductions in air pollutant emissions: 9% NOx, 17% fine particles ($PM_{2.5}$) and 38% black carbon particles. The share of diesel cars dropped from 62% in 2018 to less than 50% of the vehicles in 2020.

The successful implementation of LEZ in Brussels was facilitated by strong enforcement, cooperation among agencies, gradual phase out, stakeholder consultation,

flexible plans through exemptions, financial support, and a robust mobility plan.

BARCELONA, SPAIN

Barcelona, situated on the northeastern coast of Spain with a metro area population of approximately 5.7 million in 2023[xii], serves as the capital and largest city of the autonomous community of Catalonia and is the second-most populous municipality of Spain. Barcelona is a major cultural, economic, and financial centre in southwestern Europe.

In response to increasing annual average NO_2 concentration limits set by the EU and WHO for health protection, the Area Metropolitana de Barcelona (AMB), in a 2017 political agreement, committed to improving air quality in the Barcelona conurbation. This led to the launch of **Rondes de Barcelona (ZBE)** and other LEZ such as Area 40 and Metropolitan LEX. The ZBE became permanently operational since 01 January 2020.

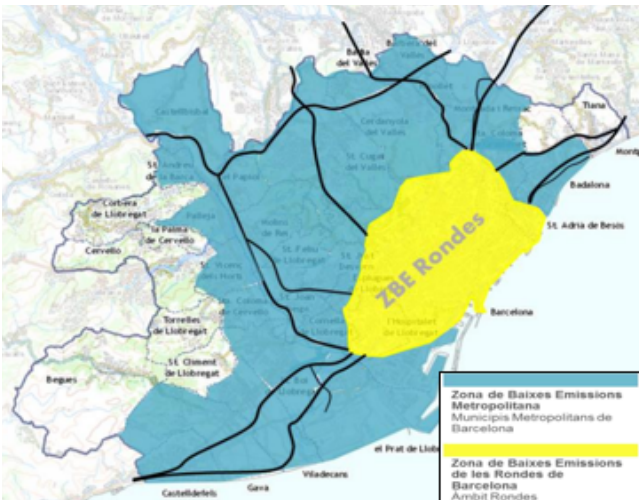

Figure 12: Map indicating the LEZ Area Barcelona (Source: AMB)

Barcelona Low Emissions Zone or ZBE covers an area of approximately 95 square kilometre, which includes the entire city of Barcelona plus L'Hospitalet de Llobregat, Sant Adrià de Besòs and parts of Espluges de Llobregat and Cornellà.

LEZ/ZBE introduction in Spain no later than 2023 in all cities with inhabitants of 50,000 + and 20,00+ with pollution problems.

INTERVENTIONS

- ZBE operates from Monday to Friday between 7 a.m. and 8 p.m. Vehicles entering during these hours must have a Directorate General of Traffic (DGT) issued environmental label. For foreign registered vehicles, registration with the AMB before arrival for €7 for cars is mandatory.

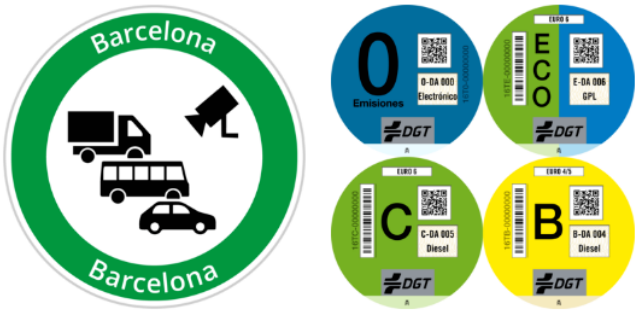

Figure 13: Non containment labels (Source: green-zones.eu)

- Drivers entering ZBE without the required environmental label (currently "B" for Diesel Euro 4 and Euro 3 for petrol) or incorrect registeration may face fines up to €200, with the exception of the main Barcelona ring roads.
- Older and more polluting vehicles can obtain a one-day pass to enter the city for €5 or €6 based on the vehicle type. Each vehicle may receive a maximum of ten one-day passes per year.
- The strong political will and involvement of authorities facilitated the design of legal instruments, including a well-defined environmental label system, regulatory municipal ordinance, regulations for vehicle registration, and regulatory tax ordinance, ensuring effective implementation of ZBE.
- Outreach activities and campaigns at the political and authorities' level were conducted to publicise the ZBE concept and raise awareness on its health benefits.

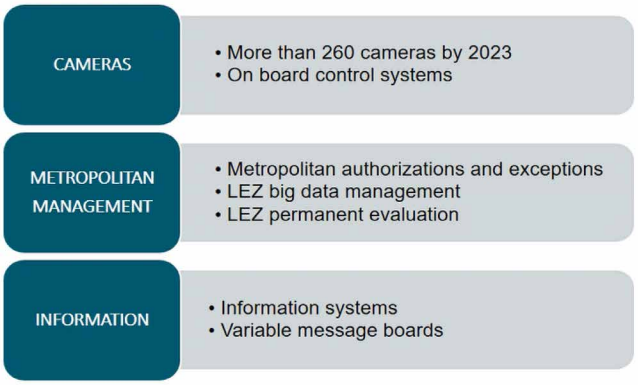

Figure 14: Technological measures for enforcement in Barcelona (Source: LTA&UITP International Transport Congress & Exhibition, 2-4 Nov, 2022)

- Exemptions are for reduced mobility individuals, low-income group members, emergency, municipal, and essential service vehicles, along with a grace period for replacement.

Complementary Measures

Free Transport for owners scrapping old vehicles for 3 yrs

Improvement in Public transport in terms of coverage & Frequency

Improvement of NMT networks

Environmentalisation of fleet by 2029 to all hybrid /electric

Figure 15: Complementary measures taken by AMD authority (Source: AMB)

Before ZBE implementation, polluting vehicles constituted 20% of the total fleet. By June 2020, this figure dropped to 6%, and by September 2021, with restrictions on passenger cars, mopeds, and motorcycles without badges, the circulation of these vehicles reduced to only 2%. This resulted in a 54.3% reduction in NO_X levels and PM_{10} by 19.2% reduction. Moreover, 76% of people no longer holding a T-Verda card reported primarily using public transport for their journeys.

The ZBE Metropolis Barcelona is one of the most ambitious supra-municipal technological projects in southern Europe. The application of big data and technology, coupled with the harmonisation of restrictions and the establishment of a strong legally system, ensured the effective implementation of the ZBE Metropolis Barcelona.

SEOUL, SOUTH KOREA

The capital city of South Korea (Republic of Korea), located in the north-western part of the country on the Han River and in close proximity to the Yellow Sea, has a population of 9.66 million (2023)[xiii]. It plays a pivotal role in South Korea's political, economic and cultural life, serving as the center for amenities, tourism, and historic places in the country.

In response to excessive emissions, fine dust particles, and increasing traffic congestion in the recent past, Seoul implemented a **LEZ known as the Green Transport Zone (GTZ)** in the city[xiv]. The aim was to develop a people-centric and car-free life.

INTERVENTIONS

- Seoul Metropolitan Government (SMG) implemented the GTZ in 2017 within a designated 16.7 square kilometre area in the city center. The goal was to reduce 30% of car traffic in the zone by 2030 through the reorganisation of major roads in the city center. In 2019, it expanded to other financial districts[5] of the city.
- Studies were conducted to understand scenarios before and after GTZ implementation , various stakeholder consultations were held between 2016 - 2017, polls were conducted for the citizens and engagement with non-profit organisations.

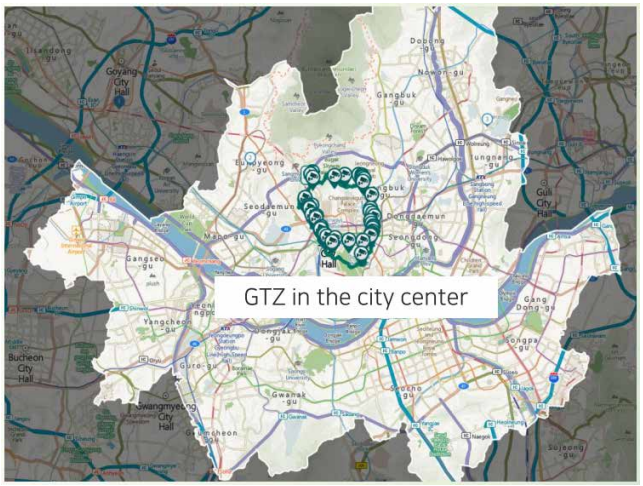

Figure 16: Map showing GTZ in Seoul (Source: Transport Policy Division, SMG)

- The restriction applies to Grade 5 vehicles, including diesel cars before 2002 and gas-powered vehicles manufactured before 1987. The ban extends to the entire city on days of "emergency reduction measures" issued when $PM_{2.5}$ levels surpass 50 μg/m³.[xv]
- Vigilance is done through real-time monitoring with the help of ANPR cameras. Enforcement period is from 6 a.m. to 9 p.m. every day, and violations result in a penalty of KRW 100,000. From the third violation, the penalty increases to KRW 200,000.

Figure 17: Traffic Volume Management done through ANPR installed at 45 entry points to the GTZ (Source: Transport Policy Division, SMG)

[5] Financial districts refer to financial centres/hubs, hosting major financial institutions in the area concerned.

- Citizens were given the option to either replace their old and polluting cars or install filters to limit emissions. Residents of the GTZ receive financial support for replacing their old/polluting cars.
- Roads for cars were reduced by reorganising pedestrian spaces, reducing lanes and extending sidewalks.

Figure 18: Key strategies adopted for successful implementation of GTZ in Seoul (Source Transport Policy Division, SMG)

- Exemptions apply to emergency vehicles and vehicles used by people with reduced mobility.
- Promotional activities such as slogans, bus campaigns, advertising, broadcasting videos, were conducted to spread awareness.

The gradual expansion of GTZ from a small area and then expansion to other areas, coupled with sincere promotion of public transport and cleaner transport, played key roles in the successful implementation of GTZ in Seoul.

KEY TAKEAWAYS

Each city covered in this knowledge brief displayed an array of initiatives to successfully implement LEZ. Table 1 highlights a comparative study of some of the major factors contributing to the successful implementation of LEZ in the six cities. Indian cities may consider these factors when implementing similar measures. It is worth noting that neither a one-rule fits all approach nor the rigidity of norms and policies resulted in successful implementation of LEZ in these cities. The instruments highlighted for LEZ implementation along with complementary measures such as promoting active transport modes (cycling and walking) and enhancing public transport coverage and frequency play a vital role in its success and its positive impact on health.

FACTORS	LONDON	BERLIN	PARIS	BRUSSELS	BARCELONA	SEOUL
Area	1,580 sq. km	85 sq. km	≈815 sq. km	161 sq. km	95 sq. km	Initially started with 16.7 sq. km
Operational time	24 hrs., throughout the year	24 hrs., throughout the year	Restriction on days and time based on type of vehicle	24 hrs., throughout the year	Between 7 A.M. and 8 P.M., Monday to Friday	6 A.M. to 9 P.M., every day
Policy enforcement jurisdiction	City/metropolitan level	National level	National level	City/metropolitan level	City/metropolitan level	City/metropolitan level
Phase-wise implementation	✓	✓	✓	✓	✓	✓
Stakeholder / Citizen consultations	✓	✓	✓	✓	✓	✓
Technology usage for enforcement / implementation	✓			✓	✓	✓
Exemptions	✓	✓	✓	✓	✓	✓
Studies conducted before & after implementation	✓	✓	✓	✓	✓	✓
Monitoring / updating schemes	✓	✓	✓	✓	✓	✓
Improving public transport	✓	✓		✓	✓	✓
Improvement in NMT facilities	✓	✓	✓	✓	✓	✓
Promoting modes of clean mobility like electric vehicles	✓					✓
Financial aids by Government to public	✓	✓	✓	✓		✓
Other measures adopted like charging facilities / park & ride / car sharing schemes / citizens' fund creation / scrappage scheme /retrofit	✓	✓	✓	✓		✓

Table 1: Comparative analysis of the key takeaways from the six case study cities based on major interventions for successful implementation of LEZ (Source: Authors)

CONCLUSION

Implementing LEZ in Indian cities represents a step forward in achieving lower carbon emissions and enhancing the Quality of Life for citizens. Based on the key takeaways from the case studies, an ideal proposed framework (Figure19) for Indian cities may be considered during LEZ implementation which is illustrated below.

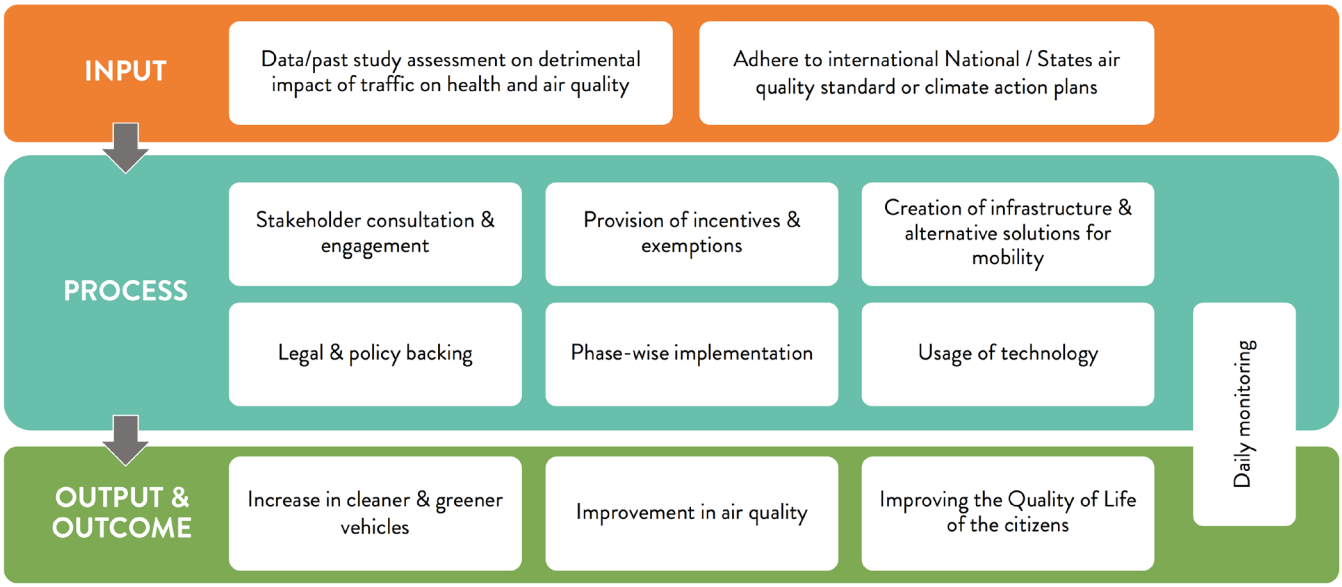

Figure 19: Ideal implementation framework for LEZ in India (Source: Authors)

India has already implemented several initiatives at the National, State and City levels aiming to combat vehicular pollution which majorly fit under the larger framework of LEZ concept. Some of them are: **National Clean Air Programme (NCAP)**[6] implemented in more than 100 cities for effective air quality management, with a national level target set at 20-30% reduction of particulate matter concentration by 2024. **Voluntary vehicles-fleet modernisation programme/scrappage policy**[7] aimed at creating an eco-system for phasing out of unfit and polluting vehicles, leading to a 15-20% reduction in emissions due to vehicular pollution. Augmenting of city bus operations and improving public transport under **'PM-eBus Sewa Scheme'** targeting to deploy of 10,000 electric buses and upgrading depot infrastructure in 169 plus cities. Delhi-National Capital Region (NCR) has implemented a **Graded Response Action Plan (GRAP)** through the Commission for Air Quality Management (CAQM) in NCR and adjoining areas. The plan aims to prevent the deteriorating air quality once it reaches a certain threshold. Additionally, cities such as Mumbai, Bengaluru, Nagpur, and others have already developed their own Climate Action Plans, and several cities are currently preparing their own. However, it may be noted that several of these measures are implemented in silos and lack of an integrated approach has resulted in dearth of significant positive impacts.

Several provisions grant the Central Government, State government, and City Authorities the power to implement a concept like LEZ. For example, the 12th Schedule under the 74th Amendment Act of 1992 in the Indian Constitution empowers local self-governments to take necessary actions and utilise its power to maintain roads, safeguard public health, and protect the environment. In addition to these provisions, several other enablers, such as the **National Urban Transport Policy (NUTP) 2006**, propose setting up a **Unified Metropolitan Transport Authority (UMTA)** in all million plus cities to facilitate more coordinated planning and implementation of urban transport programmes and projects. The creation of an **Urban Transport Fund (UTF)** is encouraged to levy dedicated taxes exclusively for meeting urban transport needs within the State. Additionally, the Central Motor Vehicles Act, 1988 empowers the enforcement of penalties and restrictions on various kinds of vehicles in specific areas/roads. Thus, a strong regulatory system is already in place which has the potential to implement LEZ in Indian cities.

Through this project, UITP India proposes to implement existing policies and put forward new recommendations under the framework of LEZ concept to generate positive impact on mitigating air pollution. The factors, chosen predominantly from international case study learnings and the existing conditions and policy framework in India, that may be considered for implementing LEZ in the Indian context, are outlined below.

[6] https://prana.cpcb.gov.in/#/about

[7] https://morth.nic.in/sites/default/files/VVMP-Investor-Handbook.pdf

Regulatory Authority	Local Self Government in coordination with relevant stakeholders	**Level of implementation**	Municipal / metropolitan level
Finance	Urban Transport Fund – to be used for incentivising citizens	**Stakeholder engagement**	Consultations with relevant stakeholders including govt. depts., CSOs, surveys on citizen opinion, awareness programmes for citizens
Area	Starting with small pockets around places of heritage monuments, tourism, Central Business District (CBD) etc.	**Time**	Starting with seasonal / episodic before it is made permanent
Enforcement	ANPR cameras used for monitoring & suitable fine to be charged on violation	**Exemptions**	Emergency services needed for security & medical purposes, vehicles of people with disability, residents given day pass & grace period
Restrictions	Phase-wise implementation, starting with ban on vehicles below Bharat Stage IV that are older than 15 years, focusing on heavier diesel vehicles that are not retrofitted	**Complementary measures**	Creation of alternative solutions like NMT facilities, increase accessibility (coverage & frequency) of PT, creation of charging infrastructure, scrappage / retrofitting incentives

Figure 20:Factors that may be considered for LEZ implementation in Indian cities (Source: Authors)

It is firmly believe that implementing all measures holistically, including the implementation of LEZ as one of the interventions has proven effective in several cities worldwide, and the the potential to enable the achievement of desired goals and outcomes in Indian cities as well; thereby, improving air quality, combatting climate change, and enhancing the Quality of Life of the citizens.

[i] https://blogs.worldbank.org/transport/transport-pollution-some-practical-solutions-developing-countries

[ii] Heydari, S.; Tainio, M.; Woodcock, J.; de Nazelle, A. Estimating traffic contribution to particulate matter concentration in urban areas using a multilevel Bayesian meta-regression approach. Environ. Int. 2020, 141, 105800.

[iii] https://cms.uitp.org/wp/wp-content/uploads/2022/02/Report-BETTER-URBAN-MOBILITY-PLAYBOOK.pdf

[iv] Applications for the Environment: Real-Time Information Synthesis (AERIS) Low Emissions

Zones: Operational Concept, U.S. Department of Transportation, 2012

[v] https://data.london.gov.uk/demography/#:~:text=The%202021%20mid%2Dyear%20estimate,London's%20population%20at%208.8%20million.

[vi] https://www.britannica.com/place/London/Climate

[vii] https://www.london.gov.uk/sites/default/files/lez_six_month_on_report-final.pdf

[viii] https://www.berlin.de/en/news/8425887-5559700-statistics-berlins-population-continues-.en.html

[x] https://www.macrotrends.net/cities/20985/paris/population

[xi] https://www.paris.fr/pages/la-zone-a-faibles-emissions-zfe-pour-lutter-contre-la-pollution-de-l-air-16799

[xii] https://www.macrotrends.net/cities/22525/barcelona/population

[xiii] https://english.seoul.go.kr/seoul-views/meaning-of-seoul/4-population/

[xiv] https://english.seoul.go.kr/seoul-to-control-grade-5-vehicles-of-emission-gas-in-green-transport-zones-from-dec-1/

[xv] https://www.koreatimes.co.kr/www/nation/2024/02/113_279677.html

[xvi] https://urbanaccessregulations.eu/

[xvi] https://www.pcmcindia.gov.in/admin/cms_upload/Department_circular/1771798561520945674.pdf

This is an official Knowledge Brief of UITP, the International Association of Public Transport. UITP has more than 1,900 member companies in 100 countries throughout the world and represents the interests of key players in this sector. Its membership includes transport authorities, operators, both private and public, in all modes of collective passenger transport, and the industry. UITP addresses the economic, technical, organisation and management aspects of passenger transport, as well as the development of policy for mobility and public transport worldwide.

This Knowledge Brief was prepared by UITP India.

The authors wish to thank **Sarah Hollands** of Brussels Environment Department of Permits and Partnerships, Department of Sustainable Mobility, Brussels; **Martin Lutz**, Head of Air Quality Management, Senate Department for Environment, Transport and Climate Protection, Berlin; **Chaeyeon Lee**, Manager, Transportation Policy Division, Seoul Metropolitan Government; Mobility, Transport and Sustainability Area of the Barcelona Metropolitan Area (AMB); **Cecile Honore**, Assistant to the Head of the PEPQA division, Department of Roads and Travel, Paris; **Laura Dyett**, Strategy and Planning Manager, Transport for London; **Lucy Hayward-Speight**, Head of Environment – Strategy and Planning, Transport for London; **Amit Bhatt**, Managing Director for India, International Council on Clean Transportation; **Palak Passi**, Assistant Programme Manager, Electric Mobility Initiative, Shakti Sustainable Energy Foundation; for their critical insights and review during the preparation of this Knowledge Brief.

FEBRUARY | 2024

UITP ADVANCING PUBLIC TRANSPORT

Rue Sainte-Marie 6, B-1080 Brussels, Belgium | Tel +32 (0)2 673 61 00 | Fax +32 (0)2 660 10 72 | info@uitp.org | www.uitp.org