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Improving air quality in cities through transport-focused low- and zero-emission zones: Legal pathways and opportunities for India

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Keywords: Legal pathways, low-emission zones, zero-emission zones, transportation, air pollution

Introduction

Air pollution is a major health burden in India and many cities have elevated concentrations of fine particulate matter ($PM_{2.5}$), ozone, and nitrogen dioxide (NO_2). In Mumbai, India's most populated city with more than 13 million inhabitants, $PM_{2.5}$ emissions from road transport almost doubled in share to 31% of total $PM_{2.5}$ emissions between fiscal years (FY) 2016–17 and 2019–20.[1] In New Delhi, the national capital and second-most-populated city with more than 11 million inhabitants, the road transport sector contributed over 80% of nitrogen oxides (NO_x) emissions and 39% of $PM_{2.5}$ emissions in 2016.[2] In Bengaluru, India's third-most-populated city with over 5.1 million inhabitants, vehicular emissions were responsible for about 53% of particulate matter (PM_{10}), 68% of $PM_{2.5}$, and 66% of NO_x emissions in 2019.[3] NO_x emissions from transport are expected to increase by about 50% and $PM_{2.5}$ by about 100% by 2040 in India in the absence of policy interventions.[4]

1 Prayag Arora-Desai, "Vehicular Emissions in Mumbai Double in Five Years, Says Study," *Hindustan Times*, June 29, 2021, https://www.hindustantimes.com/cities/mumbai-news/vehicular-emissions-in-mumbai-double-in-five-years-says-study-101624989437488.html.

2 Automotive Research Association of India and The Energy and Resources Institute, "Source Apportionment of PM2.5 & PM10 of Delhi NCR for Identification of Major Sources," (Department of Heavy Industry Ministry of Heavy Industries and Public Enterprises, New Delhi, August 2018), https://www.teriin.org/sites/default/files/2018-08/Report_SA_AQM-Delhi-NCR_0.pdf.

3 Pratima Singh et al., "Emission Inventory and Pollution Reduction Strategies for Bengaluru," (CSTEP: Bengaluru, 2022), https://cstep.in/drupal/sites/default/files/2022-02/EI_Report_Final_04Feb22.pdf.

4 Arijit Sen et al., "Understanding the Air Quality and Health Impacts of Large-Scale Vehicle Electrification in India," (ICCT: Washington, D.C., 2021), https://theicct.org/publication/understanding-the-air-quality-and-health-impacts-of-large-scale-vehicle-electrification-in-india/.

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According to the World Health Organization, transport-related emissions such as PM, NO_2, and ozone can cause severe health problems including heart and respiratory diseases, asthma, and exhaustion, and can lead to premature deaths.[5] In 2015, New Delhi ranked 6th, Mumbai 27th, and Bengaluru 67th among cities worldwide in the number of premature deaths due to transport tailpipe $PM_{2.5}$ and ozone emissions.[6]

There are various measures to address transport-related emissions. At local levels, such policies include low-emission zones (LEZs) and zero-emission zones (ZEZs). LEZs are geographically defined areas, typically in cities, where access restrictions are applied to polluting motorized vehicles. LEZs often aim to improve air quality, reduce greenhouse gas emissions and congestion, and support the switch to environmentally friendly modes of transportation such as walking, cycling, and public transit. ZEZs go further by only allowing access to battery electric vehicles and fuel cell electric vehicles that emit zero tailpipe emissions. There are about 320 LEZs in Europe today, and that number grew by 40% from 2019 to 2022.[7]

There have been a few efforts to implement LEZs and ZEZs in India. Delhi, for example, has multiple mechanisms to discourage polluting vehicles from entering the city. Delhi phased out diesel buses and gasoline and diesel auto rickshaws in favor of compressed natural gas (CNG) vehicles in the early 2000s.[8] The Delhi National Capital Region (NCR) will phase out operation of diesel auto rickshaws entirely by 2026, and only CNG and electric auto rickshaws have been allowed to be registered since January 1, 2023.[9] Additionally, diesel trucks and light-commercial vehicles are required to pay an environmental compensation charge to enter Delhi.[10] In air quality emergencies, temporary access restrictions are imposed on the circulation of polluting vehicles as prescribed by the Graded Response Action Plan (GRAP).[11] Temporary access restrictions include road-space rationing based on odd-even license plate numbers, bans for vehicles certified to a pre-Bharat Stage VI (BS VI) emission standard, and a ban on diesel trucks.

At all times, diesel vehicles 10 years or older are banned from driving in Delhi, as are petrol vehicles 15 years or older.[12] In addition, Delhi has imposed a ₹0.25 per liter air ambience charge on diesel fuel purchases, and diesel vehicles are charged a 25% higher road tax than the standard rate.[13]

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5 "Air Quality and Health: Types of Pollutants," World Health Organization, accessed January 23, 2023, https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants.

6 Susan Anenberg et al., "A Global Snapshot of the Air Pollution-Related Health Impacts of Transportation Sector Emissions in 2010 and 2015," (ICCT: Washington, D.C., 2019), https://theicct.org/publications/health-impacts-transport-emissions-2010-2015.

7 Zachary Azdad, Barbara Stoll, and Jens Müller, "The Development Trends of Low- and Zero-Emission Zones in Europe" (Clean Cities, 2022), https://cleancitiescampaign.org/wp-content/uploads/2022/07/The-development-trends-of-low-emission-and-zero-emission-zones-in-Europe-1.pdf.

8 Urvashi Narain and Alan Krupnick, "The Impact of Delhi's CNG Program on Air Quality," (Resources for the Future: Washington, D.C., 2007), https://doi.org/10.2139/ssrn.969727.

9 F.No. A-110018/01/2021. Abating Air Pollution from Public Transport Sector - Regulations on Diesel Operated Auto Rickshaws, Commission for Air Quality Management in National Capital Region and Adjoining Areas, November 30, 2022, https://caqm.nic.in/WriteReadData/LINKS/Direction%20No-7028ef4ee0-1fd1-4e9b-91d7-fedbd4d22508.pdf.

10 Shreeja Sen and Mayank Aggarwal, "SC Doubles Green Tax on Commercial Vehicles Entering Delhi," *Mint*, December 15, 2015, https://www.livemint.com/Politics/HwmDRVfTUMgrbX55qegmtM/SC-may-double-antipollution-cess-on-commercial-vehicles-ent.html.

11 Central Pollution Control Board and Ministry of Environment, Forest & Climate Change, Government of India, New Delhi, "Graded Response Action Plan for Delhi & NCR," accessed January 5, 2023, https://cpcb.nic.in/uploads/final_graded_table.pdf.

12 Indo-Asian News Service, "Over 5,442,267 Old Vehicles de-Registered by Delhi Transport Department," *Business Standard*, February 9, 2023, https://www.business-standard.com/article/economy-policy/over-5-442-267-old-vehicles-de-registered-by-delhi-transport-department-123020901609_1.html.

13 Damini Nath, "Rs.170 Crore in Air Ambience Fund Remains Unused," *The Hindu*, December 18, 2015, https://www.thehindu.com/news/national/other-states/rs170-crore-in-air-ambience-fund-remains-unused/article8006420.ece.; "Tax Rate," Transport Department, Government of National Capital Territory of Delhi, accessed March 28, 2023, https://transport.delhi.gov.in/transport/tax-rate-0 .

The Gujarat state government has attempted an electric vehicle-only area in Kevadia. Tourists park their internal combustion engine vehicles at designated parking lots from which they can travel into the area in shared electric three-wheelers and buses. The administrative authority in Kevadia in 2021 announced incentives and easier access to financing for residents to support purchase of electric two- and three-wheelers, and electric three-wheelers were subsequently rolled out in 2022.[14]

The existence of such vehicle restrictions suggests there are legal pathways for implementing LEZs and ZEZs in India. Indeed, a 2016 report found that the Central Motor Vehicle Act, 1988, the Environment Protection Act, 1986, and the Air (Prevention and Control of Pollution) Act, 1981 have sufficient provisions to abate vehicular pollution in India.[15] However, there is scant information regarding implementation pathways for LEZs and ZEZs at the national, state, and city levels. Another important question is whether LEZs and ZEZs require separate legal pathways.

This study identifies legal pathways for implementing LEZs and ZEZs in India at the national, state, and local (city) levels. We partnered with an environmental law expert to identify relevant provisions in Indian law to build the legal pathways, and these can be applied as mandates to ensure accountability in implementation. Pathways at the state and the city levels leverage autonomy available to subnational governments to enable implementation without any policy push from higher levels. We also identified the main actors in these legal pathways, and the paper ends with a comparative analysis of the pathways to understand their respective trade-offs.

Potential pathways for implementing LEZs and ZEZs in India

To identify the legal pathways for LEZs and ZEZs, we studied national and state laws. At the state level, we chose Maharashtra and focused on the cities like Pune and Nashik; Pune is a large city and Nashik is a medium-size city, and they had the state's largest and second-largest growth in vehicle registrations over the last few years, respectively. Maharashtra also has a progressive electric vehicle policy that suggests implementing LEZs alongside other provisions such as zero-emission vehicle purchase targets for public fleets and building out charging infrastructure.

We analyzed six national laws and four Maharashtra state laws to find provisions that support implementation of LEZs and ZEZs. Table 1 contains the list of analyzed laws. We summarize the specific provisions of each law, with details of the pathways presented, in the appendix.

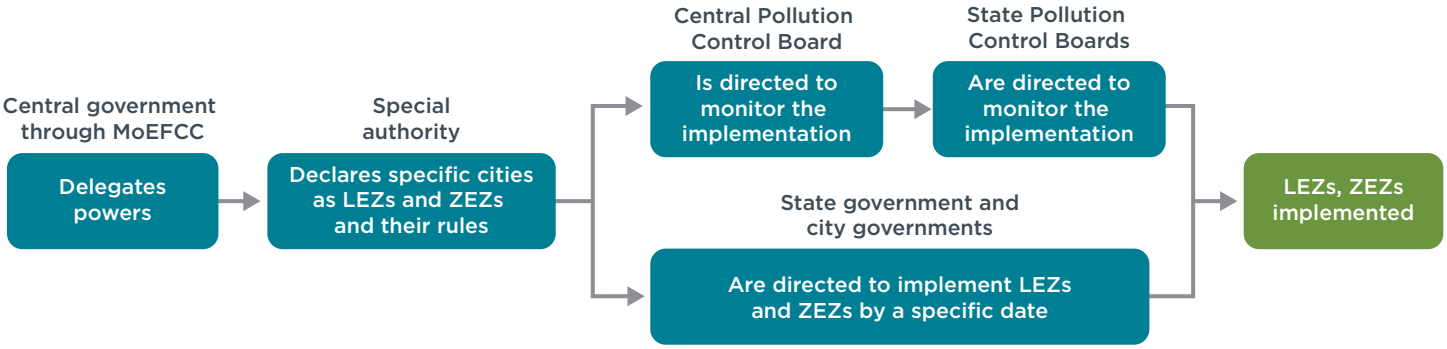
Table 1. National and state laws analyzed for this study

National	Maharashtra
Environment Protection Act, 1986	Maharashtra Municipal Corporations Act, 1949 (all municipal corporations except Mumbai)
The Air (Prevention and Control of Pollution) Act, 1981	The Maharashtra Regional and Town Planning Act, 1966
The Central Motor Vehicle Act, 1988	Metropolitan Region Development Authority Act, 2016
The National Highways Authority of India Act, 1988	Maharashtra Police Act, 1951
Indian Forest Act, 1927	
Indian Penal Code, 1861	

14 Express News Service, "Kevadia to Have First Area with Only E-Vehicles," *The Indian Express*, June 7, 2021, https://indianexpress.com/article/cities/ahmedabad/kevadia-to-have-first-area-with-only-e-vehicles-7347034/.; Sumana Sarkar, "Women Power at the Statue of Unity," *Autocar Pro*, March 8, 2022, https://www.autocarpro.in/news-national/women-power-at-the-statue-of-unity-81310.

15 Anumita Roychowdhury and Anisha Raman, "Legal Framework for Clean Air in Cities" (Centre for Science and Environment: New Delhi, 2016), https://shaktifoundation.in/wp-content/uploads/2014/02/legal-framework-for-clean-air-in-cities-dec27.pdf.

Pathway 1: The central government notifies LEZs and ZEZs through the Ministry of Environment, Forest and Climate Change and empowers state governments to implement them



This pathway involves the central government, state governments, the central and state pollution control boards (CPCB and SPCBs), and city governments. It is based on the central government's powers under two laws: the Environment Protection Act, 1986 (hereafter "EP Act"), which established the Ministry of Environment, Forest and Climate Change (MoEFCC); and the Air (Prevention and Control of Pollution) Act, 1981 (hereafter "Air Act"), which established the pollution control boards and provides a framework for the prevention, control, and abatement of air pollution in the country.

The EP Act covers all matters related to environmental protection. Section 3 of the law authorizes the central government to close, regulate, or prohibit any operations in certain areas to protect the environment. This can include operation of vehicles. For the ease of implementation and enforcement, the central government can establish special authorities; Section 23 enables the central government to delegate any of its powers to any person, officer, or authority, and Section 5 allows the central government to issue binding directions to them to close, prohibit, or regulate operations. The pollution control boards conduct monitoring and enforcement at the national and state levels.

Thus, as a pathway, the central government can publish a list of cities (or criteria for selecting cities) and declare them as LEZs or ZEZs. It can provide guidelines like an overall framework for planning and implementing zones, their rules, the planning process, the monitoring framework, and phaseout targets for various vehicle types. Next, it can set up and delegate its powers to a special authority to manage implementation of LEZs and ZEZs, and that authority can direct state governments to implement the zones and ensure compliance. Establishing a special authority is not a requirement, but it can facilitate coordination and management between various ministries, authorities, and states. The central government can also direct the CPCB and SPCBs to oversee planning and implementation. Finally, the empowered state governments can work with city governments to implement LEZs and ZEZs.

Declaration of so-called "eco-sensitive zones" is one example of MoEFCC's rulemaking powers over an area. The central government established an eco-sensitive zone around the hill station of Matheran in Maharashtra in 2003. Except for two ambulances and two fire engines, motor vehicles are not allowed to enter Matheran.[16]

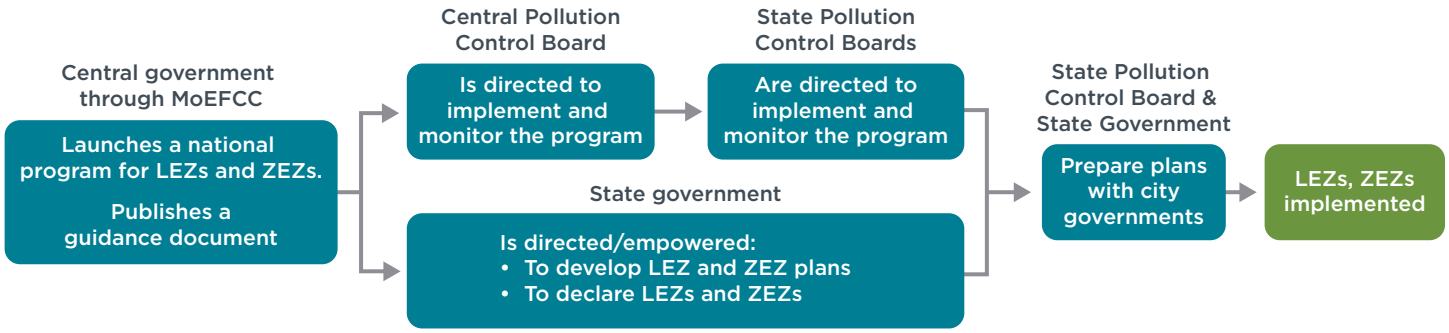
One example of a special authority is the Taj Trapezium Zone Pollution (Prevention and Control) Authority, which the central government established to protect the Taj

16 Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, New Delhi, "Pollution Control Acts, Rules and Notifications Issued Thereunder" (Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, New Delhi, April 2021), https://cpcb.nic.in/7thEditionPollutionControlLawSeries2021.pdf.

Mahal from air pollution generated through all sectors.[17] The Taj Mahal is a mausoleum at the outskirts of the city of Agra in the state of Uttar Pradesh; it is a UNESCO World Heritage Site and one of the Seven Wonders of the World.

Another example is the Commission for Air Quality Management in National Capital Region and Adjoining Areas (CAQM), which is composed of representatives from various ministries, research institutions, pollution control boards, and other government and non-government stakeholders. CAQM issues various advisories and directions to manage air quality in Delhi NCR, and these include implementing appropriate GRAP guidelines. Phaseout of diesel auto rickshaws from Delhi NCR is one example of a direction passed by CAQM.[18] The CPCB's GRAP provides prescriptive guidelines for actions to improve the air quality with respect to all sectors, including transport, when there are various levels of air quality degradation.[19]

Pathway 2: The central government launches a national LEZ and ZEZ program through MoEFCC and empowers state governments to implement the zones



The second pathway involves the central government, state governments, central and state pollution control boards, and city governments. This pathway is based on the central government's powers under the EP Act and the functions of the pollution control boards under the Air Act.

Section 3 of the EP Act empowers the central government to ensure coordination between various agencies and institutions such as state governments, ministries, and departments through nationwide programs. The pollution control boards have a similar function under Section 16 of the Air Act. Also, per Section 18 of the Air Act, the CPCB is bound by directions issued by the central government, while SPCBs are bound by directions from the CPCB or the state governments. Both MoEFCC and the pollution control boards can publish guidelines, codes, and manuals.

Thus, as a pathway, the central government can launch a national program through MoEFCC and entrust the CPCB and SPCBs to work with the state governments and urban local bodies to plan and implement the program. MoEFCC can publish a guidance document that describes the criteria that makes cities eligible to implement LEZs and ZEZs and the time-bound targets to be achieved.

The National Clean Air Programme (NCAP) is an example of a national program launched by the central government using a similar framework. Pollution control boards

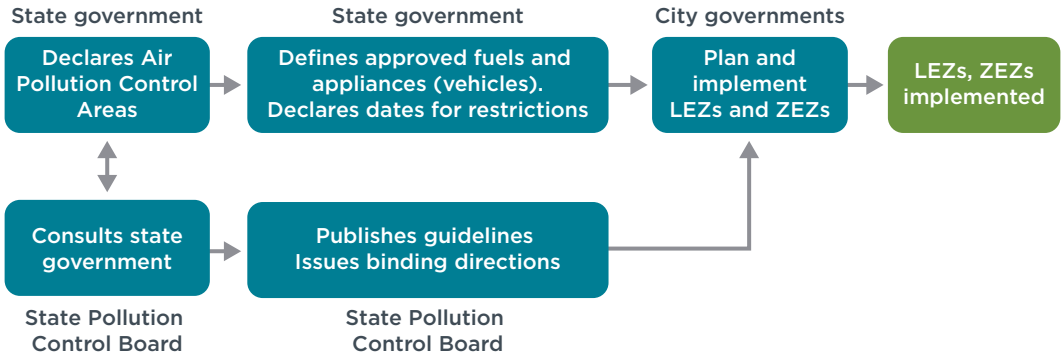
17 Department-Related Parliamentary Standing Committee on Science & Technology, Environment & Forests, New Delhi, "Two Hundred and Sixty Second Report on Effects of Pollution on Taj," (Rajya Sabha Secretariat, New Delhi, July 2015), http://www.ttzagra.com/docs/262%20P.S.C.%20Report.pdf.

18 Commission for Air Quality Management in National Capital Region and Adjoining Areas, "F.No. A-110018/01/2021. Abating Air Pollution from Public Transport Sector - Regulations on Diesel Operated Auto Rickshaws."

19 Central Pollution Control Board and Ministry of Environment, Forest & Climate Change Government of India, New Delhi, "Graded Response Action Plan for Delhi & NCR."

were entrusted to oversee its implementation. MoEFCC also published a guidance document for NCAP. In it, LEZs are included under the list of "broad strategies at various levels," but they are not explicitly stated as a requirement.[20]

Pathway 3: States declare air pollution control areas



The third pathway involves state governments, the SPCBs, and city governments. It is based on the powers of the state governments and the functions of the SPCBs under the Air Act.

Section 19 of the Air Act empowers state governments to declare any areas as air pollution control areas in consultation with the SPCB. The states can then prohibit the use of certain fuels and/or restrict the use of appliances, which can include vehicles, in all or part of the area. The states are also empowered to specify the dates in which restrictions apply, and to divide, merge, or extend such air pollution control areas. In addition, state governments can specify different dates for restricting appliances in different parts of an air pollution control area and different dates for the use of different appliances. SPCBs can issue binding directions to any person, officer, or authority with respect to regulating any operation under Section 31A of the Air Act, and this could include the operation of vehicles.

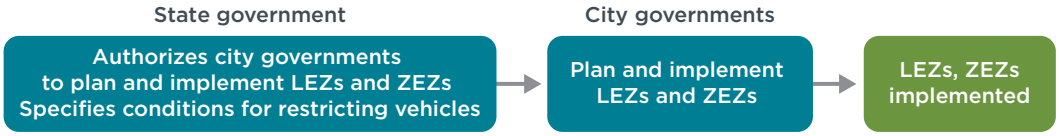
As a pathway, state governments can declare whole cities or parts of cities as LEZs or ZEZs after consulting with the SPCBs. States can declare rules for operating certain vehicle types and for fuel use in the zones and specify dates on which the restrictions apply. If a state is already an air pollution control area, the state government can divide it into multiple areas.

Many states, including Maharashtra, are air pollution control areas, and so is Delhi (National Capital Territory). An example of an SPCB restricting operations and appliances was in 2022, when the Delhi Pollution Control Committee (a pollution control committee is the equivalent of a pollution control board for a union territory) prohibited entry by non-BS VI diesel light motor vehicles, and all medium- and heavy-duty vehicles except CNG, electric, and those carrying essential goods in an effort to improve air quality. These directions were in line with GRAP guidelines.[21]

20 Ministry of Housing and Urban Affairs, New Delhi, "Long-Term, Time-Bound, National Level Strategy to Tackle Air Pollution-National Clean Air Programme (NCAP) To Achieve 20% to 30% Reduction in Particulate Matter Concentrations by 2024," news release, September 16, 2020, https://pib.gov.in/PressReleasePage.aspx?PRID=1655203.

21 Delhi Pollution Control Committee, "F. No. DPCC/CMC-I/CAQM/2022/1514," November 3, 2022, https://www.dpcc.delhigovt.nic.in/uploads/news/6fcf774ba1099f8db85685bbbc1bbb2b.pdf.

Pathway 4: States use the Central Motor Vehicle Act



The fourth pathway involves state and city governments. It is based on provisions in the Central Motor Vehicle Act, 1988 (hereafter "CMV Act").

The CMV Act establishes protocols and rules for motor vehicles. Under Section 115, "The State Government or any authority authorised in this behalf by the State Government, if satisfied that it is necessary in the interest of public safety or convenience . . . may by notification in the Official Gazette, prohibit or restrict, subject to such exceptions and conditions as may be specified in the notification, the driving of motor vehicles or of any specified class or description of motor vehicles . . . either generally in a specified area or on a specified road." If restrictions are expected to last less than one month, a gazette notification is not required. So, the state government can authorize any authority in the state to impose vehicle access restrictions, including defining the types of vehicles restricted, to protect public safety and convenience, and this protection can include protection from the health hazards of vehicular emissions. If restrictions are expected to last less than one month, a gazette notification is not required.

As a pathway, state governments can delegate powers to city governments to prohibit certain polluting vehicles from specified geographic areas (e.g., city limits or areas within cities). According to the law consultant, state governments can also enable cities to pilot LEZs and ZEZs for up to one month without issuing a gazette notification.

Delhi implemented its odd-even road space rationing scheme using Section 115 of the CMV Act.[22] Cities like Pune, Ahmedabad, and Mumbai have used this section to restrict access to heavy-duty vehicles during certain times of day.[23]

Pathway 5: The state government and city municipal corporations use the Maharashtra Municipal Corporation Act

The fifth pathway involves the state government and city governments (municipal corporation) using provisions in the Maharashtra Municipal Corporations Act, 1949 (hereafter "MMC Act"). Maharashtra is used here as an example; other states can use similar provisions if available in their laws.

22 Notification No. F.3 (218)/MRTS/Tpt./2015/302, Transportation Department, Government of National Capital Territory of Delhi, December 28, 2015, http://it.delhigovt.nic.in/writereaddata/egaz20157544.pdf.

23 Vijay Chavan, "Heavy Vehicles Banned on Nagar Road Stretch," *Pune Mirror*, November 2, 2017, https://punemirror.com/pune/civic/heavy-vehicles-banned-on-nagar-road-stretch/cid5139807.htm. ; Press Trust of India, "Gujarat: Movement of Heavy Vehicles Restricted in Ahmedabad City," *The Economic Times*, November 24, 2020, https://economictimes.indiatimes.com/news/politics-and-nation/gujarat-movement-of-heavy-vehicles-restricted-in-ahmedabad-city/articleshow/79386010.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.; Order No. 94/Addl CP/Traffic/2017, Mumbai Traffic Police, April 29, 2017, https://images.mahatrafficechallan.gov.in/GetPublicNotice/800168/201704290000_800168_NotificationNo76AddlCPTraffPermanent2017.pdf.

Section 208 of the MMC Act empowers the municipal commissioner, with approval from the municipal corporation, to "prohibit vehicular traffic in any particular public street vesting in the corporation so as to prevent danger, obstruction or inconvenience to the public by fixing up posts at both ends of such street or portion of such street" and to "prohibit in respect of all public streets, or particular public streets, the transit of any vehicle of such form, construction, weight or size . . . as may be deemed likely to cause . . . risk of obstruction to other vehicles or pedestrians along or over such street or streets, except under such conditions as to time, mode of traction or locomotion . . . and other general precautions and the payment of special charges as may be specified by the commissioner generally or specially in each case." Thus, municipal corporations can restrict vehicle access to specified streets, and can specify the types of vehicles and the amount of time covered by the restriction, as well as charges for accessing such streets.

Per sections 455 and 456 of the law, the state government can direct any municipal corporation to make any rules, or amend any rules it has made. Alternatively, the state government can make rules and direct their implementation by the municipal corporations. Thus, as a pathway, the municipal corporations can empower municipal commissioners to impose such schemes on specified streets, along with their own rules. Multiple streets can be specified to form an area. The Maharashtra state government can also direct municipal corporations in Maharashtra to frame such rules, or it can frame the rules itself and direct municipal corporations to implement them.

Other state-level pathways

There are two other possible state pathways: One could ensure that LEZs and ZEZs become part of the city's development vision; in the other, LEZs and ZEZs could be implemented in areas under the jurisdiction of the forest departments.

Regarding the first, the Maharashtra Regional and Town Planning Act, 1966 establishes practices for planning development and land use in Maharashtra. Section 13 empowers the regional board to draw up regional plans. Section 21 requires planning authorities from Maharashtra's cities to prepare development plans. While development plans cover areas under the city government, regional plans cover more territory to ensure holistic development of a larger area. Both regional and development plans should include the plan for development of transport infrastructure and could include other discretionary subjects. Metropolitan Region Development Authorities (MRDA), under the Maharashtra Metropolitan Regional Development Authority Act, 2016, supersede the municipal corporations and are entrusted with implementing regional plans, assisting local authorities in preparing and revising development plans, and coordinating their efforts. The state government can issue directions to the MRDAs, and the MRDAs can in turn issue directions to the municipal corporations under Section 15 of the law. Thus, if LEZs and ZEZs are integrated into the regional and development plans, they can become a part of the city's vision.

The second pathway is available under the Indian Forest Act, 1927. Section 25 of the Indian Forest Act empowers forest officers to "stop any public or private way in a reserved forest . . . provided that substitute for the way . . . which the State Government deems to be reasonably convenient, already exists, or has been provided or constructed by the Forest-officer in lieu thereof." The forest officers can restrict vehicle access to areas under the state forest department with approval from the state government. Thus, as a pathway, state forests can be declared LEZs or ZEZs.

For example, private motor vehicles were temporarily banned from Sinhagad Fort, located inside a reserved forest near Pune, to avoid congestion and pollution. The Maharashtra State Forest Department partnered with Pune's transit authority, which

operated electric buses to ferry passengers from parking at the foothill to the top.[24] Additionally, an environment charge has been in place for over a decade at Sinhagad Fort for private vehicles.[25]

Enabling provisions for enforcement and effectiveness of LEZs and ZEZs

Apart from the implementation pathways identified above, some legal provisions can support enforcement and enhance the effectiveness of LEZs and ZEZs.

The Ministry of Road Transport and Highways (MoRTH) is an apex body for formulating and implementing policies related to road transport and infrastructure. One of MoRTH's functions under the CMV Act is to formulate a National Transport Policy, which could include LEZs and ZEZs to abate and prevent vehicular pollution.

Additionally, MoRTH publishes standard registration marks for vehicles, and the states implement them. MoRTH can publish registration marks to help identify vehicles based on their pollution levels. MoRTH has already issued special stickers to distinguish between petrol, CNG, and diesel vehicles, and a new mark to identify BS VI vehicles.[26] India already issues green registration plates for zero-emission vehicles.

MoRTH can also strengthen India's in-service vehicle inspection and maintenance program to improve the effectiveness of LEZs and ZEZs. MoRTH drafts rules regarding the Pollution Under Control (PUC) program, which defines acceptable levels of emissions from in-service vehicles.

The National Highways Authority of India (NHAI) was formed under the National Highways Authority of India Act, 1988 for construction, maintenance, and management of India's national highways. Section 35(2) of the law empowers the NHAI to make regulations to restrict vehicles in any part of the national highway. The central government can also issue binding directions to NHAI under Section 33 (through MoRTH). Thus, in cities where national highways pass through the LEZs or ZEZs, restrictions can be extended to those segments of the highway.

Pathways 4 and 5 can also be supported by Section 33(b) of the Maharashtra Police Act, 1951, under which the police have authority to restrict vehicles to avoid danger, obstruction, or inconvenience to the public. This can be implemented by the commissioner of police upon orders from a district magistrate, subdivisional magistrate, or any other executive magistrate.

Various penalty mechanisms could be applied to improve compliance with implemented LEZs and ZEZs. The CMV Act has several provisions for penalizing noncompliance, including a general provision under Section 177 that applies ₹500 and ₹1,000 fines, respectively, for the first and second or subsequent breaches of any regulation or notification under the act. A ₹2,000 penalty can be enforced under Section 179 for disobedience of orders given by anyone empowered under the act. Finally, under Section 200, the state government can empower any officer to compound all the penalties, which could add to the deterrent effect. Under the MMC Act, anyone who does not follow the rules notified by the municipal commissioner can

24 Soha Patil, "A New Way to the Old Sinhagad Fort," *Pune Mirror*, May 14, 2022, https://punemirror.com/pune/others/A-new-way-to-the-old-Sinhagad-Fort/cid7393799.htm.

25 Sandip Dighe, "Pune: Environment Charges for Vehicles Going to Sinhagad Fort Doubled," *The Times of India*, October 20, 2021, https://timesofindia.indiatimes.com/city/pune/environment-charges-for-vehicles-going-to-sinhagad-fort-doubled/articleshow/87144434.cms?frmapp=yes&from=mdr.

26 Order Number 6052(E). Motor Vehicles High Security Registration Plate Order 2018, Ministry of Road Transport and Highways, Government of India, December 6, 2018, https://morth.nic.in/sites/default/files/circulars_document/CMVR%20rules%201989%20for%20HSRP.pdf; Order Number 1759(E). Motor Vehicles (High Security Registration Plates) Amendment Order, 2020," Ministry of Road Transport and Highways, Government of India, June 5, 2020, https://morth.nic.in/sites/default/files/notifications_document/SO%201759%28E%29-dated-5th-June-amendment-in-Green-Strip-for-BS-VI-HSRP-order-2018.pdf.

be penalized up to INR 1,000, or imprisoned for up to six months, or both, under the Indian Penal Code 1861 for not following the orders of a public servant.

Finally, the judiciary in India plays an important role as a horizontal accountability measure. When the government fails to use its powers under the law to abate vehicular pollution, the judiciary can take suo moto cognizance (take action at its own discretion) or cognizance through Public Interest Litigations (PILs) or writ petitions and direct the government to act and implement LEZs and ZEZs.

Discussion

We presented five pathways for implementing LEZs and ZEZs in India that might be useful for urban areas, and these can be implemented as mandates. For investigating state and city-level pathways, we studied laws in the state of Maharashtra. While we discussed only the most important actors with roles in setting up LEZs and ZEZs, many more actors and stakeholders would be involved during implementation and enforcement. We also discussed two supporting pathways at the state level, and mechanisms available for improving their effectiveness.

Overall, there are various pathways through which it is possible to introduce LEZs and ZEZs in India. The first pathway is the most authoritative, as the central government directly notifies various cities as LEZs and ZEZs. The second pathway includes a national-level program for LEZs and ZEZs in which the central government requires various state governments to work with cities to plan and implement LEZs and ZEZs. The third pathway begins with state governments declaring various cities or regions as air pollution control areas. In the fourth pathway, the state government empowers cities to impose restrictions on polluting vehicles under the Central Motor Vehicle Act. Finally, under the fifth pathway, municipal corporations could plan and implement LEZs and ZEZs without any state or national mandates, although the state government could also initiate the process under the Maharashtra Municipal Corporation Act.

To understand the scale of impact, pathways 1 and 2 create a national-level impact because they originate with the central government. Pathways 3 and 4 create a state-level impact, and the fifth pathway can create a state- or city-level impact, depending on which entity initiates the rulemaking process. Thus, pathways 1 and 2 can create accountability and harmonization between various LEZs or ZEZs at the national level, while pathways 3, 4, and 5 are limited to the state or city levels.

All identified pathways support implementation of both LEZs and ZEZs. All five pathways are based on provisions in the law to either prevent air pollution from all sources, including vehicles, or to restrict vehicles based on a broad set of descriptions provided by the implementing body.

All pathways have the potential to create an area-wide effect. Pathways 1 to 4 make it possible to implement LEZs and ZEZs at an area level. There is flexibility in defining the scale of the area and it could range from a few streets to neighborhoods and cities. While pathway 5 is targeted at a street level, multiple streets could be included to form an area.

Depending on the goal, different existing laws could be used. It is important to look at the purpose of the laws that support the pathways. Pathways 1, 2, and 3 are derived from laws that support reduction of air pollution. The primary purpose of pathway 4 is to regulate the circulation of vehicles to manage traffic flow, but the broad nature of the legal provisions supporting it can enable regulation of the circulation of polluting vehicles. In the case of pathway 5, danger, obstruction, and inconvenience to the public has been interpreted as a public health hazard, and protecting public health remains

the primary purpose. Pathways where protecting public health is the primary purpose could have a better chance of public and political acceptance.

If the pathways can offer design flexibility to cities, LEZs and ZEZs can be designed to meet the needs of the cities. This can be important for their success. Pathway 1 could be the least flexible, although this depends on the rules framed by the central government. Other pathways include participation by state and the city governments, which improves flexibility.

There is risk of noncompliance or abrogation with some pathways. Pathways 3, 4, and 5 originate at the state or city levels, and thus the city or the state must initiate, implement, and enforce them. Each initiator will have its own timeline, and a change of government poses a risk of abrogation of the plans. Nonetheless, implementation using pathways 1, 2, 3, and 5 can be passed on as mandates from the central or state governments. In pathway 4, the state government can only empower the city governments to restrict polluting vehicles. The choice of implementation could remain with the cities if this pathway is used in isolation.

Most pathways can also support the abatement of air pollution from other sectors. While this paper discussed transport-focused LEZs and ZEZs, multiple sectors contribute to air pollution and complementarity with other sectors could make a stronger case for LEZs and ZEZs. Because the primary purpose of the laws that support pathways 1, 2, and 3 is to prevent and control air pollution from all sources, these pathways can also help governments to manage pollution from other sources for greater public health benefits.

We also identified some supporting pathways. Supporting pathways can play an important role in starting a conversation around LEZs and ZEZs and introduce the concept to the public. One such pathway involves implementing LEZs and ZEZs in forest areas. While the impact here would be limited to tourist vehicles, it could be "low-hanging fruit" as it would be easier to provide alternative transportation in such areas. Another pathway is to include LEZs and ZEZs in regional and city development plans. As these are primarily vision documents, this could be a good way to include such zones in long-term city planning.

Finally, we discussed enablers that can help in the enforcement and effectiveness of LEZs and ZEZs. These include registration marks for vehicle identification, a better vehicle inspection and maintenance program, and the National Transport Policy. There is also a question about the enforceability of such policies because many existing policies have never been implemented. According to the law expert, any policy mandated by law is enforceable. In this case, the National Transport Policy is a statutory requirement under the Central Motor Vehicle Act, 1988, and the central government is accountable for implementing it.

To achieve maximum impact and reap maximum benefits in public health and air quality improvements from a transport-focused LEZ or ZEZ, the analysis suggests that national pathways are most suitable. However, existing state- and city-level pathways also empower state and city governments to act independently.

Appendix.

Table A1. Summary of authority at national, state, and local levels for notifying LEZs and ZEZs in India.

	National level
	State level
	Local level
	Enabler

Pathway	Authority	Description of explicit powers	Relevant citations	Precedent	Implementing agencies	Penalty	Law consultant's opinion
1	MoEFCC can declare any area as an LEZ/ZEZ under EP Act, in interest of environmental protection and safeguarding.	Blanket authority to issue rules with respect to matters such as the standard of air within an area, including any type of restriction on any operations (includes vehicles) discharging emissions in excess of prescribed standards; setting out restrictions in areas in which any industries, operations, or processes or class of industries, operations, or processes shall not be carried out; issuing directions for the closure, prohibition, or regulation of any industry, operation, or process.	EP Act Sections 3, 5, 6, 7, 23	Matheran Eco-sensitive Zone, Taj Trapezium Zone, Commission for Air Quality Management in National Capital Region and Adjoining Areas	MoEFCC, authorities set up by MoEFCC for the purpose of performing functions and powers of MoEFCC as provided in the EP Act.	Penalty Section 5 under EP Act– Imprisonment for a term which may extend to 5 years or fine up to INR.1 lakh or both.	This pathway is the most effective pathway as the MoEFCC can, without the involvement of any other authority, impose pollution restrictions in a particular area. Since it has also been empowered to set up separate authorities to do so, implementation can be relatively faster.
2	Central government can create LEZ programme that may include multiple cities	Plan programmes for prevention, control, and abatement of air pollution and secure execution of programme. Lay down standards for emissions of pollutants from automobiles CPCB is bound by the instructions of the central government and the SPCBs are bound by the instructions of the CPCB and state governments.	Air Act sections 16, 17, 18.	National Air Quality Monitoring Programme, National Clean Air Programme	CPCB, SPCBs, pollution control committees.	Under Section 31A of the Air Act the central board and the state board can issue 'any' binding directions to any person, officer, or authority. Section 37 - Failure to comply with such directions invites imprisonment for 1.5 to 6 years and with fine.	This is an important aspect of the pathway as implementation of programmes that can study the air quality of a particular state/area can help identify the measures that needs to be taken by exercising the relevant power and securing implementation.

Pathway	Authority	Description of explicit powers	Relevant citations	Precedent	Implementing agencies	Penalty	Law consultant's opinion
3	State government, after consulting the SPCB, can declare any area an LEZ or ZEZ (air pollution control areas) under Air Act	Restrict / prescribe designated fuels for use within such areas. Restrict use of appliances in the area.	Air Act Section 19	Delhi Pollution Control Committee's directions to restrict truck and diesel traffic in Delhi in November 2022. Maharashtra has been declared a pollution control area.	State government, SPCB	Section 31A Section 37 Section 38 – Whoever obstructs any person acting under the orders or directions of the board from exercising his powers and functions, fails to intimate the occurrence of the emission of air pollutants into the atmosphere in excess of the standards laid down by the state board or the apprehension of such occurrence, to the state board, shall be punishable with imprisonment for a term which may extend to three months or with fine which may extend to 10,000 rupees.	This pathway empowers the state government to take cognizance and declare pollution control areas, which is in consonance with the mandate herein. Further, considering that the penalties extend to imprisonment plus a fine, this will have a deterrent effect.
4	State government or authorized authority on its behalf can restrict access by specified vehicle classes to any road or area under CMV Act, in the interest of public safety and convenience.	Restrict access of concerned vehicle classes to specified time of day Specify access charges for concerned vehicle classes	CMV Act Section 115	Delhi odd-even rule restrictions.	State government	Section 194 of the CMV Act provides that whoever drives a motor vehicle or causes or allows a motor vehicle to be driven in contravention to the provisions of Section 115 shall be punishable with a fine of 20,000 rupees and an additional amount of 2,000 rupees per tonne of excess load, together with the liability to pay charges for off-loading of the excess load.	
5	Municipal corporations can restrict vehicle access to specific roads to regulate avoid inconvenience to public	Municipal corporations can prohibit access to vehicles to some public streets Regulate discharge of smoke, etc in a particular area State Govt can direct municipal corporations to make rules for any subject, or can do it suo motu (by itself).	MMC Act Sections 208, 457, 456		Municipal commissioner for all municipal Corporation except for the Municipal Corporation of Greater Mumbai.	MMC Act does not have any specific provision (unlike the Air Act) for enforcing compliance of the orders of the municipal commissioner. Under Section 482 (1) of the MMC Act, the commissioner of a municipal corporation has been deemed as a public servant in conjunction with the meaning assigned to it under Section 21 of the IPC. The MMC Act therefore needs to be read in conjunction with the provisions of Indian Penal Code, 1860 (IPC) and the Code of Criminal Procedure, 1973 (CrPC). When read in consonance with Section 188 of the IPC, a fine of INR 1000, up to six months imprisonment, or both may be imposed.	This pathway addresses the concern of inconvenience being caused to public by the movement of either all or some kind of vehicles depending on engineered make. It is a good pathway to reduce vehicular traffic and emissions in heavily crowded areas such as market places, narrow lanes in heavily populated neighbourhoods, and other places which provide very few options of ventilation against noxious fumes.

Pathway	Authority	Description of explicit powers	Relevant citations	Precedent	Implementing agencies	Penalty	Law consultant's opinion
Supporting pathway	Municipal corporations in Maharashtra can restrict access by specified vehicle classes or engineered type to any road under MMC Act / Police Act, in interest of public safety and convenience.	Restrict access to specified time of day. Specify access charges for concerned vehicle classes.	Section 33(b) of the Maharashtra as well as Gujarat Police Act, 1951 (Formerly the Bombay Police Act applied to both states)	Ahmedabad commissioner orders restricting movement of heavy vehicles to certain hours.	Police commissioner upon orders of a DM, SDM, or any other executive magistrate.	MMC Act does not have any specific provision (unlike the Air Act) for enforcing compliance of the orders of the municipal commissioner. However, the MMC Act needs to be read in conjunction with the provisions of IPC and the CrPC. When read in consonance with Section 188 of the IPC, a fine of INR 1000, or up to six months imprisonment, or both.	This pathway is also a good option to enforce the mandate. It applies to the entire area of a police commissioner's authority, meaning it covers larger areas as compared to Section 208 of the MMC Act which only covers particular streets.
Supporting pathway	Indian Forest Act	Authorized officers can restrict movement using public ways in a reserved forest.	Section 25	Sinhagad Fort near Pune imposes environmental charge on motorists and had banned entry of vehicles.	Forest officer, relevant state government.	Section 77 of the Forest Act provides that any person contravening any rule under the Forest Act, for the contravention of which no special penalty is provided, shall be punishable with imprisonment for a term which may extend to one month, or fine which may extend to 500 rupees, or both.	This is a good provision for implementation of LEZ/ZEZ at state level in 'forest areas' with the limitation that the forest officer can only act on the sanction of the state government and cannot act independently.
Enabler	NHAI Act	MoRTH / NHAI can make regulations regarding restriction or prohibition of access to any part of the national highway	Section 35(2)	-	MoRTH, NHAI	Section 27 of the NHAI Act provides that members, officers, employees of NHAI shall be deemed to be public servants under the IPC. When read in consonance with Section 188 of the IPC, a fine of INR 1000 or up to 6 of months imprisonment or both may be imposed.	The NHAI, as a stand-alone authority cannot implement LEZ/ZEZ but can assist other empowered authorities in implementation of the mandate.
Enabler	PILs, writ petitions	Supreme Court, High Court can issue directions to state governments, central government.	Articles 32 and 226 of the Constitution of India	-	Supreme Court, High Court		This is an independent pathway that can be used to force the authorities to use powers under various statutes to implement the pathways identified.

Note:
EP Act – Environment Protection Act, 1986
Air Act – Air (prevention and control of pollution) Act, 1981
MMC Act – Maharashtra Municipal Corporation Act, 1949
CPCB – Central Pollution Control Board
SPCB – State Pollution Control Board
CMV Act – Central Motor Vehicle Act, 1988
MoRTH – Ministry of Road Transport and Highways
NHAI – National Highway Authority of India
PIL – Public Interest Litigation