

# Low-emission zone in Sofia: Projected NO<sub>x</sub> and PM emission benefits

## BACKGROUND

The residents of Sofia, Bulgaria are exposed to levels of ambient air pollution that are among the worst in Europe. Motor vehicles contribute significantly to this pollution, making them an important target for clean air policies. One such measure, a low-emission zone (LEZ), is included in the city's most recent environmental action plan, and initial discussions are underway regarding the design and implementation schedule for the LEZ.

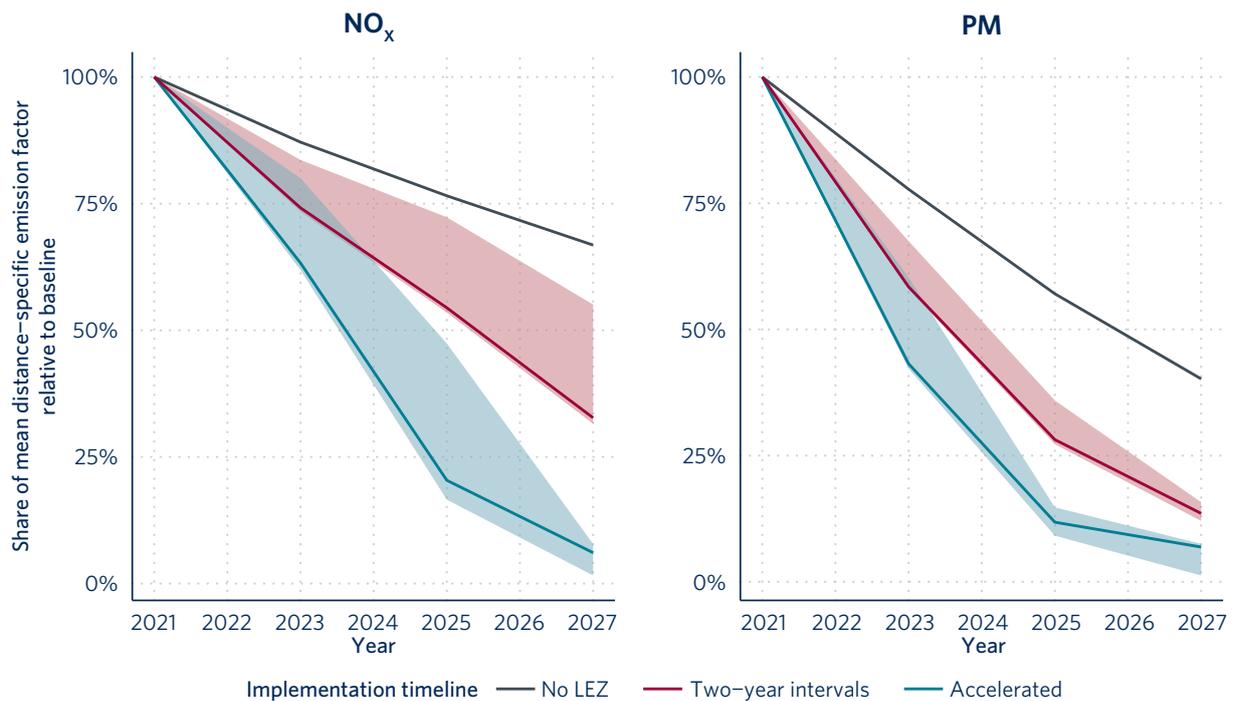
A new TRUE Initiative study investigates the impacts of an LEZ in Sofia on vehicular emissions of harmful air pollutants. Using the TRUE database of real-world emissions from European vehicles and information about the Sofia fleet, the study designs and evaluates two LEZ implementation schemes to assess the degree to which such measures can accelerate reductions in nitrogen oxide (NO<sub>x</sub>) and particulate matter (PM) from the city's passenger vehicle fleet.

## FINDINGS

- Diesel cars certified to Euro 4 or older emission standards are responsible for 56% of total NO<sub>x</sub> emissions and 85% of total PM emissions, while making up only 28% of the fleet. Actions to remove these vehicles from Sofia's roads will have a disproportionately positive impact on reducing fleet emissions.
- In the absence of new actions to address in-use vehicle emissions, natural fleet turnover will reduce the average NO<sub>x</sub> emissions of the Sofia passenger car fleet 33% by 2027 and 59% by 2032, relative to current levels. In addition, PM emission will be reduced 60% by 2027 and 83% by 2032.
- An LEZ design in which vehicle access restrictions are introduced in 2022 and tightened every two years through 2032 would deliver substantially larger emissions reductions in a shorter timeframe. Such a design would move forward the point in time at which the LEZ achieves a 75% reduction in the fleet-average emission factor six to eight years earlier for NO<sub>x</sub> and four to five years earlier for PM.
- If access restrictions are tightened every year, rather than every other year, fleet-average NO<sub>x</sub> and PM

**Table 2.** Low-emission zone design for Sofia.

Phase	Minimum standard		Implementation timeline (year)	
	Diesel	Petrol	Two-year intervals	Accelerated
	No restriction	No restriction	2021	2021
1	Euro 3	Euro 2	2022	2022
2	Euro 4	Euro 3	2024	2023
3	Euro 5	Euro 3	2026	2024
4	Euro 6	Euro 4	2028	2025
5	Euro 6d	Euro 5	2030	2026
6	Euro 7	Euro 6d	2032	2027



**Figure.** Reduction in mean distance-specific emission factors of NO<sub>x</sub> (left) and PM (right) relative to baseline (2021) levels as a result of “two-year intervals” and “accelerated” implementations of a low-emission zone as opposed to a case with no LEZ. Shaded areas show the ranges of possible emissions reductions that depend on the responses of vehicle owners affected by LEZ restrictions. Darker lines show the emissions impacts of a scenario in which vehicle owners replace their non-compliant vehicles with the cleanest available petrol vehicles. Additional scenarios considered include one in which vehicle owners switch to zero-emission activity (lower range of each shaded area) and a one in which vehicle owners buy the minimum compliant vehicles (upper range of each shaded area).

emission factors are estimated to be 82%–94% and 48%–92% lower, respectively, than in the less rapid implementation schedule by 2027. Under this schedule, the LEZ would achieve a 75% reduction in the fleet-average emission factor approximately 10–11 years earlier for NO<sub>x</sub> and 6 years earlier for PM.

- The emission benefits of the LEZ are, in part, dependent on vehicle owner’s responses to access restrictions. The greatest benefits are realized when affected drivers replace restricted vehicles with the cleanest available petrol vehicle or switch to zero-emission activity. Emission benefits are delayed if owners opt to purchase the minimum compliant vehicle at each phase of the LEZ implementation.

Additional incentivization of zero-emission activities, such as driving zero-emission vehicles, taking public transportation, or walking would complement the LEZ and strengthen its impacts.

- The LEZ would yield emission benefits as soon as it is introduced. The earlier the LEZ is implemented, the greater the emission reduction and the contribution to cleaner air quality will be.
- The effectiveness of the LEZ in reducing total emissions in Sofia depends on the area the restrictions will cover. An ambitious LEZ policy in which the LEZ expands to a greater geographic area would lead to larger emission benefits for a larger fraction of residents.



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