

The equity implications of changes in accessibility due to Low Emission Zones: the case of Madrid

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Extended abstract

Low emission zones (LEZ) have been implemented as a climate change policy intervention to **reduce GHG emissions**, improve **air quality**, and support **sustainable mobility** in many countries. Though rules vary depending on legal aspects and cultural norms, LEZ aim to deter or reduce traffic in specially designated zones under the penalty of fines and/or seizure of vehicle. In practice, this limits the volume of traffic by excluding vehicles by license plate, fuel type, or by introducing tolls. Impacts of LEZ are experienced at neighbourhood-scale and can be considered a **sustainable neighbourhood intervention**.

Fundamentally, LEZ is an intervention characterized by *geographical discrimination*. By excluding or limiting certain users from designated spaces, **LEZ** aim to influence **how people use infrastructure and technology to access destinations**. For instance, instead of a less sustainable diesel car trip from home into the LEZ for work, users are incentivized to use transit or purchase a sustainable car that can enter a LEZ (i.e., battery electric vehicle). Depending on certain factors, such as the location of the person's home, infrastructure for alternative transportation modes, and alternative locations for similar activities, the trip could mean higher travel times and/or travel costs.

As a form of geographical discrimination, these increases will have differential effects in space, and will affect people differently. **Equity considerations** are therefore crucial to understand the impact of LEZ and to ensure that those who are currently **marginalized** (i.e., low-income families, younger workers, single parents, those currently unemployed) are **not unduly impacted**.

As such, the focus of this paper is to investigate the impacts of Madrid's LEZ on **multi-modal accessibility to employment** (i.e., comparisons in the potential to commute to work using a private vehicle, public transit, or active transportation). The case study of Madrid is selected as it is one of the **pioneering municipalities** in Spain to adopt LEZ. Understanding the equity of the accessibility changes can reveal lessons for equity-informed LEZ implementation across the country (as specified in the country's recent climate change plans¹⁻²). Further, findings from this paper can be applied by municipalities internationally considering LEZ.

¹ MITECO (2020) Plan Nacional Integrado de Energía y Clima 2021-2030. Gobierno de España

² MITECO (2019) Plan Nacional de Control de la Contaminación Atmosférica. Gobierno de España

The primary research question is to evaluate how LEZ current and future expansion change Madrid's accessibility to employment for users of different modes. The secondary research question is to assess how specific policy actions can be implemented to enhance equity in LEZ-induced accessibility impacts. These policy actions could include improvements to transportation provision and infrastructure, relocation of employment, and affordable housing interventions.

A novel measure called *spatial availability*³ is used to quantify accessibility. Spatial availability is a **singly-constrained competitive accessibility measure** that proportionally allocates opportunities based on travel time to destinations and demand for spots at those destinations. The proportional allocation feature allows for comparative comparison of accessibility outputs across modes. The data used in analysis is publicly available **travel survey** for Madrid along with survey data that has been used to **estimate changes in travel behaviour** induced by the **current** LEZ and **future** LEZ plans

The findings from this analysis will provide **relevant equity-informed lessons** for countries who have not experimented with LEZ in relation to: **car access restrictions**, **pedestrianization** of city centers and/or **affordable housing** interventions as it relates to population-based equity characteristics.

³ Soukhov A, Páez A, Higgins CD, Mohamed M (2023) Introducing spatial availability, a singly-constrained measure of competitive accessibility. PLoS ONE 18(1): e0278468. <https://doi.org/10.1371/journal.pone.0278468>