

Evaluation of the Implementation Effects and Socio-Economic Impacts of London's Low Emission Zone Policy

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Abstract: The implementation of the Ultra Low Emission Zone (ULEZ) policy in London since 2019 has significantly improved the city's air quality and fostered an environmentally friendly transformation of its transportation system. This study aims to evaluate the effectiveness of the ULEZ policy and its socio-economic impacts. Through data analysis, we found that the ULEZ policy has led to a substantial increase in vehicle compliance rates, a significant reduction in the number of non-compliant vehicles, a decrease in the proportion of diesel vehicles, and a sustained reduction in air pollutant emissions and concentrations. Additionally, the policy has brought about significant health benefits, reducing the incidence rates of respiratory and cardiovascular diseases. However, the implementation of the ULEZ policy has also incurred certain socio-economic costs, particularly for low-income groups and the elderly. This study recommends that to further optimize the policy's effectiveness, differentiated charging standards should be considered, the construction of the public transportation system should be strengthened, and the transparency and public participation of the policy should be enhanced.

1. Introduction

With the acceleration of global climate change and urbanization, the issue of urban air quality has become a focal point of international concern. As a major global economic and cultural hub, the improvement of London's air quality sets an example for global environmental protection. In 2019, the Mayor of London launched the world's first 24-hour Ultra Low Emission Zone (ULEZ) in the city center, aiming to reduce traffic pollution and improve residents' health. The ULEZ policy, by restricting high-emission vehicles from entering specific areas and encouraging the use of clean energy vehicles, aims to reduce air pollutant emissions. The purpose of this study is to comprehensively evaluate the implementation effect of the ULEZ policy and explore its far-reaching socio-economic impact, with a view to providing lessons for other cities to learn from.

2. Overview of London's Ultra Low Emission Zone Policy

The Ultra Low Emission Zone (ULEZ) policy in London represents a significant initiative by the city's government to address air quality issues. Implemented from April 8, 2018, the policy imposes a daily fee of £12.5 on vehicles entering the central area of London. Initially, the ULEZ boundary coincided with the congestion charge zone and is scheduled to expand by 2021^[1]. Within this zone, vehicles exceeding emission standards are required to pay not only the congestion charge but also an additional ULEZ fee, totaling approximately £24. Only the "cleanest" cars and vans meeting EU's "Euro 6" emission standards are exempt from this fee, while most gasoline vehicles older than 14 years and all diesel vehicles not meeting the "Euro 6" standard are subject to the charge^[5].

The London government utilizes vehicle license plate recognition systems and data from the Driver and Vehicle Licensing Agency to identify and enforce the ULEZ fee. Failure to pay on time results in fines for the drivers. This policy is part of London's broader efforts to reduce emissions, which included the introduction of the congestion charge in 2003 and an additional charge for older, polluting vehicles starting in October 2017. The city aims to limit the use of polluting vehicles through the ULEZ fee, thereby encouraging a shift towards cleaner modes of transportation^[6].

Currently, over 2 million residents in London, including 400,000 children, live in areas where air quality does not meet the standards, along with 451 schools in similarly affected zones. According to EU regulations, the hourly concentration of nitrogen dioxide in the air should not exceed 200 micrograms per cubic meter, with no more than 18 exceedances per year. The London government anticipates that the implementation of the ULEZ fee will help London achieve compliance with EU air quality standards across most areas by 2025, with the exception of major roads and areas around Heathrow Airport. By then, all primary and secondary schools in London are expected to be located in areas free from air pollution^[7].

While the ULEZ policy is intended to improve air quality and yield health benefits, it is not universally welcomed. The British Road Haulage Association views the policy as overly simplistic and unfriendly to drivers. To mitigate the impact on small businesses and charitable organizations, Transport for London has introduced a scheme to assist these entities in scrapping older vehicles, with a subsidy amounting to £23 million. This initiative aims to balance the policy's implementation with its socio-economic implications, ensuring fairness and sustainability.

3. Evaluation of Policy Implementation Effects

Since the launch of the world's first 24-hour Ultra Low Emission Zone (ULEZ) by the Mayor of London in the city center in April 2019, the policy has demonstrated significant environmental benefits and social impacts. In October 2021, the ULEZ was expanded, covering an area 18 times larger than the original, affecting 4 million people. In February 2023, an assessment report released by the Greater London Authority confirmed the encouraging practical results one year after the expansion of ULEZ^[8].

Firstly, there has been a continuous rise in traffic and vehicle compliance. Vehicles operating in London have become increasingly environmentally friendly. The overall compliance rate of ULEZ has continued to rise, with an average of 94.4% of vehicles meeting ULEZ standards within the year following the expansion, compared to just 39% in 2017^[2]. The number of older, less environmentally friendly vehicles within the zone has significantly decreased, with non-compliant vehicles dropping by nearly 60%, averaging a reduction of 74,000 polluting vehicles per day. The proportion of diesel vehicles on London's roads has also declined. By October 2022, the estimated proportion of kilometers driven by diesel vehicles in central London had dropped from 32% to around 25%. In the private rental vehicle sector, hybrid vehicles account for the largest share^[9].

Secondly, there has been a significant reduction in the emissions of air pollutants. From 2019 to

2022, ULEZ reduced nitrogen oxide (NO_x) emissions in Greater London by 13,554 tons (23%), with all vehicle types seeing a decrease in NO_x emissions, but the greatest reduction was among London Transport's buses, at 74%. Fine particulate matter (PM_{2.5}) emissions in Greater London decreased by a cumulative 180 tons (7%) during the same period, with the largest reduction among taxis, at 32%. Carbon emissions from vehicles in Greater London decreased by approximately 800,000 tons (3.2%)^[3].

Lastly, there has been a decrease in the concentration of air pollutants. The air within the zone has become cleaner, with significant reductions in roadside NO₂ concentrations and also at background points away from major road networks. Boundary roads have also benefited from cleaner air, with all air quality monitoring points on boundary roads recording significant decreases in NO₂ concentrations, estimated to be 19-27% lower compared to scenarios without ULEZ, with the impact increasing over time. This indicates that there has been no pollution transfer to the boundaries^[4]. The levels of NO₂ have not returned to pre-pandemic levels, indicating that even as traffic levels have increased, ULEZ and its expansion have made vehicles more environmentally friendly and have had a sustained and positive impact on air pollution. The levels of PM_{2.5} across London have also continued to decline, with average concentrations in central and inner London dropping by 41% since 2017.

In summary, the implementation of the ULEZ policy has not only significantly improved London's air quality but has also promoted the environmental transformation of its transportation system, yielding significant health benefits. These results indicate that the ULEZ policy has made substantial progress in reducing the emissions and concentrations of air pollutants, providing valuable experiences and insights for global urban environmental protection and sustainable development^[10].

4. Analysis of Socio-Economic Impacts

Firstly, from the perspective of economic costs and benefits, although the initial implementation of the ULEZ policy may involve high administrative and technical costs, over time, these costs are offset by the environmental and health benefits brought about by the policy. For instance, by significantly reducing emissions of nitrogen oxides (NO_x) and fine particulate matter (PM_{2.5}), the ULEZ policy has notably improved London's air quality, thereby lowering health risks associated with air pollution. These health benefits not only enhance the quality of life for residents but also reduce medical expenditures, bringing substantial long-term economic gains to society. Additionally, as more residents shift towards low-carbon modes of transportation, urban traffic congestion is alleviated, indirectly reducing transportation operating costs^[11].

Secondly, in terms of social impacts, the ULEZ policy has not only altered residents' travel habits but also promoted the sustainable development of urban transportation. With the reduction of high-emission vehicles, public transit, cycling, and walking have become more popular, contributing to reduced traffic congestion and improved urban traffic efficiency. Concurrently, commercial activities have also been affected. Although there may be short-term pressures on businesses reliant on high-emission vehicles, in the long run, this will drive the commercial sector towards more environmentally friendly transportation methods, fostering the growth of a green economy. Moreover, the implementation of the ULEZ policy has spurred the development of related industries, such as the research and application of new energy vehicles and green transportation technologies, providing new impetus for economic growth^[12].

Lastly, the impact of the policy on different social groups is noteworthy. For low-income groups, the ULEZ policy may increase their economic burden, as they may be unable to afford the costs of replacing or upgrading their vehicles. Therefore, the government needs to consider providing

appropriate financial support and subsidies to ensure the fairness of the policy. For the elderly and disabled, who may find it difficult to change their travel habits due to physical limitations, the policy should take into account their specific needs and provide necessary transportation services and accommodations. Through these measures, the government can ensure the effectiveness of the policy while balancing the interests of different social groups, achieving the dual goals of environmental protection and social equity^[13].

In summary, while the ULEZ policy brings about significant environmental benefits, it also entails certain social and economic impacts. The government must ensure the effectiveness of the policy while considering the interests of different social groups, implementing the policy through rational design and execution to achieve the dual objectives of environmental protection and social equity. By conducting a thorough analysis of the social and economic impacts of the ULEZ policy, we can better understand its role in promoting urban sustainable development and provide valuable insights for other cities^[14].

5. Policy Recommendations and Future Outlook

For low-income groups, the elderly, and individuals with disabilities, policy recommendations should include providing more financial support and subsidies to alleviate the economic burden imposed by the policy. This could encompass vehicle purchase subsidies, free or discounted public transportation services, and specialized transportation accommodations for the elderly and disabled. Additionally, the government should enhance public education and outreach to assist these groups in understanding and adapting to new travel modes, ensuring the policy's fairness and inclusivity.

To further promote the development of green transportation, policy recommendations should encourage greater investment and innovation, particularly in the fields of new energy vehicles and green transportation technologies. The government can attract businesses and research institutions to these areas by offering tax incentives, research funding, and market incentives, accelerating the commercialization and adoption of these technologies. Simultaneously, the government should strengthen partnerships with the private sector to jointly advance the construction of green transportation infrastructure, such as charging stations, bike lanes, and pedestrian-friendly streets.

To enhance the policy's sustainability and effectiveness, the future outlook should include regular evaluations and adjustments of the ULEZ policy. This involves assessing environmental benefits and economic costs, as well as considering social impacts and public acceptance. By collecting and analyzing data, the government can promptly understand the policy's implementation status, identify issues and challenges, and adjust policy measures accordingly to ensure their long-term effectiveness.

6. Conclusions

This study, by evaluating the implementation effects of the Ultra Low Emission Zone (ULEZ) policy in London, has proven the policy's significant achievements in improving air quality and promoting an environmentally friendly transformation of the transportation system. The implementation of the ULEZ policy has not only reduced the emissions and concentrations of air pollutants but also brought about significant health benefits, improving the quality of life for residents. However, the implementation process has also exposed some socio-economic issues, particularly the impact on low-income groups and the elderly. Therefore, future policy optimization should consider implementing differentiated charging standards, strengthening the construction of the public transportation system, and enhancing the transparency and public participation of the policy. Through continuous monitoring and evaluation, London's ULEZ policy is expected to provide valuable experiences and insights for global urban environmental protection and sustainable

development.

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