Operationalizing fairness in next generation road pricing and mobility budgets: Helping London transport achieve net zero by 2030

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Abbreviations

ALS - Singapore's Area Licensing Scheme
BEIS - Department for Business, Energy & Industrial Strategy
CBD - Central Business District
CC - Central London Congestion Charge
CO2- Carbon dioxide
CO2e - Carbon dioxide equivalent
EV - Electric vehicle
gCO2e - Grams of carbon dioxide equivalent
GHG - Greenhouse gas
GLA - Greater London Authority
HOV - High-occupancy vehicles
KM - Kilometres
KM/PP/DAY - Kilometre per person per day
LEGGI - London Energy and Greenhouse Gas Inventory
LEZ - Low emission zone
LPR - Licence plate rationing
MtCO2e - Metric tons or tons of carbon dioxide equivalent
SDG - Sustainable Development Goal
TCS - Tradable credit scheme
TfL - Transport for London
ULEZ - Ultra low emission zone

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Introduction

In 2021, London Mayor Sadiq Khan announced the goal of London reaching net zero by 2030 (Greater London Authority [GLA], 2021). Net zero refers to the concept that greenhouse gas (GHGs) emissions are balanced by the removal of an equivalent amount of carbon dioxide (CO2) from the atmosphere or by preventing GHG emissions that would have occurred elsewhere (Element Energy, 2022). In order to reach net zero by 2030, the transport sector requires special attention. Between 2000 and 2018, London achieved a mere 7% reduction in transport emissions. Contrastingly, there was a 57% reduction in workplace emissions and a 40% reduction in home emissions (GLA, 2018b). The GLA (2022b) concluded that policies that can significantly reduce car traffic must be implemented.

The transition to net zero by 2030 must be just and fair so poorer and otherwise disadvantaged Londoners are not disproportionately affected by negative consequences of this strategic shift (GLA, 2022c). Martens (2016) observed that transport is an appropriate domain for justice and must be treated independently because injustices within the accessibility domain cannot be compensated by intervening in other domains.

LSE Cities is part of a research consortium led by the Austrian Institute of Technology called MyFairShare. MyFairShare is currently exploring the concept of individual mobility budgets as a mechanism for social and ethical carbon reduction in transport (Rode, 2022). The aim of this project is to support the work of MyFairShare, LSE Cities, and Transport for London (TfL) in preparation for a Living Lab in London. Our policy challenge is to explore how to operationalize a fairness framework as part of next generation road user charging and personal carbon mobility budgets to help London's transport sector achieve net zero by 2030.

For our scope, the project's spatial area of focus is Greater London. We consider the unified greenhouse gas (GHG) emission metric known as carbon dioxide equivalent rather than each GHG independently and focus specifically on private vehicle transport. To achieve our goal of incorporating carbon mobility budgets into road pricing mechanisms, our proposal is for London to expand the existing ultra-low emission zone (ULEZ), prohibit street parking in London's central business district (CBD), and implement a distance-based charging scheme based on a daily carbon budget allocation. We frame our policy recommendations in the context of the current political climate.

Methodology

We utilised quantitative and qualitative research methods to craft a policy recommendation aligned with what is politically feasible given existing constraints. We conducted a literature review of academic journal articles, government reports, and relevant legislation. We also conducted expert interviews with representatives from TfL.

We modelled out the London carbon budget to the individual level on a per day basis for urban mobility using the London Energy and Greenhouse Gas Inventory (LEGGI), which is compiled by the Department for Business, Energy & Industrial Strategy (BEIS) and TfL. The LEGGI includes direct (Scope 1), indirect (Scope 2), and embedded (Scope 3) carbon emissions (GLA, 2018c). Direct emissions occur within the GLA, indirect emissions result from consumption within the GLA, and embedded emissions occur outside the GLA but result from activities within the GLA (GLA, 2018c). We used the 2021 BEIS GHG Conversion Factors to determine the grams of carbon equivalent emissions (gCO2e) per kilometre (km) travelled for different modes of transport.

We employed a combination of types of equity such as fairness, inclusivity, affordability, and social justice to assign mobility budgets fairly (Litman, 2022). When thinking about implementation, we adopted an equity perspective based on the politics of fairness, data availability, and administrative constraints. We also reviewed equity consideration for locally enacted schemes in transport and other sectors such as housing, heating, and electricity.

We conducted a review of road pricing mechanisms that can be utilised to disincentivise road travel, encourage shifts to sustainable modes of transport, and build on the success of the existing London congestion charge of 2003. Transport policies from other developed countries also inform the practicality of our recommendation. Lastly, we considered the possibility of employing alternative instruments to road pricing such as nudging, tradable emission allowances, and rationing.

Section 1: London's urban mobility carbon budgets

1.1 Introduction

In 2008, the United Kingdom (UK) passed the Climate Change Act which committed the UK to reduce emissions by 80% by 2050 and to implement a system of legally binding five-year carbon budgets to do so. In 2018, Mayor Khan released a five-year carbon budgeting system for London allocated across homes, workplaces, and transport that had the more ambitious goal of reaching net zero by 2050 (GLA, 2018a). In 2021, in order to take urgent action to combat climate change in accordance with Sustainable Development Goal (SDG) 13, the Mayor boldly brought London's net zero goal forward to 2030 (Element Energy, 2022). This section will translate London's overall carbon budget to the transport sector and then to individual daily CO2e emissions for urban mobility to hit the goal of net zero by 2030.

1.2 Mobility budget

In 2018, the GLA set an annual transport budget of 5.5 million tonnes of carbon dioxide equivalent (MtCO2e) for the 2028-2032 time period (GLA, 2018a). The budget is calculated using the LEGGI and broken down into road transport, rail, aviation, and freight. In 2018 road transport emissions made up 78% of all transport emissions (GLA, 2018c). We assume this emission share will remain constant and apply this percentage to the 5.5 MtCO2e carbon budget for 2028-2032 resulting in an annual road transport carbon budget of 4.4 MtCO2e. In modelling pathways for London to hit net zero by 2030, Element Energy (2022) concluded that the transport sector would have to reduce emissions by a further 40% to reach net zero as a sector. Applying this reduction to the 4.4 MtCO2e road transport carbon budget results in a 2030 road transport carbon budget of 2.6 MtCO2e to reach net zero.

1.3 Addressable carbon budget

Conversations with TfL representatives made it clear that there is no political will to reduce travel on public transport due to the Mayor's goal of having 80% of trips in London be on active, efficient, and sustainable modes, such as walking, cycling, and public transport by 2041. Fares are also the single largest source of funding for TfL (TfL, 2020). Therefore, the amount of carbon emissions that can be targeted for reduction within this research is limited to private vehicle emissions. In 2019, the share of trips on private vehicles in Greater London was 37% (TfL, 2021a). The share of trips on private vehicles increased to 44% by 2021 due the COVID-19 pandemic (TfL, 2021a). This paper will make the assumption that private vehicle mode share will normalise to 37% and will thus use 37% of the carbon budget as the addressable carbon budget. This means the addressable carbon budget amount to achieve net zero by 2030 is 0.96 MtCO2e.

1.4 London 2030 population and urban mobility budget per person per day

GLA (2022b) forecasts London's population to be approximately 9.49 million in 2030. Taking the addressable urban mobility carbon budget of 0.96 MtCO2e, converting it to grams, dividing it by 9.49 million people, and dividing it by 365 days results in an road transport carbon budget of approximately 279 gCO2e per person per day. The table below takes the BEIS 2021 Government GHG conversion factors for company reporting to define how many kilometres may be travelled per person per day on a single mode under the proposed road transport carbon budget. Since there is a large range of petrol and diesel car engine sizes, a weighted average of gCO2e/km emitted is used. The end result is that a person's entire road transport carbon budget translates to 1.9 kilometre per person per day (km/pp/day) via internal combustion engine cars.

Table 1

gCO2e/km emitted by mode and km/pp/day per mode in accordance with the 279 gCO2e individual urban mobility budget

Mode	gCO2e/km emitted	km/pp/day
Weighted average car (petrol/diesel)	147.1	1.9
London Bus	78.1	3.6
Electric car	50.0	5.6
London Underground	44.0	6.3
Bicycle	14.0	19.9

Source: Authors' calculations

Section 2: Fairness approach

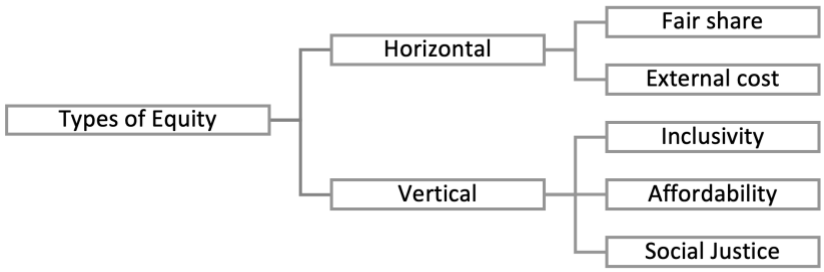
2.1 Introduction

The MyFairShare project looks for sufficiency within sustainable mobility, recognizing distribution challenges from transport and ecological mobility constraints. It considers three main pillars: allocation of mobility resources, carbon emissions, and space consumption (Rode, 2022). The application of fairness within transport policy requires identification of benefits and burdens, consideration of social characteristics, and definition of allocation principles (Martens et al., 2019). Within that framework, the differentiation of population groups may be MyFairShare's more challenging component. This section will cover theories of transport equity, explore how equity is approached in the UK, and propose who to consider for exemptions from carbon mobility budgets.

2.2 Horizontal and vertical transport equity

According to Litman (2007), equity in transportation planning must consider the fair distribution of impacts (benefits and costs). He defines horizontal and vertical equity. Horizontal equity assumes the equal treatment of people with similar needs. Vertical equity assumes a more significant share of resources, concerning inclusivity, affordability and social justice. The definition of mobility budgets as a foundation for carbon reduction addresses horizontal equity by sharing cost and public resources. To address vertical equity within mobility budgets, this study has followed Martens et al. (2019) approach by considering social characteristics and defining allocation principles.

Figure 1



Source: Types of equity. Adapted from Litman (2007)

2.3 Disaggregation criterion for equity

Our first approach to a disaggregation criterion is to identify people that lack sufficient access to transportation. Sammer et al. (2012) found 15 relevant characteristics that were identified as causing some mobility impairment and divided them into the following six groups: physical or sensory disability; lack of language skills or impaired ability to read; living in a rural area

without own car; mobility-impaired family; age and at risk of poverty. Following a similar approach, MyFairShare and its Living Labs categorised transport and mobility disadvantaged groups through eight differentiation criteria: home location and public transport access; age; income and wealth; level of car access or dependency; physical and mental impairment; gender; other (groups); ethnicity. Home location, age, and income and wealth were scored as the most relevant (Rode, 2022).

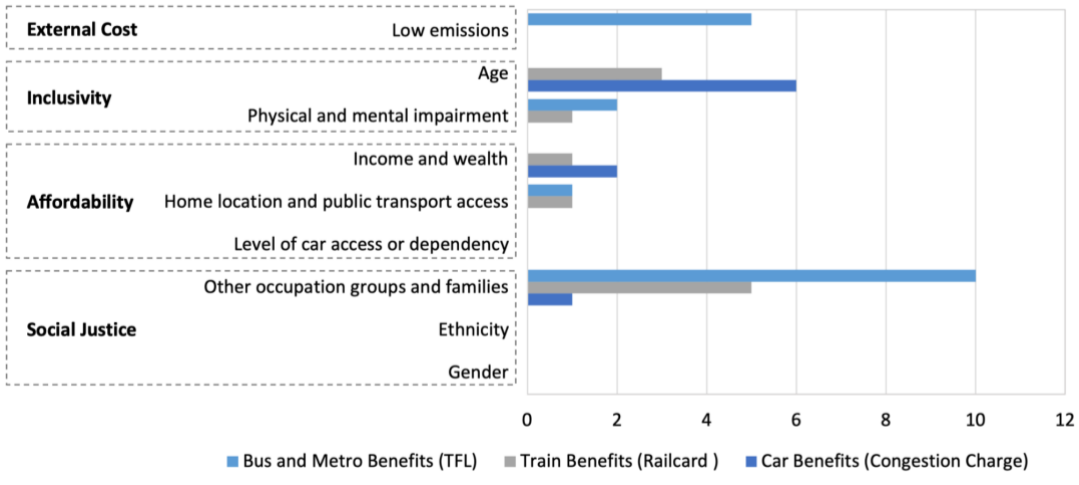
2.4 Groups in UK currently considered for transport and other social service policies

We considered the politics of fairness, data availability, and administrative constraints in order to pursue a fairness approach. We analysed 38 existing transport benefits in London through the lens of Litman's (2007) equity classification. We classified each disadvantaged group addressed by current transport benefits according to Rode's differentiation criteria and identified benefits and exemptions. While several benefits recognized organisations, physical/mental impairment, income, and age; gender and ethnicity were excluded.

Low-emission vehicles benefit is the unique criterion considered by existing transport benefits and not among Rode's categories. Therefore we included the low emissions category in the analysis but excluded a low emission exemption due to their contribution with CO2 emissions in scope 2 and 3 and the Mayor's priority to reduce congestion.

Figure 2

Number of existing transport benefits in London



Source: Authors' analysis

We looked at the allocation of existing transport benefits to assess the political and technical feasibility of operationalising equity in our study. Inclusivity measures, children, students, pensioners and disabled persons are being exempt from the transport fee or given a 30% discount. Job seekers are given a 30% discount to increase affordability. Within social justice

measures, specific groups of population such as key workers are exempt or receive a 30%-50% discount.

Figure 3

Identification of disadvantaged groups and benefits at existing transport benefits in London

Source: Authors' analysis

Additionally, we reviewed nine enacted schemes from other sectors with a strong equity perspective, including housing, pensions, credits, hitting, electricity, and council tax. We found out that benefits and financial support are mainly allocated for age, income, and wealth differentiation criteria.

2.5 What groups to consider for this project

Horizontal equity is being incorporated into mobility budgets that allow a fair share of transport costs. Vertical equity will be addressed by considering the political and technical constraints identified within current transport benefits for disadvantaged groups in London. The project recommends exempting from carbon mobility budgets 11% of the population that consider themselves to be disabled and 28% of the population that is not economically active or a student (GLA, 2022b). These exemptions take into consideration age, and physical and mental impairments, allowing an inclusive approach towards the implementation of mobility budgets. Additionally, we recommend exploring a 30% increase in the personal mobility budgets of key workers and those economically active but unemployed. These credit increases allow for the incorporation of affordability and social justice approaches towards the implementation of mobility budgets.

Ethnicity and gender have not been considered as equity criteria. Gender differentiations may imply exempting half the population, which would be economically infeasible. Ethnicity exemptions pose political, technological, and administrative challenges related to identifying

ethnic groups. Aditionally, implementing exemptions based on ethnic criteria may increase discrimination. Further research in the field of participation and spatial planning is required to overcome those barriers (Sammer et al., 2012). After the equity considerations and exemptions, a non-exempt individual's mobility budget is reduced to 1.1 km/pp/day from the initial 1.9 km/pp/day. Key workers and unemployed but economically active individuals would see an decrease to 1.4 km/pp/day.

Section 3: Individual carbon budgets and fair road pricing instruments

3.1 Introduction

Road pricing is a manner to toll or price roads, bridges, and tunnels. These mechanisms are used to reduce congestion, reduce emissions, and to raise revenue (Cohen & Hoffman, 2019). This section will cover the types or road mechanisms, the challenges to implementing road pricing for carbon mobility budgets, and our recommendation.

3.2 Road pricing mechanisms and examples from around the world

To expand our roster of transport policies to achieve the 2030 net zero goal, we look at the types of road pricing mechanisms that exist and that have been implemented in cities from around the world.

Table 2

Types of road pricing mechanisms

Mechanism	Description
Cordon pricing	Motorists pay a charge to enter the zone
Area pricing	Travel within designated zones incurs a charge.
Congestion point charging	Vehicles pay when crossing select key points.
Distance-based charging	Vehicles are charged based on distance travelled.
Full-facility tolling	Tolls must be paid by all users of a facility.
Managed, High occupancy/toll, and express lanes	Lane use restricted to high occupancy vehicles or those paying a toll. Toll amount may vary due to vehicle occupancy or congestion level.

Source: Adapted from Cohen and Hoffman (2019)

Several cities have employed road pricing mechanisms and successfully reduced car travel. Singapore's Area Licensing Scheme (ALS) implemented in 1975, is the first evidence of congestion pricing which runs until today. It led to a 44% reduction of all vehicular traffic entering the restricted zone during peak hours (Small & Gómez-Ibáñez, 1997). Milan's congestion pricing scheme has led to a 31.1% reduction in vehicular traffic (Beria, 2016). Stockholm's toll ring scheme has also been found to reduce inner-city traffic (Eliasson, 2014; Small & Gómez-Ibáñez, 1997).

3.3 Challenges of implementing mobility budgets in road pricing

We have identified technological, political, and economic challenges to implementing mobility budgets in road pricing mechanisms. Technological barriers exist to administer and monitor carbon mobility budgets because distance travelled must be accurately captured. Even if TfL were able to track this data, such as through cell phone tracking, important privacy concerns exist. Politically, multiple and layered transport policies with the congestion charge, alterations in the charges levied, different kinds of zones, revisions, and so on, have caused policy fatigue in London residents. Moreover, TfL experts state that the congestion charge has reached a ceiling and cannot be increased further without grievous political pushback. Finally, implementing a new scheme is monetarily and time intensive requiring research, infrastructure, and enforcement.

3.4 Proposal

Based on our analysis, our proposal consists of three measures. We seek to improve two existing measures and introduce a new mechanism which incorporates the carbon-mobility budget into road pricing to achieve the net zero goal by 2030.

Proposal #1: Expand current congestions zone

The current congestion charge must be expanded and levied to the entire Greater London area. London's congestion charge has been the most effective after Singapore's ALS. It led to a 33% reduction of car traffic in the cordoned zone (Metz, 2018). We suggest expanding the existing ULEZ to cover the Low Emission Zone (LEZ). TfL is already in the consultation process for this expansion (TfL, 2022). The existing equity considerations from the 2003 congestion charge must continue, with the exception that residents of the expanded zone would also pay the charge. To avoid additional exploratory and administrative costs, the existing processes for administering the congestion charge must be used.

Proposal #2: Prohibit street parking in London's Central Business District

We recommend street parking to be completely scrapped so as to radically reduce residents from driving to work into the CBD. CBD parking policies currently include high parking charges in certain areas in Central London during peak hours. Nottingham and Rotterdam found that parking charges in workplaces led to 25% and 8.6% reduction in car commuters, respectively (Strompen et al., 2012; Dale et al, 2019). We propose following a path similar to Oslo, which cut down on parking spaces in and around the city centre, introduced car-free streets, and altered traffic routes, resulting in a reduction of car traffic in the city centre by 11% (Modijefsky, 2021). Equity consideration would be taken into account by maintaining inclusive parking lots for mental and physical impairments.

Proposal #3: Introduce distance-based charging in Greater London

We strongly recommend the introduction of distance-based charging in the Greater London area to operationalize carbon mobility budgeting. It would be one of the first cities in the world to implement this. TfL has conducted interviews with London residents and there seems to be a high level of acceptance for this potential charge. Because of the technological, economic, and economic challenges that have been already described, we propose a different operational process. At the time of the annual renewal of car registration, the distance travelled by the car in terms of kms can be noted. Anything beyond the proposed 1.1 km/pp/day for non-exempt, or 1.4 km/pp/day for those receiving a discount, for the year, must be charged. A distance-based charging in Greater London would operationalize inclusivity, affordability, and social justice by distributing a fair share of carbon mobility credits to each person and allocating exemptions and discounts as described in the previous section.

Section 4: Alternative instruments to road pricing

4.1 Introduction

The rate at which transport emissions have been falling in London is commensurate with the 2050 net zero target and not the 2030 target (GLA, 2021b). To speed up progress there is an appetite to explore how alternative instruments to road pricing can operationalize fairness (TfL, 2022). In this section we will consider different intervention approaches and policy instruments such as the expansion of nudging, tradable emissions, and non-tradable rationing.

Table 3

Intervention approaches and policy instruments

Intervention Approach	Description
Push	Costs to use a car increased or use of cars is prohibited.
Pull	Incentives put in place, or services provided to increase adoption of car alternatives.

Policy Instrument	Description
Regulatory	Rules, standards, prohibitions
Economic	Taxes, subsidies, charges
Information	Nudging, marketing, persuasion

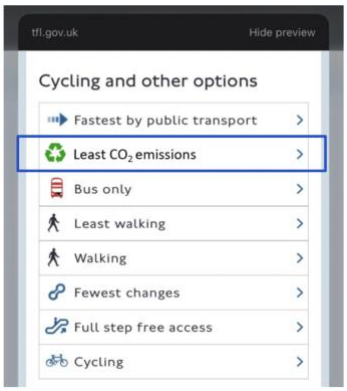
Source: Adapted from Kuss and Nicholas (2022)

4.2 Nudging

Nudging is defined as "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008). An intervention must be easy and cheap to avoid to count as a nudge (Thaler & Sunstein, 2008). Rode (2022) observed that overall emission reduction targets are ineffective at creating a sense of personal responsibility. This observation signals that nudging may be an effective information policy instrument to reduce the number of kilometres driven via the concept of mobility budgets. Nudging would operationalize fairness by communicating to everyone their fair share of the carbon budget. To implement nudging, tools like the TfL journey planner could be set so that journey choices could be set by default to the journey that produces the least emission. A user could easily select another option.

Figure 4

Mock-up of TfL journey planner option selection



Source: Authors' own

4.3 Tradable emission credit schemes

A tradable emission credit scheme (TCS) represents a push intervention approach and could be categorised as an economic and regulatory policy instrument. Under a TCS, a government may distribute travel credits up to the amount of an individual's carbon allocation for urban mobility (Fan, 2019). Users may then buy or sell mobility credits via a free trade market depending on their needs. Fan (2019) observed that existing studies demonstrate that TCS could be as efficient as congestion pricing in reducing vehicle travel demand and that it also possesses advantages in terms of revenue neutrality and social equity. A TCS would operationalize fairness by distributing a fair share of carbon mobility credits to each person. Notably, TCS is being considered by the European Union for commercial road transport. If successful, the scheme could be expanded to private road transport by 2026 (Brooks, 2021).

4.4 Non-tradable licence plate rationing (LPR)

Rationing car use based on licence plate number is a push intervention approach and a regulatory policy instrument to implement carbon mobility budgets. Under the scheme, which has been implemented in cities like Quito, Beijing, Mexico City, and New Delhi, driving is only allowed on certain days determined by the last digit of the licence plate (Bonilla, 2016). LPR operationalizes fairness by equally distributing the impact of the rationing in a random way through the licence plate numbering. Results of LPR programs have been mixed. Quito's LPR program resulted in a 9-11% reduction of GHG during peak hours (Carrillo, Malik, & Yoo, 2013). Eskeland and Feyzioglu (1997) observed that in Mexico City, LPR backfired and led to people purchasing more vehicles, exchanging licence plates, and driving more on allowed days. If political will exists to try an LPR scheme in Greater London, learning from the experience of these other cities will be paramount to avoid unintended consequences.

Conclusion

This report has aimed to support the work of MyFairShare, LSE Cities, and TfL while exploring how to operationalize a fairness framework as part of next generation road user charging and personal carbon mobility budgets to help London's transport sector achieve the 2030 net zero goal. We proposed that to achieve our goal of incorporating carbon mobility budgets into road pricing mechanisms, London should expand the existing ULEZ, prohibit street parking in London's CBD, and implement a distance-based charging scheme based on a daily carbon budget allocation.

In order to take fairness into consideration we recommended exempting people with a disability, students, and those not economically. We also proposed an increased carbon allocation to key workers and to those economically active but unemployed. Finally, we considered alternative mechanisms to road pricing such as nudging, tradable emission credits, and non-tradable rationing.

We hope this project is a starting point in thinking about transport in terms of gCO2e per kilometre travelled. This framework may help people internalise the externality of transport pollution, encourage shifting to more sustainable modes of transport, and help London reach net zero by 2030 in a just and fair way.

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