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Mechanisms with equity implications for the (non-) adoption of electric mobility in the early stage of the energy transition

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ABSTRACT

The need to reduce transport-related GHG emissions has led many governments to stimulate a shift from the use of traditional combustion engine vehicles to the adoption of electric vehicles (EVs). While private and shared electric mobility (EM) options may have positive environmental outcomes, equity concerns regarding the adoption transition to EM are receiving increasing attention. This paper examines a number of theoretical concepts that describe the underlying processes that lead to transportation inequalities and identifies empirical evidence on EM adoption mechanisms with justice implications that sustain inequalities and potentially prevent a desired social-inclusive transition to EM. The empirical findings from the literature reviewed revealed how factors such as unequal distribution of economic incentives, charging and access to EM, power configuration of the space, and differences in personal characteristics and capabilities all play a role in EM adoption. Accordingly, the acceleration of EM diffusion without a critical evaluation might lead to undesired societal outcomes regarding social exclusion and transportation burdens. The results make evident the necessity to set social inclusion as both a goal and as a process, as one of the main strategic targets, along with the urgency for decarbonisation, in the current early stage of the transition to EM.

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1. Introduction

The need to reduce transport-related GHG emissions has led many governments to stimulate a shift from the use of traditional combustion engine vehicles to the adoption of electric vehicles (EVs) and even phase out sales of conventional vehicles by law. The International Energy Agency (2021) projects 300 million electric cars by 2030 on the road, accounting for over 60% of new car sales (IEA, 2021), making the EV market a lucrative business opportunity. Automakers are investing billions of dollars in electric vehicle production research and development (more models), and many governments

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implement EV purchase subsidies (IEA, 2021) and invest in public charging infrastructure. In addition to private EVs, electric mobility (EM) is entering cities through shared electric cars, e-mopeds, e-bicycles and e-scooters. These forms of electric shared mobility serve both local objectives (reducing car traffic and air pollution, increasing livability) and global objectives (GHG reduction). In the US alone, the growing micro-mobility trend registered 136 million rides in 2019 with more than 100 dockless bike-sharing systems – a 62% ride increase from 2018 – primarily as a result of the popularity of shared e-scooters (Nacto, 2020).

While private and shared EM options may have positive environmental outcomes, equity concerns regarding the transition to EM receive increasing attention in transportation planning around the world. While some groups are not restricted in their access and use of these new options, and may even benefit from a transition to EM, other groups may have difficulty accessing EM options (e.g. price related, contextual availability, etc.), leading to inequalities in transport options and therefore also possible transport-related social exclusion (Lucas, 2012, 2019; Mullen & Marsden, 2016).

Various studies have addressed equity aspects of the transition towards EM. These studies have predominantly focused on the distributive effects of the transition towards private and shared EM. For instance, it has been well documented that private EVs are disproportionally adopted by higher income groups, and that subsidies to promote EV ownership disproportionally accrue to them (Canepa et al., 2019; Liu et al., 2022; Sovacool, Kester, et al., 2019). While results are not completely consistent, it has also been found that shared (electric) mobility options are more frequently used by higher-educated and high-income groups, and that the spatial distribution of shared mobility services often disfavours vulnerable communities (Fedorowicz et al., 2020; Shaheen, 2019). However, such distributive outcomes constitute the tangible and measurable manifestations of underlying processes related to policy-making, individual/household level decision-making and constraints, processes in the emergent transportation market ecosystem and ongoing societal debates on climate change and the need for a reconfiguration of the societal mobility function currently dependent on the private car and characterised by high levels of mobility (Bergman, Schwanen, & Sovacool, 2017; Schlosberg, 2007).

We therefore argue that an exploration and understanding of the equity effects of a transition towards EM should consider these underlying processes of EM (non-) adoption and its costs and benefits into account. This paper examines different mechanisms for the occurrence of inequity and presents examples in the domains of private EV ownership and shared electric micromobility (SEMM). To this end, we review both theoretical notions such as mobility justice, the capabilities approach and societal discourses around EM and empirical studies of inequalities in the context of EM. In the concluding section of the paper, we draw conclusions about the underlying processes of inequalities related to EM, and discuss their implications.

2. Equity theories and transportation

Different concepts and perspectives have been addressed in the literature on transport and equity. Although scarce literature has addressed environmental justice implications in relation to transport (Deakin et al., 1997; Forkenbrock & Schweitzer, 2007; Illich, 1974), the major focus of equity research in transportation has been on accessibility. Accessibility in such approaches is typically determined quantitatively based on information about land use and transport networks, and relates directly to land use and transport planning practices (Karner et al., 2020). Contemporary literature on accessibility stresses the importance of the ease of reaching destinations and the involvement in activities (e.g. accumulation approach), as key elements when measuring the performance of land use and transport systems in terms of accessibility. This approach considers monetary costs, in addition to time and distance costs, when evaluating equity at the regional and personal scale (El-Geneidy & Levinson, 2022; Manaugh & El-Geneidy, 2012; Wu & Levinson, 2020). More recent research related to transport equity highlights the legitimation and recognition of social diversity and citizen participation in the process of transport planning ("transport justice") and the recognition of social groups and citizens as legitimate agents of social change ("mobility justice") (Verlinghieri & Schwanen, 2020). The transport and mobility justice perspectives suggest a shift in emphasis from distributive transportation equity outcomes to a wider scope consideration of the process leading to these outcomes and how vulnerable social groups are actually represented. Key concepts in the justice literature with a focus on transportation may serve as a conceptual basis for interpretation of the inequity in the (non-) adoption of EM. Following the influential study on transportation equity and capabilities of Pereira et al. (2016) "based on different theoretical traditions (Fraser, 2020b; Kymlicka, 2002; Young, 1990), justice can be understood as a broad moral and political ideal that relates to" (Pereira et al., 2016, p. 171):

(1) **distributive justice** – how benefits and burdens are distributed in society;
(2) **procedural justice** – the nature of decision making and governance, including the level of participation, inclusiveness, and influence participants can wield; and
(3) **recognition justice** – acknowledgment of and respect for the needs, values, understandings, capabilities and practices of groups involved in, or affected by, decision making and governance.

The distributive justice dimension has originally been associated with the utilitarian perspective (cost-befits and the maximisation of the general utility as a principle of distribution of goods and fairness in society) and has received most of the attention in the academic transport literature (Martens, 2016; Sovacool & Dworkin, 2014). Scholars on justice-related aspects, including transportation, indicate an imbalance in the attention that distributive justice has received compared to the other aspects of justice (Verlinghieri & Schwanen, 2020). This may be due to epistemic orientations of mainstream scholars or because distributive justice, compared to procedural and recognition justice is more identifiable and better quantifiable within the socio-environmental realm (Schlosberg, 2007), and therefore more tangible for analysis. However,

> unless we take a more comprehensive understanding of mobility justice there is a risk that in attempting to address one problem, injustice is inadvertently (or deliberately) widened. That avoiding stark inequalities means collectively thinking about how resources are used, about how we value activities involving mobility, and about what sorts of goods and services we create. (Mullen & Marsden, 2016, p. 115)

In this direction, without a comprehensive understanding of all three dimensions of social justice, the EM transition could result in disadvantages for certain groups and geographic regions by failure to identify and recognise them and thereby excluding groups or areas from decision-making processes. This might results in reduced accessibility and mobility benefits of EM for certain population segments (Martens, 2016).

EM adoption at the individual level depends on a subjacent process by which individuals with different characteristics, abilities and constraints meet the conditions to adopt or not adopt EM. In this context, the **capabilities approach (*CA*)** offers useful conceptual tools in order to relate the individual resources and capabilities with other social resources. The *CA* proposed by the economist Amartya Sen and philosopher Martha Nussbaum (Nussbaum, 2006; Nussbaum & Sen, 1993; Sen, 1985, 2006), is originally concerned with distributive aspects of justice inspired by liberal philosophy but moves beyond the distributive sphere combining the concepts of freedom, welfare, and equity. Capabilities are defined as "the alternative combinations of functionings from which the person can choose one combination" (Sen, 2006, p. 154).

The *CA* is not only concerned with the allocation of resources, but also how the resources can be translated into actual available and valuable *capabilities* for individuals (especially disadvantaged people), improving their range of available resources including mobility and accessibility options, which in turn increases their subjective well-being (Hananel & Berechman, 2016). Internal and external factors affect this conversion process, ranging from individual psychological and physical characteristics to societal capital and the landscape of the environment where the resources are (or not) available, usable, and accessible (Pereira et al., 2016). Thus, "conversion factors are the individual and contextual features that allow the conversion of resources into capabilities" (Vecchio & Martens, 2021, p. 842). Mobility resources and conversion factors work together to determine people's motility: their ability to move themselves in an effective way (Kaufmann et al., 2004; Vecchio & Martens, 2021). In this paper, we explore how resources and conversion factors affect the equity implications of EM adoption.

Social discourses represent another theoretical angle to understanding inequalities in access to and use of EM, mainly because procedural issues are significantly affected by social discourses (Henderson, 2020). Social discourses are a reflection of material and non-material power relations among a wide range of stakeholders, and derived from historical developments and social movements (visions, contestation, expectations, demands), including futuristic and technocratic claims, which ultimately are embedded in the societal order, and affect the urban development (for an illustration see the case of the automobility system in Dennis & Urry, 2009). For instance, in the context of the transition to EV adoption, Henderson (2020) applies a critical evaluation of the social discourses related to environmental efficacy and decarbonisation assumptions, regarding who benefits from the technology diffusion, and what are the policy implications for the city. Social discourses such as those supporting the benefits of EM (in general, mainly focused on technical and environmental benefits) provide a source for social identity, which might play a different role depending on the group in question. For instance, adopting an EV could be associated to a green or pro-environmental personal image, but also for micro-mobility usage (e.g. e-bike or e-scooter) could be associated with the reproduction of social stigma and the fear of being targeted by the police for disadvantaged groups in certain contexts (McNeil et al., 2017). For example, Hoffmann (2016) argues in "Bike Lanes are White Lanes" that the divergent reception of bike lanes is linked to the bicycle's status as a "rolling signifier". In this sense, while e-bicycles/scooters can signal a sustainability ethic in high-income and predominantly white neighbourhoods, they can also be read as proof of someone's inability to afford a car in a low-income neighbourhood (Hoffmann, 2016).

In this paper, we review the relevant literature to identify and analyse EM adoption mechanisms with justice implications, by which inequalities are sustained and potentially prevent or distort a desired social-inclusive transition adopting EM.

3. Literature selection

The papers reviewed here evidence inequalities and exclusion issues in the adoption of EM. The term EM in this paper refers to ground passenger transportation among different ownership forms (e.g. private and shared services). The papers obtained from the bibliographic search were mainly related to two modes of electric transport: private EVs and SEMM systems. Today, electric car-sharing providers are also part of the shared mobility ecosystem, however, according to our search criteria, the papers found are mainly related to the former modes mentioned. The mechanisms related to disparities in the adoption and usage of EM will be presented according to the mode of transport, as they present different forms of usage and technical attributes.

The literature collection procedure includes papers up to March 2022 and includes scientific papers in English. Although we did not limit ourselves to a specific period, most of the literature in the field of EM adoption and diffusion was published within the last decade, which is commonly recognised as an explosion of research and

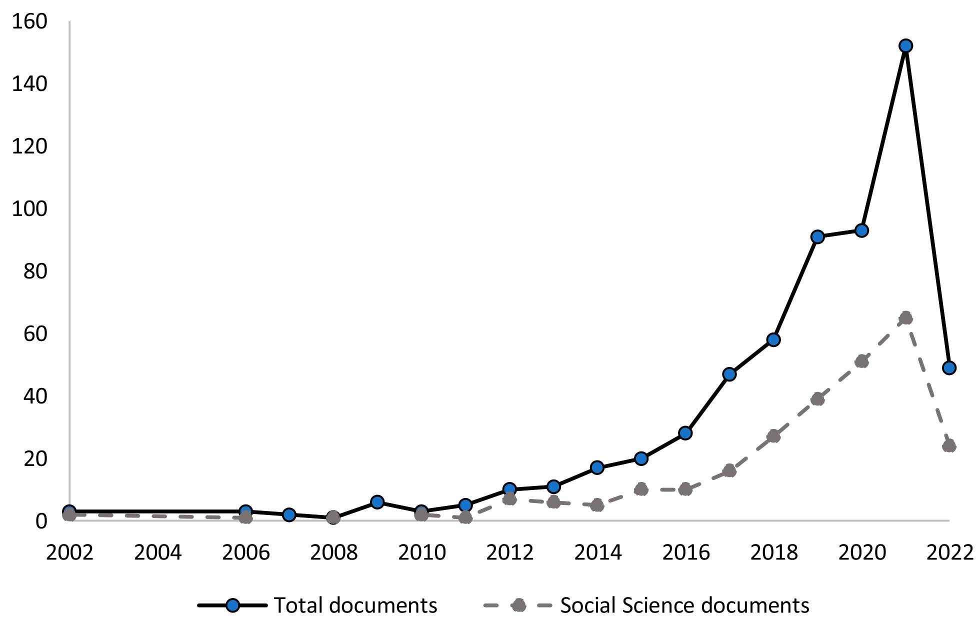

Figure 1. EM publication trends using Scopus bibliographic data base.

popular interest (see Wicki et al., 2022). This trend could also be observed in Figure 1, where most of the literature is not primarily related to social science (<20%) according to Scopus classification, even using our search terms (clearly social science oriented as described below). The bibliography used for identifying equity mechanisms adopting EM was searched using the Scopus. The papers selected were primarily empirical, focusing on actual behaviour studies based on surveys, observations, and usage data analysis, rather than hypothetical usage based on stated preferences surveys, modelling or simulations.

The bibliographic search (the search was limited to the social science, energy, environmental science, and only English papers were considered) comprise any combination of the following keywords in the title, abstract, or keywords:

> "electric mobility" OR "electric vehicle" OR "electric scooters" OR "e-scooters" OR "electric bikes" OR "e-bikes" OR "electric bicycle" AND "accessibility" OR "fairness" OR "justice" OR "equity" OR "social inclusion" OR "social exclusion" OR "electric transition" OR "inclusive" OR "inequality" OR "energy transition" OR "socio-technical transition".

The process of paper selection consisted of three main stages: first, after applying the search terms, 600 results were obtained in SCOPUS. Second, a title and abstract screening were conducted according to the topic scope related to EM adoption in the societal and urban mobility context. Technical-oriented papers focused on motor and energy technologies, energy and charging optimisation, travel behaviour and usage patterns, and papers addressing general implementation and regulation topics / economic assessment, / scenarios exploration, which do not provide empirical evidence of EM adoption at the individual level with equity implications, were not considered for further analysis. Then, 53 results were selected as potential candidates for the review. Third, 24 papers were considered for the EM adoption mechanisms review with clear justice implications. Parallel to this stage, using the snowballing technique and Google Scholar, an additional 18 resources were identified, based mainly on the papers' references, the team's knowledge and reviewers suggestions, bringing the total to 42 papers (Figure 2).

4. Equity mechanisms in the adoption of electric vehicles

The mechanisms that create or recreate inequalities or social exclusion are not always explicitly addressed in the EVs literature. For this purpose, first a brief overview of the existent scientific literature on motivators and barriers to EV adoption is conducted, mainly based on academic review papers.

Following the Coffman, Bernstein, and Wee (2016) literature review on EV adoption and reflecting the general aspects noted in other scientific reviews in that direction, the factors affecting the adoption could be classified into three main categories:

- **Ownership and technology properties:** high initial costs of purchasing a EV (Wood & Jain, 2020) and charging-related concerns e.g. charging infrastructure deployment and complexity to use, and range anxiety (Biresselioglu et al., 2018; Canepa et al., 2019; Carley, Krause, Lane, & Graham, 2013; Chakraborty et al., 2022; Wicki et al., 2022; Wood & Jain, 2020);

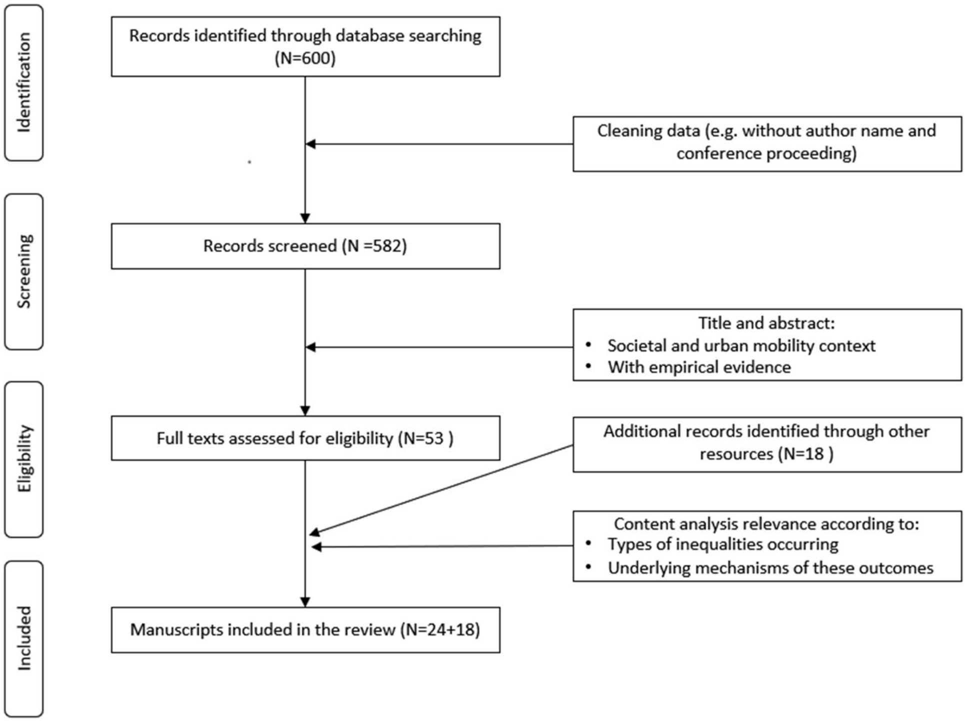

Figure 2. Literature selection: workflow.

- **Users' socio demographic characteristics, perceptions and attitudes towards EVs** such as experiences, perceived behavioural control, societal influence, self-identification and hedonic motivations (Adnan et al., 2017; Singh, Singh, & Vaibhav, 2020; Wicki et al., 2022);
- **Policy support for EV diffusion** e.g. rebates/subsidies, HOV lane access, and the importance of public campaigns and awareness in the reach of the information (Canepa et al., 2019; Hardman et al., 2017; Jenn et al., 2018; Wood & Jain, 2020).

Within the context of the motivators and barriers above, we review equity mechanisms in relation to EVs adoption.

4.1. Uneven distribution of the economic incentives among different social groups

Financial aspects related to EV adoption can both restrict adoptions (e.g. high purchase price, energy prices, battery substitution) and stimulate adoption (e.g. financial incentive, reduction of fuel costs, the efficiency of operation, potential for selling surplus energy to the grid) (Biresselioglu et al., 2018). In general, high prices are intrinsically related to the EVs market share. For instance, Mitsubishi MiEVs were found to be expensive in countries with a low EV market share, and they were cheaper in countries with a high EV market share (Sierzchula et al., 2014). High initial prizes were reported as a main obstacle regarding the intention to purchase an EV by more than 50% of the respondents in different studies (Carley et al., 2013; Coffman et al., 2016). In this sense, economic restrictions due to high purchasing costs together with operational and retail prices, are especially relevant for lower-income groups who also do not have a vast catalogue of options for EVs models in the market (Wicki et al., 2022; Wood & Jain, 2020). While many governments provide incentives to encourage EV adoption, research findings on their effectiveness are mixed (Coffman et al., 2016). Different studies have proven that asymmetries in the distribution of economic incentives across socio-economic groups and regions cause inequalities.

For instance, in a study assessing the accessibility of federal- and states-level Plug-in Electric Vehicles (PEVs) Income Tax Credits (ITC) policy in the United States, it was found that households with a higher income and fewer children qualify for a larger portion of the federal and state PEV credits. For example, a two-adult, one-child family earning $82,600 per year is only eligible for 70% of the $7,500 federal ITC. Credits are even lower for low-income families with multiple children, although the fact that vehicles from lower-income households emit higher levels of pollution (Liu et al., 2022). In a study conducted in California to investigate the economic incentives for purchasing an EV and the resulting equity effects, it was observed that 90% of federal tax credits for electric vehicles went to households with incomes greater than $75,000, highlighting the fact that electric vehicles remain less affordable for low-to-middle-income households, even after incentives (Canepa et al., 2019). Another study, also conducted in California, adds a geographical dimension to the investigation of the distributional effects of electric vehicle rebates. Equity analysis reveals that the bottom 75% of census tracts receive only 38% of total PEV subsidies. The findings also revealed neighbourhood effects, in which communities with lower median incomes or that are disadvantaged receive higher rebate amounts when they are geographically adjacent to affluent regions (Guo & Kontou, 2021).

One of the problems of policy incentives for EVs adoption is the reach of information, which means that governmental incentives are not always well-understood by potential users, or there is a lack of awareness around the existing facilities for EV acquisition (Biresselioglu et al., 2018). It also raises questions regarding the recognition of potential users' skills and practical needs in the incentives distribution. Tax deductions and credit systems need to be made better understandable through advertisements, information campaigns on renewable energy technologies and local agents, so that potential adopters know whether they will receive the (full) credit when purchasing PEVs (Jenn et al., 2018; Liu et al., 2022; Nelson et al., 2021). The overall monthly costs for EVs adoption are difficult for individuals to grasp since it is not just money out but a combo of money out and in (via credits). This makes budgeting difficult, especially for low-income groups who need to be sure of their monthly budget.

4.2. Inequalities related to charging access and battery derived costs

Another critical factor in EV adoption is the availability of convenient and effective charging infrastructure, which also has distributive implications for access to charging and possess growing challenges for transportation equity. In this sense, empirical evidence from Europe (where charging deployment is mainly effective for early adopters and wealthy communities) and North America (e.g. lack of black or Hispanic access to charging) shows that charging deployment is in areas with high and wealthy group adopters while overlooking areas with low rate adoption, including low-income and disadvantaged communities, affecting charging equity (Bissell et al., 2018; Carlton & Sultana, 2022).

From the demand perspective, home charging is the most commonly used and most important piece of infrastructure in persuading/motivating consumers to buy a EV (Chakraborty et al., 2022). Electricity rates and energy consumption by households with different income levels may increase inequities between households and not necessarily facilitate the shift to more sustainable energy use according to different perceived marginal costs, unless there are clear economic incentives (Andrich et al., 2013). Evidence from North America shows that shifting demand to the workplace is commonly observed, especially if the latter is free. In general, depending on an individual's vehicle charging needs, there is a tradeoff between monetary cost and convenience when selecting a charging location (Chakraborty et al., 2022). When EV owners have access to free workplace charging, they frequently forego the convenience of home charging in exchange for the zero cost of refuelling at work. This substitution behaviour may render this workplace infrastructure offering financially unsustainable in the long run, as well as result in negative consequences such as charge point congestion. Furthermore, housing type and geographic location influence adoption, which has a direct impact on the disparities in adoption rates observed across different built environments (Roy & Law, 2022). Apartment dwellers, for example, are more reliant on non-home charging and experiment constraints accessing to charging. Compared to EV owners in detached homes or condominiums, apartment dwellers without private parking availability are more dependent on workplace and public infrastructure than home (Canepa et al., 2019; Hsu & Fingerman, 2021).

The lack of public charging stations globally, for example in rural areas in China, remains a main barrier to EV adoption (Nelson et al., 2021). Evidence on inequalities accessing to charging across different social groups and regions is increasing but still relatively unknown in development countries (Carlton & Sultana, 2022; Machado et al., 2020). Falchetta & Noussan (2021) showed that in Europe, although market-led charging infrastructure services could provide a solution in high-demand regions where competition among operators improves the price-quality and coverage of the service, a comprehensive public charging network it is crucial for the wide social adoption filling spatial gaps across different regions and areas (Falchetta & Noussan, 2021). Nevertheless, there is still nuances in people considerations regarding EV use and adoption deriving the current charging and batteries technology. In a study modelling the choice of charging location of 3,200 EV drivers in California, it was found that adoption rates remain low, and several barriers to adoption persist, which are not due to the availability of charging stations. Used EVs with low purchase prices may be nearing the end of their warranty periods, and their battery packs may be degrading. Even if these vehicles are affordable to low-income households, they may be perceived as a high-risk purchase. The financial burden on a used EV buyer in the event of a battery pack failure may be prohibitively high (Canepa et al., 2019).

4.3. Social discourses and EVs diffusion

There is a growing literature questioning how the transition process to EM is unfolding. Specifically, structural social inequities manifested in normative social discourses supporting the technical and environmental promises of EM are conceived as a mechanism for inequity in EM adoption (Henderson, 2020; Sovacool, Hook, Martiskainen, Brock, & Turnheim, 2020). In this context, it is conceived that there is a normative conception that EVs is a neutral technology that will reduce urban pollution and is more sophisticated and efficient than the current means of transport. This conception is also associated with the formation of a new social identity that attracts and consolidates parts of the society characterised by middle and high-educated people and potentially may exacerbate in symbolic terms differences among socio-economic groups (Curran & Tyfield, 2019).

Henderson (2020) claims for a more critical approach denaturalising the common claim among climate–energy–transport scholarships and professions regarding the "essentiality" of electric transport modes to decarbonising mobility. He calls for considering the multidimensional environmental and social problems associated with EVs. Using a mobility justice framework, he questions assumptions and the influence of liberal economic theory on future projections of EVs market-based which assume more cars and more driving. These assumptions reproduce the automobility status-quo hegemony, avoiding the challenge of transitioning to green mobility (Bergman et al., 2017). Sovacool et al. (2020) discuss the implications of the Norwegian transition to EVs, elaborating an "Energy Justice" framework to analyse the types of injustices associated with low-carbon transitions. For instance, they identify empirical evidence for injustice dimensions such as: distributive – e.g. including those who cannot afford new cars, bus travellers as a consequence of increased traffic congestion sharing the lines with EVs, and erosion of revenues for ferry operators (EVs could go free of charge); procedure – e.g. exclusion of e-bikes, planning bias towards ICE cars; recognition – e.g. vulnerability of those with disabilities, single mothers, the elderly, and the rural poor who do not befit from EVs development. As a result, the authors urge a critical examination of the entire lifecycle (a cosmopolitan justice dimension) or "whole system" of these innovations, from the extraction of metals and minerals to the disposal of waste streams (Sovacool, Martiskainen, et al., 2019). Professional and academic knowledge are also present in social discourses. In addition, the complicity of institutions, agencies, or corporations in promoting the normative diffusion of low-carbon mobility, particularly EVs, involves epistemic aspects that are also part of the reproduction of a systemic logic. In this context, there is a need for critical reflection on what constitutes (scientific) evidence and how marginalised perspectives and experiences can be integrated and mobilised for each urban context (Schwanen, 2021).

5. Mechanisms with equity implications in the adoption of shared electric micromobility

According to the bibliographic search results, the papers focusing on personal light vehicles are primarily about shared electric micro-mobility systems (SEMM). SEMM is the shared use of electric low speed-modes (e.g. electric bicycle, e-scooter, e-mopeds) and represents an innovative transportation strategy that enables users to have short-term access to a mode of transportation on the basis of need (based on Shaheen, 2019). On the one hand, shared micro-mobility (SMM) systems are becoming increasingly available around the world and represent open opportunities for increased urban mobility and accessibility. On the other hand, SMM systems create challenges to cities, with respect to objectives such as sustainability, health and inclusiveness. From an equity point of view, SMM potentially may increase transportation options for those who currently face limited transportation options (Fedorowicz et al., 2020; Mooney et al., 2019). However, in North America and Europe SMM tends to be disproportionately used by younger, highly educated, and white people in city centres, while vulnerable groups in more peripheral areas, profit less from them (Böcker et al., 2020; Fedorowicz et al., 2020; Shaheen, 2019). In addition, the accumulation of SMM in city centres creates tension with respect to the use of public space by other groups, such as pedestrians and cyclists, potentially with adverse accessibility effects (Milakis et al., 2020; Tice, 2019).

5.1. Spatial accessibility and compliance with distribution policies

Although not explicitly addressed by the majority of the reviewed studies on SEMM, micromobility sharing systems' operating and ownership aspects are likely to have in/equity implications. Non-profit or publicly owned systems may take better responsibility for equity in social outcomes (Akar & Miller, 2021), compared to for-profit systems, even when operating under the regulations of regional or municipal governments. In general, it is recognised that micromobility services are limited in low-density locations and neighbourhoods with low median household incomes, lower proportions of young people, and fewer zero-car households (Christoforou et al., 2021; Fedorowicz et al., 2020). For instance, cities with clear deployment criteria for equity zones (such as Chicago, Minneapolis, Portland, and San Francisco) have a far smaller difference between designated and actual service geography, implying that policy is a crucial first step in achieving geographic equity (Meng & Brown, 2021). In this context, there are three main concerns derived from the fact that private, profit-oriented companies are responsible for distributing and operating these services in the urban space.

First, these services do not always meet the municipalities' requirements. Cities might require system operators to maintain a certain level of service in specified neighbourhoods to address spatial equity (Hirsch et al., 2019). Recent experience with e-scooter programmes, on the other hand, suggests that compliance is a concern (Dill & McNeil, 2020). In order to attain a higher level of spatial equity translated in a broad geofence coverage, the municipalities should explicitly set it as an aim in the regulatory process. This is particularly notable because, if given complete control over geofence design, operators are likely to prioritise the city's densest areas, especially if vehicle numbers are limited as evidenced in a geofence study in San Francisco longitudinally from 2017 to 2019. According to a review conducted of permit requirements and operator applications, San Francisco's geofence restrictions have been limited and inconsistent, which may have contributed to the concentration of services in one area of the city, as well as disconnected geofence "islands" (Moran, 2021).

Among other reasons discussed below, uneven accessibility has been linked to the fact that shared mobility companies are typically privately owned. Their profit-driven strategy frequently overlooks equity, putting services out of reach for many underprivileged communities. Even though these systems create stations in required disadvantage zones, they are not always properly connected with the main stations, limiting their utility for nearby users (Guo & Kontou, 2021). Meng and Brown (2021) analysed the spatial distribution of docked and dockless micromobility services to compare the designed service geography of docked and dockless systems with the actual service geography of dockless systems that reflects vehicle use. When looking at US cities, while the percentage of black residents is positively related to the designated service region, it has not translated into the actual geography of the service. The opposite is found in Latino neighbourhoods. Dockless vehicles serve Latino areas outside designated service geography in greater numbers than other communities, or it could also indicate latent demand in these areas (Meng & Brown, 2021).

Second, these services do not present stability for the users, which might prevent them from adopting a new travel practice as a daily travel habit. As described by Dill and McNeil (2020), bike share providers are often financed by venture capital, with a clear expectation to make a profit. As a consequence, they may decide to increase prices, cease operations or change location of operation if financial considerations make this necessary. This reduces the predictability of the system, and constitutes a barrier to structurally rely on shared mobilities for one's daily travel. This hits especially lower income population segment with fewer transport alternatives. Third, there are different equity implications associated with the type of micromobility service (the operating and ownership aspects) between dock-systems, more commonly used for bikesharing, and dockless systems, which are more common among electric bike and scooters providers. There is evidence that the distribution of docked systems is highly unequal, and that dockless systems greatly reduce geographical inequalities relative to docked systems (Meng & Brown, 2021). Docked systems are older, and many cities have certainly transferred lessons learned from them to newer dockless systems. The absence of spatial fairness in these services has been repeatedly highlighted (Bateman et al., 2021). Besides, as dockless systems are in general operated by private mobility companies and require lower capital investments and operating costs from de cities side, these systems can enlarge the city coverage especially to underserved neighbourhoods. Differences regarding travel behaviour and destination choices are also reported. For commuting trips for instance, free-floating systems increase accessibility for low-income persons and people of colour (Dill & McNeil, 2020). Lazarus et al. (2020) characterised the spatial distribution of demand for both dockless electric and docked non-electric bikesharing throughout San Francisco. The study found the two systems appear to complement one another. Bikesharing trips tended to be short, flat commute trips, mostly connecting to/from major public transit transfer stations, while dockless e-bike trips were a third longer and about twice as long in duration, more spatially distributed and more heavily servicing lower-density neighbourhoods (Lazarus et al., 2020). In a survey conducted in Zurich, user characteristics were compared in terms of personal and household socio-demographics, travel characteristics, and access to shared micro-mobility services. Findings show that shared e-scooter users are more representative of the general population regarding education, full-time employment, income, and gender than bike-sharing users (Reck & Axhausen, 2021).

5.2. Power differences in decision how space is configured

Struggles and the competition for more public space among different modes of transport are well-documented (Laa & Leth, 2020; Milakis et al., 2020). This is also relevant for new modes of transport such as SEMM, seeking their appropriate space in the urban environment. Due to their novelty, less is known about the specific needs of this travel practice (e.g. space, charging, skills needs and concerns). The (lack of) participation of the users and no users such as pedestrians in the procedural design of urban space for SEMM is critical for a coherent and inclusive societal implementation. Even in cases where the residents are reluctant to this systems for fear of changes in the built environment, such communities are likely to be more open to bicycle/micromobility facilities if they are included in the planning process from the start, rather than when residents' input is only sought when the services become available and visible on city streets (Hoffmann, 2016). According to Shove et al. (2012), it is reasonable to expect that individuals who are initially excluded from an e-scootering practice will become and feel more excluded over time (Shove et al., 2012).

Using a social practice approach, Fitt and Curl (2020) investigated early changes in the materials, competencies, and meanings connected with urban mobility in response to the electric scooter trial using an online survey in four New Zealand cities. The authors addressed the disruptive potential of e-scooters, both for urban transportation and social relationships, based on existing configurations of power and their implications for uneven use of public space. In the study, a large percentage of e-scooter users said they had used it in an area they did not think was appropriate, such as on shared walkways with pedestrians (Fitt & Curl, 2020). Bai and Jiao (2021) investigated the effects of public space disturbance reports about parked E-scooters in Austin, Texas on vulnerable population groups, claiming that the physical barriers caused by overcrowded dockless vehicles on streets, as well as the negative social equity implications of these modes' intrusion into the public space, are underexplored. According to the study's findings, minority and low-income populations have fewer opportunities to use e-scooters. Environmental burdens from e-scooter systems have a disproportionate impact on the poor and disabled people, and the minority population has experienced significantly longer remedial action delays than the non-minority population (Bai & Jiao, 2021). In this context, there is increasing pressure on the current allocation of road space and city policies should adequately address this competitive relationship by allocating more space to cycling infrastructure and traffic-calming zones (Laa & Leth, 2020).

5.3. Individual characteristics and its relevance for SEMM adoption

The papers reviewed focused on inequality and the exclusion of certain disadvantaged groups from using SEMM, noting that the lack of access cannot be explained only by allocating the physical presence of micromobility services, proximity, or individual cost–time considerations. There are other barriers regarding to personal capabilities (for conversion factors), e.g. forms of payment, language and lack of awareness, limited technology skills, and cultural meanings, which can also withhold people from using such modes (Dill & McNeil, 2020; Lee et al., 2021). European evidence for example from Paris (Christoforou et al., 2021), Zurich (Reck & Axhausen, 2021), and Vienna (Laa & Leth, 2020) also corroborate that among the users of SEMM young, high-educated men are overrepresented (Christoforou et al., 2021; Reck & Axhausen, 2021). Furthermore, these services have the potential to exacerbate mobility issues for vulnerable populations such as the elderly and people with physical disabilities (Bai & Jiao, 2020). In their New Zealand survey, Fitt and Curl found that people, particularly the elderly and those with physical disabilities, believed riding E-scooters was too demanding and dangerous for them due to the high level of abilities and physical capacity required to operate them (Fitt & Curl, 2020).

5.3.1. Incentives and barriers

Although discounts could improve access for low-income communities attracted by the lower price compared to other means of transport (Dias et al., 2021), they do not work in all cases. The origin of this dissonance, i.e. the existence of the system and the incentive to use but the non-adoption by the target population, lies in the lack of recognition and procedures that overlook of these groups' specific needs and capabilities. For instance a study conducted in four cities in the U.S. demonstrated the difficulties in meeting the Lime (micro-mobility operator) requirements for low-income residents, which included a valid government-issued photo ID and proof of enrolment in an assistance programme, as well as access to a computer or smartphone to upload them. The company could reduce these barriers and increase the use of electric scooters for low-income people (Frias-Martinez et al., 2021).

5.3.2. Disadvantaged groups

There is evidence that among the users of SEMM young, high-educated men are overrepresented (Christoforou et al., 2021; Reck & Axhausen, 2021). More traditionally disadvantaged groups do benefit less from using these services, including older adults (e.g. physical skills constraints, tech capabilities), women (e.g. safety concerns), people with physical disabilities (e.g. vehicle design), and children/youth (e.g. regulation, vehicle size). There is mixed evidence regarding how users with different racial/ethnic backgrounds and incomes engage with SEMM across different cities in U.S (Dill & McNeil, 2020; Laa & Leth, 2020; Reck & Axhausen, 2021). It is recognised that SEMM could improve mobility options for people who are unsatisfied with current transportation options. For example, as reported in a attitudinal study in Arizona, U.S., it was especially relevant for Hispanic/Latino and Black/African American respondents, who were significantly more likely to state that they are interested in trying e-scooters if this service is available for them (Sanders et al., 2020). Furthermore, micromobility services may also entail cultural and contextual fears and social stigma, such as fear of police harassment of people of colour. Although not directly related to EM, an examination of photos on bikeshare system websites revealed that the users in the photos were more likely to be white, even though the distribution in terms of gender and age was representative (Gavin et al., 2016). Fears of personal safety and being targeted by police are significant barriers to micromobility systems in the United States (Dill & McNeil, 2020). This is evidence of the importance of understanding the meaning of a new practice in different social contexts.

Gender disparities in the use of micromobility systems may be one of the most investigated issues, regarding inequities in adopting these systems. There are different reasons for the lower rate of women cycling, which extend the scope of this review, such as cultural norms, the gender different roles in public life/space, and greater risk aversion among women. Regarding SEMM these reasons are also relevant, along with specific issues related to the attributes of these vehicles. The first element identified in the literature review is safety-related concerns. Due to the lack of infrastructure, women reported concerns and a preference for separation from motor traffic when using SEMM (Laa &

Leth, 2020). Barriers to the use of e-scooters include not having enough safe places to ride, feeling unsteady while riding, and worrying about being hit. In this sense, street design is crucial in promoting gender inclusion in transportation and letting women fully utilise this new mode of transportation (Sanders et al., 2020). On the other hand, the literature suggests that gender disparities in personal vehicle use can be mitigated. Women are likewise more sensitive to distance and are less likely to cycle long distances, while e-bikes and e-scooters allow anyone to travel long distances effortlessly. Other advantages are due to the unique design characteristics of e-scooters. Women may feel safer using e-scooters because they are smaller than other modes of transportation and can be used on sidewalks, in many cities. In certain cultural contexts, women who wear skirts and dresses might also experience that standing on an e-scooter is simpler for them than riding on a bicycle (Dias et al., 2021).

6. Discussion, practical and policy implications

Table 1 summarises the primary mechanisms by which inequity impacts are observed for EM adoption in the two modalities analysed in the previous sections across different justice dimensions. Although the mechanisms found are classified into different justice dimensions, there is a dynamic relationship between different aspects of justice which are intrinsically related, as discussed below.

Similar mechanisms could be observed across the two modalities regarding distributive justice effects in the deployment and diffusion of the vehicles and services. First, specific mechanisms relate to the spatial distribution of the services enabling access and use. For instance, the spatial distribution of the micromobility services and the charging deployment in space are key issues for the adoption. The difficulty of spatial access derived from regulatory incompliance or lack of public charging infrastructure is a main barrier for the adoption affecting in different forms those who have access or not (e.g. low-income groups or low-density zones). Furthermore, economic incentives such as

Table 1. Summary of (non)adoption evidence with justice implications for private EVs and SEMM.

	EVs	SEMM
Distributive aspects	Economic incentives appeal more to affluent groups than low-income groups.	Spatial accessibility and compliance with distribution policies (for private companies profit-driven). High-demand zones and disconnected networks.
	Unequal access to charging options due to high demand EVs charging allocation and lack of public charging.	Type of micromobility system and lack of equity assessment in the distribution and use.
Procedural aspects	The diffusion focus on new private "clean" vehicles overlooking life-cycle assessments and alternative and inclusive forms of mobility	The diffusion assumes social digitalisation and overlook equity issues in in the design of private mobility services providers.
	Complexity in benefits packages creation (EVs are disproportionally adopted by high socio-economic groups)	SEMM (non) users' visions and public space use concerns are not well-integrated into the local planning process.
Recognition aspects	High-risk purchase perception by low-income households and second hand/affordable vehicles needs specific attention	Individual capabilities issues to face barriers in the build environment in different socio-urban contexts.
	Difficult in the materialisation of the incentives (e.g. complex tax deductions).	Difficult in the materialisation of the incentives (e.g. knowledge, payment methods and ICT access).

discounts or subsidies are effective policy measures to support EM adoption, especially considering the high investments in EV purchases. However, for both modes, disadvantaged users do not always leverage economic incentives, which might be attributed, among other factors, to the lack of recognition (e.g. unmatchable requirements) and capabilities constraints (e.g. digital access and knowledge).

The underlying processes resulting in uneven adoption among social groups were analysed both in the societal context where EM is being developed and at the individual level, understanding how individuals rely on their personal capabilities to transform opportunities and resources into EM adoption and use. In this sense, social discourses and individual capabilities provided useful conceptual tools for identifying other aspects of justice related to procedural and recognition aspects. For instance, there are justice implications derived from failures in the policymaking process, including the lack of civic participation, such as the complexity of understanding the subsidy programmes for EVs, or the constraints (e.g. appropriate infrastructure and safety concerns) on using SEMM in the public space, that exclude people from adopting or using EM. These mechanisms also reflect, or are influenced by, public discourse in EM diffusion. The social discourse around the EM transition focuses mainly on the technological and environmental benefits but perhaps overlooks issues such as social inclusion and the reconfiguration of the current mobility system (e.g. enhancing active and public transport and diminishing the need for travel through an adequately planned urban environment). These shortcomings may lead to a strong focus on the acceleration of EM diffusion by the authorities without a critical evaluation of the current societal outcomes regarding social equity and transportation burdens.

Also, the lack of recognition of social diversity in the EM diffusion process is reflected in lower adoption and use rates among socially disadvantaged groups (e.g. ethnic minorities, women, the elderly, or people with disabilities). Given the conceptual justice dimensions discussed here, inequities in EM adoption could be addressed at various levels by policymakers and practitioners. Distributive issues in allocating material, infrastructure, or financial resources should explicitly consider equity by targeting low-income or other disadvantaged communities. In this sense, equity assessments should be part of overall ex ante assessments of EM diffusion. Also, outreach and dedicated information campaigns through local and community channels, education for target groups, and marketing that makes people feel the system is for people like them while accounting for potential language issues are needed to overcome low rate and socially uneven adoption for EVs and SEMM. This entails epistemic challenges in the way that disadvantaged or non-dominant groups are fully co-producers in the knowledge creation supporting EM diffusion policies.

Furthermore, lessons could be learned from the inequities issues in EM diffusion discussed in this review. For EVs, financial incentives for low-income groups (for both new and second-hand vehicles) and special attention to the emergent second-hand market are needed, giving guarantees to reassure price depreciation, battery prices, and cycle-life concerns. Also, there is a necessity for a comprehensive public charging deployment, ensuring that the users can rely on the network for daily activities across different locations and geographies. For SEMM, beyond the necessity for equity measures in the distribution and use, it seems that the digital access that increase accessibility for most, also has the potential to exclude vulnerable groups. In this sense, non-digital alternatives, such as the use of line telephone for booking, the possibility to buy tickets in kiosks and clear explanations of how to use the systems along with creative design solutions for vehicles (relevant for people with any physical impairment or families with kids) should be considered in order to make accessible these new mobilities services to all the population (Goodman-Deane et al., 2021).

Many of the reviewed studies noted the importance of rational considerations and personal attitudes in adopting EVs and SEMM. Nevertheless, there are differences in the scope of influence in the decision-making process, which are worth noting. The different examples discussed in the paper reflect that EVs inequity mechanisms entail long-term considerations related to household budget administration for high costs and residential characteristics, while SEMM adoption is led by shorter term and volatile considerations according to personal attributes (e.g. current socio-economic and physical condition) and safety implications of using the built environment. These differences extend to policy questions in the formulation of measures supporting EM adoption. EVs financial policy is generally supported and managed at the national level while SEMM as well as charging local deployment is managed at the municipality level (Sierzchula et al., 2014). In this sense, there is a necessity for communication between different policy levels to inform and design how the EM is being deployed and adopted across diverse socio-urban areas, with a focus on groups considered disadvantaged in transportation terms, or in those groups where adoption is comparatively low.

7. Conclusion

The conceptual approach applied here could be helpful as a basis for understanding shortcomings and exclusion issues in EM diffusion and adoption through different justice dimensions analysis aimed to achieve equitable low-carbon future. The previous reflections suggest that more than exclusive dimensions of justice, there is a dynamic relationship between the justice dimensions, as presented in Figure 3. The shortcomings in one or more of the justice spheres/dimensions could impact differentially among social groups, exacerbating inequities for disadvantaged social groups. Far from being exclusive dimensions, conceptually and empirically, these dimensions are intrinsically related and the boundaries and directions are not trivial questions. For instance, in the process of the identification of the mechanisms performed in the preparation of this manuscript, as expected, distributive justice outcomes were straightforwardly identifiable (tangible) and recognised in the papers. In contrast, recognition and procedural aspects, except for a few papers, required an “extra layer” of identification and association.

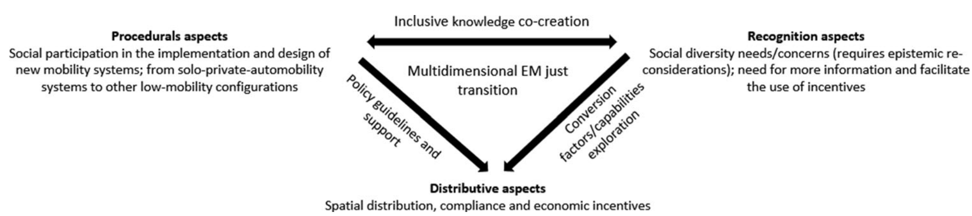

Figure 3. Main dimensions of justice and its relationships derived from the mechanisms reviewed.

According to different justice scholars, specific relationship patterns could be established (Fraser, 2000a). The configuration of distributive outcomes, e.g. maldistribution, is in part social, cultural, and policy-generated and related to the lack of recognition (cultural norms, symbols, language, skills) and participation or legitimation. In this sense, distributive aspects of justice could be seen as first-order indicators of equity. However, it is difficult to determine a hierarchical or directional relationship between the procedure and recognition dimensions: "If you are not recognized, you do not participate. If you do not participate, you are not recognized" (Schlosberg, 2007, p. 14). In this sense, policy measures addressing distributive aspects of EM, such as service requirements and geographical infrastructure coverage, and financial support, should be intrinsically accompanied by an understanding of the potential capabilities, needs, and desires of a specific target population. In turn, the formalisation of citizen participation in the decision-making process is critical in terms of the effectiveness and relevance of distributive policies.

This kind of approach may be applied and structuralised at the local/municipality level in cooperation with local communities to include disadvantaged groups but also at the national level by integrating different entities (e.g. academia and research institutes, regional/local/civil organisations/authorities). In this sense an inclusive transition becomes also process oriented and not just goal oriented. This approach could also be enhanced by considering other mobility configurations within a participation framework of social consensus, supporting collective and active modes of transport in an appropriate built environment, and decreasing the need for transport (e.g. through virtual and digital technology), which can potentially address "many of the justice concerns associated with accessibility, availability, and affordability of transport" (Marsden et al., 2014). The approach amplifies the need for transparent decision-making process which juxtapose different mobility interventions, for example, the high EV adoption costs and the effect of mass EV adoption on public space, including curbside charging and potential increases in congestion.

Following the justice framework and the empirical findings discussed in this review, the results make evident the necessity to set social inclusion including the different justice dimensions discussed, as one of the main strategic targets and challenges, along with the urgency for decarbonisation, in the current early stage and management of the EM transition.

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Appendix

Table A1. Papers reviewed exploring mechanisms of EM adoption with (un) justice implications/ evidence.

Author	Title	EV/ SEMM	Region/country	Method: Bibliographic Search (BS) / Team Knowledge and Snowball
Adnan et al. (2017)	A comprehensive review on theoretical framework-based electric vehicle consumer adoption research	EV	Not relevant – Literature review	BS
Akar and Miller (2021)	Special Issue on New Mobility Technologies and Cities	SEMM	Not specified	Team
Andrich et al. (2013)	Inequality as an obstacle to sustainable electricity and transport energy use	EV	Western Australia	BS
Bateman et al. (2021)	Barriers and facilitators to bikeshare programs: A qualitative study in an urban environment	SEMM	Alabama	Team
Bergman et al. (2017)	Imagined people, behaviour and future mobility: Insights from visions of electric vehicles and car clubs in the United Kingdom	EV	UK	Team
Biresselioglu et al. (2018)	Electric mobility in Europe: A comprehensive review of motivators and barriers in decision making processes	EV	Europe	BS
Canepa et al. (2019)	An early look at plug-in electric vehicle adoption in disadvantaged communities in California	EV	California	BS
Carley et al. (2013)	Intent to purchase a plug-in electric vehicle: A survey of early impressions in large US cites	EV	US	Team
Carlton and Sultana (2022)	Transport equity considerations in electric vehicle charging research: a scoping review	EV	Not relevant – Literature review	Team
Chakraborty et al. (2022)	Plug-in electric vehicle diffusion in California: Role of exposure to new technology at home and work	EV	California	Team
Christoforou et al. (2021)	Who is using e-scooters and how? Evidence from Paris	SEMM	Paris	Team
Curran and Tyfield (2019)	Low-Carbon Transition as Vehicle of New Inequalities? Risk-Class, the Chinese Middle-Class and the Moral Economy of Misrecognition	EV	China	BS
Coffman et al. (2016)	Electric vehicles revisited: a review of factors that affect adoption	EV	Not relevant – Literature review	Team
Dias et al. (2021)	The role of shared e-scooter systems in urban sustainability and resilience	SEMM	Braga	BS

(*Continued*)

Table A1. Continued.

Author	Title	EV/ SEMM	Region/country	Method: Bibliographic Search (BS) / Team Knowledge and Snowball
	during the covid-19 mobility restrictions			
Dill and McNeil (2020)	Are Shared Vehicles Shared by All? A Review of Equity and Vehicle Sharing	SEMM	Not relevant – Literature review	BS
Fitt and Curl (2020)	The early days of shared micromobility: A social practices approach	SEMM	New Zealand	BS
Frias-Martinez et al. (2021)	Causal effect of low-income areas on shared dockless e-scooter use	SEMM	US	BS
Gavin et al. (2016)	A Brief Study Exploring Social Equity within Bicycle Share Programs	SEMM (SMM)	US	Team
Guo and Kontou (2021)	Disparities and equity issues in electric vehicles rebate allocation	EV	California	BS
Guo and Kontou (2021)	A systematic overview of transportation equity in terms of accessibility, traffic emissions, and safety outcomes: From conventional to emerging technologies	EV	Not specified	BS
Hardman et al. (2017)	The effectiveness of financial purchase incentives for battery electric vehicles – A review of the evidence	EV	Not relevant – Literature review	Team
Henderson (2020)	EVs are not the answer: a mobility justice critique of electric vehicle transitions	EV	Not specified	BS
Hirsch et al. (2019)	Roadmap for free-floating bikeshare research and practice in North America	SEMM	North America	Team
Hsu and Fingerman (2021)	Public electric vehicle charger access disparities across race and income in California	EV	California	Team
Jenn et al. (2018)	Effectiveness of electric vehicle incentives in the United States	EV	US	Team
Laa and Leth (2020)	Survey of E-scooter users in Vienna: Who they are and how they ride	SEMM	Vienna	BS
Lazarus et al. (2020)	Micromobility evolution and expansion: Understanding how docked and dockless bikesharing models complement and compete – A case study of San Francisco	SEMM	San Francisco	BS
Lee et al. (2021)	Factors affecting heterogeneity in willingness to use e-scooter sharing services	SEMM	Seoul	Team
Liu et al. (2022)	Equity issues associated with U.S. plug-in electric vehicle income tax credits	EV	US	BS
Machado et al. (2020)	Placement of infrastructure for urban electromobility: A sustainable approach	EV	Sao Paulo	BS
Meng and Brown (2021)	Docked vs. dockless equity: Comparing three micromobility service geographies	SEMM	US	BS
Milakis et al. (2020)	Is micro-mobility sustainable? An overview of implications for accessibility, air pollution, safety, physical activity and subjective wellbeing	SEMM	Not specified	Team
Moran (2021)	Drawing the map: The creation and regulation of geographic constraints on shared bikes and e-scooters in San Francisco, CA	SEMM	San Francisco	BS

(*Continued*)

Table A1. Continued.

Author	Title	EV/ SEMM	Region/country	Method: Bibliographic Search (BS) / Team Knowledge and Snowball
Nelson et al. (2021)	Equity in Renewable Energy Technology Adoption in China: a Review of the Social-Psychological and Demographic Barriers	EV	China	BS
Reck and Axhausen (2021)	Who uses shared micro-mobility services? Empirical evidence from Zurich, Switzerland	SEMM	Zurich	BS
Roy and Law (2022)	Examining spatial disparities in electric vehicle charging station placements using machine learning	EV	California	Team
Sanders et al. (2020)	To scoot or not to scoot: Findings from a recent survey about the benefits and barriers of using E-scooters for riders and non-riders	SEMM	Tempe	BS
Schuitema et al. (2013)	The role of instrumental, hedonic and symbolic attributes in the intention to adopt electric vehicles	EV	United Kingdom	Team
Singh, Singh, and Vaibhav (2020)	A review and simple meta-analysis of factors influencing adoption of electric vehicles	EV	Not relevant – Literature review	Team
Sovacool, Kester, et al. (2019)	Energy Injustice and Nordic Electric Mobility: Inequality, Elitism, and Externalities in the Electrification of Vehicle-to-Grid (V2G) Transport	EV	Nordic countries	BS
Wicki et al. (2022)	What do we really know about the acceptance of battery electric vehicles? – Turns out, not much	EV	Not relevant – Literature review	BS
Wood and Jain (2020)	Raceways, rebates, and retrofits: an exploration of several American cities' policies to facilitate electric vehicle purchase and usage	EV	US	BS