

Sustainable urban mobility: brief considerations on plans and practices in Latin American cities

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ABSTRACT

This article presents a research excerpt, located in the diverse set of studies on urban mobility, which highlights the importance that new technologies are acquiring in the Latin American context to mitigate the urban and environmental crisis. This debate seeks to expose plans and practices that are being implemented in Buenos Aires (Argentina); Belo Horizonte, Curitiba, Porto Alegre, Rio de Janeiro and São Paulo (Brazil); Santiago (Chile); Bogota (Colombia); San José (Costa Rica); Ciudad de Mexico, Guadalajara and Leon (Mexico); Lima (Peru); Montevideo (Uruguay); and Caracas (Venezuela). Based on a descriptive and exploratory approach of the research, the text shares reflections on the increasing impact of the incorporation of electric vehicles in public and individual transport. As the investigation advanced, the analysis sought to identify nuances within this theme, providing data that raise questions and project meanings in relation to the use of policies and infrastructures that are becoming reality in urban space. We hope that the reflections presented here can enrich the discussions on urban mobility as a means of mitigating environmental impacts, inspiring new research and practices.

KEYWORDS: Emerging technologies. Sustainable Urban Mobility. Latin American cities.

1 INTRODUCTION

The article presented here is an excerpt of the¹ongoing doctoral research, which addresses urban mobility under the technological and sustainable bias, widely considered in the environmental urban context of contemporary cities today. Upon describing how the theme of sustainable urban mobility has been treated, in recent decades, in plans, programs and projects in different Latin American cities, the purpose of the excerpt is to explain contradictions and limitations of scope in their trajectories.

It is noticeable, nowadays, sensitivity to the subject. Research on digital platforms presents the issue in the most revolutionary perspective of meaning. That is, how it is inevitable to pursue urgent transformations in a context of inserting it as part of the urban-environmental problem of our time, whether relating urban mobility to opportunities²- seeking to equate socio-spatial inequalities- linking it to adherence by a matrix committed to sustainable practices³. Both views corroborate that mobility is seen as one of the variables that greatly affect the quality of space, at its different scales, and the ways of life of citizens.

In Brazil, the Covid-19 crisis highlighted problems in public transport, including passenger loss and increases in fares. Technology is seen as a solution to improve transportation supply and demand. However, the mobility revolution also reflects changes in the consumption habits of the population, emphasizing the importance of investments that prioritize the needs

¹ Research in progress within the scope of the group Cities, Urbanization Processes and Environment, which integrates the Laboratory of Place and Landscape (Lupa), of the Post-Graduation in Architecture and Urbanism (PPGAU) of the Universidade Federal Fluminense.

² The study conducted by Pereira et al. (2021), at the Institute of Applied Economic Research (IPEA), analyzes trends and inequalities in urban mobility in Brazil. When addressing the changes in mobility patterns in Brazilian cities, the authors highlight how these changes negatively affect mobility conditions and emphasize the need to reformulate public policies before such challenges.

³ The debate on smart solutions for urban mobility emphasizes the need to improve urban planning to cover a variety of options, including diverse modes of transport such as electric vehicles, autonomous vehicles and bicycles. This is discussed critically and with constructive proposals in the context of urban mobility, as exemplified in the article "The Revolution of Urban Mobility in Latin America". (Available at : <https://www.estapar.com.br/blog/revolucao-da-mobilidade-urbana-na-america-latina>. Access on: Jul 2nd 2022).

of people and the environment, an issue addressed in this article.

Observing this debate, in the context of Latin America, the problem can be expanded due to the lack of urban planning and incentives. But still, there are noticeable differences in how cities have made their choices.

In this sense, it is important to contextualize how our Latin American neighbors are facing the issue today. Some debates on digital platforms⁴ on this issue promote reflections on initiatives that turn to smart and friendly cities from urban mobility solutions. Such contributions, dependent on the study sponsored by *the Banco de Desarrollo de América Latina y el Caribe* (CAF) and carried out by the Observatory of Urban Mobility (OMU⁵) in Latin America and the Caribbean, of 2010, and released in 2011, express concern in articulating the Latin American social agenda, which today is basically an urban development agenda, with the urban mobility agenda. This study sought to analyze good practices between transport systems and their cities, in the field of displacement of people and vehicles on the local and metropolitan scale; and in its first phase, cities such as Buenos Aires (Argentina); Belo Horizonte, Curitiba, Porto Alegre, Rio de Janeiro and São Paulo (Brazil) participated; Santiago (Chile); Bogota (Colombia); San José (Costa Rica); Ciudad de Mexico, Guadalajara and Leon (Mexico); Lima (Peru); Montevideo (Uruguay); and Caracas (Venezuela). In addition, the study⁶ is aligned with what is presented for the design of effective public policies and the management of public transport information systems, and with the need for greater investments and greater attention of cities on these aspects. This can be understood in relation to the demands associated with the knowledge of the characteristics of transport and areas attended, as well as the need to improve the relations of mobility with transport, with accessibility, with urban development, in order to subsidize the formulation and management of associated public policies and provide cooperation measures in the cities management.

It is worth noting that this study, when published in 2011, had as scenario a Latin America with almost 80% of the population living in urban centers and a trend, ongoing, to increase this level to 90% in the following decades, this already reflected on the need to deepen measures to deal with transport and urban mobility systems, considering them fundamental to guide the quality of life of citizens and, therefore, the regional economy.

The study of the Urban Mobility Observatory (OMU) already highlighted the plurality of this theme in the target cities of the analysis, that is, the variety of public transport services offered. As good examples, *the Transmilênio*, in the city of Bogota, and *the Metrobís*, in Mexico City, whose inspiration was probably due to from the city of Curitiba from the model of

⁴ In the subject "Latin neighbors seek formulas to develop urban mobility" it is explored how cities in Latin America are working to solve persistent challenges related to traffic of people and vehicles (available at: <https://medium.com/para-onde-vamos/vizinhos-latinos-buscam-f%C3%B3rmulas-pr%C3%B3prias-para-desenvolver-mobilidade-urbana-a3491a3e6b11>. Access on: Jun. 30th 2022).

⁵ A study that highlighted ways to go, according to the *Banco de Desarrollo de América Latina y el Caribe* (CAF), based on a critical assessment of the transport infrastructure available in some of the main cities in Latin America (available at: <https://www.caf.com/pt/presente/noticias/2011/09/observatorio-de-mobilidade-urbana-da-caf-ira-incorporar-varias-cidades-bolivianas/>. Access on: Jul 4th 2022).

⁶ This study was carried out in the context of a first report, which included 15 metropolitan regions from 9 countries (available at: <https://ceiri.news/panorama-da-mobilidade-urbana-na-america-latina/>. Access on: Jul 4th 2022).

corredores expressos de ônibus – Bus Rapid Transit (BRT). The study also drew attention to excessive congestion and its effects on climate quality in the cities and regions studied. In this context, measures for better operation of traffic, optimization of existing infrastructure and effective priority to collective transport and active transport are still very timid in the framework of plans and practices of sustainable urban mobility in Latin American cities.

Although much remains to be done, such **contributions will** reflect initiatives and commitments to sustainable development and regional integration in Latin America, they were determinant for the study to influence other research and events in the discussion and deepening on the issue. This can be observed by the variation of the theme in debates and discussions around the world in recent times. In 2017, the International Association of Public Transport (UITP⁷) and, in 2018, the Conference on Infrastructure for the Development of Latin⁸America, held in Buenos Aires, and in 2019, *the Global Traffic Scorecard ranking*⁹ pointed out that urban flows by fossil fuel-consuming vehicles that greatly contribute to the degradation of air quality. In addition to the excess of time in congestion, together, they end up impacting the quality of spaces and life of the population, generating less healthy, less durable cities. Conditioned these contributions to local factors, drew attention to the fact that, in the wake of the lessons learned in terms of public policies associated with urban mobility, much still existed to consider regarding the transfer and adaptation of good practices among the cities. Important challenges have been identified, attributed to the most appropriate forms of urban occupation; better regulation of the provision of transport services; better control of the use of individual transport and its effects on air pollution and consequent congestion; as well as improving road safety and greater adherence to active transport, this can be endorsed in the debates that the subject continues to raise.

The CAF event and the Conference on Infrastructure for the Development of Latin America, held in 2018, discussed a series of measures to improve management practices in the field of urban mobility, endorsed in a document. This document emphasizes the necessary efforts to build a global agenda committed to urban mobility and climate change, supported by three pillars: mitigation, adaptation and cooperation. The articulation of these aspects must observe in its planning, in addition to a trajectory committed to a legal, technical and management process, the trans-scalar relationship, the associated planning instruments and the population's adherence.

Whereas the 2019 Global Traffic Scorecard considered, in its analysis, a series of variables that demand to value in the paths to be pursued by mobility planning before the peculiarities of cities and their regions. These variables concern the real demand for transport services, the socioeconomic conditions of the population and the studies of population growth, aiming to reach a new level of mobility, considering the integration of active transport with public

⁷ Program known as the "Urban Movement Promotion and Community", in which 46 projects are described in countries such as Argentina, Brazil, Chile, Mexico and Peru.

⁸ This event generated a document called transport demand management measures in Latin American cities, in the context of the LAIF-AFD-CAF Urban Transport Program (available at: [https://scioteca.caf.com/bitstream/handle/123456789/1393/6%20Medidas%20de%20ges tion%20de%20la%20dem anda%20de%20transporte%20en%20ciudades-28feb.pdf?sequence=5&isAllowed=y](https://scioteca.caf.com/bitstream/handle/123456789/1393/6%20Medidas%20de%20gestion%20de%20la%20demanda%20de%20transporte%20en%20ciudades-28feb.pdf?sequence=5&isAllowed=y). Access on: Jul 5th 2022).

⁹ INRIX Consulting presented the Global Traffic Scorecard Ranking in 2019. (Available at: <https://inrix.com/scorecard/>).

transport. How to undertake such an agenda before the diversity of Latin American territory?

With all its diversity, Latin American cities have dynamics that bring them closer, such as the rural exodus due to the attraction of industrial centers, looking for education and basic urban services. This phenomenon results in a high demographic concentration in cities such as Rio de Janeiro, São Paulo, Buenos Aires, Bogota, Lima and Ciudad de Mexico. The insertion of these cities in the map of megacities¹⁰ (UN-HABITAT; NEW YORK UNIVERSITY; LINCOLN INSTITUTE OF LAND POLICY, 2019) shows current environmental problems very similar, but of different proportions, such as excessive traffic (congestion) and mobility problems.

These cities have a high population density, especially in their peripheries, concentrating labor in the city without planning, a phenomenon independent of the country and urban plans. Carmona, Heath, OC and Tiesdell (2003) called this phenomenon unconscious urban design, the result of an ideology to support the capitalist economic base. It is also observed, according to Cuthbert (2003, 2006), that these urban centers did not develop the basic infrastructure necessary for housing, sanitation and mobility, producing an urban network marked by socio-spatial segregation influencing multiple representations of urban design. Such representations, when they mirror the real city, are nothing more than the manifestations of society in urban space, revealing meanings through specific urban forms.

Castells (1973), from a historical view, reminds us that one of the characteristics of the Latin American urbanization process are its social matrices. The first stage was experienced throughout the colonial process, and the second stage, by the imperialist process, resulting in a diverse and late urbanization, but very fast.

Lefebvre's contributions (2001) converge in observing that, in the industrial city, urban expansion is an increasingly universal dynamic and that, in contemporary cities, the process of metropolization occurs from centralities where interdependent and complex systems arise from an intensity of growth that can vary from regional contexts.

Other points of view are associated with this theoretical basis when articulating such constraints to the expansion process of the Latin American city, cities in motion.

The Latin American urban dispersion differs from the Anglo-Saxon model in its content, since the occupation of peripheral districts is traditionally affirmed as a strategy of survival of the most economically vulnerable population groups – who seek affordable housing through the informal market, and in distant areas that have less or do not have urban infrastructure... (CAMARGO *et al.*, 2020, p. 24).

In order to understand the relationship between urban expansion and population growth, sustainable urban mobility is a practice to confront contextualized negative externalities. This is not only revealed in terms of accessibility and safety of public transport services, but it extrapolates the movement of the body through the city, has a relationship with the use of the soil and with the social division of labor and classes by providing access to education, health and economic justice (BALBIM, 2016).

When talking about the patterns of displacements and gender in Latin America, Casas

¹⁰ The concept of megacity was developed by the United Nations (UN) to refer to any urban agglomeration with a population of more than ten million inhabitants. For the institution, Latin America is the second region with the most megacities in the world, with poor urban mobility as one of the main problems.

and Cindy-Espinosa (2019) point out that this mobility was built in a network of relationships in which the social space was planned from hierarchies and gender domains, defining both their activities and their physical autonomy. In this hierarchy, the male is characterized by few commuting with fixed origin and destinations, in general from home to work, but with long duration, without loads and dependents; and concerns about physical or moral aggressions are not part of their choices when planning a route, the choice of their routes is determined above all for the shortest time. On the other hand, the female has polygonal displacements, that is, several trips with different goals between them, valuing flexibility, above all, to avoid sexual robberies and aggressions.

In this scenario, it is important to highlight the climatic events that cities face, such as global warming, a phenomenon caused by the intensification of the greenhouse effect, resulting from the increase in the concentration in the Earth's atmosphere of certain gases, mainly carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). According to IPCC (2023), the most important greenhouse gas is CO₂. Several evidences (IPCC, 2023; UNFCCC, 2023) confirm that the recent and continuous increase in CO₂ concentration in the atmosphere is mainly due to anthropogenic emissions, the main cause of which comes from the increasing use of fossil fuels.

It can be considered that urban mobility within an ecological vision can be achieved under two approaches: adequacy of transport supply to the socioeconomic context and environmental quality. The first approach frames measures that associate transport with urban development and social and gender equity in relation to displacements, and the second encompasses the technology and mode of transport to be used and their energy matrices.

In the last two decades, Latin American cities have implemented policies aimed at restructuring public transport, linking existing systems to new infrastructures, such as BRTs and funiculars. These actions, outlined in mobility plans, seek to integrate operations and tariffs of different means of collective transport (bus, subway), improve the quality of service and reduce the use of individual vehicles, which promotes sustainable urban mobility and reduces greenhouse gas emissions.

2 OBJECTIVES

This article aims to analyze the public policies to promote sustainable urban mobility, specifically the experiences of cities such as Niteroi (Brazil), Lima (Peru), Mexico City (Mexico) and Bogota (Colombia), as well as their reorganizations from experiences with BRT and integrated transport systems, its limitations and contrasts.

When analyzing the implementation of mobility projects, it is intended to verify its limitations of reach as commitments to productive logic and, at the same time, distancing from the urban design appropriate to the intervention on the city, considering the way of existence of the city itself and its citizens.

This article also aims to prospect how urban planning, devoid of design, can generate contradictions and imperfections to the point of limiting the scope of urban mobility strategies committed to sustainability.

3 METHODOLOGY

This research has a diversified trajectory in three distinct parts. The first part addresses the theoretical-conceptual foundations, exploring how urban mobility is treated globally and its changes in progress. This includes an analysis of the different contemporary approaches to the subject, especially in relation to urban, energy and climate crises. The second part focuses on plans and policies to promote sustainable urban mobility through case studies in cities such as São Paulo (Brazil), Niteroi (Brazil), Buenos Aires (Argentina), Mexico City (Mexico) and Bogota (Colombia). Finally, the third part deals with technologies emerging from these plans and policies.

Given the above, this article proposes to discuss sustainable urban mobility and how it is expressed in Latin American cities. As urban planning almost always does not admit the existence of a product but of actions and investments associated, with this understanding, the concern with the physical, environmental and aesthetic attributes of the territory, often does not reveal itself in the interventions or is in the background, what seems to us a contradiction, because, beyond the legal/institutional, technical and management framework, urban culture and the environment should be premises for the desired transformations.

In the excerpt initially established, it was sought to observe the possibility of finding connections, specifically regarding the research problem, in progress. And identify which contemporary interpretations about the relationship of urban mobility, from the studies in reference, could generate possibilities of action before the challenges of planning and management of the territory in light of the field of sustainable urban mobility.

4 RESULTS

The results, herein shared, follow the methodological path from two perspectives launched on the theme: 1) sustainable approaches by the bias of plans and projects; and 2) variations of the theme and perspectives regarding the urban-environmental agenda. In the latter, sub-themes are explored, such as electric cars as individual transport, public transport without fossil fuel and, finally, active transport.

4.1 Sustainable approaches by the bias of plans and projects

In the covid-19 pandemic, the government needed to restructure itself to adapt policies in different areas. Social isolation, online commerce, behavioral changes in the city, increased active transport, emptying of public buildings and central areas, tele sociability, home office, closing of trades and the emergence of *dark kitchens*¹¹ were urban challenges, impacting urban planning and land use. The initial flexibilization of urban legislation gave rise to a post-pandemic review by the public administration, which resulted in the inclusion of virtual approaches in legislation, new rules for land use and the consolidation of temporary measures for mobility.

To promote the use of bicycles in the pandemic period as a means of transport, Mexico City has implemented a 54 km extension of temporary cycle paths along the main urban mobility

¹¹ Restaurant business model exclusively for delivery, without face-to-face service.

corridors, as an integral part of the **Plan Gradual Hacia Nueva Normalidad (COALICIÓN CERO EMISIONES, 2020)**. These temporary cycle paths had a significant adhesion by the population, which led the city government to announce, in 2022, the conversion of 28.5 km of Avenida Insurgentes – one of the busiest routes in the city – into a permanent cycle path (COALICIÓN CERO EMISIONES, 2020).

In Buenos Aires, Argentina, the municipal government created¹² necessary resolutions to establish the temporary closure of the road space for gastronomic and cultural activities. One of the resolutions provides for the responsibilities of the organizers and sellers. Another law, also in the port capital, regulates the creation of **supermanzanas**, court projects inspired by the Barcelona and Madrid projects, where the courts can be closed for cars, allowing free use of the street by pedestrians and cyclists. The creation of these **supermanzanas** may be requested by the public administration or by a popular call.

Such approaches are part of a plan aimed at revitalizing and transforming land use, in an approach aimed at combating the decline of commercial areas, encouraging the revitalization of these territorial areas that have a sound public infrastructure, especially in terms of transport.

Mexico City has adopted laws to revitalize real estate, focusing on converting idle offices into housing. The objective was to face the impacts of the pandemic, which left many offices empty due to changes in work caused by social distancing and increased telework, and also sought to boost the offer of housing in the city.

In addition to transforming spaces into housing, it is necessary that the dweller adopt measures to improve water management, reducing his or her consumption and increasing rainwater harvesting. In exchange for these initiatives, tax benefits are offered, including tax exemption in the project approval and licensing process¹³, and also an incentive to develop housing of social interest, allowing greater density of units. In 2022, the instrument of law that regulates this standard was updated, defining the areas of incidence of the instrument and prioritizing properties located in the region of the historic center of Mexico City, and in the **main transport axes**, like Av. Insurgentes and Av. Paseo de la Reforma (PIZA FONTES *et al.*, 2022).

In the city of São Paulo, **Bill number 362/22** was proposed by the Executive to regulate **dark kitchens**. The model, which grew during the pandemic, is already part of the urban landscape, without a doubt, generating impacts on the neighborhoods and the use of sidewalks. In this sense, it is up to the public authorities to create rules of use regarding polluting loads, noise, obstacles and the misuse of the public road through the new activity. A study conducted by Unicamp in 2023 showed that in the São Paulo State capital one in three restaurants registered on digital platforms is **dark kitchen**. This information demonstrates not only the need to regulate the practice, but also to understand the new phenomena that it carries and produces to the contemporary city, as delivery workers pedaling on expressways, without adequate infrastructure and exposed to the modern precariousness of platform capitalism.

The PMUS 2020/2030¹⁴ of Niteroi defines BHLS as¹⁵ a priority system for public transport by bus with operation in an exclusive corridor and segregated with open stations and

¹² Resolución Conjunta N.º 1-SSGMO/20 and Resolución Conjunta N.º 3-MCGC/20.

¹³ Artículo 14 del Acuerdo para la Reconversión de Oficinas a Vivienda.

¹⁴ Sustainable Urban Mobility Plan.

¹⁵ Bus with High Level of Service.

the possibility of integration with the existing road network. While BRT is defined in the same document as bus systems that run segregated routes, typically in the central part of the track, and have features such as overtaking at stations, level boarding and fare prepayment.

The Niteroi PMUS sets a goal for the BHLS corridor, especially in the oceanic region of Niteroi, estimating the reduction of 1% in travel distance and 1.8% in time. Such an initiative seems to be a timid goal against the investments needed for the entire infrastructure, with little capacity to impact the lives of users. Another goal mentioned in the document is the reduction in the emission of pollutants. For this, Phase II of the plan foresees the use of electric buses in its fleet. The fact is that the announcement of these investments in public transport systems in the city created expectations regarding the real estate market and the densification of the soil in the region.

4.2 Variations of the theme and perspectives on the urban-environmental agenda

The Urban Environmental Agenda, to be pursued by Latin American cities, is composed of guidelines and political actions aimed at promoting sustainable development in urban areas, prioritizing equitable and ecologically conscious communities. The Sustainable Development Goals (SDGs), established by the United Nations, seek to implement innovative practices that address environmental and social dimensions in cities. Examples include SDG 11 – Sustainable Cities and Communities, which aims to make cities more inclusive, safe and resilient, with an emphasis on efficient urban planning, waste management and access to public transport; SDG 13 – Action against Global Climate Change –, which highlights the urgency to combat climate change, emphasizing climate resilient infrastructure in cities; and SDG 17 – Partnerships and means of implementation – which emphasizes the importance of collaboration between governments, the private sector, civil society and international organizations, as well as mobilizing resources and technologies to achieve these goals.

4.2.1 The electric car as individual transportation

The ITDP published the study **The Scenario of Electric Compact Cities**¹⁶, considering the projection for 2050, with the prediction of four scenarios for urban transport: (1) maintenance of the current scenario; (2) extensive electrification of vehicles; (3) promotion of compact cities; and (4) combination of electrification, compact cities and modal shift. In conclusion, it highlights that only electrification or compaction does not reduce emissions enough to limit heating to 2°C. Only the combination of electric motors and compact planning is that will keep heating below 2°C.

The current scenario of urban passenger transport reflects current trends. Maintaining this situation would result in a substantial increase in personal vehicle travel, including motorcycles and light cars. This would occur at the expense of public transport, such as buses and trains. The gradual adoption of electric vehicles would also expand, reaching around 10% of global car sales by 2050.

¹⁶ For more information visit : <https://itdpbrasil.org/o-cenario-de-cidades-compactas-eletrificadas/>. Access on: Aug. 20th 2023.

Another point that deserves attention is the scenario of massive electrification of personal and collective vehicles. It can only reduce greenhouse gas emissions if the electricity that feeds them comes from sustainable sources. In this sense, Brazil stands out, since 74% of its electricity comes from clean and renewable sources, with the potential to expand wind and solar sources.

In addition to tax incentives, policies to promote the use of electric vehicles are being experienced in countries such as Colombia, Costa Rica and Mexico, such as creating public parking spaces exclusive to electric vehicles. In these places, the access of vehicles to internal combustion is prohibited, even if payment is made for use. As for the public charging infrastructure, necessary to ensure that such users can travel long distances, the private and public sectors use online platforms such as <https://movilidad.ute.com.uy/> or <https://www.plugshare.com/>, to view the network of rechargers.

Shared electric car systems or *carsharing*,¹⁷ pointed out as a means to decrease the ownership of vehicles (CERVERO; TSAI, 2004), have encountered difficulties of operation in Brazil. In Fortaleza, the **Alternative Vehicles for Mobility (VAMO) program** reached the end of its operations in November 2022, not prospecting its renewal.

In São Paulo, the first experience of this type of operation was in 2009, with the **American Zipcar**, which in 2014 ended its operations. However, new possibilities seem to arise. Peugeot recently launched in 2023 three electric car sharing stations. The project is the result of a collaboration between the automaker, the electric vehicle rental platform UCorp and Tupinamba, the main electric mobility startup in Brazil. Another company, **BeepBeep**, already operates *carsharing systems* with electric vehicles of Renault, with stations in airports, supermarkets, hotels, residential condominiums and stations owned by the operator between São Jose dos Campos, Indaiatuba, Campinas, São Paulo, Valinhos and Jacareí.

4.2.2 Public transport without fossil fuel

It is known that the automotive sector is a major emitter of environmental pollutants due to the predominant use of fossil fuels. In this sense, **the electric bus**, as passenger transport, is essential to mitigate environmental impacts caused by urban mobility. According to MobilIDADOS,¹⁸ ITDP Brazil's urban mobility indicators platform, public transport is responsible for 40% of the trips made in Brazilian metropolitan regions. It is estimated that, in Brazil, the replacement of buses and minibuses to internal combustion by electric models would achieve a reduction of 91.4% (or 17.44 million tons) of carbon dioxide emissions (CO₂) emitted by these vehicles (LIMA; SILVA; NETO, 2019).

The global electric bus market is expanding, with a 200% growth in Latin America's fleet over the past five years. The challenge is to make this sector ecologically sustainable, financially accessible and inclusive. Cities such as Buenos Aires, Mexico City and Santiago have zero emission targets by 2050, with initiatives such as Mexico City's commitment to invest exclusively in electric buses from 2025. The cities of São Paulo, Rio de Janeiro, Salvador and Curitiba,

¹⁷ *Carsharing* is a car rental model per hour that can replace up to 12 private vehicles in Europe and 7 in the United States, according to studies.

¹⁸ This platform can be accessed at : <https://mobilidados.org.br/>.

committed to the C40 climate program¹⁹ in Latin America, have set targets to reduce greenhouse gas emissions in public transport. Rio de Janeiro promulgated Decree 46.081, on June 11th, 2019²⁰, which establishes, as of January 1st, 2025, the exclusive use of zero-emission buses in all concession contracts or permission for public transport by bus. In this context, electrification is a relevant opportunity to reduce emissions in the region due to its renewable energy sources.

In addition to air pollution, noise pollution causes sleep loss, irritation and cardiovascular effects. In this sense, the use of electric buses reduces the noise produced by the motors, especially when driven at low speeds, promoting environmental justice and benefiting the population as a whole.

However, care should be observed. Because they are quieter, in this type of transport there is the risk of accidents with cyclists and pedestrians. Integration between active systems and public transport systems is essential to achieve efficient and inclusive mobility, making it necessary to adopt safety systems to signal the proximity and arrival of electric passenger vehicles. As security measures, the Rio de Janeiro VLT (light vehicle on rails) adopted the sound of a bell to alert pedestrians, cyclists or distracted drivers who may be on the trail during their journey. In this sense, driver training, vertical and horizontal signaling can fulfill educational and alert functions.

4.2.3 Active transport

Cycling and walking in urban areas as an active mobility policy aims to achieve the UN's Sustainable Development Goals (SDGs) established in 2015. It stands out plans to promote cities with an urban design focused on the human scale, combat sedentary degenerative diseases among others.

Among the initiatives to boost urban cycling, it is possible to highlight that of the **Secretaría Distrital de Movilidad del Distrito Central de Bogotá**, in Colombia, in which the scope of *ciclorutas* consisted of improving air quality, mitigating the emission of pollutants, giving alternatives to the intense bottling of the Colombian capital and stimulating a healthy way of life for the dwellers. The main characteristic of the *ciclorutas* was their intermodal planning connected to the **TransMilênio**,²¹ where users can be part of the bike path and part of public transport from a view of complementarity of systems.

In addition to the initiatives in terms of cycling infrastructure connected to public transport, there were also educational initiatives, such as **Escuela de la Bicicleta**, in promoting the use of bicycles by children, young people and adults, and the teaching of safety standards and use for recreational and urban displacements in events held in the **Sistema Distrital de Parques** (ALCALDÍA MAYOR DE BOGOTÁ, 2019).

In the city of São Paulo, the **2014 Strategic Master Plan**, with revisions by **PlanMob**

¹⁹ Group C40 is a global coalition of major cities focused on tackling climate change.

²⁰ Rio de Janeiro. Decree number. 46.081 June 2019. Declares the adherence of the City of Rio de Janeiro to promote green and healthy streets, associated with the reduction of greenhouse gas emissions Rio de Janeiro: City Hall (2019). Available at: <https://leismunicipais.com.br/a/rj/r/rio-de-janeiro/decreto/2019/4609/46081/decreto-n-46081-2019-declara-a-adesao-da-cidade-do-rio-de-janeiro-em-promover-ruas-verdes-e-saudaveis-com-aco-es-planejadas-para-cumprimento-de-prazos-para-reduzir-emissoes-de-gases-de-efeito-estufa-gee-da-frota-de-transporte-publico-do-municipio-do-rio-de-janeiro-e-da-outras-providencias>. Accessed on Feb. 08th 2024.

²¹ Articulated bus system in segregated routes inspired by the model of Curitiba, Paraná.

(**Mobility Plan**), of 2015, of the **2015 Cycle Road Plan**, and the **2021 Climate Action Plan**, with regard to pedestrian circulation, include the expansion of sidewalks, walks, connivance spaces and increased semaphoric time in crossings, the expansion of bicycle sharing systems throughout the city by 2028 and that all public transport stations have bike racks. However, such instruments do not prioritize or do not detail the advance of the socioeconomic distribution of these urban infrastructures, because the populations living in middle class and upper class neighborhoods are contemplated with better infrastructures for walking and cycling.

5 CONCLUSION

This article sought to contextualize the debate of practices that emerge in the contemporary city, driven by technological innovations and approaches capable of legitimizing urban mobility from new patterns and choices, equitable and fair from a social and ecologically responsible point of view. It is more than time to feed “the desire for adherence to new practices that highlight the need for planning for cities to develop without prejudice to people and the environment” (ARAUJO, 2018, page 15).

The debate focused on new technologies must take into account limitations and risks, map the city that does not walk or pedal, and lead digital inclusion as an essential part of the infrastructure becomes imperative. It is not enough just to change the matrix, in this case the energy, much more must be done and mitigated. From the point of view of urban centers, the challenge is to legislate enhancing urban vitality in terms of housing, work and mobility.

However, new risks arise. Improvements in battery manufacturing and technology are driving the development of electric vehicles, especially electric buses. Before lithium rechargeable batteries became common in the 1990, they often discharged and were difficult to recharge. However, thanks to the extended durability and more efficient recharging processes, they have been adopted in several technological innovations. The production of these batteries should increase considerably, which will also lead to an increase in the mining required for their production. Thinking about proper disposal of these devices is also necessary.

In this sense, mining brings risks to workers, to socio-political stability and to the geology of the planet, consumes a lot of water in extraction and harms the soil. The Democratic Republic of Congo, which supplies more than two-thirds of world cobalt, is criticized for using child labor²². In the Latin American landscape, according to Bittencourt (2023), Chile, Argentina and Bolivia have the “lithium triangle”, an area that holds about 60% of the world’s reserves.

Organized civil society should consider such risks when social and environmental justice is sought and identify strategies for the development and supply of batteries. Current options for prospecting lithium and cobalt generate serious impacts for humans, the environment and health. How to defend that such policies are “green”?

As the research advances, nuances within the theme of mobility problematize and project meanings in relation to the adoption of policies and infrastructures that are becoming reality in the urban space of Latin American cities. The experiences, shared here, reveal a trend,

²² International companies accused of contributing to the encouragement of child labor in Congo. Available at : <https://www.rfi.fr/br/mundo/20191217-apple-google-e-tesla-s%C3%A3o-acusadas-de-incentivar-trabalho-infantil-no-congo>. Access on: Aug. 30th 2023.

on the move, of urban mobility committed to sustainable solutions. We hope that more information and deepening discussions will contribute to a national and regional mobility agenda inspiring new research and practices.

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