



Sustainable Mobility: a Favorable Action in the Reduction of Greenhouse Gases (GHGs)

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ABSTRACT

The growth of cities has become a reflection of economic development and urbanization, increasing life expectancy, synonymous with better living conditions for the population. However, this growth has contributed to several unsustainable problems, including air pollution, due to the saturation of an accentuated urban mobility in urbanized areas. The concept of urban mobility consists of meeting the daily needs of the population – such as going to work or school –, whose journey can be made on foot, by bicycle, by bus, or by car, in addition to being used for leisure. In the search for sustainability in mobility, the objective of the article leads to understanding sustainable mobility as a favorable action in improving urban life. The methodology has the character of a theoretical review of the concepts of sustainability and mobility, in which it intends to analyze how sustainable mobility can influence the reduction of Greenhouse Gases (GHGs). As a result, it is intended to place sustainable mobility as a study for the future urban planning of a city, guaranteeing improvements and diversities in urban modes, within the ideals of urban sustainability (economic, social, and environmental), based on circulation for all, contributing to economic and social well-being without harming the environment.

KEYWORDS: Urban Mobility. Sustainable Mobility. Greenhouse Gases (GHGs).

1 INTRODUCTION

The expansion of cities has become a reflex of economic development and urbanization, which have increased life expectancy, meaning better life conditions for the population. However, this growth has contributed to many environmental issues, including air pollution, misuse of natural resources, high energy consumption in buildings, and waste generation, among other reasons. Because of these serious impacts, physical and environmental changes have made the spaces more insalubrious. For this reason, there is a greater concern with questions that are linked to the conditions of the constructed environment because, in its growth process, there has also been a degradation process.

Since the physical and environmental changes are born out of interaction and, out of the human activities that take place in the built environment, such changes are responsible for energy consumption and Greenhouse Gas (GHG) emissions. Yu *et al.* (2021, p. 1) argue that “globally, the built environment is responsible for over 70% of the energy consumption and GHG emissions, mainly attributed to the housing and transportation activities of the residents.”

One of the fields of built environment responsible for meeting people’s demands, transportation has become the biggest spreader of negative impact in the three pillars of sustainability (economic, social, and environmental). Taking the environmental aspect into account, the main impact caused by access infrastructures is due to natural resources consumption, energy, pollution, and waste generation, resulting in the degradation of the built environment. As for the socioeconomic development, the urbanization of the built environment has led to the saturation of access routes with polluting means of transport.

Xu *et al.* (2022, p. 2) assert that “our daily behavior in transportation is one of the key contributors to the buildup of air pollution and the corresponding risks of exposure.” Transportation emissions are known as the main sources of general air pollution due to the pollutants coming from vehicle exhaust emissions. Consequently, a major part of our daily exposure to pollution, especially within metropolitan areas, comes from intensive local usage of vehicles and the proximity to traffic. Dons *et al.* (2012, p. 392) state that the time spent commuting is responsible for about 21% of individual exposure and 30% of inhaled carbon (black soot).

Therefore, this article – an extension of the line of research in the Master’s Dissertation and the ongoing Ph.D. thesis – can be carried as a justification for the problem of the current setting of urban mobility, which is directly implied in local and global climate changes and, as a result, in accelerating global warming. According to Jugend *et al.* (2022, p. 54), “global warming doesn’t show signs of slowing down, and the fact is that some countries and more vulnerable regions are increasingly liable to population-threatening catastrophes.”

Among the possible alternatives for reversing the current urban mobility scenario, sustainable mobility stands out as a provider of improvements and transport diversity, making it possible for people to move around autonomously within the built environment. Moreover, this sustainable mobility should provide better social well-being and more sustainable urban and socioeconomic development.

2 RESEARCH AIMS

By means of a theory review, this article aims to understand sustainable mobility as a favorable action in improving the built environment and to evaluate the possible scenarios of reducing GHG emissions and, consequently, their impact on local and global climate changes.

3 METHODOLOGY/ METHOD OF ANALYSIS

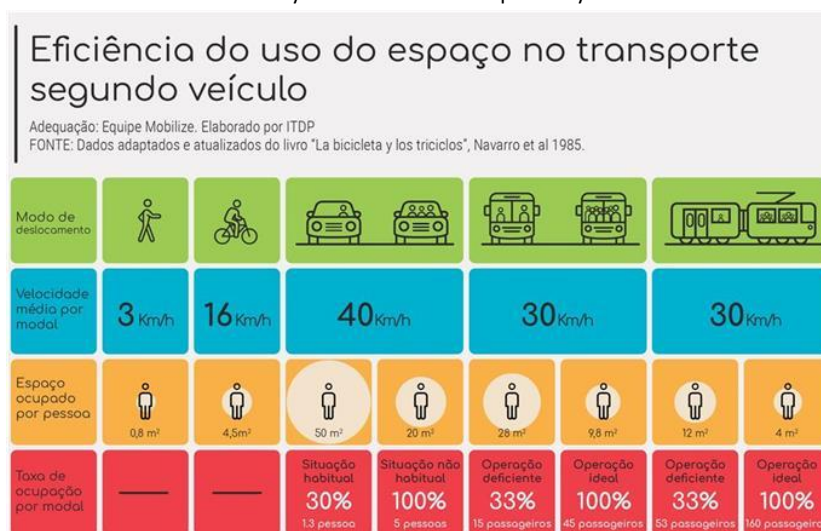
Stemming from the theory review of the concepts of sustainability and mobility, the methodology seeks to understand sustainable mobility as a favorable action for improving the built environment, analyzing possible scenarios for reducing GHG emissions.

The concept of sustainability brings different approaches to its definition. Sustainability would be present in solutions that may restore the quality of life in cities and reduce environmental impacts in an urban area, in which a pattern of production and consumption must be redirected from optimizing man’s relationship with the natural environment.

To fulfill its concept, urban mobility should attend to the daily needs of the population, such as commuting to work or school, which can be done on foot by means of transportation such as bicycles, buses, and cars, among other options. The population should also use it for their leisure. Transport facilitates people’s access to services, reduces isolation, and increases the possibilities of work and social activities that may contribute to the better functioning of cities.

One may point out that, in the built environment, the number of individual vehicles surpasses the number of other means of transportation, which are generally occupied by one or two people. The imbalance of space between vehicles and pedestrians is due to a lack of mobility planning, in which the pedestrian-oriented footpaths are inferior in mobility quality, which makes them conflicting in the view of those who choose to travel by foot (Figure 1).

Figure 1 – Efficiency in space occupancy in transports according to vehicle
Suitability: Mobilize Team. Prepared by ITDP



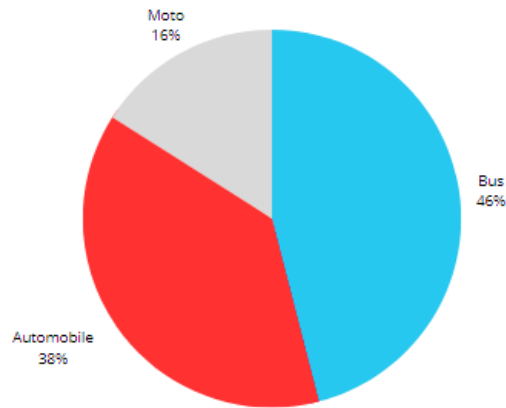
Source: <https://www.mobilize.org.br/estatisticas/>
Data adapted and updated from the book "La bicycle y los triciclos", Navarro *et al.* 1985

According to the Instituto de Pesquisa Econômica Aplicada (IPEA) (2011, p. 7), the transportation of people and goods has always been associated with the production of some sort of pollution, either atmospheric, noise pollution or visual intrusion in the built environments regardless of the predominant transport mode. The global pollutants, which are gases expelled into the atmosphere, end up impacting the whole planet through global warming, in the case of GHG emissions. The main pollutant included in this category is CO₂, which also serves as an equivalent unit for the remaining GHGs.

Air pollution is one of the factors with the most direct and negative impacts on the health of the population of the built environments and contributes to local and global climate changes. The pollutants emitted, such as the soot expelled by motor vehicles, impact the circulating spaces, streets, access areas, and, even if indirectly, building façades. Air pollution has an impact on thermal discomfort, especially for the people who travel on foot, and are constantly subject to sharing space with vehicles that generate noise, heat, and pollution.

De Carvalho Filho *et al.* (2014) state that “individual motor vehicles are the most used and more polluting means of transportation in cities” (Graph 1).

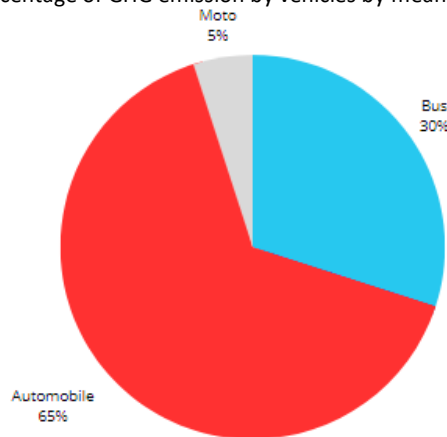
Graph 1 – Percentage of the pollutants emitted by vehicles by means of transportation



Source: Associação Nacional de Transportes Públicos - ANTP [National Association of Public Transportation] (2018, p. 18)

Even though private motor vehicles are responsible for approximately 65% of GHG emissions into the atmosphere (Graph 2), urban mobility is seen as fundamental for the development and progress of a city. However, the air quality in the urban areas is considered unsatisfactory since there is a high flow of vehicles, saturation in the infrastructure, and a reduction of the green areas.

Graph 2 – Percentage of GHG emission by vehicles by means of transportation



Source: Associação Nacional de Transportes Públicos - ANTP [National Association of Public Transportation] (2018, p. 19)

Air quality is directly linked to less use of private transportation. Sustainable actions that encourage non-motorized transportation improve the accessibility to sustainable mobility and reduce the consumption of fossil fuels that cause emissions of CO₂. Therefore, looking for sustainable transport alternatives, using cleaner energies, such as gas and hydrogen (or electrical energy itself), as well as looking into propositions that promote walkability, means thinking of improving air quality. Actions favoring sustainable mobility lead to improving the built environment and consequently help in air quality health while also reducing local noise pollution.

Associating sustainability with the mobility of people and goods in a timely fashion and at a reasonable cost is key to the objective of minimizing the negative impacts on the environment and quality of life. To do so, it is mandatory to reevaluate the current model of urban mobility by putting on the agenda access to transportation and focusing on how they are circulating on the roads. In addition, it means proposing new sustainable modes for the population’s mobility.

4 RESULTS

The current unsustainable mobility model focuses on individual motorized modes of travel. It does not optimize the spaces of circulation, thus degrading the built environment due to pollutant emissions, which leads to the saturation of access infrastructures. Carrying out a new model of sustainable mobility, we can create more space for pedestrians and sustainable modes of transport, and a more effective integration of public transportation using exclusive lanes can be implemented (Figure 2).

Figure 2 – a. Emphasis on urban mobility aimed at motorized and individual means of transportation. b. Urban mobility aimed at more sustainable means of transportation



Source: Institute for Transportation and Development Policy (ITDP, 2014 apud NETA, 2015, p. 34)

According to De Vasconcellos *et al.* (2011, p. 69), “the only way to transform the historically built conditions is facing two challenges: inverting the priorities in the use of space and diversifying mobility in the cities.” Silva and Mello (2017, p. 2) point out that Brazilian cities have presented serious problems in their urban mobility systems. These historical problems lead us to discuss how we have arrived at the current situation and the possible alternatives to reverse it.

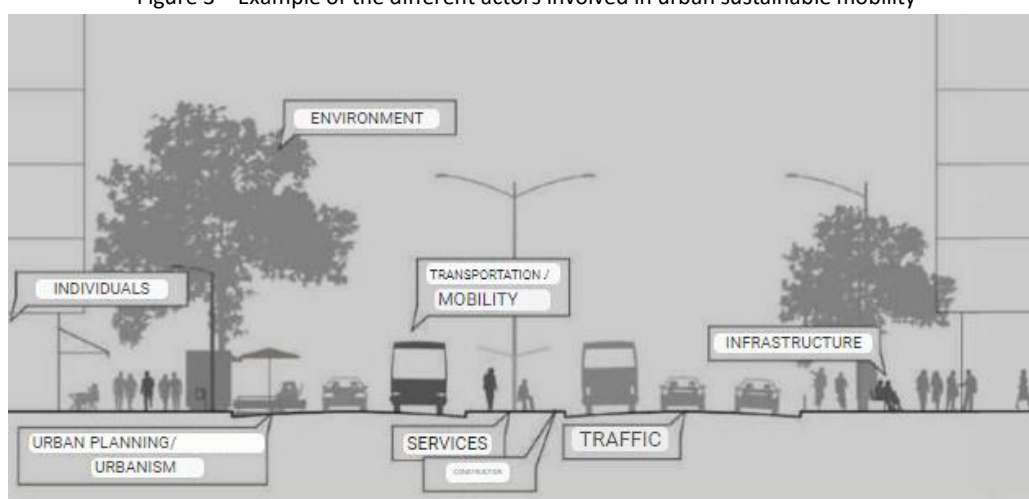
In Brazilian cities, urban spaces have not been built considering pedestrians’ movement. As cities have expanded, the interventions were directed to access infrastructure in line with city planning and development, as well as with the consumption demands of the population. This led to the alteration of urban space in the past and present.

This proposal of a model for sustainable mobility becomes a part of the alternatives for a promising future for the development of cities, leads to the planning of a better organization of means of transportation, whether public or private, with the usage and occupation of the

city’s grounds, while stimulating alternative modes of circulation that can guarantee access to activities offered by the city. In the process of urban development and planning, combined with sustainable mobility, the main goal is to strengthen social interaction, encourage transport diversity, and shorten the distances in travel.

A planning model for sustainable mobility first needs to verify the possibilities of the different actors according to the planning, implementation, and execution of its many components. The figure illustrated by the Regional Development Ministry (MDR) (2019) presents a way of identifying the responsibilities of the different actors that can be involved in the planning of urban sustainable mobility (Figure 3).

Figure 3 – Example of the different actors involved in urban sustainable mobility



Source: <https://www.gov.br/mdr/pt-br/assuntos/mobilidade-e-servicos-urbanos/planejamento-da-mobilidade-urbana/levantamento-sobre-a-situacao-dos-planos-de-mobilidade-urbana>

Because of the availability and adequate existence of accessibility, the more accessible and sustainable the access conditions to the various activities and urban activities facilities, the more inclusive the city tends to be. Other than promoting social integration, accessibility offers opportunity equality and ensures the exercise of citizenship for all people, such as education, culture, leisure, and employability, and also adds value to the spaces while benefiting not only individuals but also society as a whole.

Mello and Portugal (2017, p. 113) define “the pillars for sustainable mobility as identifiable by five attributes that prioritize pedestrians, bikers, public transportation passengers and more vulnerable people.” Attributes that are necessary for managing the planning of sustainable mobility to establish improvements in mobility and accessibility, as shown below (Figure 4):

Figure 4 – Attributes of sustainable mobility

SUSTAINABLE MOBILITY ATTRIBUTES		
	ATTRIBUTES	DESCRIPTION
i	Secure	Represents the respect for private life, which is a civil right strongly affected by the conditions of insecurity in travelling by transports and in road traffic violence.
ii	Inclusive	Expressed by the number of people who do not travel or who travel under highly unfavorable and excluding conditions, specially the most fragile segments of the population as well as people with physical restraints, such as wheelchair users, which results in high rates of immobility.
iii	Socially Fair	Highlighted by the fact that excessive time spent in transportation prevents the population from participating in other activities, such as leisure or even time with their families. This affects the exercise of citizenship, as well as quality of life of particularly the poorer sections of the population.
iv	Productive	Aims for an efficient and balanced use of public resources, such as transport infrastructure and road space, balancing demand and supply of transportation.
v	Green	Committed to environmental and energy quality.

Source: MELLO; PORTUGAL, 2017, p. 101

The benefits of sustainable mobility are characterized by the performance of a positive influence on the planning of urban mobility in the cities. These benefits come in the form of measures to reduce traffic jams, as well as in the form of the good performance of all means of transportation, which are an efficient, clean-energy way of commuting without emitting pollutants (from fossil fuels). In summary, they cover the ideals for urban sustainability (economic, social, and environmental) for urban mobility stemming from general public circulation, which can contribute to social and economic well-being without hurting the future environment.

5 CONCLUSIONS

The management of mobility is the key to promoting urban sustainability. A sustainable mode of urban mobility becomes important for achieving social, economic, and environmental development in a balanced way. Within the concepts of mobility sustainability, actions favorable to a sustainable mobility model tend to promote better travel for pedestrians and clean energy transports, which improve urban space.

In order to promote sustainable mobility, the implementation of sustainable mobility, one must first solve the dispute over the use of roads, spaces prioritized by public transportation, and, above all, by individual transport. A proposal to change the current mobility scenario and possible sustainable actions involves improving travel for the population making the city more sustainable by reducing the negative effects of old infrastructures on mobility demand. It also focuses on restricting the use of motorized vehicles, especially individual transport.

Observing the needs of the citizen, what their needs are, and the quality of the space is to put mobility in favor of sustainable urban development and also contributes to people's health. Sustainable mobility then starts to influence the accesses and means of transportation

from which the population can choose to reach their destination, providing a greater level of social integration, as well as more experiences and interactions with the city and what it has to offer.

This means that the citizen’s behavior when commuting tends to influence the choice of transportation, reducing pollutant emissions, increasing the interaction between the population and the space, making it more attractive and better connected while stimulating activity and increasing the feeling of safety. In conclusion, for sustainable mobility, the diversity of transport tends to improve the quality of life when integrating complex systems of existing mobility infrastructure and benefiting economic, social, and local activities.

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