

Sustainable Urban Mobility in the São Paulo State¹

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RESUME

Resilient cities are those that, exposed to risks, have the ability to resist, absorb, adapt and recover, in a planned and efficient manner. Currently, one of the greatest weaknesses in the world is environment related, therefore, it is urgent to rethink the way cities are developing. In this essay, the issue of air pollution will be addressed, mainly in relation to urban mobility. Based on air quality data and strategic mobility actions, some reflections will be raised taking into account the directed aspects and systemic vision of the process.

KEYWORDS: Urban Mobility. Sustainable development. Resilient City.

INTRODUÇÃO

Resilient cities have the ability to adapt, recognizing their weaknesses, absorbing knowledge from their past and creating action plans that can be used in the future to minimize risks and bring a better quality of life to the inhabitants. In this case, local governments are concerned with sustainable development in the region, investing in technologies that seek to anticipate and mitigate the damage caused by natural disasters or risks caused by human beings themselves. In 2018 the World Health Organization (WHO) developed a report that showed alarming data.

Worldwide, seven million people die every year due air pollution. Nine out of ten people breathe air containing high levels of pollutants (WHO, 2018). According to WHO Director-General Tedros Adhanom Ghebreyesus, “if we do not take urgent action on air pollution, we will never come close to achieving sustainable development” (WHO, 2018, online). According to the Organization for Economic Co-operation and Development (OECD, 2012), air pollutants are expected to become the leading environmental cause of mortality in the world by 2050.

To think of a resilient city with sustainable development, therefore, is to understand how air quality affects the population and what are the necessary means to improve this situation. This essay aims to reflect on the alternatives applied in sustainability, especially urban mobility, and how these issues can be controversial if analyzed with a focus on the systemic breadth of the process.

POLUIÇÃO ATMOSFÉRICA NO ESTADO DE SÃO PAULO

Air pollution, defined by the World Health Organization (WHO) and the Ministry of the Environment (MMA), is

Contamination of the internal or external environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (WHO, 2021, online, our translation²).

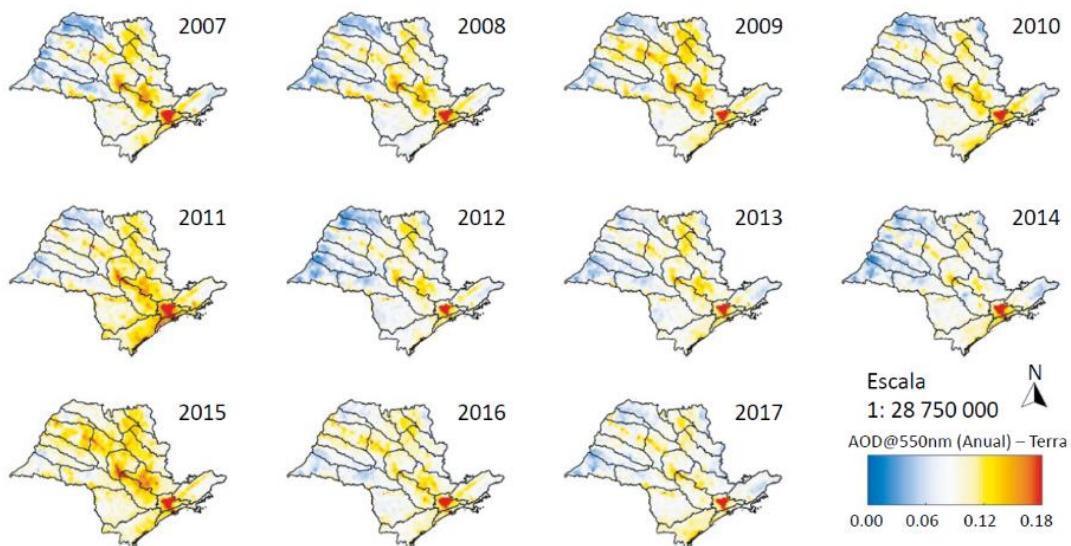
Any form of matter or energy with intensity, concentration, time or characteristics that may transform the air inappropriate, harmful or offensive to health, inconvenient to public well-being, harmful to materials, fauna and flora or harmful to safety, use and enjoyment of property and the quality of life of the community (MMA, 2021, online).

Ambient air pollution alone caused an estimated 4.2 million deaths in 2016, while air pollution from cooking with polluting fuels and technologies caused an estimated 3.8 million deaths in the same period. More than 90% of air pollution-related deaths occur in low- and middle-income countries, mainly in Asia and Africa, followed by low- and middle-income countries in the Eastern Mediterranean region, Europe and the Americas (WHO, 2018).

It is important to remember that the WHO is responsible for ensuring compliance with the Sustainable Development Goal indicator, which consists of reducing the number of deaths and diseases caused by air pollution by 2030. However, according to a report by the WHO (2020), despite the accelerated progress in the last decade, the world will not be able to guarantee universal access to affordable, safe, sustainable and modern energy before 2030, unless efforts are significantly increased, according to the latest edition of the Global Monitoring SDG 7.

In the São Paulo State, from 2007-2017, according to Araújo and Rosário (2020), the dominant structure of atmospheric pollution is presented in the urban-industrial development axes indicated by prof. Jeferson Tavares (TAVARES, 2018), with an alarming result in 2015, which one of the related factors was the water crisis that occurred this year (Figure 01).

Figure 01 – Maps of the annual average of the AOD550nm obtained through measurements of the MODIS² sensor on board the Terra satellite in the state of São Paulo, excluding the days in which there was transport of smoke from the Central-West Region and the south of the Amazon, during the burning season (between August and November). The color bar represents the variation of aerosol abundance in the atmosphere, cool (blue) and warm (red) colors indicate, respectively, low and high levels of particulate matter in the atmosphere.



SOURCE: ARAÚJO, J. M. de; ROSÁRIO, N. M. É. do. Atmospheric Pollution Associated with Particulate Matter in the São Paulo State. RBCIAMB, v.55, n.1, 2020.

² Moderate-Resolution Imaging Spectroradiometer

Although these two readings, air pollution and industrial development axis overlap, Rosário reports that the main motivator of air pollution today is fires, not industries (ROSÁRIO, 2021).

According to Araújo and Rosário (2020), between 2007 and 2017, a downward trend in air pollution can be identified in established sugarcane growing areas (Piracicaba/Capivari/Jundiaí Basin). However, there is an increase in the crop expansion area in the Turvo Grande and São José dos Dourados Basin (Figure 02).

However, it is worth noting that, despite the fire outbreaks being usually associated with sugarcane, there was a large number of outbreaks outside the sugarcane areas of the state. An example is the region of the WRMUs³ of Ribeira do Iguapé/South Coast, an area with a vocation for conservation, in which a significant amount of fires and pollution were observed (ARAÚJO; ROSÁRIO, 2020).

Figure 02 – Rate of variation of AOD550 nm per year between 2007 and 2017 in UGRHI in the state of São Paulo. Highlighted UGRHI (red color) showed a statistically valid trend using the Mann-Kendall test for a 10% significance level.



SOURCE: ARAÚJO, J. M. de; ROSARIO, N. M. E. of. Associated Atmospheric Pollution to Particulate Material in the State of São Paulo. RBCIAMB, v.55, n.1, 2020.

SUSTAINABLE URBAN MOBILITY

According to Professor Renato Anelli (2021), how to address the issue of sustainability in urban mobility without affecting other systems? This question seemed very interesting to me and I tried to delve deeper into this question in this essay.

According to WHO (2018, online) some cities are working to improve air pollution data. Mexico City, for example, has committed to cleaner vehicle standards, including switching to soot-free buses and banning private diesel cars by 2025.

³ Water Resource Management Units (WRMUs)

In Brazil, two alternatives have become prominent in sustainable actions in the national territory: the use of alcohol as a clean fuel and the change of the bus fleet to electric in large cities.

Below are some thoughts on these questions:

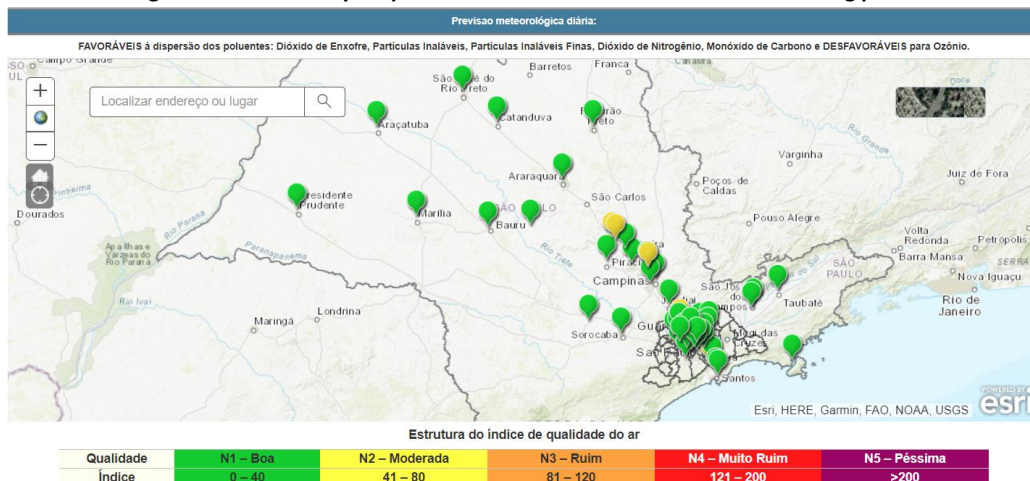
- The use of alcohol as a clean and sustainable fuel

The first question is whether the use of alcohol as the main fuel would be an alternative for less polluting transport. In this regard, it is necessary to take into account that, the more alcohol is used, the more sugarcane production will be necessary and, thus, potential damage to the air quality, as seen above.

However, it is worth mentioning that in 2007 an agro-environmental protocol was signed between the sugar and alcohol sector in São Paulo and the State Secretariat for the Environment, which determined the anticipation of the legal deadlines for the end of the sugarcane harvest through the use of fire for all signatory industrial units (2014 in the mechanized areas and 2017 in the non-mechanized areas). The sugar and ethanol sector, by signing the Protocol, also sought to strengthen the image of ethanol as a clean and sustainable fuel, which is strategically favorable for the sector (DUARTE et al., 2013).

However, according to Araújo and Rosário (2020), an in-depth analysis of the protocol results would depend on the assessment of trends in the pollutants levels observed in the state, but the *in situ* monitoring coverage of air pollution is reduced. Although the State of São Paulo has the largest and most regular monitoring network in the country, operated by the Environmental Company of the State of São Paulo (CETESB), the State does not monitor air pollution in most of its municipalities, as can be seen in the image below (Figure 03).

Figure 03 – Air Quality Map available on the CETESB website. Monitoring points.



SOURCE: <https://servicos.cetesb.sp.gov.br/qa/> Data: October, 2022.

- Changing public transport from diesel or biodiesel to electric.

Shenzhen, China, was the first city in the world with a 100% electric bus fleet. The transition started in 2009 and reduced annual CO2 emissions from buses by 48%. However, the country's energy matrix is mainly based on coal, which is polluting, as it contains substances called sulfides that can chemically react with air or water, resulting in substances such as sulfuric

acid and ferrous sulfate that go underground and into the water table, contaminating soils, rivers and lakes. The burning of coal also releases substances that cause atmospheric pollution, such as soot, acid rain, and also contribute to the greenhouse effect. Therefore, it is necessary to analyze whether, in relation to the chain as a whole, this change will be beneficial.

In Brazil, our energy is generated by hydroelectric plants, unlike the case of China, which has an energy matrix that has a direct negative result with air quality. However, it is important to assess whether the exchange expanded to the entire national territory for electric transport would be beneficial and whether the environmental damage would compensate this exchange.

The environmental impacts caused by the construction of a hydroelectric plant are irreversible. Despite using a renewable natural resource and not polluting the air, the construction of a plant requires deforestation, flooding of large areas and displacement of inhabitants of the region.

A hydroelectric plant takes an average of 10 years to build and has an average lifespan of 50 years. A sudden increase in demand for electric vehicles, and consequently in electricity, would force managers to leave thermoelectric plants in permanent operation and purchase surplus energy from neighbors, increasing atmospheric pollution and the cost of energy, which is already high in the country.

Therefore, analyzing the potential of an electric fleet is not just the reduction of pollutants in the air emitted by the vehicle, but what is the energy matrix and what is the cost-benefit in general.

Another issue is the production and disposal of the battery, which is one of the important components of electric transport. It can be very harmful to the environment and needs special actions for this component.

ELECTRIC BUSES IN BRAZIL: THE STATE OF SÃO PAULO

According to e-bus radar, in Latin America, 346.84 Kt of CO₂ emissions were avoided per year (data from September 2022). In Brazil, 44.82 Kt of CO₂ emissions were avoided by 371 electric buses (which correspond to 1.95% of the total national fleet), of which 302 are trolleybuses and 66 are conventional battery-operated buses and 2 are battery-powered Midi buses (E- BUS RADAR, 2022) (Figure 04).

Figure 04 - Diagram of the number of electric buses and avoided CO₂ emissions.



SOURCE: E-BUS Radar Platform, Data: September, 2022.

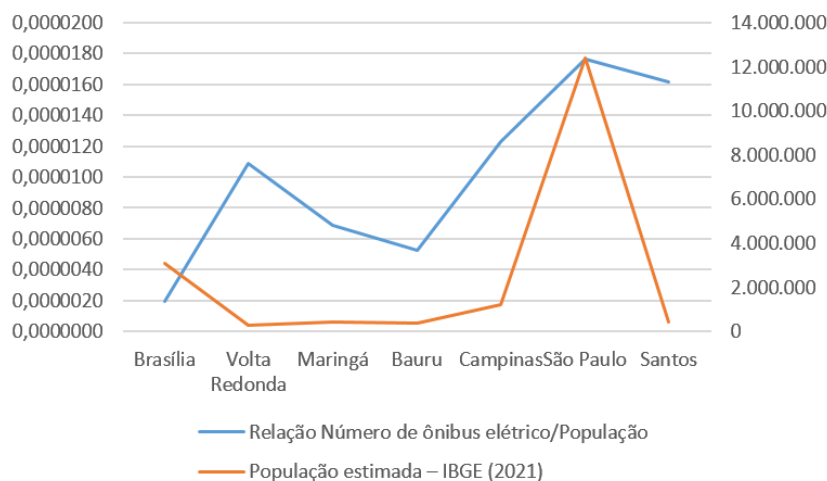
Taking into account the Brazilian municipalities included in the platform, São Paulo has the best index in relation to the number of inhabitants/electric bus, followed by Santos and Campinas. In last position is the capital, Brasília (Table 01 and Figure 05).

Table 01 - Table of the ratio between the number of electric buses and the population in seven Brazilian municipalities.

	<i>number of electric buses – E-bus Platform (2021)</i>	<i>Estimated population IBGE (2021)</i>
<i>Brasília</i>	6	3.094.325
<i>Volta Redonda</i>	3	274.925
<i>Maringá</i>	3	436.472
<i>Bauru</i>	2	381.706
<i>Campinas</i>	15	1.223.237
<i>São Paulo</i>	219	12.396.372
<i>Santos</i>	7	433.991

SOURCE: Prepared by the author with data from the E-bus Radar platform (2022) and IBGE (2022).

Figure 05 – Graph of the ratio between the number of electric buses and the population in seven Brazilian municipalities.



SOURCE: Prepared by the author with data from the E-bus Radar platform, 2021.

In Campinas, according to the platform, 15 electric buses are in operation (1.33% of a total of 1129 buses) (E-BUS RADAR, 2022).

According to the Caderno de Avanços dos Buses Elétricos na América Latina (MOBILITAS, 2021), in an interview with the current president of the Municipal Development Company of Campinas (EMDEC) Ayrton Camargo e Silva, buses are operating in two important areas of Campinas: Campo Grande-Centro region and Sousas-Centro region.

Based on the current bid, the municipality of Campinas could enter 785 cars, but the president of EMDEC pointed out that the public notice is being re-evaluated and the new configuration of buses with alternative fuel sources for the new bid has not yet been defined.

The president declares that “electric vehicles are here to stay and will certainly be part, every day in a more representative way, of the vehicle fleet in Brazil and in the world”. However, he warns that “it is necessary to evolve in this electrification, especially regarding the supply infrastructure”.

In an interview with EMDEC employee André Aranha Ribeiro (2021), the public notice for the concession of transport that created a “white area” in the city was suspended in 2019. The Fundação Instituto de Pesquisas Econômicas (FIPE) was hired “to review the entire concession modeling, which we intend to complete by the end of 2021”

Conceptually RIBEIRO (2021) reports that the previous proposal was considered wrong and that an analysis of the electrification of BRTs will be carried out. And he continues reporting that “the FIPE studies will indicate a sustainable path from an environmental, economic and social point of view”.

A municipality that has an interesting proposal in the State of São Paulo is São José dos Campos. Paulo Guimarães, Secretary of Urban Mobility of the municipality of São José dos Campos and president of the National Forum of Secretaries and Public Directors of Urban Mobility, commented on the project to implement a public transport corridor in his city to be operated exclusively with electric buses to o Progress Report on Electric Buses in Latin America (MOBILITAS, 2021).

The secretary reported that three years ago they had already carried out an experiment with the Municipal Guard, where the result is a 100% fleet made up of electric vehicles. Currently, the proposal is the insertion of a ten-kilometer corridor that will connect the southern end of the city to the central region. And it will be operated solely and exclusively with electric vehicles. The project provides for bicycle lanes and sidewalks, but the transit of cars or other internal combustion public transport will not be allowed.

The work on the corridor is being fully funded by the municipal administration. Regarding the infrastructure for charging vehicles in the corridor, Paulo Guimarães reports that the municipal government has also decided to assume this cost and has already launched a bidding process for this purpose. “The idea is that both the buses and the loading structure are delivered to the new operators as a loan, a reversible asset in the concession” (MOBILITAS, 2021). The secretary adds that in relation to the cost of energy, the municipal government is employing a different strategy. “So that we do not lose control over the value of energy, in order to maintain control of the tariff throughout the concession contract, we are carrying out two other bids for the purchase of energy, one referring to distributed generation and the other to the free market” (MOBILITAS, 2021). There are requirements regarding power generation in each of these two processes. “In the case of distributed generation, production must necessarily be done by a photovoltaic plant, and in the free market, we will only buy from those companies that produce energy in a clean way, such as wind, solar and hydroelectric power” (MOBILITAS, 2021).

FINAL CONSIDERATIONS

All attempts to improve the population's quality of life are important, however, this essay aims to expose the complex network in an assessment of the so-called “sustainable” issues. It is not just the end, that is, when the vehicle is not polluting the air, but when analyzing the system as a whole, it is important to verify that the final result is still beneficial.

It is important to understand whether the production of fuel or energy used in transport and their weaknesses compensate. If battery disposal would not adversely affect the environment, removing the benefit of switching to electric transport. It is important to evaluate the pros and cons to verify if these changes are really being effective, or if the problem is just being transferred to another location or sector.

Therefore, it is necessary to identify whether such options would be helping to reduce pollution or would be reducing risks in large cities and transferring the burden to peripheral areas, where the sugarcane plantations and the installation of hydroelectric plants would be.

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