Low-carbon policy scenarios for the urban transport sector in São Paulo City: effectiveness and challenges

Classification JEL: O18, Q54, R41

Key words: urban mobility, transports, greenhouse gases, low-carbon policies, scenarios evaluation, dynamic simulation

Abstract

Climate change has turned into a crucial issue in the pursuit of a sustainable urban and regional development, especially in metropolitan areas, where the formulation and implementation of measures of mitigation and adaptation to climate change have become mandatory. For these reasons, mitigation of GHG emissions has been integrating urban planning aims and goals in many metropolitan areas. Indeed, the evaluation of the effectiveness of these strategies requires studies of their mitigating potential according to the local market, technology and socioeconomic context.

São Paulo is the biggest Brazilian City, one of the biggest in the world, with a population of more than eleven million people. In 2009, São Paulo’s Local Government defined a goal of 30% of reduction in GHG emissions until 2012 compared to 2003. Nevertheless, from 2003 to 2011, total GHG emissions from energy and waste rose near 9%. Gasoline, ethanol and diesel combustion by transport sector responded for 61% of GHG emissions and for a growth of 25% in emissions in the same period.

The present study aims to assess the impacts of low-carbon development strategies to the transport sector in São Paulo City. First, we reviewed the most common measures to mitigate GHG emissions in the transport sector. Through an extensive research in the literature and based on a survey on urban transport policies and strategies to reduce carbon emissions, we composed a range of options for low-carbon paths to the transport sector. These scenarios were discussed with representatives of São Paulo City Hall from diverse areas (i.e. the Departments of International Relations, Environment, Services and Transports), and we finally selected the most suitable strategic proposals among diverse regulatory, technological, economic and fiscal options.

Next, we tested the policies’ effectiveness of these scenarios. Policy scenarios were projected using ForFITS, a system dynamic tool developed by UNECE (United Nations Economic Commission for Europe). ForFITS allows assessing impacts of public policies on the demand for public and private transportation, on the energy consumption and GHG emissions. In the case of São
Paulo City, the results were part of a pioneering study of applying ForFITS to assess the impact of public policy on GHG emissions from transports. ForFITS estimates emissions from each vehicle of São Paulo’s active fleet, fuel consumption per vehicle, annual travel per vehicle (km per year) and the intensity of use and fuel consumption of vehicles. ForFITS projects a logistic or S-shaped demand curve, represented by the diffusion of new vehicles in the market (of all passengers and freight modes) based on projections of GDP, population, economic growth and price inflation, as well each market share modal.

For each proposed policy, we projected GHG emissions in the period between 2010 and 2040, changing the correspondent ForFITS input parameters, which resulted in the following policy scenarios:

a) Business-as-usual (BAU): In absence of new policy interventions, energy consumption and GHG emissions from transports would reach a level more than twice the level of 2010 in thirty years. Passenger modes would respond for about half of GHG emissions in 2010, but their share decreases slightly, reaching about 42% of total in 2040. Vehicle fleets would grow significantly, following population and economic growth trends. Although most of growth occurs in the bus mode, the intensity of use of private cars is remarkable, and its share on GHG emissions among passenger modes is much higher than bus share over the period. Trucks present the biggest share of GHG emissions. Overall, most GHG emissions derive from light vehicles and trucks, but there will be a trend of increasing GHG emissions share of freight services in the long run.

b) Promoting teleworking through the reduction of regulatory barriers to the adoption of such modality of work could interfere in the number of trips within the city and, therefore, in the annual average distance traveled per light vehicles and motorcycles. In this scenario, we assume that Brazil has a potential to teleworking similar to that of United States, which could provoke a 25% reduction in average distance travelled per year by light vehicles and motorcycles. ForFITS’ projections indicate that the emissions from passenger modes would present a negative variation of 14%, or 0.56% for each percentage point of reduction in distance travelled per year. Such result indicates that São Paulo City’s transport system presents low sensibility to distance travelled per year by light vehicles and motorcycles.

c) Incentivizing shared transport (carpool or free ride) could be made with adaptation of local traffic regulation, prioritizing private vehicles with more than three passengers assigning exclusive lanes for these vehicles. In 2011, São Paulo presented a rate of 1.4 passengers per car, which is the value used in the BAU scenario. If the average number of passengers per car would reach the maximum capacity of 05 passengers per vehicle, total GHG emissions
reduction would reach 10% and emissions from passenger modes only, 24% according to simulation results. The impact of this policy in terms of GHG emissions would be higher than measures to promote teleworking.

d) Coordinated management actions could improve public transport system in São Paulo City so that it would attract more users and raise the public transport share. Management actions could include prioritization of buses on urban roads; adequate management and inspection of the operation of highway systems; incentives to use public transportation; restrictions on use of private vehicles; congestion pricing. The quality of public transport affects the share of public transport in the passenger transport system, which is constant in the BAU scenario. Changes in this index may occur after interventions to improve public transport. Supposing the adoption of such measures, we added a variation in São Paulo’s index in order to reach until 2040 a value similar to that observed in regions with a developed public transport system. The simulations show a reduction of private transport share over time, as well a reduction of 10% over GHG emissions from passenger modes compared to BAU scenario. Combined with a growth in the share of trains, in 2040 the decrease in GHG emissions from passenger modes would be near 20%.

e) Incentives to efficiency improvement in vehicle motors were tested by modifying ForFITS’ default levels of energy efficiency growth, whose default values in 2025 for light vehicles are between 20% and 25% higher than the base year and, from 2025 to 2040, between 5% and 10%. We added some percentage points in order to test the effects of a policy currently running in Brazil, which established efficiency gain goals to light vehicles motors. The difference in GHG emissions between the BAU scenario and that of Brazilian’s highest efficiency goal reaches its maximum of 4% in passenger modes’ GHG emissions reduction in 2022.

f) In the scenario with more incentives to use of ethanol, we assume that the relationship between the prices of gasoline and ethanol would remain stable and that the market share of ethanol would continue to increase. GHG emissions would decrease 11% over total (or 19% over emissions from passenger modes only) in the scenario where ethanol reaches a market share of 50% in 2040, and 33% (or 58% over emissions from passenger modes) with the biofuel having 100% of passenger private vehicles until the end of simulation period.

Taking each policy individually, the most effective policy to reduce GHG emissions would be the dissemination of the use of ethanol, in such a way that its market share among motorcycles, light vehicles and commercial light vehicles reaches 100%, leading São Paulo City to achieve the
goal of 30% near 2040. If we simulate a scenario combining measures to encourage shared transport, total GHG emission would be almost 27% lower than in the BAU scenario, and emissions from passenger modes only would be until 60% lower in 2040 than in the BAU scenario.

The scenarios projections show that policies that could affect negatively the average distance traveled per vehicle surely would contribute to a higher quality of life for São Paulo’s population. However, in terms of GHG emissions, their impacts would be more restricted, due to the limits to teleworking (neither all types of work can be made out of office) and private transport sharing (a light vehicle cannot carry more than its maximum occupancy). The intensification of use of public transport is not so impactful in terms of GHG emissions reduction, because buses, powered by diesel, account for most of the share in public transport. Public transport is crucial to population’s well-being and quality of life. However, in terms of GHG emissions, an increase of the share of subway system or of the use of biofuels would have a higher impact.

Overall, the most effective strategy may be that one that combines the massive adoption of ethanol with the reduction of the use of private transport, in scenarios with a blend of policies reaching best results considering emissions from passenger modes. The simulations unveil synergies among selected mitigation measures in São Paulo City’s transport system, which means that the goals of reducing GHG emissions may be more feasible with the adoption of policy mixes. Combined policies for passenger transport show a very high potential impact, but policies that affect freight transport should complement them.

Despite some limitations regarding the dynamic simulation model used in this study (ForFITS), such as the impossibility of comparing its results with other estimations based on different methodologies, it is a useful tool to foster discussion and learning about the likely effects of GHG mitigation policies and possible interactions and comparisons among them. In addition, it is useful to demonstrate to policymakers how important for a successful low carbon development strategy is the concomitant actions of all government levels. Moreover, there is much room for improvement and refinement of each selected measure. Successive revisions with the participation of the stakeholders are essential, especially if counting on public managers who are ultimately responsible for setting objectives and making decisions involving the implementation of the analyzed policies.