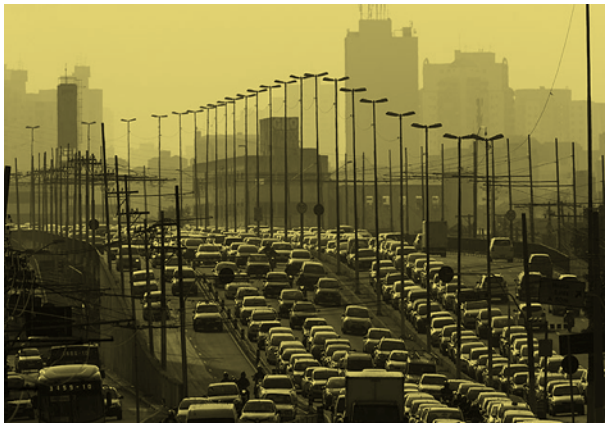
# Impacts of bicycle and electric scooter sharing systems[1]

The studies prepared by NOVí, demanded by PROMOB-e[2], an initiative by GIZ, the German government agency, and the Ministry of Economy of the Brazilian government, presents an initial diagnosis of the Brazilian market for bicycle sharing and electric scooter systems. Identifies and explores the environmental and social impacts and opportunities of operating models and vehicle components, mostly related to batteries. Thus, it can be used as a reference for information and analysis, supporting policy makers and agents involved in the implementation of urban micro-mobility services.

## Technology changes everything

The use of alternative modes of urban mobility has been growing rapidly worldwide. The high prices of fossil fuels coupled with the maintenance costs of automotive vehicles have driven the search for new models of transportation. Increasingly intense traffic in urban areas and increasing concern for environmental and social aspects have been decisive for the recent rapid and feasible growth of bicycles and scooters.



**The Brazilian context**

- 90% of the population living in urban centers in 2030;
- 7,4 vehicles for every 10 inhabitants in São Paulo;
- Increasing travel time and costs
- São Paulo is the 6th metropolis in the world in air pollution.

The technological evolution of components and the gains in production scale, with a drop in the price of vehicles, are key factors to enable the popularization of electric bicycles and scooters. Lithium batteries, the main cost component, have shown economies of scale, with decreasing costs. In 2017, the average price of batteries was $ 209 / Kwh, with forecasts of falling to $ 100 / Kwh in 2025 and $ 70 / Kwh in 2030[3]. This will be an important turning point needed for widespread the adoption of electric mobility. Additionally, new urban infrastructures will allow integration with transport systems, boosting demand.

New micro-mobility solutions, such as bikes and scooters sharing, have found attractive, viable and easily expanding investment and market conditions. With only 0.35% of market share of the bicycle market, electric bicycles have potential for rapid growth in Brazil.

## The problem shifting

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[2] The report was commissioned in March 2018 by PROMOB-e, under coordination of Jens Giersdorf and Fernando Fontes. The full version may be accessed at www.noviconsult.com.br.

[3] SloCat (2018). Transport and climate change global status report. Available at http://slocat.net/tcc-gsr

However, the search for scaled solutions that meet the growing demand also requires positive effects on economic, social and environmental aspects. In this sense, the development of electric propulsion becomes even more relevant. The benefits to society are in improving mobility, reducing air pollution and greenhouse gas emissions.

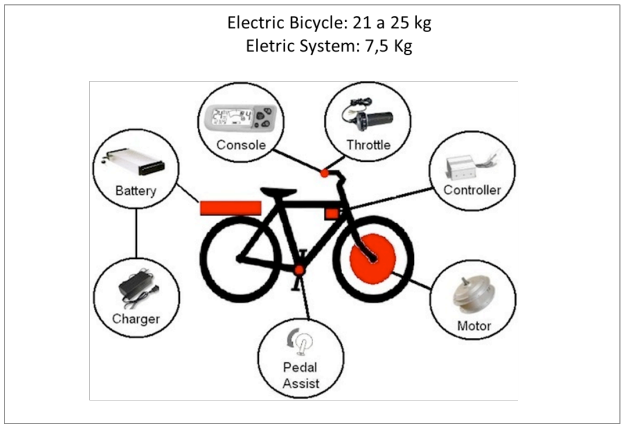
While new solutions and technologies may bring real benefits to cities and people's lives, they can also have negative social and environmental impacts that were previously unimportant. Considering electric bicycles and scooters, the new availability scale requires understanding of direct, indirect and induced impacts throughout the life cycle of its components and materials. It is necessary to understand the use and after-use aspects of lithium batteries, wastes considered potentially hazardous.

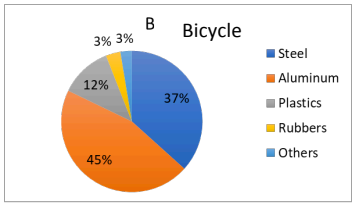
Thus, developing analyzes that identify the nature and magnitude of the challenge, considering current and future risks from the perspective of Life Cycle Analysis (LCA), becomes relevant and applicable to the bicycle and electric scooter production chain in Brazil. The National Policy on Solid Waste - PNRS (Law No. 12305/10) established shared responsibility, extending to all entities in the value chain, even if indirectly involved in the generation of solid waste. Thus, agents involved in the soaring new micro-mobility value chain must be aware to social and environmental risk management.

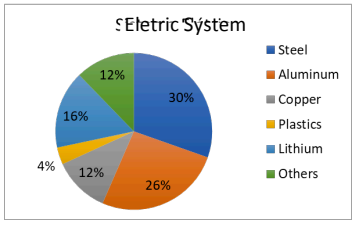
## Impact Assessment

The assessment of social and environmental impacts of micro-mobility systems should facilitate decisions that consider the technical aspects, aspirations and expectations of those involved. Bicycles and scooters are clean, dynamic and affordable means of transportation compared to the predominant use of combustion automobiles. In fact, when comparing the use stage of vehicles, it is observed relevant energy efficiency of the new equipment, considering the same utility.

Following the ISO 14040 standard, the function of analysis is the displacement of people over short distances in the Brazilian urban environment, in terms of kilometers traveled. Next, it is necessary to understand the composition and origin of the materials of the vehicles. In electric bicycles, most of the mass comes from steel and aluminum alloys, as shown below.

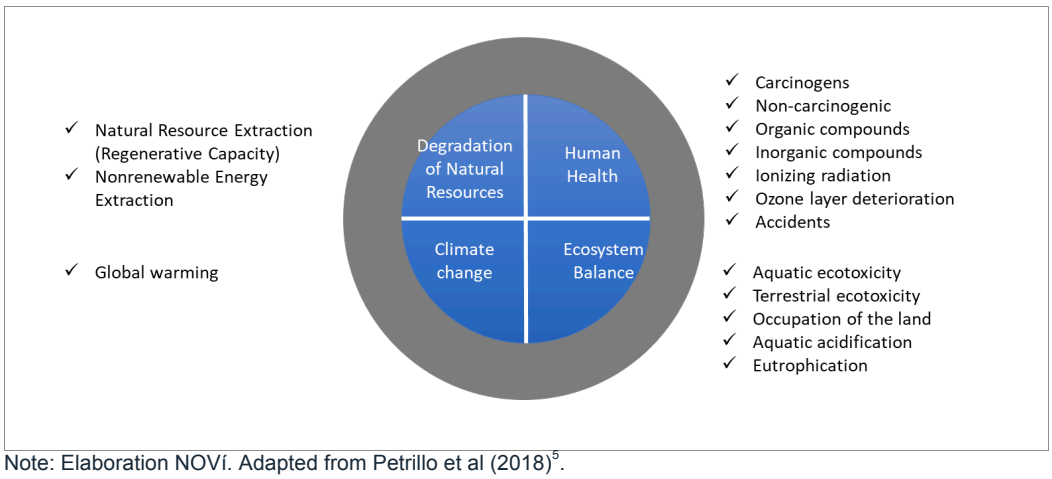


Note: Elaboration NOVí. Adapted from Duce (2001)[4]. Credits: Electric-bicycle-guide

Due to the rapid adoption of electric scooters, at the time of publication of this document, public data on equipment materials are not available. For illustrative purposes, electric scooters adopted in the Brazilian market have a weight of 12.5 kg, with predominance of aluminum and plastic structures (46%) in addition to the motor (36%). Each material, at different stages of the value chain, is assessed for environmental and social impacts, according to the aspects listed below.

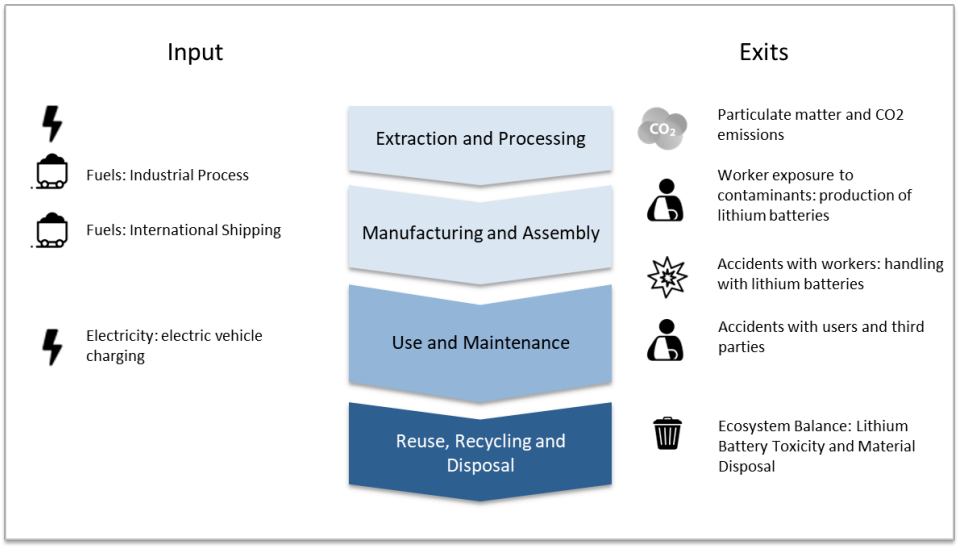



Note: Elaboration NOVí. Adapted from Petrillo et al (2018)[5].

From the analysis, the main aspect responsible for environmental impacts of new micro-mobility alternatives is the composition of the energy matrix. This aspect was observed in the pre-use stage, during lithium beneficiation, battery manufacture and, mainly, in the production of aluminum and copper components. The same was observed during the use phase, with the electricity charges of the batteries, and after use, in the recycling of the components. In the social context, the safety of users and third parties has been the main concern of those involved in sharing systems, and there are also precautions for workers' health in the production and handling of components, especially lithium batteries.

[4] Duce, A. (2011). Life Cycle Assessment of Conventional and Electric Bicycles. EMPA Materials Science & Technology. Available at: < http://www.eurobike-show.com/eb-wAssets/daten/rahmenprogramm/pdf/LifeCycleAssessment_DelDuce_englisch.pdf

[5] Petrillo, A. Mellino, S. De Felice, F. Scudo, I. (2018). Design of a Sustainable Electric Pedal-Assisted Bike: A Life Cycle Assessment Application in Italy. New Frontiers on Life Cycle Assessment – Theory and Application. Available at: <https://www.intechopen.com/online-first/design-of-a-sustainable-electric-pedal-assisted-bike-a-life-cycle-assessment-application-in-italy>.

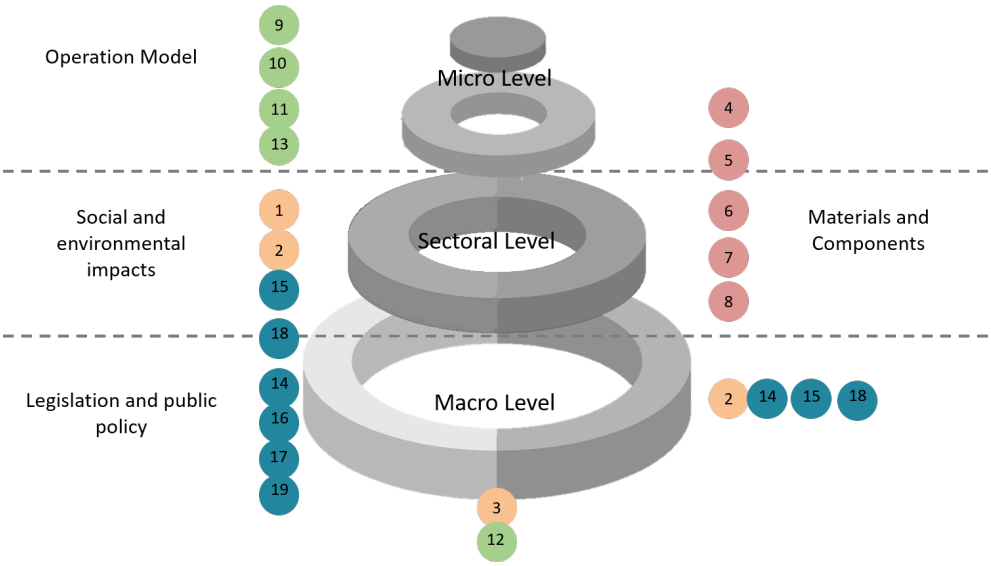



Note: Elaboration NOVí.

## Recommendations

Proper identification of risks and responsibilities allows the agents involved to take precautionary, preventive, mitigating and compensating initiatives of impacts. Additionally, it opens opportunities for the evolution of operating and business models in the value chain.

The maturity of the sector requires a systemic approach, involving agents at different levels. Solution routes include private activities, based on market conditions, as well as policy-induced solutions or clear regulatory frameworks. Below, there are 19 recommendations divided into five blocks: operation model; social and environmental impacts; materials and components; and legislation and public policy.




1. Conduct Life Cycle Analysis technical study
2. Structure primary database on social and environmental aspects
3. Mobilize sector agents and define governance for social and environmental impact assessment.
4. Prioritize energy management and use of renewable sources

5. Reduce the transport distance of materials and components
6. Develop vehicles suitable for use
7. Develop eco-efficient vehicles
8. Gain value and reduce lithium battery after-use risks
9. Adopt sustainable solution positioning
10. Encourage safe user behavior
11. Implement low impact vehicle charging system
12. Proactively act in relationship with communities
13. Adopt sustainability management system
14. Promote urban electric mobility
15. Promote precompetitive sectoral initiatives
16. Develop lithium battery after-use chain
17. Narrow local relationships
18. Set technical standards for vehicle components
19. Promote harmonization of legislation

## Conclusions

After going through the scope of analysis, there is growing evidence that electric bicycles and scooters can be viable and relevant alternatives as a solution to the challenges of urban mobility. This is a systemic transformation, with low fossil fuel use and asset sharing that will require model adjustments and precautionary to new social and environmental concerns. To sum-sup:

- The new electric sharing system are viable and relevant alternatives for urban mobility;
- The market is facing an exponential growth, but with model under experimentation;
- There an urgent need to understand the new challenges for effective management;
- Operators must take a proactive positioning, contributing in the evolution of the sector;
- There is clear space for governance and precompetitive collaboration;
- Public agents must play their role in defining normative and precautionary parameters.

## About NOVí

NOVí provides consultancy and advisory services on sustainable development issues, assisting companies, governments, international organizations and non-profit organizations to design strategies and act for opportunities resulting from rapid changes and market transitions. It has been involved in projects to identify risks and social and environmental impacts in the power generation, mining, industry, among others. www.noviconsult.com.br