



## GOVERNANCE AND PUBLIC POLICY COHERENCE IN THE DEPLOYMENT OF BATTERY-ELECTRIC BUSES IN BRAZIL: AN ANALYSIS OF THE FEDERAL AND SÃO PAULO STATE LEVELS

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### ABSTRACT

The introduction of battery-electric buses (BEBs) in Brazil faces significant resistance, mainly due to the path-dependence on diesel buses and the uncertainties surrounding this new technology among regime actors, particularly incumbents in automotive industry. This paper aims to analyze the governance of actors involved in the deployment of BEBs in Brazil through the governance dynamics across the Multi-Level Perspective levels. We argue that the successful deployment of BEBs in Brazil requires governance arrangements that promote coordination among actors across different sectors (government, industry, academy, society) as well as coherence between public policies at national and state levels.

**Keywords:** Battery-Electric Buses; Multi-Level Perspective; Multi-Level Governance; Coherence for Public Policy; Sustainability Transitions.

### INTRODUCTION

The transitions towards the electrification of public transportation, specifically through the adoption of Battery-Electric Buses (BEBs), has gained momentum as a viable alternative for decarbonizing the transport sector. BEBs do not emit Greenhouse Gases (GHGs) during operation, making them a key technology in advancing the energy transition (IEA, 2023; Bloomberg NEF, 2018). This transition also offers significant public health benefits by eliminating the emission of local air pollutants. In Brazil, BEBs are regarded as a niche innovation. According to data



from the E-Bus Radar platform, as of July 2024, approximately 300 BEBs were in operation across the country, with 180 of them operating in the city of São Paulo. The deployment of BEBs in Brazil remains comparatively slow when contrasted with other Latin-American cities, such as Santiago (Chile), and Bogotá (Colombia), which have 2,480 and 1,485 BEBs, respectively (E-Bus Radar Platform, 2024).

In Brazil, some public policies at different levels of government seek to prioritize public transport and the transition to low-emissions buses in cities. For instance, the National Urban Mobility Policy (Law 12.587/12) mandates that municipalities with more than 20,000 inhabitants develop mobility plans with a preference for low-emission buses (Brasil-Ministério das Cidades, 2012). In 2024, the federal government, launched the New Growth Acceleration Program (Novo PAC), an investment initiative in partnership with the private sector, states, municipalities, and social movements. As a part of this program, the Ministry of Cities leads initiatives in partnership with states and cities interested in the transition of their public transport fleets to BEBs and Euro VI diesel buses through the financial incentives. Despite these policies, there are no clear deadlines or targets for the decarbonization of urban public transportation, nor is there a technological roadmap outlining the prioritization of for low-emission public transport. This lack of direction has resulted in the co-existence of various technological alternatives for decarbonization of urban buses that include: hybrid-buses, gas-powered buses, biomethane, biodiesel, and green diesel, alongside the adoption of lower-emission technologies compliant with Euro VI standards.

In the case of São Paulo State, we identify three public policies and plans aimed at mitigating GHGs emissions in the transport sector: i) The Climate Adaptation Plan (2009); ii) The Climate Action Plan 2050 (2022); and iii) The State Energy Plan 2050 (2023). These policies set specific goals for decarbonizing the transport sector, with a focus on public transport and the replacement of diesel buses with BEBs. In this context, this paper aims to analyze the governance of actors involved in the deployment of BEBs in Brazil, using the typology proposed by Fisher and Newig (2016) to explore the governance dynamics across the MLP levels.



## MATERIALS AND METHODS

This paper adopts two strategies: a comprehensive literature review and the development of an analytical framework to explore governance in sustainability transitions. Drawing on prior research on electromobility (De Oliveira Filho et al, 2022; Bermúdez-Rodriguez, 2022), it provides insights into the governance dimensions and key actors involved in the deployment of BEBs in Brazil. Grounded in the Sustainability Transitions approach, this paper focuses on the governance processes that support the shift from fossil fuel-powered buses to BEBs. Additionally, the Socio-Technical Transitions and the MLP approach are employed to conceptualize transitions to low-emission transportation systems across three analytical levels: Niche Innovation; Socio-Technical Regime; and Socio-Technical Landscape (Geels, 2002). Further, we used the typology proposed by Fisher and Newig (2016) that help us to clarify the diverse roles and influences that different actors have in the transitions to BEBs. **Table 1** summarized the typology of actors.

**Table 1.** Typology of actors in sustainability transitions

Typology	Description
Multi-Level Perspective (MLP)	<p>This framework distinguishes actors based on three analytical levels:</p> <ul style="list-style-type: none"><li>• Niche actors: Associated with new and radical innovations.</li><li>• Regime actors: Support transitions by forming coalitions that align with the interests of incumbent regimes.</li><li>• Landscape actors: Represent broader societal processes that influence regime stability or change.</li></ul>
Governance Typology	<p>This perspective categorizes actors based on their roles in governance:</p> <ul style="list-style-type: none"><li>• State actors: Government entities.</li><li>• Private sector actors: Businesses and corporations.</li><li>• Academy: Universities and R&amp;D Centers.</li><li>• Civil society actors: Non-governmental organizations, and community groups.</li></ul>
Spatial Levels of Governance	<p>Actors are also categorized according to the spatial levels at which they operate, including:</p> <ul style="list-style-type: none"><li>• Local/municipal: Actors operating at the municipal level, such a local government.</li><li>• Regional/state: Actors acting in a regional o state context, such as regional governments and state agencies.</li><li>• National/Federal: Actors operating at the national or federal level, including ministries and governmental bodies.</li><li>• International: Actors participating in governance at the global level, such as international organizations and global NGOs.</li></ul>
Intermediaries	<p>These actors facilitate interactions between different levels and types of actors, playing a crucial role in the transition processes.</p>

Source: Adapted from Fisher and Newig (2016).



Specifically, the Multilevel governance (MLG) is utilized in to categorize actors in sustainability transitions based on their decision-making levels, helping to understand their interactions across different contexts and scales. This perspective is crucial for the successful deployment of BEBs, as decisions at one level affect processes at others levels, creating a complex network of influences and dependencies.

## RESULTS AND DISCUSSION

According to the typology presented in the previous section, **Table 2** presents the role of the actors involved at different governance levels to understanding their interactions, and dependencies to the transitions towards BEBs.

**Table 2.** Typology of actors involved to the deployment of ss in Brazil

Actor	Role/Function	Typology: MLP, Governance, Spatial Level
Federal Government	The Federal government, mainly the Ministry of Cities, has established incentives within the Novo PAC to promote the adoption of BEBs. Moreover, the National Urban Mobility Policy prioritizes the public transport and the low-emission buses.	<ul style="list-style-type: none"><li>• Landscape actor.</li><li>• State actor.</li><li>• Federal level.</li></ul>
State of São Paulo Government	The government of the state of São Paulo has introduced three public policies and plans aimed at decarbonizing the transport sector, with a focus on public transport and the substitution of diesel buses with BEBs. However, the state of São Paulo not defined yet specific incentives to the deployment of BEBs and is considering multiple technological alternatives for decarbonization public transport.	<ul style="list-style-type: none"><li>• Landscape actor.</li><li>• State actor.</li><li>• Regional level.</li></ul>
Financial institutions	Brazilian cities can access credit lines from federal public banks such as BNDES (National Bank for Economic and Social Development), Banco do Brasil, and Caixa Econômica Federal to finance the acquisition of BEBs. However, to be eligible for financing, the buses must be manufactured in Brazil and include local content.	<ul style="list-style-type: none"><li>• Regime actor.</li><li>• State actor.</li><li>• National level.</li></ul>
Companies with local production of buses and components	Automakers with local production capacity for BEBs included BYD, Eletra, Mercedes-Benz, Scania, Marcopolo, Volkswagen and Volvo, Caio, among others. Components: WEG, Grupo Moura. These actors operate at both the regime and niche innovation levels, depending on the products they offer to the market.	<ul style="list-style-type: none"><li>• Regime and Niche actor.</li><li>• Private sector actor.</li><li>• National level.</li></ul>
Utilities and charging infrastructure companies	Companies such as Enel X, Neoenergia, Nansen, Raizen, and CPFL Energia, among others, are involved in the implementation of BEBs infrastructure in Brazil. These actors operate at both the regime and niche innovation levels,	<ul style="list-style-type: none"><li>• Regime and Niche actor.</li><li>• Private sector actor.</li></ul>



	depending to their interest in deployment the charging infrastructure to BEBs.	<ul style="list-style-type: none"><li>• Regional/local level.</li></ul>
Public transport fleet operators	This companies face significant uncertainties regarding the performance of BEBs. Moreover, in Brazil, there is a weak alignment and limited engagement between bus operators and local government in replacing of conventional bus fleets with BEBs. Cities are struggling to successfully close tenders for the procurement of BEBs. These companies operate at both the regime and niche innovation levels, depending on their interest in acquiring BEBs.	<ul style="list-style-type: none"><li>• Regime and Niche actor.</li><li>• Private sector actor.</li><li>• Local level.</li></ul>
Electric Mobility Associations	The Brazilian Association of Electric Vehicles (ABVE), the National Electric Mobility Platform (PNME), and the Brazilian Association of Owners of Innovative Vehicles (ABRAVEi) represent the interests of various stakeholders within Brazil's electric mobility ecosystem. These associations regularly publish sectoral statistics, conduct research, and organize events such as fairs and seminars.	<ul style="list-style-type: none"><li>• Niche actor.</li><li>• Civil society actor.</li><li>• National level.</li></ul>
Universities and R&D centers	They work on research projects and human resources development, offering courses on electric mobility in both technical and planning dimensions. They can act in different levels, but in this context, we considered niche actors due to their involvement in R&D projects related to electromobility.	<ul style="list-style-type: none"><li>• Niche actor.</li><li>• Academy actor.</li><li>• Federal/Regional level.</li></ul>
International cooperation entities	International cooperation organizations provide funding and technical assistance for climate action initiatives, often used to finance electric mobility projects and implement BEBs pilot programs. Additionally, initiatives such as ZEBRA (Zero Emission Bus Rapid-deployment accelerator) and TUMI (Transformative Urban Mobility Initiative) are actively involved in the transitions to BEBs in cities across the Global South. These organizations can serve as intermediary actors, facilitating coordination between different levels of governance.	<ul style="list-style-type: none"><li>• Niche actor.</li><li>• Civil society actor.</li><li>• International level.</li></ul>

Applying this typology helps stakeholders better understand their roles and responsibilities in the transition to BEBs, promoting a more coordinated approach to achieving sustainable public transportation. It's crucial for decision-makers at different government levels to identify synergies and ensure coherence between policies, including alignment targets and financial incentives, to improve public transportation quality in Brazilian cities.

## CONCLUSION

In conclusion, identifying governance typologies is crucial for advancing the transition to BEBs, as it provides the roles of various actors across governance levels. The proposed framework highlights how local, regional, national, and international actors interact to influence BEBs adoption in Brazil. Categorizing actors helps analyze collaboration, resource mobilization, and policy coherence



necessary for successful transitions. This approach allows stakeholders to recognize the interdependencies among actors, highlighting the importance of coordinated efforts and shared objectives in overcoming barriers to the deployment of BEBs. Finally, we consider that public policies formulated by the federal government and coordinated with state-level through active governance are a prerequisite to driving public transport electrification and to overcome the lock-in in buses powered by fossil fuels.

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