

Electric Mobility – The Challenges of Regulating the Charging Infrastructure during Early Market Development in Brazil

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Abstract—Mobilizing politicians towards a national policy in favour of electric mobility may prove challenging, especially in developing countries, where a diverse agenda of priorities compete for limited taxpayer funds. Despite the still high EV prices in Brazil, specific groups, like taxi drivers and fleet operators are already considering electric vehicles a competitive choice. This paper suggests possible approaches to electricity regulators, within their scopes of competencies, aimed to reducing regulatory uncertainty to early adopters, and discuss the actions of the Brazilian Electricity National Agency (ANEEL) in this direction

Key words: *Electric mobility, Responsive regulation, Brazilian electric vehicle market.*

I. INTRODUCTION

Electric mobility has got attention around the world as one of the most promising means to achieve sustainable development goals, mainly through decarbonisation and improving energy efficiency of the transport sector [1]. However, coordinated action across several different fields and multiple stakeholders is needed to foster adoption of electric vehicles. Mobilizing politicians towards a national policy in favour of electric mobility may prove challenging, especially in developing countries, where a diverse agenda of priorities compete for limited taxpayer funds. This paper suggests possible approaches to Electricity Regulators, within their scopes of competencies, aimed to reducing regulatory uncertainty to early adopters, and discuss the actions of the Brazilian Electricity National Agency (ANEEL) in this direction.

II. THE BRAZILIAN CONTEXT

The much higher efficiency of electric motors, when compared to internal combustion engines (ICE), and their zero emissions property constitute the basic rationale for electric vehicles (EVs). Nonetheless, several variables may affect the potential benefits resulting from transport electrification. Two of them are of particular interest to the case of Brazil: (i) the actual electricity generation mix; and (ii) the main sources of Greenhouse Gases (GHG) emissions. Brazil has an electricity generation mix

dominated by hydroelectric generation (63.2% in 2014) [2]. And a national interconnected transmission system that servers most of the Country, making the case for electric mobility potentially stronger.

Brazil also has a peculiar GHG emissions profile: more than 50% (0.62 GtCO₂e/year in 2012) of total Brazilian emissions come from the forest sector and the agricultural sector [3]. Even though focusing on the GHG emissions from the transportation sector (that accounted for only 17% of total emissions in 2012, 0.21 GtCO₂e/year) may not seem the top priority for Brazil, the local emissions profiles of major cities is completely different. In São Paulo, Brazil's biggest city, the transportation sector already accounted for 78% of total GHG emissions in 2005 [4].

III. ISSUES

If there is no comprehensive national public policy to support electric mobility in Brazil, why then is ANEEL concerned about electric mobility? First, there are bills at the National Congress (e.g. PL 3895/2012 and PL 4751/2012) that, if approved, will require immediate action from ANEEL. Second, several local governments at both state and municipality levels are very much interested in electric mobility and have given incentives to it within their scopes of competencies. Third, major Brazilian cities have demonstration projects underway, in partnerships with distribution companies. ANEEL must position itself whether the ideas and models being experimented by these regulated entities are indeed positive and acceptable considering the electricity sector regulatory framework. Last, but not the least, there are also bills (e.g. PLS 174/2014) proposing tax reductions that may boost demand for EVs.

Despite the still high EV prices in Brazil, specific groups, like taxi drivers and fleet operators are already considering plug-in electric vehicles a competitive choice, and getting the support of EV manufacturers like Nissan-Renault and BYD for their projects.

The current main actors in Brazil across relevant areas of electric mobility are depicted in Figure 1.

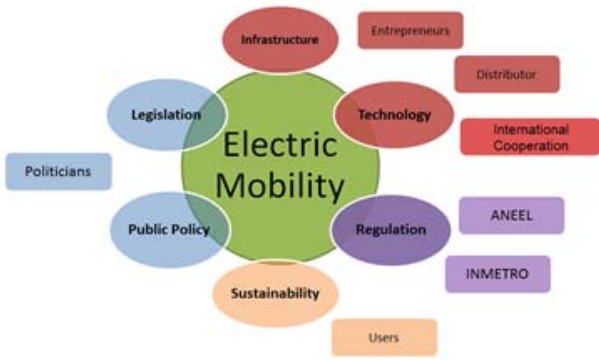


Figure 1: Electric mobility current main actors in Brazil.

IV. RESEARCH AND DEVELOPMENT (R&D) EFFORTS

Based on the potential of electric vehicles in Brazil, several electric power sector companies (transmission and generation companies included) have assigned resources for conducting research on the subject.

Sample research topics include evaluation of potential network impacts resulting from massive EV insertion, fast charging stations and the development of electric buses.

Electricity sector R&D projects related to electric mobility are listed in Table I.

TABLE I. R&D EFFORTS

Company	Project Title	Budget (US\$)
CPFL-Paulista	Electrical Mobility - Analysis of Technical and Commercial use of Electric Vehicles in Business Fleets of the Metropolitan Region of Campinas	7.848.101,27
LIGHT	Planning and Analysis Methodology for the Implementation of Electric Vehicles in Transportation Activities	231.422,78
CPFL-Paulista	Development of a modular and regenerative motorization system for vehicles	1.203.499,05
PETROBRÁS	System for supplying vehicles with hydrogen generated from electricity	1.901.898,73
LIGHT	Development of an intelligent system of management of renewable sources, distributed storage and rechargeable electric vehicles integrated to the concept and platform Smart Grid	991.266,44
ELEKTRO	Development of a propulsion system for electric passenger vehicles without the use of overhead air	511.856,67
BANDEIRANTE	Evaluation of possible scenarios, experimentation and measurement of the impacts of electric vehicles in the distribution systems of Bandeirante and Escelsa	676.776,58
ELEKTRO	Development of a fast recharge System for electrically public transport vehicles equipped with ultracapacitors	489.683,54
CEMIG-D	Methodology for Analysis of the Impacts of Electric Vehicle Integration to the Distribution Network	1.409.001,19
CEB-DIS	Solar charge station - Distributed photovoltaic generation integrated to the building architecture and its application for charging electric vehicles	394.795,85
CEB-DIS	Methodology, pilot project and computational tool for the evaluation technical and commercial arrangements for use of electric vehicles in the CEB distribution system	502.125,78
CELESC-DIS	Fast charge system with hybrid-stationary storage of power for supplying EV in a smart grid	1.137.720,36
COELCE	Development of a charge management system for EV in a Car sharing business	2.000.917,72
COELCE	Intelligent energy storage and demand management system for small-scale applications with distributed generation integration and connection for electric vehicles	1.648.481,01
FURNAS	Development a urban electric bus	3.642.797,03
FURNAS	Development and testing of electric vessel	16.432.449,86
Total Budget (US\$)		41.022.793,87

V. REGULATORY CHALLENGES

The core regulatory challenge boils down to providing a level playing field for the local incumbent distribution company and new players to compete for the greatest benefit of electricity consumers and, ultimately, society as a whole, given the policy choices of each country.

The actual pace of change results from a myriad of factors, and has been quite different in various parts of the world. Despite the potential for disruption, developing economies have experienced change in a more limited scope and at a slower pace [5]. As a consequence, developing countries like Brazil shall expect the co-existence of both traditional and innovative business models for some time.

A. Roadmap for the electricity regulator

In order, not to lose track of important aspects of the transformation process, we propose the Brazilian Electricity Regulator follows a roadmap of principles and focus areas for action. The proposed roadmap builds on a set of best practice principles and recommendations for regulatory policy and governance from the Organization for Economic Co-operation and Development – (OECD) [6, 7] and a few ANEEL’s practices as well.

To successfully navigate through the transformation maze, the electricity regulator must take care of four main areas: Regulatory Governance; Regulatory Framework; Innovation Framework; and Capacity Building. Figure 2 summarizes the four main focus areas and the main issues addressed by the proposed roadmap.

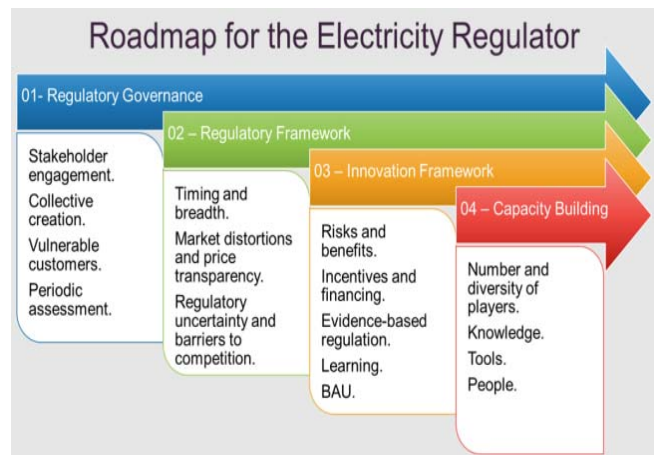


Figure 2 – Main focus areas and issues addressed by the proposed roadmap.

Regulatory Governance, in essence, means to provide the necessary conditions to achieve responsive regulation. As J. Braithwaite pointed out in [8], regulation should be “responsive to the moves regulated actors make, to industry context and to the environment”.

In the case of EV’s charge stations, we should also add that regulation must be responsive to new entrants (i.e. non-regulated actors) moves as well, to enable healthy competition for new system functions and roles.

Recommended practices related to Regulatory Governance include:

- Actively engage with all stakeholders and foster collective creation as much as possible;
- Take care of vulnerable customers. The transformation won’t be for everyone;

- Periodically assess regulation against previously established policy objectives (fit-for-purpose regulation).

Regulatory Framework, for its turn, relates to the necessary mind-set to acknowledge the potential for disruption brought by the large-scale integration of electric vehicles and to leverage the opportunities brought by the transformation to the benefit of grid users and society as a whole.

The following principles should guide the development of the regulatory framework:

- Regulate only where and when needed. Engage with stakeholders to help establish the best timing and breadth for regulating;
- Reduce market distortions and increase price transparency as much as possible (e.g. through time-of-use pricing and pay-for-service models);
- Work to reduce regulatory uncertainty and possible barriers to competition.

Innovation is such an important aspect of the transformation process we suggest it should be treated separately from the regulatory framework. The electricity sector has been a stable and heavily regulated business for decades, and thus, has never been challenged to reinvent itself to survive change, as happened to other industries (e.g. telecommunications). As a consequence, incumbent electricity companies are not used to competition, tend not to follow a customer-centred strategy, and tend to be reluctant to innovate.

An *Innovation Framework* commensurate with the potential for disruption brought by EVs ought to:

- Effectively split risks and benefits among all stakeholders. Captive consumers should not bear alone all the risks of innovation;
- Provide adequate incentives and financing mechanisms;
- Enable learning by doing, in order to lay ground for evidence-based regulation;
- Foster sharing of projects' data and results, in order to maximize learning opportunities;
- Require successful innovation to be incorporated in business-as-usual as soon as possible, so that users may get concrete benefits/value.

Last but not the least, *Capacity Building* means providing the regulator with the knowledge, tools and people skills required to fulfil its roles along the transformation process and beyond.

B. Rule-Making Practices at ANEEL

Regulators must always avoid overregulating, in particular, not to stall the sound infrastructure investments required during new technology introduction and early market development. Several areas at ANEEL have experimented with techniques and approaches that might

improve the degree of responsiveness of regulation. We will take the case of the Superintendence for the Regulation of Distribution Services (SRD), which responsibilities are closely related to EV and other distributed energy resources (DERs) regulation.

Normally, the rule-making cycle initiates with a request from an interested party to the Regulator. The interested party may be, for instance, a product manufacturer, a service provider, an entrepreneur or an early-adopter consumer. Similarly, the request to the Regulator may also result from different sources: An R&D project, some customer need or new technology. In this sense, the rule-making cycle is initiated by market demand.

To be able to adequately respond to the request, the Regulator starts a data and evidence gathering phase, which may take the form of market-monitoring activities and/or practical experimenting activities.

The next phase corresponds to the assessment of possible alternatives, including "not regulating". The assessment phase usually takes the form of a Regulatory Impact Analysis (RIA).

Whenever the need for new or amended regulation is identified, a public consultation follows. A new cycle may be initiated based on a new request of an interested party, market changes identified by monitoring and/or scheduled reviews of regulation. Figure 3 summarizes the rule-making paradigm adopted by SRD.

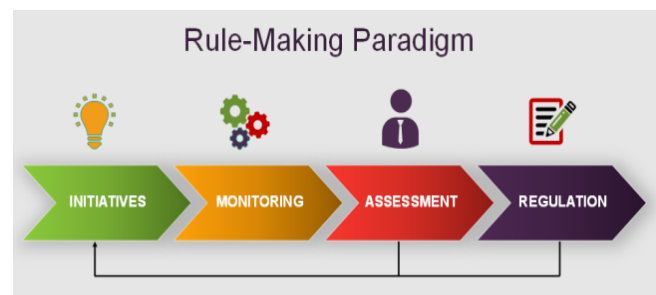


Figure 3 – Rule-making paradigm adopted by SRD.

Notwithstanding being a non-mandatory approach, the abovementioned paradigm has been applied by SRD for the purpose of regulating small-scale distributed generation (DG) and the public charging infrastructure for electric vehicles, leading to promising results and very positive feedback from stakeholders. As a result, it is now being applied to energy storage as well. Figure 4 summarizes the current position in each of these rule-making cycles.

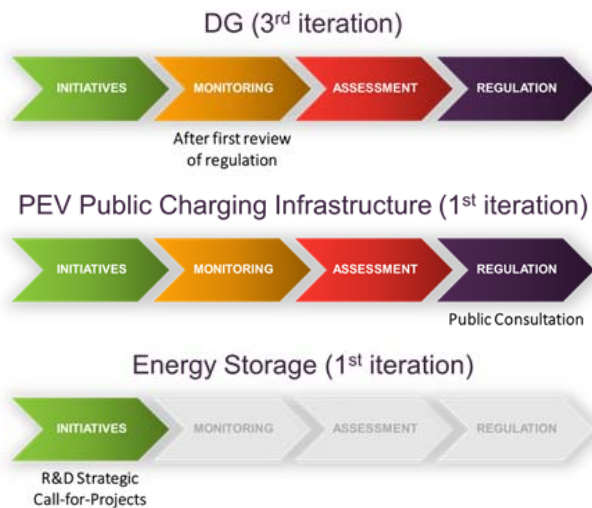


Figure 4 – Selected rule-making cycles.

C. ANEEL's positioning

A public hearing to discuss issues related to the supply of electricity to charge plug-in hybrid and battery electric vehicles and the need of some specific regulation occurred in the first half of 2017. Contributions received are under analysis and the new regulation is expected to be issued by July 2018.

Meanwhile, the Agency is evaluating each request related to developing charging infrastructure on a case-by-case basis. The objectives of this approach are two-fold: (a) reduce regulatory uncertainty, by providing entrepreneurs and stakeholders alike with a clear view about the Agency's understanding; and (b) provides ANEEL with means to monitor the progress of electric mobility initiatives and their impact on the distribution grid.

The draft regulation submitted to public scrutiny [9] has three cornerstones:

- a) the possibility of any interested party provide EV charging services;
- b) minimum interoperability requirements for EV supply equipment (EVSE); and
- c) registration of all EVSE installations, public and private, at the local distribution company.

VI. CONCLUSIONS

The number and breadth of the initiatives underway suggest electric mobility will play a role in the future Brazilian transportation sector. Moreover, a comprehensive

public consultation process, combined with active stakeholder engagement and, in the meantime, the issuance of formal authorizations on a case-by-case basis, seems the most appropriate approach, once it contributes to reduce regulatory uncertainty and provides ANEEL with means to monitor the progress of EV charging infrastructure build-up in Brazil.

Decision makers must avoid overregulation as not to stall the necessary investments during early market development. Do not consider charging embedded in value-added services as electricity retail seems to be an effective way to facilitate the development of the necessary charging infrastructure. This has been the alternative pursued by ANEEL so far, very much like it was, for instance, in several US states [10] and other international jurisdictions.

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