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ENVIRONMENTAL REGULATION AND AUTOMOTIVE INDUSTRIAL POLICIES IN BRAZIL: THE CASE OF “INOVAR-AUTO”

José Marcos Domingues, Luiz Artur Pecorelli-Peres,**
and Ronaldo Seroa da Motta****

ABSTRACT

The Brazilian Government has recently pursued policies aimed to increase the country's international competitiveness, particularly towards the industrial sector. In September 2012, a new law was passed in Congress creating several fiscal incentives to promote technological innovation for industrial activities. With this law, a new automotive regime was designed (INOVAR-AUTO program) in which a large reduction (up to 30 percent) of the federal value added tax (IPI) was granted in exchange for producers complying with innovation targets for all light-duty vehicles based on several requirements for domestic production content, safety, and emission targets during the period between 2013 and 2017. The emission standards target is modest in international terms, although the new regulation seems to be efficient and incentive compatible. This paper will first describe the emission profile of the Brazilian automobile fleet. Then, it will analyze, in detail, the emission component of the INOVAR-AUTO program. Additionally, the article explains the technological reasons for which the INOVAR-AUTO has design gaps where battery electric vehicles (BEVs) are treated without differentiation. In fact, it is considered essential and it must take into account the highly renewable Brazilian electric matrix in contrast with its inefficient transportation matrix, which is very concentrated on

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road vehicles based on internal combustion vehicles (ICVs). A new classification is proposed for vehicle propulsion systems, along with a graphical tool in order to better identify sustainability indicators. These tools are employed to justify a specific plan for BEVs considering the formation of a fund with a small taxation on ICVs aimed at lowering the costs of the most expensive component of BEVs—its electrochemical energy source. Based on that, the article proposes how to improve the design of regulatory and fiscal policies in Brazil to exploit the synergies with INOVAR-AUTO to set a basis for new pathways of emission reduction in the Brazilian automobile fleet, including the introduction of alternative instruments, such as feebate programs, and how they could create the basis for the promotion of Electric Vehicles (EVs) in Brazil.

KEY WORDS

Electric vehicle; regulatory and tax bottlenecks; new vehicle classification; Brazilian INOVAR-AUTO and feebate adjustments; tax incentives; federative tax system.

I. INTRODUCTION

AT the Brazilian Seminar on Technologies for Electric Vehicles (EVs), held in Brasília-FD in June 2011, the Ministry of Finance voiced governmental intentions to compel the auto industry to adopt a green seal that would rank vehicles based on emissions and fuel consumption.¹ Joining the federal green seal program has become a legal condition for applying for fiscal incentives under the INOVAR-AUTO program, even though it is not yet required for vehicles that run on diesel or semi-diesel engines.²

Despite the adequacy of the Brazilian energetic matrix for EV expansion, there are still barriers of regulatory and fiscal nature that ought to be addressed. The Brazilian Government has pursued policies aimed at increasing the country's international competitiveness towards the industrial sector. In September 2012, a new law created fiscal incentives to promote technological innovation for the industry, designing a new automotive regime (INOVAR-AUTO).³ This law grants a large reduction (up to 30 percent) of the federal value added tax (VAT) in exchange of makers complying with innovation targets for vehicles based on requirements

1. See José Marcos Domingues & Luiz Arthur Percorelli-Peres, *Electric Vehicles, Energy Efficiency, Taxes and Public Policy in Brazil*, 19 L. & BUS. REV. AM. 56, 56 (Winter 2013).

2. See Lei No. 12.715 de 17 de Setembro de 2012, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 18.09.2012, art. 40, § 5 (Braz.). The applicant must progressively include 100 percent of its models in the program by 2017, up from 36 percent in 2013. *Id.*

3. See *id.* art. 40–44.

for vehicle content, safety, and emission targets between 2013 and 2017.⁴ EVs were completely neglected by the program until May 2013. The target setting for emission standards seems modest, but the new law seems efficient and incentive-compatible. Also, infrastructural tax incentives were neither specified nor indicated as a matter of national public policy favoring EVs.⁵ States and municipalities have focused on case-by-case incentives to assemble facilities in the automotive sector, such as plant financing, VAT postponement, and real estate property tax exemptions.

This article describes the emission profile of the Brazilian automotive fleet and its energy matrix. It suggests improvements in designing fiscal policies to set the basis for new pathways of emission reduction in the automotive fleet, including the introduction of alternative instruments such as feebate programs, and how they could create brackets for the promotion of EVs. It also intends to deepen specific discussions on the "possibilities of environmental protection through tax incentives as environmentally oriented public policy tools, in which taxes are not perceived as a traditional fund-raising device ("fiscal taxation"), but through their non-fiscal potentiality,"⁶ while presenting advanced tax policy models aimed at environmental protection within the case of EVs. Additionally, the article explains the technological reasons for which the INOVAR-AUTO has design gaps where Battery Electric Vehicles (BEVs) are not treated as differentiated products. It is held essential and INOVAR-AUTO must take into account the highly renewable Brazilian electric matrix in contrast with its inefficient transportation matrix, which is very much concentrated on vehicles running on internal combustion engines (ICVs). Thus, a new classification was proposed for vehicle propulsion systems and a graphical tool in order to better identify sustainability indicators. These tools were employed to justify a specific tax treatment on ICVs while considering a reduced taxation for BEVs, thereby aiming at decreasing the respective costs, of which the electrochemical energy source is the most expensive component.

II. REPLENISHING ROAD VEHICLES ONLY WITH ELECTRIC ENERGY: THE DREAM

In the early twentieth century, electric power companies envisioned both urban transportation and road transportation in their business plans to create a network of streetcars and trolleybuses in Brazilian capitals, together with buses, trucks, and automobiles. The then-Brazilian Traction Light and Power Company, currently Light Serviços de Eletricidade S/A (Rio de Janeiro), had a line of electric buses and maintenance

4. *Brazil's Innovar Auto Incentive Program*, INT. COUNCIL ON CLEAN TRANSP. (Feb. 2013), available at http://www.theicct.org/sites/default/files/publications/ICCT_update_Brazil_InovarAuto_feb2013.pdf.

5. Domingues & Percorelli-Peres, *supra* note 1, at 64.

6. *See id.* at 57.

trucks.⁷

Despite the better efficiency of electric transportation means, vehicle manufacturers/assemblers and oil companies continued to integrate—benefitting from regular oil prices until the 1970's and 1980's crises.⁸ As a consequence, people perceived oil companies not as fuel-production-and-distribution companies, but rather as energy companies, which enabled a major expansion of their business to include electricity generation.⁹ A similar process enabled ethanol producers to migrate from merely supplying to a fuel-dependent, road transportation system to venture into the production of electricity from sugarcane bagasse.¹⁰ This consideration extends to fuel storage and distribution systems, which implies damages to urban mobility and involves permanent refilling of fuel stations (sources of emissions and environmental risks per se). But BEVs are fueled by electricity only, and any advanced hybrid plug-in vehicles still have to rely on fuel stations, as well as electro stations.

A. ADVANTAGES OF THE EVs: THE CASE OF BRAZIL

Historic processes of energy use demonstrate mankind's search for efficiency. This can be divided into two moments: before and after the employment of electricity for mechanical work production. This is an irreversible evolutionary process that has been established for lighting, as well as for powering industries and household appliances. The expansion of electric power systems has improved to date; intelligent power grids are now a must and can be found all around, including EVs. From social and economic perspectives, there is a self-evident synchrony between increasing well-being and the use of electricity.¹¹ Technological advancements have driven the recognition of societal spaces that must be filled by electric traction instead of thermal traction in road transportation.

These issues and changes have been diversified in many countries, considering each individual set of priorities.¹² In Brazil, a popular factor in favor of employing electric traction for road transportation comes from

7. See MARCIO PINON DE OLIVEIRA, *A INDÚSTRIA ELÉTRICA NO BRASIL NO INÍCIO DO SÉCULO XX: A COMPANHIA BRASILEIRA DE ENERGIA ELÉTRICA E A ATUAÇÃO DO GRUPO GUINLE & CIA NA PRODUÇÃO DO URBANO E SUAS REDES TÉCNICAS* [ELECTRICAL INDUSTRY IN BRAZIL AT THE BEGINNING OF THE TWENTIETH CENTURY: A BRAZILIAN COMPANY OF ELECTRICITY AND ACTION GROUP GUINLE & CIA IN PRODUCTION TECHNICAL AND URBAN NETWORKS] 1 (2012), available at http://www.ub.edu/geocrit/Simposio/cMOliveira_Aindustria.pdf.

8. Cesar Said Rosales Torres, *Oil and World Power: PEMEX and PETROBRAS*, *ANALECTICA* (Apr. 29, 2014), <http://www.analectica.org/oilworldpower-said/> (noting the creation of Petrobras from the oil crises of the 1970s and 1980s).

9. See *id.*

10. See *id.*

11. Risako Morimoto & Chris Hope, *The Impact of Electricity Supply on Economic Growth in Sri Lanka 2* (Univ. of Cambridge Judge Inst. of Mgmt., Working Paper No. 24, 2001), available at http://www.jbs.cam.ac.uk/fileadmin/user_upload/research/workingpapers/wp0124.pdf.

12. See JOAO VITOR FERNANDES SERRA, *ELECTRIC VEHICLES: TECHNOLOGY, POLICY AND COMMERCIAL DEVELOPMENT* xi (2012).

the fact that domestic production of electricity relies mostly on renewable sources, along with the favorable future perspectives of resorting to the huge available potentials of hydraulic, wind, solar, and bioenergy sources.¹³ But, since the country is rich not only in renewable energies, but also in fossil fuels,¹⁴ a more complex issue arises for making decisions in favor of EV-technology (in fact, it involves greater divergences with current prevailing economic forces).¹⁵

Experiences and attempts to establish specific plans for EV-technologies in Brazil, such as the 2009 Campinas Charter,¹⁶ have not been successful. The greatest achievement in this sector INOVAR-AUTO falls short in catering the needs of EV-technology.

It is important to mention that it is possible to save money to recharge a BEV at night avoiding peak time when the tariff is higher. In comparison to refuel an internal combustion vehicle, the price is independent of the time of day. EVs, particularly BEVs, are revolutionary in the automotive sector because they allow for a gradual shift in the impact caused by conventional vehicles.

III. SPECIFIC TECHNOLOGICAL PROPOSAL FOR BEVS

INOVAR-AUTO fails to take into account vehicles with technology differences. This article attempts to show that EVs, particularly BEVs, call for different, specific treatment mostly due to Brazil's highly renewable electrical power mix in contrast with the transport mix (the road model based on conventional ICVs are scarcely efficient). Concepts of electromechanical energy conversion¹⁷ have been used as well as those inspired by the choice awareness theory.¹⁸ Thus, it was possible to develop a graphic model¹⁹ expressing how these vehicle-propulsion systems present intrinsic characteristics different from one another in order to subsidize the development of public policies that would take into account

13. See Domingues & Percorelli-Peres, *supra* note 1, at 56.

14. Not to mention the intense use of sugarcane ethanol since 1975 with the "PRO-ÁLCOOL" program that was created to supply thermal power for vehicles. Manoel Regis Lima Verde Leal, *Technological Evolution of Sugarcane Processing for Ethanol and Electric Power Generation*, in SUGARCANE BIOETHANOL: R&D FOR PRODUCTIVITY AND SUSTAINABILITY 561 (2010), available at http://blucheropenaccess.com.br/pdf/bioetanol/SUGARCANE BIOETHANOL_51.pdf.

15. Countries that do not have oil and are not renewable-fuel producers should find even more immediate reasons for adopting electricity as their source of road traction.

16. *Carta de Campinas—uma política para veículos elétricos no Brasil [Campinas Letter—A Policy for Electric Vehicles in Brazil]*, ASSOCIAÇÃO BRASILEIRA DO VEÍCULO ELÉTRICO [BRAZILIAN ELECTRIC VEHICLE ASS'N] (Dec. 16, 2009), <http://www.abve.org.br/destaques/2009/destaque09060.asp>.

17. See generally DAVID BROWN, ELECTROMECHANICAL ENERGY CONVERSION (1984).

18. See HENRIK LUND, RENEWABLE ENERGY SYSTEMS: A SMART ENERGY SYSTEMS APPROACH TO THE CHOICE AND MODELING OF 100% RENEWABLE SOLUTIONS 15 (Elsevier, 2d ed. 2014).

19. See LINEU BELICO DOS REIS, GERACAO DE ENERGIA ELETRICA: REVISADA E ATUALIZADA [ELECTRIC POWER GENERATION : REVISED AND UPDATED] (2011).

both favorable and non-favorable attributes. The found discrepancies clarify that INOVAR-AUTO does not focus on sustainability attributes that are relevant for BEVs, which point to the need for a differentiated treatment leading to improved yield levels.

A. PARADIGM SHIFTS AND MOTIVATIONS RELATED TO THE BRAZILIAN ENERGY MATRIX

A new alliance emerges between EVs and renewable sources of energy. This contrasts with the centennial alliance between oil companies and ICV assemblers. EVs enhance technological development and energy company business because they can be recharged with power generated from different sources, thus reducing the impact and complexity of traditional fuel distribution systems.²⁰

EVs can be recharged at home through microgeneration, for instance, from photovoltaic panels.²¹ Smart grids also enable EVs to offer their stored energy surplus to electricity distributors.²² Mega Joules per Kilometer (MJ/km) consumption reductions may rise to 70 percent when an ICV-similar BEV is used to cover the same route.²³ All regulated pollutants common to all combustion processes, not only carbon dioxide (CO₂) emissions, need to be considered due to the significant damage to the environment.²⁴

Even when one considers thermoelectric power generation from fossil sources, global efficiency is usually greater for the complete EV-recharging process than for the ICV one.²⁵ There is an overabundance of the road model in the Brazilian transportation mix.²⁶ The road transportation sector consumes 26.1 percent of all energy and is second only to the industrial sector (34.2 percent) according to the 2010 Brazilian Energy Balance (the referenced values have not significantly changed so far).²⁷ Because of its prevalence over other models, road transportation is responsible for 90.41 percent of CO₂ emissions in the sector, as indicated by

20. See *Electric Vehicles: Myths v. Reality*, SIERRA CLUB, <http://content.sierraclub.org/evguide/myths-vs-reality> (last visited Sept. 12, 2014).

21. See Von Elon Musk, *Electric Cars and Photovoltaic Solar Cells*, TESLA MOTORS BLOG (Oct. 11, 2006), http://www.teslamotors.com/de_CH/node/3925.

22. See Press Release, *Endesa Present Charger that Enables Electric Vehicles to Return Power to the Grid*, ENDESA (Jun. 7, 2012), available at <http://www.endesa.com/en/saladeprensa/noticias/Documents/NOTA%20%20PRENSA%20%20PRIMER%20CARGADOR%20V2G-EN.pdf>.

23. See Lew Fulton, *Scenarios for Cutting Carbon Dioxide in Transport 70 Percent Worldwide by 2050*, in CLIMATE AND TRANSPORTATION SOLUTIONS FINDINGS FROM THE 2009 ASILOMAR CONFERENCE ON TRANSPORTATION AND ENERGY POLICY 9 (Daniel Sperling & James S. Cannon eds., 2010), available at <file:///C:/Users/41059464/Downloads/2010-UCD-ITS-RP-10-09.pdf>.

24. See *Pollutants Vehicles Emit*, BRIT. COLUM. AIR QUALITY, <http://www.bcairquality.ca/topics/vehicle-pollutants.html> (last visited Sept. 12, 2014).

25. See JAMES LARMINIE & JOHN LOWRY, *ELECTRIC VEHICLE TECHNOLOGY EXPLAINED* 247 (2d ed. 2012).

26. Domingues & Percorelli-Peres, *supra* note 1, at 67.

27. *Id.*

the 2010 Emissions Inventory by the Science and Technology Ministry.²⁸ The production capacity of the Brazilian electric power sector is enough to absorb the gradual insertion of EVs by 2030.²⁹ There is no doubt about the broad space for transport electrification, including for the road model.

B. PROPOSITION OF A CLASSIFICATION AND TOOL TO COMPARE ROAD VEHICLES ATTRIBUTES

An innovative classification tool is proposed to identify attributes of automobile motors and establish public policy criteria for BEVs in Brazil.³⁰ This tool focuses on the propulsion and replenishing system—emphasizing the source of energy used by the vehicle—rather than on the traction system. This new classification also adopts the same understanding of electromechanical energy converters acting as generators in power plants, which are identified by the primary source and are called hydroelectric power plant, thermoelectric power plant, etc. Two steps are necessary for using this tool: the preparation of a table with the previously established vehicular attributes, and a method to build a corresponding radar graph, which is considered the most appropriate way to display the favorable and non-favorable characteristics of road vehicles.³¹

According to the vehicle energetic source, the classification distinguishes clearly the fuel-dependent vehicles from the independent-fuel vehicles. The fuel production and refueling system depends on large amounts of electricity to work. Conversely, a BEV depends on a centralized electricity system that can use non-renewable and renewable primary energy sources, as well as distributed energy sources, micro-generation from small photovoltaic panels, and wind generators.³²

The classification helps to separate three big groups of vehicles: thermal energy vehicles (THV), thermal and electrochemistry energy vehicles (THELV), and electrochemistry energy vehicles (ELV). The third group consists of a radical innovation: a vehicle without a fuel tank, which only requires electricity to operate. The first and second groups represent the

28. *Id.* at 65.

29. See MINISTÉRIO DE MINAS ENERGIA [MINISTRY OF MINES ENERGY], PLANO NACIONAL DE EFICIÊNCIA ENERGÉTICA PERMISSAS E DIRETRIZES BÁSICAS NA ELABORAÇÃO DO PLANO [NATIONAL EFFICIENCY ENERGY ASSUMPTIONS AND BASIC GUIDELINES ON ESTABLISHMENT OF THE PLAN] 39 (2009).

30. See LUND, *supra* note 18, at 15 (referring to the concepts of Eletromechanical Energy Conversion as well those inspired by the Choice Awareness Theory).

31. "The Choice Awareness theory presents two theses: The first states that when society defines and wishes to implement objectives implying radical technological change, existing organizations will often seek to create the perception that the radical change in technologies is not an option and that society has *no choice* but to implement a solution involving the technologies that will save and constitute existing positions. The second thesis argues that, in such situation, society will benefit from focusing on Choice Awareness that is, raising the awareness that alternatives *do* exist and that it is possible to make a choice." *Id.* at 3–4.

32. See Musk, *supra* note 21.

existing fuel structure as well as the need for a fuel tank inside the vehicle.

C. DESCRIPTION OF THE PROPOSED CLASSIFICATION

Two road automotive systems to be observed and classified are the energy source system and the energy fueling system. Three major groups of road vehicles are identified based on these systems:

- Group G1: Thermal energy vehicles (THVs), corresponding to present ICVS, which emphasize the engine instead of the primary energy that moves the vehicle.
- Group G2: Thermal and electrochemistry energy vehicles (THELV), corresponding to actual HEVs (Hybrid EVs) and PHEVs (Plug-in Hybrid EVs), which emphasize the propulsion system instead of the two primary energies that move the vehicle.
- Group G3: Electrochemistry energy vehicles (ELVs), corresponding to BEVs and fuel cell vehicles.

D. EVALUATION TOOL FOR ATTRIBUTES

An attribute is a technological aspect of a road vehicle relative to its sustainability. Attributes were considered Favorable and Non-Favorable; three levels were associated to the respective categories: High (H), Medium (M), and Low (L). A fourth level, Null (N), is given to an inexistent attribute relative to the Favorable or Non-Favorable categories.

A favorable attribute (F) is adopted when the more it grows, the more desirable the attribute becomes. A Non-Favorable (NF) attribute is adopted when the more it grows, the more undesirable the attribute becomes. Four values are associated with each one level as follows: H= 3, M= 2, L= 1, N= 0.

The favorable and non-favorable attributes chosen to evaluate vehicle groups are described in Table 1 as well as for energy production and supply system in Table 2.

Table 1–Favorable and Non-Favorable Attributes for the Vehicle

Favorable Attributes for the Vehicle (F)	Non-Favorable Attributes for the Vehicle (NF)
Energetic Efficiency	Dependence of non-renewable combustibles
Range	Emissions of Pollutants and CO ²
Home refueling	Noise
Indoor operation	Refuel time

Table 2—Favorable and Non-Favorable Attributes for the Energy Production and Supply System

Favorable Attributes for the Supply System (F)	Non-Favorable Attributes for the Supply System (NF)
Need of only electricity to supply the vehicle and refueling station	Need of combustible reservoirs, water and electric supply in refueling stations
Insertion in energy smart grids	Pollutants emissions from the refueling station
Flexibility in the use of various forms of primary energy	Need of trucks of combustibles to supply the refueling station
Energy price varies with the day hour	Complex logistic to supply the refueling station

F. EVALUATION TOOL FOR COMPARING THE ATTRIBUTES OF ROAD VEHICLES

Since the current fleet of Brazilian road vehicles is almost exclusively composed of conventional THVs, and there is not a public policy comprehensively considering the ELVs,³³ the proposed tool was employed to compare the attributes of THVs and ELVs for light-duty vehicles (LDVs) (refer to Tables 3 and 4). The extensive use of renewable combustible mixture of sugar cane ethanol and gasoline in THVs and flex-fuel cars appear in the third column of Table 4. ELVs were considered in the Brazilian transportation matrix and in smart-energy grids, which are currently planned. More than 80 percent of the Brazilian population lives in urban centers³⁴ that do not always have air quality in accordance with WHO standards,³⁵ thus making ELVs more attractive.³⁶

The radar graphs, in general, compare attributes in a decision process. Radar graphs were utilized by Helio International as mentioned by REIS to describe sustainable indicators identified by the Commission on Sustainable Development for UN study in 2006.³⁷

33. See Domingues & Percorelli-Peres, *supra* note 1, at 67.

34. *Urban Population (% of Total)*, WORLD BANK, <http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS> (last visited Sept. 23, 2014).

35. *Brazil*, OECD BETTER LIFE INDEX, <http://www.oecdbetterlifeindex.org/countries/brazil/> (last visited Oct. 6, 2014).

36. The air quality standards are outdated and the conditions are worse than the presented statistics in accordance with studies of the Environmental and Energy Institute-IEMA in Brazil published in 2012. See generally ENVIRONMENTAL AND ENERGY INSTITUTE, www.energiaambiente.org.br (last visited Aug. 11, 2014).

37. See REIS, *supra* note 19.

Table 3–Non-Favorable Attributes Evaluation

Non-Favorable Attributes	Thermal Energy Vehicles			Electrochemistry Energy Vehicles
	1 Non-renewable combustible vehicles	2 Renewable combustible vehicles	3 Mixed non-renewable and renewable combustible vehicles	1 Battery electric vehicle
1 Dependence of non-renewable combustibles	H	M	L	N
2 Pollutants Emission	H	L	M	N
3 Noise	M	M	M	L
4 Refuel time	L	L	L	H
5 Necessity of combustible reservoirs and electric supply in the station	H	H	H	N
6 Gas Emission of the station	M	M	M	N
7 Necessity of fleet of combustible tank trucks to supply the station	H	H	H	N
8 Complex Logistic to Supply the Stations	H	H	H	M

Graph 1–Non-Favorable Attributes Evaluation

- A4 Refuel Time
- A8 Complex Logistic to Supply the Stations
- A3 Noise
- A1 Dependence of non-renewable combustibles
- A2 Gas emission
- A5 Need of combustible reservoirs underground and electric supply
- A6 Gas emission of the station
- A7 Need of fleet of combustible tank trucks to supply stations

Non-Favorable Attributes of THV and ELV

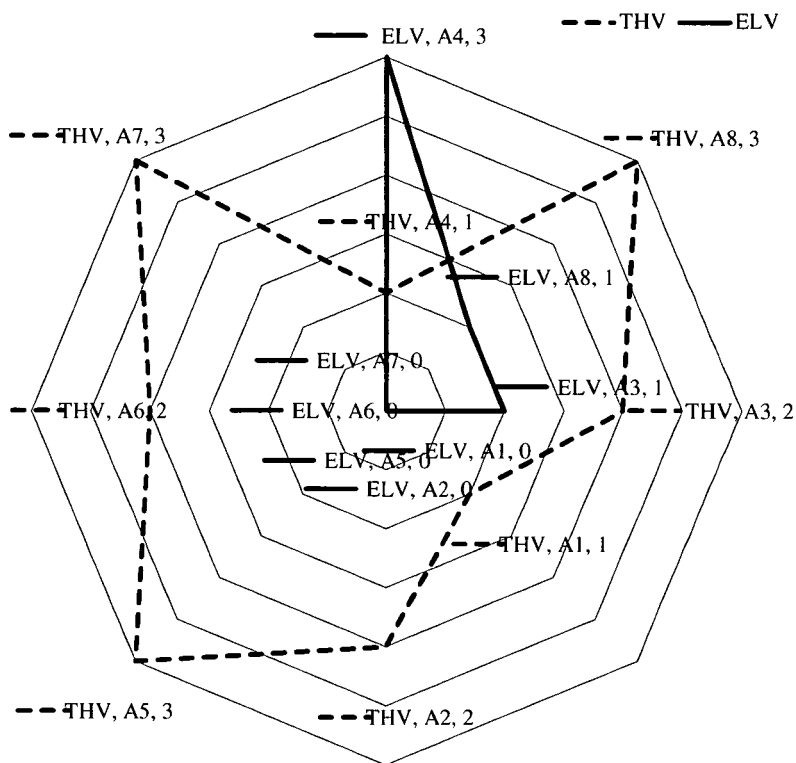
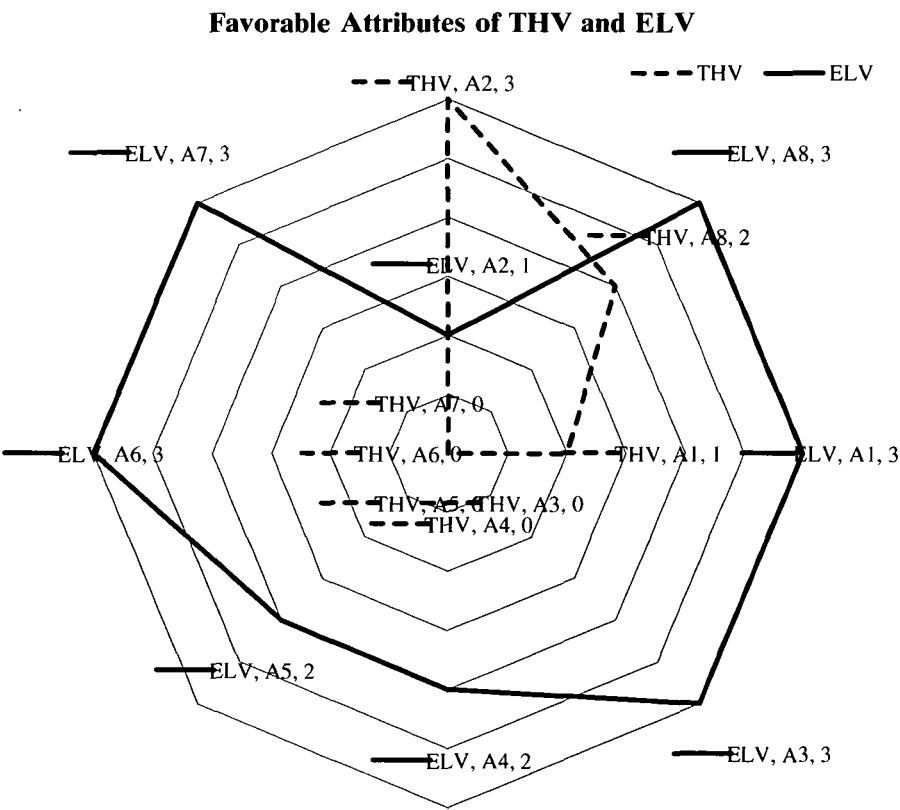


Table 4–Favorable Attributes Evaluation

Favorable Attributes	Thermal Energy Vehicles			Electrochemistry Energy Vehicles
	1 Non-renewable combustible vehicles	2 Renewable combustible vehicles	3 Mixed non-renewable and renewable combustible vehicles	1 Battery electric vehicle
1 Energetic Efficiency	L	L	L	H
2 Range	H	H	H	L
3 Home refueling	N	N	N	H
4 Energy price varies with day-time	N	N	N	M
5 Indoor operation	N	N	N	M
6 Necessity only of electricity to supply the station and the vehicle	N	N	N	H
7 Insertion in smart grids	N	N	N	H
8 Flexibility in the use of primary energy	L	M	M	H

Graph 2–Favorable Attributes Evaluation

- A2 Range
- A8 Flexibility in the use of primary energy
- A1 Efficiency
- A3 Home refueling
- A4 Energy price varies with day time
- A5 Indoor operation
- A6 Necessity only of energy to supply the station and the vehicle
- A7 Insertion in smart grids



G. ANALYSIS OF RESULTS

Graphs 1 and 2 show large discrepancies between a THV and ELV, indicating that it is adequate to adopt different public policies, which take into account their attributes. The classification based on energy sources for road vehicles showed that one of the major obstacles to increase ELVs in the market are batteries, the most expensive components.³⁸ Calcula-

38. Brad Plumer, *Expensive Batteries are Holding back Electric Cars. Can that Change?*, WASH. POST (Apr. 2, 2013), <http://www.washingtonpost.com/blogs/wonkblog/wp/2013/04/02/expensive-batteries-are-holding-back-electric-cars-what-would-it-take-for-that-to-change/>.

tions performed by Pecorelli-Peres³⁹ showed it is possible to achieve lower prices than THVs, which increased by 1 percent with the introduction of ELVs. Due to low production of ELVs when the plan is implemented, there is a reduction in battery price because at the same time there will be a large production of THVs. This proposed policy will remain in effect until the price of ELVs falls to an attractive value.

IV. REGULATORY AND TAX BURDEN ON ELECTRIC VEHICLES IN BRAZIL

EVs suffer from a bottleneck tax cost; they are taxed at 25 percent by federal VAT—the same rate applied to the most polluting combustion motor vehicles. In contrast, Electric motorcycles pay 35 percent.⁴⁰ EVs are also subject to a state VAT of 18–19 percent and are taxed at 11.6 percent by federal social contributions on sales.⁴¹ There is a yearly state vehicle tax of up to 4 percent.⁴² All taxes referred to here have the vehicle market value as the taxable basis. There is no substantial rebate or tax incentive related to the purchase of an EV. INOVAR-AUTO first excluded EVs from its product innovation and local content-incentive program, but then included them on a temporary basis.⁴³ Such tax burdens make it impossible for EV industrialization and trade in scale, thereby preventing a reduction in air pollution.

There are also municipal taxes on real estate related to the infrastructure required for EV use such as recharging stations, repair shops, and services rendered therein. For example, there is an annual 2.8 percent tax on the market value of non-residential real estate in Rio de Janeiro. Cities also tax 2 percent of the service price on the rendition of services.⁴⁴ Thus, there is no income tax incentive or financial subsidy for EV manufacturers and consumers.⁴⁵

V. AIR POLLUTION CONTROL PROGRAMS BY ROAD MOTOR VEHICLES IN BRAZIL

A. REGULATORY ASPECTS LEADING TO INOVAR-AUTO

Air pollution is a serious environmental problem in major urban areas in Brazil. This situation would be worse if there was no emission control

39. See generally Luiz Artur Pecorelli Peres et al., *A inserção do Veículo Elétrico no Planejamento Estratégico das Empresas de Energia* [The Insertion of Electric Vehicle Strategic Planning of Energy Companies], VIII ERLAC, CIGRE, CIUDAD DEL ESTE, PARAGUAY (1999).

40. See Jose Marcos Domingues, *An Introduction to The Brazilian Tax System*, 44 KOBE U. L. REV. 19, 23-24 (2010) (summarizing the Brazilian tax system); See also Domingues & Pecorelli-Peres, *supra* note 1, at 55.

41. Domingues & Pecorelli-Peres, *supra* note 1, at 63.

42. Only around one-third of Brazilian States allow any kind of tax differentiation in favor of EVs. See *id.* at 64.

43. See generally Decreto No. 8.015, de 17 Maio de 2013, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 17.05.2013 (Braz.).

44. Domingues & Pecorelli-Peres, *supra* note 1, at 64.

45. *Id.*

regulation. The Air Pollution Control Program by Motor Vehicles (PROCONVE) launched the first public policy towards vehicle emission control in Brazil in 1988. It established maximum pollution emission standards (in grams/km) for new vehicles entering the market, and manufacturers were granted a rebate of 5 percent of the federal VAT⁴⁶ levels for the adoption of catalyzers and fuel injection devices. The target was achieved earlier than planned.

The program became law in 1993⁴⁷ with a schedule of additional four phases over a large time span, but with no tax incentive. The program aimed at reaching the EURO-V standards in 2012.⁴⁸ The program as a whole was fully implemented,⁴⁹ but attempts to introduce a seventh phase with higher standards and adoption of more fuel-efficient technologies without rebate schemes faced great opposition. In response, a new and comprehensive automotive regulatory framework was created to promote vehicle technology innovation, including emission control, as well as the industrial policy goals the INOVAR-AUTO program launched.⁵⁰

INOVAR-AUTO is a type of feebate program with a limited degree of price variation. It first increases the federal VAT on vehicle sales by 30 percent and then imposes requirements and targets on vehicle efficiency, national production, R&D, and automotive technology for manufacturers in order to qualify for a 30 percent presumed tax credit.⁵¹ There is also the possibility of an additional 1 percent and 2 percent tax rebate effective between January 1st, 2017 and December 31st, 2020, if higher targets are met by October 1st, 2016.⁵² The program covers existing manufacturers and vehicle importers that plan to assemble vehicles in Brazil.⁵³

This new tax regime is also limited to vehicles manufactured between 2013 and 2017. Tax incentives are granted today, but will be measured in 2017 with severe non-compliance penalties, such as sanctions.⁵⁴

Regarding vehicle efficiency, INOVAR-AUTO sets corporate average vehicle efficiency targets rather than on each vehicle model.⁵⁵ The

46. Policy Update, *Brazil's Inovar-Auto Incentive Program*, INT'L COUNCIL ON CLEAN TRANSP. (Feb. 2013), http://www.theicct.org/sites/default/files/publications/ICCTupdate_Brazil_InovarAuto_feb2013.pdf.

47. See generally Lei No. 8.723, de 28 de Outubro de 1993, D.O.U. de 28.10.1993 (Braz.).

48. European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states stated by the Regulation (EC) No 715/2007. Current regulation in the EU is the EURO-VI with more stringent standards. See Council Regulation 715/2007, 2007 O.J. (L 171) 1.

49. Just a one year delay in the last phase on heavy vehicles. See Commission Directive 2008/74, 2008 O.J. (L 192) 51 (EC).

50. See Lei No. 12.715, de 17 de Setembro de 2012, D.O.U. de 18.09.2012 (Braz.).

51. Since Imposto sobre Produtos Industrializados (IPI) is a VAT, the rebate is in the form of presumed credit to be abated at the end of the tax processing. See Policy Update, *supra* note 46, at 1.

52. Decreto No. 7.819, de 3 Outubro de 2012, D.O.U. de 03.10.2012 (Braz.).

53. Policy Update, *supra* note 46, at 1.

54. *Id.* at 2.

55. *Id.*

targeted standards are weighted by the average of the carmaker's sale portfolio.

If these targets are met, it is expected that light-duty vehicles will improve their efficiency by at least 12 percent on average with the 30 percent tax rebate.⁵⁶ The additional 1 percent and 2 percent tax rebate may lead, respectively, to 16 percent and 18 percent improvement.⁵⁷ These targets were based on Europe's 2015 targets adapted to Brazil based on differences in driving cycle; vehicle; fuel; and road specifications, measured as average vehicle efficiency in megajoules/kilometers (mj/km) estimated on the combined (urban/highway) CAFE cycle.⁵⁸ If INOVAR-AUTO is fully implemented, it would represent between a 10 and 15 percent reduction in greenhouse gas emissions.⁵⁹

Besides energy efficiency, car makers also need to reach certain levels of manufacturing within the country and targets in two out of three other policy goals: (1) investments in R&D, (2) investments in industrial technology and engineering, and (3) participation in vehicle labeling.⁶⁰

In short, INOVAR-AUTO was devised to protect and foster car-making in Brazil, which already enjoyed benefits from temporary tax rebates and energy efficiency goals. Other requirements were designed as conditions to offer these rebates on sustained basis.

B. AN ECONOMIC CRITICISM AND ANALYSIS OF INOVAR-AUTO

INOVAR-AUTO implementation regulation⁶¹ did not mention EVs as qualified for the new regime. This generated reactions from manufacturers, environmentalists, and academics.⁶² In May 2013, a revised list of types of vehicles eligible for the tax rebate was enacted and EVs were among the vehicles listed.⁶³ Such change was welcomed as a step towards the promotion of EVs in Brazil.

In addition to INOVAR-AUTO, plans for another major governmental program, INOVA-ENERGIA, was recently announced.⁶⁴ INOVA-

56. *Id.*

57. *Id.* at 3.

58. *Id.* at 3. The Corporate Average Fuel Economy (CAFE) were regulations in the United States to improve the average fuel economy of cars and light trucks in the wake of the 1973 Arab Oil Embargo. See Fuel Economy, *Regulations and Standards*, EPA, <http://www.epa.gov/fueleconomy/regulations.htm> (last visited Aug. 18, 2014).

59. *Id.* at 2.

60. *Id.*

61. See generally Decreto No. 7.819, de 3 Outubro de 2012, D.O.U. de 03.10.2012 (Braz.).

62. See generally Jose Marcos Domingues & Luiz Artur Pecorelli-Peres, *Eficiência energética e carga tributária: o veículo elétrico* [Energy Efficiency and Tax Burden: The Electric Vehicle], MONITOR MERCANTIL (Dec. 27, 2012, 7:12 PM), <http://www.monitormercantil.com.br/index.php?pagina=Noticias&Noticia=125276>.

63. See generally Decreto No. 8.015, de 17 Maio de 2013, D.O.U. de 17.05.2013 (Braz.).

64. See generally Decreto No. 6.938, de 13 Agosto de 2009, D.O.U. de 13.08.2009 (Braz.); Lei No. 11.540, de 12 de Novembro de 2007, D.O.U. de 12.11.2007 (Braz.); Decreto No. 8.015, de 11 Outubro de 2005, D.O.U. de 11.10.2005 (Braz.); Lei No.

ENERGIA aims to promote the integration of smart grids, alternative energy sources, and EVs, through subsidy and credit funding of approximately \$1.5 billion between 2013 and 2017.

INOVAR-AUTO is, in the short run, the most important incentive program to EVs in Brazil. Because its primary target is corporate emission levels, the introduction of zero-emission EVs will facilitate compliance with INOVAR-AUTO goals. But for energy efficiency as a whole (taking into account total new vehicle sales), this program may have perverse effects. INOVAR-AUTO will reduce supply incentive effects on efficiency improvements to other combustion models. Further, this initial incentive for EVs will be limited since gains from additional efficiency improvements in INOVAR-AUTO framework are quite small with only an additional 1 percent and 2 percent tax rebate.

C. INTRODUCING ENERGETIC EFFICIENCY INCENTIVES IN INOVAR-AUTO

There has been growing interest in feebate programs as an alternative for command and control-oriented emission regulations' standards. Feebate programs impose a fee (tax)⁶⁵ on vehicles emitting emissions above a certain point (pivot point), but grant a rebate to those emitting less. Thus, feebates set a price for emission units for every vehicle according to its fuel efficiency.

Feebates combine a fee (tax) for new vehicles with fuel economy below some specified *pivot point*, with rebates for vehicles with fuel economy above the pivot point. These fees/rebates could be levied/granted at either the consumer or the manufacturer level.⁶⁶ The setting of the pivot point does not change the price of each emission unit, but affects demand and supply differently due to the new vehicle prices affected by (or granted) feebate incentives. Adamou shows that a higher pivot point will

10.973, de 2 de Dezembro de 2004, D.O.U. de 02.12.2004 (Braz.); Lei No. 10.848, de 15 de Março de 2004, D.O.U. de 15.03.2004 (Braz.); Lei No. 9.991, de 24 de Julho de 2000, D.O.U. de 24.07.2000 (Braz.); Lei No. 9.074, de 7 de Julho de 1995, D.O.U. de 07.07.1995 (Braz.). See also *Inova Energy*, FINEP (Mar. 6, 2014), http://www.finep.gov.br/pagina.asp?pag=programas_inovaenergia; *Edital de Seleção Pública Conjunta ANEEL/BNDES/FINEP de Apoio à Inovação Tecnológica no Setor Elétrico* [Notice of Public Joint Selection ANEEL/BNDES /FINEP Support Technological Innovation in The Electricity Sector-INOVA Energy-01/2013], FINEP (Jan. 2013), http://download.finep.gov.br/chamadas/inova_energia/editais/Edital_INOVAENERGIA1.pdf.

65. See JOSÉ MARCOS DOMINGUES DE OLIVEIRA, *DIREITO TRIBUTÁRIO E MEIO AMBIENTE* [TAX LAW AND THE ENVIRONMENT] (Editora Forense 3rd ed. 2007).

66. See David L. Greene et al., *Feebates, Rebates and Gas-Guzzler Taxes: A Study of Incentive for Increased Fuel Economy*, 33 ENERGY POLICY 757 (2005), http://cta.ornl.gov/cta/Publications/Reports/FeebateEnergyPolicy_FINAL.pdf; see also Carolyn Fischer, *Comparing flexibility mechanisms for fuel economy standards*, 36 ENERGY POL'Y 3116 (2008), http://ac.els-cdn.com/S0301421508001729/1-s2.0-S0301421508001729-main.pdf?_tid=e65fe612-4a90-11e4-ac76-00000aacb360&acdnat=1412294872_9429a2ba5ad5fc79ee783716455ec350.

lead to less reduction in vehicle sales with less reduction in emission.⁶⁷ On the contrary, a low pivot point will result in higher emission reduction at the expenses of larger decreases in sales; therefore, the location of a pivot point sets the trade-off between environmental and economic results of feebate programs.

According to the International Council on Clean Transportation (ICCT), the three main, positive features of a feebate program are: (i) target based on vehicle emission levels rather than on corporate ones; (ii) a continuous and linear feebate rate line with a linear metric, such as CO₂ emissions or fuel efficiency, to be applied in any vehicle model; and (iii) the pivot point set to make the system self-funding and sustainable, periodically adjusted to compensate for changing conditions.⁶⁸ The ICCT also shows that the most successful cases were in France and Canada, where full feebate programs were implemented (taxes on high emitting vehicles paying for less emitting vehicle tax cuts).⁶⁹

We propose a complete revision of INOVAR-AUTO towards an efficient mechanism that will continuously benefit technologies by decreasing emission levels without creating perverse incentives to others. As for the appropriate structure of a conventional feebate program, the main suggested changes are:

- (i) vehicle-based targets rather than corporate ones;
- (ii) linear emission rate line; and
- (iii) a pivot point reduction schedule accommodating revenue-neutral results and EV logistic and infrastructure dynamics.

These changes will enable INOVAR-AUTO to promote cost-effective vehicle efficiency, ultimately leading to zero-emission vehicles, without creating perverse incentives.

VI. REGULATORY AND TAXATION PROPOSALS⁷⁰

To adapt Brazil's regulatory and tax systems to minimize the tax cost for production and consumption of EVs, Brazil should develop a series of normative measures to support domestic production of EVs. As mentioned, the INOVAR-AUTO program must undergo an overall review to adequately consider EVs.

Aside from updating the Brazilian Traffic Code to reflect this energy-based classification of EVs, all tax adjustments should be modulated to progressively benefit THELVs, PHEVs, and ELVs—keeping in mind not only the environmental friendliness of the energy source, but the emis-

67. Adamos Adamou et al., *Designing Carbon Taxation Schemes for Automobiles: A Simulation Exercise for Germany*, (Fondazione Eni Enrico Mattei, Working Paper No. 96.2011), available at <http://services.bepress.com/feem/paper647/>.

68. *Policy Update*, *supra* note 46.

69. See DOMINGUES DE OLIVEIRA, *supra* note 65.

70. As a consequence of further interdisciplinary studies conducted by the authors, this section is an improvement of an earlier essay. Domingues & Pecorelli-Peres *supra* note 1.

sion level of each category of vehicles as well.⁷¹

A. FEDERAL VAT, INOVAR-AUTO, AND SOCIAL CONTRIBUTION ADJUSTMENTS

IPI-value added tax should be reduced for an initial period of ten to fifteen years to allow for reasonable investment amortization. First, current high tax rates of 25 percent (for electric cars)⁷² and 35 percent (for electric motorcycles)⁷³ should be eliminated. Subsequently, a dual tax-basis system should be adopted to properly fulfill the ability-to-pay principle and the polluter-pays principle applied to environmental taxation,⁷⁴ following the categorization modulation device suggested above.

Also following the categorization modulation device suggested above, "PIS-COFINS (11.6 percent contributions charged on gross revenues from vehicle sales), [and] as an exception, EV taxation ought to be . . . zero[ed] or at least [rescaled up] to 3.65 percent, which is the [respective] ordinary rate"⁷⁵

As to INOVAR-AUTO, we propose transforming this federal IPI-VAT tax incentive program from a *corporate pattern* into a *product pattern* to better benefit EVs according to environmental-friendly technological criteria, thus focusing on the efficiency-emission improvements of each class of automotive vehicle as above classified.

B. INCOME TAX DEDUCTIONS FOR COMPANIES FOLLOWING A SCALE COMPATIBLE TO THE ABOVE CLASSIFICATION OF EVs

Companies taxed on *real profit*⁷⁶ should be allowed to progressively deduct from the tax amount due, up to 10 percent of the amount invested in the purchase of EVs, limited to \$20,000.00 per EV.

As an exception,⁷⁷ companies taxed on *presumed profit*⁷⁸ should be eligible for a tax credit of up to \$20,000.00 per EV purchased, which should

71. The proposals below should not be construed as tax cuts, because there is currently no EV scale production or importation into Brazil. The only exceptions are the income tax incentive proposals, which may represent a tax bonus in lieu of direct governmental subsidies or grants.

72. Decreto No. 6.006, de 28 de Dezembro de 2006, D.O.U. de 8.01.2007 (Braz.) (approving the table of IPI tax rates for electric cars).

73. *Id.*

74. See Domingues & Pecorelli-Peres, *supra* note 72, at 76.

75. Domingues & Pecorelli-Peres, *supra* note 72, at 75; *Contribuição para o PIS/PASEP e COFINS, RECEITA FEDERAL*, 390(a), (c), <http://www.receita.fazenda.gov.br/PessoJuridica/DIPJ/2004/PergResp2004/pr363a430.htm> (last visited Aug. 12, 2014).

76. *Real profit* of effective profit is the business net profit adjusted by additions, exclusions, or offsets as provided by law. See Decreto No. 3.000, de 26 de Março de 1999, D.O.U. de 26.3.1999, art. 247 (Braz.).

77. See Decreto No. 3.000, de 26 de Março de 1999, D.O.U. de 26.3.1999, art. 526 (Braz.) (disallowing tax incentive credits when the taxpayer is taxed on the basis of presumed profit).

78. As an option, a company may be taxed on its *presumed profit*, which is a percentage of gross revenues varying from 8 percent to 32 percent depending on the business area, as provided by law (for revenue limits and specific percentages, see

be set off against the tax amount due in the same year the vehicle is purchased.

Companies manufacturing EVs should be granted energy-efficiency and emission-level progressive deductions leading to an income-tax-free treatment on profits from sales of government certified EVs and respective spare parts according to their respective environmental merits.

To stimulate equipment acquisition and renovation/modernization of the EV assembling industry, a yearly progressive accelerated depreciation of up to 20 percent—limited the respective asset cost, as the above environmental/efficiency criteria are met—should be granted.

Individual consumers should enjoy environmental/efficiency-related progressive deductions⁷⁹ of up to the equivalent to \$6,250.00 from gross revenues in relation to the acquisition of EVs, motorcycles, and tricycles (limited to 20 percent of the total cost of each vehicle).

C. STATE AND MUNICIPAL TAX DEDUCTIONS FOR/RELATED TO EVs:

State VAT is due at a general rate of 18 to 19 percent, depending on the jurisdiction. Because the National Council for Tax Policy has allowed topic reductions of this rate under Article 155, Section 2(XII)(g) of the Constitution to reduce the final tax burden on basic consumption food-stuff down to 7 or 8 percent of the respective consumer price, we propose extending a similar tax reduction to EVs in a progressive way, following the above environmental/efficiency criteria.

States also charge an annual property tax on vehicles, ranging between 1.5 to 4 percent of the respective market value.⁸⁰ Some states have already exempted EVs. It is proposed that all twenty-seven states proceed accordingly; and then, as a second step, implement a dual tax-basis system to properly fulfill the ability-to-pay principle and the polluter-pays principle applied to environmental taxation, as above proposed for federal VAT.

Municipalities charge two taxes that can be *greened* in favor of EVs: (i) the annual property tax on urban real estate (i.e., 2.8 percent tax on the market value of non-residential real estate⁸¹ in Rio de Janeiro), and (ii) the service tax on the rendition of services in general (in Rio de Janeiro, rates usually range 2 to 5 percent on the service price).⁸²

Taxes ordinarily imposed on real estate include properties used for assembling plants, EV-charging stations, EV workshops, and on related ser-

Decreto No. 3.000, art. 518-19, de 26 de Março de 1999, D.O.U. de 26.3.1999 (Braz.).

79. See *id.* art. 82.

80. Juliana Mello, *Everyday taxes in Brazil: IPVA, IPTU and IPTR*, THE BRAZ. BUS. (Sept. 9, 2012), <http://thebrazilbusiness.com/article/everyday-taxes-in-brazil-ipva-ipitu-and-iptr>.

81. Lei No. 691, de 24 de dezembro de 1984, DIÁRIO OFICIAL DO RIO DE JANEIRO [D.O.E.R.J.] de 24.12.1984 (Braz.).

82. Lei No. 3.691, de 28 de novembro de 2003, D.O.E.R.J. de 28.11.2003, *as amended* by Lei No. 5.106, de 11 de novembro de 2009 D.O.E.R.J. de 21.11.2009 (Braz.).

vices rendered therein, respectively. As a common practice, municipalities have granted ten-year long property tax exemptions for strategic businesses interested in establishing in certain cities. This tax expenditure can only be legitimate in view of predicted increases of economic activity, services, jobs, and income; thus, generating future growth of tax revenues.⁸³ Thus, we propose extending exemptions for real estate involved with manufacturing and repairing EVs, as well as charging stations and workshops. Additionally, service tax exemptions ought to be granted to services surrounding the EV market, such as designing and repairing. In short, EV-related infrastructure should be de-taxed by municipalities to reflect the environmental merit of such activities.

VII. CONCLUSION

Changes in climate have drawn attention achieving a relevant position in global concerns, mainly in relation to the responsibility of countries in reducing greenhouse effect emissions as well the air quality. Thus, all THVs and THELVs, having tail pipes, produce carbon monoxide, nitrogen oxides, etc. even when they use biofuels such as ethanol.

EVs have the great advantage of not producing such emissions even when compared to hybrids such as THELVs (combining electricity with fuels), which pollute less than vehicles powered solely by fossil fuels. EVs also excel in energy efficiency, mainly in city traffic at low speeds with frequent stops and accelerations. EVs may also boost economic growth because their production is intimately connected to several industrial segments.

Even though EVs are a reality in the developed world, they are still treated as almost a fiction in Brazil, where the respective implementation is hampered by regulatory and tax legislations that do not properly value them, and even put fuel-powered vehicles in relative advantage. In an emerging country like Brazil, aiming at exercising market leadership, hampering the insertion of EVs in the domestic productive chain is, to say the least, inconsistent with the present economic-environmental situation and national aspirations to an autonomous, efficient, and sustainable development. If EV technology is a new alternative against dependence on fossil fuels, then public policies, especially regulatory and tax policies, ought to meet the public interest as adequate tools for changing such reality by inducing sustainability through the inclusion of EVs in mobility.⁸⁴

Notwithstanding its research and development investment possibility, the INOVAR-AUTO program, even in its new version (May 2013), seems cautious in dealing with energy efficiency and environmental pro-

83. See JOSÉ MARCOS DOMINGUES, *DIREITO TRIBUTÁRIO: CAPACIDADE CONTRIBUTIVA: CONTEÚDO E EFICÁCIA DO PRINCÍPIO* [Tax Law: Ability to Pay: Content and Effectiveness of the Principle] 120 (Renovar, 2nd ed. 1998).

84. José Marcos Domingues, *A vez do veículo elétrico no Brasil*, MONITOR MERCANTIL (Sept. 8, 2011, 9:44 PM), <http://www.monitormercantil.com.br/index.php?pagina=Noticias&Noticia=99109>.

tection, but derails EVs, which are more efficient than conventional fuel combustion-powered vehicles.⁸⁵

Let Brazil devote itself to EV technology supported by adequate tax treatment with the same determination that led to the development of ethanol automotive technology. The INOVAR-AUTO program may be improved through a more rational use of the feebate system taking into account the above proposed EV categorization.

These proposed improvements to INOVAR-AUTO should inspire states and municipalities in conceiving fiscal incentives that take into account the source of the energy employed for powering transport vehicles and the financing of infrastructure (real estate and services) required to support EV introduction in the market.

85. See *Sobre Veículos Elétricos [About Electric Vehicles]*, INSTITUTO NACIONAL DE EFICIÊNCIA ENERGÉTICA, http://www.inee.org.br/veh_sobre.asp?Cat=veh (last visited Aug. 12, 2014).

Comment

