



The "Inovar Auto" Program and its impacts on Electro Mobility in Brazil

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Resumo /Resumen

Our paper intends to detail and to discuss the Inovar Auto initiative, highlighting its weaknesses and strengths, specifically analyzing if and how the development of technologies associated to the electric vehicles would effectively be fostered by this program. As the empirical foundation for this study, a set of interviews and prospective studies were conducted by the authors with experts from both the industry and from the local academy, government representatives as well as with consultants and entrepreneurs who have alternative views regarding the future of the Brazilian automotive industry.

1. INTRODUCTION

Electric cars, be they purely electrical, hybrid or fuel cell, are no longer a dream. Although there is no actual market for them yet, media and political attention to this matter can be observed all over the world, Brazil included. They can be considered a real alternative to internal combustion engines, at least for urban passenger cars, in a scenario of more restrictive gas emissions legislation and oil supply uncertainties.

Many governments, such as Europe, USA, Japan and China are creating regulations and market incentives to enable it (Oltra and Saint Jean, 2009; Jullien, 2007). As a matter of fact, one can say that automotive technology is currently undergoing "technological ferment", as defined by Tushman and Anderson (1986). The search for a better engine (environmentally, technically and economically feasible) will result in a prolonged period, perhaps decades of technological uncertainty, experimentation and the co-existence of multiple options. (Geels, 2004). So far, there has been no sign that any of the alternatives under consideration (such as purely electric, hybrid or better IC engines) would prevail as a dominant design. Hence, the industry would probably have to deal with the possibility that there would no longer be a unique dominant design. Different countries or world regions will see different local designs surviving and/or prospering (Freysenet, 2009; Anderson and Tushman, 1990; Suarez and Utterback, 1995).

In the quest for environmental and economic sustainable energy sources for mobility, Brazil has the only commercial and technical successful case regarding the use of alternative fuels for internal combustion engines: sugar cane ethanol. Since the 1970s, a complete value chain to produce, distribute and use sugar cane ethanol as an automotive fuel has been developed, showing that it is possible to artificially build a market with institutional support that is sustainable, competitive and profitable.

Yet if Brazil wants to be a market in which an important part of the automotive industry game is played in the future – not only producing, but also developing products that can be sold worldwide –, it is mandatory to develop competencies in electric-powered passenger cars. Doing so the country may avoid being locked in, as Arthur (1989) defines, by a single technological strategy, such as the ethanol powered internal combustion engine, or even as in the case of internal combustion (IC) engines that may lead to a lack of strategic investment interest of decision centers located outside Brazil.

The Brazilian government has not yet decided what kind of incentives would be granted to the electric car industry. One of the issues the electrical mobility places in the strategic map of the industry is the possibility of other players, who dominate electricity

applications, entering the market, in association with new capitalists. The automotive industry located in Brazil has not yet developed competencies in this field locally, and there is concern about Brazil becoming a mere importer in this segment, missing an opportunity to consolidate its position as a relevant global developer and producer in the automotive supply chain.

In the mid-2012, the Brazilian government established the bases of a new industrial policy for the automotive sector, for the 2013-2017 period - *Inovar-Auto*, Portuguese Acronym for Program for Fostering Technological Innovation and Densification of the Automotive Productive Chain - aiming to improve competitiveness for the sector, by encouraging companies to locally develop and to produce more economic and safer vehicles.

Our paper intends to detail and to discuss the *Inovar Auto* initiative, highlighting its weaknesses and strengths, specifically analyzing if and how the development of technologies associated to the electric vehicles would effectively be fostered by this program.

As the empirical foundation for this study, a set of interviews and prospective studies will be used, and are already being conducted by the authors with experts from both the industry and from the local academy, government representatives as well as with consultants and entrepreneurs who have alternative views regarding the future of the Brazilian automotive industry.

2. THE INOVAR AUTO PROGRAM: STRENGTHS AND WEAKNESSES:

The main aspect of the Inovar Auto program is granting an up to thirty percent discount in IPI (tax on industrialized products) to automotive vehicles produced and/or sold in Brazil, and qualified to the program. As far as 2012, the current automotive regime already provided an up to 30% IPI discount for organizations presenting the following requirements (Ibusuki et al. 2012):

- 65% regional content (production carried out in Brazil or in countries with which Brazil had specific agreements for this); 0.5% of the total Gross Revenue applied to research, development and innovation activities; and
- 6 out of 11 industrial activities conducted in the country in at least 80% of the total production.

From 2013 to 2017, for keeping the 30% IPI reduction, the number of requirements increased. However, the possibility emerged for corporations that do not yet have plants in Brazil to be granted at least part of these benefits, provided they prove their disposition or

decision to invest in production in Brazil. Corporations that do not yet have local production, such as Audi, BMW and the Chinese Chery, for example, have already adhered to the program.

As from 2013, to be qualified by the Inovar Auto program, corporations producing commercial or personal use vehicles, will have to meet energy efficiency goals with their vehicles. Also, no exceptions allowed, they will have to ensure a minimum percentile of local contents in the vehicles produced in Brazil (65%). Moreover, they will have to meet minimum annual goals (and with growing requirements until 2017), two out of the three goals are as follows:

- Conducting research and development in the country (for 2013, the minimum will be 15% of the revenues, a number smaller than the previous regime, as investments in RD&I have more accurately and correctly been defined; for 2017, the minimum will be 0.5% of the Corporation revenue);
 - Providing for expenditures in engineering, basic industrial technology and suppliers capacity building (from 0.5% in 2013 to 1% in 2017);
- Adhering to the vehicle labeling program (which informs fuel consumption and CO2 emission in g/km run); for 2013, at least 36% of the vehicles sold must be labeled and, for 2017, 100%.

The aim is to increase competitiveness and added value all along the productive chain, both in engineering and in the production conducted locally, at the same time as seeking to modernize the products traded in Brazil, matching them to those in central countries. Regarding energy efficiency, the aim is to match the power consumption of the vehicles produced in Brazil to those in other regions in the world, making the engines manufactured and sold in the country incorporate more technology and innovation, as already occurs in central countries. A study conducted by an international consulting firm (IHS)¹ shows that most of the cars manufactured in Brazil have engines that are technologically behind those sold in Europe, Japan and the USA. Innovations made in terms of engines, aiming at increasing energy efficiency, have not been introduced in the vehicles produced in Brazil because there is no legislation requiring it and for the consumer market failing to demand it. *Inovar Auto* provides that vehicles must run, on average, 17.25 km/l when fueled with gasoline and at least 11.96 km/l with ethanol. This average is what Europe is going to propose for cars to be sold in the Euro region in 2016. Hence, in 2017, Brazil will be only one year behind the European legislation as regards energy efficiency.

The current scenario allows verifying that no Brazilian car meets such level of consumption and energy efficiency; the average gasoline and ethanol consumption is 14 km/l and 9.71 km/l, respectively². To reach the goals proposed for 2017 onwards, vehicles will have to consume, on average, 12% less than they currently do. This aspect opens the possibility to foster electric vehicles, especially hybrid ones, which, for their larger dissemination, will not exclude other types of incentive (not yet put into practice) or pre requirements, as already discussed. There is still an indirect stimulus to the electric or hybrid car, which may result from an additional 2% IPI reduction in case the average consumption of the fleet is smaller than its goal in 2017.

Inovar Auto is thus an initiative the main merits of which are those of incorporating fuel consumption goals (as the major innovation inducer), improving what actually has to be considered as RD&I expenditures for incentive ends, stimulating TIB (Basic Industrial Technology) and suppliers capacity building as the assemblers counterpart, besides incorporating in the list of applicants to enjoy the benefits those corporations that intend to settle in the country but have not so far (provided that investment intentions are duly evidenced). Furthermore, the requirement as to the local content will be better followed and audited. The company that does not comply with the regulations in force concerning this item will be punished.

In turn, electric and hybrid cars have not yet received specific attention on the part of the government as regards incentive to use. If, on the one hand, concerning Emissions, these cars have to meet one of the important requirements of Inovar Auto, as the focus of the program is, above all, the corporation and the totality of its products; the program causes practically no impact on the electric and hybrid cars, given the small numerical impact these vehicles will mean for calculating the added values stipulated by the government. It is also worth stressing that, in the case of imported vehicles, there is an additional 35% IPI that is also charged on the electric vehicles traded in Brazil. Assemblers such as Toyota and Nissan, as reported, have offered the possibility of producing these cars in Brazil; for this, however, they ask for additional subsidies and incentives to purchasers, something that has not yet been included in the government agenda.

¹See:<http://www.automotivebusiness.com.br/noticia/13272/Governo%20prepara%20aperto%20em%20>

ex igências%20de%20eficiência%20energética

Yet, very recently the Brazilian government started to signal that it will consider the electric vehicle issue, establishing a work group connected to the MDIC as well as hiring some studies to identify key technologies for this transportation mode viewing to elaborate industrial and incentive policy initiatives. These studies are still in their initial stage and only in the coming months or years will there be something more concrete in that direction. Until then, we are left with the alternative to import a very small number of units from traditional assemblers that will make these units a channel for marketing their products and the also remote possibility that a Brazilian or mostly Brazilian capital assembler is established for that purpose.

3. ELECTRIC AND HYBRID VEHICLES IN BRAZIL: CURRENT STAGE AND PERSPECTIVES

Only in 2012 did the first hybrid/electric cars start to run in Brazil, some aiming at dissemination and, in other cases, a result of introducing a symbolic number of taxis, as from incentive programs coordinated by municipal governments, such as that of São Paulo. Toyota and Ford, for example, trade hybrid models in Brazil, but due to taxes, the price reaches about US\$ 60,000 (in the USA the price is around 25.000), which makes its large-scale trade unfeasible.

In the urban transportation area, there are older initiatives, timid, though, as compared to those occurring in other countries. This is an area in which there would be greater potential for developing and producing national vehicles. Two hydrogen bus prototypes are under development in Brazil. One of the projects is being developed by the Metropolitan Company of Urban Transport of Sao Paulo (EMTU-SP), in a partnership with the Ministry of Mines and Energy by means of a consortium involving AES Eletropaulo, Ballard Power Systems, Epri, Hydrogenics, Marcopolo, Nucellsys, Petrobras Distribuidora and Tuttotransporti. The project is estimated in US\$ 16 million and also counts on the support from the United Nations Development Program (UNDP) and from the Global Environment Facility (GEF). The final cost of a new bus in industrial production is expected to be intermediary between the electric and the diesel ones. Anyway, except for some outstanding initiatives as the ones above, the electric vehicle scenario in all its variants makes clear that Brazil is far behind central countries besides China and Korea, for example,

be it regarding technological development, be it in the number and relative importance the electric vehicle fleet represents to the country. This scenario must be kept for the coming years, which may be justified by the data from a research recently conducted by the authors of this paper, the results of which can be found in the next section.

4. LOCAL COMPETENCIES IN HYBRID/ELECTRIC VEHICLES

In order to map and prospect what kind of competencies are being developed concerning electric mobility in Brazil, data on patent applications in Brazil from

2002 to 2011 were researched in the WIPO (World Intellectual Property Organization) database, using the Patentscope search engine. We searched for all the patents granted in Brazil, regarding electric vehicles core technologies, and within the results, for patents whose applicants were Brazilian residents. The results, shown in Table 1 and Figure 4, indicate that a total of 1.889 patents were granted in the period 2002-2011 in Brazil, although only 30 (or 1.6% of the total) were invented there, which means that 98.4% were invented in other countries and granted in Brazil.

As a comparison, in overall patenting activity in Brazil, Oliveira Souza (2011) found that an average of 75.6% of patents granted in Brazil were invented abroad in the last 30 years. The data show that global companies intend to sell or even produce in Brazil, since they are asking for patents there, but there is actually little, almost inexistent, local technology development. Out of the patents invented in Brazil, all of them were developed by universities, research institutes or companies that do not belong to the traditional automotive sector.

Year	Granted in Brazil (by IPC Code)						Invented in Brazil (by IPC Code)					
	B60 K	B60 L	B60 M	B60 W	H01 M	Total	B60 K	B60 L	B60 M	B60 W	H01 M	Total
2002	116	14	1	36	115	282						0
2003	80	10	3	30	73	196	1				2	3
2004	11	27	5	25	136	204						0
2005	99	15	1	15	113	243						0
2006	45	12	2	12	103	174	1					1
2007	68	15	1	10	99	193					4	4
2008	69	7	1	15	72	164	1				4	5
2009	33	6	4	5	44	92	3				1	4
2010	37	7		2	24	70	2	1			4	7
2011	100	31	4	26	110	271	3	2			1	6
	658	144	22	176	889	1889	11	3	0	0	16	30

Table 1 - Patents granted and Patents Invented in Brazil regarding electric mobility, from 2002 - 2011

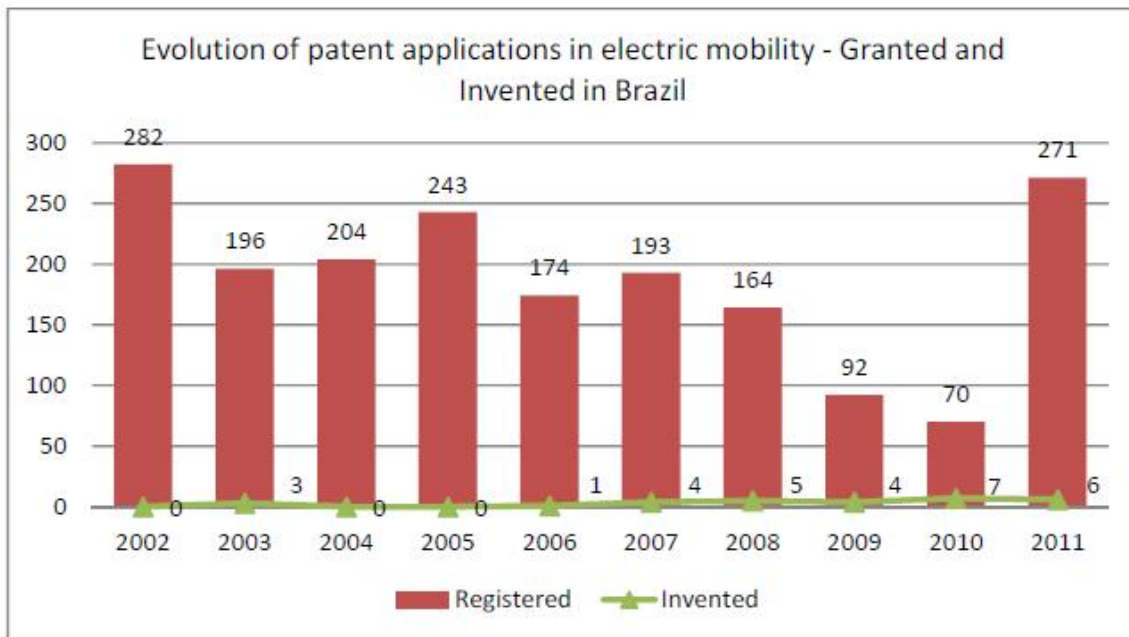


Figure 1 - Evolution of Patents granted and Patents invented in Brazil regarding electric mobility, from 2002 - 2011

The authors also conducted 11 interviews, with:

1. Director of LACTEC, a research institute linked to the State of Paraná government;
2. Project manager of an EV project conducted by CPFL, a local electric power utility. This project is also supported by a traditional automaker that operates in Brazil (Fiat).
3. Manager of a start-up company that develops and produces lithium batteries and fuel cells.
4. Managers of two start-up companies that are developing small urban electric vehicles.
5. Project manager of Magnet Marelli Brazil, in charge of a group of project and other initiatives related to the effort of developing firm competencies in EV.
6. Representative from the Federal Government Innovation Funding Agency (FINEP)
7. President and Director of ABVE (Brazilian Electric Vehicle Association), a nongovernmental association created to promote the use of electric vehicles in Brazil
8. Professor from the University of São Paulo, Mechanical Engineering Department, that studies electric vehicle development
9. Engineering Manager from Weg, a Brazilian traditional electric engine producer and developer
10. Researcher and consultant who specializes in the power industry; this interview was

conducted to obtain a better understanding of the electric sector in Brazil.

The authors also participated in a meeting organized by the Industrial Federation of a Brazilian state, aiming to bring together entrepreneurs and traditional players of the automotive sector and to discuss actions to enhance the development of competencies in Brazil. At this meeting, it was possible to informally interview many actors and to collect more impressions from people who are involved with EV initiatives. The main conclusions that arose from the interviews were the following:

- Various specific competencies are spread across the country. Initiatives for investing in different areas (batteries, embarked control systems, electric engines, etc.) are not integrated. The initiatives depend on individual interest, and there is a lack of a strong integrator or an actor that can align efforts more effectively to create local EV projects, including the design and/or production of a complete EV.
- In some cases, niche market products could be developed with a group of companies and institutions with different competencies acting and working together. This may be the most probable outcome (low-volume niche products) if no important entrepreneur takes the initiative to integrate a major program to develop and/or produce EVs in the country.
- There seems to be no public interest in investing more heavily in the development of technologies for EVs. According to the interviewees, this lack of interest is the result of the strong influence that the major auto assemblers and Petrobras, the powerful Brazilian public energy company, play in the auto industry.
- Auto assemblers and traditional auto-parts suppliers do not seem to be interested in having local EV development and production; some of them are making investments in their headquarter design center. A possible exception is Fiat, which supports an EV project developed with electric companies.
- Petrobras also does not seem to be very interested in EVs, despite some small initiatives. Almost all of its investments are focused on petrol gas, ethanol or biofuels.
- On the other hand, in 2011, the Brazilian government created a fund for granting resources to product development projects for EV. After 6 months, no project was presented for funding, indicating the low level of local development and the poor coordination of the actors so far involved in the sector.
- Ethanol flex-fuel engines are very similar to the traditional gasoline ones. Actually, the ethanol-powered engine is the same as the one that uses gasoline, with minor changes. Therefore, it has been completely incorporated by local assemblers and by Petrobras. In fact,

investing in ethanol represents, in one way or another, the reassertion of the main gasoline fuel engines because they work together. Ethanol is, of course, a renewable resource, and because it emits less CO₂ in "well to wheel" terms, it represents a substantial difference when compared with gasoline. However, EVs could emit much less CO₂ as compared with ethanol engines, considering the fact that, in Brazil, electric power is generated mainly by its hydrographic resources.

- There is still no significant societal concern about emission and pollution levels related to the use of vehicles in Brazil, and the electric solution for automobiles is still more expensive than traditional internal combustion engines. These two factors mean that the market for electric vehicles is not very attractive for investments, at least in the short term for the major players in the sector.

- The country would most likely not exhaust its oil resources in 30 to 50 years, given that huge oil reserves have been recently discovered. Thus, the interplay of the presence of petrol resources, the availability of ethanol, the lack of interest from the market and the political interest of Petrobras and the main automakers and traditional auto-parts producers might explain the absence of a more integrated set of initiatives (both public and private) toward an investment in EVs design and production in the country. The analyses performed by the authors so far also point to the importance of the role played by the government in the dissemination of technologies associated to the electric vehicle. Governments of countries such as France, China, Japan and the USA have subsidized the purchase of vehicles, have aided in fostering research by companies and the academy and also play a relevant role in the coordination of the legal stringency that eventually stimulates the adoption of cleaner technologies, as is the example of the electric car and its variations.

4. CONCLUSIONS

The Brazilian automotive industry evolved along the past 60 years through four clearly defined steps (HUMPHREY et al., 1998; ZILBOVICIUS et al., 2002):

- 1) Importation of cars, no local assembly, supply chain and development;
- 2) Local assembly of cars from 4 large major players supplied by local auto part makers and no local development, restricted importations;
- 3) Local assembly of cars by all major global players supplied by global auto parts makers, pushed by liberalization and foreign investment incentive policies, resulting in the participation of local engineering in some global projects, importation of cars from

specific segments (luxury and newcomers);

4) Same as above, but with rapid increase in the number of factories locally installed (manufacturers aiming at locally producing models that were so far imported, e.g. Toyota, Hyundai or newcomers, e.g. Chinese makers JAC, Chery). In fact, undergoing these steps has been related to market importance and attractiveness, government influence through regulations and the development of the 'global' strategy of the main manufacturers. For the purpose of this perspective, considering the worldwide move towards car electrification, we will adopt four possible alternatives for the Brazilian scenario based on the history of the local auto industry:

1. Brazil will remain an importer of electric cars
2. Brazil will locally assemble electric cars receiving 'technology' from the decision centers of each manufacturer
3. Brazil will locally assemble electric cars with the participation of local engineering and supply chain in the development of these cars. Brazil will develop a local industry supported by local capital and players from other segments (e.g. electricity).

As we already showed, Brazil has not fully developed competencies in the traditional automotive sector (automakers and autoparts suppliers) or even in new players such as universities, research institutes or start-up companies.

If the government were to enable the development of electric vehicle technologies in Brazil, there should be an environment conducting to such development. This environment is the outcome of public policies, the socio-cultural environment, user and market sensitization, and the alignment of science and technological regimes. In this context, state regulations are necessary to create market and economic conditions to overcome the local automotive industry innovative inertia (Orsatto and Clegg, 1999; Geels, 2004).

The Inovar Auto initiative is clear in the sense of improving the incentives enforced until then for increasing the capacity building of local assemblers and autoparts manufacturers, so as to root design activities, strengthening local research and development and, mainly, focusing such initiatives on the quest towards having a more modern fleet, less aggressive to the environment, driver of the most important and necessary incorporations and improvements in new automotive technologies. However, there is no explicit mention, or any type of incentive to the use of hybrid and/or electric motoring.

The issue posed is if there is a precedence relation, that is, if it is first necessary to modernize and to consolidate a conventional vehicle fleet more aligned to what there is

in central countries and only then thinking of the issue of new motoring (including the electric one), or if it makes sense to incorporate incentives immediately so that these technologies can more and more turn into a real alternative for consumers, once they are aligned with the most advanced and modern existing in those countries. In this scenario, Brazil runs the risk of not developing competencies in electric vehicles, being "stuck" to an already mature and potentially obsolete technology, as occurs with the internal combustion engine one. There are some movements in course towards the development of electric mobility in the country, but as results show, they lack the coordination of a strong entrepreneur and support from public policies and higher investments in this field. The country could take advantage of this window of opportunity to develop local competencies or even establish a local player in the sector. It became clear that this could occur through the development of local electric mobility. Thus, unlikely to happen in short terms and in a "leapfrogging" strategy, an evolutive approach from "locked-in" (or importer) to "local producer" and "co-developer", could be the best way of inserting the country in future global markets. Yet this depends on public policies and regulations to enhance market, competencies and infrastructure to develop it.

As indicated by the study on local research and development in the field of electric cars, the most plausible possibility at the moment would be to start the local production as from the import of parts and local assembly of cars in Brazil, seeing that there are not yet enough local competencies to start a truly local industry. The same strategy was used in the beginning of the automotive industry, in the 1950s. As in a large share of the world, government attention and stimulus to the development of technologies and products in the field of electric mobility seem to make sense for the country to be once more dependent on imported technology which, in turn, for not being "dominated" yet, opens promising possibilities for a country that besides counting on a large market, also counts on competencies relatively well established and under development in the conventional engine field.

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