International Conference on Renewable Energies and Power Quality (ICREPQ'15)
La Coruña (Spain), 25th to 27th March, 2015
Renewable Energy and Power Quality Journal (RE&PQJ)
ISSN 2172-038 X, No.13, April 2015

BRAZILIAN AUTOMOTIVE MARKET AND ENVIRONMENT: AN ANALYSIS OF FIGHTING MEASURES CO^2 EMISSION

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ABSTRACT
The consumption of fossil fuel derived oil has a significant impact on the quality of the environment. Air pollution, climate change, oil spills and toxic waste generation are the result of the use and production of these fuels. Automotive vehicles are among the main contributors to the problem. In Brazil, to combat this environmental pollution, public policy has been implemented to increase the efficiency of vehicles and diversify the use of alternatives to fossil fuels (ethanol and biodiesel) sources. This study proposes to examine measures to combat the emission of carbon dioxide (CO^2) adopted by Brazil dioxide.

KEYWORDS: CO^2 emissions, the automotive market, Brazil.

1. INTRODUCTION

Increasingly, the issue of vehicles relating to the preservation of the environment, among other reasons for the reduction of CO^2 emissions is discussed. In recent years, this is increasing concern related to climate change, where studies indicate that energy balance has suffered interference and increase in the emission of greenhouse gases (GHG) as well as solar radiation. This increase is a result of increased use of fossil fuels and land, which increase the level of carbon dioxide (CO^2) in addition to increased emissions of methane (CH^4) and nitrous oxide (N^2O) generated mostly by transport and agriculture and livestock (GONÇALVES, 2012).
Changes in the ecosystem have resulted global warming, which triggers other problems, such as reduction of the polar ice caps, rising sea levels, increasing the greenhouse effect and other environmental distortions as intense droughts and torrential rains. It is necessary to disseminate policies aimed at improving energy efficiency and emissions of gases that contribute to global warming (IPCC, 2007).
In 1997, the Kyoto Protocol, which is an international agreement between countries that are part of the United Nations with the goal of reducing greenhouse gas emissions, creating guidelines to mitigate the environmental impact was signed. Thus the rich countries have pledged to reduce for the period 2008-2012 gas emissions by 5.2% compared to 1990, with the main goal to reduce CO^2 emissions. This Protocol entered into force only in February 2005, after the ratification of Russia, and their goals should have been struck between the years 2008 and 2012 (ONU, 2013).
The burning of fuels for mobile sources aggravates the problem of air pollution in almost all major cities and represents a serious environmental problem, especially when it comes to developing countries. This pollution is caused by different factors, but the vehicles, are among the main contributors to the problem, because they generate pollution and contaminate the environment. Currently, cars are responsible for 70% of all pollution generated in large cities such as Rio de Janeiro, Sao Paulo, Los Angeles, Mexico City, among others (MAYER, 1999).
In Brazil, there are public policies that aim to increase the efficiency of vehicles, both new and second-hand, and diversify the energy matrix by the use of alternatives to fossil fuels (ethanol and biodiesel) sources. There is also innovation of technologies by automakers to develop hybrid and electric-powered vehicles, which mix electricity with other fuel, but all are battery-powered, fuel cell (hydrogen) or batteries (lead-acid or lithium) (RIBEIRO and REAL, 2006; RIBEIRO and ABREU, 2008; SILVA, 2011).
Given this context, this study has the objective to analyze the proposed measures to tackle emissions of carbon dioxide (CO^2) adopted by Brazil dioxide.

The methodology consists of an exploratory literature search done through books, articles and theses, covering the Brazilian automobile market, electric vehicles and environmental pollution.
Economic, technological, sociocultural and environmental transformations which society is passing seem to indicate a change in the role of vehicles, are considered guilty with regard to the emission of carbon dioxide (CO^2) due to social, environmental and economic impacts caused.

2. LITERATURE REVIEW

2.1 Brazilian Automotive Market

The first model of motor vehicle to arrive in Brazil were a Peugeot model from France in the early 1900s brought by Alberto Santos Dumont purchased for 1,200 francs (PORTAL, 2014; INVESTE, 2012). From then ran an evolution in the Brazilian automotive industry that places it among the largest producers of vehicles in the world. Automobile manufacturers in the country are responsible for the production of cars, light commercial vehicles, trucks and buses, most of these companies produce more than one product category, with the exception of Honda, Hunday and Toyota, who make only cars that DAF makes only trucks and Mitsubishi Mahhindra and only making light commercial vehicles (ANFAVEA, 2014a). Table 1 shows the fleet of vehicles in selected countries:

Table 1 – Automobile fleet - 2012

Nº	*COUNTRY*	2012
1	United States	251.497
2	China	109.220
3	Japan	76.126
4	Germany	46.538
5	Russia	45.385
6	Italy	42.000
7	France	38.138
8	**BRAZIL**	**37.271**
9	United Kingdom	35.761
10	Mexico	33.416

Source: ANFAVEA (2014a, p. 144).

Table 1 shows the size of the car fleet of the leading countries in the order of magnitude. The United States with 251.497 units has approximately 30% of the automobile fleet from 10 countries selected in that table, followed by China with an automotive fleet of 109 220 units. Following in third place comes Japan with a fleet of 76 126 units, followed by Germany in fourth place with a fleet of 46 538 units. The Brazil ranks eighth among countries with the largest automobile fleet in the world with 37.271 units.
Regardless of population size, economic and technological development and to produce in domestic automotive vehicles, discrepancies in terms of fleet size places Brazil in a prominent position among the nations with the largest automobile fleet. A relevant question with respect to the production of new automotive vehicles is related to the distribution of the countries with the largest fleet. Thus the data in Table 2 shows the licensing of new vehicles in 2013.

Table 2 – Licensing of new vehicles - 2013

Nº	*COUNTRY*	2013
1	China *	21.984
2	United States *	15.884
3	Japan	5.376
4	**BRAZIL**	**3.767**
5	Germany	3.258
6	India	3.241
7	Russia	2.950
8	United Kingdom	2.596
9	France	2.201
10	Canada *	1.780

The data of this table comprise sales or registration of nationally manufactured and imported vehicles. (*) *The data refer to domestic sales*
Source: ANFAVEA (2014a, p. 144).

The table information 2 demonstrate that significant changes in the new vehicle licensing in 2013, especially for the Chinese market with 21,984 different vehicles licensed in 2013 licensing, followed by the US with 15,884 new licenses. Japan and the other countries shown in Table 2 with the exception of India and Brazil have new licenses compatible with the size of the national fleet of these countries shown in Table 1. The highlight is the license number of new vehicles in China, in which expansion occurred in a rhythm higher than the rate occurred in the United States, which leads to the inference that the Chinese auto market is growing at a rate higher than the US. The India presents growth of the automotive market with new licenses and growth potential of its fleet because of the size of the Indian population and economic growth itself that country, it will increase the fleet size as shown in Table 1. In Brazil the licensing of 3,767 new units in 2013 supports to increase the size of the fleet of various automotive vehicles with consequent problems caused from this expansion among which stands out the bottling urban roads, increasing environmental pollution, noise, waste, energy use derived from oil among others.
Regarding the situation in Latin America production and marketing of automotive vehicles has grown exponentially in recent years. Brazil represents more than 60% of total existing automotive vehicles this part of the US (Table 3) continent.

Table 3 – Automotive Data from Latin America (2012 – 2013)

COUNTRY	***Production*** Unidades/*units*		***Domestic sales*** Unidades/*units*	
	2012	**2013**	**2012**	**2013**
Argentina	764.495	791.007	830.058	963.917
Bolivia	-	-	21.000	21.300
BRAZIL *	**3.402.508**	**3.712.380**	**3.802.071**	**3.767.370**
Chile	-	-	362.331	397.643
Colombia	149.931	120.245	315.980	293.846
Ecuador	81.398	66.906	104.377	113.812
Paraguay	-	-	31.602	31.120
Peru	-	-	190.761	201.326
Uruguay	-	-	56.459	60.897
Venezuela	104.083	71.753	130.553	98.878
Mexico	3.001.814	3.052.395	1.026.308	1.102.437
Total	**7.504.229**	**7.814.686**	**6.871.500**	**7.052.546**

Source: ANFAVEA (2014a, p. 147).

The production and marketing of automotive vehicles in Latin America plus Mexico provides an overview of the market in each country separately. Again the focus is for the Brazilian market as regards the production of vehicles followed by the Argentine market, Colombian, Venezuelan and Ecuadorian finally by merchant

producers. Other countries (Bolivia, Chile, Paraguay, Peru and Uruguay) did not produce vehicles in their territories.
Regarding the number of people per vehicle, are noteworthy Argentina and Mexico both countries with 3.6 inhabitants / vehicle, followed by Uruguay with 4.6 inhabitants / vehicle, Chile with 4.7 inhabitants / vehicles and Brazil with 5, 3 people / vehicle. Other countries in the region are rate ranging from 7.9 to 20 inhabitants per vehicle. The Brazil, Argentina, Colombia, Ecuador, Venezuela and Mexico are the countries that have domestic production, other import vehicles.
In 2013, in Brazil, the cars represent 72.88% of the automobile market (2,723,411 units), the remainder is distributed as follows: light vehicles with 20.85% (779 049 units), trucks with 5.08% (189 979 units) and buses with 1.18% (44 190 units). In the last decade (2003-2013), the production of vehicles has been increasing, especially in the light commercial segment which grew by 359%, the truck has increased 240.60% and 180.9% of cars (ANFAVEA, 2014a). These data show the importance of the automotive sector for the whole of Brazilian industry.
With respect to fuels used by different types of vehicles in Brazil matrix is the dominant fuel of fossil origin. Unlike most countries that use this type of energy source, Brazil from the first oil crisis in 1973 developed fuel Ethanol Ethanol derived from sugarcane. Subsequently improved this model and now also uses biodiesel as an alternative to fossil diesel source.
Since the mid-1990s the production of vehicles in the country now has the Flex engine, which uses two types of fuel if the ethanol and gasoline. This fact is important from the standpoint of pollution caused by the emission of CO^2, because the Flex fleet of cars (which use gasoline and ethanol) has increased since then contributing to the reduction of greenhouse gases in the atmosphere.
The energy matrix used in the national fleet of diverse vehicles has contributed to reducing the emission of pollutants. The challenge as can be seen in Table 4 is to replace the use of diesel as a power source used in trucks, buses and light commercial, which generate greenhouse gas emissions.

Table 4 – Licensing of Vehicles by Fuel -2013

Vehicles	Gasoline (Units)	Ethanol (Units)	Flex fuel (Units)	Electric (Units)	Diesel (Units)	Total
Cars	106.263	0	2.656.971	484	0	2.763.718
Light Comm.	82.853	0	512.143	7	221182	816.185
Trucks	0	0	0	0	154549	154.549
Buses	0	0	0	0	32918	32.918

Source: ANFAVEA (2014a, p. 67).

In the case of buses and trucks domestic production is 100% with diesel engines. In the case of buses, between 1959-1981 there was a choice of petrol engines from 1981 to 1984 and had the option of ethanol engine. Regarding trucks, between 1957-2000 there was a choice of petrol and between 1979-1995 the engine option ethanol (ANFAVEA, 2014a).
For vehicles, currently 96.13% of the fleet is powered by flex (gas / ethanol) engines are moved only 3.85% and 0.02% for petrol is powered by electric motors. The only ethanol-powered engines were used from 1979 to 2011, the diesel engines were used from 1990-1994, and electric motors began to be used only in 2012 (ANFAVEA, 2014a).
Regarding light commercial, 62.75% of the fleet is powered by flex (gas / ethanol) engines, diesel 27.10%, 10.15% and the gasoline only 7 used vehicles electric motor. The only ethanol-powered engines were used between 1979-2011 and electric motors began to be used only in 2012 (ANFAVEA, 2014a).
A ANFAVEA presented to the Brazilian Federal Government a proposal for the creation of a program that encourages the development of new engines for automobiles, light and heavy vehicles, it is a set of measures, with gradual implementation steps, in order to make commercially feasible the adoption of new propulsion technologies in the Brazilian market, enabling local production. The scenario is favorable because there is already interest of society by models with new engine options. In 2013, for example, 491 electric vehicles were registered, compared with 117 in 2012. In the segment flex fuel technology developed by the automotive industry in Brazil, the market share is almost total: 88.5% of graduates were flex motor vehicles, which proves the consolidation of innovative powertrain in consumer taste (ANFAVEA, 2014a).
In the proposed ANFAVEA were suggested six classifications of propulsion technologies for cars and light trucks: mild hybrid, full hybrid, plug-in hybrid, electric extended-range, full electric and fuel cell. In the heavy vehicle segment, which includes trucks and buses are eight classifications involving all known fuels today: biodiesel, biogas, ethanol, diesel from sugar cane, electricity, hydrogen, diesel and gas (ANFAVEA, 2014a).
In Brazil, the federal government owns the design of the National Program for Renewal of fleet trucks, this project was developed with the participation of the main connected to road freight transport (National Confederation of Transport-CNT, the National Federation of Automotive Vehicle Distribution agents - FENABRAVE, Brazil Steel Institute, National Institute of Enterprises of Scrap Iron and Steel-INESFA, NTC & Logistics, National Association of Cargo Transportation and Logistics, Interstate Association of Railroad Equipment and Materials and Road-SIMEFRE Industry, Company Union Scrap Iron and Steel-SINDINESFA, National Union of Vehicle Components for Automotive Industry-SINDIPEÇAS, United Steelworkers of -SMABC ABC and the National Association of Automobile Manufacturers. - ANFAVEA the initial focus of the project is to modernize fleet trucks, with direct impacts on mobility, reducing congestion caused by accidents or mechanical failures, and reducing accidents, which in 2012 generated only costs £ 4.9 billion to the INSS and SUS (ANFAVEA, 2014b).
Automotive electric vehicles are cars, light commercial vehicles, trucks and buses represent an important contribution to the fight against air pollution. Although this technology has existed since the late nineteenth century, when the Belgian Gaston Planté in 1859 demonstrated the use of the first battery, made of lead and acid (HOYER, 2008), it was not until the late 1960s environmental concerns gain momentum and put on the agenda the issue of sustainable development.

In this context that the electric car emerges as an important alternative to fossil fuels. In Brazil the use of the electric car is only 0.02% of the total number of vehicles produced. With a highly diversified energy mix at the national vehicle fleet uses little electric cars as an alternative to fossil fuels (SANTOS, FRANCISCHETTI and GOMES, 2013).

Brazil has gone through an intense process of technological innovation in the automotive sector from the early 1990s era that trade liberalization occurred in the Collor government. Until then the importation of vehicles was very restricted or even prohibited. With imports of several vehicles from trade liberalization and the establishment of new factories in the country of cars, trucks and light vehicles an intense process of technological innovation in this sector occurred. Despite these positive changes in the national fleet of automotive vehicles, we must consider that Brazil has a significant deficit in the public transport sector and quality. With the growth of the Brazilian economy and the improvement in the distribution of income within the last 12 years the transport model based on individual car led to increased fleet to unbearable levels with respect to congestion in cities and the derived pollution.

The aging national fleet of vehicles like cars, buses and trucks that because fossil fuel use leads to increased pollution caused by the emission of gases. The effects of pollution according to the pathologist Saldiva Paulo, Faculty of Medicine, USP and Heart Institute (Incor) on population health are enormous among them allergic conditions - pneumonia, heart attack and lung cancer. Four thousand people die a year more with these diseases only in the city of São Paulo, because of pollution (G1, 2011).

The Brazilian government plans to implement a program to replace the fleet of old trucks account for most of the emission of pollutants in the atmosphere. This program provides for the replacement of approximately 30 000 units per year over 10 years from the adoption of the measures, vehicles that leave the circulation will undergo retraining for reuse or dispose of components such as steel, iron and liquid waste process. The recall of older vehicles will directly impact on air quality, for example, a former truck, with more than 30 years with respect to a new model, emits 87% more hydrocarbons 81% more, 86% more nitrous oxide and 95% more particulate materials. Thus, the industry is also contributing to the National Policy on Climate Change. In contrast, the new models within the standard Proconve P7 emissions, consume about 10% less than diesel vehicles over 30 years. This means less fuel imports and savings of about R$ 5 billion reais over 10 years (ANFAVEA, 2014b).

Another key component to increasing air pollution and the aging of fleet vehicles using gasoline as the coso of old cars that do not have catalytic converters with over 20 years of use, with unregulated engines that run without supervision.

The scrapping of the national fleet is important to discuss measures to combat pollution of Brazilian cities problem. Any plan to combat pollution goes through dealing with this question, the set of solutions involving complex aspects of a country's territorial dimensions of Brazil, but ignore the size and age of the vehicle fleet using fossil fuels is not to understand the crux of the situation current.

For cars, light commercial vehicles, trucks and buses were adopted curves scrap used in the preparation of the First Brazilian Inventory of Anthropogenic Emissions of Greenhouse Gases (Reference Report: Emissions of Greenhouse Gases in the Energy Sector by Mobile Sources) MCT (2006). The scraping curves are illustrated in Figures 1 and 2 (IEMA, 2011) presented below.

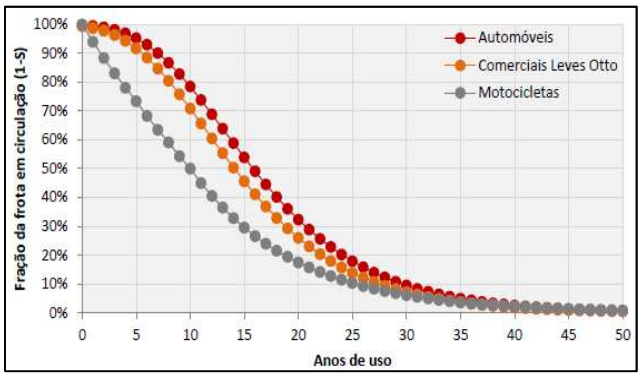

Figure 1 - Curves scrapping for Otto cycle vehicles
Source: IEMA (2011, p. 25)

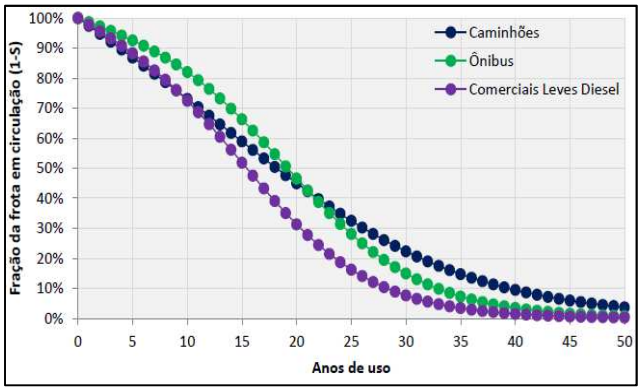

Figure 2 - Curves for scrapping vehicles Diesel cycle
Source: IEMA (2011, p. 26)

Regarding the Otto cycle vehicles, we note the car has a period of slower obsolescence in relation to others (light commercial vehicles and motorcycles), for example, if one considers scrapping of 50%, the motorcycle reaches this percentage to 10 years of use, with light commercial vehicles 13 years and 16 years. Among the vehicles Diesel cycle, the trucks have a more linear scrapping, without abrupt changes, bringing its useful life for almost 50 years. Even compared to other vehicles is noted (Otto or Diesel cycle), the national truck fleet, is the most enduring, ie, the lifetime has been increased. All other types of vehicles have similar life highlighting the motorcycle has an average life cycle of small compared to others.

2.2 Environmental pollution

Pollution from vehicles can be classified depending on their scope, impacts caused by its emission, eg pollutants generated in the surrounding areas where circulation, noise produced by the engines and exhaust soot expelled by accumulating in the streets and facades of buildings are called local pollutants. This category also enter the pollutants moving from one region to another by means of air currents, such as the gases that cause acid rain and smog effect, which occurs due to high concentration of ozone (O3), thereby forming a mist in the dense air.

Global pollutants are those gases that are released into the atmosphere, impacting the entire planet, such as global warming and greenhouse gases (GHG) and carbon dioxide (CO^2), the main pollutant in this category (CARVALHO 2009).

Being responsible for 20% of global CO^2 emissions, the transport sector is a major cause of greenhouse and other environmentally harmful gases. In Brazil, the transportation sector accounts for 9% of the total emissions of CO_2 while burning up more than 70% of emissions (CARVALHO, 2009).

Besides CO^2, fossil fuel powered vehicles are responsible for other pollutants that degrade the environment and are harmful to human health, including: carbón monoxide (CO), hydrocarbons (HC), particulate matter, nitrogen oxides (NOx) and sulfur oxides (SOx) (CARVALHO, 2009).

Another related to the emission of greenhouse gases problem, according to studies by the Laboratory of Experimental Air Pollution, School of Medicine, University of São Paulo made in the Metropolitan Region of São Paulo (MASP), is the pollution generated by vehicles is linked to 200 illnesses and about four thousand deaths per year only in São Paulo (HARARI and CRISTI, 2012). The annual cost for treating the disease is $ 1.5 billion (MARTINS, 2001).

Due to this fact, the National Environmental Council (CONAMA) created on May 6, 1986, through Resolution No. 18, the Programme for the Control of Air Pollution from Motor Vehicles - PROCONVE coordinated by IBAMA, and defining emission limits for light vehicles, to contribute to the Air Quality Standards established by PRONAR (National Program for Air Quality). According to IBAMA (2012), light vehicles are the ones that fit the following description: car designed to transport up to 12 passengers, or their derivatives to transport cargo (CONAMA 2012.).

Emission limits of gases that the vehicle can issue for each phase is available in Figure 3, where it is possibl consult and what your gas emission limit for that phase Proconve. By means of Law No. 8723 of October 28, 1993, it became mandatory to reduce the emission levels of pollutants from vehicular source, adapting the vehicle to the phase of the current year Proconve in vehicle manufacturing, promoting the technological development of manufacturers engines, parts and fuel.

For this requirement to be fulfilled IBAMA prohibits the marketing of approved vehicles not being responsible Proconve certification from the prototype to the approval of engines or gathering them if they are in disagreement front of the stage that is currently Proconve (IBAMA, 2012). Proconve was divided into stages so that the companies had time to adjust to new emission limits. Table 5 details the years and maximum emission limits allowed by the phases of the gas.

PHASE	DATE OF REQUIREMENT
L1	1988
L2	1992
L3	1997
L4	2005 (40%), 2006 (70%), 2007 (100%)
L5	2009
L6	2013 (Diesel Leve), 2014 (Otto Novos Mod.), 2015 (Otto 100%)

Table 5 – Years in which each stage has been implemented Proconve

Source: JUNIOR (2009)

Proconve was divided into stages so that the companies had time to adjust to new emission limits. **Phase L-1** (1988) for light vehicles and consisted in eliminating the most polluting vehicles and improve production (SCHOLL, 2009). The **Phase L-2** (1992), and to achieve the levels required at this stage, the vehicles had to adopt new technologies such as electronic fuel injection and catalytic converters. As ethanol is used along with gasoline, use of technology was necessary to allow the suitability of catalysts and electron injection (SCHOLL, 2009). **Phase L-3** (1997) was responsible for adding oxygen sensor in the engine (SCHOLL, 2009). **Phases L-4** (2003), **L-5** (2009) and **L-6** (2012) are characterized by lower levels, not requiring manufacturers to install equipment or items such as engines, as had been done in previous phases (SCHOLL 2009).

Junior second study (2009) it is noted that after the implementation of the phases mentioned above by Proconve really was no reduction of pollutant emissions (Graphic 3).

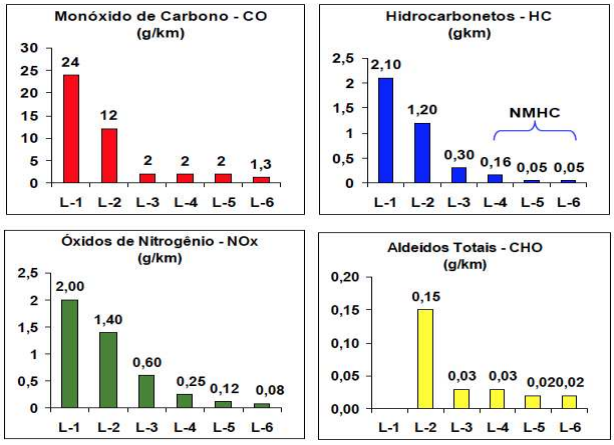

Figure 3 – Emission ceiling for phases Proconve
Source: JUNIOR (2009)

With the reduction of pollution levels of vehicles at each stage, increasing the fleet causes less impact on the environment if the vehicles did not follow the norm or the standard does not exist.

A fleet of light vehicles (cars and light commercial vehicles) of the Otto cycle is segmented according to the phases "L" PROCONVE; the vehicle Diesel cycle, the phases "P" PROCONVE; and motorcycles, second phases PROMOT. For estimates of projected emissions between 2010 and 2020, were considered phases already regulated within this period, which are the L6 and P7 PROCONVE phases (IEMA, 2011).

A point to note is that, since 2020, due to the scrapping of older vehicles, vehicles of L5 (current) and L6 phase (planned for 2014) will account for almost 75% of CO (IEMA, 2011).

3. CONCLUSION

First, we sought to know about the Brazilian automobile market, where companies established in the country were identified, the types of vehicles produced, and data in this sector in the country and its representation in the global market for automotive vehicles.

In Brazil, the cars represent 72.88% of the automobile market, the rest is distributed amongst 20.85% with light vehicles, trucks and buses with 5.08% to 1.18%. In the last decade (2003-2013), vehicle production increased significantly, particularly light commercial segment which grew 359% (ANFAVEA, 2014a).

Regarding the fuel used by different types of vehicles in Brazil matrix is the dominant fuel of fossil origin, unlike most countries using other energy sources. It is in this context that the electric car is an alternative to using fossil fuels. In Brazil the use of the electric car is only 0.02% of the total number of vehicles produced. With a highly diversified energy mix at the national vehicle fleet uses little electric cars as an alternative to fossil fuels (SANTOS, FRANCISCHETTI e GOMES, 2013).

The technology and biofuels production are also not new in Brazil that has the expertise needed to continue to foster this development and, in particular, the production of fuel alcohol which could help with the minimization of CO^2 pollution and negative environmental impacts.

In 1986, the National Environmental Council (CONAMA) created the Program for the Control of Air Pollution from Motor Vehicles (PROCONVE) whose main objective was to define the limits of pollutant emissions for light vehicles to meet the Quality Standards air introduced by PRONAR (National Program for air Quality). PROCONVE was implemented in phases, beginning in 1988 and completion scheduled for 2015, it is effective because the emission rates of pollutants are reducing every deployed phase, as can be seen in Graphic 3.

The Brazilian government plans to implement the program to replace the fleet of old trucks, which are responsible for most of the emission of pollutants in the atmosphere, such withdrawal will likely impact on air quality.

This study is not conclusive, there is the need to collect more information on proposals to reduce the levels of pollutants, analyzing the incentives to use electric and hybrid vehicles and about the barriers to entry for this type of product.

REFERÊNCIAS BIBLIOGRÁFICAS

[1] ANFAVEA. **Brazilian Automotive Industry Yearbook - 2014**. 2014a. Disponível em: <http://www.anfavea.com.br/anuario.html>. Acesso em: 26/10/2014.

[2] ANFAVEA. **Brazil Automotive Guide 2014:** guide to the brazilian automotive industry sector. 2014b. Disponível em: < http://www.autodata.com.br/pages.php?recid=19508>. Acesso em: 27/10/2014.

[3] CONAMA – Conselho Nacional do Meio Ambiente. **Resoluções do CONAMA:** publicadas entre setembro de 1984 e janeiro de 2012. Ministério do Meio Ambiente. Brasília: MMA, 2012.

[4] G1. **Quatro mil paulistanos morrem por ano por causa da poluição**, diz medico: pneumonia, infarto e câncer de pulmão são as principais doenças. 2011. Disponível em: < http://g1.globo.com/bemestar/noticia/2011/09/quatro-mil-paulistanos-morrem-por-ano-por-causa-da-poluicao-diz-medico.html>. Acesso em: 28 Out. 2014.

[5] HARARI, Isabel; CRISTI, André. 2012. **Pobres são os mais atingidos pela poluição urbana.** Disponível em: <http://cartamaior.com.br/?/Editoria/Politica/Pobres-sao-os-mais-atingidos-pela-poluicao-urbana-diz-medico-da-USP/4/25595>. Acesso em: 17/01/2015.

[6] HOYER, Karl Georg. (2008). The History of Alternative Fuels in Transportation: The Case of electric and Hybrid Cars. **Utilities Policy**. n. 16, p. 63-71.

[7] IEMA – Instituto de Energia e Meio Ambiente. **Primeiro Inventário Nacional de emissões atmosféricas por veículos automotores rodoviários: relatório final.** 2013. Revisão: Deise Anne Rodrigues de Souza. Disponível em: <http://www.cntdespoluir.org.br/Documents/PDFs/Inventario_de_Emissoes_por_Veiculos_Rodoviarios_2013.pdf>. Acesso em: 25 Out. 2014.

[8] INVESTE São Paulo. **Agência Paulista de Promoção de Investimentos e Competitividade**. 2012. Disponível em: <http://www.investe.sp.gov.br/ setores/automotivo>. Acesso em: 01/07/2014.

[9] IPCC. Climate Change (2007). **Synthesis Report. Contribution Of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change** [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds.). IPCC, Geneva Switzerland, 104 p.

[10] MAYER, Helmut. 1999. Air pollution in cities. **Atmospheric Environment**. v.33, n. 24-24, p. 4029 – 4037.

[11] MCT - Ministério da Ciência e Tecnologia – MCT. Primeiro Inventário Brasileiro de Emissões Antrópicas de Gases de Efeito Estufa. Relatórios de Referência: Emissões de Dióxido de Carbono por Queima de Combustíveis: Abordagem Top-Down. Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa em Engenharia – COPPE. Brasília, 2006.

[12] PORTAL do Governo do Estado de São Paulo. **Indústria Automobilística**. 2012. Disponível em: <http://www.saopaulo.sp.gov.br/conhecasp/historia_republica-industria-automobilistica>. Acesso em: 05/04/2014.

[13] RIBEIRO, Suzana K.; REAL, Márcia V.. **Novos Combustíveis**. Rio de Janeiro: E-papers, 2006.

[14] RIBEIRO, Suzana K.; ABREU, Adrianna. A. (2008). Brazilian Transport Initiatives with GHG Reductions as a co-benefit. **Climate Policy.** v.8, n.2, p. 220-240.

[15] SANTOS, Nilcéia Cristina dos; FRANCISCHETTI, Carlos Eduardo; GOMES, Reinaldo Gomes da. Analysis of electric vehicles: a brazilian reality and its consequences for the environment. **Renewable Energy and Power Quality Journal (RE&PQJ),** n. 12, april 2014, p. 1-6;

[16] SILVA, Elenice Rachid. **Análise do crescimento da motorização no Brasil e seus impactos na mobilidade urbana**. 2011. 142p. Dissertação (Mestrado do Programa de Planejamento Energético/COOPE) - Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro. 2011.

[17] ONU – Organização das Nações Unidas. Compêndio para sustentabilidade. Protocolo de Kyoto. Disponível em: http://www.institutoatkwhh.org.br/compendio/?q=node/42, acesso em 25/07/2013. Moussiopoulus, N. et al. (2010). Enviromental, social and economicalinformation.