The influence of mitigation policies of the International Climate Change Regime in the reduction of greenhouse gases in the area of transport

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Abstract

This paper aims to examine the evolution of greenhouse gas (GHG) emissions in the transportation sector in megacities and their countries of origin, to discuss the effectiveness of the International Climate Change Regime (ICCR). It starts by analyzing national communications from 17 countries of the United Nations Framework Convention on Climate Change and 5 national inventories, where the 31 megacities of the study are located. One can conclude that the ICCR has influence on the adoption of policies and domestic GHG mitigation actions in 14 of the countries and they have proven effective in 3 of them – Japan, France and the United States – from 2000 to 2011. Regarding the megacities, 18 of them reported GHG mitigation policies for the transportation sector and 10 of them have goals to reduce GHG in the coming years. Concerning the distribution of the countries within the categories listed in the Kyoto Protocol, it is relevant to the Conferences of the Parties (COPs) to address the discussion on the current validity of the initial division that was made among the members of this Protocol, in view of the results that have been submitted by countries in relation to GHG emission reductions. The use of more efficient and available technologies to reduce emissions in the transportation sector could be faster implemented in these countries, in line with other policies of mitigation and actions adopted by the national and local authorities and citizens.
Keywords: international negotiations, climate change, environmental impact, effectiveness of international regimes, mitigation policies, mitigation technologies, transportation sector, megacities and their countries of origin.

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1 Introduction

According to the Report on Emissions of Greenhouse Gases, 2012 United Nations Environmental Program (UNEP) [1], rapid motorization, a feature of the development occurred in the 20th century, although resulting in economic growth and an improved quality of life, has produced many adverse consequences such as congestion traffic, air pollution, hazardous roads and social inequalities. At the same time, the transportation sector has the highest projected growth in emissions of greenhouse gases (GHG) and currently accounts for 13% of these emissions and has significant potential for reducing them.

In the case of the world's megacities, positive and negative effects occur with greater intensity due to overcrowding characteristics of these urban concentrations.

The purpose of this paper is to analyze the evolution of policies for controlling GHG emissions to discuss the effectiveness of the International Climate Change Regime (ICCR) regarding the adoption of policies to mitigate emissions by the transportation sector in megacities and their countries of origin.

Considering the understanding of effectiveness, as Zartman and Spector [2], in this paper it is assumed that a regime is effective to the extent that its general principles, norms and rules instruct the action of the actors and influence in the establishment of policies in household level, to solve or mitigate the problem at hand. We have, in this case, the evidence of the effectiveness of the ICCR where the standards are observed in national or local policies and examining the effectiveness of policies when they produce the determined effect in accordance with the objectives contained in the standards.

It is understood that the analysis of effectiveness at the local level, represented by megacities, lacks consistent and reliable information about the history of GHG emissions by the transportation sector. Such information is either not available, or there is no clarity about the possibility of comparison (it is not known whether the methodology used for measuring is the same) and would depend on a historical series, which is not yet available for all of the megacities, face to preliminary results released by their GHG emissions. The difficulty in meeting such criteria prevented the analysis of the effectiveness/efficiency of these policies at the second level.

It is possible, however, to determine the effectiveness/efficiency of the implementation of mitigation policies in the area of transport for the countries in which these megacities are located, especially the countries that belong to Annex I of the Kyoto Protocol and the United States, because they have 21 years of historical results of measurements for the area of transport and for countries not listed in Annex I which have, at least, two National Communications submitted to the United Nations Framework Convention on Climate Change (UNFCCC). All these countries calculate their overall GHG measurements following the methodological guidelines of the Intergovernmental Panel for Climate Change (IPCC).

In the case of the studied megacities, there is information on the use of methodologies that are based on the IPCC methodological guidelines. However, spreadsheets or information from the reported results are not accessible yet.

Specific objectives of the study are cited hereafter:

a) systematize the International Climate Change Regime (ICCR) guidance on actions to be adopted to reduce GHG emissions in the transportation sector;

b) identify policies to mitigate emissions of greenhouse gases in the megacities and their countries of origin, affecting the transportation sector;

c) analyze the convergence of the International Climate Change Regime (ICCR) guidelines and policies identified in the transportation sector in megacities and their countries of origin;

d) identify the evolution of emissions in the transportation sector in megacities and their countries of origin, in the period between 1990 and 2012 and discuss the results;

e) identify megacities' goals and actions related to the transportation sector, after the year 2012, verifying the potential reductions to be obtained.

Hypotheses to be considered in relation to the overall goal and the specific objectives are explained in Table 1.

2 Transportation sector within the framework of the International Climate Change Regime

Yamin and Depledge [3] cited by Borges [4] report important terms and concepts for the understanding of the topics discussed in this paper, as follow:

a) International Climate Change Regime (ICCR): consists of rules generated from different sources that define how the institutions established under its tutelage should act on matters related to climate change;

b) United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP): are defined as multilateral treaties open to ratification by all States and economically integrated regional organizations such as the European Union;

c) Greenhouse Gas (GHG): refer to gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydro fluorocarbons (HFCs) and sulphur hexafluoride (SF_6));

d) Emissions: mean the release of greenhouse gases and/or their precursors into the atmosphere at a certain time and place;

e) Precursors of greenhouse gases: are emissions of nitrogen oxides, carbon monoxide and volatile organic compounds not linked to methane, also known as troposphere ozone precursors;

f) GHG source: is any process, activity or mechanism that releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol into the atmosphere;

g) Emissions from International Aviation and Maritime Transport – Bunker Fuel: they should also be reported separately from the total national emissions.

Table 1: Objectives and assumptions at work.

Objectives	Assumptions considered
Survey question: Since the establishment of the International Climate Change Regime (ICCR), how has evolved the transportation emissions control of greenhouse gases in megacities and their countries of origin? To what extent this evolution indicates effectiveness of the ICCR? General objective: The general objective of the study is to evaluate the evolution of policies for controlling GHG emissions to discuss the effectiveness of the ICCR, regarding the adoption of policies to mitigate emissions by the transportation sector in megacities and their countries of origin.	Hypothesis 1 (general) The existence of the ICCR and the commitments made by countries and megacities of this study inform the adoption of policies to control GHG emissions coming from the transportation sector. The existence of such policies indicates the effectiveness of the Regime.
Specific objective: To systematize the ICCR guidelines on the actions to be adopted to reduce GHG emissions by the transportation sector.	Hypothesis 2: In general, the policies adopted by the countries and/or the megacities meet the guidelines expressed by the ICCR.
Specific objective: To analyze the convergence of the ICCR guidelines and policies identified in the transportation sector in megacities and their countries of origin.	Hypothesis 3: Given Hypothesis 2, it is expected that the existence of policies to mitigate GHG emissions in megacities and/or their countries of origin have driven the actions of national or local governments for projects that include the ICCR guidelines.
Specific objective: To identify trends in emissions related to the transportation sector in the megacities and their countries of origin in the period of 1990–2011 and discuss the results.	Given Assumptions 2 and 3, it is expected that the megacities and/or the countries, that adopted actions arising from the ICRR's GHG mitigation policies for the transportation sector, have reduced emissions in the period of 2000–2011, i.e., the adopted mitigation policies were effective.
Specific objective: Identify actions and goals related to the megacities' transportation GHG emissions after the year 2012, verifying the potential reductions to be obtained.	The studied megacities include in their GHG's emissions reduction targets, after the year 2012, corresponding policies and actions for the transportation sector.

Source: compiled by author.

For verification purposes, CO_2 emissions related to the burning of fuels should be reported using the IPCC references and sectoral approaches;

h) international aviation and maritime transport contributes about 4% of global CO_2 emissions, and projections suggest the duplication of percentage of emissions to 8% in 2020;

i) in the case of Kyoto Protocol (KP) emissions from international bunker fuels should be regulated by the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO) and not the Kyoto Protocol. The Protocol states that Annex I countries should seek to cooperate with ICAO and IMO to reduce emissions from these sources.

According the presentations of Metz [5], Sims [6] and Pachauri [7], studies in the areas of energy supply, transport, buildings, industry, agriculture, forestry and waste indicate, with much evidence and high level of agreement, that there are substantial economic potential for the mitigation of GHG emissions in the

coming decades which could offset the projected growth of global emissions or reduce emissions below current levels.

According to Metz [5] and Pachauri [7] there is a high level of agreement and some evidence that changes in lifestyle and behaviour patterns can contribute to climate change mitigation across all sectors. Management practices can also have a positive role.

Also according to Pachauri [7], to stabilize the concentration of GHGs in the atmosphere, emissions would need to peak and after this peak, decline. The lower the stabilization level, the more quickly this peak and decline would need to occur. The mitigation effects within the next two or three decades will have a large impact on opportunities to achieve lower stabilization levels of emissions.

The stabilization levels can be achieved by employing a portfolio of technologies that are already available and those that are expected to be commercialized in coming decades. This assumes that there are appropriate incentives for the development, acquisition, organization and dissemination of technologies and the related barriers are removed. Policies that provide real or implicit price on carbon could create incentives for producers and consumers to invest in products, technologies and processes with low GHG emission (low carbon). These policies include economic instruments, government funding and regulation.

The existence of the International Climate Change Regime (ICCR) offers megacities and their countries of origin mechanisms and opportunities to access financial resources and available technologies to change chaotic and complex situations arising in the transportation of people in these mega urban conglomerates.

3 Megacities and their countries of origin and the mitigation policies of GHG emissions

The study adopts the above selected megacities as being the World‘s 30 largest settlements in 2015, defined by the Department of Economic and Social Affairs – Population Division, Population Estimates and Projections Section of the United Nations [8], contained in Table 2. It also includes the city of Hong Kong, since it has been indicated as a model for China, regarding the results presented in the area of public transportation, according to the information given in the Second Chinese National Communication [9]. The table also presents information on the situation of each country in relation to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol – KP and its specific Human Development Index (HDI).

Brazilian United Nations Development Program’s (UNDP) [10] definition of HDI is as follows: the goal of the creation of the Human Development Index was to provide a counterpoint to other widely used indicator, the Gross Domestic Product (GDP) per capita, which considers only the economic dimension of development. Created by Mahbub ul Haq in collaboration with the Indian economist Amartya Sen, Nobel Prize in Economics in 1998, the HDI aims to be a general summary measure of human development.

Table 2: 30 world's biggest population cities in 2015 and their ranking according to HDI and situation to the Kyoto Protocol (KP) of their countries of origin.

Position regarding the population	Megacity	Population (millions of people)	Country	Signatory of KP	Position related to KP	Continent	Position of the country in the HDI Index	Level of development according to HDI
1	Tokyo	38.20	Japan	Yes	Annex I	Asia	12	Very high
2	Delhi	25.63	India	Yes	Non Annex I	Asia	134	Medium
3	Shanghai	22.96	China	Yes	Non Annex I	Asia	101	Medium
4	Mexico City	21.71	Mexico	Yes	Non Annex I	America	57	High
5	New York	21.33	United States of America	No	x	America	4	Very High
6	Mumbai [Bombay]	21.21	India	Yes	Non Annex I	Asia	134	Medium
7	São Paulo	21.03	Brazil	Yes	Non Annex I	America	84	High
8	Beijing	18.08	China	Yes	Non Annex I	Asia	101	Medium
9	Dhaka	17.38	Bangladesh	Yes	Non Annex I	Asia	146	Low
10	Karachi	15.50	Pakistan	Yes	Non Annex I	Asia	145	Low
11	Kolkata	15.08	India	Yes	Non Annex I	Asia	134	Medium
12	Buenos Aires	14.15	Argentina	Yes	Non Annex I	America	45	Very High
13	Los Angeles – Long Beach – Santa Ana	14.08	United States of America	No	x	America	4	Very High
14	Lagos	13.12	Nigeria	Yes	Non Annex I	Africa	156	Low
15	Manila	12.86	Philippines	Yes	Non Annex I	Asia	112	Medium
16	Istanbul	12.46	Turkey	Yes	Annex I	Europe/Asia	92	High
17	Guangzhou, Guangdong	12.39	China	Yes	Non Annex I	Asia	101	Medium
18	Rio de Janeiro	12.38	Brazil	Yes	Non Annex I	America	84	High
19	Shenzhen	12.34	China	Yes	Non Annex I	Asia	101	Medium
20	Moscow	12.14	Russian Federation	Yes	Annex I	Europe	66	High
21	Cairo	11.94	Egypt	Yes	Non Annex I	Africa	113	Medium
22	Osaka-Kobe	11.78	Japan	Yes	Annex I	Asia	12	Very High
23	Paris	11.10	France	Yes	Annex I	Europe	20	Very High

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Table 2: Continued.

Position regarding the population	Megacity	Population (millions of people)	Country	Signatory of KP	Position related to KP	Continent	Position of the country in the HDI Index	Level of development according to HDI
24	Chongqing	11.05	China	Yes	Non Annex I	Asia	101	Medium
25	Jakarta	10.47	Indonesia	Yes	Non Annex I	Asia	124	Medium
26	Kinshasa	10.31	Democratic Republic of the Congo	Yes	Non Annex I	Africa	187	Low
27	Wuhan	10.26	China	Yes	Non Annex I	Asia	101	Medium
28	Chicago	10.20	United States of America	No	x	America	4	Very High
29	Bangalore	10.02	India	Yes	Non Annex I	Asia	134	Medium
30	Chennai [Madras]	9.89	India	Yes	Non Annex I	Asia	134	Medium

Source: prepared by the author with data extracted from the United Nations Development Program [11]; the United Nations Development Program – Brazil UNDP [10].
Observation: countries that are painted in gray belong to Annex I of the Kyoto Protocol or are only signatories to the UNFCCC (the specific case of the United States of America).

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Since 2010, when the Human Development Report completed 20 years, new methodologies were incorporated to calculate the HDI. Currently, the three pillars that constitute the HDI – health, education and income – are measured as follows:

a) a long and healthy (health) life is measured by life expectancy;

b) access to knowledge (education) is measured by: i) mean years of adult education, which is the average number of years of education received during the life of people since they are 25 years old; and ii) the expected years of schooling for children at the age of starting school life, which is the total number of years of schooling a child at the age of starting school life can expect to receive if prevailing patterns of specific enrolment rates by age remain the same during the child's life;

c) and the standard of living (income) is measured by Gross National Income (GNI) per capita expressed in Purchasing Power Parity (PPP) constant dollar, taking 2005 as the reference year.

The methodology used for the survey, classification and presentation of information collected and reported in national inventories of the countries, where the megacities are located, and information related to the megacities of the study is detailed in Borges [4].

Documental analysis techniques and statistical analysis techniques were used for the treatment and organization of information, in order to test the hypotheses presented in the Introduction of this paper.

The countries detailed in the study are: Argentina, Bangladesh, Brazil, China, Democratic Republic of Congo, Egypt, France, India, Indonesia, Japan, Mexico, Nigeria, Pakistan, Philippines, Russian Federation, Turkey, United States of America; the megacities are those stated in Table 2.

The search for information on PMAs – Policies and Mitigation Actions and results of GHG emissions for the transportation sector should cover the National Inventories Communications from all countries of the 30 megacities cited in Table 2 and city of Hong Kong and also all megacities that have information available in International Council for Local Environmental Initiatives (ICLEI) [12] and C40Cities [13] sites.

According to Sims [6] the mitigation technologies and practices currently available for the transportation industry are: vehicles with more efficient use of fuels, hybrid vehicles, diesel with cleaner combustion emissions, biofuels, changing modes of transportation vehicles from road to rail and public transport, non-motorized transport (bicycling and walking), planning of land use and transportation systems. Technologies designed to be sold in 2030 are second generation biofuels, aircraft with greater efficiency, hybrids and electric vehicles more advanced with higher power and reliable batteries. According to the author, many mitigation options have good economic potential in the transportation sector, but its effects can be offset by the strong growth of demand and strong consumer preferences.

Tirpak [14] reported eight categories of instruments of national policies available to national governments, which can be used to create incentives for action. The application of policy instruments depends on national circumstances,

and there may be advantages and disadvantages in relation to a particular instrument.

These categories and implications, according to the author, are:

a) integration of climate policies to broader development policies makes implementation easier and overcomes barriers;

b) establishing standards and regulations regarding safety and emissions standards are preferable when consumers do not respond to price changes, but may not induce innovations;

c) definition of taxation and finance charges set a price for carbon, but cannot guarantee a particular level of emissions;

d) tradable permits can establish a price for carbon and the volume determines the environmental effectiveness of the measure. The allocation of permits might have distributional consequences;

e) financial incentives (subsidies and tax credits, for example) can stimulate the development and diffusion of technologies, but costs are generally higher than other policy instruments;

f) research and development can stimulate technological advances, reduce costs and enable progress toward stabilization of emissions;

g) voluntary agreements can raise awareness and establish the evolution of national instruments, although most to date have not achieved significant reductions beyond Business as Usual (BAU);

h) information tools can promote choices, possibly contributing to behavioral changes, but impact on emissions that have not yet been measured.

The author also informed in his submission to the Intergovernmental Panel for Climate Change (IPCC) guidelines for the application of policy instruments, according to their effectiveness and applicability (as shown in Table 3).

According to Tirpak [14], policies, measures and instruments listed in Table 4, have proven effective in the environmental point of view in the transportation sector. Additionally there are informed constraints or opportunities of each block presented by the author.

4 GHG emissions for transportation area of the studied countries and megacities

This section presents the information on GHG emissions in the transportation area of countries and megacities that have been studied. By comparison, the countries belonging to Annex I of the Kyoto Protocol and the United States presented the following evolution of GHG emissions in the transportation sector, from 2000 to 2011 (according to Table 5).

The data show that the United States, France and Japan have reduced their emissions from 2000 to 2011, and the Russian Federation and Turkey increased their emissions.

United States, France and Japan have in common very high Human Development Index (HDI) and the reduction or stabilization of GHG emissions factors would be expected, according to the technical information provided by the experts of the IPCC in 2007.

Table 3: National policy instruments, applicability and effectiveness of evaluation criteria.

National policy instruments	Evaluation C criteria			
	Environmental effectiveness	Cost-effectiveness	Distribution considerations	Institutional Flexibility
Regulations and Standards	Emission levels are defined directly, subject to exceptions. Depends on the establishment and compliance with standards.	Depending on the design and uniformity of application, usually leads to higher costs to achieve compliance.	Depending on the scope can be disadvantaged for small and new actors.	Dependent on the expertise of the institution. The measure is popular with regulators in countries where markets are weak or have poorly functioning.
Taxation and definition of financial charges	Depends on the ability to set tax at level that induces behavioral change.	Better with broad application. Higher administrative costs when institutions are weak.	Regressive. Can be ameliorated with revenue recycling.	Usually it is politically unpopular. It may be difficult to enforce in countries with underdeveloped institutions.
Tradable Permits	Depends on the emissions cap, participation and compliance with established criteria	Decreases with limited participation and fewer actors.	Dependent on initial permit allocation. May pose difficulties for small emitters.	Requires well-functioning markets and complementary institutions.
Voluntary Agreements	Depends on program design including clear objectives, a scenario with defined baseline, involvement of the parties in the design and review of the agreement and the existence of monitoring provisions.	Dependent on flexibility and extent of government incentives, rewards and penalties.	Benefits are available only to participants of the agreements.	They are usually politically popular. Requires a large number of administrative staff.
Financial incentive (subsidies and other incentives)	Depends on program design. Less certain than the definition of standards and regulations.	Depends on level and program design. Can be market distorting.	May benefit some participants, possibly those who do not need incentives.	Popular with recipients; potential resistance from vested interests. Can be difficult to phase out.

Source: Tirpak [14].

Table 4: Policies, measures and instruments applicable to the transportation sector for GHG emission reduction.

Policies, measures and instruments:	Restrictions or opportunities:
Set fuel economy as mandatory; use biofuel mix in fossil fuels and limit CO_2 emissions for road transportation.	Coverage of a partial group of vehicles may limit the effectiveness of the measure.
Taxing the purchase, registration and use of vehicles and charge parking and toll motor vehicles.	Effectiveness may drop with increasing income users.
Influence mobility needs through the regulation of land use and planning of infrastructure.	Suitable for countries that are modernizing their transportation system.
Investing in public transportation that is attractive and non-motorized forms of transport.	

Source: Tirpak [14].

Table 5: Evolution of GHG emissions in countries listed in Annex I of the Kyoto Protocol and country signatory to the UNFCCC in the period of 2000 to 2011.

Country	Reduced/increased	Percentage	Human development index/note
1st Japan	reduced	-14,3%	12, classified as very high.
2nd France	reduced	-5,3%	20, classified as very high.
3rd United States	reduced	-2,8%	4, classified as very high.
4th Turkey	increased	+36%	92, classified as high/growth curve of rising GHG emissions since 1990.
5th Russian Federation	increased	+84%	66, classified as high/2011 GHG emissions are below to 1990.

Source: prepared by the author.

Turkey reported on its National Communication population and GDP growths from 1990 to 2011, which impacted in increased emissions of greenhouse gases, mainly in the energy sector.

The Russian Federation had emissions in 2011 lower than those found in 1990, before the disintegration of the former USSR and the economic problems faced by this State.

The signatory countries of the Kyoto Protocol that belong to Non-annex I are: Argentina, Bangladesh, Brazil, China, Egypt, the Philippines, India, Indonesia, Mexico, Nigeria, Pakistan and the Democratic Republic of Congo. Overall, emissions trends in transportation of the aforementioned countries have increased, mainly due to their economies development needs. The shape of the growth may be impacted by the use of new technologies and/or changes being introduced to local laws to regulate and control emissions from industry and the use of mixed fuels, combined modes of transport, massive use of public transport with low greenhouse gas emissions and non-motorized modes of transport.

By comparison, the countries of this block presented the following evolution of GHG emissions in the transport sector, in varying periods, according to information available in their National Communications. For a preliminary comparison among them, the calculated percentage values were divided by the number of years of each related periods. For those countries that have made the first National Communication the comparison was not performed.

Table 6: Evolution of GHG emissions in transportation sector in countries listed in Annex I of the Kyoto Protocol.

Country	Period for calculating the variation percentage in GHG emissions from transport sector	Increased percentage of GHG emissions from the transport sector	Annualized percentage for comparison purposes (average for the period)	Human development index of the countries/note
Argentina	1994 to 2000	11.7%	1.9%	45, Very high.
Mexico	1990 to 2010	87%	4.4%	57, High.
Brazil	1994 to 2005	41.5%	3.8%	84, High.
China	1994 to 2005	151.1%	13.7%	101, Medium.
Egypt	1990 to 2000	27%	2.7%	113, Medium.
Indonesia	1994 to 2000	18.4%	3.1%	124, Medium.
India.	1994 to 2000	22.2%	3.7%	134, Medium.
Bangladesh	2001 to 2005	21%	4.2%	146, Low.
Democratic Republic of the Congo (DRC)	1999 to 2003	2.9%	0.72%	187, Low. Note: country with internal armed conflicts from 1999 to 2004.

Source: prepared by the author.

The different socioeconomic and environmental conditions among the countries indicated by their Human Development Index (HDI), added to circumstances reported in Table 11 of the work of Borges [4], makes the comparison of earnings growth of GHG emissions among countries a reference for those with HDIs in the same classification ranges (Very High, High, Medium, Low).

It is expected that countries with very high HDI have lower growth in the transportation sector.

Countries with high HDI, such as Mexico and Brazil are changing their internal modes of transport.

In countries with medium HDI, China stands out from all other countries by its higher means of growth of GEE emissions in the reported period.

Interestingly, the National Communications of Turkey and Mexico reported that the growth of GHG emissions normally accompanies the annual economic growth of the country or is located near or below this value, as measured by GDP. In the case of China, to the values usually reported (between 7 and 8% per year for the GDP), the growth in emissions from the transport sector showed double. However, the implementation of actions and mitigation policies, with the use of new non-fossil fuels, can reduce the average growth in the coming years.

A Low HDI country, such as Bangladesh, has an average percentage increase similar to other countries with medium or high HDI. The Democratic Republic of Congo (DRC) is very below other values, due to its internal problems that were reported in its National Communication.

Several of the studied megacities participate in groups that promote local environmental initiatives and campaigns to reduce GHG emissions, which are also supported by the UNFCCC.

One of these initiatives is called ICLEI. This is a network of cities that are linked to the International Council for Local Environmental Initiatives (ICLEI) [12], in order to mobilize local governments for taking action to reduce GHG emissions and create an agenda among local governments, national governments and the United Nations Framework Convention on Climate Change (UNFCCC). The campaign provides assistance to cities and the adoption of policies and implementation of quantifiable measures to reduce GHG emissions, intended to improve air quality and life in urban centers.

Another of these initiatives is called C40 Cities Leadership Climate Group [13], with a global network of major cities with a mission to develop and implement policies and programs that generate measurable reductions on GHG emissions and climate risks.

According to Borges [4], estimates on GHG annual emissions of 1/3 of the studied megacities were presented, which were available in the ICLEI sites [12], C40 Cities [13] and the National Communications of their respective countries. These estimates included detailing percentage by categories, which allowed the calculation of GHG emissions for the transportation sector. The cities that reported higher GHG emission levels for transportation sector were Jakarta, Mexico City, Los Angeles, Tokyo and New York. The cities that have higher percentages relative to their total GHG emissions related to the transport sector are Paris, São Paulo, Rio de Janeiro, Mexico City, Jakarta, Buenos Aires and Los Angeles.

There were not available in the consulted sources reports, calculation inventories or other estimates that have been made by these cities. One must wait for the next years that this information become available for consultation and monitoring of the GHG reduction goals released by local governments.

5 The effectiveness of GHG emissions mitigation policies in transportation sector for megacities and their countries of origin

Regarding the effectiveness of the International Climate Change Regime (ICCR)'s mitigation policies in the transportation sector in megacities and their countries of origin, Borges' work [4] summarized the information related to the adoption of the ICCR's policies by countries and their megacities. The conclusions are set out as follows.

5.1 Countries belonging to Annex I of the Kyoto Protocol and country signatory to the Convention only

The policy instruments defined as Tradable Permits and Voluntary Agreements were not used by any of the countries studied in this item. Among the other policy instruments cited by the International Climate Change Regime (ICCR), all countries used the following: Definition of Regulations and Standards, Information Instruments, Infrastructure Planning, Investment in Public Transportation.

The following policy instruments were used by three of the five countries studied in this item – the United States, Japan and France: General – Integration of Climate Policies to more extensive national and municipal development policies, Research and Development. It was difficult to identify the Russian policies, as this information was available only in Russian language.

The following policy instruments of the International Climate Change Regime (ICCR) were used by the United States and France: Taxation and definition of Financial Charges on fossil fuel emissions, Investment and/or Incentive for using of non-motorized forms of transport.

In conclusion of this subsection, it is observed that the International Climate Change Regime (ICCR) has influence in the adoption of GHG mitigation domestic policies by the United States, France and Japan and in these countries the adoption of the aforementioned policies was effective in the period of 2000–2011 for the reduction of GHG emissions in the transportation sector.

Another conclusion is that these countries, in addition to the adoption of mitigation policy instruments already mentioned by the experts of the Intergovernmental Panel for Climate Change (IPCC) have also adopted other instruments such as the Integration of Climate Policies, Information Instruments and Research and Development Policies focused on the theme.

One can also conclude that the Russian Federation and Turkey partially adopt the main GHG mitigation policies disseminated by the International Climate Change Regime (ICCR). The growing results of GHG emissions from the transportation sector are impacted by population growth and GDP in Turkey and the economic recovery of the Russian Federation, after the collapse of the former Union of Soviet Socialist Republics (USSR).

5.2 Countries of the Non-annex I of the Kyoto Protocol

The policy instruments defined as Tradable Permits and Voluntary Agreements were not used by any of the countries studied in this item. Among the other policy instruments cited by the International Climate Change Regime (ICCR), all countries used the following: General – Integration of Climate Policies to more extensive national and municipal development policies, Information Instruments, Infrastructure Planning.

With respect to these instruments, it should be noted that all of them require major investments for carrying out changes or implementations in transportation sector and that several of the countries also reported a lack of national financial institutions and resources with these capacity, beyond serious problems such as the occurrence of internal disturbances (case of the Democratic Republic of Congo).

A second group of Policy Instruments recommended by the International Climate Change Regime (ICCR) for GHG reduction in the transportation sector adopted by much of the 9 countries are: Definition of Regulations and Standards, Investment in Transport, Research and Development, Improvement of Managerial Processes in the use of Modes of Transport and Improvement of Air Quality Management in Cities, Financial Incentives, Investment and/or Incentive for using Non-motorized Forms of Transport.

In this regard, it should be noted that investments in Research and Development and Public Transport are usually major investments and require more time so that we can verify their effectiveness. Several countries such as Mexico, Brazil, Argentina, China, India, and Indonesia reported investments in transport modal changes – with projected growth in transport by rail, sea and air, without, however, significantly reduce of the existing modes by road.

Mexico, which was the country among all represented in this group that invested in performing their National Communications to the United Nations Framework Convention on Climate Change (UNFCCC) and has examples of quantified reductions for Mexico City in transportation, reported that the measures implemented in recent years have indicated the decoupling of economic growth from the growth of their GHG emissions.

China, however, has results in GHG emissions in the transportation sector that are reflecting the massive investments in this modal, reported in its Second National Communication, i.e., for annual growth of Gross Domestic Product - GDP of 7%, the GHG's average annual emissions growth has been 13.7% in this specific area (therefore almost the double). China has released its options for low carbon technologies in an attempt to reduce GHG emissions per unit of Gross Domestic Product (GDP) in the coming years, which means that emissions should not decrease in the next years. China indicated the city of Hong Kong as a model to be followed by its cities, in the use of public transport by the population, as 90% of the population of Hong Kong use public transportation, according to the Chinese National Communication [9].

Beijing's city government announced major investments in urban transport and containment measures in the number of cars to reduce the effects of air pollution on the inhabitants of the megacity and, consequently, reduction of greenhouse gases emissions.

The Asian Countries, in which are located 16 of the 23 megacities of this study, listed in the countries belonging to the Non-annex I of the Kyoto Protocol (see Table 2), reported planning and investments in infrastructure (subways, Bus Rapid Transit System (BRTS), metropolitan trains), use of non-motorized means of mobility in cities (bikes and rides). Several studies are underway, including new non-fossil fuels and use of electricity or biofuels to reduce GHG emissions in this area.

It is observed that the International Climate Change Regime (ICCR) has influence in the adoption of domestic GHG mitigation policies in all the studied countries, but the effectiveness of the adoption of these policies in relation to the development needs of the countries belonging to the Non-annex I of the Kyoto Protocol have not shown results to date. The implementation of measures advocated by developing countries is necessary to their economies or to the improvement of the quality of life of their major cities, and should result, quite probably, in reducing GHG emissions in the transportation sector in the coming years, as well as in health benefits for the populations of the studied megacities. The International Climate Change Regime (ICCR) seems to be effective in the transportation sector, with regard to its ability to influence domestic policies and in taking measures to reduce GHG; such policies or measures are not always

effective in their results or there is not yet a way to measure the effectiveness due to lack of sufficient information. The emergence of new sources of non-fossil fuels that are operating on a large scale in road transportation and can be sustained to reduce GHG emissions throughout its production cycle can leverage more significant GHG emission reductions. In this sense, the adoption of national policies that facilitate these applications is desirable in all countries studied in this paper and in other unrepresented.

5.3 International climate change regime policies for GHG emission reduction in the context of megacities

The megacities of Tokyo, Paris, Moscow, New York, Los Angeles, Chicago, Buenos Aires, Mexico City, São Paulo, Rio de Janeiro, Beijing, Hong Kong, Jakarta, Chennai, Delhi, Kolkata, Dhaka and Mombai reported the adoption of mitigation policies in transportation area to reduce greenhouse gases. The effectiveness regarding the adoption of these practices by local governments cannot be observed in this paper, as the data and methodologies of the reported emissions are not yet published and the results cannot be compared over time. Some of the cited megacities also released its annual GHG emissions reduction targets for the coming years and some published their methodologies of work to meet these goals.

One can, however, check if the policies released by International Climate Change Regime (ICCR) for the reduction of greenhouse gases for the transportation sector are aligned with those adopted by the megacities, which allows us to discuss the effectiveness of the Regime, considering the theme of this paper. Regarding the Mitigation Policies once can observe that:

All megacities cited in this item adopt Information Instruments as one of the instruments to reduce its GHG emissions.

The cities of Paris, New York, Chicago, Sao Paulo, Rio de Janeiro and Dhaka adopt Investments and/or Incentive for the use of non-motorized forms of transport.

The cities of New York, Los Angeles, Chicago, Buenos Aires, Mexico City, São Paulo, Rio de Janeiro, Beijing, Hong Kong, Chennai, Delhi, Kolkata, Mumbai, and Dhaka adopt Infrastructure Planning Policies and Investment for public transportation.

The cities of New York, Los Angeles, Chicago, Mexico City, São Paulo, Rio de Janeiro and Hong Kong integrate its climate policy to the broader municipal development policies.

The cities of New York, Chicago, Mexico City, São Paulo, Rio de Janeiro, Beijing, Hong Kong and Jakarta use the Definition of Regulations and Standards to reduce their GHG emissions.

Mexico City, Rio de Janeiro and Sao Paulo use Financial Incentives Policy Instruments and Improvement of Managerial Processes in the use of modes of transport and Improvement of Air Quality Management in cities to reduce their GHG emissions. The city of Hong Kong uses Financial Incentive Policies to reduce their GHG emissions.

In conclusion, within its administrative prerogatives, the aforementioned cities align their climate policies with those instructed by the ICCR. The effectiveness of these policies should be monitored in the coming years, according to the disclosed targets, with dissemination of methodologies and results of the emission calculations.

In relation to greenhouse gas reduction targets, the cities listed in Table 7 released their goals in the C40 Cities and other websites, detailed in Borges [4]: Tokyo, Mexico City, New York, São Paulo, Buenos Aires, Los Angeles, Rio de Janeiro, Paris, Jakarta and Chicago.

Table 7: Megacities' GHG reduction targets.

Megacity	Reduction targets
Tokyo	Disclosed emissions reduction target by 25%, compared to 2000, by the year 2020.
Mexico City	It was reported the results of the Climate Action Program in 2008-2012, which was the reduction of 7.7 million CO_2e, that reached the planned target. Mexico City has the first public policy instrument in its class in the country. The reduction achieved in the transportation sector was 4.8 million tons of CO_2e (62% of the total).
New York	Disclosed target for reducing CO_2 emissions by 30%, compared to 2005, by the year 2030.
São Paulo	The São Paulo City Hall announced a goal for reducing CO_2 emissions by 30%, compared to 2005, by the year 2012.
Buenos Aires	Disclosed target for reducing CO_2 emissions by 33%, compared to 2008, by the year 2030.
Los Angeles	Disclosed target for reducing CO_2 emissions by 35%, compared to 1990, by the year 2030.
Rio de Janeiro	Disclosed target for reducing CO_2 emissions by 20%, compared to 2005, by the year 2020.
Paris	Disclosed target for reducing CO_2 emissions by 25%, compared to 2004, by the year 2020.
Jakarta	Disclosed CO_2 reduction target by30%, compared to BAU – business as usual 2005, by the year 2030.
Chicago	Disclosed two reduction targets: of 25% of GHG emissions by the year 2020, compared to 1990, and 80% reduction of the city's GHG emissions by the year 2050, compared to 1990.

Source: picture 8 from Borges [4].

5.4 The concept of Exergy as an auxiliary tool to direct GHG mitigation policies in transportation sector

With the help of Energy and Exergy concepts, it is possible to indicate, theoretically, what actions resulting from GHG emissions mitigation policies can be considered effective in reducing GHG emissions and environmental impacts.

Energy = movement or handling ability. Exergy = work (ordered motion) or ability to perform work (ordered motion).

Source: Wall [15], pp. 9:17

According to Esteves [16]:

> The use of the concept of Exergy, which is a way to quantify the availability of the systems, is extremely timely for the integrated treatment of the current problems of energy supply and environmental protection, since the optimization of energy use should aim to reduce

the loss of availability of the used sources and the control of environmental degradation must seek, ultimately, reducing losses to the availability of natural resources.

The concept of Exergy can indicate, theoretically, for a studied given system, if the adopted options for mitigation policies lead to a level where energy is better utilized, with more efficient use of energy sources. This finding can consolidate more effective ways to meet GHG reduction targets in the transportation sector in megacities and their countries of origin.

According to Rosen and Dincer [17], since acid rain, depletion of the ozone layer and climate change have become more relevant issues in the 1980s, the links between energy use and the environment have become more known. As an example, the authors cite that the environmental impact of emissions can be reduced by increased resource utilization efficiency. However, the increased efficiency has implications because it increases the life time of the reserves of existing resources, but usually demands more materials, labour and complex devices in their handlings. Thus, exergetic analysis can reveal whether and how you can design more efficient energy systems by reducing inefficiencies in these systems. The authors mention that the United Nations indicate that the energy sector should consider broader strategies for atmospheric protection through programs in two main areas: increasing energy efficiency and changes to energy systems with lower environmental impact. The major areas of research are: (i) transmission, (ii) to increase energy efficiency and thus increase the exergetic efficiency, (iii) renewable energy sources and (iv) sustainable transportation systems.

It was also found that energy efficiency programs are important means of reducing CO_2 emissions and that these activities should be accompanied by measures to reduce fossil components in the energy mix in general and the development of new sources of alternative energy.

Increased efficiency preserves the exergy, by the reduction of the necessary exergy for a given process and thus reduces the environmental impact. The increased efficiency usually degrades exergy, through generation of entropy, in the form of waste from processes to the environment, impacting the environment. The use of external exergy resources, such as solar energy also reduces environmental impact by avoiding the use of the planet‘s resources. In general, the more efficient is a process, in the exergetic viewpoint, there is less destruction of order, lower creation of chaos, what means high entropy, and less environmental impact.

In the specific case of transport, by the examples that have been previously studied in different countries and also by the above concepts, it is concluded that the use of more efficient engines, the production of fuels in higher exergetic efficient systems, the use of solar energy, and use of energy sources produced with higher exergetic efficiency leads to lower environmental impacts. When Mitigation Policies are guided in this direction, they are likely to become successful in reducing environmental impacts and GHG emissions. The Exergetic Analysis is an important tool in the direction of reducing the environmental impact.

6 Conclusions

In relation to the objectives and hypotheses in this study, the following conclusions are set out in Table 8.

Other conclusions and considerations:

a) Japan was the country that achieved the best results in reducing its GHG emissions in the transportation sector during the studied period (2000–2011). According to the information contained on its national communication, the focus in this area has been the effective implementation of regulations and standards for the automotive industry and to adjust their oil refineries emissions standards that meet national laws related to air quality. The country also maintains investments in Research and Development in the transportation sector, focusing on the use of renewable energy sources or new sources of energy that may become viable in the coming years;

b) the cities of New York, Los Angeles and Chicago declare on the C40Cities site [13] GHG reduction targets for the coming years. Special attention should be given to the construction framework of the goals reported by the New York City, where the participation of several experts in the definition of actions to reduce GHG emissions was essential for the regulations planning that are being introduced in city in the form of municipal laws over time. In this sense, the city of New York should be seen as a good example to be followed by other administrations;

c) related to the adoption of the International Climate Change Regime (ICCR) mitigation policies, it was found that there is interest of all the studied countries of this work in having such policies, which does not mean the effective implementation of the procedures recommended by these policies. In this way, information policies, initial planning that are often not maintained over time due to other interests or severe injuries in some countries (wars, extreme weather events, financial crises or others), legislation that integrate climate issues to development policies are issues that were observed in almost all countries as an initial prescription to forward important issues for the local population, which in most cases is in line with national or local political interests. It is concluded that these procedures are the early stages and many others become necessary over time, along with the strengthening of institutions that can enable the advancement of compliance with laws and rules. It was also concluded that without the help of financial mechanisms established by the ICCR, as the Global Environmental Fund (GEF), for example, little progress would have occurred in countries with very low Human Development Index (HDI);

d) Mexico City presented a good example in demonstrating compliance with their GHG reduction targets, including the Transportation sector. Being a country with high Human Development Index (HDI) and stated needs of economic development, the fact that the country accomplished its fifth National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) demonstrates the concern of the Mexican government with the climate issue, which has already impacted the Mexican economy more intensely. In this sense, Mexico stated in its fifth National Communication that

Table 8: Objectives, assumptions and conclusions of the work.

Objectives	Assumptions considered	Conclusions
Survey question: Since the establishment of the International Climate Change Regime (ICCR), how has evolved the transportation emissions control of greenhouse gases in megacities and their countries of origin? To what extent this evolution indicates effectiveness of the ICCR? General objective: The general objective of the study is to evaluate the evolution of policies for controlling GHG emissions to discuss the effectiveness of the ICCR, regarding the adoption of policies to mitigate emissions by the transportation sector in megacities and their countries of origin.	Hypothesis 1 (General) – The existence of the ICCR and the commitments made by countries and megacities of this study inform the adoption of policies to control GHG emissions coming from the transportation sector. The existence of such policies indicates the effectiveness of the Regime.	Regarding Hypothesis 1, it was found that the countries and some of the studied megacities inform their GHG emissions control policies arising from the transportation area. In this sense the ICCR has been effective in the dissemination of GHG mitigation policies in the transport sector in the studied countries and megacities that adopt local policies for GHG emissions containment. It should be noted that many automobile exhaust emissions control policies include guidelines that are aligned with the ICCR policies, as these gases are also controlled by the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP).
Specific objective: To systematize the International Climate Change Regime (ICCR) guidelines on the actions to be adopted to reduce GHG emissions by the transportation sector.	Hypothesis 2: In general, the policies adopted by the countries and/or the megacities meet the guidelines expressed by the ICCR.	Regarding Hypothesis 2, in general, it is concluded that the policies adopted by the countries and the megacities that provided information on the sources consulted in this paper meet the guidelines expressed by the ICCR.
Specific objective: To analyze the convergence of the International Climate Change Regime (ICCR) guidelines and policies identified in the transportation sector in megacities and their countries of origin.	Hypothesis 3: Given Hypothesis 2, it is expected that the existence of policies to mitigate GHG emissions in megacities and/or their countries of origin have driven the actions of national or local governments for projects that include the ICCR guidelines.	Regarding Hypothesis 3, one can conclude that the policies adopted by the countries and/or the megacities that provided information on the sources consulted in this work promoted and encouraged proceedings of national or local governments in projects that include the ICCR guidelines.
Specific objective: To identify trends in emissions related to the transportation sector in the megacities and their countries of origin in the period of 1990- 2011 and discuss the results.	Given Assumptions 2 and 3, it is expected that the megacities and/or the countries, that adopted actions arising from the International Climate Change Regime – ICRR's GHG mitigation policies for	It can be concluded that the adoption of proceedings resulting from GHG mitigation policies in transportation was effective in Japan, the United States and France, when analyzing the behaviour data of these emissions from 2000 to 2011.

Table 8: Continued.

Objectives	Assumptions considered	Conclusions
	for the transportation sector, have reduced emissions in the period of 2000-2011, i.e., the adopted mitigation policies were effective.	Turkey and the Russian Federation, on the basis of population and GDP growths in the first and in function of the economic recovery after the breakup of the former Union of Soviet Socialist Republics (USSR) in the second, did not have results that demonstrate the GHG emission reduction in the period of 2000 to 2011. It should be considered that GHG emissions of the Russian Federation in 2011 are below the emissions reported in 1990. For countries in this study belong to the Non-annex I of the Kyoto Protocol (KP) it can be concluded that the ICCR has influence on the adoption of policies and domestic GHG mitigation actions in all of them, except Pakistan, the Philippines and Nigeria, where results could not be evaluated as related concrete actions, as these countries reported to the United Nations Framework Convention on Climate Change (UNFCCC) their first national communications. To perform the analysis of the effectiveness of GHG mitigation policies, due to varying periods reported by countries to the UNFCCC in their national communications, average variations of GHG emission behaviour of the transportation sector in these periods were calculated. It is concluded that the effectiveness of the adoption of these policies and related proceedings when confronted with the development needs of the countries belonging to the Non-annex I have not shown positive results in reducing GHG emissions.
Specific objective: Identify actions and goals related to the megacities' transportation GHG emissions after the year 2012, verifying the potential reductions to be obtained.	The studied megacities include in their GHG's emissions reduction targets, after the year 2012, corresponding policies and actions for the transportation sector.	Regarding the studied megacities, 18 of the 31 analyzed have reported GHG mitigation policies for the Transportation sector and 10 of them have GHG reduction goals for the coming years, including actions in the transportation sector. Thus, it is concluded that within its administrative prerogatives, 58% of the evaluated cities align their

Table 8: Continued.

Objectives	Assumptions considered	Conclusions
		align their climate policies with those instructed by the International Climate Change Regime (ICCR). The effectiveness and efficiency of these policies, in the form of actions to reduce GHG emissions in the transportation sector, can be monitored in the coming years, according to the disclosed targets and with the release of their GHG emissions inventories, that cover the methodologies and results of the calculations.

the country shall take actions to adapt to climate change, without, however, abandon mitigation actions;

e) it is important to follow the evolution of the Mexico City Pact [18], with the accession, until May 2011, of 185 cities and local authorities. The Pact is committed to the adoption of mitigation and adaptation policies to climate change, reduction goals of local GHG emissions, as well as the dissemination of the results of local GHG gas inventories for monitoring these goals;

f) special attention to China and India should be given, not only because China is currently the world‘s largest emitter of greenhouse gases, but also because the two countries are the most populous on the planet and to meet the needs of these populations to improve their standards of quality of life certainly brings important issues, some covered in this study. It is considered important the concern of governments of these two countries with research and development in the climate area, not only for monitoring of current and future occurrences of the climate, but also in the development of alternative sources of energy to meet the growing demand of their countries, prevention risks to their poorest populations by weather events currently underway in the region and reported in their national communications;

g) it is important to monitor the development of the concept and the results of economic growth with reduction of GHG emissions per unit of GDP, which is expressed by some governments as a way to alleviate their growing greenhouse gas emissions, with goal setting to be achieved in the coming years, as the case of China, that could have a greater impact on the reduction of global greenhouse gas emissions. Hung and Tsai, cited by Viola and Lessa [19] point out the various dilemmas that are faced by the Chinese elites in relation to the accelerated economic growth to consolidate a new superpower and eradicate poverty versus the need to avoid the burden of stalling the negotiations on the climate change. China, being one of the countries most vulnerable to climate changes, is very tempted to grow quickly in an attempt to alleviate the impact on the country and its people when the situation becomes more critical. According to Viola *et al*. [20], the Chinese reformist elite is located in high development centers, especially in the city of Shanghai and in the nuclear, solar and wind

energy sectors; also the awareness of the threats of climate change is greater in coastal regions than in mainland China. According to these authors, several factors combined can explain the growth of these reformist forces in the country, the first being the strong drivers for using sources of non-fossil fuels. The second element would be the dynamics of the Communist Party, which in the last two decades have prioritized the technical and scientific capacities of its members rather than the political ideology. The third element would be the restoration of the Confucian cultural heritage;

h) for the megacities of São Paulo and Rio de Janeiro, located in Brazil, where this study was accomplished, it was observed the diffusion of almost all the International Climate Change Regime (ICCR) mitigation policies, without, however, practical results in the reduction of GEE emissions in the transportation area. The complaints of the people of these two cities and others located in Brazil in relation to the quality of service in the public transportation sector have occurred steadily for several years and especially in 2013, with several demonstrations of discontentment with public services in these areas, among other issues addressed in social events that occurred in the country. In this sense, it is important to evaluate whether it would be appropriate to focus on actions that have been proved more effective in other cities when related to the changes and goals declared by the two City Halls. The cities of Tokyo, New York, Hong Kong – with the information that 90% of the population use urban public transport to move around, and Mexico City could bring good contributions for the Administrations of São Paulo and Rio de Janeiro, as other cities that already serve as models in their current plans. It is also expected that the GHG emission inventories of both cities are carried out steadily, within the periods reported in their planning so that one can track the results of the implemented actions and/or correct the distortions observed;

i) examples of actions contained in Picture 12 of Borges [4] have shown the major role of the megacities of the World to implement solutions that improve the conditions of transport, air quality and traffic in their areas of influence. It is important to note the evolution of this framework and its GHG emission reductions in the future;

j) with respect to the distribution of countries within the categories listed in the Kyoto Protocol – Annex I and Non-annex I, it may be important and relevant that the Conference of Parties (COPs) discuss the current validity of the initial division that was made, in view of the results that are submitted by countries related to their GHG reduction emissions. According to the classification of Viola *et al*. [20], the countries that stand out in the leadership of climate global governance have behaved towards their commitments as follows: conservative (India, Russia, Argentina, United Arab Emirates, Indonesia, Saudi Arabia, Iran, Egypt, Nigeria, Pakistan, Thailand, Ukraine, Venezuela and Vietnam); moderately conservative (United States, China, Brazil, Canada, Colombia, South Africa, Malaysia, Mexico, Turkey, Israel, Australia, Bangladesh and the Philippines); and reformist (Norway, Taiwan, Switzerland, Singapore, European Union, South Korea and Japan). As Putnam [21], in its findings of significant evidence on the links between diplomacy and domestic policies, when he points

to the possibility of synergy on connected matters, in which the strategic moves in the negotiating tables facilitate unexpected coalitions in the second stage of the negotiation, it could be foreseen, in the next rounds of the Convention negotiations in the COPs, the joint action of countries like Brazil, China, Mexico, Argentina, India and others, with interest and potential in this sense, for the definition of emission growth targets of GHG per unit of Gross Domestic Product (GDP). Here, it could be proposed the creation of an intermediate category, where some countries that were evaluated in this study could be acting together with more strong actions to control their GHG emissions per unit of Gross Domestic Product (GDP). The use of more efficient technologies for reducing emissions could be objectified more intensely in these countries, including those that show up now available for adoption in transportation (such as non-fossil fuels first generation – the so-called biofuels);

k) countries with very high Human Development Index (HDI), and in this study they were represented by those which have reduced their greenhouse gas emissions in the transportation sector, need to maintain constant control over their emissions and also proceed in compliance with targets to be established in the coming years;

l) in the specific case of transport it is concluded that the use of more efficient engines, the production of fuels in higher exergetic efficient systems, the use of solar energy, and use of energy sources produced with higher exergetic efficiency leads to lower environmental impacts. When Mitigation Policies are guided in this direction, they are likely to become successful in reducing environmental impacts and GHG emissions. The Exegertic Analysis is an important tool in the direction of reducing the environmental impact, with important application in the definition of energy sources change strategies used in transportation;

m) it is the opinion of this paper's author that the findings do not constitute in any demerit for the International Climate Change Regime (ICCR), for the United Nations Framework Convention on Climate Change (UNFCCC) or even the Kyoto Protocol (KP) but a natural evolution due to the events that are already evident and are upgradeable for any schemes implemented that depend on the evolution of technology and monitoring events not fully controlled by human beings, such as the weather. Therefore, it is important that the actions defined in the Conference of Parties (COPs) are accompanied with more attention and rigor by the UNFCCC and implemented by countries and megacities to achieve the expected results.

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