

## **Carbon Market Projects: Status and Contribution to GHG Emission Reduction in Brazil**

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### **Abstract**

*This paper aims to verify current status of project activities in the carbon markets in Brazil. To this end, an empirical database was constructed with secondary data collected from the Project Design Documents (PDD) of carbon market projects undergoing approval in Brazil on June 30th, 2011. The results of this study show the high prevalence of regulated carbon market projects compared to the voluntary carbon market. In terms of the type of GHG reduced, carbon dioxide (CO<sub>2</sub>) is currently the most represented in both the regulated and voluntary markets (67% and 59% respectively). Large and small hydroelectric plants are responsible for 61% of renewable energy generation in the regulated market and 99% in the voluntary one. Finally, we recommend that future studies compare the Brazilian experience to those of the two other main host countries for regulated and voluntary carbon market projects, namely China and India.*

**Key words:** GHG Emission, Carbon Market, Brazil.

### **1. Introduction**

Discussions about sustainable development have driven not only obligations and compliance targets, but also business opportunities for companies in emerging countries, such as Brazil. Among these opportunities is the so-called Clean Development Mechanism (CDM), instituted by the Kyoto Protocol (KP), which aims to reduce the emission of polluting gases into the atmosphere. Through the CDM, companies based in signatory countries of the Protocol and those obliged to comply in terms of their emissions may reduce some of their responsibilities by purchasing carbon credits.

These carbon credits may be acquired in the form of investments in environmentally sustainable projects run by companies in emerging countries. Thus, a Brazilian industry that implements a project proven to reduce greenhouse gas emissions in its production process may be able to raise funds from foreign corporations, selling the carbon credits generated through the internally obtained reduction. The carbon market is divided into two categories: the regulated market and the voluntary market. There is no single set of rules for the voluntary market. Rather, the project design parameters, defined in the regulated market by the KP and local governments, are set by a range of International Standards (IS). These standards function as guidelines, in other words, they establish rules and frameworks that guide and confer credibility to the development of projects for the reduction of emissions in the voluntary carbon market (Bayon, Hawn & Hamilton, 2009).

Verified Emission Reductions (VERs) are commercialized in voluntary carbon markets from projects to reduce GHG<sup>1</sup> emissions and are driven by the operations of Non-governmental Organizations (NGOs), companies, governments and civil society organizations (Lima, 2007). These agents, who do not have emission reduction targets, participate within the voluntary carbon market spontaneously and are driven by values associated with company brand, socio-environmental responsibility and concern for business competitiveness (Simoni, 2009).

One of the problems of this scenario is seen in the differences within each market (regulated by Kyoto or voluntary, with rules set by ISs). These differences may be related to the profile of the negotiated projects, their characteristics, the volume of emission reductions, the scope of activities, their potential for GHG emission reduction, their energy potential, geographic location, method, the standard of project design, type of gases reduced and the specificities existing within each market, such as the existence of targets in one and their inexistence in the other, as well as the types of participants and their interests (MCT, 2011, IBRI, 2009).

Given this and considering that both the regulated and voluntary carbon markets are considered highly significant in combating climate change and providing important economic alternatives to combat environmental problems (Labat & White, 2007; MCT, 2011; Lombardi, 2008) and are also essential instruments in overcoming the shortcomings of the existing markets and contributing to the sustainability of Brazilian companies, this research seeks to answer the following question: What are the main differences between the regulated and voluntary carbon markets in Brazil?

The study's overall aim is to identify the main similarities and differences between the regulated and voluntary international markets for the commercialization of carbon credits in Brazil from 2004 to 2011, thereby contributing to the formulation of public policy aimed at the development of these markets. We also aim to create a database containing projects from the voluntary carbon market, which up to now has not existed in Brazil, as well as contributing to literature related to this still incipient research area. A world with carbon restrictions may provide opportunities but it also brings with it many risks. How a company responds to the issue of climate change may enhance or damage its value in relation to its target audience. Investors and analysts are therefore increasingly aware of what corporations are doing in relation to carbon and climate change issues (Hamilton, S Jardim & Peters-Stanley, 2010).

## **2. Materials and Methods**

Discussions about the global carbon market are rare in Brazil (Silva-Júnior, 2011), particularly in relation to the regulated and voluntary categories for the commercialization of carbon credits, which are not widely found in the literature as it is such a new topic. The nature of this area of investigation necessitates the adoption of exploratory and documentary research. The former involves a preliminary study to gain greater familiarity with the phenomenon under investigation and limited to defining objectives and seeking information about a specific subject. It usually involves bibliographic and documentary surveys (Cervo & Bervian, 1983; Kmeteuk Filho, 2005; Ruiz, 1978).

The choice of research process is a fundamental step towards consistency in the analysis of collected data. Further, in line with Quivy and Campenhout (1998), this choice requires an understanding of the characteristics of the collected data, so that the process can work towards the proposed objectives of the research.

Secondary data was collected through a content analysis of Project Design Documents (PDD), mapped and extracted from the websites and databases analyzed.

Furthermore, we undertook a mapping of the projects in the voluntary carbon market in Brazil up to June 2011 by searching databases and International Standards (IS) institutional websites as well as those of their applicants. This mapping was undertaken by searching voluntary carbon market databases, for example, that of the Markit Environmental Registry ([www.markit.com](http://www.markit.com)), which has a database of IS projects.

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<sup>1</sup> Gases such as: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and hydrofluorocarbons (HFCs). They have different Global Warming Potentials (GWP), which is measured relative to the warming potential of CO<sub>2</sub>. Thus, for example, the GWP of CH<sub>4</sub> is 23 tonnes of CO<sub>2</sub> equivalent (CO<sub>2</sub>e) per tonne of CH<sub>4</sub>, and the GWP of N<sub>2</sub>O is 296 tonnes CO<sub>2</sub>e/tonnes N<sub>2</sub>O.

However, it is important to note that, although the Markit database covers some PDDs, it does not include all the projects in the voluntary carbon market as some PDDs are only found on the IS institutional websites, which may or may not be linked to the websites of their applicants.

The PDD mapping was carried out in order to gather information about existing projects, given that there is no single database in the voluntary carbon market that includes all its projects. In Brazil's regulated carbon market, Clean Development Mechanism (CDM) projects are aggregated by the Ministry of Science and Technology (*Ministério da Ciência e Tecnologia: MCT*) in a database available through its website ([www.mct.gov.br](http://www.mct.gov.br) – in Portuguese), which contains all the PDDs that include information about these projects across the country.

The time period for mapping the voluntary market projects was January 2004 to June 2011. This period was chosen because the most recent report published by the MCT regarding the status of the market in Brazil regulated by the CDM was compiled on June 30<sup>th</sup> 2011, thus providing temporal consistency for the purposes of comparison. All the projects registered in the voluntary carbon market from 2004 onwards were mapped. This was the year when Brazil's first CDM project was registered in the regulated market, thus the research period was defined as between 2004 and 2011.

Through this mapping we identified that on June 30<sup>th</sup> 2011, the Brazilian voluntary carbon market had 111 projects linked to an IS. In the most recent compilation conducted by the MCT, the number of projects in the regulated carbon market in Brazil totaled 499.

The status of the voluntary carbon market projects we mapped ranged from: projects approved and registered by the IS; projects in the validation phase for later approval and registration by the IS; validated projects; and projects awaiting approval and registration by the IS. In the regulated carbon market, on the other hand, there are: projects that have been received by the CDM Executive Secretary but have not yet had their documents checked and submitted; projects that already have their PDD referred for appraisal, in line with the CDM cycle of projects, thus receiving approval status within the sphere of the Brazilian Designated National Authority (DNA); projects approved with DNA provisos; and projects under review.

Brazilian DNA approved projects in the regulated carbon market are submitted for approval to the UN's CDM Executive Board and receive the status of registered (when approved) or requesting registration by the Board (awaiting approval).

Table 1 shows the model of analysis constructed to operationalize the research:

CONCEPT	DIMENSION	COMPONENT	INDICATORS
Carbon Market	Regulated Carbon Market	Clean Development Mechanism (CDM)	Project status
			Project Sectoral Scope
			Number of Brazilian Projects by Sectoral Scope
			Potential for Annual Emission Reduction by Sectoral Scope
			Number of Projects by Country Region
	Voluntary Carbon Market	Projects to Reduce GHG Emissions	Type of Project by scale
			Distribution of project activities in Brazil by International Standard
			Distribution of project activities in Brazil by type of greenhouse gas reduced
			Project Market Share by potential for annual reduction by type of market in Brazil
			Capacity to generate electricity

**Table 1 – Research Analysis Model**

Source: Prepared by the Authors.

In order to verify the components of each dimension according to the defined objectives, it was necessary to determine the indicators so as to examine these components within their respective dimensions. Since this is a comparative analysis between the regulated and voluntary carbon markets, we looked for indicators which were common to both markets. This enabled us to investigate and compare the two dimensions in the model of analysis. The indicators used in the model of analysis were thus adapted for this research from those used by the MCT to outline the regulated carbon market profile in Brazil, whose results are periodically published in a publication called: “The current status of project activities in the Sphere of the Clean Development Mechanism (CDM) in Brazil and the world”.

The fact that these indicators were inherent in the project activities of the carbon market made it possible for us to use them to investigate the voluntary carbon market, where there are no indicators that reflect the status of this market in Brazil to date. These indicators were adapted and complemented by a literature review and constitute the model of analysis.

It is worth noting that the adaptations we made to the MCT indicators were essential to achieving the specific objectives of this research, given that the use of other indicators for investigation could invalidate the possibility for comparison proposed by the research. This was why we used exploratory research in order to define indicators of analysis that were compatible with a research study to investigate and compare the two markets in Brazil.

To process the data for this research we created Microsoft Excel 2007 spreadsheets in which we recorded all the information from the projects mapped in the carbon market in Brazil which related to the indicators in the model of analysis. Finally, the collected data was treated, tabulated and processed using the descriptive statistics functions of Microsoft Office Excel 2007 in order to analyze the differences between the regulated and voluntary carbon markets.

### **3. Results**

#### **3.1 Project Status**

As mentioned previously, Brazil has direct operations in both the regulated and the voluntary carbon markets, with projects to reduce GHG emissions. According to the MCT (2011) the number of CDMs in the Brazilian regulated carbon market totaled 499. This included projects received by the CDM Executive Secretary that have not yet been analyzed, so they cannot be considered as submitted; projects which have had been checked and submitted; and projects whose PDDs have been referred for appraisal, in line with the CDM project cycle.

Of these 499 projects, 268 have been approved by the Brazilian DNA, with 264 approved by the Interministerial Commission on Global Climate Change (*Comissão Interministerial de Mudança Global do Clima: CIMGC*), 3 receiving approval with provisos and 1 under review at the CIMGC (MCT, 2011), while the documents of 231 projects remain under analysis by the Executive Secretary, as seen in Table 2.

**Table 2 – Current status of projects at the Brazilian DNA**

<b>Status of Brazilian Projects in the regulated carbon market</b>	<b>Quantity</b>
Projects approved by the CIMGC	264
Projects approved with provisos from the CIMGC	3
Projects under review at the CIMGC	1
Projects whose documents are still under analysis by the Executive Secretary	231
Projects submitted to the CIMGC’s next meeting	0
<b>TOTAL NUMBER OF PROJECTS AT THE CIMGC</b>	<b>499</b>

Source: MCT (2011, p. 9).

Activities approved with provisos are those where the project is eligible and makes contributions to sustainable development but where certain quantitative and/or qualitative inconsistencies have been identified which require adjustment, while activities under review constitute documents that need to be adjusted due to errors and/or which require adaptation to meet the eligibility criteria. Of these 264, 193 projects have already been registered by the CDM Executive Board, while 71 are awaiting registration, as seen in Table 3.

**Table 3 – Current status of Brazilian project activities at the CDM Executive Board**

<b>Status of Brazilian Projects in the regulated carbon market</b>	<b>Quantity</b>
Brazilian projects registered by the Executive Board	193
Brazilian projects pending registration by the Executive Board	71
<b>TOTAL NUMBER OF PROJECTS AT THE EXECUTIVE BOARD</b>	<b>264</b>

Source: MCT, (2011, p. 9).

In the voluntary carbon market, where regulatory structures are constituted through the ISs, the current status of project activities reveals a small number of projects in Brazil. Unlike CDM projects in the regulated market, when projects in the voluntary market linked to an IS are submitted they receive the status of approved and registered. Projects which are under analysis and/or submitted receive the status “in the pipeline”, whether they are in the process of validation by the Designated Operational Entity (DOE) or awaiting approval and registration by their respective IS.

The research mapped 111 Brazilian projects which cover all the stages of the voluntary market project cycle, of which 95 have been duly approved and registered by their respective IS, with 14 projects in the prerequisite validation process for project approval and subsequent registration and 2 projects validated, awaiting approval and registration, as can be seen in Table 4.

**Table 4 – Status of Brazilian projects in the voluntary carbon market**

<b>Status of Brazilian projects in the voluntary carbon market</b>	<b>Quantity</b>
Projects Approved and Registered by the IS	95
Projects in the Validation phase for subsequent approval and registration by the IS	14
Validated projects awaiting approval and registration by the IS	2
<b>TOTAL</b>	<b>111</b>

Source: Prepared by the Authors (2011).

Whether in the regulated market category (Tables 2 and 3) or in the voluntary market category (Table 4), project activities are carried out within different sectoral scopes and certain scope differences exist between the compared markets, as discussed below.

### 3.2 Project Sectoral Scopes

Here we present and discuss the sectoral scopes existing in the regulated and voluntary carbon markets, giving a broad overview of the existing project activities in both markets, including opportunities for project development and a description of each activity. This may serve to support both decision-making for new entrants into this market and the creation of public policies for the sector.

In the energy efficiency sectoral scope, project activities which use process gas were identified in both markets, while activities for energy demand and distribution were only seen in the regulated market. Activities related to more efficient wood burning stoves specifically fell within the voluntary carbon market.

In relation to the renewable energy sectoral scope, while activities for the cogeneration of energy through the burning of sugarcane bagasse and wind energy were only identified in the regulated market, activities for the use of other biomasses in the process of generating energy, as well as Small Hydroelectric Plants (SHP) and hydroelectric plants were identified in both the regulated and voluntary markets. Both this scope and the one relating to waste include activities that are specific or common to both markets. While sanitary landfill activities, which are associated with the capture of methane and burning for the cogeneration of energy, are only observed in the regulated market, activities relating to effluent are common to both the regulated and voluntary markets.

Specificities in other scopes were identified for both the regulated and voluntary market. Fugitive emissions, charcoal and industrial process activities, such as those related to cement, the production of aluminum, N<sub>2</sub>O reduction and the use of renewable CO<sub>2</sub>, are all specific to the regulated market.

The scopes related to switching native forest fuel and recycling were only identified in the voluntary market. These native forest fuel switching activities include switching native forest charcoal for eucalyptus charcoal; native biomass for biomass from factory waste; native forest charcoal for pallets, sawdust and wood chips; native biomass fuel for planted biomass or natural biomass, such as switching native forest charcoal for sugarcane bagasse, elephant grass, coconut bagasse and rice husks; while recycling activities include the recycling of refrigerators, freezers and air conditioners, which are pioneering activities in this market in Brazil.

The sectoral scopes for managing swine manure, reforestation associated with the recovery of degraded areas, forest management and switching fossil fuels are all scopes with activities in both the regulated and voluntary markets.

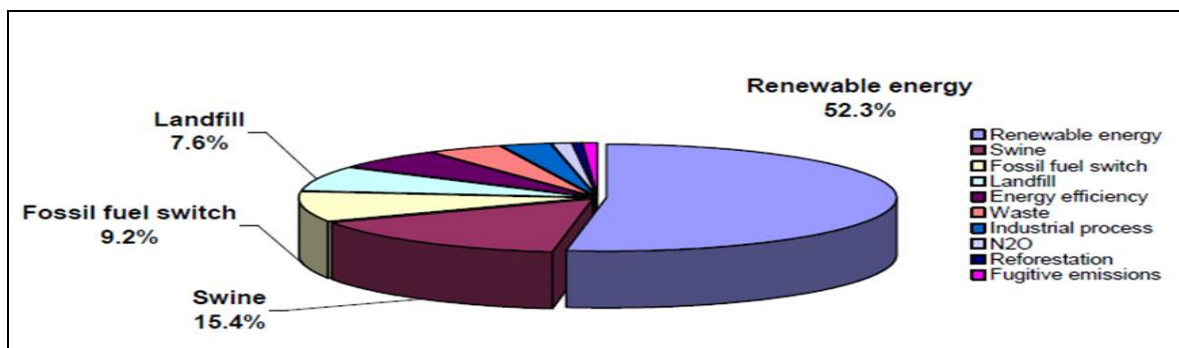
When we analyzed the scope of activities in both the regulated and voluntary markets in the light of the objectives of the National Plan on Climate Change (*Plano Nacional sobre Mudança do Clima: PNMC*), we were able to confirm that while voluntary market projects in the country are still in their early stages, they have significant potential for growth, given that most are aimed at combating the burning and deforestation of native forests, one of the principal focus areas for emissions that pollute the atmosphere and which, given the balance of global emissions, place Brazil amongst the main global emitters (Mckinsey & Company, 2009).

The distribution of project activities across both markets by sectoral scope will be presented and discussed below and this will provide a picture of each sector within both markets.

### 3.3 Number of Brazilian Projects by Sectoral Scope

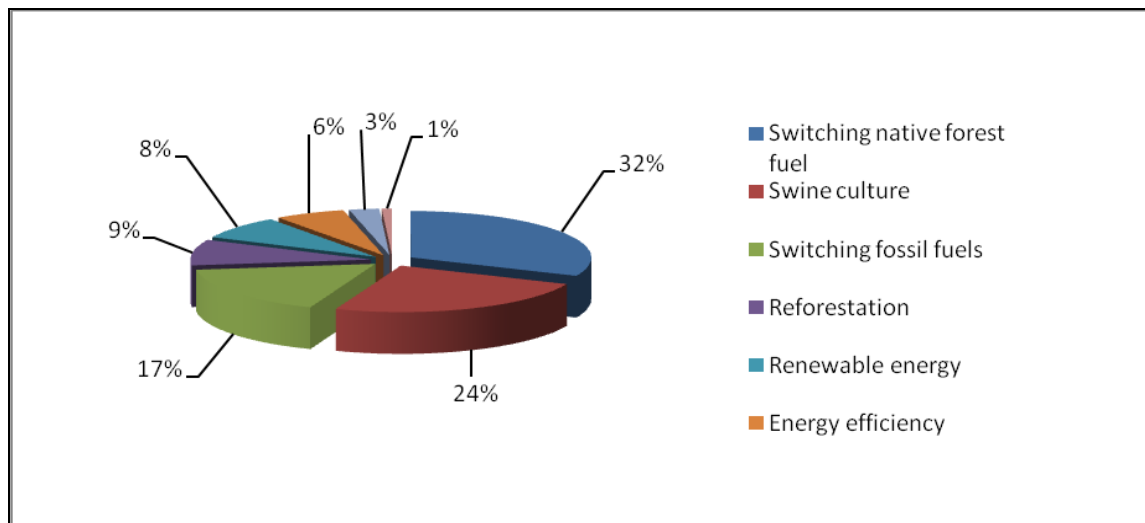
Sectoral scopes provide an overview of the activity sectors in which emission reduction projects take place. Thus one can see which sectoral scopes are more attractive to companies and/or investors in the development and/or generation of carbon credits in Brazil.

According to Figure 1, the scope with the highest number of CDM projects in the regulated carbon market in Brazil is renewable energy with 52.3%; this is in line with the principal Brazilian energy matrix which is renewable energy. Swine culture is in second place at 15.4%, followed by switching fossil fuels at 9.2% and sanitary landfill at 7.6%. Other sectors which include projects for energy efficiency, waste, industrial processes, N<sub>2</sub>O reduction, reforestation and fugitive emissions account for 15.5% of the total number of projects in this market.



**Figure 1 – Number of Brazilian projects from the regulated carbon market by sectoral scope**  
 Source: MCT, (2011, p.7).

According to Figure 2, unlike the regulated market, the dominant scope for projects in the voluntary carbon market is switching native forest fuel, 32%, with swine culture in second place with 24% of projects, followed by switching fossil fuels, 17%. Other projects are associated with reforestation, renewable energy, energy efficiency, waste and recycling, which in total account for 27% of the projects in this market.



**Figure 2 – Number of Brazilian projects in the voluntary carbon market by sector**  
Source: Prepared by the Authors.

In Figure 2 a specific factor in our comparison of the voluntary with the regulated carbon markets related to the scopes for switching native forest fuel and recycling becomes evident. This is the number of projects in this market where the native forest used in local production processes is replaced with planted forest. The voluntary market has many such projects, unlike the regulated one, which does not accept this type of project. The recycling scope, with only 1% of project activities, is a pioneering activity in Brazil and was only found in the voluntary market. These types of projects are also among the principal emission reducers within the voluntary carbon market, although projects in the regulated carbon market, mainly within the renewable energy scope, provide the most reduction and/or mitigation of GHG emissions in Brazil, as discussed below.

### 3.4 Annual Potential Emission Reduction by Sectoral Scope

An analysis of the potential for annual GHG emission reduction reveals the principal projects that contribute to the mitigation of climate change. It also allows us to examine, by sectoral scope, the contributions of these projects and of Brazil to meeting the targets established by the PNMC. Table 5 presents the potential annual reduction brought about by projects in the regulated carbon market. Here we can see that renewable energy projects, the main sectoral scope in Brazil in terms of projects (52.3%), contribute most to emission reductions, totaling 40.3% of total reductions, with an annual potential for emission reduction of 21,125,083 million tCO<sub>2</sub>e.

**Table 5 – Annual reduction of GHG emission by sector/ activity type in the regulated carbon market**

Projects in the Validation/Approval Phase	Number of Projects	Annual emission reduction (tCO <sub>2</sub> e) in millions	Annual emission reduction %
Renewable Energy	261	21,125,083	40.3%
Sanitary Landfill	38	12,307,823	23.5%
N <sub>2</sub> O Reduction	5	6,373,896	12.2%
Managing Manure from Swine culture	77	4,244,755	8.1%
Switching Fossil Fuel	46	3,329,139	6.3%
Energy Efficiency	30	2,180,709	4.2%
Reforestation	3	440,275	0.8%
Industrial Processes *	14	1,002,940	1.9%
Waste**	21	709,921	1.4%
Fugitive Emissions	4	720,068	1.4%
<b>TOTAL</b>	<b>499</b>	<b>52,434,609</b>	<b>100.0%</b>

Source: MCT (2011, p. 8).

\* This only includes projects for cement, aluminum production and the use of renewable CO<sub>2</sub> and not those related to N<sub>2</sub>O Reduction.

\*\* This accounts for effluent projects, but not sanitary landfill.

Table 5 also demonstrates that, although the number of sanitary landfill and N<sub>2</sub>O reduction projects is not significant, as demonstrated in the previous section (see Figure 1), in terms of potential emission reduction these rank second and third, respectively. Sanitary landfills contribute to an annual reduction of 12,307,823 million tCO<sub>2</sub>e, while N<sub>2</sub>O reduction projects provide an annual reduction of 6,373,869 million tCO<sub>2</sub>e. This can be explained by the different GHG Global Warming Potentials (GWP). While carbon dioxide (CO<sub>2</sub>) has a GWP of 1, methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) have GWP of 21 and 310 respectively, which explains why, although these projects only have a small number of activities, they contribute significantly to the reduction and/or mitigation of GHG (Seiffert, 2009; Araujo, 2008).

The scopes that contribute most to the annual GHG emission reduction capacity within the voluntary carbon market are those of renewable energy, with an annual reduction of 1,051,649 million tCO<sub>2</sub>e, representing 37% of the annual reduction in this market and converging with the regulated carbon market, whose projects are also the principal cause of climate change mitigation. This is followed by native forest fuel with an annual reduction potential of 630,680 million tCO<sub>2</sub>e, representing 22% of annual reduction and then reforestation with a reduction potential of 417,874 million tCO<sub>2</sub>e, representing 15% of reduction, and switching fossil fuel, with an annual reduction potential of 335,027 million tCO<sub>2</sub>e, representing 12% of total annual reduction, as seen in Table 6.

**Table 6 – Annual reduction of GHG emissions by sector**

Projects in the Validation/Approval Phase	Number of Projects	Annual emission reduction (tCO <sub>2</sub> e) in millions	Annual emission reduction %
Renewable Energy	9	1,051,649	37%
Switching Native Forest Fuel	35	630,680	22%
Reforestation	10	417,874	15%
Switching Fossil Fuel	19	335,027	12%
Recycling	1	226,626	8%
Managing Manure from Swine culture	27	108,949	4%
Waste	3	81,286	3%
Energy Efficiency	7	24,834	1%
<b>TOTAL</b>	<b>111</b>	<b>2,876,925</b>	<b>100%</b>

**Source:** Prepared by the Authors

From an analysis of Tables 5 and 6, we can confirm that, although projects to manage manure from swine culture are the second largest in the regulated and voluntary markets in terms of projects, 77 and 27 respectively, in both markets they only make a very small contribution to the reduction of GHG emissions, only 8.1% and 4% reductions, respectively, of total annual emissions.

Despite there being just one project the recycling scope merits attention as this contributes to an annual emission reduction of 226,626 million tCO<sub>2</sub>e, representing 8% of total annual reductions and ranking fifth. This is because of the type of GHGs that the project addresses: Chlorofluorocarbon (CFC) and Hydrofluorocarbon (HFC), with more potent GWP and higher carbon dioxide equivalency factors over the 100-year time horizon, some of which are 6500 times (CF<sub>4</sub>), 11700 times (HFC-23), 650 times (HFC-32), 150 times (HFC-41) and 2800 times (HFC-125) higher. These all contribute to the destruction of the ozone layer. These are used as gases in refrigeration (UNFCCC, 2011; Godoy, 2010).

Aside from the projects that are directly linked to the PNCM, reforestation projects in both the regulated and voluntary Brazilian carbon market categories contribute only very slightly to the annual reduction of GHG, with only 0.8% and 15% reductions in the total annual emissions within their respective markets.

With regard to meeting the PNM goal of a projected reduction of between 36.1% and 38.9% of GHG emissions by 2020, specific public policies need to be created in order to promote a higher number of projects in these 2 sectors, as well as to stimulate development within the other sectoral scopes, given that 76.4% of Brazilian CO<sub>2</sub> emissions come from the deforestation brought about by changes in land and forest use (WRI, 2005).



The creation of policies focused on this scenario will enable some of the goals proposed by the PNMC for the reduction of GHG to be achieved, such as 80% and 40% reduction in deforestation in the Amazon and Cerrado, respectively, and the expansion of no-till farming in the agricultural sector (Brasil, 2009).

Such policies must reach all the regions of the country and stimulate project development, given that project activities to reduce GHG emissions can be found over practically the entire national territory, despite regional inequalities, as discussed below.

### 3.5 Number of Projects by Country Region

Here we present the way in which project activities for the reduction of emissions in Brazil from both the regulated and voluntary markets are distributed and the fact that actors actively participate in running such projects in practically all the Brazilian states.

In the regulated carbon market, we found that the largest concentration of CDM projects is situated in the Southeast region of the country, with an emphasis on São Paulo, which is home to 21% of all projects, and Minas Gerais, with 16%, as seen in Figure 3. This Figure reveals the location of the 264 projects in Brazil.

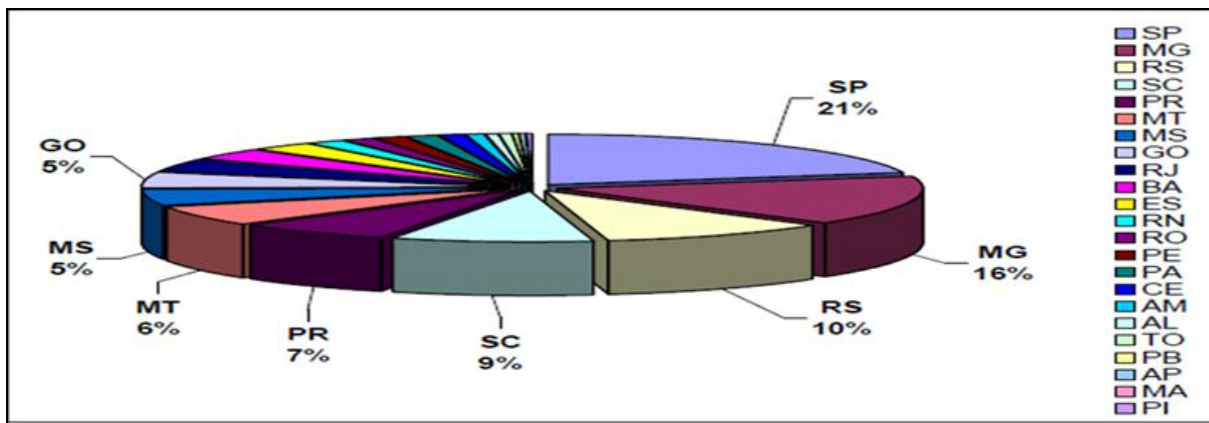


Figure 3 – Distribution of the number of CDM project activities in Brazil by state  
Source: MCT (2011, p. 11)

With regard to the distribution of projects within the voluntary carbon market by state, Figure 4 presents the location of the 111 projects operating in Brazil, as seen below.

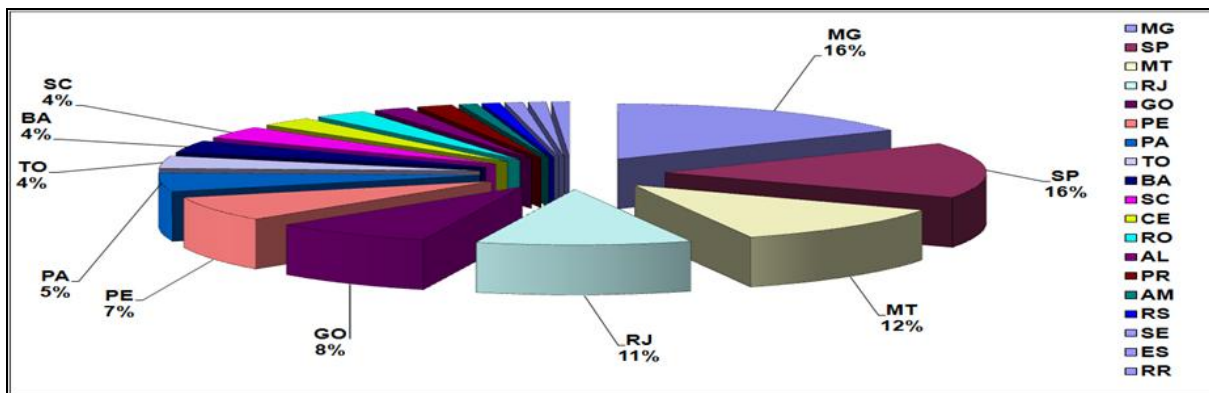


Figure 4 – Distribution of projects in the voluntary carbon market by Brazilian state  
Source: Prepared by the Authors (2011).

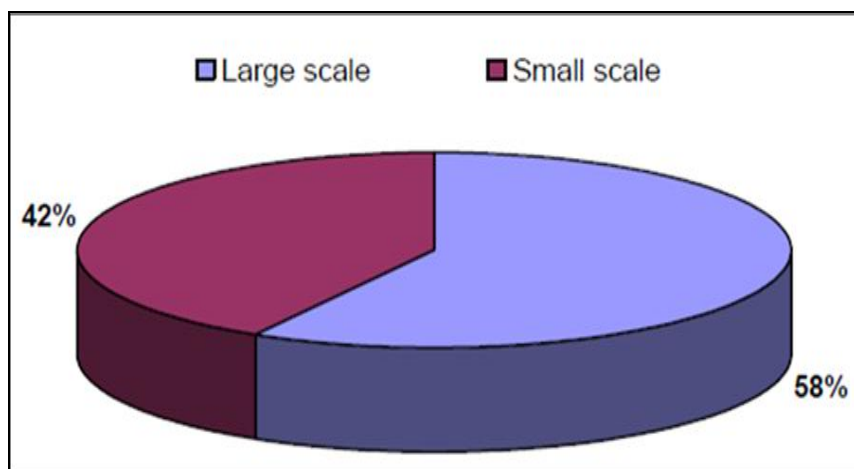
This distribution features projects in the states of Minas Gerais and São Paulo, 16% in each, and in Mato Grosso (12%), Rio de Janeiro (11%), Goiás (8%) and Pernambuco (7%), which together account for more than 70% of the projects developed and registered in the voluntary carbon market in Brazil.

It is worth highlighting the importance of the Southeast region on the domestic economic and financial scene, this is a factor in this top project ranking for the States of São Paulo and Minas Gerais in both the regulated and voluntary carbon markets in Brazil. Such projects follow specific methods which define project size in terms of scale and may be classified as small or large scale, as we will discuss in the following section.

### 3.6 Type of Project by Scale

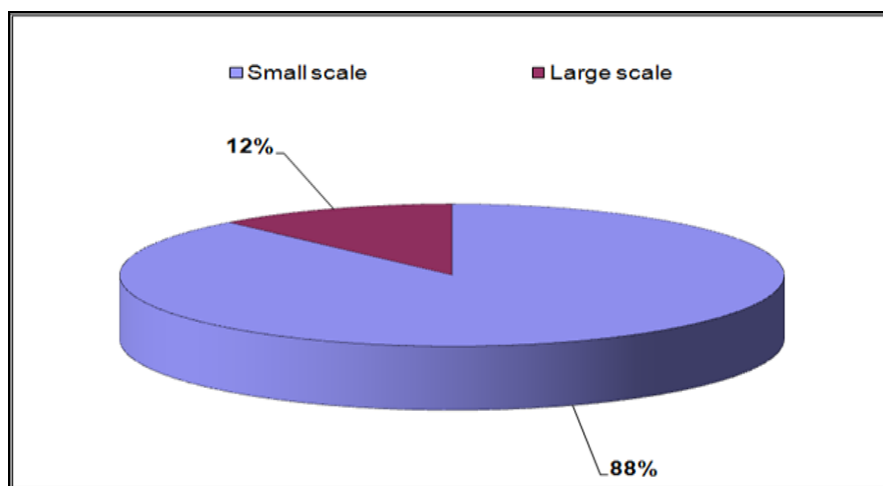
According to the MCT (2011), three types of activities define a small scale project, these are 1) renewable energy project activities (with a capacity of up to 15 megawatts) 2) improved energy efficiency project activities (which reduce the consumption of energy up to the equivalent of 60 gigawatts/hour per year and 3) project activities which result in emission reductions less than or equal to 60 kilos tCO<sub>2</sub>e per year. Other activities that do not fall within these three types are considered to be large scale.

Transaction costs are differentiated in each type scale applied to the project, whether small or large scale, with large scale projects being those with higher transaction costs. Thus, the majority of CDM projects within the Brazilian regulated market are large scale projects, constituting 58% of project activities, whereas small scale projects represent 42%, as seen in Figure 5.



**Figure 5 – Distribution of project activities in Brazil in the regulated carbon market by type of scale used**  
Source: MCT (2011, p.7).

On the other hand, unlike the regulated market projects shown in Figure 5, there is a predominance of small scale projects in the voluntary carbon market, which account for 88% of activities, while large scale projects account for 12%, as seen in Figure 6.



**Figure 6 – Brazilian projects in the voluntary carbon market according to scale**  
Source: Prepared by the Authors.

This comes about because most of the businesses participating in this type of market are of small or medium size, they therefore run smaller scale projects and are motivated by lower transaction costs compared to the costs of running a CDM project in the regulated market, which is dominated by large businesses.

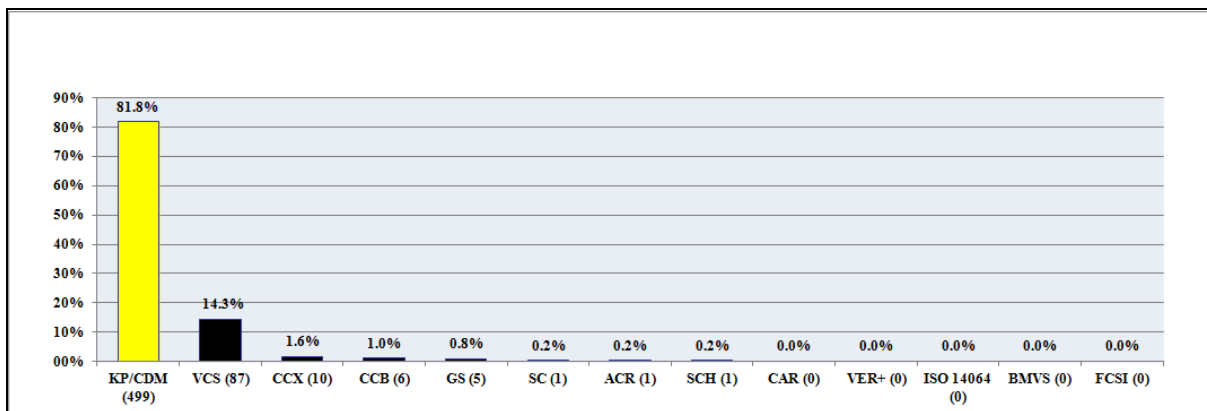
According to Bumpus and Liverman (2008), most voluntary market projects are set up in developing countries by local businesses or NGOs with funding and technical support from developed countries that fall outside the KP institutional environment.

The costs of running a project in the voluntary market are lower and the rules established for the ISs in this market are less rigid than for the regulated market, which may explain the predominance of small scale projects, contrary to the regulated market, where most projects (58%) are large scale (MCT, 2011). The distribution of these projects by their respective standards/rules can be seen in the following section.

### 3.7 Distribution of Project Activities in Brazil by International Standard (IS)

We seek here to analyze the way in which projects to reduce GHG emissions are distributed across both the regulated and voluntary carbon markets, comparing the number of projects connected to ISs with the number of projects connected to the KP rules, as well as making a comparative analysis between the ISs in their Brazilian project operations.

In terms of the projects’ respective IS, when we compare the participation of each standard in Brazilian projects, including the CDM project rules established by the KP, we can confirm that the CDM standard has the highest number of projects in Brazil (81.8%). This is therefore the main standard to which most Brazilian emission reduction projects are connected, followed by the Verified Carbon Standard (VCS) at 14.3% and the Chicago Climate Exchange (CCX) at 1.6%, as seen in Figure 7.

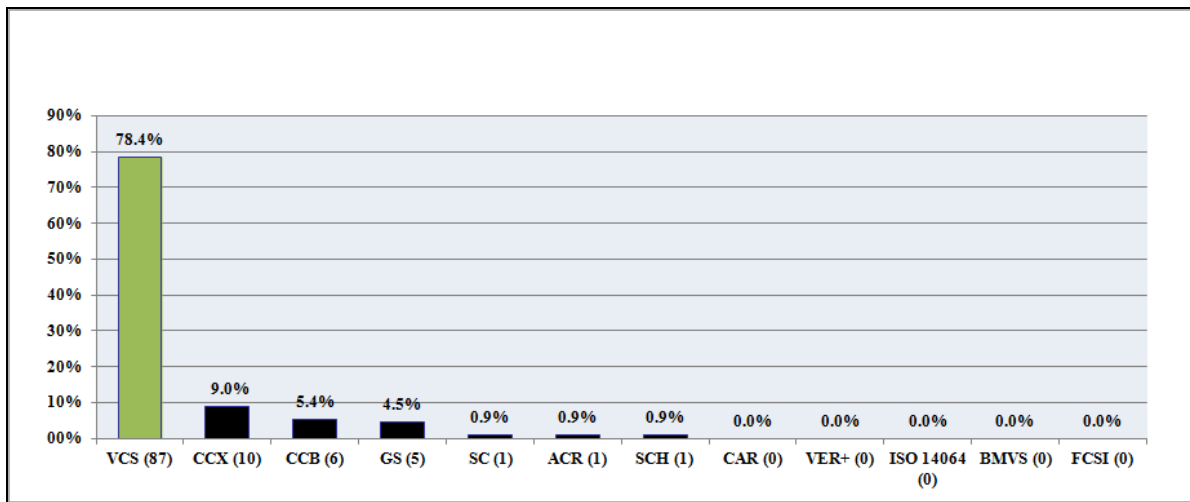


**Figure 7 – Distribution of Brazilian projects registered in the regulated and voluntary carbon markets by the type of International Standard applied**

Source: Prepared by the Authors.

**Key:** KP/CDM: Kyoto Protocol/Clean Development Mechanism; VCS: Verified Carbon Standard; CCX: Chicago Climate Exchange; CCB: Climate, Community, and Biodiversity; GS: Gold Standard; SC: Social Carbon; ACR: American Carbon Registry; SCH: Swiss Charter; CAR: Climate Action Reserve; VER+: TUD NORD Verified Emission Reduction+; ISO 14064: International Organization for Standardization 14064; BMVS: Brazil Mata Viva Standard; FCSI: Forest Carbon Standard International

For the purposes of an analysis of the Brazilian voluntary carbon market, if we exclude the KP/CDM, which is the regulated market standard, in Figure 8 we can see a Brazilian trend for the VCS standard, which is also the main IS adopted globally, accounting for 78.4% of the country’s projects in this market, followed by the CCX at 9%, the CCB 5.4%, the GS 4.5% and the SC, ACR and SCH only 0.9% each.



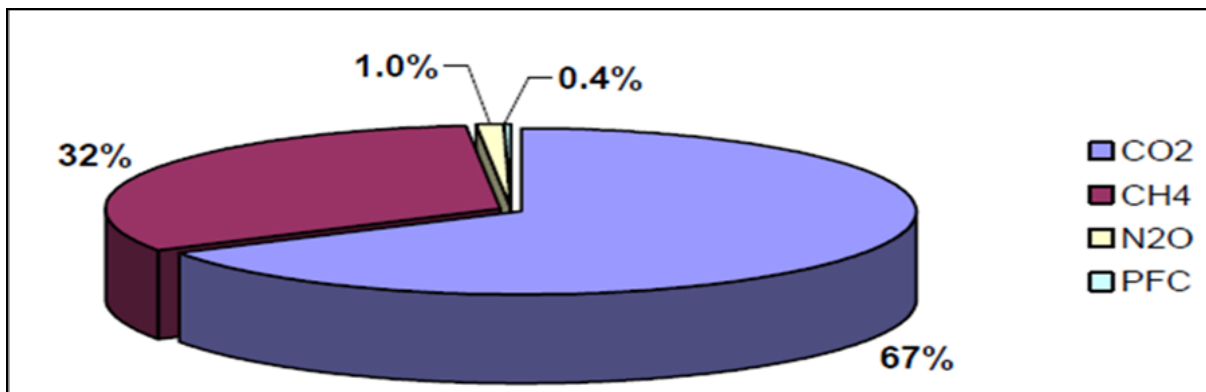
**Figure 08: Distribution of Brazilian projects in the voluntary carbon market by type of international standard applied**

Source: Prepared by the Authors (2011).

The marked presence of the VCS on the domestic scene corroborates the domination of this IS in the global market (34%) (Peters-Stanley, Hamilton & Marcelo, 2011). This domination is confirmed by the full adoption of the project design criteria of this standard, conferring a unique position of credibility on this IS for this market. However, contrary to the global trend, the CCX is in second place (9.0%) in terms of its number of projects in Brazil, while it only occupies seventh place (3%) globally, falling behind the CCB, CAR, GS, BMVS and FCSI standards. With the exception of the GS and the CCB, the other standards are not yet functioning in the Brazilian voluntary carbon market, with the absence of the BMVS being particularly noteworthy as approved projects following its rules have not, thus far, been identified in the country, although it is a Brazilian standard. Such projects are found in the global market however, and account for 5.0% of global projects in the voluntary market occupying fifth place. Another highly relevant factor in the analysis of emission reduction projects is the type of gases reduced and/or mitigated, presented in the following section.

### 3.8 Distribution of Project Activities in Brazil by type of GHG Reduced

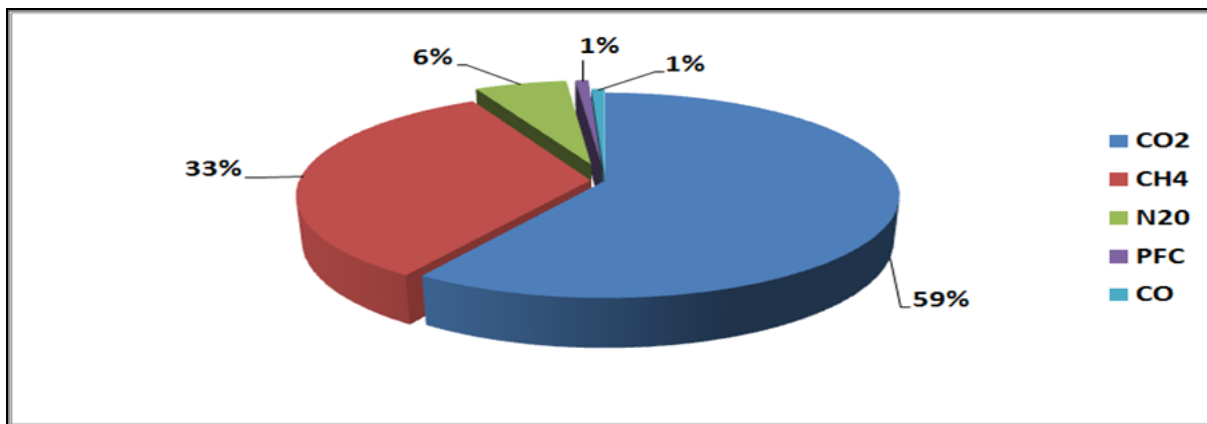
In this section we discuss the types of gases that both regulated and voluntary market emission reduction projects help to reduce and/or mitigate. With regard to CDM projects in the Brazilian regulated market and in reference to the type of gas reduced and/or mitigated by these project activities, carbon dioxide (CO<sub>2</sub>) is most strongly represented, at 67%, followed by methane gas (CH<sub>4</sub>) at 32%. It is important to emphasize that these gases are strongly correlated to the principal types of projects predominant in this market, these being renewable energy (CO<sub>2</sub>) and sanitary landfill (CH<sub>4</sub>). These gases feature more heavily than nitrous oxide (N<sub>2</sub>O) or Perfluorocarbons (PFCs), which only account for 1% and 0.4% of annual reductions, as seen in Figure 9.



**Figure 9 – Distribution of CDM project activities in the regulated market in Brazil by type of GHG reduced**

Source: MCT (2011, p. 6).

In line with the regulated carbon market, with the exception of Perfluorocarbon gas (PFCs), the gases most frequently represented in voluntary market project activities to reduce GHG emissions are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O), accounting for 59%, 32% and 6% respectively, as seen in Figure 10.



**Figure 10 – Distribution of voluntary market project activities in Brazil by type of GHG reduced**  
Source: Prepared by the Authors.

As can be seen in Figure 10, it is important to note that carbon monoxide (CO) gas caused by burnings, Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs) and Hydrofluorocarbon (HFCs), which are associated with the recycling scope, were not identified within the gases mitigated by CDM project activities in the regulated carbon market in Brazil. These are seen within the emission reduction activities in the voluntary carbon market, representing 1% each.

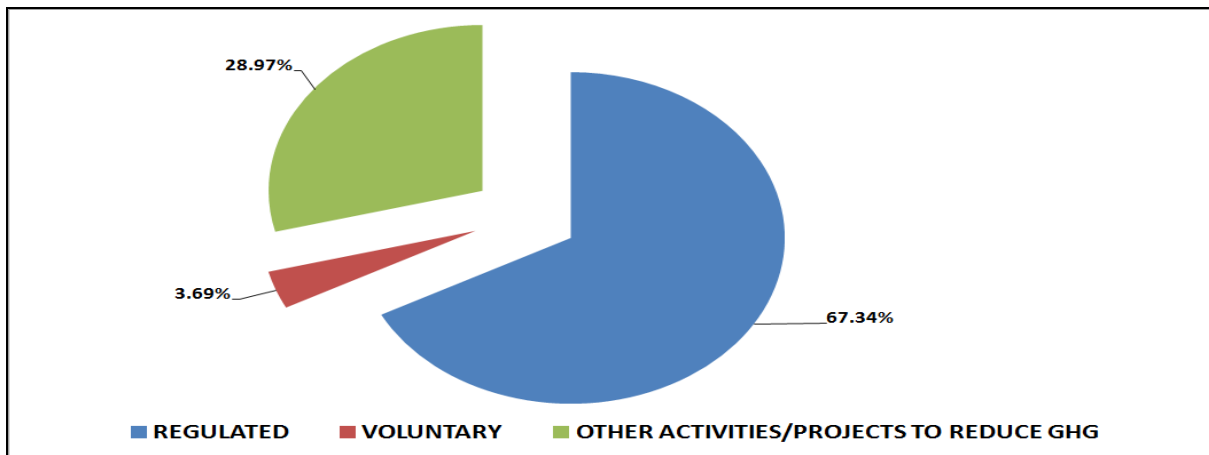
### 3.9 Market Share of the Regulated and Voluntary Carbon Markets in Brazil

In this section we present the market share of the regulated and voluntary carbon markets in Brazil, comparing them to the projected Brazilian GHG reduction emission targets for 2020.

Brazilian GHG emissions recorded in the second emission inventory publicized at the 15<sup>th</sup> COP, held in Copenhagen in 2009, covering the period between 1990 and 2005 and submitted to the UN by the government in 2010 through the Second National Communication of Brazil, totaled 2,192 gigatonnes of CO<sub>2</sub>e during that period, representing an increase of 60% compared to the first inventory, which covered the 1990 to 1994 period and totaled 1.4 gigatonnes of CO<sub>2</sub>e. The projected emissions for 2020 are 3,236 gigatonnes of CO<sub>2</sub>e, according to Article 5 of Decree No. 7,390 of December 9<sup>th</sup> 2010 (Ribeiro, 2011).

As discussed previously, through the PNMC, the Brazilian government set the 2020 projected emission reduction targets at between 36.1% and 38.9%. Thus, by 2020 the country must reduce carbon dioxide emissions by between 1,168 million and 1,259 million tCO<sub>2</sub>e; this target was written into Article 6 of Decree 7,390. Activities established by the Brazilian government in order to meet these targets include 80% and 40% reductions in Amazon and Cerrado deforestation, respectively, the restoration of pastoral grazing areas, an increase in the use of biofuel, an increase in energy efficiency, alternative sources of energy, and others (Brasil, 2011).

Thus, if the annual GHG emission reductions in both the regulated (52,284,609 tCO<sub>2</sub>e/year) and voluntary carbon markets (2,876,925 tCO<sub>2</sub>e/year) were taken into consideration in order to meet Brazilian GHG emission reduction targets by 2020, this would constitute a reduction of the order found in Figure 11.

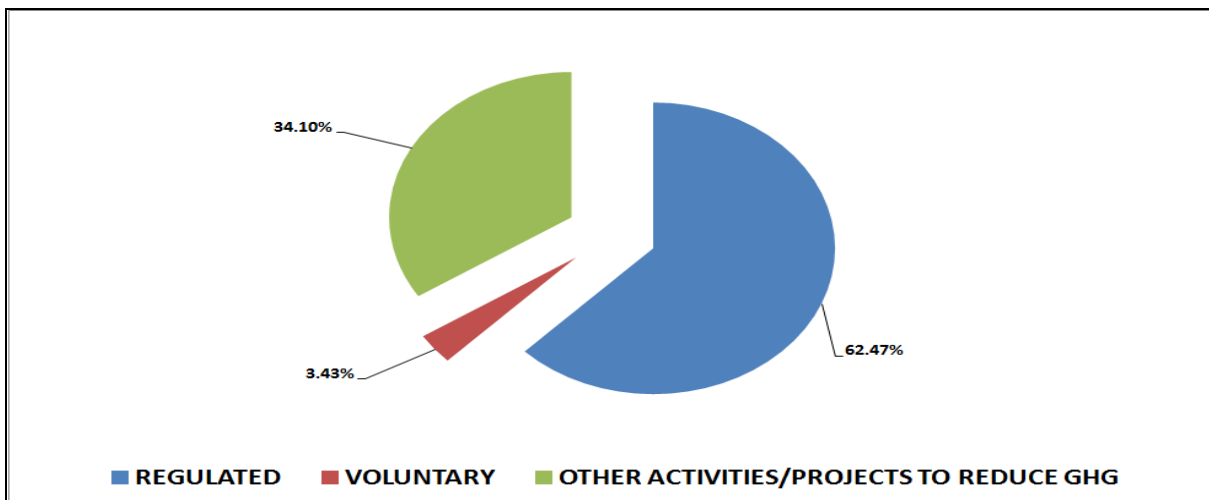


**Figure 11 – Market Share of projects by potential annual reduction of the 36.10% reduction target by type of market in Brazil**

Source: Prepared by the Authors.

As we can see in Figure 11, if we compare the contribution of the regulated carbon market, through its CDM projects, to the target of a 36.1% reduction by 2020, the contribution would be 67.34%, while projects from the voluntary carbon market would contribute 3.69% to the same target, leaving 28.97% of the target to other activities/projects to reduce GHG not commercialized in the carbon market.

In relation to the 38.9% target, the regulated carbon market would contribute 62.47%, while the voluntary carbon market would only account for 3.43%, leaving 34.10% of emissions to other activities/projects to reduce GHG not commercialized in the carbon market, as seen in Figure 12.



**Figure 12: Market Share of projects by potential annual reduction of the 38.9% reduction target by type of market in Brazil**

Source: Prepared by the Authors.

In Figures 11 and 12 we can see that the market (regulated and voluntary) contribution is already significant, with great potential for growth since approximately 28.97% (for the 36.10% target) and 34.10% (for the 38.9% target) of the voluntary target to reduce GHG by 2020 in Brazil is conditional on activities/projects included in the PNMC with serious potential for future commercialization in the carbon market. The KP extension to 2017 made at the 17<sup>th</sup> COP held in Durban, South Africa, will promote new projects to reduce GHG emissions, increasing the possibilities for growth in both carbon markets in Brazil.

It is worth noting, however, that we are only dealing here with a simulation exercise to verify the size of these markets in Brazil and their contribution to meeting the voluntary PNMC targets. Some of the carbon credits generated by these markets in Brazil, however, are exported to purchasing countries (see Annex 1 of the KP) which have compulsory targets for the reduction of GHG; double counting of these credits in order to compensate for Brazilian GHG emissions is not, therefore, permitted.

### 3.10 Project Capacity to Generate Electricity

This section will analyze the contribution of projects from both the regulated and voluntary carbon markets in Brazil to the country’s energy capacity.

We can confirm that both markets contain projects which can contribute to the strengthening of the country’s energy supply. In the regulated carbon market, there are hydroelectric plant projects, cogeneration of energy projects and SHP, as well as wind parks, projects for the cogeneration of other biomasses and biogas; these project activities have a total installed capacity of 4032 MW. Of these projects, hydroelectric plant projects account for 40% of the total potential, the cogeneration of energy from the burning of sugarcane bagasse for 30% of the total and small hydroelectric centers account for 21% of the energy generated, as seen in Figure 13.

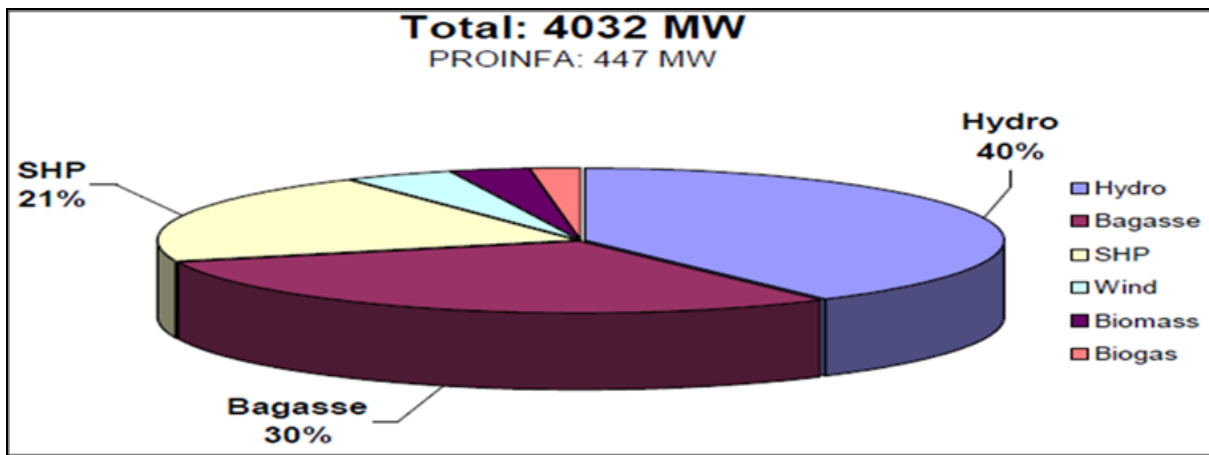


Figure 13 – Installed capacity (MW) of CDM Regulated Market project activities  
Source: MCT (2011)

The capacity to generate electricity, identified in projects from the regulated carbon market, was also identified in projects in the voluntary carbon market, albeit in a smaller proportion, as seen in Figure 14.

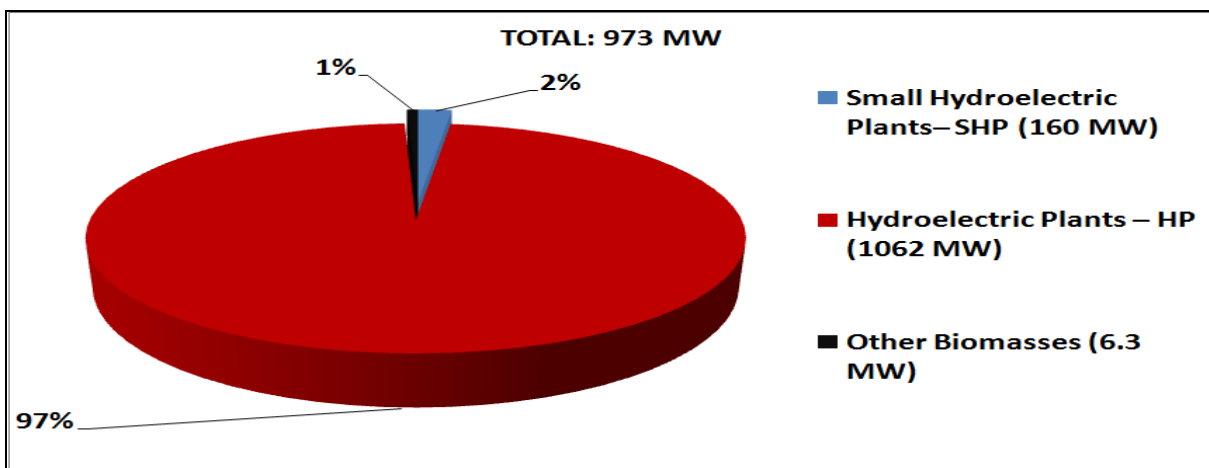


Figure 14 – Installed capacity (MW) of project activities in the Voluntary Market  
Source: Prepared by the Authors.

In Figure 14 we can see that the electrical energy capacity in the voluntary carbon market is 973 MW and the main source of this is HP projects, with 86% of installed capacity.

Thus, both the regulated and voluntary carbon markets in Brazil are sources of electricity for the country, although the latter's participation remains weak, due to the high concentration of small scale projects.

Noteworthy here is the input of the National Program of Incentives for Alternative Electricity Sources (*Programa Nacional de Incentivo às Alternativas de Energia Elétrica: PROINFA*), which was responsible for financing 11.09% of the energy generation capacity of CDM projects (447 MW), see Figure 13.

This program was set up in order to promote projects that increase electricity generation capacity, for example, projects for alternative sources of wind energy, biomass and SHPs, making it easier for investors to fund such projects. It therefore constitutes a public policy mechanism created by the government to stimulate the use of renewable sources of energy and contributing to the diversification of the Brazilian energy matrix.

The results discussed in this section confirm the differences between the Brazilian regulated and voluntary carbon markets. These results may contribute to the formulation of public policies for this sector which promote the development of emission reduction projects, given their demonstrable contributions to combating climate change, by creating project funding programs, fiscal incentives and tax exemptions for the carbon credits generated by such projects.

There is great room for improving the regulated and voluntary carbon markets in Brazil. Compared to other countries it still has weak market participation. The market may also contribute significantly to meeting the government targets established by the PNMC, given that Brazilian projects are potential emission reducers, thereby helping to establish a low carbon economy in the country.

#### **4. Conclusions**

This research has the general objective of identifying the principal similarities and differences between the regulated and voluntary international markets for the commercialization of carbon credits in Brazil which operated between 2004 and 2011. It can therefore contribute to the formulation of public policies aimed at developing these environments; the creation of a database containing voluntary carbon market projects, which had been inexistent in Brazil up to that point; and providing evidence for the Brazilian literature related to this still incipient research area.

In order to achieve the proposed objective, we carried out documentary and bibliographic exploratory research by consulting books, corporate reports, national and international periodicals, national and international scientific articles, technical reports, national and international databases, theses and dissertations and accessing institutional websites. Furthermore, we conducted a mapping of projects in the voluntary carbon market in Brazil from January 2004 until June 2011, through a search of databases and IS institutional websites and those of their applicants. This mapping was conducted through a search of voluntary carbon market databases, for example the Markit Environmental Registry (2011), which provides a database containing projects per IS, as well as searches of institutional IS websites and those of their applicants. Secondary data was collected through a content analysis of Project Design Documents (PDD), mapped and extracted from the analyzed websites and databases. Secondary data concerning the regulated market was collected from the project databases available on the MCT website, analyzing the projects for the period between January 2004 and June 2011. From the data presented we were able to confirm that all the research assumptions were validated and the specific objectives were met.

We found that both the regulated and voluntary Brazilian markets to commercialize carbon credits may constitute an extremely important economic instrument in order to make the reduction of GHG emissions viable, thus contributing to the mitigation of climate change and the attainment of national targets to reduce GHG emissions. The status of the projects in the voluntary carbon market in Brazil remains weak when compared to that of the regulated carbon market, with a concentration of projects in the Southeast region of Brazil and with the former with only 111 projects, while the latter had 499. We confirmed that differences exist in relation to sectoral scope. In the energy efficiency sectoral scope, with the exception of activities related to the demand and distribution of energy (found only in the regulated market) and activities for efficient cook stoves (found only in the voluntary market), we confirmed that the existence of gas recovery process activities was common to both markets.



In the renewable energy sectoral scope, we ascertained that activities for the use of other biomasses in the generation of energy, as well as small hydroelectric centers and hydroelectric plants, are present in both the regulated and voluntary carbon markets, a factor also observed in the scope for waste, with effluent activities common to both the regulated and voluntary markets.

Projects within the industrial process and fugitive emissions scopes were only found in the regulated market, while projects within the scopes for switching native forest fuel and recycling refrigerators/freezers were only found in the voluntary market.

All the sectoral scopes for managing manure from swine culture and reforestation, associated with the recovery of degraded areas, and for forest management and switching fossil fuel have activities in both the regulated and voluntary carbon market. In relation to the distribution of project activities in the regulated carbon market, the greatest number of projects is concentrated in the renewable energy scope (52.3%), while in the voluntary carbon market there is a predominance of projects to switch native forest fuel (32%), although swine culture projects have a significant presence in both markets, a 24% participation in the voluntary market and 15.4% in the regulated one.

Furthermore, while renewable energy projects and sanitary landfill are the main annual emission reducers in the regulated market, accounting for an annual reduction of 21,125,083 tCO<sub>2</sub>e (40.3%) and 12,307,823 tCO<sub>2</sub>e (23.5%), respectively, renewable energy projects in the voluntary market are also the main annual emission reducers, with a reduction capacity of 1,051,649 tCO<sub>2</sub>e (37%), together with projects to switch native forest fuel, which account for an annual reduction of 630,680 tCO<sub>2</sub>e (22%).

As regards the distribution of these projects across the Brazilian states, both the regulated and voluntary markets the project activities are concentrated in the Southeast region of Brazil. The states of Minas Gerais and São Paulo alone account for 37% of the projects in the regulated market and 32% of the projects in the voluntary market.

We confirmed that projects in the carbon market regulated by the KP are mostly large scale (58%) and therefore favor the predominance of large business, restricting access for small and medium sized companies, while most projects in the voluntary market are small scale (88%), with more small and medium sized companies observed here.

Furthermore, the IS with the greatest number of registered projects in the Brazilian voluntary carbon market is the VCS (78.4%), which, in terms of its rules, is the standard most similar to the regulated market. This research provided evidence that, although the CCX only participates in 3% of the global market, in Brazil its participation reaches 9.0%. The research also provided evidence that projects in both the regulated and voluntary markets contribute to the reduction of Brazilian GHG emissions.

If the annual GHG emission reduction in the regulated (52,284,609 tCO<sub>2</sub>e/year) and voluntary carbon markets (2,876,925 tCO<sub>2</sub>e/year) were taken into consideration to meet the Brazilian targets for GHG emission reductions by 2020 set by the PNMC, in terms of the target to reduce 36.1% by 2020, the regulated carbon market would contribute 67.34%, while projects from the voluntary carbon market would contribute 3.69%. In relation to the target of 38.9% by 2020, the regulated carbon market would contribute 62.47%, while the voluntary carbon market would contribute only 3.43%. Of the gases mitigated by both markets, Carbon Dioxide (CO<sub>2</sub>) is the principal gas present in project activities to reduce emissions in both markets: 67% in the regulated market and 59% in the voluntary one.

We also ascertained that projects in both markets contribute to an increased capacity for electricity generation. While the regulated market contributed by generating 4032 MW, the voluntary market contributed only 973 MW, with hydroelectric plant projects contributing 40% of this capacity in the regulated market and 86% in the voluntary one.

Moreover, with regard to the basic differences between the regulated and voluntary markets, we identified differences in each market's project cycles and existing rules. While government institutions are responsible for the regulation of the regulated carbon market, in line with the KP, the rules of the voluntary market are set by a range of private actors.

As for project cycles, stages such as DNA approval and submission to the CDM Consultative Board are only observed in the regulated market, which generally confers a more bureaucratic character on this market, with higher transaction costs compared to the voluntary carbon market, in which both the DNA's and the Consultative Board's institutional roles are performed by the ISs.

Public policies to support the development of these markets are required and these must take into consideration the markets' contribution to attaining the voluntary targets stipulated by the PNMC in 2009.

The use of projects to reduce GHG emissions as public policy instruments may significantly contribute to the attainment of the voluntary targets for the reduction of Brazilian emissions and may necessitate the creation of financial funds for these projects in Brazil, facilitating an increase in the number of projects and the consolidation of the Brazilian carbon market.

The government needs to stimulate private initiatives to invest in environmentally safe technologies, facilitating an increase in renewable energy in Brazil and contributing to a transition to a low carbon economy. In order to do this, the creation of fiscal incentives that motivate companies to develop projects for GHG emission reduction is extremely important. Such incentives can contribute to an increase in the number of projects which, alongside other activities, support the attainment of the targets set by the PNCM. International cooperation which facilitates the transfer of cleaner technologies and channels the necessary resources for investment in this sector should also be celebrated.

Furthermore, the creation of a regulatory policy for this sector will provide greater security for investments made in developing countries by investors from developed countries, as well as making transactions carried out in Brazil more secure, thereby minimizing the medium and long term risks to which they are subject.

The creation of public policies in Brazil, aligned to the global climate change policies established by the UNFCCC that stimulate emission reduction commerce, will contribute to growth in carbon credit exports from Brazilian projects to countries which have to meet targets, thus contributing to the generation of foreign exchange for the Brazilian government. Finally, we recommend that future studies compare the Brazilian experience to those of the two other main host countries for regulated and voluntary carbon market projects, namely China and India.

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