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Renewable Energy and Carbon Credit Market

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Abstract The objective of this work is to obtain a balance of carbon credits obtained and sold by mills in Brazil's sugar and ethanol sector, considering that in 2012 ended the first period of validation of projects submitted in 2005. This study aimed to perform an analysis of the proposition process, validation and execution of projects submitted to the UNFCCC and was developed from the analysis of documents (hardcopy and online), reports and secondary data from state and federal governments, agricultural and industrial sector, research institutions and research funding agencies. After identifying the context in which the problem was inserted, interviews were conducted with consulting firms for CDM projects, representatives of associations of farmers and officials responsible for managing projects in the mills. In these interviews, we tried to obtain information about the projects presented, the benefits and achievements of the company's operations in that market, and identify the volume of carbon credits obtained in each project. These factual information and goals in terms of value and quantity were analyzed, considering the responses of respondents in plants and consulting firms that develop CDM projects.

Keywords Sugarcane industry, Renewable energy, Carbon credit

1. Introduction

Since the beginning of the XX century when occurred the development and expansion of the industrial sector, it is believed that the resources of nature were plentiful and renewable, being that there was no control over the impact of this growth on the environment. However, there are reports that at the end of the 1940s these impacts began to be perceived scientifically, acquiring social-political dimension in the early 1960s.[1]

The theme of sustainability or environmental management emerges significantly in the corporate environment from the 1970s, due to the negative impact on the environment generated by economic activity and increasing demands of stakeholders, deciding factor for companies achieve their goals.[2] It is noticed that the preoccupation with the theme already spans decades, but now reached global status.[3]

The main causes of negative man's interference in the environment are intrinsically linked to globalization. This perspective corroborated the concern for sustainable development, which according to the World Commission on Environment and Development, is one that has the ability to meet present needs without damage to meet the needs of future generations.[4]

The burning of fossil fuels such as coal, natural gas, oil etc., is derived from the economic development that generates wealth for nations and also for society, but at a high environmental cost. The industrial sector is the largest polluter among sectors of the economy, accounting for the majority of actions brought by environmental regulatory agencies officials and environmental organizations. Reactive strategic measures have been developed by companies in order to modify their production processes based on a systemic view, considering environmental aspects for improving its efficacy.[5]

The GHG Greenhouse Gas Protocol is currently considered the most used tool for public and private organizations in the world to identify and control the emissions of the "greenhouse effect." Prepared through a partnership between the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) in 1998, was revised in 2004 and aims at calculating and compiling the inventory of corporate greenhouse gas emissions based on the standards of the International Organization for Standardization (ISO) and the quantification methodologies of the Intergovernmental Panel on Climate Change (IPCC), which have been applied and adapted to the national context from 2008.[6]

With the environmental aspect placed in evidence, the UNFCCC - United Nations Frameworks Convention on Climate Change, promoted conferences, since the last decade, involving several countries who discussed how to minimize the negative impacts of industrial production and find solutions to capture and reduce greenhouse gas emissions.

Prevention, recovery or compensation of environmental

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degradation are required by society and seeking to reverse the destruction the Earth's ecosystem, generated by a market worried about productivity and profitability. The human interference in the climate of the planet since the industrial revolution, accelerating the extraction of natural resources, increasing production and consumption are a few factors that must be observed in daily publications about deforestation and global warming, leading rulers to reflect on this theme through global conferences, notably Stockholm (1972), Rio de Janeiro (1992), Kyoto (1997), Johannesburg (2002) and, again, the last meeting held in Rio de January (2012).

One of the main alternatives to mitigate environmental problems arising from industrial activity was the creation of the CDM - Clean Development Mechanism, decided at its meeting in 1997 and consolidated in the "Kyoto Protocol", which became effective in 2005. The CDM aims to assist organizations that contribute to the reduction of greenhouse gas emissions and offers an alternative for those who, in short term, would be unable to meet the goals established for this purpose.

The Protocol encourages and provides financial bonus to companies, in the sugarcane industry, which has significantly reduced the impact on the environment, from the planting of sugarcane, harvesting, industrial production of sugar and alcohol until the arrival of product to the consumer. Despite the recent implementation of the CDM, innovations and new technologies in the sugarcane agriculture in state of São Paulo are evident since the harvest 1979/80, when the Alcohol Program was initiated in Brazil.[7]

In the sustainability aspect, the sugarcane industry tends to expand the energy production (using the industrial process waste) and export surplus production to warrant concern about environmental pressures and impacts of this activity on natural resources. The CDM enables the generation of electricity by biomass sources, considered as an activity contributing to the reduction of "greenhouse effect" gas.[8]

2. The Clean Development Mechanism

The Clean Development Mechanism was born from a Brazilian proposal to the UNFCCC. It is the trade of carbon credits based on sequestration projects or mitigation the emissions of "greenhouse effect" gas. The CDM is a flexible instrument that allows the market inclusion of developing countries or countries without reduction commitments, such as Brazil. Countries that fail to achieve their goals will be free to invest in CDM projects in developing countries. Thus, developed countries buy carbon credits in ton. of CO_2 equivalent, in developing countries responsible for such projects.

Carbon credits or Certified Emission Reduction (CER) are issued by a UN committee to a person or company that has reduced its "greenhouse effect" gas. Developed countries can stimulate the reduction of gas emission in developing countries through the carbon market when they buy carbon credits from the latter.

Trading in futures contracts for carbon credits already occurs on the Chicago Stock Exchange and in countries like Canada, Czech Republic, Denmark, France, Germany, Japan, Netherlands, Norway and Sweden. In 2005 also came into force the European regional market, dubbed the "European Union Emission Trading Scheme."

Brazil should benefit from this scenario as a seller of carbon credits, as well as targeted investments in projects committed to reducing greenhouse gas emissions, such as ethanol and biodiesel.

Buying these certificates in the market roughly corresponds to acquire a permit to emit gases "greenhouse effect." The price of this permission, traded in the market, must necessarily be less than the fine that the issuer must pay to the government, by issuing gases "greenhouse effect." So, for the sender, to buy carbon credits in the market means, in practice, get a discount on the fine due.

The CDM is a flexible mechanism that offers the greatest risk to the investor, the high degree of uncertainty and bureaucracy that exists to effective project approval by the UN, and the high transaction costs involved (around US$ 100,000 to 150,000). Economic studies based on future scenarios have been increasingly necessary for an understanding the long term in this environment. Currently, a ton. of carbon CDM projects is sold around US$ 5.00 to 6.00, for projects that satisfy all the assumptions of the Kyoto Protocol. However, alternative markets (voluntary) are present with more flexible rules, such as the CCX - Chicago Climate Exchange, where prices for a ton. are lower (around US$ 0.90). With the recent ratification of the Protocol, the expectation is that these values suffer increases over time.

At the conference held in Japan 1997, which established the Kyoto Protocol, were ratified some recovery mechanisms, or at least decrease the negative impacts caused by organizations through their production processes. The mechanisms of pollution control are: Joint Implementations (JI), Emissions Trading (ET), and the Clean Development Mechanism. For the Brazilian organizations, only CDM, which comprises the commercialization of carbon credits, may be put into practice, since the first two should be implemented only by the developed countries.

According to Annex A of the Kyoto Protocol, the gases considered "greenhouse effect" are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), hexafluoride (SF_6).[9]

To negotiate carbon credits, is required to design and implement projects directed to control and reduce emissions of these gases in emerging countries. Through those projects, Brazilian organizations, for example, may benefit themselves, obtaining carbon credits, which can be sold to developed countries for a market value. Thus, countries that fail to achieve the reduction targets agreed, may justify, partly, their contribution to environment, acquiring credits from those that are reducing emissions.

In October 2007, was created the Office of Carbon in FIRJAN - Federation of Industries of Rio de Janeiro, which organizes and disseminates data directed to companies,

unions, investors, municipalities and other stakeholders on concrete actions to tackle climate change, acting as a center of information on projects and carbon neutral application of CDM.

There was, however, a few years ago, some uncertainty about the continuation of the carbon market credits after 2012, with the possibility of foreclosure due to:

- lack of adoption of the Kyoto Protocol for a second period goals to be achieved by developed countries,
- the risk of not approving the methodology for baseline and monitoring (excessive delay for approval of projects by the UNFCCC)
- failure to obtain registration of the CDM Executive Board by the difficulty of proving that one can implement the project, and
- the possibility of breach of contract by the Parties.[10]

Although the last meeting held in November 2012 in Doha, Qatar, approved the validity of the Protocol till 2020, some of these predictions effectively were consummated, leading signatories to amend some provisions of the document, as we will see later.

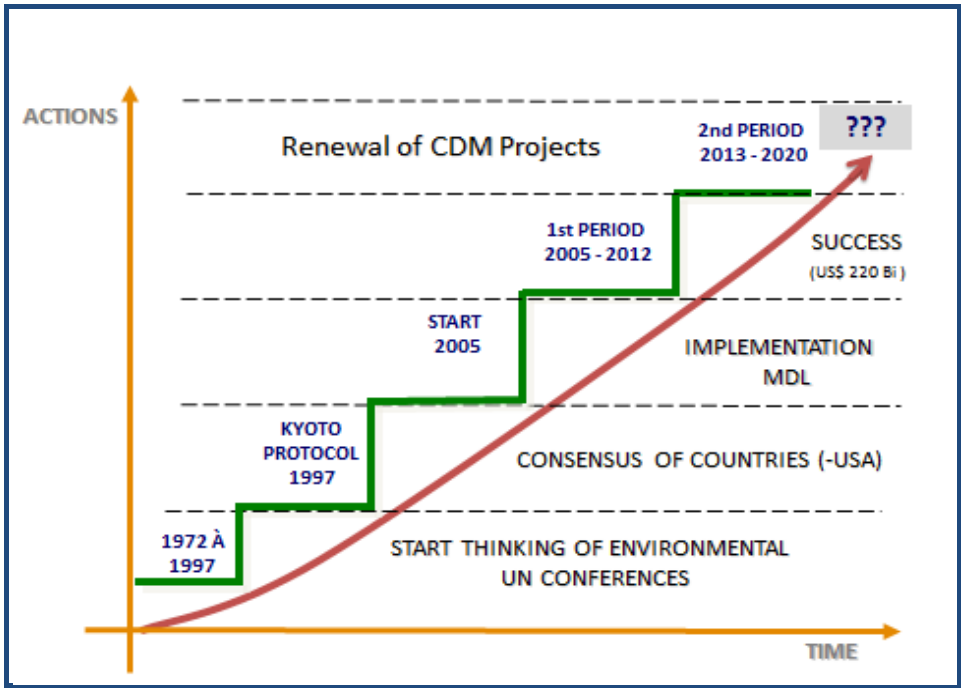
Graph 1 illustrates the chronology or timeline in the evolution of environmental thinking, since signature the Kyoto Protocol and CDM implementation.

The chart attempts to highlight the important stages of the CDM, since emerging environmental thinking, the institution of the Kyoto Protocol signed by several countries (except the USA), mainly in Europe and Asia that have pledged to reduce "greenhouse effect" emissions, the beginning of the first term of the CDM cycle with a total of $ 220 billion in carbon credits traded in the world and the unknown results related to the second period from 2013.

The Brazilian sugarcane industry has identified an opportunity to support their expansion and new sustainable practices, aimed at reducing emissions of gases "greenhouse effect" through the CDM. However, this proposal must be consistent with the norms of the UNFCCC, which requires the homogenization of organizational practices and mechanisms for approval by monitoring methodologies. One of these is the establishment the AM0015 methodology: "Bagasse based Cogeneration and connected to an electrical grid", which was approved and applied to CDM Brazilian mills, according to the characteristic of the projects presented.

The basic methodology for all types of design undergoing UNFCCC is diagrammed in Table 1. It comprises 7 steps involving firms accredited to the elaboration of projects, for certification with the UNFCCC and to monitor implementation. The Designated National Authority, which in Brazil is represented by the Interministerial Commission on Climate Global Change, approves the deployment of the project to UNFCCC and the CDM Executive Board performs the registration and subsequently issues the document of Certified Emission Reductions - CERs.

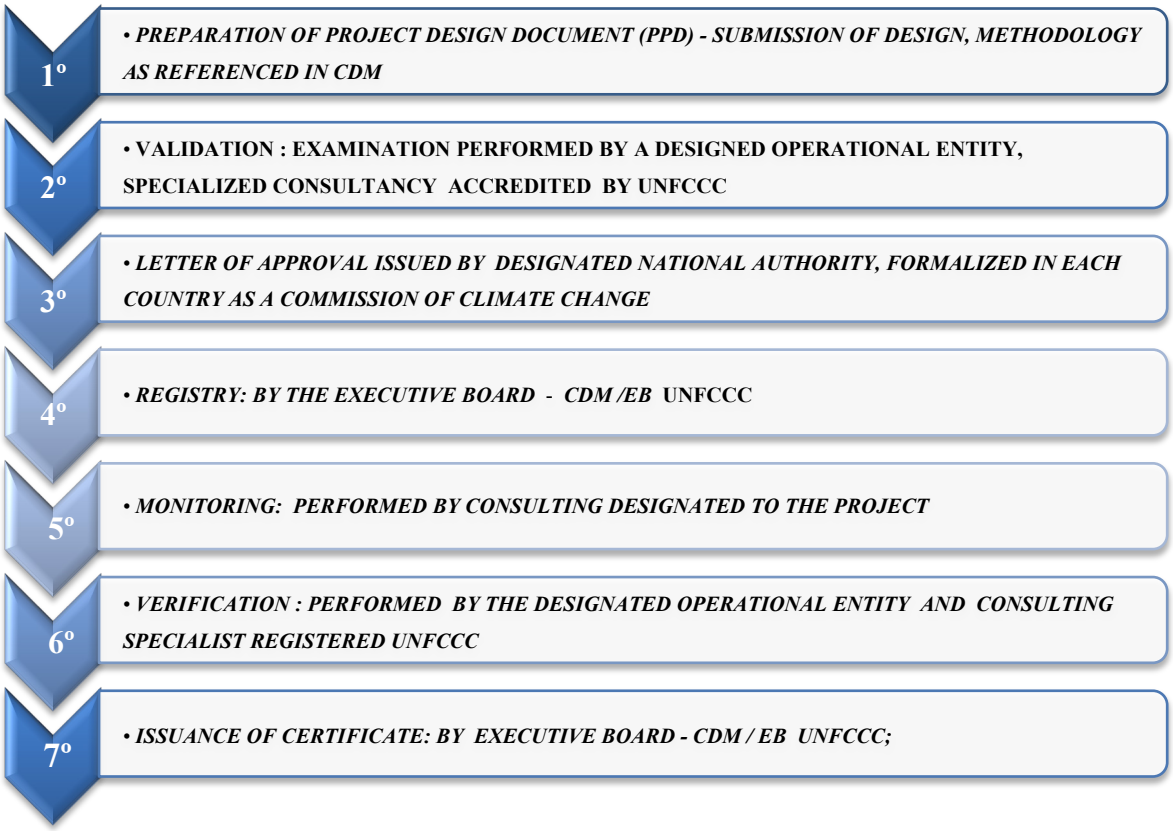
However, the agency's final decision is the UNFCCC Conference of the Parties, which meets every year to review and evaluate the implementation of the Convention during the period. These meetings are identified by the acronym MOP - Meeting of the Parties. Decisions taken by the COP make up a detailed set of rules for practical and effective implementation of the matters discussed. As the CDM is located under the Kyoto Protocol, the COP/MOP keeps it under his authority and subject to its guidelines.



Source: **elaborated by the authors**

Graph 1. Chronology or Timeline of Clean Development Mechanism

Table 1. Steps of the Process of Validation of CDM Projects candidates



Source: elaborated by the authors; adapted from UNFCCC[11]

In the virtual platform of the UNFCCC, can be identified assignments of the institutions responsible for the activities and decisions in each stage of analysis and validation the Project Design Documents - CDM PDD, as well as other constants in Chart 1, which depicts the governance structure of the UNFCCC.

The COP/MOP is the Conference of the Parties serving as the Meeting of Parties (MOP) that signed the Kyoto Protocol, which adopts decisions and resolutions discussed and published in reports COP. The assignments of the COP consist primarily: authority over the requirements for the CDM, deciding on the recommendations made by the Executive Board and designating the operational authorities that are provisionally accredited by the EB.

The Designated Operational Entity - DOE is a private organization projects that validate and verify emission reductions. The DOE under the CDM is an international organization accredited and designated (provisionally) to final confirmation by the COP and the CDM Executive Board.

It has two main functions:

- validate and meet subsequently requests registration of a CDM project activity;
- verify the emission reduction from activity registered as CDM project and request EB to issuance the Certified Emission Reductions (CERs).

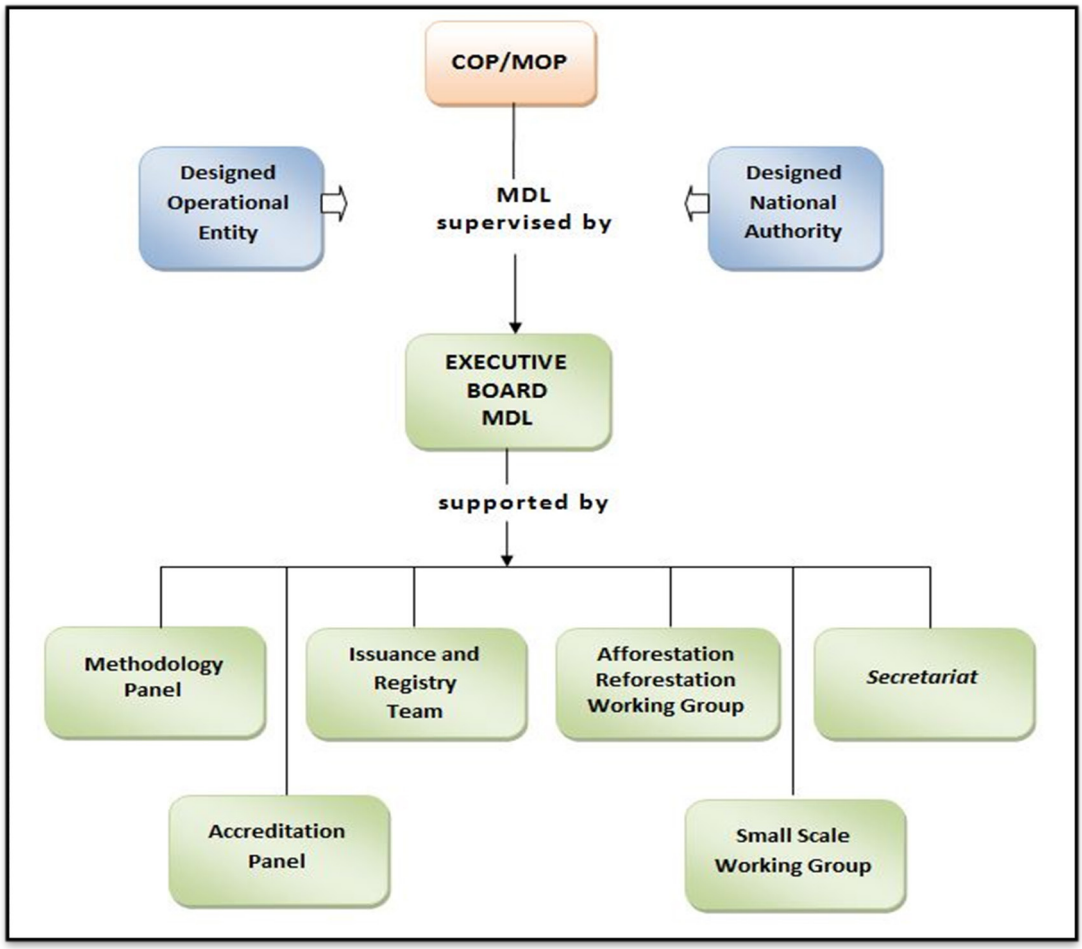
The Designated National Authority - DNA is represented by public administrative bodies or authorities in each country, approving projects and facilitating participation in accordance with the terms and procedures defined. Parties participating in the CDM shall designate a national authority to represent them. The record of activity (proposed CDM) can be done once, since the letters of approval are obtained from the DNA of each Party involved. Should also be included, confirmation by the host Party that the project activity assists it in achieving sustainable development.

The Executive Board - EB's main function is to oversee the Clean Development Mechanism of the Kyoto Protocol, under the authority and guidance of the Conference of the Parties. The EB is fully accountable to the COP, and the last point of contact between the project participants for CDM project registration and CER issuance.

The Accreditation Panel was created to prepare decisions to the Board in accordance to the procedure for accrediting operational entities; the Registration and Issuance Team assists the EB in its assessments and it is chaired by EB members whose take turns in that position.

The Small Scale Working Group analyzes and prepares recommendations on submitted proposals for new baseline and monitoring activities for small-scale CDM project.

The Working Group to Afforestation and Reforestation makes recommendations (in collaboration with the Meth Panel) on proposals for new baseline and monitoring for CDM projects in this area.



Source: **UNFCCC[12]**

Chart 1. Governance UNFCCC

The UNFCCC secretariat supports cooperation activities between countries to combat climate change and its impacts on humanity and ecosystems.

The annual meetings of the COP / MOP seek to assess the results of the period and bring contributions to streamline the certification process, stimulating the adherence to the program and the progress in terms of meeting the goals set short and long term. From the establishment and validation of the Protocol in 2005 the meetings have sought to monitor and evaluate the partial results within the framework of common goals. At the 2009 meeting, the evaluation of the COP/MOP, showed that these goals will hardly be achieved till 2012 and 2014, a period initially established by the Protocol to the fulfillment of obligations the Parties in Annex 1.

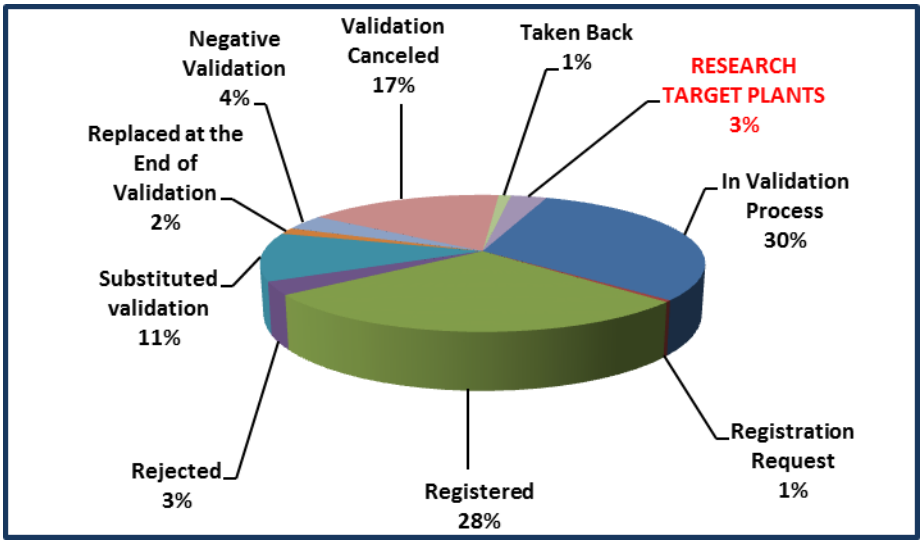
2.1. Brazilian CDM Projects

Brazilian companies send 743 projects to CDM. More than half of that total is in the category of "Renewable Energy", as can be seen in Table 2. The projects of sugarcane sector fall into this category, as "Bagasse Cogeneration Projects." The projects with emphasis on improving energy efficiency, biomass, etc., often predict activities for a period of 7 to 21 years, although the first commitment period of the Kyoto Protocol had been established from 2008 to 2012. Thus, it is very difficult to determine the potential market to carbon credits, if the crediting period was lengthened. As there was a high degree of uncertainty regarding negotiations for the second period and the last Conference of the Parties brought no clarifying instructions or guidelines for CER's sellers, unless the approval the new period to 2020, it is difficult to make predictions about the composition of this framework in the coming years.

Table 2. CDM Projects in Brazil by sectorial scope

Renewable Energy	52,30%
Pig Industry	15,40%
Exchange of fossil fuel	9,20%
Sanitary landfill	7,60%
Energy efficiency	7,00%
Waste	3,00%
Industrial processes	2,50%
Reduction of N_2O	1,00%
Reforestation	1,00%
Fugitive emissions	1,00%

Source: Ministry of Science and Technology[13]



Source: **developed by the authors**

Chart 2. Status of 743 Brazilian CDM projects

The potential of Brazil and particularly the agro-energy sector is still very large and this can be confirmed by the significant growth of agribusiness in the international market.

The current situation of Brazilian CDM projects that have been sent to UNFCCC is shown in Chart 2, where it can be seen that 30% of projects are in the process of validation and 28% are already registered under the CDM, this is, most projects are in satisfactory position in the UNFCCC, considering the 3% that represent the designs of the plants surveyed the sugarcane industry. The Interministerial Commission on Global Climate Change - CIMGC, which is the Designated National Authority - DNA in Brazil, to the CDM Executive Board, developed the "Submission for CDM Projects Manual", focusing to facilitate the submission of projects CDM in Brazil. Into a single document, are combined the rules issued by the Commission, which, as we have seen, is the first step to submit a project to UNFCCC.

The agreements between the Parties defines that the DNA must certify voluntary participation of the participants in the project activity under the CDM, attest that the activity contributes to sustainable development and ultimately issue a letter of approval to the project.

According to CIMGC, procedures contained in the Manual, beyond facilitating the implementation of such standards, are also intended to expedite the review process of project activities under the CDM by the Interministerial Commission and decrease the total time required for procedures to approval the projects.

Therefore, the provisions of the resolutions issued by the Interministerial Commission apply only to project activities under the CDM, which had their validation initiated after the publication in the Federal Government Official Press. The Interministerial Commission considers that the early validation of the project activity under the CDM occurs exactly on the date that the Project Design Document was published on the website of the UNFCCC Secretariat of the Climate Convention.[14]

3. Methodology

The study conducted so far, highlighted the option of documentary research as a strategy for collecting data and information. Theóphilo and Martins summarize this concept as “an investigation feature of studies using documents as a source of data, information and evidence[...] combine with other documentary sources, such as interviews and observation".[15] The same authors argue that interview, characteristic of field research, "it is a research technique for gathering information, data and evidences whose primary purpose is to understand and comprehend the meaning that respondents attach to issues and situations" and in this study was an extremely important tool to validate the relevance of the problem.

Interviews were conducted with associations of agricultural and industrial producers in sugarcane industry, and Mr. Francisco Santo, Director of Carbon Markets Econergy, consultancy accredited by the UNFCCC and specialize in preparing projects for submission to the CDM. According to the data collected on the platform of the UNFCCC, 90% of CDM projects submitted to the regulatory body are the responsibility of Econergy as a Designated Operational Entity – DOE, generally requested by Brazilian companies.

Once recognized the 24 producers that submitted projects to CDM, the focus of the study was directed to this group and their relative participation in the CDM level in the industry. Brazilian mills participating since the beginning of CDM, are listed in Table 2, which also identifies the date of

registration the project in the CDM Executive Board and the validation period of the project to obtain corresponding carbon credits.

Table 2. Sugarcane/Alcohol mills with projects in CDM

TITLE REGISTERED	LOCATION	REGISTRY MDL	1st PERIOD
Santa Elisa	Sertãozinho	02/20/2006	2003 to 2010
Nova América	Tarumã	02/20/2006	2001 to 2008
Alta Mogiana	São Joaquim da Barra	02/24/2006	2002 to 2009
Santa Cândida	Bocaina	02/24/2006	2002 to 2009
Colombo	Ariranha	03/03/2006	2003 to 2010
Vale do Rosário	Morro Agudo	03/03/2006	2001 to 2008
Cerradinho	Catanduva	03/03/2006	2003 to2009
Lucélia	Lucélia	03/03/2006	2002 to 2009
Caetés	Caetés (MG)	03/03/2006	2002 to 2009
Serra	Ibaté	03/03/2006	2002 to2009
Coinbra-Cresciumal	Leme	03/03/2006	2003 to 2010
S. Antonio/S. Francisco	Sertãozinho	03/03/2006	2002 to2009
Jalles Machado	Goianésia (GO)	03/03/2006	2002 to 2009
Coruripe	Coruripe (AL)	03/03/2006	2002 to 2009
Coruripe	Campo Florido (MG)	03/03/2006	2002 to 2009
Alto Alegre	Presidente Prudente	03/04/2006	2004 to 2011
Coruripe	Iturama (MG)	03/04/2006	2004 to 2011
Cruz Alta	Olímpia	03/06/2006	2003 to 2010
Santa Adélia	Jaboticabal	03/06/2006	2003 to 2010
Zillo-Lorenzetti	Lençóis Paulista	03/06/2006	2001 to 2008
Equipav	Promissão	03/09/2006	2003 to 2010
Moema	Orindiúva	03/09/2006	2001 to 2008
Cerpa (Usina da Pedra)	Serrana	03/09/2006	2003 to 2010
Itamarati	Nova Olímpia (MT)	04/06/2006	2004 to 2011

Source: UNFCCC[16]

Questionnaires were sent to all plants with the CDM projects registered, containing the following list of questions:

● What is the net result of the performance of your company in the market of carbon credits?

● There is a balance sheet accounting or financial results that can be considered positive?

● How many credits were put on the market and how many were actually sold?

● How was performed the process for submission and approval of these credits?

● You can provide numbers, even relative to the results obtained by your company? It has been requested renewal of certification of carbon credits under the CDM rules?

● The company plans to submit new projects for the CDM?

● What are the environmental aspects that can be credited for the shares of the company focused on the CDM project?

● In what areas the company focused its efforts to this end and produced projects for the CDM?

● How many projects were submitted and how they have been evaluated by the designated entities?

● The principles stipulate that the CDM carbon credits should be required for the project financially viable. This occurred on the projects submitted and approved?

● The company participates in programs of emission reductions instituted by the National Policy on Climate Change and Federal Government incentives for producers who participate and collaborate with the cuts? Your company already enjoys some of these benefits?

Only five organizations responded to the questionnaire in 2012, without providing data and records of transactions made on the market or even their expectations in relation to the carbon credits market, making harmless the possibility of obtaining sufficient information for analysis of any subject, even if superficial. In most cases it was reported that the head of the project, whose name and position consists of records from UNFCCC, was no longer part of the management staff of the plant and in other cases, the new occupant had no knowledge of the subject or was not authorized to provide information . Thus, the data presented were taken from the platform of the UNFCCC, classified and analyzed according to the study objectives. The interview with the Director of Carbon Markets in the consultancy Econergy, proved extremely fruitful, because, besides offering an analytical, comprehensive and illuminating assessment the entire CDM process, also showed us how to navigate and get a huge variety of information contained in the UNFCCC website . Indeed, information that many plants offered no details, were obtained in UNFCCC spreadsheets statistics.

4. Data Collection and Analysis

It has been observed that the process for registration and issuance of CERs, companies interested in obtaining carbon credits should find potential buyers for these securities. The countries that are likely to require carbon credits are already enrolled in the organ and may partially or totally accept the amount offered by Brazilian mills. In Table 3 are related countries through official agencies or private institutions and the financial industry, have signed up to purchase futures market, CERs issued by the UNFCCC for Brazilian mills.

Most countries committed to the commercialization of these credits are in Northern Europe (UK, Switzerland, Sweden, and Netherlands); these countries appear in almost all projects in Table 3. Appear less prominently Japan, France and Germany. Another point that must be stressed is also the participation of banks and consulting firms already involved with CDM, that endorse the project for further negotiation.

Table 3. Credit buyers from Brazilian Mills

TITLE PROJECT	CREDIT BUYER - COUNTRY/INSTITUTION
Santa Cândida Bagasse Cogeneration Project	United K. - EDF Trading, Switzerland - CM Capital Markets Holding
Nova América Bagasse Cogeneration Project	Sweden - Nynäs Refining Aktiebolag, Switzerland - Econergy Brasil
Alta Mogiana Bagasse Cogeneration Project	Government of Canada, Finland - Ministry for Foreign Affairs, France - Gas de France Germany - RWE, Japan - MIT Carbon Fund, United K. - Deutsche Bank, Sweden - Government of Sweden
Santa Cândida Bagasse Cogeneration Project	United K. - EDF Trading, Switzerland - CM Capital Markets Holding
Colombo Bagasse Cogeneration Project	Netherlands – CAF Sweden - ABN AMRO Bank, Switzerland - Econergy Brasil
Vale do Rosário - BCP Bagasse Cogeneration Project	Sweden - Government of Sweden
Cerradinho Bagasse Cogeneration Project	United K. - ABN AMRO Bank
Lucélia Bagasse Cogeneration Project	United K. - EcoSecurities, Switzerland - Government of Switzerland
Caetés Bagasse Cogeneration Project	Japan - Chugoku Electric, Switzerland - Econergy Brasil
Serra Bagasse Cogeneration Project	United K. - EDF Trading, Switzerland - Mercuria Energy Trading
Coinbra-Cresciumal Bagasse Cogeneration Project	Switzerland - Econergy Brasil
Santo Antonio e São Francisco Bagasse Cogeneration Project	Japan - Chugoku Electric, United K. - Ecopart Switzerland - Bunge Emissions Group,
Jalles Machado Bagasse Cogeneration Project	Netherlands - CAF
Coruripe Bagasse Cogeneration Project	Netherlands - CAF
Campo Florido Bagasse Cogeneration Project	United K. - EDF Trading
Alto Alegre Bagasse Cogeneration Project	Switzerland - Econergy Brasil
Iturama Bagasse Cogeneration Project	United K. - EDF Trading
Cruz Alta Bagasse Cogeneration Project	Switzerland - First Climate
Santa Adélia Bagasse Cogeneration Project	Netherlands - BHP Billiton Marketing, United K. - Ecopart, Switzerland - CM Capital Markets Holding
Zillo Lorenzetti Bagasse Cogeneration Project	Switzerland - Ecoinv global United K. - Santander Carbon Finance
Equipav Bagasse Cogeneration Project	Switzerland - Mercuria Energy Trading, United K.- Citigroup
Moema Bagasse Cogeneration Project	Sweden - Government of Sweden, United K. - 3C
Cerpa Bagasse Cogeneration Project	Netherlands - BHP Billiton Marketing, Switzerland - Ecopart
Usinas Itamarati Cogeneration Project	Japan - Chugoku Electric, United K. - Ecopart

Source: UNFCCC[17]

Table 4. Position of Brazilian Power Plants Registered in CDM

TITLE	CREDIT START TO 2020 KtCO²	VALIDATOR	kCERs	1st. ISSUANCE	UNTIL	EXPECTED kCERs	ISSUANCE SUCCESS	ISSUANCE DELAY (Months)	VERIFIER
Santa Elisa	197	DNV	70	18/Aug./06	31/Dec./07	55	126%	5,8	SGS
Nova América	236	TÜV-SÜD	37	18/Aug./06	31/Dec./05	56	66%	6,0	DNV
Alta Mogiana	224	TÜV-SÜD	70	16/Aug./06	31/Dec./06	54	129%	5,9	SGS
Santa Cândida	197	DNV	70	18/Aug./06	31/Dec./07	55	126%	5,8	SGS
Colombo	491	TÜV-SÜD	93	06/Sep./06	31/Dec./07	111	84%	6,2	SGS
Vale do Rosário	495	TÜV-SÜD	138	13/Oct./06	30/Jun./06	119	116%	7,5	DNV
Cerradinho	643	TÜV-SÜD	99	15/Jun./06	31/Dec/06	120	83%	3,5	DNV
Lucélia	265	DNV	39	30/Oct./06	31/Aug./07	56	71%	8,0	BV Cert
Caetés	563	TÜV-SÜD	180	08/Sep./06	31/Dec./07	147	122%	6,3	SGS
Serra	122	DNV	49	06/Oct./06	31/Dec./08	41	120%	7,2	SGS
Coinbra/ Cresciumal	306	DNV	102	28/Dec/06	09/Jul./10	122	83%	10,0	TÜV-SÜD
S. Ant./S.Franc.	386	TÜV-SÜD	147	28/Aug./06	20/Jun./09	146	100%	5,9	BV Cert
Jalles Machado	176	DNV	63	06/Jul./06	22/Apr./08	63	100%	4,2	BV Cert
Coruripe	86	DNV						79,2	
Coruripe	190	DNV	72	06/Jul./06	30/Nov./07	55	132%	4,2	SGS
Alto Alegre	161	TÜV-SÜD	34	15/Sep./06	31/Dec./07	34	100%	6,5	TÜV-SÜD
Coruripe	227	DNV	84	07/Jul./06	31/Dec./08	73	116%	4,2	SGS
Cruz Alta	178	TÜV-SÜD	31	22/Nov./06	30/Jun./06	30	103%	8,7	BV Cert
Santa Adélia	222	DNV	180	30/Oct./06	06/May/10	155	116%	7,9	BV Cert
Zillo-Lorenzetti	1052	DNV	352	25/Sep./06	14/Jun./08	377	93%	6,8	BV Cert
Equipav	591	TÜV-SÜD	184	11/Sep./06	31/Dec./07	170	108%	6,2	SGS
Moema	258	TÜV-SÜD	84	02/Jan./07	19/May/08	92	91%	10,0	DNV
Cerpa (Us. da Pedra)	163	DNV	129	08/Sep./06	31/Dec./08	89	146%	6,1	BV Cert
Itamarati	155	DNV	82	11/Sep./06	31/Aug./08	56	147%	5,3	BV Cert

Source: UNFCCC[18], developed by the authors

After this initial identification, the research focused on the performance of organizations in relation to the amount of "greenhouse" gases emissions reductions (ton. of CO_2) released into the atmosphere during the first cycle of the CDM, as well as the volume of carbon credits traded with firms in developed countries.

These figures were obtained by analyzing the published record of each plant on the platform of the UNFCCC. The compilation and classification of data in the form of each plant allowed to the authors to build a comprehensive and comparative table, in which, data considered important for the study analysis were aggregated and condensed into a single spreadsheet data. Table 4 reproduces information that reflects the performance of each plant in relation to the Clean Development Mechanism, specifically in terms of Certified Emission Reductions, the periods involved and designated organizations. This framework highlights the following information:

- Credit start to 2020: the figures represent the thousands of tons of CO_2 that should be reduced by the project activities.
- Validator: consulting firms accredited in UNFCCC as a Designated Operational Entity to validate the project
- kCERs: volume reductions that is explained in the Certified Emission Reduction
- 1st Issuance Date
- Date of completion of the evaluation period
- Expected kCERs: this is defined as the CERs Issued by the number of the CERs expected in the PDD (Project Design Document) for the same period
- Issuance success: it represents the percentage of achievement of established goals or overcoming these numbers
- Issuance Delay: time between the registration of the project and the first certified emission
- Verifier: companies accredited in UNFCCC to carry out project monitoring

The Power Plant project Coruripe had not yet granted the 1st issue, as can be seen in Table 4 column "Issuance delay". The number of months is 79, 2 and it means that is not approved yet. For this reason, there is no additional information.

The figures in Table 4 are self-explanatory, both in absolute terms for an analysis of the performance of each plant and for a comparative analysis of performance between them.

Should be stressed, however, the numbers presented in the "Issuance Success", where are listed the percentage of achievement of goals: the indicators show that 60% of the plants exceeded targets for reducing emissions. The analysis

of individual and aggregate performance of the plants in the CDM is significantly positive in terms of reducing emissions of "greenhouse effect" gases. However, we cannot assess the financial result of the carbon credits sale, although this has not been the primary motivation of the mill owners for the deployment of cogeneration energy projects using biomass.

From the perspective of sustainable development, in the case of Brazil, Resolution No. 1 of the Interministerial Commission on Global Climate Change states that the projects submitted, have to bring substantial environmental and social benefits, ensuring the generation of employment and income. The projects, to be approved, they must meet the prerequisite of additionality, which assumes that the project is not the most feasible economic alternative.[19]

With these constraints, the project must show that changes an entire reality-based scenarios if trends do not become viable deployment. This is technically called a "baseline", as we discussed before. A major difficulty is the lack of existing research that subsidizes and provides technology for developing these baselines, enabling the adoption of methodologies required to develop the projects.

Thus, in addition to a significant net reduction in emissions, there are other requirements for the project to be considered viable for approval. The project must meet the requirements of the CDM and CIMGC, it means, identification of alternatives consistent with federal, state and local legislation, fitted to regional common practices and reflecting the impact of CDM registration.

Of course, the financial aspect, this is, the planned investment and funding sources available for obtaining it, are conditions that need to be mentioned. The accuracy of the data related to investments in PDDs, is not yet possible to assess, even for the UNFCCC. The international carbon funds do not have the custom to disclose such information, despite having a total of US$ 14 billion, of which a maximum of 38% was invested in CDM.[20]

5. Conclusions

The UNFCCC Secretariat in preparation for the Conference of the Parties held in November 2012 produced a report showing that billions of dollars have been invested through the Clean Development Mechanism projects that reduce “greenhouse” gas emissions and contribute for sustainable development. The document entitled "Benefits of Clean Development Mechanism 2012," argues that the system has met its objectives and is providing extra benefits to developing countries.

Although it didn’t offer a sectorial vision, the study examined about four thousand projects and took into account the contribution of the CDM to sustainable development and technology transfer, as well as its regional distribution. Revised estimates of the financing and economic costs of various projects and income generated by the use of CERs were also presented.

The evaluation of all Project Design Document - PDD files by UNFCCC revealed that the capital invested in CDM projects varies significantly according to the type of activity. The average investment per project is approximately US$ 45 million, topped by China and India concentrating 65% of total investments and 45% of projects. The benefit is more PPDs mentioned in stimulating the local economy through job creation and poverty alleviation, followed by reducing pollution and encouraging access to energy (renewable and traditional).

Based on these figures, the UNFCCC concludes that, in total, US$ 215.4 billion was invested in CDM projects registered and submitted for registration by June 2012.

The report also estimates that investing in CDM projects, the Annex I countries of the Kyoto Protocol, which have targets to meet, saved up to $ 3.6 billion; this is the difference between the value of the CERs and the value of permissions issuance.

The report concludes that ".....the methodologies of the CDM, due to their large number and extensive use, influence the methodologies of other clearing systems. Indeed, the CDM is serving as an international body for quality methodologies compensation", noting that this role could be documented in the CDM “which would contribute to the identification of possible improvements and even the need for an international quality.”[21]

Despite the optimism of the UNFCCC anchored in CDM benefits, the current situation of the market for carbon credits, not appeals to European entrepreneurs, which, as we have seen, are the main buyers of these securities. Large companies like Shell, Unilever, EDF Energy, Braskem, Statoil, Swiss Re, Ricoh and Skanska and other multinationals sited in Europe, prepared a document entitled "Carbon Price Communiqué" urging regulators from the European Union to establish a pricing policy for carbon that should be clear, transparent and unambiguous to sustain the investments needed to significantly reduce emissions of "greenhouse effect” gas.[22]

Another major limitation is the transaction cost of the projects, whose minimum value is around US$ 150 thousand. In an attempt to facilitate access to small businesses or even encourage projects lower volume of CERs was approved under the UNFCCC, a different modality to favor small-scale projects with requirements and simplified methodologies in order to reduce costs transaction and encourage the involvement of small business through associative arrays.

In Brazil, the MDIC - Ministry of Development, Industry and Trade in partnership with BM&F - Brazilian Mercantile & Futures created the Brazilian Market for Emissions Reduction. The basic idea is to organize the primary market through a project database, with recording system, storage and classification. This has interesting implications, such as reducing transaction costs, improving visibility to investors, which can be identified and sought after by companies with viable projects to be implemented.

In the particular case of plants of this sector, the data revealed by the UNFCCC statistics show that the results are

positive in relation to meeting the goals established for the CDM and very significant reduction in greenhouse gas emissions of "greenhouse effect." although domestic ethanol situation is not favorable. UNICA reported that 40 sugar mills and alcohol from the Southeast and Midwest ceased their activities in the last five years.

It is also important to note that CO_2, the concept of "greenhouse gases" is the only paradigm index measuring emissions. Other gases, such as methane and sulfur dioxide are much more harmful to health, to the environment and highly polluting. The low emission or zero greenhouse gas constitutes one of the advantages of using biomass for biofuels and power generation.

Extending the analysis of this work focused on the sugarcane industry to other sectors of industrial and agricultural activities, it can be stated that the Clean Development Mechanism is a very important tool to encourage nations and firms to become directly involved in environmental issues. However, only large organizations have financial and technical conditions to meet the requirements of the UNFCCC and participate in the process. Small and medium size also has its share of blame for the pollution of the environment, sometimes even a lack of knowledge and guidance. In aggregate these companies has a significant participation in the production of industrial waste, as well as the contamination of the atmosphere. However, as already mentioned above, the bureaucratic process and the high cost of preparing and monitoring the PDD - Project Design Document which hamper the participation of these companies. Should be considered as well, the need to hire specialized consultants in the subject and UNFCCC accredited, plus expenditure on inspection tours of the committees appointed to monitor the project.

From a financial standpoint, even large organizations are not getting the expected return due to the value currently assigned to carbon credits on the international market. Thus, the broad purposes established by the Kyoto Protocol, are limited by bureaucratic process that is costly and time consuming. We are not discussing whether the requirements for the validation of the project are very strict, (it is clear that the UNFCCC require detailed information to justify acceptance of the project), but it should be recognized that a large number of cases are being prevented from participating in the process. And of course, this is not one of the purposes of the Protocol.

One of the solutions that can be studied to allow access of these companies to the CDM, can be found in the formation of business networks, coordinated by an association of companies in the same industry or by an organ of the Government in the environmental area, which in addition to distributing the costs, would take care of the bureaucratic process.

This is just an initial idea, which could be used by producers' associations to develop actions with government environmental bodies, as well as further studies of researchers devoted to the theme of environmental management in small and medium sized organizations.

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