LEGACY OF THE CDM

lessons learned and impacts from the Clean Development Mechanism in Brazil as insights for new mechanisms

ipea

Editors
Flavia Witkowski Frangetto
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Gustavo Luedemann

The Kyoto Protocol represents a milestone in the international efforts to tackle climate change. This agreement has established a legal commitment to reduce anthropogenic emissions of greenhouse gases (GHGs), which can be achieved through its flexibility mechanisms, among which is a financial incentive called Clean Development Mechanism (CDM).

Brazil was a pioneer in the development of CDM projects, registering its first project activity on November 18, 2004. Since them, until October 2018, 343 Brazilian projects had been registered in the United Nations Framework Convention on Climate Change (UNFCCC), classifying the country as the third largest host of such projects.

Within the scope of the project "Support to the Brazilian Technical Focal Point to the United Nations Framework Convention on Climate Change", commissioned by the Ministry of Science, Technology, Innovations and Communications (MCTIC), Ipea gathered in this publication the contribution of Brazilian negotiators who had a relevant participation at the UNFCCC, as well as researchers and experts who study the impacts of the CDM contribution in Brazil.

The work brings relevant aspects, from a historical perspective, not only of the formatting of the Kyoto Protocol and the CDM, but also of its effective implementation and contribution to the country. Furthermore, it provides insights on how the progress made over the course of more than two decades, since the ratification of Kyoto, could contribute to the construction of new mechanisms in the context of global climate change. All this thanks to the collaboration of the authors in telling their experiences and expectations with the CDM, making a collection of lessons learned of its implementation in Brazil and presenting what could constitute a CDM legacy.

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Brasília, 2019

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The opinions expressed in this publication are of exclusive responsibility of the authors, not necessarily expressing the official views of the Institute for Applied Economic Research and the Ministry of Economy.

CONTENTS

LIST OF ACRONYMS

ANEEL	Brazilian Electricity Regulatory Agency (*Agência Nacional de Energia Elétrica*)
APE	Energy self-producers (*Autoprodutores de energia*)
CCEE	Chamber of Electric Energy Commercialization (*Câmara de Comercialização de Energia Elétrica*)
CDM	Clean Development Mechanism
CDM-EB	CDM Executive Board
CER	Certified Emission Reductions
CGH	Hydroelectric generating plant (*Central geradora hidrelétrica*)
CH_4	Methane
CIMGC	Interministerial Commission on Global Climate Change (*Comissão Interministerial de Mudança Global do Clima*)
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	Carbon dioxide
COP	Conference of the Parties
CPA	Component Project Activity
DNA	Designated National Authority
EU	European Union
G77	The Group of 77 (at the United Nations)
GHG	Greenhouse gases
IPP	Independent Power Producer
MAE	Wholesale Electric Energy Market (*Mercado Atacadista de Energia Elétrica*)
MCTIC	Ministry of Science, Technology, Innovations and Communications (*Ministério da Ciência*, *Tecnologia*, *Inovações e Comunicações*)
N_2	Nitrogen
N_2O	Nitrous oxide
PFC	Perfluorocarbon
PoA	Programme of activities
PP	Project Participants
PROINFA	Alternative Energy Sources Incentive Program (*Programa de Incentivo às Fontes Alternativas de Energia*)
SCDE	Energy Data Collection System (*Sistema de Coleta de Dados de Energia*)
SDM	Sustainable Development Mechanism
SF_6	Sulfur hexafluoride
SHP	Small Hydro Power
SIN	National Interconnected System (*Sistema Interligado Nacional*)
UFV	Solar Photovoltaic Power Plant (*Central geradora solar fotovoltaica*)
UHE	Hydropower Plant (*Usina hidrelétrica*)
UNFCCC	United Nations Framework Convention on Climate Change
UTN	Thermonuclear Power Plant (*Usina termonuclear*)
WCD	World Commission on Dams

FOREWORD

The Institute for Applied Economic Research (Ipea), a public foundation linked to the Ministry of the Economy (ME), has as its mission "enhance public policies that are essential to Brazilian development by producing and disseminating knowledge and by advising the state in its strategic decisions". Recognizing the importance of climate change, we have contributed, for many years, with studies and participation in collegiate bodies and public hearings of the Executive and Legislative Branches, providing assistance to overcome the problems arising from it.

The consequences of increased temperature and other adverse effects resulting from climate change are quite severe for individuals, especially those in vulnerable situations, as well as for the economy sectors, which must be prepared, not only for the future scenarios, when the intensive use of fossil fuels will be restricted, but also for unambiguous adjustments of their economic activities due to the new climate conditions. On the horizon, innovation, the use of renewable energy sources and less polluting technologies will guide the sustainable economy.

Clean Development Mechanism (CDM), established under the Kyoto Protocol (1997), had – and, we believe, will still have – its role in the history of seeking for catalyst solutions in low-carbon economy. What contributions has the CDM brought to Brazil? The present work answers this question, as it provides a record that is intended to explain how the mechanism could help in the prevention and in the fight against the increase of the concentration of greenhouse gases (GHG) emissions in the atmosphere.

The invited authors have demonstrated that they worked in order to make possible the implementation of the CDM in Brazil. Among them, there are those who have collaborated both for the emergence of the mechanism in Kyoto and for the inclusion of developing countries in the carbon credit markets, following the example of the negotiations resulting in the terms of the Paris Agreement. Pioneers in the theme, these experts reported the real situations that they have personally experienced and made them experienced in the implementation of the mechanism. To read what they have critically and technically opined in this work is to gain a roadmap in which the readers can visualize the traveled pathways and the destinations in which the experiences of the CDM implementers in Brazil seem to signal fundamental changes for future mechanisms.

I would like to express my satisfaction to the specialists from the various fields who signed the sixteen chapters of the book; to the editors – Flavia Witkowski Frangetto, Gustavo Luedemann and Ana Paula Beber Veiga – who managed to develop this cartography on behalf of Ipea; and, to the Ministry of Science, Technology, Innovations and Communications (MCTIC), represented by Márcio Rojas, who supported the accomplishment of this work. I am pleased with the achievement.

Enjoy your reading!

Alexandre Xavier Ywata de Carvalho

INTRODUCTION

The Kyoto Protocol represented a milestone in international efforts to tackle climate change, establishing a legal commitment to reduce anthropic emissions of greenhouse gases (GHGs). During its first commitment period, from 2008 to 2012, 37 industrialized countries committed to reduce their emissions by an average of 5% below 1990 levels. Based on the principle of common but differentiated responsibilities, the Protocol has not established quantified emission reductions commitments for developing countries. Among its flexibilization instruments, the Clean Development Mechanism (CDM) stands out for allowing the quantified targets for developed countries to be partially achieved through emission reduction projects implemented in developing countries as an aid to the fulfillment of obligations.

It is worth emphasizing the innovative nature of this regulatory framework, by providing for the pricing of gases regulated by the Protocol, allowing the transaction of Certified Emissions Reduction (CERs) between its signatory Parties. It is assumed that the use of market-based climate policy instruments' main benefit is the promotion of economic efficiency, since they induce GHG emissions reductions where the lowest marginal costs associated with these reductions are to be find. Besides, this system encourages investments in alternative, less emission-intensive technologies, so that society adapts its consumption pattern to the growing relative prices of emission-intensive goods and services.

At the international level, Brazil was an early developer of CDM projects, with its first project activity dating back to November 18, 2004.[1] From then until the beginning of May 2018, 342 Brazilian CDM project activities were registered at the United Nations Framework Convention on Climate Change – UNFCCC, equivalent to 5.5% of total global activities. This figure ranks Brazil at a prominent position when compared to other countries hosting CDM projects, totaling a GHG emissions reduction potential of 493,119 ktCO_2e by 2020.

The publication *Legacy of the CDM: lessons learned and impacts from the Clean Development Mechanism in Brazil as insights for new mechanisms* was commissioned by the Ministry of Science, Technology, Innovations and Communications (MCTIC), as part of a partnership with the Institute for Applied Economic Research (Ipea) provided by a Decentralized Execution Term signed in 2016. Such Term proposed the explore the contribution of the CDM to Brazil'

1. At the time, CDM was considered as an exercise to have the right for a better future. Along these lines, please refer to: Frangetto, F. W. *Mecanismo de Desenvolvimento Limpo* – direito ao futuro. *In*: Batista, E.; Cavalcanti, R. B.; Fujihara, M. A. Caminhos da sustentabilidade no Brasil. São Paulo: Terra das Artes Editions, 2005.

sustainable development and a facilitator of a paradigm shift towards a low-GHG economy, assessing its possible influence on new mechanisms provided for in the Paris Agreement and other associated issues, such as the Brazilian market of emissions reductions and governance related to climate change.

Even before the Kyoto Protocol entered into force in 2005, Ipea had been contributing with analyses of the potential and difficulties in implementing CDM through the publication of texts for discussion, chapters of books, articles in journals, statements, articles in magazines and interviews in our TV program, *Panorama Ipea* (Ipea Perspective, in English), which are available at the Institute's website.

Building from the experience of its research team, a summary of propositions was prepared and an invitation was made to experts who worked intensively in implementing the CDM in Brazil, most of them even before the entry into force of the Kyoto Protocol, so that they could contribute to the subjects that were intended to be discussed in the book.

Our aim with this book is to have a CDM *ex post* evaluation of the implementation of the CDM in Brazil – what it meant and what lessons can be learned from it – and to foresee the role of possible market mechanisms in the new climate agenda, considering the Paris Agreement and under the turbulence of the current phase of international politics, especially involving cooperation on climate change.

A first debate with the invited authors was held in a workshop on April 17, 2017 at Ipea in Brasilia. On that occasion, the authors and their respective collaborators had the opportunity to express what topics they would like to discuss given their experience with CDM.

We emphasize the nobility with which Luiz Gylvan Meira Filho, invited to participate in the initial discussions about the work, referred, in that opportunity, to each one of the future chapters' author, and started interesting debates significantly contributing to the result of the work. Luiz Gylvan Meira Filho was *co-chair* of the Intergovernmental Panel on Climate Change (IPCC) Science Working Group, having conducted the main works for the existence of CDM as it was intended to be in the spirit of the Kyoto Protocol as a hard law norm.

Also worthy of note is the valuable contribution of all authors, co-authors and collaborators who, on a voluntary basis, shared their experience since the early days of the protocol. They were the first to overcome the challenges imposed in tackling climate change and contributed in different spheres – governmental, business and scientific – so that CDM and all of its developments could be implemented in the country.

Specifically for this English edition, we would like to thank the authors who have spared no effort in carrying out further revisions of the texts and acknowledge the support of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, which provided financial resources that enabled the revision of the publication.

This book tracks the past, present and provide some future perspectives for CDM. Building from this premise, the chapters were grouped into sections that congregate, respectively:

- *Part I* – the background of negotiations that led to CDM and its development, in relation to project execution and evolution of the Brazilian institutional capacity, in the past two decades;
- *Part II* – the development of CDM implementation in the country, taking into consideration significant sectors in the economy, and scientific, legal, institutional and business progress;
- *Part III* – current aspects on carbon market and how CDM is taken into account in international climate negotiations regimes, in particular in new UNFCCC agreements; and,
- Part IV - a synthesis, which seeks to measure the transformational change thanks to the CDM based on the observation of previous chapters and thoughts of the editors.

In the *first part*, the first chapter describes the intense negotiation process that ended in the constitution of the Framework Convention and the Kyoto Protocol. Elaborated by authors who, like other peers, participated in these processes, it brings an important record of Brazil's central role and, to a certain extent, its pioneering role, as the first country to regulate the creation of a Designated National Authority (DNA), and therefore to establish the institutional bases that allowed it to be the first country to register a CDM project activity.

Also, in the first part of the book, Chapter 2 presents detailed institutional arrangements that were established for the implementation of the CDM in the country. In addition, it explains the roles of the Brazilian DNA and accounts for the scope of the mechanism within the country by describing the registered CDM project activities, including information on its regional distribution, typology, history of issuance of CERs from Brazilian projects, among other dimensions.

The *second part* of the book starts with a reflection on the evolution of knowledge throughout the years, since the beginning of the mechanism's implementation. Authors in Chapter 3 demonstrate the improvement of knowledge regarding greenhouse gas emissions accounting, without forgetting to record an important remark on how the intense process of methodology revisions may ultimately have contributed to increase uncertainty for project developers and other market agents.

The following Chapters address sector-specific issues, which, in the Brazilian case, have had some relevance given the status of economic activities in the country in terms of expecting a reduction in emissions intensity. Thus, Chapters 4, 5, 6 and 7 indicate specificities of CDM projects in the energy, waste, forests and industrial sectors, respectively. The contributions in these chapters not only register the development of activities in their corresponding sector, but also indicate important lessons learned, particularly:

- Capacity building in quantifying emissions;
- Paradigm change in managing emissions and historical sectoral practices, with the availability of new technologies;
- Significant contributions to the improvement of MRV activities;
- Explicit importance of incentives for the implementation of emission reduction activities.

By the end of Part II, Chapter 8 carried out an assessment and presented a critical analysis of the mechanism's contribution for sustainable development; and Chapter 9 describes the contributions that CDM brought to Brazilian corporate environment, from a market agent point of view, as a catalyst for activities focused on sustainability.

The *third part* was design to describe some aspects that are currently being discussed about the possible influence of CDM on building new mechanisms, which are still being debated, in the scope of international negotiations on climate change. Moreover, the content presented in the last chapters of the book will introduce readers to the main aspects discussed in those negotiations, especially the relevant CDM contribution to the institutional framework dealing with climate issues in Brazil (Chapter 10), legal issues that are crucial for the success of new mechanisms in the future climate regime (Chapter 11), the future of CDM considering the progress of the Paris Agreement and its influence in the development of the Sustainable Development Mechanism (Chapter 12), important mobilization of capital for the creation of sustainable infrastructure (Chapter 13), pricing and market formation (Chapter 14) specially in Brazil under the guidance of the PMR Brazil initiative (Chapter 15).

To finish the book, the editors of the work, in the *forth part*, wrote Chapter 16 expressing that any difficulties in the implementation process of CDM projects in the country do not invalidate it. Whether or not they agree with the paths taken by the mechanism, they tried to acknowledge the legacy received by the mechanisms that supervene.

Ipea, in fulfilling its institutional mission of contributing for the debate and improving public policies that are essential for the development of the country remains attentive to this subject, on which we need to continue to focus at in order to assess what would be the best mechanisms to help Brazil and the international community to address the problems arising from it and how to mitigate them, avoiding anthropogenic emissions of greenhouse gases.

Editors

PART 1

TWO DECADES OF THE CLEAN DEVELOPMENT MECHANISM

CHAPTER 1

THE CLIMATE CHANGE CONVENTION AND ITS KYOTO PROTOCOL AS ACTION DRIVERS[1]

Adriano Santhiago de Oliveira[2]
José Domingos Gonzalez Miguez[3]
Tulio César Mourthé de Alvim Andrade[4]

1 BRIEF BACKGROUND OF THE CLIMATE CHANGE CONVENTION

In 1988, the United Nations Environmental Program (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC), aiming at evaluating, on a scientific perspective, knowledge on climate change, assessing possible socio-economic and environmental impacts, and formulating realistic strategies to address the causes and consequences of increased concentration of greenhouse gases in the global climate system. This was one of the most important steps in the recognition of this phenomenon.

The IPCC had the participation of important scientists and experts on climate-change related issues. The first panel's evaluation report was published in 1990 and led the General Assembly of the United Nations (UN) to adopt in New York in May 1992 the text that gave rise to the United Nations Framework Convention on Climate Change (UNFCCC).

An intense political-preparatory process was necessary for the adoption of the convention, as there was a need to develop international climate-change related policies and legal instruments. This process, together with other global environmental issues, culminated in the 1992 United Nations Conference on Environment and Development in Rio de Janeiro (Rio 92). The agreement came into force in 1994 and Brazil was the first country to sign it.[5]

1. This text reflects the personal position of the authors and not of the institutions of the Government to which they belong, nor do the authors necessarily share the same view on the issues addressed in this book by other chapter authors. Any contradictory views with this chapter are the result of possible divergences of opinions.

2. Chemical Engineer. Director of the Climate Change Monitoring, Support and Action Department of the Secretariat of Climate Change and Forests of the Ministry of Environment (DMAF/SMCF/MMA).

3. Electronic Engineer. Director of SMCF/MMA Climate Change Policies Department of the Secretariat of Climate Change and Forests of the Ministry of Environment (DPMC/SMCF/MMA).

4. Bachelor in Law. Member of the Brazilian Embassy in Tokyo.

5. In order to follow up other countries' ratification status, see: https://bit.ly/1ujgxQ3.

The UNFCCC was one of the conventions signed during Rio-92. The conference report is the Agenda 21 document and two other conventions were adopted in addition to the UNFCCC, which also aim at addressing global environmental priority issues: the Convention on Biological Diversity and the United Nations Convention to Combat Desertification and Mitigating the Effects of Drought.

The UNFCCC was signed by Brazil on June 4th, 1992 at the Rio de Janeiro Conference, to which 165 countries subsequently joined. For Brazil, the Convention was internalized in the legal system on May 29th, 1994, ninety days after its ratification by the National Congress on February 28th, and its deposit with the UN, in the Secretariat of the convention. The Convention entered into force on March 21st, 1994, ninety days after being ratified by fifty countries. Currently, 197 Parties have ratified it (196 Parties and a Regional Organization for Economic Integration), which makes it the most universal of the United Nations conventions.[6] Only a few countries, usually countries facing internal problems such as wars, have not adhered to the Convention on Climate Change.

Even at the time, and considering the lack of full knowledge on climate change processes and impacts, the Convention text has brought great advances to the discussion of sustainable development. The Convention recognizes, among other elements, that:

- climate change and its adverse effects to the Earth's climate are a common concern of humankind;
- developed countries cause the largest share of global, historical and current greenhouse gases emissions; and
- per capita emissions from developing countries are still relatively low and the share of their global emissions will increase so that they can meet their social and development needs.

2 OBJECTIVE OF THE CONVENTION ON CLIMATE CHANGE

The aim of the convention is to achieve the stabilization of greenhouse gases concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the global climate system. This level should be achieved within a time frame that is enough to allow ecosystems to adapt naturally to climate change, ensuring that food production is not threatened and allowing economic development to proceed in a sustainable manner.

6. A list of countries that have ratified the Convention and respective signature dates can be found at https://bit.ly/1ujgxQ3. Accessed on: May 7th, 2018.

In the text of the Convention, there are two major groups of countries: the so-called group of countries in Annex I to the Convention, which is formed by developed countries, i.e. the Organization for Economic Cooperation and Development (OECD) and the bloc formed by countries of the former Soviet Union and Eastern Europe; and the group known as non-Annex I, formed by developing countries. Each of these groups, however, are alliances of countries whose interests are not homogeneous, for example: among developed countries, specific negotiation groups with greater affinities on climate change issues such as the European Union and the group known as *umbrella*, which includes Japan, the United States, Canada, Australia and New Zealand; among developing countries, the Alliance of Small Island States (AOSIS), the Organization of the Petroleum Exporting Countries (OPEC) and, especially in the case of Brazil, the group of large emerging developing countries known as BASIC in English, which includes Brazil, South Africa, India and China. Also worthy of note is the G77 + China group of developing countries, of which Brazil is also part.

3 THE CONVENTION'S COMMITMENT ON CLIMATE CHANGE

The *National Communication* is a document provided for in the Convention[7] and represents the official information of the Government of Brazil on anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol.[8] The document also contains an overview of the measures taken or envisaged for the implementation of the convention in the country.

The elaboration of the *National Communication* follows the guidelines established by the Convention in Decision No. 8/CP 11. The inventory follows the guidelines established by the IPCC for the preparation of national inventories of greenhouse gases.

Other general commitments for all parties are listed in Article 4, paragraph 1, in particular in subparagraph (b), which states that the Parties shall formulate, implement, publish and regularly update national and, where appropriate, regional programs containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change.

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7. As per the binding commitment established in Article 4, paragraph 1, letter "a" and Article 12, paragraph 1, letter "a", of the UNFCCC.

8. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty that entered into force on January 1st, 1989. The document signed by the Parties sets specific obligations, particularly the binding progressive phase down in production and consumption of substances which deplete the ozone layer (SDOs) until its complete phase out. Some of these substances are also greenhouse gases, but since they were already controlled under this protocol, the Convention on Climate Change did not double control.

4 PRINCIPLES OF THE CONVENTION ON CLIMATE CHANGE

The Convention on Climate Change aims at stabilizing atmospheric concentrations of greenhouse gases at such levels that the climate system (atmosphere, oceans and biosphere) is not affected in a dangerous way. It also states that the speed of climate change should not exceed such value that ecosystems may have difficulty adapting to changing conditions. It also considers that stabilization of concentrations should not be made at the cost of sharp reductions in emissions levels as to adversely affect social and economic development.

The Convention on Climate Change does not specify what future levels of emissions should be, although Article 4, paragraph 2 (b) states that the Annex I countries had the aim of returning, whether individually or jointly, their anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol to their 1990 levels. Moreover, the judgment as to whether or not a particular climate change is characterized as dangerous is to a large extent a judgment which will depend on the frequency and magnitude of the adverse impacts of climate change.

In its text, which is the result of a difficult negotiation process for its elaboration and adoption, the Convention on Climate Change establishes several principles, the most important of which are listed below.

The precautionary principle, i.e. lack of full scientific certainty, should not be used as a reason for postponing the adoption of measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Even in the absence of complete certainty in forecasts, and taking into account the magnitude of the likely adverse effects, caution should be exercised and the worsening effect must be avoided.

The principle of common but differentiated responsibilities of all countries is another principle established by the Convention. Greenhouse gases have long lifetimes in the atmosphere – a decade for methane, and centuries for carbon dioxide and nitrous oxide – and are rapidly mixed in the atmosphere by planetary movement. So, it is no use thinking about climate change in only one country, as everyone will be affected.

Responsibility is differentiated among countries, as historical records show that emissions that cause climate change vary widely among them. In recognition of the fact that emissions, once produced, have a long-term effect, the Convention recognizes that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that *per capita* emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs.

Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.

The rationale behind the process of emissions and development is based on the following: *i)* in the initial part of the curve, those countries still in an initial stage of development (low gross domestic product – GDP *per capita*, like most African countries) would have a very low, close to zero, emissions rate; *ii)* as the GDP increases, emissions growth accelerates (for example, China, India, Brazil, middle-income countries), as the incorporation of larger portions of the population into the formal economy results in emissions through increased human activity; and *iii)* finally, in the stage of developed countries, with stable or declining population and economy changing from industrial to services, there is a stabilization of emissions with GDP increase. The convention states that countries in the middle of the curve (such as Brazil, China and India) should increase their emissions in order to ensure sustainable development and poverty eradication. In addition, it states that the developed countries responsible for most historical emissions of greenhouse gases must take the lead and make significant and absolute reductions in their emissions.

5 THE KYOTO PROTOCOL

The climate change policy that led to the Kyoto Protocol was conditioned by decisions made within the framework of the Convention on Climate Change itself and in the so-called Berlin Mandate – resolution of the first conference in Berlin of countries that ratified the Convention, which launched the negotiation of the Kyoto Protocol.

Following the entry into force of the Convention in 1994, the Conference of the Parties (COP) 1 was held in Berlin in 1995. At that first meeting, it was possible to identify that an increase in greenhouse gas emissions was taking place and that the proposed initial emission reduction target for developed countries would not be adequate.

The Berlin Mandate established that developed countries should set quantitative emission reduction targets for 2005, 2010 and 2020, as well as describe the policies and measures that would be required to achieve those targets, the deadline being COP 3 in Kyoto, Japan, which would be held in December 1997.

For developing countries, as is the case of Brazil, no additional commitments were established, but these countries should make progress in meeting existing commitments. That is, developing countries should establish programs to address the problem, without quantitative targets for limiting or reducing greenhouse gas emissions, and conditioned to adequate financial and technological resources being made available by industrialized countries.

The problem, therefore, for the negotiation of the Kyoto Protocol was to first decide on the emission levels of greenhouse gases that could be tolerated in the near future and then decide how the burden would be shared in order to obtain the necessary reductions among countries.

The establishment of objective and fair criteria for sharing the burden of climate change mitigation was of crucial importance for developing countries. There was a clear tendency to replace the principle of common but differentiated responsibility[9] agreed in the convention by other mechanisms that, in practice, had in effect of transferring the burden of mitigation instead of just allocating this burden according to the responsibilities of each country.

For instance, carbon budget and *per capita* emission approaches would favor developed and populous countries, respectively. Both approaches do not adequately address relevant socioeconomic issues: they are inadequate in terms of equity and are "shortsighted" because they simply focus on a given time period and disregard the historical perspective.

6 BRAZILIAN PROPOSAL OF 1997 ABOUT THE CLEAN DEVELOPMENT FUND

The Brazilian proposal for elements for the preparation of the Kyoto Protocol, elaborated by the Ministry of Science and Technology in 1997, quantified in a practical and objective way the sharing of costs of tackling climate change, according to the effective responsibility of each country in causing the problem – a principle known as "the polluter pays" principle.

Brazil proposed the adoption of a model in which each country's responsibility for climate change was estimated not in terms of its causes, i.e. the greenhouse gas emissions that give rise to the problem, but in terms of their effects – measured by the contribution of each country to the increase in the average temperature of the Earth's surface – in the effective climate change caused by those emissions.

According to the Brazilian proposal, the responsibility of each country should be attributed in terms of its relative contribution to the increase in global average temperature and not only in terms of greenhouse gas emissions in a given year or even the contribution to the concentration of gases in the atmosphere. This difference in parameters indicated that Annex I Parties had a greater contribution to the problem. While some studies estimate that emissions from developing countries may equal those of industrialized countries in two to three decades,

9. For further information on the scope for interpretation of the *principle of common but differentiated responsibilities*, see Chapter 16 (notes from the editors).

the developing countries' responsibility for increased emissions as a result of their emissions will only match that of developed countries within more than a century.

There is no single path for greenhouse gas emissions for a certain level of temperature stabilization or a given level of concentration in 2100; the path will depend on the assumptions about: *i)* patterns of economic and population growth, energy production and consumption, changes in land use and conversion of forests to other uses; *ii)* scientific uncertainties in the treatment of the global carbon cycle, global climate system response, climate sensitivity, uncertainties about natural radiative forcing, cloud formation, among others; and *iii)* choices between how much to mitigate as quickly as possible or how to adapt (adaptation becomes more costly and less effective as climate change progresses).

In theory, in order to achieve a certain level of stabilization temperature by 2100, infinite concentration paths are possible and, for a certain level of concentration, infinite emission paths are possible. For bigger emissions in the initial years, bigger reductions will have to occur in subsequent years. Defining a single path or a maximum emission limit on a certain date implies assuming a set of hypotheses that are often not explicit.

The Brazilian proposal also contained a mechanism for the provision of financial resources for actions in developing countries, through a global fund that would be fed by contributions made as a result of penalties (US$/ºC exceeded) to industrialized countries that did not comply with their agreed quantitative targets for limiting or reducing greenhouse gas emissions.

The resources made available by developed countries could be used by developing countries for projects to reduce greenhouse gas emissions (and a small portion for adaptation projects) that would enable these countries to move forward in implementing the Convention and at the same time continuing the development process in a sustainable way. This approach was fully consistent with the fact that the Convention on Climate Change recognizes that the priorities of developing countries in this context are the promotion of sustainable development and the eradication of poverty.

6.1 Adoption of the Clean Development Fund by G77 + China

Upon presenting the Brazilian proposal, the part related to the Clean Development Fund had a wide repercussion among the countries composing the G77 + China and after several meetings, it was adopted at the meeting of the subsidiary bodies, as a proposal of the group itself.

The proposal led to the Clean Development Mechanism (CDM), as will be described below.

7 ADOPTION OF THE CDM AS ARTICLE 12 OF THE KYOTO PROTOCOL

The Kyoto Protocol was adopted at COP 3, held in Kyoto, Japan, in December 1997. The Protocol established a commitment to reduce by at least 5% the greenhouse gas emissions of industrialized countries (Annex I) below levels recorded in 1990, between 2008 and 2012.

The CDM originated from the Brazilian proposal of the Clean Development Fund, which was then adopted as a G77 + China proposal. On the eve of the Kyoto Conference, a delegation from the United States came to Brazil to negotiate the terms of the Clean Development Fund proposal. The United States had two objections to it. First, they did not accept the idea of penalty in an international treaty. Second, they did not consider that a burden should be imposed on the taxpayer from Annex I countries, but on consumers participating in activities that emit greenhouse gases. From the discussions in Brazil, a joint Brazil-United States CDM proposal was elaborated, and was jointly submitted in the first week of the Kyoto conference.

This mechanism consisted in the possibility for an Annex I country to acquire certified emission reductions (CERs) – also known by the more general name of carbon credits – in projects implemented in developing countries. Thus, Annex I countries could fulfill part of their domestic commitments at lower costs, while promoting sustainable development in developing countries.

The proposal, modified in a discussion group established to negotiate it, was adopted in Kyoto and became Article 12 of the Protocol.

8 ESTABLISHMENT OF AN INTERMINISTERIAL COMMITTEE AS THE CDM NATIONAL DESIGNATED AUTHORITY

Entry into force of the Kyoto Protocol, with its resource mobilization potential of many tens of billions of dollars per year, a fraction of which could be CDM-oriented, pointed to the importance of formalizing a mechanism before the Government that could direct that potential to the development priorities. Thus, in order to achieve this objective, on July 7th, 1999, the President of the Republic, exercising the attribution conferred by Art. 84, item II, of the Constitution, enacted a decree creating the Interministerial Commission on Global Climate Change (CIMGC). The duties of the committee are:

- provide opinions, whenever required, on sectoral policy proposals, legal instruments and standards that contain a relevant component for mitigating global climate change and for adapting the country to its impacts;

- provide inputs to Government positions in negotiations under the UNFCCC and subsidiary instruments of which Brazil is a Party;
- define additional eligibility criteria to those considered by the Convention Bodies in charge of the CDM, as provided for in Article 12 of the UNFCCC Kyoto Protocol, in accordance with national strategies for sustainable development;
- assessing opinions on projects that result in emission reductions and that are considered eligible for the CDM, and approve them, as the case may be; and
- articulate with representative entities of the civil society, in order to promote the actions of governmental and private bodies, in fulfillment of the commitments made by Brazil to the UNFCCC, and the subsidiary instruments of which Brazil is a Party.

Thus, the Interministerial Commission represented an effort to articulate global climate change-related government actions. This commission is the Designated National Authority within the scope of the CDM under the Kyoto Protocol.

It should be noted that in order for countries with no quantified greenhouse gas emission reduction targets to be able to host CDM projects, there was a need for them to constitute their Designated National Authorities. In this sense, Brazil was the first country to domestically regulate the protocol, designating the Interministerial Commission on Global Climate Change, established since 1999, as its Designated National Authority. The Interministerial Commission published its first resolution in September 2003, internalizing the modalities and procedures of the CDM in Brazil,[10] following the decisions of the CDM Executive Board and the Brazilian legislation. The resolutions of the Interministerial Commission seek to internalize the modalities and procedures established at the international level, respecting the Brazilian specificities.

The Interministerial Commission's resolutions truly reflect the rules of the Kyoto Protocol and the decisions of the COPs as the meeting of the parties (MOP) of the Kyoto Protocol. In addition, they define the documentation to be submitted by the Parties, such as declarations of compliance with labor and environmental legislation, and make an additional requirement that binds proponents to provide greater transparency and opportunity for participation to affected or interested parties in specific projects. There is also the regulation of the approval process of the projects by the Brazilian Designated Authority.

10. For further information about the establishment of the Brazilian DNA, see Chapter 2. Regarding the shortcomings of this process, see Chapter 8 (notes from the editors).

The requirements to demonstrate the project's contribution to sustainable development are clear and simple and, at the same time, contain relevant aspects to guarantee it.[11] Annex III of the Interministerial Commission Resolution No. 1 states that project participants should describe whether and how the project activity will contribute to sustainable development with respect to the following aspects:

- contribution for local environmental sustainability;
- contribution for the development of work conditions and net job generation;
- contribution for income distribution;
- contribution for capacity-building and technological development; and
- contribution for regional integration and articulation with other sectors.

9 BRAZILIAN CDM PROJECT ACTIVITIES

It is possible to affirm that the CDM has achieved an unquestionable success for the achievement of real, measurable and long-term emissions reductions, especially when the results achieved are considered in a proper manner. This result is intrinsically associated with ensuring that emission reductions are in addition to those that would occur in the absence of the certified project activity. This element is one of the fundamental pillars to ensure the environmental integrity of the Kyoto Protocol. There are clear contradictions to this principle with some proposals made by developed countries to seek greater "flexibilization" of CDM modalities and procedures. These alleged flexibilizations or simplifications need to be evaluated with caution in order to avoid harm to the environmental integrity of the protocol.

Brazil was the first country ever to use this mechanism, having its first CDM Project (Novagerar, for reusing landfill biogas) registered under the UN in 2004, even before the Protocol entered into force, with ratification by the Russian Federation. Likewise, a Brazilian project methodology was one of the first ever approved by the Executive Board of the CDM: sanitary landfills in Salvador (state of Bahia).

Data from the latest CDM Executive Board report indicated that by July 13th, 2017, 7,776 CDM project activities and 310 programs of activities (PoAs) had been registered, with 2,061 components included; 1,843,750,188 CERs would have been issued for CDM project activities and 8,938,800 for PoAs; and 22,464,732 CERs would have been canceled voluntarily.[12]

11. For further information on the requirements for assessing the contribution to sustainable development, see Chapter 8 (note from the editors).

12. For further information on this topic, see Chapter 2. Further analysis of some CDM project typologies can be found in chapters 4 through 7, which deal with specific sectors that had some prominence (note from the editors).

On April 30th, 2017, the country ranked third in number of project activities, with 342 registered project activities (4.4% of the world's 7,770 CDM project activities), with China ranking first, with 3,763 projects (48.4%), and India ranking second, with 1,642 projects (21.1%).[13]

In terms of the estimated reduction of greenhouse gas emissions associated with projects in the CDM cycle, by April 2017, Brazil ranked third and was responsible for the reduction of 49,192,159 tCO_2eq, corresponding to 4.9% of the world total for the first crediting period.[14]

In terms of number of project activities, carbon dioxide (CO_2) was the most relevant at that time, with 195 project activities, followed by methane (CH_4), with 121 project activities, and nitrous oxide (N_2O), with five project activities.

The sectoral scopes that most attracted the interest of participants in CDM project activities in the country by December 31st, 2013 were the energy industry with 191 projects, followed by waste treatment and disposal (81), agriculture (59), manufacturing industry (9), chemical industry (6), afforestation and reforestation (3), metal production (3), and fugitive emissions (1).

As for the number of Brazilian project activities developed by type of project, by December 31st, 2013, hydroelectric power led with 26%, followed by biogas (20%), wind power plants (16%), landfill gas (15%) and energy biomass (13%). The project types with the highest CO2eq emission reduction estimate were the hydropower, biogas and N_2O decomposition activities, which totaled 73.2% of the total CO2eq emissions to be reduced in the first generation period credits. These three sectors had an emission reduction estimate of 268,529,454 tCO_2eq during the first crediting period of the project activities.

The total installed capacity of the CDM project activities recorded by December 31st, 2013 in the energy area was 18,168 MW. The hydroelectric plants led with 1,780 MW; followed by biogas (2,668 MW), landfill gas (2,462 MW), energy biomass (2,128 MW) and wind power plant (1,780 MW).

In terms of CERs units issued by December 31st, 2013, Brazil ranked fourth in the world, with more than 90 million CERs, being surpassed by China, with more than 868 million; India, with 189 million; and South Korea, with 120 million CERs issued. The CDM, therefore, was an important source of funding for the reduction of greenhouse gas emissions in Brazil, mainly in the energy sector.[15]

13. For further information on this topic, see Chapter 2. Further analysis of some CDM project typologies can be found in chapters 4 through 7, which deal with specific sectors that had some prominence (note from the editors).

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15. For further information, see Chapter 4 (note form the editors).

There are other non-exhaustive examples: the emission reduction achieved by the thirty Brazilian projects in the scope of reducing CH_4 (methane) in landfills[16] already registered in the Executive Board corresponds to 55% of national landfill emissions in 1994. Similarly, five Brazilian projects to reduce N_2O (nitrous oxide) in the production of adipic acid and nitric acid practically zeroed N_2O emissions in this industrial sector (chemical industry). In addition, 67 CDM projects are carried out in the area of swine farming, promoting responsible waste management and raising the awareness of agricultural entrepreneurs in making their businesses sustainable.

With regard to PoAs, Brazil had, by December 31st, 2013, eight PoAs registered in the UNFCCC, three wind power plants, two hydroelectric plants, two biogas plants and one landfill gas, with emission reduction estimates of more than 10 million tCO_2eq, occupying the eighth position in the world ranking.

As for the number of project component activities (CPAs) of PoAs, Brazil led with more than 65.8% of the world total. The first Brazilian PoA, registered in 2009, was developed in the area of capture and combustion of CH_4. It had, by December 31st, 2013, 1,050 small-scale CPAs registered under the UNFCCC. The participation of more than 1 thousand pig farms in the program demonstrates the relevance of the CDM to enable initiatives that did not have the necessary incentives to occur.

10 INDUCTION OF MITIGATION ACTIONS IN BRAZIL DUE TO THE CDM

CDM has been important in Brazil as a driver of new technologies and expansion of energy sources that had not been developed until then in the country. One can cite the case of landfills (flare methane burning), small hydroelectric plants and cogeneration using sugarcane bagasse, which had a high implementation rate due to the use of the CDM.

Evidence of the importance of CDM in electricity cogeneration using sugarcane bagasse can be measured by the paralysis following the CDM Executive Board's definition of a 25% "common practice" limit for this technology. From that point on, there were no CDM project registrations in this area, either in Brazil or in India, which demonstrates the importance of the CDM to enable the penetration of this technology.[17]

In addition to inducing the installation of new technologies, such as the N_2O burner installed by Rhodia in Paulínea in the adipic acid production line, the first of its kind in South America, the massive introduction of biodigesters in swine farms has led to improved conditions socioeconomic, health and environmental

16. For further information, see Chapter 5 (note form the editors).
17. For further information on the discussion on the impact of change on the sector, see Chapter 4 (note from the editors).

standards. These benefits brought about by the CDM continue even without the current support of the mechanism. Likewise, the results of emission reductions last beyond the crediting period under the mechanism.

10.1 Human and institutional capacity-building fostered by the CDM

The training of human resources dedicated to the theme of climate change, as well as in particular the reduction of greenhouse gas emissions and the promotion of sustainable development due to the CDM should be added to its technological development.

In this sense, there was capacity building in all institutions involved with the CDM, from the developers of greenhouse gas emission reduction projects in the various sectors to the training of new auditors specialized in the validation and registration of emission reduction projects, as well as emission reduction certification for these projects.

In the academy and non-governmental organizations, there was also training in the theme in general and search for innovative initiatives to reduce greenhouse gas emissions as compensation for individual emissions in travel, conferences (including the initiative of the Brazilian government at the Conference of Nations (Rio+20) and others such as Inhotim (MG) initiative to offset the emission caused by visitors to Inhotim Park.

Although restricted to parts of the Kyoto Protocol, the CDM was first used for non-compliance purposes (i.e. for use other than partial use of targets by Annex I countries) when CERs were voluntarily canceled by Brazil to offset emissions from the Rio+20 organization in Rio de Janeiro in 2012. The voluntary cancellation of CERs was one of the four steps taken by the COP 19 in Warsaw in 2013 to help reduce the ambition gap. Subsequently, there was a voluntary cancellation initiative to offset the emissions by the organization of the Soccer World Cup in 2014 by the Brazilian government and, more recently, similar initiatives by the Government of the State of Rio de Janeiro for the Olympic Games in 2016.

11 PROPOSED USE OF CERS AS VOLUNTARY COMPENSATION IN RIO+20 AND IN THE WORLD CUP IN BRAZIL

11.1 CERs as voluntary compensation in Rio+20

The idea of offsetting emissions by the Rio + 20 organization, held between June 13th and 22nd, 2012, in Rio de Janeiro, by the Brazilian government, was to create an additional demand for CERs of greenhouse gases in a moment when the European Union announced that it would no longer buy the CERs under the scope of the CDM of emerging countries.

In order to estimate the greenhouse gas emissions associated with the event, a greenhouse gas inventory of the activities corresponding to the Rio+20 organization was prepared, taking into account internationally accepted standards. The inventory consisted of determining the following anthropogenic emissions of greenhouse gases:

- the ones related to the *consumption of fuels in generators* in official negotiation venues during the days of the event;
- the ones related to the *consumption of energy of the Brazilian electricity grid* in the official negotiation venues during the days of the event;
- the ones related to the *adequate management of solid waste generated and collected* in the official negotiation venues during the days of the event; and
- the ones related to the *use of fuels in official ground transportation* of delegations and entourage organized by the National Organizing Committee of Rio+20 (CNO) during the days of the event.

In addition, institutional arrangements were set up to offset emissions corresponding to the organization of the Rio+20 Conference, which enabled participants and official delegations to understand the greenhouse gas emissions corresponding to their travel and participation in the conference. The preliminary inventory estimate was 150,000 tCO_2eq of emissions generated around the event.

The institutional arrangement enabled the cancellation of CDM CERs associated with Brazilian project activities and donated by partner companies in the number of tons of carbon dioxide equivalent (tCO_2eq) equal to that indicated in the *ex-post* inventory. This way, these companies had the opportunity to publicize their CDM project activities and the association of their brands with the protection of the global climate system, guaranteed by the environmental integrity of the mechanism, as well as the benefits package already offered to the companies by the organization of the event.

In order to perform the cancellation, the owner of the CERs (CDM project participant) or the receiving entity must have a CDM registration account. The organization then entered into an institutional agreement with the United Nations Development Program (UNDP), which received information on donations and cancellations of CERs from partner companies. UNDP monitored and filed requests for cancellation of CERs donated to the CDM registry, which could be canceled by the donors themselves or transferred to an account indicated by the program for later cancellation.

Finally, organizers created a virtual calculator of greenhouse gas emissions for participants and delegations to present their individual and/or collective data. In a broad sense, this calculator considered the following source as the basis for the preparation of individual and collective estimates (delegations): greenhouse gas emissions from *fuel use in the air transportation* of participants and delegations during arrivals and departures in Rio de Janeiro.

In order to quantify those estimates, the virtual calculator was made available by qualified personnel, distributed by the official Rio+20 Conference sites. It was also available on the Conference's official website.

The calculator presented the estimates of total greenhouse gas emissions that were generated by the individual or collective participation (delegation) at the Rio+20 Conference, after data entry of each participant and/or delegation. Users of the calculator had, at the end of their data collection, the opportunity to contribute voluntarily to offset their emissions by supporting one or more Brazilian CDM project activities, which had space for publicizing the logo and individualized advertisement of each project on the official website and calculators provided at the event. The UNFCCC Executive Secretary itself has voluntarily participated in the voluntary cancellation.

11.1.2 Voluntary cancellation adopted by the CDM Executive Board

As set out in Annex 2 (*Procedure for implementing voluntary cancellation in the CDM registry*) of the report of the CDM Executive Board at its 69th meeting, held in Bangkok, Thailand, from 9 to 13 September 2012, after discussion at the meeting, a procedure to implement the voluntary cancellation of CERs in the CDM registry was adopted. The adoption ratified the procedure that Brazil had used in Rio+20 and that had been a pioneer in the world.

It is important to note that in the modalities and procedures of the CDM there was no impediment to voluntary cancellation, it was not explicitly mentioned. Due to different legal interpretations, this procedure was adopted by the Board only after the proposal made by the Brazilian representative in the CDM Executive Board, taking into account the fact that already occurred in Rio+20 with the support of UNDP in the execution.

11.1.3 Voluntary cancelation adopted at COP 21

Following the recognition by the CDM Executive Board of the possibility of voluntary cancellation of CERs, a subsequent COP 19 decision in Warsaw, Poland, reiterated the invitation to the Parties to promote the voluntary cancellation of CERs (Decision No. 1 / COP 19, paragraph 5c – *Inviting Parties to promote the voluntary cancellation of CERs, without double counting, as a means of closing the pre-2020 ambition gap*).

Decision 1/CP.21 of COP 21 in its Part IV – pre-2020 Enhanced Action, "encourages Parties to promote the voluntary cancellation by Party and non-Party stakeholders, without double counting, of units issued under the Kyoto Protocol, including certified emission reductions that are valid for the second commitment period".

Finally, in 2016, the Convention secretariat established an Internet portal to facilitate the purchase of CERs by individuals or entities in a simplified way, units originated from CDM project activities that offered their available credits at a certain price in the portal.

11.2 CERs as voluntary compensation at the World Cup in Brazil

Following the success of the idea of offsetting emissions during the Rio+20 Conference in Rio de Janeiro, the Brazilian government pursued the same goal of creating additional demand for CERs in the absence of demand, given the decision of the European Union of no longer acquiring CERs from major emerging countries, in the international event of the Football World Cup of the International Football Federation (FIFA) in 2014.

Like in Rio+20, four scenarios of greenhouse gas inventories associated with the event were made, increasing coverage of emissions from the organization of the event to the arrival of fans from several countries abroad, adding new sources of greenhouse gas emissions by making compensation more comprehensive in scope.

The four scenarios prepared by the Ministry of the Environment were:

- related to the direct emissions of the *construction of stadiums and the hosting of delegations and the operational logistics of the Confederations Cup and the 2014 FIFA World Cup* in the official spaces reserved for the delegations of the national teams during the event period – this scenario was estimated to reach emissions of 59,216 tCO_2eq;
- related to emissions from the previous scenario *plus domestic flight emissions from the 2014 FIFA World Cup* – this scenario was estimated to reach emissions of 188,115 tCO_2eq;
- related to the emissions from the previous scenario *plus the emissions of the international flights of the 2014 FIFA World Cup* – this scenario was estimated to reach emissions of 1,413,609 tCO_2eq; and
- related to emissions from the previous scenario modified to include *emissions life cycle analysis for stadium construction* – this scenario was estimated to reach emissions of 2,889,103 tCO_2eq.

The Ministry of the Environment received voluntary offers of cancellation from participants of Brazilian projects in the amount of 545,500 tCO_2eq. This successful result was achieved by the partnership with 16 companies that contributed with CERs in the range of 5 thousand to 105 thousand tCO_2eq. The company that contributed the most was Tractebel (currently Engie do Brasil), with 105 thousand tCO_2eq (CER units), followed by Rhodia (which currently belongs to the Solvay Group), with 100 thousand tCO_2eq.

12 CDM RESULTS IN TERMS OF INVESTMENT ATTRACTION AND REDUCTION OF GREENHOUSE GAS EMISSIONS

Considering that the largest portion of the 90 million CERs issued for Brazilian project activities by December 31st, 2013, was traded in the initial CDM period, using a conservative value of US$ 10/tCO_2eq, a revenue impact of project participants of about US$ 900 million was estimated.

This value demonstrates the importance of the CDM in financing project activities, which were mostly innovative in their respective sectors and allowed sustainable development.

13 OBSTACLES CREATED BY THE EUROPEAN UNION DECISION AND THE RETAINING OF CERS

In a similar way, in 2012, the decision by the European Union (which until then was the largest source of demand for CERs), was unfavorable to multilateral market mechanisms, only to recognize, for the fulfillment of Community obligations in the area of climate change, CDM from activities of relatively less developed countries and small island states. CERs from large developing countries, such as Brazil, South Africa, China and India, were no longer accepted, which had contributed most to CDM projects and to the scale achieved by the mechanism.

The said decision led to a collapse in the value of CERs, and consequently, to the relative discredit of the CDM as a whole, together with the private sector.[18] From then on, there was a gradual disengagement from project entrepreneurs, designated operational entities (DOEs) and other stakeholders involved in the process of emission reduction certification and in the CDM. After 2013, at the end of the Kyoto Protocol's first commitment period, which went from 2008 to 2012, there was a low level of registration of CDM project activities.

14 DISCUSSIONS ABOUT A NEW MECHANISM AND THE USE OF THE CDM'S CERS

Emissions from aviation represent some 2% of global anthropogenic CO_2 emissions. However, the significant increase in emissions from domestic aviation is expected as developing markets in emerging countries mature, which explains in the importance of measures to mitigate these emissions through the CDM. The International Civil Aviation Organization (ICAO) has been working with the UNFCCC

18. Several chapters of the publication deal with the impact of the restriction on the commercialization of CERs by the European Union. Graph 4 in Chapter 6 shows the change in CER prices for the period (note from the editors).

Secretariat and in 2015, during the 87th meeting of the CDM Executive Board, the first methodology to reduce aviation emissions in the CDM was approved, even before COP 21.

As per paragraph 5 of Resolution No. A39-3, dated October 2016,[19] the OACI decided to implement a global market-based mechanism – GMBM in the form of carbon-offsetting and reduction scheme for international aviation – CORSIA. The aim was to address the annual increases of any total CO_2 emissions from international civil aviation (i.e. flights departing from one country and landing in another) above 2020 levels. Domestic aviation emissions are addressed by each Party under the UNFCCC.

According to paragraph 4 of the same resolution, the aim is to complement a broad package of measures to achieve the global aspirational goal of carbon neutral growth as at 2020. The scheme further reinforces the need for further progress in improving operational technologies, traffic management, infrastructure, efficient operation, and sustainable alternative fuels. It aims to ensure that progress is achieved in all elements in a balanced way, with a percentage of emission reductions increasing with time as a result of other measures (other than market-based mechanisms).

14.1 Implementation of CORSIA in stages

The implementation of the CORSIA scheme will be phased in order to take into account the different capacities and circumstances of the different countries, particularly the developing ones, and to minimize market distortion. A pilot phase will be implemented from 2021 to 2023 in countries willing to participate voluntarily.

The first phase will be implemented from 2024 to 2026 in the countries participating voluntarily in the pilot phase, as well as in any other country that wishes to join. The second phase of the scheme will be implemented from 2027 to 2035 in all countries whose share in revenue ton-kilometer (RTK) volume in 2018 is above 0.5% of the total, or whose cumulative participation in the list of countries sorted from highest to lowest RTK reach 90% of total.

The resolution strongly encourages all countries to volunteer for the pilot phase and first phase; developed countries have already volunteered and are taking the lead. It is clear that over 60 countries have agreed on taking part.

19. Go to https://bit.ly/2yoJe8o to see the resolution. Accessed on: May 11th, 2018.

14.2 Calculation formula of emissions to be offset

The quantity of CO_2 emissions to be offset by an aviation carrier in a given year starting in 2021 is calculated with the use of a formula that takes into account the increase of emissions during this given year in relation to the average of 2019 and 2020. The formula applies a weight to include both sectoral emissions growth and individual operator growth. The weight is 100% for the industry by 2029 and then has an increased weight of individual growth (to be defined by ICAO in 2028).

The resolution still has some work to do, particularly in relation to monitoring and standards. It lists a number of areas for future work and further details to be elaborated. For instance, it highlights the need for safeguards in order to ensure the sustainable development of the aviation sector, and is against the inadequate economic burden on the sector, requiring the Board to decide on what bases and criteria this action will be taken and identify how to tackle those issues.

A global market-based mechanism – GMBM requires an independent standardization and validation process in order to assure that carbon emissions are adequately balanced in the offsetting project. ICAO has developed standards in this area and the International Air Transport Association (IATA) is one of the four organizations qualified to verify which programs comply with the standards.

The resolution does not significantly provide further details about an appropriate monitoring, reporting, verification – MRV system. It is necessary that such a system is developed to be adopted by the Board in 2018.

Likewise, the development and guidelines for emissions unit criteria – EUCs, as well as recommendations for eligible emissions units are areas still underway.

14.3 The CDM creates a precedent

Verification procedures and the agreement that describes EUCs are clearly crucial for credibility and success. The Resolution decided that emission units generated in mechanisms established by the UNFCCC and Paris Agreement are eligible for CORSIA.

15 TRANSITION FROM THE CDM TO A SUSTAINABLE DEVELOPMENT MECHANISM (SDM) AS PROPOSED BY BRAZIL

The international climate change regime's ability to ensure a smooth transition from the CDM to the SDM will be pivotal for the Convention's reputation. Failure in guaranteeing that CDM stakeholders, especially project developers, will have their efforts recognized and honored and will continue to have tangible effects in the context of the Paris Agreement will threaten legal certainty as well as prevent CERs from contributing to action the pre-2020 ambition. Ultimately, it will promote the loss of credibility of the international regime by CDM project participants and will result in the loss of effectiveness of the mitigation instrument due to the lack of participation of public and private entities.

When Brazil understands that SDM is the successor to the CDM, it is of the utmost importance that there is a smooth transition between the two, in particular as regards: *i)* continued validity of CDM units through the conversion of CDM CERs for use in nationally determined contributions (NDCs) or cancellation by the parties, public and private entities for other uses; *ii)* continued validity of the CDM methodologies under the SDM; *iii)* issuance of SDM CERs for registered CDM project activities; and *iv)* transposition of the CDM accreditation system into the MDS.

Consistent with the text of the Paris Agreement, the scope of Article 6, paragraph 4, is similar to that of the CDM. In this sense, its rules, modalities and procedures should encompass the verification and certification of CER units by a DOE of the long-term, measurable and real benefits related to additional emission reductions resulting from voluntary activities authorized by each party involved and supervised by a body designated by the COP serving as the meeting of the parties to the Paris Agreement. Brazil sees the SDM as the ultimate international mechanism to certify action to combat climate change and issue credits.

The proper operationalization of the concept of additionality is central to the SDM objective and to its potential to broaden the ambition of the climate change regime. Additionality should reward projects that would not be feasible in the absence of the mechanism under Article 6, paragraph 4. With the progressive implementation of the Paris Agreement and policies implemented in the context of the NDC, it should be expected that earlier policies will not be able to demonstrate which are the first of their kind or that pass in the analyzes of common practice, barriers or investment. Brazil's view is that the CDM methodologies should also be applied to the SDM to ensure that additionality is adequately assessed.[20]

The rules, modalities and procedures of the SDM should reflect the fact that the mechanism innovates in relation to the CDM by further aiming at "encouraging and facilitating participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a part"[21] (UN, 2015, p. 29). While the demand for CERs under the CDM was originally conducted by Annex I parties, units issued under the SDM can be used by any stakeholder for any purpose that encompasses the MRV of actions to combat climate change, including finance.

20. As per the document *Views of Brazil on the process related to the rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Paris Agreement*, of the UNFCCC. Available at: https://bit.ly/2tskPZU. Accessed on: May 11th, 2018.

21. Chapter 16 presents this aspect as one of the CDM legacies, as it more recently provided for the voluntary cancellation of CERs as a way of ensuring greater participation by different agents (note from the editors).

16 TRANSITION FROM A GLOBALIZED WORLD TO A FRAGMENTED WORLD

The CDM as part of the Kyoto Protocol follows the trend of the late 1990s globalization. The rules defined in the protocol were made in the top-down approach, with a goal of global emission reduction (although restricted only to those developed countries that should take the lead in the process of fighting climate change), and their distribution between the countries was made so that there was a corresponding responsibility and capacity to meet the goals.

The Paris Agreement breaks down the trend of globalization in a more fragmented environment, with countries tending to strengthen national ties, such as the UK's decision to let the European Union and the United States withdraw from the Free Trade Agreement of North America (Naphta). The very definition of the objectives of the Paris Agreement represents this fragmented view of the world with commitments being NDCs, with no regulation implying that the sum of contributions will meet some goal that will actually help avoid the average temperature rise of the Earth's surface.

Unfortunately, in this new paradigm, the CDM seems anachronistic with its international cooperation approach, as a mechanism to limit the cost of implementing global emission reduction measures where they are most cost-effective. For countries with a very high reduction cost (e.g., Japan), a system of purchasing units to meet their targets is perfectly logical from the economic point of view. The joint Brazil-European Union proposal to extend to the SDM (Article 6 of the Paris Agreement) the ideas and principles of the CDM is the last chance to maintain a top-down approach to international cooperation and a better cost-benefit ratio for deployment of project activities, with the vision of compliance with an international treaty within the UN, even considering the trend of greater importance of national values in a fragmented world.

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CHAPTER 2

THE CLEAN DEVELOPMENT MECHANISM IN BRAZIL

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1 INTRODUCTION

The Kyoto Protocol, adopted on December 11th, 1997, in Japan, was a milestone in international efforts to tackle climate change, by establishing a legally binding commitment to reduce anthropogenic emissions of greenhouse gases (GHGs).

This regulatory framework stood out for its innovative nature, providing for the pricing of gases controlled by the Kyoto Protocol and the trading of reduction certificates among the signatory Parties. Moreover, it became an incentive for investments in alternative, less emission-intensive technologies.

The Kyoto Protocol allowed for the use of market-based climate policy instruments, among various other elements, to help developed countries in complying with their quantified commitments for the reduction and limitation of GHG emissions. In the case of Brazil, involvement in this market occurs via the Clean Development Mechanism (CDM), as it is the only mechanism in the Kyoto Protocol that admits the voluntary participation from developing countries.

The CDM is based on the development of project activities that reduce GHG emissions. The projects in the scope of the CDM are implemented in the least developed and developing countries, which can trade GHG emission reductions, known as Certified Reduction Emissions (CERs) to developed countries, thus helping them achieve their emissions reductions targets and commitments taken on before the Kyoto Protocol. These projects must generate extra emissions reductions, in addition to those that would occur in the absence of the CDM project, ensuring actual, measurable and long-term benefits for the mitigation of climate change.

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As an earlier developer of the CDM projects, Brazil has played a significant role in creating and institutionalizing the CDM during the international negotiations for the use of market mechanisms. The first CDM project activity developed in Brazil was registered on 18 November 2004 – an Energy Project based on Landfill Gas, of NovaGerar EcoEnergia Ltd.

From that time up to April 2017, 342 Brazilian project activities have been registered under the CDM Executive Board, a subsidiary body of the United Nations Framework Convention on Climate Change (UNFCCC), which is equivalent to 4.4% of the total number of projects registered globally. This figure ranks Brazil 3rd in the global ranking.[4]

Since its creation, the CDM has been through several changes and adjustments. However, these changes did not have as much impact as those related to the uncertainty generated by questions on the continuity of the CDM after the end of Kyoto Protocol's First Commitment Period[5] and the decision by the European Union, the world's largest carbon market, to only buy credits from projects registered by December 31st, 2012 (Santos, 2014) – which have contributed significantly for the excess supply of carbon credits in the global market.

During the 21st Conference of the Parties (COP-21), in 2015, a series of provisions have been agreed on, in order to establish a new market mechanism under the Paris Agreement – the Sustainable Development Mechanism (SDM). It was expected that this mechanism would go beyond traditional compensation, based on lessons learned with the CDM.

2 BRAZILIAN INSTITUTIONAL FRAMEWORK

Regulation of projects, within the scope of the CDM, is under the responsibility of the CDM Executive Board, headquartered in Bonn, Germany, and by the Government of the project's host Party.

The Board oversees the Kyoto Protocol's CDM,[6] under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP). The said Board is the last point of contact for CDM project participants to obtain registration of projects and CERs issuance.

4. For further information, please refer to the CDM project search databank. Available at: https://cdm.unfccc.int/Projects/projsearch.html. Accessed on: June 2017.

5. The first commitment period of the Kyoto Protocol started in 2008 and ended in 2012.

6. The Kyoto Protocol is an international agreement under the UNFCCC. Adopted in Kyoto (Japan) on December 11th, 1997, it entered into effect on February 16th, 2005. Detailed norms for the implementation of the protocol were adopted during the COP-7, in Marrakesh, Morocco, in 2001, and are referred to as the Marrakesh Agreement.

The National Designated Authority (NDA) is the host Party's focal point before the CDM Executive Board. Appointing an NDA is a requisite for Kyoto Protocol signatories to participate in the CDM.

Out of the NDA's responsibilities are the definition and establishment of norms for the implementation of the CDM in the country; assessment of the CDM project proposals submitted; and the issuance of letters of approval attesting that the project contributes towards sustainable development, that the Party has ratified the Protocol and that participation of the country in the CDM is voluntary. This letter is a pre-requisite for requesting project registration at the CDM Executive Board.

In Brazil, the Interministerial Commission on Global Climate Change (CIMGC) was responsible for assessing CDM projects, and, in addition to other roles provided for in Presidential Decree dated July 7th, 1999, acted as the Brazilian NDA.[7] This Decree established that the Minister of Science, Technology, Innovations and Communications would chair the Commission, with the Minister of the Environment as co-chair. It also established that the Ministry of Science, Technology, Innovations and Communications will act as Executive Secretariat of the CIMGC.

Law No. 12,187, dated December 29th, 2009,[8] established in its Art. 7, item II, that the CIMGC was the institutional instrument for the implementation of the National Policy on Climate Change (PNMC). It also established, in Art. 6, item V, resolutions of the CIMGC as instruments of this policy.

In addition to the Ministries above chairing and co-chairing the CIMGC, the Commission was also composed by representatives (incumbent and substitute members) of the following bodies: Ministry of Foreign Affairs, Ministry of Agriculture, Livestock and Supply; Ministry of Transport, Ports and Civil Aviation; Ministry of Mines and Energy; Ministry of Planning, Development and Management; Ministry of the Environment; Ministry of Science, Technology, Innovations and Communications; Ministry of Industry, Foreign Trade and Services; Chief of Staff to the Presidency; Ministry of Cities; and Ministry of Finance.

The CIMGC, in its role as NDA, acted with respect to acquired rights and perfect legal acts in terms of compliance with the applicable legislation. In this context, the Commission applied the norms described in its resolutions[9] without retroacting, reserving the right to cancel or revoke the letter of approval in case a project activity beached the law or conflicted with public interest after receipt of said letter.

7. Decree establishing the CIMGC. Available (in Portuguese) at: https://goo.gl/5eWifP.

8. National Policy on Climate Change. Available (in Portuguese) at: https://goo.gl/JDSb7f.

9. CIMGC Resolutions. Available at: https://goo.gl/xyU2wJ.

3 REQUISITES FOR THE APPROVAL OF CDM PROJECTS IN BRAZIL

Projects within the scope of the CDM are called project activities, because they refer to activities that are part of an undertaking or provide for GHG emissions reductions or an increase in carbon dioxide removal (CO_2), that would not occur in the absence of those activities (baseline scenario).

The baseline can be understood as a level of GHG emissions that an undertaking would emit in the absence of the CDM project activity – that is, it is a reference scenario in relation to which the GHG reductions effectively achieved by the CDM project activity can be estimated (CGEE, 2010).

CDM project activities must go through several stages before CERs are issued: preparation of the Project Design Document (PDD); validation; approval by the host country; registration at the CDM Executive Board; monitoring; and verification and certification of emissions reductions. The CDM Executive Board only issues CERs, which is the last part of cycle, when there is proof that reductions in gas emissions resulting from the CDM's design activities were definitively considered to be real, that is, when emissions reductions can be verified a posteriori.

The CDM Executive Board issues CERs on behalf of project activities participants, as stated in the letters of approval issued by the host country's government, deducting 2% of the total CERs issued. The percentage deducted is allocated to the Adaptation Fund to help the most vulnerable countries adapt to the effects of climate change.

In an attempt to reduce the transaction costs of the implementation of CDM projects, and aiming at simplifying the process, UNFCCC established the Programmatic CDM, or Program of Activities (PoA). This instrument enables, with only one contract and a single application, the registration of different project activities.

The steps related to the Programmatic CDM are practically the same as those followed in the development of a project activity, except that the various project activities that make up the PoA (called component project activities – CPAs) can be added to the PoA after registration, provided that they follow the same rules established in the PoA and that their inclusion is informed to the Secretariat of the CDM Executive Board (CGEE, 2010).

When assessing CDM project activities and PoAs submitted, the CIMGC considers the following aspects: voluntary participation of each party involved, Project or PoA Design Document, Validation Report and project contribution for the country's sustainable development, known as Annex III. In relation to Annex III, through CIMGC Resolution No. 1, five criteria have been established for the assessment of CDM projects: income distribution, local environmental sustainability, development of work conditions and net job generation, technological capacitation and development, and regional integration and articulation with other sectors.

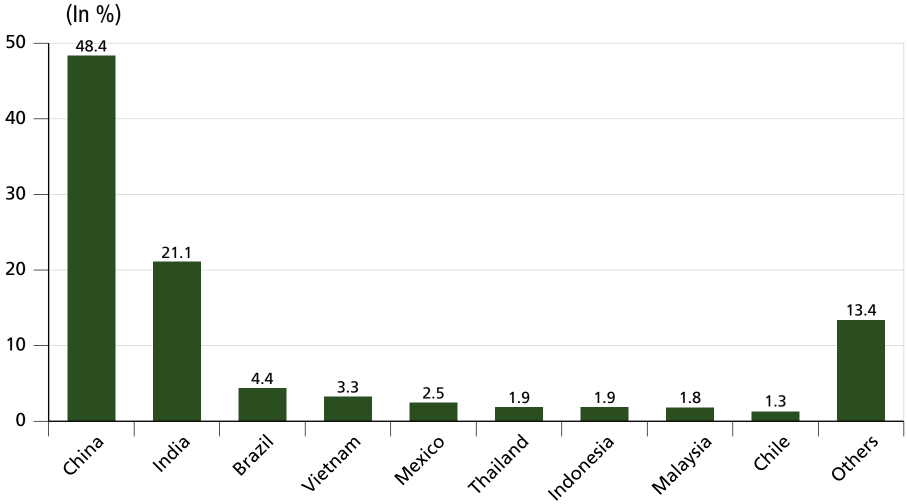
The list of documents to be sent to the CIMGC aiming at obtaining approval for CDM project activities and PoAs is mentioned in the resolutions of this commission. In order to facilitate the submission of CDM projects in Brazil and detailed information about applicable rules (necessary documents, procedures and deadlines) were collected in a single document, the *Guidelines for Submitting CDM Project Activities to the CIMGC, aiming at obtaining a letter of approval from the Brazilian Government* (Brazil, 2008a).

4 EVOLUTION OF CDM PROJECT ACTIVITIES AND POAS IN BRAZIL AND OVERSEAS

4.1 Project activities

Regarding the CDM global status, by April 30th, 2017, 7,770 project activities had been registered under the UNFCCC. Brazil ranked third in this list, with 342 registered project activities, which corresponded to 4.4% of the global total. China ranked first, with 3,763 (48.4%), and India ranked second, with 1,642 (21.1%), as per the figures presented in graph 1.

GRAPH 1
Distribution, by percentage, of CDM project activities registered by country (April 30th, 2017)
(In %)

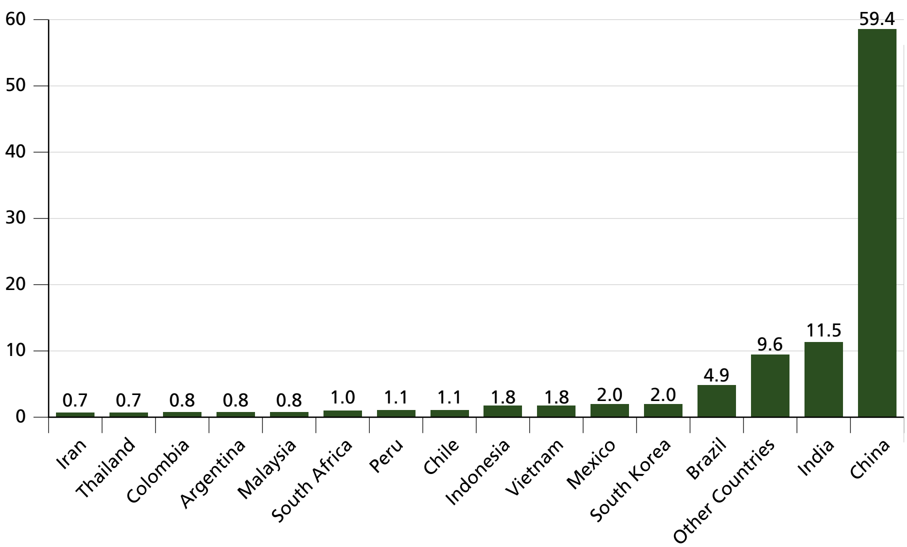


Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/gzSnSw. Accessed on: April 2017.
Obs.: Total activity projects registered: 7,770.

In terms of annual estimates of GHG emissions reductions associated to CDM project activities registered by April 2017, Brazil ranked third, with 49,192,159 tCO_2e annually, which corresponds to 4.9% of the world's total emissions reductions. China ranked first, with an average annual reduction of 596,329,439 tCO_2e (59.4%), followed by India, with 115,450,986 tCO_2e, which corresponds to 11.5% of the world's total (graph 2).

Considering the first crediting period, which may be a maximum of ten years for fixed-period projects, or seven years for renewable-period projects (three times for a total of 21 years), Brazilian CDM project activities registered until April 2017 had a GHG emission reduction potential of 379 million tCO_2e.[10]

GRAPH 2
Annual GHG reduction potential, by percentage, by country, of CDM projects (April 2017)
(In %)



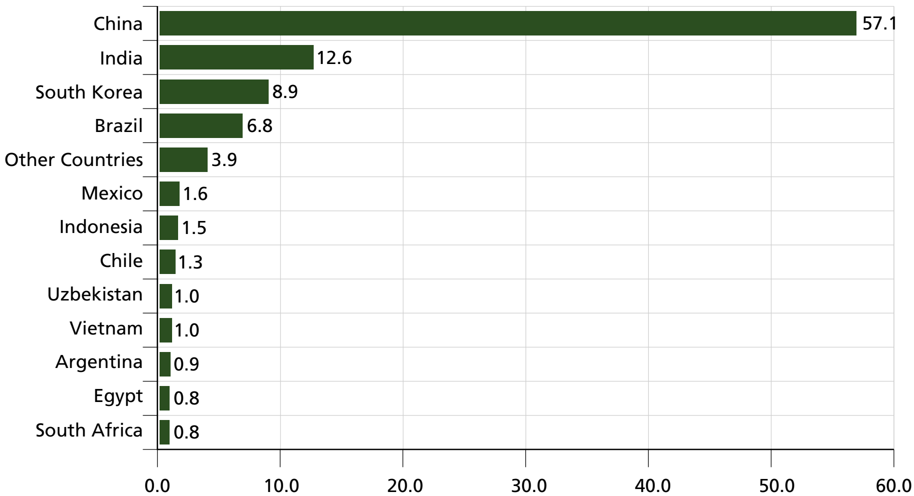
Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP. Accessed on: April 2017.
Obs.: Total GHG reduction potential per year: 1,003,836,468 tCO2e.

With regard to CERs effectively issued by the CDM Executive Board to participants in project activities, the data presented in figure 3 indicate that 1,814,448,567 CER units were issued to project participants by April 2017. Out of that total, 123,648,417 correspond to projects developed in Brazil (6.8%),

10. Calculated based on the CDM project control file of the CIMGC's Executive Secretariat.

equivalent to some 124 million tCO_2e that have been avoided,[11] which ranks Brazil fourth in the world list of issued CERs. China ranks first, with 57.1% of issued CERs, followed by India, with 12.6%, and South Korea, with 8.9%.

GRAPH 3
CERs issued in percentage, by host country, for CDM project activities (April 2017)
(In %)



Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP.
Obs.: Total number of issued CERs: 1,814,448,567 tCO2e.

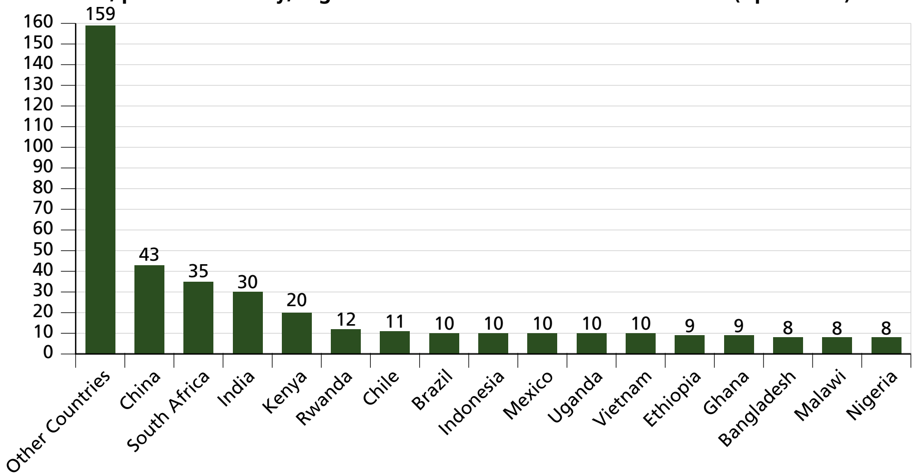
4.2 Programs of activities

With regards to PoAs, Brazil had 10 PoAS registered under the CDM Executive Board by April 2017, thus ranking 7th in the world (graph 4) and taking the lead in the number of component project activities, with about 52% of the world's total CPAs, thanks to its first PoA, registered in 2009, developed in the area of methane capture and combustion (CH_4), which enabled the registration of 1,050 CPAs under the UNFCCC.

11. One CER unit equals 1t of carbon dioxide equivalent (Frondizi, 2009).

GRAPH 4

PoAs, per host country, registered under the CDM Executive Board (April 2017)

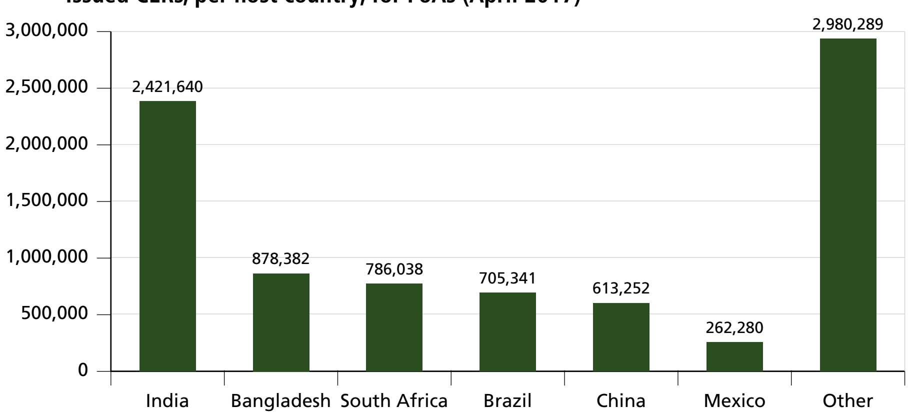


Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP. Accessed on: April 2017.
Obs.: Total PoAs registered: 402.

With regards to CERs effectively issued by the CDM Executive Board to PoAs registered under the UNFCCC, data presented in Graph 5 indicate a total of 8,647,222 CER units by April 2017. Out of the total, 705,341 CERs were destined to Brazil (8.2%), which corresponds to 700 thousand tCO_2e effectively cancelled, ranking fourth in the world. India ranked first, with 28.0% of issued CERs, followed by Bangladesh, with 10.2%, and South Africa, with 9.1% (graph 5).

GRAPH 5

Issued CERs, per host country, for PoAs (April 2017)



Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP. Accessed on: April 2017.

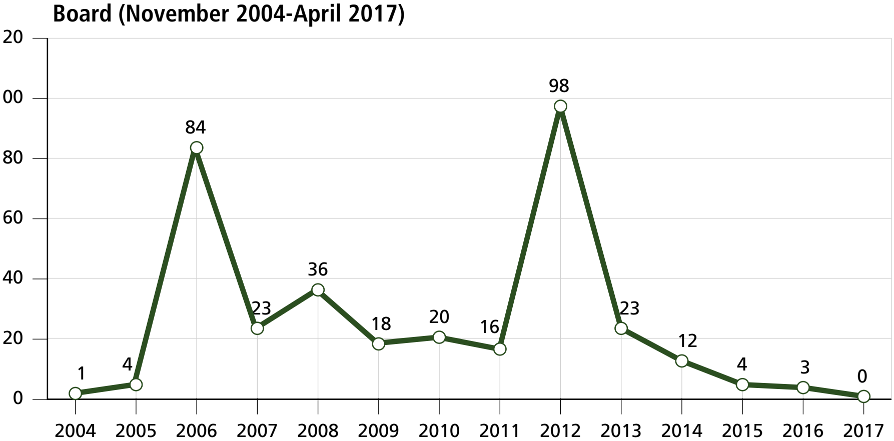
5 PROFILE OF PROJECT ACTIVITIES OF THE CLEAN DEVELOPMENT MECHANISM IN BRAZIL

In the period between February 2004 to April 2017, the CIMGC received 464 CDM project activity proposals aiming at obtaining a letter of approval from the Brazilian NDA (CIMGC). Out of this total, 424 project activities were approved by the CIMGC, one project activity was rejected and 39 were not finished or cancelled by request of project's participants.[12]

Out of the 424 project activities approved by the CIMGC, 342 were registered under the CDM Executive Board between November 2004 and April 2017. During the same period, 31 project activities were rejected by the CDM Executive Board, eight were withdrawn from the registration process by request of project participants and 43 did not apply for registration.[13]

The annual distribution of Brazilian project activities registered by the CDM Executive Board is presented in graph 6 below. There were two peak registration periods. The first in 2006, when the CDM started to consolidate in the carbon Market; and the second one in 2012, when the first commitment period of the Kyoto Protocol ended.

GRAPH 6
Annual distribution of Brazilian activity projects registration under the CDM Executive Board (November 2004-April 2017)



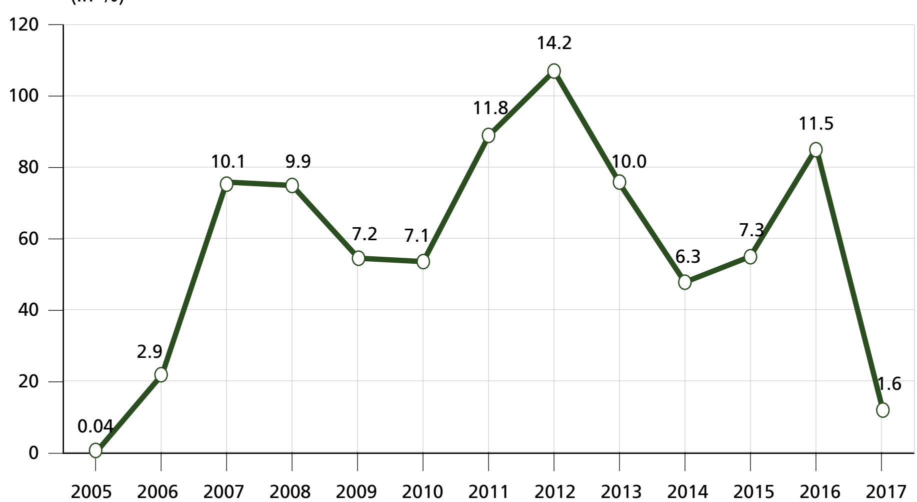
Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP.
Obs.: Project activity registered: 342.

12. CDM Projects. Available at: https://goo.gl/KGR5PM.
13. CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP. Accessed on: April 2017.

5.1 Certified GHG Emissions Reductions from Brazilian CDM project activities

Graph 7 presents data related to the annual distribution of CERs to participants of CDM project activities in Brazil between 2005 and April 2017. Of note, years 2007 and 2008, with 19.9% of total issued CERs in the period, as a consequence of the intense competition in the global market to encourage GHG reduction projects. In the occasion, the value of carbon credit reached the highest figures, being negotiated at a price range between € 16 to € 18 in the last trimester of 2007 (World Bank, 2008), thus encouraging project participants to monitor, verify and certify their projects' emissions reductions, generating CERs for sale.

GRAPH 7
Annual distribution of CERs issued by Brazilian CDM project activities (2005-April 2017)
(In %)



Source: CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP.
Obs.: Total CERs issued: 123,648,417 tCO_2e.

2001 and 2012 stand out, adding up 26% of all CERs issued in the period (as per graph 7). Although there is no proper explanation for this, it appears that participants of registered projects intensified monitoring and verification of GHG emissions reductions, in view of the uncertainties regarding continuity of the CDM after the end of the first commitment period of the Kyoto Protocol.

The global economic downturn and the uncertainties regarding global actions towards GHG emissions reductions fully reflected in a significant decline in the demand for carbon credits after 2012, which led to an excess supply, and has driven down the price of CERs to € 0.34/tCO2 by the end of 2012.[14]

Concerned with the future of the Clean Development Mechanism, the CDM Executive Board has encouraged actions towards reducing the number of CERs offered, aiming at recovering their price. In this regard, it has established rules for the voluntary cancelling of CERs in the CDM registration, thus facilitating their commercialization in new compensation markets such as South Korea, Mexico and South Africa, as well as in international organization programs, such as the Pilot Auction Facility for Methane and Climate Mitigation,[15] among others.

Based on the information provided by graph 7, a recovery trend can be observed in the issuance of CERs as of 2015, reaching a significant value in 2016, with 11.4% of the total CERs issued for Brazilian projects, although their average price has presented their lowest level since that significant fall in 2012, reaching an average value in 2016 of €0.27/tCO_2e for CERs traded on the Inter-Continental Exchange.[16]

This data allows for the assumption that the possibility of trading CERs in new compensation markets and programs at more attractive prices, although still falling short of the price level practiced before 2012, had some effect in terms of encouraging the Brazilian participants to resume their monitoring, verification and certification actions in relation to their projects' GHG emissions.

5.2 CDM project activities by type of greenhouse gas and activity

The distribution of registered projects activities in Brazil by April 2017, by type of GHG reduced, is presented in Graph 8. It should be noted that CO_2 is the most relevant, followed by CH_4 and nitrous oxide (N_2O). Data in table 1 show that the majority of project activities developed in Brazil is in the energy sector, which explains the predominance of CO_2 in the balance of Brazilian emissions reductions.

14. Further information at the QUANDL Corporation database. Available at: https://goo.gl/HLa3uH. Accessed on: June 2017.

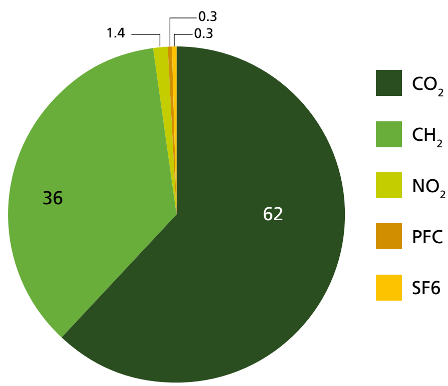
15. Climate finance model developed by the World Bank Group to stimulate investment in projects that reduce greenhouse gas emissions while maximizing the impact of public funds and leveraging private sector financing. Available at: https://goo.gl/Phrr9h. Accessed on: June 2017.

16. Further information at the QUANDL. Corporation database. Available at: https://goo.gl/Vzc1zk. Accessed on: June 2017.

GRAPH 8

Distribution of project activities in Brazil, by type of greenhouse gas, registered under the UNFCCC (April 2017)

(In %)



Source: CDM Projects. Available at https://goo.gl/hPvdvm.
Obs.: Total amount of project activities registered: 342.

TABLE 1

Distribution of CDM project activities in Brazil, by type of project activities

Types of project activities	CDM project activities		Estimated GHG emissions reductions	
	Quantity	Percentage in relation to total	tCO_2e	Percentage in relation to total
Hydropower station[1]	94	27.5	138,473,415	36.5
Biogas[2]	63	18.4	24,861,823	6.5
Wind power station	57	16.7	44,306,593	11.7
Landfill gas	52	15.2	91,367,345	24.1
Energetic biomass	41	12.0	16,091,394	4.2
Substitution of fossil fuels	09	2.6	2,664,006	0.7
Methane avoided[3]	09	2.6	8,627,473	2.3
N_2O decomposition	05	1.5	44,660,882	11.8
Heat use and recovery	04	1.2	2,986,000	0.8
Afforestation and reforestation	03	0.9	2,408,842	0.6
Use of material	01	0.3	199,959	0.1
Solar photovoltaic energy	01	0.3	6,594	0.0
Energy efficiency	01	0.3	382,214	0.2
SF_6 substitution	01	0.3	1,923,005	0.5
PFC reduction and substitution	01	0.3	802,860	0.2
Total	**342**	**100.0**	**379,762,405**	**100.0**

Source: CDM Project. Available at: https://goo.gl/ziKsuP.
Notes: [1] Micro Hydropower (MHP) Plants, Small Hydropower (SHP) Plants and Large-Scale Hydropower (LHP) Plants.
[2] Swine breeding and waste water treatment.
[3] Water treatment, composting and incineration of waste.

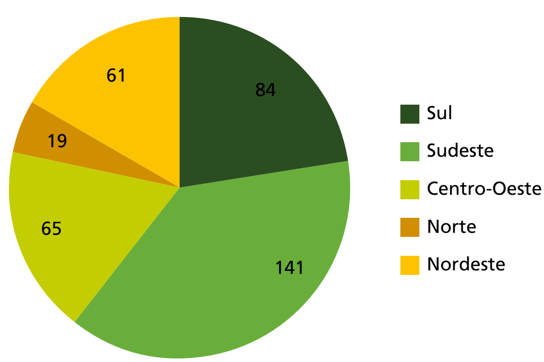
Data presented in table 1 show that 27.5% of total CDM Brazilian projects registered under the CDM Executive Board by April de 2017 originate in hydropower plants (94 projects). Biogas activity projects (18.4%) come next, leading in quantity, followed by wind power plants (16.7%), landfill gas (15.2%) and energy biomass (12.0%). In terms of GHG emission reduction potential, the largest contributions are from hydroelectric, landfill gas, N_2O decomposition and wind power plants.

5.3 Distribution of CDM activity projects by region and by state of the Federation

Graph 9 presents the regional geographic distribution by number of project activities registered at the CDM Executive Board by April 2017. Most CDM project activities in Brazil (38% of the total) are concentrated in the Southeast region, with 141 project activities, out of which landfill gas (32), biogas (32), hydroelectric (27) and energy biomass (25) stand out. In addition, the region concentrates the total number of projects for fossil fuel substitution, heat use and recovery, SF_6 and solar energy substitution, and 80% of N_2O decomposition project activities.

The Southern region ranks second, with 84 CDM project activities in effect in its territory, predominantly hydroelectric power plants (35), biogas (17), wind power plants (11), energy biomass (10) and landfill gas (8). The Center-West region, with 65 project activities, has a predominance of hydroelectric power plants (30) and biogas (29). The Northeastern region registered 61 project activities, with predominance of wind farms (45), landfill gas (8) and biogas (3). Finally, the Northern region of Brazil, with only nineteen CDM project activities, predominantly hydroelectric power plants (9), landfill gas (3), wind power plants (2) and energy biomass (2).

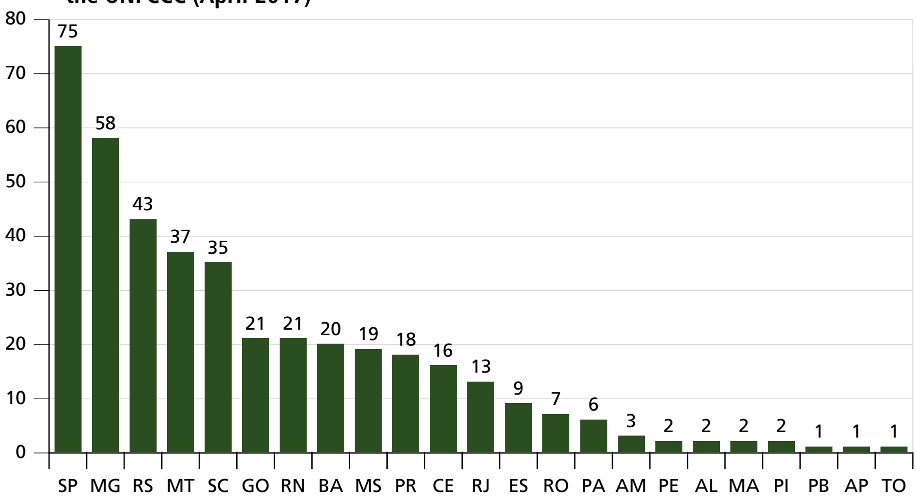
GRAPH 9
Distribution of project activities in Brazil, by region,[1] registered under the UNFCCC (April 2017)



Source: CDM Projects. Available at: https://goo.gl/Uo8ps9.
Note: [1] Some project activities encompass more than one state/region.

Regarding the distribution of CDM project activities in Brazil, by state of the Federation (graph 10), the state of São Paulo ranked first in April 2017, with 75 project activities, followed by the states of Minas Gerais (58) and Rio Grande do Sul (43), which shows a predominance of projects in the center-south of the country.

GRAPH 10
Distribution of project activities[1] in Brazil, by state of the Federation, registered under the UNFCCC (April 2017)



Source: CDM Projects. Available at: https://goo.gl/Uo8ps9.
Note: [1] Some project activities encompass more than one state/region.

6 PROFILE OF PROGRAM OF ACTIVITIES IN THE CLEAN DEVELOPMENT MECHANISM IN BRAZIL

With regard to the Program of Activities (PoAs), by April 2017, Brazil had ten PoAs registered under the CDM Executive Board, four of them being wind farms, two hydroelectric plants (SHP), two of biogas, one of landfill gas and one of renewable energies (wind, SHPs, geothermal, wave[17] and tidal[18]), with total estimated GHG emission reduction for the first crediting period of 11,573,375 tCO_2e (table 2).

17. Power generation through waves.
18. Power generation through tidal movements.

TABLE 2
Distribution of Brazilian PoAs, by type of project, registered under the CDM Executive Board (April 2017)

Type of project	Number of PoAs	Total GHG emissions reduction estimates (tCO_2e)[1]
Wind power plants	4	823,648
Hydropower plants (SHP)	2	233,149
Biogas	2	4,164,643
Landfill gas	1	4,868,813
Renewable energy[2]	1	1,483,125
Total	**10**	**11,573,378**

Source: CDM Projects. Available at: https://goo.gl/Uo8ps9.
Notes: [1] First crediting period (seven years).
[2] Wind power, SHP, geothermal and wave energy plants.

7 FINAL COMMENTS

Brazil has stood out in the international arena as an important actor linked to the clean development mechanism. The CDM was created on the basis of the 1997 Brazilian proposal for the establishment of a Clean Development Fund, which was adopted by the Group of 77 and China and later modified into a mechanism, which was adopted by the Kyoto Protocol. In addition, Brazil was one of the first countries to establish, at the local level, the legal bases that were necessary for the development of projects under the CDM, with the creation of its Designated National Authority, through the Presidential Decree of July 7th, 1999. Brazil was also the first nation to formalize the registration of its DNA in the CDM Executive Board. The first methodology approved in the scope of the CDM in its Executive Board is also Brazilian (Landfills Salvador da Bahia). Subsequently, it was the first country to have a project effectively registered under the CDM - Energy Project from Landfill Gases, of the company NovaGerar EcoEnergia Ltda. (Brazil, 2008b).

Since its creation, the CDM has reached a global dimension, and currently involves 99 countries[19] with more than 7,700 project activities registered under its Executive Board, estimating a total emission reduction for the entire crediting period of about 8.5 billion tons of CO_2. Brazil continues as one of the leading nations in this process, and occupies a prominent position, together with China and India, in terms of number of registered project activities and estimated GHG emission reduction.

19. CDM/UNFCCC Pipeline. Available at: https://goo.gl/hVQUcP. Accessed on: April 2017.

The future of the CDM is not yet defined, nor will it be the transition from the CDM to the new mechanism, if at all. However, it is understood that the new mechanism will probably use many elements of the CDM in order to build upon the experience gained by trying to learn from mistakes while adopting the best practices and, possibly, the best methodologies (Brazil, 2016).

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PART 2

THE CDM DEVELOPMENTS IN BRAZIL

CHAPTER 3

THE CDM AND KNOWLEDGE-BUILDING IN GHG EMISSIONS REDUCTION QUANTIFICATION: FROM THE INITIAL PROPOSAL TO THE PROGRAM OF ACTIVITIES

Gustavo Barbosa Mozzer[1]
Giampaolo Queiroz Pellegrino[2]

1 CATALYZING IDEAS, INNOVATIONS, TECHNOLOGIES AND SUSTAINABILITY

The Kyoto Protocol, through its Clean Development Mechanism (CDM), has demonstrated the feasibility of an international cooperation instrument to mitigate the effects of climate change through technology transfer and sustainable development. In addition, it was a catalyst for discussions and technological innovations, which moved various segments of society, from small scale activities and large industrial projects to academia, civil society and the political sector. This innovative instrument promoted the engagement and stimulated the training and capacity-building of human resources related to the problem of climate change. In Brazil, where the CDM was widely disseminated during the initial phases of its implementation, there was certainly a popularization of the global perception of the risks associated with climate change, which contributed to a greater engagement of civil society and interest from schools and the productive sector.[3]

Beyond the tangible benefits of the CDM, the main legacy of this multilateral instrument of cooperation and innovation was its pedagogical effect. In addition, it was used to test strategies to mitigate greenhouse gas (GHG) emissions. It also had an important influence in the increase of the perception regarding the relevance of long-term strategic planning, investments in adaptation and the importance of establishing structured governance on the theme of climate change.

Under the United Nations Framework Convention on Climate Change (UNFCCC), the CDM Executive Board (EB) and panels of experts – in particular the panel of methodologies – played a crucial role in balancing over-regulation and

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3. Further information on the gradual increase of interest on CDM in Brazil from the perspective of a market agent, see Chapter 9 (note from the editors).

rigidity in monitoring and flexibility for the acceptance and dissemination of the instrument that marked the years of implementation of the CDM.

The success of the CDM was certainly relativized due to the national capacity to generate opportunities for the mitigation of GHG, as well as expertise for the development of projects. Therefore, countries with an installed industrial park with an eminently coal-based mix in the electric grid, or other fossil sources, or even with inefficiencies, were the main beneficiaries of this mechanism.

Regarding the private sector, as developers, who took on the whole process (and risk), it was an opportunity to start using new technologies, which, in addition to reducing emissions, would possibly reduce costs in the medium to long term. In this context, the CDM was seen as a new market – even in terms of income – by relevant actors, who became project developers – which had not necessarily been idealized in the building of the CDM. Creativity and innovation were framed in a structure that fostered the free thought of proposing ideas and thus the promotion of new methodologies were an extremely important component of the CDM, though particularly fruitful in the early stages of this mechanism. This characteristic certainly instigated curiosity, sharpened discussions of ideas about the effectiveness of proposed mitigation strategies in the form of new large-scale methodologies and projects.

Over the last fifteen years, up until 2017, more than 8,000 projects have been able to achieve the status of registered projects, according to EB records (UNFCCC, 2017). During this period, 1.86 billion tons of Certified Emission Reductions (CERs) were issued, thus avoiding the emission of equivalent GHGs, calculated in tons of CO_2e. In addition, afforestation and reforestation activities contributed with 11.23 million temporary Certified Emission Reductions (tCERs) in addition to 505.08 thousand tons of Certified Long-Term Emission Reductions (lCERs), equivalent to a temporary removal of 11.73 million tons of CO_2.

However, more important than all the GHG mitigation effort provided by the CDM implementation is the legacy in terms of ideas, innovations, technologies and sustainability that the CDM catalyzed in the Brazilian society. This positive influence has affected from primary schools to the highest executive positions of companies concerned to remain relevant in a changing global economy.

2 CRITICAL CHOICES FOR THE FEASIBILITY OF A NEW MODEL

With regard to the discussions on global sustainability, based on the famous report *The Limits to Growth*, of 1972, it has always been possible to identify significant uncertainty and dichotomy between theoretical fronts that defended the urgency of measures aimed to balance consumption and environmental conservation and the group advocating orthodox economic policies, focused on economic growth by stimulating consumption, development and expansion of manufacturing industries.

Amid the turmoil, the transition between the 1980s and 1990s brought together a series of socially emblematic facts, responsible for shaping, in part or in whole, the perception and thus the will to change. In particular, this period of history was profoundly marked by Perestroika (1985-1991) and all the symbolism represented by the perception of the end of a long cycle marked by the constant and diffuse state of alert and insecurity inherent to the Cold War. This moment brought the general notion of a bright and encouraging future. However, this hope for peace and prosperity was notably modulated by the iconic nuclear accident of April 26th, 1986 in the city of Chernobyl in Ukraine.

Among the countries affected by the disastrous radiation cloud that has traveled the European continent, a deep social concern (social knowledge) was consolidated on issues related to sustainability and the model of the future that was intended to be built in the coming century. As described by Gupta (1997), there were interrelated circumstances, factors and interactions that strengthened the development of multilateral environmental arrangements. Not surprisingly, the scientific bases of all knowledge about sustainability found resonance in social concern, and, thus, enabled a historical summit, in 1992, in the city of Rio de Janeiro (the United Nations Conference on Environment and Development, Rio 92).

One result of all this political construction and the main mandate given in Berlin in 1995 at the first Conference of the Parties (COP) to the UNFCCC was the determination to achieve an arrangement capable of catalyzing efforts and synthesizing solutions for a more sustainable world, away from the consumption fossil fuels and in search of innovative, environmentally and socially appropriate technological solutions. Two years later, the CDM was legally formalized, during the 3rd Conference of Parties (COP-3) in Kyoto, which marked a memorable victory for diplomacy. This agreement represented a major focus on the political feasibility to craft a multilateral instrument based on a robust international monitoring and cooperation system.[4]

At that time, there was a perception on the symbolic importance that CDM could come to exert on various societies with the establishment of a multilateral instrument capable of coopting dissonant perception, which would converge both interests of conservationists and developmentalists.

It was due to the scale of the environmental, social and economic impact inherent to the intensive use of fossil fuels, which were pointed out in the late 1970s and early 1980s as responsible for the environmental imbalance (Carson,

4. For further information on negotiations' background and design of the CDM, see Chapter 1 (note from the editors).

1962; Lutzenberger, 1980; WCED, 1987), that the development of the Kyoto Protocol prioritized the establishment of rules and procedures specifically designed to operate in the most demanding energy sectors, particularly those dependent on fossil fuels.

Perhaps the most delicate and contentious technical aspect of the CDM negotiation process has been the concern about the environmental integrity of this mechanism. The concept of environmental integrity, forged in long diplomatic battles throughout the initial CDM negotiation process, reflected insecurities with possible leakage and/or regulatory or methodological imperfections that would allow double counting of emission reductions. Any methodological error or imperfection of this nature would open up potential gaps for distortions and would lead to the improper use of this mechanism, away from its primary objective of catalyzing reductions of GHG emissions by anthropogenic sources of emissions.

A major effort was made to structure the functions of the UNFCCC Secretariat and the EB aiming at ensuring a robust project verification cycle, which, together with the designation of operational entities, comprised of verification and auditing companies with a solid structure and proven competence, that would work together with designated national authorities to ensure the environmental integrity of this mechanism.

It was necessary to establish methodological panels with experts from various areas of interest and competences to ensure that methodologies proposed by project developers were adequate and robust enough to guarantee that emission reductions converted into CERs were translated into a real effort to reduce GHG emissions, without the occurrence of leaks or double counting.

In addition to all these concerns with the design, monitoring and verification of projects and their respective methodologies regarding the robustness to ensure the environmental integrity of the mechanism, the financial feasibility of the project and its monitoring needed to be considered in its monitoring plan. It would be of no advantage to a CDM project to predict the emission of environmentally sound CERs if the complexity and cost of monitoring made the project financially unfeasible. This crucial concern was translated during the initial CDM conception by climate negotiators, who sought a mechanism that could be implemented through ideally simple monitoring methodologies, replicable in different circumstances and regions and that would impose a low-cost and low-effort to be monitored. The need to have a well-defined and circumscribed project boundary as well as other prerogatives led to energy, industry, transport and waste treatment sectors being the focus for the design and thus to the negotiation of general frameworks that would define the core of the first phase of the Mechanism. Other sectors, such as agriculture, bunker fuels[5] and forests, would be left for a second moment as they are considered to be more complex.

However, politically, the idea of asymmetry between losses and gains, which is inherent to climate change policies (Barrett, 1999; Barrett and Stavins, 2003) that imposes to the poorest countries the highest relative costs to deal with this global challenge, coupled with the classic prisoner's dilemma and the theory of the common good, which states that a non-collaborative stance among nations must prevail in favor of individual interests and thus this would lead to the development of more rational free-riding parasitism strategies, rather than the active engagement in solving the problem (Gupta, 1997). However, the CDM was designed to propose an alternative path that would make engaging in concrete actions seeking to reduce emissions more attractive by rewarding those capable of anticipating and developing economically viable and environmentally sustainable projects.

It is no coincidence that the Alliance of Small Island States (AOSIS) and the Least Developed Countries (LDCs) considered the negotiation of a mechanism that did not include carbon stocks in forests to be distributive, and consequently, evaluated it to be unfavorable. Despite the lack of interest, possibly due to how multilateral negotiation process are extremely demanding in terms of human resources, knowledge as well as financial resources, classically favoring the consolidation of developed countries positions (Gupta, 2000) it is possible that during the strenuous negotiation process of the Berlin Mandate, some developing countries were not able to distinguish the Brazilian proposal of a Clean Development Fund (CDF), presented only a few months before COP-3 in Kyoto, from the US proposal for a Clean Development Mechanism (Richards 2001).

According to Gupta (2000), negotiators from African countries confirmed that many of them did not understand the distinction between the CDF, which had been studied thoroughly before the meeting, and the CDM, presented only during the heat of negotiations. Mumma (2001) points out that most African countries remained hesitant about the CDM, considering that, unlike the case of emerging countries (China, India, Brazil and South Africa), which would be strategically favored, this mechanism would not be effective in prioritizing actions for the African continent.

According to Makina (2013), the historical reason for the minimization of African positions in the negotiation process is due to the condition, commonly attributed to some countries, of recipients, or victims, rather than agents capable of providing answers and solutions to the dilemmas of climate change. Given this context, the support offered by Latin American countries and AOSIS was

5. Bunker fuels are fuels used in both the aviation industry and shipping. They are composed of liquid fuels that have been fractioned and distillated from crude oil.

fundamental to enable the approval of the CDM (Agarwal, Narain and Sharma, 1999). The convergence point and the political bargain levied by Africans, Latin America and AOSIS were also evident at the end of the Kyoto negotiations. In order to approve the CDM, these countries have lobbied to reverse the Cartesian approach to CDM implementation, with a preponderant focus on sectors where monitoring could be done in a "simplified" way, calling for inclusion also of the forest sector, despite obvious complications which involved monitoring it.

The reason for this concern was obviously the lack of industrial parks or other significant sources of GHG emissions in many countries of these regions, restricting opportunities for emission reductions and effective involvement with the CDM. The general view of this group of countries was that the focus on the sectors of industry, energy and transport would not benefit them, on the contrary, it would exclude them from the CDM, reinforcing the perception that this market mechanism would primarily benefit the United States and a minority of developing countries with large industrial parks (Agarwal, Narain and Sharma, 1999).

Finally, the document generated reflected this great effort of integrative negotiation, aiming at a mutually acceptable agreement. Obviously, the conciliation of all these positions contributed to dilute ambition, as observed by Michaelowa (1998), a trend in the negotiations of multilateral environmental arrangements.

The difficulties to work on CDM projects with a focus on the agricultural and forestry sectors were notorious.[6] The monitoring of GHG emissions represent both at the time as well as today, a technological barrier, from the point of view of implementations costs as well as accuracy. These challenges basically emerge due to the large area and natural uncertainties in well defining the project boundaries. Such uncertainty creates complexities and therefore increase the costs associated to the design of monitoring plans capable to address leakage issues and the permanence of carbon stocks.[7]

3 THE CDM POLICY CONSTRUCTION PROCESS

After the initial euphoria with the ratification of the UNFCCC and approval of the Kyoto Protocol's base-text at COP-3 in 1997, the years that followed were of major concern, especially after the failure of COP-6 in The Hague in 2000. The fundamental differences between the United States and the European Union showed that the prospect of the Kyoto Protocol entering into force became more precarious as the proportional importance of large emitting countries, in particular

6. Although comparable to the agricultural sector, it is necessary to point out that the forest sector received a different treatment during the initial phase of implementation of the Kyoto Protocol.

7. For further information on forest project monitoring issues, which the author has pointed out as both a possible barrier and an important legacy for the forest sector, see Chapter 6 (note from the editors).

Russia and the United States. According to the requirements of the agreement and due to the relevance of their emissions mathematic imposed that at least one of these big emitting countries had to ratify the agreement to ensure that the Kyoto Protocol finally entered into force.

The situation got worse in the following years, with Democrat North American president Bill Clinton leaving office and the inauguration of the conservator Republican George W. Bush administration. During the new Republican administration, the feasibility for an agreement involving the United States in the effort to operationalize Kyoto was canceled. As a form of response to previous administration concerns with sustainability W. Bush policy favored the consumption of fossil fuels and opening new fronts of oil exploration, including the emblematic policy of opening oil fields in areas of environmental preservation in Alaska.

In 2001, approval of the Marrakesh Accords made room for early implementation of the CDM via the so-called prompt start rule[8] and finally represented the first major achievement in the diplomatic arena since the Kyoto Protocol was approved. It is necessary to emphasize the strategic and political relevance of this decision in the context of the impasse that was formed due to the intensification of the North American position in view of the ratification of the protocol.

4 ENTRY INTO FORCE OF THE KYOTO PROTOCOL

On the days before COP-10, a solution cautiously negotiated by the European Union and Russia Federation resulted in Russia's ratification of the Kyoto Protocol in the second half of 2004 and, consequently, its entry into force in early 2005. COP-10 in Buenos Aires was the stage for the articulation of the final preparations for the effective entry into force of the Protocol, and COP-11 in Montreal was the inaugural meeting of the Meeting of the Parties of the Kyoto Protocol (MOP), which ratified all the interim understandings reached in Marrakesh. In short, because of the delay in ratifying the Protocol, the first commitment period started only in 2008, and lasted for five years until 2012.

Subsequently, during COP-12 in Kenya, it was agreed that a negotiation process on the continuity of the Kyoto Protocol should be initiated and concluded over two years. As a result of this process, in 2007, during COP-13/MOP-3 in Indonesia, a set of understandings were agreed upon with the objective of laying the foundations of a potential future agreement, capable of articulating the United States' involvement as well as emerging economies such as China, India, Brazil

8. Mechanism that allowed for the immediate entry into force of all CDM functions, including the establishment of the United Nations Secretariat, the CDM Registry, the teams of independent consultants to review the Registry and Issuance of CER units, and the establishment and full entry into activity of the EB.

and South Africa, albeit in a differentiated way. This instrument became known as the “Bali Road Map”.

5 CHARACTERIZATION OF THE DYNAMICS AND PROCESSING OF LARGE-SCALE METHODOLOGIES IN THE FOREST AND OTHER CONVENTIONAL SECTORS

In order to understand how the dynamics and procedure required for the submission of a new methodology over the years of CDM implementation took place, all the official data made available on the UNFCCC website and its records for all the large-scale methodologies for the forestry sector and other sectoral scopes were assessed. The choice to discriminate forest methodologies was due to the great difference among carbon credits generated by this sector, as a result of the transitory or temporary nature of carbon stock in afforestation and reforestation projects.

All records available in the UNFCCC database were segregated into three clusters and grouped among afforestation and reforestation project and other sectoral scopes:

- new proposed technology;
- approved methodology; and
- consolidated methodology.

These clusters also represent the natural flow of the submission process of methodologies, which initially appear as a new proposed methodology, and, when analyzed, it can either receive approval or rejection. Methodologies can undergo consecutive reviews throughout its period of validity and, eventually, be consolidated or replaced. In special cases, an approved methodology can also be suspended.

Table 1 presents a summary of the records available in the UNFCCC database which considers the clusters adopted in this analysis. In all, 403 different cases (N of cases) were analyzed, which involved the submission of new methodology, the re-sending of alternative methodologies during the proposal phase of new methodologies and the registration for an approved or consolidated methodology. We consider in the analysis all records available on the UNFCCC website until November 2017.

TABLE 1
Data available at the UNFCCC database for large-scale methodologies

Groups		N cases	N review	Sectorial scopes														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Afforestation and reforestation	Approved (AR)	14	85														14	
	Consolidated (AR)	3	13														3	
	New proposal (AR)	19	19														19	
Other sectoral scopes	Approved	118	458	50	3	11	24	16	0	5	0	0	6	9	0	17		0
	Consolidated	26	255	17	0	0	6	2	0	2	0	0	0	0	0	5		0
	New proposal	223	223	114	3	15	48	25	0	11	0	0	12	11	0	32		0

Source: UNFCCC databank. Available at: https://bit.ly/2JRf17b. Accessed on: November 2017.
Obs.: The records were subdivided into groups such as "approved", "consolidated" and "new proposal".

We also analyze the background of interactions carried out within the scope of the EB in relation to large scale methodologies. This analysis considered all the versions deliberated by the Board and recorded on the UNFCCC methodological website,[9] based all records on active methodologies and other previous records available in their data. It included, therefore, all the versions of active methodologies, whether they were old versions, others that over time were replaced or consolidated, as well as the original methodologies proposed in the submission phase.

Methodologies related to afforestation and reforestation activities (scope 14) were dealt with in an individualized manner, the other scopes were grouped up. The number of cases consists of the records related to the submission of new methodologies, the re-sending of alternative methodologies during the submission phase of a new methodology and the registration of the approved methodology, in addition to the consolidated ones, where relevant. "Number of reviews" indicates the background of interactions observed under the EB, which includes all versions of the same methodology. "Sectorial scopes" indicates how the methodologies analyzed are distributed in terms of the areas of concentration.

6 CHALLENGES IMPOSED ALONG THE CDM OPERATING PERIOD (2001-2016)

Also due to the delay in ratifying the Protocol, the COP in Montreal was responsible for initiating discussions on the second Kyoto commitment period, scheduled to be concluded in 2007 during COP13 in Bali. The lack of a firm legal framework for the continuity of the second commitment period of the Kyoto Protocol (2012 onwards) has obviously generated some strangeness and insecurity for the market.

Investors and project developers anticipated with great concern the possibility of a legal chasm, which would occur after December 31st, 2012, because of

9. Available at: https://bit.ly/2JRf17b.

the concrete possibility of uncertainties about the regulations for the second commitment period. In practical terms, negotiations on the second commitment period were completed on the days before the fateful date during COP-18 in Doha. The Doha Amendments were adopted, thus concluding the negotiation process for the second period, which entered into force in the following year, 2013, avoiding the abyss and ensuring the continuity of the Protocol by December 31st, 2012. This amendment was ratified by the Brazilian National Congress in February 2018, however, as the minimum number of countries for the instrument to enter into force has not yet been reached, the formal effectiveness of this instrument remains suspended at the international scenario.

The challenge imposed on negotiators during the Bali meeting in 2007[10] was to come up with an arrangement that could enable discussions on the second commitment period of the Kyoto Protocol to be sufficiently creative in order to allow the engagement of the United States and to deal with the lack of ambition of countries with high energy dependence on fossil fuels. A creative solution capable of effectively promoting the reduction of global GHG emissions had to be built.

This understanding would mark the beginning of the redistribution process of forces and of the geopolitical order during the following decade. In the midst of this tumultuous political moment, the EB was responsible for managing the mechanism in search for solutions and ideas that could promote an adequate balance between the dynamism and the environmental integrity of the CDM. Characterized by its proactivity, the EB adopted the management of methodologies for CDM projects as an important component of its strategy.

Large-scale projects had their methodologies submitted by project developers for the EB approval. In this context, it tried to ensure the viability of the projects, but with great attention to precepts that safeguard the environmental integrity of the CDM. Small-scale methodologies were developed by the Methodology Panel in order to meet the priorities defined by the Board. In general, small-scale methodologies have tried to prioritize the dynamism of the mechanism, stimulating less sophisticated projects with less monitoring requirements.

Throughout the operation of the CDM, particularly from 2001 to 2016, activity records for submission of new methodologies, referral of alternative methodologies and registration of approved methodologies, in addition to being consolidated, clearly reflected the phases and challenges faced by the EB in the management of the CDM. Graph 1 shows the dynamics of methodology reviews related to afforestation and reforestation activities (scope 14) from 2001 to 2015.

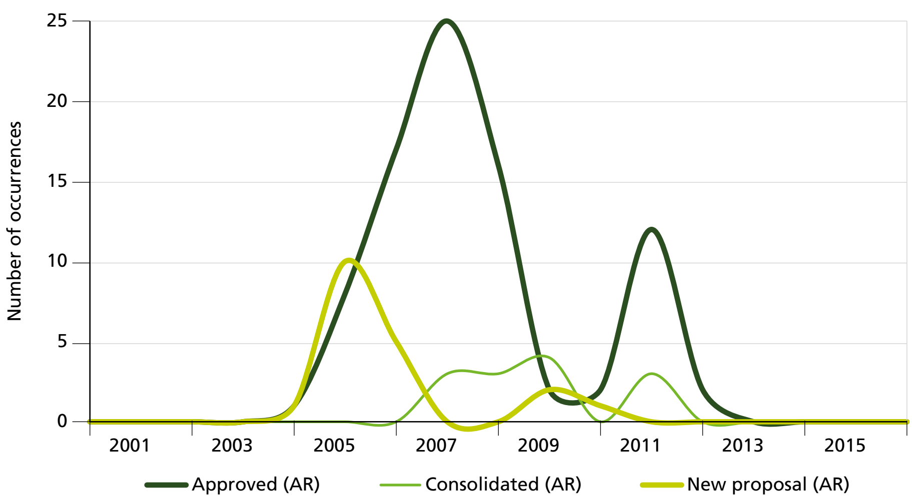
10. The Bali COP has set a historic milestone with the definition of two-way negotiation, in parallel negotiation processes related to the review of the framework agreement and the Kyoto Protocol, respectively, in order to enable a universal and binding agreement with quantifiable targets of emission reductions.

The graph consists of the distribution of 117 records, interactions observed within the EB, including all versions of the same methodology for the groups of approved methodologies (85 registers), consolidated methodologies (thirteen registers) and new proposed methodologies (nineteen registers). There are clearly two high activity moments for the records of approved methodologies.

The first peak occurs in 2008, when 25 interactions were recorded. Out of the fourteen methodologies approved for the forest area, only four did not undergo a review, while the majority underwent two reviews, and two of them (AR-AM0005 and AR-AM0007) underwent four distinct reviews of versions that year, with the period being noted as the period with the highest number of reviews and also with the greatest dispersion (variance 1.87) in this regard. The second peak occurred in 2012, with a very different nature from the first one, being more homogeneous (variance 0.28) as to the number of reviews, in which only the AR-AM0014 had more than one review and only methodologies AR-AM0003, AR-AM0001 and AR-AM0008 had no reviews.

GRAPH 1

Review dynamics in methodologies related to afforestation and reforestation activities – scope 14 (2001-2015)



Source: UNFCCC database. Available at: https://bit.ly/2JRf17b. Accessed on: November 2017.
Obs.: The records were subdivided into groups such as "approved", "consolidated" and "new proposal".

The intensity of review activity in methodologies observed between 2005 and 2009 characterizes the first phase of the CDM, in which there was great concern on the part of the EB with the environmental integrity of the Protocol. The methodologies have undergone several interactions and, in general, have become more complex in attempting to ensure the environmental integrity of the Protocol.

The peak of this activity was registered in 2008 and almost coincides with the first attempt of simplification executed by the EB, by means of the envelopment of similar methodologies in a single consolidated methodology.

The year 2012 reflects, however, another reality, with the realization that the CDM had become too complex, lacking simplifications to attract the interest of the private sector. With a view to attracting the private sector's interest in the CDM, new project modalities have been developed, including the Programmatic CDM.

However, even with all this effort, afforestation and reforestation projects (scope 14) were no longer able to attract the interest of the private sector. The last new methodology was presented in 2012 and the last methodological consolidation effort occurred in 2013. In 2014, the latest methodologies related to this sector were approved by the EB, and there has been no activity since then, a reflection of the eminent crisis, mistrust on the second commitment period and investor skepticism.

The Board's concern to ensure the Protocol's environmental integrity was also a source of constant criticism from the private sector. One of the main arguments put forward concerned the time and effort required to achieve the approval of a new methodology. Analyzing the peak and the amplitude of the dynamics of submissions of new methodological proposals and the review dynamics of approved methodologies, the timeframe between the submission of a new methodologies and the respective impact on the set of approved methodologies was approximately two years.

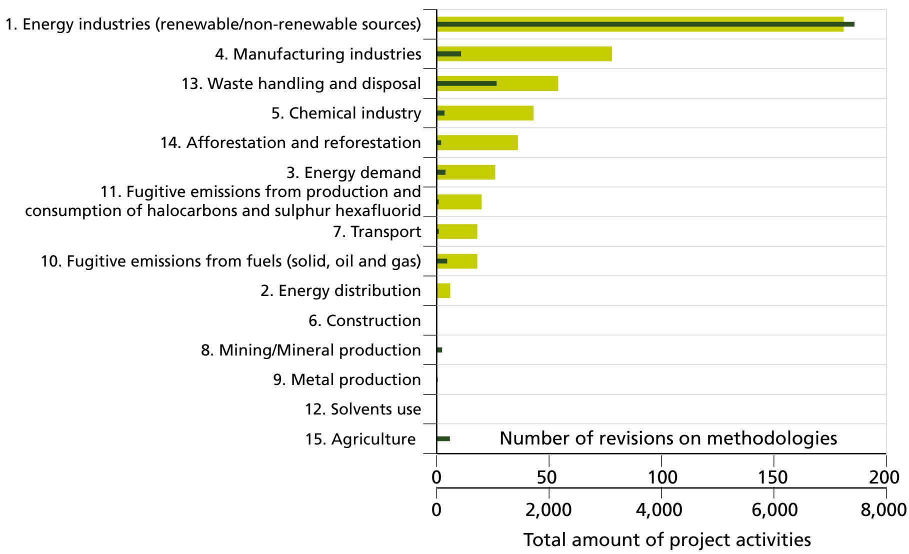
The extent of distribution of "Approved (AR)" and "New Proposal (AR)" samples is due to frequent changes in the versions of approved methodologies, which indicates that, even after approval of a methodology, project developers had to make a great deal of effort in following them up. Frequent changes of versions incurred financial costs for the readjustment of projects under development and reviews of the monitoring plans of projects already approved during the renewal phases.

The review dynamic of forest methodologies, shown in Graph 1, reflects how the work of both the EB and the methodological panels became increasingly complex throughout the early years of the CDM implementation. However, the great volume of work and the greater amount of resources invested by these institutes was directed to analyze methodologies from allother types of activities (sectorial scopes) excluding forests, due to the interest of the market, particularly in the following scopes: 1 (energy industry, renewable and non-renewable); 13 (waste management and disposal); and 4 (manufacturing industry), respectively, as shown in graph 2.

For the other sectoral scopes, as well as observed for scope 14 (afforestation and reforestation), there was great euphoria during the initial phases of the CDM implementation (2002-2008). However, interest in projects was much more significant, particularly for the energy industry sector, which accounts for 75.1% of projects registered, followed by the waste management and disposal sector (10.7%) and the manufacturing industry sector (4.4%). Activities related to afforestation and reforestation represent only 0.8% of effectively registered project activities.

GRAPH 2

Total review effort in large-scale methodologies by sectoral scope[1] and total number of registered CDM projects[2]



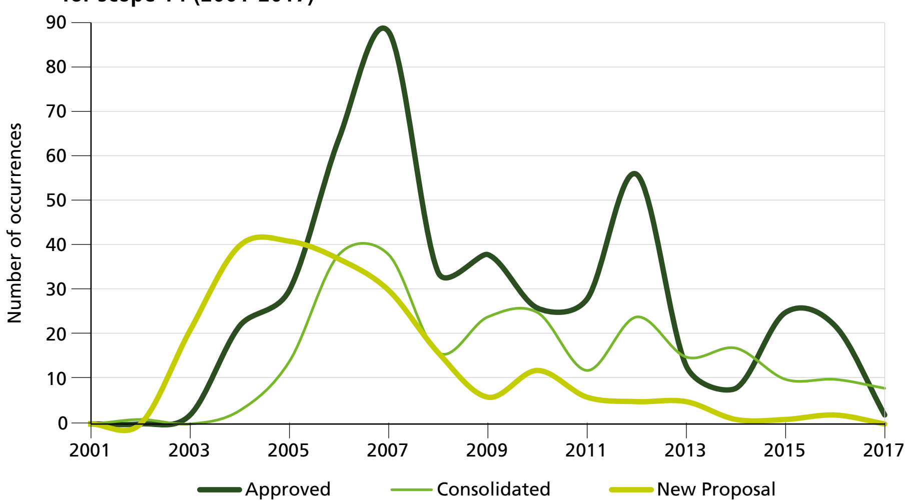
Source: UNFCCC database. Available at: https://bit.ly/2JRf17b. Accessed on: November 2017.
Notes: [1] Orange bar, main.
[2] Including large and small scale.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

The greater interest observed for some sectorial scopes was translated into a respective greater dynamic of methodological reviews, which is reflected in graph 3. In the other scopes, a similar dynamic is observed for sectorial scope 14 (afforestation and reforestation – graph 1), by 2013, of the implementation of the CDM projects.

It is evident from the analysis of the dynamics shown in graph 3 that after 2008, the EB started to consider the potential negative impact that the entire process of methodological reviews produced and which continued to reverberate in the form of harsh criticism from the private sector, which indicated a set of political circumstances and market skepticism. In this context, in 2009, the Board began to promote the development of a new set of consolidation of large-scale methodologies. In subsequent years, this institute proposed simplifying rules and procedures for small- or micro-scale projects, which in 2012 systematically reflected methodological reviews aimed at simplifying procedures for large-scale projects.

During this period, a major effort made by the EB to promote the advance for the universalization of the CDM, through a new type of CDM project activity model, called Program of Activities (PoA), resulted in some revitalization of the market and managed to re-attracted the interest in CDM project activities. The idea of the Board was to foster the proliferation of very small projects, called Component Project Activities (CPA), which could exist, without the need for prohibitive implementation and monitoring costs, under a large "umbrella", the PoA. Project developers reacted positively, reversing for a moment, in 2010, the saturation tendency in proposing new methodologies.

GRAPH 3
Review dynamics in methodologies for large-scale CDM project activities – except for scope 14 (2001-2017)



Source: UNFCCC database. Available at: https://bit.ly/2JRf17b. Accessed on: November 2017.
Obs.: The records were subdivided into groups such as "approved", "consolidated" and "new proposal".

Despite the good intentions of all stakeholders involved in the validation cycle of CDM projects, the wave of optimism did not last for long. The complex political scenario with respect to Annex I countries' ambition to mitigate emissions, the eminent risk of a legal vacuum of the second commitment period, and the adverse economic condition faced by the big economies, made it impossible for the carbon market to remain strong.

Despite the salutary intention of the EB in establishing the PoA as a model of universalization of the CDM and the extrinsic factors mentioned above, factors intrinsic to the mechanism also contributed to the low initial adoption of the PoA. In particular, legal caveats and uncertainties have driven away many Designated Operational Entities (DOEs), responsible for validating projects, thus creating obstacles to the initial validation of PoA projects. The reason for the concern of DOEs is that they are required to attest, as part of their validation of the PoA, that the methodologies applied and the monitoring plans would be sufficiently robust to ensure the environmental integrity of the Protocol. The pulverized nature of the Programmatic CDM has given rise to concern from many DOEs, which initially did not welcome this type of project activity, making it difficult to adopt them promptly.

The closing phase of the CDM, analyzed in the context of this document, encompasses the period from 2013 to 2017. During this period, activity in sectoral scope 14 (afforestation and reforestation) was no longer monitored. The political and economic scenario was very inflexible, resulting in lack of interest in the European Emissions Trading Scheme (ETS) for the acquisition of new CERs, which resulted in an irreversible process of slowing down the global carbon market.

In a way, the CDM was a victim of its own success, having achieved abatement levels of emissions reductions around 300 $MtCO_2$/year (Grubb, 2016), which contributed to reduce the market demand for new credits, in light of a political environment that is not friendly to the increase in ambition due to the unfavorable economic scenario (the subprime crisis in the United States), the COP-15 diplomatic fiasco in Copenhagen, the subsequent contagion of the crisis to Europe and, more recently, to emerging countries.

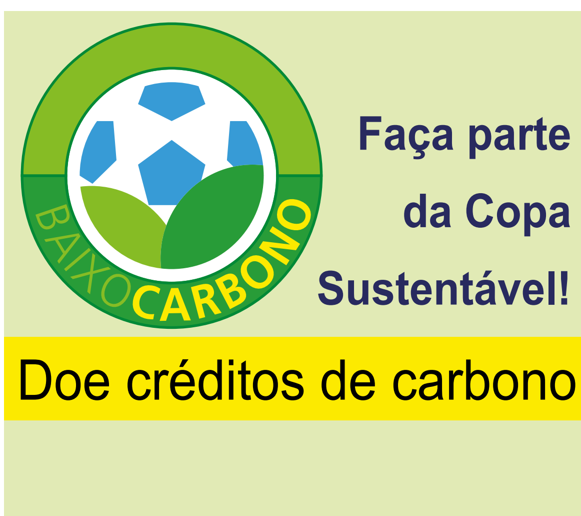
From December 31st, 2012, when the first commitment period of the Kyoto Protocol came to an end, and when the UNFCCC Secretariat finished accessing the Greenhouse Gas Emissions Inventories to meet the Kyoto targets, conclusion was that the overall effort by Annex I countries to reduce 2.7 $GtCO_2$/year over the five years of implementation of the Kyoto Protocol was adequately under control for almost all countries. The exceptions were the United States, which refused to ratify the agreement, and Canada, which withdrew just days before the end of the first commitment period.

In a few words, five main factors contributed to the achievement of Kyoto Protocol targets: *i*) actions, policies and planning developed by the countries themselves; *ii*) the flexibilization mechanisms of the Kyoto Protocol, including the carbon market of the CDM; *iii*) the subprime economic crisis in the United States; *iv*) the dilutive impact arising from the accounting rule under the so-called “ETS bubble” or “EU bubble”; and *v*) the negative effect of the so-called “hot air” inherent in the abrupt rupture of the technological production model that occurred in the countries of the former Soviet Republic after the Perestroika process, with the adoption of new and more efficient technologies.

At the same time, concerned about the negative impact on the CDM market, the Brazilian Government sought to adopt alternative measures to give some continuity to the carbon market and a political response to the companies that had invested in this initiative. The main idea was the promotion of international strategies for voluntary abatement of CERs, linked to some type of sustainability certification. In Brazil, this idea was adopted during "big events", such as Rio+20, the World Cup and the Olympic Games, when the Ministry of the Environment (MMA) granted the "Low Carbon" sustainability seal (figure 1) to companies that were willing to donate their CERs.[11]

This reassuring measure did not have great international adherence and was obviously not able to reverse the downward price trend of CERs in the market. With the negotiation of the Paris Agreement and the ongoing negotiation of the new Sustainable Development Mechanism (SDM), little energy has been dedicated by companies to expand investments during the second CDM commitment period.

FIGURE 1
"Low Carbon" sustainability seal granted to companies that were willing to donate their CERs



Source: Tolentino (2014).
Obs.: MMA Ordinance No. 70, of February 19th, 2014, provides for the "Low Carbon" sustainability seal.

11. For further information on the cancellation of CERs for their voluntary use, see Chapter 1 (note from the editors).

7 VOLUNTARY COMMITMENTS AND THEIR SYNERGY WITH THE CDM IN THE CONTEXT OF THE PARIS AGREEMENT

Considering the current scenario, and the way in which the CDM has influenced innovation and sustainability as a solution to a development paradigm shift, the Paris Accord naturally becomes the next natural step. The challenge posed to society is to plan and invest in actions and strategies that need to be adopted as soon as possible, in order to reduce the intensity of GHG emissions, and thus, in the future, stabilize the concentration of these gases, and consequently of the average global temperature, in a level that allows the adequate maintenance of the ecological processes, essential for the maintenance of the life of the planet. According to Wigley (1997), for us to succeed, this effort needs to be made on the time scale of two or at most three generations.

In addition, it is necessary to evaluate the fact that tackling climate change is considered the greatest challenge of modern society (Bolin, 1985, 2007, Kerr, 1995, Houghton, 1997 and Skodvin, 2000). Thus, current measures to mitigate GHG emissions, which are mainly related to the consumption of fossil fuels in energy production, transportation and industrial activities, do not immediately solve the problem of climate change (Lanchbery and Victor, 1995). The Paris Agreement provides that the average temperature rise of the planet should be stabilized to below 2°C. The agreement, however, stresses the urgency of the problem and indicates, in a prudent way, that the stabilization target of the average elevation of the planet's temperature should be 1.5°C. In this sense, the Paris Agreement seeks to establish an important reference framework on the acceptable limit for the balanced concentration of GHGs in the atmosphere, and, therefore, reduces the uncertainties pointed out by many authors in the 1990s about the feasibility of the climate agreement.

The Paris Agreement provides for the CDM, and opens up opportunities for future regulations and adaptations. It also establishes room for discussion of new market mechanisms, in a clear positive response to the idea of voluntary markets.[12] However, if in the past developing countries offered good opportunities for emissions mitigation projects in the context of the CDM, today they are concerned with developing nationally appropriate activities, with a focus on fulfilling their own voluntary commitments in their Nationally Determined Contributions (NDC).

It is still uncertain how the regulation of the Paris Agreement and its Sustainable Development Mechanism (SDM) will circumvent the resulting effect of the new constituted order, in which it is no longer crystal clear the segmentation between developing countries, offering opportunities for implementing mitigation, and

12. For further information on the Paris Agreement, its mechanisms, and how they relate to the CDM, see Chapter 12 (note from the editors).

developed countries with emission abatement targets and eager to acquire carbon credits at a cost lower than the investment required to offset their emissions on their own territory.

Regardless of the design of the SDM implementation, it is clear that the lessons learned from the CDM will be crucial and will form the basis upon which the new mechanism will be developed. The legacy of the CDM in fact needs to be contemplated under more angular lenses, capable of capturing all the multiple benefits and co-benefits resulting from the implementation of this mechanism.

At least three main aspects could be characterized as direct benefits of the CDM under the Paris Agreement:

- the diffusion of knowledge, legal framework and governance – involving the capacity-building to deal with the diversity and interactions of distinct areas of knowledge, encouraging academic debates in the various levels of society, serving as drivers to improve environmental legislation and the structuring of efficient governance units on climate change;
- prioritization of the environmental theme in corporate systems, stimulating the creation, adoption and innovation of renewable generation systems, diversification of the mix and adoption of energy efficiency principles, strengthening more efficient and profitable forms of business in the generation sector and use of energy, to the point of overcoming any possibility of significant use of fossil fuels, becoming the energy standard and no longer considered as "alternative energy"; and
- the improvements mentioned in the two previous paragraphs should be expressed in the form of legal and public policy frameworks that not only incorporate and stimulate social and corporate initiatives, but also create means of implementation that can be clearly assimilated as a social investment that will be largely supplanted benefits generated in the various sectors, such as logistics, health, education, transportation, industry and the environment.

These are just some of the aspects that can be objectively attributed to the CDM as part of its important legacy and which become strategic to contributing to the objectives of Paris Agreement.

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CHAPTER 4

EXPERIENCIES AND LESSONS OF CDM IN THE ENERGY SECTOR

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Karen M. Nagai[2]

1 THE ENERGY SECTOR: INTRODUCTION

This chapter addresses the Clean Development Mechanism (CDM) in the context of the energy sector and includes the following sectoral scopes presented in Annex A of Kyoto Protocol (UNFCCC, 2015):[3]

- energy industries (renewable/non-renewable sources);
- energy distribution;
- energy demand;
- transportation; and
- fugitive emissions from fuels (solid, oil or gas).

The indicated scopes include the following activities: *i*) power generation – either off-grid or grid-connected; *ii*) grid connection of isolated systems; *iii*) energy efficiency measures; *iv*) fuel or raw material switch; *v*) energy distribution; vi) transportation; and *vii*) fugitive emissions from fuels.

The energy component is considered in most of the registered Brazilian CDM projects. This chapter includes, for example, the industry initiatives, which involve the energy issue through the switching or replacing of fuels – by using renewable ones or less carbon-intensive fuels –, energy efficiency measures and thermal energy generation, through the use of renewable fuels (residues from forestry and agricultural activities). The energy generation from the treatment of waste gases will not be addressed in this chapter, but in the chapter dedicated to biogas and biomethane (Chapter 5 – *Waste*).

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3. Sectoral scopes are categories of greenhouse gas (GHG) sources, or groups of activities applicable to CDM projects activities or CDM activity programs. They are based on the sectors and source categories established in Annex A of Kyoto Protocol. One CDM project activity, or one CDM activity program, can be classified in more than one sectoral scope.

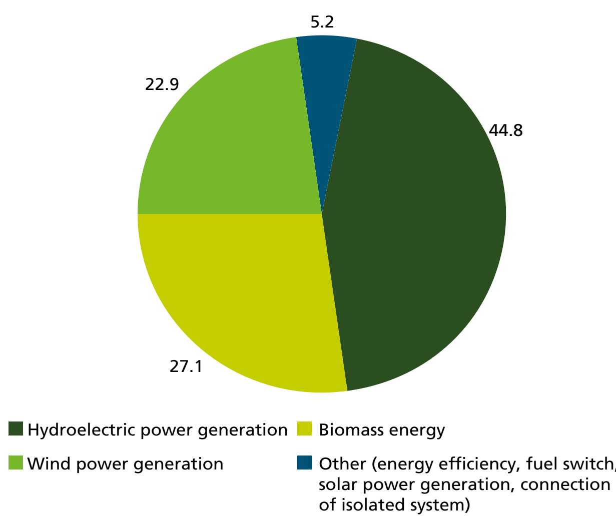
2 ANALYSIS OF THE REGISTERED ENERGY PROJECTS

Up to June 2017, 342 CDM projects were registered in Brazil, of which 210 are projects involving the generation, transmission or consumption of energy, 68.6% of them are large-scale projects and 31.4% are small-scale projects.[4,5] Under the *Programme of Activities* (PoAs), among the ten ones that have been registered in Brazil, seven of them are renewable energy generation projects and the other three involve the recovery and destruction or energetic use of methane (CH_4).[6]

Technologies implemented in the energy sector can be categorized into: *i)* electricity generation to the National Interconnected System (SIN, from the Portuguese "Sistema Interligado Nacional"), which includes wind, solar, hydroelectric and thermoelectric generation with renewable biomass as an independent power producer (IPP); *ii*) off-grid generation (isolated systems) in the condition of power auto producer (APE); *iii*) connection of isolated systems to the SIN; *iv*) fuel switch; *v*) energy efficiency; and *vi*) thermal energy from biomass.

Out of the 210 registered energy projects, 94 are hydroelectric projects, 57 are wind farms, 48 of biomass, 6 of fuel switch, 3 of energy efficiency, 1 of connection of isolated system and 1 of solar generation (chart 1).

CHART 1
CDM projects registered in Brazil involving energy (March 2017)
(In %)



Source: Centre on Energy, Climate and Sustainable Development of the United Nations Environment Program (UNEP). Available at: https://goo.gl/HQjdLY. Accessed on: March 28th, 2017.

4. Except for projects involving biogas and biomethane.

5. Data obtained on the website of the Centre on Energy. Climate and Sustainable Development of the United Nations Environment Program (UNEP). Available at: goo.gl/vr99Rp. Accessed on: March 28th, 2017.

6 The United Nations Framework Convention on Climate Change (UNFCCC). Project Search 2017. Available at: goo.gl/y4rrGL. Accessed on: May 30th, 2017.

Only one wind power project is for off-grid generation. The remaining wind, hydroelectric and solar projects are connected to the national grid. Regarding the biomass projects, 39 out of 48 registered projects generate electric power for the grid; the other nine projects only involve thermal power and/or fuel switch.

Regarding the issuance of *certified emission reductions* (CERs), out of the 122,324 ktCO_2e issued, 25,269 ktCO_2e are from energy projects (20.7% of the total). The remaining CERs are divided into: nitric acid plants (N_2O abatement, 45.8%); landfill gas (25.2%); methane avoidance from manure and waste water (3.5%); reforestation (3.5%); avoidance of sulfur hexafluoride emissions (SF_6) and perfluorocarbons (PFCs) emissions (1.3%); avoidance of fugitive emissions from coal production (0.1%); and substitution and recycling of carbon dioxide (CO_2) (0.01%) (table 1).

Although the nitric acid plants, with five projects, account for only 1.5% of the registered projects, they are responsible for 45.8% of the issued credits, due to the high global warming potential of nitrous oxide (N_2O).

TABLE 1
Quantity and representativeness of registered CDM projects and CERs issuance – Brazil (March 2017)

Type	Registered projects	Registered projects (%)	Credits issued (kRCE)	Projects issued (%)
Energy	210	61.4	25,269	20.7
Biomass as energy source	48	22.9	9,410	37.2
Interconnection of isolated systems	1	0.5	316	1.3
Energy efficiency	3	1.4	353	1.4
Fuel switch	6	2.9	712	2.8
Hydropower	94	44.8	14,135	55.9
Windpower	57	27.1	343	1.4
PV generation	1	0.5	0	0.0
Other projects	132	38.6	97,055	79.3
Total	**342**	**-**	**122,324**	**-**

Source: United Nations Environment Program (UNEP). Available at: goo.gl/ih3zxB. Accessed on: March 28th, 2017; The United Nations Framework Convention on Climate Change (UNFCCC), 2017. Available at: goo.gl/y4rrGL. Accessed on: May 30th, 2017.

3 ELECTRICITY INTO TO THE GRID

3.1 Simplicity and robustness of the methodologies

Based on the analysis of the Brazilian CDM projects, a significant participation of grid-connected electricity generation from renewable energy sources, can be noticed. Some factors can be mentioned regarding this significant participation in relation to other types of projects.[7]

In the case of "greenfield" projects, i.e. new plants, which represents the largest portion of registered projects – the baseline scenario is determined[8] as the electric power generated by the project, replacing the electric power that would be generated by a combination of existing and new (others that would be built) plants, reflected in the grid emission factor. Therefore, the only parameters required for the calculation of baseline emissions and, consequently, the determination of the CERs, are the electric power generated by the CDM project and the emission factor of the grid. The Brazilian emission factors have been made available by the Brazilian Designated National Authority (DNA) since 2007 (Brazil, [s.d.]).[9]

Even for cases of expansion and/or retrofit of existing generation plants, the calculation remains very simple. The baseline scenario is identified by the electric power generated by the project before CDM. Thus, emission reductions are directly determined by the difference between the previous generation in the baseline scenario and the generation after the expansion and/or retrofit. Therefore, the additional generation after the expansion and/or retrofit multiplied by the CO_2 emission factor of the grid results in the baseline emissions of the project.

Therefore, the emission scenario of the baseline is easily defined by the methodology, and the accounting of the emission reductions depends – almost exclusively – on the energy generation dispatched to the grid, which is monitored by the project participants (PPs) independently of a GHG emission reduction project or not.

3.2 Monitoring plan without procedures unrelated to the operation

All information regarding energy generation and its reliability, as well as the appropriateness of the operation of the plants, are required during the project validation/verification. Thus, electricity generation data, calibration of meters,

7. This analysis does not include electric power generation projects from biomass residues, since there was a significant reduction in the records of these types of projects from 2006, most probably due to the substitution, in the perception of the authors, of the extremely simple methodology AM0015 – Bagasse-based cogeneration connected to an electricity grid – by the extremely complex ACM0006 – *Electricity and heat generation from biomass.*

8. ACM0002 – Large-scale methodology for grid-connected electricity generation from renewable sources.

9. The emission factors of the construction and operation margin are available on the website of the Brazilian Designated National Authority (DNA), information since 2006. Such factors are calculated using the dispatch data analysis method and the simple adjusted method.

operating license, among others, are easily obtained, as they are part of the operating routines of the projects, without the need for: the installation of additional monitoring equipment, outsourced labor force, specialized training of operators or changes in the plant's work routine.

In addition, the monitoring of electricity carried out by the PPs can be easily verified with data from third parties regularly operating in the market. This is the case of the Electric Energy Trading Chamber ("Câmara de Comercialização de Energia Elétrica" – CCEE)[10] via the online Energy Data Collection System (SCDE), or even the data from the local energy concessionaire/distributor, just to mention some of the evidence and official documents most commonly use to confirm this information.

There are examples of additional projects that remained unfeasible, due to physical and financial constraints related to the implementation of additional monitoring required by the CDM. As an example, the AMS-II.E methodology – Energy efficiency and fuel switching measures for buildings – requires monitoring by energy efficiency measures, which cannot be simply accounted from the consumption of electricity directly, as it includes actions that may have some degree of subjectivity on the direct influence of the CDM project. As example, it can be mentioned the improvement of operation management and maintenance through the adoption of procedural changes, the establishment of best practices, the replacement of lamps, among others. The difficulty in unequivocally accrediting any reduction of electricity consumption directly to the actions of the CDM project, and the difficulty in precisely linking individual measures each MWh consumption avoided were the reasons given for the rejection of energy efficiency projects in a supermarket chain involving 94 branches distributed in seven Brazilian states.[11]

In the case of the electricity generation connected to the grid, there are no difficulties in accrediting improvements, and not even the need for procedures apart from the normal operation of the projects, which, consequently, simplifies the work and reduces the project's implementation, operation and transaction costs.

3.3 Autonomy from the participation of third parties

Due to the size of the grid-connected electric power generation projects, there is no need, normally, for a wide variety of monitoring actions, which can greatly increase operating costs. Examples of such actions can be observed in microscale projects (energy efficiency projects or household-scale electric power generation),

10. The Electric Energy Trading Chamber (CCEE) is an institution created in 2004, replacing the Wholesale Electric Energy Market (MAE), as a result of the new Brazilian electric power sector framework. It is responsible for managing the commercialization of electric power in the interconnected system.

11. Available at: https://goo.gl/8Ey1rd. Accessed on: June 16th, 2017.

when monitoring/follow-up actions of the operation of each equipment must be individually programmed, even if there is a possibility of sampling. Thus, the PPs of power generation do not depend on the confirmation and/or exchange of information with third parties, who may bring the need for additional procedures, such as the signing of individual contracts and preventive maintenance in a pulverized manner. In cases of household-scale electric power generation, for example, in order to develop the CDM process, individual participation and consultation are necessary for several participants, which bring bureaucracy to the project development and also raises its costs.

In conclusion, it is quite reasonable to assume that more simplified emission reduction calculation and procedures for demonstrating the baseline scenario, carrying out monitoring without the need of additional procedures and/or equipments, as well as the autonomy in participation of third parties, very likely contributed to a more intensive development of grid-connected electric power generation CDM projects.

4 RELEVANT EVENTS FOR THE DEVELOPMENT OF CDM PROJECTS IN THE ENERGY SECTOR IN BRAZIL

4.1 Review and consolidation of methodologies: biomass and cogeneration projects

Brazil has a significant potential for generating electricity to the grid with the use of biomass residues, but there are still many barriers to further development in the sector. In a way, CDM has helped, for some time, in making these projects more attractive. But this typology of projects is an example of how frequent revisions of calculation methodologies and somewhat academic demands – in other words, little related to the reality of the operation of actual projects – may influence the development of the sector. Due to the importance of cogeneration with biomass to Brazil, participants in some Brazilian projects proposed and obtained the approval, in September 2004, of the large-scale methodology AM0015, specifically for the use of sugarcane bagasse in the generation of electricity to the grid. The methodology was extremely simple and very similar to those employed for power generation from hydroelectric and wind turbine generators (WTGs). While AM0015 was valid – registration requests were allowed until December 25th, 2005; i.e. that is, during the period of approximately fifteen months of validity – 24 large-scale projects were registered using it. AM0015 was replaced by the consolidated methodology ACM0006, which is much more detailed and with the introduction of several complex restrictions and unclear parameters and constraints; for example, the efficiency of hypothetical multiple uses of biomass waste.

Since its adoption, the ACM0006 methodology has become increasingly complex by adopting different types of theoretical scenarios for the generation of electricity, heat/steam, mechanical energy, biomass and biogas. Currently ACM0006 methodology has seventy pages, not considering the related referred tools on which the methodology is also based.

Sixty-four project design documents have been published since then, and began their validation in Brazil, but only two cogeneration projects obtained the registration, one in 2007 and another in 2011, and other two were rejected – in 2008 and 2009. Only 6 out of the 24 projects registered with AM0015 could renew their crediting period with the use of ACM0006. The sector has grown in the period, but it still holds great unfulfilled potential, and although it would make sense, the CDM, unfortunately, does not represent a realistic incentive for the sector.

4.2 Methodological uncertainties and pressure from stakeholder groups: large hydropower plants – additionality and reservoirs

The discussion on the additionality of large-scale hydroelectric power plants has always been present in the CDM. Stating that large hydroelectric projects are additional has always caused discomfort to many stakeholders.[12]

In its turn, the *tool for the demonstration and assessment of additionality* was developed in an attempt to objectively demonstrate whether a given project is additional or not. In the case of energy projects, which receive other revenues than possible emission reduction credits and could be developed by any other developer, the feasible demonstration of additionality is essentially carried out through the financial analysis. The other option is the barrier analysis, but this one is practically not used, due to extreme subjectivity and impossibility of being unequivocally demonstrated in practice. Therefore, the additionality tool can be considered a good tool, when it comes to establish means to define: *i*) realistic alternatives to the implementation of the project; *ii*) the pioneering projects and what is common practice in the market; *iii*) the obstacles faced by the projects; and *iv)* the financial attractiveness of the project and alternatives.

It surely is very unlikely that an entrepreneur will invest in a project that is not very financially attractive and depends exclusively on very uncertain funding as the trading of emission reduction credits; for this reason, the tool for demonstration and assessment of additionality aims at describing the steps for a rational and reasonable analysis and it is, in the authors' opinion, a valid way to evaluate the additionality of the project from a theoretical point of view. Obviously, there are discussions regarding its effectiveness, but the authors consider that the application

12. Stakeholders who are directly or indirectly involved by the project implementation.

of a concept that can be very subjective and essentially theoretical (the scenario of the absence of the project is counterfactual) has to use some flexibility. This is exactly what happens in the abovementioned tool, for example, by acknowledging that a rational investor – when comparing two economically feasible alternatives – would choose the one that is financially more attractive. That being said, the project does not necessarily need to be unfeasible and then become feasible exclusively by revenues from the emission reduction credits to be additional.

BOX 1
Comments from the public consultation process for CDM in hydroelectric power plants

In the consultation process of the stakeholders, during the validation phase, large hydroelectric plants – such as the Santo Antonio, Teles Pires and Jirau hydropower plants (HPP) – received several negative comments regarding additionality, reservoir emissions, environmental impacts, and the licensing process in Brazil.[1] The PPs responded to all comments based on the ACM0002 methodology, procedures and tools approved by the CDM Executive Board for the validation of projects. Even though they received apparently severe criticism, such projects were registered as CDM project activities. In the authors' opinion, this happened essentially because the criticism was focused much more on processes and regulators, for example, when the effectiveness of the additionality tool was questioned, rather than the characteristics of the projects themselves.

Prepared by the authors.
Note: [1] For example, comments on the Santo Antonio hydroelectric power plant (HPP) project are available at: goo.gl/Apf91Q. The response of the project participants (PPs) can be found in the link available at: goo.gl/isEmZH. Accessed on: April 30th, 2018.

Hydroelectric power is very important for the Brazilian electric power sector. However, only run-of-river (RoR) projects or projects built in existing reservoirs were eligible in the first methodologies related to hydropower plants. The concept of run-of-river was never precisely defined in the scope of the CDM, but this did not prevent the registration of thirteen projects in Brazil in 2006. However, the potential for CDM projects in hydroelectric plants with new reservoirs and not ROR systems has always existed. But it was only after version 6 of ACM0002, in July 2006, that hydroelectric plants with new reservoirs became eligible, through the introduction of the concept of power density, derived from Brazilian reference studies (Brazil, 2006).

For hydroelectric power project activities that result in single or multiple reservoirs, the following criteria must be observed:

- the methodology is not applicable if the power density of the project activity is lower than or equal to 4 W/m^2;
- CH_4 and CO_2 emissions from the reservoir should be considered if the power density of the project activity is greater than 4 W/m^2 and lower than or equal to 10 W/m^2; and
- emissions from the water reservoir are set as zero if the power density of the project activity is greater than 10 W/m^2.

The first Brazilian project that was clearly not ROR was registered in May 2008 (Fundão-Santa-Clara Energy Complex – CEFSC), which includes a hydroelectric plant with a power density of 6.13 W/m^2. Several others have been registered since then.

The power density and emission limit-values were defined based on the eligibility recommendation of the CDM Methodology Panel (UNFCCC, 2006b). Based on empirical data from Brazilian reservoirs, estimates were demonstrated for hypothetical reservoirs with 10 W/m^2 of power density and 60% of capacity factor, which resulted in emissions ranging from 20.14 to 76.40 kgCO$_2$e/MWh. From these figures, the CDM Executive Board took the conservative decision of adopting emissions of 90 kgCO$_2$eq/MWh for reservoirs with power density greater than 4 W/m^2 and lower than or equal to 10 W/m^2.

In order to confirm the conservativeness of the procedure – under the approved CDM methodology –, table 2 was prepared using the latest literature compilation data available for Brazilian hydroelectric power plants (HPPs) (Demarty and Bastien, 2011).

TABLE 2
Greenhouse gas (GHG) emissions from HPPs

Dam/reservoir	Total annual emissions	Age of reservoir	Area of reservoir	Installed capacity	Power density	Annual emission factor of the reservoir
	10^6 tCO$_2$eq	Years	km^2	MW	W/m^2	gCO$_2$eq/m^2
Miranda	0.15	1	70	408	5.83	2.14
Serra da Mesa	2.14	1	1,784	1,275	0.71	1.20
Xingo	0.16	4	60	3,000	50.00	2.67
Tucurui	28.73	5	2,875	8,370	2.91	9.99
Segredo	0.09	6	82	1,260	15.37	1.10
Itaipu	0.20	7	1,350	12,600	9.33	0.15
Samuel	2.60	11	560	216	0.39	4.64
Balbina	2.43	16	2,360	250	0.11	1.03
Barra Bonita	0.57	35	334	141	0.42	1.71
Três Marias	4.21	36	1,155	396	0.34	3.65

Source: Demarty and Bastien (2011).
Prepared by the authors.

From the available figures, it is clear that, under certain circumstances, there is potential for large gross amounts of GHG emissions. However, all plants with high gross CO$_2$ emissions would not be eligible in the context of the CDM because their power densities are all lower than 4 W/m^2 – highlighted in red in table 2.

Using generation data of 2012, it is possible to estimate the emission factor of the plants in table 2 that are eligible in the CDM (table 3). It should be noted that the calculation is performed using gross emissions, without the distinction between emissions due to the reservoir and natural emissions. From these estimates, the rationale is very clear and, in some cases, it is also clear the excessive conservatism of the limits used in CDM projects.

TABLE 3
Estimates of emission factors in eligible plants in the CDM (2012)

Dam/reservoir	Total MWh[1]	Área (m^2)	Total emissions (tCO_2e)	Power density (W/m^2)	Emission factor ($kgCO_2e/MWh$)
Miranda	2,096,372	70,000,000	150,000	5.83	71.55
Xingo	19,673,435	60,000,000	160,000	50.00	8.13
Segredo	5,993,278	82,000,000	90,000	15.37	15.02
Itaipu	89,204,754	1,350,000,000	200,000	9.33	2.24

Source: Demarty and Bastien (2011).
Prepared by the authors.
Note: [1] Source: The National Electricity System Operator.

From the results, it can be concluded that the approved ACM0002 methodology is conservative in relation to the reservoir emissions for most of the eligible cases.

However, it should be recognized that additional efforts are required to develop a robust measurement protocol, aiming to estimate GHG emissions from water bodies more accurately.

The market, on the other hand, defines the criteria for the purchase of carbon credits from large-scale hydroelectric projects. Thus, even if large projects generate credits, if there are no buyers for these credits, the incentive will not exist in practice.

In 2007, developers of hydroelectric projects and buyers of carbon credits went through regulatory uncertainties in the European Union (EU) regarding eligibility of credits generated by hydroelectric plants with installed capacity above 20MW. At the time, there were rumors about the ban on the marketing of these credits on the European market, which paralyzed several ongoing negotiations.

In 2008, the EU began to require projects with installed capacity above 20MW to be assessed against the criteria of the World Commission on Dams (WCD),[13] so that the credits generated by those projects became eligible in the

13. The World Commission on Dams (WCD) has seven principles: *i*) public acceptance and consultation of stakeholders; *ii*) assessment of comprehensive options; *iii*) assessment of existing dams; *iv*) sustainability of rivers and livelihood; *v*) recognition of entitlements and shared benefits; vi) ensuring compliance; and *vii*) sharing of rivers for peace, development and security (WCD, 2000).

EU Emissions Trading Scheme.[14] Likewise, buyers in the voluntary market also began to require such certification.

BOX 2

Calculation of reservoir emissions

Project emissions from water reservoirs are calculated according to the following equation:[1]

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \tag{1}$$

In which:

$PE_{HP,y}$ Project emissions from hydroelectric plants reservoirs in year y (tCO2e);

EF_{Res} Default emission factor for reservoirs emissions of hydroelectric power stations; namely, 90 kg CO2e/MWh;

TEG_y Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity given to the internal loads, in the year y (MWh).

The power density of the project activity is determined by the following equation:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \tag{2}$$

In which:

PD Power density of the project activity, in W/m2;

Cap_{PJ} Installed capacity of the hydroelectric plant after the implementation of project activity (W)

Cap_{BL} Installed capacity of the hydroelectric plant prior to the implementation of the project activity (W). For new hydropower plants, this value is zero;

A_{PJ} Area of single or multiple reservoirs measured on the water surface, after implementation of the project activity, when the reservoir is full (m^2);

A_{BL} Area of single or multiple reservoirs measured on the water surface, before implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

Although the determination of the methodology for the A_{BL} parameter is zero for new reservoirs, some projects were registered discounting riverbeds. Thus, A_{BL} is the surface area of the river before the implementation of the project, and therefore the area considered for power density calculation purposes is the difference between the reservoir area and the existing river channel area. This approach is based on the clarification provided by the CDM Executive Board, which reads: "in order to calculate the power density, the correct equation will be the increased power capacity divided by the increased flooded area measured in the water surface".[2]

Prepared by the authors.

Notes: [1] ACM0002 – large-scale methodology – consolidated baseline methodology for grid-connected electric power generation from renewable sources. Most recent version available at: http://cdm.unfccc.int/methodologies/index.html.

[2] Request for clarification for approved large-scale CDM methodology, AM_CLA_0049 – calculation of power density. Available at: goo.gl/KQUzLu. Accessed on: December 20th, 2017.

14. Mandatory program for limitation and trading of emissions that allows the use of carbon credits from the mechanisms of the Kyoto Protocol. Available in: http://www.co2offsetresearch.org/policy/EUETS.html; goo.gl/uepkj6. Accessed on June 16th, 2017.

4.3 Lack of publicly available information and differences in interpretation of methodologies: CO_2 emission factor of the grid/interconnected system emission factor

Since the earliest discussions of the development of CDM projects in the energy sector in Brazil, it was clear that projects generating electricity from renewable sources would play an important role.

But at the outset, there was great difficulty for these projects, namely: how to calculate the grid emission factor. In the early 2000s, articles on the subject were published specifically for Brazilian grid grid (Esparta et. al, 2001, Esparta and Martins, 2002). However, this was only partially resolved with the publication of the first CDM approved methodologies: for small scale projects, version 2 of AMS-I.D, in December 2003; for large-scale projects, AM0015 and ACM0002, both in September 2004.

The emission factor of interconnected systems, for all methodologies, is calculated using the concepts of operating margin and build margin introduced for the Brazilian system by Meyers *et al.* (2000) and further elaborated by Sathaye *et al.* (2002). The idea is that when adding a new power plant to the installed system, there will be a marginal impact on the operation (electricity with the highest operating cost, which represents the operating margin, will be displaced) and the construction of new plants (the construction trend observed in recent years, the build margin, will change).

From the publication of the methodologies, a group of private companies sourced and processed publicly available information in order to make made available the first emission factors for the period 2004-2006 for the Brazilian interconnected system. Some projects were approved using these emission factors. The first project was registered in January 2006, and by the end of the first half of 2006, there were already thirty registered power generation by renewable sources.

However, as at the second half of 2006, differences in interpretation between the Brazilian Designated National Authority (DNA), the Interministerial Commission on Global Climate Change (CIMGC, from the Portuguese "Comissão Interministerial de Mudança Global do Clima"), and project proponents on what methods to use for operating margin calculation – the CIMGC required the use of the hourly dispatch data analysis method, which requires non-publicly available information – and which applicable system boundaries (the Southern, Southeastern + Center-West, Northern and Northeastern, four regions for the CIMGC and the South + Southeastern + Center-West + Northeastern + North, two regions for project proponents) made it difficult – or impossible – to approve projects in the sector during the period.

From the beginning of 2007, the CIMGC initiated the publication of emission factors, according to the assumptions considered most appropriate by the commission itself (operating margin for dispatch data and four electrical systems). Even so, these assumptions were questioned by PPs, who favored the use of 100% publicly available data. The matter was only finally resolved after a public hearing held in December 2007, which resulted in the publication of Resolution CIMGC No. 8,[15] which defined the whole SIN as a single system and accepted other calculation methods for the operating margin prepared by the project participants.

Discussions on the emission factor are an example of the persistence and perseverance of PPs, which were able to have other emission factors approved in methods other than those initially prescribed by the DNA. Such discussions, their repercussions, and the learning about how to deal with different views, of the project developers and the government regulator in the case, are part of the CDM's legacy for grid-connected power projects.

4.4 Proinfa Projects and the governmental ownership of credits

The Brazilian Alternative Energy Sources Incentive Program (known as Proinfa from the Portuguese "Programa de Incentivo às Fontes Alternativas de Energia Elétrica") – created by Law No. 10,438, of April 26th, 2002 – aimed at increasing the participation of alternative renewable sources (small hydroelectric power plants – SHPs, wind power plants and biomass thermoelectric projects) in the generation of electricity, privileging entrepreneurs who had no corporate links with generation, transmission or distribution concessionaires.[16] The law that created the program did not provide ownership of possible carbon credits. However, in its regulation, two years later (Decree No. 5,025 of March 30th, 2004), the reduction of GHG emissions under the Kyoto Protocol was explicitly stated as one of the objectives of the program, to the point that financial resources of the Proinfa account were allocated to Eletrobras ("Centrais Elétricas Brasileiras", the federal state-run utility), with the objective of pursuing financial benefits from the CDM.[17] Some PPs with generation units in the program tried to register their projects in the CDM without the direct participation of the Federal Government. The vast majority of those who tried were harshly questioned about ownership of CERs, but a few[18] were able to register. But despite the desire of the Federal Government and the great

15. Resolution No. 8 of the Interministerial Commission on Climate Change (CIMGC), of May 26th, 2008. Available at: https://goo.gl/yxZ64S. Accessed on Dec. 22nd, 2017.

16. Available at: http://www.aneel.gov.br/proinfa. Accessed on Dec. 27th, 2017.

17. For example, the Annual Plan of the Brazilian Alternative Energy Source Incentive Program (Proinfa) 2013, produced by the Centrais Elétricas Brasileiras SA (Eletrobras, 2012), indicates specific coverage for the development of the activities aimed at obtaining carbon credits from the program, in the amount of just over BRL20.6 million.

18. For example, the Cerradinho and Couripe thermal electric plants, the Água Doce wind farm, the Aquarius small hydroelectric plant and the Osorio wind farm.

effort in human and financial resources, Eletrobras found it very difficult to register the Proinfa projects in the CDM. Only in October 2012, four groups of SHP projects and wind farms started the validation process, but until December 2017, no project had been registered and, consequently, the possible financial benefit of the mechanism was lost. The experience would merit further discussion – which unfortunately will not be possible here – to accurately understand the difficulties and problems, and finally try to avoid them in similar future situations.

5 ELECTRIC POWER SECTOR

In order to evaluate the impact of the CDM on the electricity sector, the projects that started operations and registered under the mechanism are analyzed in the next paragraphs. For this purpose, the following observations shall be considered:

1) Operations startup is based on ANEEL's (Brazilian Electricity Regulatory Agency) generation database; data collected on June 6th, 2017.

2) Only projects that started operations as Independent Power Producers (IPP) according to the Brazilian regulation are included. Therefore, projects involving micro-scale hydropower, solar photovoltaic power plants and and thermonuclear power plants were not included (such entrepreneurships are under the Brazilian regulation either captive generators or public services).

3) The first Brazilian power generation CDM project was registered on November 18th, 2004.[19] However, registered CDM projects started operations before that (for example, in 2000), as there was the possibility of obtaining retroactive credits for projects submitted to registration by March 31st, 2007 (UNFCCC, 2006a).

4) There are CDM projects that started operating before 2000, and therefore their registration in the mechanism refers to expansion and/or retrofit projects, as it is the case of most sugarcane bagasse cogeneration projects. Thus, for example, despite the fact that ANEEL indicates that a certain plant came into operation in 1994, for example, the CDM project is related to expansion and/or retrofit carried out by the entrepreneur after 2000.

5) CDM projects for the generation of electricity by biogas were not included, since it was not possible to correlate the projects identified by ANEEL with the projects registered on the website of the United Nations Framework Convention on Climate Change (UNFCCC). In addition, this type of project will be discussed in Chapter 5 (*Waste*).

19. The first project registered by the CDM was "NovaGerar" – a project on energy from landfill gases. Available at: https://cdm.unfccc.int/Projects/DB/DNV-CUK1095236970.6/view; goo.gl/CYdvYx.

Since the first CDM project was registered, at the end of 2004, the authors decided to evaluate two periods, ten years prior to and after 2005 in order to try and understand the impact of the mechanism in the sector. In the period 1996-2005, 164 projects started operating as Independent Power Producers (IPP), of which 42 were registered in the CDM – that is, 25.6% of the total (table 4).

Considering the period 2006-2015, 742 projects started operation, of which 221 are CDM projects – that is, 29.8% of the total (table 4).

TABLE 4
Number of projects that started operation, by source and CDM representativeness (1996-2005/2006-2015)

Period	1996-2005			2006-2015		
Source	Number of projects that started operating	Number of CDM projects	CDM (%)	Number of projects that started operating	Number of CDM projects	CDM (%)
TPP[1]	89[2]	17	19.1	180[3]	4	2.2
SHP	48	22	45.8	223	78	35.0
HPP	25	3	12.0	36	8	22.2
WindPower[4]	2	0	0.0	301	131	43.5
Total	**164**	**42**	**25.6**	**740**	**221**	**29.9**

Source: ANEEL. Available at: https://goo.gl/oGuhgT; UNFCCC (2017).
Prepared by the authors.
Notes: [1] Thermal Power Plant.
[2] Of which 38 are renewable (sugarcane bagasse, forest waste and rice husk).
[3] Of which 125 are renewable (sugarcane bagasse, forest waste, rice husk, elephant grass and biogas from municipal solid waste).
[4] Wind power plants.

Since projects that began operations from 2000 onwards could ask for retroactive credits, another analysis was carried out considering the period before and after 2000. From 1990-1999, 42 projects started operating, of which five thermoelectric plants (UTE from the Portuguese "Usinas Termo-Elétricas") were registered in the CDM due to retrofit and expansion projects (11.9% of the total). In the following period (2000-2009), 332 projects started operating, of which 76 were registered in the CDM – that is, 22.9% of the total (table 5).

In the 2000-2009 period, six projects were rejected (two thermoelectric plants, three SHPs and a large-scale hydroelectric plant) and two projects withdrawn (both hydroelectric).

It is worth noting that the electric sector underwent deep restructuring in the 1990-2000 period, with the creation of new institutions, the de-verticalization of the sector with the separation of the generation, transmission and distribution segments, as well as privatization programs, only to mention a few of the changes. The results of these initiatives are clearly observed with the analysis of the number of enterprises which started operations from 1990 to 1999 (42 projects) and between 2000 and 2009 (332 projects).

TABLE 5
Number of projects that started operation, by source and CDM representativeness (1990-1999/2000-2009)

Period	1990-1999			2000-2009		
Source	Number of projects that started operating	Number of CDM projects	CDM (%)	Number of projects that started operating	Number of CDM projects	CDM (%)
TPP	24[1]	5	20,8	137[2]	21	15,3
SHP	11	0	0,0	134	47	35,1
HPP	5	0	0,0	35	6	17,1
Wind Power	2	0	0,0	26	2	7,7
Total	42	5	11,9	332	76	22,9

Sources: ANEEL. Available at: https://goo.gl/oGuhgT. UNFCCC (2017). Available at: goo.gl/y4rrGL. Accessed on: May 30, 2017. Prepared by the authors.
Notes: [1] Of which 16 are renewable (sugarcane bagasse, forest waste).
[2] Of which 73 are renewable (sugarcane bagasse, forest waste, rice husk, biogas from municipal solid waste and blast furnace biomass gas).

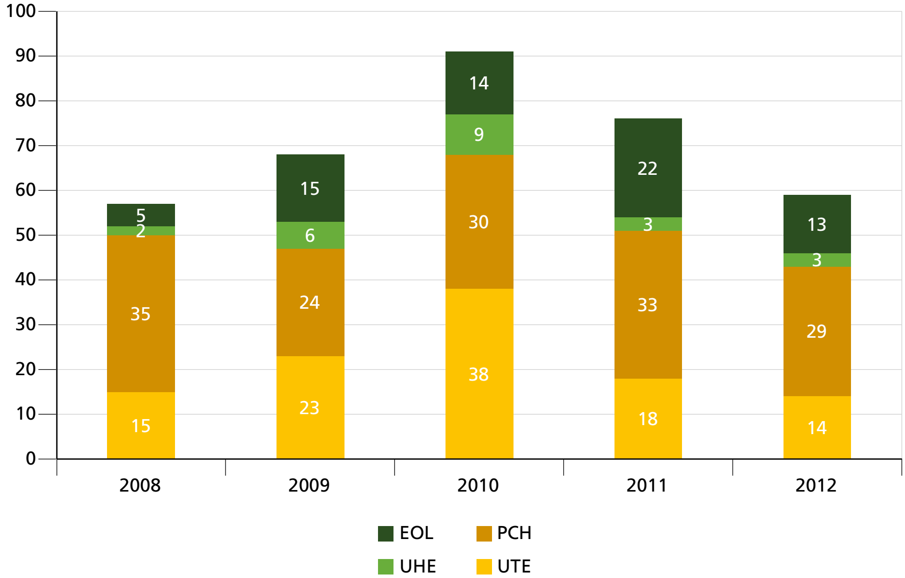
Taking into account only the first commitment period of the Kyoto Protocol (2008 to 2012), 351 projects started operations, of which 75 were registered in the CDM (chart 2).

Charts 3, 4, 5 and 6 show the start-up of projects in the 2008-2012 period, by type of source and number of projects registered in the CDM.

Small hydroelectric plant is the most registered type of energy project by 2012. After that year, wind farms dominated the market with 88.8% of total projects registered in the 2013-2016 period. During that period (2013-2016), only fourteen SHP projects were registered in the CDM, an amount previously registered annually. This reduction also reflects the decrease in the implementation of this type of project, with a decrease of almost 50% in the average number of projects that started operations compared to the average of the four previous years (2009-2012).

CHART 2

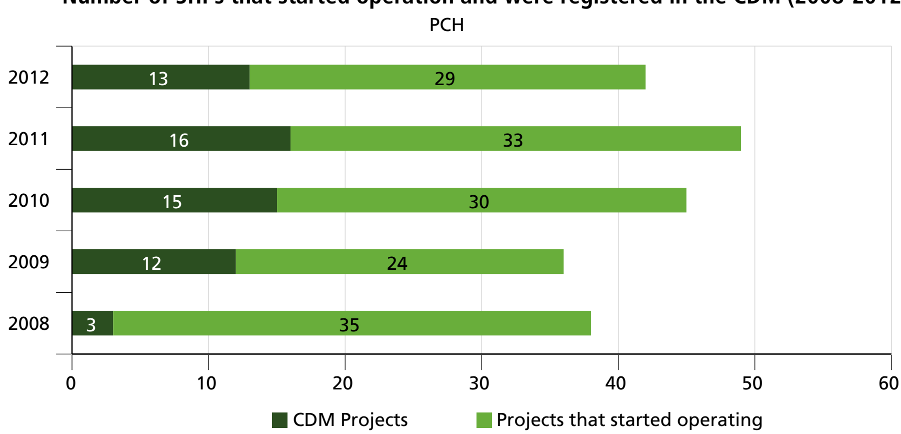
Number of projects that started their operation in 2008-2012, by source



Source: ANEEL. Available at: https://goo.gl/oGuhgT.
Prepared by the authors.

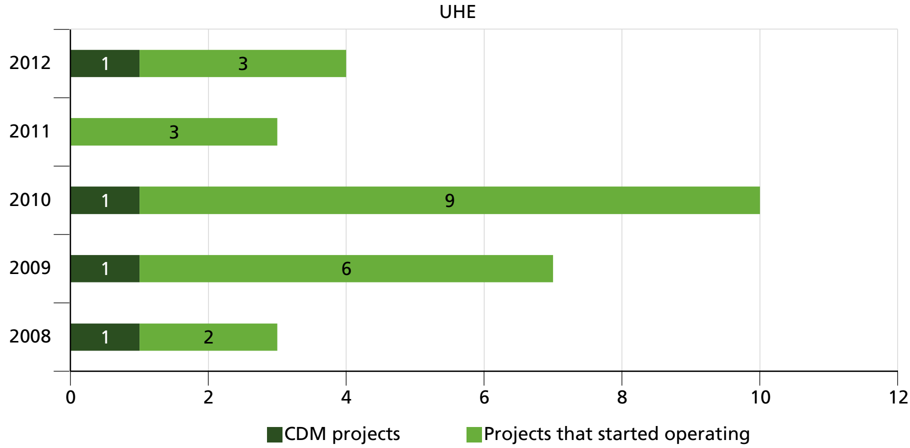
CHART 3

Number of SHPs that started operation and were registered in the CDM (2008-2012)



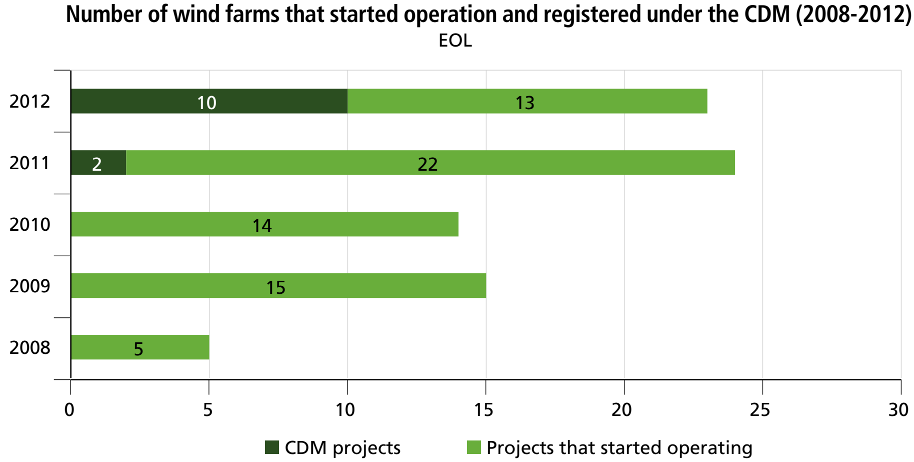
Source: ANEEL. Available at: https://goo.gl/oGuhgT. UNFCCC (2017).
Prepared by the authors.

CHART 4
Number of HPPs which have started operation and registered under the CDM (2008-2012)



Sources: ANEEL. Available at: https://goo.gl/oGuhgT. UNFCCC (2017). Available at: goo.gl/y4rrGL. Accessed on: May 30th, 2017. Prepared by the authors.

CHART 5
Number of wind farms that started operation and registered under the CDM (2008-2012)



Source: ANEEL. Available at: https://goo.gl/oGuhgT. UNFCCC (2017). Available at: goo.gl/y4rrGL. Accessed on: May 30th, 2017 Prepared by the authors.

In 2008-2012, only four hydroelectric power plants were registered: July, 14th, Baguari, Engenheiro José Luiz Muller de Godoy Pereira (former Foz do Rio Claro) and Santo Antônio. It should be noted that some projects – for example, the Jirau and Teles Pires HPPs – were registered in the CDM in 2012; however, they started commercial operation after 2012 and, therefore, they were not considered for this analysis, given that it takes into account the year projects started operating and which of these are CDM. The project registration deadline by 2012 due to uncertainties after the first commitment period was one of the criteria for many developers to initiate the CDM process in advance – before project commercial operation.

The Brazilian wind farms started regular registration under the CDM in the beginning of 2011. Before that, only two projects were registered as part of the mechanism.[20] Considering the post-2012 period (2013 to 2016), 323 wind farms started operating, of which 135 were registered in the CDM – that is, 41.8% of the total.

The rationing occurred in 2001/2002 to meet the demand had also an impact in the urgency of diversification of the electricity sources. Regarding the incentive to renewable sources, one of the government initiatives was the creation of the Brazilian Alternative Energy Sources Incentive Program (PROINFA), by Law Nr. 10,438, of April 26th, 2002.[21] Through PROINFA, biomass projects, SHPs and wind farms entrepreneurships were encouraged by offer of long-term (20 years) power purchase agreements signed between the project developers and Eletrobras. The purchase price of energy was established for each type of source with the floor of 80% of the national average final consumers' tariffs with the additional costs to the system are covered by all consumers consumers.

In the first phase of the program, projects were expected to start operating by December 2006. However, due to the difficulties faced by project developers and the lack of equipment supply – not only for wind turbines, but also for other types of projects, considering the booming world energy market and the need to comply with the index of nationalization in the short term – the last deadline defined for initiating the projects selected in the program was postponed to December 2010 (as determined by Law No. 11,943, of May 28th, 2009.[22]). As a reference, the price paid for wind farms under Proinfa in December 2013 reached BRL 361.86/MWh (Eletrobras, 2012); that is, three times the amount paid in the new energy auction for wind farms in 2013 – an average of BRL 120/MWh (CCEE, 2016).

In the period of 2008-2012, of the 69 wind farms that started operation, eighteen participated in PROINFA (26.1% of the total). In fact, this program made the scenario and the learning curve possible for the development of wind farms. Of the 415 wind farms currently in operation, 170 are part of PROINFA and/or CDM and five have been rejected in the CDM. The program has allowed the development of the wind industry in the country, which currently has a production capacity of around 750 MW of new installed capacity per year, reaching a nationalization rate of 70% (EPE, 2009). Although PROINFA has always considered participation in

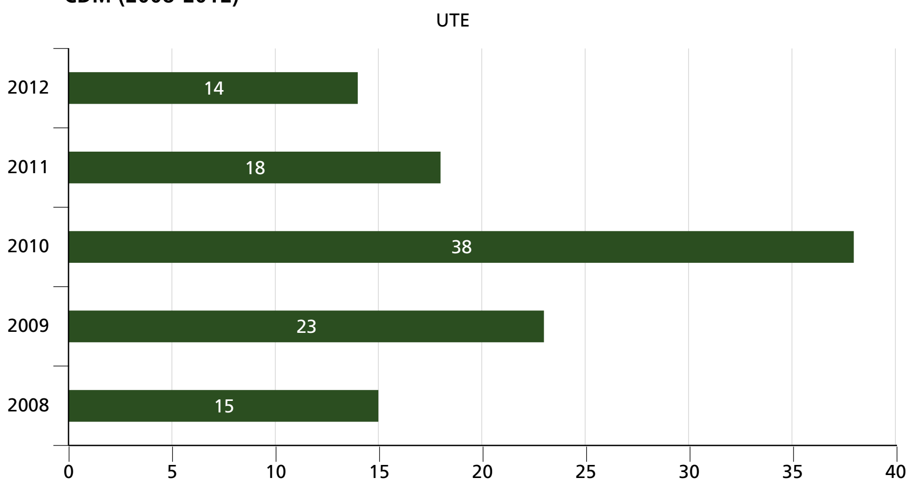
20. "Água Doce" and "Osório" wind farms.

21. Available at: goo.gl/hDhdvS. Accessed on: June 29th, 2017.

22. Available at: https://goo.gl/iFr4A7. Accessed on: June 29th, 2017.

the CDM, after facing many difficulties during years in the attempt, Eletrobras still seeks the registration of these projects.

CHART 6
Number of thermal power plants that started operation and registered under the CDM (2008-2012)



Sources: ANEEL. Available at: https://goo.gl/oGuhgT. UNFCCC (2017). Available at: goo.gl/y4rrGL. Accessed on: May 30th, 2017.
Prepared by the authors.

As observed in chart 6, no thermoelectric project was registered in the CDM in the 2008-2012 period. This is strongly due to the replacement of AM0015 by ACM0006 and subsequent reviews, as discussed earlier in this chapter. In 2009, a cogeneration project was submitted for registration with version 6 of ACM0006 and was rejected,[23] because according to the CDM-EB report (UNFCCC, [s.d.]), the project participants failed to demonstrate conservatism in selection of the reference plants and in the financial analysis of the project.

Considering the assessment above, it is possible to state that the CDM was an important incentive for the development of renewable electricity generation projects during the first commitment period of the Kyoto Protocol. Of course, this was not the only factor taken into account for the implementation of the projects, but the CDM certainly played a role as an additional incentive.

The electric power sector reform carried out in the period prior to the CDM and the country's favorable investment environment also helped the development of these projects. Although the CERs could not be offered as a financial guarantee due to uncertainties in project registration and/or monitoring during verifications,

23. Santa Cruz S.A. – Sugar and alcohol – *Cogeneration project.*

it can be said that potential emission reduction credits improved the attractiveness of projects when considered in their cash flows.

6 OTHER ENERGY PROJECTS

In addition to grid-connected electricity generation projects within sectoral scope 1 (energy industries and renewable/non-renewable sources), there are other types of projects within sectoral scopes, such as scope 2 (energy distribution), 3 (demand of energy), 7 (transportation) and 10 (fugitive emissions). However, there are no Brazilian CDM projects registered under these scopes. The only initiative formally identified is that of the Pão de Açúcar Group, which involves scope 3 with energy efficiency measures; five projects were submitted for registration, but were rejected due to difficulties in monitoring requirements exactly as prescribed in the methodology.[24]

Emission reduction initiatives in these scopes exist; however, they did not take carbon credits into account. The high complexity of the validation, approval and registration process, as well as additional monitoring requirements, the high cost involved (hiring a specialized consulting firm and designated operational entity, registration fee, among other examples) and the high uncertainty of success in the registry influenced significantly so that the CDM was and is not considered.

An example is the expansion of the yellow line of the São Paulo Subway, in which there was a bidding process for feasibility analysis of the CDM project and partnership between the state of São Paulo and the Inter-American Development Bank (IDB) for the development of two CDM methodologies. However, the initiative has no publicly available results, and therefore the reasons for the non-continuity of the initiative as CDM project are not known.

There are several government and other institutions studies on the consideration of the CDM for expanding the use of biofuels – such as ethanol and biodiesel – and the fuel switch from diesel oil to natural gas in public transport, but there were no further repercussions.

Not only in the case of transportation, but also in other sectors, the government's difficulty in participating directly in economic mechanisms designed for the private sector such as the CDM is evident – as is the example of PROINFA. Only in the case of landfill biogas, municipal governments were able to participate in the initiative in a late manner, by questioning concessions without GHG capture and leaving the process for registration and responsibility for private entities. Here, the authors do not claim that this is the only possible solution, but only that it was the only one with a positive result in the first commitment period of the Kyoto Protocol.

24. Information on CDM rejected projects can be found at: https://cdm.unfccc.int/Projects/rejected.html. Accessed on July 19th, 2017.

In the industrial field, there are several studies on CDM opportunities in the sector, also involving the PoA, which are not implemented in practice. In the case of the industrial sector, some energy efficiency initiatives can be identified, but it is difficult to prove additionality, since they involve other revenues in addition to carbon credits due to reduced energy consumption. Moreover, the difficulties associated with monitoring measures by type of equipment are not always easy to apply, as in the case of the Pão de Açúcar Group project previously discussed.

Some reasons may be cited for the non-consideration of the CDM:

1) Proof of additionality in order to demonstrate lack of financial attractiveness for projects receiving revenues other than CDM and/or when there is regulation on a given emission reduction initiative, as is the case of energy efficiency measures applied to energy distributors;
2) Difficulties in monitoring equipment/measures;
3) High costs, high complexity and intense bureaucracy in the process of project registration and monitoring;
4) Uncertainties regarding successful validation and registration;
5) Uncertainties about the Kyoto Protocol and/or future markets;
6) Uncertainty about prices and volatility of a market that is extremely dependent on EU regulations.

7 CONCLUSION

Revenues from CDM carbon credits have unequivocally contributed to improving the attractiveness of projects in the electricity sector. The simplicity of the baseline definition and the calculation of emission reductions, monitoring without the need to install additional equipment or to implement complex procedures contributed to the greatest success in registering CDM projects of grid-connected electricity generation plants compared to other types of project.

A respectable CDM legacy is the development, acceptance and practical application of additionality assessment in a more robust, yet rather complex, way – including the assessment of alternatives to the project, financial analysis and barriers to project implementation, plus the survey of common practice – rather than simply by reducing emissions.

Another important legacy is the demonstration that it is possible to establish a process involving all stakeholders aiming acceptable solutions to complex situations, such as the acceptance of large hydroelectric plants and the determination of the CO_2 emission factor for grid-connected electricity generation. In these cases, the process managed to define criteria and procedures that were reasonably applicable in practice, although the time needed for this definition have been somewhat extended in some situations.

A clear difficulty in the process was presented in the local approval procedures. In the case of Brazil, the process was often too long and involved several redundancies, not only in relation to the demands of the Convention on Climate, but also in relation to the national regulation, demanding many public and private resources and, consequently, making the process in Brazil more resource intensive and expensive than in other countries. The fact that the process was exceptionally very accelerated in the final half of the first crediting period (July to December 2012), showed that it is possible to do it in a more expedite way.

The aim of the criticism here is to identify problems and look for solutions, as it is undeniable that there is much room for improvement. The process is complex and overly redundant (all projects go through various levels of review, e.g. in Brazil, the Designated Operational Entity, the Designated National Authority (DNA) and the UNFCCC Secretariat), procedures are frequently revised and changed (in the 2008 to 2012 period, methodologies, tools, manuals, forms, etc. were revised annually or even more frequently), registration and issuance fees are absolutely unrelated to market prices, some types of projects, although very promising, produced very few projects (evidence of practical implementation difficulties, for example in transport and energy efficiency), to name just a few of the difficulties that deserve a closer look at possible market developments.

An example of intention that did not resulted in good results in practice is the desirable incentive to small-scale projects with the adoption of simplified procedures and expected lower fees, which in the end, has been diluted in higher costs of a more robust (more redundant in the praxis) of the procedures of registration and issuance. An evidence of that is the fact that projects of the same typology have essentially the same cost and require the same term regardless of whether they are small or large scale. The CDM-EB itself indirectly acknowledged some of these problems by promoting, albeit belatedly, the adoption of positive lists, automatic additionality and programme of activities.

Despite the difficulties, the authors are confident that the capacity built during the implementation of the CDM will be extremely useful for the definition of future mechanisms. The mechanism's contribution to the development of projects, methodologies and procedures is undeniable, as it is the basis for many voluntary markets and the promotion and encouragement of labels and other certification standards, as well as their complementary use with other certificates. For those who work in the sector there is no doubt: certified CDM emission reductions are the most credible "carbon credits" in the market.

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CHAPTER 5

ENHANCEMENTS TO THE WASTE MANAGEMENT BASED ON CDM: GOVERNANCE, NEW TECHNOLOGIES AND BETTER PRACTICES IN THE SECTOR[1]

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1 INTRODUCTION

When the Brazilian Government adopted the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 (Brasil, 1992), it made the commitment to periodically draw up the national inventory of emissions and anthropogenic removals of greenhouse gases (GHG), not controlled by the Montreal Protocol, and publish their results.[4]

The abovementioned inventory should be developed using the GHG emission estimation methods developed by the Intergovernmental Panel on Climate Change (IPCC, 2000, chapter 5) adopted by the Conference of the Parties of the UNFCCC.

The IPCC methods are applied worldwide to develop GHG emissions inventories.

As a country party to the UNFCCC, the Brazilian Government adopted the Kyoto Protocol in 1997 at the 3rd Conference of the Parties (COP 3). In the Protocol, UNFCCC Annex 1 countries[5] committed themselves to reducing their emissions by 5% below 1990 levels in the commitment period from 2008 to 2012. Although Brazil, one of the non-Annex 1 countries to the UNFCCC, participated in the Kyoto Protocol projects (CDM), it was without undertaking a quantified emission reduction commitment such as Annex 1 countries of the UNFCCC.[6]

The waste sector is one of the sectoral scopes in which CDM projects can be carried out under the Kyoto Protocol.[7] In Brazil, by 2015, 12% of the CDM

1. This chapter essentially reveals the experience of one of the authors in the waste sector in order to show how the CDM has entered the waste management agenda as a stimulating enhancement of management (note from the editors).

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3. Physicist. Tenured professor, Doctor in Electrical Engineering from USP.

4. National Inventories are available at: http://sirene.mctic.gov.br.

5. Annex 1 countries to the UNFCCC are countries that make up the European Union, Oceania, plus the United States of North America, Canada and Japan.

6. For further information on UNFCCC and Kyoto Protocol, see Chapter 1 (note from the editors).

7. Annex A of the Kyoto Protocol lists all sectoral scopes for project development and can be consulted in: goo.gl/YiLyZo.

projects were related to the enhancement of waste management, in which 59 projects were implemented in landfills, contributing to the emission reduction of 1.7 million tCO_2 equivalent in the period 2003- 2015.

This chapter discusses the impacts, lessons learned and legacy of the CDM in the waste sector in Brazil. The CDM had been adopted in 1997 and came into force in 2005. It is provided in Art. 12 of the Kyoto Protocol.

2 QUANTIFICATION OF GHG EMISSIONS FROM WASTE TREATMENT AND DISPOSAL

GHG quantification methods can be: those used in CDM projects, those used in national GHG emission inventories and those used in corporate GHG emissions inventories.

2.1 Quantification of GHG in CDM projects

The methods used on the estimates of the Clean Development Mechanism (CDM) projects are developed and approved by the UNFCCC to estimate the amount of avoided GHG emission. In addition to the principles considered in the IPCC methods described below, CDM project methods quantify and consider future decreases in avoided GHG emissions from project-related activities and include rigorous registration mechanisms, performance guarantees, redundancy and safety of the data. The issuance of Certified Emission Reductions (CER) must follow a certification procedure in the language of the host country of the project and in English. Besides the object of certification, the project includes an institution responsible for designing the project, two different certifying units, one accrediting agency, the designated national authority of the host country of the project and a division focused on the management and monitoring of CDM projects of the UNFCCC.

In order for the CDM projects in the waste sector to materialize the Emission Reductions Certificates, approximately 116 methodologies were approved, about seven of them associated with the waste sector. More than 25 consolidated CDM project methodologies were approved as well, having 4 associated with the waste sector and other nearly 100 small scale methodologies, where 5 are associated with the urban solid waste, rural waste and effluent treatment.

The estimation of avoided GHG emissions by soil disposal is initiated by the estimated methane generation due to the disposal in the soil, considering the amount and composition of waste, climate, the quality of the operation of the final disposal site and the premises. The amount of captured methane and put through combustion represents the avoided GHG emission, discounting the amounts that would be destroyed without the project and the GHG amounts emitted by additional activities caused by the CDM project.

The organic material deposited in the soil by anaerobic processes of decomposition is degraded, generating methane for decades. Therefore, estimates of methane generation in a landfill require data from decades of waste disposal in the soil.

Voluntariness and additionality are requirements of the methodology adopted in CDM projects, that is, the implementation of the project should not be mandatory and the resources originated by the remuneration of the emission reductions should favor their execution, respectively. CDM projects consider future reductions in avoided emissions due to emissions that would occur even in their absence (baseline emissions). Measurement and recording of avoided GHG emission quantities are also part of the CDM.

In addition to each CDM project, the prerequisites for the CDM idea to be materialized required the preparation, approval and review, under the UNFCCC, of CDM project methods, a project accreditation and monitoring certification, operating and ensuring the credibility of each carbon credit registered. All this was done with carbon credits resources.

2.2 Quantification of GHG in National Inventories

The quantification of GHG emissions used in the preparation of national inventories follows the method prescribed by the IPCC (1995) and approved by the UNFCCC, which is divided into five sectors: energy, agriculture, land use, change in the land use and forestry, waste and emissions from industrial processes. The UNFCCC also approved the use of the *Guide to Good Practices for Inventory Preparation* (IPCC, 2000), which considered the same five sectors. In this guideline to good practices, the land use, the change in the land use and forestry sectors are added to agriculture and livestock sector, resulting in agriculture, forestry and other land uses sector.

The GHG emissions inventory methods from IPCC subdivide the waste sector into: urban solid waste, industrial solid waste, domestic sewage and industrial effluent.

The method recommends that the estimated emissions from the treatment or disposal of rural waste be added to the others in the agricultural sector. The IPCC method also recommends that the estimation of GHG emissions from the use of fossil fuels in the waste transportation and GHG emissions from the waste incineration should be accounted for in the power sector, when carried out with the waste-to-energy processes.

In national calculations, the IPCC requires the estimation of emissions from thermal treatment of municipal solid waste and industrial waste, and also provide for the accounting of emissions from disposal of municipal solid waste in the soil, from sewage treatment and the treatment of industrial effluents and their launch into bodies of water. The latter is limited only to the most representative economic activities.

The estimation of emissions due to the thermal treatment of municipal solid waste considers the treated amount, the composition of the treated waste, the possible addition of complementary fuel and the type of incinerator, which may be a pyrolysis or gasifier reactor. The product of the emission factor of each treatment option and the mass of treated waste correspond to the GHG emission from the waste fraction submitted to this type of treatment.

Estimates of emissions from domestic sewage treatment consider the amount of organic load generated and treated and the treatment option, as well as the quantities of organic load released directly into untreated water bodies. The product between the amount of organic loads and the emission factor of each option defines the emission of GHG.

2.3 Quantification of GHG in corporate inventories

In addition to the methods used to prepare national GHG inventories and the methods used to develop CDM projects, there are methods for developing corporate inventories and methods for developing subnational inventories – which may be regional, state, metropolitan or municipal.

The corporate GHG emissions inventories differ from the national inventory methods and methods used in CDM projects, mainly due to the way GHG emissions are consolidated. They use the principles of the IPCC proposed methodology. The corporate inventory method determines that estimates may be divided into direct and indirect emissions,[8] or indicating the emissions liability. The responsibility for the emissions may be: corporate or operational, that is, the person in charge of emissions may be the owner of the project or the person in charge of the project's operation (GHG Protocol, [s.d.]).

Life cycle analysis applied to GHG emissions estimates and carbon footprint estimates[9] are options that use the GHG estimation principles of IPCC methods and can contribute to enhance the understanding and improvement of GHG management. In this sense, the CDM experience in the waste sector led to the implementation of inventories in order to obtain the possible gains from the mechanism and, consequently, corroborated the governance of waste treatment and disposal companies.

8. Direct GHG emissions, according to the GHG Protocol, are Scope 1 emissions; indirect GHG emissions, according to the GHG Protocol, are Scope 3 emissions. Emissions from the consumption of electric energy, according to the GHG Protocol, are Scope 2 emissions.

9. The term "carbon footprint" refers to an estimated GHG emission corresponding to the production of a good or to the performance of a service.

The years of operation of CDM projects in the waste sector have led to changes in waste management in Brazil. When proposing a CDM project in a landfill,[10] the waste disposal manager materializes the good sanitary performance and allows the possibility of biogas extraction from the landfill.

With the implementation of a CDM project in a landfill, two collaborative and sometimes, conflicting activities are established in the landfill hosting the project. On one hand, the waste disposal is performed according to the landfill project. This arrangement prioritizes the aspects of compaction, stability and the flow of fluids. On the other hand, the installation of pipelines for the collection, for the transportation, for the processing and combustion with the use of biogas are privileged.

Aware of the new reality, the landfill manager starts to control the waste disposal at the landfill. The manager tends to maximize the generation of biogas, preventing the disposal of contaminant residues or inhibitors of anaerobic activity.

The sanitary landfill now has the potential for energy generation and leaves behind the negative aspects that have always characterized dumpsites.

Finally, in terms of quantification, it is still worth discussing the possible equivalence factors used to estimate emissions in terms of equivalent carbon dioxide (CO_2equivalent) in relation to their relative uncertainty. For the purposes of calculating the sector's emissions, since the emissions are related to methane, it is necessary to calculate the equivalence between methane and carbon dioxide.

For this purpose, two options are presented in the literature: the global warming potential (GWP) (Houghton et al., 1996), and the global temperature potential (GTP) (Myhre and Shindell, 2013, p. 714). These equivalence factors, which vary significantly, allow to express the different GHGs in terms of equivalent carbon dioxide (CO_2equivalent). GTP indicates that one ton of CH_4 is equivalent to four tones of CO_2 equivalent and the GWP indicates that one ton of CH_4 may equal from 21 to 28 tons of CO_2 equivalent. In this regard, during the first commitment period of the Kyoto Protocol, CDM projects used exclusively GWP equal to 21, that is, one ton of CH_4 equals 21 tons of CO_2 equivalent. When GHG estimates are presented in terms of CO_2equivalent, it is essential to indicate the equivalence factor used.

10. According to National Survey on Basic Sanitation (IBGE, 2010a, p.185), the landfill is a "final disposal facility for solid urban waste through its adequate disposal on the ground, under permanent technical and operational controls, so that neither waste, nor its liquid and gaseous effluents may cause damage to public health and/or the environment. To that end, the landfill must be located, designed, installed, operated and monitored in accordance with the current environmental legislation and the official technical standards governing this matter".

3 GHG EMISSIONS BY THE WASTE SECTOR IN THE WORLD, IN BRAZIL AND IN THE STATE OF SÃO PAULO

On a global scale, in 2005, 49Gt of CO_2equivalent were emitted (Bogner et al., 2008). According to these authors, the emission of methane due to the treatment and waste disposal in that same year was estimated at 1.4 Gt of CO_2equivalent or 3% of the total. In Brazil, in 2010, the emission of methane as a consequence of the disposal of residues in the soil represented 2.2% of total GHG emissions (BRAZIL, 2015, p.42).

The reduced fraction of GHG emissions from the waste sector in Brazil partially reflects the precariousness of the sector. The rate of waste collected is relatively low when compared to the rates of the European Union and North American countries.

The estimation of GHG emissions from the waste sector takes into account treatment alternatives, however, in Brazil, the disposal of municipal solid waste in the soil is the most used option; treatment options, whether they are biological or thermal, are practically non-existent. Waste disposal in dumpsites[11] prevails.

According to the National Energy Balance, of the Energy Research Company (EPE, 2015, p.182), the installed capacity of electrical generation from biogas in Brazil reached 80MWe in 2013, largely due to the success in efficient energy utilization of this energy source in the state of São Paulo. Alves (2017, p.25) made considerations regarding the possibility of electricity generation from biogas and estimated for the hypothesis of waste disposal in the soil, energy recovery and use of biogas, an upper limit of electricity generation of 700MWe.

Table 1 shows GHG emissions from waste management in Brazil in the 1990 -2015 period. The amount of methane emitted in the country increased from 1990 to 2003. As a consequence of methane recovery projects, the growth rate was reduced from 2003 onwards, starting with the first commitment period of the Kyoto Protocol.

11. According to the National Survey on Basic Sanitation (IBGE, 2010a, page 214), dumpsites are a "place used for the disposal of raw garbage, on the ground, without any special care or technique. The open pit is characterized by the lack of measures to protect the environment or public health".

TABLE 1
Methane emitted by the management of MSW (1990-2015)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					[thousand tCH_4]					
Brazil	795	823	852	879	907	933	960	989	1,017	1,046
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
					[thousand tCH_4]					
Brazil	1077	1108	1,143	1,171	1,158	1,173	1,200	1,195	1,175	1,186
Year	2010	2011	2012	2013	2014	2015				
					[thousand tCH_4]					
Brazil	1,260	1,325	1,397	1,400	1,500	1,500	--	--	--	--

Sources: By 2012: MCTI (2014, p. 158-161). From 2013 to 2015: MCTIC (2017, p. 47).

4 CDM PROJECTS IN THE WASTE SECTOR AROUND THE WORLD AND IN BRAZIL

In the early years of the 21st century, the recovery and the energetic use of biogas was widely practiced in North America and Europe. In Brazil, they were still seen with distrust by the public manager of the waste sector regarding their technical efficiency and financial viability. Only academic experiments thrived in Brazil. The Kyoto Protocol contributed decisively to the emergence of methane capture and combustion undertakings and electricity generation, such as the thermoelectric plants in the Bandeirantes landfill and the São João landfill, both in the city of São Paulo.

Between 2004 (before the Kyoto Protocol) and 2014, non-Annex 1 countries submitted more than 8,100 CDM projects; among them, more than 1,000 projects, or approximately 12% of total projects, were from the waste sector (UNFCCC, 2016).

During the first commitment period of the Protocol 422 CDM projects were submitted to the designated national authority of Brazil, 59 of which were biogas recovery and combustion in landfills of municipal solid waste, keeping the world average.

Listed by Cetesb (2014), the CDM projects in the waste sector represented a voluntary initiative to adapt sites where the waste was disposed of on soil. The estimate of GHG generation, the record of the quantity of the GHG collected and the avoided GHG emission record were incorporated to the waste management in the landfills where the CDM projects were installed.

The following projects are some of the 59 CDM projects in the waste sector in Brazil that have shown some prominence in terms of their pioneering in different dimensions of the corresponding emissions management practice: financing, technology, and commercialization of certified emission reductions.

4.1 Nova Gerar

The first CDM project in Brazil and in the world that associated the reduction of GHG emissions with the generation of electricity with biogas and the elimination of a dumpsite that was replaced by a landfill in the city of Nova Iguaçu, Rio de Janeiro.

4.2 Bandeirantes

The Bandeirantes landfill, located in the northern part of the city of São Paulo, received the waste collected in the north and west zones of the city from 1979 to 2007. Forty million tons of waste was accumulated on 140 hectares. In 2004, the project to generate biogas-based electricity with a 20MW capacity started operating in this landfill, recovering approximately 70% of generated biogas that up to then used to be released into the atmosphere. Methane was then used as fuel in the thermoelectric plant installed there. In 2016, nine years after the closing of the landfill, the amount of recovered biogas was still sufficient to supply the thermoelectric plant with a 5MWe power.[12]

The electricity generated by an accounting resource compensated for the electricity consumed by the agencies of a large private bank operating throughout the country, the Unibanco.

The project benefited from the Law No. 10,438/2002, which exempted the transmission and distribution from the biogas-based electricity taxes.

Fifty percent of the carbon credits generated by the project were reverted to the city hall of the city of São Paulo. Certified emission reductions (CERs) were auctioned at the Commodities & Futures Exchange, generating approximately BRL 35 million that should be spent on improvements in the surrounding areas of the landfill.

4.3 São João

The São João landfill, located in the eastern part of the city of São Paulo received the waste collected in the eastern and southern parts of the city from 1992 to 2007. Twenty-six million tons of waste was accumulated on 80 hectares. In 2008, another project to generate biogas-based electricity was put into operation.

Developed by the same designers who implemented the Bandeirantes landfill thermoelectric plant, the biogas thermoelectric plant at the São João landfill operated initially with 20 MW. The same 50% transfer condition of the CERs granted to the municipal government was applied in this project.

12. Personal communication with Mr. Anderson, the project manager of the Bandeirantes and São João projects, engineer at Biogas-Ambiental.

4.4 Jardim Gramacho

Between 1976 and 2014, approximately 60 million metric tons of waste collected in nearby cities were deposited in Jardim Gramacho, in the city of Duque de Caxias, located on northwestern Rio de Janeiro, on the shores of Guanabara Bay and occupying about 150 hectares. In 2013, the waste management facility started operating, aiming at the use of methane thermal energy in the Petrobras refinery of Duque de Caxias (Reduc). The thermal power of 9,000 Nm^3CH_4.h-1 obtained from biogas replaced the equivalent natural gas energy.

4.5 Tremembé

The ONYX SASA landfill, with over 2 million m^3 waste capacity, in an 80 hectares area, opened in 1996 and received waste from cities and industries in the region of Vale do Paraíba, in the state of São Paulo. From 2003, the slurry treatment of waste collected in the landfill in an evaporator with the use of biogas as energy source started operating.

4.6 Marca

In 1995, the Marca landfill opened, operating in the city of Cariacica, receiving waste from the Metropolitan Region of Vitória, state of Espirito Santo. This was the third project approved in Brazil. In this landfill, the CDM project in addition to reducing GHG emissions into the atmosphere has been integrated into a series of other activities focused on sustainability, such as separation and recycling of paper, plastics and inert waste. The management of the landfill encouraged the installation of recycling cooperatives, primarily employing the neighboring landfill population in need.

5 OTHER OPTIONS FOR GHG REDUCTION PROJECTS IN THE WASTE SECTOR

5.1 Recovery and energetic use of biogas in breweries

The Brazilian brewing industry, which traditionally adopted anaerobic technology to treat its effluents, has optimized its production process by fully utilizing upflow anaerobic sludge blanket digestion to treat its effluents. The brewing industry recovered the biogas generated and burned it with low efficiency and without energy utilization. In 2004, boiler burners were adapted for the use of biogas with high content of methane.

According to the rules of the CDM projects, projects developed by breweries in Brazil were highly profitable. In practical terms, the biogas that would previously go to a low efficiency burner, started to be sent to boilers that burned fuel oil or natural gas. Even though this was a partial replacement, it proved to be quite cost-effective, but did not meet the criterion of financial additionality imposed by the CDM projects and thus all brewery projects were excluded from the Kyoto Protocol and the emissions avoided were not included in the activities of the Kyoto Protocol. No brewery project, being profitable, was classified as a CDM project.

In short, the reduction promoted by brewery projects, by not being commercialized, led to a real reduction compared to the reductions in CDM projects, which were marketed and transferred to the accounts of the carbon credit buyer country.

5.2 Recovery and energetic use of biogas in pig farming

During the first commitment period of the Kyoto Protocol, over 2,000 pig farms in all regions of Brazil deployed linear anaerobic reactors covered by PVC banners to treat their waste. In these devices, generated methane was collected, measured and burned in burners.

A large national food industry was responsible for approving the first project of the Brazilian Program of Activities (PoA) in the UNFCCC, with the inclusion of CDM Project Activity (CPA).

Among the properties that hosted CDM projects, almost all of them chose for the simple methane burning. A few others, unrelated to carbon credits, besides the treatment of their waste, promoted the recovery of biogas with the installation of electric power generators, burners and heat exchangers benefiting from the generation of energy and cogeneration with projects of high profitability.

In its few years of existence, the CDM of the Kyoto Protocol created conditions for the materialization of projects that could not prosper in Brazil, although successful in European Union and North American countries. A new economic activity arose in the country.

6 THE CONTRIBUTION TO THE SUSTAINABLE DEVELOPMENT OF CDM PROJECTS IN THE WASTE INDUSTRY IN BRAZIL

Rotondaro (2007) evaluated the contribution to sustainable development of CDM projects in the Brazilian waste sector and noticed that the criteria listed in Annex III of Resolution No. 1 of the Interministerial Commission on Global Climate Change (CIMGC, 2003) are not sufficient to foster social and environmental benefits beyond the generation of carbon credits,[13] as determined by the Kyoto Protocol.

The commitments made by Brazilian CDM projects, in compliance with Annex III of CIMGC Resolution No. 1 (2003), are not necessarily monitored by

13. For further information on this topic, it is recommended to read Chapter 8 of this publication, since it discusses carefully and critically, from the perspective of its author, the relevance and efficiency of the criteria adopted by Brazil to verify CDM Projects' contribution to sustainable development (note from the editors).

the designated national authority and, therefore, it is not possible to be ascertained whether or not they have been fulfilled or to what extent. However, despite its debatable effectiveness, the criteria set forth in Annex III of the CIMGC Resolution 1 were an attempt to materialize this concept as proposed by the Kyoto Protocol.

7 CONTRIBUTION OF CDM PROJECTS IN THE WASTE SECTOR TO GHG EMISSIONS REDUCTION IN BRAZIL

Observing the amounts of biogas recovered during the operation of CDM projects in landfills and comparing them with the methane emissions originally projected by the project developers, Santos (2014, p. 101) considers that the recovery of biogas can vary from 12% to 141% compared to initial estimates. All this variation has different justifications, for instance: project planning mistakes, variation in the quality of landfill operation or different efficiencies in drain distribution, and consequently the quantities collected and burned differ from the projected generations. At the Adrianopolis landfill, in the state of Rio de Janeiro, for example, 12% of the estimated methane was collected and destroyed. At the Caieiras landfill there was a deceptive 141%-efficiency in the methane collection and combustion.

The amounts of methane recovered annually from CDM projects were recorded by the CIMGC and are presented in table 2, which also highlights the relevance of State of São Paulo in the execution of methane recovery projects in landfills, which, in the period 2003-2010, contributed with up to 42% of the recovery of the national GHG emissions from the solid waste sector.

TABLE 2
Methane recovered (R) in Brazil in the state of São Paulo (2003-2015)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	[thousand $tCH_4.year^{-1}$]												
Brazil	1	44	61	73	123	192	230	240	200	220	140	180	180
São Paulo	1	30	35	42	94	147	171	168	146	141	52	60	22

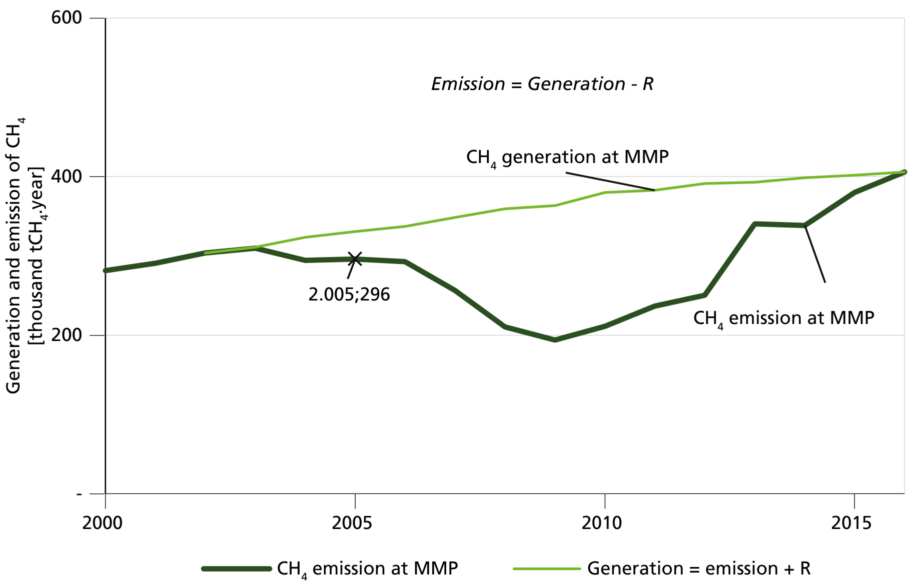
Sources: Data of Brazil from 2003 to 2010: MCTI (2015, p. 28). Data of Brazil from 2011 to 2015: MCTIC (2017, p. 47). Data of São Paulo from 2003 to 2015: Alves (2017, p. 139).

Having a methane recovery and methane combustion project as a reference, the non-use of this technology for the recovery and destruction or utilization of the methane density in biogas present in landfills allows a 150% higher methane emission, considering the same amount of waste.

Analyzing the state of São Paulo, particularly, since 1997 the intensification of inspection, investments and technical support for the adequacy of waste disposal sites on the soil have caused the reduction of dumpsites, making landfills more prevalent in that state. Consequently, the necessary improvement in the operation of final disposal sites intensified methane emissions until 2003, the year the CDM projects started to operate.

However, the implementation of methane capture projects in landfills led to a decrease in the theoretical methane emission (calculated and representing what would have been emitted without the projects), given the high gas recovery recorded between 2000 and 2015 in the state. Chart 1 shows the generation and emission of CH_4 at the São Paulo Macrometropole (MMP) (Macrometropole Paulista), the most developed region of the state, and where all the CDM projects for landfills in that state were concentrated.

CHART 1
Methane generated and emitted by the disposal of MSW at the MMP

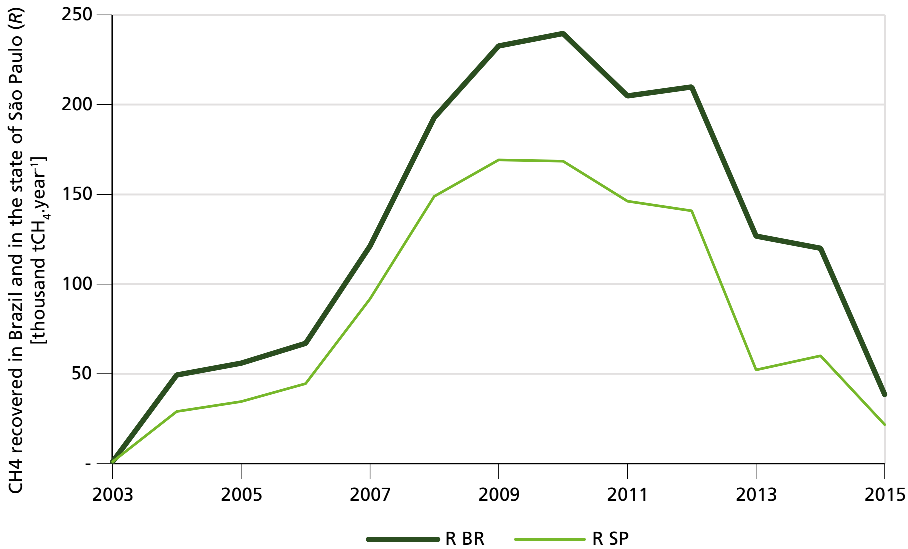


Source: Alves (2017, p. 142).

Chart 2 illustrates the information in Table 2. In Brazil and the state of São Paulo, carbon credit projects have been successful in reducing the sector's emissions in the country. With the end of the first commitment period of the Kyoto Protocol and changes in the trading conditions of Certified Emission Reductions (CER),[14] the quantities recovered decreased, leading to the discontinuation of an action that was profitable and environment-friendly.

14. For further information on market contingencies that have affected project continuity, as mentioned by the authors, see Chapter 12 (note from the editors).

CHART 2
Methane recovered (R) in Brazil and in the state of São Paulo



Source: Alves (2017, p. 143).

The non-adoption of a new commitment period under the Kyoto Protocol registered a drop in the demand for Certified Emission Reductions (CER) and CDM projects. The adoption of the Paris Agreement at the 21st Conference of the Parties (COP 21) in 2015, even with the establishment of a commitment to reduce Brazil's national emissions, without expressing any considerations regarding costs and the need for remuneration for avoided emissions, coincides with the low attractiveness of CDM projects and the return to pre-2003 conditions.

8 LESSONS LEARNED FROM CDM PROJECTS IN THE WASTE SECTOR IN BRAZIL

From 2008 to 2012, EU countries have complied with part of their quantified emission limitation and reduction commitments under Article 3 of the Kyoto Protocol, by acquiring Certified Emission Reductions of CDM projects, including those from the landfill sector in Brazil.

The end of the Protocol's first commitment period in 2012 had the effect of reducing the demand for Certified Emission Reductions, thus reducing the amounts offered by avoided emission quantities and reducing revenue from projects that included reducing emissions of methane.

During this period, this option proved to be feasible.

9 OBSTACLES AND OPPORTUNITIES TO THE CONTINUITY OF GOOD PRACTICES ADOPTED WITH THE CDM PROJECTS IN THE WASTE SECTOR

The first decade of the 21st century was a period of intense learning about the possibilities of recovery and waste-to-energy through biogas in Brazil. The little importance given by the state, federal and municipal governments to sanitation in the second decade of this century, time of this evaluation, is the main obstacle to the continuity of biogas recovery and waste-to-energy energy process.

The National Survey on Basic Sanitation (PNSB), the last major survey in the sanitation sector published by the Brazilian Institute of Geography and Statistics (IBGE), considering data from 2008, found out that 73% of the waste collected in the country was disposed of in dumpsites (IBGE, 2010, p. 60).

The ban on dumpsites is provided on the Art. 54 of the National Policy on Solid Waste (PNRS), 2010 (Appendix A), and should have occurred in 2014. However, very little has been done since its promulgation.

Bill (PL) No. 425 of 2014, approved by the Federal Senate and sent to the Chamber of Deputies, proposed extending the country's tolerance to the public manager who was not complying with the provisions of the National Policy on Solid Waste. The National Congress had not yet completed the process of that legislative bill by 2018.

The Federal Legislative Branch and the State and Municipal Legislative Branches, in addition to fully implementing the National Policy on Solid Waste, should consider possible waste management routes and the means for the adequate waste uútdisposal on soil as well as the possibilities of reduction or tax exemption applied to the acquisition of goods associated to the biogas energy production cycle.

On the other hand, international cooperation was very effective during the first decade of the century, led by the United States Government through initiatives such as Methane to Markets (MTM), at the second decade of the 21st century renamed as Global Methane Initiative (GMI).[15] In 2018, 43 countries participated in this cooperation.

In the United States, the Landfill Methane Outreach Program (LMOP),[16] which is part of the United States Environmental Protection Agency (US EPA), promotes the recovery and energetic use of biogas from landfills in the countries participating in the cooperation. In partnership with the Brazilian Ministry of Foreign Affairs (MRE) and the Ministry of Science, Technology, Innovations and Communications (MCTIC), GMI promoted technical meetings, supported the development of projects, publicized projects and brought together potential suppliers and project participants.

15. Available at: globalmethane.org/.

16. Available at: epa.gov/lmop.

The German-Brazilian Chamber of Commerce and Industry (AHK), reproducing the technological development and German experience, held annual meetings in Brazil to promote the diffusion of municipal solid waste treatment options, promoted meetings between potential Brazilian contractors, potential suppliers and German financing lines. As well as the Brazilian Ministry of Cities (MCidades), the Brazilian-German Project on Energy from Biogas (Probiogás)[17] has supported the expansion of the efficient use of biogas by inserting methane into the national energy mix and reducing emissions. Complementing the Brazil-Germany cooperation, the German Agency for International Cooperation (GIZ)[18] prospects the waste management market, fostering the use of more sustainable options.

In support of the use of biogas generated mainly in rural areas, the Brazilian Association of Biogas and Biomethane (ABiogás) promotes the insertion of biogas into the national energy mix, developing the segments involved in the production, regulation and use of this by-product of waste treatment.

The National Development Bank (BNDES) has maintained and publicized a credit line focused especially on sanitation projects.

The 2010 Demographic Census (IBGE, 2010) listed 5,565 municipalities with a total urban population of approximately 161 million inhabitants. This Census also shows that: 253 municipalities had an urban population of less than one thousand inhabitants; 3,551 municipalities had an urban population of less than 10 thousand inhabitants; and 5,315 municipalities had a population of less than 100 thousand inhabitants; 250 municipalities with an urban population of more than 100 thousand inhabitants; and 14 municipalities with an urban population of more than one million inhabitants.

Art. 45 of the National Policy on Solid Waste provides for the formation of intermunicipal consortia for the waste disposal on the soil. Such consortia will allow, for instance, the viability of adequate waste disposal in landfills with a more adequate scale, benefiting more than five thousand municipalities in the country.

10 FINAL CONSIDERATIONS ON THE CDM LEGACY TO THE WASTE SECTOR IN BRAZIL

Options such as the recovery and energetic use of biogas from anaerobic solid waste reactors or recovery and energetic use of landfill biogas, which, in the pre-CDM period, were both technically and financially disregarded and questioned, proved to be feasible and capable of, at the same time, reducing sanitation costs, contributing to good energy practices and reducing GHG emissions.

17. Available at: cidades.gov.br/saneamento-cidades/probiogas.

18. Available at: giz.de/de/html/index.html.

Successful CDM projects in this sector led to the creation of a market for parts, equipment and services. As a consequence, the design and operational planning of waste disposal sites in the soil or equipment for their treatment could take into account the aspect of the energy potential of biogas with less uncertainty.

Since the first decade of the 21st century, the previously discarded biogas generated in the upstream anaerobic upflow reactors from the country's breweries has replaced part of the oil or natural gas used in those breweries' boilers.

Similar to landfills, treatment of effluents in pig farming can generate methane when carried out under anaerobic conditions. With the implementation of linear anaerobic digesters, covered by PVC blankets, methane was no longer emitted, and started being recovered. This practice reduced GHG emissions, included an additional source of energy and improved sanitation in rural areas.

State governments, such as Rio de Janeiro and São Paulo, have created incentive programs for the energetic use of biogas, reducing taxes on industrialization, imports and trade of equipment used in the biogas generation chain.

The Brazilian Electricity Regulatory Agency (ANEEL), which established national targets for the generation of biogas-based electricity must quantify avoided GHG emissions, besides stimulating this practice (ANEEL, 2015).

At the end of the first commitment period of the Kyoto Protocol, thermoelectric plants started operating with biogas from 1 MW to 30 MW, without CDM resources[19]. This fact associated with the provisions of the National Policy on Solid Waste, as well as all the experience gained during the period in which the CDM projects were fully operational, suggests that large landfills may exist, serving large cities, and also other large landfills provided that they serve consortia of small municipalities. All these landfills may have economic, operational, energy and environmental viability.

Seemingly, according to the analysis presented, the CDM in the first place served to give credibility to the waste sector regarding the use of less intensive GHG technologies.

19. July 2014: landfill in Itajaí/SC, installed capacity between 2 MWe and 4 MWe; June 2015: landfill in Minas do Leão/RS, installed capacity between 9 MWe and 15 MWe; September 2016: landfill in Caieiras/SP, installed capacity 30 MWe; June 2016: Sant'Ana do Parnaíba/SP, installed capacity 4 MWe.

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APPENDIX A

GENERAL CONCEPTS ON THE BRAZILIAN NATIONAL POLICY ON SOLID WASTE

When dealing with projects in the waste sector, it is interesting to know the regime that is applicable to the development of projects in the area. In Brazil, the specific regulations in force date from 2010. The National Policy on Solid Waste was enacted (Brazil, 2010) eighteen years after the adoption of the United Nations Framework Convention on Climate Change (UNFCCC), thus establishing a series of innovations for solid waste management in Brazil.

The National Policy on Solid Waste defines waste as:

> Solid waste: any material, substance, object or good disposed as a result of human activities in society, whose final disposal must occur, aims at occurring or is obliged to occur at the solid or semisolid states, as well as gases and liquids within containers, whose peculiarities prevent them to be discarded in public sewers or water bodies, or require technical solutions or economically unviable solutions in the face of the best available technology (Brazil, 2010).

Another innovation in the wake of National Policy on Solid Waste is its Art. 9, which define the priority of waste management actions: no generation, followed by reduction, reuse, recycling (the 3R), treatment and environmentally adequate disposal of waste on the soil. The Art. 42, in turn, determines that the public branches establish inductive measures and financing lines that contribute to compliance with the hierarchy of waste management proposed by Art. 9. Picture A.1 illustrates the hierarchy of actions determined by the National Policy on Solid Waste.

The no-generation of waste presupposes rethinking consumption patterns and is represented by the elimination of disposals. It occurs, for example, by the use of returnable bags in place of disposable plastic bags. Reduction of waste generation occurs with the reduction of losses in the distribution of food, for example. Reuse is exemplified by the use of goods or materials repeatedly, for a long period, under their best conditions. Recycling is done by separating the goods, or materials, after its use, reinserting them into the productive process so as to providing new goods. In the production of recycled goods recycled materials replace raw materials, at least partially.

PICTURE A.1
Hierarchy of actions in managing municipal solid waste, according to the National Policy on Solid Waste

Source: Brazil (2010) *apud* Alves (2017, p. 44).

The treatment options can be thermal and biological. At the end of the second decade of the 21st century, incineration plants with or without heat recovery units, pyrolysis plants and waste gasification plants are operating in countries on a commercial scale. Both pyrolysis and gasification produce synthesis gas, which can be used as fuel.

In addition to the thermal treatment, the biological treatment, focused on the organic fraction of waste, can be aerobic or anaerobic. Both treatment options can produce fertilizers. The anaerobic option, in addition to the fertilizer, can produce methane with potential energetic use.

Other treatment options have been developed and can be established as a technical and economical option in a few years.

By inducing changes, the National Policy on Solid Waste differentiates the words *waste* and *residue*. *Waste* is the solid material remaining from *residues* after all recyclable materials have been removed and contain some recoverable value.

Art. 3 of the National Policy on Solid Waste (Brazil, 2010, p.3) maintains the public authority responsible for the management of MSW and imposes part of this responsibility on the manufacturer of the goods. This rule should be exercised by the adoption of sectoral agreements of reverse logistics[20] between the public authority and the manufacturers.

The National Policy on Solid Waste empowers the producer of goods to include in the cost of the product the means to either practice the 3R or discard the waste, and encourages the adoption of actions that ease such practices.

Article 54 of the National Policy on Solid Waste, in force since 2010, determined the banning on dumps in July 2014. In 2015, after failing in complying with this provision, the Federal Senate approved Bill No. 425/2014, extending the deadlines defined in the aforementioned article of the National Policy on Solid Waste. The obligation to dispose of waste at an appropriate location has been postponed in accordance with the dates and conditions set out in chart A.1.

CHART A.1
Changes in deadlines mentioned in Art. 54 of the PNRS for adequate waste disposal

Original date on the National Policy on Solid Waste	Date proposed by Senate Bill No. 425/2014	Condition of the bill
31/7/2014	31/7/2018	Capitals of states and municipalities belonging to metropolitan regions
	31/7/2019	Municipalities with a population of over 100 thousand inhabitants in 2010
	31/7/2020	Municipalities with population between 50 thousand and 100 thousand inhabitants in 2010
	31/7/2021	Municipalities with a population of less than 50 thousand inhabitants in 2010

Source: Brazil (2014).

Even though being a measure that aims to foster compliance with the National Policy on Solid Waste, this Bill rewards the public manager who fails to comply with the legislation. It is illegal to dispose of waste in inappropriate places since the approval of the Environmental Crimes Act (Law 9605/1998). As it has been pointed out in Art. 54, the penalty is "imprisonment from one to four years and a fine is imposed to those causing pollution by the discharge of solid waste in disagreement with the technical requirements" (Brazil, 1998).

In 2018, eight years after the approval of the National Policy on Solid Waste, there are no actions that indicate that the management of the MSW must be adapted so that waste is no longer disposed of in landfills, but in suitable places, mainly sent to landfills.

20. Reverse logistics is a principle introduced by the National Policy on Solid Waste and means to be an "instrument of economic and social development characterized by a set of actions, procedures and means to enable the collection and restitution of solid waste to the business sector, for reuse, in its cycle or in other productive cycles, or other environmentally appropriate final destination" (Brazil, 2010).

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CHAPTER 6

FOREST CDM IN BRAZIL: FUNDAMENTALS, LEGACY AND ELEMENTS FOR THE FUTURE[1]

Fábio Nogueira de Avelar Marques[2]

1 INTRODUCTION

This chapter aims at assessing the legacy of the forestry scope of the Clean Development Mechanism (CDM) in Brazil, as well as the main obstacles and opportunities that shape its potential future use.

Two main arguments are discussed. The first is that the most relevant impact of the forestry CDM in Brazil seems to be more associated with the institutional legacy than with the scale of net removals of greenhouse gases (GHG), although they were relevant when considering market limitations. Much of this sub-optimized mitigation potential may be related to international constraints on demand for forest credits, due to technical, economic and political factors, as well as the inherent complexity of the mechanism. The second is that, despite the various barriers, there may be a substantive potential for future use of the forest CDM, albeit in different forms. Nevertheless, this possibility tends to be quite conditioned to the proactive and cross-cutting insertion of the mechanism into broader public policies capable of increasing its mitigation efficiency through a combination of instruments, which corroborates several references in literature.

In order to develop the analysis, this chapter was divided into five sections, including this brief introduction. In the next section, the characteristics that differentiate the forestry scope of the CDM from the other scopes of the mechanism are presented, as the understanding of these specificities greatly influences the analytical effort. Section 3 discusses the experience in Brazil, considering cases of projects and broader aspects, in light of the main barriers related to supply and demand. Section 4 seeks to identify and analyze the main elements that may

1. The present chapter was based on author's personal capacity and it does not necessarily represent the views of the organization for which he works, partners or consultancy clients. The author is especially thankful to the following Plantar Carbon members for comments and support: Rodrigo Ferreira, Diego Toledo, Cristiana Oliveira and Gabriela Marzano.

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influence the potential for the future use of the forestry CDM, considering the current moment of transition in the international climate change regime, domestic policies and instruments. Section 5 presents the final considerations.

It should be noted that, in addition to the bibliography, the chapter is based on the author's practical experience in the development of CDM methodologies and projects, including in one of the cases addressed, as well as in the engagement in national policies and multilateral negotiations over the last fifteen years.

2 FUNDAMENTAL CHARACTERISTICS AND SPECIFICITIES

The insertion of forestry activities in the CDM was marked by a significant degree of complexity throughout the negotiating process of the Kyoto Protocol (UNFCCCa, 1997). On one hand, the international community recognized the important role of forests in mitigating climate change and in promoting sustainable development. By removing or "sequestering" CO_2 from the atmosphere, based on photosynthesis, forests can create and maintain carbon stocks in terrestrial ecosystems, which results in the reduction of the GHG concentration in the atmosphere.[3] Art. 3.3 of the Protocol requires countries to compute GHG removals from certain forestry activities to meet national commitments. The effect can be analogous to that of a carbon sink, according to the management practices adopted. On the other hand, there was a need to reconcile these potential climate benefits with the emissions compensation rationale that is inherent to a market-based mechanism such as the CDM.

This conciliation involved two main challenges: *i)* to create methodological tools to meet the *additionality criteria*[4] of the potential climate benefits generated by forestry activities; and *ii)* to create an appropriate form of accounting in which the risk of *non-permanence* of forests and their respective carbon stocks would be adequately addressed. That is, the key issue was how to ensure the integrity of a mechanism in which CO_2 removals (*negative flows*) generated by new forest stocks were used to offset emissions (*positive flows*) in Annex 1 countries, in light of the risk of loss of forest stocks and the subsequent return of carbon to the atmosphere.

The answer to this question is quite complex and will be dealt with later. To this day, it is the subject of more in-depth reflections than those developed in this chapter. Nevertheless, the parties to the Kyoto Protocol have been able to reach a consensus, albeit under various limitations, by means of Decision 19, adopted at

3. Hereinafter, "emissions" will be used as reference to "greenhouse gas emissions"; "removals" will be used as a reference to "net removals of greenhouse gases from the atmosphere by increasing forest stocks".

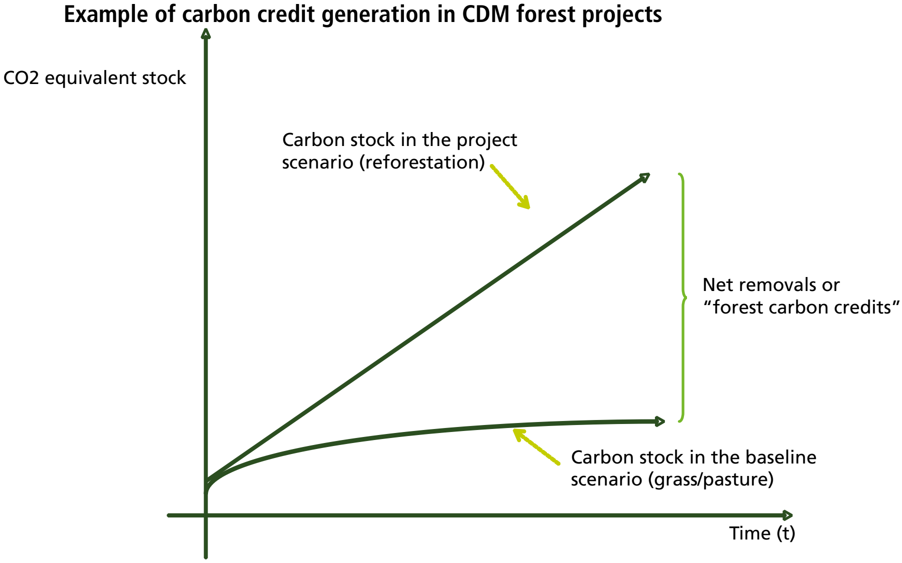
4. The concept of additionality is provided in annex A.

the 9th Conference of the Parties (COP-9) held in Milan in the end of 2003.[5] In practice, the Decision adapted the mechanism rationale to the specificities of the forest scope, based on Decision 17 of COP-7 (Marrakesh), which had regulated all other scopes of the CDM.[6] Most adaptations were made to key concepts such as baseline, additionality, definition of project boundaries, leakage and the characterization of units representing forest carbon credits.

While in other CDM scopes carbon credit is defined as the additional emission reduction in relation to the baseline scenario, in the forest scope the carbon credit generally corresponds to the net removal of 1t of CO_2 from the atmosphere, through the establishment of additional forest stocks in relation to a baseline scenario where such removals would not occur.[7]

Graph 1 shows the generation of forest carbon credits, by means of a symbolic example of a reforestation project, implemented in an area previously covered with grasses or pasture.

GRAPH 1
Example of carbon credit generation in CDM forest projects



Author's elaboration.

5. See UNFCCC (2003), which is a version of Decision 19/CP.9, translated into Portuguese by the Ministry of Science, Technology and Innovation (MCTI).

6. As a result of the entry into force of the Kyoto Protocol in 2005, Decisions 19/CP.9 and 17/CP.7 and 11/CP.7 (containing the definitions on land use and forests) have now been referenced, respectively, as Decision 5/CMP.1 (UNFCCC 2005c) Decision 3/CMP.1 (UNFCCC 2006a) and Decision 16/CMP (UNFCCC, 2006c), during the formal meeting of the I Meeting of the Parties to the Kyoto Protocol. Available at: https://bit.ly/2KiuMnK.

7. For a full concept, see the definition of actual net GHG removals in Annex A of this chapter, which also contains the main specific definitions of forestry CDM.

As for the adaptation of the main definitions of the CDM to the forestry scope, three groups of concepts deserve special attention, since they represent structural differences in relation to the other scopes: *i)* the concepts of afforestation and reforestation, which specify eligible activities for the scheme; *ii)* the risk of non-permanence of forest carbon, a crucial aspect to ensure fungibility between forest credits and other units under the Kyoto Protocol, including the units representing the emission limits for Annex 1 countries; and *iii)* the potential contribution to sustainable development. Each of these groups will be explained in detail below.

2.1 CDM Eligible forestry activities: afforestation and reforestation

The inclusion of forestry activities in the CDM was limited to afforestation and reforestation (A/R) activities, characterized by the anthropic establishment of new forests in areas that previously did not contain forests. After much controversy, conservation activities or management of existing forest stocks were excluded, for reasons that go beyond the scope of this chapter.[8] In order to understand the A/R definitions, first it is important to know the applicable forest definition:

> "Forest" is a *minimum area of land of 0.05-1.0 hectares* with tree crown cover (or equivalent stocking level) of *more than 10-30 per cent with trees* with the potential to reach a *minimum height of 2-5 metres* at maturity in situ. A forest may consist either of closed forest formations (where trees of various storeys and undergrowth cover a high proportion of the ground) or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes" (UNFCCC, 2006c p.3, author highlights in italics).

The general concept of forest is based on three ranges of values and parameters, which are highlighted in italics above. In order to accommodate the different realities and national perceptions about the term forests, each country was responsible for choosing the values among the ranges highlighted in the citation, generating the specific forest concept applicable to its jurisdiction.

In Brazil, the Interministerial Commission on Global Climate Change (CIMGC), through Resolution No. 2 of August 10th, 2005, adopted the highest values out of the three ranges. Therefore, in Brazil, forests are areas with at least 1 ha, with tree crown cover or equivalent stocking level with more than 30% of trees with potential to reach a minimum height of 5m, according to the other parameters of general definition of forests presented in the citation above. From this concept, A/R activities were defined as the only forest activities eligible for the CDM.

8. One of the causes for the exclusion of these activities was the fear that a perverse incentive would be created for the deforestation of existing forests, that is, the concern that there would be a kind of threat to clear an area if there were no additional resources coming from credits. Also contributing to the decision were fears regarding the verification of additionality and monitoring and the risks of leakage, along with broader political issues.

> "Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed source (UNFCCC, 2006c, p. 5).
>
> "Reforestation" is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on December 31st, 1989(UNFCCC, 2006c, p. 5).

The main difference between the definitions of afforestation and reforestation is the period in which the project area did not contain any forest before its implementation: fifty years before the project, in the case of afforestation; and in the case of reforestation areas can not contain forests on December 31st, 1989. In practical terms, this conceptual difference has little relevance, since the type of climate benefit generated by A/R projects is the same (removals generated by the planting of new forests).

One of the factors of greater influence in the negotiation of these concepts was the concern to avoid a perverse incentive for deforestation. There could be room for it, if regulation allowed for the reforestation of areas that had been deforested shortly before the implementation of a project, which helps to partially explain the choice of specific cut-off dates for the non-existence of forest cover in the project area.

The definitions have succeeded in leaving no room for perverse incentives for deforestation. However, in the case of the definition of reforestation, combining a very old cut-off date with the physical definition of what is a reforestation activity has generated a relevant restriction. All areas of developing countries that contained planted forests (production florests) in 1989 and which, by definition, would be *harvested* regardless of the CDM, which differs from *deforestation* of native forests, were excluded. The lack of differentiation between harvesting and deforestation for CDM purposes is also one of the reasons that contribute to this inadequacy. There also appears to be some regulatory contradiction, since Annex 1 countries can differentiate deforestation from harvesting in the accounting under national GHG inventories, which, in turn, influence on the compliance with mitigation commitments.[9] There is an attempt to improve this matter under the CDM, proposed by Brazil, which has not been approved so far.[10]

9. For an example of differentiation between harvesting and deforestation, refer to New Zealand's Greenhouse Gases Inventory (2015). Available at: https://bit.ly/1WoEu5R. Accessed on: May 27th, 2017.

10. Refer to box 1 for a more detailed discussion.

The accounting for changes in carbon stocks in A/R activities should be made based on changes in inventories in the different carbon pools, project boundaries, the baseline scenario, and the project scenario. Five carbon reservoirs are eligible and can be considered, either alone or in combination, according to project developers: *i)* above-ground biomass (carbon in tree trunks, branches and leaves); *ii)* below-ground biomass (carbon in roots); *iii)* litter (for example, leaves on the ground); *iv)* dead wood; and *v)* soil organic carbon.[11]

BOX 1
Possible eligibility of areas that had planted forests[12]

Although there is room for differentiation between harvesting and deforestation for the purposes of Annex 1 country inventories, the same logic has not been adopted in the eligibility criteria for A/R CDM project areas. Even areas that contained only planted forests in their last cycle, in 1989 or before a project, were excluded. That is, the current rules have made ineligible those areas that would be harvested anyway ("forests in exhaustion") and, as such, do not represent the deforestation of native forests.

Eligibility of a certain area means the possibility or permission to attempt to develop an A/R project for various purposes in that area. The fact that an area has already been covered with planted forests in the past does not necessarily mean that new A/R activities would occur automatically after the final harvest in the same area. By definition, planting new trees (reforestation) for production or conservation purposes depends on new investment decisions. Therefore, assessing the extent to which new A/R activities would occur in an area that contained planted forests is a matter of additionality rather than eligibility. Of course, for the correction of this gap to be effective, the additionality of A/R projects in those areas would have to be assessed, as in any CDM project.

The theme is relevant for developing countries, especially Brazil. In the past, the country had a fiscal incentive program for the establishment of planted forests, created in 1967 (the Sector Investment Fund – Fiset), through which large areas of land were reforested.To a great extent, these areas have been harvested and reverted to non-forested areas. According to data from the Food and Agriculture Organization of the United Nations (FAO), in Brazil there were 5 million hectares of planted forests in 1989, and 52.7 million hectares in Latin America, Asia and Africa (FAO, 2005 *apud* UNFCCC, 2011a). Under current rules, these areas cannot be used for new A/R CDM projects. Hence, new projects are forced to look for new areas, which makes the sustainable reuse of the same portion of land unfeasible.

Aware of this potential, the Brazilian delegation, with the support of Ethiopia, has been presented proposals to solve the problem since COP-14/MOP-4 held in Poznan, Poland in 2008. The COP requested the CDM Executive Board to evaluate the measure in 2009 and to make a recommendation to COP-15/MOP-5 in Copenhagen in 2010. The Executive Board has come to a favorable conclusion, informing that the term would be consistent with the modalities and procedures of A/R projects, if the reforestation definition were adjusted. (UNFCCC, 2009b). However, the measure was not approved by the COP. In an apparent asymmetry, New Zealand has put forward a proposal in Copenhagen to differentiate the harvesting of planted forests from deforestation, for the purposes of national inventories, by introducing the new terms "planted production forests" and "equivalent forests" (UNFCCC, 2009a). In 2012, Brazil hosted a technical workshop at its Ministry of Foreign Affairs, with representatives of governments and experts involved in the negotiation, followed by a field visit to areas in eastern Minas Gerais. The results of the workshop were reported to the Subsidiary Body for Scientific and Technological Advice (SBSTA) (UNFCCC, 2012a). However, some developed countries, especially the European Union, have opposed the idea, alleging, basically, inconsistency with current definitions and that this would be a new type of activity (UNFCCC, 2011a). The topic is on the agenda of negotiations. There has been technical evolution, but there is stagnation at the political level. The discussion will be resumed at the SBSTA intersessional meeting of 2019.

Author's elaboration.

11. As per Paragraph 1.a of the Annex to Decision 5/CMP.1.

12. Background of the discussions on the theme, referred to as *inclusion of lands with forests in exhaustion*. Available at: https://bit.ly/2KvtuoQ.

2.2 Approaches to the matter of non-permanence

The matter of non-permanence was one of the main challenges faced in drafting the regulatory framework of the forestry CDM. The solution adopted was to transform the removals generated by A/R projects into temporary carbon credits, through two types of units of measurement: tCER (Temporary Certified Emission Reduction) and lCER (Certified *Long-Term* Emission Reduction). According to the definitions presented below, these two units reflect, differently over time, the amount of credits that can be issued by a project, that is, *the actual net removals of greenhouse gases generated by A/R activities, through the additional amounts of carbon temporarily stored in project areas*. Each tCER or lCER is equal to 1t CO_2, defining what is informally known as the "forest carbon credits".

> A "Temporary CER" or "tCER" is a CER issued for an A/R CDM project activity, as per the provisions of Section K.…, which expires at the end of the commitment period following the one during which it was issued (UNFCCC, 2003, p. 5).
>
> A "Certified Long-Term Emission Reduction" or "lCER" is a CER issued for an A/R CDM project activity, as per the provisions of Section K.…, which expires at the end of the crediting period of the A/R CDM project activity or A/R PoA for which it was issued (UNFCCC, 2003, p. 6).

A central element in understanding these definitions is acknowledging the differentiation between the *period for obtaining credits* (henceforth referred to as crediting period) and the *commitment period*. While the crediting period is one in which a project can generate credits, the commitment period is the interval during which the Kyoto Protocol signatory countries must meet their emission reduction targets. The first commitment period of the Kyoto Protocol was from 2008 to 2012 and the second from 2012 to 2020.

In the case of A/R projects, the *crediting period* is different from other types of CDM projects. According to Decision 19/CP.9, project participants should choose between a period of up to thirty years or a period of twenty years, which can be renewed up to two times and can therefore last up to sixty years. In the latter case, renewal of the crediting period can only be granted upon revalidation of the project, i.e. only if a Designated Operational Entity (DOE) determines and informs the Executive Board that the baseline adopted at the beginning of the project remains valid or that has been updated, according to new data and analysis. Project participants are free to choose when to conduct the first verification audit. However, other audits should be carried out every five years from the date of first verification, but only once in each commitment period.

There is also freedom to choose the non-permanence approach to be adopted (tCER or lCER). But the choice must be made at the time of project validation, and cannot be changed over time.

2.2.1 The dynamics of tCERs

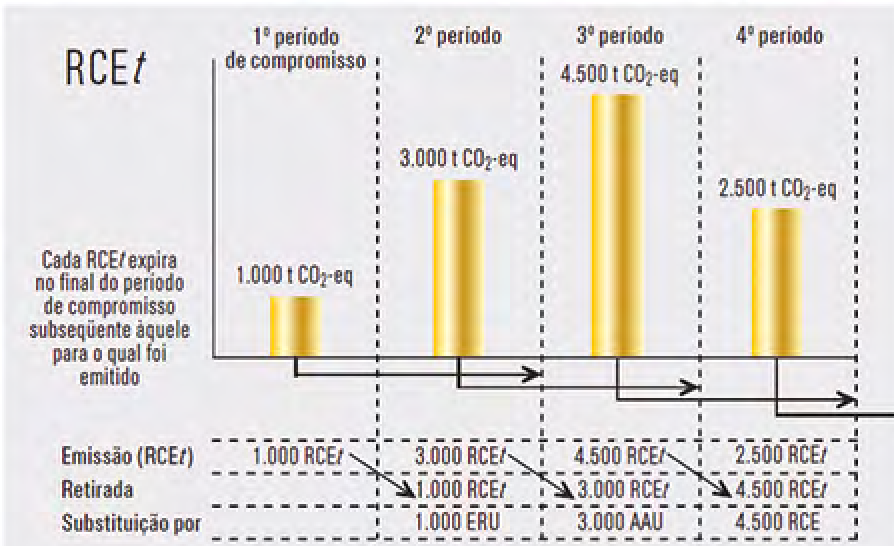
In general, tCERs are equivalent to *real net removals* (net removals, discounting leakage and emissions) or additional net carbon stock in the areas of an A/R project, on the date on which the project was verified by a DOE.

tCERs can be used by Annex 1 countries to meet their emission reduction targets. However, they expire at the end of the commitment period that is subsequent to the period in which they were generated. They must be replaced by the organization that used them to fulfill commitments (UNFCCC, 2005c). The replacement of tCERs can be done with other tCERs and with CERs (unit of all other types of CDM projects). It can also be done with AAUs (Assigned Amount Units), which represent the quotas or emission permits of Annex 1 countries,[13] and with ERUs (Emission Reduction Units) and ERMs (Emission Removal Units), which are units used to account for emission reductions and removals generated in Annex 1 countries. An lCER cannot be used to replace a tCER, although it is also a forest carbon credit.

Despite expiration, new tCERs can be generated (issued) by the same A/R project in the subsequent commitment period. As in the previous period, the tCERs will be equivalent to the net difference between the carbon stocks on the project verification date and the carbon stock equivalent to the project baseline. graph 2 illustrates the dynamics of generation and replacement of tCERs, demonstrating when tCERs are issued, withdrawn (expired) and replaced by other acceptable units.

13. For an explanation about each of these units, see Decision 13/CMP.1 (UNFCCC, 2005b).

GRAPH 2
The dynamics of tCERs



Source: Frondizi (2009, p. 77).
Obs.: 1. AAUs (*Assigned Amount Units*) and ERUs (*Emission Reduction Units*).
2. Replacements can be made with AAUs, CERs, ERUs, and/or tCERs.
3. Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

2.2.2 The dynamics of lCERs

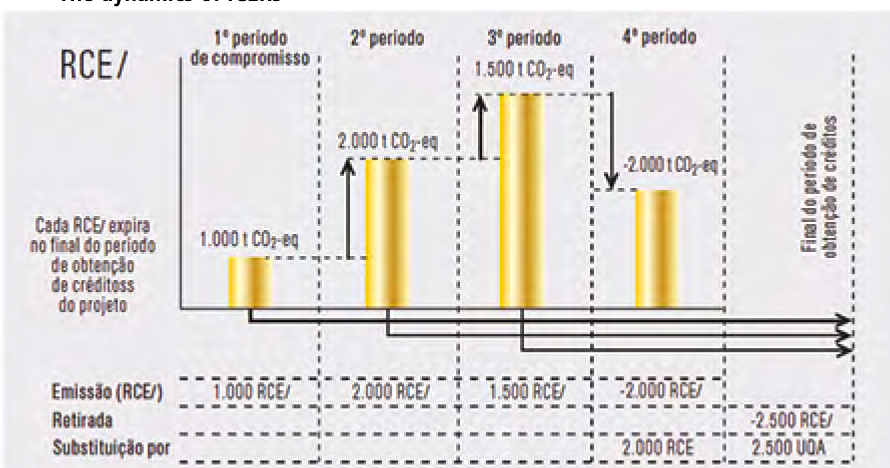
Unlike tCERs, which expire at the end of the commitment period following the one during which it was issued, lCERs are monitored and may last throughout the project's crediting period. They only expire at the end of the crediting period, which may include more than one commitment period, as adopted by the Parties to the Kyoto Protocol.[14] Thus, lCERs will also always represent the project's net carbon stocks at the time of verification, but are subject to adjustments (additions or subtractions) in relation to the carbon stocks determined in the previous verification.

As per graph 3, if the net stock of a given project is equivalent to 1,000 tCO_2e at the time of first verification,[15] project participants will be entitled to the issuance of 1,000 lCERs. If, on the second verification, in the next commitment period, the stock has increased by 2,000 tCO_2e, adding up to 3,000 tCO_2e, the project participants are entitled to the additional issuance of 2,000 lCERs. However, if

14. With the Paris Agreement and the possible discontinuity of the Kyoto Protocol in the post-2020 period, there is regulatory uncertainty over the treatment of these credits, which will require some measure that enables a fair transition.
15. In order to facilitate reasoning, only one verification was carried out in each commitment period. Initially, it was envisaged that the next commitment periods would be five years, but the second period of the Kyoto Protocol ended up being eight years. Either way, the rationale is the same.

there is a decrease in the carbon stock over the previous period, the organization using the lCERs of the project in question should complete the difference, as shown in the 4th period of graph 3 (UNFCCC, 2005c). Thus, unlike the dynamics of tCERs, lCER replacements do not necessarily occur at the end of each commitment period, but only if there is a negative difference in relation to the previous period. If there is no difference, the replacement will only occur at the end of the project crediting period.

GRAPH 3
The dynamics of lCERs



Source: Frondizi (2009, p. 78).
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

Given that an lCER may last longer than a tCER, its market value could be higher than that of a tCER. Conversely, the transaction costs of generating an lCER would tend to be higher due to the risk of reversals in carbon stocks and the need for a monitoring system for periods well beyond five years, in addition to contractual provisions appropriate to the constant adjustment of carbon stocks. However, the low liquidity of the forest credit market does not seem to have allowed confirmation of this premise. Most registered A/R projects opted for tCERs (61 out of the 66 projects).[16] Most likely, this was due to the greater simplicity in management, since in the case of tCERs the project manager need not worry about the variation of carbon stocks in relation to the last verification. At the same time, the buyer has predictability, by knowing that the purchased units will have to be replaced and that the replacement burden falls on the buyer.

16. According to research done in the documentation of each of the registered projects, available at the UNFCCC website by 6/30/2017. Available at: https://bit.ly/2KyxFQL.

It can be argued that the creation of a specific category for forest credits, based on the non-permanence/temporality of the assets, ended up generating a different type of flexibility to meet the targets of Annex 1 countries. Since tCERs and lCERs have an expiration date, and new units may be issued, the purchase of these assets is equivalent to: *i)* an incentive to maintain the generated carbon stocks; and *ii)* more time for the organization that has an emission reduction commitment to decide which type of permanent unit it will use to meet its commitment when the forest credit has expired.

In theory, such additional flexibility could result in "win-win" situations in the relationship between Annex 1 and non-Annex 1 countries, or simply between buyers and sellers. For example, a firm may have the option to purchase CERs or lCERs to meet its mitigation target up to term *x* and use the money saved (represented by the price difference between tCERs or lCERs and CERs – more valued for not being temporary) on definitive technological improvements, whose maturation process would not be feasible by term *x*. This would allow the same company to reduce emissions autonomously after term *x*. There would be time for the development of new technologies, and with a cheaper price of forest credit, there would be no trade-off between using resources to purchase a more expensive credit or investing in long-term research for a new technology.

BOX 2
Alternative approaches for the non-permanence of forest credits

For post-2012 negotiations, an agenda item was included on alternative approaches for the treatment of non-permanence of forest credits in A/R projects under the SBSTA. Proposals were submitted by different countries (UNFCCC, 2012b; 2013a; 2013b), but the discussion is also stagnant. Some suggestions mention approaches that have already been adopted in the voluntary carbon market, such as the use of insurance mechanisms and the creation of *buffers. Buffers* are usually a reserve consisting of part of the forest credits – not issued/sold in the market – attributable to a project, which can be used to cover the cases of losses in carbon stocks.. The proportions of this reserve vary according to the risk of loss of carbon stocks in each project (VCS, 2017).

One approach that seems to make sense is based on the contribution of Dr. Luiz Gylvan Meira Filho, fBrazilian negotiator who co-chaired the negotiating working group of the Kyoto Protocol (Meira Filho, 2016). In general, the approach is based on the natural decay time of the CO_2 in the atmosphere. According to the IPCC (2006), 47% of a certain amount of emitted CO_2 is naturally eliminated from the atmosphere in approximately thirty years and the remaining 53% is eliminated in hundreds and thousands of years. Thus, there may be room for a correlation between the duration of a reforestation activity and the permanence of its respective carbon credit. For example, while a certain reforested area reaches a longevity of 30 years, almost half of the credits generated in that area (47%) can be considered permanent, since during that period an equivalent amount of CO_2 will have already decayed, that its, will no longer be affecting the atmosphere.

Finally, another relevant aspect, defended by the author, may be consider as permanent the carbon stored in the roots of planted trees, in combination with other approaches for the other reservoirs of forest biomass. Very rarely, there is risk of root withdrawal, and even when the tree is harvested or destroyed, much of the carbon in its roots is fixed to the ground. Studies based on destructive samples may serve as the basis for the proportion of permanence factors. The literature indicates that the volume is significant, and may represent up to 27% of the total carbon stored in the live biomass of the trees (Scolforo, Oliveira and Acerbi Júnior, 2008; Brazil, 2016; IPCC, 2006).

Author's elaboration.

For sellers, forest credits represented an opportunity to stimulate mitigation and sustainable development actions associated with the land-use and forest sector. This sector often deals with structural factors that hinder access to capital, including long term investment maturity periods for reforestation or restoration.[17] However, a potential win-win relationship has not been fully exploited due to several supply-side barriers and, especially, demand-side barriers, which will be dealt with in the next sections, together with the possibilities for future use of the mechanism.

2.3 Contribution to sustainable development

It is important to recall that in addition to the mitigation objective (to help Annex 1 countries achieve their emission reduction targets), the CDM was also created with the objective of contributing to sustainable development in developing countries, according to Art. 12 of the Kyoto Protocol. The regulatory process of this double objective was quite asymmetric. The regulation of the mitigation objective is subordinated to a complex multilateral regulatory process by consensus, as shown in previous items. However, due to the difficulty of giving up national sovereignty to define what is a "contribution to sustainable development", the regulation of the second objective of the CDM was left to each country and was subject to the most diverse interpretations, with different levels of rigor (Cosbey et al., 2006; Olhoff et al., 2005; Olsen and Fenhann, 2006; UNDP, 2006).[18] According to Resolution No. 1 of the CIMGC (Brazil, 2003), Brazil has adopted the following criteria to evaluate the contribution of CDM projects to sustainable development:

- local environmental sustainability;
- development of work conditions and net job generation;
- income distribution;
- training and technological development; and
- regional integration and liaison with other countries.

17. As the CDM regulation makes no distinction about the purpose of the reforestation activity, within the scope of this chapter, the term "restoration" is used to characterize the *reforestation with the main objective of restoring the various types of conservation areas*. That is, the term falls within the CDM definition of reforestation, but is used only to denote a specific type of activity.

18. It is easier to understand this discrepancy in the light of the main objective of the Climate Convention: the stabilization of the GHG concentration in the atmosphere. The fact that a project does not generate other benefits besides emission reduction does not represent demerit per se, as long as its potential negative impacts are adequately addressed. It is very common to hear in multilateral negotiations that the CDM cannot be required to carry with it the obligation to solve other environmental or socioeconomic problems, despite the recognition that the solution of the problem involves the restructuring of a new economy.

The criteria apply to any type of project. However, it can be said that there is a relatively greater sensitivity regarding the contribution of A/R projects to sustainable development, since there is a direct relationship with the following themes: land aspects and rural development, deforestation processes and forest policies, biodiversity, water resources, etc. A simplified comparison between an A/R project and a project aimed only at burning industrial gases illustrates the difference in terms of impact on sustainable development, since the second case may not generate significant changes beyond the destruction of gas. Several authors confirm this perception in works that evaluate the potential contribution to the sustainable development of forestry projects in relation to other types of projects (Olsen and Fenhann, 2006; UNDP, 2006; Olhof et al., 2005; Cosbey et al., 2006). This can also be considered one of the aspects that differentiate the forest scope in relation to the other CDM projects.

3 THE BRAZILIAN EXPERIENCE: CONDITIONS AND IMPACTS

Due to the diverse specificities applicable to the forestry scope, an analysis of Brazil's experience is likely to be more relevant if it also deals with qualitative aspects, which go beyond the implicit quantitative impact – number of projects or quantities of GHG removals. This section addresses the Brazilian experience, based on a broader context and weighted by the main aspects that have conditioned the *demand* for forestry credits and the capacity to *supply* A/R projects.

3.1 The demand side

According to the UNFCCC[19] over 7.7 thousand CDM projects had been approved worldwide by June 2017. Out of these, only 66 projects, or less than 1% of the total, are forestry projects, three of which are Brazilian. Although forestry CDM, may include specificities that do not exist in other types of projects, e.g. area eligibility restrictions and non-permanence treatment, the complexity level of the other CDM scopes is also quite high. Such a significant difference in relation to other CDM projects (66 out of 7.7 thousand) does not seem to be attributable only to the marginal operational complexity of the forestry scope in relation to other types of projects.

One of the hypothesis that seems to make more sense to explain this discrepancy is related to the existence of barriers on the demand side for forestry credits. These barriers appear to be predominant in relation to barriers on the supply side, herein defined as those barriers to the operational capacity of the projects.

19. Data available at: www.cdm.unfccc.int by June 19th, 2017.

It is worth highlighting four major barriers on the demand side that have strongly restricted the role of forest CDM in Brazil and other countries.

The first came with the creation of the forest CDM. An overly strict limit was set for the use of forest credits (tCERs or lCERs) to meet Annex 1 countries' reduction targets under the Kyoto Protocol: 1% per year during each commitment period, i.e., in the first commitment period, from 2008 to 2012, the total limit would be restricted to 1% multiplied by five years.

The second, and certainly the most impacting, since these limits were not even reached, was the exclusion of the use of forestry credits in some domestic markets for carbon credits (cap and trade systems), especially in Europe. Forest credits were banned from the European Emissions Trading Scheme (EU-ETS),[20] which regulated emissions from private organizations and was linked to the CDM carbon market. Without the United States in the Kyoto Protocol, Europe was the main driver for CDM credits, followed by Japan and Canada (Kossoy et al., 2015). Therefore, forest credits were excluded from the largest source of demand, although some European governments used modest amounts of forest credits.

The third barrier is exogenous, unpredictable and only affected the market later: the general effects of the 2008 global economic crisis. Together with regulatory uncertainty over the post-2012 Kyoto Protocol negotiations, the crisis has impacted the carbon market, reducing overall demand (Niblock and Harrison, 2011; Harvey, 2012; Climate..., 2011). This effect, coupled with the modest targets of Annex 1 countries during the first commitment period (averaging 5.2% below 1990 levels), contributed to the plunge in CDM credit prices and other types of credits under the Kyoto Protocol (graph 4).

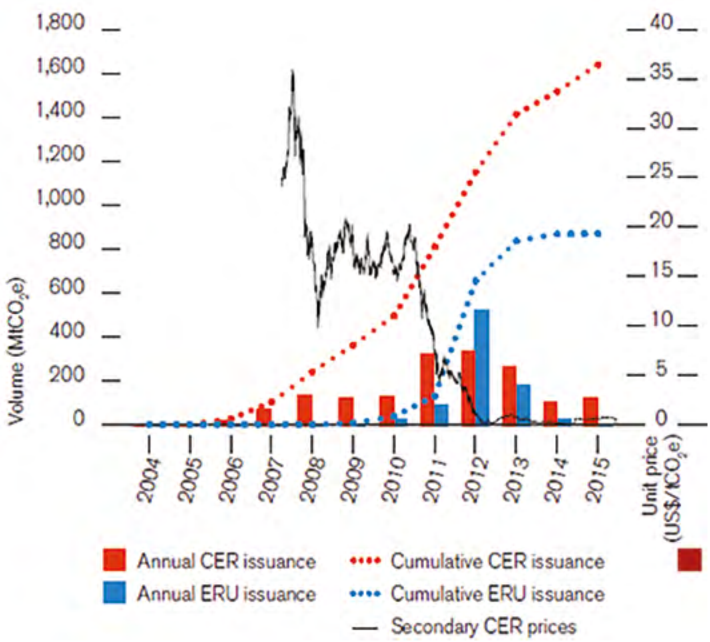
In the second commitment period of the Kyoto Protocol (2012-2020), Europe would still place a fourth barrier to the CDM, which would restrict the use of credits only to those generated in the least developed countries, hence excluding all emerging economies, like China, India, Brazil, South Africa and others. Even before this barrier, demand for credits had declined sharply, and prices were already low, falling from EUR10/CER to below EUR1/CER between 2010 and 2012.[21] The marginal contribution of this barrier to market collapse

20. European Union – Emissions Trading Scheme. Available at: https://bit.ly/2Myu5Dy. Although there are few formal justifications for such a restriction, the main arguments used in international negotiations are generally related to the timing of claims and who are responsible for the repayment of claims (governments, buying and selling companies).

21. Refer to the *secondary CER prices* curve in graph 4.

may be questionable, since the market was already falling. But its qualitative impact may have been significant, having conveyed a strong political message that, irrespective of market dynamics, Europe would not accept credits from emerging economies. It is a measure that structurally affects the formation of expectations by market players and incentives for mitigation in developing countries. There is also a certain "moral hazard," because entrepreneurs who backed investment decisions in multilateral rules agreed upon by all countries – including those that later banned credits from emerging countries and forest credits from their private systems – did not count on second thoughts on something that had already been agreed . If aspects such as these are not addressed in negotiations on future mechanisms, they may become aa relevant element of uncertainty and a discouraging factor.

GRAPH 4
Volumes issued and prices variation of CDM and JI projects



Source: World Bank, Ecofys e Vivid Economics (2016, p. 38).
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

To date, CDM credit supply has been at levels well above the regulatory demand determined by the modest Kyoto target (World Bank, Ecofys e Vivid Economics, 2016; Kossoy et al., 2015; Warnecke, Day e Tewari, 2015)[22] which, in turn, was further significantly decreased by the other barriers presented above. The term “over-supply” has been widely used. However, “sub-dmeand is likely to be the most appropriate term,, since the constraints seem to have come from the demand side. If this effect is highly impacting for CDM projects as a whole, the chances of a possible improvement in short-term demand for forest credits would be lower. For a recovery, there is a need for new sources of demand, which could come from more ambitious targets or an end to unilateral restrictions on forest credits. “Developed countries committed to reducing GHG emissions should stop banning CDM A/R project credits in their bilateral/multilateral emissions trading systems” (World Bank, 2011, p. 15).

In addition to the end of unilateral barriers, an alternative with a potential immediate effect on demand would be the explicit permission, by a formal decision of the Conference of the Parties of the UNFCCC or at the domestic level, by Brazil itself, that credits generated in the pre-2020 period be accepted for compliance in the post-2020 period. Under the Paris Agreement, the level of ambition for mitigation is substantially higher than it was in Kyoto, although it is more heterogeneous.

Another possibility, which could be developed as part of the regulation of the new market-based mechanism provided for in Art. 6.4 of the Agreement, is the creation of a system to absorb exogenous shocks, such as the effect of economic crises on the market, or even endogenous shocks, as potential errors in the allocation of emission quotas in carbon markets. The European Union, for example, has created a relevant system, namely the Market Stability Reserve (MSR), which will take effect from January 2019, to manage possible excesses in the amount of credits available in its cap and trade system.[23] A similar rationale could be applied to the CDM market or to its successor mechanism, interconnected or not with domestic carbon pricing schemes (see section 4).

22. Warnecke, Day and Tewari (2015) make an interesting analysis of the recovery potential of the market with prices at EUR2, EUR5 and above EUR5 / CER, indicating that for the band above EUR5 there could be a substantial chance of decreasing the deficit between demand and offer. The authors also highlight the role of the price crisis in the project's ability to generate credits, suggesting that current analyzes may be overestimating the potential for effective credit generation by 2020.

23. In general, the MSR allows for the creation of a credit reserve, which is supplied by credit withdrawals from the market, when it reaches a maximum level established by the regulator, and by the injection of credits in the market, when it reaches an established minimum level by the regulator. This dynamic, similar to that of a regulatory stock, enables price adjustments in the event of external shocks or possible internal failures. For more information on MSR, go to: https://goo.gl/i47waV.

Finally, there is also an initiative proposed by Brazil, already under implementation under the framework of the UNFCCC, which aims to promote the voluntary cancellation of credits generated in the CDM for several purposes, besides the fulfillment of official commitments – for example, offsetting of emissions of major events and economic activities in general. For now, the level of demand is still at very low levels to generate any immediate impact in prices on a significant scale. Nonetheless, the initiative has created a relevant official link between the multilateral CDM market and the voluntary market for emission reductions. It can open the door to innovative practices of private agents seeking multilateral legitimacy for their actions.

BOX 3
Forestry credits: different technical criteria or climate protectionism?

In World Trade Organization (WTO) negotiations, disputes between countries, regarding potentially protectionist practices, are very common. Commercial disputes often clash developed and developing countries. A classic example is the criticism posed by Brazil and other developing countries about restrictions on agricultural markets. On the other hand, developed countries often question restrictions on service markets or certain types of industrial policy in developing countries, even though developed countries have resorted to similar instruments in other times (Chang, 2003).

Practical and regulatory experience with the forestry CDM suggests that there may be a similar situation with regard to the multilateral regulation of carbon markets under the UNFCCC. The CDM's forestry scope has been subject to strong demand constraints, although: *i)* The Kyoto Protocol requires countries to account for the removals generated by reforestation, including for compliance with emission reduction commitments; and *ii)* the CDM has been approved by all countries. On the basis of the risk of "non-permanence" of forest credits and the difficulty of dealing with responsibility for the replacement of (temporary) credits, its use has already been restricted by a strict quota – 1% per year multiplied by the number of years in the commitment period. Even after the adoption of such a stringent multilateral regulation, some countries, especially in Europe, have banned forest credits from their domestic carbon markets (EU-ETS), which have been linked to the Kyoto Protocol Market.

Later in the regime's history, regulations for the inclusion of carbon capture and storage (CCS) activities in the CDM began, which may allow the generation of credits by injecting CO_2 into former oil reservoirs. Indeed, the referred carbon storage occurs through processes other than forest photosynthesis. Nonetheless, there is a risk of non-permanence, albeit in a different way. For the time being, there is no indication that such credits will be temporary or banned from other carbon trading systems. Although technically distinct processes, these measures represent, in some way, asymmetries to the treatment of different mitigation technologies. Coincidentally or not, the potential of using forestry practices as a tool for mitigation and sustainable development is much more relevant for developing countries, in light of their soil and climatic characteristics.

In fact, the biogenic nature of forest carbon demands additional precautions, considering several factors, including the risk of non-permanence. But these issues were dealt with in the regime, and there seem to be important alternatives. In this context, the extent to which differences in technical treatment do not result from a kind of "climate protectionism" to technologies and mitigation practices, which are more applicable to certain groups of countries, seems to deserve additional research efforts.

Author's elaboration.

3.2 The supply side

In general, the CDM has always been criticized for regulatory complexity and other aspects that go beyond this chapter.[24] As mentioned earlier, to a certain extent, it is normal for trade-offs to exist between the regulatory rigor, the scope, and the effectiveness of the mechanism. Much of the complexity is attributable to the need to ensure environmental integrity, i.e. the need for emissions reductions or removals to be real enough, so that they can be fungible with quantitative mitigation targets.

In fact, the logic of the mechanism is based on the attempt to "prove" *additionality* in relation to what would occur *in the absence of the project*. For the sake of logic, achieving the so-called "absolute certainty" about something that will occur in the future is not possible. There will always be room for discussion about how far regulatory rigor should go, especially regarding additionality. However, the fact that there are difficulties and scope for imperfections does not mean that relevant results cannot be achieved. Some authors, such as Trextler (2007), offer interesting perspectives for understanding this challenge and the usefulness of market-based mechanisms such as CDM.

> There is a well-understood axiom in the statistics that one cannot simultaneously minimize false positives and false negatives. However, false positives and false negatives can be handled in a manner that is conducive to the advancement of the main public policy objectives associated with the market (Trextler, 2007, p. 83).

In addition, the process of generating certified emission reductions is also known as a having a significant level of sophistication, which aims to ensure the accountability of the system as a whole. This is done through public consultations for each project, at local and global level, various independent audits, from the validation to verification phase, as well as several internal checks, within the CDM Executive Board and its various subsidiary bodies and panels.

The complexity of regulation is therefore a natural constraint on the ability to supply credit, provided there is a continuous improvement effort. There are specific challenges that have a direct impact on the CDM's forestry scope. One of the most structural aspects refers to the long-term nature of A/R projects compared to other types. Even in the case of using fast growing species under optimized edaphoclimatic conditions, such as the case of eucalyptus in Brazil, the first harvest takes approximately seven years, a short period for world standards, but a significant one for developing countries with less favorable financing conditions. In forest restoration activities, the maturity time is even longer, and may exceed twenty years.

24. Caney and Hepburnb (2011) make a counterpoint between criticism of ethics and the functioning of carbon markets. Repetto (2001) criticizes institutional complexity early in the mechanism.

The long-term nature that is inherent to forestry activity magnifies the CDM regulatory challenge for project developers, as it makes projects relatively more impacted by fluctuations in the carbon market, the difficulty in obtaining financing, and especially the risks of institutional and regulatory instability of a mechanism such as the CDM. For example, A/R projects that may have credit periods of twenty to sixty years have to cope with changes in rules and with the transition between broader frameworks, such as the process that will begin to occur in the transition from the Kyoto Protocol to the Paris Agreement, even if they had the right to generate credits in the long-term, as previously approved.[25]

The World Bank, via its BioCarbon Fund, commissioned what may be the most -comprehensive study on the experience of CDM forestry projects (World Bank, 2011). The analysis encompassed sixteen countries and almost one-third (21) of all 66 projects already registered. In addition to highlighting the demand-side barriers, especially the impacts of non-permanence treatment as a structural obstacle (discussed in the previous section), the study identified several barriers that have contributed to the underutilization of the mechanism. Some of the main obstacles raised in the study are highlighted and summarized below, with supplements applicable to Brazil, based on the author's practical experience.

- Land eligibility criteria: as explained in section 2, only those lands that did not contain forest fifty years ago or on December 31st, 1989 can be used for A/R projects. According to the study, many areas in developing countries were deforested in the 1990s, which limits the applicability of the forest CDM with direct impacts in Brazil (box 1).
- Difficulties in meeting project boundary criteria: even with advances in remote sensing techniques, project developers have difficulty meeting requirements for setting project boundaries. There is some regulatory flexibility, which allows project participants to demonstrate control over only two-thirds of the area at the beginning of the project. But the total limit of the project must be defined in the validation phase, which still results in a short period of time to find all of the required area.. This point may have been partially resolved by the program of activities (PoA) approach, in which specific areas can be incorporated over time. There are still few concrete cases to be asessed.
- Rigor in the accounting rules of carbon flows versus field reality: the operationalization of accounting rules and monitoring of carbon flows

25. The European Union, for example, mentioned in a position paper submitted recently in the negotiating process that the CDM should not continue beyond 2020, but that there should be significant discussions on transitional arrangements under Art. 6.4, while pointing out that concepts such as "additionality" and "environmental integrity" should be part of the key elements. For more information, access: https://bit.ly/2tEBBWq.

goes beyond the routine of forest operations. Even with the support of external consultants, it is not easy to implement. The study also points out difficulties in complying with specific rules to estimate the emissions of activity displacement of an A/R project (leakage). Finally, the lack of specific scientific data for developing countries often results in the suboptimization of a project´s mitigation potential. For example, in the absence of local data, projects should be based on factors of the Intergovernmental Panel on Climate Change (IPCC), which, by conservatism, end up representing lesser amounts of carbon stocks. In the case of Brazil, none of the three registered projects computes the potential gains from additional carbon stocks in pools such as soil or litter, which illustrates the challenge.

- Transaction and financing costs: the various barriers and elements of uncertainty associated with the forest scope make it the scope with higher transaction costs compared to the others (greater than USD1/ tCO_2e and according to the study). The difficulty in accessing adequate funding for the long-term reality of the forestry sector is also part of this context. Another aggravating factor is that the current CDM regulation allows only one verification and therefore a single issuance of credits during each commitment period (in the case of the Kyoto Protocol, the first was five years, from 2008 to 2012, and the second, from eight years, from 2012 to 2020). This restricts the ability to periodically generate revenue for a cash flow that is already heavily affected by the long term nature of the investment.
- Excessive rigor for framing small-scale cases: even under the special rules for small-scale cases, the study indicates that the maximum value (removals of 16,000 tCO_2e/year – UNFCCC, 2005a) is still too low to allow the engagement of smaller-scale producers. This aspect also seems to affect the specific potential in Brazil, since the current CIMGC rules for small-scale projects have determined a stricter maximum income criterion than the conditions defined in the National Program for Strengthening Family Farming (Pronaf) (Brazil, 2006). There are proposals to improve this criterion.[26]

In the same study (World Bank, 2011), there are a number of recommendations for adjustments to the mechanism in terms of regulation, financing, capacity building, and demand restraint. Suggestions include measures such as: standardization of baselines (which was later allowed) and consideration of broader national

26. Personal exchange with the Ministry of Science, Technology, Innovations and Communications, and the Ministry of the Environment in 2017.

and sectoral contexts to facilitate the demonstration of additionality, alternative approaches to the treatment of non-permanence to improve credit fungibility (in addition to the end of demand constraints by developed countries), monetization of the co-benefits of sustainable development as a means of improving access to financial resources, allowing more than one verification per commitment period, increasing the process of simplification and consolidation methodologies, promoting interfaces with other land use activities such as REDD+ and the agriculture sector, improving the capacity of DOEs and national organizations responsible for managing the mechanism at the domestic level (Nationally Designated Authority), improving communication with the Executive Board, etc.

In such a broad regulatory and political universe, it should be recognized that the system has also been able to improve itself in some significant aspects. These improvements can serve as a basis for a fair transition and a potential extension of the mechanism in the post-2020 context, marked by the Paris Agreement. In addition to the possibility of standardization of baselines, the process of consolidation and simplification of forest project methodologies deserves to be highlighted. The CDM Executive Board has succeeded in approving more than 15 A/R project methodologies, applicable to different realities around the world, and then consolidating them into four, two large-scale and two small-scale (UNFCCC, 2013c; 2013d; 2013e; 2013f). Another important aspect, and perhaps the one with the greatest impact, was the creation of the PoA system (UNFCCC, 2005d), analogous to an umbrella approach, in which each project component (in the case of forestry, different areas) can be incorporated in a single management structure and under specific methodologies, over time, with the possibility of sampling verification procedures. The logic of the PoA, although incipient in the forest scope, may represent a bridge in the transition from the CDM to the new mechanism, provided for in Art. 6.4 of the Paris Agreement, and to interface with wider instruments (section 4).

3.3 Impacts on Brazil

Brazil has generated significant amounts of emission reductions certified by the CDM during the first commitment period of the Kyoto Protocol (2008 to 2012). In all project scopes, more than 88.6 million tCO_2e have been reduced in this period, of which 4.2 million came from forestry projects (Brazil, 2014), or 4.8% of the total. Considering the various constraints of demand and the fact that only three projects have been registered in the country, this is a relevant value. It shows the mitigation potencial of A/R activities and also the potential for future use by Brazil as a forestry country.

It was from two forestry projects developed in Brazil that a good part of the main elements of the four forest methodologies currently in force in the CDM (UNFCCC, 2013c; 2013d; 2013e; 2013f) was generated. In the first case (The Plantar Project– box 4), the methodological elements associated to reforestation for multiple economic purposes were created and the first forest credits (tCERs) in the world were issued. The other case (AES Tietê – box 5) generated the methodological elements associated with reforestation activities for the restoration of of conservation areas (for example, permanent preservation or legal reserve areas). The third A/R project in Brazil was developed by Vale, already based on previous methodologies, with relevant mitigation potential in northern Brazil (Vale Florestar, 2012).[27]

In the cases of Plantar and AES Tietê, pioneers in reforestation and for production and restoration purposes, respectively, the development of projects was based on different levels of partnership with Carbon Funds managed by the World Bank, which were also innovative in the world. In addition to the development of methodologies by the diverse teams and the first contracts in the world for the transaction of official forest credits, the projects made possible the application of socio-environmental parameters, often more stringent than Brazilian regulations – for example, in the Plantar case, the FSC (Forest Stewarship Council) certification and, in the case of AES Tietê, the acceleration of the process of restoration of permanent preservation areas (APPs). That is, the monetization of carbon allowed the incorporation of other important variables for sustainable development, including the level of accountability of the activities.

Throughout the process, both projects were approved, despite numerous barriers and difficulties inherent to innovation at various levels (operational, management and multilateral regulation). In practice, both transactions also represented the overcoming of the demand constraints in the market, since the commercial conditions with the funds, including the price of the credit, were set at the beginning of the process.

In the case of Plantar, the arrangement with the World Bank allowed the company to be partially free of the CDM regulatory risk in the initial moments. Since the project was a pioneer in the country and the CDM rules were developed in parallel to its implementation, the funds managed by the bank would honor the commercial commitment to purchase the credits even if they were not approved by the UNFCCC. The guarantee against regulatory risk, beyond the control of the project managers, has generated sufficient confidence in the developers to create and maintain a long-term commitment.

27. This project is under a process of change of control, which is why it was not included in the analysis.

The operation with the World Bank also created an innovative institutional arrangement in the world financial market: the securitization of receivables, based on carbon trading. This operation made it possible to anticipate future revenue from credits, the main part of which would only be generated after seven years (harvest of the first plantations). Rabobank, a Dutch financial institution, anticipated, through a loan agreement, the proceeds that would be generated from the sale of the credits, and accepted the contract with the World Bank as part of the collaterals of the operation. As a result, credit risk was also associated with the World Bank-managed fund and not only with Plantar (a family-owned company). As a result, the financial spread has decreased, being a decisive factor to enable lower interest rates.

BOX 4
The case of the Plantar Group

The Plantar Group's CDM projects were pioneer in the country and began to be implemented in 2000 in partnership with the World Bank Carbon Prototype Fund. The initiative illustrates an example of vertical synergy along the forest production chain, with three mitigation drivers: *i)* generation of net removals or additional carbon stocks through reforestation of non-forested areas (Plantar, 2009); *ii)* reduction of methane (CH_4) emissions in the charcoal production process (Plantar, 2007); and *iii)* emission reductions in blast furnaces with the additional use of renewable charcoal instead of coal coke (Plantar, 2016, Sampaio et al 1999). Approximately 23,000 hectares of planted forests (eucalyptus) have been established, capable of supplying renewable charcoal for the annual production of approximately 240,000 tons of pig iron. The project also includes the conservation of approximately 9,000 hectares of native vegetation, through permanent preservation areas (APPs) and legal reserves associated with plantations. The carbon stocks in these areas are not part of the project's generation of credits. Through the CDM, the company became the first in its industry to base all of its pig iron production on renewable charcoal.

The projects were created on an integrated basis, but due to the evolution of the CDM regulatory framework, they had to be split into three – one for each mitigation activity. One of the important elements of this separation was precisely the differentiation of forest credits – attributable to the reforestation activities of the project – whose modalities and procedures were only ready at COP 9 in Milan, 2003. Over ten years, the project team developed three methodologies approved by the UNFCCC - methodologies A/R AM0005, AM0041 and AM0082 - which allowed for the incorporation of the three abovementioned mitigation vectors into the CDM..

Despite several barriers and elements of complexity, there was significant technological progress, which resulted from the project. For example, due to the possibility of generating carbon credits, the company developed customized research for the improvement of renewable charcoal production technology. The result of the work established, for the first time in the world, a negative correlation between methane emissions and the gravimetric yield of the carbonization process. Through process control, especially of temperature and new furnaces, it was possible to develop a method to reduce emissions. In addition to being transformed into a globally applicable methodology, there were important impacts for the elaboration and diffusion of public policies associated with charcoal in Brazil (see section 4 for an example: sustainable iron & steel program).

The project also generated a pioneering financial arrangement in the world, through the securitization of receivables backed by carbon credits, in partnership with Rabobank. Under the CDM and the partnership with the World Bank, a number of sustainable development criteria have been incorporated into production, anchored in the bank's safeguards and in the a globally recognized forest certification systems, consisting of hundreds of civil society organizations (FSCs). It was also the first case of forest certification in the independent pig iron sector. These criteria include: identification and monitoring of fauna and flora to conserve and increase local biodiversity; implementation of native forest ecological corridors between eucalyptus plantations, monitoring of physical, chemical and biological aspects of water resources; and social variables, in order to improve local impacts and interaction with communities. In fact, Plantar is, until today, the only company in the independent pig iron producer in Brazil and in the world that counts on this certification. Although not a requirement of the CDM, it was enabled by the mechanism, as it was incorporated into the arrangement with the World Bank.

There is good potential for replication in Brazil and the world, not only in terms of mitigation, but also in terms of sustainability criteria. In general, despite the advanced Brazilian forestry technology, the use of renewable charcoal is more complex than fossil-based alternatives, which increases the importance of monetary recognition for the climate benefit.

After 28 years, the projects are expected to contribute to reducing the GHG concentration in the atmosphere by approximately 12.8 million tCO_2e. By 2017, approximately 5 million credits related to removals in the forestry component and to emission reductions in the blast furnace had already been successfully generated.

Author's elaboration.

In the case of AES Tietê, an Emission Reduction Purchase Agreement was signed with the World Bank Fund, providing for the purchase of carbon credits as a consequence of the first verification carried out by the DOE, which was partially subsidized by the bank. The value of each tCER was kept even after a revision of the Project Design Document had to be conducted as part of the monitoring process under thefirst verification period. The costs of this process were originally borne by the bank. At the time of the settlement of the tCERs, the values referring to the issuance fees, charged by the UNFCCC, as well as the costs with the DOE were discounted.

One of the highlights of the project was the dissemination of scientific knowledge. Due to pioneer generation or carbon credits, through forest restoration with a high variety of species, the project mobilized researchers internally and externally. Different academic organizations have been involved, with the purpose of subsidizing the process of generation, monitoring and verification of net GHG removals.[28] The AES Tietê case also illustrated the potential for synergies between the CDM and legal provisions, since the mechanism served as an instrument to facilitate and accelerate the implementation of legislation applicable to the restoration of PPAs at the time.[29]

28. Personal communication with AES Tietê (2017).

29. See Manfrinato et al. (2005) for further discussion on the CDM interface, including additionality criteria, with legal instruments related to Permanent Preservation Areas and legal reserve areas. The discussion may also be applicable to the current context, under the new Brazilian Forest Code, which already provides for the possibility of using market-based mechanisms. Section 4 of this chapter explores the basis for an expanded CDM potential in the future, considering several aspects.

BOX 5
The AES Tietê case

The AES Tietê project aims at restoring, via reforestation, some 5.6 mil hectares of Permanent Preservation Areas, distributed along the banks of ten hydroelectric reservoirs located in the Tietê, Grande and Pardo rivers in the states of São Paulo and Minas Gerais. It is also a pioneer effort in the CDM, especially in relation to the use of native species to recover and accelerate the rate of reforestation of Permanent Preservation Areas.

Project implementation began in 2004. In twenty years, the project is expected to restore riparian forests similar to the previously existing native forests along the riverbanks of the regions, removing approximately 4 million tons of CO_2 from the atmosphere. The project includes the planting of 11 million seedlings of over 80 different species, treated in the company's seed bank. By the end of 2016, over 2,000 hectares had already been reforested under the CDM and approximately 167,000 tCERs issued and transacted with the World Bank's BioCarbon Fund.

In addition to the generation of net CO_2 removals, the project created biodiversity corridors to interconnect remaining habitat areas of the original fauna. Another possible additional benefit is the reduction of the risks of silting rivers and subsequent loading of toxic substances into the waters. The project was also developed in an integrated way to the company's strategy to mitigate the risks of irregular occupations of reservoir banks areas, and generated new parameters of interaction with local riverside communities.

As in the case of the Plantar Group, AES Tietê also had to develop an A/R methodology applicable to the case (AR/AM 0010), generating an innovative regulatory base. The potential for replication in Brazil is significant. In addition to the possibility of adding value to an already renewable energy source, such as hydroelectricity, AES Tietê has opened up the possibility of using the CDM for the recovery of Permanent Preservation Areas and legal reserve areas in several production chains. All this becomes even more relevant in the current context of implementation of the new Forest Code and the Brazilian NDC.

Author's elaboration, based on AES Tietê (2009) and AES Tietê (2012).

In practical terms, these innovative Brazilian initiatives contributed for pricing the climate variable in the forest scope,for the first time, , under the global legitimacy of the UNFCCC multilateral system, a central element for fair solutions to a major collective action problem such as climate change (see Ostrom, 1990).

Although an in-depth analysis of the performance of each project goes beyond the scope of this work, it can be said that in both cases the experience was broader than the technical aspects of the creation of methodologies and regulation of forest carbon credits. New parameters were generated for the interface with global funds, under the seal of international organizations, as well as new economic, financial and contractual arrangements, and the incorporation of other socio-environmental variables in the production process.

Even in the context of strong restrictions on the demand side, the cases illustrate the main legacy of the forest CDM in Brazil: the *lato sensu* institutional development (methodological, technological, economic and diverse co-benefits) capable of generating incentives for cooperation in mitigation actions, as well as for the internalization of the carbon value in forest investment decisions, despite all the complexity involved (North, 1990; Laffont and Martmort, 2002).

4 BASIS FOR AN ENCHANCED POTENTIAL

Since the adoption of the Paris Agreement in 2015, the multilateral climate change regime has been going through a transitional period that tends to have profound implications at the international and national levels and, of course, for the CDM.

One of the most relevant aspects was the change in the rationale of national mitigation commitments. Unlike the Kyoto Protocol, where a common metric – a percentage of specific emissions reduction in relation to the base year 1990 – was established in the text of the agreement for each Annex 1 country – top-down approach – the Paris Agreement was based on a bottom-up rationale, in which all countries committed themselves to establishing their own commitment through Nationally Determined Contributions (NDCs). This opens up scope for greater heterogeneity and therefore for more flexible interaction between the Paris Agreement regulation and the various national mitigation policies/instruments.

In this context, it is possible to identify three structural elements that seem to strongly influence the potential for future use of the forest CDM experience in Brazil and even in other countries: *i)* the interface with carbon pricing instruments, whether through the transition to a new mechanism in the Paris Agreement, or the relationship with national systems; *ii)* interface with national policies and other instruments; and *iii)* the interface with other sustainable development topics.

4.1 Interface with new carbon pricing instruments

The Paris Agreement provides for the creation of a new market mechanism under Art. 6.4, which may assist in the implementation of NDCs. It was determined that existing mechanisms should be taken as the basis – defined by the CDM. The Brazilian delegation has called this new mechanism Sustainable Development Mechanism (SDM). In the transition from the CDM to the SDM, there may be scope to address the constraining factors of the forest CDM, at the level of supply/operationalization of the mechanism, and especially at the level of demand, which has been strongly influenced by political factors, as explored in the previous section. Outside the scope of the Paris Agreement, but still at the multilateral level, the recently approved market mechanism for the civil aviation sector provides for the possibility of using the CDM.[30] Depending on further regulations, this could generate some type of demand.

30. Carbon Offsetting and Reduction Scheme for International Aviation (Corsia) within the framework of the Inter-American Civil Aviation Organization.

In this context, several countries are already developing or studying – in the case of Brazil – domestic carbon pricing systems, which include carbon markets (cap and trade schemes)and/or carbon taxation.[31] The methodological and institutional experience of the CDM can contribute through the following possibilities:

1) The direct incorporation of net removals in an eventual national carbon pricing system. In the case of a direct link between the generation of removals and the regulated sectors, the removals can be recorded in the net balance – emissions minus removals – of the participating organizations.

2) The indirect incorporation, since net removals, generated by reforestation and restoration activities outside the scope eventually covered by the pricing system, can also be treated as offsets – fungible credits with system units, which could be used to offset emissions of its participants.

In addition to providing several institutional elements for a potential Brazilian carbon pricing system, the transition from the CDM to the SDM can also be an opportunity for direct or indirect interconnections between the various pricing systems in other countries, under the multilateral legitimacy of the United Nations (UN).

Today, domestic pricing systems already cover nearly 25% of global emissions if considered developing systems in China (World Bank, Ecofys and Vivid Economics, 2016). Each domestic system can have different characteristics. But because the SDM will have multilaterally accepted rules and can be interconnected to domestic systems, depending on the interest of each country, the mechanism could also represent a global link, albeit partial or indirect. A very recent example of this possibility is the new carbon tax decree in Colombia, which allows for the use of CDM credits to meet tax obligations (Colombia, 2017). In China and South Africa, there are ongoing experiences using the CDM experience in carbon pricing systems, including forestry sector (South Africa, 2016; Hamrick and Gallant, 2017).

31. In general, in the case of taxation, the government determines the price of carbon – the value of the tax – and the volume of emission reductions results from the dynamics of regulated organizations. In cap and trade systems, the government determines the amount of emission reduction through an emissions cap, and price is determined by market dynamics (Goulder and Schein, 2013; Icap and PMR, 2016).

4.2 Interface with mitigation instruments and policies

It is common knowledge that there is no single instrument capable of solving the problem of climate change, probably the greatest problem demanding collective action ever faced by mankind. While the CDM represents a significant incentive to reduce emissions, via carbon pricing, there are also natural limitations, in addition to complexity. The literature indicates that the integration of pricing instruments with public policies and broader instruments is a determining factor for the greater mitigation potentials (Prahl, [s.d.]; Mehling et al., 2013; Cecilia2050, 2015; Boasson and Wettestad, 2013).

While the CDM market operated more vigorously in the world and in Brazil until 2011,[32] there have been important cases for which the mechanism contributed to the achievement of national policies. A good example was the consideration of the CDM as one of the instruments for implementing the program to promote alternative sources in the Brazilian electricity sector (Proinfa: Incentive Program for Alternative Energy Sources) and the new electric sector model created in 2004 (Hauser and Medeiros, 2010). Hauser et al. (2015) indicate that the mechanism contributed to a substantial share of the emissions reductions generated in the sector and also to the country's voluntary commitments in the pre-2020 period in the context of nationally appropriate mitigation actions[33] (NAMAs, under the framework of the Copenhagen Accord).

In the forestry sector, despite the methodological evolution and pioneer cases of CDM projects, the same government effort to integrate with public policies was not observed. There is an attempt in the state of Minas Gerais, where the CDM was explicitly integrated with the state's new forest law, but there were still no signs of successful implementation.[34] In fact, Brazil did not develop a cross-cutting policy to promote the use of the mechanism as a mitigation instrument, despite the existence of relatively successful experiences, as in the case of the power sector, and to have created good technical and regulatory capacity through the CIMGC.

However, the Brazilian NDC has been incorporated into national legislation and represents a significant opportunity, as it relies heavily on several mitigation actions, directly and indirectly linked to the forestry sector, including restoration and reforestation activities eligible for the CDM (box 6). It is worth remembering that activities related to land use, including agriculture and forests, represent the main source of net emissions in Brazil (Brazil, 2016a).

32. See an abrupt fall in prices between 2010 and 2012 in graph 4.

33. *Nationally appropriate mitigation actions*.

34. In 2009, local stakeholders from the forestry and steel sector, together with the World Bank, developed a preliminary assessment of a possible CDM program of activities, but the initiative was not implemented, most likely due to the price crisis.

BOX 6
Activities provided for by the Brazilian NDC related to the forestry base[35]

Group 1: mitigation activities mentioned in the Brazilian NDC with direct relation to the generation of net GHG removals through the forest sector:

I) strengthen compliance with the Forest Code at the federal, state and municipal levels;

II) strengthen policies and measures aimed at achieving zero illegal deforestation by 2030 in the Brazilian Amazon and offsetting GHG emissions from legal suppression of vegetation by 2030;

III) restore and reforest 12 million hectares of forest by 2030 for multiple uses;

IV) scale up sustainable forest management systems through georeferencing and traceability systems applicable to native forest management, in order to discourage illegal and unsustainable practices; and

V) In the agricultural sector, strengthen the Low-Carbon Agriculture Plan (ABC Plan) as the main strategy for sustainable development in agriculture, including through the additional restoration of 15 million hectares of pasture degraded by 2030 and 5 million hectares of crop-livestock-forest integration (iLPF) systems by 2030.

Group 2: mitigation activities mentioned in the Brazilian NDC that may be directly related to the generation of GHG emission reductions through the forest sector – for example, use of forest biomass and second-generation biofuels:

VI) to increase the share of sustainable bioenergy in the Brazilian energy mix by approximately 18% by 2030, expanding the consumption of biofuels, increasing the supply of ethanol, including by increasing the share of advanced biofuels (second generation), and increasing the contents of biodiesel in the diesel blend;

VII) in the energy sector, to achieve an estimated 45% share of renewable energy in the energy mix by 2030, including:

- to expand the use of renewable sources, in addition to hydropower, in the total energy mix for a 28 to 33% share by 2030; and
- to expand domestic use of non-fossil energy sources, increasing the share of renewable energy (in addition to hydropower) in the supply of electricity to at least 23% by 2030, including increasing wind, biomass and solar energy.

VIII) in the industrial sector, promote new clean technology standards and expand measures of energy efficiency and low-carbon infrastructure.

Source: Brazil, ([s.d.]).
Author's elaboration.

Given that CDM regulations have allowed the mechanism to be used as a means of implementing policies and legislation, it is natural to assume that this principle would continue to apply to new mechanisms. [36] Thus, when considering: *i)* the role of removals in Brazilian NDC; *ii)* the diversity of policies in the areas of reforestation and restoration; *iii)* the demand for significant resources to implement

35. Indicative activities. Division in groups made at the discretion of the author.

36. In the CDM, the E+ and E-policy regulations made it possible to exclude mitigation policies and measures from the baseline, in order to prevent the CDM from being applicable to emission reduction projects within the scope of their respective policies (regulation of the 22nd Meeting of the CDM Executive Board). Hauser and Medeiros (2010) make a more complete analysis of these regulations. Manfrinato et al. (2005) assess similar situation related to the interface with legal instruments.

them;[37] and *iv)* the urgent need for coordination among these policies, the use of the CDM forest experience and the use of a new mechanism emerge as a relevant means of implementation for the country's full mitigation potential. This is an opportunity that goes well beyond the use of the framework for the measurement, reporting and verification of emissions reduction already included in the CDM methodologies.[38]

In addition to the implementation of the new Forest Code, including the recovery of legal reserve areas and Permanent Preservation Areas through Environmental Regularization Programs[39] and possible synergy with the mechanisms provided for by the Code (especially environmental reserve quotas), there are other important policies that can be optimized through synergies with the mechanism – for example, the National Policy on Planted Forests (PNFP), the Low-Carbon Agriculture Plan (ABC Plan) and the National Plan for the Recovery of Native Vegetation (Planaveg). Even national efforts to combat deforestation (Plan of Action for the Prevention and Control of Deforestation in the Legal Amazon – PPCDAm and Plan of Action for the Prevention and Control of Deforestation and Burnings in the Cerrado – PPCERRADO)[40] can be taken into account. Although they address other types of forest mitigation activity (avoiding deforestation), they also mention the need to create additional wood stocks to reduce pressure on native forests. In this regard, there seems to be good potential for synergies with the National REDD+ Strategy. A clear opportunity is the creation of a reference level (analogous to a baseline in the CDM) for increasing forest carbon stocks under the REDD+ system. This could provide the basis for raising funds for restoration and reforestation activities, at the aggregate level and through results-based payments, even if they do not involve offset markets.

Figure 1 illustrates in a simplified way the design of the main plans, policies and regulatory elements, at national and international level, whose synergy potential can be better utilized, considering the transversal synergies with a market-based mechanism such as the CDM or its successor.[41]

37. One of the studies on the cost of implementing actions related to forest recovery indicates costs that could get to R$ 52 billion (Kishinami and Watanabe Júnior, 2016).

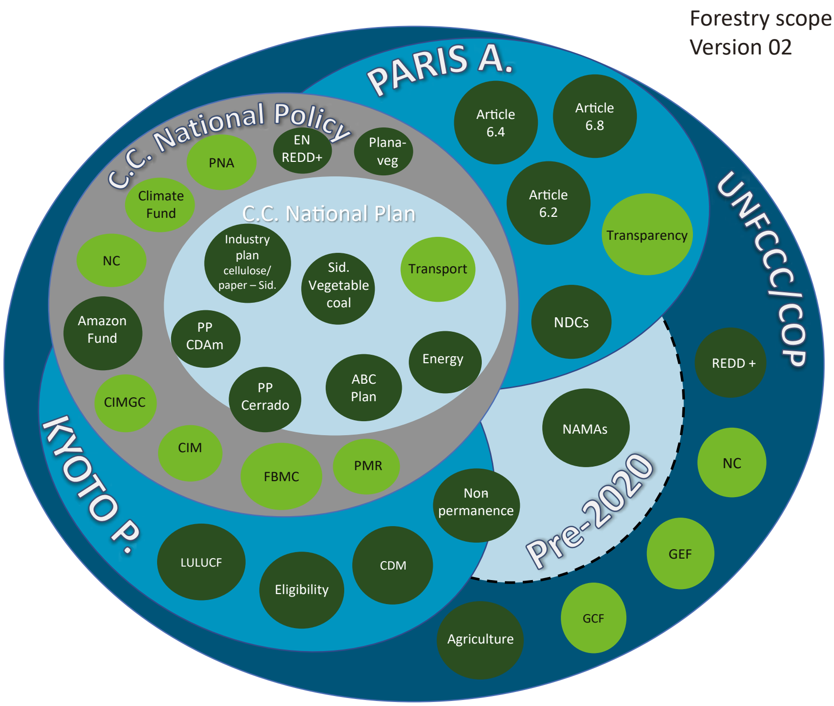
38. Naturally, credits generated by the use of the CDM or the future SDM should be accounted only once. A CDM or SDM project can be carried out in the country, but if the respective credits are sold, the accounting of emission reductions should be carried out only by the agent or country that has acquired the credits, which should not be confused with double counting.

39. The national legislation, through the new Forest Code (Law no. 12.651, of May 25, 2012) already provides for the use of market-based mechanisms, under the terms of Para. 4, of Art. 41: "The maintenance activities of the Permanent Preservation Areas, Legal Reserve and restricted use areas are eligible for any payments or incentives for environmental services, configuring additionality for national and international markets for certified greenhouse gas emission reductions" (Brazil, 2012). This provision is consistent with the use of the CDM or the substitute mechanism.

40. National Plans to fight Deforestation in the Amazon and Cerrado regions (Brazil, 2016b).

41. In addition to the government tools cited in this version of Figure 1, there are a number of civil society governance initiatives in which there is also potential for synergies – for example, corporate reports from the Carbon Disclosure Project (CDP), ISO 14.064 and GHG Protocol, and in some cases voluntary markets, such as the Verified Carbon Standard (VCS).

FIGURE 1
Climate change governance: government policies and instruments[42]



Source: Plantar Carbon.
Preparation: Fábio Marques and Rodrigo Ferreira.

The interface with the previously mentioned policies also represents the potential for *horizontal synergies* between two types of reforestation activities contemplated by the CDM, that is, for economic and restoration purposes. If there is greater demand, these synergies can be explored in scale, for example through the umbrella structure of the program of activities, as explained in section 3.2. In addition, there is the potential for *vertical synergies* between projects along production chains that can generate emission reductions through the use of renewable forest biomass instead of fossil or non-renewable energy products and sources.[43] The Brazilian NDC contemplates several measures in this area.[44] There

42. See in appendix A all the acronyms used in figure 1.

43. In terms of carbon accounting, the two types of climate benefits generated by removals from increased carbon stocks and by emissions reductions generated by the use of forest biomass should be computed separately, according to the rules applicable respectively to the sector of land-use change and forests and the industrial and energy process sectors.

44. See Group 2 activity in box 6.

are also a number of activities, not mentioned explicitly in the NDC, which can be encouraged by the mechanism, in coordination with industrial, energy and transport policies, as described below.

- Examples of activities that are not fully disseminated, but technologically handled: more advanced wood carbonization technologies – conversion of wood to charcoal – which reduce CH_4 emissions; replacement of diesel oil by forest biomass in boilers; technologies for the use of carbonization gases and blast furnace gases for energy cogeneration;[45] independent thermoelectric generation through forest biomass; use of various wood products, including those based on pulp and paper; and use of treated wood in civil and rural construction instead of fossil or non-renewable wood inputs, etc.
- Examples of activities still under technological development: the recovery and use of lignin from pulp production processes; cellulosic ethanol; the best use of black liquor from the industrial processing of wood and the production of bio-oil; and the recovery and refining of the tar from the carbonization process to replace petroleum derivatives, plastics and resins etc.

The design of projects or policies that address removals and emissions reductions by the use of wood and its byproducts throughout production chains may enable several benefits, such as: substantial gains in scale, the development and diffusion of new technologies and improvements in the distribution of value attributable to mitigation along the supply chain. This approach may be especially relevant now that the government has announced the revision of the governance structure related to climate change.

Some policies and initiatives under development indicate that there is room for the best use of vertical synergies. A good example is the Sustainable Iron & Steel Program, implemented by the Federal Government[46] and by the United Nations Development Program (UNDP), based on resources from the Global Environment Facility (GEF), with the support of the Minas Gerais State government. The program aims at promoting alternatives for low-carbon development in the national iron & steel industry, especially in the process of producing charcoal, through payments for mitigation results attributable to corporate investments. The CDM methodological basis has been used as

45. See the Plantar Case (box 6) for an example of vertical synergies and technological development.

46. Technical coordination of the Ministry of the Environment with the Ministry of Industry, Foreign Trade, and Services and the Ministry of Science, Technology, Innovations and Communications. For more information, go to: https://bit.ly/2yXydLw.

a reference for structuring the monitoring process. Another example is the potential for the use of forest biomass as a source of thermoelectric generation. These activities are already included in the Ten-Year Energy Expansion Plan of Brazil (2024), but could be better explored through the energy auctions criteria. There is also the possibility of promoting reforestation activities, in synergy with the potential of hydroelectric generation, as the wood biomass could be treated as a backup for the activation of thermal plants in periods of droughts (Penido e Azevedo, 2016).

It is also important to highlight the interfacing potential with diverse financial instruments, as a cross-cutting measure. In addition to the creation of specific funds related to the financing of mitigation activities – for example, the Climate Fund (Ministry of the Environment/National Bank for Economic and Social Development) – there is a possibility of combining the certified emission reductions (CERs) with other financing mechanisms. The recent green bond market, which reached $118 billion in 2016, is a good example (Climate Bonds Initiative, 2016). One possibility would be to link the remuneration of the security to the issuance of CERs or future units (credits) under Art. 6.4. Various forms can be studied – for example, the progressive reduction of spreads associated with the generation of credits, call options and even the distribution of part of the credits or the respective income to the holders of the securities. The same logic can be applied to the traditional debt market – for example, by gradually reducing interest rates vis-à-vis the generation of CERs. All of these possibilities, which need to be further analyzed, could enable the combination of incentives for mitigation, linking finance to the monetary value of a carbon asset.

It should be emphasized that the interface with broader financial policies and instruments could also help overcome some of the barriers affecting the supply and demand side. An example of a relevant solution on the demand side is the Pilot Auction Facility (PAF), recently developed by the World Bank. Under the PAF, CDM project developers have the possibility to guarantee a minimum price for their CERs, through a *put options system*. Project developers pay a premium to have the right to sell a specific amount of credits in the future, at a predetermined price regardless of the market price in the future. The PAF still does not address F/R projects, but the same logic could be used in the design of similar programs in Brazil.

At last, in view of the strong connection between the topic and the international context – considering regulatory, cooperation and funding perspectives –, the coordination between the elements of domestic policy and the formulation of foreign policy is a crucial factor for optimized results and for overcoming supply and demand side barriers. A permanent internal consultation mechanism could facilitate, given the technical complexity of the subject and the need for in-depth sectoral knowledge. There also appears to be room for South-South cooperation, based on balanced incentives for both suppliers and users of technologies. It should be recalled that despite the various internal barriers, the country has the most advanced forestry technology. And on the other hand: *i)* more than 2 billion people on the planet still depend on forest biomass as a source of energy (FAO, 2017); *ii)* there is a theoretical demand for the establishment of an additional 250 million additional hectares of forest stocks (WWF, 2012); and *iii)* most NDCs depend on the land-use and forest sectors, especially in developing countries (Canaveira, 2015).

4.3 THE INTERFACE WITH OTHER SUSTAINABLE DEVELOPMENT TOPICS

Some studies suggest that the potential contribution of CDM projects to the second objective of the mechanism – promotion of sustainable development – is significantly conditioned to additional incentives or to the creation of supplementary institutions (Marques, 2007, Cossen et al., 2006, Olsen, 2005). Such incentives can be provided by the State through better coordination with broader public policies, which may include the NDC, as mentioned above, and also address policies on other issues – for example in the areas of biodiversity and water resources. However, if the coordination between a market-based mechanism and mitigation policies within aNDC is not straightforward, as illustrated in the previous item, the challenges and transaction costs associated with possible co-ordination with other sustainable development topics seem to be even deeper. While there are desirable synergies, there may be trade-offs between the mechanism's efficiency as a mitigation tool and coordination with other areas.

It is possible to generate incentives through the market and civil society actions, by legitimazing practices that differentiate projects, in addition to government regulations. As an example, one can mention the adoption of forest certification processes, observed in some cases of CDM projects in Brazil, or sustainability seals with a high degree of market acceptance, which could generate a premium price for the respective forest carbon credits. Under the CDM, a number of voluntary initiatives have been implemented for this purpose, and continue to face the challenge of combining additional benefits, emissions reduction and good pricing.[47]

47. Some examples: Gold Standard, Climate Community and Biodiversity Alliance (CCBA), Community Development Carbon Fund (CDFC).

By making a conceptual relationship between these experiences and the future, the reference to a *sustainable development mechanism* is a clue *per se*. Given the embryonic state of regulations, any conclusive analysis is premature. There are indications from the past that supplementary institutions, in addition to carbon pricing, are in fact necessary for a greater contribution of projects to sustainable development.

5 FINAL CONSIDERATIONS

The CDM is a market-based mechanism, and as such, it is important to bear in mind that it represents an attempt to internalize a new variable in economic activities at the micro level (project), based on classic principles of Environmental Economics (Coase, 1960; Kahn, 2005). This is intrinsically complex from the technical and political point of view, particularly for the need for multilateral consensus.

There are additional complexity layers in the forest scope, shown by various aspects of the current regulation. The challenge of the fungibility of forest credits in the carbon market, which is determined by addressing the issue of non-permanence, and the need to improve eligibility criteria of areas illustrate two central aspects. Regulatory complexity is of course one of the elements that contributes to the low number of F/R projects in the world and in Brazil. The constraints on the demand side, however, seem to have played a more significant role. Even with all the complexity, what would be the performance of the forest CDM in Brazil and in other countries if it were not for the exclusion of forest credits of the largest demand markets?

The answer to this question goes beyond the scope of this chapter. But Brazil's forest potential and the volume of transactions generated in other types of projects suggest that there may be a much greater potential. Two of the three projects approved in Brazil managed to overcome the demand barrier (credit sales). Substantial results have been generated in terms of mitigation and sustainable development. Depending on the level of innovation of the mechanism and, above all, on constraints on the demand side, the analysis of the role of the forest CDM in the country, and probably in the world, cannot be made only in terms of the number of projects or the volume of removals achieved.

In this context, it is possible to support the argument that the main legacy of the mechanism in Brazil was institutional. A central and positive element of this legacy was the creation of methodologies in the country and approval at the multilateral level, which made it possible, for the first time, to internalize the climate variable in the economic routine of reforestation and restoration activities. They also generated monitoring , reporting and verification parameters for GHG removals, as well as *accountability* in a broader sense. Such benchmarks can be simplified and leveraged to build public and organizational policies – for example, criteria for domestic carbon pricing systems and compliance with the NDC. Two other important elements of the institutional legacy were the creation of new contractual arrangements, both technological and financial, essential for the viability of a new low-carbon economy, and, finally, the internalization, via carbon, of other sustainable development parameters.

Despite all the challenges, over 192 countries reached a set of methods that are globally applicable by any organization as a mitigation tool. Brazil was successful in leading the inclusion of two of its main forestry activities in the process: reforestation and restoration.

It is precisely the recognition of the inherent constraints of the mechanism and its imperfections that allows an analysis, although preliminary, of its future potential. Perhaps because it was the first multilateral carbon pricing mechanism, there has been an over-expectation on its role in fighting climate change, even if it was created "only" to give flexibility or cost-effectiveness to mitigation efforts by Annex 1 countries, and with a generic reference to the promotion of sustainable development. The literature presents studies that indicate that carbon pricing cannot be seen as the only mitigation measure and that its intended effects require articulation with broader policies. Given the complexity of the forestry sector, the application of this comprehensive rationale to market-based mechanisms seems to be even more necessary, since it enables synergies between the public and private sector. The experience of the CDM in the country is a relevant reference in this regard.

Thus, the potential to use the forestry CDM in Brazil in the future may be significant, but tends to be conditioned by several factors, among which the transition to the new market-based mechanism in the Paris Agreement and the possible interface with a domestic carbon pricing system. Both could represent the overcoming of supply and demand side barriers. Nonetheless, if some form of transition succeeds, such a potential seems to be strongly related to Brazil's ability to promote proactive coordination, with broader mitigation policies and instruments, taking into account vertical and horizontal synergies. Cross-cutting coordination could effectively convert the capillarity provided by the institutional legacy of the mechanism – a bottom-up approach through scalable projects and programs – into means of implementation of mitigation and sustainable development policies.

The cross-cutting nature of the forest sector is such and its role in the Brazilian NDC is so relevant, that it is necessary to think of a specific plan for this area, conducive to the coordination of interdisciplinary actions and the promotion of vertical and horizontal synergies. This integrated approach could create the basis for a virtuous cycle where the broader public policy framework could facilitate the overcoming of transaction costs, inherent to the mechanism, and generate additional incentives for entrepreneurs through a marginal and marked-based revenue source, in order to achieve public objectives. This is especially applicable to Brazil, as a country with major public spending restrictions, which often jeopardizes nationally determined objectives. The task is not simple. But since there is no single policy instrument capable of providing the ultimate solution for climate change on its own, it would be a huge waste not to take advantage of a significant legacy derived from the leadership of Brazilian society in building the only multilateral market-based mechanism since 1992.

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ANNEX A

SPECIFIC CDM DEFINITIONS FOR THE FOREST SCOPE

Approaches to baseline definition: in selecting a baseline methodology for a project for afforestation or reforestation under the Clean Development Mechanism (CDM), project participants should select, among the following approaches, the one considered more appropriate to the project activity, taking into account any guidance from the Executive Board and justifying their choice:

- Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project;
- Changes in carbon stocks in the carbon pools within the project boundary from a land use that represents an economically attractive course of action, taking into account barriers to investment; and
- Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts (UNFCCC, 2003, p. 22, with our highlights).

Additionality: an A/R CDM project activity or A/R CPA will be additional if actual net GHG removals increase above the sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the A/R CDM project activity or A/R CPA (UNFCCC, 2003, p. 11).

Forest: A minimum area of land of 0.05–1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10–30% with trees that have the potential to reach a minimum height of 2–5 metres at maturity in situ, and may include either closed forest formations where trees of various storeys and undergrowth cover a high proportion of the

ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10–30 per cent or tree height of 2–5 metres are considered as forests, as well as areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention, such as harvesting, or natural causes (UNFCCC/Decision 11/CP.7, p. 58).

Afforestation: The direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or human-induced promotion of natural seed sources (UNFCCC/ Decision 11/CP.7, p. 58).

Leakage: an increase in GHG emissions which occurs outside an A/R CDM project activity, and which is measurable and attributable to the A/R project activity (UNFCCC, Decision 19/CP.9, p. 5).

Project boundary: the physical delineation and/or geographical area of the A/R CDM project activity under the control of the project participants. The PoA may have more than one distinct are of land (UNFCCC, Decision 19/CP.9, p. 5).

Baseline: for an A/R CDM project activity or A/R CPA, the scenario for the A/R CDM project activity or A/R CPA that reasonably represents the sum of the changes in carbon stocks in the carbon pools within the project boundary that would occur in the absence of the project activity. (UNFCCC, Decision 19/CP.9, p. 11).

Temporary certified emission reduction (RCE*t*): a CER issued for a CDM A/R project activity which expires at the end of the commitment period following the one during which it was issued (CQNUMC, Decisão 19/CP.9, p. 5).

Long-term Certified Emission Reduction, or lCER: a unit issued pursuant to an A/R CDM project activity which expires at the end of the crediting period of the A/R CDM project activity for which it was issued (UNFCCC, Decisions 19/CP.9, p. 6).

Reforestation: The direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources on land that was forested but has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989 (UNFCCC/Decision 11/CP.7, p. 58).

Actual net GHG removals by sinks or forest carbon credits converted into tCERs ou lCERs: the sum of the verifiable changes in carbon stocks in the carbon pools within a project boundary, minus any increase in GHG emissions, measured in carbon dioxide equivalents, from sources that have increased *as a consequence* of the implementation of the A/R project activity, avoiding double counting, at the project boundary, *attributable to the afforestation or reforestation project activity under the CDM* (UNFCCC, Decision 19/CP.9, p. 5, with our highlights).

Small-scale projects: projects producing up to 16,000 actual net tCO2e per year. In addition to this requirement related to the amount of removals, the project has to be implemented by low-income communities, according to criteria determined by the host country. In the case of Brazil, the Interministerial Commission on Global Climate Change defined in Art. 3 of its Resolution No. 3 of March 24, 2006, that low-income communities are those in which members involved in the development and implementation of A/R project activities have a monthly family income per capita of up to half a minimum wage.

Small-scale A/R projects may benefit from regulatory simplification for larger projects, including: *i)* the use of simplified methodologies and forms; *ii)* the right to use the same Designated Operational Entity to carry out the validation and verification processes; and *iii)* exemption from the 2% CER rate for aid to adaptation measures to the adverse effects of climate change in the most vulnerable countries. These benefits are the same as those granted to other small-scale CDM projects (UNFCCC, 2005a).

REFERENCE

UNFCCC – UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE. **Decision 19/CP.9**. Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol. UNFCCC, 2003.

APPENDIX A

KEY FOR THE ACRONYMS USED IN FIGURE 1 – CLIMATE CHANGE GOVERNANCE: GOVERNMENT POLICIES AND INSTRUMENTS (FOREST SCOPE)

- National Policy on Climate Change
    - Instruments
        - Climate Fund
        - PPCerrado – Action Plan for the Prevention and Control of Deforestation in Cerrado
        - PPCDAm – Action Plan for the Prevention and Control of Deforestation in the Legal Amazon Forest
        - CN – National Communication
        - Amazon Fund
        - PNA – National Adaptation Plan
        - EN REDD+ – National Strategy of REDD+
        - PlanaVEG – National Native Vegetation Recovery Plan
        - National Climate Change Plan
            - Energy – Ten-Year Energy Plan
            - Industry – Sector Plan on Climate Change Mitigation for the Consolidation of a Low Carbon Emission Economy in the Processing Industry
            - Charcoal-Based Steel Industry – Steel Industry Emission Reduction Plan
            - Sustainable Steel Industry – Payment Program for Emission Reduction Results in the Steel Industry.
- Institutional Instruments
    - CIM – Interministerial Committee on Climate Change
    - Gex – Executive Group on Climate Change
    - CIMGC – Resolutions of the Interministerial Commission on Global Climate Change
    - FBMC – Brazilian Climate Change Forum

- PMR – Partnership for Market Readiness
  - COP – Conference of the Parties to the Convention
    - GCF – Global Climate Fund
    - GEF – Global Environmental Facility
    - NC – National Communications from Parties not Included in Annex I to the Convention
    - Agr – Agriculture
    - REDD+ – Reduction of Emissions from Deforestation and Forest Degradation and Conservation.
  - CMP – Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
    - LULUCF – Land use, land use change and forestry
    - CDM – Clean Development Mechanism
    - Eligibility – Eligibility of AR CDM
    - Permanence – Non-permanence for tCERs.
  - Pre-2020
    - NAMAs – Nationally Appropriate Mitigation Actions (MRVs + Diversity)
  - The Paris Agreement
    - Article 6.4 – New Market Mechanisms
    - Article 6.2 – Cooperative Approaches
    - Article 6.8 – Non-Market Mechanisms
    - Transparency Framework
    - NDC – Nationally Determined Contribution

CHAPTER 7

USE OF THE CDM BY THE BRAZILIAN INDUSTRY: CONSIDERATIONS IN FAVOR OF ENERGY EFFICIENCY AND NEW TECHNOLOGIES[1]

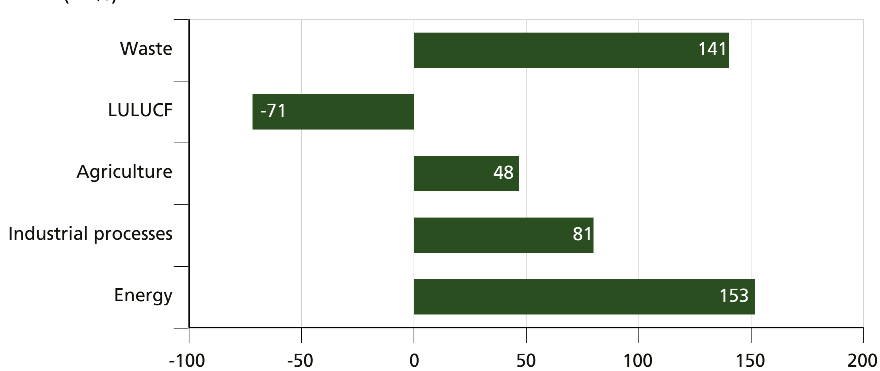
Ana Paula Beber Veiga[2]

1 INTRODUCTION

The industrial processes sector, as adopted in the official reports for the monitoring of Brazilian GHG emissions (Brazil, 2016c), comprehend the emissions resulting from industrial activity which are not the result of fuel combustion and comprise the following subsectors: mineral products, metallurgy and chemistry, production and consumption of hydrofluorocarbons (HFCs) and sulfur hexafluoride – SF_6 (Brasil, 2016a).

In this context, recent estimates indicate that, in 2014, the industrial sector accounted for 7% of Brazil's total net GHG emissions[3] (Brazil, 2016a), but, despite its small contribution to the total Brazilian GHG emissions, it presented an expressive positive variation from 1990 to 2014, similarly to the other sectors with exception of the LULUCF sector (graph 1).

GRAPH 1
Variation in GHG emissions/removals in Brazil (1990-2014)
(In %)



Source: Brazil (2016a).
Elaboration of the author.

1. The author thanks Paula Bennati Shayani, who for many years has been at the forefront of discussions on climate change as a representative of the National Confederation of Industry (CNI, in Portuguese), for her contribution to initial stages of writing this chapter. The author also thanks Mauro Meirelles de Oliveira Santos for the authorship of the texts of annexes A and B.

2. Forest Engineer and Environmental Manager. Ipea Research Assistant.

3. Considers GHG emissions and removals promoted by the land use sector, land use change and forestry (LULUCF) sector.

Several alternatives can be implemented by Brazilian industries to reverse the emissions scenario, for example, the substitution of fossil fuels by renewable fuels or less intensive in GHG emissions and the promotion of energy efficiency measures, such as heat recovery from processes to generate energy for own consumption.

From 2005 – when the Kyoto Protocol came into force – until 2012 – the year from which a sharp drop in in the registration of projects was perceived – the Clean Development Mechanism (CDM) contributed to the implementation of emission reduction projects of the industrial scope in Brazil.

This chapter will address some initiatives conducted by representative institutions of national industry focused on the climate agenda, what were and the impacts of Brazilian CDM projects in the industrial sector. It will also present some of the main perceived barriers for the execution of CDM projects; and the future prospects for the sector's emission reduction goal to be achieved, in line with the commitments established in recent international agreements.

2 CDM PROFILE AND PERFORMANCE IN THE INDUSTRIAL SECTOR

By May 2018, 342 CDM project activities[4] had been registered with the United Nations Framework Convention on Climate Change (UNFCCC), of which twenty had been developed by industries[5] that are distributed in sectoral scopes:[6] Scope 1 – Energy industries (renewable/non-renewable), nine CDM project activities; Scope 5 – chemical industry, nine CDM project activities; and scope 9 – metal production, two CDM project activities.

Despite corresponding to a small portion of the total number of registered CDM projects, the initiatives of the industrial sector correspond to a reduction of 62,464ktCO_2e or 47% of certified emission reductions (CERs) achieved by Brazilian projects.[7] The relevance of this contribution is mostly attributed to a single project developed by the chemical industry sub-sector (scope 5), while the other projects contribute approximately equally (graph 2 and table 1).

4. According to Annex A of the Kyoto Protocol, the sectors/source categories were subdivided into energy, industrial processes, use of solvents and other products/agriculture, waste and others. Industrial processes involve: mineral products, chemical industry; metal production; other production; production of halocarbon and sulfur hexafluoride; consumption of halocarbons and sulfur hexafluoride; others. Energy includes the transformation and construction industries among others.

5. The analysis presented in this chapter disregards the following types of CDM project activities: hydroelectric; landfill gas; energy generation from solar, biomass and wind sources; energy distribution; and methane avoidance.

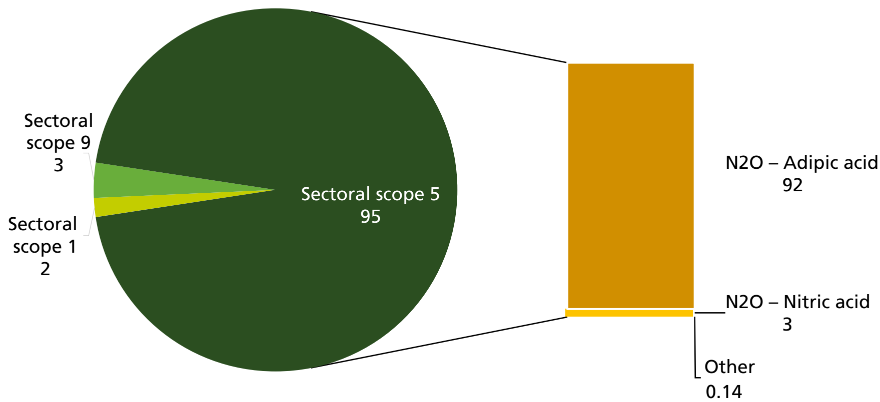
6. Sectoral scopes correspond to the set of activities within the same sector and that share the same source of GHH emissions, as listed in Annex A of the Kyoto Protocol, available at: <https://bit.ly/2tilXzH>. Accessed on: May 15th, 2018.

7. The analysis presented includes the emission reduction corresponding to the CERs voluntarily canceled (0.7% of the total of the CERs issued for the projects of the industrial sector under analysis).

GRAPH 2

Representativeness of registered CDM projects in the Brazilian industrial sector, by sector scope

(In %)



Source: UNEP (2018a).
Elaboration of the author.

TABLE 1

Certified emission reductions of CDM projects in the industrial sector, by type and scope

Scope	Type of CDM project	Number of projects	Certified emissions reductions (kRCEs)[1]
1 – Energy industries (renewable/non-renewable)	Energy efficiency – own use	3	353
	Fossil fuel switch	6	712
	Subtotal	9	1,065
5 – Chemical industry	Adipic acid – N_2O	1	57,603
	Use of CO_2	1	10
	Nitric acid – N_2O	4	1,772
	Fugitive emissions	3	78
	Subtotal	9	59,463
9 – Metal production	Perfluorocarbons -PFC	1	0
	SF_6	1	1,936
	Subtotal	2	1,936
Total		**20**	**62,464**

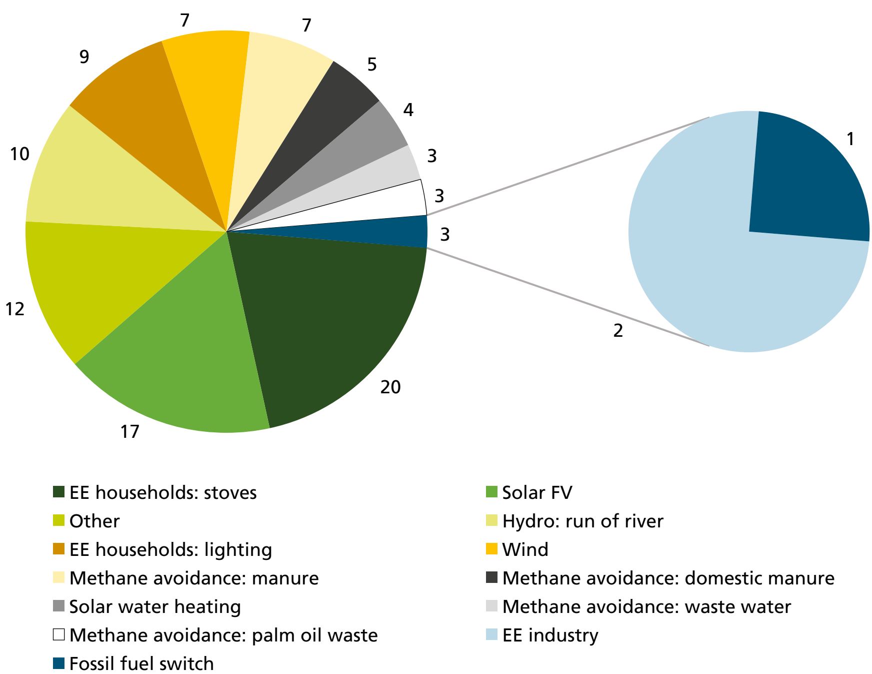
Source: UNEP (2018a).
Elaboration of the author.
Note: [1] One CER is equivalent to one tCO_2e.

Its worth mentioning that, between the two registered projects in scope 9, only one successfully issued CERs, illustrating a possible barrier to the quantitative contribution to GHG emission reductions of CDM projects in the industrial sector. From the total number of registered projects considered in the analysis, seven did not issue CERs until the beginning of May 2018, possibly indicating problems in the implementation of the projects or in the process of certifying emission reductions.

However, the qualitative observation of Scope 1 projects, which include fuel switch and energy efficiency activities for own use,[8] reveals the wide range of industries that could benefit from mechanisms such as the CDM to reduce GHG emissions from their production processes, as they were developed in different industrial units, such as: petrochemicals, cement plants, metal producing industrial units, pulp and paper mills, among others.

As for the registration of Program of Activities (PoA), by May 2018, only ten projects in which Brazil in the Host Party had been registered, none of which consists of initiatives undertaken by the industrial sector.[9] In global terms, only eight PoAs, or less than 3% of the registered PoAs, correspond to the implementation of activities aimed at reducing GHG emissions by the industrial sector – two PoAs of fuel switch; and six of energy efficiency in the industry (graph 3).

GRAPH 3
Distribution of PoAs registered in the world, by type of activities
(In %)



Source: UNEP (2018b).

8. Energy generation and biomass projects, which correspond to sectoral scope 1, are analyzed in Chapter 1 of this publication.
9. For further information on registered PoAs by Brazil, see Chapters 2 and 4 of this publication.

3 HIGHLIGHTS REGARDING THE IMPLEMENTATION OF THE CDM IN THE INDUSTRY

The implementation of CDM industrial sector projects presents some success stories, such as N_2O emission reduction projects, and episodes that illustrate the barriers faced by activities, not only related to industries, but also to other sectoral scopes. Issues related to methodologies and calculations of emission factors were, in many opportunities, determinants for the success, or not, of undertakings in the sector.

In addition, there has been, and still there is at the current moment of climate negotiations, a paradox between the criteria for the public availability of the CDM projects and patents registration in the industry. Many of the advances made by the industry are patented and, for reasons of competitiveness, remain confidential for as long as the right to register the patent lasts. This conduct is sometimes confronted with the CDM process requirement that all project documentation must be made publicly available, including project descriptions, containing information on how emission reductions are achieved and financial information if this is used to inform compliance with the requirement of project additionality.

It is possible to sustain, to a certain extent, the availability of information, since it favors the replicability of projects, increases global environmental gains. As in the other examples presented in this section, it is intended to leverage subsidies from the experience observed in the implementation of projects in the industry segment, with a view to future mechanisms being made feasible thanks to preexisting initiatives, or avoiding the misunderstandings of the past, consequently, benefiting the entire sector with opportunities from emission reductions.

3.1 Nitrous oxide projects (N2O): additionality, leakage and significant environmental gains

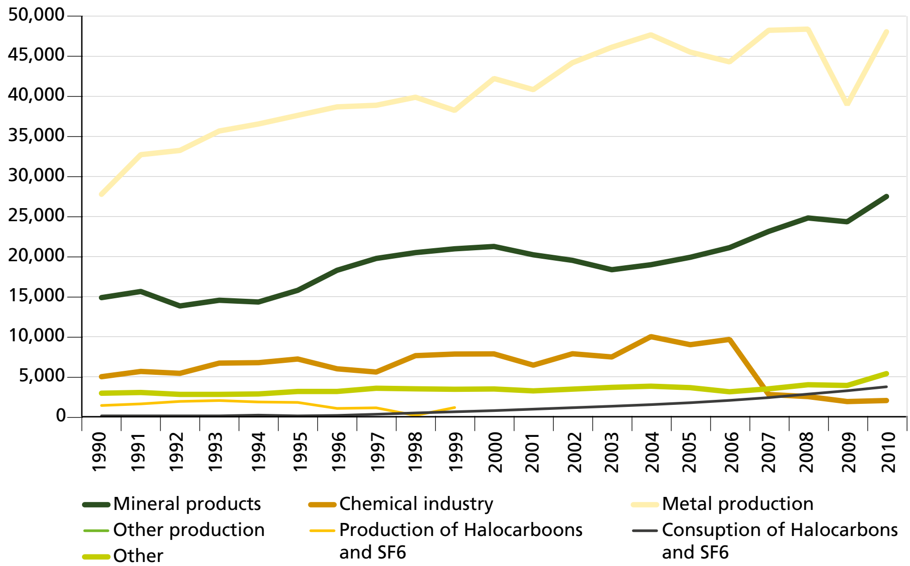
CDM projects aimed at reducing N_2O emissions make an important contribution to GHG emissions, due to the high Global Warming Potential (GWP) of this gas (310 for the first commitment period of the Kyoto Protocol, and 298 for the second commitment period).[10] In this regard, the Brazilian CDM Projects in Sectoral Scope 5 have contributed to a GHG emission reduction of 59,463ktCO_2e, and Rhodia's project alone represents 97% of the contribution to the reduction of GHG emissions from the projects in the sector. Registered on December 25th, 2005, this was the first CDM project in the industrial sector and consisted of preventing N_2O emission directly into the atmosphere after the generation of adipic acid.[11]

10. GWP information for the different GHGs is available in table 2.14 at https://bit.ly/2MbXxz2. Accessed on: May 15th, 2018. During the first commitment period, data from the IPCC Second Assessment Report was used. In the second commitment period, information for a hundred-year horizon is considered.

11. Project documents are available in English at https://bit.ly/2JUNZMd. Accessed on: May 5th, 2018.

In fact, the implementation of projects in the chemical industry sub-sector had an incredible reach, as they contributed to a drastic reduction in emissions of the industrial sector from 2006 – which coincides with the beginning of the crediting period of the adipic acid emissions reduction project in November of that same year (graph 4).

GRAPH 4
Evolution of emissions, by sub-sector of Brazilian industry (1990-2010)
(In GHG emissions/GgCO_2)



Source: UNFCCC.[12]
Elaboration of the author.

Despite the positive effects in terms of significant reductions in GHG emissions provided by this type of project, after its implementation and subsequent issuance of CERs, there was an intense debate about its real contribution, specifically related to issues of additionality and fugitive emissions.[13] Notwithstanding criticism, the initiative is notable as a potential CDM contribution to the sector.

3.2 Energy efficiency – was a clean baseline ever an issue?

Brazil has an electricity matrix strongly influenced by renewable energy sources, such as hydroelectricity, which leads to a low result for the CO_2 emission factor of the National Interconnected System (SIN), or at least not as high as other

12. For further information, see https://bit.ly/2Nl5u5X.
13. For further information on fugitive emissions issues, refer to Schneider (2011) and Schneider, Lazarus and Kollmuss (2010).

countries' matrices that use non-renewable sources, such as petroleum or coal byproducts, for this purpose.

This fact ends up creating a barrier to the implementation of energy efficiency projects in the industry that aim at the efficiency of electricity consumption from the grid or its replacement by other renewable sources, since the revenues obtained from the commercialization of CERs – determined by the amount of emission reductions – calculated, in a simplified manner, by multiplying the amount of energy that is no longer consumed by the CO_2 emission factor of the grid, are lower than the investment required to implement the projects.

During the first commitment period of the Kyoto Protocol, there was intense debate on the calculation of the grid emission factor. Annex A provides additional information on some of the issues discussed during the publication process, by the Ministry of Science and Technology, Innovations and Communications (MCTIC), of the national CO_2 emission factor.

However, the three Brazilian energy efficiency CDM projects include measures aimed at increasing efficiency in thermal energy generation by heat recovery from processes, with only one of them having been successful in obtaining CERs so far. In this context, it can be inferred that an explanation for the low number of projects in this category is the fact that they are complex activities, of little return; or then, are not directly related to the productive process of the manufacturing unit, which in theory would lead to a decrease in interest in it execution.

It is assumed that some of the main barriers to the implementation of energy efficiency measures in industry are: aversion to risks arising from the adoption of new, more efficient technologies; lack of public resources specifically designed to implement energy efficiency measures (which are usually for the residential, commercial and public sectors); a supposed short-term view of industry, which favors investments in production; low technical capacity for the identification and execution of energy efficiency measures; little attention to thermal insulation procedures, which would reduce consumption (GVces, 2015; Brazil, 2011; Rathmann et al., 2017)

Finally, it can be observed from the data in Table 1 that, for projects with an energy component in the industrial sector, there was a higher prevalence of fuel switch projects. Five of the six registered projects had issued CERs by May 2018. It should be noted that these projects contribute little to GHG emissions reductions in the industrial sector, compared to the avoided N_2O project, previously mentioned in item 3.1.

3.3 The need to overcome methodological and procedural barriers

3.3.1 Cement projects: methodology and additionality issues

Cement production is the second most GHG-emitting industrial activity in the Brazilian industrial sector, preceded only by pig iron and steel production. In 2014, the cement industry accounted for 28.5% of the industrial sector's GHG emissions (Brazil, 2016a). Worldwide, the largest sources of GHG emissions in cement production are related to the production of clinker (50.0%), the fuel burning for furnace heating (40.0%) and the use of electricity and transportation (10.0%).[14]

In Brazil, two projects[15] were submitted by the cement industry aiming at increasing the use of materials other than clinker, but were not approved by the UNFCCC registration process. These projects together sought to reduce emissions during their respective first crediting periods amounting to 2,945ktCO_2e, and the main reasons for their rejection by the CDM Executive Board at that time were an alleged fail to comply with aspects related to the requirement of additionality of projects and prior consideration of the mechanism for carrying out the activity.[16]

It is worth noting that the Brazilian cement industry has historically used alternative materials to replace clinker, which contributes to its CO_2 emissions per ton of cement being lower than the world average (Brazil, 2013). However, attention should not be diverted to other specific indicators of clinker production. The data in graph 5 clearly demonstrate that Brazil does not follow the global trend of reducing the carbon intensity in clinker production, the largest source of emissions from cement production.

14. For further information, access https://bit.ly/2JWBgbl.

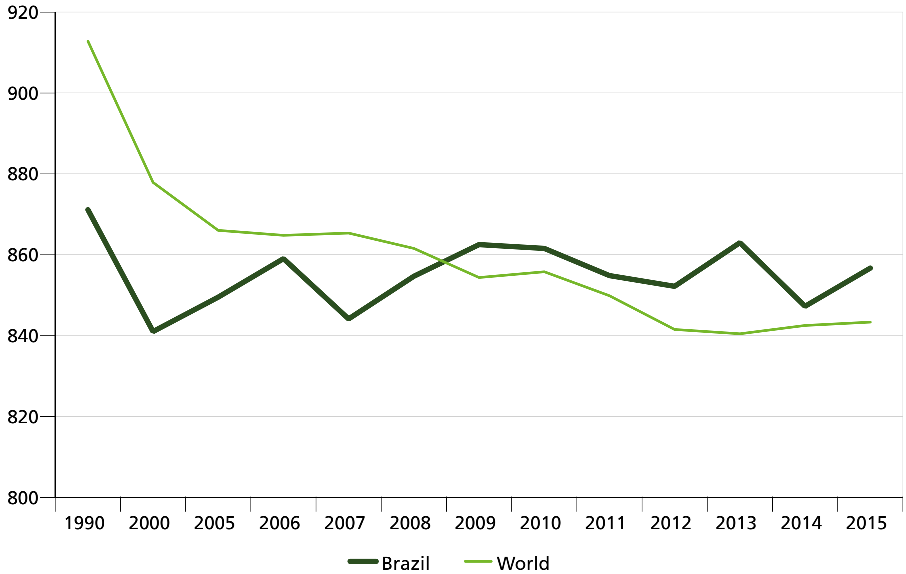
15. Votorantim Cimentos Project, available at: https://bit.ly/2tg3hk7; and Mizu Project, available at: https://bit.ly/2tdh0ld. Accessed on: May 9th, 2018.

16. CDM Executive Board reports containing reasons for projects rejection are available at: https://bit.ly/2JZ4Hdl. Accessed on: May 9th, 2018.

GRAPH 5

Comparison of Brazilian and global CO_2 emissions, weighted by clinker production

(In kg of CO_2/t clinker)



Source: Cement Sustainability Initiative. Available at: https://bit.ly/2tkiFMo.
Elaboration of the author.

It should be recalled that the Executive Board, after rejecting the Brazilian projects in June 2007, decided to put on hold[17] the ACM0005 methodology[18] and to recommend its revision due to the difficulty in determining the barriers to project implementation, which were an integral part of the claims for the analysis of additionality.

There is undeniable growing knowledge in GHG quantification and formulation of methodologies and procedures for the execution of CDM projects, but examples such as these, discussed in 3.3.1, illustrate the barriers faced by many projects regarding the methodological issue and the efforts to prove additionality. The two Brazilian projects have not resumed the registration process so far.

17. Minutes of the 46th CDM Executive Board Meeting. Available at: https://bit.ly/2KcO0uf. Accessed on: May 9th, 2018.

18. The ACM0005 methodology and all its revisions are available at the link: https://bit.ly/2tdh0ld. Accessed on: May 9th, 2018.

3.3.2 Expectations regarding the use of PoA by the industry

In 2007, the CDM Executive Board approved the first version of a document called *Guidance on the registration of project activities under a program of activities as a single CDM project activity*.[19] At subsequent meetings, the Executive Board improved the decisions on the implementation of this new concept and in July 2007 approved the first versions of the CDM-PoA-DD-Form project design document,[20] which marks the effective possibility of implementing CDM Program of Activities (CDM-PoA) under the Kyoto Protocol.

PoAs consist of a set of CDM activities, called CDM Component Project Activities (CPA), registered under the same project, which share the same technology, and therefore use the same CDM methodology, or set of methodologies, for the calculation of GHG emission reductions. The main difference between this new scheme and the grouping of activities into a CDM project activity is that CPAs can be included after the PoA registration for a longer crediting period lasting up to 28 years – or 60 years for forest scope projects (Climate Focus, 2013).

The main advantages of developing a PoA rather than a CDM project activity are: a faster validation process once that at the time of registration only one CPA needs to be submitted as a practical case of PoA implementation and the inclusion of the subsequent CPAs is made directly by the Designated Operational Entity; each CPA has an individual crediting period, which increases the period for obtaining PoA credits; greater flexibility to include new projects since CPAs can be included or excluded throughout the PoA crediting period; and, the possibility of conducting the verification of CERs (CNI, 2010; Climate Focus, 2013).

The benefits of developing PoAs over traditional CDM projects would be able to reduce the time required to register projects and the transaction costs in executing all phases, from validation to verification and subsequent issuance of CERs. Given this favorable scenario, there was an expectation that the number of registered projects would increase, but, in practice, this was not observed.

In terms of contribution to emissions reduction, no PoA of the industry sector had issued CERs by May 2018 (table 2). This chapter is not intended, however, to address what issues contributed to the small number of projects in the industrial sector or the non-issuance of CERs, which may be related either to difficulties in monitoring and verifying the CERs, or to the non-physical implementation of the project for reasons not related to the CDM project itself.

19. Annex 15, 28th EB Meeting on December, 2006. Available at: https://bit.ly/2KazfrD. Accessed on: May 16th, 2018.
20. 33th EB Meeting on July, 2007. Available at: https://bit.ly/2M8S4ca. Accessed on: May 16th, 2018.

TABLE 2
Outcomes of activities under a CDM Program of Activities

	Estimated emissions reductions (ktCO2 by 2020)	Verified emissions (tCERs by May 2018)
PoA Brazil	26,573	1,244
PoA world	331,331	13,852
PoA world – industry	568	0
CDM Brazil	493,119	133,588
CDM industry	103,090	62,464
CDM world	9,568,198	1,904,100

Sources: UNEP (2018a) and UNEP (2018b).
Elaboration of the author.
Obs.: Results in terms of estimated GHG emission reductions by 2020, and emissions of CERs completed by May 2018.

It is known, however, that for energy efficiency projects in the industry, a major barrier to the development of the PoA is at its initial design phase, when details of the proposed activities (including equipment) are required, and the establishment of the eligibility criteria that a CPA must meet to be included in its scope.

These criteria often require a thorough detailing, depending on methodology and activity, which can be considered a difficult factor for framing future CPAs. Of the industrial sector PoAs registered in other countries, none led to the inclusion of additional CPAs to the one included at the moment of the PoA registration (UNEP, 2018b).

3.4 RELEVANT ISSUES ON PRICING FROM AN INDUSTRY PERSPECTIVE

A Technical Chamber on Carbon Pricing is being created by the Brazilian Industry Climate Network (*Rede Clima da Indústria Brasileira*, in Portuguese),[21] aiming at articulating, capacitating and consolidating contributions from the industrial sector, comprising the seven sectors regulated by the Industry Plan, to the Partnership for Market Readiness (PMR) Project[22] of the Finance Ministry. This Chamber must be composed of representatives in the areas of Economy, Environment and Sustainability of the CNI – Brazilian Industry Confederation, industry federations, sectoral associations and companies.

It is worth mentioning some specific concerns of the sector regarding carbon pricing, which are currently a great challenge for the private sector, as described below.

1) Need to reconcile national pricing schedules with those being established in other countries.

21. To know more about this network, see, in this sense, section 4 of this text.

22. The Ministry of Finance's PMR project will study carbon pricing instruments and their impacts on the Brazilian economy over the 2016-2019 horizon. For further information, see Chapter 15 of this publication.

2) Non-acceptance of the carbon-based accounting proposal, compared with other modalities based on absolute targets and the necessity to meet existing market policies, such as that of China, which is on the way to absolute emissions.

3) Concern about the need to consider early actions, which is the case of many companies that have anticipated legal requirements.

4 THE ROLE OF CNI TO SPREAD KNOWLEDGE ABOUT CDM IN BRAZIL

The CNI represents the Brazilian industry. It is the highest body of the trade union system of industry and, since its foundation in 1938, defends the interests of the national industry together with the Executive, Legislative and Judiciary powers, in addition to various entities and bodies in Brazil and abroad. It represents 27 industry federations and 1,250 employer's unions, to which almost 700 thousand industries are affiliated.[23]

In partnership with the Center for Strategic Studies and Management (CGEE, in Portuguese) and the Government, under the supervision of MCTIC,[24] CNI organized and sponsored CDM training courses in different states of the country, through industry federations distributed among the various regions.[25] The objective of the training activities was to disseminate the possibilities that the CDM presented to the industrial sector for the achievement of GHG emission reductions, through the awareness of the business class, striving to disseminate knowledge and create a critical mass capable of carrying out the identified opportunities (CGEE, 2008).[26]

Also trough CNI, as presented by Cantarino (2017), the Brazilian industrial sector created the Brazilian Industry Climate Network, which has the following objectives:

- carry out articulation, interlocution, institutional relations, negotiation and defense of the Brazilian industry interests before government agencies, technical groups and business entities at the national and international levels;

23. Institutional profile available at: https://bit.ly/2tp6zAY. Accessed on: May 10th, 2018.

24. At the time of the launch of the initiative, the Ministry's formal name was Ministry of Science and Technology (MCT).

25. The courses started in 2006 as a pilot project in the industry federations of the states of São Paulo (FIESP), Rio de Janeiro (FIRJAN), Pernambuco and Rio Grande do Sul. In 2017, as an effective course, it was offered in the industry federations of the states of Goiás, Ceará, Minas Gerais, Bahia, Maranhão, Santa Catarina, again in Sao Paulo and Rio de Janeiro; as well as at the Federal District.

26. For further information on the courses offered in this initiative, which began in 2008 and lasted until 2011, can be accessed at: https://bit.ly/2MOFn7o. Accessed on: May 10th, 2018. To consult the work, in Portuguese, Manual de capacitação: mudança climática e projetos de Mecanismo de Desenvolvimento Limpo, produced within the scope of this initiative, the link is available at: https://bit.ly/2lqPt1O. Accessed on: June 5th, 2018.

- promote analysis of competitiveness and strategic positioning of the Brazilian industry in relation to national regulations and international agreements on climate change;
- spread the information, qualify the debate and align the position of the industrial base;
- identify priority themes, trends, risks and opportunities for the industry sector's value chain in the climate change agenda; and
- prepare the industrial sector for the future, through the promotion of business development, partnerships for innovation, technology development, market and incentives, aiming at consolidating a low carbon economy.

The following are the lines of work of the Brazilian Industry Climate Network in its different approaches:

- technical and regulatory – elaboration of technical opinions; competitive analysis, training and strategic positioning of the Brazilian industry before national regulations (policies, bills and executive projects, decrees and provisional measures); and international agreements on climate change;
- policy and institutional – articulation of the industrial sector through the Brazilian Industry Climate Network, negotiation and defense of interest in forums, meetings, work groups, technical chambers and events on climate change, promoted by governmental, nongovernmental entities and national and international business entities;
- economic and market – analysis and positioning on the economic and market impacts on the Brazilian industry value chain, regarding carbon pricing; adaptation measures, prevention and risk management of climate change; and financing lines for the consolidation of a low carbon emission economy; and
- technological and innovation – foster the development of technology and innovation in the industrial sector towards the consolidation of a low-carbon economy through the establishment of partnerships; seek to reduce bureaucracy in access to technologies and financing; map trends and good practices; and creation of environments for exchange of experiences (connection between the industrial sector and startups).

5 CURRENT POSITION OF THE INDUSTRIAL SECTOR WITH REGARDS TO EMISSIONS MANAGEMENT AND PLANNING FUTURE ACTIVITIES

The Kyoto Protocol remains valid, even though the Doha Amendment[27] not being in effect. Despite the difficulties faced in recent years by the emission reduction market due to the significant fall in the value of CERs,[28] some Brazilian CDM projects issued CERs during the second commitment period of the Kyoto Protocol, including three of the twenty projects in the industrial sector analyzed in this chapter (two of N_2O and one of SF_6). The continuity of the actions foreseen in these projects is, directly or indirectly, related to the effects of the decisions made at the international level and, in some way to the internal policies on climate change.

The enactment of the National Climate Change Policy (PNMC, as in Portuguese), Law No. 12,187, of December 29th, 2009, made official the voluntary commitment assumed by Brazil during the Copenhagen Conference of the Parties and established internal targets for the reduction of GHG emissions, which, later, with the adoption of the Paris Agreement, were consigned in the Brazilian intended Nationally Determined Contribution (iNDC) submitted to the UNFCCC in September 2016 (Brazil, 2009).[29] Specifically for the industrial sector, the Brazilian iNDC highlights that the country is committed to "promoting new standards of clean technologies and expanding measures of energy efficiency and low-carbon infrastructure" (Brazil, 2016b).

In 2017, the MCTIC published the *Mitigation Options of Greenhouse Gas (GHG) Emissions in Key Sectors in Brazil,* which identified the main actions to be taken, as well as the barriers to be overcome by the country in order to comply with its iNDC targets in all economic sectors. Among the initiatives highlighted by the document for the industrial sector, listed according to the most cost-effective criterion, are the energy efficiency initiatives (table 3), in particular the efficiency in heat and steam recovery (Rathmann et al., 2017).

27. The Doha Amendment establishes the second commitment period of the Kyoto Protocol (2013-2020). For it to enter into force, 144 parts of the UNFCCC need to ratify it. By May 2018, 122 parts of the Convention had ratified the Doha Amendment, including Brazil, on February 13th, 2018. For further information on this agreement and its implications, see Chapter 12 of this publication. Ratification status can be found at: https://bit.ly/2mBJXNq. Accessed on: June 7th, 2018.

28. For further details on the emissions trading market, refer to chapters 14 and 15 of this publication.

29. The full document submitted by Brazil to the Convention, as well as the documents submitted by the other parties, is available in English at the link: https://bit.ly/2dZryCB. Accessed on: May 18th, 2018.

TABLE 3
Cost-effectiveness of mitigation options for iNDC compliance in 2025, for the industrial sector

Sector (segment)	Mitigation options	Mitigation potential ($MtCO_2e$)	Total cost (US$ millions)	Index
Industry (cement)	Fuel switch	0.7	0.9	1.3
Industry (chemicals)	Heat Recovery for Process Efficiency	1.2	9.7	8.1
Industry (cement)	Heat Recovery for Process Efficiency	3.2	33.3	10.4
Industry (steel)	Heat Recovery for Process Efficiency	0.2	2.4	12.2
Industry (other sectors)	Steam Recovery for Process Efficiency	7.0	119.2	17.0
Industry (chemicals)	Steam Recovery for Process Efficiency	0.9	22.8	25.3
Industry (other sectors)	Furnace efficiency and process optimization	2.4	84.6	35.2

Source: Rathmann et al. (2017).
Elaboration of the author.

Some of the instruments for the implementation of the PNMC, as determined by the decree that regulated it (Decree No. 7,390, of December 9th, 2009), are the sectorial plans. Of interest to the industrial sector, the Sector Plan for Mitigation and Adaptation to Climate Change for the Consolidation of a Low-Carbon Economy in Transformation Industry (Industry Plan), published in 2013, and the Sector Plan for Emission Reduction in the Steel Industry, still under development (Brazil, 2010), stand out.[30]

The Industry Plan initially comprised the aluminum, lime, cement, pig iron and steel, pulp and paper, chemical and glass industries, which accounted for 90% of the direct GHG emissions from the manufacturing industry in 2005. The plan is structures considering five action lines: carbon management; recycling and co-processing; energy efficiency and cogeneration; voluntary mitigation actions; and sustainable technologies (Brazil, 2013).

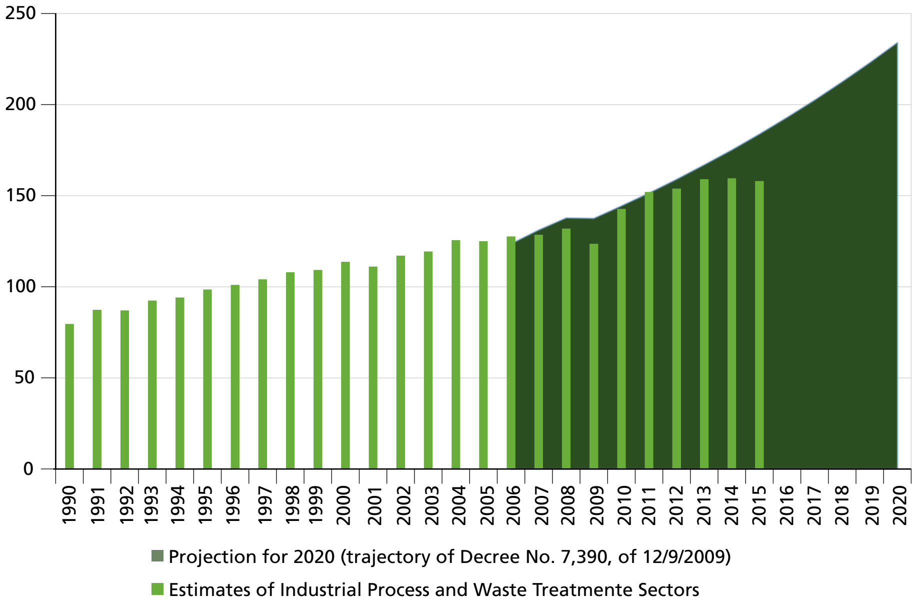
As indicated in the Industry Plan, GHG emissions reductions from the industrial sector would not be necessary to meet the reduction targets agreed by the country at the international level. It also highlights that the industries considered have a better environmental performance when compared to the industry performance of similar sectors worldwide.

In fact, although total emissions from the sector increased between 1990 and 2014 (graph 1), if we take the government monitoring data, which considers statistics from 2005 onwards, we can infer that emissions from the industrial sector and the waste treatment sector were 14% lower than the projections established by the PNMC's regulatory decree for the year 2015 – graph 6 (Brazil, 2017).

30. According to information available on the website of the Ministry of the Environment. Available at: https://bit.ly/2K7SlPb. Accessed on: May 28th, 2018.

However, it is worth noting that the projections, considered in the decree, for GHG emissions up to 2020 – and their respective targets – were calculated assuming a scenario of economic activity growth (gross domestic product – GDP) of 5% during the period, which was not achieved.

GRAPH 6
Emission estimates by 2015 and emission limit for 2020 for the industrial process and waste treatment sectors (1990-2020)
(In $TgCO_2e$)



Source: Brazil (2017).

As provided for in the decree, sectorial plans would have to be reviewed every two years after their publication, so that adjustments and possible actions could guarantee compliance with the agreed targets. However, since its publication, in 2013, the Industry Plan has not yet been revised.

It should be noted that several goals established in the plan have not yet been implemented. One example is the targets related to the National Energy Efficiency Plan (PNEf), which clearly points to the non-adoption of energy efficiency practices by the industrial sector (despite being the country's largest energy consumer) because investments in energy efficiency compete with investments in production (Brazil, 2011).

6 CLOSING REMARKS

It is a frequent argument of the various segments of the industrial sector that emission reductions should occur without compromising their growth. Technologies and solutions to accomplish this result while ensuring competitiveness already exist. Nevertheless, there are still barriers to their use from both a commercial and cultural point of view.

Given the fact that the contribution of the GHG emission reductions from industries, in terms of the number of CDM project activity registered, is smaller when compared to the other sectors, it is important to increase the pace and scale of its implementation.

Climate change policies must be based on economic competitiveness. This means prioritizing measures aiming at increasing energy consumption efficiency, capable of providing a significant share of the necessary reductions in GHG emissions. Likewise, it is also convenient to reinforce the special attention to sectors such as the steel and chemical industries, which face intense competition from countries that do not yet seek to cut their emissions.

The N_2O CDM projects are an emblematic example of how financial incentive policies, such as the CDM, allow for not-so-complex changes to be made rapidly by industry in proportion to the evidence of perceived gain. As discussed in this text, although the sector's emissions correspond to 7% of total emissions in Brazil, and therefore are not that representative, it can be said that there is an upward trend.

In addition, it is worth signing that, despite the national circumstances of each country, it is essential to implement several minimally coordinated policies so that there is no overlap between the federal, state and municipal levels. Also, policies that permeate different sectors must be aligned so as not to generate the need to produce the same information in different formats to meet the need of different agents.

Emission reduction opportunities in the industry are concentrated in activities of low perceived economic gain. Thus, there is no alternative but to implement other incentive policies that contribute to GHG emission reduction measures to be carried out by the sector and contribute, albeit on a small scale, to the fulfillment of the commitments established by the country in the international context of climate change negotiations.

In this regard, the government must consider mechanisms to protect sectors that are more sensitive to international competition and evaluate possible benefits to encourage the industrial sector to engage in the issue of climate change, reducing its emissions; without jeopardizing the insertion of the sector in the international market and the country's economic growth. Several examples have been presented by the industry in relevant fields, such as low-carbon development support policies, tariff incentives and the production and consumption of energy-efficient products and financing for energy efficiency.

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ANNEX A

USE OF THE NATIONAL INTERCONNECTED SYSTEM EMISSIONS FACTOR WITH THE ADJUSTED SIMPLE OPERATION MARGIN OPTION[1]

Resolution No. 8 of May 26th, 2008, of the Interministerial Commission on Global Climate Change (CIMGC) provided that the National Interconnected System (SIN) would be treated as a single system, with no subdivisions, for the purposes of any project activity in the Clean Development Mechanism (CDM) supplying or using the grid power. The Resolution also provided that emission factors would be published on a regular basis, in tCO_2/MWh, calculated for the single system and made available per month, day and hour on the CIMGC website.

The "Tool to calculate Emission Factor for an electricity system", mentioned in Resolution No. 8, allows, in its detailing, four options for the calculation of the operating margin. The alternative *i)* simple operating margin (OM), which cannot be applied to the Brazilian case, for having more than 50% of generation in water basis, which lead to alternatives *ii)* simple adjusted operating margin (OM); *iii)* Dispatch Data Analysis Operating Margin (OM); and *iv)* average operating margin (OM).

As per the decision in Resolution No. 8, emission factors published on an hourly basis are to be considered as option *iii*) Dispatch Data Analysis OM. While it can be understood that the publication of emission factors, as indicated in Resolution 8, addresses all projects, this is not the case. Projects that cannot be controlled hourly, such as energy efficiency, which estimates the energy savings by comparing the energy actually consumed (measured by the monthly bill) with the energy used at the baseline, or those projects that increase the capacity of an existing plant, where the comparison is made by the annual amount of energy generated, are not contemplated with the publication of the emission factor using the dispatch data analysis.

Option *iv*) average OM, is also published by the CIMGC, but because it represents an option that offers a very low value for the emission factor in the Brazilian case – more than 80% of clean generation, in practice it is only used for corporate inventories, for which it is explicitly indicated on the CIMGC website.

Option *ii*) simple adjusted OM would be the only one possible for the Brazilian case, allowing for a choice of an emission factor for a CDM project activity

1. Annex A text prepared by Mauro Meirelles de Oliveira Santos.

valid for an entire period, whether in advance and fixed for the entire crediting period (ex-ante), or afterwards, calculated for each year of monitoring (ex-post).

Apparently to meet projects that would like to use option *ii)* simple adjusted OM, the CIMGC requested the CDM Executive Board at its 50th meeting, from October 13 to 16, 2009, to include the following sentence in methodology ACM0002 (renewable electricity generation for the grid) and to review the "Tool to calculate Emission Factor for an electricity system": "Dispatch data analysis should be the first methodological choice. Where this option is not selected, project participants shall justify the reasons and may use the simple OM, the simple adjusted OM or the average emission rate method taking into account the provisions outlined hereafter".

After the Executive Board launched the CDM Methodology Panel (Meth Panel), it presented at its 43rd meeting a proposal that classified dispatch analysis as mandatory,[2] which was rejected during the 54th meeting of the Executive Board, when there was a new suggestion for the Meth Panel to study the ex-ante calculation for the simple operating margin and the adjusted simple operating margin, taking into account the data of the dispatch analysis. The Meth Panel presented, at its 45th meeting, an information note stating that calculation was not possible, but that another ex-ante calculation based on the dispatch analysis could be studied. The 56th session of the Executive Board considered this note and requested that the possibility be considered later. However, the subject was no longer raised. It is concluded that there is no ex-ante option for both the simple operating margin and the adjusted simple operating margin based on the dispatch analysis.

Thus, it is necessary for the CIMGC to disclose the emission factor based on the simple adjusted OM option, which can be used both ex-ante and ex-post, so as not to hinder the development of the aforementioned CDM project activities. Such emission factors can only be calculated with data from the National System Operator (ONS) that cannot be published.

Taking into account that the operating margin method for the analysis of dispatch data is the most accurate, the CIMGC may restrict the use of the simple adjusted OM option in Brazil, although it is an option authorized by the Executive Board and its use does not indicate, at first, higher or lower CO_2 reduction values, i.e. certified emission reductions – CERs (carbon credits). A simulation between the different options for OM is in the annex to this document.

It is also worth remembering that in 2012, a Brazilian project used the option of simple adjusted OM: Project No. 365, a Project Activity of the Wind Power Complex of Rio Grande do Norte and Ceará, received its letter of approval on

2. For the use of the verb shall in the English version. See the original text in the Bibliography used section of this appendix.

September 24th, 2012. The OM emission factors were calculated using information "provided by the ONS", according to the Project Design Document (PDD), including thermal generation and type of fuel used, although project proponents have not made them explicit in the project's public documentation.

The project was rejected for submitting data for financial analysis after the start of the project. Nothing was said about the calculation for the emission factor using the simple adjusted OM, and DNV Climate Change Services[3] validated such a calculation. The spreadsheet with all the data has not been published, but in the calculation of the CERs, according to the public spreadsheet on the UNFCCC website,[4] it is possible to see that the results for the emission factors do not match mine, related to the simple adjusted OM, and (construction margin, EF_{BM2010}: 0,1166 t CO_2/MWh in the PDD, against 0.1404 t CO_2/MWh, published by the CIMGC). In addition, the annual generation of energy dispatched does not match that provided to the Ministry of Science and Technology, Innovations and Communications (MCTI) by the ONS. As a result of this particular calculation of the project proponent, values lower than those calculated with the correct ONS data were used to calculate the project reductions, using a more conservative methodology, since they lacked accurate energy efficiency data, reducing the generation of CERs and hampering project performance.

Starting in 2014, after a few more considerations of its members, the CIMGC finally began to officially publish these emission factors as an official calculation.

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EB50:[5] 16 October 2009

28. In the context of a letter from one of the DNAs, the Board requested the Meth Panel to consider the following language from version 6.0 of ACM0002 and use it appropriately to revise the *Tool to calculate the emission factor for an electricity system*: "*Dispatch data analysis should be the first methodological choice*. Where this option is not selected project participants shall justify why and may use the simple OM, the simple adjusted OM or the average emission rate method taking into account the provisions outlined hereafter." This option of calculating the operating margin emission factor using the dispatch data analysis method should be considered particularly if the necessary data is available.

3. Designated Operational Entity by the United Nations Framework Convention on Climate Change (UNFCCC).
4. Spreadsheet 7682-20121011-CER SHEET.xls. Available at: https://bit.ly/2u62KRo.
5. For further information, see: https://bit.ly/2KEhyRR.

Meth Panel Meeting 43 – 22-26 February 2010

Annex 7 – Draft revision to *Tool to calculate the emission factor for an electricity system*:

…

Dispatch data analysis OM (option c) *shall* be used if (1) the data required to apply this option is publicly available and (2) off-grid power plants are not included in the project electricity system as per Step 2 above. For the dispatch data analysis OM, the emission factor shall be determined for the year in which the project activity displaces grid electricity and updated annually during monitoring.

In case the grid emission factor is used to calculate project emissions or leakage, any of the four options could be used, provided that the conditions specified below are fulfilled for the selected option.

…

EB53:[6] March 26th, 2010

27. The Board agreed to continue the consideration of the proposed revision to the *Tool to calculate the emission factor for an electricity system* at its next meeting.

EB54:[7] May 28th, 2010

25. The Board considered the draft revised *Tool to calculate the emission factor for an electricity system* and requested the Meth Panel to revert to the original tool *and revise it to allow the use of dispatch analysis data for the ex-ante calculation* of the operating margin emission factor in the simple operating margin and the simple adjusted operating margin. The Board requested the Meth Panel to recommend the final draft tool for consideration by the Board at its fifty-sixth meeting.

6. Access the site: https://bit.ly/2Kvoi54.

7. Available at: https://bit.ly/2lQX4Hc.

Meth Panel Meeting 45 – 9-13 August 2010

Annex 10 – Information note on the *Tool to calculate the emission factor for an electricity system*

Response from the Meth Panel to the request contained in paragraph 25 of the fifty-fourth meeting report of the Executive Board

1. The Meth Panel (the panel) is of the opinion that *it is not possible to use ex-ante dispatch data for the calculation of the simple operation margin or the simple adjusted operating margin emission factor* as requested by the CDM Executive Board, but that *it may be possible* to calculate *an* ex-ante operating margin emissions factor based on dispatch analysis data.

2. The panel believes that the use of ex post dispatch analysis data when available is the most accurate approach to determine the operating margin emission factors and should be used whenever possible. It should be noted however, that the use of the ex post dispatch analysis data operating margin requires the project proponents to obtain data on the displacement of the grid on an hourly basis.

3. This is the case for the majority of the project activities based on a low emitting power plant but not all. In some methodologies the displacement of grid electricity is obtained as the difference between power generation of the project activity plant minus the electricity which would have been generated in the baseline situation, which is determined only at the annually level (case of project activities increasing the capacity of an existing plant). The same applies to the majority of the demand side management project activities (use of energy efficient appliances) for which only annual electricity savings are available. This is the main reason why *the panel is inclined not to mandate dispatch analysis as priority*.

4. The panel is of the opinion that *further analysis* would be needed to determine if the use of *ex-ante dispatch analysis* is suitable compared with other methods of estimating operating margin. On one side, it can be argued that the dispatch of power plants at the margin of the merit order of generation is more susceptible to temporal variation than the average dispatch of power plants. Change in the relative price of fuel will affect the amount of generation of each power plant as well as the lambda factor, but its impact on the power plants at the margin of the merit order may be larger. On the other hand, in a host country with relatively stable relative prices of fuel and/or high variability regarding hydropower generation, the dispatch data would give a better representation of the power displaced by a project activity than an average based on all thermal power plants of the grid.

EB56:[8] September 17th, 2010

32. The Board considered a note by the Meth Panel regarding the "Tool to calculate the emission factor for an electricity system" and requested the panel to perform further analysis to determine if the use of *ex ante dispatch analysis* is suitable when compared with other methods of estimating operating margin and revise the tool as appropriate. The revised tool should be available for consideration by the Board at its fifty-ninth meeting.

8. Available at: https://bit.ly/2u0TA8U.

ANNEX B

SIMULATIONS ON THE SIMPLE ADJUSTED OM OPTION, WHICH DO NOT INDICATE A PRIORI GAIN OR LOSS OF CARBON CREDITS[1]

TABLE B.1
Non-wind/solar energy generation projects[1]

Year	EF using OM dispatch *ex-post*, considering an uniform generation	EF using $EF_{adj\text{-}OM}$ *ex-ante*	EF using $EF_{adj\text{-}OM}$ *ex-post*	Comparison with other options, in relation to EF using OM dispatch *ex-post* [2]					
		EF_{CDM}	EF_{CDM}	*ex-ante* $EF_{adj\text{-}OM}$ 2011	*ex-ante* $EF_{adj\text{-}OM}$ 2010	*ex-ante* $EF_{adj\text{-}OM}$ 2009	*ex-ante* $EF_{adj\text{-}OM}$ 2008	*ex-ante* $EF_{adj\text{-}OM}$ 2007	*ex-post* $EF_{adj\text{-}OM}$
	tCO_2/MWh			%					
2012	**0.3621**	0.2855	0.3098	-39.8%	-32.8%	-44.1%	-33.2%	-44.7%	-14.5%
2011	**0.2010**	0.2179	0.2064		21.0%	0.7%	20.3%	-0.5%	2.7%
2010	**0.3113**	0.2432	0.2614			35.0%	-22.3%	-35.7%	-16.0%
2009	**0.1656**	0.2024	0.1895				46.1%	20.8%	14.4%
2008	**0.3153**	0.2419	0.2494					-36.5%	-20.9%
2007	**0.1875**	0.2001	0.2001						6.7%

Notes: [1] Equal weights for operating margin and construction margin.
[2] Comparisons of one-year *ex-ante* option can only be made with the options of later years.

TABLE B.2
Wind/solar power generation projects[1]

Year	EF using OM dispatch *ex-post*, considering an uniform generation	EF using $EF_{adj\text{-}OM}$ *ex-ante*	EF using $EF_{adj\text{-}OM}$ *ex-post*	Comparison with other options, in relation to EF using OM dispatch *ex-post* [2]					
		EF_{CDM}	EF_{CDM}	*ex-ante* $EF_{adj\text{-}OM}$ 2011	*ex-ante* $EF_{adj\text{-}OM}$ 2010	*ex-ante* $EF_{adj\text{-}OM}$ 2009	*ex-ante* $EF_{adj\text{-}OM}$ 2008	*ex-ante* $EF_{adj\text{-}OM}$ 2007	*ex-post* $EF_{adj\text{-}OM}$
	tCO_2/MWh			%					
2012	**0.4426**	0.3277	0.3641	-38.1%	-33.5%	-40.4%	-34.5%	-40.9%	-17.7%
2011	**0.2487**	0.2741	0.2568		18.4%	6.1%	16.6%	5.1%	3.3%
2010	**0.3967**	0.2946	0.3219			-33.5%	-26.9%	-34.1%	-18.9%
2009	**0.2087**	0.2639	0.2446				38.9%	25.2%	17.2%
2008	**0.4000**	0.2900	0.3012					-34.6%	-24.7%
2007	**0.2424**	0.2614	0.2614						7.8%

Notes: [1] 75% weight for operating margin and 25% weight for construction margin.
[2] Comparisons of one-year *ex-ante* option can only be made with the options of later years.

1. Annex B text prepared by Mauro Meirelles de Oliveira Santos.

CHAPTER 8

CONTRIBUTION OF THE CLEAN DEVELOPMENT MECHANISM TO SUSTAINABLE DEVELOPMENT[1]

Henrique de A. Pereira[2]

1 INTRODUCTION

As a principle (Article 12, paragraph 5, of the Kyoto Protocol), clean development mechanism (CDM) projects should be voluntary, provide real, measurable and long-term support for mitigating climate change, produce greenhouse gas (GHG) emissions that are additional to those that would occur in the absence of the mechanism and contribute to the sustainable development of the host country.

The concept of sustainable development emerged in the '80s, and became popular in 1987 with the publication of *Our Common Future* by the World Commission on Environment and Development (UN, 1987). Sustainable development carries the economic goal of growth, linked to the reduction of poverty and inequality and the need to maintain natural resources. It is noted that the scope in defining this concept implies that the determination of the means to achieve sustainable development is quite complex and specific to the evaluation context.

As a result, the evaluation of required elements of a CDM project activity was objectively disciplined by standards, procedures and methodologies approved by the CDM Executive Board, with the only exception being evidence of the project's contribution to sustainable development. In the absence of international standards for the definition of sustainable development, and due to national sovereignty (COP 7),[3] the prerogative of assessing the CDM's contribution to sustainable development was transferred exclusively to host countries.

In the Brazilian case, the Interministerial Commission on Global Climate Change (CIMGC) acts as the Designated National Authority (DNA) to approve projects under the CDM. This was established in Annex III to Resolution No. 1,[4]

1. Note from the editors: the assertions made throughout this text are an opinion, as per the personal judgment of the author. They do not reflect a doctrinal understanding or a universally scientific character, but provide a range of reflections on subjects that are still presented as challenges of the CDM experience.

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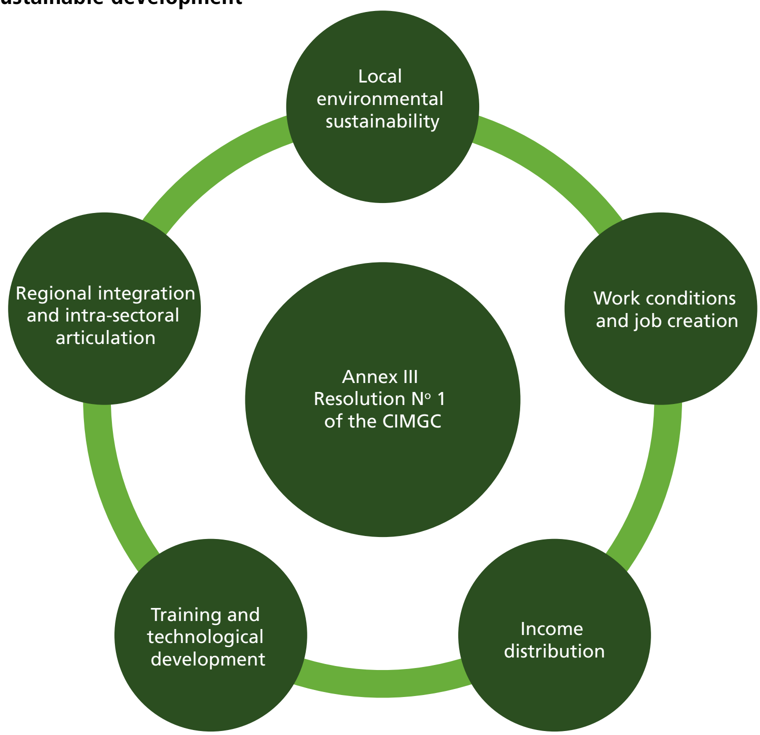
3. For more information, go to: http://unfccc.int/resource/docs/cop7/13a02.pdf.

4. Available at: https://goo.gl/ZShqVu. Accessed on July 19th, 2018.

dated September 11st, 2003, five aspects for assessing the contribution of CDM project activities to national sustainable development, namely: *i*) contribution to local environmental sustainability; *ii*) contribution to working conditions and net job creation; *iii*) contribution to the income distribution; *iv*) contribution to training and technological development; and *v*) contribution to regional integration and articulation with other sectors (figure 1).

FIGURE 1
Contributions from clean development mechanism project activities to national sustainable development



Source: CIMGC.

Thus, all Brazilian CDM projects submitted to the CIMGC evaluation must necessarily prepare a document evidencing, from the criteria established in Annex III of the CIMGC, its contribution to the national sustainable development. Following the flow of national approval to issue the letter of approval (LOA), each self-declaration submitted by the project proponent is evaluated by the committee issuing an opinion on the expected contribution to national sustainable development. Annex III of each CDM Project submitted for approval by the

CIMGC is public and made available at the Ministry of Science, Technology, Innovations and Communications (MCTIC) website.[5]

This chapter analyzes the contribution of the CDM to the sustainable development of Brazil. To this end, it defines timeframes by evaluating all the Brazilian projects registered by the CDM Executive Board during the first commitment period of the Kyoto Protocol.

2 OBJECTIVE

Therefore, the procedure adopted by the Brazilian government to evaluate the contribution of CDM project activities to national sustainable development involves the definition and analysis of a list of specific pre-established criteria. Despite the availability of these public occurrences, there are no initiatives aimed at using this information to carry out an objective assessment of the CDM impact on national sustainable development.

Thus, the general objective of this chapter is to present an analysis of the CDM contribution to sustainable development in Brazil, based on the criteria established by the Interministerial Commission on Global Climate Change. For this purpose, timeframes were established in order to evaluate all the Brazilian projects registered by the CDM Executive Board during the first commitment period of the Kyoto Protocol, which ended on December 31st, 2012.

This chapter also has specific objectives, as described below.

- To propose and test an assessment method of the CDM contribution to national sustainable development.
- To identify the project typologies with greater/lesser impacts to the sustainable development of Brazil.
- To provide a critical view of the CDM contribution to sustainable development and to the procedures of the CIMGC in order to provide recommendations for future procedures within the mechanism or another instrument that might replace it.

3 MATERIAL AND METHODS

Annexes III of the projects registered between 2004 and 2012 were evaluated for the construction of eleven indicators that allow for the aggregation and hierarchization of projects from the perspective of their contribution to sustainable development

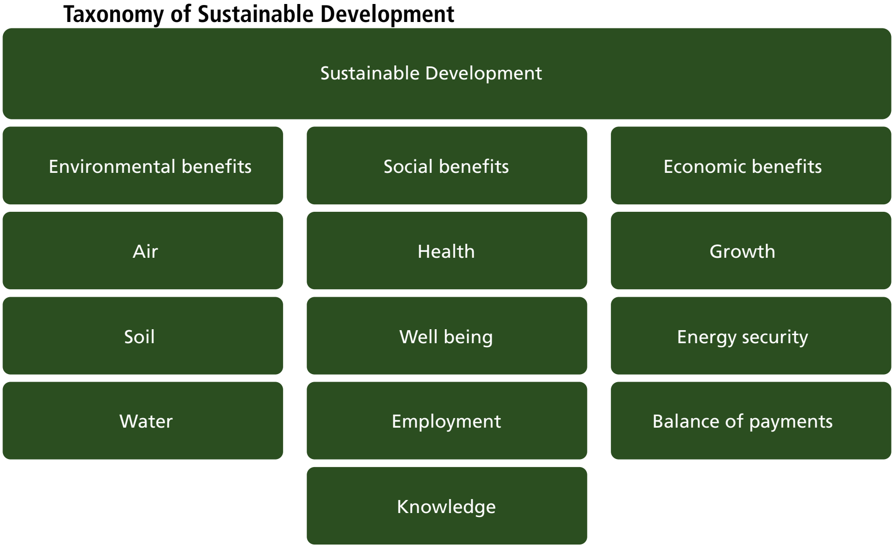
5. Available at: https://goo.gl/7p54Mv. Accessed on July 19th, 2018.

based on a multicriteria analysis (MCA). MCA methods are usually applied in the evaluation of heterogeneous indicators that, at first, cannot be directly compared.

The MCA is a diagnosis tool that can be used both prior to executing a project (*ex-ante*), for the definition of priorities or other strategic decisions in the planning phase; and after executing a project (*ex-post*), allowing performance and impact assessments against a set of pre-established criteria. In practical terms, the results represent an effort to quantify the self-declared sustainable development contributions by project proponents.

The eleven analysis indicators were defined in accordance with Annex III of the CIMGC, aligned with the taxonomy of sustainable development (figure 2), presented by Olsen and Fenhann (2008), and used by the United Nations Framework Convention on Climate Change (UNFCCC) as the basis for its CDM assessment and contribution tool for sustainable development launched in 2012 (Teri, 2012).

FIGURE 2
Taxonomy of Sustainable Development



Source: Olsen and Fenhann (2008).

Environmental, social and economic indicators and their relative weights are presented in detail in Annex B herein. The contribution scales have a score from 0 to 3,[6] the non-contribution of the project to the national sustainable development being the lowest score (0) and the largest contribution being the highest score (3).

6. For more details, see tables B.1 (environmental indicators), B.2 (social indicators) and B.3 (economic indicators) in Annex B herein.

Regarding the environmental dimension, Annex III of the CIMGC refers specifically to local environmental sustainability. Thus, indicators were defined to evaluate the contribution of projects to improving local air quality, improving water quality and reducing or mitigating soil pollution. In addition, an indicator was included that evaluates the contribution of the project to the national GHG reductions.

The social attributes described in Annex III of the CIMGC refer to the contribution of the CDM project to improving working conditions, net job creation, income distribution and capacity building. Thus, indicators were defined to evaluate the CDM project's commitments to social and labor responsibilities, the implementation of health and education programs and the defense of civil rights, reducing inequality and improving the quality of life of low-income populations and for applied technology training and reproducibility activities.

Finally, there are four economic indicators evaluated. According to Annex III of the CIMGC, the direct and indirect net job creation, the degree of technological innovation, the transfer of technology and the contribution of the project to the regional development are assessed. In addition, the project's contribution to structural sectoral changes and changes in the common practices of the sector in which the project is inserted have also been assessed.

Utility functions, for each dimension being evaluated – environmental, social and economic –, were constructed based on a *multi-attribute utility theory.* The utility function describes how the weighted attribute scores are summed to integrate a final score for a particular rating. The general formula of the utility function with m attributes is given by:

$$U(x_1, \ldots, x_m) = \sum_{i=1}^{m} w_i U_i\,(x_i) \tag{1}$$

where U represents the utility value of an i attribute, x is the initial score of the attribute at hand, and w is the weight. The assessment was carried out individually by project. A database was structured to release the notes and other relevant information. The aggregation of data and weights and the algebra of the final score was performed according to equation (1).

For each analysis attribute, the indicators notes were weighted as shown below:

$$U_{AMB} = \sum_{i=1}^{m} w_i U_i\,(AMB_{AR}, AMB_{SOLO}, AMB_{AGUA}, AMB_{CO2e}, \ldots, x_m) \tag{2}$$

$$U_{SOC} = \sum_{i=1}^{m} w_i U_i\,(SOC_{COND\_TRAB}, SOC_{IGUALDADE}, SOC_{CAPACITACAO}, \ldots, x_m) \tag{3}$$

$$U_{ECO} = \sum_{i=1}^{m} w_i U_i\,(ECO_{EMPREGO}, ECO_{TECNOLOGIA}, ECO_{INTEGRACAO}, ECO_{RCEs}, ECO_{PRAT\_COM} \ldots, x_m) \tag{4}$$

The final database allows for the hierarchization of results by project, geographic distribution and project typology. The fact that Annex III of the CIMGC does not request information regarding the potential negative impacts of CDM activities is highlighted as limiting the assessment. Thus, the zero score means that the project proponent has not stated any positive impact on any of the evaluated aspects.

It should also be noted that the methodology is limited to evaluating the data contained in the declarations provided by the CDM project proponents to the CIMGC in response to Annex III of the CIMGC, not considering any additional elements to the information listed from the public data available on the MCTIC site.[7]

4 CDM ADVANCES IN BRAZIL: SAMPLE DEFINITION OF ANALYSIS

Brazil was the first to develop CDM projects, and registered its first project activity on November 18th, 2004.[8] Between 2004 and 2012, Brazil had 28 projects rejected and eight that were withdraw from the UNFCCC registration request. Also, the number of projects that did not go through the validation stage is surprising. The public data do not allow a careful evaluation of the causes, but a total 175 projects failed to go through the validation stage. It is noteworthy that only 32 projects received a negative opinion formalized by a designated operational entity (DOE) during validation. The other projects were either replaced or had validation interrupted at the proposing country request.

TABLE 1
Detailed status of the Brazilian CDM portfolio (2004-2012)

Project Status	Number of projects
Registered	300
Validation interrupted	175
Replaced at validation	86
In the process of validation	66
Validation denied	32
Rejected	28
Replaced, validation interrupted	13
Withdrawn	8
Requesting registration	1
Replaced, validation denied	1

Source: CDM Pipeline.

7. A complementary study developed by the author carried out a sectoral approach seeking to identify the impact of the CDM on the national sustainable development from economic, technological and socioenvironmental macrotransformations.
8. Brazil NovaGerar Landfill Gas to Energy Project – UNFCCC ID CDM00007.

Because it is understood that only the registered projects comply with the requirements of the CDM, both at the international and domestic levels, this study is carried out based on the three hundred[9] CDM projects registered during the first commitment period of the Kyoto Protocol, which ended on December 31st, 2012.

4.1 Profile of projects registered between 2004 and 2012

Table 2 details the number of projects registered by type, during the assessment periods. Hydroelectricity projects, which include micropower plants,[10] small hydroelectric power plants[11] and large hydroelectric power plants, represent 25.7% of the total Brazilian projects. It should be noted that seven types of projects represent 94% of the total portfolio and are therefore a priority for the development of this analysis (graph 1).

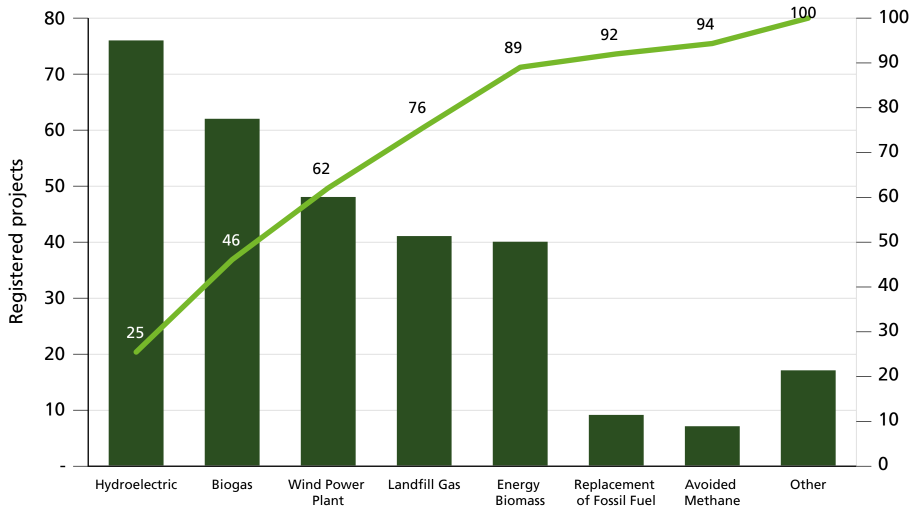
TABLE 2
Projects registered by type of project (2004-2012)

Type of project	Number of projects	Share (%)
Hydroelectric	77	25.7
Biogas	62	20.7
Wind power plant	48	16.0
Landfill gas	40	13.3
Energy biomass	39	13.0
Replacement of fossil fuel	9	3.0
Avoided methane	8	2.66
Other	17	5.7

Source: MCTIC (2016). Available at: https://goo.gl/J2z76j.
Note: This research was developed under the cooperation agreement with the United Nations Development Program (UNDP), the data were opened directly by the CIMGC to the author in XLSX format.

9. Annex A herein presents the list of the three hundred projects assessed.
10. Undertakings with up to 1 MW installed power.
11. Undertakings between 1,1 MW and 30 MW installed power.

GRAPH 1
Projects registered by type and representativeness in the portfolio (2004-2012)
(In %)



Source: MCTIC. Available at: https://goo.gl/J2z76j.

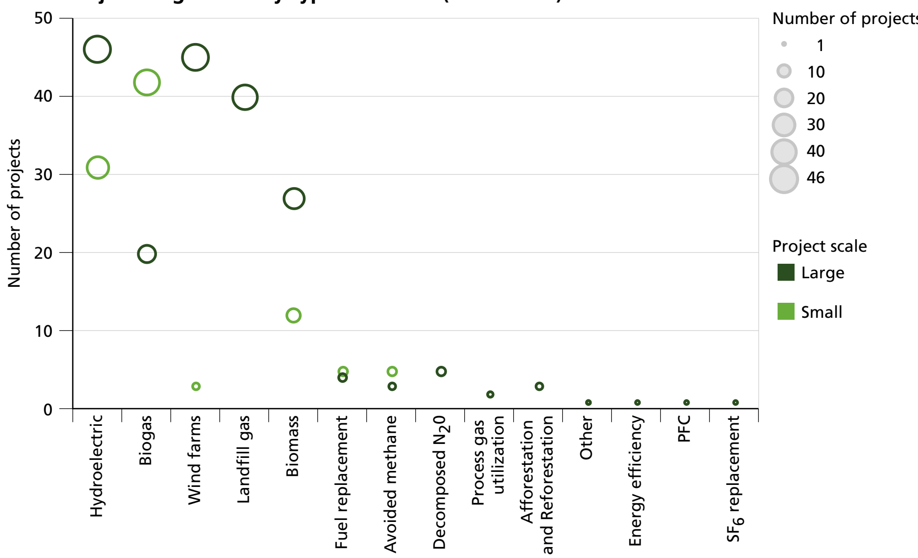
In terms of scale, small-scale projects represent approximately 33% of Brazilian CDM projects and were developed mainly for biogas (42 projects), hydroelectric (31 projects) and biomass (12 projects) projects (figure 2). For renewable electricity generation activities, projects that qualify as small-scale[12] projects have developed as such, benefiting from the simplified modalities and procedures of the CDM. Therefore, small hydroelectric power plants (SHPs), hydroelectric generating plants, small biomass cogeneration plants and wind power plants have greater representation among small-scale projects in Brazil, adding up 46 projects.

Biogas projects have the largest representation among small-scale activities in pig farming. It should be noted that the evaluation carried out based on the number of registered projects covers a fundamental characteristic of these project activities: pig farming projects are mostly microprojects. Thus, a small-scale project design document (PDD) typically aggregates a set of poultry farms.[13] Therefore, the number of pig farming projects quantified from the PDDs does not represent the real extension of this project activity in terms of the number of farms participating.

12. Installed power below 15 MW. Available at: https://bit.ly/2MYkK8X.
13. Project Bundle. Available at: https://bit.ly/2Kn1Qqz.

GRAPH 2

Projects registered by type and scale (2004-2012)

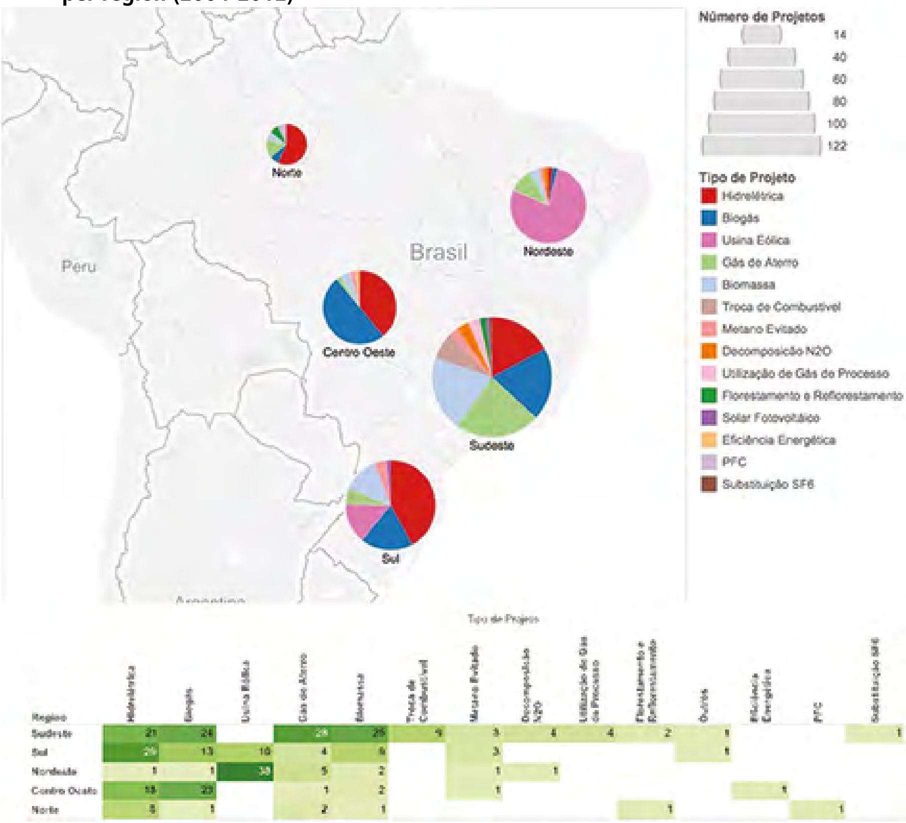


Source: MCTIC. Available at: https://goo.gl/J2z76j.

Geographically, projects are distributed heterogeneously throughout the national territory. Due to the grouping of project activities in the same PDD, the option was to not conduct such assessment by state of the Federation, but by region. Figure 3 shows the location of the projects, divided by type, by country. It is clear that the distribution of activities reflects the physical and socioeconomic characteristics of the Brazilian regions. The Southeast region has 122 projects, with predominance of landfill gas (28), energy biomass (25), biogas (24) and hydroelectric power plants (21). In addition, the region aggregates all fuel replacement projects (9), process gas utilization (4), SF_6 replacement (1), and 80% N_2O destruction projects (4).

The South region has 69 projects, the majority of them include hydroelectric power plants (29), followed by biogas (13), wind power plants (10) and energy biomass (9). The Northeast reached the record of 49 projects with total predominance of wind farms (38), followed by landfill gas (5) and energy biomass (2) projects. The Midwest region, with 46 projects and a dynamic agricultural sector, has a predominance of biogas (23) and hydroelectric projects (18). Finally, Northern Brazil with only fourteen CDM projects took advantage of its water resources to register eight hydroelectric projects.

FIGURE 3
Geographic distribution of CDM projects registered by number and type of projects – per region (2004-2012)



Source: MCTIC. Available at: https://goo.gl/J2z76j.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

The geographical and technological distribution points to a potential limitation of the CDM contribution to the sustainable development of Brazil. This hypothesis is anchored in conclusions of other studies and refers to two main elements.

First, the geographical concentration of CDM projects in the more developed regions, especially in the Southeast and South, tends to reduce the CDM contribution to sustainable development. Disch (2010) demonstrates that the regional development stage influences the mechanism's additional contribution to local development. In his evaluation, he points out that South Africa had, on average, better scores than Brazil with the exception of environmental indicators. In other words, developed regions capture little or no contribution from the CDM to sustainable development, and it is not possible to identify elements that, in fact, have a relevant positive impact. In a similar discussion, Fenhann (2011) concludes that the more developed countries (Brazil, China, India and Mexico) have a worse performance in advancing sustainable development when compared to less developed countries with less participation in the CDM.

Second, the predominance, in the Brazilian case, of technologies with low potential to have a local positive impact. It should be noted that the evaluation criteria in Annex III of the CIMGC assess elements on which these technologies have limited impact. For example, wind farms do not contribute to the improvement of the local environmental quality in relation to the reference scenario and the generation of jobs is concentrated in the implementation phase. Obviously, at the national level, there is a positive impact of renewable generation sources, mainly due to the technological diffusion and structuring of a national industrial park. However, the criteria defined by the CIMGC are also concerned with elements of positive impact and transformation at the local level.

5 EVALUATION CRITERIA FOR THE CONTRIBUTION OF THE CLEAN DEVELOPMENT MECHANISM FOR SUSTAINABLE DEVELOPMENT IN BRAZIL

5.1 Sustainable development in the context of the CDM

The principles of the CDM are defined in Art. 12 of the Kyoto Protocol, which states that CDM project activities shall contribute to the sustainable development of the host country. Furthermore, in 2001, the Marrakesh Agreement defined that the host country has the prerogative to assess the contribution to sustainable development. An evaluation by Schneider and Grashof (2007) concluded that in practice such a decision materialized in the evaluation of project design documents (PDDs) by designated national authorities from a set of pre-established criteria covering environmental, social and economic aspects. Still, some criticism has been raised suggesting that the CDM has limited impact on local sustainable development (Lohmann *et al.*, 2006; Boyd *et al.*, 2009) and that in some cases of large-scale projects, countries have opted to redirect part of the financial flows from the trading of Certified Emission Reductions (CERs) for local development projects seeking to reverse this situation (Ellis *et al.*, 2007). China, for example, applies tax rates of 65% on CERs revenue from HFCs destruction projects (Boyd *et al.*, 2009).

As a market-based instrument, the value of CERs reflects the dynamics of supply and demand for carbon emission reductions rather than the value of socio-environmental development benefits potentially linked to a reduction certificate. Therefore, the sustainability assessment criteria established by the host country are critical to the tangible contribution of CDM projects to national sustainable development since the market will not reflect such benefits in price variations. Such a commoditization process implies that the provision of additional benefits from emissions reduction projects is a consequence of the process by which countries approve projects (Ellis *et al.*, 2007). When comparing CDM projects in Brazil and Peru, for example, Cole and Roberts (2011) concluded that these countries have established quite different social development objectives. While the former emphasized job creation and income distribution, the latter sought to meet the aspirations of local communities.

This difference between Brazil and Peru was also reflected in the institutionalized assessment processes of each country. Peru has opted for an *ad hoc* approach whereby the DNA selects and visits project sites and interviews communities to identify their needs and how the project contributes to them (Cole, 2007). In the Brazilian case, the DNA established a set of criteria that should be considered by the CDM projects and informed to the DNA, by means of a declaration containing the fulfillment description of the criteria established by Annex III of Resolution No. 1 of the CIMGC. It is noteworthy that one can hardly argue in favor of one approach or another. The difference between the countries, in the case of this example, is sufficient to disqualify any judgment in favor of one or another evaluation process.

Other publications have, in fact, defended the approach used by the Brazilian DNA. Olhoff *et al.* (2004) define the Brazilian process as a list of specific criteria for assessing the contribution of the CDM to national sustainable development. According to the authors, the Brazilian criteria focus on local environmental benefits, job creation and income distribution, technological changes, training, health, education and financial returns to local agents. Olsen and Fenhann (2006) also point out that the method employed by Brazil is the most commonly used by other DNAs, although small variations have been identified, including other large emerging countries such as India, South Africa, Mexico and China.

Finally, market-based standards have come up to attest the impact of CDM projects on local sustainability through specific procedures and audit systems, for example the *gold standard (GS*). In order to achieve additional certification, the project proponent must submit to the DOE specific documentation, in accordance with the socio-environmental impact standard employed, and the evidence needed to validate their statements. However, studies on additional project certifications suggest little or no additional benefit in terms of sustainable development compared to projects without such certifications (Teri, 2012).

5.2 Annex III of the Interministerial Commission on Global Climate Change

For the purposes of this analysis, the concept of sustainable development is that defined by the Designated National Authority of Brazil through its Annex III of Resolution No. 1,[14] dated September 11st, 2003. According to the annex, the evaluation of the CDM project activity contribution is based on the evaluation of a description by the project proponent of how the project will contribute to sustainable development in relation to the five criteria described below.

1) Contribution to local environmental sustainability – evaluates the mitigation of local environmental impacts allowing comparison with expected local environmental impacts for the baseline scenario.
2) Contribution to the development of working conditions and net job creation – evaluates the project's commitment to social and labor responsibilities, health and education programs and the defense of civil rights. It also evaluates the increase in the qualitative and quantitative level of jobs (direct and indirect) comparing the project scenario with the reference scenario.
3) Contribution to income distribution – evaluates the direct and indirect effects on the quality of life of low-income populations, observing the socioeconomic benefits provided by the project in relation to the reference scenario.
4) Contribution to training and technological development – evaluates the degree of technological innovation of the project in relation to the reference scenario and the technologies used in activities that can be compared with those provided for by the project. It also evaluates the possibility of reproducing the technology employed, observing its demonstrative effect, also evaluating the origin of the equipment, the existence of *royalties* and technological licenses, and the need for international technical assistance.
5) Contribution to regional integration and articulation with other sectors – assesses the project's contribution to regional development by integrating the project with other socioeconomic activities in the implementation region.

6 CDM CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

The results of the analysis are presented in this section, including an effort to a clipping of the sample by type of project.

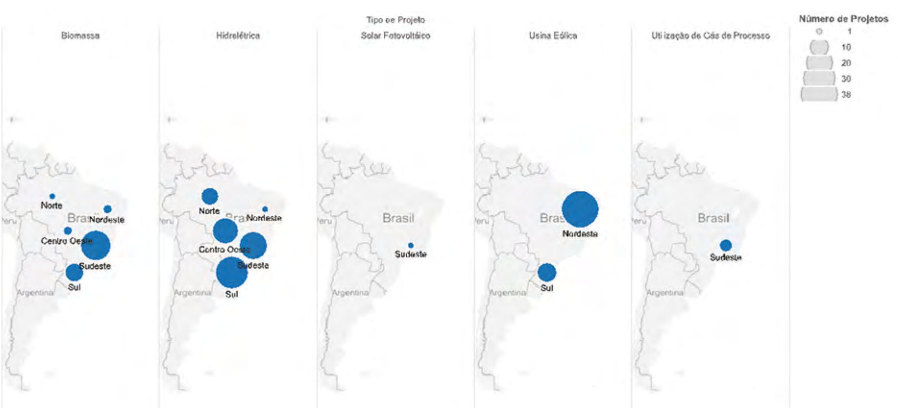
14. Available at: https://goo.gl/tVv5Zs. Accessed on July 19th, 2018.

6.1 Evaluation by type of project

6.1.1 Renewable energy

Renewable energy projects constitute 55% (159 projects) of the Brazilian portfolio in number of projects and 52.26% of estimated GHG reductions (187,893 $MtCO_2e$). CDM projects for renewable energy include hydroelectric plants, which are subdivided into hydroelectric generating units, small hydroelectric power stations and hydroelectric generating plants; thermoelectric biomass, which in Brazil include exclusively with residual biomasses such as bagasse, rice hulls, black liquor and wood residues; wind power plants; a solar photovoltaic plant and projects of use of process gas, mainly in the steel industry. Figure 4 shows the distribution of the projects, by type and regions of Brazil.

FIGURE 4
Geographic distribution of renewable energy CDM projects by number of projects and type – by region (2004-2012)



Regiao	Biomassa	Hidrelétrica	Solar Fotovoltáico	Usina Eólica	Utilização de Gás de Processo
Sudeste	25	21	[illegible]		4
Sul	9	29		10	
Nordeste	2	1		38	
Centro Oeste	2	18			
Norte	1	8			

Source: MCTIC. Available at: https://goo.gl/J2z76j.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

The project activities are mainly distributed among three regions of the country. The Southeast holds 51 projects, followed by the South region with 48 projects and the Northeast with 41 projects. The Midwest region recorded 20 projects while the Northern region registered nine. Hydroelectricity is therefore highlighted with 77 projects, wind generation with 48 and biomass thermals add up 39 projects.

The hydroelectric projects add 750.42 MW of installed capacity to the Brazilian electrical mix. The figure is quite modest compared to the expansion of this source in the period between 2004 and 2012. Data from the Energy Research Company (EPE, 2013) show an expansion of 13,436 MW, from 70,858 MW in 2004 to 84,294 MW in 2012. Therefore, the CDM projects contributed with 5.58% of the new installed power in the analysis period.

Unlike hydroelectric generation, wind power plants became representative among the Brazilian electricity grid sources from 2004. CDM wind energy projects added up 3,750 MW, 44.17% of all wind energy contracted in the evaluation period, signaling for the relevance of the mechanism to boost this generation source. Also, it is known that the financial model of wind farms participating in energy auctions often considered the revenues from the sale of CERs in the composition of the final price of electricity.

The last group of relevant projects in terms of number of registered activities and estimated emission reductions is the group of energy biomass ventures. Thirty-nine projects with a large area of sugarcane bagasse were registered as the main energy input in 27 projects (69%). From the data presented in the PDDs of the sugarcane bagasse projects, it was observed that their installed capacity is 1,226 MW. Thus, they represent 21.91% of the total installed potential of sugarcane bagasse during the analysis period.

The grades for each renewable energy CDM project were scored individually and then aggregated by type to make a contribution to sustainable development (figure 5).

FIGURE 5
Contribution to the sustainable development of renewable energy projects – by hydroelectric, wind and biomass types

Prepared by the author.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

From the analysis of the graphs in figure 5, it can be seen how hydroelectric projects contributed to the sustainable development of Brazil. It reinforces the low environmental contribution of this type of project; on the other hand, these are projects with relevant social and economic components, contributing to the job creation, working conditions and social equality.

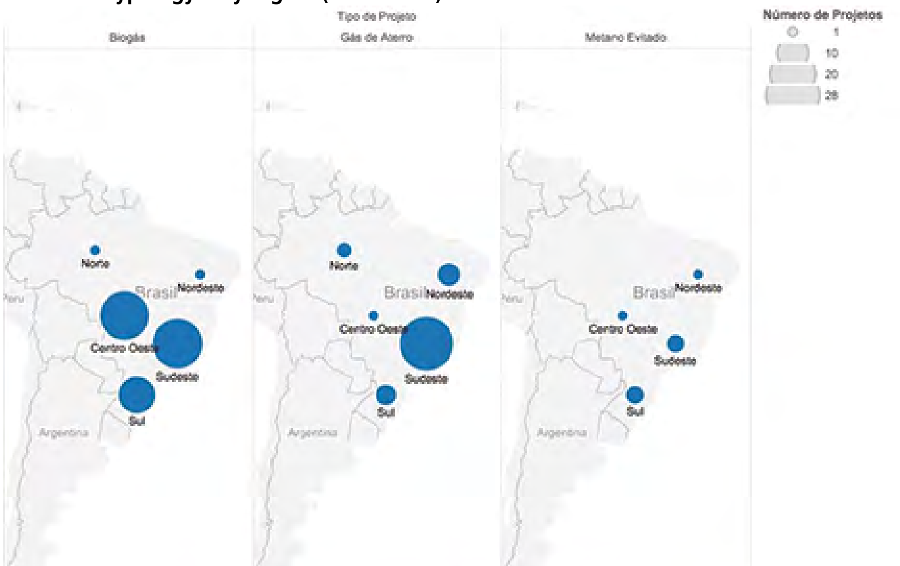
In the case of wind farm projects, the contribution to environmental development is also of little relevance. The only exception is the expected emission reductions, since the estimated volume of CERs for these projects is significant. In turn, the social and economic contributions are relevant, with maximum marks obtained in equality, capacity building, job creation and regional integration indicators.

Finally, the evaluation of biomass projects reinforces the low relevance of the CDM in the energy sector in contributing to environmental development. In addition, energy biomass projects presented an intermediate profile in terms of technology transfer and diffusion by applying technologies available nationally, but not used, until 2004, by the sector. Therefore, although the technology was dominated by the national industry, as in the case of hydroelectric plants, high-efficiency cogeneration systems were not used for electricity generation from biomass. Therefore, these projects contributed to the inter-sectoral technological transference, presenting a strong demonstrative character.

6.1.2 Methane

The methane CDM projects constitute 33.66% (110 projects) of the Brazilian portfolio in number of projects and 31.74% of the estimated reductions (111,951 $MtCO_2e$). CDM projects in pig farming represent the main initiative with the potential to contribute to the sustainable development of small-scale producers in microscale. Another relevant set of activities is the capture and flaring of landfill gas and avoided methane activities that cover composting projects and replacement of liquid effluent treatment technologies.

FIGURE 6
Geographic distribution of registered methane CDM projects by number of projects and typology – by region (2004-2012)

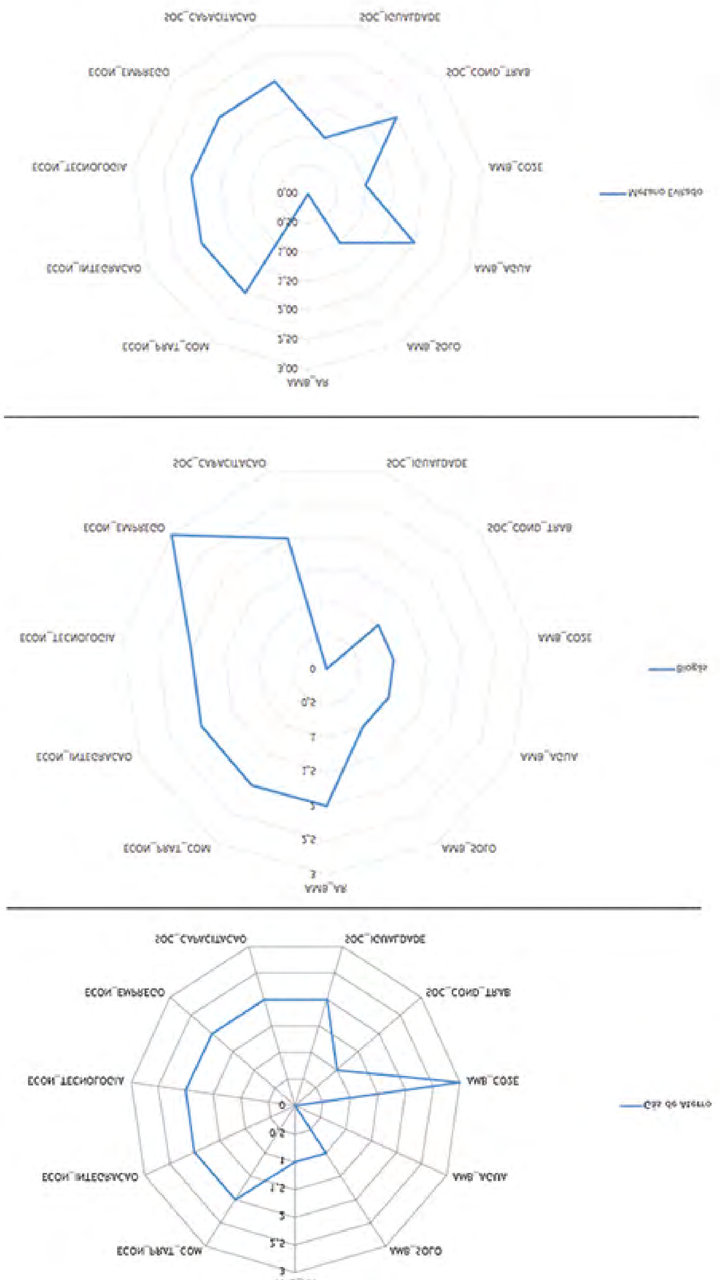


	Tipo de Projeto		
Regiao	Biogás	Gás de Aterro	Metano Evitado
Sudeste	24	28	3
Centro Oeste	23	1	1
Sul	13	4	3
Nordeste	1	5	1
Norte	1	2	

Source: MCTIC. Available at: https://goo.gl/J2z76j.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

Methane projects were implemented in all regions of Brazil. For landfill gas projects, the Southeast region stands out, with twenty-eight projects registered. The Northeast region has five projects of this type and the South region has four. Therefore, the geographic distribution of the projects reflects the sanitation infrastructures in the country with clear leadership of the Southeast region. It should be noted that the projects initially developed prioritized landfills in operation for decades, since they have the greatest biogas generation potential

FIGURE 7
Contribution to sustainable development – projects for methane, landfill gas, biogas and avoided methane



Prepared by the author.
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It should be emphasized that the data presented do not include, in a disaggregated way, the program of activities (PoAs) developed for landfills (Ref. 6573),[15] composting (Ref. 7760) and pig farms (Ref. 2767). PoAs were introduced in 2007 during the 32nd and 33rd meetings of the CDM Executive Board. A program allows to register, as a CDM project, the coordinated implementation of policies, measures and objectives that lead to emission reductions. After the registration of a PoA, an unlimited number of project components (CPAs) can be added to the program. Therefore, PoAs aim, first and foremost, at the scalability of small-scale emission reduction actions within a single CDM project. It is emphasized, therefore, that for all purposes, a PoA is considered a project activity. For methane projects, programs played an important role in swine farming by adding 1,050 methane reduction activities to pig farms.

Landfill gas projects have not reported any impact on water quality and only nine have provided evidence of contribution to soil and air quality. On the other hand, this type of project has great potential to reduce emissions of greenhouse gases, which is reflected in the high score of the environmental criterion of GHG emissions. The other indicators had a medium score, with a high concentration of indicators with 2, with the only exception being the social indicator of contribution to working conditions. In addition, the internalization of the technology did not actually happen, and although the projects use active biogas suction systems produced abroad, there was not enough scale of projects to foster the national industry and the transfer of technology.

In the case of biogas projects, the contribution of these projects to the local air quality stands out in the environmental dimension. In the specific case of these projects, the contribution was to the reduction of odors, not of gaseous pollutants. This contribution was systematically observed in Annexes III. In addition, above-average scores are observed for indicators of job creation, technology and common practice. In the case of job creation, there is a clear confusion between swine activity and the emission reduction project. It is understood that, for the execution of the CDM project, the emission baseline already existed, and so did the farm, jobs and revenues from this economic activity. In this scenario, it is difficult to agree with the argument that the installation of biodigestors generates direct jobs in a relevant way.

Finally, in relation to avoided methane projects, it is observed that the lowest scores in the environmental dimension were from the effluent projects. Similar to the swine situation, the implementation of an aerobic treatment stage does not imply significant environmental gains since the baseline plant was operating at the efficiency levels required by the legislation. The highest environmental score

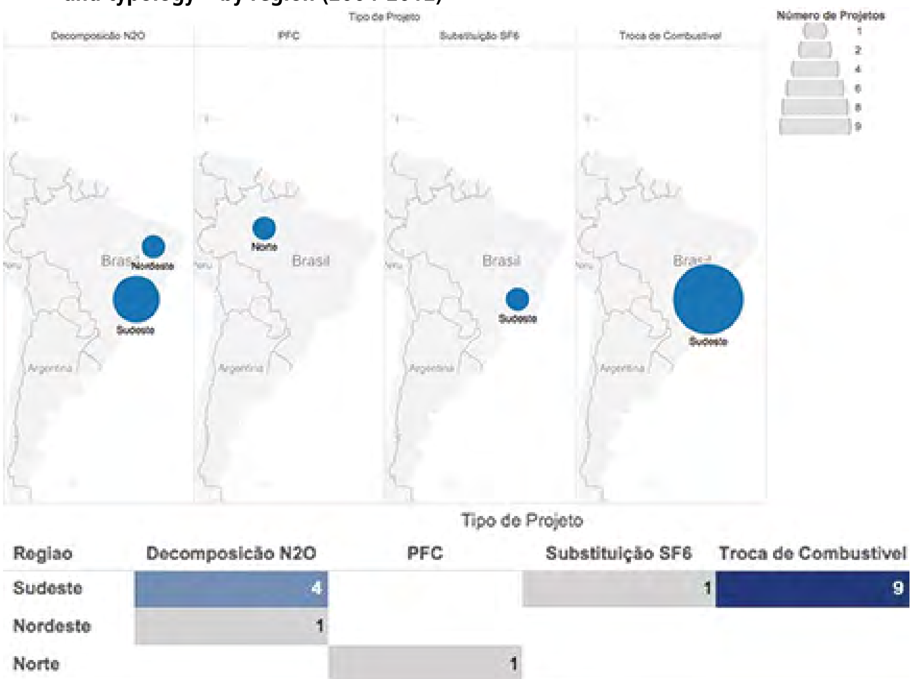
15. Registration number under the UNFCCC.

was achieved by the Queiroz Galvão carbonization project in Maranhão, mainly because it is a project with high emission reduction potential (AMB_CO_2). Here, the confusion between carbonization activity throughout its cycle, including planting, handling, cutting and production of coal, is also highlighted, with the CDM project activity exclusively dealing with the replacement of traditional kilns by industrial kilns. Thus, the environmental benefits derived from the production of renewable energy biomass should not be accounted for by the project, but were presented as contributions of the project to sustainable development. In the social dimension, carbonization projects stand out because they are known to contribute to the improvement of working conditions, income generation and equality, and training and capacity building. Finally, the economic dimension received higher-average scores than social contributions. The avoided methane projects contributed mainly to the exchange of common practices in industry, charcoal production and waste treatment.

6.1.3 Industrial projects

The industrial projects constitute 5.33% (sixteen projects) of the Brazilian portfolio in number of projects and 14.26% of the estimated reductions (50,302 $MtCO_2e$). Industrial gas destruction projects, such as N_2O, SF_6 and PFC, have been heavily criticized for being projects with little or no impact on sustainable development. The industrial CDM projects are divided into four types: *i*) decomposition of N_2O; *ii*) PFCs; *iii*) replacement of SF_6; and *iv*) exchange of fossil fuel. The first three are quite specific to some segments of the industry while fuel substitution activities can be performed in any major energy-consuming industrial activity, primarily thermal energy in the form of heat or steam.

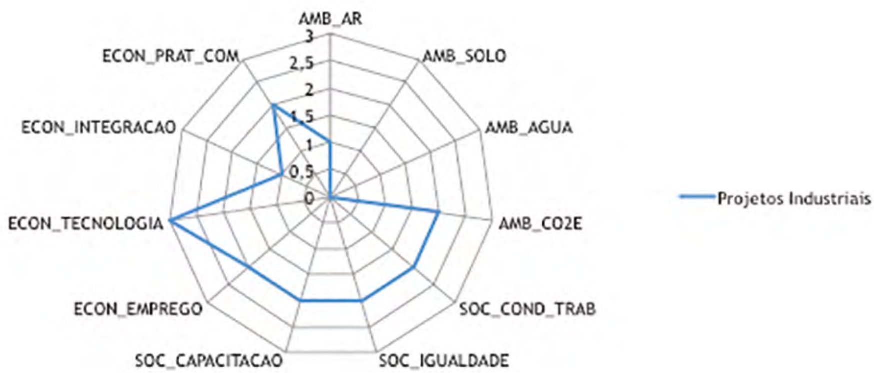
FIGURE 8
Geographic distribution of CDM industrial projects registered by number of projects and typology – by region (2004-2012)



Source: MCTIC. Available at: https://goo.gl/J2z76j.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

As observed, the Southeast region, due to having a more developed industrial park, registered fourteen of the country's sixteen industrial projects, including 100% of fuel substitution activities. The Northeast holds, at the petrochemical complex of Camaçari, one of the N_2O decomposition projects.

FIGURE 9
Contribution to sustainable development – industrial projects



Prepared by the author.
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Due to the smaller number of industrial projects, it was decided not to present the evaluation by type of project (figure 9). The low contribution of these projects to national sustainable development is confirmed, especially in relation to the environmental dimension. The indicators score is only average, with variations between one and two scores and two environmental indicators, soil and water quality, with a score of 0. The industrial projects reached a maximum mark in the technology item. Firstly, by the implementation of technology not available in Brazil, in the case of projects for the destruction of industrial gases, and also due to the contributions and demonstrative effects of registered fuel replacement projects, which represented the first wave of large-scale industry, mainly benefited by the country's newly deployed natural gas distribution infrastructure.

6.1.4 Forestry projects

Forestry projects constitute only 1% of the Brazilian portfolio in number of projects, with three projects registered and 0.67% of the estimated reductions (2,363 $MtCO_2e$). The forest CDM projects registered in Brazil include two groups of activities, the reforestation of energy forests for use in the pig iron chain and the activities of reforestation of native forests for recovery of riparian forests and permanent preservation areas (APPs) around reservoirs.

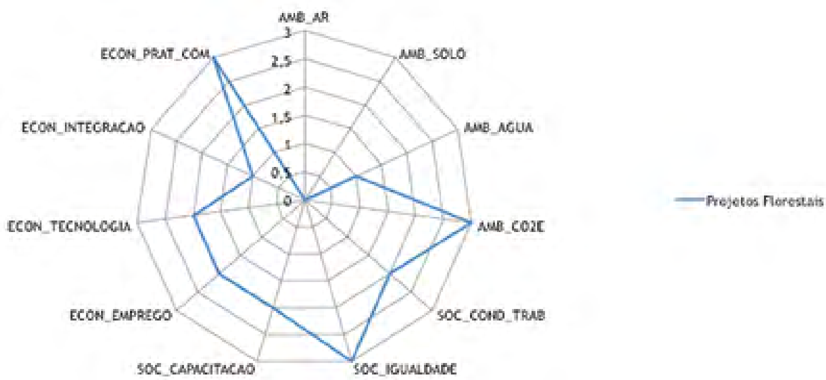
The forestry CDM projects are composed of two activities in Brazil: *i*) reforestation of energy forests; and *ii*) reforestation of native forests. Only three forestry projects were registered in Brazil, two in the state of Minas Gerais and one in the state of São Paulo (figure 10). It highlights the great potential of Brazil for the development of these projects and, at the same time, the low number of registered projects. Of course, much of the justification for this fact concerns the technical demands for execution and registration of forestry CDM projects and the costs associated with the implementation of the monitoring plan.

FIGURE 10
Geographic distribution of forestry CDM projects registered – by region (2004-2012)

Source: MCTIC. Available at: https://goo.gl/J2z76j.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

The maximum environmental score was only achieved by the emission reduction indicator. In fact, no project has stated positive environmental impacts to air or soil. On the other hand, the social and economic performance of the projects was high, including a maximum score in the social and economic dimension and an average score in the economic dimension above 70% in the aggregate of projects.

FIGURE 11
Contribution to sustainable development – forest projects



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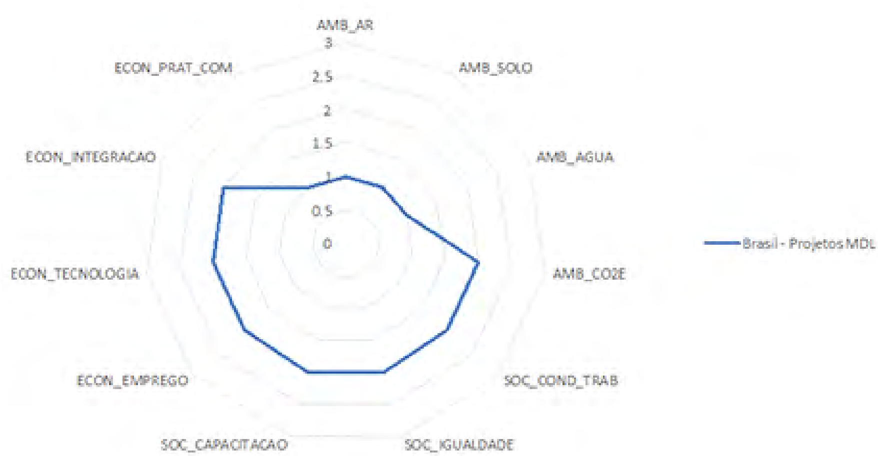
6.2 Aggregated score of Annex III evaluations

This section presents the aggregate assessment of Brazil's contribution to sustainable development derived from the evaluation of Annexes III. On the average, the contribution to environmental indicators was worse evaluated, both from the point of view of air, water and soil quality. Given the average emission reduction volume of Brazilian CDM projects, the emissions indicator received a slightly higher score.

FIGURE 12
Average score of sustainable development indicators in Brazilian CDM projects



Prepared by the author.
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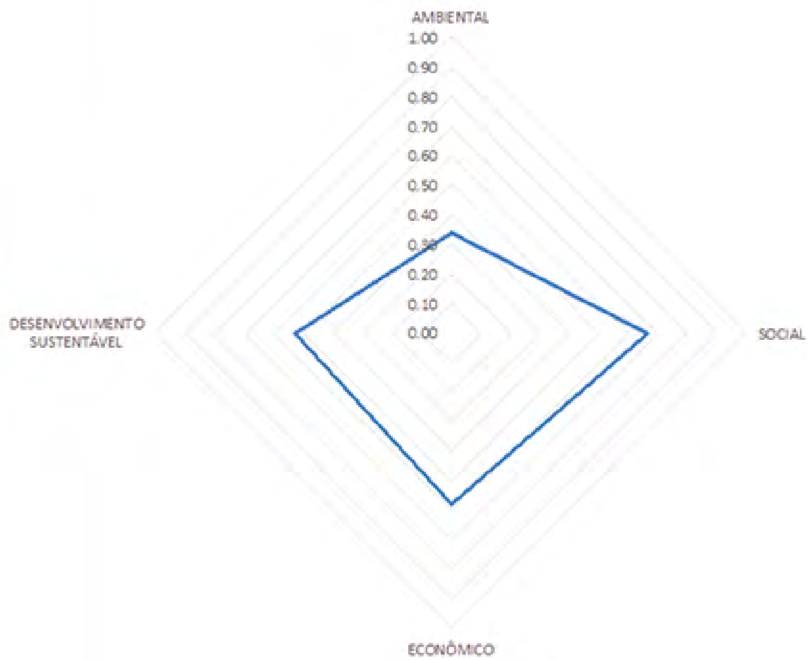
In the average of the projects, the social indicators totaled 2 points. This indicator was the one that presented the greatest variation among the types of projects reflecting the scale of the project. Finally, the economic dimension also presented an average score 2 in its indicators.

For the set of projects, the indicators were aggregated in their respective dimensions, allowing another look at the contribution of the CDM to the sustainable development in Brazil (figure 13). In the aggregate, the environmental dimension was the worst evaluated, adding up a score of 0.34. The social dimension score was 0.67, the highest among the three dimensions of sustainable development. The economic dimension obtained a score of 0.58.

FIGURE 13
Scores of the environmental, social and economic dimensions and general score of the contribution to the sustainable development of Brazilian CDM projects



Prepared by the author.
Obs.: Figure displayed in low resolution and whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

Table 3 summarizes the environmental, social and economic dimensions of the typologies of projects evaluated by this report. As a final observation, it is noteworthy that in the environmental field the lowest score was obtained by hydroelectric projects (0.25), while fuel, landfill gas and biogas projects reached the highest scores (0.42). In the social sphere, the lowest score was for biogas projects (0.33) and the highest scores were obtained by wind, biomass and forestry projects (0.78). Finally, in the economic dimension, the lowest score was obtained by fuel replacement projects (0.33) and the highest score by wind, biomass and biogas projects (0.75).

TABLE 3
Summary of scores in assessing the contribution to sustainable development

	Environmental	Social	Economic
Hydroelectric	0.25	0.67	0.50
Wind	0.42	0.78	0.75
Energy biomass	0.25	0.78	0.75
Fuel replacement	0.42	0.56	0.33
N_2O decomposition	0.25	0.56	0.67
Landfill gas	0.42	0.56	0.67
Biogas	0.42	0.33	0.75
Avoided methane	0.33	0.56	0.67
Forestry	0.33	0.78	0.67
Brazil	0.34	0.67	0.58

Prepared by the author.

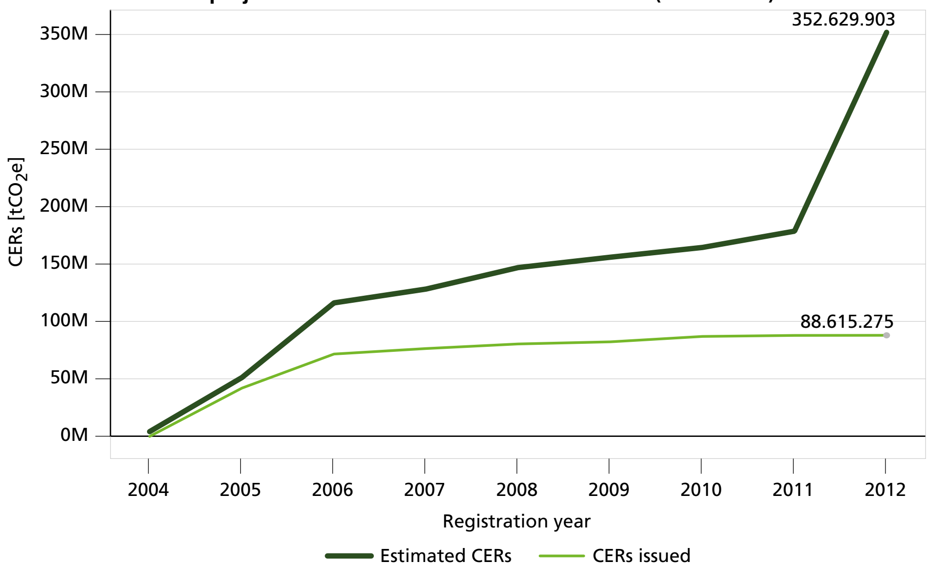
Before moving on to the final section of this discussion, two other relevant results to the CDM's contribution to sustainable development will be presented below. First, the capacity of CDM projects to effectively contribute to national emission reductions was evaluated, and then data were collected from the Central Bank of Brazil (BCB) to provide a look at the CDM contribution to the balance of payments in Brazil.

6.3 Emission reductions achieved during the analysis period

The three hundred projects that have been registered have, together, an emissions reduction potential of 352.629.903[16] tCO_2 according to the project design documents (PDDs). Out of this potential, 88,615,275 certified emission reductions (CERs) were issued in 2012, representing approximately 25.13% of emission reductions expected for the review period. Graph 3 shows the evolution, between 2004 and 2012, of estimated emission reductions in the registered PDDs and the CERs issued per year in the same period.

16. MCTIC data calculated for the first crediting period registered in the first commitment period of the Kyoto Protocol.

GRAPH 3
Brazilian CDM project CERs estimated ex-ante CERs issued (2004-2012)



Source: MCTIC. Available at: https://goo.gl/J2z76j.

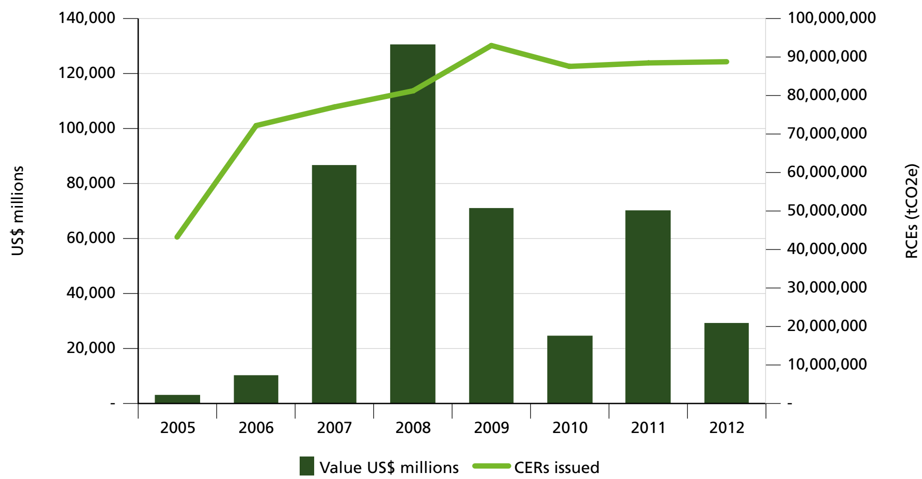
The value presented is relevant, since according to the analysis presented previously, the main contribution of the CDM projects to the environmental dimension is the estimated GHG emission reduction volume. It should be noted that, even excluding this sudden increase, the average CERs issuance performance of Brazilian CDM projects in the period from 2004 to 2010 was 49.36% of the volume of expected reductions.

6.4 International currency inflows

Another important factor that must be considered is the inflow of financial resources into the country through the trading of CERs. However, the nature of contracts does not allow this information to be readily available because they are bilateral negotiations between private entities. Moreover, the efforts needed to accurately collect this information go beyond what was initially anticipated by this analysis. Thus, in order to advance this information in some way, and contribute to the proposed debate, we opted to work with national aggregated data provided by the Central Bank of Brazil.

Since 2005 (Circular Letter 3291), the Central Bank of Brazil has established a classification code for the closing of foreign exchange related to the sale of carbon credits. The current legislation (Circular Letter 3690) is of December 2013 and presents the code under various services – carbon credits/rights issue (47939). From the request made directly by the Ministry of Science Technology and Innovation to the Central Bank of Brazil, the total value of inflows (in dollars) was provided for the period from January 1st, 2004 to December 31st, 2012.

GRAPH 4
Foreign currency inflow for the trading of carbon credits and annual emissions of CERs (2005-2012)
(In US$ millions)



Source: Central Bank and MCTIC.

During the first commitment period of the Kyoto Protocol, US$ 425.4 million entered Brazil identified by the Central Bank as revenue from the sale of carbon credits. In the same period, 631.5 million CERs were issued by Brazilian projects. If we assume that all CERs issued in the period were traded, we will have an average price per CERs of $0.70. However, it is known that the average market prices in the period were well above this value. It is true that part of sales revenue never reached the country, especially in the case of multinational companies projects and in the cases in which the projects, mainly in the swine industry, received advances in equipment and provision of services, causing the first trading revenues of CERs to be retained by financing agents and consultants, many of them with operations abroad.

7 DISCUSSION

Once an outcome has been envisaged, which adds to the evaluation efforts of Annexes III, this section seeks to discuss practical implications of gaps, challenges, lessons learned and best practices. The main conclusions of this study are presented below.

7.1 Overview of outcomes

Firstly, it should be noted that Annexes III constitute a self-declaration provided by project proponents. Therefore, these submitted annexes are documents that present the intended contribution to sustainable development by the project and not its real concrete contribution.

From an environmental perspective, the results demonstrate a limited contribution of CDM projects to sustainability. The criteria established by the CIMGC are focused on local environmental impacts. This analysis sought to identify contributions to improve air quality, soil and water resources management, as well as to include an additional component of GHG emission reduction. In general, the projects do not declare relevant contributions to environmental sustainability and this dimension is the least important in the analysis. Also, it can be noted that most CDM projects have a non-impact or low-environmental impact profile, and do not necessarily contribute to the improvement of environmental quality.

From the social perspective, it can be concluded that projects that are capital-intensive, such as renewable energy projects, end up having a better score since they systematically invest in the training of their collaborators and contribute to better working conditions. Also, large-scale projects are able to present the generation of direct and indirect jobs, the number of people impacted by the training process, and the positive impacts on local communities in a recurrent, objective and quantitative way.

From an economic perspective, the most controversial issue identified is the contribution of CDM projects to national integration. Often the projects stated that they would contribute to national integration, however, without presenting evidence to that effect. This is the case of projects that produce energy for the electricity grid, which have consistently claimed to contribute to national integration. The limited role of the CDM for technology transfer and the contribution to changing common practices stands out. It is noted that the CDM played an important role in the introduction of emission reduction technologies in the country without necessarily constituting transfer of technology. This is the case with landfill gas projects and N_2O destruction. The N_2O projects, in fact, implemented unconventional technology in the country, but it cannot be considered as technology transfer since the replicability of this activity is limited. Technology transfer can be identified for wind and biogas projects.

Finally, the low performance in achieving the estimated GHG reductions (figure 3) is largely explained by the phenomenon of the *race for the registration*, observed in 2011 and 2012. Some projects, especially in the electric sector, reached historical milestones in terms fast registration in these two years. This race was caused by the pressing risk of exclusion of CERs from CDM projects registered after

December 2012 in the post-Kyoto negotiations. Therefore, the observed increase reflects emission reductions of projects registered at the end of the commitment period that did not have time to issue their certificates, either because they had not completed a monitoring cycle, usually of 12 months, or because they were still in the implementation, as in the case of most wind farms registered as CDM projects in the period.

7.2 Absence of a completeness and objectivity procedure

Annex III lacks a completeness and objectivity procedure. In providing a set of open-ended questions, Annexes III have become a compilation of statements that do not necessarily reflect the CIMGC's assessment interest, such as the assessment of the contribution of a given project to national sustainable development. Similarly, the lack of a completion procedure also imposes limitations on the evaluation team and the learning curve over the years has led to a series of understandings and changes in approaches to the approval of CDM projects in Brazil.

These changes include the obligation, in the CDM's first years, to declare the contribution of the project to all dimensions of sustainable development. Such a decision has even impacted the evaluation proposed by this study since the projects registered in the first three years tend to present a more extensive list of contributions in its annexes III simply to fulfill the procedural demands.

The lack of completeness and objectivity procedure is clearly observed in the variability of project sample scores. The various interpretations of the project proponents are evident to present the contributions of the projects submitted in annexes III. Undoubtedly the results should present scores with variations associated with the typology of different projects, and the regions of implementation. In turn, there should be some harmonization of contributions to sustainable development among project typologies, with more consistent scores. Otherwise, it is not possible to identify any scoring pattern by region or by project typology, even in cases where the contribution of a project (or technology) to sustainable development is quite evident.

7.3 What is (and what is not) a CDM project

There is a recurring confusion over what is, in fact, a CDM activity. The objective of the CIMGC's Annex III is to evaluate exclusively the contribution of the CDM project to the sustainable development of Brazil. For example, in renewable energy projects, the generating plant is the component that allows the reduction of GHG emissions. Therefore, evaluating the contribution to the sustainable development of the project is the same as evaluating the contribution to the sustainable development of the renewable generation plant. This is, for example, the case of wind farm projects and the implementation of new SHPs.

However, there are situations where the CDM activity is only one component of a broader activity or project. For example, cogeneration activities with sugarcane bagasse are mainly interventions in existing plants and involve the installation and operation of more efficient equipment in a thermoelectric plant that had already been operating. Similarly, the repowering of SHPs under the MDL approach addresses the activities that led a SHP in operation to produce more energy. The contribution of the CDM to sustainable development, in these cases, has no relation with the generation plant in a broad context, since it deals exclusively with the exchange of equipment such as boilers, turbines and generators. In many cases, the CDM project was analyzed from the larger context, which does not reflect the real contribution of the activity to sustainable development.

This inconsistency in the declarations of Annex III of the CIMGC has been recurrently identified, but are especially relevant for methane projects. To put it in another way, most methane CDM projects do not relate to the construction and operation of landfills or effluent treatment systems or pig farms, but rather to the installation and operation of capture and burning systems. methane with or without energy recovery. Annexes III should reflect the impacts of the biogas capture activity and its subsequent destruction or energy use and not the landfill or pig farm, for example.

7.4 Annex III as a phase of a bureaucratic process

The ultimate goal of CIMGC's Annex III is to enable the Brazilian DNA to assess whether CDM projects are meeting a central requirement of the mechanism that is contributing to national sustainable development. However, it has been widely observed that for project proponents, this is only one step within a complex bureaucratic process. There is no genuine effort to ensure that CDM project activities actually contribute to sustainable development. Undoubtedly, the costliest situation to reflect this situation is the fact that many "Annexes III" present the same wording, that is, exact textual copies were frequently used for similar projects or developed by the same proponent.

7.5 Annex III as a summary of environmental licensing

An inherent trend of the environmental licensing process stands out, in which many projects do not argue in favor of positive impacts, focusing, instead, on reducing or mitigating any negative social and environmental impacts. Thus, it was identified that CIMGC's Annex III, in most part, reflects, in a summarized way, the registration contained in studies for environmental licensing.

Surprisingly, this fact produced a perverse incentive for this study: projects with greater socio-environmental impact end up having a greater number of licensing constraints that increase the score in the social and economic dimensions of the evaluation. This fact also corroborates the assertion that the contribution of the CDM to the Brazilian sustainable development was limited, since the implemented actions, mainly those considered initially as voluntary, can originate from environmental licensing constraints.

However, it is understood that positive impacts could have been listed and presented by project proponents mainly in situations where the CDM project contributed to a better environmental control of the activity or in situations where the project has clear environmental co-benefits such as cases of fuel replacement projects or projects that use waste for energy generation.

7.6 CDM limitations towards sustainable development

The results of this study corroborate the arguments of Lohmann (2006) and Boyd et al. (2009), concluding that the contribution of the CDM to sustainable development is limited. This research provides additional evidence as to why the mechanism does little to contribute to local sustainable development.

First, one conclusion is that the intensions of the mechanism are too great. The Marrakesh Agreement levels up GHG emissions reductions and the contribution to sustainable development. One must recognize the ultimate goal of the mechanism: to produce economic incentives for the execution of emission reduction activities. A scenario was constructed, based on the north-south dichotomies, that the mechanism would be enough to generate not only financial but also technological flows, human resources, knowledge and good practices. There is no evidence to prove that this scenario materialized in Brazil.

The evaluation indicates, however, that the CDM in Brazil was an important driver of change. Thus, the role of the mechanism was, at first, a demonstrative effect in which the private sector assumes great risks seeking larger marginal returns on its investments. It is also noted that the Brazilian potential for the mechanism is significantly higher than that exploited and that the registered emission reduction activities aimed at the most obvious opportunities and effective costs. Unequivocally, the restructuring of the electricity sector places renewable generation activities as one of the most obvious opportunities for the CDM in Brazil and, in fact, this type of project is more representative in the portfolio of Brazilian projects. It is argued, therefore, that the CDM provides evidence that public policies aimed at fostering the transition of the Brazilian economy to a low-carbon economy could be strengthened if integrated with carbon pricing mechanisms.

Because it is a market-based mechanism, there must be no innocence in relation the mechanism's developments. The main consultancy firms operating in Brazil were foreign and were capitalized. Thus, a business model was adopted in which CDM projects (PDDs, validation, registration and verification fees) were taken over by these consultants, in exchange for a contract guaranteeing the purchase of CERs for pre-established values. Thus, the maximization of the return on investment is exclusively related to the emission reduction performance of the CDM project. In other words, these consultancy firms were only interested if the project was operational and the monitoring system was in perfect functioning. That is, the contribution to sustainable development has never been a priority for economic agents operating in the market.

Finally, the impacts of the CDM on sustainable development can also be considered as limited, as some CDM projects tend to discontinue their activities due to low prices and uncertainty over demand. Therefore, even if relevant contributions to sustainable development actually existed, they may not persist in the long run. In this context, CDM projects can be separated into two distinct groups: *i)* those that require large capital investment and have other revenues than the CDM; and *ii)* those whose initial investment has already been redeemed and do not have additional revenues beyond the CDM. The first case includes renewable energy projects, some industrial projects and forestry projects. Most likely, these activities will remain operational even if the CDM is no longer a relevant financial incentive. In the second scenario, it is virtually certain that activities, mainly methane capture and destruction, will cease to operate, thus disregarding the perennial contribution to sustainable development identified by this study.

7.7 Demand for monitoring

A very straightforward lesson learned with this publication is the need to implement a monitoring mechanism of contributions to sustainable development. According to Teri (2012), no country monitors the long-term contributions to sustainable development. As it is a self-declaration of a claim to contribute to sustainable development, the content of Annex III of the CIMGC, or any tool that may replace it, must be monitored.

Monitoring can be sporadic or by sampling, as long as it is done. In order to reduce costs and increase the number of projects monitored annually, the DNA may request evidence of the implementation of the activities listed in the CIMGC's Annex III or of the aforementioned sustainable development contributions.

7.8 Uncertainties may determine the end of the mechanism

Finally, as an innovative mechanism, barriers and lessons learned about the CDM were expected to be observed throughout the first commitment period of the Kyoto Protocol. However, it was verified that the history of changes in the rules of the mechanism, such as revisions of procedures and methodologies, together with the current market uncertainties, established a scenario of acute crisis of confidence. A view shared by all sectors evaluated is that much time and money has been invested and that this investment has been lost. In this context, the discussion on future procedures becomes irrelevant if the Brazilian engagement in the construction of the climate regime is not necessarily followed by the establishment of clear and long-term rules that can guarantee both market security (in the case of a market-based mechanism) and legal and institutional security. The crisis of confidence created may result in the non-participation of the private sector, either in a new CDM cycle or in a new *offseting* mechanism.

Finally, it should be borne in mind that the CDM represented an innovative milestone in environmental regulation and that the period under review carries a strong learning component for both the UNFCCC and the CIMGC. Consequently, the implications for public policy and the subsidy of future procedures are mostly a set of lessons learned. As discussed, the procedure adopted by the Brazilian DNA was the most commonly adopted in the world (Olsen and Fenhann, 2006) and, in general, this procedure was evaluated as more objective than that adopted by most DNAs, which were limited to evaluate the content of the PDD of the projects (Schneider and Grashof, 2007).

From the perspective of this international discussion to review the mechanism, it is understood that a revision of the method and procedures for the evaluation of the contribution of emission reduction projects to sustainable development in the future is necessary. A clear definition of the indicators will, for example, allow documentary evidence to be provided by project proponents to support their self-declarations. Also, once the objective criteria for quantifying the contribution of GHG emission reduction projects to sustainable development have been established, clear rules can be established for the approval of the projects, which may include the achievement of a minimum overall grade or a grade sustainable development.

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ANNEX A

TABLE A.1
Projects registered by December 31, 2012

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
14	108	12/9/2005	Becker Farm GHG Mitigation Project
15	47	1/30/2006	GHG capture and combustion in manure management systems of Faxinal dos Guedes and Toledo farms – Sadia project – Brazil
48	337	5/25/2006	AWMS GHG BR05-B-07 Mitigation Project, Minas Gerais, Mato Grosso and Goiás – Brazil
43	364	6/18/2006	AWMS GHG BR05-B-02 Mitigation Project, Minas Gerais and São Paulo – Brazil
49	365	6/18/2006	AWMS GHG BR05-B-09 Mitigation Project, Goiás and Minas Gerais – Brazil
47	409	7/8/2006	AWMS GHG BR05-B-06 Mitigation Project, Bahia – Brazil
74	417	7/9/2006	AWMS GHG BR05-B-10 Mitigation Project, Minas Gerais, Goiás, Mato Grosso and Mato Grosso do Sul – Brazil
82	420	7/9/2006	SMDA GHG BR05-B-14 Mitigation Project, Espírito Santo, Minas Gerais and São Paulo – Brazil
46	412	7/9/2006	AWMS GHG BR05-B-05 Mitigation Project, Minas Gerais and São Paulo – Brazil
81	419	7/9/2006	SMDA GHG BR05-B-13 Mitigation Project, Minas Gerais and Goiás – Brazil
83	421	7/9/2006	SMDA GHG BR05-B-15 Mitigation Project, Paraná, Rio Grande do Sul, Santa Catarina – Brazil
45	411	7/9/2006	AWMS GHG BR05-B-04 Mitigation Project, Paraná, Santa Catarina and Rio Grande do Sul – Brazil
84	422	7/15/2006	SMDA GHG BR05-B-16 Mitigation Project, Bahia, Goiás, Mato Grosso, Minas Gerais, Rio de Janeiro and São Paulo – Brazil
42	335	8/29/2006	AWMS GHG BR05-B-01 Mitigation Project, Minas Gerais – Brazil
98	466	9/10/2006	SMDA GHG BR05-B-08 Mitigation Project, Paraná, Paraná and Rio Grande do Sul – Brazil
99	472	9/11/2006	SMDA GHG (Greenhouse Gas) BR05-B-12 Mitigation Project, Mato Grosso, Mato Grosso do Sul, Minas Gerais and São Paulo – Brazil
106	469	9/29/2006	MASTER Agropecuária: GHG capture and combustion of GHG in swine farms in Southern Brazil
100	467	9/30/2006	SMDA GHG BR05-B-17 Mitigation Project, Espírito Santo, Mato Grosso, Mato Grosso do Sul and Minas Gerais – Brazil
44	336	10/16/2006	AWMS GHG BR05-B-03 Mitigation Project – Brazil
154	1,158	2/1/2008	SMDA BR06-S-21 Methane Recovery Project, Goiás – Brazil
149	1,154	2/1/2008	SMDA BR06-S-19 Methane Recovery Project, Goiás – Brazil
157	1,162	2/1/2008	SMDA BR06-S-27 Methane Recovery Project, Goiás – Brazil
155	1,159	2/1/2008	SMDA BR06-S-24 Methane Recovery Project, Mato Grosso and Mato Grosso do Sul – Brazil
150	1,157	2/1/2008	SMDA BR06-S-20 Methane Recovery Project, Minas Gerais – Brazil

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
153	1,161	2/1/2008	SMDA BR06-S-26 Methane Recovery Project, Minas Gerais, Brazil
156	1,160	2/1/2008	SMDA BR06-S-25 Methane Recovery Project, Minas Gerais, Brazil
168	1,164	2/1/2008	SMDA BR06-S-29 Methane Recovery Project
164	1,163	2/1/2008	SMDA BR06-S-28 Methane Recovery Project, Santa Catarina – Brazil
152	1,234	2/4/2008	SMDA BR06-S-23 Methane Recovery Project, Mato Grosso and Goiás – Brazil
165	1,529	3/17/2008	SMDA BR06-S-30 Methane Recovery Project
151	1,528	4/7/2008	SMDA BR06-S-22 Methane Recovery Project, Minas Gerais – Brazil
169	1,532	4/10/2008	SMDA BR06-S-33 Methane Recovery Project
192	1,534	4/10/2008	GHG Mitigation Projects of Farms included in DPPs BR07-S-34
148	1,521	6/5/2008	SMDA BR06-S-18 Methane Recovery Project, Paraná, Rio Grande do Sul and Santa Catarina – Brazil
191	1,531	6/5/2008	GHG Mitigation Projects of Farms included in PDDs BR07-S-31
209	1,968	1/12/2009	COTRIBÁ Project to Treat Swine Manure
224	2,316	3/10/2009	Amazon Carbon Project to Treat Swine Manure 03
215	2,335	3/10/2009	Amazon Carbon Project to Treat Swine Manure 02
222	2,318	3/16/2009	BRASCARBON Project to Recover Methane BCA-BRA-01, version 5, May 26th, 2008 – Brazil
212	2,249	6/9/2009	Perdigão – Swine Sustainable Production 01 – Methane capture and combustion
246	3,454	8/7/2010	BRASCARBON Methane Recovery Project BCA-BRA-03
248	3,456	8/21/2010	BRASCARBON Methane Recovery Project BCA-BRA-07
247	3,455	8/21/2010	BRASCARBON Methane Recovery Project BCA-BRA-05
262	3,538	8/28/2010	Agroceres – methane capture and combustion project at Granja Paraíso Composting Project at Organoeste Dourados & Andradina
245	3,220	11/8/2010	BRASCARBON Methane Recovery Project BCA-BRA-02
249	3,222	11/8/2010	BRASCARBON Methane Recovery Project BCA-BRA-08
273	3,984	2/26/2011	Batavo Cooperativa Agroindustrial: reduction of gas emissions in swine farming through the installation of better manure treatment systems
285	4,212	10/13/2011	GHG reductions from an improved treatment of industrial residual waters in Embaré – Lagoa da Prata, Minas Gerais – Brazil
280	5,494	6/12/2012	BRASCARBON Methane Recovery Project BCA-BRA-13 BRASCARBON Methane Recovery Project BCA-BRA-14
281	5,496	6/12/2012	BRASCARBON Methane Recovery Project BCA-BRA-14
304	6,411	6/18/2012	BRASCARBON Methane Recovery Project BCA-BRA-15
227	2,939	8/24/2012	Ecobio Carbon Treatment and use of swine manure – Swine culture no 1
278	5,492	11/1/2012	BRASCARBON Methane Recovery Project BCA-BRA-09
276	5,484	11/6/2012	BRASCARBON Methane Recovery Project BCA-BRA-04A

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
277	5,478	11/6/2012	BRASCARBON Methane Recovery Project BCA-BRA-06A
323	7,635	11/19/2012	Small Thermoelectric Power Plant at ETE Arrudas in COPASA MG
279	5,488	12/5/2012	BRASCARBON Methane Recovery Project BCA-BRA-10
352	8,832	12/27/2012	Methane Recovery Project in Waste Treatment
75	418	7/9/2006	GHG AWMS BR05-B-11 Mitigation Project, Mato Grosso, Minas Gerais and São Paulo – Brazil
22	187	3/3/2006	Cogeneration Project with Bagaço Jalles Machado (PCBJM)
63	211	4/6/2006	Cogeneration of Itamarati Plants in Brazil
54	185	3/3/2006	Cogeneration Project with Bagaço Coruripe (PCBC)
61	208	3/3/2006	Cogeneration Project with Bagaço Campo Florido (PCBCF)
71	206	3/3/2006	Cogeneration Project with Bagaço Usinas Caeté Sudeste (PCBUCSE)
325	7,577	12/28/2012	Use of Charcoal from Renewable Biomass Plantations as a Reducing agent in pig iron mill in Brazil
23	43	3/3/2006	Cogeneration Project with Bagaço Lucélia (PCBL)
24	65	2/24/2006	Cogeneration Project with Bagaço Santa Cândida (PCBSC)
28	178	2/20/2006	Cogeneration Project with Bagaço Santa Elisa (PCBSA)
29	199	3/3/2006	Cogeneration Project with Bagaço Vale do Rosário (PCBVR)
30	190	3/9/2006	Cogeneration Project with Bagaço Moema (PCBM)
31	205	3/9/2006	Cogeneration Project with Bagaço Equipav (PCBE)
32	179	2/20/2006	Cogeneration Project with Bagaço Nova América (PCBNA)
33	203	3/3/2006	Cogeneration Project with Bagaço Cerradinho (PCBC)
34	180	3/3/2006	Cogeneration Project with Bagaço Colombo (PCBC)
37	216	3/6/2006	Cogeneration Project with Bagaço Cruz Alta (PCBCA)
38	181	2/20/2006	Cogeneration Project with Bagaço Alta Mogiana (PBCAM)
50	201	3/3/2006	Cogeneration Project with Bioenergy (Santo Antônio Power Plant – United States)
51	209	3/9/2006	Cogeneration Project Central Energética do Rio Pardo (Cerpa)
52	200	3/6/2006	Santa Adélia Thermoelectric Project (TSACP)
53	202	3/6/2006	Cogeneration Project with Bagaço Zillo Lorenzetti (PCBZL)
60	213	3/3/2006	Cogeneration Project with Bagaço Serra (PCBS)
62	207	3/4/2006	Cogeneration Project with Bagaço Alto Alegre (PCBAA)
67	215	3/3/2006	Cogeneration Project with Bagaço Coinbra-Cresciumal (PCBCC)
70	212	3/4/2006	Cogeneration Project with Bagaço Iturama (PCBI)
193	4,810	9/9/2011	Cogeneration Project at Usina Interlagos
87	1,062	6/22/2007	Cogeneration Project Santa Terezinha – Tapejará
73	485	8/28/2006	Cogeneration Project with Bagaço Cucaú (PCBC)

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
20	168	5/12/2006	Pesqueiro Energia, S.A Small Hydroelectric Plant in Brazil
241	3,487	1/12/2011	Paragominas CDM Project
214	2,319	8/4/2009	INPA Fuel Replacement Project
66	529	9/29/2006	Guará da Bunge Biomass Project
9	114	9/29/2006	Electricity Generation Project from Biomass Rickli
17	403	8/31/2006	Electricity Generation Project from Biomass in Inácio Martins
18	401	11/30/2006	Electricity Generation Project from Biomass in Imbituva
7	404	7/7/2006	IRANI Project for Electricity Generation from Biomass
58	228	2/11/2006	Piratini Energy Project – Brazil
72	231	2/11/2006	Biomass Electricity Generation Project CAMIL Itaqui
167	1,089	7/19/2008	GEEA Project of 5 MW Biomass Power Plant
170	1,202	11/5/2007	Burning of solid biomass for the generation of process steam in the production of beers
357	8,128	11/19/2012	Energia Barueri CDM Project Activity
39	268	4/23/2006	Metano Lages no Brazil Methane Emissions Reduction Project
25	116	12/25/2005	N_2O emissions reductions in Paulínia SP
141	1,011	6/2/2007	N_2O reduction project at the plant in Paulínia
203	1,784	11/13/2008	Nitrous Oxide Reduction Project in PAN2 Fosfertil Piaçaguera
208	2,257	3/21/2009	Nitrous Oxide Reduction Project in PAN4 Fosfertil Cubatão
226	1,731	10/29/2009	Nitrous Oxide Reduction Project in Petrobras FAFEN-BA
171	1,067	7/12/2007	Grupo Rede CDM Project
8	143	1/22/2006	UTE Barreiro S.A. Renewable Electricity Generation Project
68	184	5/15/2006	o – Generation of Electric Power through the recovery of LDG - CST – Brazil
266	3,921	12/24/2010	Residual gas recovery for the generation of thermal energy in the Três Marias Plant – Project Activity
306	6,453	8/16/2012	Coqueria da SOL Electricity Generation Project through a heat recovery process
158	1,908	2/19/2009	Landfill emissions reduction project activity at Aterro SANTECH Resíduos
2	52	8/15/2005	Vega Bahia Project – Landfill project in Salvador da Bahia
76	893	4/8/2007	Canabrava Landfill Gas Project – Salvador-BA – Brazil
202	1,626	7/12/2008	Landfill Gas Project in Feira de Santana
162	1,165	1/30/2008	PROBIOGÁS-JP Project
360	7,637	10/17/2012	BioLandfill Project for Energy in Natal
288	4,211	7/8/2011	Landfill Project in Manaus
80	888	4/30/2007	Aurá Landfill Gas Project
4	137	1/23/2006	Landfill Project for Energy of the company MARCA

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
198	1,491	5/28/2008	Emissions reduction project at the Vila Velha Landfill
242	3,464	6/4/2011	Biogas Collection and Combustion Project at the Landfill of the Solid Waste Treatment Plant – CTRS / BR-040
358	7,110	9/4/2012	Uberlândia I and II Landfill Projects
1	8	11/18/2004	NovaGerar Project – Energy Project from Landfill Gas
291	4,657	8/11/2011	Itaoca Landfill Project
428	9,087	12/24/2012	Gramacho Landfill Project
5	91	5/15/2006	Landfill Conversion Project in the Lara Landfill - Mauá – Brazil
6	27	11/24/2005	ONYX Tremembé Landfill Recovery Project – Brazil
10	165	3/3/2006	ESTRE Landfill Recovery Project – Paulínea (PROGAE)
11	171	3/9/2006	Biogas Emission Reduction Project, Caieiras – Brazil
13	164	2/20/2006	Bandeirantes Landfill and Power Generation Project in São Paulo – Brazil
16	226	12/15/2006	Anaconda Landfill Gas Project
21	373	7/2/2006	São João Landfill Project and Power Generation in Brazil
89	1,179	10/15/2007	Bragança Landfill Gas Project – EMBRALIXO/Araúna
109	1,636	5/29/2008	Alto-Tietê Landfill Gas capture project
114	1,133	5/6/2008	Environmental Landfill Project (PROGATA)
115	911	8/17/2007	Itapevi ESTRE Landfill Project – (PROGAEI)
116	912	5/27/2007	Quitaúna Landfill Project (PROGAQ)
138	1,134	2/12/2008	CDR Pedreira Landfill Project (PROGAEP)
182	1,247	10/14/2008	URBAM/ARAUNA – Landfill Gas Project (UAPGAS)
234	7,799	12/21/2012	TECIPAR – PROGAT Landfill Project
298	6,553	7/18/2012	CGR Guatapará Landfill Project
302	5,947	5/8/2012	CTL Landfill Project
363	8,011	11/9/2012	ENGEP & BEGREEN CDM project at UTGR Landfill – Jambeiro
376	8,603	12/11/2012	Controeste Biogas project for energy
390	8,751	12/20/2012	390/2012 – CGA Iperó Project for Landfill and Power Generation of Proactiva
407	8,213	12/26/2012	ESTRE Piratininga Landfill Project
295	3,958	9/29/2011	CTR Candeias Landfill Project
93	648	12/31/2006	SIL (PROGAS) Landfill Project
397	9,290	12/27/2012	ITVR São Leopoldo Landfill Project
180	1,506	8/13/2008	Tijuquinhas da Proactiva Project for Capturing and Burning Landfill Gas
255	3,002	4/2/2010	São Domingos II Hydro Power Plant Project
104	891	7/31/2007	Buriti and Canoa Quebrada Small Hydroelectric Power Plant Project

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
147	1,317	2/11/2008	Paraíso Small Hydroelectric Power Plant Project
65	530	12/15/2006	ARAPUCEL – Small Hydroelectric Power Plant Project
123	809	7/31/2007	Garganta da Jararaca Small Hydroelectric Power Plant Project
296	4,996	4/2/2012	Pampeana and Terra Santa (Graça Brennand) Small Hydroelectric Power Plant Project
368	9,042	12/21/2012	Santa Gabriela and Planalto Small Hydroelectric Power Plant
125	693	12/31/2006	CDM project of the Hydroelectric Plant with existing reservoir "Pedra do Cavalo" of Votorantim
185	1,843	10/20/2008	Primavera Small Hydroelectric Power Plant Project
423	9,226	12/26/2012	Jirau Hydropower Plant
434	9,282	12/27/2012	Santo Antônio Small Hydroelectric Power Plant Project
144	1,342	5/2/2008	São João Small Hydroelectric Power Plant
145	1,232	5/26/2008	Mascarenhas HPP Energy Repowering Project
57	520	10/2/2006	Cachoeira Encoberta and Triunfo – Brascan Energética Minas Gerais S.A (BEMG) Small Hydroelectric Power Plant Project in Brazil
230	2,606	12/25/12009	CDM Project Activity of the Piedade Small Hydroelectric Power Plant
265	3,922	4/5/2011	Baguari Hydropower Plant CDM Project Activity
269	3,898	1/4/2011	Guanhães Energia, Minas Gerais – Brazil CDM Project
292	4,788	5/12/2011	Cachoeirão (JUN1092) CDM Project
320	6,382	12/6/2012	Pipoca Small Hydroelectric Power Plant Project Activity
347	7,071	8/31/2012	Serra das Agulhas Small Hydroelectric Power Plant Project Activity
370	7,685	12/27/2012	DAS Pequenas Centrais Quartel I, II, and III CDM Project
289	4,676	6/15/2011	SHP Malagone, Minas Gerais – Brazil CDM Project
342	7,035	8/20/2012	PCHs Energisa Rio Grande
69	489	12/15/2006	SHP repowering in the state of São Paulo – Brazil
251	3,316	12/22/2010	Queluz and Lavrinhas Renewable Energy Project
294	4,937	10/11/2011	Anhanguera SHP Project
91	773	4/8/2007	CDM Project Activity of Monte Claro Water Power Plant CERAN
205	1,829	4/9/2009	CERAN 14th July Hydroelectric Power Plant
220	2,375	1/7/2010	CERTEL SHP Project – Cooperativa Regional de Eletrificação Teutônia Ltda.
223	2,500	1/11/2010	Moinho and Barracão SHP CDM Project
293	4,936	7/25/2012	Ouro SHP Project – Brennand CDM Activity Project
300	6,041	10/22/2012	Complexo Carreiro II CDM Project Activity
310	6,464	12/19/2012	Criúva and Palanquinho SHP CDM Project Activity
328	7,612	10/18/2012	Serra dos Cavalinhos I SHP CDM Project Activity
330	7,483	10/11/2012	Pezzi SHP CDM Project Activity

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
362	7,739	10/22/2012	Quebra Dentes SHP CDM Project Activity
366	8,018	11/26/2012	Jorge Dreher and Henrique Kotzian SHP CDM Project Activity
393	8,512	12/7/2012	393/2012 – Toropi Complex SHP CDM Project Activity
181	1,279	5/25/2008	Fundão-Santa Clara (PCEFSC) Energy Complex Project
260	3,895	7/3/2012	Arvoredo and Varginha SHP Generation of energy from renewable sources
309	6,208	7/25/2012	Ibirama SHP Project – Brennand CDM Activity
349	7,858	12/21/2012	Salto Góes SHP Generation of electricity from renewable sources
235	3,486	1/24/2011	Goiandira, Pedra do Garrafão, Pirapetinga and Sítio Grande SHP Project Activity
430	9,301	12/27/2012	Teles Pires Hydroelectric Power Plant Activity
59	519	10/2/2006	Passo do Meio, Salto Natal, Pedrinho I, Granada, Ponte and Salto Corgão – Brascan Energética S.A. SHP Project
210	1,999	3/22/2009	Piabanha River SHP Project
86	831	4/2/2007	Santa Edwiges II SHP Project
94	830	12/26/2006	Santa Edwiges I SHP Project
213	2,165	8/7/2009	Rialma Companhia Energética III S / A - Santa Edwiges III Small Hydroelectric Power Plant - Small scale project
90	627	12/15/2006	Aquarius SHP Project
112	663	11/25/2006	Santa Lúcia II SHP Project
113	668	11/25/2006	Braço Norte IV SHP Project
124	667	11/25/2006	Braço Norte III SHP Project
200	3,270	6/11/2010	ARS SHP
236	2,793	1/11/2010	Santana I SHP CDM Project
378	8,474	12/7/2012	Maracanã SHP Project
136	1,378	6/26/2008	Martinuv Espigão Hydroelectric Power Plant Project
187	1,526	3/16/2009	Saldanha SHP Project
35	477	8/28/2006	Ivan Botelho II (Palestina) SHP– Brascan Energética Minas Gerais S.A. (BEMG)
36	543	9/24/2006	Nova Sinceridade SHP – Brascan Energética Minas Gerais S.A. (BEMG)
219	2,570	8/27/2009	Jaguari-Mirim River SHP Project
19	242	2/26/2006	Pesqueiro Energia S.A. Small Hydroelectric Power Plant Project
195	1,800	12/15/2008	Cristalino SHP Project
405	8,500	11/30/2012	Itaguaçu (JUN 1146) – Brazil SHP CDM Project
26	229	4/22/2006	BT Geradora de Energia Elétrica S.A. Small Scale CDM Project.
40	480	9/8/2006	Jaguari Energética S.A. – Furnas do Segredo SHP Project
301	6,042	4/16/2012	Santa Carolina SHP CDM Project

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
316	6,465	7/2/2012	Albano Machado and Rio dos Índios (JUN1115) SHP CDM Project
128	1,146	8/11/2007	Alto Benedito Novo SHP Project
131	860	3/2/2007	Spessatto, Santo Expedito and Barra do Leão SHP Project
240	2,994	6/1/2010	Estelar CDM Project
264	3,669	5/20/2011	Rodeio Bonito SHP Project
374	8,023	11/3/2012	São Sebastião SHP CDM Project
77	968	4/27/2007	"Incomex" Brazil SHP Project
371	9,125	12/23/2012	Salto do Cafesoca SHP Project
297	5,483	4/26/2012	Caquende and Juliões SHP Project
189	1,410	1/19/2008	Irani Avoided Methane Project
232	2,555	9/18/2009	Avelino Bragagnolo Project – effluent treatment using an aerobic system
217	2,610	2/26/2010	JBS S.A. Project – Aerobic Treatment of Slaughterhouse Effluents – Vilhena Unit
286	4,262	12/23/2010	Grupo Queiroz Galvão – Maranhão –- Brazil Green energy carbonization project - Mitigation of methane emission in the production of charcoal
163	1,051	8/9/2007	Plantar Green energy carbonization project - Mitigation of methane emission in the production of charcoal
218	2,609	3/23/2010	JBS S.A. Project - Aerobic Treatment of Slaughterhouse Effluents –Barra do Garças Unit
369	8,067	12/5/2012	GHG Emissions Reductions in pig farming through the installation of composting systems
263	3,517	12/21/2010	Organoeste Dourados & Andradina Composting Project
166	1,092	9/14/2007	GEEA Project – SBS Biomass Treatment
206	1,860	1/4/2009	PFC Emissions Reductions in ALBRAS, Alumínio Brasileiro S.A.
318	7,258	9/12/2012	Vale Florestar Project – Reforestation of degraded tropical areas in the Brazilian Amazon
228	2,569	7/21/2010	Reforestation Project as a Renewable Source of Wood Supply for Industrial Use in Brazil
271	3,887	1/7/2011	AES Tietê CDM Reforestation Project in the State of São Paulo
426	9,056	12/21/2012	Generation of electricity from renewable sources connected to the electric grid: Sete Lagoas Solar Power Plant
56	429	7/2/2006	"Replacement of Fuel Oil for Natural Gas in Klabin's Piracicaba Boilers" in Brazil
41	484	10/20/2006	Project for Replacement of Fuel Oil for Natural Gas at Solvay Indupa do Brazil S.A.
101	755	12/28/2006	Project for Replacement of Fuel Oil for Natural Gas at Votorantim Cimentos, Cubatão
111	828	3/9/2007	Quimvale Project for Replacement of Fuel for Natural Gas
132	889	3/10/2007	Rima in Bocaiúva Project for Replacement of Fuel for Natural Gas
55	1,037	5/19/2007	Aços Villares Project for Replacement of Fuel for Natural Gas

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
137	1,224	1/10/2008	Nobrecel Project for Fuel Replacement in the black liquor boiler
139	1,117	5/16/2008	Replacement of fuel oil by sebum at Companhia de Fiação and Tecidos Santo Antônio
274	3,849	12/9/2010	Fuel replacement project at Samarco Mineração S. A.
102	698	3/9/2007	Raudi Sais Químicos Project
229	2,486	7/2/2009	Conversion of SF_6 to alternative SO_2 cover gas in the production of magnesium at RIMA
303	6,571	9/4/2012	Seabra, Novo Horizonte and Macaúbas Wind Farm CDM Project
313	8,834	12/24/2012	Pedra do Reino Wind Farm Project
319	8,905	12/26/2012	Pedra do Reino III Wind Farm
324	7,597	10/18/2012	Renova Área 6-8 Wind Farm Project
413	9,192	12/31/2012	Cristal II Wind Farm
414	9,075	12/28/2012	Serra Azul Wind Farm
415	9,064	12/21/2012	Cristal, Primavera e São Judas Wind Farm
416	9,069	12/31/2012	Curva dos Ventos Wind Farm
333	7,065	12/13/2012	Mel 2 Wind Farm CDM Project Activity
334	7,021	8/24/2012	Guajiru Wind Farm Project
336	7,027	8/24/2012	Porto do Delta Wind Farm CDM Project
337	7,026	8/24/2012	Mundaú Wind Farm CDM Project
338	7,023	8/24/2012	Trairi Wind Farm CDM Project
364	8,219	11/21/2012	Faísas CDM Project Activity of Wind Power Complexes
380	8,122	12/22/2012	Acaraú II Wind Farm – 39 MW – Brazil
381	8,493	12/14/2012	Acaraú I Wind Farm – 147 MW – Brazil
382	9,110	12/22/2012	Aracati Wind Farm – 25,5 MW– Brazil
391	9,325	12/27/2012	Dunas de Paracuru Wind Farm
394	8,586	12/10/2012	Generation of electricity from renewable sources connected to the grid: Bons Ventos da Serra I Wind Farm
326	7,878	10/31/2012	Aeolis Beberibe Wind Farm
327	7,879	10/31/2012	Aeolis 2011 Wind Farm Project, Aracati
417	9,072	12/31/2012	Fontes dos Ventos Wind Farm
335	7,017	8/24/2012	Fleixeiras I Wind Farm CDM Project
340	8,021	11/21/2012	Delta do Parnaíba Wind Farm CDM Project
305	6,350	11/8/2012	Generation of electric energy from renewable sources project Macacos, Juremas, Pedra Preta and Costa Branca Wind Farms
314	8,904	12/24/2012	Cabeço Preto IV Wind Farm
322	7,196	9/17/2012	Generation of electricity from renewable sources connected to the grid: União dos Ventos Wind Farm Complex, Serveng Civilsan S.A.

SEXEC/CIMGC Reference number	EB Reference number	Registration date (MM/DD/YY)	Project name
331	7,059	11/8/2012	Arizona 1
332	7,769	12/21/2012	Renova 2010 Wind Farms
339	7,802	11/5/2012	Generation of electricity from renewable sources - Campo dos Ventos II Wind Farm
344	7,157	12/3/2012	Lagoas de Touros CDM Project Activity of wind electric power plants
346	9,149	12/26/2012	Riachão III and V CDM Project Activity of wind electric power plants
354	7,725	10/23/2012	Generation of electricity from renewable wind sources – Morro dos Ventos Wind Farm
367	9,328	12/28/2012	Pelado Wind Farm
403	8,253	12/26/2012	Generation of electricity from renewable wind sources –Morro dos Ventos Wind Park phase 2
418	9,077	12/31/2012	El Modelo Wind Farm
350	7,012	8/31/2012	Calango and Caetité CDM Wind Farm Project Activities
95	603	12/28/2006	Osório Wind Farm Project
307	6,609	12/28/2012	Palmares (PCEEP) Wind Power Plant Project
308	6,607	12/28/2012	Osório 2 (PCEEO2) Wind Power Plant Project
345	7,109	10/17/2012	REB Cassino CDM Wind Farm Project Activities
359	7,964	12/27/2012	Santana do Livramento Grid connected to the generation of electricity from renewable sources
384	8,012	11/9/2012	Generation of electricity from renewable sources connected to the grid: Santa Vitória do Palmar and Chuí Wind Farm Complex
424	9,375	12/31/2012	Corredor dos Senandes CDM Project
299	5,495	5/15/2012	Generation of electricity from renewable sources –Santa Clara I, II, III, IV, V, VI e Eurus VI Wind Farms
140	843	3/9/2007	Petrobras Wind Energy Project for Oil Pumping in Macao
78	575	9/30/2006	Água Doce (PGEEAD) Wind Power Generation Project
79	486	8/28/2006	Horizonte (PGEEH) Wind Power Generation Project

ANNEX B

CRITERIA FOR THE EVALUATION, BY SIZE, OF SUSTAINABLE DEVELOPMENT

TABLE B.1
Environmental Indicators

AMB_AR	Contribution of the project to the improvement of local air quality
Note	Criteria
0	Not declared by project proponent.
1	Project states that it contributes to the reduction of at least one air pollutant (MP, NOx, SOx, VOC, NMVOC) in addition to reductions of greenhouse gases (GHGs).
2	Project states that it contributes to the reduction of at least one air pollutant (MP, NOx, SOx, VOC, NMVOC) in addition to GHG reductions, specifying the contribution to air quality in a place of low saturation of atmospheric pollutants.
3	Project states that it contributes to the reduction of at least one air pollutant (MP, NOx, SOx, VOC, NMVOC) in addition to GHG reductions, specifying the contribution to air quality in a place of high saturation of atmospheric pollutants.
AMB_ÁGUA	Contribution of the project to the improvement of water quality
Note	Criteria
0	Not declared by project proponent.
1	Project states that it has no negative impact on water availability.
2	Project states that it contributes positively to water availability through higher quantity or quality of water.
3	Project states that it contributes positively to water availability through higher quantity or quality of water in regions with water stress.
AMB_SOLO	Contribution of the project for the reduction or mitigation of soil pollution
Note	Criteria
0	Not declared by project proponent.
1	Project states that it has no negative impact on soil quality.
2	Project states that it reduces risk of negative impact on soil quality compared to the baseline scenario.
3	Project states that it has a positive impact on soil quality compared to the baseline scenario.
AMB_CO_2E	Evaluates the contribution of the project or technology to the achievement of GHG emission reductions in Brazil
Note	Criteria
0	Not declared by project proponent.
1	Reductions by 60,000 tCO_2e per year.
2	Reductions between 60,001 and 100,000 tCO_2e per year.
3	Reductions above 100,001 tCO_2e per year.

TABLE B.2
Social indicators

SOC_COND_TRAB	Project commitment with social and labor responsibilities, health and education programs, and civil rights
Note	Criteria
0	Not declared by project proponent.
1	Project abides by social and labor laws.
2	Project abides by social and labor laws, and implements a voluntary program in the areas of health, education or civil rights.
3	Project abides by social and labor laws, and implements more than one voluntary program in the areas of health, education or civil rights.
SOC_IGUALDADE	Contribution of the project to reduce inequality and quality of life of low-income populations
Note	Criteria
0	Not declared by project proponent.
1	Project states that it contributes to the increase of the municipal, state or federal public tax collection.
2	Project states that it gives preference to the hiring of unskilled local labor guaranteeing professional qualification.
3	Project states that through the project activity, infrastructure improvements and access to public services (for example, energy, sanitation, education and health) are feasible and thus have a positive impact on reducing inequality.
SOC_CAPACITACAO	Degree of knowledge and training internalized by the project, evaluation of the capacity to reproduce technology, observing its demonstrative effect
Note	Criteria
0	Not declared by project proponent.
1	Project builds employees' capacities with basic fundamentals, such as literacy or safety at work and environmental education.
2	Project presents a training program for employees with internalization and diffusion of knowledge about the process or technology employed by the project.
3	Project uses unconventional technology for the industry, with replication potential, scalability and proven demonstrative effect.

TABLE B.3
Economic indicators

ECON_EMPREGO	Contribution of the project to net generation of direct and indirect jobs
Note	Criteria
0	Not declared by project proponent.
1	Annex III mentions the generation of direct, indirect or permanent jobs.
2	Annex III quantifies direct or indirect job creation.
3	Annex III quantifies permanent job creation in the region.
ECON_TECNOLOGIA	Assesses the degree of technological innovation and the technologies employed, especially the cases of technology transfer
Note	Criteria
0	Not declared by project proponent.
1	Project contributes to the diffusion of technology in its sector of activity.
2	Project employs low penetration technology in its sector, contributing with the demonstrative effect and helping to change common practices.
3	Project states to use technology that is not available nationally or not applied to its sector, demonstrating international or intersectoral technology transfer.
ECON_INTEGRACAO	Assesses project's contribution to regional development
Note	Criteria
0	Not declared by project proponent.
1	Project is developed in developed regions or has limited impact of regional integration.
2	Project is developed in less developed regions.
3	Project states to contribute to regional integration (e.g. grid-connected power generation, infrastructures, transfer of skilled labor etc.) or articulates cooperation between sectors.
ECON_PRAT_COM	Assesses project's contribution to structural sectoral changes and changes in common practices
Note	Criteria
0	Not declared by project proponent.
1	Project states that it follows a sectoral trend using technology that is not common practice, but has been expanding in its sector.
2	Project states that it uses an innovative or unusual technology or process in its industry leading structural sectoral changes and changes in common practices.
3	Project is the first of its kind, demonstrating the use of innovative technology, or has systematic research and development activities contributing to the demonstration of new technologies or processes.

CHAPTER 9

CONTRIBUTIONS OF THE CLEAN DEVELOPMENT MECHANISM TO BUSINESS GOVERNANCE, ACCORDING TO A MARKET AGENT[1, 2]

Ernesto Cavasin Neto[3]

The materialization of the concept of sustainable development in the 1990s was a great challenge: how to put it in practice and encourage economic growth towards this direction? In that decade, it became clearer to society that the rational use of natural resources and the reduction of the impacts imposed by human activities on the environment were necessary to achieve durability. Not that this point of view did not exist before, but extreme issues have become popular over time, like the “ozone hole” and how it impacted our lives.

The Montreal Protocol was the first global action to address an environmental issue that impacted everyone on the planet. The integration of private enterprise in this area, in a fast way and with viable solutions, contributed so that results were reached even before expected. Companies learned how to win consumers over; marketing was an important conductor to stimulate the progress of new technologies over chlorofluorocarbons (CFCs), which depleted the ozone layer. It is logical that much of the success of the Montreal Protocol was due to the fact that it did not require major financial efforts from countries and companies, the technologies to replace CFCs were feasible, but nothing would have been possible without society engagement, especially consumer pressure.

The environmental issue started the last decade of the millennium under the spotlight, bringing the understanding that our actions have consequences that we need to be aware of. At the time, some studies on the Earth’s average temperature increase and its relation with the concentration of greenhouse gases in the atmosphere caused great discussions in the scientific arena.

Companies also started to understand the need to preserve natural resources, and what the impacts resulting from their bad use could have on their business. One example was the concern of large soft drink companies with the water used in manufacturing their products. The more polluted the sources of water, the greater

1. This text is the author’s point of view as a representative of project developers during several years implementing the clean development mechanism (CDM) in Brazil (note from the editors).

2. The author thanks Pedro Miguel de Almeida Gomes Antunes Sirgado for preparing box 1 (Repercussion of CDM in companies).

3. Mechanical engineer and business administrator.

the costs of treatment, and these often made a plant unviable. Oil companies realized that gas emissions resulting from manufacturing process affected the air quality of the locations where their facilities were, and this affected people's health, many of whom worked on their plants. It became increasingly clearer that all actions generated a reaction, and often this reaction could be toxic to the very development of human activities.

I once spoke about sustainability at a presentation in the city of Caxias do Sul, state of Rio Grande do Sul, for a local business association; the event was a large one, and very well organized, with some three hundred people attending. At the end, I was invited by the association's chairman to talk with him and some authorities in his room. This conversation was very interesting, because while we were talking, the chairman said:

> Today, we must take more responsibility for our actions and demand that governing bodies provide more readiness and support. That time when we used to set up a company and then call the mayor to the inauguration serving game meat, as long as we paid tax, is long gone.

In a simple but direct way, what this entrepreneur made clear is that companies have a broad and integrated role with society, and that rulers are not extras, but part of the process.

The concern with the consequences of our actions was heavily present in societies during the 90s, and environmental issues gained relevance – as I wrote earlier, at that time, climate change studies were already advanced and pointed to the need for action. In this regard, the United Nations (UN) again took the lead in the search for solutions for this global problem.

The ozone layer and global warming are problems affecting the planet altogether; it does not matter whether rich or poor, aware or not, these problems have an impact on our lives and cannot be solved without people getting together. Integration is the only way to solve this, but we need to consider that responsibility over the problem is not as uniform as the impacts. Also, collaboration to solve it must be proportional to capacity and responsibility. How can we be able to create a mechanism that considers these peculiarities while at the same time fights what causes them?

I reckon that the Kyoto Protocol, by using market mechanisms, was the greatest catalyst of this new way of thinking, analyzing and acting.

Looking at Brazil and the rest of the world, this impulse to change came particularly from the Clean Development Mechanism (CDM). The frenzy generated by the CDM led to really innovative, mitigating projects, and was the sparkle for a more balanced way of thinking, not only in large companies, but also as part of initiatives of all sizes and sectors. Its tenet was interesting, with responsibilities shared according to countries' capacities, while creating a bonus for those who were more efficient and innovative. Its mechanisms were self-powered by baselines that could change as technologies matured; this would constantly stimulate improvement. Kyoto generated an incentive and a need for knowledge. Young professionals were motivated to prepare for a professional future in a low-carbon economy. At the time, I myself was starting my professional career and the incentives were wonderful; being part of CDM projects was an opportunity to interact with multidisciplinary projects, including engineering, finance, biology and other sciences. This would open our minds to multiple possibilities. On a personal note, I can downright affirm that the chance I had to start my career inserted in CDM projects provided for a body of work and background that have opened multiple doors. In 2010, this background turned my career around and I only succeeded because these experiences prepared me not only technically but also in the way I learned to express myself.

I recall that when the Kyoto Protocol was ratified in 2005 by Russia, a flurry of conferences on this issue happened in Brazil; there were many already, but they were intensified in the period, and the number of participants was large for such conferences – involving university students looking for a professional path, self-employed professionals, executives, civil servants, people of different profiles who formed large audiences to understand what was happening. At the time, in my lectures, I liked very much to use a sentence that was a consensus among those working in the sector: "The Kyoto Protocol was just the first step towards the right direction". The fact is that the chance to speak to people, to express myself, encouraged me. I had the opportunity to publish several articles that taught me to prepare myself by studying that everything we do has multiple impacts and that we always need to look at the whole picture.

The world demands professionals who not only look at aspects of their responsibilities technically and coldly. Today, it is difficult to find a company in Brazil – and also in a large part of the world – where the word sustainability is not part of its principles or goals, and, I dare say that most companies also highlight issues related to climate change mitigation. Thus, professionals who know how to interact with these issues have their space and value.

During the first decade of the third millennium, the number of companies trying to find sustainable projects or some direction towards sustainability was large. At the time, I was a consultant in this area, and my schedule of meetings, visits and events was colossal. Brazil learned a lot from that. Firstly, the country realized that the myriad of situations enabled the qualification of professionals, who were even sent overseas. Secondly, it realized that concepts are crosscutting our society, with retail starting to think on how to explain those concepts to the final customer – I mean, the population wanted to be informed; which is the most important level for initiatives to succeed.

And this is, in my opinion, the most important point of CDM: this mechanism brought concepts about effectively being and not just appearing; established a solid logic of governance, which is environmentally and socially balanced with the economy; created a map of good practices to be followed; and became a springboard for contemporary environmental thinking in Brazil.

This clarity and logic facilitated the participation of private enterprise, and also brought the necessary security for investments favoring sustainability, and this led to a lot of new initiatives. The CDM was the basis for the creation of sustainability programs in several companies in Brazil, some programs went beyond and became institutes focused on climate change. Companies began to have something to show; the media understood people wanted to be informed and to follow this evolution. The cycle came to life, and its evolution started its own movement.

The need to standardize and compare initiatives brought about indexes and other initiatives, such as the Global Reporting Initiative (GRI), whose objective is to approach business practices and stakeholders in a clear manner; the Dow Jones Sustainability Index (DJSI) in Brazil; the Corporate Sustainability Index (ISE) of the São Paulo Stock Exchange, Commodities and Futures Exchange Paulo (BM & BOVESPA) – currently B3 –, among several others. In addition, awards have been created by means of communication, such as the *Época* Climate Change Award, which in the following years was complemented and led to creation of the *Época* Green Company Award, in addition to publications related exclusively to the theme. Also, the manner that carbon emissions were dealt with was used as a basis to rethink how to pursue other urgent needs, such as water and waste, for example. Remuneration ideas for environmental services were conceived.

The Global Reporting Initiative is an international organization created to provide guidance not only to businesses, but also governments and non-governmental organizations, to discuss, understand and lend visibility to their actions' impacts on society. It is focused on the environment, climate change, human rights, workers' rights, corruption, among other relevant issues. This way of reporting helps organize information in a reliable, standardized manner, thus highlighting relevant issues.[4] Upon having all the information, two practical consequences are evident: communication with society runs more smoothly and clearer, but in my opinion the greatest gain is companies' becoming better at assessing and deciding about projects, strategies and actions to be developed. In a world with the kind of connectivity we have today, where information flow so quickly, every decision must be made with as much rationale as possible; their impacts must be known fully known. Building a reputation takes years, but it takes minutes to ruin it,

4. Source: Brazilian Business Council on Sustainable Development (*Conselho Empresarial Brasileiro para o Desenvolvimento Sustentável* – CEBDS).

and, with the variety of assumptions that affect decisions, tools like the GRI are powerful sources of rationale, they create procedures and guides to prevent us from focusing only on the "trees" and start focusing on the entire "forest".

Perenniality and loyalty are administrative and commercial mantras, respectively, in corporations. Out of the 100 largest Brazilian companies in 1990, few are currently included in this index; obviously, this is not only due to failure – merger and brand switching processes also affect this indicator. But what I want to point out with this data is that brands have changed; this is due to a transformation in the entire business environment, and the loyalty and permanence of companies depend on the speed with which they adapt.

Too often, initiatives such as the Corporate Sustainability Index (*Índice de Sustentabilidade Empresarial* – ISE), which proposes to create an investment environment that serves the interests of the society of sustainable development and ethics, do not deliver extremely different results. However, time – a measure of perenniality – demonstrates that they solidify the initiative's image, which is measure of retention. The ISE was created in 2005, from an initiative financed by the International Finance Corporation – IFC, which is a member of the World Bank Group for private investment. The idea was to create a tool that would provide for a comparative analysis of companies' stock market performances. Criteria were based on indicators such as

> economic efficiency, environmental balance, social justice, corporate governance, level of commitment to sustainable development, equity, transparency and accountability, product nature, business performance in the economic, financial, social, environmental and climate change dimensions (ISE).[5]

ISE's mission is to "Support investors in their decision-making processes on socially responsible investments and encourage companies to adopt best practices for business sustainability". Again, the intention is, without a doubt, to compare and highlight best practices, but in the form of indicators, and not a mere competition (which is what we also see in the Dow Jones Sustainability Index). The DJSI was the precursor of this movement to indicate companies that seek to create value for their shareholders in the long term, with perenniality, in order to manage, in a transparent and clear way, the risks associated with their operations from the economic, environmental and social point of view. Companies that are attentive to this long-term view of investors know that it is imperative to retain customers.

According to this logic of creating more process that aim at strengthening companies' capacities to debate, both internally and externally, about their practices and ability to reduce their impact, the CDM was considered by several executives

5. Available at: https://www.isebvmf.com.br/.

and businessmen as an important tool to generate discussions. For many years, environmental and social issues were seen only as a cost center, always as the target of some corporate discrimination. The CDM helped change this vision: the possibility of valuing these actions and the recognition given by society to such initiatives turned things around, with more and more professionals focused on seeking the connections between companies' projects and activities with sustainability and emissions reduction. This movement strengthened this topic in Brazil.

In addition to the CDM actions, carbon neutrality actions also began to come to life and to be valued. I see that the carbon issue at the beginning of the third millennium has fostered creativity, changed the way we thought about and valued it; all in connection with new financial and value models. Carbon taught me to value the intangible. That is, we stopped looking at the operation and now we observe the total value chain.

Imagine that carbon credit was almost valued as a commodity; however, it was a product you earned most when produced less – that is, the contrary of a normal commodity. We used to joke about this, saying that we were trading wind. And that happened with interesting mechanisms, in which contracts presented a complex valuation by intangible issues, such as support to local communities and other actions that could differentiate the project.

At the time, projects in companies like Sadia, Energias de Portugal (EDP) and Arcelor sought to integrate not only their value chains, but also the community and the environment in their actions. In the case of Sadia, it managed to turn a threat into a business strategy – by encouraging its affiliates – and added value to its brand, brought positive exposure and status, so much so that at the time its competitors rushed to develop similar proposals. Arcelor sought competitive advantage in similar projects, and a broad carbon project involving coal substitution for charcoal was developed to reduce the costs of obtaining the fuel and integrating the local society to the process. It was a challenging process, but it managed to bring the company together, and created sound discussion environments, thus encouraging the search for solutions. It was no different at EDP: the company used carbon benefits to accelerate the necessary projects, such as linking the Murtinho Port (in the state of Mato Grosso do Sul) to the interconnected power system, supporting and integrating local communities in its small hydroelectric projects (SHPs), among other actions. The added and perceived value of the actions taken by these companies' managers was so great that it gave rise to operational bodies; for example, the EDP Institute (box 1 below). These experiences are not the only success stories; many others stood out and were important at the time.

BOX 1
CDM Repercussion in companies

EDP Brasil has followed the whole process leading to the adoption of the United Nations Framework Convention on Climate Change at the United Nations Conference on Environment and Development (Rio-92) and, subsequently, to the Kyoto Protocol, with its framework of challenges and opportunities.

Suddenly, we understand flexibility mechanisms as a potential tool to encourage agents to go beyond business-as-usual practices in order to reduce emissions. Thus, in mid-2006, EDP Brasil began looking at the CDM with particular attention; and sought a true and intrinsic connection with the concept of sustainable development.

At the time, with the support of PricewaterhouseCoopers (PwC), we reflected on how revenues from the sale of carbon credits could be reverted to socio-environmental initiatives in a structured and continuous manner and professionally managed. The EDP Institute was created, and became a true social, environmental and cultural platform for all EDP companies in Brazil.

In the end, not everything went as planned; the sharp decline in the value of certified emission reductions (CERs or CERs) has given the EDP Institute new challenges in terms of funding. But the seed had been planted thanks to the context provided by the CDM; and the EDP Institute completed ten years of operation, with investments of some R$100 million, which benefited more than 3 million Brazilians. The CDM is a significant part of this history.

Thus, EDP is making history in the Brazilian market, starting twenty years ago, with a very strong connection with renewable energies. The EDP Group's concern with sustainable development means that the company is permanently aware of best practices and new trends as a means of building and strengthening its relations with all stakeholders.

Prepared by Pedro Miguel de Almeida Gomes Antunes Sirgado.

A number of actions were taken, even outside carbon projects under the CDM, such as companies helping in the management of fleets and fuel. These companies have created simple and intelligent systems to better control the consumption of their customers and stimulate users to have less-impacting profiles, and this has been widely used as a competitive difference in sales.

New businesses have come up and overcome barriers, such as the green courier or zero carbon. Bicycle deliveries began to be normal, and although delivery time was sometimes greater than the usual, companies learned to see greater advantages – that is, to analyze not only an indicator, but also to balance the advantages with new proportions and considerations. Society as a whole began to demand products with a call for sustainability; coffee shops with environmentally and socially correct products have conquered loyal customers, so did organic and sustainable stores.

Crediting all this evolution only to the CDM may be too much, but the capacity that this mechanism has brought to Brazilians, and the world, to look at businesses in a different way and to prepare critical mass is clear.

But the carbon market suffered a blow after the 15th Conference of the Parties – COP15; in a predominantly capitalist market, in order to generate interest, one must create wealth. The ability of Kyoto and climate change to draw attention of the people, as well as voters, has made politicians aware. What we saw in Copenhagen was plain politicking, not only by Brazil, but also by the whole world, but I will stick to the Brazilian example, because it is more relevant for the case in point.

During the Copenhagen climate conference, we saw a flood of pre-candidates for the Presidency of Brazil parading in the corridors of the COP seeking spotlights and microphones. Unfortunately, the demand for personal promotion far outweighed our understanding of the planet and our community's needs; we were victims of simply disproportionate statements, such as: "The environment disrupts sustainable development." It was unfortunate to have heard, but worse to acknowledge that the statement came from the leader of the Brazilian delegation.

This sudden interest of politicians in a technical issue such as climate change has sadly paved the way for the replacement of the Kyoto Protocol. If we seek relevance, we must follow the path we know, and so did politicians. I do not discard the relevance of politics and politicians, they are of great importance in any scenario since the beginning of humanity; however, it is like an experienced mechanic trying to patch your heart valve: the probability of going wrong is almost certain. This is what we have seen, from Copenhagen to Paris in 2015, we are in a limbo; often blaming economic crises, but in fact lacking not money, but clarity about which way to follow. The solution that came up in Paris and that we try to implement today is the only one that every politician knows: it involves state regulation and control, and therein lies the mistake, because nation-states have very well-defined boundaries.

Wealth and benefits do not reach everyone at the same time; according to Angus Deaton, Nobel laureate in economics, this proves that there is no single, uniform solution. Governments do not have flexibility and should not have; they need to follow rules. Having said that, we must seek solutions that open different paths to converge in a continuous fashion. There is no one-way road for global problems that fulfils everyone and every need. Right paths do not exist; we live in a reality in which the range of options is increasingly diverse. Politicians and rulers do not have the option of error; so sometimes it is better to procrastinate and slow down actions than to go wrong. Science, in turn, is a play of trials, in which we have errors in search of rightness, in which experience and experiments flow towards continuous improvement. This is sustainability; and one thing is for sure: leaving the search for solutions on behalf of Governments alone is a condition doomed to failure.

Some critics might say that the lack of a common path might delay the solution, but is there a unique solution? Amartya Sen, in his book Inequality Reexamined (2001), states that even among those who believe in the need for equality, there are many differences in what needs to be equalized.

Life offers many possibilities; not only humans, but also nature. Evolution is sometimes brutal, but what would we be without our ability to adapt?

As goes a small popular text, whose author I do not know,

> I learned that not everything is flowers, not every day is sunny. But there is no sadness that shall not pass, nor happiness that lasts forever. Cloudy days will come, the flowers will wither, but then spring will surely arrive! One day, I discovered that life is worth being lived and harnessed to the maximum, regardless of the circumstances. There will always be a new day, a new chance, a new love, a new opportunity ... But life is unique!

The fact is that every time we try to imprint a certain view of right and wrong out of our habitat, we are bound to error at some point; only relativity is right – that is, what works for us may not be the best for the others. The only certainty we have is the inflexibility of time and that every minute we miss the opportunity to act.

The beauty of the Kyoto Protocol structure is that it allowed for the creation of individual solutions and the only obligation was that the solution proposed was a contribution. That is, the baseline was an important factor for improvements to be measured, and that climate change was not detrimental to the environment. The plasticity of this concept is perfect, from freedom to creation, to development, makes us use time for solutions, not the rigidity of laws and rules.

I am an optimist when I think about the human capacity to find ways and understand the peculiarities of each environment. I also know too well that rigidity of certainty in something absolute is important for certain people and communities. This is part of human nature and helps men believe and fight blindly; otherwise, important advances would not be achieved. However, I always see that actions along these lines need specific soils to grow – that is, it has borders.

The need to do something cannot overcome the need to understand what needs to be done.

I believe that, in order to assist in the development of the carbon market and facilitate dialogue, the Brazilian Association of Carbon Market Companies (ABEMC) was created; the idea was good and aimed at facilitating the dialogue between those who developed projects and the government, which was responsible for regulating the initiatives. This model was, in my opinion, perfect. But as I anticipated, I believe that its relevance caused it to succumb to the fear of the new.

Unfortunately, red tape in fighting climate change has taken nine valuable years from us. In my opinion, failure in Copenhagen has killed one of the best integration attempts the planet has ever seen: the Kyoto Protocol and its mechanisms.

But since nothing is definite, I believe that the doors to this path are still open, and the experiences gathered in this book can help us re-establish positive experiences and deal with the negative ones. Twenty years separate us from the

Kyoto Conference; it is not a long time in terms of history, but it is a lot of time when we look at our goals for the future.

Moreover – thinking of the agility and plurality of solutions needed to combat global warming – I see that the integration, as Kyoto proposed, of people into solutions, whether they are scientists, entrepreneurs, executives or inventors, is the best way to achieve convergence towards a socioeconomically and environmentally balanced society.

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CHAPTER 10

CDM INSTITUTIONAL-REGULATORY EVOLUTION AND FUTURE PERSPECTIVES[1]

Maria Bernadete Gomes Pereira Sarmiento Gutierrez[2]

1 INTRODUCTION

The Clean Development Mechanism (CDM) has played an important role in financing projects that contribute to the sustainable development of developing countries. However, the use of the mechanism has been constrained by its high transaction costs, resulting in CDM-generated carbon credits market that is below its true potential. Acknowledging this constraint led to international negotiations among Parties to the United Nations Framework Convention on Climate Change (UNFCCC) with a view to reforming CDM, making it more cost-effective in order to achieve its main objective of promoting the sustainable development of beneficiary countries. In that respect, a Programmatic CDM was created, aiming at broadening project financing possibilities and policies that can promote sustainable development and at the same time reduce greenhouse gas emissions (GHG).

Despite its high transaction costs, the CDM generated over 1.9 billion Certified Emission Reductions (CER)[3] by May 2018, which has attracted private-sector investments in developing countries and contributed to their sustainable development objectives, given their voluntary nature. During the two initial commitment periods, encompassing 2005-2020, the institutional-regulatory structure evolved significantly, with sectoral expansion and its simplification through the Programmatic CDM and the standardization of analysis methodologies. The high transaction costs, despite being a constraint, have contributed to high-quality certification, since projects' environmental integrity enjoys the highest credibility.

It can be stated that the CDM is a certification instrument for the effective implementation of mitigation actions in developing countries in a transparent, verifiable and independent way, as it meets all the criteria, such as monitoring, report and verification (MRV). Therefore, its potential use as a certification mechanism,

1. The views expressed here are the author's opinions on CDM, that she had expressed before in other publications. Please refer to the author's previous works, see Gutierrez (2009; 2010) (note from the editors).

2. Engineer. Researcher at Ipea.

3. Information available at: https://bit.ly/2Mq4ah5.

in a context of mitigation results-based climate finance, is very high, and applies both to national commitments of countries that are Parties to the Paris Agreement and to financial channels that are being implemented, such as the Green Climate Fund (GCF), in order to assist developing countries. In fact, the debate about establishing a connection between the CDM and financing channels in the scope of UNFCCC is already part of the agenda of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol.

This chapter is broken down into the following structure: it begins with a background of how the CDM started and its important role in the creation of a carbon market (section 2). The underlying high transaction costs of the certification process of the CDM carbon credits are detailed right after. It is also indicated that the stage of high transaction costs was necessary in order to guarantee projects' environmental integrity. Then, the main outcomes of a research on the CDM transaction costs in Brazil follows suit (section 3). Finally, perspectives on the future use of the CDM infrastructure are detailed in section 4, in which the main conclusions are also presented, particularly the mitigation actions certification mechanism for developing countries, notably Brazil, as established by the Paris Agreement, to receive international financial support.

2 THE KYOTO PROTOCOL AND THE CDM

The entering into force of the Kyoto Protocol, in 2005, laid the foundations for a global carbon market, constituted by different regional or national markets, as well as mechanisms of projects reducing emissions, such as the CDM or Joint Implementation (JI). The different markets disagree in several aspects, among which: size, conception characteristics, sectoral and geographic scope, and nature, and may be either voluntary or not. Some of those markets were created with a view to complying with emissions reduction commitments negotiated under the Kyoto Protocol, which includes the CDM, while others are of a voluntary nature, such as the *Chicago climate exchange* (CCX), which functioned from 2003 to 2010. The recent expansion of national or regional initiatives towards the creation of carbon markets demonstrates the high political priority given to this instrument, as a recognition of its economic efficiency advantages and as an instrument that induces technological innovation (World Bank, 2016).

On the one hand, the carbon market trades two types of assets: *i*) emissions allowances allocated under Kyoto Protocol's cap and trade approach; e *ii*) emission reductions based on projects that include the CDM and JI. On the other hand, one can concisely affirm that the carbon market is divided into two segments: *i)* Kyoto, headed by the European Union; and *ii)* non-Kyoto, headed by the United States.

Despite some existing initiatives, such as CCX, it is safe to say that the carbon market was consolidated by the Kyoto Protocol flexibility mechanisms. Two sectors emerge in the carbon market: cap and trade and reduction credit trade, generated by generated by projects that are reducing emissions. The former, as described before, occurs when Annex I countries[4] exceed their cap on the total emissions allowed and trade allowances to other Annex I countries. In this case, the "currency" used is the Assigned Amount Unit (AAU). The latter is originated in the CDM and JI mechanisms. Respective currencies are CERs and ERUs – Emission Reduction Units. In the latter case, while final certification of the reduction generated by projects by the United Nations Organization (UN) is not granted, the relevant concept will be the ERU.

It is worth mentioning that the carbon market is, therefore, a universe that encompasses several transactions through which volumes of GHG emissions reductions are traded, differing in size, format and regulation. Information on this market is limited and many of the transactions take place in a strictly private manner, with no publication of the terms of each agreement, particularly the prices and volumes of GHG reductions.

3 THE CDM AND INSTITUTIONAL ASPECTS: HIGH TRANSACTION COSTS

3.1 General Institutional Aspects

Transaction costs, in the context of the Kyoto Protocol, are defined as those costs incurred in the preparation of CERs. Basically, transaction costs are generated by three main sources: *i*) preparation of documents; *ii*) validation and certification by Designated Operational Entities (DOE), including follow-up costs; and *iii*) costs charged by the CDM's Executive Board and host country (CEPAL, 2004).

In 2003, therefore before the Kyoto Protocol came into effect, World Bank estimates indicated an average value of US$ 270,000, related to the costs of a project only to meet the technical and bureaucratic requirements of the CDM. Even for small-scale projects,[5] which are subject to a simplified analysis, the World Bank estimated that at the time, US$ 110,000 would contribute to reducing the economic and financial profitability of the CDM projects (OECD, 2004). This is a real financial barrier for many projects, particularly in the absence of specific sources of capital financing or projects that are not being supported by a carbon fund.

4. Annex I countries are the ones with emissions reductions targets; non-Annex I countries do not have mandatory reduction targets.

5. COP-8 defined simplified modalities and procedures for the CDM projects ranked as small-scale projects: *i*) renewable energy project activities which have an output capacity up to 15 megawatts; *ii*) energy-efficiency up to 15GWh (or equivalent); and *iii*) other projects that aim to achieve GHG emission reductions up to 15t of carbon dioxide equivalent ($KtCO^2e$).

A survey conducted by Limiro (2009),[6] apud Souza et al. (2012), demonstrated that transaction costs remain high even after the implementation of the CDM, and varied, in 2009, between US$ 60 thousand and US$ 205 thousand, depending on the scale of the project and the need, or not, for proposing new methodology. In 2011, therefore, at the end of the first commitment period of the Kyoto Protocol, even with the intensification of requests for project registration, the costs of preparing the CDM projects averaged US$ 200 thousand (excluding those resulting from the proposal of new methodologies – US$ 125,000). Such costs could not be neglected, depending on the number of CERs generated by the projects (Ambrosi, 2011).

Very often, carbon funds and other brokers bear the transaction costs, and then recover them by selling CERs. The initial expectation that transaction costs would fall with a larger number of CDM projects was partially missed because of the CDM Executive Board's rejection of many baseline methodologies and monitoring processes that had already been approved by Designated Operational Entities. The consequence of transaction costs is the significant increase of potential CDM projects' costs, as well as lower supply, given that many projects never get off the ground due to high transaction costs.

The most adverse effect of transaction costs is to favor large-scale projects, which may virtually generate a large number of CERs and maintain a net financial and economic profitability of these costs. Noticeably, projects involving electricity generation and capture of methane, hydrofluorocarbon destruction (HFC), among others, are of the type that tend to maintain economic profitability in the context of the CDM rules. Projects that are the most affected by transaction costs are certainly small-scale ones, which will not be able to generate CERs to cover their own costs.

Furthermore, transaction costs are added to the degree of risk where emission reductions are certified. The trading of most of the reductions, that is, ERU units and not CERs, occurs in a context of uncertainty as to the final certification of these emission reductions, hence directly affecting the expected revenue of the projects, both in terms of volume and price of carbon credits. Other equally important risks include the usual ones, associated with project implementation and success, as well as technological, economic and political risks. In addition to the said transaction costs, the presence of risk at all levels tends to be a source of additional costs, which reduces the CDM's potential profitability (Janssen, 2001). The possible result of the project not being carried out is highlighted, however, it would not eliminate the aforementioned costs.

6. Limiro, D. *Créditos de Carbono*: Protocolo de Kyoto e Projetos de CDM. Curitiba: Juruá Editora, 2009.

3.2 Institutional aspects in Brazil

In Brazil, assessing the CDM projects is a responsibility assigned to the Interministerial Commission on Global Climate Change (CIMGG), which is also Brazil's National Designated Authority (NDA), in charge of implementing the Kyoto Protocol at the national level. In the assessment process, the following aspects are considered: voluntary participation on behalf of each Party involved, project design document (PDD), validation report and project's contribution towards the country's sustainable development. The latter encompasses five criteria: income distribution, local environmental sustainability, development of work conditions and net job generation, capacity-building and regional integration with other sectors. In Brazil, the CDM process has granted certification to project activities and program of activities (PoA).[7]

For a Project to become a CER, project activities and PoAs must necessarily go through the seven stages of the project's cycle: PDD development, validation, national approval, registration, monitoring, verification, and issuance of CERs.

In Brazil, the process of assessing project feasibility is very strict, compatible with the pursuit of environmental integrity as a goal of maximum importance. This process generates high transaction costs, both at the stage of PDD review and after its approval, and requires it to be effectively operational, since it is necessary to verify whether the emission reductions are actually occurring according to the initially proposed estimates. In fact, these high costs were necessary to guarantee project environmental integrity and their alignment with the objectives of sustainable development in Brazil. According to Miguez et al. (2010), the Brazilian approval process is considered exemplary and safe by investors, which guaranteed an additional value to Brazilian projects by reducing regulatory risk at the international level.

A research commissioned by Godoy (2013) tries to answer the question about whether inherent transaction costs to the CDM had an adverse impact in developing a CDM project in Brazil. The universe that has been investigated and included in this research comprises the 89 companies with CDM projects implemented in Brazil that already had certificates issued up to March 2009. Out of these CDM projects, distributed in eleven sectors, 41 responded to the survey, which corresponds to 46% of responses on the total questionnaires sent.[8]

Transaction costs in this research have been divided into ex ante (associated to the effective implementation of a project) and ex post (incurred after their implementation). Ex ante costs include information costs, broker costs and other costs – with particular reference to those arising from the time spent between the preparation of the project and its implementation –, in addition to the costs of

7. Project activity is an action causing a reduction in GHG emissions and program of activities is a program encompassing several component project activities (CPA) with the same purpose.

8. Please refer to Godoy (2013) for further detail.

drafting contracts to guarantee the purchase of carbon credits, since this is an over-the-counter market. Ex post costs are basically associated with monitoring costs.

The research's main conclusions indicate that: *i)* the CDM's most important objective is to look for environmental improvement, even though the possibility of trading CERs has been a relevant encouragement; *ii)* the costs of negotiating CERs are within reason, with the consultancies hired playing the role of middleman between buyers and sellers; *iii)* the intrinsic complexity of the CDM process in all its stages created a need for companies to hire private consulting firms; *iv)* the need to improve the institutional set-up, where there is great dissatisfaction with DOEs and the CDM Executive Committee, has given greater transparency and speed to decisions; *v)* the uncertainty about the future of the CDM at that moment; and *vi)* high rates of registration and auditing, which have often offset the profit obtained with trading CERs.

The research outcomes indicate, beyond question, that inherent transaction costs in the approval process of CDM projects can act as a barrier. It is an extremely complex institutional framework, with strict national and international regulatory aspects, one that is constantly changing, and complying with it involves high financial resources and time, which often becomes an impediment for small and medium enterprises to have access to the CDM. However, it is worth mentioning the scope of environmental integrity, for which, without a doubt, certification of a CDM project is a highest standard seal of environmental quality not only locally, but mainly internationally.

Mindful of transaction costs, the CDM Executive Committee created the Programmatic CDM, through which several projects with common characteristics can be grouped together to manage the process in a unified way, thus significantly reducing transaction costs – PoA, as previously defined. Another important initiative is the systematic search for simplification and consolidation of methodologies.

4 CONCLUSIONS: THE CDM'S INSTITUTIONAL CONTRIBUTION IN THE UNFCCC AND TO THE BRAZILIAN GOVERNMENT

Despite the end of Kyoto first commitment period and the non-ratification of its second commitment period by the parties to the Convention for it to go into legal effect, its legacy can and should be used as an important tool in the implementation of sustainable development policies to combat climate change. Despite the negative moment experienced by the CDM, where demand tends to be zero, except for the existence of some multilateral agencies and philanthropic supporters, the CDM is nevertheless a unique instrument for the GHG reduction process, via its projects and program of activities in developing countries, and enjoys the highest credibility.

The complex institutional-regulatory framework created with the CDM, with the interaction of several national and international governance levels, was a very fruitful learning process for the different stakeholders involved in the process. Despite the intrinsic constraints posed by transaction costs, which have significantly limited the use of the CDM – but were necessary at a first instance – the evolution of this structure was positive, and important initiatives were taken to reduce these costs, in particular the possibility of PoA. Once again, it is crucial to highlight the importance of environmental integrity in the CDM projects, which is guaranteed by the process itself, from this framework of sustainable governance and its potential application in other climate change policy contexts.

According to Lutken (2016), the CDM is still the only instrument able to provide significant cash flows for investments with GHG emission reductions benefits. With the upcoming cessation of the CDM, this flow will no longer exist, and projects reducing emissions run the risk of not having access to specific sources of funding. Also, rightly according to him, market-based mechanisms alone are not enough to promote funding for emissions reductions that have not yet been certified: two concrete proposals are presented with a view to providing initial funding for emission reduction projects. The first one suggests the securitization of emission reductions that have not yet been certified; the second one establishes a set value for CERs to be certified (Lutken, 2016). Both proposals aim to guarantee initial capital for CDM-type projects, prior to certification of CERs.

The CDM created a highly credible institutional-regulatory framework, able to measure, report and verify the outcomes of the emissions reduction process in the scope of projects and programs. With the progress of negotiations on future mechanisms, there are alternatives for the use of this infrastructure in various instances of policies related to combating climate chan.

Having that in mind, during the XI United Nations Conference on Climate Change (CMP-11), held in December 2015 in Paris on the occasion of COP-21, the CDM Executive Board was invited to map out new possibilities for the use of the infrastructure developed from the CDM in the context of potential funding channels that emerge under the UNFCCC. The CDM Executive Board (2016) identified several instances in which the CDM infrastructure could be a means to:

- provide an array of opportunities for actions and projects that aim to reduce GHG emissions to have access to specific funding channels, aiming at verifiable mitigation;
- provide flexible options to comply with emission reduction commitments in different contexts (commercial aviation agreements, for example); and
- indicate various possibilities for different stakeholders (companies, cities, international entities, etc.) can voluntarily offset emissions.

The Green Climate Fund (GCF), created in the scope of the UNFCCC to support developing countries in their adaptation and mitigation efforts, aims at supporting projects, programs and policies, via thematic funding windows, with the expectation that the volume of funding will reach US$ 100 billion annually by 2020. It would be a natural consequence to combine the GCF with the CDM infrastructure, as has been advocated (Mikolajczyk et al., 2016).

In turn, the Paris Agreement is a legal global framework that strengthens response to the threats imposed by climate change, relying on the experience acquired by the UNFCCC in the past few years. In order to accomplish the objective of keeping the average temperature rise, if possible, below 1.5ºC, the agreement provides for the urgent implementation of mitigating actions. Expanding the carbon market and strengthening financial institutions in order to increase funding and allow for a transition to a low-carbon economy are crucial points in the Agreement and serve as a basis for the future mechanism established by its Art. 6.4. It should be noted that more than half of the nationally determined contributions (NDCs) submitted do recognize the importance of market mechanisms, through international, regional and domestic emission schemes, including the CDM as a complement to their national mitigation actions, taking into consideration greater efficiency and the lower costs achieved.

The Brazilian NDC provides for greenhouse gas emissions reductions below 2005 levels by 37% by 2025, besides indicating a reduction by 43% below 2005 levels of domestic emissions by 2030. The strategy of ensuring flexibility in national implementation grounded its elaboration, given that it was not detailed by specific policies and sectors. It is worth mentioning that the Brazilian NDC is compatible with and supports the objectives established by the National Policy on Climate Change, defined by Law No. 12,187, dated December 29th, 2009, and ruled by Presidential Decree No. 7,390, dated December 9th, 2010, comprising the period between 2005-2020. In the list of challenges associated with achieving the NDC's targets, are also those related to the development of a strategy for its financing and the institutional aspects of its implementation, even though there is no conditionality regarding international financial support. Brazil is openly positioning itself for the use of UNFCCC financial mechanisms to possibly receive support from developed countries, aiming at generating benefits (Pretendida..., 2015).

In that respect, the CDM appears as a powerful instrument, capable of attesting/certifying mitigating actions in the different countries that have signed the Paris Agreement in a transparent, verifiable and independent manner, particularly for developing countries. Its potential as an MRV framework provides an important basis for channeling funding for actions that can potentially be considered within the scope of the GCF. In addition, the Paris Agreement also established that national mitigation actions/contributions are reported in a transparent and comparable manner, which makes the CDM infrastructure appropriate to the MRV process of developed countries.

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CHAPTER 11

LEGAL NATURE AND CREDIT AND TAX ISSUES OF CERTIFIED EMISSION REDUCTIONS[1]

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1 INTRODUCTION

How to finance the adaptation and mitigation measures needed to enable low-carbon economies has been a top priority and at the same time one of the greatest challenges for nations that are part of the United Nations Framework Convention on Climate Change (UNFCCC). Commitments for the transfer of resources from developed to developing countries under the 2016 Paris Agreement involve $100 billion a year as at 2020. The Clean Development Mechanism (CDM) was established by the Protocol of Kyoto, in 1997, on the basis of this north-south dichotomy, in order to finance measures to be adopted by developing countries in the tackling of climate change.

The Kyoto Protocol, enacted in Brazil by Decree No. 5,445, dated May 12th, 2005, established the CDM as one of its three market-based mechanisms. It is the mechanism of this protocol that enables the voluntary participation of developing countries in the effort to reduce greenhouse gas (GHG) emissions, especially from mitigation projects that generate Certified Emissions Reductions (CERs), which can be bought by developed countries in order to achieve their emission reduction targets. This transaction would promote the transfer of resources and technology from developed to developing countries, aiming at consolidating low carbon economies (Torres, Fermam and Sbragia, 2016).

The genesis of the CDM had optimistic expectations of reconciliation of the great differences between developed and developing countries on solutions to the climate dilemma, considering the synergy inherent in the CDM among those countries and their potential contribution to sustainable development.

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One of the pillars of the CDM is the generation of carbon credits (or CERs) certified by the United Nations (UN), but definitions of their legal nature in the domestic sphere remain to be seen. Some bills – currently filed by the National Congress, as discussed in the next section – aimed at legally conceptualizing CERs, as well as establishing rules on these certificates, which included tax measures to promote CDM projects in Brazil.

This chapter examines the legal nature of CERs and related tax and credit issues with the objective of assessing aspects related to the domestic regulation of carbon credits, considering also the possible replacement of the CDM by the sustainable development mechanism (SDM), provided by the Paris Agreement. In addition to this introduction section, the chapter is organized in another three sections. We will cover the domestic and international context of the CDM in the next section. The following section will cover the legal nature and the credit and tax issues associated with CERs. Then, conclusions will be drawn from the reflections of the two previous sections.

2 DOMESTIC AND INTERNATIONAL CONTEXTS OF THE CDM

The economic rationale of the CDM is associated with the lower cost, for developed countries, for financing mitigation projects in developing countries, compared to the cost that the more industrialized nations would have to reduce their emissions domestically. These projects must result in mitigation, that is, emissions reductions, when compared to a situation of not implementing the project, a characteristic known as additionality.

In fact, CDM projects are subject to a thorough analysis by the National Designated Authority (NDA), which in Brazil is represented by the Interministerial Commission on Global Climate Change (CIMGC, in the Portuguese acronym). Once approved, projects are registered and CERs are issued by the CDM Executive Board (a UN body), corresponding to the total GHG that, due to the existence of the project, will no longer be emitted or will be sequestered.[4] Each CER is equivalent to 1 ton of carbon dioxide equivalent and can be traded and granted via onerous transfer (sold) and used by Annex I countries to meet part of their emission reduction targets under the Kyoto Protocol.

The use of market-based instruments in the execution of public environmental policies can achieve results that would not be achieved otherwise by the traditional instruments of command and control, executed by the public power. Several authors argue that market-based solutions would allow a minimal cost to achieve

4. The National Policy on Climate Change (Law No. 12,187, December 29th, 2009) defines this sequestration as a sink: "a process, activity or mechanism that removes greenhouse gas, aerosol or precursors of greenhouse gases from the atmosphere" (Brazil, Art. 2, IX).

environmental policy objectives, as well as foster technological innovation by the increasing adoption of less polluting techniques within an emissions trading system, for example. However, the CDM is associated with high transaction costs[5] due to the bureaucracy inherent in the process of obtaining credits (Gutierrez, 2010).

Other critical aspects have been evaluated. One of the more comprehensive literature reviews on the CDM suggests that its operation by market forces alone would not contribute significantly to sustainable development[6] in developing countries, and above all it would not contribute to alleviating poverty (Olsen, 2007). In a regional analysis on the impacts of the CDM, the excessive focus on economic aspects of the mechanism and the little importance given to the social dimension are pointed out, (Lazaro and Gremaud, 2017).

The first commitment period of the Protocol, with emission reduction obligations by developed countries (parts of Annex I of the UNFCCC) was in force between 2008 and 2012. The second period was only established at the XVIII Conference of Parties (COP-18) in Qatar, by means of the Doha Amendment (in reference to the capital of that country), which determined that this period would cover years 2013 to 2020, during which Annex I countries would have to reduce emissions by at least 18% below the 1990 levels. However, the amendment has not yet entered into force, as it must be ratified by at least 144 UNFCCC member countries. By October 2019, 134 countries had ratified the amendment.

In Brazil, the National Congress approved the Doha Amendment by Legislative Decree No. 178 of 2017. However, in order for the amendment to enter into force at the domestic level, after ratification by at least 144 countries, it will be necessary that it is enacted by an Executive decree, which is one of the requirements for it to prevail in Brazil with an ordinary law status.[7] It should be noted that the countries responsible for most of the world emissions are in one of the following situations: either they have not ratified the Kyoto Protocol, so they will not ratify Doha (in the case of the United States); they have no obligation to reduce emissions (China, India, Brazil and other developing countries); or they did not sign the Doha Amendment (Russia, Japan and Canada, for example).

This poor adherence to the Kyoto Protocol commitments has negatively influenced the implementation of CDM projects, since the inherent logic of the

5. For further information on transaction costs and its influence on development of CDM projects, see Chapter 10 (note from the editors).

6. For further information on this topic, it is recommended that you read Chapter 8 of this publication, which discusses, carefully and critically, from the perspective of its author, the relevance, relevance and efficiency of the criteria adopted by Brazil for the verification of CDM Projects' contribution to sustainable development (note from the editors).

7. As per the decision by the rapporteur, Minister Celso de Mello, on the Direct Action of Unconstitutionality No. 1,480-3/DF (September 4th, 1997), the Federal Supreme Court considers that the international treaties promulgated by the Executive Branch have normative parity with ordinary laws. It is the so-called thesis of the ordinary legality of international treaties, reaffirmed in later decisions of the Court. See: <https://goo.gl/PEM5rW>. Accessed on: November 19th, 2019.

mechanism is precisely the purchase of CERs by countries that have obligations to reduce emissions, which depends on the commitment of these nations (Voigt, 2008). In addition to this, there is also the decision, by the European Union (the main purchaser of CERs, through the European emissions trading system)[8] to restrict the purchase of these certificates, as at 2013, only for CDM projects from less developed countries.[9] This explains a significant increase in the number of CERs in 2012, since Brazil, China and India (which account for about 75% of the projects) have accelerated their UN registration processes, prior to the beginning of this restriction.

Since the implementation of the CDM to January 2016, the Secretariat of the Convention has recorded 7,690 CDM project activities, according to the CIMGC report.[10] Brazil is one of the 3 countries with the highest number of projects (339, or 4.4% of the total), followed by India (1,598, or 20.8% of the total) and China (3,764, or 48.9% of the total).[11]

The CDM projects registered in the country are responsible for a reduction of 375 million tons of carbon dioxide equivalent, about 5% of the world total emissions that will be avoided as a result of these projects, which corresponds to the first period of obtaining credits. China would account for about 60% of total avoided emissions from CDM projects and India for 11.5%. Approximately 75% of Brazilian CDM projects are associated to the generation of renewable energy, according to the most recent report on the status of projects, prepared by the CIMGC.[12]

It can be stated that the Kyoto Protocol (and the CDM) is in a situation of uncertainty, considering the low commitment of the parties, especially regarding the ratification of the Doha Amendment. Since 1990 (base-year of protocol reduction commitments), world emissions have increased by about 50%, mainly due to economic growth in China and other countries in Asia, South America and Africa. If in 1990 developed nations accounted for two-thirds of emissions, in 2012 those countries emitted less than 50% of total GHG emissions (Schiermeir, 2012). As a result, it can be said that, although the Kyoto Protocol has achieved its objective with regard to developed countries' responsibility under UNFCCC, the regime has lacked other protocols that would contribute to global emissions reductions. Hence, while overall emissions reductions for the stabilization of

8. European Union Greenhouse Gas Emission Trading System – EU ETS.

9. Chapters 14 and 15 of this publication present relevant considerations regarding marketing issues and their impacts on both the CDM and the new market mechanisms and formats, as suggested by PMR Brazil's experience in Chapter 15 (note from the editors).

10. For further information, see the Clean Development Mechanism (CDM) Project Status Report in Brazil - compiled by January 31st, 2016, prepared by CIMGC in 2016. Available at: <https://goo.gl/xCi3Wf>. Accessed on November 19th, 2019.

11. For further information on CDM Projects developed in Brazil, see Chapter 2 (note from the editors).

12. For further information on CDM Projects for the energy sector, see Chapter 4 (note from the editors).

greenhouse gas concentrations in the atmosphere have not been observed, Kyoto laid the groundwork for climate policies adopted today by the parties and served as an experiment for the formulation of the Paris Agreement as a recent multilateral understanding on climate change.

The entering into of the Paris Agreement, enacted by Decree No. 9,073, de 2017, led to a more comprehensive effort to reduce emissions, with voluntary obligations of all parties – not just developed countries, as in the Kyoto Protocol. This effort is brought about by the Nationally Determined Contribution (NDC), established by each country in the agreement – another difference from Kyoto, which defined quantified reduction commitments only for developed countries based on the principle of common but differentiated responsibilities. Unlike Kyoto, the Paris Agreement seeks voluntary cooperation in the implementation of NDCs by the parties to allow greater ambition in their mitigation and adaptation actions.[13]

According to the Paris Agreement, the mechanisms provided for in Art. 6 still require regulation of its modalities and procedures. Under the new agreement, emissions trading mechanisms allow all parties to be both buyers and suppliers of carbon credits as they all commit to reducing their emissions (Fraxe and Kässmayer, 2016).

Of interest for this analysis, the agreement established the SDM, according to Art. 6, Paragraph 4. During negotiations for the regulation of the agreement, as per proposals submitted by Brazil to the Secretariat of the Framework Convention, the country considers the SDM to be "the" international mechanism for certifying climate actions and issuing credits, based on the experience obtained with CDM. The SDM would be, according to the Brazilian proposals, an expanded CDM,[14] a centralized and voluntary certification, subject to multilateral governance to guarantee its environmental integrity. While the use of credits generated in the CDM only assists Annex I countries (to achieve their emissions reduction obligations) rather than Non-Annex I, the SDM has been set up with much greater flexibility to encourage and facilitate participation in mitigation of GHG emissions by public and private entities authorized by any party.

Brazil argues that the new rules have to guarantee a transition from the CDM to the SDM, in such a way that CERs are also instruments for mitigation according to the new agreement. In this sense, it argues that the rules and bodies dedicated to SDM are established based on the structure and standards of the CDM system, considering their rigor, transparency and reliability. It further argues that emission reductions resulting from SDM projects in a given country can be transferred to enable the NDC of another country, with safeguards to avoid double counting in

13. For more information on the format and main features of the Paris Agreement, see Chapter 12 (note from the editors).
14. For more information on the Brazilian proposal for the SDM, see Chapter 12 (note from the editors).

the global inventory; or that they can be used to achieve the NDC of the country proposing the project.

The SDM could indeed be considered an expanded CDM, depending on the regulation that the parties will give to the rules of this mechanism, which, unlike the CDM, enables: *i*) that the project be carried out by both developed and developing countries; *ii*) more levels beyond the national levels – for example, subnational (regional and local) level; and *iii*) that not only countries, but also public and private entities authorized by the party can develop projects.

There is great potential for growth in sectors that can benefit from mechanisms like the CDM and SDM, such as the generation of electricity from solar photovoltaic source, with estimates indicating that this source may represent around 32% of the energy mix in 2040, with investments estimated at BRL 685 billion (Ramos, 2017). According to the National Electric System Operator (NOS), wind power sources have also gained increased share in this mix, mainly in the Brazilian Northeast, where they accounted for about 58% of the total energy generated in August 2017, reaching up to an average 5,873 MW.

Maybe the greatest challenge in transitioning to a low-carbon economy is related to the necessary investments. In this regard, market-based mechanisms, such as the CDM, would contribute to make this transition economically feasible.

Other challenges include the tax burden associated to the development of sectors related to this economy and the creation of a proper regulatory environment. The lack of a legal framework is one of the main obstacles to the necessary legal certainty to support projects (Gutierrez, 2007).

As for legislative proposals that sought such regulation, Bill No. 493 of 2007 dealt with CERs generated from the CDM. The project approached the trading of certificates in the stock exchange or organized over-the-counter markets and provided for tax breaks for investors in CDM projects that generated CERs, with various tax exemptions, which included exemptions from the contribution for the Social Integration Program (PIS) and the Contribution for Social Security Financing (Cofins) for operations involving the transfer of CERs. However, in 2015, the Bill was filed by the Chamber of Deputies, based on a regimental provision that determines the filing of projects that remain without final deliberation over a long period.

Regarding the legal definition of CERs, in addition to Bill No. 594, of 2007 (which intended to define carbon credit certificates as a security), there was Senate Bill No. 33, of 2008, which also leveled CERs with securities, and submitted these certificates to the regulation of the Brazilian Securities and Exchange Commission. However, in 2014, Senate Bill No. 33 was rejected in the Senate, on the basis that it would not be convenient to consider a CER as a security and that its approval would generate additional and unnecessary costs for the carbon credits market, considering that the Brazilian market would have of some mechanisms capable of financing and structuring projects for the issuance of carbon credits, regulated by the Brazilian Securities and Exchange Commission. Bill No. 594/2007 was filed in the Chamber of Deputies in 2015, due to the delay in achieving a final deliberation.

In the next section, we will cover crucial points for establishing a regulatory environment: defining the legal nature of CERs and the tax and credit issues associated with certificates.

3 LEGAL NATURE AND TAX AND CREDIT ISSUES OF CERS

The concrete effectiveness of the CDM in adding equity in the form of CERs to those who develop projects aimed at reducing GHG emissions is necessarily related to both the certainty (or not) of collecting proceeds from CERs and the possibility of negotiating such assets and, consequently, to the definition of the actual economic results to be obtained.

This effectiveness is also severely influenced by the effects of the negotiation of such assets, especially in a society where the level of private savings is low – a fact that is common to many of the countries not included in Annex I – where credit has a crucial role as a way of financing economic activities. In this context, special attention should be paid to the economic and financial effects of both the effective receipt of asset values and their anticipation through secondary market negotiations. The effects discussed here are fundamentally of two natures: credit and tax.

Credit effects come up when negotiating in the secondary market, and deserve very special attention, since credit in Brazil (as in several developing countries): *i*) takes on high volumes in the financing of projects – that is, usually economic agents that are CERs creditors are indebted to the institutions of the National Financial System; and *ii*) imposes extremely high interest rates when compared to those practiced in the rest of the world.

In this context, CERs holders who are indebted to the National Financial System are tempted to negotiate their bonds before their maturity date, offering significant discounts, since the holder of the purchasing power, as a rule, is the National Financial System. Thus, buyer institutions can at the same time take advantage of the eventual economic fragility of CERs holders and impose on them discounts that also reflect the high rates practiced in the financial market. As a result, the actual amount to be received from CERs, when anticipated, is significantly reduced as a result of the discount offered by the financial market.

The *tax effects* on the efficiency in collecting proceeds from CERs are verified in two moments: due to the collection of CER, and due to its negotiation.

Several authors, especially Silva (2015), point out that tax effects should be examined in the light of the legal nature of CERs, and to this end, this author raises four hypotheses assumed by the doctrine about its legal nature: intangible or immaterial property, environmental commodity, securities or derivatives.

3.1 The legal nature of CERs

Usually, CERs are considered a "transactable financial asset", and this concept is the starting point for the examination of its legal nature. It should be borne in mind, however: *i)* that the definition of the legal nature constitutes a form of classification of the asset among defensible hypotheses; and *ii)* that legal classifications make sense when different categories have different norms that give meaning and relevance to classification.

In fact, as explained above, the National Congress attempted to rank CERs as securities via Bills 493/2007 and 549/2007, which were processed in the Chamber of Deputies, and Senate Bill No. 33/2008. The Bills were shelved in the Chamber of Deputies for not having been approved in two legislatures (each lasting four years). The Senate's was expressly rejected by deliberation of the Committee on Economic Affairs.

Frustration of the attempt to legislate, which would have the effect of concluding the discussion on the legal nature of CERs, does not, however, remove the most lucid understanding on the issue, which was the subject of an earlier article by the authors of this chapter (Fraxe and Remígio, 2010), in which we argue that CERs are securities.

On the other hand, the Brazilian Securities and Exchange Commission distances CERs from the incidence of Brazilian legal regulations related to securities, according to the following text:

> This chapter will present some of these securities and their main characteristics. First, however, an introduction will be made to the concept of securities. This discussion becomes important insofar as the characterization of securities as marketable securities makes them subject to the rules and supervision of the Brazilian Securities and Exchange Commission, with a significant change in the way these securities can be offered and traded in the market (Brazilian Securities and Exchange Commission, 2014, p. 70).

Along these lines, Silva (2015, p. 190-191), following the guidance above, states that

> Discussions on the possibility of CERs being considered as securities originate from the assumption that only those instruments that may be listed under Art. 2 of Law 6,385/76 can have this nature. In this sense, we have the statement of a Brazilian Securities and Exchange Commission director admitting that "securities, more than a theoretical category, are all that the law defines as such, for the purposes of defining the competence of the state regulator." Although the legal list has ceased to be *numerus clausus* since the reform of Law 6,385/76, in 2001, however, a financial instrument can only be considered as a security if it can be classified among the modalities of Art. 2 of the aforementioned law which, since 2001, has come to include derivatives and collective investment contracts. Since the CER is a "financial instrument, tradable in secondary markets", we must verify if it can be included in the modalities of that legal provision.

It is quite true that the authors do not share these thoughts for two very clear reasons: *i)* the wording of the caption of Art. 2 of Law No. 6,385, dated December 7th, 1976, provides that its items only list the "securities" that are "subject to the provisions of this Law"; and *ii)* the scholar admits that the list in Art. 2 is not *numerus clausus*, therefore, it allow for the possibility of other assets being framed there.

The literal interpretation of the above text allows no misconstruction: the subjects of the sentence – which are the subsections – are "securities subject to the regime of this law".

This cannot conduct to the conclusion that: *i)* the list that follows the caption contains the only securities possible; *ii)* consequently, what is not in that list, is not security.

What Art. 2 intends to bind is the listing of items submitted to the effects of the said law – and that is it. It is irrefutable that the text derives from the indisputable characterization of the items as securities. In fact, the policy-maker could even have omitted such an expression and drafted the caption simply with the text: "Are subject to this Law's regime: [...]".

It is clear that the Law only established the characteristics of the items (they are securities), however the legislative writing in no way intended to exhaust the assumptions of securities.

We understand that CERs are securities, given that their nature has the two necessary characteristics for this definition: they are assigned a value and are tradeable. When examining the matter in its essence (ie, abstracting from the mere effects of Law No. 6,385/1976), it is observed that, in practice, all securities are marketable securities.

In other words, if there is a security, it is, by nature, a marketable security, which does not mean that all the securities will be subject to the supervision of the

Brazilian Securities and Exchange Commission, as is the intention of those who (in our view, mistakenly) only recognize those listed in the said Law.

The very concept of securities began with the bill of exchange, notes payable, the duplicate and the check. These securities, however, although they are essentially securities, are not, as a rule, subject to the control and supervision of the CVM.

In the case of the Brazilian Emissions Reduction Market, however, there is legislation that goes beyond Law No. 6,385/1976, which not only expressly recognizes CERs as securities, but also subordinates the market for its negotiations to the authorization of the Brazilian Securities and Exchange Commission. Art. 9 of Law No. 12,187/2009 (Climate Change National Policy) provides that

> The Brazilian Emission Reduction Market will be operated in commodities and futures exchanges, stock exchanges and organized over-the-counter entities, authorized by the Brazilian Securities and Exchange Commission, where trading of securities representing certified emission reduction of greenhouse gas (Brazil, 2009).

As previously stated, in the authors' standpoint, in essence, there is no doubt that CERs are securities.

3.2 Taxation of CERs

In the Brazilian context, there may be up to three types of legal facts that involve CERs and that are of interest to Tax Law, since they subsume under the assumptions of incidence, in general, of income tax, in this case, as capital gain, and of the Social Contribution on Net Profits (CSLL, in the Portuguese acronym): the sale by the holder of the project in the domestic secondary market; the sale by that same original holder to the international buyers of countries listed in the aforementioned Annex I; and, finally, the sale by the buyers in the secondary market to international buyers.

When the sale is made by the original holder, whether on the domestic secondary market or to international buyers, the tax rules are the same, and capital gain is calculated from the following subtraction: value received less the cost of production, according to certain rules that define the expenditures that can be subtracted.

In the specific case of companies that calculate profit by the presumed profit method, the legislation determines that the cost will be 68% of the income earned, in other words, the calculation basis will be 32%, according to Art. 15, Paragraph 1, III, *c*, of Law No. 9,249, of December 26, 1995.

> The basis of calculation of the tax, in each month, will be determined by applying the percentage of 8% (eight percent) on gross revenue earned monthly, observing the provisions in Art. 12 of Decree-Law No. 1598, of December 26, 1977, deducted from the discarded, canceled sales and unconditional discounts granted, without prejudice to the provisions of Arts. 30, 32, 34 and 35 of Law No. 8,981 of January 20, 1995.

> Paragraph 1: For the following activities, the percentage referred to in this article will be: (...)
>
> III – thirty two percent, for activities including: (...)
>
> c) administration, lease or assignment of real estate, movable property and rights of any kind;

In the case of the secondary market, capital gain is calculated by simply subtracting the value obtained from the sale less the amount paid for the purchase.

The result of the operations described will constitute profit, and rates of 15% or 20% will be applied, due to the fact that the company's profit, in theory, were above BRL$ 20,000 per month, as determined by Arts. 3 and 15 of Law No. 9,249/1995.

Regarding the Social Contribution on Net Profits, it is applied at a rate of 9% on profits, whether it is assessed, as the income tax, or in the presumed or actual form. Due to the nature of CERs, its sales are not taxed by other indirect taxes (such as the Tax on Industrialized Products – IPI, the Tax on the Circulation of Goods and Services – ICMS and the Tax on Services – ISS) neither by indirect contributions (PIS and Cofins).

Building from this data, the result is that by the presumed income method, CER income is taxed at the rate of 10.88% (corresponding to 25% of Corporate Income Tax – IRPJ plus 9% of the Social Contribution on Net Profits, applicable to a profit base of 32%); in real profit, this general percentage will only be defined as a result of costs that, in theory, will be higher than 68%, which means that the real rate tends to be lower than 10.88%.

Therefore, there is a significant tax burden on operations involving CERs, which may discourage the gain in scale in CDM projects. In addition to the tax effects, there are credit effects that may also negatively impact the financial results of the CDM project proponents.

3.3 On credit effects

One of the factors of greater relevance for the effectiveness of CERs is the capacity of effective financial reimbursement, from the appropriation of the carbon credit generated. This temporary aspect deserves special importance in view of the adverse economic context that Brazil has faced in recent years.

The low level of internal savings, coupled with the steady reduction in economic activity, leads companies to seek anticipation of their receivables, with a view to the composition of their financial resources destined to working capital and the fulfillment of the obligations assumed by them in the exercise of the economic development activity. In this context, the anticipation of CERs receivables is relevant, since it constitutes a form of financial income decoupled from any assumption of liabilities.

However, the domestic financial market imposes interest rates that considerably degrade the real value of the asset. In August 2017, for example, consulting the Central Bank's website to obtain interest rates on loans for working capital to less than 365 BCB days[15] showed that such rates vary from 11.33% to 75.70% a year, and present an average of 32.67%, which means that a bond worth, for example, BRL132,667.70 will be negotiated, on average, for BRL100,000, suffering, therefore, a discount of BRL 32,667.70, that is, a discount of 24.62% in one year.

Taking this period as a possible base for real discount, and adding to it the average tax of 10.88% (when it comes to the presumed profit method), the conclusion is that, in order to realize the early entry of a CER, the company will have to give up 24.62% of the security, and, on the net value, pay 10.88% of taxes. That is, it will receive the net amount of BRL89,120.00, in the case of the example of BRL132,667.70, which corresponds to 67.18% of the gross value owed to the company.

4 CONCLUSIONS

There are current uncertainties regarding the effectiveness of the Kyoto Protocol, whose second commitment period (2013-2020) has not even come into effect, particularly as a result of the low commitment of countries with high GHG emissions in ratifying the Doha Round. In addition, the decision by the largest purchaser of CERs, the European Union, to restrict the purchase of credits generated by the CDM only from less developed countries, has reduced the demand for Brazilian CERs, which has negatively affected Brazilian CDM projects.[16]

This critical situation can be overcome with the Paris Agreement, which established the SDM, an instrument that, according to Brazilian proposals, would replace the CDM, with greater flexibility and based on the institutional framework created under the Kyoto Protocol.

Several authors point out the importance of establishing a regulatory framework to ensure the necessary legal and economic security for CDM projects, based on the provisions of the National Policy on Climate Change about the Brazilian Emission Reduction Market. However, the main legislative initiatives on the subject were

15. For further information, refer to *Pessoa jurídica – Capital de giro com prazo até 365 dias* (Legal Entity – working capital with a term of up to 365 days) at the Central Bank website. Available at: https://goo.gl/M4bmgE. Accessed on: Aug 21st, 2017.

16. Several chapters of this publication deal with the impact of restricting the marketing of CERs by the European Union. Chapter 12 identifies the uncertainty and consequences of this decision. Graph 4 in Chapter 6 shows the change in CER prices for the period (note from the editors).

frustrated, by the filing or rejecting of projects. These proposals sought, in addition to other measures, to define the legal nature of CERs.

In addition to the absence of a regulatory framework, other aspects that weaken the effectiveness of the CDM are related to tax and credit effects. The legal nature of CERs is one of the fundamental aspects for the analysis of tax effects. We understand that CERs are securities. And we estimate that, in the case of presumed profit, the CERs are charged an equivalent to 10.88% of the revenues generated; and, in the case of real profits, a rate lower than 10.88%. Considering the effect of an anticipation of CERs credits – with the objective, for example, of capitalizing a CDM project bidder – and based on an average tax of 10.88%, we estimate that such a company will receive around 67% of the gross amount due to it for the generation of CERs.

These tax and credit effects reinforce the importance of an adequate regulatory framework that promotes the scale-up of CDM projects, including fiscal incentive measures for project proponents. Thus, a low-carbon economy would be strengthened through this instrument of the Kyoto Protocol, whose assumptions will eventually be incorporated into the SDM regulation, under the Paris Agreement, in order to enable the fulfillment of the goals taken on by Brazil in the global effort for the balance of the Earth's climate.

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PART 3

RECENT CLIMATE AGREEMENTS AND NEGOTIATIONS: THE FUTURE OF THE MECHANISM

CHAPTER 12

THE CONTINUATION OF THE CDM UNDER THE PARIS AGREEMENT AND ITS ARTICULATION WITH THE SDM[1]

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Tulio César Mourthé de Alvim Andrade[3]

1 INTRODUCTION

The use of market mechanisms to combat climate change was introduced by the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1997. In force since 2005, the Kyoto Protocol established the Clean Development Mechanism (CDM).[4]

The CDM has scaled emission reduction projects in developing countries and was able to start a fully fungible carbon credits market. Doubts about the Kyoto Protocol, however, cast uncertainty on the mechanism itself.

With a view to extending the CDM's advantages to the post-2020 context, where a new agreement under the UNFCCC would become the main reference for the international response to climate change, Brazil presented, in the negotiations that would culminate in the adoption of the Paris Agreement, in 2015, a proposal for an extended CDM (CDM+). The main elements of the Brazilian proposal were incorporated into the final text of the agreement, in Art. 6, Paragraph 4, in the form of the "Sustainable Development Mechanism" (SDM).

2 SDM BACKGROUND

The concept of a new centralized GHG emission reduction (GHG) certification mechanism within the scope of the Paris Agreement under the UNFCCC was based on a proposal submitted by Brazil to the 20th Conference of the Parties (COP-20) to the UNFCCC and 10th Meeting of the Parties to the Kyoto Protocol (CMP-10) in Lima in December 2014. The Brazilian proposal to COP-20, known as the "proposal for concentric convergence", sought to provide a solution to one

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4. Art. 12, of the Kyoto Protocol to the UNFCCC.

of the most controversial aspects of the negotiations that would culminate in the Paris Agreement under the UNFCCC: respect for the principle of common but differentiated responsibilities in a scenario in which all countries – both developed and developing – would be called upon to contribute to the mitigation of global GHG emissions.

By concentric convergence, countries' obligations to combat climate change would be differentiated according to their historical responsibility for global warming. Progressively, there would be a prospect of gradual convergence among the State Parties, as the large developing countries increased their individual responsibility for the increase in global average temperature.

Presented in a broader negotiating context, the Brazilian proposal provided, in an ancillary way, for the establishment, under the Paris Agreement, of a new emission compensation mechanism, similar in scope to the CDM, with other functions.

2.1 Conception of the SDM: the Brazilian proposal for a CDM+

The proposal for concentric convergence included a chapter on economic mechanisms, which covered, in particular, an expanded clean development mechanism. The aim of the CDM+ would be to encourage developing countries and economies in transition to implement certified actions to fight climate change as additional to their emissions mitigation pledges under the Paris Agreement and, at the same time, to facilitate the achievement of what would be promised by developed countries.

The CDM+ would aim to reduce anthropogenic GHG emissions and increase removals by sinks by applying the modalities, procedures and methodologies of the Kyoto Protocol's CDM in the process of certifying project activities in developing countries. Similar to the CDM, emission reductions certified under the CDM+ would be converted into carbon credits, which could be used by countries with economy-wide emissions reduction targets, to achieve their commitments under the Paris Agreement. Also similar to the CDM, the CDM+ credits could be acquired by countries with absolute targets, for later offsetting their respective emission levels. This would make it easier for them to demonstrate compliance with what they would later promise under the Agreement.

Again, based on the CDM, Brazil proposed that CDM+ be allowed to voluntarily cancel units defined under its framework in the form of certified emission reductions (CERs). Under the Brazilian proposal, the voluntary cancellation of CERs would be done not only by State Parties to the UNFCCC, but also by non-state entities – such as subnational entities, private sector and even individuals – with a view to fostering the engagement of these actors in actions mitigation and to increase the ambition and environmental integrity[5] of the fight against climate change. Parties choosing to allocate financial resources for the cancellation of CERs would have recognized such allocation as part of the fulfillment of their financial obligations under the convention.

According to the Brazilian proposal, the CDM+ was supposed to guarantee a high level of environmental integrity in its use and operation. Achieving the goals of developing countries should be promoted on the basis of positive incentives rather than punitive models.

Brazil, supported by many developing countries, defended that such a centralized mechanism under the Paris Agreement should be an update of the CDM. In addition, Brazil proposed in its 2014 submission for concentric convergence that countries with absolute economy-wide emission reduction targets would have the prerogative to engage in "international emissions trading" under the auspices of the new agreement, or they would be eligible to buy developed and developing country credits that chose to adopt more ambitious absolute targets. Brazil also argued that the eligibility to host CDM+ projects for sustainable development should be restricted to developing countries – including those with absolute goals, such as the Brazilian case. This would allow Brazil a privileged situation: because it is a developing country with absolute goals, it could either buy credits or host the CDM+.

3 BRAZIL AND THE EUROPEAN UNION ON THE WAY TO PARIS

Throughout the negotiations leading up to COP-21 (Paris, December 2015), there was no clarity as to the role of market-based mechanisms under the Paris Agreement. In parallel to the negotiations on the new 2015 agreement, the topic of market-based approaches to combating climate change was discussed in three distinct strands within the UNFCCC: a new market mechanism (NMM), a framework for various approaches (FVA) and non-market approaches (NMA). The degree of divergence between the parties about the appropriateness of market approaches in the Convention was so strong that there was no consensus even about the scope of the three negotiations.

From 2011 to 2015, the Paris Conference, negotiations under the convention for new market-based mechanism, framework for varied approaches and for non-market-based approaches achieved limited progress, and eventually fell into paralysis

5. Environmental integrity is understood here as the prevalence of environmental benefits over economic benefits, and technical accuracy in delivering results. In the case of actions to combat climate change, an action would be considered as environmentally sound if its performance actually contributed to the reduction of GHG emissions. Rigorous environmental integrity review is essential to avoid cases of fraud and deception in conducting green washing projects where an action is presented as allegedly environmentally advantageous, but from the technical-scientific point of view it is counterproductive for environmental efforts.

at COP-20 in Lima. The same applied to the new market mechanism established in the Doha Amendment to the Kyoto Protocol (COP-18/CMP-8, Doha, 2012), which was never discussed or implemented.

The negotiating parties had divergent concerns about a number of aspects related to market-based mechanisms for fighting climate change. In addition to distinct technical views, there were various perspectives on the guarantees of environmental integrity and the intention to stimulate international cooperation involving trade in countervailing credits without the international supervision of the UNFCCC.

This framework of uncertainties undermined market predictability in relation to multilateral market-based mechanisms, which adversely affected the value of countervailing credits with the United Nations "seal". At the same time, carbon credits gained space without international support and without environmental integrity safeguards, in the sense that what was traded transnationally effectively represented a decrease in the atmospheric concentration of GHG. The negotiating political context within the UNFCCC, which was eminently non-consensual with regard to market-based mechanisms, did not favor the expectation that a solution on the issue could be reached during COP-21.

In 2013, the decision made by the European Union – up to that moment, the largest source of demand for CERs – to stop using CDM credits unless they originated from activities of relatively less developed countries – was similarly unfavorable to multilateral market-based mechanisms. Therefore, CERs from large developing countries, such as Brazil, South Africa, China and India, were no longer accepted, and those were precisely the countries that had contributed most to CDM projects and to the importance achieved by the mechanism.

The European decision led to the collapse of CER prices and, consequently, to the discrediting of the CDM as a whole in the private sector. Since then, there has been a gradual disengagement of project entrepreneurs, Designated Operational Entities (DOEs) and other stakeholders involved in the process of emission reduction certification and CDM unit trade. After 2013, at the end of the first commitment period of the Kyoto Protocol, which extended from 2008 to 2012, there was low registration of CDM project activities.

Despite this unfavorable negotiating context, both Brazil (through the proposal for CDM+) and the European Union gave signs to the use of market-based mechanisms in the Paris Agreement, provided that it is accompanied by robust rules, guarantees of environmental integrity and international supervision to avoid fraud and deception in conducting emission reduction projects.

Brazil, as well as a large number of countries of the Group of 77 and China (negotiating bloc in the UNFCCC involving more than 130 developing countries) supported the use of market-based mechanisms under the Paris Agreement as a continuation of the successful experience with the CDM under the Kyoto Protocol. The success of the CDM is evidenced by the reports of its Executive Board, which at each meeting lists the number of projects, programs of activities (PoAs) and their registered components, as well as issued CERs and voluntarily canceled units. Data from the last Executive Board report indicated that as of July 13th, 2017, 7,776 CDM project activities and 310 PoAs had been registered, with 2,061 components included; 1,843,750,188 CERs would have been issued for CDM project activities and 8,938,800 for PoAs; and 22,464,732 CERs would have been canceled voluntarily.[6]

The perspective of developing countries in supporting the CDM was justified by the benefits in terms of mitigation outcomes proposed by the mechanism, which would not occur in its absence, as well as by the associated environmental, social and economic gains. As a model for multilateral emission reduction certification (by an Executive Board composed of twenty countries), the CDM also served as an alternative to bilateral emissions trading schemes that did not have the supervision of the Convention and, therefore, are seen as a threat to the environmental integrity, effectiveness and credibility of the international climate change regime.

Specifically, Brazil has taken a stand in the negotiations under the convention arguing that only a centralized market-based mechanism under the climate change regime, subject to scrutiny by all parties, could collectively ensure that GHG emission reductions were effectively monitored, verified and certified with the required accuracy of the environmental integrity requirement. According to the Brazilian view, only multilateral surveillance could ensure that the alleged reduction of 1t of CO_2 equivalent actually represents 1t of CO_2 equivalent not released into the atmosphere.

The negotiating position of the European Union, in turn, was to reaffirm that the bloc would not use credits from market-based mechanisms to meet its targets under the Paris Agreement. The objective of the European Union would be to prevent any new mechanism from reflecting the differentiation between developed and developing countries enshrined in the UNFCCC and its Kyoto Protocol, and to introduce rules to avoid double counting in emissions accounting or emission reductions. It should be noted, however, that the alleged double-counting risk is non-existent in the framework of the protocol, since its electronic transfer system, known as International Transaction Log (ITL) – analogous to that of bank terminals – ensures constant verification of the integrity of multilateral credit transfers. Emission trading schemes that run in parallel to the international climate change regime do not have such a safeguard.

6. Report of 95th Meeting of the CDM Executive Board. Available at: https://goo.gl/eGWVG8. Accessed on: July 20th, 2018.

3.1 Discussions with the European Union during the period from 2014 to 2015

Brazil and the European Union have been key interlocutors in the CDM Executive Board and in the market negotiations under the Kyoto Protocol and the UNFCCC. At the same time, the two Parties represent different interests in these discussions, which has led to the emergence of conflicts.

Roughly speaking, Brazil defends the point of view of project participants, because they bring benefits to sustainable development. The European Union, on the other hand, acts from the point of view of the CER market and the allocation of capital in European territory. As a country that develops CDM project activities in its territory, Brazil mainly represents the perspective of project entrepreneurs facing the challenges and risks of engaging in emission reduction projects. As a potential purchaser of CERs, the European Union mainly represents the perspective of market players who want collateral for purchased credits. They also defend the interests of DOEs seeking to mitigate risks related to the verification and certification of emission reductions.

In the UNFCCC negotiations, the European Union has sought to convert the mandate to the "revision of the CDM" into a "reform" of the mechanism. In addition to questioning the procedural legitimacy of the European position, Brazil has challenged the bloc's proposals, since they would imply perverse incentives, restrictions on national prerogatives or difficulties for new project activities. Disagreements between the Parties have led to a series of "no-conclusion" outcomes in the negotiations on the revision of the CDM under the Kyoto Protocol.

As part of its action, the European Union has consistently advocated the establishment of mandatory standardized baselines to facilitate the demonstration of additionality of projects, which is a CDM key requirement. The proposal would favor the work of DOE, but in many cases, it would penalize the most efficient project entrepreneurs in a single sector, perversely rewarding the largest emitters and preventing recognition of the total mitigation effort of a specific project. The bloc also supports the imposition of supranational requirements related to sustainable development, a position that disrespects international consensus within the United Nations, particularly the newly adopted Agenda 2030 for Sustainable Development, which confirmed the national prerogative of countries in the evaluation of progress in this area. Other European proposals have the potential to hinder new project activities by suggesting the imposition of very low limits on market penetration. According to the European Union, it would be impeded, for example, by the greater penetration of cogeneration of electric energy from bagasse in Brazil and India in the supply of electric energy.

Brazil has always reiterated that considerations on sustainable development are a national prerogative, therefore, they must not be subject to a multilateral analysis under the climate change regime. Therefore, much like the CDM, the rules, modalities and procedures of the new mechanism should not include top-down criteria for sustainable development. Their promotion, however, should be a key factor in the approval of project activities by the Designated National Authorities (DNAs), recognizing the primary responsibility of government for follow-up and review in this area.

In discussions under the Convention (NMM, FVA and NMA), Brazil also did not share the European Union's position. It feared that if market-based methods were prematurely established under the Convention, outside scope of the Kyoto Protocol or the Paris Agreement, the bottom-up nature of the framework for measurement, reporting and verification under the Convention would be unable to guarantee environmental integrity similar to that which existed in the robust accounting system under the Kyoto Protocol. In the Brazilian view, the Protocol model would be the only one to avoid "fictitious emission reductions" (commonly known as green washing) in the issuance of marketable units and to prevent a single marketable unit from being used twice. The European Union was pressing for discussion of post-2020 accounting to be discussed in the FVA, and Brazil maintained that this would pre-judge accounting discussions in the Paris Agreement. The European Union advocated the elaboration of modalities and procedures for the new market-based mechanism, and Brazil questioned the urgency of such rules in the light of the lack of a global demand for a new mechanism (largely due to the unilateral decisions of the European Union in relation to the CDM).

During COP-20 in Lima, in 2014, the positions of all Parties became more rigid in light of the expectation of a new agreement during COP-21 in Paris in 2015. Formal and informal market discussions have created confusion over the scope of the necessary rules for the agreement. As a result, there has been a proliferation of parallel initiatives on the assumption that it would not be possible to agree on a mechanism for market-based approaches to combating climate change in the context of the new agreement. In the absence of multilateral rules on market approaches, Parties would be free to cooperate without the Conventions' guidelines and without the certification and accounting rules of the Kyoto Protocol. This situation would become even more complex with the variety of types and coverage of nationally determined contributions (NDCs) to the new Paris Agreement, as defined by each Party to the Convention, in their own national interest. This situation reflected the view of the United States and Canada (non-members of the Kyoto Protocol) whose main concern is the responsibility for federal supervision of the exchange of emissions reductions at the subnational level, which were not under their jurisdiction.

The perspective of a complete deregulation of international emissions trading was not, however, of interest to Brazil or the European Union. Both sought to ensure the environmental integrity of the climate change regime. Allowing countries to demonstrate compliance with their obligations with carbon credits in parallel to the regime could pose serious risks to the effective fight against global warming. Drawing on this common interest, starting in 2014, negotiators from Brazil and the European Union who had worked together as members of the CDM Executive Board began preliminary contacts in the margins of the preparatory negotiations for COP-21. With the Paris Conference approaching, against the backdrop of fundamental disagreement, Brazilian and European negotiators understood that some agreement would be necessary between the two of them, based on the joint understanding that, without a Brazil-European Union agreement and given the different views in the negotiations, the result would be the lack of rules for markets and an environment with different local rules. This would make it impossible for public and private entities to develop emission reduction projects in view of the prohibitive transaction cost of monitoring individual regulations on markets in several countries.

3.2 Joint work between Brazil and the European Union and joint proposal of SDM Brazil-European Union in the first week of Paris

In Paris, Brazilian and European Union negotiators worked together to find a text language for the new agreement that would include a robust market accounting system and a centralized certification mechanism to eventually succeed the CDM and, at the same time, abide by the negotiation limits of each of the Parties.

In negotiating the joint proposal during the first week of Paris, the European Union and Brazil worked on the draft text of December 3rd, 2015, which included the two basic provisions supported by the European Union and Brazil respectively: rigid accounting in international emissions trading, and the establishment of an emissions trading market-based mechanism. This text, however, also reflected the diversity of views of the Parties.

The result on December 8th, 2015 was a game changer, and is presented below in its original version (box 1),[7] including a clear accounting device for use of internationally transferred mitigation outcomes (ITMOs) – in relation to emissions trading, with additional environmental integrity safeguards proposed by Brazil, accepted by the European Union, as well as an ambitious Brazilian proposal for a mechanism based on Art. 12 of the Kyoto Protocol, accepted by the European Union, with a mention of contribution "beyond the NDC", and explicit prohibition of the use of the same certified emission reduction unit by two Parties, in order to comply with its NDC.

7.The text was kept in English in order to avoid, in a future translation, inadvertently resolving ambiguities that allowed the Brazilian and European visions to agree with this version.

The Brazil-European Union proposal outlined the view that a broader agreement would be possible for market-based approaches, and quickly became the focus of discussions in Paris. However, a range of additional interests from other parties in both market elements still required a solution, before consensus could be reached on the issue.

The joint proposal did not include language on "non-market mechanisms", a matter advocated mainly by the Bolivian delegation, which questioned any usefulness of market-based mechanisms to fight climate change. This issue was resolved in the last hours of COP-21, with a significant joint effort from the United States and Bolivia. The final version of Art. 6 firmly anchors the market-based mechanisms in the Paris Agreement. Parties now need to address rules, nature and scope of regulation to be developed.

BOX 1
Join Proposal Brazil-European Union

1. A mechanism to contribute to the mitigation of greenhouse gas emissions and to support sustainable development [in developing countries] is hereby established. This mechanism shall be under the authority and guidance of the CMA, supervised by a body designated by the CMA, and would aim to:

(a) Promote mitigation of greenhouse gas emissions [in developing country] Parties, while fostering sustainable development;

(b) Enhance ambition [by developing country Parties], by incentivizing supplementary voluntary mitigation of greenhouse gas emissions, beyond their ###;

(c) Assist Parties with a ### that reflects an absolute target in relation to a base year to fulfil their ###, through the use of emission reductions from mitigation activities [in developing countries];

(d) Incentivize and enable participation in mitigation of greenhouse gas emissions by public and private entities authorized by a Party.

2. The CMA shall adopt modalities and procedures for the above-mentioned mechanism, on the basis of:

(a) Voluntary participation approved by each Party involved;

(b) Real, measurable, verified and long-term benefits related to the mitigation of climate change;

(c) Reductions in emissions that are additional to any that would otherwise occur, certified by operational entities to be designated by the supervisory body;

3. The CMA shall ensure that a share of the proceeds from the certification of emission reductions is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.

4. Emission reductions resulting from this mechanism cannot be used to demonstrate achievement of the host Party's ###, if used by another Party to demonstrate achievement of it's ###.

"place holder" for NDC definided later in the Paris Agreement

Authors' elaboration.

The issue of differentiation of the Parties by the application and use of the mechanism by only a certain group of Parties was left open in the joint proposal and the text that differentiated its application was left in square brackets so that the issue was discussed by all Parties.

In the proposal, the mechanism would be monitored by a supervisory body under the Conference of the Parties to the Paris Agreement (CMA),[8] similar to the governance structure of the CDM. The joint proposal also established a list of objectives.

The role and involvement of "authorized by the party" public and private entities would be a potential strengthening of the joint proposal on the CDM. The joint proposal "encourages and enables" the participation of these entities. In addition, the CDM eligibility criterion, originally restricted to Parties that ratified the Kyoto Protocol, excluded Non-Parties, which represented an unnecessary restriction on the demand for CERs. The new mechanism was designed to foster universal engagement by stakeholders rather than Parties, providing a way for countries outside the Paris Agreement and non-state stakeholders to continue to engage in the multilateral environment and thus strengthen the international regime of climate change.

In other words, while the demand for CERs under the CDM was originally addresses towards Annex B Parties of the Kyoto Protocol (voluntary cancellation of CERs was only regulated in 2012), the SDM would already have, since the beginning, been designed to allow that issued certified reductions were used by any stakeholder – either state or non-state; public or private – for any purpose that corresponds to the measurement, reporting and verification of action – including for financial instruments, corporate strategies of socioenvironmental responsibility, financing based on results, positive pricing etc. This would allow the SDM to be operationalized, since the beginning, to favor the access of non-state entities. If properly developed, the rules, modalities and procedures of the SDM could effectively enhance the fight against climate change by state and non-state stakeholders, and would thus contribute to a comprehensive and ambitious response to the urgency of combating climate change.

Eligibility criteria should be as open as possible to encourage engagement by state and non-state stakeholders. Although restricted to parts of the Kyoto Protocol, the CDM was used for the first time for non-compliance purposes when CERs were voluntarily canceled by Brazil to offset emissions from the United Nations Conference on Sustainable Development (Rio + 20) organization, in Rio de Janeiro in 2012. The voluntary cancellation of CERs was one of the four steps taken by COP-19 in Warsaw in 2013 to help reduce the so-called pre-2020 ambition gap.

An essential measure to retaining the CDM rationale in the proposed new mechanism was the objective of contributing to the reduction of the level of emissions of the Party carrying out the project activity and would benefit from

8. Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA). Paris Agreement on Climate Change (CMA).

the resulting mitigation activities, which could also be used by another Party to comply with their NDC. The idea behind this mechanism, which was negotiated extensively by the end of COP-21, is that the Party developing the project would benefit from the positive mitigation impacts resulting from the certified emission reduction activity. At the same time, marketable units of such activities could be used by a second Party who purchased the units to service their NDC. In this case, contrary to what happens under the Kyoto Protocol, in emissions trading (Article 17) or in the joint implementation mechanism (Article 6), there would be no corresponding adjustments applicable to the country that is developing the project. The logic of the new mechanism of art. 6 of the Paris Agreement would in fact follow the model of the CDM of the Kyoto Protocol, with the aim of encouraging project entrepreneurs and the involvement of developing countries. It should be noted, however, that for NDCs purposes, each SDM unit could be used only once, by a single Party.

The Brazil-European Union joint proposal also makes clear that the mechanism's objective includes an additional incentive to mitigate GHG "beyond the NDC". This was a crucial step in terms of compromise as it bridges the longstanding conflict between the European Union and Brazil over the country's additional contribution. This text, however, did not prevail after the broader negotiation with all Parties, both for lack of clarity in its definition and because of its nature being perceived as tending to the scarcity of projects.

One of the key components of the agreement in the joint proposal and, later, in the adoption of Art. 6 of the Paris Agreement, was the explicit exclusion of double counting of emissions reductions. With the proposed alternative formulation, the double counting potential was clearly avoided.

The agreed formulation avoided an open reference to double counting that could not be accepted by Brazil. In the Brazilian view, there is no possibility of double counting when using the ITL system of the Kyoto Protocol – a system similar to that of bank transfers by remote terminals – because it is not possible to transfer the unit and maintain the unit – putting it in a metaphor: one cannot make an omelet without breaking the eggs. In the Brazilian perspective, the European Union's repetition of this idea (avoid double counting) to exhaustion, as a mantra, led other parties (besides the European umbrella group, the Independent Association of Latin America and the Caribbean – AILAC and the Alliance of Small Island States – AOSIS) to erroneously start replicating this idea (in a different context of pledges of Cancun and Kyoto Protocol operating simultaneously). Cancun's pledges were not internationally supervised, unlike the Kyoto Protocol, which would allow the Parties to meet both commitments, in theory, with the same unit, which resulted in the idea that countries would use the same unit for domestic compliance and emissions trading. Such confusion remains in the process of regulation, given the existence of several interpretations of what should be the implementation of Art. 6.

4 ADOPTION OF THE SDM AS PER ART. 6.4 OF THE PARIS AGREEMENT

The establishment of a mechanism such as the CDM under the Paris Agreement was among Brazil's highest priorities in market-related negotiations, as well as the introduction of safeguards for the transfer of mitigation results for NDC compliance.

The mechanism outlined in the Brazil-European Union joint proposal was essentially a successor to the CDM, and there was no reference to the joint implementation mechanism of the Kyoto Protocol.

The mechanism mentioned in Paragraph 4 of Art. 6 of the Paris Agreement, largely reflects the Brazilian proposal for a CDM+ mechanism (box 2). The basic structure of the initial version follows directly the basic structure of Art. 12 of the Kyoto Protocol. It retains, without modification, concepts such as voluntary participation authorized by the Party involved; the need for real, measurable and long-term benefits for mitigating climate change; emissions reductions, which are additional to those that would occur in their absence; and verification and certification of emission reduction. It also established supervision by a body under the authority of the CMA and part of the resulting units for the cost of administrative expenses and for the adaptation.

BOX 2
Art. 6 of the Paris Agreement, and creation of the SDM, as per Paragraph 4 (and subsequent paragraphs, from 5 to 7)

4. A mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development is hereby established under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement for use by Parties on a voluntary basis. It shall be supervised by a body designated by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, and shall aim:

i. To promote the mitigation of greenhouse gas emissions while fostering sustainable development;

ii. To incentivize and facilitate participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a Party;

iii. To contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and

iv. To deliver an overall mitigation in global emissions.

5. Emission reductions resulting from the mechanism referred to in paragraph 4 of this Article shall not be used to demonstrate achievement of the host Party's nationally determined contribution if used by another Party to demonstrate achievement of its nationally determined contribution.

(Continues)

(Continued)

6. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall ensure that a share of the proceeds from activities under the mechanism referred to in paragraph 4 of this Article is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
7. The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall adopt rules, modalities and procedures for the mechanism referred to in paragraph 4 of this Article at its first session.
Related Decision Paragraphs
37. Recommends that the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement adopt rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Agreement on the basis of:
(a) Voluntary participation authorized by each Party involved;
(b) Real, measurable, and long-term benefits related to the mitigation of climate change;
(c) Specific scopes of activities;
(d) Reductions in emissions that are additional to any that would otherwise occur;
(e) Verification and certification of emission reductions resulting from
mitigation activities by designated operational entities;
(f) Experience gained with and lessons learned from existing mechanisms and approaches adopted under the Convention and its related legal instruments;
38. Requests the Subsidiary Body for Scientific and Technological Advice to develop and recommend rules, modalities and procedures for the mechanism referred to in paragraph 37 above for consideration and adoption by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its first session;

Authors' elaboration.

The formulation of the mechanism in the joint proposal was heavily negotiated in the days following submission of the joint proposal. The major difference between the joint proposal and the mechanism mentioned in Art. 6 is that there is no differentiation of groups of Parties.

The objectives of the agreement are focused on the shared interests of mitigation and sustainable development, rather than serving the interests of different stakeholder groups.

5 OVERALL MITIGATION

Another major difference is a more explicit wording relating to the provision about the contribution "beyond the NDC", which includes a new paragraph with reference to overall mitigation.

What is relevant to SDM is to ensure that CERs are not used twice, as defined in Art. 6.4 (c). The modalities and procedures should create incentives for the overall development of project activities. Although they ensure environmental integrity and overall mitigation in global emissions, modalities and procedures should not be designed to impose additional barriers to the host country in complying with the NDCs. The lack of effective incentives and comparative advantages for host Parties to authorize SDM project activities in their jurisdiction would prevent additional action by public and private entities that the Party may authorize, and generate perverse incentives for the parties not to reflect their level of maximum ambition in their progressive NDCs.

The SDM should deliver more action, greater engagement and greater ambition. Firstly, it should encourage and facilitate action by the private sector, civil society and public authorities, which are complementary to national policies and measures on climate change within the NDC, thereby broadening the ambition of the Party. As already mentioned, SDM project activities should either contribute to compliance with the NDC by the host Party, or go beyond the host Party's policies and measures if CERs are effectively used to comply with another Party's NDC.

Second, the SDM must provide environmental integrity, to be guaranteed by multilateral rules and governance for certification activities under Art. 6.4. Brazil believes that a key element in ensuring that the SDM effectively results in comprehensive mitigation of global emissions and goes beyond the policies and measures envisaged by the host Party is based on the concept of additionality. Pursuant to Paragraph 37d of Decision 1/CP-21, certified activities must correspond to emission reductions that are additional to any that would occur otherwise.

Additionality can be assessed by demonstrating that the mitigation activity is the first of its kind and by means of common practice, barrier or investment analysis demonstrates that the project activity would never have been developed without the adoption of Art. 6 of the Paris Agreement.

Overall mitigation in global emissions can also be ensured by strict environmental integrity requirements and time-limited crediting periods.

5.1 REDD+

REDD+ activities are not eligible for the SDM, since they are provided for in Art. 5 of the Paris Agreement, in a separate provision and with no relation to Art. 6. REDD+ relates to positive incentives, not to emissions compensation activities.

In addition, REDD+ is, by definition, related to mitigation outcomes achieved through national-level policies – with subnational approaches admitted on a provisional basis.

Through the existing framework, as established by the guidelines and decisions already agreed by the convention, it is the Developing Country Party that performs the measurement, reporting and verification procedures, and as such, ultimately assumes responsibility for its REDD+ results. Attempts to link Arts. 5.2 and 6.4 are equivalent to reopening the discussion of the scale of REDD+ activities, which has already been agreed upon in decisions made previously by the Convention, with rejection of the project scale.

5.2 SDM Registry

The SDM Executive Board should maintain a record of CERs issued to participants from public and private entities, which includes serial numbers. In accordance with the authorization of the public or private entity participating in the project activity, CER units shall be transferred by means of a mechanism similar to the ITL of the Kyoto Protocol for the national accounts of the host Party or the acquiring Party.

The SDM registry shall also receive CERs issued under the CDM and converted to SDM that have not been canceled or retired for compliance under the Kyoto Protocol.

This would set a positive signal for the private sector and, at the same time, extend pre-2020 action with rigid environmental integrity guarantees in recognition of the efforts of participants in CDM project activities. CDM participants have invested resources in good faith in the multilateral response to climate change. If their efforts are not recognized, trust and legal certainty about the regime and the new mechanisms of the Paris Agreement will be seriously threatened.

6 THE PHASE THAT INITIATES THE REGULATION OF ART. 6 AND SHALL FINISH IN 2018

The practice of conventions adopted by the United Nations, and in particular the Framework Convention on Climate Change, is to establish a regulatory deadline for the two-year agreement. However, the Paris Agreement is following a different path, since each negotiating process for regulating the different provisions of the agreement is following different mandates and deadlines.

The item of Art. 6 Paragraph 4 is being negotiated with an understanding between the Parties that the deadline for finalizing such regulation will be two years, with a view to completing the work in 2018. However, there was no decision establishing this deadline, which was presented only as a proposal by the facilitators of the regulation of the agenda item of the mechanism.

6.1 The need to clarify the eventual transition process from CDM to SDM (mechanism, project activities and institutions) after 2020

Since Brazil understands that the SDM is the successor to the CDM, it is of the utmost importance that there is a smooth transition between these two mechanisms, especially with regards to: *i*) the continued validity of CDM units, through the conversion of CDM CERs for use in NDCs, or cancellation by Parties, public and private entities for other uses; *ii*) continued validity of the CDM methodologies within the SDM; *iii*) the issuance of CERs from SDM to CDM registered project activities; and *iv*) the transposition of the CDM accreditation system to SDM.

Consistent with the text of the Paris Agreement, the scope of Art. 6, Paragraph 4, is similar to that of the CDM. In that sense, its rules, modalities and procedures should encompass the verification and certification of CERs by a DOE and the long-term, measurable and real benefits related to additional emission reductions resulting from voluntary activities authorized by each party involved and supervised by a body designated by the CMA. Brazil sees the SDM as the maximum international mechanism to certify action to fight climate change and issue credits.

Proper operationalization of the concept of "additionality" is central to SDM's goal and its potential to broaden the ambition of the climate change regime. Additionality should reward projects that would not be possible in the absence of the mechanism of Art. 6.4. With the progressive implementation of the Paris Agreement and policies in the context of the NDC, it should be expected that earlier policies will not be able to demonstrate that they are first-of-their-kind or pass in the analyzes of common practice, barriers or investment. Brazil believes that CDM methodologies should also be applied to the SDM to ensure that additionality is adequately assessed.

The rules, modalities and procedures of the SDM should reflect the fact that the mechanism innovates in relation to the CDM by further aiming to "encourage and facilitate participation in the mitigation of greenhouse gas emissions from public and private entities authorized by the Party". While the demand for CERs under the CDM was originally conducted by Annex B Parties to the Kyoto Protocol, units issued under the SDM may be used by any stakeholder for any purpose that encompasses measurement, reporting and verification of actions to fight change climate change, including finance.

The rules, modalities and procedures of the SDM shall further establish that any certified emission reduction unit issued by the SDM Executive Board is made available in the SDM Registry. Units in the SDM Registry may be used either by the Party, to comply with its NDC, or by another non-Party stakeholder, for its voluntary strategy or commitment to fight climate change. If a Party acquires a unit to comply with its NDC, that unit shall be transferred to its national registry within the multilateral registry to be established, in accordance with the guidelines in Art. 6.2. Once transferred to a national account, the SDM unit accounting will follow the guidelines of Art. 6.2. In the event that the units are acquired by non-Party stakeholders, such units shall be canceled in the SDM registry, with a clear statement of the purpose of the unit's proposed cancellation and use.

6.2 Obstacles for transition

6.2.1 Acknowledgement of a smooth transition from the CDM to the SDM

The ability of the climate change regime to ensure continuity and a smooth transition from the CDM to the SDM will be key to the convention's reputation. Failure to ensure that CDM stakeholders, especially project developers, will have their efforts recognized and honored, and will continue to have tangible effects in the context of the Paris Agreement, would jeopardize legal security, which is crucial to an environment conducive to new projects, preventing CERs from contributing to immediate action and increased ambition pre-2020. Ultimately, it would promote the loss of credibility of the international regime by CDM project participants and would undermine the effectiveness of the mitigation instrument by the lack of participation of public and private entities.

6.2.2 Corresponding adjustments

Under the Paris Agreement, the parties must demonstrate the scope of their NDCs, including accounting for their emissions in relation to what they have promised internationally. Such accounting shall include the use of ITMOs relating to emissions trading. That is, if a Party has promised to issue up to a certain aggregate and national limit, it may overtake it, but still comply with its NDC if it compensates for its non-reduced emissions through acquisitions of ITMOs. In the context of emissions trading, i.e., Art. 6.2 of the Paris Agreement, the transaction of an ITMO will entail a corresponding adjustment, through additions and subtractions, between the buying Party and the selling Party, in order to avoid the so-called "double counting". This adjustment, however, does not apply to the mechanism described in Art. 6.4 of the Paris Agreement.

It should be noted that once a Party acquires a CER, there will be a settlement of accounts to add it to the national account of the Party acquiring it and to subtract it from the record of the SDM. The subtraction, however, does not happen in relation to the host country of the SDM activity, but in the record of the SDM. In any case, a situation could be envisaged in which the host country decided to purchase CERs derived from activities in its own territory to demonstrate the scope of its own NDC. In the latter case, there would be a set of accounts to be added to the national account of the Party that acquires it – which, in this case, is also the host country – and to subtract it from the SDM registry. If, in a second transaction, the host country decided to sell the CER they had purchased, the logic would be that of Art. 6.2, i.e. there would be a corresponding adjustment between national accounts. However, in the first transaction, the settlement of accounts will always be between the purchasing country national account and the multilateral register of the SDM, never between the national account of the latter and the national account of the host country. This is explained from the legal, technical and environmental integrity point of view.

From a legal point of view, corresponding adjustments to avoid double counting are restricted to the guidelines referred to in Art. 6.2, and do not apply to the rules, modalities and procedures established by Art. 6.4. It is equally important to consider that one of SDM's objectives is "to contribute to the reduction of emission levels in the developing Party, which will benefit from mitigation activities resulting from emission reductions that can also be used by another Party, in complying with its NDC".[9] The application of "corresponding adjustments", in the context of Art. 6.4, would therefore be contrary to the Paris Agreement and international law.

From a technical perspective, since the CERs issued by the SDM Executive Board will be in the SDM Registry, and not in a national account, it is illogical to think of units being subtracted from the national accounts of the country developing the project, since the country where the project is located did not participate in this first transaction. It should be noted that the availability of CERs in the SDM registry will be critical to ensuring that the SDM is fully accessible to non-Parties, as well as to maintain its prerogative to multilaterally market certified emission reduction units for purposes other than demonstrating compliance with NDCs.

In addition, if a Party holding mitigation activities under the SDM had units subtracted from its national account by a corresponding adjustment, the Party's ability to demonstrate compliance with its NDC would be significantly impaired. This would create disincentives for Parties to approve SDM mitigation activities on their territory, undermining the mechanism's potential to deliver long-term, measurable and real benefits for additional emissions reductions.

Finally, from an environmental perspective, environmental integrity concerns related to double counting applicable to Art. 6.2 do not apply to the dynamics of the mechanism of Art. 6.4. This is because Art. 6.5 prevents double counting by not allowing SDM CERs to be used by the country where the project is located if used by another Party to demonstrate compliance with its NDC.

Some have suggested that, even with the safeguard of Art. 6.5, there would be a risk of double counting of a mitigation result from a CER: the unit could be used by the acquiring Party to count in its NDC at the same time that the host country of the project would be able to benefit from the mitigation mentioned in its inventory.

This assumption is not supported by the accounting rules of the international climate change regime. Similar to the CDM, the SDM mitigation activities will not necessarily affect the calculation of emission levels in national inventories. The calculation of emission levels in national inventories follows the guidelines of the Intergovernmental Panel on Climate Change (IPCC) for National Greenhouse Gas Inventories. These guidelines correspond to actual estimates, and reflect actual

9. Paris Agreement, Art. 6, Paragraph 4, item "c".

emissions. The amount of CERs generated by a CDM/SDM project activity, in turn, is determined by the application of a monitoring methodology and a baseline approved by the Executive Board. This emission reduction is a counterfactual estimate, and reflects hypothetical emissions, which never existed.

According to the IPCC Inventory Guide, anthropogenic GHG emissions are estimated at *bona fide*. In the energy sector, for example, which is traditionally the main source of emissions, the estimation of emissions requires, in most cases, the use of an average emission factor for the combination of source and fuel category.

In contrast, as an example, the CDM's methodological tools determine the CO_2 emission factors of the electricity generated by power plants by calculating the "combined margin" emission factor of the grid. Consequently, there is no correspondence in the calculation of the CERs issued and the estimated emissions in the national inventories that would justify a "corresponding adjustment".

Instead of a risk of double counting of mitigation results, corresponding adjustments, in the context of Art. 6.4, would correspond to a double-counting risk to the detriment of the host country. In the worst-case scenario, they would imply additional emissions to the host country which, in practice, did not occur – as in the case of wind turbines. This would again create disincentives for the Parties to approve SDM mitigation activities within their territory, which would undermine the potential of the long-term measurable and real benefit mechanism for emission reductions.

From an environmental perspective, therefore, corresponding adjustments are not required for the SDM's goal of "delivering comprehensive mitigation in global emissions".[10] The additionality requirement for the issuance of CER units ensures that emissions reductions occur at a level beyond what would be achieved by the NDC of the host Party and the acquiring Party in the aggregate. In addition, conservative baseline and monitoring methodologies additionally contribute to comprehensive mitigation of global emissions.

In summary, if the results of the SDM mitigation activity are used by another Party, the host Party should restrict itself to further efforts to achieve its own commitments. This means that in the case where there is no transfer of an SDM CER to a second party, the host country will retain the benefit of the mitigation, and if it acquires CERs for project activities within its territory, it will also be able to use those units for the fulfillment of its NDC. Conversely, in case SDM credits are transferred to second Party, the host country will retain the mitigation benefit – through its inventory – but will not be able to account for the units for its own NDC.

10. Paris Agreement, Art. 6, Paragraph 4, item "d".

Finally, it should be stressed again that, under the Paris Agreement and Decisions, the reference to "*guidance to ensure that double counting is avoided on the basis of a corresponding adjustment by Parties for both anthropogenic emissions by sources and removals by sinks*"[11] is applicable only to Art. 6.2, and not to Art. 6.4. This issue of double counting should not be covered by the rules, modalities and procedures of the mechanism of Art. 6.4.

REFERENCE

BRAZIL. Submissions in the UNFCCC process on Article 6, 2017, two submissions made at: http://unfccc.int; and a new one to be submitted by COP-23.

11. COP-21, Decision 1/CP.21, Paragraph 36.

CHAPTER 13

GLOBAL COOPERATION AND CHALLENGES OF SUSTAINABLE DEVELOPMENT: CDM RESULTS AND LESSONS LEARNED FOR THE DESIGN OF NEW FINANCIAL MECHANISMS

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1 INTRODUCTION

By July 2018, the Paris Agreement had been signed by 195 countries, of which 176 ratified it (UNFCCC, 2018b). This inspires hope that the global community will be able to define a multilateral governance that is effective in curbing global climate change. The objective defined by the Agreement is to "hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" (UN, 2015).

In order to achieve this objective, henceforth referred to as "below 2°C Scenario", the Paris Agreement is based on Nationally Determined Contributions, which are prepared by each Party (UNFCCC, 2018a) based on the self-assessment of their responsibilities and respective capacities for climate change mitigation. This process of self-defining objectives is different from the approach of the Kyoto Protocol (UN, 1997).

The Protocol, negotiated in 1997 and adopted in 2005, is based on the principle of "common but differentiated responsibilities and respective capabilities" (UN, 1997), instituted by the United Nations Framework Convention on Climate Change – UNFCCC, negotiated in 1992. Based on this concept, the UNFCCC defines as "Annex I" the group of countries that are industrial economies or economies in transition, and as "Non-Annex I" the group of developing countries.

Building from this differentiation, the Kyoto Protocol provides that Annex I countries are responsible for leading mitigation efforts through the definition of absolute targets to reduce their national GHG emissions. At the same time, the

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Protocol defines that developing countries do not have the same responsibility or capacity to act on climate changes. Thus, Non-Annex I countries are not bound to formal mitigation targets. The justification is the understanding that their "priority is socioeconomic development and poverty eradication" (UN, 1992).

In order to uphold their right to socioeconomic development, while at the same time promote mitigation opportunities in developing countries, the Kyoto Protocol created the Clean Development Mechanism – CDM). The CDM's objectives are "to assist Parties not included in Annex I in achieving sustainable development (…) , and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under" (UN, 1997).

From the environmental standpoint, the CDM has played a key role in connecting[3] the industrialized countries in Annex I, which are characterized by high mitigation costs arising from the need to replace existing fossil fuel based infrastructures, with developing countries that offer opportunities to avoid emissions growth through investments that promote the clean development of their economies.

Unfortunately, this rationale of the Kyoto Protocol and the international cooperation through the CDM, faced a series of criticisms and problems that prevented its evolution. Although it is not the purpose of this text to detail these discussions, we present a brief summary of the main difficulties:

1) Lack of balance between supply and demand for carbon credits: because of the non-ratification of the Kyoto Protocol by the United States and the omission and withdrawal of Canada,[4] the countries of the European Community, Australia and Japan were the parties with real demand for Certified Emissions Reductions (CERs) generated by the CDM. This did not only limited aggregate demand but also the ambition of countries to continue and broaden their engagement in the context of the second commitment period of the Kyoto Protocol between 2012 and 2020.

2) Transfer of resources and investments: although the transfer of funding from industrialized countries to developing countries is capable of reducing the overall cost of mitigation, there was concern that it would be detrimental to the growth of industrialized economies. Another criticism was that a cost reduction mechanism would not be in line with the concept of differentiated responsibilities. The reasons for this criticism

3. In the theory of environmental economy, pricing mechanisms lead to equalization of marginal costs of reducing pollutants among the participating economic agents, minimizing the aggregate cost of meeting the objective of reducing pollution levels.

4. Following ratification in December 2002, Canada withdrew from the Kyoto Protocol on December 15th, 2011, effective on December 15th, 2012.

would be that industrialized countries should demonstrate their leadership through costly domestic efforts, rather than promoting and purchasing more cost-effective mitigation outcomes in developing countries.

3) Lack of understanding of the nature of an avoided emission: as a result of low energy consumption and the low socioeconomic level of the developing countries, there is an opportunity to promote investments capable of promoting economic expansion and, at the same time, preventing the increase emissions. Unfortunately, the concept of avoided emissions, which underlies most CDM projects presented, was questioned, while the concept of a reduction in historical emissions, which prevails in industrialized countries, was easier for stakeholders to understand.

4) Inquiries regarding the environmental integrity of CERs: in the absence of own reduction targets by developing countries (Non-Annex I), the CDM depends on methodologies for the measurement and certification of emission reductions in relation to a specific baseline for each project. The result of this situation was the creation of highly complex and expensive certification methodologies and procedures. Despite this effort, which generated high costs and risks for the projects, the criticism undermined the prestige and role of the CDM as a tool for international cooperation.

5) Focus on end-of-pipe projects: concern about the environmental integrity of CERs led to the popular understanding that only projects whose financial viability depended exclusively on the sale of carbon credits would be truly additional. The consequence of this view is that only greenhouse gas abatement projects at the end of the process and without additional economic benefits are seen as legitimate by a relevant part of stakeholders. In turn, structural and capital-intensive projects, such as renewable energy investments, face questions and criticism because they receive other revenues.

In the context of the lack of alignment of Annex I countries and growing criticism in relation to mechanisms for cooperation with developing countries, there has been a need to reform international climate policy and its mechanisms. Unfortunately, the slow pace in defining reforms and, lastly, the lack of agreement on a second commitment period of the Kyoto Protocol from 2012 onwards, has led to a crisis with serious impacts for countries and investors who had worked with an expectation of continuity of the economic instruments established by the Kyoto Protocol.

In the context of this crisis, the international community began negotiations for a new agreement that could overcome the differentiation of countries into groups and thus minimize the economic distortions that occur between countries with differences in their ambitions and mitigation costs. The outcome of this negotiation was the Paris Agreement, of 2015, which replaces the more normative regulatory logic of the Kyoto Protocol, an approach that is called *top down*, by the logic of self-definition of objectives, targets and mitigation policies by each country, in a so-called *bottom up* approach.

The advantage of this new process of sovereign definition of plans and targets is that countries have the autonomy to define their mitigation objectives and policies in relation to climate change in a way that fits their situation in terms of the availability of natural and financial resources, as well as to their socioeconomic demands and regulatory capacities. The disadvantage of this process is that industrialized countries remain subject to high mitigation costs, while developing countries continue to lack the necessary financial and human capital to avail of their clean development opportunities.

In any case, this process of self-determination was decisive for the success of the Paris Agreement, that is, to gather all countries into an agreement that abandoned country differentiation by development category. Nevertheless, it also made it difficult to compare and aggregate the different and often idiosyncratic country specific targets and policies. In addition, the logic of individual goal-setting neglects the potential of international cooperation that is essential to mobilize financial and technological resources and thus mitigate the overall costs of climate change mitigation. Based on this fact, together with adopting the Paris Agreement, the UNFCCC "notes with concern that the estimated aggregate greenhouse gas emission levels (...) resulting from the NDCs do not fall within least-cost 2°C Scenarios, (...) and also notes that much larger emission reduction efforts will be required" (UN, 2015).

In fact, recent assessments show that the aggregate of the proposed NDCs leads to an increase of 3.2°C in the mean global temperature by 2100 and that the "below 2°C scenario" objective requires a significant increase in efforts (UNEP, 2017). In order to address this gap between the mitigation objective defined by the Paris Agreement and the aggregate ambition of its members, the Agreement presents a number of mechanisms, focused on three elements (UN, 2015), according to the following provisions.

1) The Agreement provides for NDCs to be revised every five years to promote increasingly ambitious commitments that can meet the "below 2°C Scenario".
2) Article 9 of the Paris Agreement states that "developed countries must provide financial resources to assist developing countries in both mitigation and adaptation" (UN, 2015). As already agreed within the framework of the Convention, this commitment entails the collective mobilization of

US$ 100 billion per year between 2020 and 2025 to promote mitigation and adaptation actions in developing countries, as well as a commitment to increase the volume of resources in the period after 2025.

3) Article 6 of the Paris Agreement allows Parties to look for "voluntary cooperation in implementing their Nationally Determined Contributions (NDCs) to allow greater ambition in their mitigation and adaptation actions and to promote sustainable development" (UN, 2015). In order to regulate such cooperation, the Agreement defines the possibility of using "internationally transferred mitigation outcomes" (UN, 2015) as long as such transfers promote sustainable development and are subject to a governance that can ensure transparency and environmental integrity, with a focus on avoiding double counting of results in the context of NDCs in the respective countries.

In addition, Article 6, paragraph 4, establishes a mechanism that can "contribute to the mitigation of greenhouse gas emissions and to support sustainable development", which seeks to "encourage and facilitate participation in mitigation of greenhouse gas emissions by public and private entities" (UN, 2015). The objectives and the rationale for this mechanism are generally compatible with the Kyoto Protocol's CDM rules. The differences are that the Paris Agreement puts additional emphasis on the contribution to sustainable development and adds the requirement that "emissions reductions resulting from the mechanism (...) shall not be used to demonstrate achievement of the host Party's NDC if used by another Party to demonstrate achievement of its NDC".

Based on this context, the Parties to the Paris Agreement are in the process of negotiating the regulation of their various elements and thereby defining the effective instruments and procedures for the post 2020 period. At the same time, countries are in the process of regulating the implementation of their NDCs, as well as reflecting on the use of the mentioned international cooperation mechanisms.

Aiming at supporting the process of discussing and defining such new mechanisms, this article presents an assessment of the current Brazilian economic situation, as well as the experiences in the use of the CDM, and a reflection on the role of climate financing mechanisms in the current Brazilian economy. From this analysis, the article proposes a series of conclusions and recommendations that seek to contribute to the design and definition of public policies in this area.

2 BRAZIL FROM THE PERSPECTIVE OF GLOBAL CLIMATE POLICIES

Brazil is a player of great relevance for a sustainable low carbon world. Its success in mitigating climate change and defining a path of sustainable development is essential for the conservation of its biodiversity and its environmental services, as well as for meeting the international demand for food, raw materials and low-carbon manufactured products. Aware of this responsibility, Brazil has been a proactive actor both in international diplomacy and in the definition of domestic policies to mitigate climate change.

On the diplomacy side, Brazil stood out as the host of the 1992 United Nations Conference on Environment and Development, which resulted in the negotiation of the UNFCCC, which remains the fundament of international climate policy negotiations. In addition, Brazil is credited with the creation of the CDM and the country has been a proactive and decisive player in the negotiations and regulations of subsequent climate agreements, as well as their economic mechanisms. More recently, the Brazilian State, in partnership with the European Community, presented the proposal for the Sustainable Development Mechanism, which was the basis for the creation of the mechanism mentioned in Article 6, paragraph 4, of the Paris Agreement (European Commission, 2015).

On the domestic climate policy side, Brazil also took the lead in integrating the CDM in the definition of domestic policies and incentives to promote mitigation activities. The country began to develop the first CDM projects in 2001, the same year of the definition of CDM rules and procedures, and four years before the full ratification of the Kyoto Protocol. Initially, the focus was the development of biomass cogeneration projects, as well as the abatement of methane emissions and other gases with greater global warming potential. After that, CDM development activities extended to projects of fossil fuel substitution and small hydroelectric power plants. In this initial phase of the CDM, Brazil saw the engagement of new agents and investors, small and medium Brazilian companies, as well as international investors and consultants that were attracted by the carbon credits generated from such GHG mitigation investments.

As a result of this dynamic, Brazil ranked third in the number of CDM projects and the mechanism proved to be an extraordinary instrument for mobilizing capital and promoting good practices in the search for more sustainable energy generation and production patterns. As a result, as of December 31st, 2008, Brazil had registered a total of 148 projects, with a capacity to reduce emissions of almost 20 million tCO_2e (tons of carbon dioxide – CO_2 equivalent) per year. Of this total, 76 projects offered the generation of renewable electricity with a capacity of 2,338 MW,[5] mainly from biomass and with small hydroelectric plants (SHPs).

Despite this success, the broadening of results depended on the next stage of regulatory evolution, defined in the context of the National Plan on Climate Change (Brazil, 2008) and the presentation of Brazil's Nationally Appropriate

5. Calculated with the data provided by UNEP Risoe CDM Pipeline of April 2018. Available at: https://bit.ly/2L5BZ7d.

Mitigation Actions (NAMAs) at the Climate Conference in December 2009 (Brazil, 2010). The Brazilian NAMAs set the ambitious goal of avoiding the increase in emissions by 36.1% to 38.9% when compared to business as usual projections, for the year 2020.

Although the Brazilian announcement to the United Nations had the format of voluntary targets, the country instituted the National Policy on Climate Change (NPCC) by Law No. 12,187/2009 and its regulation through Decree No. 7,390/2010. Particular emphasis is given to Article 6 of the NPCC which defines the instruments to promote reductions of greenhouse gas emissions, such as:

- specific credit lines of public and private financial agents (mainly the National Bank for Economic and Social Development – BNDES);
- public-private partnerships and authorization, permission, granting and concession for exploitation of public services and natural resources; and
- financial mechanisms that exist within the framework of the UNFCCC and the Kyoto Protocol.

With this combination of CDM and domestic incentive policies (Hauser and Medeiros, 2010), Brazil was able to diversify and accelerate the development of mitigation projects with increasingly transformational[6] scale. Of particular importance to this result was the BNDES' strategic performance in providing long-term financing for infrastructure projects with long capital amortization periods (Hauser et al., 2015).

This solution overcame the criticism that the CDM was not able to promote and fund transformational programs or projects because of the inability to mobilize sufficient resources. At the same time, this combination of the CDM and climate financing established by Brazil complied with the recommendation that the CDM be a tool to "support governments to achieve their mitigation objectives in a cost-effective way". (CDM Policy Dialogue, 2012).

Unfortunately, projects resulting from the investments promoted by the combination of the CDM as a pricing mechanism for emission reduction, and the climate funding offered by the BNDES, took between two and five years to be licensed and built. However, such a deadline, which is normal for investments in infrastructure, has resulted in an effective registration and commissioning of projects only at or after the end of the first Kyoto period in 2012. In the absence of a second commitment period and new demand for CERs, the prospects for

6. In the context of climate literature, the term "transformational" describes strategies for mitigation and adaptation to climate change that differ in scale, degree of innovation or their programmatic and spatial impact compared to incremental mitigation or continuous improvement strategies (Gillard et al., 2016). In the context of the Brazilian NPCC, this term can describe government programs to promote renewable energy in a cross-cutting and large scale.

private and public investors to obtain adequate returns have been thwarted. This led to significant economic losses, which will be analyzed below.

This loss of complementary revenues in foreign exchange came at a time of economic crisis, which led to a decline in the Brazilian gross domestic product (GDP) of 8.1% in the period between 2014 and 2016, with a sharp decline in investments of nearly 30% (Castro, 2018). Although the causes of this situation are complex, part of its origin lies in a serious hydrological crisis that showed the costs and difficulties of the expansion of the electricity sector based on variable electricity sources such as wind, as well as hydroelectric plants without accumulation reservoirs, a strategy that was promoted by the CDM and Brazil's NPCC.

As a consequence of this situation, the Brazilian government was forced to reduce incentives for investments in renewable energy and other types of infrastructure. According to data from ABDIB (2017), investments in infrastructure in Brazil[7] fell by an average of 2.1% of the GDP between 2004 and 2014, to 1.5% in 2017. A minimum of 3.0% would be required so that Brazil could maintain its existing capital stock.

In order for Brazil to actually overcome its infrastructure shortfalls, the Infra 2038 Project initiative[8] recommends increasing investments to 6.5% of the GDP over the course of twenty years. According to the authors, this effort is necessary so that the country can achieve gross fixed capital formation of 77.0% of the GDP, a rate considered compatible with the pattern of developed countries, like the United States or Spain.

Achieving this level of investments in energy generation and transmission infrastructure, sustainable transport and logistics, effluent and waste treatment, as well as in Brazil's industrial park, is essential so that the country can achieve an adequate level of social development. To the same extent, the recovery of the Brazilian economy is essential if the country is to finance the conservation and sustainable use of its natural resources and to play its role as a producer of low-carbon food, raw materials and manufactured goods, contributing to a decarbonized world.

3 CDM BACKGROUND, EVOLUTION AND OUTCOMES IN BRAZIL

Over the last fifteen years, since the beginning of validation of the first Brazilian CDM project in December 2003,[9] a total of 756 projects, including 740 individual large-scale and small-scale projects and 16 PoAs (programs of activities) were presented by the country. Of this total, as of June 2018, 342 CDM projects and

7. It includes energy, transportation, sanitation and telecommunications. Oil and gas are not included.

8. For further information, please go to: https://bit.ly/2MYK1yY.

9. The Salvador Bahia Landfill Gas Management Project, developed by SUEZ Environment, was the first CDM project to start a public consultation process in Brazil.

10 PoAs,[10] with a total of 25[11] component project activities (CPAs), were effectively registered in the UNFCCC.

Unfortunately, such figures do not let us evaluate which projects were implemented effectively, or which ones are still operational. For the purposes of our analysis, we assume that only registered projects have been effectively implemented, disregarding that some projects have been carried out without effective registration by the United Nations.[12] This perspective, in turn, neglects the fact that some projects may have achieved registration, but that their implementation or operation has become unfeasible despite this achievement.

In any case, 170 projects have actually been able to issue carbon credits, a fact that proves their implementation, although it is believed that there have been cases of projects that have subsequently been discontinued. Thus, based on such simplifications, we elaborated a series of evaluations with the purpose of describing the evolution and the effects of the CDM in the context of Brazilian climate policy.

3.1 Project assessment by categories

The main objective of the analysis is to assess the impact of the CDM on the mobilization of capital for different types of investments. In order to conduct this analysis, we aggregate the data of 336[13] projects and 25 CPAs registered in Brazil in groups that show homogeneity in terms of nature of GHG reduction technology, Capex, and, in the case of renewable energies, their electricity generation capacity. The data were obtained from several databases.[14]

Table 1 represents relevant information about projects, besides a first assessment of results.

10. CDM insights data from April 2018. Available at: https://bit.ly/2MqBuEI.

11. Data and accounting from UNEP Risoe CDM Pipeline April 2018 (available at: https://bit.ly/2L5BZ7d) were used. That aggregates the CPAs according to submission groups. Following that logic, a total of 1,050 CPAs from the PoA Methane capture and combustion from the Animal Waste Management System (AWMS) of the 3S Program farms of the Healthy Sustainability Institute is aggregated into three groups of 1,961 and 88 CPAs, respectively.

12. Failure to achieve registration does not necessarily mean that the project is not capable of generating emission reductions with additionality. This is explained by the fact that the investment decision is often irreversible and that the subsequent registration in the CDM is often made impossible by methodological changes or by the post-2012 carbon market crisis.

13. For the purposes of this assessment, six registered projects with aggregate emission reduction capacity of 104 ktCO_2 were neglected for lack of data on their specific investment cost (CAPEX).

14. Data from April 2018 of UNEP Risoe CDM Pipeline and PoA Pipeline were used, available at: https://bit.ly/2L5BZ7d; of the IGES CDM Project Database, available at: <https://bit.ly/2IzZqDA>; and UNFCCC CDM Insights, available at: https://bit.ly/2MqBuEI.

TABLE 1
Definition and characteristics of the main categories of CDM projects registered in Brazil

Type of project	Number of projects	$ktCO_2e$ per year of reduction	Investment MUS$	Reduced US$/$tCO_2e$	US$/kW of generating capacity	Credits issued
Renewable energy	210	27,579	31,152	2,101	2,150	24,769
Bioelectricity	40	2,147	3,427	4,329	3,287	9,271
Wind power	68	8,247	10,472	1,425	1,880	976
Hydroelectricity	98	16,857	16,364	1,484	1,823	14,522
Solar energy	4	328	889	9,601	3,416	
Methane abatement	126	18,039	608	53	1,690[1]	40,734
Fugitive Emissions Abatement	7	6,735	45	25		61,311
Fuel change and energy efficiency	15	1,057	151	158	1,336[2]	2,479
Reforestation	3	244	62	760		4,239
Total	**361**	**53,654**	**32,019**	**1,234**	**2,097**	**133,531**

Sources: UNEP, IGES CDM Project Database and UNFCCC.
Notes: [1]. This number relates to 25 projects with capacity of 250MW that use methane for electric generation.
[2]. This number relates to 2 projects with capacity of 165MW that use residual energy and gases in the steel industry.

The data presented in table 1 show that the 361 projects that have been registered have a greenhouse gas emission mitigation potential of almost 54 million tCO_2e per year. The category of renewable energy, with 210 projects (58%) and disaggregated in bioelectricity, wind, hydroelectricity and solar energy sources, accounts for a reduction of 27 million tCO_2e per year, equivalent to 51% of the total potential. The second most relevant category is formed by 126 methane abatement projects. This category includes the burning and use of landfill gas, the treatment of waste and effluents and the abatement of methane emissions in the production of charcoal. The aggregate mitigation potential is 18 million tCO_2e per year. The third relevant category in terms of emission reduction potential covers seven fugitive emissions reduction projects of nitrous oxide,[15] perfluorinated compounds (PFC)[16] and sulfur hexafluoride (SF_6).[17] Although Brazil has few

15. Nitrous oxide is a waste gas generated in the production of nitric acid. Brazil has four registered CDM projects that use catalysts to destroy nitrous oxide and thus avoid its emission, with only three issuing a total of 1.7 million CERs. In addition, nitrous oxide is a byproduct of the adipic acid production produced by Rhodia at the Paulínia plant in São Paulo. The project No. 116 "*N_{20} Emission Reduction in Paulínia, SP, Brazil*" is the only CDM project of this type in Brazil and, alone, corresponds to the issuance of 54,353 million CERs. Thus, a single project corresponds to 89% of the issuance of CERs in this category and 41% of the generation of CERs in Brazil as a whole.

16. Tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) are byproducts of aluminum production, and project No. 1860, PFC Emission Reductions at ALBRAS, Alumínio Brasileiro S.A., registered on January 4th, 2009, allows for the reduction of their emissions through operational control improvements. Despite the completed record, the project never actually issued CERs.

17. SF_6 is a gas with high global warming potential, used as an inert gas in electric circuit breakers and metallurgical processes. In Brazil, project No. 2486, Conversion of SF_6 to alternative SO_2 cover gas in the production of magnesium from the Rima Industrial group replaces the use of gas and thereby reduces greenhouse gas emissions. To date, the project has already issued 1,649 million CERs.

projects registered in this category, their potential for mitigation of greenhouse gases is 6.7 million tCO_2e per year.

Finally, fifteen fossil fuel substitution and energy efficiency projects with a potential reduction of one million tCO_2e per year and three reforestation projects with a mitigation potential of 244,000 tCO_2e per year were considered. Based on the definition of these groups, we evaluated the total capital invested in the different categories. In order to determine these values, we used several public databases[18] that reproduce data from Project Design Documents (PDDs) registered in the CDM for a total of 186 projects.

Unfortunately, not all PDDs provide this information explicitly[19] and for 175 projects it was necessary to determine Capex through the use of specific indicators, either by mitigation capacity (USD/ tCO_2e per year) or by USD/kW of installed capacity. In order to determine these indicators, the CDM database was used, as well as a recent U.S. Energy Information Administration (EIA, 2018) publication for renewable energy.

Based on this methodology, it is estimated that the CDM in Brazil helped mobilizing a total of US$ 32 billion in investments. Interestingly, the 210 renewable energy generation projects correspond to 97% of the total capital invested. This large capital mobilization is explained by the fact that the CDM was able to promote renewable energy generation investments with a total installed capacity of almost 20 GW.

Another factor to be taken into consideration is the notorious capital intensity of 1,800 USD/kW for hydroelectric or wind power generation and more than 3,000 USD/kW for solar or biomass generation. Along these lines, the capital needed to mobilize a potential reduction of one tCO_2e per year with these technologies is around USD 2,000. Although such figures may seem high, it is important to remember that these projects generate renewable energy for many decades and thus represent structural and transformational mitigation opportunities with numerous socioeconomic and environmental co-benefits.

The comparison shows that reforestation represents the second most capital-intensive activity, demanding investments of around USD 760 for each ton of CO_2 sequestered[20] per year. The third most capital-intense category is the various activities

18 Data from April 2018 of UNEP Risoe CDM Pipeline and PoA Pipeline were used, available at: https://bit.ly/2L5BZ7d; of the IGES CDM Project Database, available at: <https://bit.ly/2IzZqDA>; and UNFCCC CDM Insights, available at: https://bit.ly/2MqBuEI.

19. This is often the case for projects that have not presented a financial analysis for their demonstration of additionality.

20. Unlike other activities that reduce or prevent the emission of greenhouse gases, reforestation is able to remove CO_2 from the atmosphere and store carbon in timber. This sequestration capacity reduces over time to zero as forests grow to full maturity. This difference, and the fact that CO_2 can be released at the time of cutting, explains that reforestation CERs are considered to be temporary CO_2 removals. As a result, these credits are subject to lower market acceptance and prices.

of fossil fuel substitution and energy efficiency. While this is a heterogeneous group and the average may not be representative for the individual projects, the modest Capex of 158 USD/tCO_2e mitigated per year reinforces the view that this type of initiative has a substantial benefit to the climate and the energy efficiency of the Brazilian industry in general.

Finally, methane abatement activities, with a cost of USD 53 per tCO_2e mitigated per year, and fugitive emissions abatement, with a cost of 25 USD/tCO_2e per year represent the least capital intensive GHG abatement opportunities. A more detailed analysis of methane abatement activities shows that this category contains 25 methane projects for the generation of electric power with an aggregate capacity of 250MW.

For such activities, a Capex of 1,700 USD/kW is comparable to the specific cost of hydroelectricity and wind power, but the cost of 608 USD/tCO_2e mitigated per year is lower because of the benefit of methane destruction, which has a high global warming potential and thus leads to an increased volume in GHG mitigation. In the case of simple methane flaring, without energy utilization, investments are low with an average cost of USD 17 for a mitigation potential of one tCO_2e per year.

The fugitive emissions abatement group follows the same rationale of end-of-pipe mitigation, which does not demand structural changes in processes and simply avoids or eliminates emissions through filters, catalysts and flaring devices, or through the use of substitutes. Because of such simplicity, this type of mitigation is usually very easy and quick to implement, but offers no benefit other than avoided emission. Moreover, this type of project is often non-structural and imply the risk of returning to the previous common practice without emission abatement.

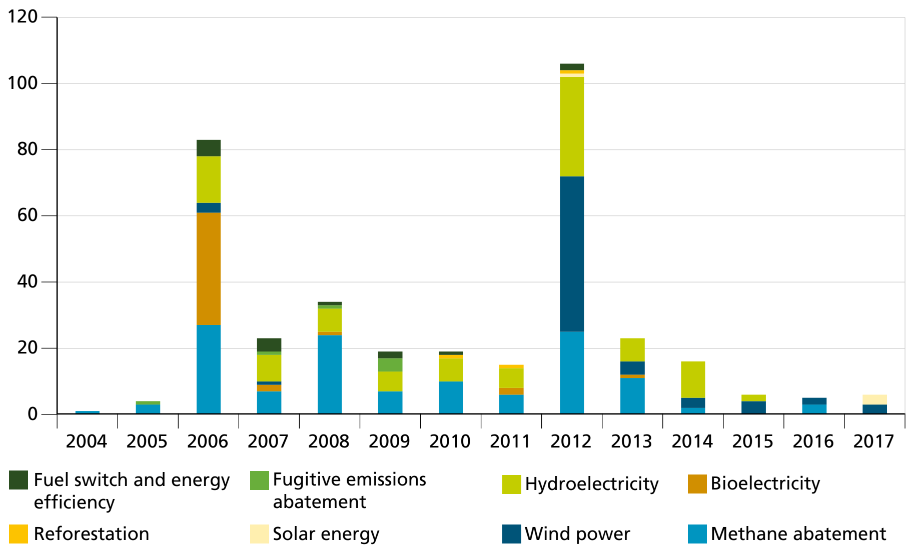
Based on the contextualization of these categories, it is now possible to evaluate mitigation results in terms of effectively issued CERs, as shown in the last column of table 1.

This analysis shows that the last category of fugitive emission abatement, which accounts for only seven projects and accounts for only 0.1% of the total investment, was responsible for issuing 61 million CERs, corresponding to 46.0% of all certificates issued by Brazil. Similarly, the category of methane abatement, with 126 projects, corresponds to 1.9% of investments and accounted for 41 million CERs, which corresponds to 31.0% of total certificates issued by Brazil. In turn, the category of renewable energy, which accounts for 97% of the investments mobilized, has been responsible for issuing only 25 million credits, which corresponds to 19% of all certificates issued by the country.

3.2 Assessment of the evolution in project registration

In order to deepen the evaluation of CDM results, we analyze their temporal evolution. Graph 1 identifies the number of projects registered over time, by category.

GRAPH 1
Evolution of CDM registry (2004-2017)
(In numbers by project per category)



Sources: UNEP, IGES and UNFCCC.
Prepared by the authors.

An evaluation of the graph above indicates that, over time, structural changes have occurred in the types of projects registered in the CDM. Initially, in 2006, the number of bioelectricity projects was large, but this type of project disappeared in subsequent years. The reason is that a methodological change in the CDM practically made it impossible to register this type of investment after 2006.[21] In the absence of this incentive, the registration and development of new projects of this category were limited in subsequent years, despite the great potential of biomass cogeneration in Brazil.

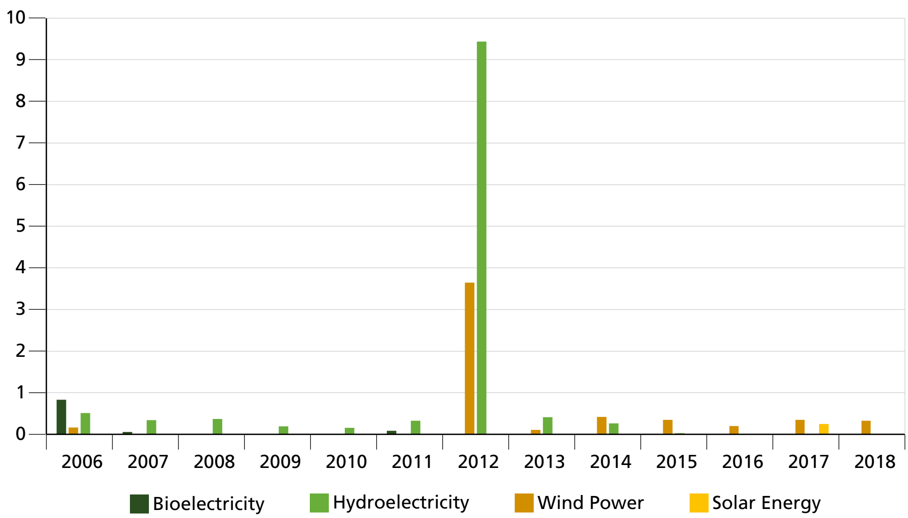
Another observation is that fugitive emissions abatement projects were developed before 2009. At that time, also a large part of methane abatement projects was developed. Finally, it is also interesting to note that there were practically no

21. Initially, bagasse-based cogeneration projects using the methodology AM0015: bagasse-based cogeneration connected to an electricity grid – Version 1.0, which allowed the submission of applications by December 25th, 2005, for registration in the year 2006. After this, bagasse cogeneration projects must use the more complex ACM0006, a fact that prevented the development of such new projects under the CDM. At the same time, few new projects of this kind were developed, a fact that indicates that the CDM was an important and effective support mechanism.

wind power projects before 2012 and that the first solar projects only recently obtained registration in 2017.

It is therefore of interest to assess the evolution of energy generation from renewable sources in a more specific way. For this purpose, graph 2 illustrates the evolution of renewable generation projects registration in terms of installed capacity. Data show that completion and registration of substantial hydro and wind power generation capacities occurred only at the end of the first commitment period of the Kyoto Protocol. This fact is explained by the long process of development, licensing and construction of these project types. As a consequence of this delay between the decision and conclusion of investments, projects were mostly commissioned at a time when carbon credit prices had already deteriorated.

GRAPH 2
Renewable energy project registration by capacity and type over time (2006-2018)
(In GW)



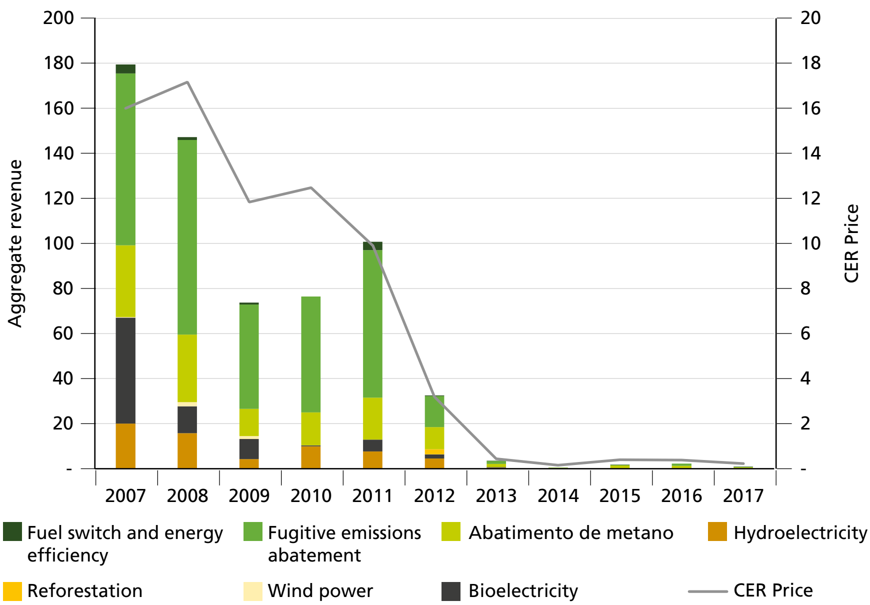
Sources: UNEP, IGES and UNFCCC.
Prepared by the authors.

3.3 Evaluation of credit issuance and revenue generation by project category

As can be seen, different types of projects have been concluded at different times of the CDM. Similarly, carbon credit prices deteriorated during the first commitment period of the Kyoto Protocol due to the lack of agreement on a second commitment period, as explained in section 1. In this sense, this combination of both developments over time indicates that different project categories obtained different economic benefits.

In order to estimate the revenues generated by each category of projects, it is possible to assume that investors sold their credits in the year of their actual issuance.[22] For an estimate of sale value, we take the average price of each year,[23] adding a 20% discount, in order to offset transaction and brokerage costs. Graph 3 presents the result of this revenue estimate for different categories.

GRAPH 3
Estimated revenue per CDM project category (2007-2017)
(In U$ millions)



Sources: CD4CDM/UNEP, UNFCCC and Quandl.
Prepared by the authors.

Graph 3 confirms that fugitive emissions and methane abatement categories have been able to take advantage of high prices at the beginning of the first commitment period of the Kyoto Protocol and have thus generated substantial revenues. Another category that benefited was bioelectricity and, to a lesser extent, some small hydroelectric plants that achieved CDM registration at the start of the first commitment period of the Kyoto Protocol.

22. In the case of credits generated before 2012, it is assumed that 11% of the credits were not sold. For credits generated after 2012, it is assumed that 56% of the credits issued were not sold. These ratios were calculated from carbon stock inventories still available and reported by the UNFCCC. The increase in the percentage of unsold credits in the post-2012 period is a direct result of the fall in prices.

23. Quandl. Available at: https://www.quandl.com/databases/SCF.

At the same time, it is clear that the activities of fuel replacement and energy efficiency, reforestation and renewable energy projects registered in 2012, including large hydroelectric plants and the numerous wind power projects to date, have obtained any economic benefit from the CDM. The results of this analysis, therefore, leads to the conclusion that the CDM was efficient in promoting GHG mitigation projects with low-cost and effort, but that transformational investments in important energy infrastructure were affected by the lack of continuity of this mechanism.

In this regard, Table 2 shows the effects of this distortion by comparing the different categories in terms of their share in the potential reduction and investments, as well as their participation in revenues generated by the mechanism.

TABLE 2
Comparison of revenues generated by different CDM project categories registered in Brazil

Type of Project	Projects (%)	Reduction (%)	Investment (%)	Credits (%)	Revenue generated	Revenue (%)	Revenue/ investment (%)
Renewable energy	58.0	51.0	97.0	19.0	142.4	23.0	0.40
Bioelectricity	11.0	4.0	11.0	7.0	75.8	12.0	2.20
Wind power	19.0	15.0	33.0	1.0	3.4	1.0	0.03
Hydroelectricity	27.0	31.0	51.0	11.0	63.1	10.0	0.40
Solar power	1.0	1.0	3.0	0.0	0.0	0.0	0.0
Methane abatement	35.0	34.0	1.9	31.0	121.2	20	19.0
Fugitive emissions abatement	2.0	13.0	0.1	46.0	342.7	55.0	383.0
Fuel replacement and energy efficiency	4.0	2.0	0.5	2.0	10.4	2.0	6.8
Reforestation	1.0	0.0	0.2	3.0	2.2	0.0	3.5
Total	**361 projects**	**53,654 $MtCO_2$ e per year**	**32,019 MUSD**	**133,5 $MtCO_2$ e**	**619 MUS$**	**100**	**1.9 (average)**

Sources: UNEP, IGES and UNFCCC.
Prepared by the authors.

An analysis of the figures above indicates that the fugitive emissions abatement category, which accounts for only 2% of projects, 0.1% of investments and 13% of the potential for reducing emissions, has generated revenue that represents almost 50% of all generated resources by the CDM. With their low capital intensity, these projects obtained a financial return of 383% on investments. Renewable energy generation infrastructure, in turn, accounted for 58% of projects and 97% of capital expenditures with mitigation potential of 51% of the total. This category generated only 23% of revenues, thus receiving an average financial contribution of 0.4% on the mobilized capital.

For the other categories of methane abatement, fuel switch and energy efficiency, the results seem more balanced, but it should be noted that these groups are heterogeneous and require more specific discussion. Finally, the reforestation category appears to have produced interesting results that also deserve a more detailed analysis.[24]

4 CONCLUSIONS

The evaluation of Brazilian results and experiences with the CDM over the last decade provides a series of conclusions for the development of financial policies and mechanisms with better capacity to expand and improve the results of Brazil's socioeconomic development efforts. In a first estimate, it was found that the CDM was able to leverage a mitigation potential of almost 54 million tCO_2e per year, representing 2.6% of the national emissions in 2005, the year that generated the reference for the Brazilian NDCs. In addition, the mechanism was able to mobilize a total of US$ 32 billion in investments, which represents around 1.8% of GDP of US$ 1.796 billion in 2017.[25] Although these investments have taken place over several years, this contribution is significant today in the context of low infrastructure investments.

In addition, it is interesting to recognize that the total inflow of US$ 619 million over the period from 2008 to 2012 (some US$ 124 million per year), represents a return of 0.4% per year on the total of US$ 32 billion of capital mobilized by the CDM. Considering the low capital costs for currencies in dollars and euros of the last decade, this annual remuneration can be seen as a substantial support for such investments in Brazil. To be effective, such support obviously needs to be continued over the full 21 years that the CDM originally offered in order to remunerate capital intensive investments with long-term maturity.

Therefore, unfortunately, our analysis shows that the lack of sustainability and predictability of the CDM as a mechanism to encourage sustainable development has jeopardized projects with significant structural and transformational potential. On one hand, the CDM has channeled excessive financial rewards to end-of-pipe abatement projects with low-cost mitigation and no structural benefits. On the other hand, the CDM promoted large capital-intensive investments without adequate economic return, thus contributing, to the worsening of the economic crisis and retraction of investments in Brazil.

24. Considering the fact that the CERs of reforestation projects do not have the value of the traditional CERs, our model uses a discount of 75% to estimate their revenue. Nonetheless, this projection may still be optimistic as this type of credits had little demand.
25. The World Bank. Available at: https://bit.ly/2yXDDGq.

5 RECOMENDATIONS

From the experiences of the CDM, it is possible to conclude that the creation of international financial mechanisms can play a relevant role in the mobilization of investments in sustainable infrastructure, for the adequate treatment of waste and effluents, for industry technology updating, as well as for activities of reforestation. However, a series of strategies must be considered to avoid rent seeking and credit export by low-cost opportunities and to ensure that investments are targeted to strategic areas of the Brazilian economy. Below are a series of reflections to contribute to this discussion.

1) Legal security and long-term vision: the development of infrastructure projects or programs with transformational range and depth requires sound and predictable policies with long-term fundamentals. Any mechanism to be created in the future should prevent that investors are subject to instabilities, political interference or mechanisms without long-term sustainability and reliability. Along these lines, it is essential that new mechanisms to be created recognize the results already achieved in the context of the CDM so as not to deepen disbelief in relation to this type of economic instrument.

2) Complementarity of pricing and climate financing: Brazil's ambitious results are the consequence of the integration of domestic development and financing policies with the CDM as an international incentive, a strategy developed based on the Brazilian NPCC. Unfortunately, the current fiscal situation of the Brazilian Government does not allow the continuation of this policy and the low domestic savings rate of the Brazilian economy shows the need to attract more international investments. In this context, it is advisable to evaluate the Brazilian experience to develop solutions that ensure the synergistic combination of mechanisms for carbon pricing and climate financing and thus promote foreign direct investment in the areas that are strategic for the country's low emissions development.

3) Focus on promoting structural and transformational mitigation: it is understandable that the CDM has focused on low-cost mitigation, but in the context of the Paris Agreement, this tendency to prioritize the least cost mitigation should be re-evaluated. The reason is that the Paris Agreement provides that reductions resulting from cooperation mechanisms "shall not be used to demonstrate achievement of the host Party's NDC if used by another Party to demonstrate achievement of its NDC" (UN, 2015). Considering the need to account for the international transfer of mitigation results, the export of low-cost carbon credits without

additional development benefits may not be in the interest of the host country. Therefore, Brazil should promote policies and solutions that prioritize the sale and transfer of mitigation results of GHG mitigation activities with higher-cost or with important demand for the import of capital and technology.

4) Solving controversies about environmental integrity: the new Paris Agreement structure, with targets for all countries and the requirement to account for the international transfer of mitigation results, allows for overcoming criticism about the lack of environmental integrity of international flexible mechanisms. In order to take advantage of such an opportunity, it is important that Brazil promotes the definition of solid and transparent rules to authorize and account for transfers without risk of double counting by buyers and sellers. This type of transparency is fundamental to promote the use, and therefore, the demand for this type of mechanism and its mitigation results. In addition, recognition and accounting by the government can reduce the costs and difficulties of developing projects.

5) Establishment of a new sustainable development mechanism: the experience of the CDM and its focus on the minimum cost of abatement and no transformational effects for the host country indicates the need to encourage the use of a mechanism that is more effective in promoting truly transformative investments in order to promote the country's sustainable development objectives (UNBR, 2015). Therefore, the search for the minimum cost for mitigating greenhouse gases must be complemented by the search for solutions that can transform infrastructure, productive processes and social relations towards a more sustainable economy.

Based on these conclusions, it is important that Brazil aims at defining guidelines and policies that leverage the realization of low-cost emission reductions in the context of domestic policies and without exporting them. At the same time, it is recommended that Brazil seeks its insertion in a possible future carbon market to leverage investments with high intensity and cost of capital and the attraction of technologies and industries that are strategic for the low emissions development of the country.

The CDM provided important lessons for the discussion and definition of regulatory strategies. The main conclusion is that these solutions should be pragmatic, economically efficient and, to the extent possible, free of ideological, political and regulatory risks and interferences. In this moment of crisis in the Brazilian economy, the definition of new national and international mechanisms for carbon market and climate financing may be an opportunity to overcome the lack of investment and to promote the environmental and economic efficiency of the Brazilian industry so that the country can play its essential role in decarbonizing the global economy.

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CHAPTER 14

CARBON PRICING: FROM THE KYOTO PROTOCOL TO THE PARIS AGREEMENT

Ronaldo Seroa da Motta[1]

1 INTRODUCTION

When fighting global warming, a necessary condition towards a low carbon economy is mitigation of greenhouse gas emissions (GHGs). In order to achieve this, the economic literature suggests the application of price instruments as a "better" way to make this transition faster and less costly from the social point of view.[2]

When facing a higher relative price of pollution, private agents will have to choose between paying to pollute or reducing pollution by comparing the marginal control cost with the price of pollution. All emissions presenting lower control costs when compared with the price of pollution shall be controlled. In this situation, the control trajectory would follow the path of lower cost among the agents and, therefore, lower aggregate cost for the whole economy. Consequently, agents with lower costs would have more control than agents with higher costs, and thus the cost of society aggregate control would be lower.

Moreover, those who control spend less with a unit of controlled pollution as their control cost is lower than the price of pollution. Those who do not control are forced to pay the price for uncontrolled pollution. Hence, agents who control pollution have a lower total control cost and become more competitive.

Therefore, polluters will maintain an interest in adopting cleaner production methods in order to reduce their cost of pollution, which creates a stronger dynamic incentive for environmental technological innovation. Hence, it is always more efficient to have an equal unit price for all emission sources, thereby ensuring equal incentives and encouraging cost-effective reductions and innovation.

This chapter assesses approaches in carbon pricing, from the adoption of the Kyoto Protocol to the proposals included in the Paris Agreement. In order to do so, it begins with a brief theoretical analysis on pricing instruments, making a

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2. That is, for the economy as a whole. The basic bibliography for the development of the theoretical and conceptual part of this section are CEBDS (2016) and Seroa da Motta (2008).

distinction between the carbon taxes system from the emissions trading schemes and project credit offsets. It then goes on describing the various forms of pricing developed under both the Climate Convention and voluntary modalities. The main experiences with the European Union Emissions Trading System (EU ETS) and the Clean Development Mechanism (CDM) are then analyzed in detail. The chapter then discusses market instruments that are recognized and regulated in Arts. 5 and 6 of the Paris Agreement and how they connect with existing experiences. Finally, opportunities for Brazil to further advance its excellence with the CDM are discussed, as well as the environmental and competitive advantages of other instruments.

2 CARBON PRICING

There are two approaches to setting a price to pollution. Directly, as a compulsory tax per unit issued; or indirectly, by the exchange of emission rights defined compulsorily. In both cases, the company decides the desired aggregate level of emissions and then sets the billing amount or, in the trading system approach, the distribution among the equivalent emission allowance.

In the case of carbon taxes, a value per unit of pollution is determined in such a way that the sum of the pollution reductions of each polluter results in the new aggregate level of control desired. In the trading system approach, regulators distribute emission rights that are equivalent to the desired aggregate level of emissions among pollutants, but allow those rights to be traded between them. This gives rise to a market for the trading of these rights and, consequently, trading prices for these rights.

Given that control decisions are based on the same marginal cost control curves, therefore, in the absence of uncertainty and transaction costs, both instruments generate the same price result and controlled amount. The difference is the initial restriction that is quantitative in the market and the price when using carbon taxes.

When there is uncertainty, one instrument may be preferable over the other. When uncertainty over control costs is greater than that of damage, that is, a more elastic damage curve with respect to emissions, and therefore, small variations in control quantities generate very sudden variations in damages, it would be more efficient to use quantitative controls such as market ones. When, on the other hand, control costs are more elastic to emissions and, therefore, costs vary greatly with the level of control, then taxes would be preferable to avoid sharp price variations in the emissions trading approach. Another option would be hybrid systems in which price control is adopted within an emissions trading scheme to reduce the variability of the traded prices.

Transaction costs must also be considered. Transaction costs of carbon taxes, when using the current treasury system, might be smaller than in the emissions trading system, in which economic agents have to find out prices and enter into contracts and, therefore, other institutional arrangements, such as records and stock exchanges, will have to be developed. Moreover, transaction costs might restrict the scope of application of the emissions trading approach when involving many economic agents needing a high frequency of rights transactions, such as in the transportation and agricultural sectors.

Finally, it should be noted that the choice and formatting of these instruments has been strongly influenced by political economy factors, in which the participation and influence of regulated parties and regulators can overshadow these technical issues.

There are currently fifty-one national and subnational jurisdictions have already adopted carbon pricing, including some of Brazil's main economic trading partners. Of these jurisdictions, 25 have market approaches in place and 26 have tax approaches. In total, the two forms of pricing cover 20 percent of global emissions, with an annual value of US$ 82 billion—a sum that underscores the importance of recycling these resources within the sector. The carbon price levels vary widely, from US$ 1/tCO2e to US$ 139/tCO2e; but in 49 percent of cases, the prices are lower than US$ 25/tCO2e, and in 17 percent of cases they are lower than US$ 10/tCO2e. (World Bank, Ecofys and Vivid Economics, 2017). Although it is still a small percentage of the Parties involved in the Paris Agreement, there is a number of initiatives being planned, including in Brazil.[3] Out of these experiences, the best known and covering the largest number of countries is the one including the countries of the European Community.

3 The World Bank project Partnership for Market Readiness - PMR Brasil under coordination of the Brazilian Ministry of the Economy, available at: http://www.fazenda.gov.br/orgaos/spe/pmr-brasil.

3 THE EUROPEAN UNION CAP AND TRADE SYSTEM

As mentioned above, in emissions trading schemes, usually known as cap and trade (C&T), the maximum desired emissions quantities for all the economy is distributed among the agents (cap), for free of charge or auctioned, and economic agents may trade their individual emissions allowances.

The problem of company cost minimization is the same, whether allowances are allocated free of charge or auctioned; therefore, efficiency will remain the same, always resulting in the same equilibrium price. The free allocation, however, favors those who have received a greater proportion of their issuance needs and/or have a higher cost of control. The sale of allowances, for example, by auctions, do not have these distributive effects and can still generate tax revenues.

The cap and trade market for carbon pricing with the larger scale and duration is the European Union Emissions Trading System.[4] In the Kyoto Protocol, the then member-countries of the European Union (EU) committed to reduce their aggregate emissions of greenhouse gases by 8% below the 1990 levels in the period 2008-2012. This collective commitment has translated into differentiated national emission targets for each country in the community.

One of the instruments to achieve those goals was the European Union Emissions Trading System (EU ETS), created in 2005, which focused on the regulation of emissions from energy-intensive industrial sectors, such as electricity generation, cement, paper and cellulose. It has had three phases so far.

Phase I, 2005-2007, was an experimental stage, with a reduction target by 2%. Phase II, 2008-2012, established the target for the first commitment period of the Kyoto Protocol. Both phases distributed emissions allowances for free, according to national targets,[5] called EUA (emission unit assignments, of the EU ETS). Due to political pressure resulting from the fear of losing international competitivity, the distribution ended up favoring highly energy-intensive sectors with generous allocation, which resulted in an emissions' increase and high sales profits with the trading of the sector's allowances.[6]

4. The sulfur emissions market in the United States in the 1990s was the first large-scale experience with pollution rights markets and its success was inspiring for subsequent experiments, see, for example, Joskow, Schmalensee, and Bailey (1998).

5. Auctions were allowed, if the country wanted so, but only Denmark, Hungary and Lithuania used it to distribute a small part of their allowances. See Fazekas (2008) and Matthes and Neuhoff (2007).

6. See, for example, Martin, Muûls and Wagner (2016).

In phase III, 2013-2020, the final emissions target was 14% below the levels of 2005 (equivalent to 21% below the levels of 1990). In this stage, 40% of allowances were auctioned, and an emissions allowance reserve was created as a price stabilization mechanism.[7]

The impacts on trading prices were significant. They dropped from €30 per ton of CO_2 in 2005 to €10-09 until the 2008 crisis, when they plunged to less than €2. With the effects of the crisis fading, the new form of distribution and the perspectives of a new climate agreement, prices started to rise sharply again in 2012. €6 (Marcu, Elkerbout and Stoefs, 2016). Today EU ETS allowances are trade around €25.[8]

It is noted that when faced with an imposed target of GHG reductions, companies in the European Community would already have higher costs and, consequently, competitiveness loss. With the EU ETS, in turn, although there is still some loss of productivity and profit, there was a significant incentive to the growth of regulated companies when compared to the regulated ones.

The studies that have assessed the EU ETS indicate that, in addition to the fact that negative economic impacts are not that significant, the application of these instruments also generated positive effects. For example, even with the rise in the price of electricity, diesel and gasoline, when analyzing the performance of European companies before and after the creation of the ETS, most studies show that EU ETS has positively affected production, employment and investments of regulated firms, although in some countries a small loss of jobs has been observed. The effects on productivity and profit are ambiguous, with some studies showing both positive and negative variations.[9]

Despite that, the distribution of allowances was not free of controversies. Even if studies on EU ETS demonstrate that the benefits of auctioning revenues and reducing tax expenditures with exemptions would outweigh the costs associated with the loss of competitiveness due to leaks,[10] the transition to an auction system faced a high degree of rejection by regulated energy intensive companies. There has also been disagreement conflict over the use of proceeds raised with auctions, with regulated parties wanting them to return to their sectors in the form of credit subsidies and offsets, and regulators preferring greater flexibility in application such as reducing the overall tax burden of the economy or incentives for technological innovation.[11]

7. For more details, see: https://bit.ly/2Kscf7V. Accessed on August 9th, 2017.

8 See at https://bit.ly/2sjSOXe, accessed on November 12th, 2019.

9. See, for example, Marin, Pellegrin and Marino (2018), Martin, Muûls and Wagner (2016) and Ellerman and Buchner (2007).

10. Carbon leaks is the situation in which companies move their production to other jurisdictions where the constraints of climate policies are less stringent and can therefore lead to an increase in aggregate greenhouse gas emissions.

11. See, for example, Bushnell, Chong and Mansur (2013) and Ellerman and Buchner (2008).

The experience with EU ETS indicates that although efficiency gains in a C&T market are relevant, generating them is not something trivial. On the other hand, the technical and institutional development obtained with EU ETS has been valid in other national markets and other forms of pricing, such as offset mechanisms.

4 OFFSET MECHANISM

A baseline and credit type scheme (B&C) is somewhat similar to the C&T system, as emissions below the baseline limit generate credits that can be sold to those that emit above the baseline limit, the so-called offset, of emissions with credits from other sources or companies.[12] The baseline is calculated by multiplying a scale measure of use or production by a required proportion of emissions for that scale.

For example, emission standards, indicating quantitative emission limits by some unit of mass or volume, may serve as a baseline. As a result, companies could meet this standard either by reducing their own emissions or by buying credits from other companies whose levels are lower than the standard.

For instance, the program to ban lead from gasoline in the US dates back to the 80s, and used a baseline and credit approach, based on a lead intensity standard per unit produced. If a refinery, for example, produced 100 gallons of gasoline, it would have the right to emit 110 grams of lead per gallon produced.

If the lead content of gasoline produced by the refinery was below the baseline, then the difference could be negotiated.[13] Recently, in Alberta, Canada, a credit and baseline system has been implemented that requires large emitters to reduce their emissions intensity by 12%, allowing this target to be met with offsets between the companies within the system and also with others outside it to reduce their emissions on a voluntary basis[14] (CDC, EDF and IETA, 2015).

There are other initiatives that are similar to credit and baseline systems, such as:

- Australia: Carbon Farming Initiative (CFI) and NSW Greenhouse Gas Reduction Scheme (GGAS) and NSW Energy Savings Scheme (ESS);
- China: Certified Emission Reduction Scheme (CCER);

12. *Offset* is a reduction in greenhouse gas emissions in one jurisdiction to compensate for emissions in another jurisdiction.
13. See, for example, Hahn (1989).
14. Or with payments that are equivalent to a climate fund.

- India: Perform Achieve Trade scheme (PAT);
- United States: California Air Resource Board Compliance Offsets.

There is also a joint credit mechanism (JCM) created by Japan to assist developing countries in their mitigation efforts towards technological diffusion. In this mechanism, emission reductions are also defined as the difference between baseline and project emissions based on previously established and supposedly conservative standards and parameters to provide more transparency but without the requirement to prove additionality.[15]

Another system for the negotiation of offsets will happen in the scope of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), when airlines will be forced to buy offsets, or "emission units", to counterbalance their CO_2 emissions increase from international transport above the 2020 levels. From 2021 to 2026, CORSIA will only apply to international flights between countries that participate in the pilot phase on a voluntary basis. As at 2027, participation will be compulsory, except for some least developed countries, landlocked developed countries, and small island developing states.[16]

Although B&C schemes set a price on emissions, they differ from C&T schemes because there is no limit to explicit aggregate emissions, but there is an implicit limit equivalent to the sum of individual baselines. As a result, emissions vary with the level of aggregate production and, therefore, B&C performs differently from C&T in the long run since regulated companies have an incentive to expand production to generate more credits and consequently more emissions (Fischer, 2003 and Buckley, Mestelman and Muller, 2008).

The experiences created under the Kyoto Protocol are among the most developed experiences of international compensation mechanisms, with emphasis on the clean development mechanism.

5 INTERNATIONAL COMPENSATION

Most C&T and B&C schemes described above also accept offsets, generated in other jurisdictions, even if they do not have charges or markets. Jurisdictions that adopt reduction targets, even without charges or markets, can accept that the attainment of these goals is partially offset from other jurisdictions. In the case of climate agreement targets under the Climate Convention, there are mechanisms for this purpose.

15. See more details in Mizuno (2013).
16. See more details in Gehring and Phillips (2016) and at https://bit.ly/2N75AhQ. Access on July 12th, 2017.

The longest and most successful international offset experience is the Kyoto Protocol's flexibilization mechanisms. Considering that in this protocol, countries that are considered developed (Annex B Parties), have accepted emission caps, while others did not, three mechanisms were approved, namely:

1) International Emissions Trading (IET):[17] mechanism by which countries with emission caps, measured by assigned amount units (AAUs), may trade spare emission units with other countries that also have targets for reducing emissions.

2) Joint Implementation (JI):[18] credit mechanism, accounted as emission reduction units (ERUs), that encourages the creation of emission-reduction projects to transfer between countries with emission caps. Unlike the emissions trading scheme, credit comes from projects, and not spare emission units.

3) Clean Development Mechanism (CDM):[19] mechanism where credits result from the implementation of projects in countries with no emission caps that generate voluntary reductions, that are accounted as certified emission reduction (CER) credits.

In the CDM case,[20] in which the generating country does not have targets, credit accounting is more complex. First, the baseline must represent a scenario in which anthropogenic emissions would have occurred in the absence of the project. Second, the project must create additionality, that is, it must demonstrate that it is different from the baseline, meaning that not having the benefit of the CDM was not the most likely or profitable option, or that there were barriers to its implementation. Third, these reductions must be permanent. Finally, CDM projects must be aligned with sustainable development objectives.

Because compliance with these criteria is not trivial, the issuance of CER credits face a lengthy process of validation and verification from their initial proposal until they are endorsed by the CDM Executive Board under the Climate Convention. That is, the more rigid the process, the greater the resulting transaction costs and the less feasible the smaller projects. The World Bank, for example, has estimated that transaction costs, including project preparation costs, range from approximately US$ 0.02 for large industrial projects to US$ 1.2 per CER unit for smaller projects (World Bank, 2009).

17. International Emissions Trading (IET).

18. Joint Implementation (JI).

19. Clean Development Mechanism (CDM).

20. It is also mostly applied to Joint Implementation (JI) schemes involving Annex B countries that do not meet all the eligibility criteria, mainly, inventories that allow the monitoring of credit transactions.

However, the effort of the CDM Executive Board since the instrument's implementation in 2005 has been recognized to enhance the process' effectiveness and thus ensure the integrity of the environmental objectives without significantly affecting incentives to reduce emissions and the adoption of low carbon technologies (Gillenwater and Seres, 2011; Shishlov and Bellassen, 2012 and Michaelowa, 2014).

Where adherence may be temporary, the approach used was to define a special type of "temporary" credit with certified temporary emission reductions (tCERs). These additional units have been used for projects in afforestation and reforestation activities, but projects that reduce emissions from deforestation reduction and forest degradation have been prevented from generating CDM credits. Later, an approach to reducing emissions from deforestation and forest degradation (REDD) was created under the Climate Convention for these activities.

Moreover, the European Community prohibited the use of afforestation and reforestation CERs in EU ETS. Besides, contentious issues of additionality and adherence have been used for each CER-purchasing country to create barriers to CDM transactions within their countries by discriminating by both transaction volume ceiling and eligible activity. In addition to forestry activities, there are also restrictions in the EU ETS for certain types of gases (HFC-23 and N_2O, for example) and additional requisites for hydro power plants.

There are, however, economic reasons for these barriers, particularly for forestry projects. These are due to the fear of local companies that the availability of cheap CERs generates a high price differential in relation to their control costs[21] to the detriment of the demand for local technologies and often allowing an abnormal rent to the issuers of CERs (Gillenwater and Seres, 2011; Shishlov and Bellassen, 2012 and Michaelowa, 2014).

So much so that, whatever the CDM credit, in the EU ETS, for example, there is a maximum quota of CERs that is allowed to enter the market.

Finally, the experience with the CDM exemplifies the difficulties of B&C systems. Although it requires a dynamic, evolutionary and fairly rigorous process to determine the baseline and additionality, this determination is not free from errors and uncertainties. Therefore, the CDM has been criticized for poor environmental integrity, high transaction costs and complex governance. When non-additional projects are erroneously accepted, the effect may be an increase in overall net emissions. The CDM mechanism has been, therefore, the object of several analyzes[22] that still point at weaknesses in the application of these criteria. Current estimates

21. This restriction appears to have reduced the impact of transaction prices on that market. Nazifi (2010) evidences that CER values do not affect the US, when coming directly from the EU ETS, it is the other way around. CER prices are anchored in US prices, probably because CER transactions are limited in the EU ETS and thus have no scale to lead prices.
22. See, for example, Warnecke, Day and Tewari (2015), Spalding-Fecher et al. (2012) and Schneider (2009).

indicate that the environmental integrity of CDM projects has improved over time, and their performance over transaction and governance costs has improved significantly since 2009, especially as of 2011. Standardization has begun with a boost (Michaelowa, 2014; Warnecke, Day and Tewari, 2015).

Experience with the CDM is a clear indication of the technical and institutional complexity in order to guarantee the environmental integrity of offsetting instruments. However, the results of this experience have been perfected over time, and can now contribute to the scope and scale of such mechanisms.

6 PRICING INSTRUMENTS IN THE PARIS AGREEMENT

Notwithstanding the difficulties discussed in the previous B&C and C&T initiatives highlighted above, these experiences generated a technical and institutional basis that encourages us to continue the evolution and the adoption of these instruments, as well as allows other pricing systems to be considered, as expressed in Arts. 5 and 6 of the Paris Agreement.

The discussion below is about how Art. 5 reinforces past deliberations on reduction of emissions by deforestation and forest degradation, Art. 6 encourages international cooperation with pricing instruments.

6.1 Art. 5 of the Paris Agreement

Since deforestation accounts for more than 15% of global GHG emissions, there is an interest in funding mechanisms for reducing emissions from deforestation and forest degradation. Art. 5 of the Paris Agreement reinforces the REDD decisions already agreed under the Climate Convention. This article contains two paragraphs. The first emphasizes the decision to encourage actions to conserve and improve sinks and reservoirs of greenhouse gases, including forests, as appropriate.

The second paragraph encourages measures to implement and support, together with results-based payments, the guidelines and decisions that have been already approved for activities related to emissions reductions from deforestation and degradation, and also conservation, sustainable management and sustainable forest management and increased forest carbon stocks in developing countries. It also includes joint mitigation and adaptation approaches for integrated and sustainable management of forests, reaffirming the importance of encouraging the other benefits in addition to non-carbon benefits associated with such approaches.

The technical issues in the implementation of REDD approaches are the same as those we have seen in the CDM regarding the baseline and additionality for afforestation and reforestation related to the timing of the credits. The possibility of such an approach generating a very large supply at very low costs reinforces the identified fears of reducing the attractiveness of local stocks and therefore likely to be subject to limiting quotas for offset.

6.2 Art. 6 of the Paris Agreement

Art. 6 directly addresses the provisions of market and non-market mechanisms, procedures and protocols for cooperation among countries in implementing the agreement. In this study, we will stick to market-based ones.

The first paragraph acknowledges the voluntary cooperation among countries in implementing their NDCs in order to allow for greater ambition in their mitigation and adaptation actions to promote sustainable development and environmental integrity. The ensuing paragraphs refer to voluntary cooperation modalities.

Paragraphs 6.2 and 6.3 describe the international transfers of mitigation outcomes that are the result of cooperative approaches, known as international transfer of mitigation outcomes (ITMO). These transfers are "mitigation results" that may result from any mechanism, procedure or protocol without the need for approval by the CMA, which is the body that oversees the implementation of the Paris Agreement.

Despite that, these provisions require these provisions require ITMO accounting to follow the CMA guidelines and hence rules that are yet to be defined, and should, in principle, be guided to avoid double counting and create records that can be tracked in transactions (Marcu, 2016; IETA, 2016; Gehring and Phillips, 2016).

Although the introduction of accounting metrics for ambition goals in mitigation and adaptation actions, sustainable development and environmental integrity can add a degree of complexity and uncertainty, ITMOs are instruments that only require the approval of the parties involved.

Moreover, there is no reference to additionality in Paragraphs 6.2 and 6.3, and if this is the case, international transfers of any type of mitigation outcomes would be possible, and not only those with B&C systems. Therefore, other forms of offset, such as EUA, REDD and JCM, would be recognized by the provisions of paragraphs 6.2 and 6.3 (Marcu, 2016; Gehring and Phillips, 2016).[23]

Paragraphs 6.4 and 6.7, in turn, establish a mechanism to "contribute to greenhouse gas emission mitigation and support sustainable development", known as sustainable development mechanism (SDM) or emissions mitigation mechanism (EMM). Its creation was initially thought of in the Brazilian proposal as an improved CDM (Brazil, 2014). To that end, in this Brazilian proposal, the mechanism would incorporate the modalities, procedures and methodologies of the CDM to continue to allow the negotiation of CERs.[24]

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23 Although such authors acknowledge that this limitation, B&C's approach, appears in some preliminary versions of the Paris Agreement.

24 For a more detailed discussion on the differences and similarities between the CDM and SDM, please refer to Greiner et al. (2017).

Inspiration in the CDM has shifted to the text of the Paris Agreement as paragraph 4 (a) highlights the promotion of GHG emissions mitigation in order to strengthen sustainable development. And in paragraph 4 (b), much like to the CDM, the mechanism should encourage and facilitate participation in greenhouse gas emissions mitigation by authorized public and private entities.

The Brazilian proposal (Brazil, 2014) also provides that the mechanism is established in order to assist mitigation efforts of target countries and to assist developing countries in implementing project activities with the aim of reducing GHG emissions or increasing removals by sinks. Thus, all countries could emit SDM certified emission reductions, and the scope could cover a wide range of activities, including those associated with sinks (Marcu, 2016; IETA, 2016).[25]

Paragraph 6.4 (c) seems to confirm this possibility, as it refers to mitigation activities and the reduction of emission levels by the generating country, reaffirming in paragraph 6 (d) the fact that the SDM should "provide global mitigation in global emissions". Thus, along these lines, it would be possible to include a wide range of activities, including forestry ones, such as the REDD mechanism (Marcu, 2016).

Finally, paragraph 7 provides that the CMA must adopt rules, modalities, and procedures for the SDM. That is, unlike ITMO, the SDM will depend on the CMA's authority and not just the wishes of the stakeholders.

As discussed earlier, ITMOs contemplate a non-restrictive scope in which other mechanisms could be recognized. This broad scope also seems to be accepted for SDM. However, the coverage of these instruments under the SDM may be more attractive by the very mark required by the CMA. Although the SDM process may be less flexible and with higher transaction costs, the carbon transacted through the SDM may be more valued in trades (Marcu, 2016).

7 FINAL COMMENTS

Although the parties involved have not reached a consensus on the opportunity to create a global market, the Paris Agreement progresses and consolidates the experiences of carbon pricing, such as the CDM mechanism and the REDD approach. Because of the diversity of such instruments, not even the adoption of all these pricing options would specifically create an international regulated market, like EU ETS. However, once implemented, the negotiations of these instruments will signal with various prices that will certainly influence the mitigation decisions of each jurisdiction or sector insofar as they will affect the regulated or implicit prices of carbon previously practiced.

25. Although the Brazilian proposal mentions trade in CERs, the regulation of this mechanism and its procedures are still under discussion.

There is a range of opportunities for Brazil to expand its NDC's financing options and the expansion of mitigation measures. In addition, if not as important, they may generate benefits of technological innovation and protection of biodiversity.

One of these opportunities is the integration of REDD and SDM. A proposal developed by Costa et al. (2017) would be an instrument called "Integrated REDD". It proposes the creation of distinct, but complementary, markets in which REDD+ would be associated with balanced portfolios with the inclusion of other non-forest projects, such as the SDM mechanism. Such an association could, for example, be regulated by a balance between REDD credits and other types of credit setting a maximum percentage of REDD+ credits. This distinction would protect prices and demand for these credits. Consequently, and equally important, the impact of demand for REDD+ would be very low and would avoid volatility in markets for other types of offsets. With this, the financial resources would flow to the forest sector as to other sectors of the economy, thus contributing to the process of innovation and decarbonization of the economy.

In short, there are many experiences with carbon pricing that have been adopted in many jurisdictions. The most significant were the EU Emissions Trading Scheme and the CDM, both under the Kyoto Protocol. Many others have been adopted on a voluntary or subnational basis. However, as discussed here, the Paris Agreement broadens these opportunities and creates incentives to recognize them within the protocols and procedures of the Climate Convention.

Consequently, the implementation of these instruments will contribute to reducing the cost of mitigation in all jurisdictions, which will help achieve the goals of the Paris Agreement. For Brazil, it is the opportunity to further advance its excellence under the CDM and now capture the environmental and competitive advantages of REDD as well.

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CHAPTER 15

PMR BRAZIL PROJECT: PERSPECTIVES ON THE BRAZILIAN EMISSION REDUCTIONS MARKET

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1 INTRODUCTION

In 2015, with the adoption of the Paris Agreement (PA), during the 21st Conference of Parties (COP 21) of the United Nations Framework Convention on Climate Change (UNFCCC), a new phase of discussions began about instruments capable of achieving emission reduction targets taken on by the signatory countries of the agreement. Art. 6 basically establishes four types of mechanisms: *i)* cooperative approaches (paragraphs 6.1); *ii)* international transfer of mitigation results (paragraphs 6.2 and 6.3); *iii)* mechanisms that contribute to emissions mitigation and support sustainable development (paragraphs 6.4 to 6.7); and *iv)* non-market approaches (paragraphs 6.8 and 6.9). The rules, modalities and procedures – for each of these approaches – are to be negotiated in the coming years, shedding a light on what each of these mechanisms will mean in practice and how they can contribute to the achievement of Nationally Determined Contributions (NDCs), at the lowest possible cost.

At the domestic level, Law No. 12,187, of December 29th, 2009, established the National Policy on Climate Change, its objectives, guidelines, principles and instruments, as well as specifying the country's voluntary contribution to mitigation of greenhouse gas (GHG) emissions – by 2020. In addition, Decree No. 7,390 of December 9, 2010 outlined the strategy to achieve this mitigation target, listing sectoral plans containing several instruments: command and control – to contain deforestation in the Amazon and Cerrado (Brazilian savanna); incentives – such as the subsidized credit line for investments in low-carbon projects in agriculture, entitled Program for Reducing Emissions of Greenhouse Gases in Agriculture (ABC Program); and development, through funding or investment with funds

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from the General Budget of the Union (OGU). Thus, the strategy outlined was based on the prediction that costing and investment budget resources would be allocated to meet voluntary mitigation targets.

In the case of the energy sector, the scope of the mitigation target is guided by the existing sectoral planning instrument (Ten-Year Energy Expansion Plan). In other sectors, the estimate was to redirect or increase budgetary resources, or to adjust priorities and targets contained in preexisting plans. This strategy proved to be limited in effectiveness, largely due to budget constraints, which made the necessary unfeasible expansions and made it more difficult to redirect resources. In addition, this may have contributed to the lack of confirmation of the National Policy on Climate Change's priorities by sectoral policymakers – in the midst of changes in the direction of the bodies and consequent reviews of priorities – and, in addition, discontinuity in monitoring governance, on behalf of the National Policy on Climate Change, as well as its implementation measures.

In this context, this policy did not evolve into a state of institution of some economic instrument aimed at creating an explicit price signal for the emission of greenhouse gases, either through the operation of a domestic cap-and-trade type emissions trading system (ETS), or by the imposition of a tax on GHG emissions (Carbon Tax – CTax) in the country.

After 2020, the National Policy on Climate Change should be reviewed to incorporate emission reduction targets set for 2025 and indicated for 2030 for the Brazilian NDC. Considering that the phenomenon of global climate change refers precisely to the creation of emission-related externalities, which impose costs on society not borne by those who emit GHGs, the internalization of these externalities – through the creation of a price signal that improves guidance on the decision-making process of economic agents in relation to the optimal level of emissions of their activities – should be a fundamental part of the instruments adopted to mitigate climate change (Stern, 2006).

Currently, the General Coordination of Environment and Climate Change at the Secretariat for Economic Policy of the Ministry of Finance (COMAC/SPE/MF) is implementing the Partnership for Market Readiness (PMR) Brazil Project, aimed at evaluating the costs and benefits of adopting alternative designs of economic instruments for the pricing of emissions in the country (ETS and/or CTax) that can be incorporated into the measures that will achieve the country's goals in the PA. In this sense, the experience acquired with the implementation of clean development mechanism (CDM) projects in Brazil should be incorporated, in some way, into any eventual emission pricing instrument to be adopted in the country. The implementation of the PMR Brazil Project has already identified some challenges harmonizing these instruments, which will be discussed along this chapter.

From the point of view of the new round of international negotiations on the definition of market instruments, with a view to achieving the targets assumed in the NDCs, it is understood that the process of analyzing the adoption of a domestic ETS in the country must be attentive to the UNFCCC negotiations, especially those relating to the issues dealt with under PA paragraphs 6.2 to 6.7. With the possibility of linking a domestic ETS with other national and/or regional markets around the world, it is possible that the results of these future transactions will be interpreted as "international transfers of mitigation results" (paragraphs 6.2 and 6.3) in a future PA regulation; reason why this possibility must be analyzed in a possible future proposal of instrument design.

In addition, the mechanism defined in paragraphs 6.4 to 6.7 of the PA, which is being called a sustainable development mechanism (SDM), also has the potential to interact with a possible national ETS,[3] especially knowing that sectors that could be regulated by this system could also generate credits in the SDM. Therefore, the analysis of the adoption of pricing instruments in Brazil should take into consideration possibilities of harmonizing between different available instruments (ETS/CTax and CDM/SDM), ideally building from the definition of objectives that the country would expect to achieve with the adoption of each of these.

Thus, this chapter intends to bring some elements of reflection about the advantages of adopting an emission pricing instrument (ETS and/or CTax) in the national policy, its relationship with the types of instruments based on the generation of offsets and some challenges already identified in the PMR Brazil Project, regarding the harmonization of these types of instruments in the National Policy on Climate Change. For this purpose, section 2 discusses basic concepts around the instruments of emission pricing, contextualizing the option for such mechanisms in the list of instruments available to deal with mitigation objectives. Section 3 presents the PMR Brazil Project, describing its organization and the activities implemented. Section 4 further discusses the challenges of integration between ETS/CTax (national) and CDM/SDM (international) type instruments. The last section, as usual, approaches conclusions and possible recommendations.

2 CARBON MARKET IN THE NATIONAL POLICY ON CLIMATE CHANGE: DEFINITION OF THE POLICY INSTRUMENT AND ITS RELATION TO THE CDM/SDM

The emissions trading concept discussed here encompasses two types of mechanisms: one known as emissions trading systems (ETS) and the other based on the construction of a baseline with subsequent generation of credits (baseline and credit schemes).

3. For further information on the proposed MDS under the Paris Agreement, see Chapter 12. Issues about markets in operation and formatting are discussed in Chapter 14 (note from the editors).

An ETS consists of the definition of maximum limits of GHGs (cap) that can be emitted by sources subject to the regulation, located in a certain country or region, in a certain period of time (compliance period). This total limit is distributed or sold – by auction – to the companies that own the regulated sources under the system, through licenses or quotas that represent the right to emit certain amount of GHGs during that period. At the end of the compliance period, firms must submit to the regulatory body the licenses or quotas corresponding to their emissions. Companies that cannot reach the stipulated limits by reducing their emissions – probably because they have very high abatement costs – should buy licenses or permits from those who emitted less than their cap – presumably because they had comparatively better abatement costs. From this transfer of licenses between the companies, comes the market of licenses or emission quotas (trade), where the equilibrium price of allowances is defined.

Another less frequent approach to emissions trading, called a baseline and credit, is one in which certified emission reductions (CERs) – commonly known as carbon credits – are generated for a previously defined baseline. In that case, emissions below the baseline in a given year generate credits that can be sold to any companies that have issued more than the one set in its baseline.

As they are usually applied in relative terms, such mechanisms do not imply the adoption of an emissions cap as in ETS. Thus, by setting baselines that depend on economic performance parameters,[4] companies do not receive their emission allowances in advance, but rather credits that are generated after verification of emission reductions. This means that – once the baseline is defined – the cap-and-trade system is administratively simpler, given that the option for the crediting system means that the system will have to be accounted for and issued annually, whereas the permissions are defined and distributed throughout the compliance period (EEA, 2006).

The rationale behind emissions trade – whether they are ETS or baseline and credit – is that the former allows reductions to be carried out by companies that have lower abatement costs, since the trade of allowances and/or credits in the market would equalize the marginal costs of abatement among all the participants of the scheme. For this reason, it is important that the participants of these schemes have different abatement costs, in order to guarantee the possibility of exchanging emission quotas between them.

In the case of an ETS, for example, given the emission cap of each source, the decision to implement an abatement measure in the company itself or to buy permits in the market will be made by comparing the company's marginal abatement

4. As in the case where targets are set by emissions intensity.

cost (MAC) and the equilibrium price in the allowance market (P_C). If MAC > P_C, the company will be a buyer in the market of permissions; if MAC < P_C, the company will be selling in the market of permissions. Obviously, buyers and sellers have alternated over time given the investment decisions in new technologies that lead to differentiations in the marginal costs of each company's future abatement.

Thus, emissions trading schemes ensure that the emissions reductions achieved through them will be implemented primarily by operators whose abatement costs are lower. Hence, the total mitigation costs for the economy as a whole are reduced, with a given target set – either by the cap or by the baseline. In other words, assuming that a market for permits and/or credits operates in perfect competition, the equilibrium price will be such that there is no profitable opportunity for someone to offer emission quotas at a cheaper price on the market, and therefore, these will be the lowest costs that the group of regulated agents can achieve to meet the target emission reduction target.[5]

Moreover, the creation of a price signal for GHG emissions has a great potential to provide incentives for issuers to continue to seek cheaper discounting options in the future through new technologies, which means that this type of instrument can also result in the induction of innovations, as well as new productive investments aimed at generating employment and income and sustainable development.

In turn, a tax on emissions is a charge on the volume of GHGs issued by a given source. The concept of an emissions tax is based on the polluter pays principle, from which it is considered that the owner of a given emission source must bear the costs of any emission reduction necessary to maintain a given environmental/climate objective. Thus, in the absence of other market imperfections and assuming the imposition of a Pigouvian tax,[6] the levying of an emission tax should lead issuers to adopt the cheapest abatement options, making this instrument cost-effective in static sense.

In addition, if perceived by the regulated parties as an instrument that will last in the long term, the tax entails incentives for issuers to continue to seek cheaper options for discount in the future through new technologies, which means that this type of instrument also results in dynamic efficiency. At least in principle, the tax provides a stable price signal to investors, since the only source of price volatility comes from unanticipated political adjustments that might alter the value of the tax (OECD, 2009).

5. It must be emphasized that this result is theoretically anticipated, assuming that the market operates in perfect competition, since the existence of market power reduces the cost-effectiveness of the instrument. Therefore, issues related to the defense of competition should also be analyzed in the event that concrete possibilities of inclusion of sectors and design alternatives are discussed, in order to avoid the existence of market power in the permits market, which also can have an impact on competition between companies in the product market.

6. A Pigouvian tax is one applied to a market activity to correct externalities. In this case, it would be used to internalize external costs, being employed in the same amount of the generated externality.

For these reasons, instruments that establish a price for emissions are considered cost-effective – that is, their adoption leads to the most efficient results possible, both from the static (with production cost savings and transaction in the present) and dynamic (via generation of innovations and consequent reduction of costs in the future) points of view. It can be concluded, therefore, that price-based instruments are important pieces in a climate change mitigation policy, since not only are they able to correct externalities generated by GHG emissions, but they also result in reduction of compliance costs of fixed targets.

Mechanisms of the type ETS, CTax and baseline and credit are not exclusive. South Africa, for example, has been considering the use of CERs for CDM project activities developed in the country as a mechanism for offsetting the emissions tax that is to be created. In turn, carbon credits generated from a baseline can normally be used as offsets in cap-and-trade schemes, as in the carbon market regulated by the Kyoto Protocol, where credits generated under the CDM – in non-Annex I countries – can be used to offset emissions from sources covered by ETS mechanisms in Annex I countries.

In this type of arrangement, when sources covered by a scheme of the type ETS are defined, it may be allowed that other sources not covered by this regulation generate compensatory credits to be used by the scheme participants. The rationale for this type of authorization is that there are sources that – for one reason or another – cannot be regulated at present but have abatement costs low enough to be appropriated by scheme participants, so that the total cost of a certain cap is even more reduced. In this case, the adoption of a combined cap-and-trade scheme with the possibility of using compensatory credits could increase the cost-effectiveness of the policy.

Given that ETS, CTax and baseline and credit instruments are not necessarily mutually exclusive, it would be important to assess how different types of instruments can promote compliance to the NDC in the country as cost-effectively as possible, considering the regulatory framework to be negotiated in the coming years under Art. 6 of the PA.

From a practical point of view, any strategy to be adopted should take into account everything that has already been built up with the implementation of the CDM – as well as everything that can be leveraged with the implementation of this mechanism – in relation to: *i)* creation of bodies, methodologies, rules and procedures for approval of projects and credits; *ii)* accumulated experience in the country on project development and accounting of emissions at the corporate level; and, *iii)* the possibility of using credits generated by these mechanisms, as part of a domestic pricing scheme.

Therefore, the PMR Brazil Project is an opportunity for this experience to be incorporated into any eventual emission pricing instrument to be adopted in the country in a new phase of the National Policy on Climate Change; some challenges and the subject have been identified, and will be discussed in the next section.

3 PMR BRAZIL PROJECT: PROPOSALS AND CHALLENGES

The Partnership for Market Readiness (PMR) was launched in Cancun on December 8th, 2010. The Organizational Meeting was held in April 2011 in Bangkok, Thailand, and the 1st Meeting of the Partnership Assembly (PA1) took place in May 2011 in Barcelona, Spain. The central objective of the initiative is to support countries in the adoption of cost-effective approaches to mitigation of GHG emissions, focusing on the analysis, preparation and implementation of emission pricing instruments. Another nineteen implementing countries[7] and thirteen contributing countries[8] joined, as well as four countries or subnational entities as technical partners.[9] The Secretariat of the PMR is the World Bank Secretariat and it has a $127 million fund for non-reimbursable funding of implementing country initiatives.

The central axis of the PMR is technical and financial support to the implementing countries for the analysis, rationale and design of GHG pricing instruments, including the preparation of components necessary for their operation, such as a Monitoring, Reporting and Verification system (MRV) on emissions data or tools for recording and tracking certificate transactions or emission permits. In addition, the PMR was created a platform for the exchange of experiences, technical discussions and collective innovation on innovative instruments geared to the mitigation of GHGs, through workshops and other events, working groups and technical notes.

In these activities, the concrete experience and challenges of policy formulation in the area are analyzed and associated topics such as the economic modeling of pricing instruments, the use of benchmarks, the connection of different ETSs, generation and use of offsets, the possibility of leakage (carbon leakage) etc. Hence, the PMR has contributed to the rapid evolution of this theme by sharing knowledge among government agents, business organizations, civil society entities and international organizations, including the UNFCCC, in a concomitant way with the development of the new framework of commitments created by the PA.

7. Argentina, Brazil, Chile, China, Colombia, Costa Rica, India, Indonesia, Jordan, Mexico, Morocco, Peru, South Africa Sri Lanka, Thailand, Tunisia, Turkey, Ukraine and Vietnam.

8. Australia, Denmark, European Commission, Finland, Germany, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom and the United States.

9. For further information, see: www.thepmr.org. The Secretariat of the Partnership can be contacted at: pmrsecretariat@worldbank.org.

Brazil joined the PMR through the Ministry of Finance, and it occurred as a consequence of the process of analysis on economic aspects of climate change and carbon pricing, initiated in the Ministry of Finance in 2008.[10] During this period, the Ministry touched base with this subject on different fronts: the process of preparation and approval of the legal framework of the National Policy on Climate Change; the elaboration of Brazil's voluntary targets for the Copenhagen Agreement; and participation in the orientation council of the study Economics of Climate Change in Brazil: costs and opportunities (Margulis and Dubeux, 2010).[11] Subsequently, between 2011 and 2012, the Ministry of Finance coordinated the Interministerial Working Group on Carbon Market, created by the Interministerial Committee on Climate Change (CIM) on September 20, 2011, whose final report was presented in May in 2012.[12] In addition, the Ministry has established partnerships and coordinated several studies on issues related to carbon pricing in recent years.[13]

As per the procedures for participation in the PMR, Brazil's manifestation of interest in integrating the partnership was presented in October 2011, presenting a diagnosis of the country context in terms of mitigation policies and use of market-based instruments for this purpose, and indicating as a focal point the Secretariat of International Affairs and the Secretariat of Economic Policy of the Ministry of Finance. The next step was the presentation and approval, in May 2012, of the organizing framework, which established the scope of activities to be developed in Brazil. This began the preparation phase of the Brazilian project within the PMR, which was concluded in 2014, and consisted of two studies, as described below.

10. Between 2008 and 2010, the then Deputy Executive Secretary of the Ministry of Finance (MF), Francisco de Assis Leme Franco, carried out systematic internal meetings to deepen economic aspects related to climate change – including carbon pricing – with representatives of the various Ministry of Finance units (the Executive Secretariat, the National Treasury Secretariat, the Federal Revenue Secretariat of Brazil, the Secretariat of International Affairs, the Secretariat of Economic Policy, Secretariat of Economic Monitoring and the Attorney General of the National Treasury, as well as external guests).

11. The MF was represented on the Orientation Board by Francisco de Assis Leme Franco, Deputy Executive Secretary.

12. According to Decree No. 6,263 of November 21st, 2007, the Interministerial Committee on Climate Change (CIM) is the body that guides the preparation of the National Plan on Climate Change and makes other provisions. Upon approval by the CIM, the Interministerial Working Group on Carbon Market was established by an Ordinance of the Ministry of Finance dated November 29th, 2011, which also established the internal WG to the Ministry, with a view to supporting the functioning of the Interministerial Working Group on Carbon Market. The creation of this Interministerial Working Group had as objectives: to analyze the feasibility of the requirements for the implementation of the Brazilian Emission Reduction Market (MBRE) – provided for Art. 9 of Law No. 12th,187/2009; study the possible instruments and analyze the design alternatives of the MBRE, in articulation with those involved; and to support decision-making on the preparation and implementation of the MBRE. The Final Report was presented to the Executive Group of the CIM in May 2012; however, it was not analysed by the CIM, and the document has been kept under secrecy since then.

13. The studies carried out by the Center for Sustainability Studies of the São Paulo Business School of the Getulio Vargas Foundation (GVces/EAESP/FGV) in 2012 and 2013, focusing on: emission reporting systems; corporate emission inventories; emissions trading system (ETSs); incentives to reduce emissions; carbon intensity indicators – reports available at: goo.gl/umfkMe; and the two phases of the Green Fiscal Policy project, in partnership with the British Embassy in Brazil are worthy of note.

1) Evaluation of the macroeconomic impacts of the goal to reduce GHG emissions through instruments (emissions tax, emission trading and command and control), through the General Equilibrium Model of Energy and Brazilian GHG Emissions (Brazilian Energy and GHG Emissions General Equilibrium Model – BeGreen).[14]
2) Review of the economic literature and analysis of the international experience in taxation of GHG emissions; and analysis of the possibilities of introducing a tax of this nature in Brazil, considering the legal framework of the Brazilian tax system.[15]

Based on the subsidies generated by these works, the Brazilian Market Readiness Proposal (PMR) was prepared and submitted to the Partnership Assembly in May 2014, being approved in September this year, with allocation of the corresponding resources.[16]

The PMR Brazil Project, as it is now called, aims to implement a robust analytical set capable of providing evidence and supporting the decision-making process regarding the adoption of GHG emissions pricing instruments in Brazil, giving transparency to related costs and benefits. Thus, the project was structured to answer two questions: whether it would be convenient and feasible to add instruments aimed at creating price signals for GHG emissions to the National Policy on Climate Change after 2020; and, if possible, what is the best instrument (price regulation via tax, quantity regulation via ETS or a combination of both).

Thus, the PMR Brazil Project was structured in three components, as described below.

1) Component 1: sectoral studies and instrument design: sector´s organization analysis, GHG emissions profile and mitigation options in the electric, fuel, agricultural and industrial sectors (cement, iron and steel, aluminum, chemical, glass, lime, paper and cellulose); analysis of sectoral policies and their potential interaction with GHG pricing; and, finally, proposals for alternative designs of pricing instruments – and adjustments to existing policies.
2) Component 2: evaluation of the impacts of proposed instrument designs – and adjustments in existing policies – in two complementary approaches: economic modeling, with a view to capture macroeconomic, sectoral and social impacts; and regulatory impact analysis, with the objective of

14. The model developed by the Center for Regional Development and Planning of the Faculty of Economic Sciences of the Federal University of Minas Gerais (Cedeplar/UFMG). Study commissioned by the consortium formed by Cedeplar/UFMG, WayCarbon and South Pole.

15. Study commissioned by the consortium formed by Climate Focus, Ludovino Lopes Advogados and WayCarbon.

16. Via Resolution No. PA/IP/2014-1, which has allocated US$ 3 million for its implementation.

aggregating the estimated impacts on modeling and other dimensions of costs and benefits, including qualitative ones, in order to order regulatory options.

3) Component 3: engagement and participation of actors, with:

    - four technical workshops, with a view to deepening methodological issues of impact assessment and other relevant issues for the project; and
    - three seminars, with a view to disseminating the outcomes of the project, as well as knowledge and experience on the subject.

The Secretariat of International Affairs and the Secretariat of Economic Policy of the Ministry of Finance were the Executive Coordinators of the PMR Brazil Project, together with the World Bank office in Brazil. A PMR Brazil Project Advisory Committee was established in order to provide transparency and allow the monitoring of the activities of the Project with the participation of representatives of the federal government, the private sector and civil society.[17]

Parallel to the institutional arrangements for the implementation of the PMR Brazil Project, the Brazilian government submitted its Brazilian contribution to the PA in September 2015, the preparation of which was conducted by the Ministry of the Environment (MMA). An absolute goal of "reducing greenhouse gas emissions by 37% below 2005 levels by 2025" was established, with the subsequent indicative contribution "to reduce greenhouse gas emissions by 43% below levels of 2005, in 2030" (Brazil, [n.d.]).

Given this definition, the analytical framework of the PMR Brazil Project was guided to take as reference these results and to verify to what extent the incorporation of emission pricing instruments, combined or not with the policy review, will reduce the aggregate costs to reach them.

It is therefore a question of comparing the costs of achieving the same environmental outcome through different "policy packages": the first, considered as the policy-base scenario, composed of the list of measures and actions through which it is intended to achieve the goals, taking into account the best information available at the time of analysis – according to the institutional definition stage of the NDC implementation strategy; and two or more alternative "packages", which include different approaches to the pricing of emissions, by means of ETS, of emissions tax(es) or combinations thereof. This work therefore embodies the challenge of identifying and quantifying public and private costs associated with the implementation of mitigation measures in each of the scenarios, in a context where this strategy may still have significant degrees of uncertainty.

17. Ministry of Finance Ordinance No. 853, dated October 19th, 2015, established the Executive Committee of the PMR Brazil Project and authorized the installation, at its discretion, of the PMR Brazil Project Advisory Committee.

If we consider as a reference the annex of the Brazilian contribution to the PA, the policy-base scenario will tend to require the continuity of the policy, with expansion of targets and measures similar to those defined in the first phase of the National Policy on Climate Change – especially in the agricultural sector – in addition to the incorporation of other quite challenging ones – particularly in the forestry and land use change sector. In addition, it is assumed that new standards of clean technologies will be promoted and measures of energy efficiency and low-carbon infrastructure will be expanded.

This must occur in the context of a strong restriction of public spending, both by the containment of expenses in progress since 2015, and by the New Tax Regime.[18] Thus, actions whose costs are borne by the federal government may be affected by such measures, as in the case of deforestation control, subsidies in the financing of low emission technologies, tax incentives or diffusion and promotion programs.

In addition, in the absence of new regulatory measures, the policy-base scenario tends to assume that the various sectoral bodies will direct their policies and programs – and will allocate available resources – for the implementation of the recommended measures, which often compete with others that are more viable or attractive in technical, economic or political terms. The policy-base scenario also tends to consider that private agents from different sectors will, by voluntary decision – maintained the absence of regulations on GHG emissions – and in a timely manner, the investments required to adopt the identified low carbon technologies, including bearing the associated financial costs.

Thus, a challenge for the PMR Brazil Project is to consider a policy-base scenario that demonstrates minimum feasibility conditions, given the fiscal context and the political-institutional conditions for its implementation. In the case of the scenarios for the adoption of pricing instruments, the challenges are to identify *ex ante* potential interactions between these instruments and existing policies, which can embed implicit price signals for GHG emissions, or render ineffective the intended induction by the attribution of explicit prices to these emissions.

In addition to the technical complexity of identifying such interactions, it is necessary to consider possible political resistance to the revision of previous policies motivated by other objectives. Another challenge is to capture – through regulatory impact analysis – the costs and benefits associated with the new policies, both for the public sector (databases on GHG emissions at the economic agent level, as well as capacity to establish and control regulations), as well as private ones (MRV of emissions and carbon asset management).

18. Constitutional Amendment No. 95, dated December 15th, 2016, established that the limit of primary expenditures will be given by the limit value referring to the immediately preceding year, corrected by the variation of the National Consumer Price Index or another index that replaces it – for the twelve-month period ended in June of the previous fiscal year referred to in the Annual Budget Law.

Another challenge is to capture – through regulatory impact analysis – the costs and benefits associated with the new policies, both for the public authority (databases on GHG emissions at the economic agent level, as well as capacity to establish and control regulations), as well as private ones (MRV of emissions and carbon asset management).

Finally, there is a set of challenges related to economic modeling: to capture the differentiation of results – between ETS and CTax, and between different designs of ETS; to represent important aspects of instrument design (scope of sectors/agents covered, use of offsets, form of allocation of permissions, temporal flexibility such as banking/borrowing and stabilization of prices); to explore the potential advantages of offsets in the forestry sector – both through incentives to the sector and reduction of compliance costs in the regulated sectors; to capture the effects of connecting one domestic ETS with other ETSs; to simulate adjustments in relevant policies; to endogenize technological change; and to obtain possible distributive effects, among others.

Given the variety of challenges of the PMR Brazil Project, some pertinent to the relationship between ETS and baseline and credit instruments have also been identified. Because they identify more with the discussion of this chapter, such issues will be discussed and explored in the next section.

4 ALTERNATIVE DESIGNS FOR EMISSION PRECISION INSTRUMENTS: IDENTIFIED ISSUES

One of the first issues involving the adoption of an emission pricing mechanism in Brazil is a legal one. The National Policy on Climate Change establishes the operation of the Brazilian Emission Reduction Market in commodities and futures exchanges, stock exchanges and organized over-the-counter entities, authorized by the Brazilian Securities and Exchange Commission; which would be the *locus* to trade securities representing certified GHG reductions. It is observed, therefore, that Art. 9 of Law No. 12,187/2009 seems to have as its objective only to better organize the transaction of securities related to the reduction of emissions; assets generated through the adoption of baseline and credit mechanisms, as well as the carbon credits resulting from the implementation of the CDM project activities.

The ambition of the PMR Brazil Project, however, is to analyze the possibility of adopting an ETS in the country, in which both supply and demand of emission quotas (allowances) would be defined; and license securities would be issued. Therefore, a legal definition would be necessary for this asset, including its nature – whether it is a financial asset, securities, etc. – obligations and liabilities for issuance, custody and withdrawal, among other definitions.

In addition, an ETS involves the definition of the competence of a governmental body to establish emission limits, mechanisms for monitoring and controlling obligations and penalties for non-compliance with emission reduction obligations, among other examples. It is understood, therefore, that any proposal to create a national ETS would mean the need to review Art. 9 of Law No. 12,187/2009, considering that the Brazilian Emission Reduction Market does not establish an adequate design for the adoption of the mechanism that is being analyzed by the Ministry of Finance, based on the transaction of emission quotas.

Another important aspect to consider is the learning and knowledge accumulated in the country with the realization of projects of CDM activities, especially with regard to MRV emissions stage. Thanks to Brazil's successful participation in the mechanism, a good part of the companies potentially regulated by a national emissions-pricing instrument have some knowledge about emissions accounting, and are even familiar with the mechanisms of credit transactions in the Kyoto carbon market, which also involves the registration procedures of CERs through systems of control of issuance, custody and the chain of transactions of these assets.

On the other hand, it should be borne in mind that the experience of the CDM in Brazil has waived legal or normative definitions regarding the nature of these assets, their attributes, taxation on transactions, or procedures and criteria for their issuance, custody and trading.[19]

This experience should be harnessed and expanded in the eventual adoption of an instrument for the pricing of emissions in Brazil, so as not to miss the lessons already learned regarding the application of methodologies, the carrying out of corporate inventories and the structuring of specialized services for the accounting and verification of emissions and reduction of GHG emissions.

An interesting example of how the learning and infrastructure created by the CDM could be dynamized is that of China, which has been using its seven regional ETS pilots as a demand vector for its certified emissions reduction compensation program called China Certificated Emissions Reductions – CCER. The seven ETSs pilots were formally announced in October 2011 and – as the Kyoto carbon markets – slowly declined, China continued to mobilize investors and service providers involved in the functioning of the carbon market with the promise of implementing other instruments that would recognize and value the reduction efforts undertaken.

In this sense, the measures adopted with the introduction of the CCERs eventually offered a compensation mechanism in addition to the respective allowances, capable of maintaining interest and investment in projects to reduce emissions on Chinese soil.

19. For a detailed legal analysis of the CDM in Brazil, see Chapter 11 (note from the editors).

Because it had been engaged for a number of years in actively participating in the CDM, the Chinese government was aware of the concepts and advantages of a market system to reduce emissions. According to Swartz (2016), this direct experience with the CDM by China's leading industrial enterprises probably had a major influence on policy making by the National Development and Reform Commission (NDRC), the body responsible for designing and implementing national ETS. The NDRC officially launched the national ETS in December 2017.[20]

The process of incorporating CCERs into regional pilot designs was led by the NDRC and took place as follows: initially, some two hundred types of CDM project activity already approved by the CDM Executive Board and its Methodological Panel (Swartz, 2016) were assessed. Using criteria based on the frequency of use of the methodology, its applicability in China and its complexity, 52 methodologies of interest were identified, which were then converted into voluntary types of CCER projects (Swartz, 2016).

Therefore, there are four types of CCER projects that can be registered and issued by the NDRC: *i)* CDM projects registered by the UNFCCC with CERs that have not been issued; *ii)* CDM projects approved by the NDRC but not yet registered by the UNFCCC; *iii)* CDM projects approved by the NDRC, with emission reductions produced prior to registration in the UNFCCC ("pre-CDM" projects); and *iv)* projects that adopt the methodologies approved by the NDRC.

By March 2016, more than 330 CCER projects had already been approved by the NDRC. For compliance with obligations on the seven Chinese pilots, 2015 was the first year in which these certificates could be delivered. All pilots allow compensations with CCER in their respective systems, but the limits on the use of this compensation differ between the ETSs.

China's progress with MRV in the seven pilot projects can also be credited to the NDRC, which, through PMR resources, has been helping to develop domestic emission and MRV data collection processes in anticipation of the national ETS. In this sense, it is emphasized that the structuring of a national emission data-collection system at the facility level could be an important instrument for maintaining the MRV learning of emissions achieved with the CDM, as well as having great potential to dynamize the sector of emission accounting services provision in Brazil.

The third important aspect to be considered in the analysis of a possible ETS in the country refers to how such an instrument could – or not – be related to the mechanisms to be regulated under Art. 6 of the PA.

20. National Development and Reform Commission, National Development and Reform Commission Issues National Carbon Emissions Trading Market Construction Plan, December 18th, 2017. Available at: http://goo.gl/muiQ7x.

An open question is still the lack of clarity as to how the MRV will be made of the emissions subject to the commitments made under the PA and, consequently, how the scope of NDC by the countries will be proven. This issue is fundamental to discuss some implications for the adoption of a national ETS and its interrelationship with the mechanisms defined in Art. 6 of PA.

By establishing a carbon budget and operating it through allocated quantities units (AAUs) and removal units (RMUs), the Kyoto Protocol allows that flexibility mechanisms, based not only on the marketing of AAUs and RMUs, but also on CERs and Emission Reduction Units (ERUs), are closely related to the accounting of national emissions and to verification of compliance with targets assumed under KP by each signatory country.[21]

In the case of PA, however, it is not clear how the mechanisms defined in Art. 6 would be used to prove compliance with the NDC, especially those based on the international transfer of mitigation results (paragraphs 2.6 and 6.3) and in the SDM (paragraphs 6.4 to 6.7). In theory, such mechanisms have the potential both to generate emissions/removal units that could be transferred internationally – what is being called ITMOs – as ERUs – in the case of SDM – but there is still no clarity in the regulations about how such units could be used to comply with the NDC.

Such uncertainty creates even more complexity when one thinks of the possibility of linking a domestic ETS with other international and regional ETSs, which may or may not have their emissions accounted for individually in UNFCCC processes. The emissions covered by California's ETS, for example, are embedded in the US national accounting, but from this do not follow naturally that emission quotas eventually transacted between a hypothetical Brazilian ETS and the California ETS would be recognized as ITMOs, accounting in the US, or in Brazil.

For the purposes of verifying compliance with the NDCs, paragraphs 6 and 6.3 would need to be regulated in order to ensure not only the recognition of the connection between domestic markets, but also the correct accounting of their transactions within the UNFCCC. If unit transfers between countries with connected markets are beyond the scope of the convention accounting, verification of compliance with the NDC will most certainly be flawed and will not reflect the actual volume of emissions undertaken jointly by PA signatory countries during the assessed compliance period.

In this sense, it is also understood that the units resulting from the implementation of the SDM should be discounted from the NDC of the host country, in cases where it was transferred to other countries that may use

21. For further information on the Kyoto Protocol, see Chapter 1 (note from the editors).

such units to comply with their NDC. This is the case with ERUs transacted between Annex I countries as a result of the adoption of joint implementation (JI) project activities.[22]

Unlike CERs, emission reduction units issued in countries that have a pre-defined carbon budget are considered units already accounted for in AAUs, which means that such reductions are not considered additional to the pre-defined budget and therefore cannot increase these countries' emission cap. Thus, according to UNFCCC rules, before being transferred to the country that acquired them, ERUs are issued in the national registry of the host country by converting AAUs or RMUs previously issued and maintaining them in their national registry. An AAU or RMU must be converted to ERU by adding a design identifier to the units' serial number and changing the type indicator to the serial number to indicate an ERU (UN, 2005).

In order to guarantee the environmental integrity of the NDCs, it must be recognized that only what is (well) measured can be managed, and in the current scenario – where all countries have a defined goal in the PA – an eventual ERU transaction not accounted for by a given host country could represent double counting, which could have serious consequences for achieving the ultimate objective of the UNFCCC to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

In general, the idea of emission or reduction units of tradable emissions is related to the definition of a carbon budget (cap), that transformed into transactional units can be managed at an extremely accurate level – as much as the processes and the methodologies for conducting emission inventories. Thus, mitigation objectives can be accounted for and monitored over time, and a kind of accountability of the assumed commitments is defined.

In this scenario of complexities, and while more precise definitions are not created about how proof of compliance with the NDCs and the role to be played by the mechanisms defined in the PA, it is necessary that the country reflects on how much of its commitments could be achieved through the adoption of the different instruments available and how they could be better combined, so that it can achieve its commitments in the most transparent and cost-effective manner.

Finally, a more practical and immediate last issue concerns the treatment to be given to CERs already issued by companies that could be regulated in a national cap-and-trade market after 2020. As the period for obtaining credits for

22. Joint implementation (JI) is one of the flexibility mechanisms provided for in the Kyoto Protocol in addition to the CDM and emissions trading (note from the editors).

a project activity ranges from 7 to 21 years, it is possible that after 2020 there are still Brazilian projects generating CERs, which, somehow, would need to be accommodated in the emissions cap defined for the national ETS, since the energy and industry coincide with those who participated most in the development of CDM projects in Brazil.

In these cases, there would be some alternatives. If they are credits not yet transacted by project proponents, a viable alternative would be to consider CERs held by these companies as early actions, which could be canceled in the CDM registry and converted into emission quotas in the national ETS registry. Thus, the unit conversion flow between AAUs/RMUs and ERUs in KP would be reversed. In this case, companies that still had CERs not traded for the post-2020 period could be rewarded for investments made when they were not yet subject to national regulation.

Another option would be to do as in China and create a national compensatory credits program, in which some Brazilian body would establish its own rules – possibly based on internationally approved methodologies, as in the Chinese case – and be responsible for the generation of emission reduction credits Brazilian Certified Emissions Reductions (BCERs).

In this case, such a program could be used in the case of adoption of a ETS type instrument. On the other hand, in the case of the creation of a tax on emissions, it would be necessary to analyze the feasibility – both from a legal and public financial point of view – of accepting BCERs as payment of the tax.

It is also important to consider that companies to be regulated in a national ETS should not be eligible to participate in compensatory programs – including the SDM. This is because in the system any reduction of emissions from regulated sources is reflected in excess of emission quotas for the holder of these sources, which can then sell them in the market.

In the case of a ETS internationally linked to other international/regional ETS, the sale of these quotas to other countries could be accounted for as ITMOs, and there is no need for the regulator to design a project – and comply with all rites and regulations and bear additional costs of project development and certification – because, as mentioned, any and all emission reductions are automatically reflected in your corporate inventory, which results in "free" emission quotas to be sold.

However, if – in addition to these free quotas – the regulator also gained emission reduction units in a compensatory program, there would clearly be a double counting problem, which is why it is not recommended to overlap emission-based mechanisms and ERUs that addressed to the same sources.

5 CONCLUSIONS

Project PMR Brazil, carried out by the Ministry of Finance with the support of the World Bank, is analyzing the possibility of adopting an emissions trading system as part of the National Policy on Climate Change package of instruments after 2020. By adopting an innovative approach, the Ministry of Finance has been commissioning studies that better guide decision-making on the issue, not only with regard to the appropriateness and timeliness of the creation of a domestic ETS in Brazil, but also with regard to the best design of an instrument given the national circumstances.

In addition to the conclusion of this broad process of analysis of cost-effective alternatives for the mitigation of GHG emissions, the PMR Brazil Project poses the challenge of thinking of a new paradigm for National Policy on Climate Change: the explicit regulation of GHG emissions. Thus, the prospect of using a ETS or CTax involves going beyond the current policy framework, based on preexisting sectoral policies and measures.

The future adoption of an instrument for pricing of emissions in Brazil cannot do without the experience of the CDM. Particularly in terms of learning – especially in the private sector – on the application of methodologies, the conduct of corporate inventories and the structuring of specialized services in the accounting and verification of emissions, as well as in activities to reduce GHG emissions.

In this sense, it is important to bear in mind that the analysis of the adoption of pricing instruments in Brazil must take into account possibilities for harmonization between different available instruments (ETS/CTax and CDM/SDM), ideally from the definition of objectives that the country would expect to achieve with the adoption of each of these. In order to do so, it will be necessary to rethink the role of CERs and see the CDM experience in a new light, considering the development of a national strategy to promote a low-carbon economy capable of generating dynamic effects of innovation and investment, as well as materialize potential advantage comparisons of national products and processes.

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PART 4

CONCLUSIONS

CHAPTER 16

CONTRIBUTION TO THE EVALUATION OF THE CLEAN DEVELOPMENT MECHANISM AS A TRANSFORMATIONAL CHANGE CATALYST INSTRUMENT

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1 INTRODUCTION

This chapter brings a reflection on the Clean Development Mechanism (CDM) in order to detect if there is a chance to frame the CDM experience into the concept of transformational change (TC). To test whether or not TC has happened, the content of the previous chapters and some CDM history selected by the authors of this chapter will help as subsidies.

This exercise aims at measuring if there was, in fact, a perennial change induced by the CDM implementation, and if, to some extent, this experience can provide inputs – and which inputs, if there is any – for the formulation of new mechanisms under discussion in the international regime of negotiations on climate change.

Let it be said beforehand: analyzing the CDM using the concept of TC becomes a disruptive way of detecting learning. Whether or not some flaws have occurred during implementation, how much of supposed imperfection is attributed to the CDM leaves it free to be, with time, effective in what would have been due to its *raison d'être*. It is worth recalling the very noble purpose of the CDM, which is to reduce greenhouse gas emissions (GHGs) while achieving sustainable development.

At the end of the chapter, an assessment is presented which, gathering the results of the CDM experience, reveals its contribution under various aspects of climate management.

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2 THE TC INITIATIVE AND ITS RELATION WITH THE CDM VERIFIED

2.1 Concept

The concept of TC is under development within the framework of the World Bank initiative, with an indication that its definition should be limited to an abstract concept, since transformational changes imply a temporal issue and a change of a status quo or possible improvement in the face of evidence of damage or risk.[4]

The need for a TC concept arose due to an economic reason. Multilateral development banks (MDBs) have to finance the solutions for various development hurdles over which member countries of the various conventions and agreements, both donor countries and recipient countries, acknowledge they do not have enough approved financial flows to solve them all at the long-term.

In order to achieve goals that would be unattainable only with direct investment from the available resources, the need arose for solutions that could leverage resources beyond those provided from public sources in donor countries. It turned out that it was necessary to focus on large-scale behavioral change as the main objectives and goals, avoiding spending resources with projects with limited boundaries which replication without multilateral resources would be hard to achieve.

In this context, the idea of leveraging resources in a higher level than those agreed between donor countries and recipient countries does not focus only on financial market solutions, such as green bonds, but mainly on changes occurring in the beneficiary territory of the investment projects that cause the largest possible impact. It is expected, therefore, that financing will support a transformation, a deviation from the development path and the private business as usual behaviour, in the sense that all small private efforts will result in a desired change on a much larger scale than what could be achieved only with direct investments of the MDBs.

Notwithstanding the difficulty in qualifying what is transformational, a TC working definition is being thought of, one which can be used, namely: "*strategic changes in targeted markets and other systems with large-scale, sustainable impacts that accelerate or shift the trajectory toward low-carbon and climate-resilient development*"[5] (Dickman, 2018). A report by the Global Environment Fund – GEF brings the following definition:

> Transformational interventions are defined as engagements that help achieve deep, systemic, and sustainable change with large-scale impact in an area of global environmental concern. The underlying theory of change is that by strategically identifying and selecting projects that address environmental challenges of global

4. Available at: https://goo.gl/H3f6va.

5. Excerpt from original text.

> concern and are purposely designed to support fundamental changes in – i.e., 'flip' – key economic markets or systems, GEF interventions will be more likely to cause a large-scale and sustainable impact, subject to the quality of implementation/execution and supportive contextual conditions[6] (GEF, 2017, p. ii).

In this effort in attempting to have a definition, some elements have been left out,[7] without prejudice; this fact does not prevent the framing of "legacies"[8] in what could be mentioned as *transformational*.

When applying the concept of TC to the need to deal specifically with global climate change, there is fear that the $100 billion annual flow target will be much lower than necessary to implement proposals for all nationally determined contributions – NDCs, mainly after the global stocktake. Through this exercise, it is intended that the difference in the sum of individual ambitions of each NDC in relation to what the Intergovernmental Panel on Climate Change (IPCC) indicates as indispensable in terms of emission reductions is reduced, based on scientific knowledge (Allen, Mustafa and Shukla, 2018) to achieve the goal of the United Nations Framework Convention on Climate Change (UNFCCC) to stabilize concentrations of GHGs in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

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6. Excerpt from original text.

7. It is worth mentioning, as a record of the reasoning of the construction process of what can be classified as TC, that, at a workshop held at the World Bank headquarters in Washington, the representative of Ipea brought a collection of elements that were discussed, until the configuration of what remained as a possible "definition of work", in the following terms (original text): "*Transformational change, in the context of the international climate finance, is defined [by the CIF][by other body/ies] as a significant deviation in terms of greenhouse gas emission reduction, carbon dioxide sequestration or adaptation to a new or a foreseen climatic condition – or a combination between those mitigation and adaptation characteristics – from the "business as usual" scenario of a certain region, country or any subnational division.*
Significant, in this definition, means that the deviation values from the given time the transformation is said to begin, in terms of GHG emissions, C dioxide sequestration or any adaptation or resilience proxy, do not match to the previous standard values – due to changes in the "business as usual" action scenario, i.e. the observed change can be traced back to a behavioral change, to the use of new technologies or other actions that result from an intervention financed with the aim of mitigating climate change, adapting to new climate circumstances or both. The physical boundaries that should be verified to classify an observed change as transformational or not depends on the applicant to the climate finance body. If a national government's application is supposed to result in transformational change, the observed change is expected to be at national level, at least. The same applies to regional or subnational requests for financing.
Transformational change can be assessed in an early phase of the project, in terms of project's design potential to trigger transformational change, and if it presents prerequisites known for transformation to happen in the ground, during and nearly after project implementation by using proxies to evaluate if transformation has the optimal conditions to take place, and after the time the project design has foreseen the transformation to occur. [Despite being possible to assess transformational change only in terms of emission reduction, it is recommended to assess if the observed changes also correlate with distributional disparities of incomes, a negative gender influence, whether negatively affects indigenous people or has any other negative impact on the resilience to climate adversities in any given territory where the transformation occurs.]" (Gustavo Luedemann about the TC definition, as decided at the workshop *Exercise on defining Transformational Change*, of 2017).

8. It is noted that the word "legacy", in the context of the CDM approach to this book, is distinguished from the sense used when designing the universal climate legacy metric (UCLM), which referred to the formation of intergenerational legacies and emerged in the context of the formulation of options to strengthen the Kyoto Protocol, including the prospection of future regime and the implementation of solutions for the efficient implementation of the CDM, within a research supported by the United Nations Foundation (2007-2008), held at the Oxford Institute for Energy Studies (OIES).

Towards new dimensions of climate finance, it should be noted that compilations and syntheses by the UNFCCC Secretariat of submissions from developed countries on their strategies for increasing the scale of climate finance between 2014 and 2020, "many Parties highlighted their pledges and expected future commitments to the Green Climate Fund (GCF), stressing the role of the fund in financing high-impact, transformational projects and catalyzing finance from other sources and noting that the GCF will be the key multilateral fund supporting nationally determined contribution (NDC) implementation"[9] (UNFCCC, 2017, p. 4).

The CDM appeared in a context prior to the discussion on solutions to reinforce climate financing: when the definition of environmental externality and the economic instruments capable of minimizing these market failures were popularized (Motta, 2006). The environmental externality and GHG emissions in the case of climate change are the result of some economic activity, but were, until the CDM operation, invisible to the market because they were not traded in it. A negative externality, such as GHG emissions, causes measurable losses, but the agents that cause the damage to the community do not repair the damage, do not pay for the emission of GHGs or receive for their efforts to reduce their emissions. In this sense, the CDM emerged as an economic instrument to encourage emissions reduction. It promised to generate a great deal of efficiency in the cost of mitigating climate change, because of its voluntary nature and incentive: those who would have the greatest chance of reducing large emissions at low cost would be attracted to participate in the mechanism while helping other stakeholders achieve reduction targets by providing low-cost certified emission reductions.

Although it has emerged as an economic instrument with the specific purpose of optimizing the costs of reducing GHG emissions, it is worth considering whether or not the CDM was a transformative instrument, in the sense and in the current context in which the TC concept arises.

2.2 The intricate formation of a different approach

It is worth making some remarks about the need for pre-judging that what may be *transformational* also needs to be *dynamic*, given the temporal question that it is only possible to become a transformation before the world of facts, concrete situations.

In this exercise, with the purpose of raising the legacy left by the implementation of the CDM in Brazil, one is allowed to reflect on the connections between the points considered as legacy throughout the chapters that make this publication up, as well as what the authors of this chapter consider as positive legacies, including

9. Excerpt from the original text.

correction reactions (learning) in the face of mistakes, misunderstandings or mistakes made during the CDM practice, historically in the country.

It is possible, according to this exercise proposal, to inquire if errors occurred during the implementation of the CDM, trying to find possible flaws[10] that led, in the worst-case scenario, to what one can, unless considered otherwise, qualify as supposedly flawed certified emission reductions (CERs).

When a flaw arises, in the context of the facts, what would grant legal basis – finally, as a *devoir être* – is disrespected. As a consequence, a disorder is established in what should have been made correctly if the object (tangible and intangible, direct and indirect) sought by the normative protection that gave rise to the creation of the *instrument* was finished, since it was created by a valid norm, enforceable and to which is attributed the indispensable effectiveness on the part of the addressees in making it happen in the real world what the regime was supposed to regulate. In this case, the instrument is the CDM. The norm is the UNFCCC, and the modality is international treaty – *hard law*,[11] of general knowledge, at least in the internationalist circles.

The hypothesis of investigating if there have been cases of flawed CERs does not necessarily reveal a CDM instability, as it is an alternative to a more honorable assessment than to just consider the CDM a not so efficient instrument, just criticizing it. It may be useful to investigate whether, in the past, it would have been possible or not to have given the CDM a different history than the fate of ultimately being criticized as fragile or overly flawed. It is believed to be useful to do so, in principle, according to the perspectives described in previous chapters (Chapters 1 to 15) by Brazilian operators. It can be seen from the synthesis of Table 1 that the texts produced throughout the chapters have identified strengths, weaknesses and legacies. This aimed at restoring the CDM to its essence, in line with the ruling that made it a more flexible mechanism: the Kyoto Protocol.

The collaborating authors of this work, listed in the present chapter, believe the legacies are those briefly described in the following table – all of which could possibly pass the evaluation test and apprenticeship by a transformational note.

10. In *Climate Change and International Agreements*, the possibility of correcting possible implementation mistakes within the system itself was reinforced: "in the face of the problem of possible misconstructions as to what the Kyoto Protocol actually requires, legitimized bodies are entitled to act in order to correct them throughout its implementation. In this sense, for correction purposes, access to various authorities is being offered, through the institutional system of the UNFCCC, to existing forums (such as the International Court of Justice and the Facilitating and Coercive Branch of the Kyoto Protocol) and expected arbitration bodies for climate, including within the framework of the United Nations) "(Meira Filho and Frangetto, 2010, p.53). In *Legal Feasibility of the Clean Development Mechanism (CDM) in Brazil: the Kyoto Protocol and international cooperation*, the access channels for the adequacy of the practice to the original CDM theory were explained in the following order: "legal solutions to future conflicts and (...) 1. Limitations of the national jurisdiction (...) 1.1 Relevance of access to administrative proceedings (...) 1.2 Relevance of access to the Judiciary (...) 2. Overcoming controversies in the international forum 2.1 Institutional organization for the effectiveness of the CDM (...) 2.1.1 The need for an organizational structure to overcome setbacks in CDM (...) 2.1.2 Establishment of a CDM feasibility committee (...) 2.2 Hypothetical contributions of an international jurisdiction "(Frangetto and Gazani, 2002, pp. 141-155).

11. See an explanation on *hard law* and *soft law* in Frangetto and Gazani (2002, p. 34-37).

BOX 1
CDM impacts: strong points, weak points and legacy

	CHAPTER	strong point	weak point	LEGACY
1	The Climate Change Convention and its Kyoto Protocol as action drivers	Important source of financing for execution of GHG emission reduction projects.	Regulation may negatively influence the adoption of a given practice/ technology by a particular country (e.g., sugarcane plants).	Robustness of the validation, verification and emission system. Recent initiatives to use CERs, which are internationally acknowledged as real and measurable reductions: voluntary cancellation for emission abatement, CORSIA. The CDM will serve as the basis for the SDM.
2	The Clean Development Mechanism in Brazil	Brazil was the first country in establishing the bases for the adequate domestic implementation of the mechanism. It is the first country to register its DNA on the Executive Board, as well as the first methodology and the first CDM project.	Negative influence of CER prices on project implementation.	CDM progress as a basis for the formulation of new mechanisms, in particular the SDM.
3	The CDM and Knowledge-Building in Reduction Quantification of GHG Emissions: from the initial proposal to the Program of Activities	Capacity-building in accounting GHG and other aspects involved in CDM projects (social and economic aspects, for example).	Intense process of revising the methodologies can negatively influence project development.	Catalyst of environmental activities in corporate environments. Robust accounting system will serve as the basis for the SDM.
4	CDM Experiences and Lessons Learned in the Energy Sector	Simplicity in baseline definition, calculation of GHG emission reductions and monitoring contributed to making the sector one of the most benefited by the mechanism.	Strict costs and procedures, sometimes preventing the development of projects.	Knowledge generated by the CDM is the basis for formatting voluntary markets and future mechanisms under the Convention.
5	Improvement of waste management from the CDM: governance, new technologies and best practices in the sector	Success of the CDM experience contributed to the formation of a market for parts, materials and equipment.	Lack of an agreement on the new commitment period has caused the capture of methane to drastically drop as of 2011.	Made a change in waste management in Brazil possible.
6	Forest CDM in Brazil: fundamentals, legacy and elements for the future	Brazil with a prominent role in proposing methodologies and elaboration of forest sector projects, which created the country's technical capacity of excellence.	Regulatory complexity and demand constraints prevented the execution of a larger number of projects.	Significant institutional contribution, providing input for improvement of MRV in the forestry sector and construction of new contractual, technological and financial arrangements. Cross-cutting forestry issues indicates that new institutional arrangements are needed if the sector is to effectively contribute to mitigating the effects of climate change and achieving sustainable development goals.

	CHAPTER	strong point	weak point	LEGACY
7	Use of the CDM by the Brazilian industry: considerations in favor of energy efficiency and new technologies.	The low implementation of registered CDM project activities evidences barriers (e.g., technical barriers such as operational risk, economic barriers such as low perceived gain, and cultural barriers, such as prioritization of investments in increased production) and methodological issues.	Potential, as a financial incentive, to increase the energy efficiency of the national industry.	Experience shows the need for greater synergy with other policies and economic incentives for the implementation of projects and guarantee the competitiveness of the country's industrial sector.
8	Contribution of the Clean Development Mechanism to sustainable development	The CDM was an innovative instrument that allowed the implementation of practices aimed at sustainability	No requirement to monitor the criteria for contribution to sustainable development (SD) may have contributed to the poor performance of projects, in terms of their contribution to sustainable development.	Strong learning on DS issues in both the Convention and the CIMGC. Brazil as a reference in defining the DS contribution criteria.
9	Contribution of the CDM to corporate governance, according to a market agent	CDM was a driver of initiatives related to environmental issues inside and outside corporations (ISE, CEBDS, ABEMC).	Lack of multilateral consensus in the latest negotiations caused by largely political discussions/interests that have jeopardized the system as a whole.	Creation of relevant technical capacity in the country to work on climate-change related issues.
10	Regulatory-institutional evolution of the CDM and future prospects	Creation of a relevant institutional structure in Brazil, which was a pioneer country in regulating its DNA.	Deterrent transactional costs. Low demand, due to lack of international consensus on the second period, paralyzed the market.	High credibility MRV structure should serve as a basis to new mechanisms.
11	Legal nature and credit and tax issues of certified emission reductions	Rigor of the framework adopted for project approval and verification of CERs. The experience serves as a basis for shaping the current climate policy.	Absence of a regulatory framework, with impacts on demand issues, and consequently effectiveness of the protocol, as well as uncertainties regarding legal (tax) and credit issues.	Relevant CDM assumptions in the formulation of a future mechanism, such as the SDM, so that the low carbon economy and the Brazilian NDC goals can be implemented.
12	The continuity of the CDM with the Paris Agreement and its articulation with the SDM	The CDM successfully achieved a scale of emission reduction projects in developing countries and was able to inaugurate a fully fungible carbon credits market.	Economic decisions have strongly affected the demand for CERs and discouraged the execution of new projects.	Multilateral supervision model for the issuance of CERs provides a favorable environment and guarantor of the environmental integrity of the projects, anchored in the ITL system.

	CHAPTER	strong point	weak point	LEGACY
13	Global cooperation and the challenges of sustainable development: CDM results and lessons learned for the design of new financial mechanisms	It was able to mobilize an important amount of resources for the mobilization of investments in sustainable infrastructure.	Lack of predictability of the CDM prevented the instrument's incentive to sustainable development.	Experience with the CDM "provided important lessons for the discussion and definition of regulatory strategies, since the main conclusion is that these solutions should be pragmatic, economically efficient and, to the extent possible, free of ideological, political and regulatory risk interferences".
14	Carbon pricing: from the Kyoto Protocol to the Paris Agreement	In addition to EU ETS, the CDM is one of the most expressive experiences with carbon pricing that has been adopted so far.	High transaction costs, which are directly proportional to the rigor needed to ensure integrity of CERs (complex governance).	The increase in standardization, practiced as of 2011, may indicate the solution to reduce transaction costs. "The results of this [CDM] experiment have been improving over time and can now contribute to scaling up these mechanisms".
15	PMR Brazil Project: perspectives on the Brazilian Emission Reduction Market	Consolidated CDM procedures (methodologies, mainly) and well-structured and solidified emissions trading and monitoring system.	Specifically, for Brazil, there is a lack of legal and normative definitions about the nature of the assets generated from the implementation of CDM projects.	Experience of the private sector acquired with the CDM on "application of methodologies, (...) conducting corporate inventories and (...) structuring of specialized services in the accounting and verification of emissions (...)" will contribute to the future adoption of pricing instruments in Brazil.

Prepared by the authors.

Note: CORSIA – Carbon Offsetting and Reduction Scheme for International Aviation; SDM – Sustainable Development Mechanism; DNA – Designated National Authority; ISE – Corporate Sustainability Index; CEBDS – Brazilian Business Council for Sustainable Development; ABEMC – Brazilian Association of Carbon Market Companies; MRV – Measurement, Reporting, Verification; ITL – International Transaction Log; EU ETS – European Union Emissions Trading System.

In analyzing the weak points of this table, one can see that there are viable legal solutions for Chapters 1, 3, 5, 6, 7, 8, 11, 13 and 15. Weaknesses are associated with acts and facts that were accomplished with the internalization of the Kyoto Protocol in Brazil. Further, it should be noted that some of these acts and facts were completed by forgetting certain fundamental legal criteria, examples that can be represented as supposed "findings" from a rational examination in order to optimize the potential of the CDM. Thus, the experience of the CDM is a list of findings that may sound critical, not of the CDM, but its underutilization.

2.2.1 Finding 1 – regulation could have been improved

The normative content of the UNFCCC could have been developed without complications in a more dynamic, enlightening and specific way – for example, by providing details of the impact of the CDM on administrative procedures directly linked to the mechanism (such as the approval letter), or indirectly (such as the repercussion of processes that determine environmental licensing constraints in the face of the measurement of sustainable development).

Since the beginning of the regulation of the Kyoto Protocol in the country – for example, the resolution that came to govern the matter, Resolution No. 01/2003 of the Interministerial Commission on Global Climate Change (CIMGC) –, the issuing of normative content that was less than the CIMGC could have done, since it was the DNA responsible for the implementation of the treaty in Brazil. In editing the document, the Commission lost the opportunity to regulate, or even scrutinize, the properties of the CDM in Brazil, and those details could have granted definitive inaugural legal security for the mechanism in the country. For instance, it could have specified situations in which there was synergy among the conditions for meeting the requirement of real, measurable and long-term benefits through the prediction of assumptions for sustainability, in addition to the criteria established and the criteria already formally adopted by the entrepreneur due to environmental licensing. However, the mere translation of almost all the Marrakesh agreements sufficed. The moment for internal regulation was lost, and so far, no initiative has been in force.

In the absence of a determined legal government determination, fundamental questions have been considered less serious or even unnecessary to be discussed *ex ante*,[12] such as the uncertain distribution of credits in projects involving both public administration and those administered, as in the case of private companies acting as concessionaires of public services and companies benefiting from government incentives.Another example would be the controversial debate on additionality, that it would only exist if there is compliance to an environmental legislation in force that implied in emissions reduction, in a context in which the Federal Constitution of 1988 demands the maintenance of an ecologically-balanced environment, therefore, a progressively less-carbon intense environment. Strictly speaking, such a restrictive interpretation would turn any project non-additional. In the absence of an accurate interpretation, to the extreme, the unconstitutionality of the Kyoto Protocol could be raised, as it is doubtful to use an incentive mechanism for those reducing GHG emissions in a larger proportion based on a less demanding baseline to the environment compared to competitors that has been historically emitting less.

Therefore, other examples can be mentioned, in line with the importance of observing, under the legal perspective, the limits and freedoms allowed in the CDM regime, as follows.

12. Regarding the possibilities of considering the CDM legally, see this explanation: "the act of looking at the CDM from an Environmental Law perspective is a means of providing legal certainty to the carbon projects and the certificates thereof. The project may be at a stage of apparent compliance with climate law, and yet, even if relations between project participants and, for example, the CDM Executive Board, have ceased, the validity of what has been obtained may be questioned. The assumption that a developed country will question the certificate that it has acquired is a possibility; or even a third party to do so with respect to another country that wishes to use the benefit to pay off its obligation to reduce greenhouse gas (GHG) emissions. That is, even after the production of the certificate there is continuity of responsibility. It is therefore essential to stick to the legal aspects. For such analysis of the CDM law, it is necessary to reason juridically. Reasoning juridically is an exercise, always based on an object, an objective and at least a certain legal norm and the respective procedure before this norm. The object is related to some problem, consisting of a question. For example, what is the legal context in which the CDM is inserted. In relation to the objective, one always has the intention of seeking a certain purpose that seeks to improve relations in society. One must find out what imposition is necessary to the pursuit of that end. As is well known, the purpose of the CDM is to promote sustainable development and, at the same time, reduce levels of greenhouse gases in the atmosphere, so that the CDM helps developed countries meet their GHG reduction targets. The pursuit of the purpose to which the CDM has been created is irrevocable. Regarding the standards on the question of the legal context of the CDM, there is the Framework Convention (UNFCCC), the Kyoto Protocol and the decisions resulting from the meetings of the conferences of the parties to those treaties" (Frangetto, 2007, p. 36). Also, "if climate change is a problem that has been recognized by the nations, and there is an increasing presence of GHGs in the environment that can cause environmental imbalances, it is true that the role of these gases is no longer the only factor to be considered as elements to be treated in an original way by the Law. Thus, the quality of GHGs being essential for human life is replaced by the debate about the problems of increasing their presence in the atmosphere, focused on the risk of climate change, in the face of a global warming threat. In this context, Law comes to insert a form of behavior that is appropriate to the anthropogenic activities that lead to a GHG increase, which is more than necessary for the environment at the temperature limit in which humans have conditions to live. Law will delimit the behaviors, formalizing them in order to decide what should be done, what is required in relation to this behavior. The UNFCCC then comes up with a series of determinations, linked to specific definitions, principles, objectives and related obligations, annexes with certain references, and the installation of structures in which certain stakeholders will act to achieve the desired result in their objectives. These associated elements condition the possibilities of applying the norm with the intention for which it was created. Thus, it becomes feasible to implement the UNFCCC in certain States that wish to apply it, because they have acceded and ratified it by making it a domestic regulation within their territory. In general terms, these have made a commitment to achieve their goals, seeking their objectives. Achieving the ultimate goal of the UNFCCC, which is to stabilize GHG levels in the atmosphere, is, through the climate legal system, made feasible from an organized way established by it plus its regulations. Based on certain parameters, a language common to States is established; which allows even the comparability between them in the measurements of intensities of implementation of international treaties concerning the climate and effectiveness of its purposes" (Frangetto, 2007, p. 37-38).

2.2.2 Finding 2 – would have been positive if all the relevant stakeholders had coordinated more action in favor of the CDM

The powers that have been established could have further intensified attention to the CDM in order to make it possible[13] in the sense of confirming it for its optimized implementation, and not hinder or discourage its use.

The ideal would have been to have, on the part of the competent agents, more dedicated attention to solve the implications of the duty to reduce GHG emissions in the country. Normatively, in the case of the Legislative. Jurisprudentially, in the case of the Judiciary Branch, and it should be noted that the jurisdictional action rarely happened in the CDM matter – perhaps because the Court needs, except in cases where the judge acts ex officio, to be brought to law enforcement. In the case of the Executive Branch,[14] through clarifications, to entrepreneurs interested in obtaining carbon credits, in order to elucidate that carrying out the reduction stimulated by an international financial mechanism was compatible with the motivation of the trusteeship for an ecologically balanced environment.[15]

Simultaneously with the international rules that are intrinsic to the climate issue governed in the context of the UNFCCC, the CDM projects implemented in the Brazilian territory must fulfill the miscegenated Law of the international

13. In this sense, it was recommended: "even in the absence of specific rules, the administrator who is responsible for issuing opinions or decisions on the CDM is bound to carry out administrative acts in full compliance with the legal powers assigned, so that strict legality governs the exercise of their public functions. When it comes to the competent body responsible for implementing the UNFCCC, the Kyoto Protocol, and the CDM, the interministerial commission must pay attention to the internal characteristics of the joint operation of ministries. In that sense, cooperation among them is essential if the Executive Secretariat, elected by the commission, and the commission itself are to exercise their functions in a participatory manner, to act effectively and fairly. Therefore, any CDM-related settlement system necessarily has to undergo a process that is conducive to conducting CDM administrative procedures to decisions that ensure the consonance of the use of the CDM to the objectives of the international and national climate legal system" (Frangetto and Gazani, 2002, p. 145-146).

14. It is worth mentioning that, in 2014, the CIMGC raised before the Federal Public Prosecutor's Office the concern to increase the institution's relationship with the CDM. There was an approach possibility by means of courses that were to be given to the associations of Prosecution Offices' representatives.

15. "The fact that Brazil enjoys a protectionist constitutional legislation of the environment, insofar as it determines all to be holders of the ecologically balanced environment, represents an inadaptability of the Brazilian position regarding the fulfillment of duties, this time, national or international, concerning the fight against climate change. If the primary objective of the Convention under consideration is to stabilize concentrations of greenhouse gases at a level that would prevent dangerous anthropogenic interference with the climate system, whatever the effort in this regard, it will always correspond to the pursuit of an ecologically balanced environment, to which everyone has a right in the Brazilian environmental legal system. (...) Therefore, we cannot exempt ourselves from acting concretely so that there is no warming of the atmosphere, which causes the consequences capable of decreasing the quality of life" (Frangetto and Calasans, 2001, p. 403).

community with Brazilian law.[16] According to the Constitution of 1988, the environment is in the category of common use by the people and essential to a healthy quality of life, being protected under the nature of diffuse and collective rights, and implying all legal protection also applicable to any issues associated with climate change.

2.2.3 Finding 3 – the guarantees and the principles and instrumental interfaces of the regime applicable to the CDM could have been more used

Many of the concerns raised by the implementation of the CDM would have been solved by propaedeutics. Perhaps the mechanisms envisaged in Article 6 of the Paris Agreement have resulted from the amalgamation of rights and wrongs of the CDM in the various sectors of the economy, other sciences and ways of thinking about the efficiency of managing the issue of climate change. Let this be read not with a judgmental tone about the procrastination for the configuration of expected transformations in the attempt to face global climate change, but rather for reflection on the establishment of the conditions that would have been favorable to consider the CDM as a global success.

As presumed from the comments made in the analysis of Box 1, due to the explained characteristics of the regime applicable to any CDM project implemented in Brazil, many problems that occurred in CDM practice would have been (and, if the mechanism is not prescribed, may continue to be) solved if the instruments offered by the legal system itself has been observed at the time. Some examples

16. In this sense, one can use the academic term mixed law, along the lines of past discussions, when dealing with CDM law: "this refers to a set of legal norms specific to or applicable to the CDM. These standards may be of international and national origin. In addition to the specific CDM standards, those that are already involved in managing environmental resources relevant to climate and sustainable development are associated. They are, for example, standards dealing with air (type, air pollution) or waste. The differential when referring directly to the issue of climate change is that it provides legal input from the international community, to solve a problem that is perceived as being universal, which is global warming. Countries jointly decide on ways to avoid climate change. When international diplomas take effect on national states, the common rule (of the common treaty) merges with the national legal system already in force. Hence the CDM's right to a merged legal system. It has been asserted that the application of the CDM is personalized in each country, since nevertheless always a follower of the legal framework imposed by the international order will receive the contributions of the legal system in which it is executed. There will therefore be particularities in the implementation of the CDM according to the peculiarities of the host CDM project. It is necessary to keep to the importance of international norms, not forgetting in their implementation the effects of the internal rules that they reflect in the former without, however, wishing to detract from them - on the contrary, by attempting to optimize their aims consistent with the legal system national "(Frangetto, 2007, pp. 42-43). In the same sense, it was previously stated: "The Brazilian legal system will take effect on the international treaty in force for the country. Thus, with the entry into force of the Kyoto Protocol, the legal regime of the CDM will come mainly from international environmental law, thus making the legal regime applicable to the CDM a special regime, i.e., the legal regime applicable to the CDM, associated to the international and Brazilian legal regime, form, together with the intersection of legal systems by other countries -part of the Kyoto Protocol, in a unique system: the climate legal system" (Frangetto and Gazani, 2002, p. 113).

are listed below, all of which are more readily apparent ex post, although types of alerts have been exposed by experts in discussions at certain fora.[17]

Due to the requisite of sustainable development, an example would be exercising the pre-established competencies of licensing environmental bodies in favor of the joint appreciation of social and ecological aspects. Special regulation would have been possible aiming at approaching the two procedures (licensing and approval of a CDM project) regarding the specificities expected in the conditions of the environmental licenses, in cases where the two processes are simultaneously in progress, without compromising the incumbencies of the CIMGC, but assisting it in its work.

1) In some cases where errors or shortcomings had to be corrected in the documentation prepared by the DOEs that worked in the country, the CIMGC was prepared to fill deficiencies in order to contribute to the success of the intended project. In others, projects received criticism even after they generated CERs. It is necessary to ask if in these situations all possible ways of compensation have been explored if it were effectively configured that damage was caused by action or omission of DOE and, in this sense, whether it was possible to see the activation of liability insurance contracted to cover eventual excess CERs issued during the period in which they exercised their mandates in relation to the developer of the CDM project.[18] Maybe these questions would grant more security to the CDM implementation process.

17. It is interesting to observe that, among other occasions that are equally worth recalling, in 2003, during the *2nd National Conference of Carbon Credits Market: fundamental issues on making this market effective*, carried out in São Paulo by the International Business Communications (IBC), a round table on *Carbon Trade: current status of the carbon credit market, progress and undefined issues*, concluded that there are definitions yet to be made so that this market can effectively exist. Fundamental questions were discussed such as: when this market will be effectively consolidated; what are the remaining problems; what stage the negotiations are in; how the market is developing; prospects for the effective functioning of this market in Brazil with the ratification or not of the Kyoto Protocol; whether Brazil can take advantage to establish its position in this market; price formation; and discussions of recent transactions. Marco Antonio Fujihara was the coordinator of the debate and José Domingos Gonzales Miguez, Virgílio Gibbon, Ingo Plöger and Mario Monzoni participated. In 2004, during the event *Legal, Financial and Business Prospects for the Consolidation of the Carbon Credit Market: the sustainability of CDM projects in practical presentations by national and international experts*, also promoted by the IBC, the session on *Prevention of Legal Risks in CDM projects* addressed the following topics: i) the association of CDM law with the requirements of Brazilian environmental law: administrative procedures and discharge of legal environmental obligations to regulate the GHG reducing activity; ii) the conclusion of legal business based on the potential for generating carbon credits: precautions and contracts related to the expectation of the right to trade CERs; and iii) implementation of CDM projects and legal certainty of the project participants in relations with entities involved in the CDM process: national and international levels (stakeholders, DNA and designated operational entities - DOEs, Executive Board and Compliance Committee of the Kyoto Protocol).

18. As per Appendix A (*Standards for the accreditation of operational entities*) of Decision 17/CP.7: "1. An operational entity shall: (...) (c) Have the financial stability, insurance coverage and resources required for its activities". Available at: https://goo.gl/m257EA. It is also worth mentioning that the accreditation manual of DOEs confirms that insurance must be hired as a requisite to protect against financial risks (*liability insurance*). Available at: https://bit.ly/2PHToZN. Accessed on: October 18th, 2018.

2) Due to the understanding on how to meet the additionality requirement, methodologies should have been applied without disregarding how incoherent it is to start from baseline scenarios that have been wrongly built based on non-abiding factors.

Some other examples of warnings that were made just in time to correct flaws were the several questions with the wrong understanding about additionality, mentioned above, and the requisite of real, measurable and long-term benefits.

In 2006, the International Emissions Trading Association (IETA) warned:

> "At COP/MOP1 [Conference of the Parties/Meeting of the Parties 1] the parties clearly stated their desire for broader input on the additionality tool (...). The COP/MOP asked the EB [Executive Board] to address this issue at its 24th ED meeting. The EB put out a request for input. Input was provided by stakeholders, including IETA. However, the EB will not consider this issue until EB27 meeting (...). By failing to give this issue the higher priority it deserves, IETA feels that the EB failed to live up to the expectation stated during COP/MOP1 that this issue be addressed by EB 24. IETA feels that the EB continues to fail to recognize the fundamental importance of this issue to the long-term development and relevance of the CDM [Clean Development Mechanism]" (IETA, 2006, p. 19).[19]

Additionality, on one hand, was considered as an observed criterium if the financial bias or ineffective norm (in the identification of the baseline scenario)[20] were at stake: the activity that would have not occur in the absence of the project was the one representing a non-compliance trend, as exemplified in the previous item (item 2), when the legal approach was presented below that required for safety in the implementation of the CDM. This is an absolute inconsistency with the Brazilian legal system,[21] according to the interpretation set forth there in. Failure

19. Excerpt from original text.

20. Original text: "*The Marrakech Accords define additionality in relation to emission reductions compared to a baseline scenario, but not in relation to a project activity. Once methodologies for baseline calculation are developed, they will be used to ensure that the [conditions of the] additionality test is met. As such the Board should speed up its consideration and adoption of implication of the current additionality as well as alternative ways to the demonstration of additionality provided by stakeholders following the EB's call for input and in line Decision 7 CMP.1*" (IETA, 2006, p. 30).

21. As a result of legal warnings about the supposedly misleading interpretation of additionality, some progress has been made, although it has been hindered, it has been noted: "CDM applicators are improving, awareness is being spread, in line with the principle of common but differentiated responsibility, there is no point in the CDM finding a deterrent factor to project promotion in the fact that developing countries legislate in favor of the environment (and thereby guide behaviors for the reduction of emissions). Otherwise, the Kyoto Protocol in Brazil could even lead to a declaration of unconstitutionality by the Federal Supreme Court. But the additionality requirement seems to be better understood, so much so that, in the international order, a methodology has been approved for CDM projects for reforestation in a riparian area (where the owner is obliged to allow natural regeneration" (Frangetto, 2005, p. 186-187). Regarding the methodology mentioned, which at the time was being negotiated to prevent the CDM for reforestation, see Manfrinato (2005). In the preface to the publication, Goldemberg (2005, pp. 9-10) explained: "in the run-up to the 9th Conference of the Parties to the Climate Convention held in December 2003 in Milan, the eligibility of protected areas was the subject of a wide debate and intense mobilization involving several governmental and non-governmental Brazilian institutions. The international agreement signed at the time does not preclude the possibility that reforestation of areas under legal protection will generate carbon credits. It is not about weakening or questioning the effectiveness of the command and control instruments provided for in the Forest Code, but rather recognize the need to seek additional instruments that may help the viability of programs for the recovery of degraded areas and the restoration of large-scale native forests. This issue should be analyzed with due attention and care".

to comply with the general duty to maintain an ecologically-balanced environment turned into a claim to justify gains.

Like the understandings about what was eventually taken as "truth" about meeting the additionality requirement. In a previous evaluation, this risk was highlighted:

> emission reduction is the difference between a baseline (assumption) and a fact (verified emissions). In this context, it should be clarified that the protocol requires that the reductions be additional to those that would occur in the absence of the project, that is, if the reductions were already taking place, it would be necessary for the project to produce even greater reductions.
>
> The concept of additionality, however, has been misinterpreted as meaning that it is necessary to demonstrate the baseline, which is logically impossible. This fact is responsible for the difficulties of developing methodologies and, therefore, for the low penetration of the CDM in the Brazilian industrial sector – when it is noted that the amount of emission reductions through the CDM (taking into account the potential related to the commitments of reduction or quantified limitation of emissions listed in Annex B to the Protocol) could, with the correct use of the concepts, be much greater if it involved more categories of projects (according to the GHG list and of sectors/source categories, listed in Annex A to the protocol) and fewer concerns about demonstrating additionality. It should also be noted that many times in Kyoto, mention is made of countries or parts of Annex B, as it is in this Annex of the Kyoto Protocol that the quantified emission limitation or reduction commitment are listed (Meira Filho and Frangetto, 2010, p. 53).

In addition, there were several concerns that the CDM would be lost. It is worth remembering, in the passages transcribed below:

> the strict application of Public International Law (...) would have allowed the effective implementers (or supposed implementers) of carbon projects in developing countries to make good use of the CDM so as not to let it escape from the legal system reserved for the management of climate change. By virtue of the pressures the CDM has undergone, however, it has gone so far as to be purged of the legal system. And the worst is that this was not due to any factor related to its legal nature, as according to good analysts of the rules and principles it does not contain any flaws. The reason for such criticism was much more related to the loose implementation of its standards than to any "flaw" that the CDM might have (Frangetto, 2009, p. 267-268).

Freestone and Streck affirmed (2007, p. 55):

> "The flexible mechanisms of the Kyoto Protocol are the only carbon trading mechanisms that have been recognized and implemented worldwide and as such stand as models for various other markets and initiatives. The mechanisms still show teething problems and continue to be plagued by a number of design failures. However, these failures can be addressed through relatively simple adjustments to the mechanisms. A professional regulatory system, free from political interference

(to achieve transparency and a guarantee of administrative due process) and with a long-term perspective of the carbon market (to achieve long-term investment security) are among the most important points on the reform agenda".[22]

Underused, the CDM survived.

3 COMPARISON WITH THE CDM LEGACY: *EVALUATION & LEARNING* DIAGNOSIS AND TRANSFORMATIONAL EFFECTS

3.1 Perspectives of framing the CDM into a TC experience

It is not necessary that the tone be too critical, to the point of becoming intolerant. While it is possible to assess what could have been better, it is commendable to acknowledge the efforts that have been made in several of the CDM implementation experiences. The advances occurred especially under the performance of the private enterprise, so enthusiastic about a mechanism of international origin that came to Brazil to enable sustainable actions.[23] The public authority, in turn, had its undeniable cumulative share in this effort. In fact, the very existence of the CDM is due to the relevant role of Brazilian negotiators and scientists.[24]

There were indeed so many events about the theme that for a few years (the period from 2002 to 2007 stands out), it was difficult to follow the meeting agenda[25] whose subject was the market for carbon credits or the CDM itself. Some explained

22. Excerpt from original text.

23. See, for instance, Chapter 13, about more investments in sustainable infrastructure in the country.

24. The emergence of the CDM is a result of some transformation in the usual positions of the time, with the participation of Brazil: "the country's conservative position in 1997 – which denied any possibility of developing countries to adopt emission reduction targets – was consistent in terms of narrow national interest, given the very high emissions of the land use, land use change and forestry sector at the time. However, there were strong divisions within the Cardoso administration in relation to this definition: while Minister Lampreia was attempting a macro policy more convergent with the positions of the developed world, in the climate area nationalist sectors stood out, aspiring to lead the world and avoiding international regulations on forests. In this sense, the Brazilian delegation was always under the control of the Ministry of Science and Technology (which results from the fundamental role of the president of the Brazilian Space Agency, Luiz Gylvan Meira Filho) in the important aspects and Itamaraty in aspects related to the negotiating process. By 1999, the Presidency of the Republic did not consider the negotiation of the protocol as an important issue on which it should interfere, although the protocol ratification process occurred quickly. The definition of the Brazilian position was very restricted between 1996 and 1999, almost without the participation of state governments, businessmen or NGOs [non-governmental organizations]. As at the year 2000, the definitions have expanded with the inclusion, in a secondary position, of the Ministry of the Environment, the Brazilian Business Council for Sustainable Development, some state governments of the Amazon and several NGOs. In June 1997, Brazil made an original proposal, the Clean Development Fund, which had strong support from emerging and poor countries, but was strongly criticized by all developed countries. However, in October 1997, following an unexpected development, the United States and Brazil articulated an amended version of the Fund, which was renamed the Clean Development Mechanism (CDM), considering one of the novelties of the Kyoto Protocol and a notable moment of cooperation between US and Brazilian diplomacies. Because of the CDM, Brazil accepted the proposal of market-based mechanisms to complement emission reduction commitments of developed countries, which meant the country's rupture with its historical position, marked by opposition to joint implementation (as established by the Rio de Janeiro Convention) and marketable quotas among Annex I countries. Between 1999 and 2001, the country led a successful bid for the CDM to be the first of the three flexibilizing mechanisms to be implemented and, in for emerging and poor countries (non-Annex I) to have a stronger representation than that achieved in the Global Environment Fund (GEF)" (Viola, Franchini and Ribeiro, 2013, p. 280-281).

25. See Chapter 9 herein.

how far the actions were being pursued with a view to making the CDM feasible nation-wise. Strengthening the CDM has become part of the agenda of various agencies and entities, as well as being present at the Conference of Parties/Meeting of the Parties 1 (COP/MOP1). The CDM practice has produced knowledge, enabled individuals to act spontaneously in favor of preventing climate change.[26]

3.2 Contribution of the CDM to TC

The CDM sequence was expected with a view to regulating additional protocols[27] and led to the Paris Agreement.

> The new forms of financial mechanisms will follow the example of valuing climate change management under the positive perspective of, through mitigation actions of net greenhouse gas emissions, combining ecological, social and economic returns in the same business model.
>
> In the midst of the economic crisis that destroys relations between countries, a sustainable way is certainly to seek the balance of relations among those who are classified as developed and those in development, in the alternatives with which the most articulate teach the most disabled how to generate wealth based on the promotion of environmental improvement initiatives.
>
> This is the logic of the CDM which, in the long run, could benefit all if it were everlasting. Maybe a CDM of the 21st century would be the hero of the partnership between rich and poor parts of an international treaty as infinite as the UNFCCC.
>
> In this case, in order to maintain the logic of the CDM, connections would be necessary for its materialization in a global market. How timely it would be if those

26. "We'd better be optimistic about the Kyoto Protocol. The way the world is affected by natural disasters, the context is favorable to comment on this international treaty that allows the sale of goods from a correct attitude towards the environment. The Clean Development Mechanism (CDM), a financial instrument created by the Kyoto Protocol, seems to project a change of scene in Brazil: from the poor waste pickers to the illustrative image of shouting executives on the Stock Exchange & Futures (BM&F) "(Frangetto, 2005, p.186). About BM&F, it is worth remembering that there was an effort to call for the trade of credits (BM&F)" (Frangetto, 2005, p. 186): Notice of Invitation to Tender nº 001/2007; *seller*: São Paulo Municipal Government; *marketplace*: Brazilian Mercantile & Futures Exchange – *auction for the sale of certified emission reductions (CERs)*, for CERs from de Bandeirantes Landfill Gas Project and Energy Generation, in São Paulo, Brazil.

27. "A new protocol is being thought of to be added to the UNFCCC. One that reinforces measures of non-financial support to the Kyoto Protocol may be a good solution for raising consumer awareness that influences decision-making by producing, purchasing or using a less greenhouse-gas-emitting system. The organization of a system of circulation of information concerning the prevention of climate change remains crucial. Finally, the new additional protocols to the UNFCCC should lead to ancillary and complementary issues to the Kyoto Protocol itself. Thus, a protocol could be concluded that solves the impasse of the difficulty of implementing the Rio-92 Conventions (climate, biodiversity, desertification) in synergy, considering that activities are in line with the objectives of the three legal texts without compromising one or the other, but rather combining them in searching for sustainable development. Another bold but timely regulation under the Climate Convention is the definition of liability for damage or threat of ecological imbalance due to the benefit of the activity of emitting greenhouse gases. The attribution of an emissions quota by individual or sector of activity can be a matter of national debate, to the point that internal emissions trading markets can be created. It may also have its relevance at the international level, when means of voluntary proportional application of the degree of negative impact of global warming can be instituted to avoid attitudes that might increase the concentration of greenhouse gases. The measure of objective environmental accountability would be in the definition (possibly by arbitration) of the minimum necessary for healthy living in a more or less developed country" (Frangetto, 2005, p. 187).

still weak to reduce emissions in industrialized countries would do so, and if an individual concentrator of wealth in a late industrialized country decided to pay for the world to have the effects of climate change avoided. Effective international cooperation – noting that stabilization results are not dependent on new quantified commitments – with which it becomes feasible to reduce emissions globally is the only way to achieve the ultimate goal of the UNFCCC.

Imagine the efficiency of a CDM that can be used on a global scale and with which its options for the intergenerational regime are increased, as well as being widely implemented equally by natural persons and environmental protection equivalents in the various forms demanded by nature (Frangetto, 2009, p. 270-271).

Due to a convergence of subjects, between the perception of the recently transcribed section in italics and the analysis made by the authors In Chapter 12 herein, it is worth referring to the statements also transcribed below:

the new mechanism was designed to encourage universal engagement by stakeholders rather than parties, providing a way for countries outside the Paris Agreement and non-state stakeholders to continue to engage in the multilateral environment and thus strengthen the international regime of climate change. (...) Since its inception, the SDM would have allowed certified reductions to be used by any stakeholder – whether state or non-state; public or private – for any purpose that corresponds to the measurement, reporting and verification of action – including for financial instruments, corporate social and environmental responsibility strategies, results-based financing, positive pricing etc (Chapter 12, subsection 3.2).

The SDM should deliver more actions, greater engagement, and greater ambition. First, it should encourage and facilitate action by the private sector, civil society and public authorities (Chapter 12, section 5).

Along these lines, it could be said that the tendency for a broad participation in the CDM, if the interpretation of the mechanism had been different from what it was in practice, had already been signaled. And with the advent of new mechanisms, the idea of involving more stakeholders, is being used.

Moving on, not to record the inglorious struggles of the past, but, rather, historical reflections:

Host countries of CDM projects seem to close their siege, they rejoice in disputing the Treasury's shelves, while, instead of raising doubts as to the size of the piece that they will take to their public coffers, they could take a proactive stance of internationally positioning themselves, restricted by negative international taxation. If this were to be done, and there would be due legal backing and corrective measures needed for the flawed implementations of a poorly applied CDM, there would be love for the cause, and the CDM could survive.

Out of the 1,059 projects registered, totaling 214,692,149 CERs/year and 1,270,000 CERs by 2012, by the mid-2008, there could be a geometric progression of initiatives

> to reduce emissions of greenhouse gases. This would encourage CDM supporters to call it "the CDM, the right to the future" and the pessimists or skeptics of its use would be gathering reasons why, as the CDM is in extinction, it deserves more protection – undoubtedly a smarter behavior than the counter-insult of an international disorder of daring to create a financial instrument and then annihilating it (Frangetto, 2009, p. 271).

In the words of Freestone and Streck, however, after listing several of the criticisms that existed in the course of implementing the CDM:

> Despite these valid points of criticism, the CDM must be considered a success. The measure of its success lies not only in the reduction of GHG emissions that it has facilitated – for these are still too small to change the emission trends on a global scale – but more importantly in the fact that the CDM has helped to create a global partnership between countless actors united in their efforts to finance emission-reducing projects and create emission reductions. The CDM has proven to be a global market experience of unprecedented scale. It has brought the idea of market-based approaches to parts of the world new to the notion of a global market. It has helped to leverage funds for renewable energy technologies and other emission reducing activities. And, last but not least, it has helped to test methods to calculate emissions and emissions reductions, develop monitoring protocols, and an essential infrastructure of emission registers[28] (Freestone and Streck, 2007, p. 52).[29]

It can be seen from the previous texts that the CDM implemented in Brazil had to deal with external factors to a particular project (transaction cost, crises management, regulatory challenges) and, in doing so, ended up performing lower in terms of benefits of mitigation and sustainable development, to which it would have absolutely favorable conditions to invest in CDM projects. In this sense, answering the question of whether the CDM was able to represent TC is not a simple task. If there were changes in the paths of GHG emissions in the various sectors, has the CDM corroborated the trend towards a progressive reduction of emissions in the long term?

Additional measures to support the implementation of the CDM could have been adopted. Undoubtedly, the adoption of some measures extended the chances of implementing it. For example, the CDM's Programs of Activities (PoAs) indicate a shift from a project-based approach to one that is backed by sectoral initiatives, a trend maintained in the PoA, and thus makes it possible to effectively change GHG emissions from countries in favor of the adoption of less emissions-intensive and durable practices. It is possible that such measures were not enough to configure effective TC.

28. The evolution of quantification methods was explored in Chapter 3 herein. For further information about the registration system (ITL), see Chapter 12.

29. Original text.

A TC is not evident in terms of emission reductions, since, except for those related to deforestation, Brazilian emissions have increased in all sectors during the period discussed herein. An analysis of sectoral baselines is necessary to evaluate if there was a deviation of the expected paths of emissions increase by sector. Considering that the sectoral reduction targets proposed in the Brazilian Nationally Appropriate Mitigation Actions (NAMAs) have been achieved (Brazil, 2017), it is understood that there was a deviation in the path of expected emission reductions, but an assessment is necessary to ascertain as to whether the deviation is related to the CDM or not. The mechanism is certainly not responsible for all the reductions but it would be reasonable to understand that it had an influence on the acceleration of the learning curve of important technologies and practices that generate emission reductions.

Moreover, as illustrated in table 1, a number of lessons could be drawn from the CDM practice, and lessons learned can serve as lessons to induce course changes, i.e., inflections on the emissions curve that would put the sectors at a higher-level mitigation, which, per se, would be a transformation. Along these lines, an invitation for future analysis of how much the CDM has been, and still is, generating, effective or potential TCs, is in order.

3.3 A new financial system since the CDM

> The lesson of the CDM will never perish: at the juncture of the year the UNFCCC Conference of Parties will meet in late 2009 in Copenhagen (Denmark) and at a time when several newspapers extol the initiatives of avoided deforestation in the Amazon Brazil, it is worth – even if it were done for the last time in its full existence under the Kyoto Protocol – to take up the essence of the CDM and verify its power to leave the wisdom of providing viability for the next generations of new market mechanisms particular positive environmental actions.
>
> Taking up the fundamental concepts of the financial instrument in question (...), if it is indeed doomed to be replaced by a distinct mechanism, then it is not plausible to believe that States (consciously or unconsciously) agree, definitively, on an international treaty additional to the UNFCCC that ignores the advantages absorbed from the experience of using the first international legal mechanism capable of assimilating the basic aspects of sustainability, that is, the economic, ecological and social vectors of the environment (Frangetto, 2009, p. 268).

3.4 Individual legitimation

Under the CDM regime, project implementers qualify as holders, claiming to be eligible for carbon credits (in the form of CERs). These could be individuals, physical persons, as well as legal entities. In summary, in the context of comments on transparency, IETA gladly exploited this legitimacy, which in this case was contextualized in relation to the revision of the report issued by the Executive Board:

> to increase transparency and interaction, IETA recommends that the process to review the EB report at COP/MOP2 in Nairobi include the opportunity for stakeholders, such as IETA, to make presentations to the group undertaking the review on behalf of the COP/MOP. This does not in any way contravene UN procedures and can be seen as necessary given the special nature of the CDM, which is a mechanism under the regulatory authority of the UN, but overwhelmingly implemented by the business sector (IETA, 2006, p. 29).[30]

According to Viola, Franchini and Ribeiro (2013, p. 209-211), alluding to other authors, the role of non-state stakeholders is highlighted:

> the important role that some non-state actors have played in building the current governance structure in this subject is widely highlighted in the climate change literature (Okereke and Bulkeley, 2007; Hurrell, 2005; Porter et al., 2000).

In order to clarify further the role of these actors in climate governance, it seems appropriate to refer to the concept of "*transnational climate change governance*" of Andonova *et al.* (2007). Defined as "*transnational government occurs when networks operating in the transnational political sphere purposively steer constituent members or populations to act*" (Andonova *et al.*, 2007:4), the concept refers to relations that occur across state boundaries but are not controlled by central political authorities and bring local and global governance systems in contact through the public and private levels.

According to the authors, climate change is one of the most propitious areas for the expansion of this type of governance. Firstly, it is an arena that is already densely populated with business and defense organizations interested in climate governance issues. Second, because climate change involves multiple sectors, not an industry or few stakeholders as in the case of classical environmental problems. And thirdly because the climate regime itself creates incentives for its participation – especially through the flexible Kyoto mechanisms.

3.5 Transactions in the financial market

From a financial point of view, the availability of resources for the idealization of CDM projects in the country can be discussed. It is pointed out that the projects needed financial resources for the pre-project stage. Investors, however, need security to invest in good projects. It was evident that there was a clear interest in funding the Brazilian CDM projects in Brazil during the first years of CDM implementation (especially from 2000 to 2007), but in several cases, only if they were already set up, idealized and organized – that is, provided that someone had previously paid for all that quality.

30. Original text.

In fact, successful projects have received financial and technical support needed to succeed. Project design documents, agreements (from the Emission Reduction Purchase Agreement (ERPA) to the Certified Emission Reduction Sale and Purchase Agreement)[31] were well entered into with the governmental authorities of the various levels (federal, state and municipal) in the areas of administrative, environmental, social, urban, civil, national and international law, along with science – an arsenal of measures forming an arrangement; however, some projects were submitted to the DNA with flaws. Attempts to unite public authority and private enterprise or individual entrepreneurship led to curbs, as being pioneers does not properly capture as spontaneity deserving of immediate and sufficient legal recognition to remove the risks of unfair competition in the practices of sustainability that were emerging in the country at the time.

Brazil was a promising export power of CERs. Only it was not strong enough. It lacked "common sense" in terms of a detectable *mea culpa ex post*, but which, in the course of implementation, was already evident – it had already been the subject of alert and even attempt to correct course. In this sense, it may be the case that the European Union's decision cannot be attributed solely to the decline in the attractiveness of implementing CDM projects in Brazil. Overcoming the problems that could be remedied could have made the CDM stand as a mode of climate governance and generate benefits in reducing emissions.

4 FRAGILITIES AND POSITIVE ATTRIBUTES OF THE CDM: LESSONS IN FAVOR OF MANY TCS

In a much larger rhythm, volume and cross-cutting nature, actions could have been taken in order to implement the CDM. In this sense, Frangetto affirmed (2007, p. 40-41):

> In the event that a municipality, as a direct administration entity, takes action on the bus fleet, placing ethanol as fuel in the place of diesel oil – should a CDM project be possible, as well as respective carbon credits, due to the exchange of fuels given the lower emission from alcohol – it just so happens that the individuals that make use of that transport act in a certain way as participants in the emission reduction process. In the case of a private individual, it can even be legally inferred that individuals as owners of their vehicles may be able to receive carbon credits.
>
> This is closer to reality than one imagines; tourism agencies have already taken the first step, making an option for the spontaneous acquisition of a right available to consumers of the air transport service. In proportion to the additional figure given

31. This contract paradigm model was designed to reflect the particularities and needs of carbon credit sellers. The CERSPA initiative was led by Charlotte Streck and Robert O'Sullivan, made possible by the Inter-American Investment Corporation in 2006, with the participation of lawyers from various parts of the world, especially representing the views of non-Annex I players.

to the ticket, part of the price paid goes to the recomposition of the environment corresponding to the degradation that the travel causes in terms of emission of polluting gases. It is about acquiring an upgrade to be more sustainable. Along the same lines, even in residences, carbon credits can be claimed, due to preferences that imply a smaller reduction, such as the option for solar heating systems in instead of gas heating. It is worth remembering that the pollution caused by fuels used by airlines has already been a concern raised during the Parties' conferences. Are policies relevant in this area – and why not, if technically feasible, have policies that encourage the implementation of CDM projects? – in the scope of the European Community Commission, to reduce emissions through the encouragement of voluntary initiatives which can be adopted by the Association European Airlines (AEA).

Also, in the area of tourism, transportation sectors in locations where winter tourism is strong, such as in the Colorado Ski Resorts, have been promoting programs to prevent climate change. They work, for example, with electric vehicles (lower emission) due to the alarm that snowy periods would be decreasing.

Similar strategies can be set up for other emitter activities besides those that cause fugitive emissions in relation to fossil fuels, oil and natural gas: industrial activities, mineral processes, chemical industry, halocarbon production and hexafluoride. This is a serious problem in the case of the refrigerator industry, considering its high potential for global warming compared to carbon dioxide and even methane.

A reflex of the private sector can be identified to the new environmental conjuncture, with the acting industry at present experiencing an advance of what in the future will be regulated. It should not be forgotten that the same phenomenon comes to occur in the automobile industry to the environmental problem of noise pollution due to the emission of noise. PROCONVE (Program for the Reduction of Vehicle Emissions) is mentioned at this stage, which can certainly be reinforced by the effects of international regulations on the emission of gases.

It should be noted that other sectors are also considered important in the process of reducing emissions, such as agriculture, rice cultivation and agricultural land use. Many of these activities were not even noticed as being environmentally relevant to problems on a global scale such as climate change. Under the new perspective of the Kyoto Protocol, the perception is changed, with the acceptance of manure treatment, so that the carbon capture of methane from it can be obtained. Something that was previously nobody's business, such as waste, is given economic importance thanks to environmental law.

The impact of "upgrading" these previously forgotten activities is translated into conflicts. This is evident in the case of methane from waste decomposition in landfills, which, before the opportunity to generate carbon credits, were almost the subject of a simple treatment of burning flares, but rarely with piping connected to a power generation system. For the purpose of defining who owns the possible carbon credits generated, the question arises as to who would have been entitled to "methane gas" as good, which was practically disregarded in the bidding processes between the public

> administration, which is competent to pass on the provision of waste treatment services or generation of electric energy, and the concessionaire. The consequence, in cases where the public administration does not foresee in advance the possibility of generating carbon credits, are later agreements that are often subject to questioning, despite the arduous task of promoting the resolution of a problem resulting from the lack of strategic planning in relation to the use of environmental goods, due to lack of knowledge or socio-economic-ecological immaturity, as useless or unusable.

In any case, it seems that now (that the CDM is no longer the apple of the UNFCCC's eyes) emissions reduction practices are becoming more acceptable in relation to the development of technology alternatives, compared to the time when there was expected reduction activities via the CDM, as described by Frangetto (2007). At the time, the potential of the mechanism seemed to be quite promising for all sectors. It would be interesting to analyze each one, but as it is not the scope of this book to verify the presence or absence of TCs, it is enough to try to apprehend, as an illustration, how paradigmatic the waste sector was. In order to do so, from the findings in Chapter 5, the following questions can be asked as a reflection on the contribution of the CDM in favor of improving waste management in the developing country being studied.

Experiences in the urban solid waste sector, described in the reference chapter (Chapter 5), have been successful insofar as the implementation of the CDM contributed to the formation of a market for parts, materials and equipment (table 1 of the said chapter). In a country with a huge sanitation deficit such as Brazil, where regulations in the last decade failed to eradicate the open disposal of urban solid waste (dumps), the CDM favored the allocation of resources to collect landfill gas with energy utilization. Although the availability of resources invested in solid waste in Brazil was below that which would be sufficient for an adequate and widely efficient waste treatment system. In this regard, therefore, the CDM was embodied in a proof that the CDM performed in a way that made possible a partial change in waste management in Brazil.

The CDM contributed so that many landfills in big Brazilian cities could develop methane destruction or energy recovery projects from landfill gas. Undoubtedly, this experience positively influenced capacity building of engineers and technicians who work with solid waste management insofar as the management approach strongly restrained the climate factor.

These aspects show significant learning and behavior-change as a consequence of the CDM in Brazil. Although many landfills that have registered CDM projects are not verifying their emission reductions nor issuing CERs as a result of the fall in demand for credits, which once again generated price stimulus, there are no more learning barriers and behaviors that prevent the due treatment of landfill gas. Thus, the impact of the CDM, we dare to affirm, transcends project boundaries, reaching virtually all types of projects in Brazil, by expanding the notion of emission reduction and its environmental importance to different stakeholders in society.

4.1 Highlight – monitoring process

In some cases, there were attempts to solve the CDM implementation problems by means of palliatives, instead of addressing the issues until solving them. One example is based on problems related to functioning of DOEs, as highlighted by IETA in 2006 in discussions on CDM governance:

> A disturbing trend at the EB is the introduction of additional layers of bureaucracy to address perceived or actual shortcomings in existing processes. A key example of this trend is the creation of the CDM Registration and Issuance Team (RIT), which appears to be designed to duplicate the role of DOEs [designated operational entities] with respect to the determination of project's eligibility for registration and/ or issuance. DOEs are accredited by the EB precisely so that their judgement can be relied upon. If the EB has concerns within the DOE structure instead creating a duplicative function.
>
> Critically, the perception on the part of developers and investors is that DOE determinations can no longer be relied upon because they are subject to second-guessing.
>
> *This increases perceived regulatory risk and discourages project investment* (IETA, 2006, p. 11-12).[32]

The IETA concludes by recommending that (2006, p. 12), for the purposes of improving CDM governance: *"instead of including more control bodies into the CDM process the EB should put more trust into its own"*.[33]

On the other hand, it is necessary to remember that the IETA gathers the DOEs, which means that among its members are the ones that are being evaluated by the RIT. It could be argued that there is a wide debate on the win-win situation between contractors and verifiers, generating undue certifications, and that, in the case of the CDM, could lead to failures in approving projects that are in the baseline or do not meet the prerequisites for participation in the mechanism, based on partial validation reports.

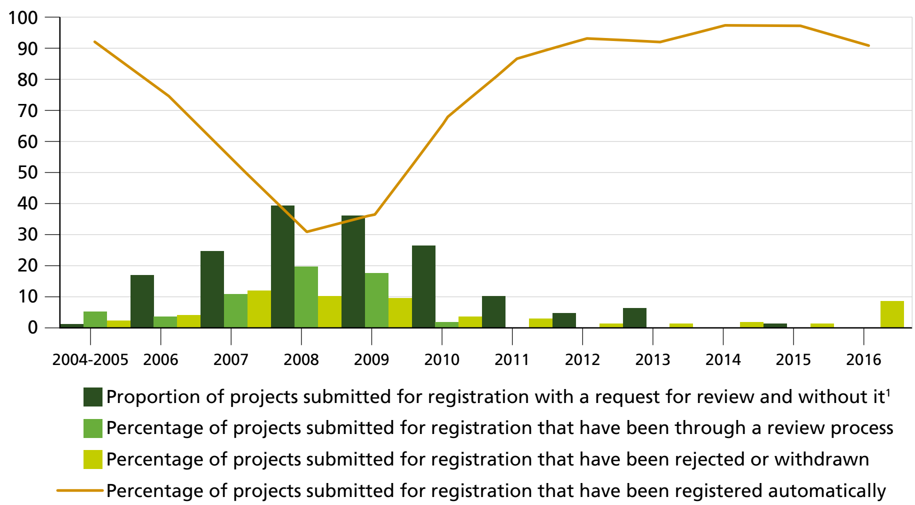
The RIT solution, in this sense, can be seen as a counterbalance in this relationship, an audit of the process prior to the approval of the projects by the Executive Board. The RIT members are individual experts who are usually in continents different from the proponents of the project under analysis, and are unlikely to be related to each other or to the DOEs. Their participation is relatively

32. Excerpt from original text.
33. Excerpt from original text.

inexpensive, and their comments on the project and its validation are not binding, they only support the decision-making body.

It should be noted that there was, in fact, more rigor in the analysis of the projects. As of 2006, the number of automatic project registrations fell sharply and, on the other hand, revisions requests and proper revisions increased, only returning to the initial levels from 2011 onwards (graph 1). The anticipation of this scenario may have motivated criticism from IETA. Even so, the DOEs remained subject to criticism regarding certain performances, particularly in relation to alleged failures in the validation and verification reports.

GRAPH 1
Background of reviews by the CDM project activity Executive Board (2004-2016)
(In %)



Source: UNEP (2018).
Prepared by the authors.
Note: [1] Includes projects that have been registered after the request for review, with or without corrections.
Note: [2] See Frondizi (2009) for more details on the development cycle of the CDM project activities.

In this sense, this chapter mentioned that the broad knowledge of DOEs in hiring insurance granted more safety to operations. Another observation would be possible in the context of the institutional structure of the CDM providing successful instrument performance, in terms of sustainable development assessment provided by the implemented CDM project. Much of the criticism towards the CDM in the disagreements between Annex I and non-Annex I countries lie in the fear of interference from developed countries over what represents or should represent sustainable development in the developing or less developed countries.

Regarding degrees of country development and their consequences, by means of the normative discipline in Paragraph 40 item "a"[34] of Decision 17/CP.7 (*Modalities and Procedures for a Clean Development Mechanism*, as defined in Article 12 of the Kyoto Protocol), the risk of the North-South relationship in developed countries has been minimized to prescribe what developing/least developed countries must do to become sustainably developed. Even in terms of sustainable development, the CDM was right when it imposed the host country, through the DNA, to declare the promise of sustainable development designed by the project proponent. The estimate, by itself, showed the adoption, by the protocol, of the bottom up (instead of top down) approach, even before the Durban Platform.

However, it is interesting to note the need for solutions to possible limitations in the institutional capacity of analysis regarding the potential presence of sustainable development, project by project. This theme was highlighted in this book in Chapter 8, when the author discussed the uncertainties that still remain about how to ensure the sustainable development of CDM projects. The multiple and interpersonal nature of what constitutes real sustainable development is addressed in the Sustainable Development Goals (ODS) and, perhaps, the alliance with new parameters could grant new rationalizations about such a synergistic CDM requirement and, perhaps, new mechanisms.

5 FINAL CONSIDERATIONS: LEGACY TOWARDS ROBUSTNESS IN THE TC PROCESS

Yes, the CDM experience is a legacy. Far from a naive attempt to try and make the CDM of the Kyoto Protocol prevail (1997), this work sought to identify the legacy of the CDM. From the discussions above, which have been debated again in this last chapter of the book, the original capabilities of the CDM were studied.

The Waste Sector is shown as an example, containing some elements that lead to the belief that a TC was provided by the CDM in Brazil. New assessments would be worthwhile for other sectors, and for now this is the contribution of the authors.

The findings of Chapter 9 confirm this point of view on governance, according to which there was indeed the creation of relevant technical capacity in the country in order to work on issues related to climate change. This demonstrates that the CDM presents its own skills to evolve global management of climate change.

34. According to Paragraph 40, item "a", of Decision 17/CP.7, a DOE shall: "prior to the submission of the validation report to the Executive Board, have received from the project participants written approval of voluntary participation from the designated national authority of each Party involved, including *confirmation by the host Party that the project activity assists it in achieving sustainable development*" (UNFCCC, 2002, p. 35, original text with Italics marked by us).

It was also up to the publication to emphasize the obligation to observe the principles, as well as the principle of common but differentiated responsibility (PCDR).[35]

Progresses have been achieved in governance, methodology[36] implementation of UNFCCC. *Mutatis mutandis* the terminology used, when commenting on improvements in the CDM implementation, specifically regarding the timing of approval of methodologies,[37] IETA, either prognostic or intuitively, described the CDM as transformative. Although it was not in the context of CIF, it is worth noting:

> "new technologies and project activities can only be applied and carried out under the CDM if new methodologies are developed and approved. Unfortunately, the new methodology approval process is creating a serious bottleneck that is needlessly delaying or discouraging these new types of project activities. At present, approval of a new methodology can take two years or longer (…) and more than one year for methodologies that have already received a 'B' grade from the Meth Panel. Continued delays of this magnitude will cause investors and developers to become disenchanted with the CDM process, and lead to quality projects, with significant sustainable development benefits, to go undeveloped.

35. It is worth strengthening the understanding that: "The UNFCCC principle is based on the principle of sustainable development in North-South relations (between countries north of the Equator, normally more developed than those in the south, and countries located south of the line, where a large part of the considered underdeveloped or developing countries are located). This is the principle of exception to the principle of reciprocity of obligations among the parties, the principle of common but differentiated responsibility set out in Articles 3, 1 and 3 (2) of the UNFCCC. This principle asserts that the specific needs and special circumstances of the 'developing' countries are taken into account, and that in view of their fragile situation, action to combat climate change and its effects must be taken by developed countries. In line with the polluter pays principle, those countries using polluting techniques (developed countries) longer than developing countries must contribute proportionately to the pollution they caused, bearing the burden of mitigating the adverse effects of climate change. Hence, the adoption of the principle of common but differentiated responsibility, according to the degree of pollution caused by developed countries. It is the evolution from equality of treatment to fair treatment between those who present themselves, in terms of industrial development, at different levels in the international economic and financial system. Article 3, paragraph 5, of the UNFCCC states that the Parties should cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in all Parties, particularly developing country Parties, thus enabling them better to address the problems of climate change. Thus, the principle of common but differentiated responsibility, together with the principle of sustainable development, becomes the basis for true international cooperation, in which the 'weakest' are assisted by the 'strongest'. In this sense, CDM projects – say Clean Development Mechanism (CDM) projects capable of generating CERs – enable international cooperation, insofar as, on the one hand, part of the obligations of a country in Annex I of the UNFCCC can be fulfilled and, on the other, there is an increase in investment in developing countries (macroeconomic measure), through the inflow of foreign capital and the increase of the domestic capital destined to the environmental cause, especially the fight against climate change. The strengthening of macroeconomic measures, transposed to North-South relations between Annex I countries and non-Annex I countries, is complemented by the strengthening of microeconomic measures such as investment in non-financial mechanisms (e.g. education, awareness raising and awareness raising on climate change), which improves the knowledge on this environmental problem and even affects economic improvements, since it creates a demand for capacity building, whose supply acts as a form of internal cooperation, and avoids the overcoming of anthropogenic actions that provoke climate change" (Frangetto and Gazani, 2002, p. 37-39).

36. It is interesting to note that "the methodologies for calculating the emission levels reduced from a baseline constructed in a certain reference scenario can be used by third parties other than those who submitted them for approval, without any burden – what can be called socialization of the investments made in CDM, in order to prevent the coming of a sustainable anti-development process - in this case, against the phenomenon of climate change" (Frangetto, 2005, p. 187). Another note that represents the experience generated through the development of a methodology is the repercussion for new options of emission reductions, according to, for example, what Boneti (2007) discussed.

37. For further information on the proposition and review of methodologies, see Chapter 3 herein.

> New methodologies are the essential building blocks for the success of the CDM as a transformative mechanism" (IETA, 2006, p. 17).[38]

Therefore, taking advantage of the knowledge acquired during the implementation of the CDM for new formatting mechanisms is justified. Numerous methodologies have been developed over the years, which have been applied to the most different sectors of activity. Building new mechanisms from this knowledge would be very efficient.

The plain CDM was differentiated from the one that was put in practice as a CDM, because it was concluded, even with the flaws, and the lessons. Even if a supposedly flawed mechanism – incapable of generating valid CERs – could have been created, the CDM itself was able to provide an institutional structure in which validity assumptions were raised until they were properly resolved, saving the mechanism from any errors or misinterpretations.

This book has provided room for an analysis of emerging subjects in terms of climate financing, and noticed that the financial mechanisms trend, to be regulated under the Paris Agreement, results from the experience of implementing the CDM.

Problems that were not necessarily the CDM's were considered as such, but they were actually application, interpretation and coherence flaws. To some extent, there was a lack of adherence to the climate regime established by the UNFCCC and, from a systemic point of view, there was also a lack of common sense or rationality in a series of episodes of CDM implementation. An emblematic error, which was more evident over the years in climate policy, was to take the implementation of the CDM as a way of controlling emissions, whereas in reality the Kyoto Protocol system was based on valuing emission reduction initiatives (the limitations of Annex I countries were based on the percentage reductions).

In the practical daily language, a habit was to refer to the CDM as a concession of a right to pollute.[39] Pollution is a crime in Brazil, and a negative environmental impact always raises responsibility in the area of environmental protection, so that the sum of environmental impacts does not cause environmental damage. With this, any emission needs a behavior capable of nullifying it, as if it were an act of counter-emission: it would be the emission reduction. In the case of the Kyoto Protocol, Decision 15/CP.17 sought to clarify that the Protocol did not grant or

38. Excerpt from original text.

39. It is worth recalling the criticism regarding the CDM: "Some sectors in developing countries criticized it under the assertion that it disobeyed the polluter-pays environmental legal principle, as if it rewarded those who emit and authorized emissions" (Frangetto, 2009, p. 269).

authorize any right to issue.[40] The market, however, seems to have been weakened by the fallacy that has arisen in the practice of carbon credits being generated by the right to issue.

As can be seen in the analyzes made throughout the chapters, which were highlighted by the authors, those aspects related to CDM weaknesses (table 1) were recognized as problems. Some aspects of relevance among the problems brought up are listed below. It is important to note that the problems of insecurity in the implementation of CDM projects were recurrent; however correctable.

There was an attempt to avoid the "toxic pest" that poisoned the mechanism since the moment the "plantations" began, meaning, the implementation of projects. Consider the effects of the distortion in basing all the intended action to reduce emissions and contribute to sustainable development on the incapacity or reverse history of the polluting behavior: instead of the mechanism being regarded as award for the fulfillment of the commandment of stabilization and of the exercise of the right to sustainable development, the fact that the baseline is calculated on the reference scenario of the disorder led to the natural consequence of considering the right as wrong (i.e. creditable projects that would prove to improve the environmental quality standard). Legally speaking, the rationale would have been to remember that liability for any and all emissions is already classified as objective and, with this, it was assumed that emissions lead to environmental threat and damage (climate change, in this case) but the non-issuance implies the prevention of damage and non-occurrence of the threat, and the stakeholders of compliance measures are allocated the right to accreditation by means of awards.

Additionality was attempted to be calculated on the basis of the logic of Brazilian law, in which everyone has the right to an ecologically balanced environment and, at the same time, has the duty – especially the public authority and collectivity – to defend and preserve it in favor of present and future generations. Likewise, it was tried that the part of the Brazilian obligation for stabilization, which is a common objective of the parties to the UNFCCC, should be observed as a premise in the granting of procedural authorizations to the progress of the projects in the course of the cycle within Brazil and towards the Secretariat of the Convention.

40. The protocol only warned about the fundamental aspects. Frangetto (2005, pp. 187-188) states: "the generation of carbon credits under the Kyoto Protocol is coming from a perspective of greater certainty. Risks tend to be minimized. In this respect, two elements are extremely important. First, the elimination of the view that, according to the Kyoto Protocol, poor countries sell pollution credits to rich countries (when in fact, in addition to being illegal, Decision 15/CP.7 expressly recognizes that the 'Kyoto Protocol did not create or grant the parties included in Annex I any right, title or permit for any type of issue'). Second, the conclusion of legal acts in order to provide risk management guarantees for the commercialization of carbon credits. In the event of extreme risks of the contract leading to hardship and, in the event of the impossibility of delivering certified emission reductions (CERs) as promised to the credit substitution program resulting from CDM projects of the same level of that commercialization. The recommended actions are a means to ensure the success of the CDM negotiations and the consequent effectiveness of the Kyoto Protocol".

Likewise, there was an attempt that part of the Brazilian obligation for stabilization, which is a common objective of the parties to the UNFCCC, be observed as a premise in the granting of procedural authorizations to the progress of projects in the course of the cycle within Brazil and towards the Secretariat of the Convention.

However, these efforts required a shift in the basis of conscious and unconscious deviations of purpose in the CDM implementation process. Also fragmenting international law formed by the influence of the country-parties, the technical reasoning of project development began to bring beliefs that some modes of calculation should become the method in judgments of modalities and procedures. And so, they became. In practice, the sub-rules were met, instead of observing the principles and rules of the legal regime of climate change.

It may be considered that the principles should have been better applied. For example, the principle of sustainable development, the application of which has brought so many questions,[41] could have been explored to the extent where project developers, in line with policy makers in the course of the CDM cycle, have valued the rising levels of sustainable development over time – even if only one of the sustainability items (social, ecological or economic) and only one initiative (for example, increase of the number of species elements in the project's area of influence) was focused. In the context of this line of reasoning:

> Thus, development, in environmental terms, can make the classification of countries, in environmental terms, new. They would be classified in relation to sustainable development; all countries would somehow have the ideal profile of moving towards the pursuit of sustainable development until they reached the state of grace of true sustainability, which would be the state of total sustainability, with social, economic and ecological balance throughout the world. This state could be illustrated in specific CDM projects, capable of taking into account the differences between countries and intrinsically making a carbon project a promoter of sustainable development (Frangetto, 2007, p. 52).

Another example of a warning occurred in the area of the definition of ownership over credit, which to some extent is a matter of autonomy of the will. A controversial case occurred in 2007, when the potential of credits generated by the Program for Incentive to Alternative Sources of Electricity (PROINFA) ended up permeating the interests of both Eletrobrás and energy users from alternative sources, interested in receiving their installments on credits. Similarly, in the case of landfills, the granting authority and the waste-disposal concessionaire eventually had to reach an agreement in which each party would receive a proportion of the

41. See Chapter 8 herein for a critical and detailed analysis of the criteria and their application in the context of verification of the contribution to the country's sustainable development by CDM projects.

credits generated. Until then, even the bidding document for the installation of a thermoelectric plant from the captured methane resulting from the process of decomposition of the waste provided for the ownership issue over the credits, since it only supported the gain from the energy source to be generated, and not accessories like a carbon credit.

One might agree that mistakes have been made in interpreting CDM standards, misadventures in the world of facts, CDM devaluation in countries that have decided not to buy CERs from Brazil or have bought them in smaller quantities than would be desirable to the country's entrepreneurs who have sought the Kyoto financial instrument to carry out emission-reducing activities and contribute to reducing inequalities.[42]

Ontologically, the *must-be*, the CDM. by nature, has to be perfect; in practice, the CDM experience has shown that its implementation, even in situations of insecurities or application failures, can be guided by the essence of the CDM, so that everything goes well.

The institutional framework within which the CDM is constituted, within the framework of the Convention and the regulatory framework from the international to the national scope, is justified insofar as it works to the benefit of the CDM and therefore has tools and forums, which, developed, would have the ability to correct errors and misunderstandings, saving the mechanism of any negative criticism.

The CDM remains, despite criticism, restrictions imposed by the emissions market for its commercialization, and obstacles in international negotiations. In an *ex post* evaluation, from the contributions of previous chapters herein, it is suggested that the identified contingencies can be overcome. The final recommendation is that the experiences of implementing the mechanism and its projects in Brazil serve as a motivating factor for the improvement of internal markets and new mechanisms within the framework of multilateral governance. As discussed in Chapter 15, possibilities are being studied in the Partnership for Market Readiness (PMR) project in Brazil. Also, the expansion of Brazilian participation in international initiatives – for example, in CORSIA, discussed in Chapter 1 – can benefit from the lessons learned. The CDM, in turn, solving the mistakes of the past, can work again as expected, thus ensuring that the desired TCs are in fact perennial

42. As stated in 2001: "For the purposes of specific obligations, liability becomes proportional to the degree of development. Paragraph 7 of Article 4 of the Convention is explicit in that regard, stating that the extent to which developing country Parties will effectively implement the commitments undertaken will depend on the effective implementation by the developed country Parties of their programs for the provision of financial resources and transfers of technologies; and will take full account of the fact that economic and social development and the eradication of poverty are the overriding and absolute priorities of developing country Parties" (Frangetto and Calasans, 2001, p. 405).

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