FIRST BIENNIAL UPDATE REPORT OF BRAZIL

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GENERAL COORDINATION ON GLOBAL CLIMATE CHANGE

NATIONAL FOCAL POINT TO THE UNFCCC

Division of Climate, Ozone and Chemical Safety of the Ministry of Foreign Relations

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Ministry of Cities – *MCidades*

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Presentation

The Brazilian Government hereby submits Brazil´s first Biennial Update Report (BUR) under the United Nations Framework Convention on Climate Change (UNFCCC).

The report follows the biennial update reporting guidelines for developing countries according to the Decision 2/CP.17, paragraphs 39-42, and its Annex III.

This first BUR presents, in addition to the summary results of the inventory of anthropogenic emissions by sources and removals by sinks for years 1994, 2000 and 2010, information related to the mitigation actions and its effects; the financial support received in relation to global climate change; constraints and gaps, and related financial, technical and capacity needs, including a description of support needed and received; report on national circumstances and institutional arrangements relevant to the preparation of the national communications on a continuous basis; and, information about the domestic MRV (measurement, reporting and verification). The structure of this document has been developed on the basis of the decision of the Convention, adapting it to the national circumstances and the programs and actions developed in the country.

Finally, in accordance with the "Warsaw Framework for REDD-plus" (Decisions 9 to 15/CP.19), this first BUR encloses the Technical Annex referred to in decision 14/CP.19, paragraph 7, containing the results achieved from REDD+ activities by Brazil.

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1. National Circumstances and Institutional Arrangements

1.1 National Circumstances

Country Profile

With an area of 8,515,767.049 km^2, Brazil has an extensive coastline and rich biodiversity. Comprising 5,570 municipalities[1], distributed by five major political-administrative regions - North, Northeast, Midwest, South and Southeast – the country counts a population of 190.7 million people (IBGE, 2010[2]).

In Brazil, available water resources are abundant and unevenly distributed throughout the territory. With a high potential for electrical energy generation, these resources have been leveraged by the country and, as a result, today Brazil has one of the cleanest electrical matrices in the world, including a large share of renewable sources.

Brazil boasts one of the most renewable energy mix in the world, with over 41% of its supply coming from sources such as water resources, biomass and ethanol, in addition to wind and solar energy (BEN, 2014[3]). Hydroelectric power plants are responsible for over 79% of the electric energy generated in the country. Comparatively, the global energy supply mix consists of 13% of renewable sources. In the case of industrialized countries, it drops to 8.1% among Organization for Economic Cooperation and Development (OECD) countries.

Being a country of continental dimensions, Brazil has five climatic regions: Equatorial (North), Tropical (most of the territory), Semi-arid (Northeast), Tropical of Altitude (Southeast), and Subtropical (South). Along with this climatic diversity, variations in topography determine vegetation groups, which are grouped into six biomes[4] with wide biodiversity: Amazon, Atlantic Forest, Cerrado, Caatinga, Pantanal and Pampa. The six biomes serve as a reference for the establishment of specific biome-oriented public policies, as it is the case of the Action Plans for the Prevention and Control of Deforestation in the Legal Amazon, as well as for the Prevention and Control of Deforestation and Forest Fires in the Cerrado biome.

1 Smallest Brazilian political-administrative unit.

2 2010 census of the Brazilian Institute of Geography and Statistics – *IBGE*. Available at: http://www.ibge.gov.br/home/estatistica/populacao/censo2010/.

3 The Synthesis Report of the National Energy Balance – BEN 2014 presents data about the accounting of the supply, processing and final consumption of energy products in Brazil, based on the year 2013. Available at: <ben.epe.gov.br/BENRelatorioSintese2014.aspx>.

4 Biome is conceptualized in map as a set of life (plant and animal) composed by grouping types of contiguous and identifiable vegetation at a regional scale, with similar geoclimatic conditions and a shared history of changes, resulting in a unique biological diversity. (*IBGE*, 2004)

Brazil's performance in regard to the reduction of poverty, extreme poverty and income inequality rates highlights the fact that Brazil is one of the countries that contributed most to the global attainment of the first goal of the Millennium Development Goals (MDG): eradicate extreme poverty and hunger. This result is considered as positive not only for the improvement of living conditions of the Brazilian population, but also for increasing resilience to adapt to the adverse effects of climate change.

In general terms, despite the evolution of economic and social indicators verified in recent years, it is worth recognizing that Brazil is still a developing country, with a growing population, where the basic needs of the population in some places have not been met, and with incipient infrastructure that requires substantive improvements.

Policy Dimensions

Brazil's National Policy on Climate Change (PNMC) was launched in 2009, with the aim of promoting sustainable development; reducing greenhouse gas emissions (GHG) from relevant sources, as well as strengthening removals of these gases by sinks; and implementing measures to adapt to climate change, in order to reduce the adverse effects and the vulnerability of environmental, social and economic systems.

The instruments of the National Policy on Climate Change (PNMC) are the National Plan on Climate Change; two action plans, one developed for Amazonia and another for the Cerrado, to prevent and control deforestation; and plans for mitigation and adaptation, described in item 3 of this document for agriculture, land-use, land-use change and forestry, energy and charcoal. These plans have been elaborated in an open and participative process, involving representatives of academia, the scientific community, economic sectors and civil society organizations.

Only Parties to the Kyoto Protocol included in the Annex I of the UNFCCC shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments. However, under the UNFCCC, after the 9th Conference of the Parties in Copenhagen, Brazil indicated to the Convention its mitigation actions intended to be taken voluntarily. It was anticipated that these domestic actions would lead to an expected reduction of 36.1% to 38.9% regarding the projected GHG emissions of Brazil by 2020. Among the actions to achieve this reduction, Brazil indicated the reduction by 80 per cent of the CO_2 emissions from gross deforestation in the Legal Amazon by 2020, relative to the average emission in the period from 1996 to 2005, inclusive.

The reduction of emissions from gross deforestation in Brazil since 2006 represents a significant contribution to global mitigation efforts. The Brazilian Government submitted its REDD+ Forest Reference Emission Level for Amazonia to the UNFCCC in June 2014 and underwent a technical assessment. The expectations of ex post payment compensation for the results achieved are in line with the fulfillment of requirements defined by the "Warsaw

Framework for REDD-plus" and other decisions under the Convention. As part of this BUR, the results of REDD+ are included in the Technical Annex for consideration by the International Consultation and Analysis (ICA) process in the context of the Convention.

1.2 Institutional Arrangements

The governance of PNMC involves, in a coordinated way, federal agencies and entities of the Brazilian civil society, as per the following tables. A premise of the National Policy is its multistakeholder and transversal nature, as legally established, primarily based on the performance of sector-specific and relevant government agencies.

In this context, a governance structure was established for the implementation of the National Policy with specific mandates and assignments, that are complimentary to each other. These bodies also assist in the implementation of the Convention and its Kyoto Protocol in Brazil. In addition, there are other institutional arrangements that are relevant to the Policy implementation, which include the participation of civil society, researchers and financing institutions.

Regarding academic and research contribution, the Brazilian Research Network on Global Climate Change (*Rede CLIMA*), established in 2007 by the Ministry of Science, Technology and Innovation, has the mission to generate and disseminate knowledge about the causes and effects of global climate change, by producing information for the formulation and follow up on implementation of public policies on climate change and by providing subsidies to Brazilian Delegations to meetings under the UNFCCC.

Concerning the participation of civil society, the Brazilian Forum on Climate Change (*FBMC*), presided by the President of the Republic, has as its main purpose the promotion of spaces of discussion on climate change with broader segments of the society. It has helped with the coordination of public consultation processes in support of policies on climate change in Brazil, mainly through the creation of national and subnational forums on climate change that hosts public hearings on the theme.

Interministerial Committee on Climate Change (*CIM*):

Leading Institution	Chief of Staff of the President of the Republic
Other institutions involved	Coordinated by the Chief of Staff of the President of the Republic, includes the following Ministries: Ministry of Agriculture, Livestock and Supply (*MAPA*); Ministry of Science, Technology and Innovation (*MCTI*); Ministry of Defense (*MD*); Ministry of Education (*MEC*); Ministry of Finance (*MF*); Ministry of National Integration (*MI*); Ministry of Health (*MS*); Ministry of Cities (*MCidades*); Ministry of Foreign Relations (*MRE*); Ministry of Mines and Energy (*MME*); Ministry of Agrarian Development (*MDA*); Ministry of Development, Industry and Foreign Trade (*MDIC*); Ministry of Environment (*MMA*); Ministry of Planning, Budget and Management (*MPOG*); Ministry of Transport (*MT*). It also includes the Secretariat of Strategic Affairs of the Presidency of the Republic (*SAE*) and the Brazilian Forum on Climate Change, as a guest.
Main objective of the institutional arrangement	To guide the development, implementation, monitoring and evaluation of the National Plan on Climate Change (Climate Plan).
Summary description of the institutional arrangement	The Interministerial Committee on Climate Change (*CIM*) was established by Decree no. 6263/2007 to elaborate a preliminary proposal for the general objectives, principles and means of implementation of the National Policy on Climate Change, as well as the preliminary *version* of the National Plan on Climate Change. The National Policy on Climate Change was officially created in December 2009. The National Plan on Climate Change was launched in December 2008 after an extensive public consultation and is currently under a updating process.
Additional Information	Decree no. 6263 of November 21, 2007

Executive Group on Climate Change (*GEx*):

Leading Institution	Ministry of Environment
Other institutions involved	Coordinated by the Ministry of Environment, includes the following components: Chief of Staff of the Presidency of the Republic; Ministry of Agriculture, Livestock and Supply; Ministry of Science, Technology and Innovation; Ministry of Finance; Ministry of Foreign Relations; Ministry of Mines and Energy; Ministry of Agrarian Development; Ministry of Development, Industry and Foreign Trade, Ministry of Planning, Budget and Management; and Secretariat of Strategic Affairs the Presidency of the Republic, in addition to the Brazilian Forum on Climate Change.
Main objective of the institutional arrangement	To develop, implement, monitor and evaluate the National Plan on Climate Change (Climate Plan), under the guidance of the Interministerial Committee on Climate Change (*CIM*).
Summary description of the institutional arrangement	The Executive Group on Climate Change, subordinated to the *CIM*, was established by Decree no. 6263/2007 to develop a preliminary proposal for the general objectives, principles and means of implementation of the National Policy on Climate Change and the National Plan on Climate Change. The *GEx* is also responsible for the coordination of policy instruments such as the action plans for the prevention and control of deforestation in the Brazilian biomes, the mitigation plans and adaptation to climate change all of which may effectively contribute to the implementation of the National Policy on Climate Change.
Additional Information	Decree no. 6263 of November 21, 2007 www.mma.gov.br/clima/grupo-executivo-sobre-mudanca-do-clima

Interministerial Commission on Global Climate Change (*CIMGC*):

Leading Institution	Ministry of Science, Technology and Innovation
Other institutions involved	Chaired by the Ministry of Science, Technology and Innovation, includes the following Ministries: Civil Office of the Presidency of the Republic; Ministry of Environment (Vice-chair); Ministry of Agriculture, Livestock and Supply; Ministry of Finance; Ministry of Foreign Relations; Ministry of Mines and Energy, Ministry of Transport, Ministry of Development, Industry and Foreign Trade, Ministry of Planning, Budget and Management and the Ministry of Cities.
Main objective of the institutional arrangement	To articulate government actions under the UNFCCC, mainly as Designated National Authority (DNA) for the Clean Development Mechanism (CDM).
Summary description of the institutional arrangement	The Interministerial Commission on Global Climate Change (*CIMGC*), created by the Presidential Decree of July 7, 1999, as amended by the Decree of January 10, 2006. The Commission has the mandate to provide subsidies for the elaboration of the Government's positions in negotiations under the Convention and subsidiary instruments, as well as considering CDM projects, in light of national strategies for sustainable development. The Commission also provides inputs on proposals for sectorial policies, legal instruments and standards containing component to the mitigation and adaptation to the impacts of climate change.
Additional Information	www.mct.gov.br/index.php/content/view/4016.html

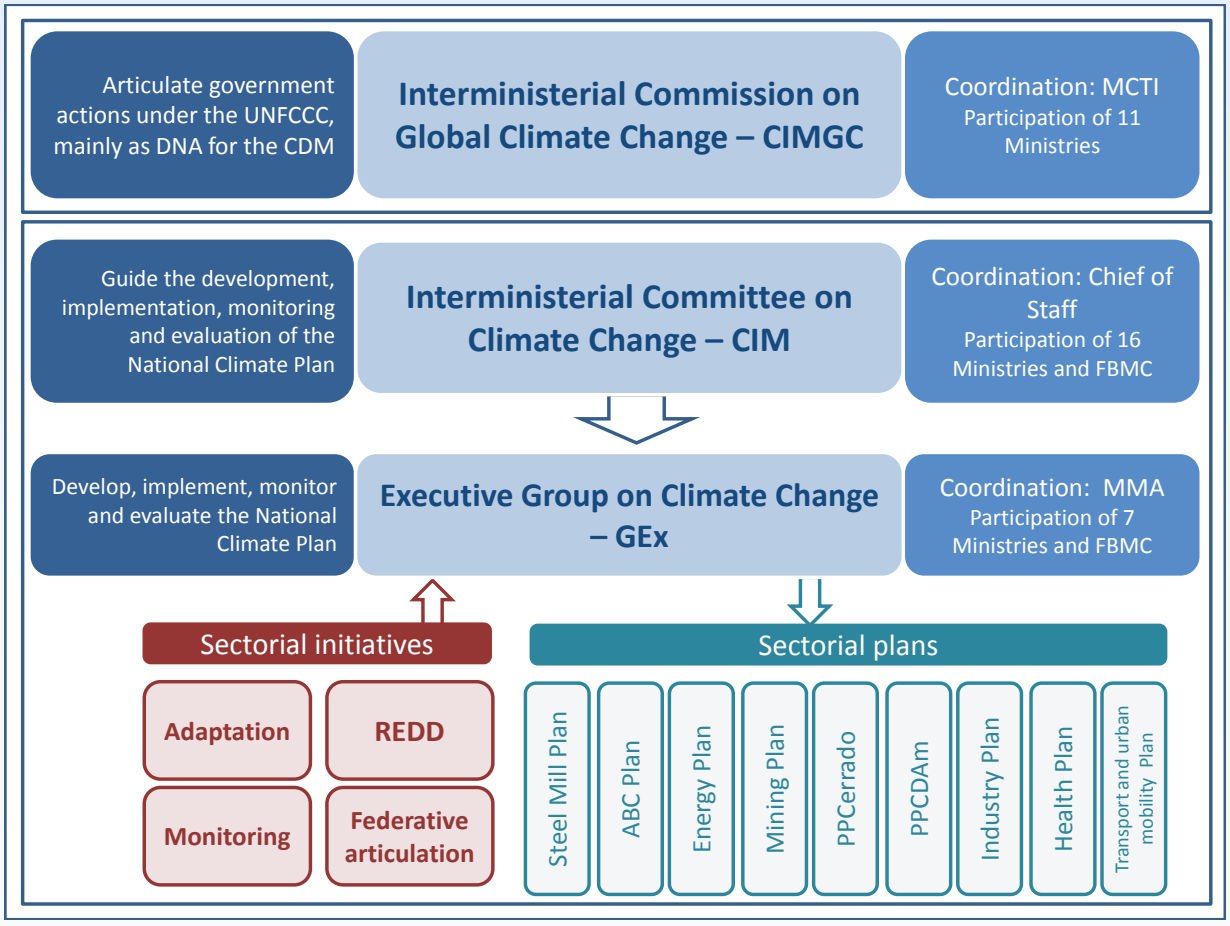

Figure 1: Institutional arrangement.

2. National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases Not Controlled by the Montreal Protocol

The preparation of the National GHG Inventory, herein referred to as Inventory, is in accordance with the guidelines for the elaboration of the National Communications of the Parties not included in Annex I to the Convention, established in decision 17/CP.8.

The methodological approaches and guidance used in the development of the National GHG Inventory was based on the following: *"Revised 1996 IPCC Guidelines for National Greenhouse Inventories" – Guidelines 1996; "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" – Good Practice Guidance 2000, and "Good Practice Guidance for Land Use, Land Use Change and Forestry" - Good Practice Guidance 2003*. Some of the estimates already take into account information published in the document *"2006 IPCC Guidelines for National Greenhouse Gas Inventories" - Guidelines 2006*.

The following table presents the results of the anthropogenic emissions by sources minus removals by sinks of greenhouse gases for the years 1994, 2000 and 2010, per type of gas and sector (Energy, Industrial Processes, Land-Use Change and Forestry, Use of solvents and other products, Agriculture and Waste).

The net emissions informed in the Second Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases Not Controlled by the Montreal Protocol were updated.

Due to the ongoing elaboration of the Third National Communication, which will contain the most recent data of the National GHG Inventory, the data provided in this BUR should be considered as provisional and are subject to revision, to be aligned with the Third National Communication, which is due to be submitted soon.

Table 1 - Greenhouse gas emissions by sources for 1994 in gigagram (Gg).

Sector	Unit	CO_2	CH_4	N_2O	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	CF_4	C_2F_6	SF_6	NO_x	CO	NMVOC
Energy	Gg	193,669	494.7	14.53										1,870.0	9,632.1	1,120.9
Industrial Processes		52,445	44.2	17.47	0.1566	-	-	0.0685	-	-	0.3231	0.0279	0.0140	52.9	834.3	364.5
Use of Solvents and Other Products																2,299.1
Agriculture			9,865.1	334.7										106.2	3,908.1	NE
Land use, Land use change and Forestry		820,888	1,213.8	48.72										592.8	21,291.3	NE
Waste		66	1,361.2	4.73												
TOTAL		1,067,068	12,979.0	420.12	0.1566	0.0000	0.0000	0.0685	0.0000	0.0000	0.3231	0.0279	0.0140	2,621.9	35,665.8	3,784.5
Bunker Fuels	Gg	7,298	0.0	0.13										1.7	0.7	6.8
Biomass Fuels		173,888														

Table 2 - Greenhouse gas emissions by sources for 2000 in gigagram (Gg).

Sector	Unit	CO_2	CH_4	N_2O	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	CF_4	C_2F_6	SF_6	NO_x	CO	NMVOC
Energy	Gg	267,646	511.8	18.99										2,273.3	8,181.0	987.4
Industrial Processes		67,042	43.7	21.14	-	-	0.0071	0.4988	0.0075	0.0001	0.1465	0.0117	0.0153	94.9	790.5	532.8
Use of Solvents and Other Products																3,154.0
Agriculture			10,382.3	355.9										97.2	3,576.4	NE
Land use, Land use change and Forestry		1,336,408	2,070.7	82.42										995.0	36,177.8	NE
Waste		95	1,754.2	5.68												
TOTAL		1,671,191	14,762.7	484.16	0.0000	0.0000	0.0071	0.4988	0.0075	0.0001	0.1465	0.0117	0.0153	3,460.4	48,725.7	4,674.2
Bunker Fuels	Gg	13,639	0.1	0.20										3.2	0.9	14.9
Biomass Fuels		166,435														

Table 3 - Greenhouse gas emissions by sources for 2010 in gigagram (Gg).

Sector	Unit	CO_2	CH_4	N_2O	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	CF_4	C_2F_6	SF_6	NO_x	CO	NMVOC
Energy	Gg	347,974	629.1	31.97										2,567.1	7,695.9	900.5
Industrial Processes		81,994	45.3	2.15	-	0.1059	0.5012	2.6671	0.4671	-	0.0767	0.0059	0.0087	100.8	809.6	736.8
Use of Solvents and Other Products																4,749.9
Agriculture			12,415.6	472.1										171.6	6,313.5	NE
Land use, Land use change and Forestry		402,255	1,759.7	82.04										1,128.6	33,257.1	NE
Waste		175	2,470.1	7.21												
TOTAL		832,398	17,319.8	595.45	0.0000	0.1059	0.5012	2.6671	0.4671	0.0000	0.0767	0.0059	0.0087	3,968.1	48,076.1	6,387.2
Bunker Fuels	Gg	18,550	0.2	0.27										4.3	1.1	21.4
Biomass Fuels		303,170														

The reduction of GHG emission in Brazil is mainly due to the drop in deforestation rates in the Brazilian biomes, especially in the Amazon, whose rate has been decreasing since 2004. Thus, Land Use Change and Forestry sector is responsible for the largest decrease in GHG emissions regardless of the common metric to be used (Global Warming Potential (GWP) or Global Temperature Potential (GTP)).

Other sectors increased absolute emissions compared to 1990. However, in 2010 those sectors had very satisfactory performance in relation to the projection for the year 2020 (based on Decree 7390/2010), much lower than those projected emissions. With reference to the GTP, the Agricultural sector has lower participation in total emission, in comparison with the Land Use, Land Use Change and Forestry sector and Energy sector.

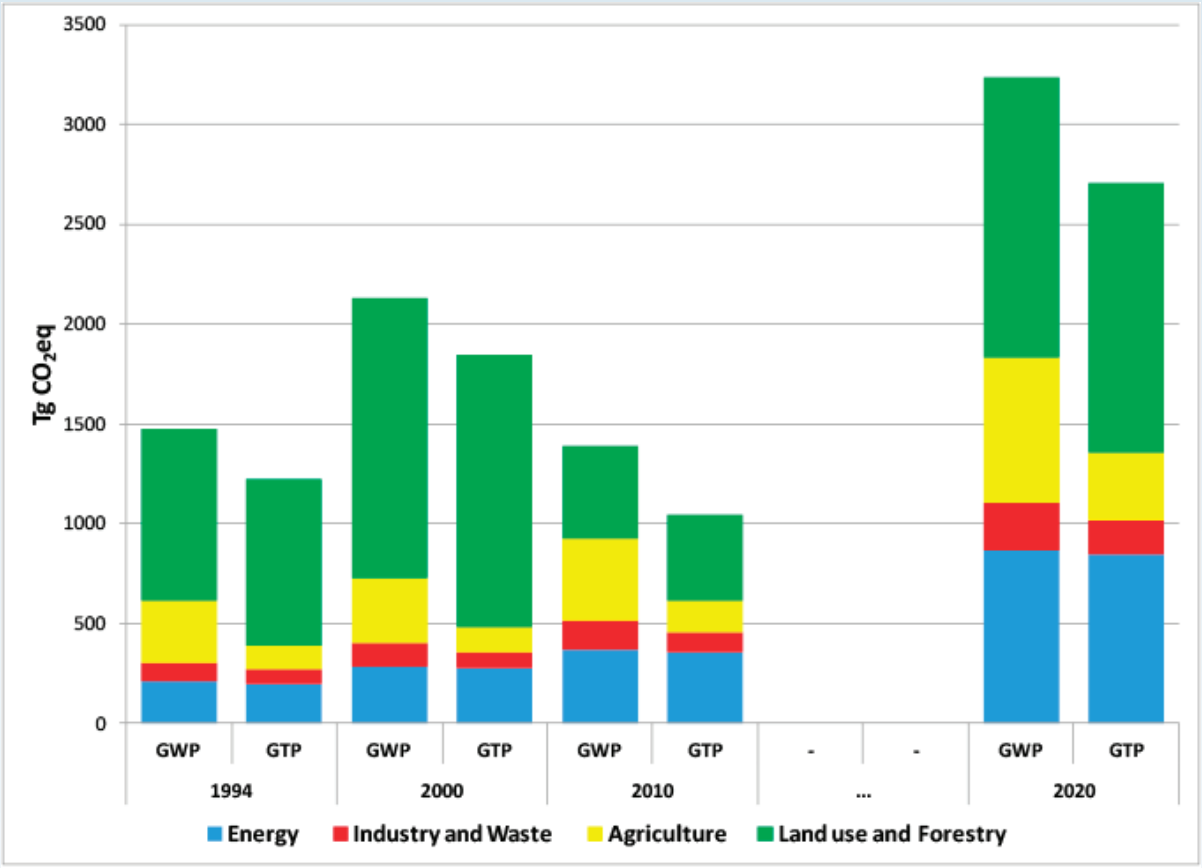

Figure 2 – GHG emissions by sector in Brazil (Tg CO_2eq – Metrics: GWP 100 and GTP 100 according to IPCC SAR/1995 and AR5/2013, respectively).

3. Mitigation Actions and their Effects

The mitigation actions presented below are the Nationally Appropriate Mitigation Actions (NAMA) informed to the Convention. The timeframe varies according to the beginning of the implementation of each specific activity, starting in 2004 and going up to until the first half of 2014. At national level the Brazilian government established Sectorial Plans as instruments to support the implementation of its NAMAs.

Table 04 - Mitigation Actions in Brazil

Name: National Plan for Low Carbon Emission in Agriculture (ABC Plan)	
Nature of the action: NAMA	
Sector: Agriculture	
Gas(es): CH_4, N_2O, CO_2	
Main objective: increase the area under sustainable agricultural production systems	
Description: Brazil has been investing in the sustainability of its agricultural sector. Through research and technology development, Brazil has achieved an important role in food production, by increasing productivity while maintaining almost constant the area under farming activity: in the last 35 years, Brazilian agricultural productivity has increased from 1.2 t/ha to 3.4t/ha. In this context, the ABC Plan was established in 2011, as one of the government's tools to promote the increase of area under sustainable agricultural practices. In order to promote the adoption by farmers of a set of technologies, developed within a conservationists agriculture framework, the Plan establishes a series of actions, involving training, technology transfer, establishment of Technological Reference Units, among others. The set of technologies promoted by the Plan (Recovery of Degraded Pasturelands, Integration Agriculture-Livestock-Forest and Agroforestry Systems, No-Tillage System, Biological Nitrogen Fixation, Planted Forests; Manure Management and Treatment) is a result of solid long time research, and have proven to increase agricultural productivity, integrating the concerns of soil and water conservation, as well as biodiversity, resulting in production systems that are more resilient to climate variability, adding to the efforts of maintaining the country's food production capacity in a context of global concern regarding food security. Further, the chosen set of technologies has also proven to reduce the GHG emissions originated from conventional farming activities, adding to the ongoing efforts by Brazil to reduce GHG emissions.	
Period considered: 2010 – 2014	
Specific objectives	**Progress achieved**
i. establishment of the Sector Plan for Mitigation and Adaptation to Climate Change for the Consolidation of an Economy of Low Carbon in Agriculture - ABC Plan	i. Sector Plan established in 2011

ii. transform 35,5 millions of hectares currently under poor agricultural practices into sustainable agricultural production systems by 2020	ii. Brazil has already invested to this point, through credit lines, almost USD $ 3.57 billion[5], covering around 30,000 contracts in private projects aiming at the improvement of agricultural production systems, according to the ABC Plan. A more detailed monitoring system is under development, in order to evaluate the effective area under transformation, which involves the mentioned projects added to private financed project. Under the governance of the Plan, 20,000 professionals where already trained, and further training activities are being planned for both technicians and farmers. Technological reference units as well as further research is being developed through the country in order to improve the possible production systems design, considering its large ecological and social diversity.

Name: Action Plan for the Prevention and Control of Deforestation in the Legal Amazon – PPCDAm

Nature of the action: NAMA

Sector: Land use, land use change and forestry (LULUCF)

Gas(es): CO_2

Description: The Action Plan for the Prevention and Control of Deforestation in the Legal Amazon – PPCDAm was launched in 2004, as an effort of Federal Government to reduce deforestation rates in Legal Amazon. PPCDAm identified a number of measures, policies and actions to reverse the deforestation trend. Since then, the Federal Government has been working in coordination with the various stakeholders, including governments at state and municipal levels as well as civil society, to promote a sustainable model of forest resource use and agricultural practices. PPCDAm is structured in three thematic axis that guide governmental actions towards reducing deforestation: i) Land Tenure and Territorial Planning; ii) Environmental Monitoring and Control, and iii) Fostering Sustainable Production Activities. The Plan is periodically revised for each of its phases, as follows: 1st phase (2004 - 2008), 2nd phase (2009-2011) and 3rd phase (2012-2015). The National Policy on Climate Change (Law 12,187) included PPCDAm as one of its instruments.

Main objective: Promote the continuous and consistent reduction of deforestation in the Amazon Region. According with Decree 7,390, which regulates the National Policy on Climate Change, Brazil committed to reduce, by 2020, 80% of the annual rate of deforestation relative to the average annual gross deforestation in the period 1996 to 2005 (km^2), inclusive.

Period considered: 2004 – 2013

Specific objectives	Progress achieved
Promote the land ordering of public lands	Creation of 50 million hectares of conservation units (at federal and state levels) (2004 - 2011) 10 million hectares of indigenous lands approved (2004 - 2011) More than 1 million hectares of intended public lands (2012 and 2013)
Implement the instruments of spatial planning aiming at the conservation of the forest	Preparation of MacroZEE (Macro Ecological and Economic Zoning System) forf the Legal Amazon (2004 - 2011) Support for the preparation of state and regional ZEEs (Ecological and Economic Zoning) (2012 - 2013) Implementation of conservation units (2012 - 2013) Resolution of land conflicts in conservation units and indigenous lands (2012 - 2013)

5 Equivalent to BRL $ 8 billions, considering conversion rate of USD $ 2.405.

Increase the effectiveness of the monitoring and control activities	Establishment of satellites monitoring systems (STOP,- Terraclass, DEGRAD) (2004 - 2011) Improvement of DETER, improving the spatial resolution (DETER-AWIFS). Continuity of the historical series of DEGRAD and Terraclass (2012 - 2013) More than $ 4 billion[6] in fines, in addition to 850 thousand ha of interdicted areas (2004 - 2013) Strengthening of the enforcement actions in federal conservation units and deployment of operational bases in the units (2012 - 2013) Dismantling criminal groups which violated the system of forest control (2012 - 2013)
Promote the environmental responsibility of the main productive chains related to illegal deforestation	Institution of Sectorial Pacts with the business sector to reduce deforestation and the environmental responsibility of the productive chains (Soy Moratorium, Legal Timber) (2006 - 2013) Institution of the Rural Environmental Registration Law no. 12,651 (2012)
Promote the viability of productive chains that are alternatives to deforestation	Incentives for the marketing of biodiversity products through the Guarantee Policy of Minimum Prices for Products of Biodiversity - PGPM-Bio (2009-2013)
Promote good agricultural practices, including the replacement of the use of fire	1482 (571 technicians, 1911 multipliers) people trained in good agricultural practices (2012-2013) 26 Technological Reference Units deployed for the dissemination of crop - livestock - forest integration techniques (ILPF) (2012-2013) 10 projects implemented to disseminate good agricultural practices without the use of fire (2012-2013)
Increase the production and marketing of wood through Sustainable Forest Management	Granting of 136 thousand hectares of Public Forests for Sustainable Forest Management (2004 - 2013)
Promote environmental adaptation and foster sustainable productive activities in settlements of agrarian reform and in Family Agriculture	Incentives for the marketing of products of family farming by means of institutional markets and subvention (2004-2013) 533 environmental permits filed for agrarian reform settlements in the Legal Amazon in their respective state environment organizations (2004-2011) 13,852 families assisted in projects for the management of natural resources in settlements, aiming at the recovery of Areas of Permanent Preservation and Legal Reserves, and adoption of sustainable production practices (2004-2011) Creation of the Green Settlements Program (2012-2013)
Generate C, T & I on the Amazon in order to subsidize the sustainable development	US$2.6[7] billion were invested in projects of scientific research and technological innovation in the Biotechnology Center of the Amazon (2012 - 2013)

Name: Action Plan for the Prevention and Control of Deforestation and Forest Fires in the Cerrado biome - PPCerrado

Nature of the action: NAMA

Sector: Land use, land use change and forestry (LULUCF)

Gas(es): CO_2

6 Taking as a basis the average value of the commercial dollar for the 2004 to 2013 period (R$ 2.086733). Source: http://economia.acspservicos.com.br/IEGV/IEGV_DOLAR.HTM

7 Taking as a basis the average value of the commercial dollar for the 2012 to 2013 period (R$2.056167). Source: http://economia.acspservicos.com.br/IEGV/IEGV_DOLAR.HTM

Description: The Cerrado biome has been included as a priority area for actions of prevention and control of deforestation and fires in the National Policy on Climate Change - PNMC (Law 12,187/2009). Thus, the PPCerrado, created by the Presidential Decree of September 15, 2010, was established as one of the main instruments of the PNMC. Developed from the successful experience of the PPCDAm, the PPCerrado also has 3 action axes: 1) Monitoring and Control; 2) Protected Areas and Land use Planning; and 3) Fostering Sustainable Activities. Currently, the Plan is undergoing a revision.

Main objective: The general objective of PPCerrado is to promote the continuous reduction of the rate of deforestation and forest degradation, as well as the incidence of forest fires in the Cerrado biome, through linkage of actions and partnerships between the Central Government, the States, Municipalities, civil society organizations, business sector and universities. In accordance with the Decree 7390/2010, which regulates the National Policy on Climate Change, Brazil committed domestically to reduce, by 2020, 40% of the annual rate of deforestation relative to the annual average rate from 1999 and 2008, i.e., reduction of 15,701 sq. km^2 to 9,420 km^2 per year. The PPCerrado, as an instrument of PNMC, shares the responsibility for the attainment of this objective.

Period considered: 2010 – 2011

Specific objectives	Progress achieved
Promote sustainable forest management	Preparation of reference guides on Sustainable Forest Management of 5 non-timber products native from Cerrado.
Expand and qualify the technical assistance and rural extension in sustainable production models	Training of 1,035 rural producers in the use of sustainable models of production (crop-livestock-forest, no tillage, organic agriculture and SAF). Provision of technical assistance for sustainable activities (agroforestry, organic agriculture, crop-livestock and no-tillage) to 100.921 families.
Encourage the marketing and consumption of products of biodiversity	Inclusion of 3 new products in the Guarantee Policy of Minimum Prices - PGPM (baru - fruit of Dipterys alata, mangaba - fruit of Hancornia speciosa and umbu - fruit of Spondias tuberosa) and 1 in the National Policy of School Feeding - PNAE. Acquisition of 8,061 tons of products of agro-extractivism and biodiversity by the Food Purchase Program - PAA. Support 6 projects for the strengthening of the social and productive organization of traditional and extractive communities, and 15 projects to support sustainable production of indigenous peoples and the environmental management of their lands.
Recover degraded areas in Legal Reserves and Permanent Preservation Areas	Implementation of 7 Reference Centers in Recovery of Degraded Areas (CRADs)
Strengthen the integrated surveillance of deforestation in special areas (Conservation Units and Indigenous Lands) and areas of priority for the conservation of biodiversity and water resources	Perform the Corcel Negro II operation, which supervised the chain of the coal produced for the steel industries
Enhance the prevention and control of forest fires	Training of 630 and hiring of 490 brigadiers in Federal Conservation Units in the Cerrado Deployment of two Operational Bases for Preventing and Fighting Forest Fires, in ESEC Serra Geral of Tocantins and PARNA Serra do Cipó Training of 3,646 fire fighters in municipalities with a high occurrence of forest fires

Create and consolidate protected areas (Conservation Units and Indigenous Lands) for the conservation of biodiversity and the sustainable use of natural resources	Registration of 17,294,941ha of public forests in the Cerrado Declaration of the traditional possession of 5 Indigenous Lands Completion of studies concerning the 3 areas for the creation of Conservation Units: Nascentes Juruena, Nascentes Rio Papagaio and RESEX Retireiros do Médio Araguaia
Promote the territorial planning of the Cerrado biome	Conclusion of the proposes of Ecologic-Economic Zoning for the Parnaiba and Tocantins-Araguaia rivers basins, where the MacroZEE (Macro Ecological and Economic Zoning System) of the Cerrado biome is under preparation

Name: Increase in the Supply of Energy by means of Hydroelectric Plants

Nature of the action: NAMA

Sector: Energy

Gas(es): CO_2eq

Description: Introduction of hydroelectric power plants to supply electricity to replace the implementation of thermoelectric plants

Main objective: Increase the hydroelectric power in the National Energy Matrix

Period considered: 2005 – 2013

Specific objectives	Progress achieved
Granting of hydroelectric plants	Concessions of Hydroelectric Power Plants from 2005 until 2013 (Source: -Ministry of Mines and Energy). Total Installed Capacity of power plants in the period: 35,493 MW

Name: Use of Alternative Energy Sources

Nature of the action: NAMA

Sector: Energy

Gas(es): CO_2eq

Description: Introduction of wind power plants, small hydroelectric power stations (PCH) and electricity generation from biomass to supply electricity to replace the implementation of thermoelectric plants.

Main objective: Increase of alternative sources in the National Energy Matrix

Period considered: 2004 – 2013

Specific objectives	Progress achieved
Granting of Small Hydroelectric Power Plants, Biomass Thermal Power Plant sand Wind Power Plants	Concessions of alternative sources from 2004 until 2013. (Source: Ministry of Mines and Energy). Total Installed Capacity in the period: PCH 2,157 MW; Biomass 6,129 MW; Wind Power: 13,585 MW

Name: Increased Use of Biofuels	
Nature of the action: NAMA	
Sector: Energy	
Gas(es): CO_2eq	
Description: Increase the supply of anhydrous and hydrated ethanol, as well as biodiesel to replace fossil fuels	
Main objective: Increase the amount of Biofuel in the National Energy Matrix	
Period considered: 2004 – 2013	
Specific objectives	**Progress achieved**
Supply of anhydrous and hydrated ethanol and biodiesel	Domestic supply of ethanol in the period from 2004 to 2013 (Source: National Agency of Petroleum, Natural Gas and Biofuel - ANP): 226,682,000 m^3. Domestic supply of biodiesel in the period from 2005 until 2013. (Source: National Agency of Petroleum, Natural Gas and Biofuel - ANP): 13,943,773 m^3 Mandatory addition of biodiesel to fossil diesel in the percentage of 7% as per law 13,033/2014.
Name: Implementation of Energy Efficiency	
Nature of the action: NAMA	
Sector: Energy	
Gas(es): CO_2eq	
Description: Reducing the use of fossil fuels and electricity through the increase of energy efficiency in different sectors of the economy.	
Main objective: Reducing the consumption of fossil fuels and electric power	
Period considered: 2004 – 2013	
Specific objectives	**Progress achieved**
Reduction of electric power consumption	National Electrical Energy Conservation Program (Procel). The results of the electricity savings from 2004 to 2013: 52.8 million MWh saved. (Source: Procel).
Reducing the consumption of fossil fuels	National Program for Rational use of Oil Products and Natural Gas (Conpet) - results of Conpet during the period from 2005 until 2013: more than 1 billion liters of diesel oil saved and more than 6 million m^3 of Petroleum Liquefied Gas (GLP) saved (Source: Conpet)
Regulations of minimum rates for electrical equipment	Specific CGIEE Regulations (Managing Committee of Energy Efficiency Indicators): Ordinances regulated with minimum rates until 2010. Three-phase Electric Engines - Decree 4,508 of 11 December 2002; Compact Fluorescent Lamps - Interministerial Ordinance No 132 of 12 June 2006; Refrigerators and freezers - Interministerial Ordinance No 362 of 24 December 2007; Stoves and Gas Furnaces - Interministerial Ordinance →

Regulations of minimum rates for electrical equipment	➔No 363 - December 24, 2007; Gas Water Heaters - Interministerial Ordinance No 298, 10 September 2008; Reactors for Electromagnetic Sodium Vapor and Metal Halide Lamps, Interministerial Ordinance #959, December 09 2010; Incandescent lamps - Interministerial Ordinance #10077 of 31 December 2010.

Name: Sustainable Charcoal for iron and steel production

Nature of the action: NAMA

Sector: Industrial processes and Energy

Gas(es): CO_2 and CH_4

Main objective: To promote the sustainable production of charcoal used as an input in the production of iron and steel

Description: The main objective of this mitigation action is to promote the sustainable production of charcoal used as an input in the production of iron and steel, aimed at reducing emissions and increasing the competitiveness of the sector. The transition to sustainability involves the development of solutions for the adequate supply of sustainable raw material (planted forests, forest management, wood residues) for charcoal production as well as development and diffusion of more efficient charcoal production technologies that increase efficiency in the conversion of wood into charcoal and ensure environmental quality improvement and GHG emissions monitoring.

Period considered: 2010 – 2013

Specific objectives	Progress achieved
Reduce emissions in 8 to 10 Million tons of CO_2 by replacing the use of native forest for planted forest to produce charcoal used as a thermo-reducer in the production of pig-iron.	The Brazilian Government launched, in 2010, specific Emission reduction Plan to support the achievement of this goal. The first phase of the Plan was implemented from 2010 to 2013 and the Plan is currently under revision to assess the impact of the international economic crisis of 2008 on the pig-iron sector and the need for adjustment in the Plan's strategy and targets. MDIC commissioned a survey of the sector by leading experts with the participation of private sector representatives associations. In the first period of the Plan, the main actions were the creation of specific credit lines to finance planted forests and technology's development – particularly more efficient kilns and environmental monitoring technology – from BNDES (Climate Fund, Forestry BNDES, etc.) and FINEP (Inova-Energy) and the engagement of public and private sector that resulted in the adoption of voluntary measures by industry associations (IABr, Ethos Institute) to increase the sustainability of the sector. The Government and the private sector also started the development of new sustainable production standard by the National Association of Technical Standards (ABNT). The enforcement of national legislation against deforestation and the intensification of enforcement actions reduced the supply of illegal charcoal and the voluntary initiatives from the private sector resulted in a reduction in the use of native forest in the charcoal production from 3,8 million tons in 2008 to 1,9 million tons in 2012, reducing the percentage of native forest in charcoal production from 51% to 33%.

3.1 Clean Development Mechanism (CDM) projects in Brazil: a brief summary

Project activities under the CDM in Brazil are an opportunity for the country to join the global effort against climate change, receiving foreign funding and technology for the implementation of emission reduction projects. The country occupies a prominent position in the global framework of the CDM, both in terms of number of projects, such as GHG emission reduction potential, with a great potential for growth.

In Brazil, the Interministerial Commission on Global Climate Change (CIMGC) is responsible for the evaluation of CDM projects (see section 1.2), which considers the following aspects: voluntary participation by each party, Project Design Document (PDD), Validation Report and the project's contribution to sustainable development. Regarding contribution to sustainable development, five criteria are assessed: income distribution, local environmental sustainability, development of working conditions and net job creation, training and technological development, and regional integration and articulation with other sectors.

In November 2014, Brazil had a total of 330 projects registered by the CDM Executive Board, equivalent to 4.4% of the global total, occupying the 3rd position in number of projects registered. As for the reduction of GHG emissions projected through the CDM, the Brazilian potential of registered projects until November 2014 was about 370 million tons of CO_2 equivalent (CO_2eq) – for the first crediting period (in maximum 10 years for fixed period projects or 7 years to renewable period projects). It means that Brazilian CDM projects registered with the UNFCCC contribute to an average reduction of greenhouse gas emissions of approximately 48 million tons of CO_2eq per year.

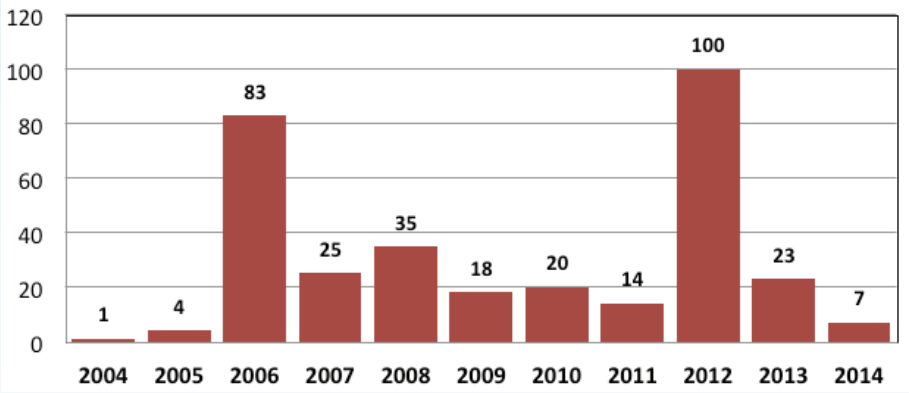

Figure 3 - Registered Brazilian project activities in the CDM Executive Board until November 30, 2014

3.1.1 Distribution of project activities in Brazil by sectorial scope and type of Project

This indicator shows the sectorial scopes that have attracted the interest of CDM project participants in the country. The Energy Industry leading with 197 projects, followed by Waste treatment and

disposal (82), 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 by project type, the Hydropower led with 26.4%, followed by Biogas with 19.1%, Wind Power Plants 16.4%, Landfill Gas 15.2% and Biomass energy 12.4%. The project types with the highest estimate of CO_2eq emission reduction were the Hydropower project, Landfill Gas and N_2O decomposition, which totaled 72.5% of total CO_2eq emissions to be reduced in the first period crediting. These three sectors had an emission reduction estimated 269,029,763 t CO_2eq during the first crediting period of the project activities.

Table 5 – Project activities distribution in Brazil by type of Project

Types of Projects	Number of CDM project activities	% Number of CDM project activities	Estimated GHG reduction (tCO_2eq)[7]	% Estimated GHG reduction (tCO_2eq)[7]
Hydroeletric	87	26.4%	137,088,500	37.0%
Biogas	63	19.1%	24,861,823	6.7%
Wind Power	54	16.4%	40,968,209	11.0%
Landfill gas	50	15.2%	87,280,381	23.5%
Biomass Power	41	12.4%	16,091,394	4.3%
Substitution of Fossil Fuel	9	2.7%	2,664,006	0.7%
Methane Avoided	9	2.7%	8,627,473	2.3%
Decomposition of N_2O	5	1.5%	44,660,882	12.0%
Utilization and heat recovery	4	1.2%	2,986,000	0.8%
Reforestation and Afforestation	3	0.9%	2,408,842	0.6%
Use of Materials	1	0.3%	119,959	0.0%
Photovoltaic Solar Energy	1	0.3%	6,594	0.0%
Energy Efficiency	1	0.3%	382,214	0.1%
Replacement SF_6	1	0.3%	1,923,005	0.5%
PFC reduction and Replacement	1	0.3%	802,860	0.2%
Total	**330**	**100.0%**	**370,872,142**	**100.0%**

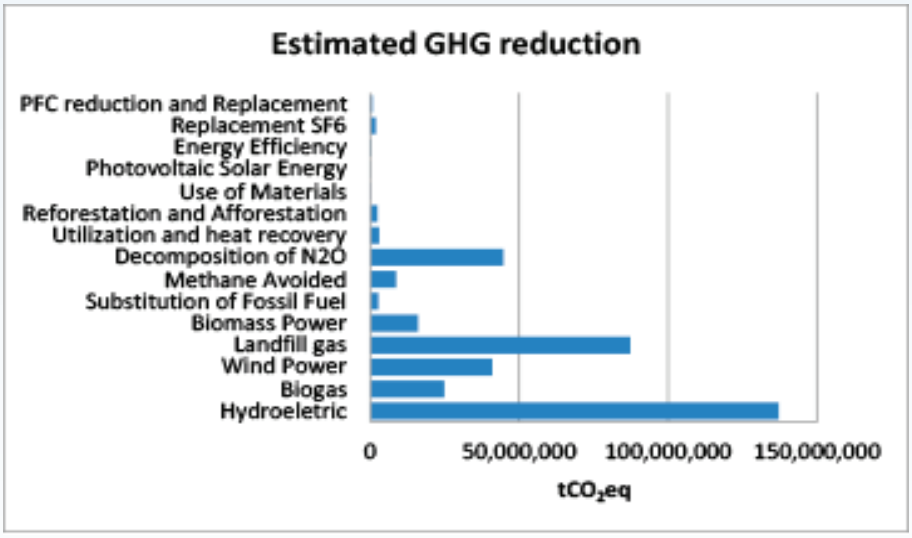

Figure 4 – Estimated GHG reduction by CDM project activities.

4. Constraints and gaps, and related financial, technical and capacity needs; Information on support received

4.1 Constraints and gaps, and related financial, technical and capacity needs

Due to the country dimensions and diversity in terms of social, economic and environmental factors, the information presented in this chapter shall be regarded as provisional and partial, as it was not possible to have an in-depth consideration of all aspects relevant to the identification of constraints and gaps, and related financial, technical and capacity needs in Brazil, in time to be presented at this first BUR. The information below captures some indication of interest from sectorial agencies on further developing international cooperation in priority areas, without excluding other areas of interest to be identified in the future.

On January 28, 2014, the Ministry of Science, Technology and Innovation (*MCTI*) was designated as the Brazilian National Designated Entity (NDE) to the Climate Technology Center and Network (CTCN), part of Technology Mechanism of the Convention. Since then, *MCTI* has held meetings with representatives of federal agencies responsible for the Sectorial Plans with the aim of establishing partnerships for the definition of institutional criteria and regulatory framework for the effective operationalization of the NDE. This is an ongoing work which will provide better clarity regarding technological constraints and gaps and related needs.

Furthermore, there is the need to enhance and expand bilateral technical cooperation in some specific areas, and to promote the exchange of knowledge, tools and technologies to increase the effectiveness of the actions proposed in sectorial plans.

The Brazilian government through the Ministry of Cities would be interested in exploring technical cooperation opportunities to advance its sectorial plan related to promoting sustainable cities, transport and urban mobility:

- Technical Cooperation for greater efficiency in the urban water supply systems aiming at improving of the efficient use of electrical power in sanitation service providers, thus reducing greenhouse gas emissions and the loss of water.
- Use and management of solid waste – Cooperation for the strengthening of the management and intelligent use of solid waste.
- Energy Efficiency in Social Interest Housing (HIS) buildings – Technical Cooperation for the development of cheaper and environmentally sustainable houses through the employment of new and diverse raw materials, architectural projects that may reduce the consumption

of electricity and water, as well as building techniques that may reduce the construction wastes (rubble).

- Increase the capacity and scope of the project to include biogas use.
- Technical cooperation with the purpose of promoting greater exchange of knowledge, tools and technologies in the preparation and implementation of projects of integrated urban development, encompassing the areas of spatial planning, housing, sanitation, mobility and urban transit, in compliance with the laws and other regulations of each country. Such actions may result in a reduction of greenhouse gas emissions due to the more efficient management, for example, of urban mobility, waste disposal, public transport and transit and planning of the cities.

Additionally, there have been positive results from the country's efforts to increase the agricultural areas under sustainable production systems. In particular, the *ABC* Plan has been very well received by implementation partners and farmers. The technological background is solid, as are the institutional arrangements and frameworks that established a well thought process. While the country is optimistic in achieving the established goals, there are still many challenges to be overcome, considering the country's territorial extension and diversity, both biological and cultural. These challenges are exacerbated by the impacts of climate change, as well as the increasing demand for food, among others. Therefore, the Brazilian government welcomes close interaction and cooperation, in order to maintain the progress achieved, develop new strategies for institutional structure, society involvement and learning processes, as well as catalyze ongoing actions, by accelerating the implementation of some activities. Other areas could be also further developed in cooperation, such as evaluation and impact analysis, research in some key technologies, monitoring, among others.

Regarding the Action Plans for the Prevention and Control of Deforestation in the Brazilian biomes, the main challenges are related to engagement and integration among different government sectors, awareness and dissemination of the importance of plans and evaluation of public policies. The list below presents international cooperation opportunities for the Cerrado and Amazon biomes.

Action Plan for Prevention and Control of Deforestation in the Amazon – *PPCDAm*:

- Support to the states in development - implementation - monitoring & evaluation cycles - review of State Plans for Prevention and Control of Deforestation (PPCDs);
- Support for the integration of state and federal initiatives through seminars, workshops, exchange of experiences;
- Development of implementation scenarios of public policies and pilot projects for promoting sustainable production and a forest economy;
- Evaluation of contribution of public policies for reducing deforestation;
- Development of pilot projects for structuring of sustainable production and supply chains;
- Technical support to sustainable settlements;
- Pilot project to test model agreements between major projects and the local social and economic development;
- Support for the pastures and degraded areas restoration and incentives.

Action Plan for Prevention and Control of Deforestation and Fires in the Cerrado – *PPCerrado*:

- Support the implementation of *PPCerrado*;
- Raising awareness at national and international levels on the importance of the Cerrado;
- Support the development of local and state strategies for deforestation prevention and control;
- Development of research projects for recovery of Cerrado degraded areas;
- Support to small farmers for the development of sustainable production chains;
- Development of a training program on sustainable production techniques for small producers;
- Development of monitoring protocols for degradation in the Cerrado.

Common to the both Plans:

- Development of a pilot initiative of payment by results for recovery of degraded areas in rural properties;
- Support for studies about main *commodities*, their impact on biomes deforestation and direction of public policies;
- Strengthening South-South cooperation, especially with other tropical countries with interest in forest recovery.

4.2 Information on the support received

Some criteria have been defined for the presentation of information on financial support received:

- The table includes resources on a grant or concessional basis received from bilateral and multilateral channels for climate-specific actions, in line with the principle of additionality of climate finance, as per article 4.3 of the UNFCCC.
- Due to lack of precise guidelines for MRV of support and a consequential lack of available information, resources directed to the private sector were not included.
- The table does not include resources received directly by subnational entities.

Other partners in promoting sustainable development in Brazil through bilateral cooperation have not been included in the table below due to different approaches for accounting the provision of support and cooperation, which could not be effectively assessed or were not encompassed by the criteria above.

Table 06 - Financial support received by Brazil, information provided by funding source, grouped per year (all values presented in US dollars).

Financial support received in the context of Climate Change								
Source	**1996**	**1997**	**1998**	**1999**	**2001**	**2004**	**2005**	**2006**
Inter-American Development Bank (IDB)						120,000.00		
Global Environment Facility (GEF)	1,500,000.00	3,750,000.00		15,000,000.00	12,274,000.36		3,400,000.00	21,000.00
International Bank for Reconstruction and Development (IBRD)								
Other multilateral channels			858,000.00					
Bilateral (Norway)								
Bilateral (Federal Republic of Germany)								
Bilateral technical cooperation								

Financial support received in the context of Climate Change								
Source	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**TOTAL (USD)**
Inter-American Development Bank (IDB)				1,900,000.00				2,020,000.00
Global Environment Facility (GEF)		3,305,000.00	17,786,000.00	47,273.00	6,180,000.00	20,678,500.00		83,941,773.40
International Bank for Reconstruction and Development (IBRD)				10,000,000.00				10,000,000.00
Other multilateral channels					37,500,000.00			38,358,000.00
Bilateral (Norway)		20,960,578.70	28,283,364.59		62,966,809.05	646,378,595.78		758,589,348.12
Bilateral (Federal Republic of Germany)[8]		3,750,000.00	3,952,500.00	7,500,000.00		7,864,832.89	16,505,874.51	39,573,207.40
Bilateral technical cooperation[8]	8,627,044.14	2,633,678.75	2,167,885.00	3,390,649.43				16,819,257.31

8 The original values were in Euro, the conversion rate considered is 1 Euro = 1,25 USD (http://www4.bcb.gov.br/pec/conversao/conversao.asp). The values in Euro were to "Bilateral (Germany)" 3,000,000.00 € in 2009 and 6,000,000.00 € in 2011; and to "Bilateral technical cooperation" 6,901,635.31 € in 2008, 2,106,943.00 € in 2009, 1,734,308.00 € in 2010 and 2,712,519.54 € in 2011.

5. Funds received for the preparation of the BUR

Pursuant to the guidelines for the preparation of the biennial update reports, the Brazilian government has prepared this first BUR with a view to enhance transparency on mitigation actions, as well as on finance, technology and capacity-building support needed and received.

Without prejudice to any future request for financial support in subsequent update reports or in any other communications, in accordance with articles 4.3, 4.7 and 12 of the Convention, the Brazilian government has elaborated this first BUR concurrently to the efforts to prepare the country's Third National Communication.

The team involved in the preparation of this BUR would like to acknowledge the support provided by the Consultative Group of Experts (CGE), through the organization of two training workshops on the preparation of BUR, which significantly contributed to facilitate the preparation of this document.

6. Information on the description of domestic measurement, reporting and verification arrangements (MRV)

In order to establish a robust measurement, reporting and verification arrangement, Brazil is developing and implementing a modular system (SMMARE, *Sistema Modular de Monitoramento e Acompanhamento das Reduções de Emissões de Gases de Efeito Estufa*) to monitor actions and GHG emission reductions to be achieved through the Brazilian Climate Change Mitigation Plans. This system also aims at supporting the analysis and management of the mitigation actions implemented by Brazil. It is being developed by the Ministry of Environment.

The SMMARE is being designed as a tool to provide information, in particular in relation to the mitigation actions implemented in each Mitigation Plan and its associated methodologies and assumptions, the progress made in their implementation and information on domestic measurement, reporting and verification. SMMARE can also be used for the purposes of performance-based payment, once the GHG emissions reduction results can be made available through system.

Two scenarios are envisaged under SMMARE:

(1) monitoring GHG emissions reductions based on existing data (and/or data that can be easily obtained), which can be implemented at a national level in the short-term;

(2) monitoring GHG emission reduction at a disaggregated level that would require improved data collection to enable spatial analyses of emission reductions.

Each Mitigation Plan under SMMARE has a specific monitoring module based on methodologies contained in IPCC Guidelines for National Greenhouse Gas Inventories.

Since the Mitigation Plans are in different stages of implementation and they are substantially different in terms of mitigation actions, each Mitigation Plan will be associated to a "Monitoring Module" in the SMMARE that will be implemented in different points of time.

The first results are envisaged to come from voluntary actions which have been informedsince COP 15. These actions are being implemented in accordance with the principles and provisions of the Convention, particularly Article 4, paragraph 1, Article 4, paragraph 7, Article 12, paragraph 1 (b), Article 12, paragraph 4 and Article 10, paragraph 2 (a). The actions are listed below:

- Reduction in Amazon deforestation;
- Reduction in Cerrado deforestation;
- Restoration of grazing land;
- Integrated crop-livestock system;
- No-till farming;
- Biological N_2O fixation;
- Energy efficiency;
- Increase the use of biofuels;
- Increase in energy supply by hydroelectric power plants;
- Other renewable energy sources;
- Charcoal (iron and steel).

The use of the CDM is not excluded.

A group of experts from each sector, with wide experience on national GHG inventory planning, implementation and review, was invited to support the development of the Monitoring Modules (i.e. the procedures and methodologies necessary for monitoring the GHG emissions reduction achieved through the several actions of the Mitigation Plans).

The coordination of such development was conducted by the Center for Strategic Studies and Management (*CGEE* – a non-profit organization with the mission of rendering Science, Technology and Innovation as Brazil's best allies for economic growth, competitiveness and well-being) under the supervision of the Ministry of Environment. The system was conceived during a one year process and extensive and continuous dialogue with all the Ministries responsible for each Mitigation Plan.

Several institutions are being invited to participate in the SMMARE design and implementation and the final list will depend on the results of on-going negotiations.

It is worth mentioning that all these institutions have the necessary technology and human capital to implement the Monitoring Modules, under the supervision of correspondent Ministry responsible for the Mitigation Plan as well as the general coordination of Ministry of Environment.

The SMMARE is planned to be supported by a software platform that will ensure transparency and cost effectiveness to the system. Each Monitoring module will have its own software application with features to gather the data and to calculate the indicators of the GHG emissions reduction required to assess the goals established in the Mitigation Plan. Each Monitoring Module are expected to share information through standardized interfaces, in order to provide centralized coordination and supervision of the efforts undertaken by the country. The Monitoring Modules will encompass the following elements:

- List of mitigation actions assessed (including their stage of implementation);
- Methodological assumptions;
- Results per mitigation action – "Indicators" (disaggregated at the appropriate level, and to the extent possible, according to the scenario in which the monitoring takes place);
- Quality Assurance and Quality Control procedures.

The experience in the development and implementation of the SMMARE led to the following understanding:

1 - The participation of technical experts, with wide experience in national GHG inventory planning, implementation and review in the development phase has been vital to achieve methodological robustness;

2 - Each Mitigation Plan should have a Monitoring Module, able to assess the GHG emissions reduction achieved through the actions implemented by each Plan;

3 - The on-going dialogue with the Ministries responsible for each Mitigation Plan will provide the necessary political and operational guidance for each Monitoring Module;

4 - The use of "external" institutions, with the necessary technology and human capital, will produce the key Indicators for each Monitoring Module in a cost effective manner;

5 - A software platform connecting all Monitoring Modules will ensure transparency and cost effectiveness to the system;

6 - A general coordination is necessary to promote synergies and avoid the duplication of efforts.

Therefore, the SMMARE will be an official system to assess and manage the results of the mitigation actions and their achievement under the Brazilian National Climate Change Law.

7. Technical Annex pursuant to decision 14/CP.19

Results achieved by Brazil from Reducing Emissions from Deforestation in the Amazon biome for REDD+ results-based payments

Coordination:

Ministry of Environment (MMA)

Ministry of Science, Technology and Innovation (MCTI)

Working Group of Technical Experts on REDD+:

Ministry of Science, Technology and Innovation, National Institute for Space Research (MCTI/INPE)

Ministry of Science, Technology and Innovation, National Institute of Amazon Research (MCTI/INPA)

Foundation for Space Science, Applications and Technology (FUNCATE)

University of São Paulo (USP)

Ministry of Environment, Brazilian Institute for the Environment and Renewable Natural Resources (MMA/IBAMA)

Ministry of Environment, Brazilian Forest Service (MMA/SFB)

Federal University of Goiás (UFG)

Ministry of Agriculture, Livestock and Supply, Brazilian Enterprise for Agricultural Research (MAPA/EMBRAPA)

University of Brasilia (UnB)

Brazilian Research Network on Global Climate Change (Rede CLIMA)

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1. Introduction

Brazil welcomes the opportunity to submit a Technical Annex to its Biennial Update Report (BUR) in the context of results-based payments for reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) under the United Nations Framework Convention on Climate Change (UNFCCC).

Brazil underlines that the submission of this Technical Annex with REDD+ results is voluntary and exclusively for the purpose of obtaining and receiving payments for REDD+ actions, pursuant to Decisions 13/CP.19, paragraph 2, and 14/CP.19, paragraphs 7 and 8[9].

This submission, therefore, does not modify, revise or adjust in any way the Nationally Appropriate Mitigation Actions (NAMAs) currently being undertaken by Brazil pursuant to the Bali Action Plan (FCCC/AWGLCA/2011/INF.1), neither prejudges any nationally determined contribution (NDC) by Brazil in the context of the protocol, another legal instrument or an agreed outcome with legal force under the Convention currently being negotiated under the Ad Hoc Working Group on the Durban Platform for Enhanced Action.

This submission was developed by the Brazilian government with the support of the Working Group of Technical Experts on REDD+, created in February 2014 by the Ministry of Environment (MMA) through the Ministerial Ordinance No. 41.

This Technical Annex presents the results from reducing emissions from deforestation in the Amazon biome, measured against the forest reference emission level (FREL) presented by Brazil to the UNFCCC in June 2014[10]. Brazil´s FREL submission went through a technical assessment from July to November of 2014 by two LULUCF experts appointed by the UNFCCC Secretariat. Brazil´s final FREL and the report of the technical assessment can be found at the UNFCCC REDD web platform (http://unfccc.int/methods/redd/items/8414.php).

This Technical Annex for REDD+ was developed following the guidelines of Decision14/ CP. 19 and contains the following elements:

1. Summary of information from the final report containing each corresponding assessed forest reference emission level;
2. Results in tonnes of CO_2eq per year, consistent with the assessed FREL;
3. Demonstration that the methodologies used to produce the results are consistent with those used to establish the assessed FREL;

9 Decision 14/ CP 19, paragraph 7, "requests developing country Parties seeking to obtain and receive payments for results-based actions, when submitting the data and information referred to in paragraph 3 above, through the biennial update reports, to supply a technical annex as per decision 2/CP.17, annex III, paragraph 19". Paragraph 8, "underlines that the submission of the technical annex referred to in paragraph 7 above is voluntary and in the context of results-based payments".

10 For more information see: http://www.mma.gov.br/redd/index.php/en/forest-reference-emission-levels-frel/spatial-information, last accessed on November 19th, 2014.

4. A description of national forest monitoring systems and the institutional roles and responsibilities for measuring, reporting and verifying the results;

5. Necessary information that allows for the reconstruction of results;

6. A description of how the elements contained in Decision 4/ CP.15, paragraph 1(c) and (d), have been taken into account[11].

The elements of Brazil´s Technical Annex for REDD+ are presented below.

2. Summary of information from the FREL for reducing emissions from deforestation in the Amazon biome

Brazil´s FREL, submitted on a voluntary basis for a technical assessment in the context of results based payments, covers the activity 'reducing emissions from deforestation" in the Amazon biome[12], the most significant of the five activities included in paragraph 70 of Decision 1/CP.16.

Brazil applied a step-wise approach to the development of its FREL, in accordance with Decision 12/CP.17, paragraph 10, and has presented a subnational FREL with the aim of transitioning to a national FREL in the future, by incorporating other biomes and activities. The step-wise approach enables Parties to improve the FREL by incorporating better data, improved methodologies and, where appropriate, additional pools.

Brazil used the 2003 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance for Land Use, Land-use Change and Forestry as a basis for estimating changes in carbon stocks from forest land converted to other land-use categories.

11 Decision 4/ CP.15, paragraph 1, "requests developing country Parties, on the basis of work conducted on the methodological issues set out in decision 2/CP.13, paragraphs 7 and 11, to take the following guidance into account for activities relating to decision 2/CP.13, and without prejudging any further relevant decisions of the Conference of the Parties, in particular those relating to measurement and reporting: (c) To use the most recent Intergovernmental Panel on Climate Change guidance and guidelines, as adopted or encouraged by the Conference of the Parties, as appropriate, as a basis for estimating anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes; (d) To establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems that: (i) Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes; (ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities; (iii) Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties."

12 The Amazon biome covers 4,197,000 km^2, corresponding to almost half (49.29 per cent) of the territory, and is responsible for 50.8 percent of the national net CO_2 emissions of Brazil in 2000 (Second National Communication, BRASIL, 2010).

Accordingly, the gross emissions from deforestation were estimated from 1996 onwards by combining activity data (i.e. the area of annual gross deforestation per forest type considered) with the appropriate emission factor (i.e. carbon densities associated with the forest types considered). Regarding the pools, the submission considers aboveground biomass, belowground biomass and litter. Dead wood and soil organic carbon (for mineral and organic soils) were not considered to be significant sources. Regarding greenhouse gases, the submission includes gross CO_2 emissions.

The basis for the activity data used in the construction of the FREL for the Amazon biome was the historical time series from the National Institute for Space Research (INPE), Ministry of Science, Technology and Innovation (MCTI). INPE, through the Amazon Gross Deforestation Monitoring Project – PRODES, has been assessing annual gross deforestation in the Legal Amazon since 1988 using Landsat-class satellite data on a wall-to-wall basis, with a minimum mapping unit of 6.25 hectares. The areas from the Cerrado and Pantanal biome in the Legal Amazon were excluded from the construction of the FREL. Data on deforestation are available in analogue format until 1997 and in digital format from 1998 onwards.

With regard to the emission factors, the carbon density associated with the different forest types in the Amazon biome were estimated by combining sample-plot information from RADAMBRASIL, with various equations to convert circumference at breast height (CBH) into total carbon stock in living biomass (above and below-ground) and litter. Based on this information, and complemented by data from the literature, a carbon density map including 22 different forest types was constructed. Brazil assumed that the biomass immediately after the forest conversion to other land uses is zero and does not consider any subsequent CO_2 removal after deforestation.

To estimate annual emissions from deforestation, the following procedure was applied: the area of each deforested polygon under a certain forest type was multiplied by the emission factor (i.e. carbon density in tonnes C/ha) of the corresponding forest type and by 44/12 (to convert carbon into CO_2). Then, for each year, the emissions from all the areas deforested were summed up.

Brazil´s FREL is a dynamic mean of the CO_2 emissions associated with gross deforestation since 1996, updated every five years, using the best available historical data and consistent with the most recent National GHG Inventory submitted by Brazil to the UNFCCC at the time of the construction of the FREL.

This base year was chosen by the Working Group of Technical Experts on REDD+ so as to leave out the high deforestation peak in 1995 and also to maintain consistency with other initiatives in Brazil, including the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm)[13], the National Climate Change Policy[14] and the Amazon Fund[15].

13 For details regarding relevant policies and plans for the Amazon biome see: http://www.mma.gov.br/redd/index.php/en/environmental-policies-related-to-redd/deforestation-reduction, last accessed on November 19th, 2014.

14 For more information on the Presidential Decree no. 7390 of December 9, 2010 see: http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7390.htm, last accessed on September 18th, 2014.

15 For more information on the Amazon Fund see: www.amazonfund.gov.br, last accessed on November 4th, 2014.

The dynamic nature of Brazil´s FREL is meant to reflect the effects of policies and plans implemented in the Amazon biome, as well as improvements in data quality and availability.

Brazil's FREL does not include assumptions on potential future changes to domestic policies.

In summary, for results based payments the following applies:

- For results obtained in the period from 2006 to 2010, inclusive, the FREL is equal to the mean annual CO_2 emissions associated with gross deforestation (calculated as adjusted deforestation increment) from the period 1996 to 2005, inclusive (refer to ***Figure 1*** and ***Table 1***).
- For results obtained in the period from 2011 to 2015, inclusive, the FREL is equal to the mean annual CO_2 emissions associated with gross deforestation (calculated as adjusted deforestation increment) from 1996 to 2010, inclusive (refer to ***Figure 1*** and ***Table 1***).
- For results obtained in the period from 2016 to 2020, the FREL is equal to the mean annual CO_2 emissions associated with gross deforestation (calculated as adjusted deforestation increment) from 1996 to 2015, inclusive.

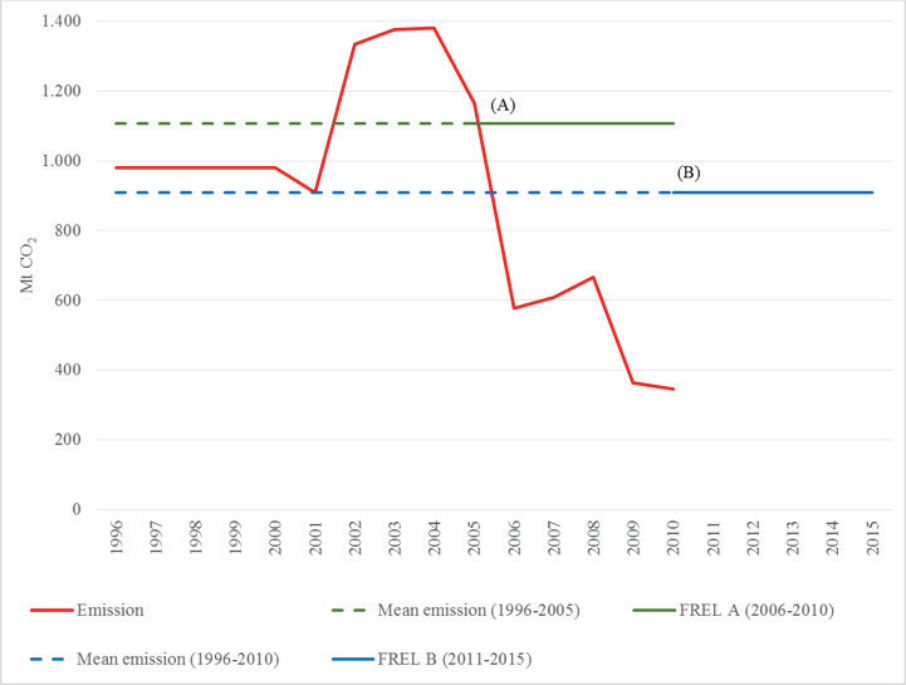

Figure 1: Pictorial representation of Brazil's FREL, where (A) refers to the mean annual CO_2 emissions from the period 1996 to 2005 (1,106,027,616.63 tCO_2); (B) refers to the mean annual CO_2 emissions from the period 1996 to 2010 (907,959,466.33 tCO_2).

Table 1: Adjusted deforestation increments and associated emissions (in tC and t CO_2) from gross deforestation in the Amazon biome, from 1996 to 2010[16].

YEAR	ADJUSTED DEFORESTATION INCREMENT (ha)	EMISSIONS FROM GROSS DEFORESTATION (tC)	CO_2 EMISSIONS FROM GROSS DEFORESTATION (tCO_2)
1996	1,874,013.00	267,142,749.24	979,523,413.88
1997	1,874,013.00	267,142,749.24	979,523,413.88
1998	1,874,013.00	267,142,749.24	979,523,413.88
1999	1,874,013.00	267,142,749.24	979,523,413.88
2000	1,874,013.00	267,142,749.24	979,523,413.88
2001	1,949,331.35	247,899,310.88	908,964,139.89
2002	2,466,603.88	363,942,942.80	1,334,457,456.93
2003	2,558,846.30	375,060,876.74	1,375,223,214.70
2004	2,479,429.81	376,402,076.09	1,380,140,945.68
2005	2,176,226.17	317,420,001.73	1,163,873,339.68
2006	1,033,634.15	157,117,398.10	576,097,126.38
2007	1,087,468.65	165,890,835.62	608,266,397.26
2008	1,233,037.68	181,637,813.29	666,005,315.39
2009	596,373.64	99,365,584.69	364,340,477.19
2010	583,147.53	93,929,048.84	344,406,512.43
1996 - 2005			1,106,027,616.63
1996 - 2010			907,959,466.33

The areas presented in ***Table 1*** are the ***adjusted deforestation increments*** of gross deforestation estimated for the Amazon biome. Note that those from PRODES correspond to the ***rate*** of gross deforestation estimated for the Legal Amazon. See ***Box 2*** for detailed explanation of the differences between these two approaches.

16 The grey lines in ***Table 1*** correspond to years for which data are only available in analogic format. For any year in the period from 1996 to 2010, gross CO_2 emissions from deforestation have been calculated following ***Steps 1-4*** in ***Figures 6*** to ***8***, and ***Step 5*** presented in Brazil´s FREL available through the UNFCCC REDD web platform (http://unfccc.int/methods/redd/redd_web_platform/items/4531.php). Brazil is investing considerable human and financial resources to improve its historical data sets. INPE has a project to expand Digital PRODES to years before 2001 which will allow for the spatial analysis of deforestation and lead to more precise estimates for years before 2000. With the improved data, Brazil will submit a revised FREL to the UNFCCC. REDD+ decisions under the UNFCCC value the constant improvement of data sets and information over time. It is not expected that countries will submit their information to the UNFCCC only when and if they have the most accurate data available for all significant pools. Brazil understands that the most important element before accuracy is to ascertain consistency and transparency of the data submitted.

3. Results in tonnes of CO_2eq per year, consistent with the assessed FREL for the Amazon biome

Decision 14/ CP. 19 paragraph 3, "*decides* that the data and information used by Parties in the estimation of anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and forest carbon stock and forest-area changes, as appropriate to the activities referred to in decision 1/CP.16, paragraph 70, undertaken by Parties, should be transparent, **and consistent over time and with the established forest reference emission levels and/or forest reference levels** in accordance with decision 1/CP.16, paragraph 71(b) and (c) and chapter II of decision 12/CP.17".

CO_2 emissions from gross deforestation in the Amazon biome from 1996 to 2010 were calculated for Brazil´s FREL using the methodology presented in the previous section. For this Technical Annex, the results for years 2006 to 2010 were calculated simply by subtracting the reference value for that period of 1,106,027,616.63 tCO_2 from the emissions for each year from 2006 to 2010. So for year *t*, the reduced emissions from deforestation were as follows:

REDD+ (*t*) = FREL (1996-2005) – Gross emissions from deforestation at year *t*; (tCO_2)

As an example, the emission reductions in 2006 correspond to:

1,106,027,616.63 tCO_2 - 576.097.126,38 tCO_2 = 529.930.490,25 tCO_2

The total result achieved by Brazil in reducing emissions from gross deforestation in the Amazon biome from 2006 to 2010, was the sum of the results achieved for each year of the period, i.e. ***2,971.02 $MtCO_2$ (Figure 2)***.

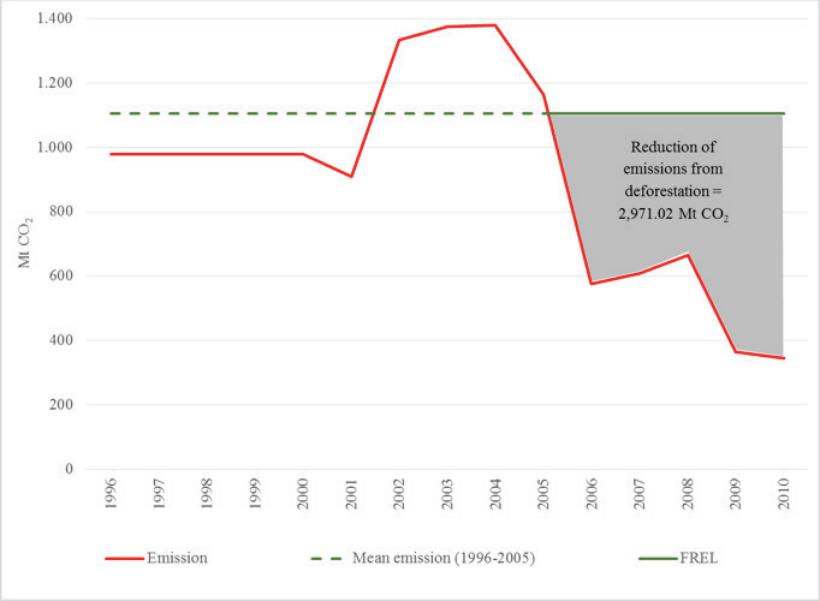

Figure 2: REDD+ results from 2006 to 2010 calculated based on the FREL submitted to the UNFCCC in June 2014

Table 2: Annual REDD+ results in tonnes of CO_2 from 2006 to 2010

Year	EMISSIONS FROM GROSS DEFORESTATION (tCO_2)	FREL (1996-2005, tCO_2)	REDD+ RESULTS(2006 -2010, tCO_2)
1996	979,523,413.88	1,106,027,616.63	
1997	979,523,413.88	1,106,027,616.63	
1998	979,523,413.88	1,106,027,616.63	
1999	979,523,413.88	1,106,027,616.63	
2000	979,523,413.88	1,106,027,616.63	
2001	908,964,139.89	1,106,027,616.63	
2002	1,334,457,456.93	1,106,027,616.63	
2003	1,375,223,214.70	1,106,027,616.63	
2004	1,380,140,945.68	1,106,027,616.63	
2005	1,163,873,339.68	1,106,027,616.63	
2006	576,097,126.38		529,930,490.25
2007	608,266,397.26		497,761,219.37
2008	666,005,315.39		440,022,301.24
2009	364,340,477.19		741,687,139.44
2010	344,406,512.43		761,621,104.20
TOTAL			**2,971,022,254.49**

4. Demonstration that the methodologies used to produce the results are consistent with those used to establish the assessed FREL

The calculation of the REDD+ results presented in this Technical Annex uses the same methodology, the same data set and the same information used for Brazil´s FREL for the Amazon biome.

Accordingly, **the emissions from gross deforestation in the Amazon biome between 2006 and 2010 had already been presented by Brazil on its FREL that was subjected to a technical assessment.**

As presented in the previous section, the results between 2006 and 2010 were measured as emissions at year *t*, minus the average annual CO_2 emissions from gross deforestation in the Amazon biome between 1996 and 2005, i.e. ***1,106,027,616.63 tCO_2***.

5. A description of national forest monitoring systems and the institutional roles and responsibilities for measuring, reporting and verifying the results

5.1. The Amazon Gross Deforestation Monitoring Project – PRODES

Brazil has a consistent, credible, accurate, transparent, and verifiable time-series for gross deforestation for the Legal Amazon (and hence, for the Amazon biome). PRODES is part of a larger program (Amazon Program) developed at INPE to monitors gross deforestation in the Legal Amazon[17]. It uses satellite imagery to identify new deforestation polygons every year in areas of ***primary forest***. Deforestation is associated with clear-cut activities, normally associated with the conversion of forest land to other land-use categories. Gross deforestation is assessed annually, on a wall-to-wall basis, encompassing the analysis of approximately 215 Landsat images, aided by additional Landsat class data (CBERS/CCD, REsourcSat/LISS3 and DMC) to reduce the incidence of cloud cover, with the minimum mapping area of 6.25 hectares (***Box 1***).

Box 1: PRODES minimum mapping area

PRODES was set in 1988 to map deforestation over hardcopy prints of Landsat images at the 1:250,000 scale. Consistent data for gross deforestation are available on an annual basis since 1988. Minimum mapping unit was defined as 1 mm^2, which is equivalent to 6.25 ha in the surface.

Since 2008, deforestation polygons with area larger than 1 ha and under are retrieved in a separate dataset and registered as PRODES deforestation as they coalesce to a size larger than 6.25 ha.

The first three years of this dataset are inflated by past deforestations. However, for all years since 2011 the total area (in km^2) of small deforestation polygons stabilizes at values around 500 $km^2\ yr^{-1}$, (642 km^2 in 2011, 390 km^2 in 2012 and 479 km^2 in 2013).

The consistency of the PRODES time series is ensured by using the same deforestation definition, same minimum mapping area, similar satellite spatial resolution[18], same Forest/Non-Forest vegetation boundaries, and same methodological approach to analyze the remotely sensed data at every new assessment.

17 The Legal Amazon covers the totality of the following states: Acre (AC), Amapá (AP), Amazonas (AM), Pará (PA), Rondônia (RO), Roraima (RR) and Tocantins (TO), Mato Grosso (MT) and part of the state of Maranhão (MA), totalizing approximately 5.217.423 km^2 (521.742.300 ha).

18 Spatial resolution is the pixel size of an image associated with the size of the surface area being assessed on the ground. In the case of the Landsat satellite, the spatial resolution is 30 meters.

Forest areas affected by forest degradation that do not have a clear-cut pattern in the satellite imagery are not included in PRODES. A separate project, named DEGRAD is carried out by INPE to address forest degradation. This ensures the consistency of the PRODES deforestation time series over time.

At the start of PRODES, deforestation polygons were identified by visual interpretation on false color composites of Landsat imagery at the scale of 1:250,000 and mapped on overlays that contained the aggregated deforestation up to the previous year. Subsequently these deforestation polygons were manually digitized in a Geographic Information System (GIS) developed by INPE. This analogical approach to assess deforestation (*Analog PRODES*) was employed from 1988 until 2002.

Due to the increased computing capability built at INPE, it was possible to transition from an ***analogical*** approach to ***digital*** annual assessments of deforestation (*Digital PRODES*) after 2000, which was preceded by a 1997 ***digital base map***, and an aggregated deforestation assessment for years 1998-2000.

Digital PRODES maintains full consistency with the Analog PRODES data. This includes consistency with the forest/non-forest boundaries in Analog PRODES and the aggregated deforestation polygons. Despite the evolution to a digital assessment, the identification of the deforestation polygons continued to be carried out through visual interpretation in the screen and not through digital classification methods[19]. This ensured even greater consistency between the *Analog and Digital PRODES*.

Due to the large volume of analogic data when *Digital PRODES* started, INPE decided to map the deforestation polygons from years 1998 to 2000 on an aggregated deforestation map until 1997 (***digital base map***). Hence, the deforestation polygons for these years were lumped into a single digital database, with no discrimination of the specific year when deforestation occurred. From year 2000 onwards, the deforestation polygons have been annually assessed and included in the *Digital PRODES* database. The *Digital PRODES* allows for the visualization of the deforestation polygons every year, in a single file. Thus, the geographical expansion of deforestation, as well as its spatial pattern, can be assessed and monitored.

In summary, the ***digital database*** does not have individual deforestation information for years prior to 1997, inclusive; it has information for years 1998 to 2000 in an aggregated format; and information (deforestation polygons) for all years since 2000 on an annual basis.

Digital PRODES allowed INPE to make available through the web the deforestation maps in vector format, as well as all the satellite images used, thus ensuring full transparency to the public in general. Since 2003, INPE began to publish the annual deforestation rate in the web, together with all the satellite imagery used to generate the information, and the maps with the identification of deforestation polygons (http://www.obt.inpe.br/prodes/index.php). Annually INPE provides for the download of approximately 215

19 INPE has developed alternative methodologies to identify deforestation increments in satellite imagery (e.g., linear mixture model, Shimabukuro *et al.*, (2004). However, the visual assessment demonstrated to be simpler and more efficient).

Landsat satellite images of Landsat5/7/8 (or similar data as CBERS/CCD, REsourceSat/LISS3 and DMC). Each image is accompanied by the associated map containing all past deforestation.

INPE continuously improves its tools to better manage large-scale projects such as PRODES. Its latest development, the TerraAmazon, is a system that manages the entire workflow of PRODES, annually storing approximately 600 images (e.g., Landsat, CBERS, DMC, Resourcesat). It performs geo-referencing, pre-processing and enhancement of images for subsequent analysis in a multi-task, multi-processing environment. The database stores and manages approximately 4 million polygons.

There are some steps that are followed until the deforestation increments are identified in the satellite imagery. These are now detailed:

Images selection

Figure 3: Steps prior to identification of the deforested polygons.

The first step consists of selecting the images to be used. For this, a query is conducted directly from INPE´s Image Generation Division (DGI) site (http://www.dgi.inpe.br/siteDgi_EN/index_EN.php) to identify (preferably) Landsat images (or similar) for the year of interest (usually corresponding to the months of July and August), with minimal cloud cover, better visibility and a suitable radiometric quality.

Satellite imagery available in the DGI are usually pre-processed for geometric correction and made available in UTM projection. Figure a.2 shows an image from Landsat 5 selected in the DGI library.

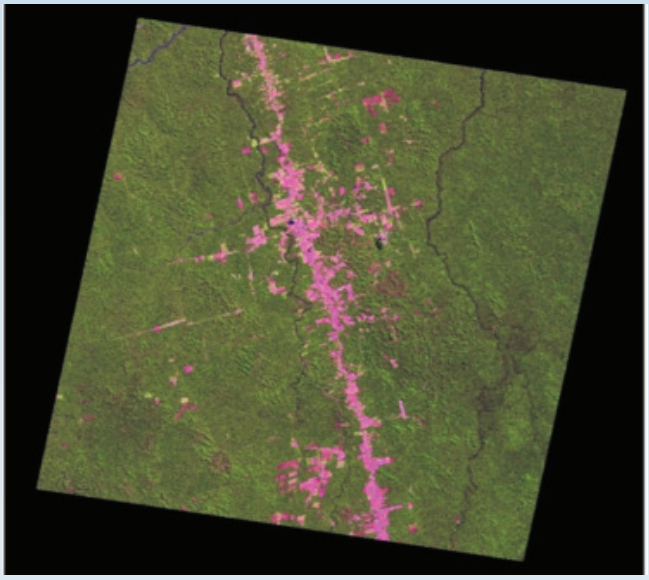

Figure 4: Landsat 5 (pathrow 227/65) of 01/07/2002 Note: Color composite Red, Green, Blue for bands 5, 4, 3, respectively, available on the DGI catalog.

Database and geo-referencing

The next step consists of image geo-referencing, which is carried out through visual collection of at least nine control points evenly distributed in coherent features (rivers, roads intersection) in the image to be geo-referenced. INPE uses as reference data the orthorectified Landsat mosaic for the year 2000, produced by Geocover NASA project (https://zulu.ssc.nasa.gov/MrSID). The geo-referencing is carried out by linear matrix transformation of first or second order, depending on the image quality, with transformation parameters obtained by least-square method applied to the set of control points.

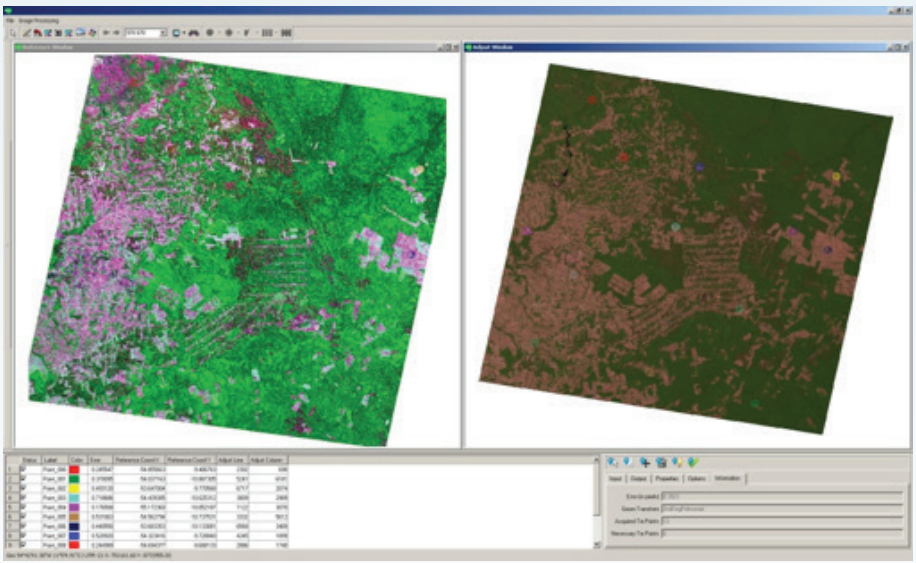

Figure 5: An example of control points collection.

Contrast enhancement

Finally, the technique of contrast enhancement may be applied to improve the quality of the images under the subjective criteria of the human eye. The contrast between two objects may be defined as the ratio between their average gray levels.

The goal at this step is to increase the contrast to facilitate the visual discrimination of objects in the image.

Activity data for Brazil´s Technical Annex and FREL

The area of the deforestation polygon by forest type (in km^2 or hectares) is the ***activity data*** necessary for the application of the first order approximation to estimate emissions[20] as suggested in the IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry (GPG LULUCF) (IPCC, 2003).

These areas have been obtained from PRODES time series data (modified to consider only deforestation in the Amazon biome) and the vegetation map from the Brazilian Institute for Geography and Statistics (IBGE).

The fact that satellite data from optical systems (e.g., Landsat) are the basic source of information to identify new deforestation events every year, and considering that the presence of clouds may impair the observation of deforestation events under clouds, requires the application of an approach to deal with the estimation of the areas of primary forest under clouds that may have been deforested so as not to underestimate the total deforestation at any year (refer to ***Box 2*** for alternative approaches to estimate the area of gross deforestation in the Amazon biome). This is in line with good practice as defined in GPG LULUCF (IPCC, 2003).

20 "In most first order approximations, the "activity data" are in terms of area of land use or land-use change. The generic guidance is to multiply the activity data by a carbon stock coefficient or "emission factor" to provide the source/or sink estimates." (IPCC, 2003; section 3.1.4, page 3.15).

Box 2: Approaches to estimate the area of gross deforestation in the Amazon biome

There are several approaches to estimate the area deforested and each may lead to different results. The total deforested area may be different if calculated as deforestation increment, or deforestation rate, or adjusted deforestation increment. To further clarify the above, the text that follows explains the different approaches and terminologies used throughout this submission.

1. **Deforestation Polygons** (at year *t*): refer to new deforestation events identified from the analysis of remotely sensed data (satellite images) at year t as compared to the accumulated deforestation mapped up to year *t-1*. Each deforestation polygon is spatially identified (geocoded), has accurate shape and area representations, and has an associated date of detection (the date of the satellite image from which it was mapped). For each year, a map containing all deforestation polygons (deforestation map) is made available in shapefile format for PRODES (and hence, for the Amazon biome, after exclusion of the areas associated with the Cerrado and Pantanal biomes) at (http://www.obt.inpe.br/prodesdigital/cadastro.php). This map does not include deforestation polygons under cloud covered areas. However, the deforestation map also renders spatially explicit distribution of the cloud covered areas.

2. **Deforestation Increment** (at year *t*): refers to the sum of the areas of all observed deforestation polygons within a given geographical extent. This geographical extent may be defined as the boundaries of a satellite scene which has the same date as the deforestation polygons mapped on that scene; or the entire Amazon biome, for which the deforestation increment is calculated as the sum of the individual deforestation increment calculated for each scene that covers the biome. The deforestation increment **may underestimate** the total area deforested (and associated emissions), since it does not account for the area of deforestation polygons under clouds.

3. **Adjusted Deforestation Increment** (at year *t*): this adjustment is made to the deforestation increment at year *t-1* (or years *t-1* and *t-2*, etc., as applicable) to account for deforestation polygons in areas affected by cloud cover and that are observable at time *t*. It is calculated according with ***Equation 1***:

$$Inc_{adj(t)} = Inc_{(t)} - \sum_{\Delta=1} A_{CC(t-\Delta),(t)} + \sum_{\Delta=1} \frac{A_{CC(t-\Delta),(t)}}{\Delta+1} + \sum_{\Omega-1} \frac{A_{CC(t+\Omega),(t)}}{\Omega+1} \quad \textit{Equation 1}$$

where:

$Inc_{adj(t)}$ = adjusted deforestation increment at year *t*; km^2

$Inc_{(t)}$ = deforestation increment at year *t*; km^2

$A_{CC(t-\Delta),(t)}$ = area of the deforestation polygons observed (cloud-free) at year *t* over cloud-covered areas at year *t-*; km^2. Note that when Δ=1, $A_{CC(t-1),(t)}$ equals the area of the deforestation polygons observed at year *t* over cloud-covered areas at year *t*-1 (but which were under cloud-free at year *t*-2); for Δ=2, $A_{CC(t-2),(t)}$ equals the area of the deforestation polygons observed at year *t* over an area that was cloud-covered at both years *t*-1 **and** *t*-2.

$A_{CC(t+\Omega),(t)}$ = area of the deforestation polygons observed at year t+ over cloud-covered areas at year *t*; km^2. Note that when Ω=1, the term $A_{CC(t+1),(t)}$ provides the area of the deforestation polygons observed at year *t*+1 over the area that was cloud-covered at year *t*; when Ω=2, the term $A_{CC(t+2),(t)}$ provides the area of the deforestation polygons observed at year *t*+2 over the area that was cloud-covered at years *t* **and** *t*+1.

Δ = number of years that a given area was persistently affected by cloud cover prior to year *t* but was observed at year *t*; Δ=1, 2, ...

Ω = number of years until a given area affected by cloud cover at year t is observed in subsequent years (i.e., is free of clouds); Ω = 1,2, ...

As an example, suppose that the area of the deforestation increment observed at year *t*, $Inc_{(t)}$, is 200 km² and that 20 km² of this occurred over primary forest areas that were cloud covered at year *t*-1 (but are cloud-free at year *t*). Since these 20 km² may accumulate the area of the deforestation polygons under clouds at year *t*-1 and the area of the deforestation polygons that occurred at year *t*, the deforestation increment **may overestimate** the total area deforested area (and associated emissions) at year *t*.

The adjusted deforestation increment $Inc_{adj(t)}$ at year *t* evenly distributes the total area of the deforestation polygons observed at year t under the cloud-covered area at year *t*-1 (or before, if the same area was also cloud covered at year *t*-2, for instance) among years *t*-1 and *t*. Hence, the adjusted deforestation increment at year t is 190 km² (200 – 20/2) and not 200 km², assuming that there were no cloud-covered areas at year t (in which case the adjusted deforestation increment at year t would be adjusted by where = area of the deforestation polygons observed at year *t*+ over cloud-covered areas at year *t*; and Ω is the number of years that a given area affected by cloud cover at year *t* is observed (i.e., is free of clouds).

The rationale behind Equation 1 is to remove from the deforestation increment the area to be distributed among the years (-) and then add back the portion allocated to year *t* . The last term of the equation refers to the area distributed from subsequent years (or year) over cloud covered areas at year *t*.

4. **Deforestation Rate** (at year *t*): was introduced in PRODES to sequentially address the effect of cloud cover; and, if necessary, the effect of time lapse between consecutive images. The deforestation rate aims at reducing the potential under or over-estimation of the deforested area at year t. The presence of cloud-covered areas in an image at year t impairs the observation of deforestation polygons under clouds, and may lead to an underestimation of the area deforested; while the presence of clouds in previous years (e.g., at year t-1) may lead to an overestimation of the area deforested if all deforestation under clouds at year t-1 is attributed to year t.

   This **over** or **under-estimation** may also occur if the dates of the satellite images used in subsequent years are not adjusted. To normalize for a one year period (365 days) the time lapse between the images used at years t and t+1, the rate considers a reference date of August 1st and projects the cloud corrected increment to that date, based on a model that assumes that the deforestation pace is constant during the dry season and zero during the wet season. Refer to Annex I, Part I for more information on PRODES methodology for calculating the deforestation rate.

   As an example of cloud correction, suppose that the primary forest area in an image is 20,000 km² and that 2,000 km² of this occurred over primary forest areas that were cloud covered. Suppose also that the observed **deforestation increment** is 180 km². As part of the calculation of the rate, it is assumed that the proportion of deforestation measured in the cloud-free forest area (18,000 km²) is the same as that in the area of forest under cloud (2,000 km²). Therefore the proportion 180/18,000 = 0.01 is applied to the 2,000 km², generating an extra 20 km² that is added to the observed deforestation increment. In this case, the **cloud corrected** increment is 200 km².

IMPORTANT REMARKS:

1. Note that at any one year, an estimate based on the adjusted deforestation increment may be higher or lower than the rate of gross deforestation.
2. For the sake of verifiability, this submission introduces a slight change in the methodology used in PRODES to estimate the annual area deforested. PRODES methodology to annualize observed deforestation and to take into account unobserved areas due to cloud cover is not directly verifiable unless all the estimates are adjusted backwards.
3. The approach applied in this submission relies on a verifiable deforestation map and does not annualize the time lapse between consecutive scenes. It deals with the effect of cloud cover by equally distributing the area of the deforestation polygons observed at year t over cloud-covered areas at year t-1 (or to years where that area was persistently cloud covered) among years t and t-1.
4. The use of the adjusted deforestation increment to estimate the area deforested and associated gross emissions is deemed to be more appropriate for REDD+, due to the verifiability.

Calculating deforestation rates based on deforestation increments

Deforestation rate calculations are elaborate, and have as a basis the information on deforestation increments. The simple sum of the mapped, observed deforestation polygons is the deforestation increment.

Table 3: Deforestation increments vs deforestation rates Source: INPE, 2014

Deforestation Increments	Deforestation Rates
Value measured by image interpretation Calculated for each pair of LANDSAT image Indicating the date of image acquisition	Value is estimated Interpolated to a reference date (August 1st) Takes into account the area covered by clouds

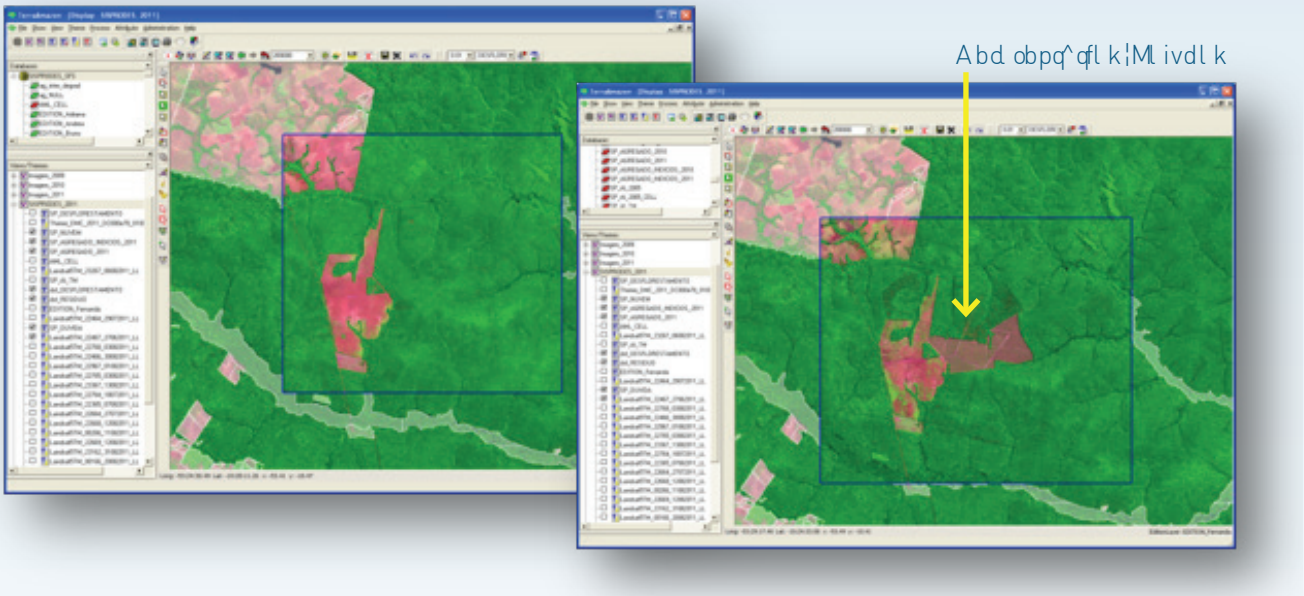

Figure 6: Deforestation polygon as shown by PRODES Source: INPE, 2014

It should be noted that up to 2000, the Landsat TM scenes 222/61 and 222/62 were never considered by PRODES since they were persistently covered by clouds. In 2001, it was possible to observe these scenes. It was then verified that a large area was cleared in these scenes, leading to a high deforestation increment at that year (2001). This implies that there will be a substantial difference between increments and rates in years before 2001.

In early 2000s, there was a predilection for scenes without clouds, even when they were taken many days before the date of reference (August 1st). A limit to the number of days for the analysis of scenes was only later defined as a measure to avoid the discrepancy between deforestation rates and deforestation increment. In 2004, INPE decided to select only the images with

dates as close as possible to the next reference date, so that after 2005/2006, the discrepancies between deforestation rates and deforestation increment became very small.

Comparing the emissions estimates: deforestation rates vs. adjusted increments

Deforestation rates were not the basis for the FREL calculations. The FREL was calculated based on adjusted deforestation increments and these are two different approaches. Brazil´s FREL is conservative because it uses only historical data and is dynamics through time (which is not required in any REDD+ decision).

PRODES maps up to 2001 were analogic and constrained the integration with the carbon map adopted in this FREL. As an exercise, the annual CO_2 emissions per year were calculated taking as a basis the deforestation rates from PRODES and applying the average carbon stock per unit area (tC ha^{-1}). This was done to assess the average difference in CO_2 emissions using the annual rates of gross deforestation from PRODES and the emission estimates presented in this submission for years 1996 – 2005 based on the adjusted increments. The formula used was:

Deforestation rate (ha)/year * 151.6 tC/ha * 44/12

Table 4: Emission estimates from deforestation rate vs emission estimates from the FREL

Year	Deforestation (km^2)	Deforestation (ha)	Emission PRODES (tCO_2) (Mean = 151,6 tC/ha)	Emission FREL (tCO_2)
1996	18,161	1,816,100	1,009,509,453	979,523,414
1997	13,227	1,322,700	735,244,840	979,523,414
1998	17,383	1,738,300	966,263,027	979,523,414
1999	17,259	1,725,900	959,370,280	979,523,414
2000	18,226	1,822,600	1,013,122,587	979,523,414
2001	18,165	1,816,500	1,009,731,800	979,523,414
2002	21,651	2,165,100	1,203,506,920	1,334,457,457
2003	25,396	2,539,600	1,411,678,987	1,375,223,215
2004	27,772	2,777,200	1,543,752,907	1,380,140,946
2005	19,014	1,901,400	1,056,924,880	1,163,873,340
Mean			1,090,910,568	1,106,027,617
Difference				**1.39%**

The average emissions from 1996 through 2005, using PRODES rates were **1,090,910,568 tCO_2**. The average emissions from 1996 through 2005 presented in the FREL were **1,106,027,617 tCO_2**. Since the FREL uses the average emissions of 10 years, these differences balance out at the end, being only 1.4 per cent.

The use of adjusted increments to estimate emissions from gross deforestation provides a more accurate figure for the deforested area through time.

5.2. Roles and responsibilities for measuring, reporting and verifying (MRVing) the results

Table 5: Roles and responsibilities for REDD+ MRV

MRV	Instrument/ Project	Responsible Institution	Roles	Additional Information
Measuring		Foundation of Science, Application and Space Technologies (FUNCATE)	Calculating emission reductions from deforestation in the Amazon biome based on the adjusted deforestation increments and the carbon map from RADAMBRASIL project.	http://www.funcate.org.br/
	Amazon Program	INPE, MCTI	Verifying the calculations done by FUNCATE	http://www.obt.inpe.br/prodes/index.php
Reporting	Working Group of Technical Experts on REDD+	MMA MCTI	Providing technical inputs for REDD+ submissions to the UNFCCC and ensuring its quality control.	http://www.mma.gov.br/redd/index.php/en/
	Modular System for Monitoring and Tracking Greenhouse Gases Emission Reductions (SMMARE)	MMA	Tracking and reporting on the implementation of PPCDAm actions that lead to emission reductions. A tool to provide information, in particular in relation to the mitigation actions (NAMAs) implemented in each mitigation plan and its associated methodologies and assumptions, the progress made in their implementation and information on domestic measurement, reporting and verification.	www.mma.gov.br
Verifying	International Consultation and Analysis	UNFCCC	Verifying the submissions from Parties, by appointing two LULUCF experts to assess the FREL submissions and the technical annexes.	http://unfccc.int/methods/redd/redd_web_platform/items/4531.php

6. Necessary information that allows for the reconstruction of results

Complete information, for the purposes of REDD+, means the provision of the following information that allows for the reconstruction of the FREL and this Technical Annex.

Below is a description of the information that allows for the reconstruction of the results. Links to the database and information that allows for the reconstruction of results was detailed in ***Section b.1*** of Brazil´s FREL and are available through the website: http://www.mma.gov.br/redd/index.php/pt/forest-reference-emission-levels/the-submission-of-brazilian-forest-reference-emission-levels

1. All the satellite images used to map the deforestation polygons in the Amazon biome from 1996 to 2010.
2. Accumulated deforestation polygons until 1997 (inclusive), presented in a map hereinafter referred to as the ***digital base map*** (see ***Annex I, Part I*** for more details).
3. Accumulated deforestation polygons for years 1998, 1999 and 2000 mapped on the ***digital base map.***
4. Annual deforestation polygons for the period from 2001 to 2010, inclusive (***annual maps***).

IMPORTANT REMARK 1: All maps referred to in (2), (3) and (4) above are available in shapefile format ready to be imported into a Geographical Database for analysis. All satellite images referred to in (1) above are provided in full resolution in geotiff format. Any individual deforestation polygon can be verified against the corresponding satellite image.

IMPORTANT REMARK 2: The maps referred to in (2), (3) and (4) above are a **subset** of those produced by INPE for PRODES (for additional information see http://www.obt.inpe.br/prodes/index.php) and refer only to the Amazon biome, the object of this submission. The information in (2) and (3) above are provided in a single file.

5. The **deforestation polygons by forest type attributes and RADAMBRASIL volume**; For each year, the deforestation polygons are associated with the corresponding forest type and RADAMBRASIL volume. These files are large and are thus presented here only for year 2003[21], the year that has been used to exemplify the calculation of the adjusted deforestation increment (refer to ***Box 2*** and ***Annex II, Part I***). It is worth noting that for all since 2001, the stratification of the deforestation polygons by forest type attributes and RADAMBRASIL volume indicated that deforestation concentrates mostly in the so called "*Arc of Deforestation*" (a belt that crosses over RADAMBRASIL volumes 4, 5, 16, 20, 22 and 26 – refer to ***Figure 11***), and marginally affects forest types in RADAMBRASIL volumes associated with higher carbon densities.

21 For year 2003, a total of 402,176 deforestation polygons have been identified. For each deforestation polygon in the file, the following information is provided: the State of the Federation it belongs (uf); the RADAMBRASIL volume (vol); the associated forest type (veg) and the associated area (in ha).

6. The **information that allows for the calculation of the adjusted deforestation increments for years 2001, 2002, 2003, 2004 and 2005 is** available at: http://mma.gov.br/redd/index.php/pt/forest-reference-emission-levels/spatial-information. ***Annex II, Part I*** provides an example of the calculation of the adjusted deforestation increment for year 2003 (see **"calculo_def_increment_emission_2003"** thought the FTP. file available at: http://mma.gov.br/redd/index.php/pt/forest-reference-emission-levels/spatial-information).

7. A map with the carbon densities of different forest types in the Amazon biome (**carbon map**), consistent with that used in the Second National GHG Inventory, the latest submitted by Brazil to the UNFCCC at the time of construction of the FREL.

8. Samples of the relevant[22] RADAMBRASIL data that have been used as input to the allometric equation by Higuchi *et al.* (1998). They are generated from the original RADAMBRASIL database, which is the basis for the construction of the carbon map. Consultation with the Working Group of Technical Experts on REDD+ led to the understanding that there may be cases of apparent inconsistencies in carbon densities within a forest type due to specific circumstances of the sample unit. This is part of the natural heterogeneity of the biomass density distribution in tropical vegetation.

7. A description of how the elements contained in Decision 4/ CP.15, paragraph 1(c) and (d), have been taken into account

7.1. Use of the most recent IPCC guidance and guidelines

Brazil´s FREL and its respective Technical Annex use the IPCC methodology as a basis for estimating changes in carbon stocks in forest land converted to other land-use categories as described in the GPG LULUCF (IPCC, 2003). For any land-use conversion occurring in a given year, GPG LULUCF considers both the carbon stocks in the biomass immediately before and immediately after the conversion.

As stated on the previous sections, the area of the deforestation polygon by forest type (in km^2 or hectares) is the activity data necessary for the application of the first order approximation to estimate emissions as suggested in the IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry (GPG LULUCF) (IPCC, 2003).

22 The original RADAMBRASIL data for the volumes where deforestation occurs most frequently (CBH, forest type, RADAMBRASIL volume) are provided at: http://mma.gov.br/redd/index.php/pt/forest-reference-emission-levels/spatial-information, as RADAMBRASIL sample units data.

7.2. Establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems

The activity data used for the construction of the FREL and as a basis for calculating the results presented in this Technical Annex was the historical time series from PRODES (for details refer to ***Section 5.1*** above).

PRODES forest definition includes all vegetation types of Evergreen Forest Formations in the Legal Amazon and forest facies of other formations such as Savanna and Steppe, which are generally classified as "Other Wooded Land" according to the Food and Agriculture Organization of the United Nations (FAO) classification system. The presence of these facies in the Amazon biome is not significant. However, when deforestation occurs in any of these facies, the associated emissions are calculated using their corresponding carbon density from the RADAMBRASIL carbon map.

At the beginning of PRODES in 1988, a map containing the boundary between Forest – Non-Forest was created based on existing vegetation maps and spectral characteristics of forest in Landsat satellite imagery. In 1987, all previously deforested areas were aggregated in a map (including deforestation in forest areas that in 1987 were secondary forests) and classified as ***deforestation***. Thereafter, on a yearly basis, deforestation in the Amazon biome has been assessed on the remaining annually updated Forest.

For the purposes of PRODES, the areas of Non-Forest are not monitored (regardless of being managed or unmanaged following the IPCC definition of managed land[23] (IPCC, 2006). Deforestation occurring in Forest land (managed or unmanaged) is monitored and the associated CO_2 emission calculated assuming instantaneous oxidation at the year deforestation occurs. Hence, the accumulated gross deforestation in the Brazilian Amazon never decreases at each new assessment.

The Brazilian deforestation time series from PRODES relate only to deforestation in primary forests that may or may not have been impacted by human activities or natural events but has not shown a **clear cut** pattern in the satellite imagery. Hence, areas previously logged, whenever identified in the satellite imagery as **clear cut**, are included as deforestation in PRODES. The definition of deforestation adopted for PRODES and maintained in the FREL (i.e., clear cut), in conjunction with the annual wall-to-wall assessment of deforestation based on satellite imagery of high spatial resolution (up to 30 meters) allows deforestation polygons to be identified and mapped with very high accuracy. No ground truth is required for the Amazon biome since there is an unequivocal identification of the clear cut patches in the Landsat imagery from one year to another. Only new polygons of deforestation are mapped each year on the aggregated deforestation map containing deforestation up to the previous year.

23 Managed land is land where human interventions and practices have been applied to perform production, ecological or social functions. (IPCC, 2006)

All deforestation polygons[24] mapped for the Amazon biome (i.e., aggregated until 2007; aggregated for years 1998, 1999 and 2000; and annual from 2001 until 2010) are available at http://www.mma.gov.br/redd/index.php/en/forest-reference-emission-levels-frel/spatial-information.

Note that this information is a subset of that made available since 2003 by INPE for PRODES at www.obt.inpe.br/prodes. At this site, for each satellite image (see (1) above), a vector map in shapefile format is generated and made available, along with all the previous deforestation polygons, the areas not deforested, the hydrology network and the area of non-forest.

The experts appointed by the UNFCCC Secretariat noted on their report of the technical assessment of Brazil´s FREL that the transparency and completeness of information significantly improved in the final submission and commended Brazil for the efforts taken. According to their report, the information provided in the final FREL submission, including through the data made available in websites and the examples of how estimates of deforestation were calculated, increased the reproducibility of FREL numbers. This Technical Annexes uses of the emissions calculated in the FREL for estimating the REDD+ results achieves in the Amazon biome from 2006 to 2010.

24 The information for PRODES is also available for the Legal Amazon are publicly available since 2003 at INPE´s website (www.obt.inpe.br/prodes).

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