BRAZIL'S THIRD BIENNIAL UPDATE REPORT

TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

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BRAZIL'S THIRD BIENNIAL UPDATE REPORT

TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

BRASIL
2019

FEDERATIVE REPUBLIC OF BRAZIL

MINISTRY OF FOREIGN AFFAIRS
Secretariat for National Sovereignty and Citizenship Affairs
Department for the Environment
Environment Division II - National Focal Point to the UNFCCC

MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATIONS AND COMMUNICATIONS
Secretariat of Policies for Development and Strategic Actions
General Coordination on Climate Change

TASK FORCE FOR THE THIRD BIENNIAL UPDATE REPORT
Ministry of Foreign Affairs – MRE
Ministry of Science, Technology, Innovations and Communications – MCTIC
Ministry of Environment – MMA
Ministry of Agriculture, Livestock and Food Supply – MAPA
Ministry of Mines and Energy – MME
Ministry of Economy – ME
Brazilian Agricultural Research Corporation – Embrapa
Brazilian Cooperation Agency – ABC

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1

NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

1 NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

1.1 NATIONAL CIRCUMSTANCES

Country Profile

Brazil is a developing country with continental dimensions and a complex and dynamic economy (Table I). It is an urban-industrial country, with its agricultural sector playing a leading role in the global economy. For the past 45 years, the country has been investing in tropical agriculture technological research and development. This R&D, together with public policies and technical assistance for optimizing the use of open areas and restoring grazing lands, has increased productivity by 380%. These actions have also contributed to a transition from a vulnerable, food-importing country into one of the world's largest food suppliers[1,2].

One of the country's most distinctive characteristics is its energy mix, with a significant share of renewable sources particularly in the generation of electric energy, affording a low-carbon profile to the sector. Maintaining this profile in the future, considering the need for economic, growth poses a great challenge to Brazil.

The vast territory encompasses an extraordinary mosaic of ecosystems, with broad climate and topographic diversity. Its various biomes are home to the greatest biodiversity of flora and fauna in the planet, with 20% of the total number of species.

TABLE I: RELEVANT INFORMATION ABOUT BRAZIL.

Standard	Characteristic
Territory	Total area of 8,515,759,090 km^2; divided in five political-administrative regions – North, Northeast, Midwest, South and Southeast; composed of 26 states and the Federal District (IBGE, 2018).[3]
Population	209.3 million people (IBGE, 2017[4]).
Climate	Five climatic regions: Equatorial (North), Tropical (most of the territory), Semi-arid (Northeast), Tropical of Altitude (Southeast), and Subtropical (South).[5]
Biodiversity	Six biomes: Amazon, Atlantic Forest, Cerrado, Caatinga, Pantanal and Pampa.
Water resources	12 river basins provide abundant water resources; however, they are unevenly distributed throughout the territory.
Energy Mix	In 2017, renewables accounted for 43.2% of the Brazilian energy mix, a significantly higher share than the world (13.8%) and the OECD (10%) averages. Biofuels and sugarcane biomass supplied 40.3% of total energy. Renewables supplied 80.4% of electric energy. Hydraulic sources generated 59.4% of total electricity, natural gas 10.5% and wind 6.8%. (MME, 2018[6]).

Socio-economic indicators have greatly improved in Brazil over the past 30 years. Nevertheless, the country still faces many development challenges common to other developing countries with a growing population, in areas such as poverty eradication, education, and public health, employment, housing, infrastructure, access to energy and basic sanitation (Table II).

[1] *MAPA, 2018. Available at: http://www.agricultura.gov.br/assuntos/politica-agricola/todas-publicacoes-de-politica-agricola/estatisticas-e-dados-basicos-de-economia-agricola. Accessed 09 out 2018.*
[2] *Conab, 2018. Available at: https://portaldeinformacoes.conab.gov.br/index.php/safra-serie-historica-dashboard. Accessed 09 Oct 2018.*
[3] *IBGE, 2018. Available at: https://www.ibge.gov.br/geociencias-novoportal/organizacao-do-territorio/estrutura-territorial/15761-areas-dos-municipios.html?=&t=o-que-e. Accessed 09 Oct 2018.*
[4] *IBGE, 2017. July 2017 estimate. Available at: https://www.ibge.gov.br/estatisticas-novoportal/sociais/populacao/9103-estimativas-de-populacao.html?=&t=destaques. Accessed 19 Jul 2018.*
[5] *According to the Weather Map prepared by the IBGE. Available at: ftp://geoftp.ibge.gov.br/informacoes_ambientais/climatologia/mapas/brasil/Map_BR_clima_2002.pdf. Accessed 20 Sept 2018.*
[6] *Resenha Energética Brasileira 2018 – ano ref 2017. Available at: http://www.mme.gov.br/web/guest/publicacoes-e-indicadores/boletins-de-energia. Accessed 20 Feb 2019.*

TABLE II: SOCIOECONOMIC INDICATORS.

Socio-economic Indicators	1990	1995	2000	2005	2010	2015	2017(2)
Gross Domestic Product (GDP) (in BRL billions)[7]	774	854	1,199	2,170	3,886	6,000	6,560
GDP per capita (in BRL thousands)[8]	17.24	18.71	18.81	20.32	19.88	29.32	31.59
Agriculture Gross Domestic Product (in % of GDP)[9]	8.1	5.01	4,75	4.65	4.12	4.27	4.57
Industry Gross Domestic Product (in % of GDP)[9]	38.7	23.38	23.01	24.17	23.27	19.19	18.48
Service Sector Gross Domestic Product (in % of GDP) [9]	53.2	58.12	58.25	56.08	57.61	62.43	63.07
Human Development Index (HDI) [10]	0.590	0.633	0.669	0.792	0.726	0.754	0.759
Gini Index[11]	0.614	0.601	0.593	0.570	0.527	0.515	0.515(1)
Percentage of the population living with less than USD 1.90 (PPP) per day[12]	20.56	12.99	13.36	9.55	6.18	6.5	6.5(1)

(1) Data unavailable for the year; previous year data repeated.

(2) Most recent year with available data for all the indicators shown.

Policy Dimensions

The national governance for climate change and its corresponding legal instruments remain as described in Brazil's first BUR and its Third National Communication. The National Policy on Climate Change (PNMC in the Portuguese acronym) is the legal basis for climate change action in Brazil. Its main features are summarized in Table III and Figure I below.

TABLE III: NATIONAL POLICY ON CLIMATE CHANGE (PNMC).

PNMC	Information
Legal framework	Law Number 12,187, enacted in 2009
Objectives	Promoting sustainable development while protecting the climate system; reducing greenhouse gas (GHG) emissions from relevant sources, as well as strengthening removals of these gases by sinks; implementing measures to adapt to climate change in order to reduce its adverse effects and the vulnerability of environmental, social and economic systems.
National voluntary commitment	Expected emissions reduction of between 36.1% and 38.9% below its projected emissions in 2020 (business as usual).
Instruments	National Plan on Climate Change; two action plans to prevent and control deforestation, one for the Amazon and the other for the Cerrado biome; and plans for mitigation and adaptation in agriculture, energy and charcoal.
Regulation	Decree Number 7,390/2010, which indicates the projected emissions for 2020 and provides details on the national voluntary commitment
Governance and institutional arrangements	Coordination among federal agencies and entities of the Brazilian civil society. A governance structure was established for the implementation of this policy with specific mandates and assignments that are complimentary to each other. The main institutional instruments, within the governmental scope, are: the Interministerial Committee on Climate Change (CIM) and its Executive Board (GEX); and the Interministerial Commission on Global Climate Change (CIMGC). At the civil society level, the Brazilian Forum on Climate Change (FBMC) and the Brazilian Research Network on Global Climate Change (*Rede CLIMA)* also assist in implementation.

[7] *IBGE, 2018. Brazil in Summary: national accounts. GDP at current values. Available at: https://brasilemsintese.ibge.gov.br/contas-nacionais/pib-valores-correntes.html. Accessed 13 Aug 2018.*

[8] *IBGE, 2018. Brazil in Summary: national accounts. GDP per capita. Available at: https://brasilemsintese.ibge.gov.br/contas-nacionais/pib-per-capita.html. Accessed 13 Aug 2018.*

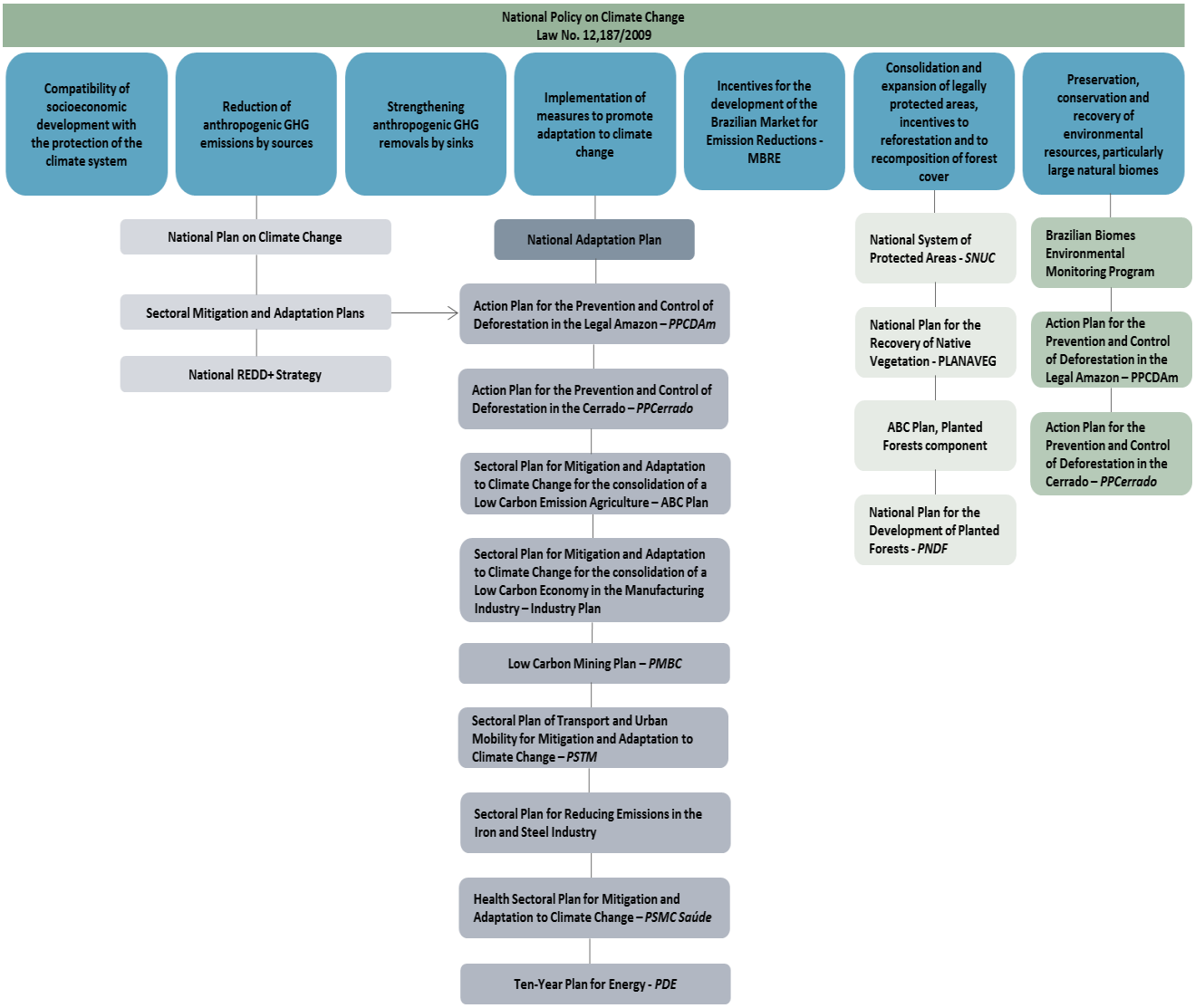
[9] *IBGE, 2018. Social Indicators Summary – SIS. Available at: https://www.ibge.gov.br/estatisticas-novoportal/sociais/trabalho/9221-sintese-de-indicadores-sociais.html?=&t=o-que-e. Accessed 22 Aug 2018.*

[10] *UNDP, 2016. Human Development Report 2016. Available at: http://hdr.undp.org/en/content/human-development-report-2016-human-development-everyone. Accessed 09 Oct 2018.*

[11] *UNDP, 2016. Human Development Report 2016. Available at: http://hdr.undp.org/en/content/human-development-report-2016-human-development-everyone. Accessed 09 Oct 2018.*

[12] *IBGE, 2018. Social Indicators Summary – SIS. Available at: https://www.ibge.gov.br/estatisticas-novoportal/sociais/trabalho/9221-sintese-de-indicadores-sociais.html?=&t=o-que-e. Accessed 22 Aug 2018.*

FIGURE I: COMPONENTS OF THE NATIONAL POLICY ON CLIMATE CHANGE (PNMC).



The PNMC includes the National Adaptation Plan (PNA in the Portuguese acronym), instituted on 10 May 2016 via Ordinance No. 150 by the Federal Government together with the civil society, private sector, and State Governments. It aims at reducing national vulnerability to climate change and managing the associated risks. Among the activities to support monitoring and assessing adaptation measures, the Center for Climate Intelligence in Agriculture stands out, with two-fold components: i) Monitoring System and Agriculture Risk and Vulnerability Simulation; ii) integration of the Monitoring System and Agriculture Risk and Vulnerability Simulation to the Monitoring and Alert networks of the National Plan to Reduce Risks and Disasters.

In September 2016, Brazil deposited the instrument of ratification of the Paris Agreement, under which the country committed to adopt mitigation measures by means of a Nationally Determined Contribution (NDC).13 The first Brazilian NDC aims to reduce GHG emissions by 37% below 2005 levels in 2025, with an indicative effort to achieve a 43% reduction below 2005 levels in 2030 (referenced by the emissions reported in the Second National Communication of Brazil to the UNFCCC)14 (Table IV).

In addition, in December 2017, Brazil ratified the Doha Amendment to the Kyoto Protocol.

[13] *Available at: http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf. Accessed 29 Sep 2017.*
[14] *Available at: http://sirene.mctic.gov.br/publicacoes.: Accessed 7 Jan 2019.*

TABLE IV: BRAZIL'S NATIONALLY DETERMINED CONTRIBUTION UNDER THE PARIS AGREEMENT.

NDC	Description
Contribution	To reduce GHG emissions by 37% below 2005 levels in 2025.
Subsequent indicative contribution	To reduce GHG emissions by 43% below 2005 levels in 2030.
Type	Absolute target in relation to a base year
Scope	100% of the territory, economy-wide, including CO_2, CH_4, N_2O, perfluorocarbons, hydrofluorocarbons and SF_6.
Baseline year	2005.
Time horizon	Single-year target for 2025; indicative values for 2030 for reference purposes only.
Metrics	100-year Global Warming Potential (GWP-100) using the Intergovernmental Panel on Climate Change (IPCC, 2014) Fifth Assessment Report (AR5) values [15].
Methodological approaches, including estimation and accounting of anthropogenic emissions of GHG and removals, as appropriate	Inventory based approach for estimating and accounting anthropogenic GHG emissions, and, as appropriate, removals, in accordance with the applicable IPCC guidelines. The NDC takes into account the role of conservation units and indigenous lands as forest managed areas, in accordance with the applicable IPCC guidelines on the estimation of emission removals.
Use of market-based instruments	Brazil reserves its position in relation to the possible use of any market mechanisms that may be established under the Paris agreement. Brazil emphasizes that any transfer of units resulting from mitigation outcomes achieved in the Brazilian territory will be subject to prior and formal consent by the Federal Government. Brazil will not recognize the use by other Parties of any units resulting from mitigation outcomes achieved in the Brazilian territory that have been acquired through any mechanism, instrument or arrangement established outside the Convention, its Kyoto Protocol or its Paris agreement.

1.2 INSTITUTIONAL ARRANGEMENTS

The General Coordination on Climate (CGCL) of the Ministry of Science, Technology, Innovation and Communications (MCTIC) was responsible for coordinating Brazil's First, Second and Third National Communications to the UNFCCC. The MCTIC is currently working on Brazil's Fourth National Communication. These are developed with the support from the Global Environment Facility (GEF), with the collaboration of the United Nations Development Programme (UNDP) and the consent of the Brazilian Cooperation Agency (ABC).

The Ministry of Foreign Affairs, as the Brazilian National Focal Point for the UNFCCC, is responsible for coordinating the BURs with the support of a task-force comprised of the ministries of Science, Technology, Innovation and Communication (MCTIC), Environment (MMA), Agriculture, Livestock and Supply (MAPA), Mines and Energy (MME), Economy (ME), the Brazilian Agricultural Research Corporation (Embrapa), and the Brazilian Cooperation Agency (ABC).

The Technical Annexes pursuant to decision 14/CP.19 were prepared by the Ministry of the Environment through the Working Group of Technical Experts on REDD+, created in February 2014.

[15] *Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf. Accessed 19 Jul 2018.*

2

NATIONAL INVENTORY OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES NOT CONTROLLED BY THE MONTREAL PROTOCOL

2 NATIONAL INVENTORY OF ANTHOPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES NOT CONTROLLED BY THE MONTREAL PROTOCOL

General Aspects

This section presents the historical time series of emissions of the Third National Inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases (GHG) not controlled by the Montreal Protocol16 submitted to the UNFCCC in April 2016 and adds emission estimates until 2015 by using activity data publicly available, in an update of the information presented in the second BUR.

This inventory is organized according to the structure suggested by the Intergovernmental Panel on Climate Change (IPCC), and covers the following sectors: Energy; Industrial Processes; Agriculture; Land Use, Land-Use Change and Forestry; and Waste. GHG removals by sinks occur in the Land Use, Land Use Change and Forestry sector as a result of management activities in protected areas, reforestation, abandoned managed land and increasing soil carbon stock.

Institutional Arrangements

Preparation of the national emissions inventory involved significant participation of the Brazilian scientific and business communities, in addition to various government agencies. The Ministry of Science, Technology, Innovation and Communications (MCTIC) coordinates the preparation of the inventory, including by convening different working groups that survey sectoral information and conduct studies to obtain country-specific emission factors (Figure III). The MCTIC establishes formal partnerships as well as extends formal invitations to government agencies responsible for official statistics and data. After establishing these partnerships, the technical team in charge of the inventory conducts technical discussions with the partners, monitors the updating and availability of information, and carries out quality control.

The Brazilian Research Network on Global Climate Change (Rede CLIMA), established by the MCTIC in 2007, contributes significantly with updating of activity data, parameters and emission factors. Rede CLIMA contributes by presenting the best available science in support of sectorial studies through experts from different thematic sub-networks from universities and research bodies such as: the Federal University of Rio de Janeiro, which coordinates the updating of data and parameters for the Energy sector; the University of Brasilia and the Federal University of Pernambuco, for the Land Use, Land-Use Change and Forestry; the Federal Institute of Alagoas, for the Agriculture sector; and the Brazilian Agricultural Research Corporation and its several research units, which contribute to the Agriculture and Waste sectors; among other universities and partner institutions that support updating, publishing and validating sectoral information.

Filing and Disclosure

Brazil's national inventories have been filed as a set of spreadsheets in MCTIC's institutional network. Their respective sectoral reference reports, which transparently describe methodological details with indication of data sources and the assumptions adopted for the preparation of the inventory, are also filed in the MCTIC. These reports, initially available on the MCTIC's webpage, are publicly available at the National Emissions Registry System (SIRENE) website[17].

In 2017, the MCTIC was officially[18] charged with implementing and maintaining SIRENE to provide security and transparency to the preparation of national GHG emissions inventories. Since 2016 the national

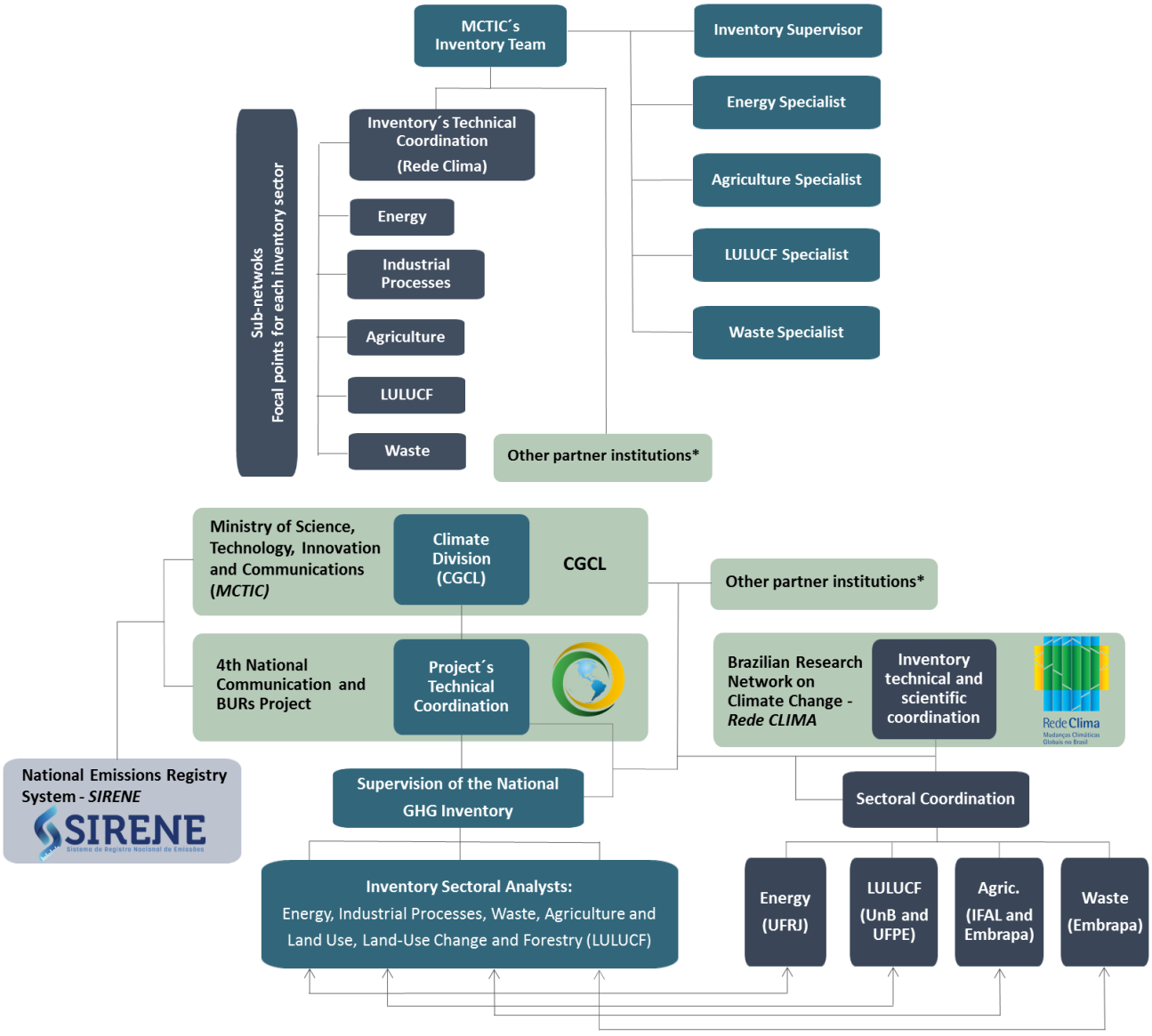
[16] *Ministry of Science, Technology and Innovation. (2016). Third National Communication of Brazil to the United Nations Framework Convention on Climate Change – Volume III. Brasília: MCTI, 333p. Available at: http://sirene.mcti.gov.br/publicacoes. Accessed 13 Oct 2017.*

[17] *http://sirene.mctic.gov.br*

[18] *Decree No. 9,172/2017: http://www2.camara.leg.br/legin/fed/decret/2017/decreto-9172-17-outubro-2017-785582-publicacaooriginal-153988-pe.html. Accessed 08 Oct 2018.*

emissions estimate database has been hosted on the MCTIC's servers and is also publicly available on the SIRENE website.

FIGURE II: INSTITUTIONAL ARRANGEMENTS FOR THE PREPARATION OF NATIONAL INVENTORIES.



*Other institutions involved in the preparation of the Inventory	
National Civil Aviation Agency – ANAC	National Supply Company - CONAB
National Terrestrial Transport Agency - ANTT	National Steel Company – CSN
National Association of Automobile Manufacturers - ANFAVEA	National Beef Cattle Council – CNPC
National Agency of Petroleum, Natural Gas and Biofuels – ANP	National Department of Mineral Production – DNPM Rio Grande do Sul and Santa Catarina Chapters
Beneficient Association of the state of Santa Catarina Coal Industry – SATC	Mining Companies of the states of Paraná, Rio Grande do Sul and Santa Catarina
Brazilian Association of Chemical Industry – ABIQUIM	Brazil's National Confederation of Agriculture and Livestock - CNA
Brazilian UHT Milk Association - ABLV	Agricultural Research Corporation of the state of Minas Gerais - EPAMIG
Brazilian Aluminium Association – ABAL	Company of Agriculture Research and Rural Extension of the state of Santa Catarina - EPAGRI
Brazilian Food Industry Association - ABIA	Energy Research Company – EPE
Brazilian Association of Pork Producers and Exporters - ABIPECS	Brazil Steel Institute - IABr and affiliates
Brazilian Association of Dairy Cattle Breeders	Brazilian Tree Industry - Ibá
Brazilian Association of Brown Swiss Cattle Breeders	Brazilian Institute of Geography and Statistics - IBGE
Brazilian Association of Public Cleaning and Special Waste Companies – ABRELPE	Brazilian Institute of the Steel Industry - IBS
Brazilian Association of Solid Waste Treatment Companies - ABETRE	Institute of Agricultural and Forest Management and Certification - Imaflora
Brazilian Coal Association - ABCM	Zootechnical Institute – APTA
Brazilian Association of Holstein Cattle Breeders	Rio Grande do Sul Rice Institute
Brazilian Association of Motorcycle, Motorbike, and Bicycle Manufacturers ABRACICLO	P&D Consultoria Empresarial Ltda.
Brazilian Association of Agricultural Limestone Producers – ABRACAL	Petrobras
Swine Breeding Association of the state of Santa Catarina – ACCS	Rima Industrial S.A.
Swine Breeding Association of Western Paraná	State of Santa Catarina Coal Producers Union - SIECESC
National Association for Fertilizer Diffusion - ANDA	National Cement Industry Union - SNIC
Swine Breeding Association of the state of São Paulo	Brazilian Sugarcane Industry Association - UNICA
Swine Breeding Association of the state of Minas Gerains – ASEMG	White Martins
Clean Coal Technology Center - CTCL	Brazilian Agricultural Research Corporation - Embrapa

2.1 METHODOLOGY

The National GHG Emissions Inventory is prepared in accordance with the guidelines for the elaboration of the National Communications of Parties not included in Annex I to the Convention, adopted by decision 17/CP.8.

The methodological approaches and guidance used in the National GHG Inventory were based on the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC, 1997); "Good Practice Guidance for Land Use, Land-Use Change and Forestry" (GPG LULUCF, 2003) and "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" (GPG, 2000). Some of the estimates already take into account information published in the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC, 2006).

In relevant sectors for Brazil, such as agriculture and land use, land-use change and forestry, no methodologies can be readily applied, given that the emission factors recommended by the IPCC largely reflect temperate climate developed countries circumstances, not necessarily adequate to Brazilian national characteristics. For the Third National Inventory a great effort was undertaken to obtain information corresponding to domestic circumstances, thus allowing for the use of more detailed IPCC methodologies and more accurate estimates.

Methodological references, activity data, emission factors and assumptions adopted for the preparation of this BUR were the same as those stated in Brazil's Third National Communication. Detailed information on sectoral estimates and associated uncertainties are available in Volume III of Brazil's Third National Communication. Emissions beyond the last reported year in Brazil's second BUR were estimated based on national official data from public platforms or yearbooks from different government or private bodies, in addition to information from industrial associations for activity data updates, while maintaining the same parameters and emission factors as those of the third inventory. The main sources of information on activity data are the Brazilian Institute of Geography and Statistics (IBGE), the Brazilian Agricultural Research Corporation (Embrapa), the Energy Research Office (EPE) and the National Institute for Space Research (INPE).

To comply with the good practices for quality control recommended by the IPCC, a team of experts undertakes a detailed methodological verification which encompasses spreadsheet revision and technical discussions for validating data and parameters. This team also reviews sectoral reference reports, which include methodological details and a record of all information sources and equations used and are also made available to external experts outside the inventory team through public consultation. These quality control and assurance processes ensure that the GHG inventory reflects the best possible emission estimates for the available data and the state of the art of scientific knowledge.

Furthermore, for the national inventory, as set forth in paragraph 12 of Decision 17/CP.8, to the extent possible, the key categories are analyzed, pursuant to the IPCC´s good practice guidelines, to identify the subsectors that should be prioritized in terms of methodological refinement, taking into consideration the national circumstances, as well as the contribution of the identified subsectors to the total emissions result.

2.2 UNCERTAINTY ANALYSIS

Tables V through VIII present emissions uncertainties estimates for CO_2, CH_4 and N_2O, which account for 99.3% of total GHG emissions in the last year reported. The same criteria used for calculating uncertainties for the third Inventory has been used for year 2015. Figure III presents the country's total GHG emissions with an indication of associated uncertainties throughout the historical series.

TABLE V: UNCERTAINTIES ASSOCIATED WITH CO_2 EMISSIONS.

Sector	2015	
	Uncertainty (%)	Emissions (Gg CO_2)
Energy	3	420,313
Burning of fossil fuels	3	402,709
Fugitive emissions	25	17,604
Coal mining	32	1,822
Extraction and Transport of Oil and Natural Gas	28	15,782
Industrial Processes	3	84,212
Cement Production	4	23,767
Lime Production	10	6,392
Other uses of Limestone and Dolomite	21	1,058
Iron and Steel Production	6	42,284
Aluminum Production	6	1,281
Chemical Industry	7	2,952
Other Industries	4	6,478
Land-Use Change and Forestry	32	293,093
Waste	57	222
TOTAL	**12**	**797,840**

TABLE VI: UNCERTAINTIES ASSOCIATED WITH CH_4 EMISSIONS.

Sector	2015	
	Uncertainty (%)	Emissions (Gg CH_4)
Energy	51	688.1
Burning of Fossil Fuels	73	465.7
Fugitive Emissions	45	222.4
Coal mining	73	51.5
Extraction and Transport of Oil and Natural Gas	54	170.9
Industrial Processes	11	40.7
Pig Iron and Steel	15	25.4
Other Metallurgical industries	15	3.4
Chemical Industry	17	11.9
Agriculture	31	12,887.5
Enteric fermentation	34	11,620.1
Manure management	38	632.4
Rice cultivation	45	462.5
Burning of agricultural waste	32	172.5
Land-use change and forestry	72	1.144.8
Waste	16	2,860.8
Solid waste	23	1,493.4
Effluents	23	1,367.4
Industrial	30	817.8
Domestic	35	549.6
TOTAL	**23**	**17,621.9**

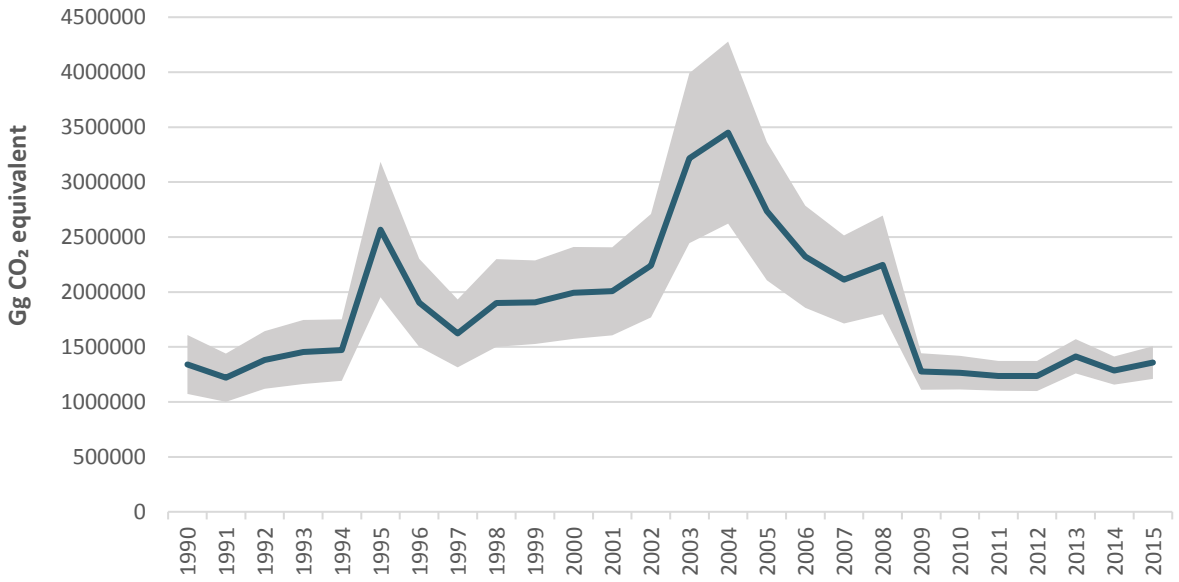
TABLE VII: UNCERTAINTIES ASSOCIATED WITH N_2O EMISSIONS.

Sector	2015	
	Uncertainty (%)	Emissions (Gg N_2O)
Energy	101	47.24
Industrial Processes	10	1.86
Chemical Industry	4	0.71
Metallurgical Industry	17	1.15
Agriculture	48	510.54
Manure management	43	15.52
Agricultural soils	50	490.55
Animals on Pasture	81	172.84
Other direct sources	56	134.90
Indirect emissions	102	182.81
Burning of agricultural waste	51	4.47
Land-use change and forestry	101	47.33
Waste	15	7.73
TOTAL	**41**	**614.70**

TABLE VIII: COMBINED UNCERTAINTIES ASSOCIATED WITH TOTAL EMISSIONS OF CO_2, CH_4, N_2O AND RESULT IN CO_2eq.

Gas	Emissions 2015 (Gg)	Uncertainty (%)	GWP (SAR IPCC)	Emissions 2015 (Gg CO_2eq)
CO_2	797,840	12	1	797,840
CH_4	17,621.90	23	21	370,060
N_2O	614.7	41	310	190,557
TOTAL		**11**		**1,358,457**

FIGURE III: TOTAL EMISSIONS IN CO_2eq (GWP-100 SAR/IPCC) WITH UNCERTAINTY RANGES (IN GRAY).



NATIONAL GHG EMISSIONS IN CO_2eq

For the purposes of the national inventory, anthropogenic emissions by sources and removals by sinks of GHG not controlled by the Montreal Protocol must be reported on a gas-by-gas basis and in units of mass, as required by UNFCCC COP Decision 17/CP.8. In case emissions are reported also in carbon dioxide equivalent (CO_2eq), this Decision recommends using Global Warming Potential (GWP) values for a 100-year time horizon, as published in the IPCC Second Assessment Report (SAR). For information purposes, the results of the inventory are presented below in CO_2 equivalent using different conversion metrics.

Although GWP-SAR is suggested as a metric for inventories of Non-Annex I Parties, the IPCC periodic assessment reports present updated values for GWP per gas. The IPCC Fifth Assessment Report (AR5) (IPCC, 2014) presents for the first time values for the Global Temperature change Potential (GTP), defined as a metric based on temperature change – i.e. the change in global mean surface temperature at a chosen point in time in response to an emission pulse – relative to that of CO_2.

According to the IPCC (2014), the most appropriate metric and time horizon will depend on which aspects of climate change are considered most important to a particular application. No single metric can accurately compare all consequences of different emissions, and all have limitations and uncertainties.[19] The IPCC further states that the GTP metric may be more suitable for a temperature limit such as the 2°C target, while the GWP metric is not directly related to such a temperature limit[20]. Considering this, GTP may be considered a more useful metric for policymakers to assess emissions impacts on the increase in global average temperature below 2°C above pre-industrial levels.

This BUR presents results using three sets of metrics: GWP-SAR, as per decision 17/CP.8; GWP-AR5, reflecting the most up-to-date science; and GTP-AR5, the most adequate for the correlation between emissions and temperature.

TABLE B.1: ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GHG IN CO_2eq PER METRIC (GWP-SAR, GWP-AR5 AND GTP-AR5), BY SECTOR

GWP (SAR)	1994	2000	2010	2012	2015
ENERGY	209,959	286,371	374,727	422,173	449,408
INDUSTRIAL PROCESSES	62,234	73,892	89,923	97,042	95,338
AGRICULTURE	310,915	328,367	407,072	414,987	428,905
LULUCF	861,964	1,265,607	349,176	252,013	331,806
WASTE	31,900	39,847	52,863	56,866	62,695
TOTAL	1,476,972	1,994,084	1,273,762	1,243,081	1,368,152
GWP (AR5)	1994	2000	2010	2012	2015
ENERGY	213,677	289,825	378,344	425,303	452,675
INDUSTRIAL PROCESSES	61,970	73,313	90,842	97,962	96,407
AGRICULTURE	364,908	385,027	472,736	480,469	496,142
LULUCF	868,265	1,276,261	355,006	257,538	337,690
WASTE	41,810	52,255	69,356	74,669	82,373
TOTAL	1,550,630	2,076,681	1,366,283	1,335,940	1,465,287
GTP (AR5)	1994	2000	2010	2012	2015
ENERGY	199,554	274,997	360,802	408,075	434,696
INDUSTRIAL PROCESSES	60,928	71,336	84,617	91,582	88,310
AGRICULTURE	117,771	124,818	160,127	164,964	171,016
LULUCF	837,638	1,224,549	326,295	230,216	308,747
WASTE	6,957	8,661	11,472	12,272	13,474
TOTAL	1,222,848	1,704,360	943,313	907,109	1,016,243

FIGURE B.1: EMISSIONS IN CO_2eq PER METRIC (GWP-SAR, GWP-AR5 AND GTP-AR5), 1990 TO 2015

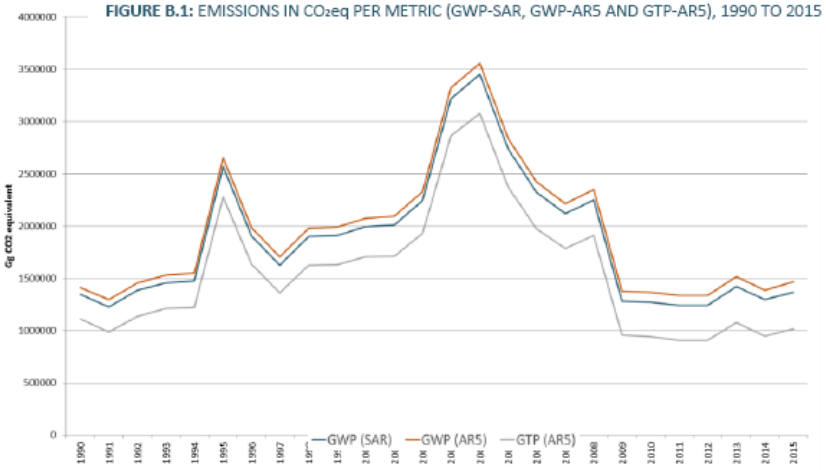
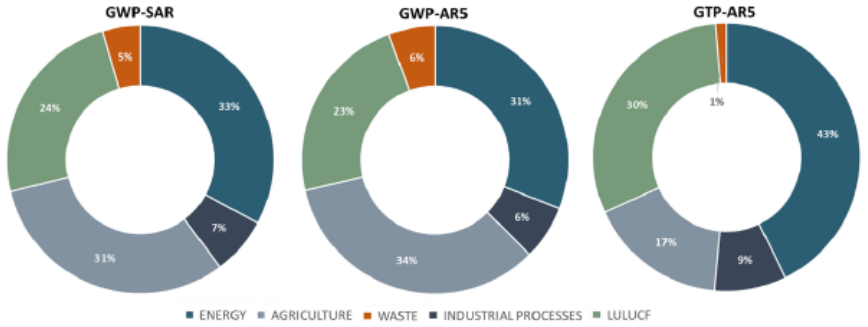


FIGURE B.2: TOTAL GHG EMISSIONS BY SECTOR IN CO_2eq, PER METRIC, 2015



[19] *IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. SPM D.2 p.15.*

[20] *See Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. pp. 710-720. See furtherStocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie, 2013: Technical Summary. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. pp. 58-59.*

Tables IX to XIII present GHG emissions estimates for 1994, 2000, 2010, 2012 and 2015 by type of gas and sector, according as suggested by decision 17/CP.8[19]. Additionally, Figure IV presents results by gas for the complete historical time series.

[19] *Decision 17/CP.8 – "Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention". Available at: https://unfccc.int/files/meetings/workshops/other_meetings/application/pdf/dec17-cp.pdf. Accessed 19 Jul 2018.*

TABLE IX: GREENHOUSE GAS EMISSIONS BY SOURCES, YEAR 1994, IN GIGAGRAM(Gg)[7;7.1]

	Gg																	
1994	CO_2 (gross emissions)	CO_2 (removals)	CO_2 (net emissions)	CH_4	N_2O	CO	NOx	NMVOC	PFCs		HFCs							SF_6
									CF_4	C_2F_6	HFC-23	HFC-32_pot	HFC-125_pot	HFC-143a_pot	HFC-152a_pot	HFC-134a		
ENERGY	193,669		193,669	570.5	13.90	15,512.4	1,233.4	1,484.8										
Fuel Combustion	185,665		185,665	484.7	13.84	15,512.4	1,233.4	1,484.8										
Energy Subsector	23,841		23,841	24.4	3.41	1,292.7	258.6	293.9										
Public Service Power Plants	7,455		7,455	0.1	0.05	3.9	61.2	0.9										
Self-Producers Power Plants	2,839		2,839	0.8	0.16	39.3	16.4	0.6										
Charcoal Plants	0		0	13.8	1.84	918.5	2.3	275.6										
Other	13,547		13,547	9.7	1.36	331.0	178.7	16.8										
Industry Subsector	39,443		39,443	17.7	2.97	837.7	159.5	31.7										
Iron and Steel	5,318		5,318	0.2	0.03	3.1	13.1	1.3										
Ferroalloy	105		105	0.0	0.00	0.1	0.2	0.0										
Chemical Industry	9,114		9,114	0.8	0.12	27.5	31.7	2.8										
Non-ferrous	1,380		1,380	0.1	0.02	3.4	2.8	0.2										
Pulp and Paper	2,954		2,954	1.2	0.49	381.4	18.7	8.9										
Food and Beverages	3,642		3,642	9.9	1.69	178.1	39.2	9.4										
Cement	5,060		5,060	2.3	0.10	46.9	13.0	1.7										
Mining	3,216		3,216	0.2	0.03	7.1	9.4	0.8										
Textile	1,338		1,338	0.1	0.04	9.3	2.8	0.4										
Ceramics	2,529		2,529	2.1	0.28	128.5	13.3	3.9										
Other Industries	4,787		4,787	0.8	0.17	52.3	15.3	2.3										
Transport Subsector	91,283		91,283	156.1	3.64	12,072.4	635.2	936.8										
Civil Aviation	4,446		4,446	0.0	0.12	35.2	4.4	1.3										
Road Transportion	82,058		82,058	155.7	2.95	12,024.6	520.2	930.6										
Railways	1,242		1,242	0.1	0.48	4.2	20.8	1.8										
Navigation	3,537		3,537	0.3	0.09	8.4	89.8	3.1										
Residential Subsector	15,239		15,239	269.4	2.85	1,218.4	27.4	182.8										
Agriculture Subsector	12,332		12,332	13.5	0.93	86.3	142.0	36.4										
Commercial Subsector	1,570		1,570	3.5	0.03	4.0	4.1	2.4										
Public Subsector	1,957		1,957	0.1	0.01	0.9	6.6	0.8										
Fugitive Emissions	8,004		8,004	85.8	0.06	0.0	0.0	0.0										
Coal Mining	1,348		1,348	42.4	0.00	0.0	0.0	0.0										
Oil and Natural Gas	6,656		6,656	43.4	0.06	0.0	0.0	0.0										
INDUSTRIAL PROCESSES	51,277		51,277	44.2	17.47	834.0	51.1	370.7	0.3231	0.0279	0.1566	0.0000	0.0000	0.0000	0.0000	0.0685	0.0140	
Cement Production	10,086		10,086	0.0	0.00	0.0	0.0	0.0										
Lime Production	4,098		4,098	0.0	0.00	0.0	0.0	0.0										
Other Uses of Limestone and Dolomite	1,480		1,480	0.0	0.00	0.0	0.0	0.0										
Soda Ash Use	187		187	0.0	0.00	0.0	0.0	0.0										
Ammonia Production	1,689		1,689	0.0	0.00	0.0	0.0	0.0										
Nitric Acid Production	0		0	0.0	2.01	0.0	0.6	0.0										
Adipic Acid Production	0		0	0.0	13.99	0.8	0.3	0.0										
Caprolactam Production	0		0	0.0	0.31	0.0	0.0	0.0										
Calcium Carbide Production	0		0	0.0	0.00	0.0	0.0	0.0										
Methanol Production	59		59	0.5	0.00	0.0	0.0	0.0										
Ethylene Production	4		4	5.7	0.00	0.0	0.0	2.7										
Vinyl Chloride Production	120		120	0.0	0.00	0.0	0.0	3.5										
Ethylene Oxide Production	85		85	0.3	0.00	0.0	0.0	0.0										
Acrylonitrile Production	18		18	0.0	0.00	0.0	0.0	0.1										
Carbon Black Production	406		406	0.0	0.00	0.0	0.0	0.0										
Phosphoric Acid Production	87		87	0.0	0.00	0.0	0.0	0.0										
Production of Other Chemicals	0		0	0.1	0.00	0.0	0.0	24.3										
Iron and Steel Production	29,153		29,153	32.8	1.04	708.1	29.8	20.7										
Ferroalloy Production	178		178	3.7	0.08	73.6	1.9	1.9										
Non-Ferrous Metals except Aluminium	1,279		1,279	1.1	0.04	22.8	10.8	0.7										
Aluminium Production	1,955		1,955	0.0	0.00	0.0	0.0	0.0	0.3231	0.0279								
Magnesium Production	0		0	0.0	0.00	0.0	0.0	0.0										0.0099
Pulp and Paper	0		0	0.0	0.00	28.7	7.7	19.0										
Food Industry	0		0	0.0	0.00	0.0	0.0	140.9										
Beverage Industry	0		0	0.0	0.00	0.0	0.0	156.9										
HCFC-22 Production	0		0	0.0	0.00	0.0	0.0	0.0			0.1566							
HFCs, PFCs and SF6 Use	0		0	0.0	0.00	0.0	0.0	0.0				0.0000	0.0000	0.0000	0.0000	0.0685	0.0041	
Non-Energetic Consumption other than that in Chemical Industries	393		393	0.0	0.00	0.0	0.0	0.0										
SOLVENTS AND OTHER PRODUCT USE			0	0.0	0.00	0.0	0.0	55,789.8										
AGRICULTURE			0	9,865.1	334.67	3,908.1	106.2	0.0										
Enteric Fermentation			0	8,786.7	0.00	0.0	0.0	0.0										
Cattle			0	8,370.5	0.00	0.0	0.0	0.0										
Dairy Cattle			0	1,262.8	0.00	0.0	0.0	0.0										
Beef Cattle			0	7,107.7	0.00	0.0	0.0	0.0										
Other Animals			0	416.2	0.00	0.0	0.0	0.0										
Manure Management			0	457.9	11.21	0.0	0.0	0.0										
Cattle			0	204.6	3.04	0.0	0.0	0.0										
Dairy Cattle			0	37.6	1.24	0.0	0.0	0.0										
Beef Cattle			0	167.0	1.80	0.0	0.0	0.0										
Swine			0	169.4	2.48	0.0	0.0	0.0										
Poultry			0	61.3	5.39	0.0	0.0	0.0										
Other Animals			0	22.6	0.30	0.0	0.0	0.0										
Agricultural Soils			0		320.49	0.0	0.0	0.0										
Direct Emissions			0		201.60	0.0	0.0	0.0										
Animals on Pasture			0		137.50	0.0	0.0	0.0										
Cattle			0		116.02	0.0	0.0	0.0										
Other			0		21.48	0.0	0.0	0.0										
Synthetic Fertilizers			0		14.74	0.0	0.0	0.0										
Animal Manure Applied to Soils			0		15.87	0.0	0.0	0.0										
Cattle			0		4.97	0.0	0.0	0.0										
Other			0		10.90	0.0	0.0	0.0										
Agricultural Residue			0		18.94	0.0	0.0	0.0										
Soy bean			0		6.07	0.0	0.0	0.0										
Sugarcane			0		1.15	0.0	0.0	0.0										
Beans			0		1.17	0.0	0.0	0.0										
Rice			0		1.21	0.0	0.0	0.0										
Corn			0		5.29	0.0	0.0	0.0										
Manioc			0		2.67	0.0	0.0	0.0										
Other			0		1.38	0.0	0.0	0.0										
Organic Soils			0		14.55	0.0	0.0	0.0										
Indirect Emissions			0		118.89	0.0	0.0	0.0										
Atmospheric Deposition			0		24.94	0.0	0.0	0.0										
Synthetic Fertilizers			0		3.76	0.0	0.0	0.0										
Animal Manure			0		21.18	0.0	0.0	0.0										
Cattle			0		16.71	0.0	0.0	0.0										
Other			0		4.47	0.0	0.0	0.0										
Leaching			0		93.95	0.0	0.0	0.0										
Synthetic Fertilizers			0		13.87	0.0	0.0	0.0										
Animal Fertilizer			0		80.08	0.0	0.0	0.0										
Cattle			0		62.68	0.0	0.0	0.0										
Other			0		17.40	0.0	0.0	0.0										
Rice Cultivation			0	505.8	0.00	0.0	0.0	0.0										
Crop Residue Burning			0	114.7	2.97	3,908.1	106.2	0.0										
Cotton			0	0.5	0.01	16.8	0.5	0.0										
Sugarcane			0	114.2	2.96	3,891.3	105.7	0.0										
LAND USE, LAND-USE CHANGE AND FORESTRY	1,176,406	-355,019	821,387	1,213.2	48.71	21,286.6	593.1	0.0										
Land Use, Land-Use Change	1,167,415	-355,019	812,396	1,213.2	48.72	21,286.6	593.1	0.0										
Lime Application to Soils	8,991		8,991	0.0	0.00	0.0	0.0	0.0										
WASTE	66		66	1,446.1	4.73	0.0	0.0	0.0										
Solid Waste	66		66	1,023.6	0.00	0.0	0.0	0.0										
Effluents	0		0	422.5	4.73	0.0	0.0	0.0										
Industrial	0		0	126.9	0.00	0.0	0.0	0.0										
Domestic	0		0	295.6	4.73	0.0	0.0	0.0										
TOTAL	1,421,418	-355,019	1,066,399	13,139.1	419.48	41,541.1	1,983.8	57,645.3	0.3231	0.0279	0.1566	0.0000	0.0000	0.0000	0.0000	0.0685	0.0140	

[7] In view of the absence of specific methodologies to estimate NMVOC emissions from the Waste, Agriculture and LULUCF sectors in the IPCC guidelines (1996), these emissions were not estimated. As set forth in paragraph 17 of Decision 17/CP.8, emissions of gases not controlled by the Montreal Protocol such as SOx, may be presented at the country´s discretion, therefore, considering the nonexistence of a specific IPCC methodology to estimate such emissions, Brazil has chosen to not estimate them.

[7.1] Emissions from international aviation and marine bunker fuels for information purposes only are reported in the Appendix.

TABLE X: GREENHOUSE GAS EMISSIONS BY SOURCES, YEAR 2000, IN GIGAGRAM(Gg)

	Gg																		
2000	CO_2 (gross emissions)	CO_2 (removals)	CO_2 (net emissions)	CH_4	N_2O	CO	NOx	NMVOC	PFCs		HFCs							SF_6
									CF_4	C_3F_6	HFC-23	HFC-32_pot	HFC-125_pot	HFC-143a_pot	HFC-152a_pot	HFC-134a		
ENERGY	267,057		267,057	588.9	22.41	13,250.3	1,433.3	1,342.2										
Fuel Combustion	256,320		256,320	469.9	22.30	13,250.3	1,433.3	1,342.2										
Energy Subsector	40,484		40,484	20.8	3.01	1,104.7	400.7	249.6										
Public Service Power Plants	19,075		19,075	0.4	0.14	9.1	136.4	2.1										
Self-Producers Power Plants	5,141		5,141	1.4	0.25	63.4	34.3	1.3										
Charcoal Plants	0		0	11.7	1.56	777.7	1.9	233.3										
Other	16,268		16,268	7.3	1.06	254.5	228.1	12.9										
Industry Subsector	58,419		58,419	19.9	3.33	1,036.8	221.5	41.7										
Iron and Steel	4,620		4,620	0.1	0.02	3.2	10.8	1.1										
Ferroalloy	37		37	0.1	0.01	5.0	0.3	0.1										
Chemical Industry	13,938		13,938	1.3	0.13	20.4	59.4	3.3										
Non-ferrous	3,709		3,709	0.1	0.02	1.1	7.3	0.1										
Pulp and Paper	4,320		4,320	1.5	0.60	483.5	23.8	10.2										
Food and Beverages	4,476		4,476	11.1	1.84	187.5	44.6	9.7										
Cement	10,350		10,350	2.3	0.12	114.2	20.6	8.3										
Mining	5,302		5,302	0.3	0.05	7.1	14.9	0.8										
Textile	1,268		1,268	0.1	0.04	7.3	2.5	0.4										
Ceramics	3,382		3,382	2.2	0.31	140.8	17.5	4.2										
Other Industries	7,017		7,017	0.8	0.19	66.7	19.8	3.5										
Transport Subsector	121,748		121,748	152.6	12.09	9,845.1	612.9	836.2										
Civil Aviation	6,206		6,206	0.0	0.17	40.3	6.1	1.7										
Road Transportion	111,337		111,337	152.2	11.36	9,793.5	510.8	830.0										
Railways	1,247		1,247	0.1	0.48	4.3	20.9	1.9										
Navigation	2,958		2,958	0.3	0.08	7.0	75.1	2.6										
Residential Subsector	17,179		17,179	261.5	2.85	1,172.3	28.5	175.9										
Agriculture Subsector	14,152		14,152	12.0	0.96	86.9	159.7	35.5										
Commercial Subsector	2,216		2,216	3.1	0.04	3.9	5.3	2.5										
Public Subsector	2,122		2,122	0.0	0.02	0.6	4.7	0.8										
Fugitive Emissions	10,737		10,737	119.0	0.11	0.0	0.0	0.0										
Coal Mining	1,291		1,291	43.3	0.00	0.0	0.0	0.0										
Oil and Natural Gas	9,446		9,446	75.7	0.11	0.0	0.0	0.0										
INDUSTRIAL PROCESSES	64,314		64,314	43.7	21.09	788.1	79.1	532.1	0.1465	0.0117	0.0000	0.0000	0.0071	0.0075	0.0001	0.4988		0.0153
Cement Production	16,047		16,047	0.0	0.00	0.0	0.0	0.0										
Lime Production	5,008		5,008	0.0	0.00	0.0	0.0	0.0										
Other Uses of Limestone and Dolomite	1,756		1,756	0.0	0.00	0.0	0.0	0.0										
Soda Ash Use	243		243	0.0	0.00	0.0	0.0	0.0										
Ammonia Production	1,663		1,663	0.0	0.00	0.0	0.0	0.0										
Nitric Acid Production	0		0	0.0	2.09	0.0	0.6	0.0										
Adipic Acid Production	0		0	0.0	17.51	1.0	0.3	0.0										
Caprolactam Production	0		0	0.0	0.34	0.0	0.0	0.0										
Calcium Carbide Production	51		51	0.0	0.00	0.0	0.0	0.0										
Methanol Production	56		56	0.5	0.00	0.0	0.0	0.0										
Ethylene Production	5		5	7.9	0.00	0.0	0.0	3.7										
Vinyl Chloride Production	125		125	0.0	0.00	0.0	0.0	3.6										
Ethylene Oxide Production	133		133	0.5	0.00	0.0	0.0	0.0										
Acrylonitrile Production	20		20	0.0	0.00	0.0	0.0	0.1										
Carbon Black Production	457		457	0.0	0.00	0.0	0.0	0.0										
Phosphoric Acid Production	104		104	0.0	0.00	0.0	0.0	0.0										
Production of Other Chemicals	0		0	0.1	0.00	0.0	0.0	35.6										
Iron and Steel Production	34,052		34,052	31.0	1.06	674.4	54.9	20.6										
Ferroalloy Production	512		512	3.6	0.07	72.4	3.8	1.8										
Non-Ferrous Metals except Aluminium	1,462		1,462	0.1	0.02	3.1	9.5	0.2										
Aluminium Production	2,116		2,116	0.0	0.00	0.0	0.0	0.0	0.1465	0.0117								
Magnesium Production	0		0	0.0	0.00	0.0	0.0	0.0										0.0103
Pulp and Paper	0		0	0.0	0.00	37.2	10.0	24.6										
Food Industry	0		0	0.0	0.00	0.0	0.0	252.8										
Beverage Industry	0		0	0.0	0.00	0.0	0.0	189.1										
HCFC-22 Production	0		0	0.0	0.00	0.0	0.0	0.0			0.0000							
HFCs, PFCs and SF6 Use	0		0	0.0	0.00	0.0	0.0	0.0				0.0000	0.0071	0.0075	0.0001	0.4988		0.0050
Non-Energetic Consumption other than that in Chemical Industries	504		504	0.0	0.00	0.0	0.0	0.0										
SOLVENTS AND OTHER PRODUCT USE			0	0.0	0.00	0.0	0.0	78,597.4										
AGRICULTURE			0	10,382.3	355.93	3,576.4	97.2	0.0										
Enteric Fermentation			0	9,349.5	0.00	0.0	0.0	0.0										
Cattle			0	9,005.8	0.00	0.0	0.0	0.0										
Dairy Cattle			0	1,177.9	0.00	0.0	0.0	0.0										
Beef Cattle			0	7,827.9	0.00	0.0	0.0	0.0										
Other Animals			0	343.7	0.00	0.0	0.0	0.0										
Manure Management			0	479.7	11.49	0.0	0.0	0.0										
Cattle			0	215.9	2.98	0.0	0.0	0.0										
Dairy Cattle			0	34.1	1.09	0.0	0.0	0.0										
Beef Cattle			0	181.8	1.89	0.0	0.0	0.0										
Swine			0	166.5	2.06	0.0	0.0	0.0										
Poultry			0	78.1	6.20	0.0	0.0	0.0										
Other Animals			0	19.2	0.25	0.0	0.0	0.0										
Agricultural Soils			0		341.72	0.0	0.0	0.0										
Direct Emissions			0		213.85	0.0	0.0	0.0										
Animals on Pasture			0		140.12	0.0	0.0	0.0										
Cattle			0		122.04	0.0	0.0	0.0										
Other			0		18.08	0.0	0.0	0.0										
Synthetic Fertilizers			0		21.28	0.0	0.0	0.0										
Animal Manure Applied to Soils			0		15.88	0.0	0.0	0.0										
Cattle			0		4.87	0.0	0.0	0.0										
Other			0		11.01	0.0	0.0	0.0										
Agricultural Residue			0		21.66	0.0	0.0	0.0										
Soy bean			0		8.00	0.0	0.0	0.0										
Sugarcane			0		1.82	0.0	0.0	0.0										
Beans			0		1.06	0.0	0.0	0.0										
Rice			0		1.28	0.0	0.0	0.0										
Corn			0		5.27	0.0	0.0	0.0										
Manioc			0		2.52	0.0	0.0	0.0										
Other			0		1.71	0.0	0.0	0.0										
Organic Soils			0		14.91	0.0	0.0	0.0										
Indirect Emissions			0		127.87	0.0	0.0	0.0										
Atmospheric Deposition			0		26.53	0.0	0.0	0.0										
Synthetic Fertilizers			0		4.94	0.0	0.0	0.0										
Animal Manure			0		21.59	0.0	0.0	0.0										
Cattle			0		17.49	0.0	0.0	0.0										
Other			0		4.10	0.0	0.0	0.0										
Leaching			0		101.34	0.0	0.0	0.0										
Synthetic Fertilizers			0		19.66	0.0	0.0	0.0										
Animal Fertilizer			0		81.68	0.0	0.0	0.0										
Cattle			0		65.59	0.0	0.0	0.0										
Other			0		16.09	0.0	0.0	0.0										
Rice Cultivation			0	448.1	0.00	0.0	0.0	0.0										
Crop Residue Burning			0	105.0	2.72	3,576.4	97.2	0.0										
Cotton			0	0.0	0.00	0.0	0.0	0.0										
Sugarcane			0	105.0	2.72	3,576.4	97.2	0.0										
LAND USE, LAND-USE CHANGE AND FORESTRY	1,591,107	-393,934	1,197,175	2,048.8	81.96	35,879.9	993.8	0.0										
Land Use, Land-Use Change	1,582,390	-393,934	1,188,458	2,048.8	81.96	35,879.9	993.8	0.0										
Lime Application to Soils	8,717		8,717	0.0	0.00	0.0	0.0	0.0										
WASTE	95		95	1,809.1	5.68	0.0	0.0	0.0										
Solid Waste	95		95	1,204.3	0.01	0.0	0.0	0.0										
Effluents	0		0	604.8	5.67	0.0	0.0	0.0										
Industrial	0		0	233.1	0.00	0.0	0.0	0.0										
Domestic	0		0	371.7	5.67	0.0	0.0	0.0										
TOTAL	1,922,573	-393,934	1,528,641	14,872.8	487.07	53,494.7	2,603.4	80,471.7	0.1465	0.0117	0.0000	0.0000	0.0071	0.0075	0.0001	0.4988		0.0153

TABLE XI: GREENHOUSE GAS EMISSIONS BY SOURCES, YEAR 2010, IN GIGAGRAM(Gg)

	Gg																	
2010	CO_2 (gross emissions)	CO_2 (removals)	CO_2 (net emissions)	CH_4	N_2O	CO	NOx	NMVOC	PFCs		HFCs							SF_6
									CF_4	C_3F_6	HFC-23	HFC-32_pot	HFC-125_pot	HFC-143a_po	HFC-152a_pot	HFC-134a		
ENERGY	348,883		348,883	683.0	37.10	10,051.2	1,625.4	1,113.9										
Fuel Combustion	333,669		333,669	502.1	36.89	10,051.2	1,625.4	1,113.9										
Energy Subsector	58,859		58,859	34.6	5.03	1,620.1	583.6	251.8										
Public Service Power Plants	26,593		26,593	1.2	0.32	19.7	155.2	3.5										
Self-Producers Power Plants	9,446		9,446	6.0	0.94	305.2	54.9	2.6										
Charcoal Plants	0		0	10.8	1.45	723.2	1.8	217.0										
Other	22,820		22,820	16.6	2.32	572.0	371.7	28.7										
Industry Subsector	68,977		68,977	34.3	5.73	1,708.8	287.2	66.3										
Iron and Steel	5,540		5,540	0.2	0.02	3.7	11.4	1.4										
Ferroalloy	102		102	0.1	0.02	7.7	0.6	0.2										
Chemical Industry	13,847		13,847	2.5	0.18	22.5	58.3	3.4										
Non-ferrous	5,476		5,476	0.2	0.03	2.1	9.7	0.2										
Pulp and Paper	3,855		3,855	2.5	1.03	938.9	35.9	18.5										
Food and Beverages	3,965		3,965	23.2	3.52	260.9	81.0	14.5										
Cement	14,708		14,708	1.1	0.12	138.6	28.0	13.6										
Mining	7,289		7,289	0.3	0.07	25.5	21.1	2.7										
Textile	1,015		1,015	0.1	0.04	8.3	1.8	0.4										
Ceramics	5,007		5,007	3.1	0.42	202.3	19.4	6.4										
Other Industries	8,173		8,173	1.0	0.28	98.3	20.0	5.0										
Transport Subsector	168,598		168,598	120.8	21.59	5,288.3	511.3	545.5										
Civil Aviation	9,751		9,751	0.0	0.27	38.5	9.3	1.2										
Road Transportion	151,497		151,497	120.2	20.01	5,228.8	338.4	535.8										
Railways	2,935		2,935	0.2	1.19	10.5	51.5	4.6										
Navigation	4,415		4,415	0.4	0.12	10.5	112.1	3.9										
Residential Subsector	17,249		17,249	290.1	3.15	1,306.7	30.6	196.1										
Agriculture Subsector	17,348		17,348	18.5	1.33	122.5	208.9	51.1										
Commercial Subsector	1,446		1,446	3.8	0.04	4.6	2.6	2.7										
Public Subsector	1,192		1,192	0.0	0.02	0.2	1.2	0.4										
Fugitive Emissions	15,214		15,214	180.9	0.21	0.0	0.0	0.0										
Coal Mining	1,846		1,846	39.2	0.00	0.0	0.0	0.0										
Oil and Natural Gas	13,368		13,368	141.7	0.21	0.0	0.0	0.0										
INDUSTRIAL PROCESSES	80,786		80,786	45.3	2.15	809.6	100.8	736.8	0.0767	0.0059	0.0000	0.1059	0.5012	0.4671	0.0000	2.7196		0.0077
Cement Production	21,288		21,288	0.0	0.00	0.0	0.0	0.0										
Lime Production	5,950		5,950	0.0	0.00	0.0	0.0	0.0										
Other Uses of Limestone and Dolomite	3,060		3,060	0.0	0.00	0.0	0.0	0.0										
Soda Ash Use	396		396	0.0	0.00	0.0	0.0	0.0										
Ammonia Production	1,739		1,739	0.0	0.00	0.0	0.0	0.0										
Nitric Acid Production	0		0	0.0	0.80	0.0	0.6	0.0										
Adipic Acid Production	0		0	0.0	0.13	1.4	0.4	0.0										
Caprolactam Production	0		0	0.0	0.00	0.0	0.0	0.0										
Calcium Carbide Production	42		42	0.0	0.00	0.0	0.0	0.0										
Methanol Production	56		56	0.5	0.00	0.0	0.0	0.0										
Ethylene Production	6		6	10.6	0.00	0.0	0.0	4.6										
Vinyl Chloride Production	213		213	0.0	0.00	0.0	0.0	6.2										
Ethylene Oxide Production	146		146	0.5	0.00	0.0	0.0	0.0										
Acrylonitrile Production	22		22	0.0	0.00	0.0	0.0	0.1										
Carbon Black Production	647		647	0.0	0.00	0.0	0.1	0.0										
Phosphoric Acid Production	112		112	0.0	0.00	0.0	0.0	0.0										
Production of Other Chemicals	0		0	0.2	0.00	0.0	0.0	50.3										
Iron and Steel Production	38,360		38,360	28.6	1.08	633.2	60.1	20.2										
Ferroalloy Production	1,195		1,195	4.8	0.11	96.7	6.2	2.5										
Non-Ferrous Metals except Aluminium	4,332		4,332	0.1	0.03	4.9	13.8	0.3										
Aluminium Production	2,543		2,543	0.0	0.00	0.0	0.0	0.0	0.0767	0.0059								
Magnesium Production	0		0	0.0	0.00	0.0	0.0	0.0										0.0000
Pulp and Paper	0		0	0.0	0.00	73.4	19.6	48.5										
Food Industry	0		0	0.0	0.00	0.0	0.0	407.2										
Beverage Industry	0		0	0.0	0.00	0.0	0.0	196.9										
HCFC-22 Production	0		0	0.0	0.00	0.0	0.0	0.0			0.0000							
HFCs, PFCs and SF6 Use	0		0	0.0	0.00	0.0	0.0	0.0				0.1059	0.5012	0.4671	0.0000	2.7196		0.0077
Non-Energetic Consumption other than that in Chemical Industries	679		679	0.0	0.00	0.0	0.0	0.0										
SOLVENTS AND OTHER PRODUCT USE			0	0.0	0.00	0.0	0.0	152,514.6										
AGRICULTURE			0	12,415.6	472.08	6,313.5	171.6	0.0										
Enteric Fermentation			0	11,158.0	0.00	0.0	0.0	0.0										
Cattle			0	10,798.4	0.00	0.0	0.0	0.0										
Dairy Cattle			0	1,424.0	0.00	0.0	0.0	0.0										
Beef Cattle			0	9,374.4	0.00	0.0	0.0	0.0										
Other Animals			0	359.6	0.00	0.0	0.0	0.0										
Manure Management			0	608.1	14.83	0.0	0.0	0.0										
Cattle			0	258.7	3.46	0.0	0.0	0.0										
Dairy Cattle			0	44.0	1.38	0.0	0.0	0.0										
Beef Cattle			0	214.7	2.08	0.0	0.0	0.0										
Swine			0	214.9	2.35	0.0	0.0	0.0										
Poultry			0	115.3	8.78	0.0	0.0	0.0										
Other Animals			0	19.2	0.24	0.0	0.0	0.0										
Agricultural Soils			0		452.45	0.0	0.0	0.0										
Direct Emissions			0		282.31	0.0	0.0	0.0										
Animals on Pasture			0		170.24	0.0	0.0	0.0										
Cattle			0		152.00	0.0	0.0	0.0										
Other			0		18.24	0.0	0.0	0.0										
Synthetic Fertilizers			0		35.74	0.0	0.0	0.0										
Animal Manure Applied to Soils			0		21.33	0.0	0.0	0.0										
Cattle			0		5.77	0.0	0.0	0.0										
Other			0		15.56	0.0	0.0	0.0										
Agricultural Residue			0		39.49	0.0	0.0	0.0										
Soy bean			0		16.75	0.0	0.0	0.0										
Sugarcane			0		5.47	0.0	0.0	0.0										
Beans			0		1.09	0.0	0.0	0.0										
Rice			0		1.29	0.0	0.0	0.0										
Corn			0		9.02	0.0	0.0	0.0										
Manioc			0		2.73	0.0	0.0	0.0										
Other			0		3.14	0.0	0.0	0.0										
Organic Soils			0		15.51	0.0	0.0	0.0										
Indirect Emissions			0		170.14	0.0	0.0	0.0										
Atmospheric Deposition			0		35.65	0.0	0.0	0.0										
Synthetic Fertilizers			0		9.13	0.0	0.0	0.0										
Animal Manure			0		26.52	0.0	0.0	0.0										
Cattle			0		21.71	0.0	0.0	0.0										
Other			0		4.81	0.0	0.0	0.0										
Leaching			0		134.49	0.0	0.0	0.0										
Synthetic Fertilizers			0		33.65	0.0	0.0	0.0										
Animal Fertilizer			0		100.84	0.0	0.0	0.0										
Cattle			0		81.41	0.0	0.0	0.0										
Other			0		19.43	0.0	0.0	0.0										
Rice Cultivation			0	464.2	0.00	0.0	0.0	0.0										
Crop Residue Burning			0	185.3	4.80	6,313.5	171.6	0.0										
Cotton			0	0.0	0.00	0.0	0.0	0.0										
Sugarcane			0	185.3	4.80	6,313.5	171.6	0.0										
LAND USE, LAND-USE CHANGE AND FORESTRY	1,057,995	-747,259	310,736	1,135.5	47.08	20,231.4	589.9	0.0										
Land Use, Land-Use Change	1,047,571	-747,259	300,312	1,135.5	47.08	20,231.4	589.9	0.0										
Lime Application to Soils	10,424		10,424	0.0	0.00	0.0	0.0	0.0										
WASTE	175		175	2,402.5	7.21	0.0	0.0	0.0										
Solid Waste	175		175	1,268.5	0.01	0.0	0.0	0.0										
Effluents	0		0	1,134.0	7.20	0.0	0.0	0.0										
Industrial	0		0	621.2	0.00	0.0	0.0	0.0										
Domestic	0		0	512.8	7.20	0.0	0.0	0.0										
TOTAL	1,487,839	-747,259	740,580	16,681.9	565.62	37,405.7	2,487.7	154,365.3	0.0767	0.0059	0.0000	0.1059	0.5012	0.4671	0.0000	2.7196		0.0077

TABLE XII: GREENHOUSE GAS EMISSIONS BY SOURCES, YEAR 2012, IN GIGAGRAM(Gg)

	Gg																	
2012	CO_2 (gross emissions)	CO_2 (removals)	CO_2 (net emissions)	CH_4	N_2O	CO	NOx	NMVOC	PFCs		HFCs							SF_6
									CF_4	C_3F_6	HFC-23	HFC-32_pot	HFC-125_pot	HFC-143a_po	HFC-152a_pot	HFC-134a		
ENERGY	394,632		394,632	660.9	44.07	10,242.1	1,781.1	1,154.4										
Fuel Combustion	379,871		379,871	486.8	43.91	10,242.1	1,781.1	1,154.4										
Energy Subsector	69,386		69,386	33.1	4.86	1,587.8	682.9	255.3										
Public Service Power Plants	34,673		34,673	1.7	0.44	27.6	197.2	4.5										
Self-Producers Power Plants	9,873		9,873	6.4	1.00	331.9	61.8	2.9										
Charcoal Plants	0		0	11.2	1.49	746.0	1.9	223.8										
Other	24,840		24,840	13.8	1.93	482.3	422.0	24.1										
Industry Subsector	71,261		71,261	36.1	5.88	1,760.7	301.4	68.9										
Iron and Steel	5,401		5,401	0.1	0.02	3.8	10.9	1.5										
Ferroalloy	238		238	0.1	0.02	6.9	1.4	0.2										
Chemical Industry	14,011		14,011	2.5	0.18	22.0	56.6	3.2										
Non-ferrous	5,900		5,900	0.2	0.03	2.3	10.1	0.2										
Pulp and Paper	3,864		3,864	2.4	1.01	926.2	35.3	17.2										
Food and Beverages	4,267		4,267	24.0	3.64	268.2	86.8	15.0										
Cement	16,828		16,828	2.0	0.16	177.1	33.4	16.2										
Mining	6,403		6,403	0.3	0.05	25.8	23.1	2.8										
Textile	989		989	0.1	0.04	6.7	1.8	0.3										
Ceramics	5,220		5,220	3.3	0.45	221.1	20.9	7.2										
Other Industries	8,140		8,140	1.1	0.28	100.6	21.1	5.1										
Transport Subsector	201,605		201,605	137.5	28.94	5,600.3	552.4	601.8										
Civil Aviation	11,218		11,218	0.0	0.31	42.6	10.6	1.4										
Road Transportion	183,199		183,199	136.9	27.29	5,536.9	383.0	592.1										
Railways	3,034		3,034	0.2	1.23	10.9	53.3	4.7										
Navigation	4,154		4,154	0.4	0.11	9.9	105.5	3.6										
Residential Subsector	17,598		17,598	258.4	2.85	1,167.1	29.1	175.1										
Agriculture Subsector	17,490		17,490	17.7	1.32	121.2	212.1	50.1										
Commercial Subsector	1,701		1,701	4.0	0.05	4.8	2.4	2.9										
Public Subsector	830		830	0.0	0.01	0.2	0.8	0.3										
Fugitive Emissions	14,761		14,761	174.1	0.16	0.0	0.0	0.0										
Coal Mining	1,372		1,372	41.0	0.00	0.0	0.0	0.0										
Oil and Natural Gas	13,389		13,389	133.1	0.16	0.0	0.0	0.0										
INDUSTRIAL PROCESSES	87,870		87,870	44.0	1.86	795.1	104.1	734.0	0.0655	0.0050	0.0000	0.1286	0.4795	0.4767	0.0000	2.8953	0.0083	
Cement Production	24,998		24,998	0.0	0.00	0.0	0.0	0.0										
Lime Production	6,403		6,403	0.0	0.00	0.0	0.0	0.0										
Other Uses of Limestone and Dolomite	1,770		1,770	0.0	0.00	0.0	0.0	0.0										
Soda Ash Use	375		375	0.0	0.00	0.0	0.0	0.0										
Ammonia Production	1,758		1,758	0.0	0.00	0.0	0.0	0.0										
Nitric Acid Production	0		0	0.0	0.51	0.0	0.9	0.0										
Adipic Acid Production	0		0	0.0	0.12	1.0	0.3	0.0										
Caprolactam Production	0		0	0.0	0.00	0.0	0.0	0.0										
Calcium Carbide Production	42		42	0.0	0.00	0.0	0.0	0.0										
Methanol Production	46		46	0.4	0.00	0.0	0.0	0.0										
Ethylene Production	6		6	10.3	0.00	0.0	0.0	4.4										
Vinyl Chloride Production	154		154	0.0	0.00	0.0	0.0	6.0										
Ethylene Oxide Production	146		146	0.5	0.00	0.0	0.0	0.0										
Acrylonitrile Production	22		22	0.0	0.00	0.0	0.0	0.1										
Carbon Black Production	647		647	0.0	0.00	0.0	0.1	0.0										
Phosphoric Acid Production	90		90	0.0	0.00	0.0	0.0	0.0										
Production of Other Chemicals	0		0	0.2	0.00	0.0	0.0	48.9										
Iron and Steel Production	41,455		41,455	28.3	1.10	630.8	62.2	20.4										
Ferroalloy Production	1,044		1,044	4.2	0.09	84.9	5.5	2.2										
Non-Ferrous Metals except Aluminium	5,857		5,857	0.1	0.04	6.5	15.9	0.4										
Aluminium Production	2,378		2,378	0.0	0.00	0.0	0.0	0.0	0.0655	0.0050								
Magnesium Production	0		0	0.0	0.00	0.0	0.0	0.0										0.0000
Pulp and Paper	0		0	0.0	0.00	71.9	19.2	47.5										
Food Industry	0		0	0.0	0.00	0.0	0.0	407.2										
Beverage Industry	0		0	0.0	0.00	0.0	0.0	196.9										
HCFC-22 Production	0		0	0.0	0.00	0.0	0.0	0.0			0.0000							
HFCs, PFCs and SF6 Use	0		0	0.0	0.00	0.0	0.0	0.0				0.1286	0.4795	0.4767	0.0000	2.8953	0.0083	
Non-Energetic Consumption other than that in Chemical Industries	679		679	0.0	0.00	0.0	0.0	0.0										
SOLVENTS AND OTHER PRODUCT USE			0	0.0	0.00	0.0	0.0	129,247.4										
AGRICULTURE			0	12,511.7	491.10	5,616.9	152.6	0.0										
Enteric Fermentation			0	11,287.7	0.00	0.0	0.0	0.0										
Cattle			0	10,934.5	0.00	0.0	0.0	0.0										
Dairy Cattle			0	1,435.1	0.00	0.0	0.0	0.0										
Beef Cattle			0	9,499.4	0.00	0.0	0.0	0.0										
Other Animals			0	353.2	0.00	0.0	0.0	0.0										
Manure Management			0	610.9	14.95	0.0	0.0	0.0										
Cattle			0	261.0	3.51	0.0	0.0	0.0										
Dairy Cattle			0	43.7	1.42	0.0	0.0	0.0										
Beef Cattle			0	217.3	2.09	0.0	0.0	0.0										
Swine			0	215.9	2.32	0.0	0.0	0.0										
Poultry			0	115.3	8.88	0.0	0.0	0.0										
Other Animals			0	18.7	0.24	0.0	0.0	0.0										
Agricultural Soils			0		471.88	0.0	0.0	0.0										
Direct Emissions			0		292.69	0.0	0.0	0.0										
Animals on Pasture			0		170.44	0.0	0.0	0.0										
Cattle			0		152.82	0.0	0.0	0.0										
Other			0		17.62	0.0	0.0	0.0										
Synthetic Fertilizers			0		43.70	0.0	0.0	0.0										
Animal Manure Applied to Soils			0		21.01	0.0	0.0	0.0										
Cattle			0		5.86	0.0	0.0	0.0										
Other			0		15.15	0.0	0.0	0.0										
Agricultural Residue			0		41.91	0.0	0.0	0.0										
Soy bean			0		16.04	0.0	0.0	0.0										
Sugarcane			0		5.82	0.0	0.0	0.0										
Beans			0		0.97	0.0	0.0	0.0										
Rice			0		1.33	0.0	0.0	0.0										
Corn			0		11.58	0.0	0.0	0.0										
Manioc			0		2.52	0.0	0.0	0.0										
Other			0		3.65	0.0	0.0	0.0										
Organic Soils			0		15.63	0.0	0.0	0.0										
Indirect Emissions			0		179.19	0.0	0.0	0.0										
Atmospheric Deposition			0		37.38	0.0	0.0	0.0										
Synthetic Fertilizers			0		10.79	0.0	0.0	0.0										
Animal Manure			0		26.59	0.0	0.0	0.0										
Cattle			0		21.84	0.0	0.0	0.0										
Other			0		4.75	0.0	0.0	0.0										
Leaching			0		141.81	0.0	0.0	0.0										
Synthetic Fertilizers			0		40.87	0.0	0.0	0.0										
Animal Fertilizer			0		100.94	0.0	0.0	0.0										
Cattle			0		81.90	0.0	0.0	0.0										
Other			0		19.04	0.0	0.0	0.0										
Rice Cultivation			0	448.3	0.00	0.0	0.0	0.0										
Crop Residue Burning			0	164.8	4.27	5,616.9	152.6	0.0										
Cotton			0	0.0	0.00	0.0	0.0	0.0										
Sugarcane			0	164.8	4.27	5,616.9	152.6	0.0										
LAND USE, LAND-USE CHANGE AND FORESTRY	990,035	-774,724	215,312	1,080.0	45.23	19,337.7	571.6	0.0										
Land Use, Land-Use Change	975,072	-774,724	200,349	1,080.0	45.23	19,337.7	571.6	0.0										
Lime Application to Soils	14,963		14,963	0.0	0.00	0.0	0.0	0.0										
WASTE	195		195	2,590.4	7.33	0.0	0.0	0.0										
Solid Waste	195		195	1,382.2	0.01	0.0	0.0	0.0										
Effluents	0		0	1,208.2	7.32	0.0	0.0	0.0										
Industrial	0		0	686.8	0.00	0.0	0.0	0.0										
Domestic	0		0	521.4	7.32	0.0	0.0	0.0										
TOTAL	1,472,732	-774,724	698,009	16,887.0	589.59	35,991.8	2,609.4	131,135.8	0.0655	0.0050	0.0000	0.1286	0.4795	0.4767	0.0000	2.8953	0.0083	

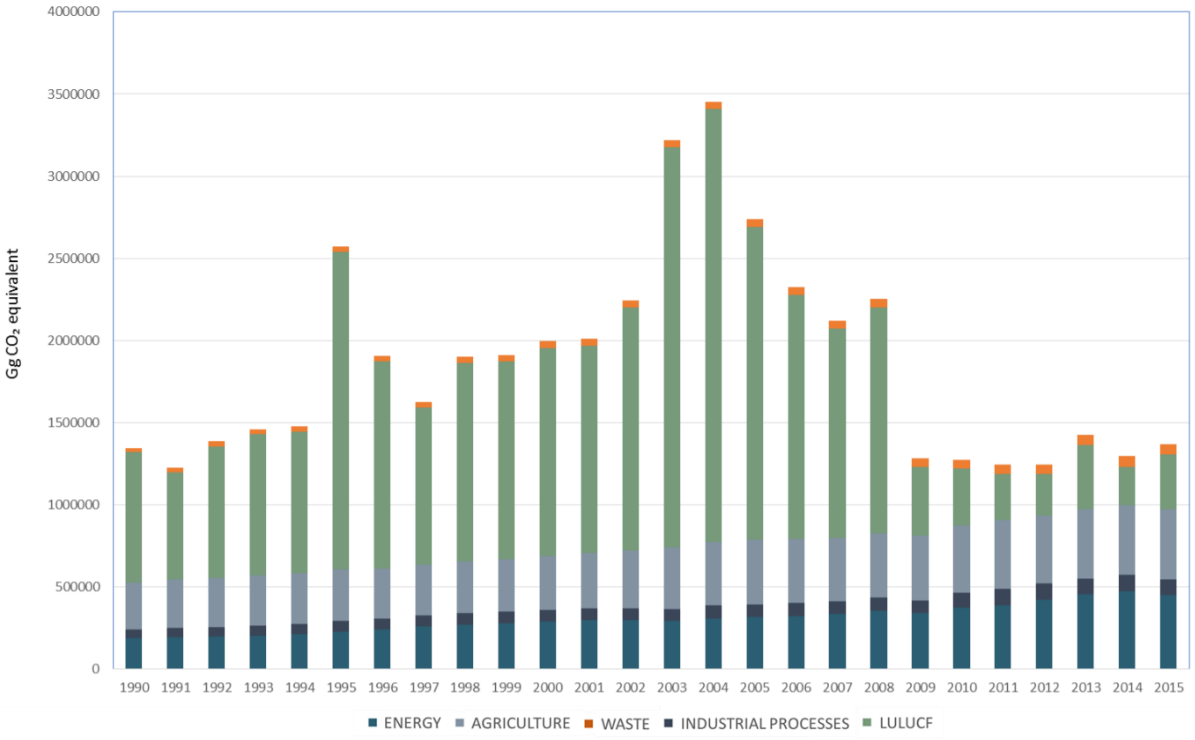
TABLE XIII: GREENHOUSE GAS EMISSIONS BY SOURCES, YEAR 2015, IN GIGAGRAM(Gg)

	Gg																	
2015	CO_2 (gross emissions)	CO_2 (removals)	CO_2 (net emissions)	CH_4	N_2O	CO	NOx	NMVOC	PFCs		HFCs							SF_6
									CF_4	C_3F_6	HFC-23	HFC-32_pot	HFC-125_pot	HFC-143a_pot	HFC-152a_pot	HFC-134a		
ENERGY	420,313		420,313	688.1	47.24	9,291.6	1,815.7	1,026.6										
Fuel Combustion	402,709		402,709	465.7	47.00	9,291.6	1,815.7	1,026.6										
Energy Subsector	96,252		96,252	38.6	5.82	1,745.1	794.8	235.3										
Public Service Power Plants	56,669		56,669	2.9	0.76	41.3	224.9	5.2										
Self-Producers Power Plants	10,597		10,597	8.7	1.34	451.3	75.3	3.9										
Charcoal Plants	0		0	9.8	1.31	653.9	1.6	196.2										
Other	28,986		28,986	17.2	2.41	598.6	493.0	30.0										
Industry Subsector	68,978		68,978	32.5	5.56	1,929.8	293.9	66.1										
Iron and Steel	5,484		5,484	0.1	0.02	3.9	10.5	1.4										
Ferroalloy	117		117	0.1	0.01	5.4	1.0	0.1										
Chemical Industry	13,188		13,188	2.4	0.17	21.3	53.9	3.0										
Non-ferrous	5,523		5,523	0.2	0.03	1.9	9.8	0.2										
Pulp and Paper	4,033		4,033	2.6	1.19	1,150.1	41.7	17.6										
Food and Beverages	4,235		4,235	21.0	3.20	247.1	79.9	13.7										
Cement	15,637		15,637	1.6	0.15	162.4	30.8	15.2										
Mining	6,535		6,535	0.3	0.06	27.5	23.7	3.0										
Textile	670		670	0.1	0.03	5.6	1.3	0.3										
Ceramics	5,147		5,147	3.1	0.42	208.4	20.3	6.8										
Other Industries	8,409		8,409	1.0	0.28	96.2	21.0	4.8										
Transport Subsector	198,857		198,857	117.1	31.30	4,333.4	466.5	494.0										
Civil Aviation	11,696		11,696	0.0	0.31	36.7	10.7	1.3										
Road Transportion	181,257		181,257	116.6	29.75	4,279.1	326.8	485.5										
Railways	2,811		2,811	0.2	1.16	10.3	50.4	4.5										
Navigation	3,093		3,093	0.3	0.08	7.3	78.6	2.7										
Residential Subsector	18,021		18,021	252.9	2.80	1,143.2	29.1	171.6										
Agriculture Subsector	18,370		18,370	20.6	1.47	135.3	228.6	56.5										
Commercial Subsector	1,413		1,413	4.0	0.04	4.6	2.1	2.8										
Public Subsector	818		818	0.0	0.01	0.2	0.7	0.3										
Fugitive Emissions	17,604		17,604	222.4	0.24	0.0	0.0	0.0										
Coal Mining	1,822		1,822	51.5	0.00	0.0	0.0	0.0										
Oil and Natural Gas	15,782		15,782	170.9	0.24	0.0	0.0	0.0										
INDUSTRIAL PROCESSES	84,212		84,212	40.7	1.86	717.4	102.2	732.1	0.0333	0.0025	0.0000	0.1730	0.6103	0.6075	0.0000	3.9276	0.0092	
Cement Production	23,767		23,767	0.0	0.00	0.0	0.0	0.0										
Lime Production	6,392		6,392	0.0	0.00	0.0	0.0	0.0										
Other Uses of Limestone and Dolomite	1,058		1,058	0.0	0.00	0.0	0.0	0.0										
Soda Ash Use	375		375	0.0	0.00	0.0	0.0	0.0										
Ammonia Production	1,805		1,805	0.0	0.00	0.0	0.0	0.0										
Nitric Acid Production	0		0	0.0	0.51	0.0	0.8	0.0										
Adipic Acid Production	0		0	0.0	0.20	0.7	0.2	0.0										
Caprolactam Production	0		0	0.0	0.00	0.0	0.0	0.0										
Calcium Carbide Production	42		42	0.0	0.00	0.0	0.0	0.0										
Methanol Production	32		32	0.3	0.00	0.0	0.0	0.0										
Ethylene Production	6		6	10.9	0.00	0.0	0.0	4.4										
Vinyl Chloride Production	154		154	0.0	0.00	0.0	0.0	6.0										
Ethylene Oxide Production	146		146	0.5	0.00	0.0	0.0	0.0										
Acrylonitrile Production	22		22	0.0	0.00	0.0	0.0	0.1										
Carbon Black Production	647		647	0.0	0.00	0.0	0.1	0.0										
Phosphoric Acid Production	98		98	0.0	0.00	0.0	0.0	0.0										
Production of Other Chemicals	0		0	0.2	0.00	0.0	0.0	48.9										
Iron and Steel Production	42,284		42,284	25.4	1.05	572.5	65.9	19.1										
Ferroalloy Production	800		800	3.3	0.07	66.7	4.3	1.7										
Non-Ferrous Metals except Aluminium	4,665		4,665	0.1	0.03	5.6	11.7	0.3										
Aluminium Production	1,281		1,281	0.0	0.00	0.0	0.0	0.0	0.0333	0.0025								
Magnesium Production	0		0	0.0	0.00	0.0	0.0	0.0										0.0000
Pulp and Paper	0		0	0.0	0.00	71.9	19.2	47.5										
Food Industry	0		0	0.0	0.00	0.0	0.0	407.2										
Beverage Industry	0		0	0.0	0.00	0.0	0.0	196.9										
HCFC-22 Production	0		0	0.0	0.00	0.0	0.0	0.0			0.0000							
HFCs, PFCs and SF6 Use	0		0	0.0	0.00	0.0	0.0	0.0				0.1730	0.6103	0.6075	0.0000	3.9276	0.0092	
Non-Energetic Consumption other than that in Chemical Industries	638		638	0.0	0.00	0.0	0.0	0.0										
SOLVENTS AND OTHER PRODUCT USE			0	0.0	0.00	0.0	0.0	98,236.7										
AGRICULTURE			0	12,887.5	510.54	5,876.4	159.7	0.0										
Enteric Fermentation			0	11,620.1	0.00	0.0	0.0	0.0										
Cattle			0	11,247.8	0.00	0.0	0.0	0.0										
Dairy Cattle			0	1,410.2	0.00	0.0	0.0	0.0										
Beef Cattle			0	9,837.6	0.00	0.0	0.0	0.0										
Other Animals			0	372.3	0.00	0.0	0.0	0.0										
Manure Management			0	632.4	15.52	0.0	0.0	0.0										
Cattle			0	265.6	3.53	0.0	0.0	0.0										
Dairy Cattle			0	41.9	1.45	0.0	0.0	0.0										
Beef Cattle			0	223.7	2.08	0.0	0.0	0.0										
Swine			0	227.1	2.29	0.0	0.0	0.0										
Poultry			0	120.2	9.46	0.0	0.0	0.0										
Other Animals			0	19.5	0.24	0.0	0.0	0.0										
Agricultural Soils			0		490.55	0.0	0.0	0.0										
Direct Emissions			0		307.74	0.0	0.0	0.0										
Animals on Pasture			0		172.84	0.0	0.0	0.0										
Cattle			0		154.41	0.0	0.0	0.0										
Other			0		18.43	0.0	0.0	0.0										
Synthetic Fertilizers			0		44.31	0.0	0.0	0.0										
Animal Manure Applied to Soils			0		22.43	0.0	0.0	0.0										
Cattle			0		5.85	0.0	0.0	0.0										
Other			0		16.58	0.0	0.0	0.0										
Agricultural Residue			0		52.35	0.0	0.0	0.0										
Soy bean			0		23.74	0.0	0.0	0.0										
Sugarcane			0		6.06	0.0	0.0	0.0										
Beans			0		1.07	0.0	0.0	0.0										
Rice			0		1.41	0.0	0.0	0.0										
Corn			0		13.90	0.0	0.0	0.0										
Manioc			0		2.52	0.0	0.0	0.0										
Other			0		3.65	0.0	0.0	0.0										
Organic Soils			0		15.81	0.0	0.0	0.0										
Indirect Emissions			0		182.81	0.0	0.0	0.0										
Atmospheric Deposition			0		38.24	0.0	0.0	0.0										
Synthetic Fertilizers			0		11.21	0.0	0.0	0.0										
Animal Manure			0		27.03	0.0	0.0	0.0										
Cattle			0		22.05	0.0	0.0	0.0										
Other			0		4.98	0.0	0.0	0.0										
Leaching			0		144.57	0.0	0.0	0.0										
Synthetic Fertilizers			0		41.64	0.0	0.0	0.0										
Animal Fertilizer			0		102.93	0.0	0.0	0.0										
Cattle			0		82.69	0.0	0.0	0.0										
Other			0		20.24	0.0	0.0	0.0										
Rice Cultivation			0	462.5	0.00	0.0	0.0	0.0										
Crop Residue Burning			0	172.5	4.47	5,876.4	159.7	0.0										
Cotton			0	0.0	0.00	0.0	0.0	0.0										
Sugarcane			0	172.5	4.47	5,876.4	159.7	0.0										
LAND USE, LAND-USE CHANGE AND FORESTRY	1,067,816	-774,724	293,093	1,144.8	47.33	20,370.8	591.6	0.0										
Land Use, Land-Use Change	1,054,334	-774,724	279,611	1,144.8	47.33	20,370.8	591.6	0.0										
Lime Application to Soils	13,482		13,482	0.0	0.00	0.0	0.0	0.0										
WASTE	222		222	2,860.8	7.73	0.0	0.0	0.0										
Solid Waste	222		222	1,493.4	0.01	0.0	0.0	0.0										
Effluents	0		0	1,367.4	7.72	0.0	0.0	0.0										
Industrial	0		0	817.8	0.00	0.0	0.0	0.0										
Domestic	0		0	549.6	7.72	0.0	0.0	0.0										
TOTAL	1,572,563	-774,724	797,840	17,621.9	614.70	36,256.2	2,669.2	99,995.4	0.0333	0.0025	0.0000	0.1730	0.6103	0.6075	0.0000	3.9276	0.0092	

2.3 EMISSIONS RESULTS

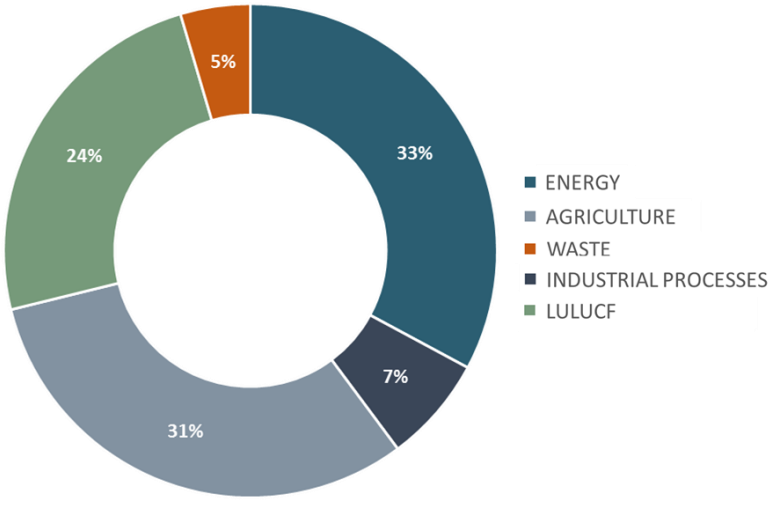
Figure IV presents the annual historical time series of GHG emissions in Brazil, by sector, from 1990 to 2015, in CO_2 equivalent (GWP – 100 years[20]).

FIGURE IV: GREENHOUSE GAS EMISSIONS IN CO_2 EQUIVALENT BY SECTOR, 1990 TO 2015.



In recent years the profile of Brazilian emissions has changed (Figure V). Due to the success in implementing policies and measures to reduce deforestation, the share of national emissions from the Land Use and Forestry sector has decreased. Consequently, other sectors such as Energy and Agriculture have become more relevant in the context of climate change.

FIGURE V: SHARE OF GREENHOUSE GAS EMISSIONS BY SECTOR, 2015.



[20] *GWP – 100 years metric, reference values as per the Second Assessment Report (SAR), IPCC, 1995. Available at: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml. Accessed on: 19 Jul 2018.*

3

MITIGATION ACTIONS AND THEIR EFFECTS

3 MITIGATION ACTIONS AND THEIR EFFECTS

This section presents detailed information about Brazil's Nationally Appropriate Mitigation Actions (NAMA) communicated to the UNFCCC via document FCCC/AWGLCA/2011/INF.1. The period varies according to the beginning of the implementation of each NAMA, going up to 2018, whenever possible. At the national level, the government of Brazil established Sectoral Plans as supporting instruments to the implementation of all NAMAs, pursuant to its National Policy on Climate Change (PNMC). The PNMC includes additional actions other than the NAMAs included in this BUR.

The table below presents the Brazilian NAMAs according to the guidance established by Decision 2/ CP17, Annex III, and includes: name, nature of the action, sector, coordinating institution, gases, general objective, description, period, methodology and assumptions, specific objective, goals, progress indicators, actions/steps taken and results[21]. This revised format represents an evolution from the previous reporting, based on progress in monitoring the NAMAs and the lessons learned as part of the international consultation and analysis process (ICA) of the first and second BURs.

TABLE XIV: MITIGATION ACTIONS IN BRAZIL.

Name: National Plan for Low Carbon Emission in Agriculture - ABC Plan
Nature of the Action: NAMA
Sector: Agriculture
Coordinating Institution: Ministry of Agriculture, Livestock and Food Supply (MAPA)
Gas (es): CH_4, N_2O, CO_2
General Objective: increase the area under sustainable production systems ensuring the reduction of GHG emissions.
Description: Brazil has been investing in research and technology development for the sustainability of its agricultural sector for the past five decades. In this context, the ABC Plan was established in 2011 as one of the government's tools to promote sustainable agricultural practices throughout the country. The ABC Plan promotes the adoption, by farmers, of a set of technologies toward increasing productivity and profitability, as well as resiliency and adaptive capacity of national agricultural systems, with the integration of soil, water and biodiversity conservation strategies. These technologies have contributed to increase food production and, therefore, food safety, while maintaining almost unchanged the area under farming activity and making production systems more resilient to climate change and more efficient in controlling GHG emissions related to agricultural activities. The ABC Plan includes, among other complementary actions, the implementation of the following NAMAs: • Restoration of grazing land; • Integrated crop-livestock systems; • No-till farming; • Biological nitrogen fixation.
Period: 2010-2018
Estimated GHG reduction: • Restoration of grazing land: 83 to 104 million tCO_2e by 2020 • Integrated crop-livestock systems: 18 to 22 million tCO_2e by 2020 • No-till farming: 16 to 20 million tCO_2e by 2020 • Biological nitrogen fixation: 16 to 20 million tCO_2e by 2020
Methodologies and assumptions: GHG emissions in agriculture are mainly the result of: (i) biotic processes inherent to the use and management of soil; (ii) processes inherent to the specific physiology of herd animals (enteric fermentation of ruminant cattle); (iii) anaerobic decomposition processes related to deep-water cropping systems (such as flooded rice cultivation); (iv) treatment and disposal of vegetation and animal waste; and (v) management of native areas for their use as agricultural ecosystems.

[21] The estimated reductions informed herein are only indications in view of the difficulties in quantifying mitigation actions results in the country. However, the actions/measures taken and the results reported, together with the recognition of gaps and capacity needs and efforts reported in the Sections concerning SMMARE and MRV of actions, reflect the efforts that Brazil has been undertaking to quantify greenhouse gas emissions reductions and transparency of information.

The central assumption of the ABC Plan is that the adoption of conservationist agriculture strategies, combined with the integration of production systems, increases the resilience of production systems, their ability to adapt to external impacts and are more efficient in controlling GHG emissions. These strategies encompass the adequate management and conservation of soil, water and biodiversity, duly compatible with the use of external inputs, thus intensifying production.
Monitoring of the implementation of mitigation actions in the agricultural sector will be improved by a strategy that includes:

1) Data collection:
    - Analyses of satellite images where actions have been implemented;
    - Information collected directly from the banking sector (contracts under the financing line established by the ABC Plan);
    - Census data from the Brazilian Institute of Geography and Statistics (IBGE), the National Supply Company (Conab) and/or private companies; and
    - Surveys (field or of technical plans).
2) Data processing: centralized through the Multi-Institutional Platform of Climate Change and Agriculture (ABC Platform), established in 2017 through a partnership between the Brazilian Agricultural Research Corporation (Embrapa) and members of Rede CLIMA. The ABC platform involves experts from several institutions for information survey, analysis and validation; explaining reference scenarios and establishing calculation methodologies used to account for reductions applicable to the Brazilian ecological and technical conditions.

Specific Objective: Restoration of grazing land

Goal: Recover 15 million hectares of degraded pastures/grazing land.

Progress Indicators: Area (ha) of recovered pastures.

Specific Objective: Integrated crop-livestock system.

Goal: Broaden the adoption of agriculture-livestock-forest integration in 4 million hectares and agroforestry systems in 2.76 million hectares.

Progress Indicators: Area (ha) implemented with agriculture-livestock-forest Integration and agroforestry systems.

Specific Objective: No-till farming.

Goal: Increase the adoption of the no-till farming system to 8 million hectares.

Progress Indicators: Area (ha) managed under no-till farming systems.

Specific Objective: Biological nitrogen fixation (BNF).

Goals: Increase the adoption of BNF to 5.5 million hectares of cultivated areas, substituting nitrogen fertilizers.

Progress Indicators: Area (ha) cultivated with BNF and number of inoculants traded.

Specific Objective: Planted forests.

Goal: Increase plantation to 3.0 million hectares.

Progress Indicators: Area (ha) with planted forests.

Specific Objective: Manure Management.

Goal: Broaden the use of technologies for the treatment of 4.4 million m^3 of manure.

Progress Indicators:

- Volume of processed biogas;
- Volume of methane used for the generation of energy;
- Volume of electric power generated with the use of biogas;
- Tons of organic compost generated.

Specific Objective: Adaptation to Climate Change.

Goal: Strengthen the agriculture sector's capacity to adapt to climate change.

Progress Indicators:

- Number of actions to increase the adaptive capacity of plants and productive systems;
- Area (ha) with adaptation actions in the mapped regions.

Actions/Steps taken: The central action of the ABC Plan is the appropriation of information by the rural producer. The availability and accessibility of information, confidence in the technology presented, and safety in the process lead the producer to invest in transformative measures. In addition to private sector initiatives, actions directly taken by the federal government include:

- over 3,400 capacity-building events;
- training of some 60 thousand producers all over the country;
- 940 Technological Reference Units and/or Test Demonstration Units in the several Brazilian biomes;
- over BRL 16 billion passed on contracts throughout the national territory through an innovative credit line, focusing on the structuring of the sustainable production system and conservationist agriculture proposed by the ABC Plan;

- establishment of scientific research lines[22] that consolidate sustainability and add alternatives to the various technological systems proposed;
- managing and equipping the High-Resolution Phenotyping Laboratory, aiming at characterizing the genetic resources for diverse attributes, which is essential for the identification of crops that are adaptable to all possible climate conditions;
- vulnerability analysis;
- mapping of main cultivated species according to their adaptability to climate projections;
- development of research projects with integrated systems (Agriculture-Livestock-Forest Integration and Agroforestry Systems) contemplating mitigation of GHG emissions in the production and risk reduction systems by the diversification of activities;
- creation of State Management Groups and development of state ABC Plans, which establish goals and actions in line with the environmental, cultural and institutional characteristics of each Brazilian federal State;
- initiatives to raise awareness among the most diverse target audiences and dissemination of the ABC Plan in all Units of the Federation;
- conclusion of the Governance System of the ABC Plan (SIGABC) and the establishment of the Multi-Institutional Platform for Monitoring GHG Emission Reductions in Agriculture (ABC Platform);
- Structuring of the Center for Climate Intelligence, which aims at consolidating the information needed to communicate and establish an early warning process to society, in particular to rural producers and decision makers.

ABC Plan activities are implemented aligned with other sectoral plans and government actions, namely:

- promoting forest planting for the supply of charcoal to steel mills;
- promoting the adoption of agriculture-livestock-forest integration and agroforestry systems, the sustainable use of areas already open, and the recovery of degraded areas for agricultural production contributing to the reduction of deforestation and forest degradation;
- contributing to increasing the diversification of renewable energy sources through the production of biomass and the treatment of animal waste;
- implementation of the Brazilian Forest Code: environmental registration of rural producers and recovery of the environmental deficit of agricultural production properties.

Outcomes:
From 2010 to 2018, about 27.65 million hectares of production systems have incorporated sustainable practices (see detailed outcomes below). These technologies were adopted countrywide, in 2,885 Brazilian municipalities. Much of this expansion was exclusively promoted by the financing line established by the ABC Plan.
Detailed outcomes:

- According to data on the financing of the ABC Program resources, from 2010 to 2018, 4.46 million hectares of degraded pastures were recovered, which can be increased to 10.44 million hectares, if IBGE data is considered.
- According to data from the ABC Program, the Agriculture-Livestock-Forest Integration Network, the ABC Platform and IBGE, from 2010 to 2016, the area of adoption of Agriculture-Livestock-Forest Integration expanded by 5.83 million hectares.
- According to data from the ABC Platform based on the Census of Agriculture (2006 and 2017), from 2010 to 2016, the area of adoption of No-Tillage systems increased by 9.97 million hectares and the area of adoption of Biological Fixation of Nitrogen (BFN) expanded by 9.97 million hectares (No -Tillage areas overlap BFN).
- According to data from the Brazilian Tree Institute, from 2010 to 2018, the area of forests planted for commercial purposes expanded by 1.10 million hectares.
- According to MAPA estimates, from 2010 to 2018, 1.70 million m^3 of animal waste treatment were adopted.

Name: Action Plan for the Prevention and Control of Deforestation in the Legal Amazon – PPCDAm[23]

Nature of the action: NAMA

Sector: Land Use, Land-Use Change and Forestry (LULUCF)

Coordinating Institution: Ministry of the Environment

Gas (es): CO_2e

General Objective: Launched in 2004, it aims at reducing deforestation and the degradation of native vegetation by promoting the maintenance of ecosystem services through the sustainable use of forest resources and the promotion of sustainable agricultural practices.

[22] Special attention to integrated productive arrangements suitable for the various Brazilian regions; new strains of inoculants for grass species, risk studies, productivity, the effect of various production systems and technology on soil carbon storage capacity, among others.
[23] Because the strategy to reduce deforestation is structured by biomes, some results accounted for under the PPCDAm have national impact and are therefore reported both here and in the section on PPCerrado.

Description: PPCDAm is currently on its fourth implementation stage (2016-2020). This Plan encompasses several policies and actions from the Federal Government and is structured in nine specific objectives distributed into four thematic axes: i) environmental monitoring and control; ii) land tenure regularization and territorial management, iii) fostering sustainable productive activities and iv) normative and economic instruments.
As one of the instruments of National Policy on Climate Change (Law No. 12,187), PPCDAM aims at reducing deforestation by 2020 and contributing to ban illegal logging by 2030.
The specific objectives described herein were proposed by the Federal Government when drafting the PPCDAm, and not only by the Ministry of the Environment, thus showing that deforestation is a challenge that goes beyond the environmental agenda. Like the PPCerrado, many of its actions are countrywide.

Period: 2004-2017

Estimated reduction related to the NAMA: 564 million tCO_2e by 2020

Specific Objective: To promote allocation and tenure of public lands

Methodologies and assumptions: The significant portion of public land not yet allocated or tenured was identified as a critical cause of deforestation in the Brazilian Amazon.

Goal: 10 million hectares of federal public lands allocated.

Progress Indicators:

- Public federal area effectively allocated (ha).

Actions/Steps taken: The Federal Government, by means of the Legal Tenure Program (PTL in the Brazilian acronym), has been working since 2009 to promote the tenure of federal public lands. Priority was initially accorded to titling land possessed in these areas. Over time, the initial stage of land allocation met also a series of other highly relevant demands in combating deforestation, such as acknowledging indigenous lands and making areas available for the establishment of conservation areas, among others.

The strategic nature of land tenure regularization under the PPCDAm was consolidated during its second stage (2009-2011), due to its structuring importance towards fighting deforestation. Actions were scaled up and accelerated with the creation of the Technical Chamber for the Allocation and Land Tenure Regularization of Federal Rural Public Land in the Legal Amazon in 2013. Since then, over 11 million hectares have been allocated, out of which 7.5 million are protected areas.

Outcomes:

- 100% of the 60 million hectares of federal public land without allocation or clear land tenure (baseline 2013) have been analyzed by the Technical Chamber, with 47.8 million hectares already processed, i.e. clearly allocated or tenured, without overlapping interests between the federal agencies.

Specific Objective: To promote land-use planning, strengthening protected areas.

Methodologies and assumptions: The expansion of protected areas reduces deforestation and protects biodiversity.

Goal: 30% of the Amazon biome under protected areas.

Progress Indicators: Percentage of the biome protected within conservation units.

Actions/Steps taken:

- Establishment and expansion of conservation units in priority areas for biodiversity conservation;
- The Campos Ferruginosos National Park was created in 2016 (79,029 hectares).

Results:

- 28.5% of the Amazon biome is protected by Federal, State and Municipal conservation units;

Goal: Speed up the acknowledgement of indigenous lands in areas under greater deforestation pressure.

Progress Indicators: Indigenous lands area (ha) listed in declaratory rulings of the Justice Ministry.

Actions/Steps taken: Granting full property rights to indigenous peoples, acknowledging their lands.

Results:

- Declaratory rulings for approximately 1 million hectares of indigenous land in 2016.

Specific objective: To promote accountability for environmental crimes and infractions.

Goal: To reduce deforestation in conservation units.

Progress Indicators: Deforested areas (ha) in conservation units.

Actions/Steps taken: Surveillance of conservation units and federal public lands, including:

- 270 notices of infraction issued;
- 165 surveillance actions;
- 56 conservation units served;
- BRL 105,389,209.00 charged in simple fines;
- BRL 2,356,242.60 in seizures; and
- 46,343.7 hectares of embargoed areas

Results:

- Decrease by 84% in deforested areas inside conservation units between 2004 and 2017.

Specific Objective: Effectively implement joint forest management.

Methodologies and assumptions: Environmental and forest management in Brazil is to a great extent a responsibility of the States. The Federal Government's role is to unify and make national data on forest and environmental management available for the development of public policies and for monitoring and control of deforestation. In this context, the National System of the Rural Environmental Registry (Sicar) and the National System for the Control of the Origin of Forest Products (Sinaflor) were created. The Rural Environmental

Registry (CAR) is a recordkeeping of private rural properties and their compliance with the Brazilian Forest Code. It contains geo-references information about the legal protected areas in private rural properties, allowing for the identification of areas in which the suppression of native vegetation has been authorized by the federative units and areas in which illegal deforestation occurs. Sinaflor is a monitoring system for tracking the transportation of native wood products.
Goal: To implement the National System for the Control of the Origin of Forest Products (Sinaflor).
Progress Indicators: Number of States integrated into Sinaflor.
Actions/Steps taken: Promotion of the integration and interoperability of States' forest-control systems with the National System.
Results:

- Implementation of Sinaflor in seven of the nine States in the Legal Amazon region (Roraima, Amazonas, Amapá, Rondônia, Acre, Tocantins and Maranhão).

Goal: Register 100% of all private rural properties in Brazil in the Rural Environmental Registry (CAR).
Progress Indicators: Index of environmental regularity of rural properties (number or area of rural properties in regularization/total real estate).

Actions/Steps taken: Improvement and availability of the modules for analysis and monitoring of:

- Rural Environmental Registry. Availability of the spatial data of all private rural properties by municipality for public access;
- Registration, analysis, monitoring, access management and reporting modules were made available to the appropriate federal unit agencies via the Rural Environmental Registry.

Results:

- 100% (5.5 million) of rural properties registered (at the national level). 469.7 million hectares of rural properties registered (at the national level). *Registers are self-declaratory and will go through a validation phase by the relevant state bodies.

Specific objective: To prevent and combat the incidence of forest fires.
Methodologies and assumptions: The incidence of forest fires in Brazilian biomes results in the degradation of the vegetation and GHG emissions. Federal environmental agencies have implemented policies and measures to reduce degradation and promote conservation through integrated fire management with a view to reduce forest fires that are harmful to biodiversity.
Goal: To reduce the area affected by forest fires.
Progress Indicators:

- Burned area (ha);
- Number of heat spots.

Actions/Steps taken:

- Implementation of the Federal Forest Brigade Programme, aiming at reducing the number of forest fires in priority federal areas;
- Implementation of Fire Integrated Management;
- Regulation of Art. 40 of Law No. 12,651/2012 (National Policy on the Management and Control of Burnings, Prevention and Combat of Forest Fires);
- Elaboration of Forest Fire Prevention and Combat Plans in conservation units;
- Prevention and combat action planning in six priority conservation units;
- Elaboration of the Draft Law of the National Integrated Fire Management Policy;
- Hire 222 firefighters in 19 federal conservation units (ICMBio) and in 50 priority federal areas (Prevfogo/Ibama).

Results:

- 50% decrease in areas affected by fire within conservation units in 2017 (136,112.52 ha) compared to 2016 (271,679.41 ha);
- Heat spots reduced from 190,506 ha (2015) to 158,532 ha (2017).

Specific objective: To improve and strengthen the monitoring of vegetation cover.
Methodologies and assumptions: The real-time deforestation detection system is the main tool used by the environmental surveillance to control deforestation, being improved every year by INPE and Censipam. It is the system that provides daily data to federal environmental agencies to support law enforcement actions. In addition to the optical sensors, the detection of deforestation is also being carried out in periods of high cloud cover incidence in the Amazon with the use of radar images. In addition to deforestation, INPE is monitoring and measuring the heat sources and burned areas in all biomes, providing essential information to implement policies to reduce forest fires and integrated fire management, especially for environmental conservation within protected areas.
Goal: To improve deforestation alert systems.
Progress Indicators:

- Image area worked on per month in the Deter systems (in spatial resolutions of 250m, 60m and 30m);
- Deforestation Alert Index/Image area worked (in spatial resolution between 3 and 6m).

Actions/Steps taken:

- Improvement of the real-time deforestation and forest degradation detection and mapping system (Deter: A, B and C);
- Development and improvement of the deforestation mapping system by radar.

Results:

- Systems are fully operational, with INPE's TerraBrasilis platform available online;
- Improvement of the real-time radar deforestation and degradation mapping system (SIPAM-SAR) for detection and warning of deforestation under cloud cover;

- Images already available for federal environmental surveillance.

Goal: Annual mapping of burned area in all Brazilian biomes.
Progress Indicators: Monitored area (ha) and digital maps of burned area (in spatial resolution of 30m and 1km).
Actions/Steps taken:

- Implementation of the annual estimation system of burned area with spatial resolution of 30 meters and 1km;
- Improvement of near-real-time monitoring of vegetation fire outbreaks.

Results:

- Satellite monitoring of vegetation fire outbreaks by INPE's *Programa Queimada* for all biomes was carried out in low spatial resolution images (1km), with the automatic generation of monthly and annual summaries, and of spot locations of burning.

Specific objective: To promote sustainable forest management.
Methodologies and assumptions: Fostering the development of a forest economy in the Amazon is crucial for the conservation of the forest and valuation of its environmental assets. Sustainable use of the forest can extract high-value wood and non-timber products while also conserving the forest and promoting the local and regional forest economy, creating employment opportunities and income for local communities.
Goal: Increase the volume of marketed timber, non-timber and socio-biodiversity products from sustainable forest management areas.
Progress Indicators: Volume of production of timber, non-timber and socio-biodiversity products for trading (t, m^3 or other) from areas under sustainable management plans.
Actions/Steps taken:

- Promotion of forest concessions;
- Insert new socio-biodiversity products in the Policy for Guaranteeing a Minimum Price for Biodiversity Products - PGPM-Bio;
- Implementation of the National Plan to Strengthen Extractive and Riparian Communities;
- Promoting Community Forest Management and the strengthening of the management of community undertakings.

Results:

- Increase of forest area under forest concession, from 841,805 ha (2016) to 1,018,000 ha (2017).
- Increase of wood production in federal forest concessions, from 126,110 m3 (2015) to 174,143 m3 (2017).

Specific objective: To implement economic instruments to control deforestation.

Methodologies and assumptions: Decreasing deforestation and forest degradation also relies on positive incentives. PPCDAM's thematic area of economic and normative instruments consists of an array of Federal Government initiatives to design and implement incentives-based mechanisms to encourage sustainable production through the amendment of legal, financial, credit and tax instruments.

Goal: To enhance the positive incentives to reduce deforestation and foster new models of production and sustainable use of the forest.

Progress Indicators: Resource flows to forest conservation.

Actions/Steps taken:

- Increased access to credit for sustainable forest management activities (business, small holders and community), regularization and environmental recovery;
- Establishment of progressive credit goal agreements with federal public financial institutions for the sustainable productive sector;
- Study and design credit incentives for private rural properties in compliance with the Forest Code, including the extension of the credit limit, without further restrictions and with the monitoring guarantee;
- Foster credit access for community forest management;
- Foster the integration of information systems (SICOR/Bacen, CAR and embargoed areas) to support the verification of environmental compliance in financing contracts;
- Establish socio-environmental criteria, of progressive application, within the scope of credit concessions targeting large forest products consumer chains;
- Proposition of preference criteria for certificate timber or timber from forest concessions and for socio-biodiversity products in contracts and public purchases of federal, state and municipal governments;
- Expansion of access channels to public purchasing mechanisms through collaborative instruments to socio-biodiversity and agro-ecology products;
- Incentivize socio-biodiversity products through tax breaks and differentiated minimum prices;
- Foster the establishment of the Environmental Reserve Quota regulation (Art 40 of the Forest Code);
- Diagnosis of standards and procedures related to the process for issuing authorizations and environmental licensing of sustainable forest management activities. The objective is evaluating its efficiency, the need for harmonization and integration of processes, bridging normative gaps and distinguishing forest management activities by type (community, business and smallholders);
- Design and implementation of a Sectoral Pact for the Meat Supply Chain;
- Enactment of Decree No. 9,179/2017, which establishes the Program for the Conversion of Environmental Fines issued by the federal government bodies and entities that are part of the National Environmental System.
- Enactment of Decree No, 9,178/2017, which establishes the criteria for sustainable purchases by the federal government.

Results:

- Amazon Fund:
  - Increase of 17.6% in the total amount allocated to projects (BRL 1,563,932,024.95) compared to the previous year (R$ 1,329,045,340.92); and
  - Increase of 67% in the amounts disbursed on an annual basis (BRL 223,760,804.23) compared to 2016 (R$ 134,145,446.07)[24], distributed among 77 projects in 2016 and 84 in 2017

Name: Action Plan for the Prevention and Control of Deforestation and Forest Fires in the Cerrado biome - PPCerrado)[25]

Nature of Action: NAMA

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

Coordinating Institution: Ministry of the Environment

Gas (es): CO_2e

General objective: To reduce deforestation and degradation of native vegetation, by promoting the maintenance of ecosystem services and the sustainable use of forest resources and agricultural practices.
The specific objectives described herein were proposed by the Federal Government when drafting the PPCerrado, and not only by the Ministry of the Environment, thus showing that reducing deforestation is a challenge that goes beyond the environmental agenda. Like the PPCDAm, many of its actions are countrywide. Brazil implements its strategy to reduce deforestation by biome but some of the results herein have a national impact and are also included in the PPCDAm NAMA.

Description: Launched in 2010, PPCerrado was established as one of the main instruments of the National Policy on Climate Change (Law No. 12,187). The Plan is in its 3rd implementation stage (from 2016 to 2020).
PPCerrado encompasses several Federal Government policies and actions and is structured in nine specific objectives distributed into four thematic axes: i) environmental monitoring and control; ii) land tenure regularization and territorial management, iii) incentives for sustainable productive activities and iv) developing normative and economic instruments.

Period: 2010-2017

Estimated reduction related to the NAMA: 104 million tCO_2e by 2020

Specific objective: To promote spatial planning, strengthening protected areas.

Methodologies and assumptions: The increase of protected areas reduces deforestation and protects biodiversity.

Goals: 17% of the Cerrado biome in protected areas as conservation units.

Progress Indicators: Percentage of the biome area protected as conservation units.

Actions/Steps taken:

- Creation and expansion of conservation units in priority areas for biodiversity conservation.
- Expansion of the Chapada dos Veadeiros National Park from 65,514 ha to 240,611 ha;

Results:

- Expansion from 175,097ha (1.75km²) in areas protected by conservation units, totaling 170,095km², which represents 8.3% of the biome within areas protected by conservation units.

Specific objective: To improve accountability for environmental crimes and infractions.

Goal: To reduce deforestation in conservation units.

Progress Indicators: Deforested area in conservation units.

Actions/Steps taken: Surveillance in conservation units

Results:

- Reduction of deforested area within conservation units by 48% between 2010 and 2017.

Specific objective: To effectively implement joint forest management.
Environmental and forest management in Brazil is to a great extent a responsibility of the States. The Federal Government's role is to unify and make national data on forest and environmental management available for the development of public policies and for monitoring and control of deforestation. In this context, the National System of the Rural Environmental Registry (Sicar) and the National System for the Control of the Origin of Forest Products (Sinaflor) were created. The Rural Environmental Registry (CAR) is a recordkeeping of private rural properties and their compliance with the Brazilian Forest Code. It contains geo-references information about the legal protected areas in private rural properties, allowing for the identification of areas in which the suppression of native vegetation has been authorized by the federative units and areas in which illegal deforestation occurs. Sinaflor is a monitoring system for tracking the transportation of native wood products.

Goal: To implement the National System for the Control of the Origin of Forest Products (Sinaflor).

[24] Disbursements for the supported projects occur in installments in the course of their implementation and follow deadlines, normally ranging from one to six years as per each project schedules.

[25] The Cerrado is the second largest biome in South America, occupying an area of 2,036,448 km2, about 22% of the national territory. Its continuous area encompasses the states of Goiás, Tocantins, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Bahia, Maranhão, Piauí, Rondônia, Paraná, São Paulo and Distrito Federal, and also enclaves in the states of Amapá, Roraima and Amazonas.

Progress Indicators: Number of States integrated into Sinaflor.

Actions/Steps taken: Promotion of the integration and interoperability of States' forest-control systems with the National System.

Results:

- Implementation of Sinaflor in 5 out of 12 states in the Cerrado biome: Paraná, Maranhão, Tocantins, Mato Grosso do Sul and Goiás.

Goal: Register 100% of all private rural properties in Brazil in the Rural Environmental Registry (CAR).

Progress Indicators: Index of environmental regularity of rural properties (number or area of rural properties in regularization/total real estate).

Actions/Steps taken: Improvement and availability of the modules for analysis and monitoring of:

- Rural Environmental Registry. Availability of the spatial data of all private rural properties by municipality for public access;
- Registration, analysis, monitoring, access management and reporting modules were made available to the appropriate federal unit agencies via the Rural Environmental Registry.

Results:

- 100% (5.5 million) of rural properties registered (at the national level). 469.7 million hectares of rural properties registered (at the national level). *Registers are self-declaratory and will go through a validation phase by the relevant state bodies

Specific objective: To prevent and combat the incidence of forest fires.

Methodologies and assumptions: The incidence of forest fires in Brazilian biomes results in the degradation of the vegetation and GHG emissions. Federal environmental agencies have implemented policies and measures to reduce degradation and promote conservation through integrated fire management with a view to reduce forest fires that are harmful to biodiversity.

Goal: To reduce the area affected by forest fires.

Progress Indicators:

- Burned area (ha);
- Number of heat spots.

Actions/Steps taken:

- Implementation of the Federal Forest Brigade Programme, aiming at reducing the number of forest fires in priority federal areas;
- Implementation of Fire Integrated Management;
- Regulation of Art. 40 of Law No. 12,651/2012 (National Policy on the Management and Control of Burnings, Prevention and Combat of Forest Fires);
- Elaboration of Forest Fire Prevention and Combat Plans in conservation units;
- Prevention and combat action planning in six priority conservation units;
- Elaboration of the Draft Law of the National Integrated Fire Management Policy;
- Hire 1.029 firemen in 21 federal conservation units (ICMBio) and in 66 priority federal areas (Prevfogo/Ibama);
- Implementation of Fire Integrated Management in 14 conservation units.

Results:

- 50% decrease in areas affected by fire within conservation units in 2017 (136,112.52 ha) compared to 2016 (271,679.41 ha);
- Heat spots reduced from 190,506 ha (2015) to 158,532 ha (2017).

Specific objective: Improve and strengthen monitoring of vegetation cover.

Methodologies and assumptions: The real-time deforestation detection system is the main tool used by the environmental surveillance to control deforestation, being improved every year by INPE, providing daily data to federal environmental agencies. In addition to the detection system, it is important to emphasize the national effort to map vegetation cover annually, given its high relevance for the measurement of the goals and impacts for the policies to reduce deforestation.

Goals: Development of an alert system (Deter) for the Cerrado.

Progress Indicators: Image area effectively worked on a monthly basis in the DETER system in the Cerrado biome.

Actions/Steps taken:

- Implementation of a real-time detection system (Deter-B e C).

Results: Detection is fully operational; data are being sent to enforcement bodies and are publicly available. So far, area indicators have not been made available.

Goals: Annual Cerrado mapping.

Progress Indicators: Deforestation mapping in the Cerrado by types of physiognomies in the period 2000-2018.

Actions/Steps taken: Construction of the historical series of deforestation in the Cerrado and mapping of phytophysiognomies in the period 2000-2018.

Results: Publication of the historical series of deforestation in the Cerrado, from 2001 to 2018.

Goal: Annual mapping of the burned area in all Brazilian biomes.

Progress Indicators: Monitored area (ha) and digital maps of the burned area (for resolutions 30m and 1km).
Actions/Steps taken:

- Implementation of an annual burned area estimate system with resolution of 30m and 1km;
- Improved monitoring of near-real-time vegetation fire outbreaks with satellites;

Results: Satellite monitoring of vegetation fire outbreaks by INPE's Programa Queimada for all biomes was carried out in low spatial resolution images (1km), with the automatic generation of monthly and annual summaries, and of spot locations of burning.

Specific objective: Promote sustainable forest management.

Methodologies and assumptions: Fostering the development of a forest economy is crucial for the conservation of the biome and valuation of its environmental assets. Sustainable use of the forest can extract high-value products while also conserving the forest and promoting the local and regional forest economy, creating employment opportunities and income for local communities.

Goal: Increase the volume of marketed non-timber and socio-biodiversity products from sustainable forest management areas.

Progress Indicators: Volume of production of non-timber and socio-biodiversity products for trading (t, m^3 or other) from areas under sustainable management plans.

Actions/Steps taken:

- Include new socio-biodiversity products in the Policy for Guaranteeing a Minimum Price for Biodiversity Products - PGPM-Bio;
- Inclusion of the buriti fruit in PGPM-Bio;
- Strengthening extractive activity (implementation of the National Plan to Strengthen Extractive and Riparian Communities);
- Fostering Community Forest Management and strengthening the management of community undertakings.

Results:

- Direct support to structuring the 8 supply chains of socio-biodiversity products from the Cerrado biome.

Specific objective: To implement normative and economic instruments to control deforestation.

Methodologies and assumptions: PPCerrado's thematic area of economic and normative instruments consists of an array of Federal Government initiatives to design and implement incentives-based mechanisms to encourage sustainable production the amendment of legal, financial, credit and tax instruments.

Goal: To enhance positive incentives to reduce deforestation and encourage new production models and the sustainable use of the forest.

Progress Indicators: resource flows for positive incentives for conservation.

Actions/Steps taken:

- Increased access to credit for sustainable forest management activities (business, small holders and community), regularization and environmental recovery;
- Establishment of progressive credit goal agreements with federal public financial institutions for the sustainable productive sector;
- Study and design credit incentives for private rural properties in compliance with the Forest Code, including the extension of the credit limit, without further restrictions and with the monitoring guarantee;
- Foster credit access for community forest management;
- Foster the integration of information systems (SICOR/Bacen, CAR and embargoed areas) to support the verification of environmental compliance in financing contracts;
- Establish socio-environmental criteria, of progressive application, within the scope of credit concessions targeting large forest products consumer chains;
- Proposition of preference criteria for certificate timber or timber from forest concessions and for socio-biodiversity products in contracts and public purchases of federal, state and municipal governments;
- Expansion of access channels to public purchasing mechanisms through collaborative instruments to socio-biodiversity and agro-ecology products;
- Incentivize socio-biodiversity products through tax breaks and differentiated minimum prices;
- Foster the establishment of the Environmental Reserve Quota regulation (Art 40 of the Forest Code);
- Diagnosis of standards and procedures related to the process for issuing authorizations and environmental licensing of sustainable forest management activities. The objective is evaluating its efficiency, the need for harmonization and integration of processes, bridging normative gaps and distinguishing forest management activities by type (community, business and smallholders);
- Design and implementation of a Sectoral Pact for the Meat Supply Chain;
- Enactment of Decree No. 9,179/2017, which establishes the Program for the Conversion of Environmental Fines issued by the federal government bodies and entities that are part of the National Environmental System.
- Enactment of Decree No, 9,178/2017, which establishes the criteria for sustainable purchases by the federal government.

Results:

- Results are yet to be compiled.

Name: Sustainable Steel Industry Plan

Nature of the Action: NAMA

Sector: Industrial processes; Energy

Coordinating institution: Ministry of Industry, Foreign Trade and Services; Ministry of the Environment

Gas (es): CO_2e

General objective: To promote sustainable production of charcoal used as an input in the production of pig iron, steel and ferroalloys.

Description: The Sustainable Steel Industry Plan seeks to promote the sustainable production of charcoal used as an input in the production of pig iron, steel and ferroalloys, aiming at reducing emissions and increasing the sector's competitiveness.
Launched in 2010, the Plan is in its second phase of implementation (2016-2019), structured in two components: a forest preservation component, under the responsibility of the Ministry of the Environment, and an industrial and technological component for increasing efficiency in the carbonization process, under the responsibility of Ministry of Industry, Foreign Trade and Services.
The Plan fosters the development of solutions for the adequate supply of sustainable raw material by encouraging the use of wood from planted forests and the development and diffusion of charcoal production technologies that increase the efficiency in the conversion of wood to charcoal, with improved environmental quality and reduced GHG emissions.

Period: 2010-2017. BUR3 focuses on the biennium 2016-2017. Information on the 2010-2016 period are available in BUR1 and BUR2.

Estimated reduction related to the NAMA: 8 to 10 million tCO2e by 2020

Specific objective:

- To replace the raw materials sourced from native forest by planted forest.
- To reduce emissions from the wood carbonization process.
- To increase the use of sustainable charcoal in the pig iron, steel and ferroalloy production sectors, in the context of a low carbon circular economy.

Methodologies and assumptions: GHG emissions may be reduced by replacing sourcing from native forest with sourcing from sustainably-planted forest and updating replacing existing carbonization process for more efficient charcoal-producing technologies. The charcoal sustainably sourced, is then used in metallurgical processes for the production of pig iron, steel and ferroalloys, which account for about 95% of the total charcoal consumption of in Brazil.

Goal:

- Increase the incentive to technological innovations and the adoption of more efficient and sustainable production processes in the conversion of wood to charcoal.
- Establish an MRV system platform to monitor the emission reductions of the demonstrative units.

Progress Indicators:

- Number of contracts signed;
- Status of the MRV platform;
- Number of Demonstrative Units created.

Actions/Steps taken:

In 2016, pilot project BRA/14/G31 (Sustainable Steel Industry) initiated, coordinated by the Ministry of the Environment and implemented by the UNDP and supported by the Project Monitoring Committee, which also brings together the Ministry of Industry, Foreign Trade and Services, the Ministry of Science, Technology, Innovation and Communications, the Ministry of Agriculture, Livestock and Supply and the Government of the State of Minas Gerais.

This project aims at deploying more efficient technologies in existing carbonization processes through a financial incentive mechanism for results-based payments, as well as the establishment of public policies to encourage forest sustainability in the sector. The project is initially focused on the State of Minas Gerais, which houses around 80% of the country's charcoal production, with a projected horizon up to the first half of 2020.
Six projects were hired through the results-based payment mechanism. An MRV Platform is being concluded to monitor the progress of these activities, assisting in the quantification of emission reductions. 2 Demonstration Units (Zona da Mata and Northeast of Minas Gerais) were installed for smallholder charcoal producers, with a forecast of another 3 Units installed by 2020, which will serve as a basis for the training program.
Consultancy studies were concluded and will be the basis for public policies towards forest sustainability in the sector.

Results:

- 6 signed and ongoing charcoal producer support contracts at the industrial level, with the adoption of the Payment by Results mechanism for charcoal production with the use of more efficient and sustainable production technologies;
- On-going development of an MRV system platform to monitor emission reductions from the implemented projects;
- Implementation of 5 Demonstration Units, developed in cooperation with the University of Viçosa, with the aim of training small independent producers through training courses.
- Expected GH emission reduction: 564.5 thousand tons of CO_2eq/year.

Name: Increase in energy supply by hydroelectric power plants

Nature of the Action: NAMA

Sector: Energy

Coordinating institution: Ministry of Mines and Energy

Gas (es): CO_2eq

General Objective: To increase installed capacity from hydroelectric power plants in the national energy mix

Description: Introduction of hydroelectric power plants to supply electricity. In Brazil, the inclusion of low-emission sources starts in the planning stage and includes projections for a 10-year horizon. Auctions to buy energy are carried out 6 years in advance. This system provides the guarantee needed for these undertakings to be inserted in the energy-generating complex.

Period: 2010 -2017. BUR3 focuses on the biennium 2016-2017. Information on the 2010-2016 period are available in BUR1 and BUR2.

Estimated reduction related to the NAMA: 79 to 99 million tCO2eq by 2020

Specific objective: To introduce hydroelectric power plants.

Goal: Increase installed capacity of hydroelectric sources.

Progress Indicators: Installed power of hydroelectric plants in the electric system.

Methodologies and assumptions: Electric energy auctions are instruments for the insertion of new enterprises for the supply of electric energy. The regulation on the trading of electric energy provides that electric power distribution companies must guarantee the attendance of their electric energy market. Thus, auctions are promoted including, but not limited to, the objectives of hiring energy at the lowest possible price and attracting investors for the construction of new plants for the expansion of generation, including hydroelectric plants.

Actions/Steps taken: In the period from 2016 to 2017, there were 06 auctions of different formats that included the insertion of hydroelectric generation, among other sources.

Results:

- Additional 8,296 MW in the biennium 2016-2017.

Specific objective: To promote the insertion of small hydroelectric plants in centralized parks and per distributed generation.

Goal: Increased installed capacity of small hydroelectric plants.

Progress Indicators: Installed capacity (MW) of small hydroelectric plant (SHP and Hydroelectric Power Plants inserted in the electric system).

Methodologies and assumptions: Electric energy auctions are instruments for the insertion of new enterprises for the supply of electric energy. Electric energy trading regulations establishes that electric power distribution companies must ensure provision to their electric energy markets. Auctions are promoted including, but not limited to, the objectives of contracting energy at the lowest possible price and attracting investors for the construction of new plants, including hydroelectric plants. In 2015, ANEEL published Normative Resolution No. 687, providing a set of rules for Distributed Generation that regulates consumer generation surplus supply to the local distribution network.

Actions/Steps taken: In the period from 2016 to 2017, 6 auctions of different formats were held that included the insertion of hydroelectric generation, among other sources.

Results:

- Additional 373 MW in the biennium 2016-2017.

Name: Alternative Energy Sources

Nature of Action: NAMA

Sector: Energy

Coordinating institution: Ministry of Mines and Energy

Gas (es): CO_2eq

General objective: Increased installed capacity in solar, wind and biomass sources in the national energy mix.

Period: 2010 -2017. BUR3 focuses on the biennium 2016-2017. Information on the 2010-2016 period are available in BUR1 and BUR2.

Estimated reduction related to the NAMA: 26 to 33 million tCO_2eq by 2020.

Specific objective: to promote the insertion of wind power plants by concentrated and distributed generation.

Goal: Increased installed capacity of wind power source.

Progress Indicators: Installed capacity (MW) of wind farms inserted in the electrical system.

Methodologies and assumptions: Electric energy auctions are instruments for the insertion of new enterprises for the supply of electric energy. Electric energy trading regulations establishes that electric power distribution companies must ensure provision to their electric energy markets. Auctions are promoted including, but not limited to, the objectives of contracting energy at the lowest possible price and attracting investors for the construction of new plants, including wind plants. In 2015 ANEEL published Normative Resolution No.

687, providing a set of rules for Distributed Generation that regulates consumer generation surplus supply to the local distribution network.

Actions/Steps taken: Electric energy auctions and regulation of distributed generation.

Results:

- Additional 4,660 MW in the biennium 2016-2017.

Specific objective: To promote the insertion of biomass thermal power plants by concentrated and distributed generation.

Goal: To increase electric generation installed capacity of biomass plants.

Progress Indicators: Installed capacity (MW) of biomass thermal plants inserted in the electric system.

Methodologies and assumptions: Electric energy trading regulations establishes that electric power distribution companies must ensure provision to their electric energy markets. Auctions are promoted including, but not limited to, the objectives of contracting energy at the lowest possible price and attracting investors for the construction of new plants, including biomass thermal plants. In 2015 ANEEL published Normative Resolution No. 687, providing a set of rules for Distributed Generation that regulates consumer generation surplus supply to the local distribution network.

Actions/Steps taken: Energy auctions and regulation of distributed generation.

Results:

- Additional 1,302 MW in the biennium 2016-2017.

Specific objective: To promote the insertion of photovoltaic (PV) power plans by concentrated and distributed generation.

Goal: To increase PV installed capacity.

Progress Indicators: Installed capacity (MW) of PV power plants inserted in the electric system (MW).

Methodologies and assumptions: Electric energy trading regulations establishes that electric power distribution companies must ensure provision to their electric energy markets. Auctions are promoted including, but not limited to, the objectives of contracting energy at the lowest possible price and attracting investors for the construction of new plants, including PV plants. In 2015 ANEEL published Normative Resolution No. 687, providing a set of rules for Distributed Generation that regulates consumer generation surplus supply to the local distribution network.

Actions/Steps taken: Energy auctions and regulation of distributed generation.

Results:

- Additional 1,066 MW in the biennium 2016-2017.

Name: Increase the use of Biofuels.

Nature of the Action: NAMA

Sector: Energy

Coordinating institution: Ministry of Mines and Energy

Gas (es): CO_2eq

General objective: To increase the amount of biofuel in the national energy mix.

Period: 2010 -2017. BUR3 focuses on the biennium 2016-2017. Information on the 2010-2016 period are available in BUR1 and BUR2.

Estimated reduction related to the NAMA: 48 to 60 million tCO_2 eq by 2020

Specific objective: Promote consumption of anhydrous and hydrated ethanol to replace gasoline.

Goal: Encourage the supply of anhydrous and hydrated ethanol.

Progress Indicators: Production volume of ethanol (cubic meters).

Methodologies and assumptions: The RenovaBio Program aims at promoting the adequate expansion of biofuels in the energy mix, thus promoting the regularity of fuel supply in the market and inducing gains in energy efficiency and reduction of GHG emissions.

Actions/Steps taken: Establishment of the National Policy on Biofuels (RenovaBio Program) through Law 13.576/2017.

Results:

- Additional 26,606 (10^3 m^3) of ethanol produced in the biennium 2016-2017.

Specific objective: To promote the consumption of biodiesel to replace fossil diesel.

Goal: To encourage the supply of biodiesel.

Progress Indicators: Biodiesel production volume (cubic meters).

Methodologies and assumptions: Law No. 13,263/2016 determined that the percentages of mandatory blending of biodiesel into diesel oil should be 8% (eight percent) 12 months after the enactment of the Law; 9% (nine percent) 24 months after the enactment of the Law; and 10% 36 months after the enactment of the Law. In 2019, the biodiesel blending might get to 15% after tests and trials with engines.

Actions/Steps taken: Establishment of the National Policy on Biofuels (RenovaBio Program) through Law 13.576/2017, and establishment of biodiesel blending percentages in fossil diesel through Law 13,263/2016.

Results:

- Additional production of 4,291 (10^3 m^3) in the biennium 2016-2017.

Name: Energy Efficiency

Nature of the action: NAMA

Sector: Energy

Coordinating Institution: Ministry of Mines and Energy

Gas (es): CO_2eq

General objective: To reduce the use of fossil fuels and of electricity through increased energy efficiency in different sectors of the economy.

Period: 2010 -2017. BUR3 focuses on the biennium 2016-2017. Information on the 2010-2016 period are available in BUR1 and BUR2.

Estimated reduction related to the NAMA: 12 a 15 million tCO_2eq by 2020

Specific objective: To encourage the reduction of electricity consumption through government programs.

Goal: To encourage the reduction of electric energy consumption.

Progress Indicators: Electric energy consumption (GWh).

Methodologies and assumptions: Reducing electricity consumption reduces GHG emissions. The calculation of the results of the PROCEL Program to reduce electricity consumption will be the basis for measuring progress of this specific objective implementation.

Actions/Steps taken: Enactment of Law 13,280/2016, with regulation on the use of resources for the PROCEL Program through Law 13,280/2016. Implementation of the PROCEL Resource Application Program.

Results:

- Additional 36,700 GWh in the biennium 2016-2017.

Specific objective: To improve the minimum levels of energy efficiency in the consumption of electric energy of appliances.

Goal: To increase the supply of appliances with high-levels of energy efficiency.

Progress Indicators: Number of appliance categories using the PROCEL label.

Methodologies and assumptions: Participation in the appliance labeling program is voluntary. The PROCEL label was created to increase the number of certified appliances with high-energy efficiency levels. The label is a widely publicized award, which contributes to brand recognition.

Actions/Steps taken: Awarding the PROCEL label for high efficiency appliances, with the Brazilian Labeling Program as a reference

Results:

- Equipment: 06 new categories with the PROCEL label.

Specific objective: Improve the minimum levels of Energy Efficiency in fuel consumption in equipment/vehicles.

Goal: Increase the supply of highly efficient equipment/vehicles.

Progress Indicators: Number of equipment/vehicle brands/models using the CONPET label.

Methodologies and assumptions: Participation in the equipment/vehicle labeling program is voluntary. The CONPET label was created to increase the number of certified equipment with high-energy efficiency levels. The label is a widely publicized award, which contributes to brand recognition.

Actions/Steps taken: Awarding the CONPET label for high efficiency equipment, with the Brazilian Labeling Program as a reference.

Result:

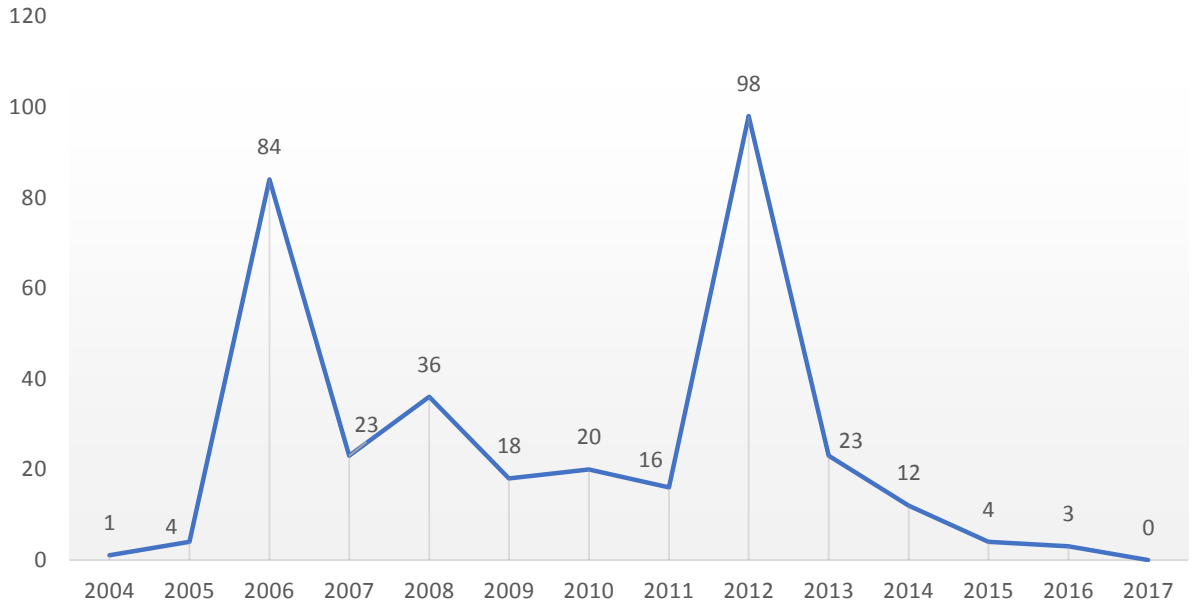
- Vehicles: 214 new brands/models with the CONPET label. Gas ovens/stoves: 88 new brands/models with the CONPET label.

3.1 CLEAN DEVELOPMENT MECHANISM (CDM) PROJECTS IN BRAZIL: AN UPDATE

From February 2004 to December 2017, the Inter-ministerial Commission on Global Climate Change – the Brazilian Designated National Authority (DNA) for the CDM – received 464 CDM project activity proposals. Out of these, 424 project activities were approved, 1 was rejected and 39 had their assessment not finalized or canceled at the request of the project participants.

Of the total projects approved, 342 project activities were registered with the CDM Executive Board.

FIGURE VI: ANNUAL DISTRIBUTION OF BRAZILIAN PROJECT ACTIVITIES REGISTERED WITH THE CDM EXECUTIVE BOARD (NOV/2004-DEC/2017)[26].



Most registrations occurred in 2006, when the CDM started to consolidate its position in the market; and in 2012, marking the end of the first commitment period of the Kyoto Protocol.

Table XV shows that 27.7% of the total CDM projects in Brazil registered by December 2017 are related to hydropower plants (94 projects), followed by biogas (18.4%), wind power plants (16.7%), landfill gas (15.2%) and biomass energy (12,0%). As for the reduction of GHG emissions, the largest contributions result from hydropower plants, landfill gas, decomposition of N_2O and wind power plants. For projects registered from 2004 to 2017, Brazil has a significant reduction potential of 379 million tCO_2eq.

TABLE XV: DISTRIBUTION OF CDM PROJECT ACTIVITIES IN BRAZIL PER TYPE OF PROJECT ACTIVITY, REGISTERED BY DECEMBER 2017.

Types of project activities	CDM Project Activities		Estimated GHG reductions	
	Quantity	% in relation to total	tCO_2eq	% in relation to total
Hydropower	94	27.7	138,473,415	36.5
Biogas	63	18.4	24,861,823	6.5
Wind power	57	16.7	44,306,593	11.7
Landfill gas	52	15.2	91,367,345	24.1
Biomass energy	41	12.0	16,091,394	4.2
Substitution of Fossil Fuel	09	2.6	2,664,006	0.7
Methane Avoided	09	2.6	8,627,473	2.3

[26]*The number of activities registered annually has been updated in relation to the previous BUR as a result of withdrawals or inclusions of projects.*

Types of project activities	CDM Project Activities		Estimated GHG reductions	
	Quantity	% in relation to total	tCO_2eq	% in relation to total
Decomposition of N_2O	05	1.5	44,660,882	11.8
Utilization and heat recovery	04	1.2	2,986,000	0.8
Reforestation and Aforestation	03	0.9	2,408,842	0.6
Use of Materials	01	0.3	199,959	0.1
Photovoltaic Solar Energy	01	0.3	6,594	0.0
Energy Efficiency	01	0.3	382,214	0.2
Replacement of SF_6	01	0.3	1,923,005	0.5
PFC reduction and Replacement	01	0.3	802,860	0.2
Total	**342**	**100.0**	**379.762.405**	**100.0**

The estimated annual reduction of GHG emissions associated with CDM project activities registered up to December 2017 was 49,192,159 tCO_2eq per year, since 2004, corresponding to 4.9%[27] of global total emission reduction associated with the CDM. This demonstrates the significant contribution that the country has made to the global effort to fight climate change.

[27] *Source: Pipeline CDM/CQNUMC (April 2017). Available at: https://cdm.unfccc.int/Projects/projsearch.html. Accessed 04 Dec 2017.*

4

GAPS, CONSTRAINTS AND NEEDS AND INFORMATION ON SUPPORT RECEIVED

4 CONSTRAINTS, GAPS AND RELATED FINANCIAL, TECHNICAL AND CAPACITY-BUILDING NEEDS; INFORMATION ON SUPPORT RECEIVED

4.1 CONSTRAINTS, GAPS AND RELATED FINANCIAL, TECHNICAL AND CAPACITY-BUILDING NEEDS

Due to the country's dimensions and diversity in terms of social, economic and environmental factors, the information presented in this item should be considered as provisional, partial and non-exhaustive. There are considerable challenges related to any in-depth consideration and identification of constraints and gaps, and related financial, technical and capacity needs at a comprehensive scale. In addition to the information presented in the second BUR, the table below summarizes technical, capacity building and financial support needs in some areas of interest for further international cooperation, without prejudice to other areas that may further be identified.

TABLE XVI: GAPS AND CONSTRAINTS; FINANCIAL, CAPACITY-BUILDING, AND TECHNICAL NEEDS.

ACTIVITY	SECTOR	RELATED NAMA	GAP	CONSTRAINT	FINANCIAL NEEDS	CAPACITY-BUILDING NEEDS	TECHNICAL NEEDS
Measurement, reporting and verification of transformation and maintenance actions of resilient and sustainable production systems	Agriculture	ABC Plan	Lack of on-site data and of images for measurement and validation	Limited resources for image purchase and field trips	Financial resources image purchases and field trips	NA*	NA
Measurement, reporting and verification of transformation and maintenance actions of resilient and sustainable production systems	Agriculture	ABC Plan	Lack of a participatory methodology to feed the monitoring system and fluid processes for data input and information output	Limited resources for hiring expert in data storage and organization and for updating existing systems	Financial resources for expert hires	NA	NA
Measurement, reporting and verification of transformation and maintenance actions of resilient and sustainable production systems	Agriculture	ABC Plan	Lack of a participative process and an integrated system for validation and verification by experts and stakeholders	Limited resources for hiring staff and for developing an integrated system for results validation and verification	Financial resources for the development and implementation of an integrated system and a participatory process for validating the results of the analysis	NA	NA
Measurement, reporting and verification of transformation and maintenance actions of resilient and sustainable production systems	Agriculture	ABC Plan	Lack of preliminary studies for a traceability and certification system	Limited resources, given the variety of data and institutions to ensure the necessary transparency and reliability of a national traceability and certification system	Financial resources for the establishment of an effective traceability and certification system	Training of specialists in traceability and certification systems	NA

ACTIVITY	SECTOR	RELATED NAMA	GAP	CONSTRAINT	FINANCIAL NEEDS	CAPACITY-BUILDING NEEDS	TECHNICAL NEEDS
Enhance the capacity of technical and financial assistance agents	Agriculture	ABC Plan	Knowledge gap in relation to best practices and technologies and systems that are appropriate to the various biomes	Limited resources to promote continuous training of stakeholders in different States, in view of the dynamic evolution of activities, technologies and knowledge as well as differences in behavior of technologies and systems in different Brazilian biomes	Financial resources for technological development, consolidation and dissemination of knowledge	Support for professional training and dissemination of knowledge	NA
Technological research and development	Agriculture	ABC Plan	Lack of data, new studies and technological development in the biological and agricultural field, including statistics and data interpretation, for the generation of alternative and innovative solutions	Limited resources for technological research and development	Financial resources for infrastructure, equipment and studies	Knowledge exchange	Technology exchange
Data center structuring and situation room of the Center for Climate Intelligence for Agriculture (CICLAG)	Agriculture	ABC Plan	Lack of systematized data for fast end-user use	Limited resources for systematized data	Financial resources for Infrastructure, equipment and studies	Support for professional training and knowledge dissemination	Cooperation for technological development
Broaden the insertion of non-conventional renewable sources in the national energy mix	Energy	Alternative energy sources	Knowledge gap in relation to best practices and technologies for energy exploration by concentrated solar power plants, energy storage and energy from municipal solid waste.	Limited resources for technological development, consolidation and dissemination of knowledge	Financial resources for the technological development, consolidation and dissemination of knowledge	Support for professional training and dissemination of knowledge	Cooperation for technological development
Federal public land allocation	LULUCF	PPCDAm	Limited digital interaction among public record agencies	Limited resources, including lack of personnel	NA	Support for digital interaction among public record agencies	NA

ACTIVITY	SECTOR	RELATED NAMA	GAP	CONSTRAINT	FINANCIAL NEEDS	CAPACITY-BUILDING NEEDS	TECHNICAL NEEDS
Improve environmental and territorial management of indigenous lands	LULUCF	PPCDAm and PPCerrado	Limited digital interaction among public record agencies	Limited resources, including lack of personnel and budget constraints	NA	Support for digital interaction among public record agencies	NA
Traceability of production chains	LULUCF	PPCDAm and PPCerrado	Lack of information on financing of productive areas and insufficient information on cattle ranchers and animal transit guides	Limited resources	NA	Support for digital interaction among public record agencies	NA
To promote accountability for environmental crimes and infractions (environmental enforcement)	LULUCF	PPCDAm and PPCerrado	Lack of personnel	Limited resources, including budget constraints	NA	Support for digital interaction among public record agencies	NA
Environmental enforcement at federal conservation units	LULUCF	PPCDAm and PPCerrado	Lack of personnel	Budget constraints	NA	Support for digital interaction among public record agencies	NA
To promote sustainable forest management	LULUCF	PPCDAm	Small-scale timber production from sustainable forest management plans through forest concessions.	Degradation and illegal logging on public lands make the economic activity of sustainable forest management uncompetitive	NA	Support for digital interaction among public record agencies	NA
Low-carbon Technologies	Industry	Sustainable Steel Plan	Lack of financial and business model for the technology adoption; dissemination of information on technology and innovations	Lack of resources and low adoption of new process technologies in emission-intensive sectors (cement, steel); behavioral barriers.	Resources to finance low carbon technology	NA	NA
Energy efficiency	Industry	Sustainable Steel Plan	Lack of financial and business model for the adoption and dissemination of information on technology	Limited adoption of energy management systems; behavioral barriers	NA	Technical training and dissemination of energy management systems.	NA
Quantification of GHG emission reductions resulting from the implementation of mitigation actions	Agriculture, Energy, LULUCF and Industry	All	Difficulties in quantifying emissions reductions	NA	NA	Technical training on methodology application ; Infrastructure, equipment and studies	Methodologies and technologies to quantify emission reductions

NA: Not applicable.

Some examples of the country's efforts to quantify the reduction of GHG emissions are listed in section 6.1 of this BUR. These can be improved as gaps, financing, technology and training needs are met. As these gaps and needs are addressed, it will be possible to expand estimates to other NAMAs and specific activities.

Regarding technology transfer relevant to all NAMAs, Brazil has recently obtained support through the Global Environment Fund (GEF) for a Technology Needs Assessment – TNA, coordinated by the MCTIC, aiming at developing technological roadmaps and respective action plans relevant to mitigation actions. Due to budgetary constraints, the scope of this project does not include an assessment of technological needs for adaptation, and this gap remains to be addressed.

The need for support through the provision of financial resources for the periodic preparation of BURs remains. These resources allow hiring consultants and essential services to ensure the updating of relevant information, in particular to prepare the GHG emissions inventory.

4.2 INFORMATION ON SUPPORT RECEIVED

External financing through multilateral and bilateral channels plays a key role in fighting climate change and its effects in Brazil. International resources have contributed with the implementation of public policies and programs to reduce GHG emissions and increase resilience to the effects of climate change. They have also leveraged private resources for investment and supported social initiatives. It is crucial to identify the amount and allocation of these flows, evaluate their outcomes and their contribution to the implementation of national priority actions, with a view to optimizing the use of available resources.

Following up from BUR1 and BUR2, this section provides information on public resources committed to Brazilian entities through multilateral and bilateral channels (Parties included in Annex II of the Convention) in years 2016 and 2017. This chapter seeks to provide, in a table format, the information in a more complete, disaggregated and transparent manner. In addition to maintaining the same BUR2 reporting parameters, which had already represented a breakthrough in relation to BUR1, this section added two new parameters related to information about possible technical training component and/or technology transfer and links to the project/contract, allowing the reader reference to detailed information.

In collecting data for this chapter, information from multilateral institutions was much more transparent, accessible, comprehensive and comparable than available data on bilateral flows. Notwithstanding improvements in the current Biennial Reports, the information provided by developed country Parties still lacks the necessary completeness, transparency and comparability to allow identification of the projects supported, with a view to their due recognition.

Because of these restrictions, information on bilateral channels only includes resources that have been internalized through a public entity or implemented under the coordination of a public entity (whether federal, state or municipal). Information on multilateral channels, in turn, also includes resources directed to private companies. For the same reasons, like the BUR2, the resource commitment date is used as reference for inclusion in the listing. Therefore, projects currently under implementation that were approved or had their resources committed by the relevant institutions before the period 2016-2017 were not included. Exceptions to this criterion are donations to the Amazon Fund, which were included based on the date of receipt of funds by the fund manager.

In terms of financial instruments, available information on grants, loans and shareholding is reported herein. All amounts are in US dollars. When data was available in a currency other than the US dollar, the conversion rate used that of the OECD annual exchange rate for the project commitment year. In terms of climate relevance of individual projects, the percentage of the climate component for multilateral resources was based in most cases on the criteria of the funding institution, except in a few cases where different criteria were applied in order to meet the climate relevance. For most bilateral resources, there was no assessment of the specific climate component readily available. In order to avoid double counting, projects whose primary purpose was not mitigation or adaptation were considered to have less than 100% of their external resources accounted for as climate finance. Likewise, for projects with a stated main objective of

both mitigation and biodiversity, according to the OECD Rio Marker assignment given by the donor, 50% of the resources received were accounted for as a specific climate component.

The allocation of resources to Brazil in the period 2016-2017 amounts to USD 3.15 billion, of which 86% from multilateral channels and 14% from bilateral channels. This represents a decrease of 14% in relation to the support received in the biennium 2014-2015, informed in BUR2. With regard to financial instruments, grants and loans decreased by respectively 11% and 14%.

For the identification of technical training and technology transfer components, the criteria used were those adopted under the UNFCCC, available at the following links: https://bigpicture.unfccc.int/content/capacity-building.html#content-capacity-building and https://unfccc.int/resource/docs/2009/sb/eng/02.pdf.

TABLE XVII: SUPPORT RECEIVED THROUGH MULTILATERAL CHANNELS IN 2016

Instituition	Type of support (mitigation, adaptation, cross-cutting, other)	Sector (energy, transportion, industry, agriculture, forests, water resources and sanitation, cross-cutting, other, not applicable)	Project name	Total financing (US$)	Climate specific component (%)	Climate specific financing (US$)	Financing instrument	Commitment / receipt date (DD/MM/YYYY)	Capacity-building (1) / Technology transfer (2) / Not applicable (NA)	Source
IBRD	Adaptation	Water resources	BR Municipal APL: Teresina Enhancing Municipal Governance and Quality of Life Project	88,000,000.00	11%	9,680,000.00	Loan	24/2/2016	1	http://projects.worldbank.org/P088966/br-municipal-apl-teresina-enhancing-municipal-governance-quality-life-project?lang=em
IBRD	Mitigation	Agriculture / fishing / forests	FIP - Development of systems to prevent forest fires and monitor vegetation cover in the Brazilian Cerrado	9,250,000.00	100%	9,250,000.00	Grant	28/3/2016	1	http://projects.worldbank.org/P143185/development-systems-prevent-forest-fires-monitor-vegetation-cover-brazilian-cerrado?lang=en
IFC	Mitigation	Cross-cutting (small and medium enterprises)	BANCO ABC BRASIL SA	85,710,000.00	50%	42,855,000.00	Loan (non-concessional)	12/5/2016	NA	https://disclosures.ifc.org/#/projectDetail/SII/37960
IFC	Mitigation	Agriculture	CERRADINHO BIOENERGIA SA	49,000,000.00	100%	49,000,000.00	Loan (non-concessional)	27/7/2016	NA	https://disclosures.ifc.org/#/projectDetail/SII/35523
IADB	Mitigation	Energy	Regional Project (BRA, COL, MEX, PAR e URU) LAC Green Finance Program to Mobilize Private Investment in Mitigation Actions and Low-Carbon and Sustainable Business Models through National Development Banks (NDBs) (RG-X1244)	5,495,000.00 (1,099,000.00 to Brazil)	100%	1,099,000.00	Grant	1/2/2016	1	https://www.iadb.org/pt/project/RG-X1244
GEF/PNUD	Cross-cutting	Cross-cutting	Fourth National Communication and Biennial Reports to the UNFCCC	7,528,500.00	100%	7,528,500.00	Grant	11/8/2016	1	https://www.thegef.org/project/fourth-national-communication-and-biennial-update-reports-united-nations-framework
IADB	Mitigation / Adaptation	Transportation	Fortaleza Urban Transportation Program II (BR-L1333)	57,908,000.00	8%	4,500,000.00	Loan	24/2/2016	1	https://www.iadb.org/en/project/BR-L1333
CAF	Mitigation	Transportation	Coordination and Rezoning of the urban and recreational space, access, and mobility of Porto Alegre - Programa Orla POA	92,000,000.00	37%	34,076,379.00	Loan	10/8/2016	1	Not available
CAF	Mitigation / Adaptation	Transportation	Sustainable Niterói Ocean Region Program - Pro-Sustentável	100,000,000.00	100%	100,000,000.00	Loan	30/11/2016	1	Not available
IADB	Adaptation	Energy / circular economy	PROADAPT2 - Circular Economy and Climate Change Adaptation in São Paulo. Recycling Used Cooking Oil (BR-T1343)	1,100,000.00	100%	1,100,000.00	Grant	14/12/2016	1	https://www.iadb.org/en/project/BR-T1343
IADB	Mitigation	Transportation	Support for the Development of a Sustainable Infrastructure Portfolio for Public Investments which take into Consideration Climate Change and tourism potential in the state of Mato Grosso (BR-T1341)	500,000.00	40%	200,000.00	Grant	9/12/2016	1	https://www.iadb.org/en/project/BR-T1341
IADB/FOMIN	Adaptation	Circular economy	Maceió More Inclusive with Circular Economy Models (BR-T1342)	1,200,000.00	100%	1,200,000.00	Grant	2/11/2016	1	https://www.iadb.org/en/project/BR-T1342
IADB	Mitigation	Transportation	Support for the Structuring of Sustainable Infrastructure Projects in the State of Mato Grosso through Public-Private Partnerships (PPPs) (BR-T1336)	625,000.00	100%	625,000.00	Grant	20/10/2016	1	https://www.iadb.org/en/project/BR-T1336
Total financial support received for climate action through multilateral channels						**150,328,879.00**				

TABLE XVIII: SUPPORT RECEIVED THROUGH BILATERAL CHANNELS IN 2016

Country / Instituition	Type of support (mitigation, adaptation, cross-cutting, other)	Sector (energy, transportion, industry, agriculture, forests, water resources and sanitation, cross-cutting, other, not applicable)	Project name	Total financing	Total financing (US$)	Climate specific component (%)	Climate specific financing (US$)	Financing instrument	Commitment / receipt date (DD/MM/YYYY)	Capacity-building (1) / Technology transfer (2) / Not applicable (NA)	Source
Germany/BMUB	Cross-cutting	Cross-cutting	Climate Policy Programme Brazil - PoMuC (SMCF-PoMuC-001)	EUR 9,000,000.00	9,955,752.21	100%	9,955,752.21	Grant	1/8/2016	2	https://www.international-climate-initiative.com/en/nc/details/project/climate-policy-programme-brazil-pomuc-16_I_205-492/ http://sre.mma.gov.br/
Germany/BMUB	Cross-cutting	Cross-cutting	Adapting Public Investment to Climate Change in Latin America - IPACC II (SMCF-IPACII-0010)	EUR 1,000,000.00	1,106,194.69	100%	1,106,194.69	Grant	1/5/2016	1, 2	https://www.international-climate-initiative.com/en/nc/details/project/adapting-public-investment-to-climate-change-in-latin-america-ipacc-ii-15_II_125-465/ http://sre.mma.gov.br/
Germany/KfW	Mitigation	Forests	KfW CAR - Environmental Regularization of rural lands in the Amazon and in the Amazon-Cerrado transition zone	EUR 33,000,000.00	36,504,424.78	50%	18,252,212.39	Grant	1/8/2016	2	http://sre.mma.gov.br/
Norway	Mitigation	Forests	Amazon Fund	US$ 97,953,351.16	97,953,351.16	100%	97,953,351.16	Grant	16/12/2016	NA	https://www.regjeringen.no/en/topics/climate-and-environment/climate/climate-and-forest-initiative/kos-innsikt/brazil-and-the-amazon-fund/id734166/ http://www.fundoamazonia.gov.br/pt/fundo-amazonia/doacoes/
Total financial support received for climate action through bilateral channels							**127,267,510.45**				

OBS: The link <http://sre.mma.gov.br/> refers to the Ministry of Environment´s Transparency Portal on External Resources Projects

TABLE XIX: SUPPORT RECEIVED THROUGH MULTILATERAL CHANNELS IN 2017

Instituition	Type of support (mitigation, adaptation, cross-cutting, other)	Sector (energy, transportion, industry, agriculture, forests, water resources and sanitation, cross-cutting, other, not applicable)	Project name	Total financing (US$)	Climate specific component (%)	Climate specific financing (US$)	Financing instrument	Commitment / receipt date (DD/MM/YYYY)	Capacity-building (1) / Technology transfer (2) / Not applicable (NA)	Source
IBRD	Adaptation	Urban and rural social resilience	Fortaleza Sustainable Urban Development Project	146,600,000.00	27%	39,582,000.00	Loan	28/4/2017	1	http://projects.worldbank.org/P153012/?lang=en&tab=overview
IBRD	Cross-cutting	Environment and natural resources	Amazon Sustainable Landscapes Project	60,330,000.00	100%	60,330,000.00	Grant	14/12/2017	1	http://projects.worldbank.org/P158000/?lang=en&tab=overview
IFC	Mitigation	Industry (fertilizers)	CIBRAFERTIL COMPANHIA BRASILEIRA DE FERTILIZANTES	40,000,000.00	79%	31,600,000.00	Loan	29/8/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/38380
IFC	Mitigation	Agriculture	JALLES MACHADO SA	35,000,000.00	87%	30,513,000.00	Loan	8/12/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/39264
IFC	Mitigation	Transportation	LOGGI TECHNOLOGY INTERNATIONAL	5,000,000.00	100%	5,000,000.00	Equity	3/2/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/39134
IFC	Mitigation	Telecommunications	PHOENIX TOWERS PARTICIPACOES S.A.	46,021,445.99	100%	46,021,445.99	Loan	13/12/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/40763
IFC	Mitigation	Health	REDE D'OR SAO LUIZ SA	130,000,000.00	37%	48,724,000.00	Loan	31/5/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/38202
IFC	Mitigation	Agriculture	SAO MARTINHO S/A.	60,000,000.00	75%	45,264,000.00	Loan	15/5/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/37809
IFC	Mitigation	Cross-cutting (financial services)	SOCIETE GENERALE EQUIPMENT FINANCE	20,121,180.75	100%	20,121,180.75	Loan	28/11/2017	NA	https://disclosures.ifc.org/#/projectDetail/SII/39086
NDB	Mitigation	Energy	BNDES - Brazilian Development Bank	300,000,000.00	100%	300,000,000.00	Loan	26/4/2017	NA	https://www.ndb.int/wp-content/uploads/2017/12/country-summary-disclosure_-BNDESBrazil-.pdf
IBRD	Mitigation	Forests	FIP: Environmental regularization of rural lands in the Cerrado of Brazil	32,480,000.00	100%	32,480,000.00	Loan	22/5/2017	NA	http://projects.worldbank.org/P143334/fip-environmental-regularization-rural-lands-cerrado-brazil?lang=en&tab=overview
GEF	Mitigation	Cross-cutting	FAO GCP/BRA/085/GEF - Reversing Desertification Process in Susceptible Areas of Brazil: Sustainable Agroforestry Practices and Biodiversity Conservation (REDESER)	3,930,155.00	38.80%	1,525,050.00	Grant	21/11/2017	2	https://www.thegef.org/project/reversing-desertification-process-susceptible-areas-brazil-sustainable-agroforestry
GEF	Mitigation	Forests	Amazon Sustainable Landscapes Project (GEF PAISAGENS)	60,330,000.00	11.62%	7,010,000.00	Grant	19/12/2017	2	https://www.thegef.org/project/amazon-sustainable-landscapes-project
FIP	Cross-cutting	Cross-cutting	Brazil Investment Plan Coordination Project (FIP Coordenação)	1,000,000.00	100%	1,000,000.00	Grant	4/12/2017	NA	http://projects.worldbank.org/P152285?lang=em
GEF	Adaptation	Agriculture	Taking Deforestation Out of the Soy Supply Chain in Brazil	6,600,000.00	100%	6,600,000.00	Grant	30/5/2017	2	https://www.thegef.org/project/taking-deforestation-out-soy-supply-chain

IADB	Mitigation	Rural development and agriculture	Development of a Macauba-Based Silvopastoral System and Value Chain (BR-Q0019)	4,330,000.00	50.00%	2,165,000.00	Loan / grant	26/7/2017	1	https://www.iadb.org/en/project/BR-Q0019 https://www.iadb.org/en/project/BR-T1333
IADB	Mitigation	Energy	Atlantic II – Lagoa do Barro Wind Project (BR-L1514)	22,500,000.00	100%	22,500,000.00	Loan	14/11/2017	NA	https://www.iadb.org/en/project/BR-L1514
IADB	Mitigation	Transportation	Maracanaú Transportation and Urban Logistics Program (BR-L1445)	31,784,500.00	100%	31,784,500.00	Loan	13/12/2017	NA	https://www.iadb.org/en/project/BR-L1445
IADB	Adaptation	Low-carbon agriculture	Sustainable Rural Development - Phase II MATOPIBA Kick-Off Project (Phase II of Project BR-X1028)	340,000.00	100%	340,000.00	Grant	31/8/2017	1	https://www.iadb.org/pt/project/0?projectNumber=ATN/LC-16259-BR
IADB	Mitigation / Adaptation	Cross-cutting	CND InfraInvest: Sustainable Infrastructure in Brazil	600,000.00	100%	600,000.00	Grant	26/12/2017	1	https://www.iadb.org/pt/project/BR-T1377
IADB	Adaptation	Sanitation / others	National Tourism Development Program in Salvador (PRODETUR Salvador)	52,512,340.00	5.20%	800,000.00	Loan	6/6/2017	1	https://www.iadb.org/en/project/BR-L1412
IADB	Mitigation	Energy	Financing Program for Sustainable Energy (BR-L1442)	750,000,000.00	100%	750,000,000.00	Loan	10/11/2017	NA	https://www.iadb.org/en/project/BR-L1442
IADB	Adaptation	Transporte	Strategic Program for Transportation Infrastructure and Logistics in Paraná (BR-L1434)	235,000,000.00	50%	117,500,000.00	Loan	20/12/2017	1	https://www.iadb.org/en/project/BR-L1434
IADB	Mitigation / Adaptation	Sanitation and water resources	Sanitation for Nova Estrada Watershed - PROMABEN II (BR-L1369)	125,000,000.00	100%	125,000,000.00	Loan	28/12/2017	1	https://www.iadb.org/en/project/BR-L1369
IADB	Adaptation	Sanitation and water resources	Project Viva Cidade 2 - Environmental Revitalization and Urban Municipality Joinville (BR-L1405)	70,000,000.00	100%	70,000,000.00	Loan	1/8/2017	1	https://www.iadb.org/en/project/BR-L1405
IADB	Mitigation	Transportation	Program for Integrated Urban Development of the Municipality of Campo Grande - Viva Campo Grande II (BR-L1422)	56,000,000.00	5%	2,600,000.00	Loan	12/5/2017	NA	https://www.iadb.org/en/project/BR-L1422
FONPLATA	Adaptation	Cross-cutting	Corumbá Integrated Development Program	40,000,000.00	60%	24,000,000.00	Loan	27/1/2017	NA	https://www.fonplata.org/paises-miembros/item/979-bra16-2014-programa-de-desarrollo-integrado-de-corumba.html
CAF	Mitigation / Adaptation	Transportation	Alagoinhas Social Promotion, Environmental and Urban Rezoning Program	20,318,481.00	45%	9,254,056.00	Loan	17/5/2017	NA	Not available
CAF	Mitigation / Adaptation	Transportation / sanitation	Caxias do Sul Infrastructure and Basic Services Development Program II - PDI II	50,000,000.00	100%	50,000,000.00	Loan	28/12/2017	NA	Not available
CAF	Mitigation / Adaptation	Transportion / environmental conservation	Taubaté Urban Mobility and Socio-Environmental Improvement Program	60,000,000.00	100%	60,000,000.00	Loan	5/10/2017	NA	Not available
CAF	Mitigation	Transportation	São Bernardo do Campo Urban Infrastructure Program - PROINFRA	125,000,000.00	100%	125,000,000.00	Loan	1/12/2017	NA	Not available
CID / China Co-financing Fund for LA	Mitigation	Energy	Porto de Sergipe LNG to Power Plant (BR-L1505)	50,000,000.00	100%	50,000,000.00	Loan	12/12/2017	NA	https://www.iadb.org/en/project/BR-L1505
Total financial support received for climate action through multilateral channels						**2,117,314,232.74**				

TABLE XX: SUPPORT RECEIVED THROUGH BILATERAL CHANNELS IN 2017

Country / Institution	Type of support (mitigation, adaptation, cross-cutting, other)	Sector (energy, transportion, industry, agriculture, forests, water resources and sanitation, cross-cutting, other, not applicable)	Project name	Total financing	Total financing (US$)	Climate specific component (%)	Climate specific financing (US$)	Financing instrument	Commitment / receipt date (DD/MM/YYYY)	Capacity-building (1) / Technology transfer (2) / Not applicable (NA)	Source
Germany/BMUB	Adaptation	Cross-cutting	Supporting Brazil in the Implementation of its National Agenda for Change Adaptation - ProADAPTA (SMCF-IKI-0007)	EUR 5,000,000.00	5,636,978.58	100%	5,636,978.58	Grant	1/8/2017	2	https://www.international-climate-initiative.com/en/nc/details/project/supporting-brazil-in-the-implementation-of-its-national-agenda-for-climate-change-adaptation-17_II_137-2871/?cookieName=search_results&source=single http://sre.mma.gov.br/
Germany/BMUB	Adaptation	Cross-cutting	Enhancing Climate Services for Infrastructure Investments - CSI (SMCF-CSI-0008)	EUR 730,000.00	822,998.87	100%	822,998.87	Grant	1/3/2017	2	https://www.international-climate-initiative.com/en/nc/details/project/enhancing-climate-services-for-infrastructure-csi-17_II_143-555/?cookieName=search_results&source=single http://sre.mma.gov.br/
Germany/BMUB	Mitigation	Other	Climate Friendly Technologies and Capacity Development for the Implementation of the Brazilian Nacional Waste Policy (SRHQ-RESIDUOS-0001)	EUR 5,000,000.00	5,636,978.58	100%	5,636,978.58	Grant	1/5/2017	2	https://www.international-climate-initiative.com/en/nc/details/project/climate-friendly-technologies-and-capacity-development-for-the-implementation-of-the-brazilian-national-waste-policy-17_I_264-544/?cookieName=search_results&source=single http://www.protegeer.gov.br/
Norway	Mitigation	Forests	Amazon Fund	US$ 41,791,004.78	41,791,004.78	100%	41,791,004.79	Grant	14/12/2017	NA	https://www.regjeringen.no/en/topics/climate-and-environment/climate/climate-and-forest-initiative/kos-innsikt/brazil-and-the-amazon-fund/id734166/ http://www.fundoamazonia.gov.br/pt/fundo-amazonia/doacoes/
Germany/KfW	Mitigation	Forests	Amazon Fund	US$ 39,820,465.20	39,820,465.20	100%	39,820,465.21	Grant	12/12/2017	NA	https://www.giz.de/en/worldwide/12550.html http://www.fundoamazonia.gov.br/pt/fundo-amazonia/doacoes/
Germany/KfW	Mitigation	Forests/REDD+	REDD for Early Movers (REM) Program Acre Phase I	US$ 1,620,000.00	1,620,000.00	100%	1,620,000.00	Grant / results-base payment	2/2/2017	2	https://www.kfw-entwicklungsbank.de/International-financing/KfW-Development-Bank/Topics/Climate/REDD/ http://imc.ac.gov.br/wp-content/uploads/2017/12/resultados_red_emissoes_prog_rem_ac_fase1.pdf
Germany/KfW	Mitigation	Forests/REDD+	REDD for Early Movers (REM) Program Acre Phase II	US$ 5,890,000.00	5,890,000.00	100%	5,890,000.00	Grant / results-base payment	29/12/2017	2	https://www.kfw-entwicklungsbank.de/International-financing/KfW-Development-Bank/Topics/Climate/REDD/ http://imc.ac.gov.br/wp-content/uploads/2018/06/ACS_2006-_2015-1.pdf
Germany/KfW	Cross-cutting	Energy	Diffusion of Biogas Technologies	US$ 57,699,696.27	57,699,696.27	100%	57,699,696.28	Loan	December/2017	1	https://www.kfw-entwicklungsbank.de/International-financing/KfW-Development-Bank/Local-presence/Latin-America-and-the-Caribbean/Brazil/
Germany/KfW	Cross-cutting	Other	Protection of Indigenous Areas (IIEB and FUNAI)	US$ 9,226,426.80	9,226,426.80	100%	9,226,426.80	Grant	December/2017	1	http://www.funai.gov.br/index.php/comunicacao/noticias/4381-funai-firma-acordo-com-kfw-e-abre-inscricoes-para-gestor-financeiro-do-projeto?highlight=WyJrZnciXQ==
Germany/KfW	Cross-cutting	Energy	Sustainable Energy and Energy Efficiency - Pró-Clima Program (BNDES)	US$ 141,720,000.00	141,720,000.00	100%	141,720,000.00	Grant	December/2017	1	https://www.bndes.gov.br/wps/portal/site/home/imprensa/noticias/conteudo/bndes-e-kfw-celebram-linha-de-credito-de-us$-142-milhoes
Total financial support received for climate action through bilateral channels							**309,864,549.11**				

5

FUNDS RECEIVED FOR THE PREPARATION OF THE BUR

5 FUNDS RECEIVED FOR THE PREPARATION OF THE BUR

Brazil received financial support from the Global Environmental Fund (GEF) to prepare this report. These resources were crucial in updating the information provided and ensuring transparency and data collection. GEF financial support amounted to USD 500,000 and was made available through a joint project to prepare the Fourth National Communication of Brazil. This project is executed by the MCTIC and implemented in partnership with UNDP.

TABLE XXI: CAPACITY-BUILDING AND FINANCIAL SUPPORT RECEIVED FOR THE PREPARATION OF BUR 3.

Type	Activity	Period	Source	Information on support needed
Capacity building	Regional technical workshops	2017 and 2018	CGE/UNFCCC and GEF	Training and technical discussions to prepare national inventories
Financial support	Consultancy and other services	2017 and 2018	GEF	Funds received through trilateral project (GEF/MCTIC/PNUD)

The resources for the preparation of the BUR and its technical annexes included, but were not limited to, those received by the GEF. The institutions involved had the support and decisive contributions of different agencies and firm engagement of teams from other projects and from the Government. The technical annexes also had the effective participation of GTT-REDD+ members and financial resources from other projects (PoMuC – Policies on Climate Change and Program for Reducing Deforestation and Burning in the Brazilian Cerrado).

6

DESCRIPTION OF DOMESTIC MEASUREMENT, REPORTING AND VERIFICATION (MRV) ARRANGEMENTS

6 INFORMATION ON THE DESCRIPTION OF DOMESTIC MEASUREMENT, REPORTING AND VERIFICATION (MRV) ARRANGEMENTS

This section describes, in a non-comprehensive way, the different databases and arrangements involved in the domestic MRV of NAMAs in Brazil.

6.1 MODULAR SYSTEM FOR MONITORING ACTIONS AND GHG EMISSIONS REDUCTIONS (SMMARE) AND MRV OF ACTIONS

In 2013, in cooperation with Ministries in charge of implementing Nationally Appropriate Mitigation Actions (NAMAs), the Ministry of the Environment designed the Modular System for Monitoring Actions and GHG Emissions Reductions (SMMARE, in the Portuguese acronym), for which, in 2014, guidelines and methodological bases were established[28].

In order to avoid duplication of work, among other obstacles, the Government decided to wait for the conclusion of the Enhanced Transparency Framework under the Paris Agreement to resume implementation of the SMMARE transparency arrangement. In considering the lessons learned and the shortcomings identified in the previous process, such resumption is ongoing taking into account the need for monitoring NAMAs and indicative actions for the implementation of the Nationally Determined Contribution (NDC).

A new approach to SMMARE is underway with a pilot project that initially aggregates forest sector data. In addition, the Ministry of the Environment has developed an information-sharing tool to allow the monitoring of the main climate change mitigation and adaptation actions. With the objective of improving transparency, the Ministry launched the EducaClima portal (educaclima.mma.gov.br) at the beginning of 2018, on the National Awareness Day on Climate Change. The platform hosts the SMMARE pilot project and brings together content such as government commitments, legislation and education actions. It is also planned to aggregate several MRV modules in different sectors.

Different database and arrangements, described below, have contributed for the improvement and strengthening of domestic MRV arrangements.

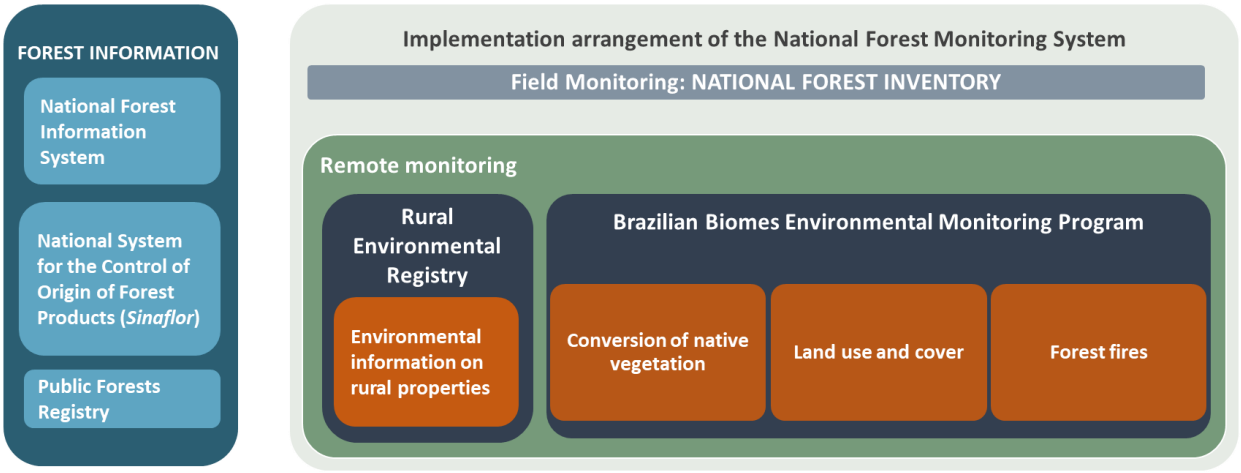
6.1.1 ACTIONS IN LAND USE, LAND-USE CHANGE AND FORESTRY

With extensive native vegetation coverage and unique land use and tenure dynamics, Brazil has been implementing different systems to monitor and implement actions in the LULUCF sector (Figure VII). These systems allow for the monitoring of the LULUCF NAMAs and the measuring, reporting and verification (MRV) process for REDD+ results[29].

[28] *The needs in quantifying results of mitigation actions are identified in the "Constraints and gaps, and related financial, technical and capacity needs" section.*

[29] *Further information on:*
The National Forest Information System, go to http://snif.florestal.gov.br/pt-br/
The System for the Control of the Origin of Forest Products, go to http://www.ibama.gov.br/
The Public Forest Register, go to http://www.florestal.gov.br/cadastro-nacional-de-florestas-publicas

FIGURE VII: MAIN SYSTEMS FOR MONITORING AND IMPLEMENTATION OF ACTIONS IN THE LULUCF SECTOR.



In addition to the systems described above, the Ministry of the Environment established[30] a process for the systematization and tracking of information about areas of vegetation suppression authorized by the federative units. The main characteristics and purposes of the initiatives that make up the implementation arrangement of the national forest monitoring system are described below.

National Forest Inventory (NFI)

The main purpose of the NFI is to generate information on forest resources, both natural and planted, based on a 5-year measurement cycle, to support the formulation of public policies aiming at forest resources use and conservation. The NFI will produce information on forest stocks, composition, health and vitality, as well as the patterns of change in time. The NFI includes also the development of allometric equations to estimate wood volume and biomass for different forest physiognomies, in partnership with universities and research institutes. These estimates will support the design of public policies for sustainable use of the forest resources and the development of future GHG inventories for the LULUCF sector.

Brazilian Biomes Environmental Monitoring Program (PMABB)

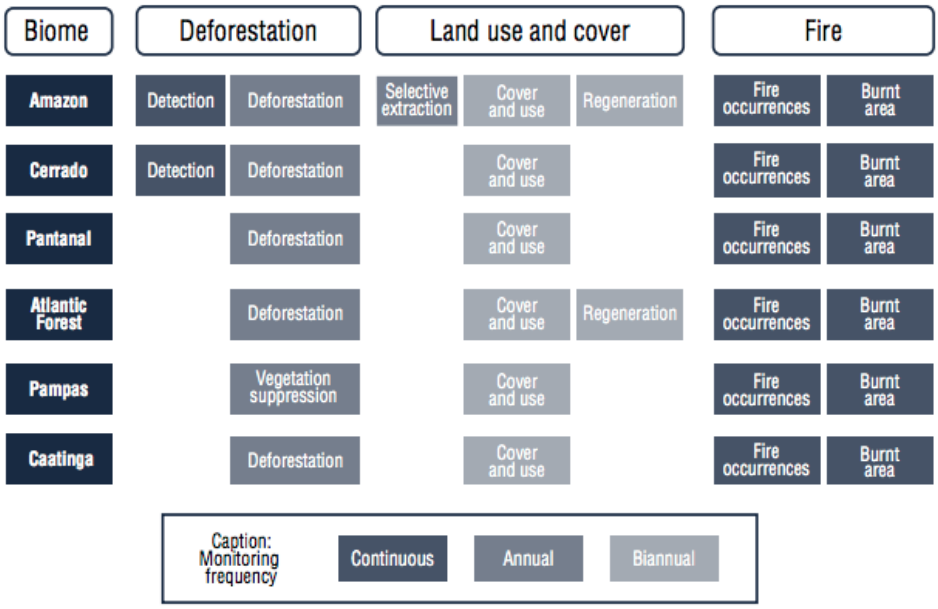
The Program seeks to promote joint actions, in coordination with various Federal Government agencies working with satellite monitoring of land cover and use initiatives (such as Embrapa/MAPA, IBGE, IBAMA/MMA, INPE/MCTIC and research institutions), to harmonize as much as possible, the various mappings of the Brazilian biomes, in various cartographical and time scales, according to the characteristics of each theme. The objective is to produce and make available harmonized, systematic and updated official information.

Mapping a territory of over 8.5 million square kilometers, where approximately 60-70% of the surface is covered by natural vegetation is challenging. The program focuses on: i) mapping and monitoring deforestation; ii) vegetation cover and land use assessment; iii) fire monitoring; and iv) vegetation restoration and selective logging.

The complexity of the Brazilian Biomes Environmental Monitoring Program is reflected in the number of expected outcomes (Figure VIII). Considering a total of seven different types of mapping routines, six biomes and a long historical series up to 2020, it is necessary to prioritize actions and plan the specific timelines for each routine. It is structured in three phases[31]: I) Amazon and Cerrado (2016-2017); II) Atlantic Forest (2016-2017) and III) Caatinga, Pampa and Pantanal (2017-2018). The mapping and monitoring will be performed through real-time and periodic assessments, with data and satellite images that are suitable to the specific characteristics of the topics and biomes addressed.

[30] *Ministry of the Environment, Ordinance No. 373/2018*
[31] *Ministry of the Environment, Ordinance No. 365/2015*

FIGURE VIII: TYPES AND FREQUENCY OF MAPPING PER BIOME[32].



Several mapping products have been developed by INPE in partnership with universities and other research institutions. The different land use and land cover data can be accessed through the Terra Brasilis platform[33]. Information on the occurrence of vegetation burning is available on the Queimadas portal[34]. Additional information on land use, by an analysis of areas already deforested, is available on TerraClass sites Cerrado[35] and TerraClass Amazon[36].

Chapter 7 (Technical Annexes on REDD+) presents additional information on satellite monitoring of deforestation by clear cutting in the Legal Amazon and Cerrado (PRODES), as well as information on annual deforestation rates for the Amazon and Cerrado biomes.

Rural Environmental Registry System (SICAR)

The Rural Environmental Registry System was created to manage, at the national level, environmental information on rural properties. Today, the System encompasses 5.2 million properties registered throughout the country, totaling 455.4 million hectares registered and monitored. This information is an important input for informing actions to combat deforestation and for the mapping of registered rural properties.

6.1.2 SIGABC AND ABC PLATFORM

The MRV of the ABC Plan is being implemented with a combination of the ABC Plan Governance System (SIGABC) and the Multi-Institutional Platform for Monitoring Greenhouse Gas Emission Reduction in Agriculture (ABC Platform).

The ABC Plan Governance System is the management system for tracking actions during the implementation of the ABC Plan. Coordinated by MAPA, it registers the results of the actions of dissemination, training, implementation of Technological Reference Units (URTs) and/or Test and Demonstration Units (UTDs), and data related to financial credit agreements granted by the banking system that implements the line of credit designed for the ABC Plan, among others.

[32] *Available at: http://www.mma.gov.br/images/arquivos/gestao_territorial/pmabb/Strategy_environmental_monitoring_program_PMABB.pdf Accessed 20 Feb 2019.*
[33] http://terrabrasilis.info/composer/DETER-B
[34] http://www.inpe.br/queimadas
[35] http://www.dpi.inpe.br/tccerrado/
[36] http://www.inpe.br/cra/projetos_pesquisas/dados_terraclass

The ABC Platform is the MRV instrument instituted in the context of the ABC Plan, and aims at developing and validating a broad and integrated identification, qualification and monitoring system towards the adoption of technologies by the ABC Plan and their contribution in GHG emission reductions by sources and removals by sinks. The assessment methodologies follow international GHG emissions monitoring protocols and the IPCC guidelines, together with national scientific data at the state, municipal or biome levels. The executive management of the Platform is under the responsibility of Embrapa, with the support of a Steering Committee coordinated by MAPA, Embrapa and composed by representatives of the Ministry of the Environment, Ministry of Science, Technology, Innovations and Communications, Ministry of Foreign Affairs, Rede Clima, besides experts and representatives of private enterprise and civil society.

6.1.3 STEEL INDUSTRY (CHARCOAL)

The Emissions Reduction Plan for the Charcoal Steel Industry, launched by the federal government in 2010, aims not only to promote compliance with the sector's NAMA but also modernizing the production of charcoal needed to promote the sustainability of the steel industry. The Plan's implementation strategy has been developed via a pilot project called "Sustainable Steel", funded by the Global Environment Facility (GEF), coordinated by the Ministry of the Environment (MMA), with participation of the Project Monitoring Committee (CAPS), Ministry of Industry, Foreign Trade and Services (MDIC – currently Ministry of Economy), Ministry of Science, Technology, Innovation and Communications (MCTIC), Ministry of Agriculture, Livestock and Supply (MAPA) and the Government of Minas Gerais , and its implementation started in 2016.

In order to follow up the development of this action, a MRV Platform is in the final stages of being developed to assist in the identification and quantification of the emission reduction of GHG associated with a given industrial process and/or technology for the production and use of charcoal as a thermal-reducer agent.

6.2 NATIONAL EMISSIONS REGISTRY SYSTEM (SIRENE)

The Brazilian Government launched the National Emissions Registry System (SIRENE)[37] as the official tool to release national greenhouse gases emissions estimates in the country[38]. This system was developed by the Ministry of Science, Technology, Innovation and Communications (MCTIC), aiming at maintaining continuity and accessibility to the estimates of the National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases Not Controlled by the Montreal Protocol.

SIRENE's mission and the scope of the information made available there are described in Brazil's Second BUR. The Ministry of Science, Technology, Innovation and Communications is in charge of coordinating, managing and maintaining SIRENE, which also counts with the collaboration of specialists in sectoral GHG emissions, public and private partner institutions and government representatives. The contribution of these different stakeholders is provided through the availability of activity data, studies of emission factors and participation in the process of control and quality assurance of information.

Since its launching in April 2016, SIRENE has been accessed by a diverse audience, with greater interest from academics and government officials to monitor the evolution of Brazil's GHG emissions and as a contribution for the development of mitigation studies.

The Brazilian government is working to improve SIRENE on two fronts: firstly, the evolution of the system's business rules, with the inclusion of all activity data in its database, emission factors and other parameters pertinent to the national inventory; and secondly, the redesign of the portal, to improve the user interface and to aggregate new sector analyzes – and relevant indicators to support decision making, particularly in the adoption of mitigation measures.

[37] *SIRENE:* http://sirene.mctic.gov.br
[38] *Decree No. 9,172/2017*

TECHNICAL ANNEXES PURSUANT TO DECISION 14/CP.19

TECHNICAL ANNEX I

RESULTS ACHIEVED BY BRAZIL FROM REDUCING EMISSIONS FROM DEFORESTATION IN THE AMAZON BIOME FOR REDD+ RESULTS-BASED PAYMENTS

TECHNICAL ANNEX I: RESULTS ACHIEVED BY BRAZIL FROM REDUCING EMISSIONS FROM DEFORESTATION IN THE AMAZON BIOME FOR REDD+ RESULTS-BASED PAYMENTS

1. INTRODUCTION

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

Brazil notes that the submission of this Technical Annex with REDD+ results is voluntary and exclusively for the purpose of obtaining and receiving results-based payments for its REDD+ actions, pursuant to decisions 13/CP.19, paragraph 2, and 14/CP.19, paragraphs 7 and 8.

This submission, therefore, does not modify, revise or adjust in any way the Nationally Appropriate Mitigation Actions (NAMA) voluntarily submitted by Brazil under the Bali Action Plan (FCCC/AWGLCA/2011/INF.1), nor does it interfere with its Nationally Determined Contribution (NDC) under the Paris Agreement under the UNFCCC.

This submission was developed by the Brazilian government with the technical support from the Technical Working Group of Experts on REDD+ (GTT REDD+, for its acronym in Portuguese) created in February 2014 by the Ministry of Environment (MMA) through the Ministerial Ordinance No. 41. This document presents the results achieved in reducing emissions from deforestation in the Amazon biome in the 2016-2017 period, and also the progress made in producing data and information to continuously improve Brazil's submissions.

2. SUMMARY INFORMATION FROM THE ASSESSED FOREST REFERENCE EMISSION LEVEL FOR REDUCING EMISSIONS FROM DEFORESTATION IN THE AMAZON BIOME

Brazil´s second forest reference emission level for reducing emissions from deforestation in the Amazon biome for REDD+ results-based payments under UNFCCC from 2016 to 2020, hence forth referred to as FREL C, was submitted on a voluntary basis for a technical assessment in the context of results-based payments and covers the activity "reducing emissions from deforestation" in the Amazon biome, Brazil's most significant of the five activities included in paragraph 70 of decision 1/CP.16.

The second BUR included a Technical Annex with the emission reduction results achieved in the Amazonia biome in the period 2011-2015, based on FREL B, estimated as the mean of the annual CO_2 emissions from gross deforestation from the period 1996-2010. The Annex also included a proposed FREL C, for assessing emission reduction from deforestation for the period 2016-2020, for results-based payments. The FREL C proposed in the BUR was estimated as the mean of the annual CO_2 emissions from gross deforestation from 1996-2015, maintaining the same emission estimates in the time-series as for FREL A (1996-2005) and FREL B (1996-2010), and updating with adjusted emission estimates for the period 2011–2015. The LULUCF experts responsible for the technical analysis of the Technical Annex of the BUR did not technically assess the FREL C since it was considered to be outside the scope of the guidelines for technical analysis of BURs.

Therefore, Brazil's second FREL submission for the Amazon biome (FREL C) presents all emission estimates from deforestation in the period 1996-2015 re-estimated based on the updated adjusted increments from deforestation in the period 1996-2010, using deforestation data from the period 2011-2015. This re-estimation resulted in an increase of 0.17% and 0.23% to the total increment of deforestation and associated total emissions in the period 1996-2010, respectively.

The submission of FREL C maintains close resemblance with the construction of both FREL A and FREL B, and is considered to be an update of the first submission for the Amazonia biome, which is consistent with Decision 12/CP.17. Nonetheless, the second submission considers suggested improvements from the technical assessment of the first FREL and includes new text to continuously improve the transparency and clarity of the submission.

Brazil recalls paragraphs 11 and 10 of Decision 12/CP.17 (FCCC/CP/2011/9/Add.2) that respectively indicate that a subnational FREL may be developed as an interim measure, while transitioning to a national FREL; and that a step-wise approach to a national FREL may be useful, enabling Parties to improve the FREL by incorporating better data, improved methodologies and, where appropriate, additional pools. Although the FREL C includes only CO_2 emissions from gross deforestation in the Amazonia biome, Brazil is implementing the National REDD+ Strategy and is carrying out concrete efforts to transition to a national FREL.

The construction of the FREL C was based on the National Institute for Space Research's (INPE, for the Portuguese acronym) historical time series for gross deforestation in the Legal Amazonia using Landsat-class satellite data on an annual, wall-to-wall basis since 1988. This time series is considered to be the most reliable source of the areas annually deforested, due to its consistency through time, transparency, verifiability, and low uncertainty. Due to the characteristics of the time series data (e.g., annual wall-to-wall assessments, adjustment for different dates between annual assessments), the use of these data (instead of data from the II and III National Inventories that provide average estimates for an 8-year period and are based on a more coarse work scale) is considered to be the most accurate for the purposes of the FREL construction for the Amazonia biome.

The emissions from deforestation for the period 1996-2015 were estimated through the combination of activity data (i.e. the area of annual gross deforestation per forest type considered) with the appropriate emission factor (i.e. carbon stocks associated with carbon pools of the forest types considered). The FREL Amazonia considers the following carbon pools: living biomass (above and below-ground biomass) and litter, consistent with the first submission for the Amazonia biome. Dead wood and soil organic carbon (for mineral and organic soils) were not included, as they are not considered to be significant sources, following the Second National Greenhouse Gas Inventory, the most recent inventory at the time of the FREL Amazonia submission. As per the gases included in the submission, only CO_2 was considered.

FREL C includes only the activity "Reducing Emissions from Deforestation" in the Amazonia biome, using PRODES data as a basis. In accordance with the technical assessment of the previous FREL for the Amazonia biome, Brazil understands the importance of better understanding forest degradation and its linkages with deforestation. Brazil is carrying out efforts to include emissions from forest degradation in its national submission.

Regarding the emission factors, the carbon stock in aboveground biomass was estimated for the different forest typologies considered using a country-specific allometric equation (tier 3) and data collected in sampled plots by the RADAMBRASIL Project (circumference at breast height - CBH). The estimates were adjusted to include carbon in belowground biomass, litter, biomass in palms and lianas, as well as in the biomass of trees with CBH below 100 cm1 and were extrapolated to the entire territory of the biome

[1] *RADAMBRASIL project collected data on trees with circumference at breast height (CHB) greater than 100 cm.*

following defined rules. Hence, a Carbon Map for the Amazonia biome was created for the 22 types of forest physiognomies2.

The FREL C uses 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. Brazil assumed that the biomass immediately after the conversion to other land-use category was zero and did not consider any CO_2 removals after the conversion (that is, only gross emissions from deforestation were considered).

The emission factors in the FREL C are defined as the carbon densities in living biomass (above and below-ground biomass) and litter, consistent with those adopted in the construction of both FREL A and FREL B (i.e., based on the carbon map data from the II National GHG Inventory). The application of the carbon map developed for the III National GHG Inventory resulted in an insignificant difference (0.22 per cent) relative to the carbon map of the II National GHG Inventory, maintained the same carbon pools (living biomass and litter).

The annual emissions from gross deforestation were estimated from the annual deforestation increments3, adjusted to include potential deforested areas under clouds, as detailed in **Section 4** herein and in the assessed FREL C Amazonia. The areas of the deforestation polygons for a given forest typology were multiplied by the corresponding emission factors (total carbon[4], in tonnes of carbon per unit of area (tC ha^{-1}) and subsequently by 44/12, to convert tonnes of carbon to tonnes of CO_2 (tCO_2 ha^{-1}). Then, for each year considered, the CO_2 estimates associated with each polygon were summed up.

Following the approach established in the first FREL submission, of a dynamic FREL5, the FREL C for results-based payments for emission reductions from deforestation in the period from 2016 to 2020 is the mean of the annual CO_2 emissions associated with the adjusted gross deforestation from 1996 to 2015 (refer to Figure 1 and Table 1).

As in the first submission (for FREL A and FREL B), Brazil's FREL C does not include assumptions on potential future changes to domestic policies.

[2] Details about the Carbon Map are included in section b (Transparent, complete, consistent and accurate information used in the construction of the Forest Reference Emission Level) of the original FREL submission.

[3] Increment of deforestation refers to the sum of the area of all observed deforestation polygons within a certain geographic area. In the FREL C submission and also in this Technical Annex, increment of deforestation refers to the sum of observed deforested area in each Landsat scene that covers the biome. The increment of deforestation may underestimate the total area deforested (and corresponding emissions), since it does not include potential deforestation in cloud covered areas.

[4] Total carbon refers to the sum of the carbon in aboveground biomass, belowground biomass and litter.

[5] See page 24 of the Brazil's first submission of a FREL for the Amazonia biome (https://goo.gl/p4YP3T)

FIGURE 1: PICTORIAL REPRESENTATION OF BRAZIL'S FREL C (751,780,503.37 TCO_2).

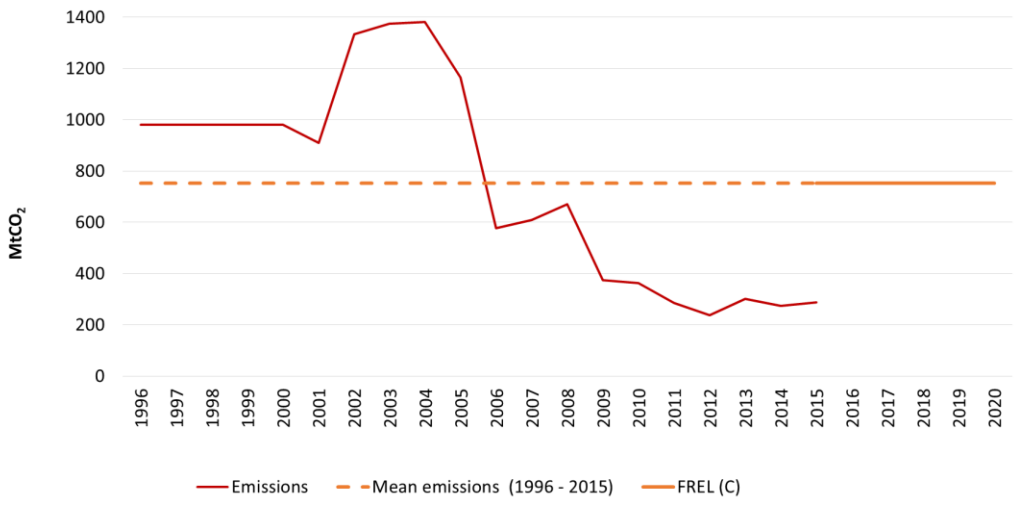


TABLE 1: ADJUSTED INCREMENTS OF DEFORESTATION (IN HA) AND CORRESPONDING ADJUSTED CO_2 EMISSIONS (IN TCO_2) FOR THE PERIOD 1996-2015 USED IN THE CONSTRUCTION OF FREL C (IN TCO_2).

Year	(A) ANNUAL ADJUSTED INCREMENT FROM DEFORESTATION (ha)	(B) ANNUAL ADJUSTED CO_2 EMISSIONS FROM DEFORESTATION USING DATA FROM 2011-2015 (tCO_2)
1996	1,874,013.33	979,523,618.48
1997	1,874,013.33	979,523,618.48
1998	1,874,013.33	979,523,618.48
1999	1,874,013.33	979,523,618.48
2000	1,874,013.62	979,523,849.37
2001	1,949,331.97	908,964,575.38
2002	2,466,605.01	1,334,458,298.72
2003	2,558,847.66	1,375,224,078.19
2004	2,479,431.66	1,380,142,199.34
2005	2,176,233.21	1,163,879,134.73
2006	1,033,687.21	576,136,731.11
2007	1,088,545.83	609,101,478.18
2008	1,237,179.07	669,215,058.08
2009	608,154.57	373,066,456.69
2010	610,642.15	362,507,086.87
2011	501,406.41	285,507,794.61
2012	425,499.51	236,684,154.44
2013	537,857.10	301,847,850.91
2014	490,851.45	273,591,600.59
2015	524,055.95	287,665,246.39
AVERAGE 1996-2015	**1,402,919.78**	**751,780,503.37 (FREL C)**

The REDD+ decisions under the UNFCCC value the continuous update and improvement of relevant data and information over time. Brazil values consistency and transparency of the data submitted as fundamental, and gives the highest priority to these. Nonetheless, Brazil continues its efforts to improve the accuracy of the estimates for all carbon pools included in the FREL. Brazil's data is presented in a transparent and verifiable manner, allowing the reconstruction of the FREL C.

3. RESULTS IN TONNES OF CO_2 PER YEAR, CONSISTENT WITH THE ASSESSED FOREST REFERENCE EMISSION LEVEL 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 section II of decision 12/CP.17".

CO_2 emissions from gross deforestation in the Amazon biome in the period from 1996 to 2015, used in the construction of the FREL C, were estimated using the methodology presented in the previous section. For this Technical Annex, the increments of deforestation (2016 to 2017) were adjusted until 2013 to avoid over or under-estimating the emissions from deforestation, due to the non-observation of potential deforestation polygons in areas covered by clouds. The cloud adjustment was performed only for the 4 years prior to the most recent increment of deforestation, since it has been the period with the largest variations (see FREL C, Table 1).

The annual REDD+ results for the period from 2016 to 2017 were calculated by subtracting the mean annual CO_2 emissions (calculated from the adjusted deforestation increments) from the forest reference emission level for the period from 1996 to 2015 (see FREL C in **Figure 1** = 751,780,503.37 tCO_2).

Hence, for year t in the period from 2016 to 2017, the emission reduction from deforestation was estimated as follows:

REDD+ (*t*) = FREL C (1996-2015) – Gross emissions from deforestation at year *t*; (tCO_2)

For example, the emission reduction from deforestation for year 2016 is equal to:

751,780,503.37 tCO_2 – 374,436,497.34 tCO_2 = 377,344,006.03 tCO_2

The total emission reduction from gross deforestation in the Amazon biome, from 2016 to 2017, was equal to the sum of the emission reduction results achieved for each year in the period, i.e., 769,000,872.95 **tCO_2 (Figure 2 and Table 2)**.

FIGURE 2: REDD+ RESULTS FROM 2016 TO 2017 CALCULATED BASED ON THE FREL C SUBMITTED TO THE UNFCCC IN AND ASSESSED BY TECHNICAL EXPERTS.

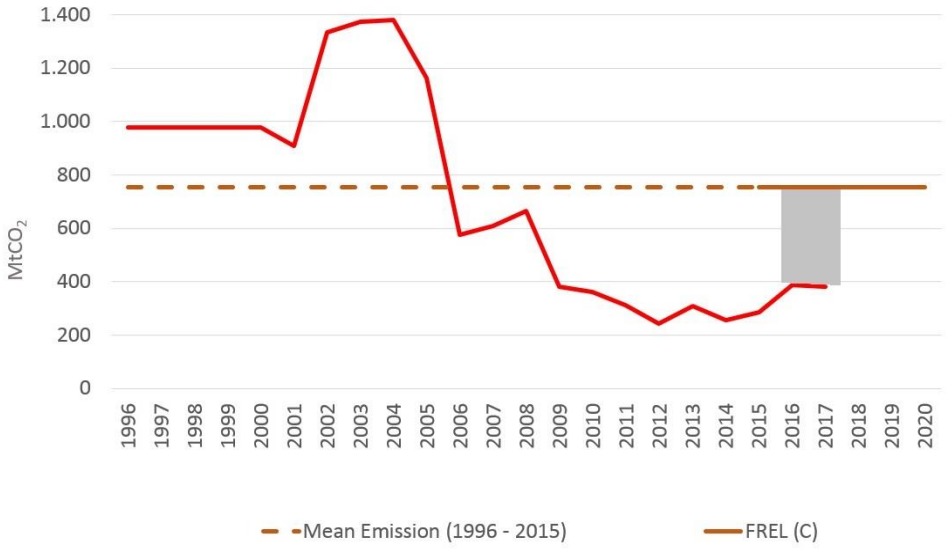


TABLE 3: ANNUAL EMISSIONS FROM DEFORESTATION (TCO_2/YR) FROM 1996 TO 2017; FOREST REFERENCE EMISSION LEVEL USED TO ESTIMATE THE EMISSION REDUCTION RESULTS IN THE PERIODS OF 2016-2020 AND REDD+ RESULTS ACHIEVED (TCO_2).

Year	Annual emissions from deforestation (tCO_2/yr)	Annual adjusted CO_2 emissions (2016-2017) until 2013	FREL C (tCO_2)	Annual REDD+ results 2016 e 2017 (tCO_2/yr)
1996	979,523,413.88			
1997	979,523,413.88			
1998	979,523,413.88			
1999	979,523,413.88			
2000	979,523,413.88			
2001	908,964,139.89			
2002	1,334,457,456.93			
2003	1,375,223,214.70			
2004	1,380,140,945.68			
2005	1,163,873,339.68			
2006	576,097,126.38			
2007	608,266,397.26			
2008	666,005,315.39			
2009	364,340,477.19			
2010	344,406,512.43			
2011	**285,507,794.61**			
2012	**236,684,154.44**			
2013	**301,847,850.91**	**303,958,845.75**		
2014	**273,591,600.59**	**278,146,273.90**		
2015	**287,665,246.39**	**319,184,911.63**		
2016		**374,436,497.34**	**751,780,503.37**	**377,344,006.03**
2017		**360,123,636.45**	**751,780,503.37**	**391,656,866.92**
Total emission reductions result (2016-2017)				**769,000,872.94 tCO_2**

4. DEMONSTRATION THAT THE METHODOLOGIES USED TO PRODUCE THE RESULTS ARE CONSISTENT WITH THOSE USED TO ESTABLISH THE ASSESSED FOREST REFERENCE EMISSION LEVEL

The methodology, data sets and information used in the calculation of the results presented in this Technical Annex are the same as the ones used in Brazil's FREL C, as demonstrated in the following items: (4.1) activity data; (4.2) emission factors; (4.3) carbon pools; (4.4) Non-CO_2 gases; and (4.5) REDD+ activities.

4.1 ACTIVITY DATA

The area of each deforestation polygon with a certain forest physiognomy is the data needed to estimate the emissions from deforestation6, following the IPCC good practice guidance for LULUCF (IPCC, 2003).

Similar to the way the FREL C was calculated, the activity data used here to generate the results are derived from PRODES, adapted to include only deforestation within the geographical boundaries of the Amazon biome. The minimum mapping area of 6.25 hectares was maintained (see **Box A.1**, page 77 of the FREL C for further information).

In the construction of FREL C, the increments of deforestation were adjusted to avoid over or under-estimating the emissions from deforestation for any given year, due to the non-observation of potential deforestation polygons in areas covered by clouds (see **Box 3**, page 18 of the FREL C for details). The same Vegetation Map used to identify the forest physiognomies associated with the deforestation polygons was used to identify the forest physiognomies affected by deforestation in the results presented in this Technical Annex.

4.2 EMISSION FACTORS

Although Brazil has submitted to the UNFCCC, in March 2016, its Third National Greenhouse Gas Inventory, with a new Carbon Map for the Amazon biome, the results here presented were calculated using the same Carbon Map included in Second National Greenhouse Gas Inventory to ensure consistency between the **FREL C** and the results.

4.3 CARBONS POOLS

The FREL C includes the following carbon pools: above and below-ground biomass and litter. The Carbon Map of the Second National GHG Inventory mentioned in **Section 4.2** includes the carbon in the biomass of these three pools. The results presented in this Technical Annex maintain the same pools. Considerations regarding the dead wood pool are presented in **Box 1** below.

BOX 1 - THE TREATMENT OF DEAD WOOD IN FREL C

Paragraph 28 of the technical evaluation of the FREL submitted by Brazil to the UNFCCC (FCCC/TAR/2014/BRA) indicated the treatment of the emissions from dead wood as an area for future improvement of the FREL. Although the results presented in this submission do not include emissions from this pool, in order to ensure consistency with the construction of both FREL A and FREL B, the III National GHG Inventory includes this pool in the carbon map for the Amazonia biome there proposed.

[6] *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).*

4.4 NON-CO_2 GASES

The FREL C includes only CO_2 emissions from gross deforestation in the Amazon biome. However, the III National Inventory includes estimates of non-CO_2 emissions from biomass burning resulting from deforestation in the Amazonia biome. **Box 2** presents some considerations regarding the treatment of non-CO_2 gases.

BOX 2 – CONSIDERATION REGARDING NON-CO_2 GASES

Paragraph 29 of the technical evaluation report of the FREL submitted by Brazil to the UNFCCC indicates the treatment of emissions of non-CO_2 gases as an area for future technical improvement of the FREL. An analysis of the impact of non-CO_2 emissions of carbon monoxide (CO), methane (CH_4), nitrous oxide (N_2O) and NO_x for year 2010, included in the III National GHG Inventory indicates the following emissions: 8,400 Gg; 549 Gg; 16 Gg; and 129 Gg, respectively.

Non-CO_2 emissions from deforestation in the Amazonia biome are not available for other years and hence; recalculation of the emission estimates to include non-CO_2 emissions would not be possible, nor would it be consistent with FREL A and FREL B. Estimation of emissions from fire resulting from deforestation is expected to be improved in the next national inventories, and if it is possible, non-CO_2 emissions from fire will be included in the national FREL, if the consistency of the time-series can be assured and if deemed relevant.

4.5 REDD+ ACTIVITIES

The FREL Amazonia was constructed targeting emissions from gross deforestation and, hence, does not include emissions resulting from other REDD+ activities.

The results presented in this Technical Annex are consistent with the assessed FREL C Amazonia.

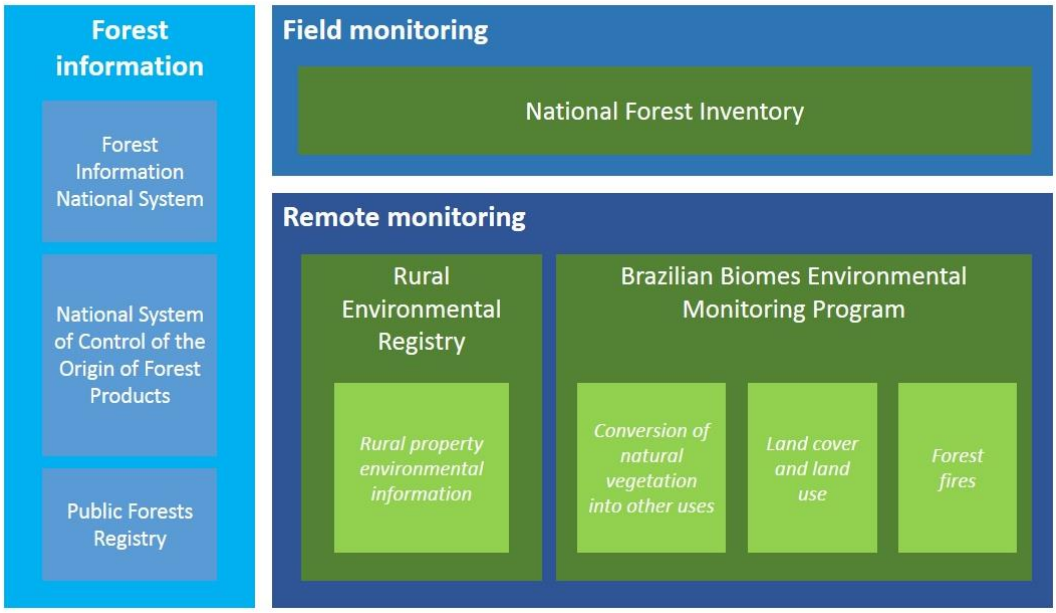
Brazil is carrying out internal discussions through the GTT REDD+ regarding the treatment of forest degradation and how its associated emissions can be included in future submissions. **Annex III (page 93) and BOX A.4 in the FREL C submission** provide some considerations regarding the treatment of forest degradation.

5. DESCRIPTION OF THE NATIONAL FOREST MONITORING SYSTEM AND INSTITUTIONAL ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING THE RESULTS

5.1 ARRANGEMENT OF BRAZIL'S NATIONAL FOREST MONITORING SYSTEM

Due to Brazil's extensive coverage of native vegetation and the dynamics of land use and occupation, the Brazilian Government has been implementing a series of systems to monitor these phenomena over the years. These systems, each with its own characteristics and purposes, make up a robust arrangement for monitoring and implementation of actions in the LULUCF sector. Figure 3 below presents the main systems that make up this arrangement.

FIGURE 3: IMPLEMENTATION ARRANGEMENT OF THE NATIONAL FOREST MONITORING SYSTEM.



As per Section 6 of the BUR, the systems presented above provide contributions to the implementation and monitoring of LULUCF's NAMAs, as well as the MRV process of REDD+ results, in addition to those intended to provide and organize forest information7. Further to what has been described in section 6 of the BUR, additional information is presented below about the initiatives that provide inputs directly related to the MRV of REDD+.

5.1.1 BRAZILIAN BIOMES ENVIRONMENTAL MONITORING PROGRAM (PMABB)

The Ministry of the Environment established the Brazilian Biomes Environmental Monitoring Program for the monitoring of deforestation, land cover and land use, selective logging, forest fires and recovery of native vegetation, through MMA Ordinance no. 365, of November 27, 2015.

With the development of geoprocessing and remote sensing technologies, Brazil has become a benchmark in the development and deployment of land cover and land-use monitoring systems. The resulting knowledge on the dynamics of land-use change has been a key element for curbing deforestation in the Amazon.

Research and innovation in the field of remote sensing have helped the mapping of land cover and land-use change dynamics at local, regional, and national levels. This has been essential for better understanding the spatial aspects related to the expansion, retraction, transition, intensification, conversion and diversification of the Brazilian agricultural production. Understanding the dynamics of land-use is important not only for assessing the condition of different ecosystems, but also for estimating the impacts caused by different human activities on biodiversity and climate change. Information on deforestation and forest degradation are fundamental for the implementation of Brazil's National REDD+ Strategy.

[7] *For further information:*
National Forest Information System: http://snif.florestal.gov.br/pt-br/
National System for the Control of the Origin of Forest Products: http://www.ibama.gov.br/
Public Forest Register: http://www.florestal.gov.br/cadastro-nacional-de-florestas-publicas

5.1.2 AMAZONIA DEFORESTATION SATELLITE MONITORING PROJECT - PRODES

PRODES is part of a larger program (Amazonia Program) developed at the National Institute for Space Research (INPE) to monitor gross deforestation in areas of primary (natural) forest in the Legal Amazonia through use of satellite imagery, starting its time series in 1988.

Deforestation is associated with clear-cut activities, normally related to the conversion of forest areas to other land-use categories. Gross deforestation is annually estimated through a complete wall to wall analysis that involves approximately 215 Landsat scenes, with minimum mapping area equal to 6.25 hectares. It uses satellite imagery to identify new deforestation polygons every year in areas of primary forest, aided by additional Landsat class data (CBERS/CCD, Resourcesat/LISS3 and DMC) to reduce areas that are not observed due to the presence of cloud cover.

Since 2003, INPE began to publish the annual rate of deforestation online, together with all the satellite imagery used and the maps with the observed deforestation polygons, ensuring complete transparency of the deforestation estimates and public online access (http://www.obt.inpe.br/prodes/index.php). Approximately 215 Landsat 5/7/8 scenes (or similar data, as for instance, from CBERS/CCD, Resourcesat/LISS3 and DMC) are annually available and each scene is accompanied by the respective mapping of the observed deforestation in that year and previous ones.

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.

PRODES, which for decades has generated reliable deforestation data for Amazonia, is key in the context of expanding land cover monitoring to the other Brazilian biomes. The Project, open coded and evaluated by national and international experts, ensures the quality of the data used by Brazil on its REDD+ submissions.

5.2 ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING (MRV) REDD+ RESULTS

The measuring, reporting and verifying process for REDD+ results in Brazil are presented in Figure 4 below.

FIGURE 4: MRV FOR REDD+ IN BRAZIL.

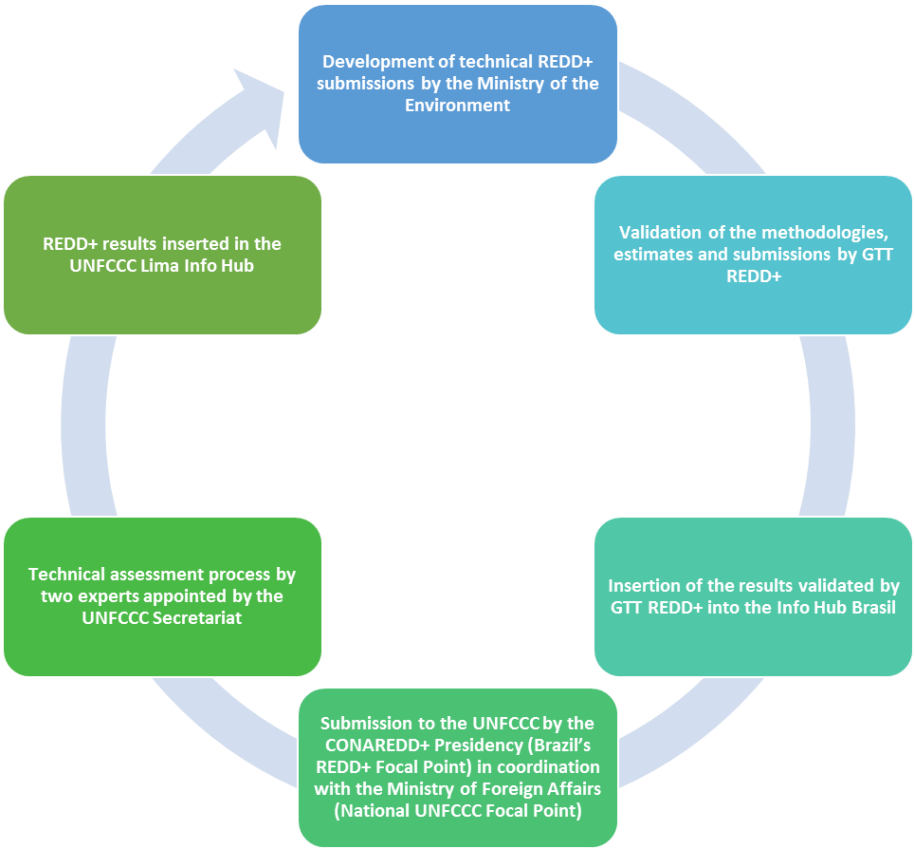


Table 3 presents the mapping of the institutions responsible for measuring, reporting and verifying (MRV) REDD+ results.

TABLE 2: ROLE AND INSTITUTIONAL RESPONSIBILITIES FOR REDD+ MRV IN BRAZIL.

MRV	INSTRUMENT	RESPONSIBLE INSTITUTION	ROLE	ADDITIONAL INFORMATION
MEASURING	GTT REDD+	*Institution contracted to do the mapping and generating the results estimates*	Map the deforestation polygons in the Amazon biome, consistent with the methodologies used in the assessed FREL Amazonia; estimate the annual emissions, ensure consistency with the Second National GHG Inventory	http://www.funcate.org.br
		INPE/MCTI	Carry out the quality control and quality assurance of the products generated by the contracted institution.	http://www.obt.inpe.br/prodes/index.php
	Executive Secretariat of the National REDD+ Committee (CONAREDD+)	MMA	Carry out quality control of the emission estimates produced by the contracted institution. Develop the submissions to the UNFCCC under the guidance of the GTT REDD+. Verify consistency with the FREL.	http://redd.mma.gov.br/en/the-national-redd-committee

MRV	INSTRUMENT	RESPONSIBLE INSTITUTION	ROLE	ADDITIONAL INFORMATION
REPORTING	Presidency of CONAREDD+ Focal point to the UNFCCC	MMA MRE	Forward the REDD+ submission to the UNFCCC.	http://redd.mma.gov.br/en/the-national-redd-committee
	Info Hub Brasil	MMA	Compile and make available documentation needed for the recognition of the REDD+ results until its verification by the ICA and insertion in the Lima REDD+ Information Hub.	http://redd.mma.gov.br/en/infohub
VERIFYING	International Consultation and Analysis	UNFCCC	Verify the submission by Parties, indicating experts in Land use and Forestry (LULUCF) to evaluate the FREL submissions and technical annexes.	http://unfccc.int/methods/redd/redd_web_platform/items/4531.php
		MMA	Provide the clarification information requested by the experts in charge of the technical evaluation and verification of the consistency of results. Exchange with the experts indicated by the UNFCCC for the technical evaluation of the submission of the FREL and results.	

6. NECESSARY INFORMATION THAT ALLOWS FOR THE RECONSTRUCTION OF THE RESULTS

For REDD+ purposes, **complete** information means the provision of data that allows for the reconstruction of the FREL and the REDD+ results.

The links to the database and the information that allows for the reconstruction of the results are listed in **Section b.1 of the FREL C**. These data are described below and can also be accessed at: http://redd.mma.gov.br/en/infohub

1. **Satellite imagery** used in the identification of deforestation polygons in the Amazon biome, from 2001 to 2017. The images (approximately 220 per year) are made publicly available by INPE.
2. **Accumulated deforestation polygons until 1997** (inclusive) presented in a map hereinafter referred to as the digital base map (for more details, see Annex I.1 of the FREL C).
3. **Accumulated deforestation polygons for years 1998, 1999 and 2000** are presented in the digital base map.
4. **Annual deforestation polygons** (annual maps) for the period from 2001 to 2017.
5. Deforestation polygons by forest type attributes and RADAMBRASIL volume for the period 2001-2015.
6. **Map with the carbon stocks for the different types of forest in the Amazon biome** (Carbon Map), consistent with FREL C.
7. **Information regarding deforestation under cloud cover and calculation of the adjusted deforestation increment**.

IMPORTANT NOTE 1: All the maps listed under (2), (3) and (4) above are available in shapefile format (.shp), ready to be incorporated in a Geographical Information System for analysis. All the satellite images cited in (1) above are available in full resolution in format GeoTIFF at INPE's site. Any specific deforestation polygon can be verified using the corresponding satellite image.

IMPORTANT NOTE 2: The maps cited in (2), (3) and (4) above are a subset of the maps produced by INPE for PRODES (for more information access <http://www.obt.inpe.br/prodes/index.php> and refer only to the Amazon biome, object of this submission. The information in (2) and (3) above is available as a single file.

7. 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

The FREL C and the respective Technical Annex use the methodologies described in the IPCC Good Practice Guidance for LULUCF (IPCC, 2003) as a basis for estimating the changes in carbon stock in forested areas converted to other land uses. For any conversion occurring at a given year, the IPCC considers the carbon stock in the biomass immediately before and immediately after the conversion. Brazil only considers the loss of the carbon stock in the biomass present immediately before the conversion (gross emissions). Brazil applies the basic method for estimating emissions suggested by IPCC, i.e., emissions estimated as the product of activity data and emission factor.

7.2 ESTABLISH, ACCORDING TO NATIONAL CIRCUMSTANCES AND CAPABILITIES, ROBUST AND TRANSPARENT NATIONAL FOREST MONITORING SYSTEMS

The activity data used in the construction of all FREL and Technical Annexes submissions originated from PRODES historical time series, which is one of the products under the Brazilian Biomes Environmental Monitoring Program. In a near future, as described in Section 5.1, the harmonization of land use/cover monitoring initiatives will allow the regular production of emission data from deforestation in the remaining biomes (Caatinga, Atlantic Forest, Pantanal and Pampas)). Field data will also be available through the National Forest Inventory that will certainty enhance the quality of the forest carbon estimates. Both initiatives are of great importance to the advancement of the forest agenda in Brazil and are instrumental for the establishment of robust and transparent forest monitoring systems at the national level.

TECHNICAL ANNEX II

RESULTS ACHIEVED BY BRAZIL FROM REDUCING GREENHOUSE GAS EMISSIONS FROM DEFORESTATION IN THE CERRADO BIOME FOR REDD+ RESULTS-BASED PAYMENTS

TECHNICAL ANNEX II: RESULTS ACHIEVED BY BRAZIL FROM REDUCING GREENHOUSE GAS EMISSIONS FROM DEFORESTATION IN THE CERRADO BIOME FOR REDD+ RESULTS-BASED PAYMENTS

1. INTRODUCTION

Brazil welcomes the opportunity to submit a Technical Annex to its Third Biennial Update Report (BUR) in the context of results-based payments for reducing emissions from deforestation and forest degradation, conservation of forest carbon stocks, 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 notes that the submission of this Technical Annex with REDD+ results is voluntary and exclusively for the purpose of obtaining and receiving results-based payments for its REDD+ actions, pursuant to decisions 13/CP.19, 13/CP.19, paragraph 2, and 14/CP.19, paragraphs 7 and 8.

This submission, therefore, does not modify, revise or adjust in any way the Nationally Appropriate Mitigation Actions (NAMA) voluntarily submitted by Brazil under the Bali Action Plan (FCCC/AWGLCA/2011/INF.1), neither the Brazilian Nationally Determined Contribution (NDC) under the Paris Agreement under the UNFCCC.

This submission was developed by the Brazilian Government with the technical support from the Technical Working Group of Experts on REDD+ (GTT REDD+, for its acronym in Portuguese) created in February 2014 by the Ministry of Environment (MMA) through Ministerial Ordinance No. 41. This document presents the results achieved by Brazil from reducing greenhouse gas emissions from deforestation from 2011 to 2017 in the Cerrado biome.

The Cerrado is Brazil's second largest biome in terms of territory. Together with the Amazon biome, they comprise approximately 73% of the national territory. This initiative is another step for Brazil towards the measurement, reporting and verification of REDD+ results for the entire national territory. It benefits from improvements established after previous submissions evaluation processes regarding the Amazon biome and from FREL evaluation that endorse the results presented in this Annex.

2. SUMMARY INFORMATION FROM THE ASSESSED FOREST REFERENCE EMISSION LEVEL FOR REDUCING EMISSIONS FROM DEFORESTATION IN THE CERRADO BIOME

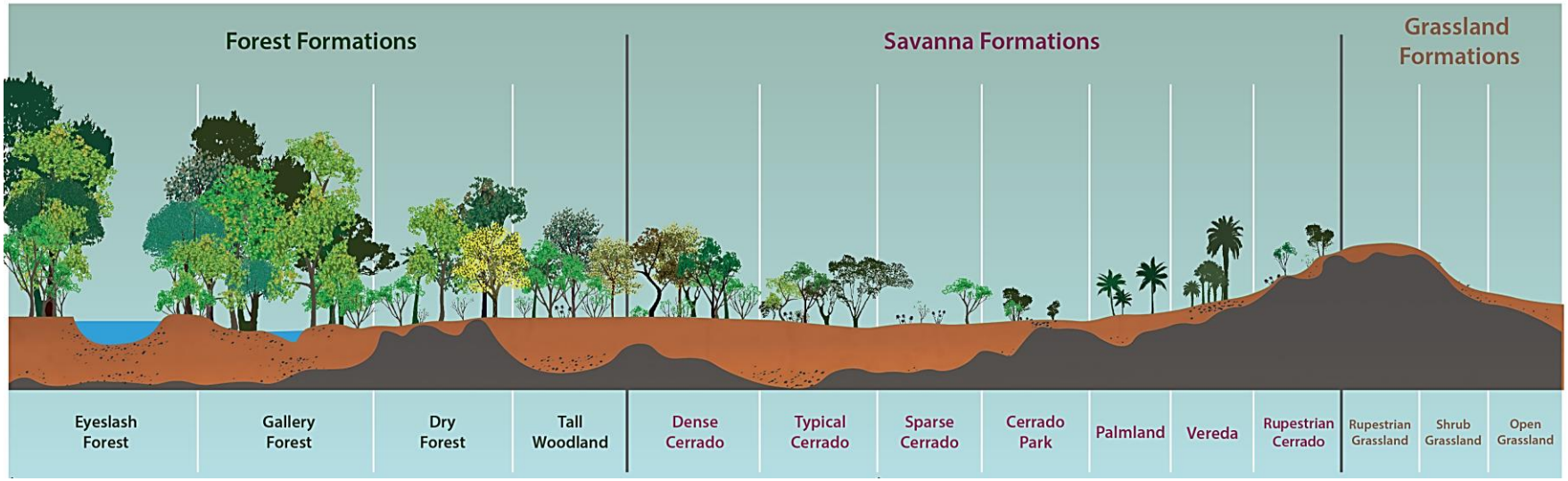
Brazil applied a step-wise approach to develop a national FREL, in accordance with decision 12/CP.17, paragraph 10. The step-wise approach enables Parties to continuously improve their data and submissions, by incorporating better data, improved methodologies and, where appropriate, additional carbon pools.

The Forest Reference Emission Level for the Cerrado biome, henceforth referred to as FREL Cerrado, was submitted on a voluntary basis by Brazil for a technical assessment in the context of results-based payments for REDD+ and covered the activity "reducing greenhouse gas emissions from deforestation", considered the most significant for Brazil among the five REDD+ activities included in paragraph 70 of decision 1/CP.16.

The construction of the FREL Cerrado followed the guidelines set out in the IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry1 (IPCC, 2003) to estimate the changes in carbon stocks in areas of natural forest converted to other land-use categories.

The classification of the vegetation used in the FREL Cerrado is that of Ribeiro and Walter (2008), which define forests as environments with predominance of tree species and continuous or discontinuous canopy formation, while the savanna formations are constituted by the coexistence of the tree, shrub and herbaceous extracts. The outland formations are characterized by the predominance of herbaceous and shrub species, with few trees, where no canopy formation is observed. Figure 1 is a representation of different vegetation phytophysiognomies of the Cerrado. In addition to the forest formations identified in the figure, other phytophysiognomies that fit the structural characteristics of the forest definition adopted by Brazil in other international communications were included – Cerrado Denso (Thick Cerrado) and Cerrado Típico (Typical Cerrado).

FIGURE 1: PICTORIAL REPRESENTATION OF THE MAIN VEGETATION PHYTOPHYSIOGNOMIES IN THE CERRADO BIOME, IN A BIOMASS GRADIENT (FROM THE LARGEST FOREST FORMATIONS, ON THE LEFT, TO THE SMALLEST ONES - SAVANNAS AND GRASSLANDS, ON THE RIGHT).



Source: *Adapted from Ribeiro and Walter, 2008.*

[1]*Henceforth referred to as IPCC Good Practice Guidance for LULUCF.*

Emissions from deforestation in the period 2000-2010, which are part of the FREL Cerrado, were estimated by combining activity data (annual deforested area in different forest types) and appropriate emission factors (carbon stocks in biomass associated to the relevant forest type).

Activity data for the elaboration of the FREL Cerrado were included in the series of the National Institute for Space Research (INPE), under the Ministry of Science, Technology, Innovations and Communications (MCTIC). INPE, as a supplier of the Brazilian Biomes Environmental Monitoring Program (PMABB), has been generating the Cerrado biome growth harvest using Landsat class satellite data for a complete survey of the region, with a minimum mapping of 1 hectare and employing an interpretation scale of 1: 75,000. From a reference map, natural areas (including savannas, rupestrian and forest formations) were mapped and converted to other uses in the years 2000-2002; 2002-2004; 2004-2006; 2006-2008 and 2008-2010.

The next stage involved a territorial cut of the relevant forest typologies. 23 phytophysiognomies were defined, including, the two most abundant being the Wooded Savannah (Sa) and the Submontane Semi Deciduous Seasonal Forest (Fs), which cover approximately 29% and 12% of the biome, respectively. The forest formations considered for the FREL Cerrado account for about 65% of the area of the biome; the remaining 35% are distributed in rupestrian and savannah formations, which are not included in the FREL Cerrado.

The emission factors for the FREL Cerrado were defined in the form of carbon in living biomass (above and belowground biomass) and dead organic matter (litter and dead wood), and are consistent with those adopted in the III Inventory. Regarding the gases included, the FREL Cerrado considered emissions of CO_2 and non-CO_2 gases. The premise adopted was that the biomass immediately after the conversion of forest to other categories of land use is zero, and did not consider any CO2 removal after conversion (considering only the gross emissions from deforestation).

Gross annual emissions from deforestation were estimated from the increased annual deforestation observed[2], as discussed in detail in section 4.1 and in the FREL Cerrado. The areas of polygons deforested in a given forest typology were multiplied by the corresponding emission factor, generating the total carbon quantity3 (in tons of carbon per hectare (tC ha^{-1}). Subsequently the amount of total carbon was multiplied by an equivalence factor of 44/12 to convert tonne of carbon into tonne of CO_2 (tCO_2 ha^{-1}). Calculations are also performed to estimate the emissions of non-CO_2, CH_4 and N_20 gases, with equivalence factors for each of these gases, in order to express them in CO_2eq. Then, for each year considered, estimates of CO_2eq emissions associated to each polygon were summed (see spreadsheets with emission estimates available at <http://redd.mma.gov.br/en/infohub>).

FREL Cerrado does not include future projections. It is based on historical deforestation data.

For emissions reductions results from 2011 to 2020, the FREL is the average annual CO_2eq emissions associated to gross deforestation in the period 2000 ta 2010, inclusive (see **FIGURE 2** and **TABLE 1**).

[2] Increased deforestation refers to the sum of the area of all deforestation polygons observed within a given geographic extent. In the submission of the FREL and also in this Technical Annex, increased deforestation refers to the sum of deforested areas observed in each satellite scene that covers the biome. The increase in deforestation may underestimate the total deforested area (and corresponding emissions), since it does not include the area of deforestation under clouds.

[3] Total carbon refers to the sum of carbon in above-ground biomass, below-ground biomass, litter and dead wood.

FIGURE 2: PICTORIAL REPRESENTATION OF BRAZIL'S FREL FOR THE CERRADO BIOME. THE CONTINUOUS LINE REFERS TO THE MEAN OF THE AVERAGE ANNUAL CO_2eq EMISSIONS FROM DEFORESTATION FROM 2000 TO 2010 (335,540,289 tCO_2eq year-1).

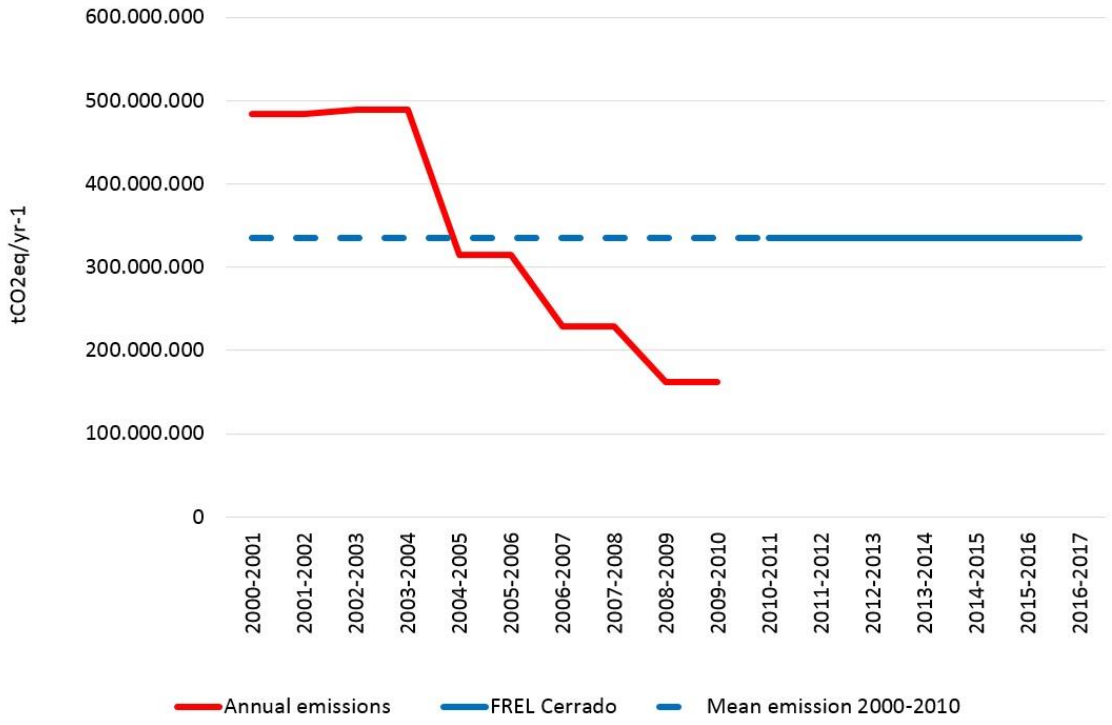


TABLE 1: ANNUAL INCREMENTS OF DEFORESTATION AND ASSOCIATED EMISSIONS IN THE CERRADO BIOME, FROM 2000 TO 2010.

Period	Average annual increments of deforestation (ha/yr)	Average annual CO_2 emissions from deforestation (tCO_2/yr)	Average annual CH_4 emissions from deforestation (tCO_2eq/yr)	Average annual N_2O emissions from deforestation (tCO_2eq/yr)	Total average annual emissions from deforestation (tCO_2eq/yr)
2000-2001	2,087,304	465,970,129	12,178,766	5,287,700	483,436,595
2001-2002	2,087,304	465,970,129	12,178,766	5,287,700	483,436,595
2002-2003	2,124,167	471,978,963	12,248,373	5,317,921	489,545,257
2003-2004	2,124,167	471,978,963	12,248,373	5,317,921	489,545,257
2004-2005	1,343,484	302,901,230	8,008,462	3,477,063	314,386,755
2005-2006	1,343,484	302,901,230	8,008,462	3,477,063	314,386,755
2006-2007	990,019	220,010,901	5,858,795	2,543,735	228,413,431
2007-2008	990,019	220,010,901	5,858,795	2,543,735	228,413,431
2008-2009	751,923	156,192,837	3,992,941	1,733,630	161,919,408
2009-2010	751,923	156,192,837	3,992,941	1,733,630	161,919,408

3. RESULTS IN TONNES OF CO_2eq PER YEAR, CONSISTENT WITH THE ASSESSED FOREST REFERENCE EMISSION LEVEL FOR THE CERRADO 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, 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".

The CO_2eq emissions from gross deforestation in the Cerrado biome in the period from 2000 to 2010, used in the construction of the Cerrado FREL, were estimated using the methodology presented in the previous section. For this Technical Annex, the results for the period from 2011 to 2017 were calculated by subtracting the mean annual CO_2eq emissions from forest reference emission level for the period from 2000-2010, totaling 335,540,289 tCO_2eq.

Hence, for year t in the period from 2011 to 2017, the emission reduction from deforestation was estimated as follows:

REDD+ (t) = FREL (2000-2010) – Total mean emissions at year t; (tCO_2eq)

For example, the emission reduction from deforestation in 2013 is equal to:

335,540,289 tCO_2eq – 192,977,260 tCO_2eq = 142,563,029 tCO_2eq

The total emission reduction from gross deforestation in the Cerrado biome, from 2011 to 2017, was equal to the sum of the emission reduction results achieved for each year in the period: **1,274,723,330 tCO_2eq** (**FIGURE 3** and TABLE **2**).

FIGURE 3. PICTORIAL REPRESENTATION OF BRAZIL'S REDD+ RESULTS ACHIEVED IN THE CERRADO BIOME, BASED ON THE MODIFIED VERSION OF FREL CERRADO.

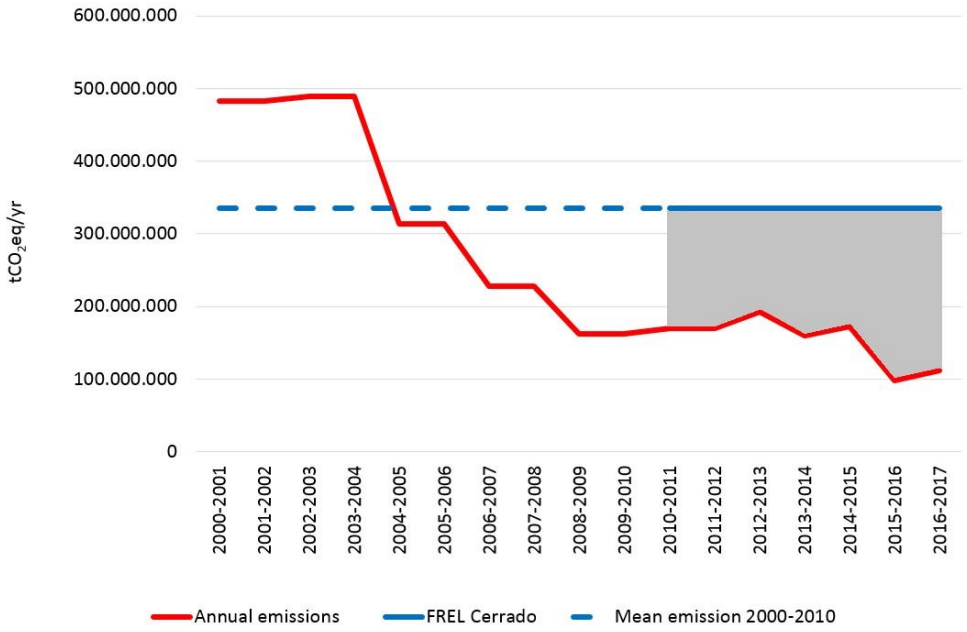


TABLE 2: AVERAGE ANNUAL EMISSIONS (TCO_2eq/yr) FROM 2000 TO 2017; FOREST REFERENCE EMISSION LEVEL USED TO ESTIMATE THE EMISSION REDUCTION RESULTS IN THE PERIOD 2011-2017 (TCO_2eq/yr); AND REDD+ RESULTS ACHIEVED (TCO_2eq/yr).

Period	Average annual increments of deforestation (ha/yr)	Average annual CO_2 emissions from deforestation (tCO_2/yr)	Average annual CH_4 emissions from deforestation (tCO_2eq/yr)	Average annual N_2O emissions from deforestation (tCO_2eq/yr)	Total average annual emissions from deforestation (tCO_2eq/yr)	FREL Cerrado (tCO_2eq/yr)	Annual REDD+ results 2011 - 2017 (tCO_2eq/yr)
2000-2001	2,087,304	465,970,129	12,178,766	5,287,700	483,436,595		
2001-2002	2,087,304	465,970,129	12,178,766	5,287,700	483,436,595		
2002-2003	2,124,167	471,978,963	12,248,373	5,317,921	489,545,257		
2003-2004	2,124,167	471,978,963	12,248,373	5,317,921	489,545,257		
2004-2005	1,343,484	302,901,230	8,008,462	3,477,063	314,386,755		
2005-2006	1,343,484	302,901,230	8,008,462	3,477,063	314,386,755		
2006-2007	990,019	220,010,901	5,858,795	2,543,735	228,413,431		
2007-2008	990,019	220,010,901	5,858,795	2,543,735	228,413,431		
2008-2009	751,923	156,192,837	3,992,941	1,733,630	161,919,408		
2009-2010	751,923	156,192,837	3,992,941	1,733,630	161,919,408		
2010-2011	780,329	170,077,706	122,172		170,199,878	335,540,289	**165,340,411**
2011-2012	780,329	170,077,706	122,172		170,199,878	335,540,289	**165,340,411**
2012-2013	1,012,529	192,663,414	304,879	8,967	192,977,260	335,540,289	**142,563,029**
2013-2014	763,679	159,504,096			159,504,096	335,540,289	**176,036,193**
2014-2015	884,988	171,624,991	271,089	7,973	171,904,054	335,540,289	**163,636,235**
2015-2016	514,511	97,706,934	154,202	4,535	97,865,671	335,540,289	**237,674,618**
2016-2017	571,616	111,225,004	177,627	5,224	111,407,856	335,540,289	**224,132,433**
Total of REDD+ achieved in the period 2011-2017 (tCO_2eq/yr)							**1,274,723,330**

4. DEMONSTRATION THAT THE METHODOLOGIES USED TO PRODUCE THE RESULTS ARE CONSISTENT WITH THOSE USED TO ESTABLISH THE FOREST REFERENCE EMISSION LEVEL

The methodology and data sets and information used for calculating the results presented herein are the same as the ones used in the construction of the **FREL Cerrado**, as demonstrated below:

4.1 ACTIVITY DATA

The area of each deforestation polygon with a certain forest physiognomy is the data needed to estimate the emissions from deforestation4, following the IPCC good practice guidance for LULUCF (IPCC, 2003).

Similar to the way the FREL Cerrado was calculated, the activity data used here to generate the results are derived from the PMABB, adapted to include only land use change in areas that used to be forests. The minimum mapping area of 1 hectare was maintained, obtained with resolution 1:75,000 during visual interpretation.

The vegetation map used to identify the forest phytophysiognomies affected by deforestation and the references used to generate the carbon estimates were the same as those used in the III National Inventory of Greenhouse Gases, submitted to the UNFCCC in May 2016, thus ensuring total consistency between the FREL Cerrado and the national inventory of greenhouse gases.

4.2 EMISSION FACTORS

The emissions factors used for the forest phytophysiognomies considered for the calculation of REDD+ results achieved in the Cerrado biome are the same used in the modified FREL Cerrado version and carbon map of the Third National Communication of Brazil to the UNFCCC.

4.3 CARBONS POOLS

The FREL Cerrado includes the following carbon pools: above and below-ground biomass, litter and dead wood. The Carbon Map of the Third National GHG Inventory mentioned in section 4.2 includes the carbon in the biomass of these four pools. The results presented in this Technical Annex maintain the same pools.

4.4 NON-CO_2 GASES

Consistent with the FREL Cerrado, this submission considered non-CO_2, C_H4 and N_2O gases. The decision to include these gases in the FREL Cerrado was made after an international assessment process, in which experts pointed out by the UNFCCC Secretariat recommended it and the REDD+ Workgroup accepted the suggestion.

[4] In most first order approaches, "activity data" are expressed in terms of land use area or land use change. The general guideline is to multiply the activity data by a carbon stock coefficient or "emission factor" to get to the estimates of sources/or sinks." (IPCC, 2003; section 3.1.4, page 3.15).

4.5 REDD+ ACTIVITIES

Like the FREL Cerrado, emissions estimates were calculated focusing on emissions from gross deforestation, and, therefore do not include emissions from other REDD+ activities.

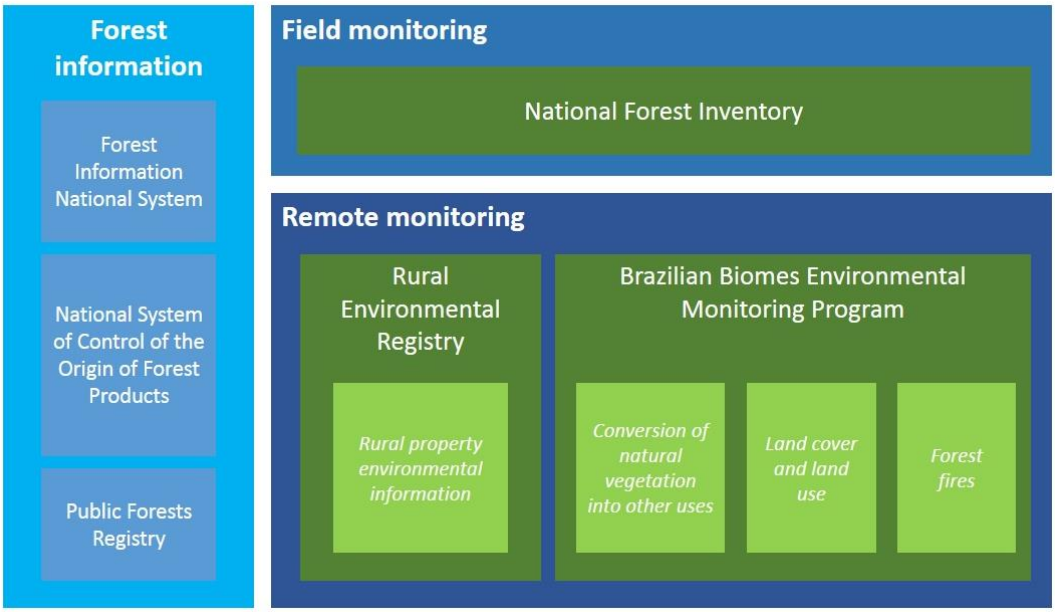
Brazil has been conducting internal discussions since 2015 within the framework of the REDD+ Workgroup on the treatment of forest degradation and how their respective emissions can be included in future submissions. Although there are monitoring initiatives that advance the production of information on forest degradation in the Amazon biome, the REDD+ Workgroup considers that the monitoring of this activity for the Cerrado biome is even more complex.

5. DESCRIPTION OF THE NATIONAL FOREST MONITORING SYSTEM AND INSTITUTIONAL ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING THE RESULTS

5.1 ARRANGEMENT OF BRAZIL'S NATIONAL FOREST MONITORING SYSTEM

Due to Brazil's extensive coverage of native vegetation and the dynamics of land use and occupation, the Brazilian Government has been implementing a series of systems to monitor these phenomena over the years. These systems, each with its own characteristics and purposes, make up a robust arrangement for monitoring and implementation of actions in the LULUCF sector. Figure 4 below presents the main systems that make up this arrangement.

FIGURE 4: IMPLEMENTATION ARRANGEMENT OF THE NATIONAL FOREST MONITORING SYSTEM.



As per Section 6 of the BUR, the systems presented above provide contributions to the implementation and monitoring of LULUCF's NAMAs, as well as the MRV process of REDD+ results, in addition to those intended to provide and organize forest information[5]. Further to what has been described in section 6 of the BUR, additional information is presented below about the initiatives that provide inputs directly related to the MRV of REDD+.

[5]*For further information:*
National Forest Information System: http://snif.florestal.gov.br/pt-br/
National System for the Control of the Origin of Forest Products: http://www.ibama.gov.br/
Public Forest Register: http://www.florestal.gov.br/cadastro-nacional-de-florestas-publicas

5.1.1 BRAZILIAN BIOMES ENVIRONMENTAL MONITORING PROGRAM (PMABB)

The Program seeks to promote joint actions, in coordination with various Federal Government agencies working with the satellite monitoring of land cover and use initiatives (such as Embrapa/MAPA, IBGE, IBAMA/MMA, INPE/MCTIC and research institutions), to harmonize as much as possible the various mappings of the Brazilian biomes, in various cartographical and time scales, according to the characteristics of each theme, to produce and make available harmonized, systematic and updated official information.

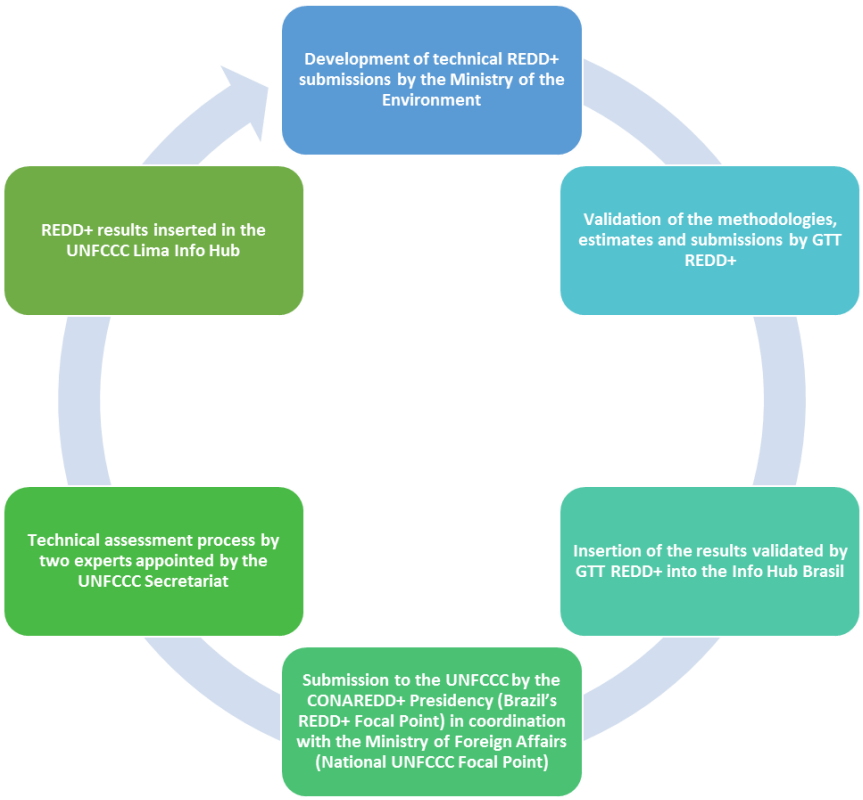
For the Amazon and Cerrado, the Program provides for the monitoring of past deforestation, to develop the definitions of reference levels of these biomes' greenhouse gas emissions. For the Amazon, the monitoring of land use in 1991, 2000, 2004 and 2008 was carried out recently and, for the Cerrado, the mapping of the historical deforestation series was completed every two years from 2000 to 2010, as well as annual data between 2012 and 2017 – which were the basis for the FREL Cerrado and for this Technical Annex on REDD+. The availability of deforestation data will also contribute to the control and management of authorizations to suppress natural vegetation, especially at the state level.

The monitoring of natural vegetation conversion, land cover and land use will be extended throughout Brazil, by the gradual and programmed extension of the program's area of activity. For extra-Amazonian Brazilian biomes, there is a need to expand monitoring initiatives, especially those related to deforestation and land cover and use. Such information will also support decision-making in actions to promote the conservation of Brazilian biodiversity and contribute to a strategic territorial management that combines the various interests on land use and allows the country's sustainable development.

5.2 ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING (MRV) REDD+ RESULTS

Figure 5 below presents the MRV process of REDD+ results in Brazil.

FIGURE 5: MRV FOR REDD+ IN BRAZIL.



Erro! Fonte de referência não encontrada. presents the institutions in charge of MRV for REDD+ in Brazil.

TABLE 3: ROLE AND INSTITUTIONAL RESPONSIBILITIES FOR REDD+ MRV IN BRAZIL.

MRV	INSTRUMENT	RESPONSIBLE INSTITUTION	ROLE	ADDITIONAL INFORMATION
MEASURING	GTT REDD+	Institution contracted to do the mapping and generating the results estimates	To map the deforestation polygons in the Cerrado biome, consistent with the methodologies used in the assessed FREL Cerrado; estimate the annual emissions, ensure consistency with the Third National GHG Inventory	http://www.funcate.org.br
		INPE/MCTIC	To carry out the quality assurance and quality control of the products generated by the contracted institution.	http://www.obt.inpe.br/prodes/index.php
	Executive Secretariat of the National REDD+ Committee (CONAREDD+)	MMA	To carry out quality control of the emission estimates produced by the contracted institution. To develop the submissions to the UNFCCC under the guidance of the GTT REDD+. To verify consistency with the FREL.	http://redd.mma.gov.br/en/the-national-redd-committee
REPORTING	Presidency of CONAREDD+ Focal point to the UNFCCC	MMA MRE	To Forward the REDD+ submission to the UNFCCC.	http://redd.mma.gov.br/en/the-national-redd-committee
	Info Hub Brasil	MMA	To compile and make available documentation needed for the recognition of the REDD+ results until its verification by the ICA and insertion in the Lima REDD+ Information Hub.	http://redd.mma.gov.br/en/infohub
VERIFYING	International Consultation and Analysis	UNFCCC	To verify the submission by Parties, indicating experts in Land use and Forestry (LULUCF) to evaluate the FREL submissions and technical annexes.	http://unfccc.int/methods/redd/redd_web_platform/items/4531.php
		MMA	To provide the clarification information requested by the experts in charge of the technical evaluation and verification of the consistency of results. To exchange with the experts indicated by the UNFCCC for the technical evaluation of the submission of the FREL and results.	

6. NECESSARY INFORMATION THAT ALLOWS FOR THE RECONSTRUCTION OF THE RESULTS

For REDD+ purposes, complete information means the provision of data that allows for the reconstruction of the FREL and the REDD+ results.

The links to the database and the information that allows for the reconstruction of the results are listed in Section b.1 of the FREL Cerrado. The data is listed below and can be accessed at Info Hub Brasil (http://redd.mma.gov.br/en/infohub).

1. **Satellite imagery from years 2000, 2002, 2004, 2006, 2008 and 2010** used to identify deforestation polygons in the Cerrado biome during 2000-2010.
2. **Reference map** containing accumulated deforestation in forest phytophysiognomies by 2000, inclusive.
3. **Maps containing deforestation polygons identified in each period** (2000-2002, 2002-2004, 2004-2006, 2006-2008, 2008-2010) from an analysis of images indicated in (1).

IMPORTANT NOTE 1: Maps listed under (2) and (3) are available in shapefile format, ready to be incorporated in a geographical database for analysis. Any individual deforestation polygon can be verified in relation to the corresponding satellite image.

4. **Database listing all deforested polygons in each period**, their area, forest phytophysiognomy, emission factors used for live biomass and dead organic matter reservoirs) and emissions associated with the polygon
5. **Carbon stock values per unit area** of different phytophysiognomies in the Cerrado biome, consistent with that used in III Inventory;
6. **Bibliographical references used to estimate carbon** in above and below-ground biomass; litter; and dead wood.

7. 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

The FREL Cerrado and this Technical Annex use the methodologies described in the IPCC Good Practice Guidance for LULUCF (IPCC, 2003) as a basis for estimating the changes in carbon stock in forested areas converted to other land uses. For any conversion occurring at a given year, the IPCC considers the carbon stock in the biomass immediately before and immediately after the conversion. Brazil only considers the loss of the carbon stock in the biomass present immediately before the conversion (gross emissions). Brazil applies the basic method for estimating emissions suggested by IPCC, i.e., emissions estimated as the product of activity data and emission factor.

7.2 ESTABLISH, ACCORDING TO NATIONAL CIRCUMSTANCES AND CAPABILITIES, ROBUST AND TRANSPARENT NATIONAL FOREST MONITORING SYSTEMS

The activity data used in the construction of the FREL Amazonia and FREL Cerrado for the calculation of the results presented on the Technical Annexes originated from initiatives in the scope of the Brazilian Biomes Environmental Monitoring Program. As described in Section 5.1, in a near future, the harmonization of land use/cover monitoring initiatives will allow the regular production of emission data from deforestation in the Caatinga, Atlantic Forest, Pantanal and Pampas biomes.

Field data will also be available through the National Forest Inventory that will certainly enhance the quality of the forest carbon estimates. Both initiatives are of great importance to the advancement of the forest agenda in Brazil and are instrumental for the establishment of robust and transparent forest monitoring systems at the national level.

APPENDIX I

HISTORICAL TIME SERIES OF GREENHOUSE GAS EMISSIONS

CO_2

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Energy	169,985	175,607	179,327	185,011	193,669	208,832	224,595	239,097	248,685	260,220	267,057	276,281	273,578	267,928	282,615	291,019	296,083	309,501	328,441	316,368	348,883	363,372	394,632	423,565	445,059	420,313
Burning of Fossil Fuels	162,431	168,246	171,882	177,435	185,665	201,318	216,774	230,493	239,222	250,097	256,320	264,560	262,360	256,729	271,775	277,142	283,201	296,032	314,234	297,934	333,669	349,252	379,871	406,931	427,417	402,709
Energy Subsector	21,271	20,860	22,802	22,867	23,841	25,281	27,799	31,218	32,221	39,121	40,484	44,838	39,777	39,450	45,372	47,400	47,967	47,494	58,435	47,617	58,859	53,744	69,386	88,457	102,511	96,252
Industrial Subsector	35,558	37,042	37,612	38,308	39,443	42,776	47,601	50,482	51,352	54,785	58,419	57,515	57,852	55,628	56,346	59,551	60,174	66,089	66,230	63,276	68,977	73,712	71,261	72,307	72,508	68,978
Steel Industry	4,436	4,606	4,905	5,154	5,423	5,388	5,352	5,201	4,594	4,302	4,657	4,510	4,759	4,891	4,975	5,526	5,491	6,012	5,811	4,543	5,642	5,482	5,639	5,552	5,671	5,601
Chemical Industry	8,606	8,811	9,080	8,578	9,114	10,057	11,493	13,352	12,343	13,547	13,938	13,926	14,157	13,503	14,320	14,479	14,880	15,598	14,283	14,446	13,847	14,479	14,011	13,528	12,868	13,188
Other Industries	22,516	23,625	23,627	24,576	24,906	27,331	30,756	31,929	34,415	36,936	39,824	39,079	38,936	37,234	37,051	39,546	39,803	44,479	46,136	44,287	49,488	53,751	51,611	53,227	53,969	50,189
Transport Subsector	79,338	83,405	83,708	86,899	91,283	100,457	107,864	114,496	121,389	120,217	121,748	124,867	128,029	127,081	135,200	135,991	140,648	146,421	151,984	150,448	168,598	184,788	201,605	208,223	213,670	198,857
Air Transport	4,232	4,606	3,854	4,180	4,446	4,732	4,509	5,324	5,857	6,017	6,206	6,626	6,677	5,871	6,193	6,316	6,563	7,220	7,325	8,330	9,751	10,863	11,218	10,978	11,344	11,696
Road Transport	70,094	73,931	74,786	77,159	82,058	90,916	97,772	105,030	111,067	109,634	111,337	113,548	115,889	116,036	123,083	123,519	127,773	131,881	136,953	134,811	151,497	166,726	183,199	190,075	194,611	181,257
Other Transport	5,012	4,868	5,068	5,560	4,779	4,809	5,583	4,142	4,465	4,566	4,205	4,693	5,463	5,174	5,924	6,156	6,312	7,320	7,706	7,307	7,350	7,199	7,188	7,170	7,715	5,904
Residential Subsector	13,842	14,220	14,717	15,257	15,239	15,942	16,598	16,619	16,760	17,095	17,179	17,247	16,675	15,532	15,863	15,591	15,616	16,123	16,530	16,738	17,249	17,487	17,598	17,994	18,002	18,021
Agriculture Subsector	9,846	10,272	10,569	11,676	12,332	13,222	13,803	14,342	13,824	14,496	14,152	15,579	15,207	15,291	15,075	14,964	15,162	16,096	17,478	16,790	17,348	16,816	17,490	17,520	18,225	18,370
Other Sectors	2,576	2,447	2,474	2,428	3,527	3,640	3,109	3,336	3,676	4,383	4,338	4,514	4,820	3,747	3,919	3,645	3,634	3,809	3,577	3,065	2,638	2,705	2,531	2,430	2,501	2,231
Fugitive Emissions	7,554	7,361	7,445	7,576	8,004	7,514	7,821	8,604	9,463	10,123	10,737	11,721	11,218	11,199	10,840	13,877	12,882	13,469	14,207	18,434	15,214	14,120	14,761	16,634	17,642	17,604
Coal Mining	1,353	1,316	1,200	1,247	1,348	920	654	902	1,004	1,150	1,291	1,936	1,151	1,208	1,429	1,381	1,246	1,510	1,658	1,758	1,846	1,506	1,372	2,006	1,901	1,822
Extraction and Transportation of Oil and Natural Gas	6,201	6,045	6,245	6,329	6,656	6,594	7,167	7,702	8,459	8,973	9,446	9,785	10,067	9,991	9,411	12,496	11,636	11,959	12,549	16,676	13,368	12,614	13,389	14,628	15,741	15,782
Industrial Processes	43,551	49,037	47,440	50,584	51,277	54,373	57,767	60,268	61,490	60,214	64,314	61,836	64,282	64,956	67,118	65,750	65,238	71,166	73,490	64,844	80,786	87,398	87,870	88,089	86,822	84,212
Cement Production	11,062	11,776	9,770	10,164	10,086	11,528	13,884	15,267	16,175	16,439	16,047	15,227	14,390	13,096	13,273	14,349	15,440	17,200	18,884	19,031	21,288	22,845	24,998	26,652	26,308	23,767
Lime Production	3,688	3,755	3,948	4,241	4,098	4,104	4,248	4,338	4,141	4,352	5,008	4,811	4,956	5,064	5,505	5,356	5,410	5,666	5,690	5,060	5,950	6,337	6,403	6,486	6,278	6,392
Ammonia Production	1,683	1,478	1,516	1,684	1,689	1,785	1,754	1,829	1,718	1,943	1,663	1,396	1,567	1,690	1,934	1,922	1,968	1,866	1,811	1,576	1,739	1,995	1,758	1,805	1,805	1,805
Iron and Steel Production	21,601	26,118	26,417	28,048	29,153	29,886	30,418	31,756	32,272	30,313	34,052	33,403	35,788	36,700	37,574	35,349	33,916	37,136	37,440	29,828	38,360	42,885	41,455	40,430	41,076	42,284
Ferroalloy Production	116	119	197	191	178	202	223	167	562	451	512	575	534	922	938	932	942	1,080	1,142	1,018	1,195	1,070	1,044	957	891	800
Production on Non-Ferrous Metals except Aluminium	897	857	803	1,518	1,279	1,749	2,109	1,378	1,127	1,217	1,462	1,319	1,436	1,622	1,685	1,749	1,798	2,003	1,778	1,882	4,332	5,949	5,857	5,636	5,544	4,665
Aluminium Production	1,574	1,901	2,011	1,946	1,955	1,965	1,981	1,975	2,007	2,079	2,116	1,879	2,176	2,198	2,408	2,472	2,646	2,739	2,753	2,544	2,543	2,375	2,378	2,156	1,589	1,281
Other Industries	2,930	3,033	2,778	2,792	2,839	3,154	3,150	3,558	3,488	3,420	3,454	3,226	3,435	3,664	3,801	3,621	3,118	3,476	3,992	3,905	5,379	3,942	3,977	3,967	3,331	3,218
Land-Use, Land Use Change and Forestry	756,970	616,425	761,554	821,046	821,387	1,837,508	1,191,467	898,942	1,145,470	1,137,736	1,197,175	1,192,787	1,401,764	2,311,652	2,501,327	1,797,842	1,399,630	1,193,617	1,294,043	379,257	310,736	247,427	215,312	348,643	198,723	293,093
Land Use Change	751,867	611,706	754,774	812,396	812,396	1,832,113	1,184,596	891,436	1,138,370	1,131,002	1,188,458	1,184,833	1,391,958	2,300,008	2,489,746	1,790,368	1,392,216	1,183,866	1,283,495	370,862	300,312	234,512	200,349	333,070	182,498	279,611
Application of Limestone to Soils	5,103	4,719	6,780	8,650	8,991	5,395	6,871	7,506	7,100	6,734	8,717	7,954	9,806	11,644	11,581	7,474	7,414	9,751	10,548	8,395	10,424	12,915	14,963	15,573	16,225	13,482
Waste	19.0	31.0	54.0	61.0	66.0	78.0	78.0	78.0	84.0	88.0	95.0	95.0	99.0	117.0	120.0	128.0	136.0	155.0	159.0	168.0	175.0	186.0	195.0	204.0	213.0	222.0
TOTAL	970,525	841,100	988,375	1,056,702	1,066,399	2,100,791	1,473,907	1,198,385	1,455,729	1,458,258	1,528,641	1,530,999	1,739,723	2,644,653	2,851,180	2,154,739	1,761,087	1,574,439	1,696,133	760,637	740,580	698,383	698,009	860,501	730,817	797,840
For information purposes only																										
Bunker fuels	6,086	5,584	6,239	6,914	7,298	8,667	10,077	10,835	12,105	13,881	13,639	15,545	15,823	14,094	14,362	14,766	15,150	16,347	19,998	15,461	18,550	20,076	19,049	17,834	18,133	20,091
Air transport	4,366	3,147	3,610	3,619	3,539	4,520	5,541	5,911	6,621	5,397	4,626	5,388	4,381	4,035	4,303	4,707	4,543	4,936	5,675	5,167	5,784	6,410	6,896	6,972	7,006	6,816
Shipping	1,720	2,437	2,629	3,295	3,759	4,147	4,536	4,924	5,484	8,484	9,013	10,157	11,442	10,059	10,059	10,059	10,607	11,411	14,323	10,294	12,766	13,666	12,153	10,862	11,127	13,275
Biomass CO_2 emissions	166,035	166,454	165,295	163,296	173,888	168,791	171,036	177,229	177,266	180,877	166,435	174,763	190,567	207,531	219,888	228,295	242,178	263,113	285,378	281,439	302,848	287,410	290,772	303,834	312,226	324,299

CH_4

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Energy	610.0	621.2	608.4	571.0	570.5	556.0	553.9	570.0	578.4	582.8	588.9	616.6	645.2	644.2	676.4	751.9	707.1	690.3	691.4	736.1	683.0	645.6	660.9	673.9	696.6	688.1
Burning of Fossil Fuels	519.5	526.7	523.4	482.3	484.7	470.5	478.6	483.9	484.2	480.6	469.9	477.4	513.4	536.4	542.6	545.7	537.8	521.1	518.5	496.1	502.1	481.7	486.8	457.4	472.9	465.7
Energy Subsector	25.6	24.7	23.0	23.3	24.4	23.1	22.5	23.4	21.1	21.4	20.8	20.7	22.3	25.8	28.4	29.2	29.9	32.6	36.7	30.3	34.6	32.1	33.1	36.3	37.7	38.6
Industrial Subsector	15.7	14.8	15.3	15.5	17.7	18.1	19.2	19.3	20.5	21.8	19.9	22.1	23.9	26.0	27.9	28.4	31.7	32.9	32.9	31.9	34.3	35.4	36.1	35.3	33.8	32.5
Steel Industry	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2
Other Industries	15.5	14.6	15.1	15.3	17.5	17.9	19.0	19.1	20.4	21.6	19.7	21.9	23.7	25.8	27.7	28.2	31.5	32.7	32.7	31.7	34.0	35.2	35.9	35.1	33.6	32.3
Transport Subsector	136.7	148.9	149.3	148.5	156.1	168.2	181.0	182.5	179.0	166.2	152.6	146.8	146.4	150.1	146.6	141.5	127.7	124.0	119.9	112.1	120.8	132.6	137.5	133.5	133.5	117.1
Residential Subsector	318.4	316.8	316.9	277.4	269.4	243.7	238.6	241.5	247.2	255.3	261.5	272.8	304.9	316.7	321.1	327.6	329.0	311.1	307.1	300.8	290.1	259.7	258.4	229.0	244.2	252.9
Other Sectors	23.1	21.5	18.9	17.6	17.1	17.4	17.3	17.2	16.4	15.9	15.1	15.0	15.9	17.8	18.6	19.0	19.5	20.5	21.9	21.0	22.3	21.9	21.7	23.3	23.7	24.6
Fugitive Emissions	90.5	94.5	85.0	88.7	85.8	85.5	75.3	86.1	94.2	102.2	119.0	139.2	131.8	107.8	133.8	206.2	169.3	169.2	172.9	240.0	180.9	163.9	174.1	216.5	223.7	222.4
Coal Mining	49.7	54.3	44.2	47.0	42.4	41.1	25.5	32.6	33.0	34.0	43.3	60.0	44.0	41.0	48.0	49.1	48.3	54.9	58.6	52.3	39.2	43.4	41.0	60.1	54.2	51.5
Extraction and Transportation of Oil and Natural Gas	40.8	40.2	40.8	41.7	43.4	44.4	49.8	53.5	61.2	68.2	75.7	79.2	87.8	66.8	85.8	157.1	121.0	114.3	114.3	187.7	141.7	120.5	133.1	156.4	169.5	170.9
Industrial Processes	47.1	42.1	39.6	43.0	44.2	41.1	37.9	38.2	36.0	40.0	43.7	40.0	41.4	47.8	55.5	54.9	56.4	58.3	56.4	39.2	45.3	47.2	44.0	41.6	41.0	40.7
Chemical Industry	5.2	5.2	5.4	6.0	6.6	6.6	6.6	7.4	7.9	8.3	9.0	8.6	8.3	8.9	9.3	9.4	12.4	12.7	11.5	11.9	11.8	13.2	11.4	11.9	11.9	11.9
Metals Production	41.9	36.9	34.2	37.0	37.6	34.5	31.3	30.8	28.1	31.7	34.7	31.4	33.1	38.9	46.2	45.5	44.0	45.6	44.9	27.3	33.5	34.0	32.6	29.7	29.1	28.8
Agriculture	9,185.6	9,474.1	9,639.0	9,681.3	9,865.1	10,058.2	9,742.2	9,887.9	9,963.9	10,111.9	10,382.3	10,757.6	11,121.3	11,666.8	12,195.7	12,357.7	12,293.0	11,707.1	11,955.4	12,166.2	12,415.6	12,660.4	12,511.7	12,613.8	12,692.0	12,887.5
Enteric Fermentation	8,223.9	8,470.3	8,596.8	8,625.8	8,786.7	8,957.1	8,738.7	8,899.2	8,979.5	9,057.6	9,349.5	9,713.3	10,050.1	10,574.9	11,049.3	11,213.8	11,162.0	10,573.0	10,730.3	10,908.0	11,158.0	11,362.6	11,287.7	11,383.9	11,440.8	11,620.1
Cattle	7,808.9	8,049.5	8,175.2	8,218.7	8,370.5	8,534.3	8,413.3	8,572.9	8,650.5	8,722.2	9,005.8	9,368.0	9,708.9	10,228.3	10,698.6	10,855.7	10,801.9	10,220.4	10,376.3	10,555.6	10,798.4	10,996.1	10,934.5	11,027.3	11,079.9	11,247.8
Dairy Cattle	1,197.7	1,245.1	1,279.3	1,258.3	1,262.8	1,297.1	1,081.0	1,123.9	1,136.7	1,143.1	1,177.9	1,206.7	1,236.6	1,268.8	1,320.5	1,371.4	1,396.3	1,296.8	1,331.4	1,384.6	1,424.0	1,457.5	1,435.1	1,461.4	1,475.9	1,410.2
Beef Cattle	6,611.2	6,804.4	6,895.9	6,960.4	7,107.7	7,237.2	7,332.3	7,449.0	7,513.8	7,579.1	7,827.9	8,161.3	8,472.3	8,959.5	9,378.1	9,484.3	9,405.6	8,923.6	9,044.9	9,171.0	9,374.4	9,538.6	9,499.4	9,565.9	9,604.0	9,837.6
Other Animals	415.0	420.8	421.6	407.1	416.2	422.8	325.4	326.3	329.0	335.4	343.7	345.3	341.2	346.6	350.7	358.1	360.1	352.6	354.0	352.4	359.6	366.5	353.2	356.6	360.9	372.3
Manure Management	421.6	435.5	443.0	447.1	457.9	471.6	431.0	442.3	448.8	461.1	479.7	500.5	500.6	519.6	533.0	543.9	545.6	558.0	575.4	593.3	608.1	618.6	610.9	603.1	616.2	632.4
Cattle	191.2	197.6	200.4	201.2	204.6	208.7	200.3	204.7	207.0	209.0	215.9	224.4	223.6	235.9	248.5	254.0	252.9	245.3	249.0	253.4	258.7	263.0	261.0	262.0	263.1	265.6
Dairy Cattle	35.9	37.5	38.4	37.7	37.6	38.5	31.1	32.6	33.0	33.2	34.1	34.7	35.5	36.4	38.5	39.7	40.4	40.6	41.5	43.1	44.0	44.6	43.7	43.9	44.2	41.9
Beef Cattle	155.3	160.1	162.0	163.5	167.0	170.2	169.2	172.1	174.0	175.8	181.8	189.7	188.1	199.5	210.0	214.3	212.5	204.7	207.5	210.3	214.7	218.4	217.3	218.1	218.9	223.7
Swine	159.5	161.8	161.9	164.4	169.4	173.7	146.4	149.1	152.2	158.6	166.5	174.5	176.7	180.5	178.4	178.7	179.8	188.5	196.0	207.2	214.9	218.4	215.9	205.8	212.1	227.1
Poultry	48.4	53.3	57.8	59.2	61.3	66.3	65.9	69.9	70.9	74.6	78.1	82.4	81.2	83.8	86.6	91.5	93.2	104.9	111.2	113.7	115.3	117.8	115.3	116.4	121.9	120.2
Other Animals	22.5	22.8	22.9	22.3	22.6	22.9	18.4	18.6	18.7	18.9	19.2	19.2	19.1	19.4	19.5	19.7	19.7	19.3	19.2	19.0	19.2	19.4	18.7	18.9	19.1	19.5
Rice Cultivation	433.6	462.9	490.8	511.9	505.8	510.8	456.0	430.3	416.2	479.9	448.1	431.7	451.4	440.6	477.3	463.7	438.8	423.5	474.2	486.0	464.2	503.6	448.3	451.5	462.5	462.5
Burning of Agricultural Waste	106.5	105.4	108.4	96.5	114.7	118.7	116.5	116.1	119.4	113.3	105.0	112.1	119.2	131.7	136.1	136.3	146.6	152.6	175.5	178.9	185.3	175.6	164.8	175.3	172.5	172.5
Land-Use, Land Use Change and Forestry	1,041.5	959.3	1,153.3	1,222.4	1,213.2	2,895.7	2,016.2	1,657.1	1,984.3	1,979.1	2,048.8	2,048.4	2,321.9	3,898.7	4,148.9	3,237.9	2,565.3	2,324.4	2,441.7	1,221.3	1,135.5	1,046.6	1,080.0	1,254.5	1,033.4	1,144.8
Waste	1,249.1	1,297.1	1,350.1	1,396.5	1,446.1	1,506.3	1,560.5	1,622.0	1,681.1	1,749.2	1,809.1	1,855.6	1,933.8	2,009.0	2,055.2	2,124.1	2,185.3	2,232.0	2,260.8	2,312.4	2,402.5	2,554.2	2,590.4	2,793.1	2,844.3	2,860.8
Solid Waste	898.9	929.4	961.9	992.5	1,023.6	1,052.9	1,084.3	1,117.4	1,147.3	1,177.3	1,204.3	1,233.6	1,266.1	1,295.3	1,280.1	1,299.2	1,316.8	1,291.3	1,249.8	1,234.2	1,268.5	1,349.3	1,382.2	1,500.9	1,484.6	1,493.4
Effluents	350.2	367.7	388.2	404.0	422.5	453.4	476.2	504.6	533.8	571.9	604.8	622.0	667.7	713.7	775.1	824.9	868.5	940.7	1,011.0	1,078.2	1,134.0	1,204.9	1,208.2	1,292.2	1,359.7	1,367.4
Industrial	82.6	94.0	107.8	116.4	126.9	149.1	162.3	178.0	193.3	216.4	233.1	238.0	271.1	304.2	352.2	388.3	417.8	475.6	530.4	581.7	621.2	687.7	686.8	751.8	814.6	817.8
Domestic	267.6	273.7	280.4	287.6	295.6	304.3	313.9	326.6	340.5	355.5	371.7	384.0	396.6	409.5	422.9	436.6	450.7	465.1	480.6	496.5	512.8	517.2	521.4	540.4	545.1	549.6
TOTAL	12,133.3	12,393.8	12,790.4	12,914.2	13,139.1	15,057.3	13,910.7	13,775.2	14,243.7	14,463.0	14,872.8	15,318.2	16,063.6	18,266.5	19,131.7	18,526.5	17,807.1	17,012.1	17,405.7	16,475.2	16,681.9	16,954.0	16,887.0	17,376.9	17,307.3	17,621.9
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Bunker fuels	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.2
Air transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shipping	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.2

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Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Energy	12.62	12.68	12.62	12.54	13.90	15.25	17.35	19.71	21.32	22.21	22.41	23.77	25.66	27.46	29.17	30.17	30.47	31.95	33.47	32.75	37.10	40.51	44.07	46.17	49.08	47.24
Fuels Combustion	12.56	12.63	12.56	12.48	13.84	15.19	17.28	19.64	21.24	22.12	22.30	23.66	25.54	27.34	29.06	29.96	30.31	31.80	33.30	32.46	36.89	40.33	43.91	45.97	48.85	47.00
Industrial Subsector	2.54	2.53	2.59	2.65	2.97	2.97	3.02	3.15	3.42	3.60	3.33	3.60	3.82	4.07	4.33	4.42	4.90	5.18	5.19	5.27	5.73	5.74	5.88	5.86	5.69	5.56
Transport Subsector	2.28	2.47	2.54	2.67	3.64	5.35	7.45	9.48	11.08	11.62	12.09	12.98	14.12	15.06	16.06	16.67	16.40	17.36	18.12	18.30	21.59	25.73	28.94	30.69	33.25	31.30
Other Sectors	7.74	7.63	7.43	7.16	7.23	6.87	6.81	7.01	6.74	6.90	6.88	7.08	7.60	8.21	8.67	8.87	9.01	9.26	9.99	8.89	9.57	8.86	9.09	9.42	9.91	10.14
Fugitive Emissions	0.06	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.09	0.11	0.11	0.12	0.12	0.11	0.21	0.16	0.15	0.17	0.29	0.21	0.18	0.16	0.20	0.23	0.24
Industrial Processes	11.83	14.56	13.60	17.28	17.47	18.57	14.67	13.17	20.07	20.02	21.09	17.33	21.44	19.90	27.42	24.22	26.12	4.36	3.70	1.96	2.15	2.19	1.86	1.81	2.02	1.86
Chemical Industry	10.69	13.46	12.55	16.14	16.31	17.45	13.62	12.12	19.07	18.98	19.94	16.25	20.29	18.62	25.99	22.83	24.78	2.94	2.28	1.01	0.93	0.93	0.63	0.66	0.88	0.71
Nitric Acid Production	1.81	1.93	1.89	2.00	2.01	2.05	2.07	2.12	2.06	2.06	2.09	2.06	2.14	2.14	2.21	2.24	2.20	2.07	1.58	0.79	0.80	0.75	0.51	0.52	0.52	0.51
Adipic Acid Production	8.63	11.25	10.41	13.84	13.99	15.08	11.22	9.66	16.75	16.62	17.51	13.90	17.80	16.19	23.48	20.29	22.31	0.57	0.37	0.14	0.13	0.18	0.12	0.14	0.36	0.20
Other Productions	0.25	0.28	0.25	0.30	0.31	0.32	0.33	0.34	0.26	0.30	0.34	0.29	0.35	0.29	0.30	0.30	0.27	0.30	0.33	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Metals Production	1.14	1.10	1.05	1.14	1.16	1.12	1.05	1.05	1.00	1.04	1.15	1.08	1.15	1.28	1.43	1.39	1.34	1.42	1.42	0.95	1.22	1.26	1.23	1.15	1.14	1.15
Agriculture	303.54	311.30	320.00	323.49	334.67	340.16	318.98	329.47	337.23	339.71	355.93	366.75	382.26	412.38	419.86	428.97	433.03	445.43	448.06	453.87	472.08	494.38	491.10	503.48	513.49	510.54
Manure Management	10.03	10.58	10.93	10.92	11.21	11.49	10.62	10.89	10.87	11.16	11.49	11.88	11.80	12.16	11.29	12.82	12.93	13.70	14.31	14.65	14.83	15.16	14.95	14.95	15.52	15.52
Cattle	2.90	2.96	3.00	3.01	3.04	3.07	2.83	2.89	2.92	2.93	2.98	3.05	3.13	3.22	2.13	3.29	3.29	3.27	3.33	3.40	3.46	3.53	3.51	3.55	3.53	3.53
Swine	2.43	2.48	2.49	2.43	2.48	2.54	1.95	1.97	1.99	2.04	2.06	2.11	2.03	2.04	2.13	2.17	2.20	2.22	2.24	2.30	2.35	2.36	2.32	2.22	2.29	2.29
Poultry	4.40	4.83	5.13	5.18	5.39	5.58	5.60	5.79	5.72	5.95	6.20	6.47	6.40	6.65	6.78	7.11	7.19	7.97	8.50	8.71	8.78	9.02	8.88	8.94	9.46	9.46
Other Animals	0.30	0.31	0.31	0.30	0.30	0.30	0.24	0.24	0.24	0.24	0.25	0.25	0.24	0.25	0.25	0.25	0.25	0.24	0.24	0.24	0.24	0.25	0.24	0.24	0.24	0.24
Agricultural Soils	290.75	297.99	306.26	310.07	320.49	325.59	305.34	315.57	323.27	325.61	341.72	351.96	367.37	396.81	405.04	412.62	416.30	427.77	429.20	434.58	452.45	474.67	471.88	483.99	493.50	490.55
Direct Emissions	184.07	188.19	193.71	195.06	201.60	205.28	191.67	198.00	202.19	204.21	213.85	221.03	230.01	247.99	253.43	257.09	259.54	266.16	269.13	271.45	282.31	294.97	292.69	300.98	306.42	307.74
Animals on Pasture	129.73	133.73	135.65	135.36	137.50	140.20	130.03	132.95	134.44	135.85	140.12	144.62	150.82	158.19	164.86	167.45	166.82	162.37	164.36	166.83	170.24	172.59	170.44	170.89	171.68	172.84
Synthetic Fertilizers	9.81	9.79	10.94	12.52	14.74	14.27	14.98	16.23	18.06	17.16	21.28	20.70	23.09	27.95	28.31	27.51	28.83	34.64	31.33	32.11	35.74	42.14	43.70	46.26	48.19	44.31
Animal Manure and Vinasse	14.90	15.31	15.77	15.64	15.87	16.40	14.76	15.30	15.56	15.65	15.88	16.00	16.12	16.64	15.44	17.81	18.14	18.94	20.15	21.30	21.33	21.88	21.01	20.85	21.92	22.43
Agricultural Residue	15.32	14.99	16.92	17.05	18.94	19.80	17.23	18.79	19.34	20.70	21.66	24.74	24.95	30.12	29.67	29.11	30.48	34.88	37.90	35.76	39.49	42.79	41.91	47.29	48.88	52.35
Organic Soils	14.31	14.37	14.43	14.49	14.55	14.61	14.67	14.73	14.79	14.85	14.91	14.97	15.03	15.09	15.15	15.21	15.27	15.33	15.39	15.45	15.51	15.57	15.63	15.69	15.75	15.81
Indirect Emissions	106.68	109.80	112.55	115.01	118.89	120.31	113.67	117.57	121.08	121.40	127.87	130.93	137.36	148.82	151.61	155.53	156.76	161.61	160.07	163.13	170.14	179.70	179.19	183.01	187.08	182.81
Burning of Agricultural Waste	2.76	2.73	2.81	2.50	2.97	3.08	3.02	3.01	3.09	2.94	2.72	2.91	3.09	3.41	3.53	3.53	3.80	3.96	4.55	4.64	4.80	4.55	4.27	4.54	4.47	4.47
Land-Use, Land Use Change and Forestry	42.56	41.18	47.09	49.08	48.71	106.98	80.69	70.31	80.06	79.95	81.96	81.99	90.07	144.95	152.41	125.25	105.16	97.90	101.45	51.66	47.08	44.26	45.23	50.63	43.89	47.33
Waste	4.34	4.43	4.53	4.63	4.73	4.83	4.93	5.12	5.33	5.54	5.68	5.79	6.08	6.38	6.49	6.61	6.72	6.83	6.96	7.08	7.21	7.27	7.33	7.60	7.66	7.73
TOTAL	374.89	384.15	397.84	407.02	419.48	485.79	436.62	437.78	464.01	467.43	487.07	495.63	525.51	611.07	635.35	615.22	601.50	586.47	593.64	547.32	565.62	588.61	589.59	609.69	616.14	614.70
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Bunker fuels	0.14	0.11	0.13	0.13	0.14	0.17	0.20	0.22	0.25	0.25	0.24	0.27	0.26	0.23	0.23	0.24	0.25	0.27	0.32	0.27	0.31	0.31	0.32	0.32	0.31	0.33
Air transport	0.12	0.09	0.10	0.10	0.10	0.13	0.15	0.16	0.18	0.15	0.13	0.15	0.13	0.12	0.12	0.13	0.13	0.14	0.16	0.15	0.17	0.18	0.20	0.20	0.20	0.19
Shipping	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.10	0.11	0.12	0.13	0.11	0.11	0.11	0.12	0.13	0.16	0.12	0.14	0.13	0.12	0.12	0.11	0.14

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Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Energy	14,744.7	15,475.6	15,349.5	15,155.0	15,512.4	15,682.2	16,183.4	15,953.7	15,376.7	14,387.9	13,250.3	12,589.9	12,483.3	12,431.0	12,249.9	11,792.8	10,881.9	10,608.5	10,408.4	9,522.9	10,051.2	10,231.3	10,242.1	9,928.4	9,970.2	9,291.6
Burning of Fossil Fuels	14,744.7	15,475.6	15,349.5	15,155.0	15,512.4	15,682.2	16,183.4	15,953.7	15,376.7	14,387.9	13,250.3	12,589.9	12,483.3	12,431.0	12,249.9	11,792.8	10,881.9	10,608.5	10,408.4	9,522.9	10,051.2	10,231.3	10,242.1	9,928.4	9,970.2	9,291.6
Energy Subsector	1,402.4	1,308.2	1,215.1	1,250.3	1,292.7	1,208.7	1,149.1	1,171.6	1,065.3	1,099.2	1,104.7	1,083.8	1,149.0	1,347.9	1,499.3	1,528.7	1,536.7	1,653.7	1,779.1	1,415.0	1,620.1	1,570.2	1,587.8	1,665.0	1,713.4	1,745.1
Industrial Subsector	758.1	749.5	735.6	792.2	837.7	815.1	858.3	852.2	916.2	998.9	1,036.8	1,035.1	1,059.6	1,160.2	1,223.3	1,283.5	1,363.3	1,448.5	1,541.4	1,558.8	1,708.8	1,770.6	1,760.7	1,839.8	1,915.9	1,929.8
Steel Industry	2.5	2.7	2.8	4.0	3.2	3.2	4.8	6.4	6.2	7.1	8.2	7.3	8.7	9.8	11.0	11.4	11.5	12.2	12.3	9.5	11.4	10.8	10.7	10.2	9.8	9.3
Food and Beverage	182.3	185.7	170.6	172.0	178.1	175.8	179.7	179.3	186.7	191.9	187.5	189.8	191.8	192.5	200.3	204.8	214.8	223.8	230.5	236.8	260.9	263.6	268.2	262.0	256.1	247.1
Other industries	573.3	561.1	562.2	616.2	656.4	636.1	673.8	666.5	723.3	799.9	841.1	838.0	859.1	957.9	1,012.0	1,067.3	1,137.0	1,212.5	1,298.6	1,312.5	1,436.5	1,496.2	1,481.8	1,567.6	1,650.0	1,673.4
Transport Subsector	11,050.6	11,893.9	11,884.7	11,768.2	12,072.4	12,465.0	13,007.6	12,747.4	12,193.0	11,052.3	9,845.1	9,153.4	8,814.4	8,400.0	7,981.5	7,404.8	6,399.4	5,992.8	5,579.1	5,065.8	5,288.3	5,592.7	5,600.3	5,260.3	5,099.1	4,333.4
Road Transport	11,004.1	11,849.7	11,844.3	11,723.5	12,024.6	12,419.1	12,958.3	12,697.0	12,138.8	11,000.3	9,793.5	9,102.7	8,764.5	8,353.6	7,931.6	7,356.6	6,352.2	5,941.8	5,524.4	5,010.7	5,228.8	5,532.4	5,536.9	5,196.8	5,034.3	4,279.1
Other Transports	46.5	44.2	40.4	44.7	47.8	45.9	49.3	50.4	54.2	52.0	51.6	50.7	49.9	46.4	49.9	48.2	47.2	51.0	54.7	55.1	59.5	60.3	63.4	63.5	64.8	54.3
Residential Subsector	1,443.2	1,433.6	1,427.2	1,254.8	1,218.4	1,098.7	1,072.1	1,084.7	1,107.6	1,142.1	1,172.3	1,221.8	1,361.6	1,418.9	1,439.1	1,468.4	1,472.8	1,397.7	1,382.2	1,361.6	1,306.7	1,173.4	1,167.1	1,031.9	1,106.2	1,143.2
Other sectors	90.4	90.4	86.9	89.5	91.2	94.7	96.3	97.8	94.6	95.4	91.4	95.8	98.7	104.0	106.7	107.4	109.7	115.8	126.6	121.7	127.3	124.4	126.2	131.4	135.6	140.1
Industrial Processes	900.8	810.4	759.8	819.3	834.0	777.5	714.0	706.3	651.9	722.6	788.1	721.3	761.3	884.0	1,034.9	1,019.6	994.4	1,034.8	1,024.8	663.6	809.6	825.0	795.1	735.1	719.7	717.4
Iron and Steel Production	775.0	669.2	628.1	686.0	708.1	655.9	577.1	602.5	557.1	622.3	674.4	635.8	660.1	743.0	885.7	864.9	833.9	862.8	846.8	506.3	633.2	659.0	630.8	576.0	566.1	572.5
Ferroalloy Production	60.8	81.9	69.6	84.2	73.6	64.1	97.2	65.2	54.9	60.8	72.4	44.6	56.4	90.1	94.8	96.7	97.6	104.5	106.7	82.5	96.7	86.6	84.9	79.7	74.2	66.7
Production of Non-Ferrous Metals	44.4	36.1	36.2	21.8	22.8	27.5	8.4	6.5	5.6	2.4	3.1	3.0	3.5	3.9	4.1	4.2	4.5	4.8	4.8	4.6	4.9	6.0	6.5	6.5	6.7	5.6
Other productions	20.6	23.2	25.9	27.3	29.5	30.0	31.3	32.1	34.3	37.1	38.2	37.9	41.3	47.0	50.3	53.8	58.4	62.7	66.5	70.2	74.8	73.4	72.9	72.9	72.7	72.6
Agriculture	3,627.6	3,590.2	3,696.5	3,289.4	3,908.1	4,045.8	3,968.2	3,957.5	4,067.1	3,861.7	3,576.4	3,818.0	4,060.8	4,485.9	4,637.8	4,644.4	4,996.6	5,198.4	5,980.4	6,095.2	6,313.5	5,984.4	5,616.9	5,973.4	5,876.4	5,876.4
Burning of cotton crop residues	128.4	114.8	80.0	31.9	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sugarcane burning	3,499.2	3,475.4	3,616.5	3,257.5	3,891.3	4,045.8	3,968.2	3,957.5	4,067.1	3,861.7	3,576.4	3,818.0	4,060.8	4,485.9	4,637.8	4,644.4	4,996.6	5,198.4	5,980.4	6,095.2	6,313.5	5,984.4	5,616.9	5,973.4	5,876.4	5,876.4
Land-Use, Land Use Change and Forestry	18,429.4	17,390.4	20,397.4	21,446.1	21,286.6	48,855.6	35,319.7	29,864.8	34,894.5	34,821.8	35,879.9	35,881.7	40,075.6	65,971.8	69,818.3	55,810.0	45,459.9	41,737.2	43,552.8	21,977.9	20,231.4	18,828.9	19,337.7	22,063.4	18,634.2	20,370.8
TOTAL	37,702.5	37,266.6	40,203.2	40,709.8	41,541.1	69,361.1	56,185.3	50,482.3	54,990.2	53,794.0	53,494.7	53,010.9	57,381.0	83,772.7	87,740.9	73,266.8	62,332.8	58,578.9	60,966.4	38,259.6	37,405.7	35,869.6	35,991.8	38,700.3	35,200.5	36,256.2
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Bunker fuels	1.9	1.2	1.4	1.6	1.5	2.2	3.0	3.6	4.4	4.8	5.5	5.8	5.8	5.1	5.4	5.5	5.4	5.6	6.8	5.9	6.5	4.4	4.2	5.4	4.7	5.6
Air transport	0.9	0.6	0.7	0.7	0.7	0.9	1.1	1.1	1.3	1.1	0.9	1.1	0.9	0.8	1.1	1.2	1.0	0.9	1.2	1.0	1.1	1.2	1.3	1.3	1.3	1.3
Shipping	1.0	0.6	0.7	0.9	0.8	1.3	1.9	2.5	3.1	3.7	4.6	4.7	4.9	4.3	4.3	4.3	4.4	4.7	5.6	4.9	5.4	3.2	2.9	4.1	3.4	4.3

NOx

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Energy	1,029.8	1,099.1	1,134.8	1,182.3	1,233.4	1,309.3	1,421.5	1,460.7	1,466.5	1,492.4	1,433.3	1,444.9	1,406.7	1,424.6	1,469.7	1,491.8	1,476.0	1,531.7	1,625.6	1,553.9	1,625.4	1,668.9	1,781.1	1,865.4	1,967.1	1,815.7
Burning of Fossil Fuels	1,029.8	1,099.1	1,134.8	1,182.3	1,233.4	1,309.3	1,421.5	1,460.7	1,466.5	1,492.4	1,433.3	1,444.9	1,406.7	1,424.6	1,469.7	1,491.8	1,476.0	1,531.7	1,625.6	1,553.9	1,625.4	1,668.9	1,781.1	1,865.4	1,967.1	1,815.7
Energy Subsector	218.1	229.7	248.5	251.3	258.6	269.1	291.6	335.1	344.1	391.5	400.7	422.7	388.8	422.0	456.4	486.9	497.9	507.7	592.8	564.4	583.6	589.9	682.9	774.0	850.5	794.8
Industrial Subsector	134.8	138.4	140.9	146.1	159.5	169.3	179.7	192.3	200.3	216.8	221.5	221.7	225.9	228.0	234.9	241.9	254.1	276.8	270.4	269.8	287.2	301.2	301.4	306.3	304.7	293.9
Steel Industry	10.4	11.1	12.3	12.9	13.3	12.3	10.7	11.5	10.4	10.4	11.1	10.5	10.8	10.6	10.6	12.1	11.8	11.9	11.4	9.8	12.0	11.9	12.3	11.9	12.2	11.5
Other industries	124.4	127.3	128.6	133.2	146.2	157.0	169.0	180.8	189.9	206.4	210.4	211.2	215.1	217.4	224.3	229.8	242.3	264.9	259.0	260.0	275.2	289.3	289.1	294.4	292.5	282.4
Transport Subsector	525.6	574.9	586.6	614.8	635.2	682.5	757.4	733.5	726.6	679.8	612.9	587.2	578.5	561.7	566.3	553.3	511.7	524.3	518.5	482.6	511.3	541.0	552.4	541.4	556.8	466.5
Road Transport	408.4	460.7	468.4	483.9	520.2	567.4	622.0	631.8	616.8	567.5	510.8	474.0	451.9	443.0	430.8	413.1	369.9	357.9	340.9	312.8	338.4	371.1	383.0	372.5	372.6	326.8
Other Transports	117.2	114.2	118.2	130.9	115.0	115.1	135.4	101.7	109.8	112.3	102.1	113.2	126.6	118.7	135.5	140.2	141.8	166.4	177.6	169.8	172.9	169.9	169.4	168.9	184.2	139.7
Residential Subsector	29.2	29.3	29.6	27.8	27.4	26.3	26.5	26.8	27.2	27.9	28.5	29.2	30.6	30.6	31.1	31.3	31.3	30.8	31.0	30.9	30.6	29.1	29.1	27.6	28.7	29.1
Other sectors	122.1	126.8	129.2	142.3	152.7	162.1	166.3	173.0	168.3	176.4	169.7	184.1	182.9	182.3	181.0	178.4	181.0	192.1	212.9	206.2	212.7	207.7	215.3	216.1	226.4	231.4
Industrial Processes	42.1	42.5	41.8	47.7	51.1	50.7	53.5	58.4	65.5	72.5	79.1	77.2	84.7	98.9	105.4	106.0	106.5	114.5	117.7	98.4	100.8	107.1	104.1	100.1	102.8	102.2
Production of Metals	36.0	35.8	34.3	39.7	42.5	42.0	44.5	49.2	55.7	61.9	68.2	66.4	73.0	85.7	91.3	90.9	90.2	97.1	99.1	78.8	80.1	86.7	83.6	79.7	82.4	81.9
Other productions	6.1	6.7	7.5	8.0	8.6	8.7	9.0	9.2	9.8	10.6	10.9	10.8	11.7	13.2	14.1	15.1	16.3	17.4	18.6	19.6	20.7	20.4	20.5	20.4	20.4	20.3
Agriculture	98.6	97.5	100.5	89.4	106.2	109.9	107.8	107.5	110.5	104.9	97.2	103.8	110.3	121.9	126.0	126.2	135.8	141.3	162.5	165.6	171.6	162.6	152.6	162.3	159.7	159.7
Burning of cotton crop residues	3.5	3.1	2.2	0.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sugarcane burning	95.1	94.4	98.3	88.5	105.7	109.9	107.8	107.5	110.5	104.9	97.2	103.8	110.3	121.9	126.0	126.2	135.8	141.3	162.5	165.6	171.6	162.6	152.6	162.3	159.7	159.7
Land-Use, Land Use Change and Forestry	526.7	531.9	582.2	597.6	593.1	1,196.0	979.2	898.9	978.8	978.6	993.8	994.7	1,060.5	1,631.8	1,692.9	1,470.3	1,304.5	1,243.5	1,273.8	659.0	589.9	563.9	571.6	619.2	561.8	591.6
TOTAL	1,697.2	1,771.0	1,859.3	1,917.0	1,983.8	2,665.9	2,562.0	2,525.5	2,621.3	2,648.4	2,603.4	2,620.6	2,662.2	3,277.2	3,394.0	3,194.3	3,022.8	3,031.0	3,179.6	2,476.9	2,487.7	2,502.5	2,609.4	2,747.0	2,791.4	2,669.2
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Bunker fuels	12.5	8.1	8.8	11.0	9.6	16.1	22.5	28.8	35.2	41.9	51.4	53.1	55.1	48.9	49.0	49.1	49.9	53.3	63.6	55.2	61.6	38.2	35.2	47.8	40.0	49.6
Air transport	1.3	0.9	1.0	1.1	1.0	1.3	1.6	1.7	1.9	1.6	1.4	1.6	1.3	1.2	1.3	1.4	1.4	1.5	1.7	1.6	1.8	2.0	2.1	2.1	2.1	2.1
Shipping	11.2	7.2	7.8	9.9	8.6	14.8	20.9	27.1	33.3	40.3	50.0	51.5	53.8	47.7	47.7	47.7	48.5	51.8	61.9	53.6	59.8	36.2	33.1	45.7	37.9	47.5

NMVOC

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Energy	1,471.1	1,502.1	1,476.8	1,458.9	1,484.8	1,486.2	1,503.6	1,495.3	1,452.3	1,402.3	1,342.2	1,298.3	1,321.5	1,350.9	1,373.7	1,339.2	1,253.2	1,233.6	1,213.0	1,055.7	1,113.9	1,151.1	1,154.4	1,097.4	1,100.3	1,026.6
Burning of Fossil Fuels	1,471.1	1,502.1	1,476.8	1,458.9	1,484.8	1,486.2	1,503.6	1,495.3	1,452.3	1,402.3	1,342.2	1,298.3	1,321.5	1,350.9	1,373.7	1,339.2	1,253.2	1,233.6	1,213.0	1,055.7	1,113.9	1,151.1	1,154.4	1,097.4	1,100.3	1,026.6
Energy Subsector	337.6	299.9	276.0	289.2	293.9	271.6	243.9	238.1	216.8	232.7	249.6	234.3	245.3	287.8	330.9	329.1	323.0	333.0	337.8	228.4	251.8	263.5	255.3	239.0	237.1	235.3
Industrial Subsector	31.2	30.8	29.7	29.8	31.7	31.2	30.5	30.2	33.5	38.8	41.7	43.5	42.9	44.7	46.1	48.6	52.5	56.9	59.7	58.9	66.3	69.7	68.9	70.5	68.6	66.1
Steel Industry	1.1	1.2	1.2	1.3	1.3	1.3	1.2	1.3	1.3	1.2	1.2	1.2	1.2	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.6	1.7	1.7	1.6	1.6	1.5
Food and Beverage	9.2	9.4	8.9	8.9	9.4	9.2	9.4	9.4	9.9	10.2	9.7	10.0	10.3	10.4	10.9	11.1	11.9	12.6	12.8	13.2	14.5	14.6	15.0	14.7	14.2	13.7
Other industries	20.9	20.2	19.6	19.6	21.0	20.7	19.9	19.5	22.3	27.4	30.8	32.3	31.4	32.9	33.8	36.1	39.2	42.9	45.5	44.4	50.2	53.4	52.2	54.2	52.8	50.9
Transport Subsector	844.9	915.8	918.5	912.6	936.8	977.6	1,027.1	1,022.6	995.5	919.0	836.2	797.0	787.2	761.2	734.9	694.9	609.4	584.1	553.9	512.3	545.5	588.9	601.8	576.9	571.0	494.0
Road Transport	838.3	909.3	912.0	905.5	930.6	971.3	1,020.2	1,016.9	989.2	912.7	830.0	790.3	779.4	753.9	726.6	686.7	601.0	574.9	544.1	503.0	535.8	579.3	592.1	567.2	560.8	485.5
Other Transports	6.6	6.5	6.5	7.1	6.2	6.3	6.9	5.7	6.3	6.3	6.2	6.7	7.8	7.3	8.3	8.2	8.4	9.2	9.8	9.3	9.7	9.6	9.7	9.7	10.2	8.5
Residential Subsector	216.5	215.1	214.1	188.3	182.8	164.9	160.9	162.8	166.2	171.4	175.9	183.3	204.3	212.9	215.9	220.3	221.0	209.7	207.4	204.3	196.1	176.1	175.1	154.9	166.0	171.6
Other sectors	40.9	40.5	38.5	39.0	39.6	40.9	41.2	41.6	40.3	40.4	38.8	40.2	41.8	44.3	45.9	46.3	47.3	49.9	54.2	51.8	54.2	52.9	53.3	56.1	57.6	59.6
Industrial Processes	345.0	340.9	347.7	369.4	370.7	426.1	437.0	456.8	463.0	506.6	532.1	501.1	541.4	589.9	628.7	615.8	745.1	694.6	723.5	717.4	736.8	734.8	734.0	732.3	732.1	732.1
Chemical industry	26.6	24.8	24.7	27.8	30.6	31.4	31.4	33.7	35.0	37.5	43.0	40.7	42.3	45.3	49.1	49.1	53.9	56.3	56.6	59.5	61.2	59.4	59.4	59.4	59.4	59.4
Production of Metals	24.3	22.5	21.2	22.9	23.3	21.9	20.3	20.4	19.0	20.5	22.6	20.8	22.1	25.2	29.0	28.3	27.4	28.8	28.4	18.4	23.0	23.7	23.0	21.3	21.1	21.1
Pulp and paper	13.3	14.9	16.7	17.5	19.0	19.2	20.2	20.8	22.0	23.9	24.6	24.5	26.6	30.4	32.3	34.8	37.7	40.5	43.0	45.5	48.5	47.6	47.5	47.5	47.5	47.5
Food production	110.5	115.1	128.2	137.5	140.9	179.7	188.2	202.0	204.0	238.8	252.8	223.1	255.5	291.3	317.4	338.8	331.0	374.8	386.6	386.8	407.2	407.2	407.2	407.2	407.2	407.2
Production of beverages	170.3	163.6	156.9	163.7	156.9	173.9	176.9	179.9	183.0	185.9	189.1	192.0	194.9	197.7	200.9	164.8	295.1	194.2	208.9	207.2	196.9	196.9	196.9	196.9	196.9	196.9
Use of Solvents	50,049.7	44,308.2	56,612.1	49,560.5	55,789.8	59,392.2	61,304.6	63,694.9	84,787.4	67,289.2	78,597.4	66,374.6	80,756.5	60,208.1	75,050.1	80,582.2	108,803.9	100,287.5	121,651.7	112,728.4	152,514.6	129,148.0	129,247.4	134,081.1	155,882.6	98,236.7
TOTAL	51,865.8	46,151.2	58,436.6	51,388.8	57,645.3	61,304.5	63,245.2	65,647.0	86,702.7	69,198.1	80,471.7	68,174.0	82,619.4	62,148.9	77,052.5	82,537.2	110,802.2	102,215.7	123,588.2	114,501.5	154,365.3	131,033.9	131,135.8	135,910.8	157,715.0	99,995.4
For information purposes only																										
Bunker fuels	2.9	4.4	4.7	5.9	6.8	7.3	7.9	8.3	9.1	14.4	14.9	17.1	19.2	16.9	16.9	16.9	17.9	19.3	24.2	17.1	21.4	24.0	21.3	18.5	19.3	22.8
Air transport	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Shipping	2.7	4.2	4.5	5.7	6.6	7.1	7.6	8.0	8.8	14.1	14.7	16.8	19.0	16.7	16.7	16.7	17.7	19.1	24.0	16.9	21.2	23.8	21.1	18.3	19.1	22.6

CF_4

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Production of aluminium	0.3022	0.3365	0.3565	0.3348	0.3231	0.3060	0.2976	0.2027	0.2276	0.2013	0.1465	0.1147	0.1351	0.1362	0.1241	0.1239	0.1219	0.1174	0.1145	0.0823	0.0767	0.0631	0.0655	0.0569	0.0416	0.0333
TOTAL	0.3022	0.3365	0.3565	0.3348	0.3231	0.3060	0.2976	0.2027	0.2276	0.2013	0.1465	0.1147	0.1351	0.1362	0.1241	0.1239	0.1219	0.1174	0.1145	0.0823	0.0767	0.0631	0.0655	0.0569	0.0416	0.0333

C_2F_6

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Production of aluminium	0.0263	0.0290	0.0311	0.0290	0.0279	0.0264	0.0261	0.0157	0.0172	0.0154	0.0117	0.0092	0.0117	0.0115	0.0100	0.0104	0.0104	0.0099	0.0096	0.0064	0.0059	0.0049	0.0050	0.0044	0.0032	0.0025
TOTAL	0.0263	0.0290	0.0311	0.0290	0.0279	0.0264	0.0261	0.0157	0.0172	0.0154	0.0117	0.0092	0.0117	0.0115	0.0100	0.0104	0.0104	0.0099	0.0096	0.0064	0.0059	0.0049	0.0050	0.0044	0.0032	0.0025

HFC-23

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Production of HCFC-22	0.1202	0.1375	0.1636	0.1723	0.1566	0.1530	0.0890	0.0953	0.0130	0.0972	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0.1202	0.1375	0.1636	0.1723	0.1566	0.1530	0.0890	0.0953	0.0130	0.0972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

HFC-32

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Use of HFCs, PFCs and SF_6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0718	0.0420	0.0872	0.1059	0.1138	0.1286	0.1434	0.1582	0.1730
TOTAL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0718	0.0420	0.0872	0.1059	0.1138	0.1286	0.1434	0.1582	0.1730

HFC-125

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Use of HFCs, PFCs and SF_6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0071	0.0392	0.0508	0.0548	0.1207	0.1249	0.2517	0.2850	0.3021	0.3587	0.5012	0.4359	0.4795	0.5231	0.5667	0.6103
TOTAL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0071	0.0392	0.0508	0.0548	0.1207	0.1249	0.2517	0.2850	0.3021	0.3587	0.5012	0.4359	0.4795	0.5231	0.5667	0.6103

HFC-143a

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Use of HFCs, PFCs and SF_6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0075	0.0271	0.0398	0.0500	0.1037	0.0929	0.2157	0.2520	0.3074	0.3209	0.4671	0.4331	0.4767	0.5203	0.5639	0.6075
TOTAL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0075	0.0271	0.0398	0.0500	0.1037	0.0929	0.2157	0.2520	0.3074	0.3209	0.4671	0.4331	0.4767	0.5203	0.5639	0.6075

HFC-152a

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Use of HFCs, PFCs and SF_6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0295	0.0081	0.0238	0.0543	0.1748	0.2800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0295	0.0081	0.0238	0.0543	0.1748	0.2800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

HFC-134a

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Use of HFCs, PFCs and SF_6	0.0004	0.0009	0.0042	0.0080	0.0685	0.0028	0.0471	0.1641	0.2804	0.3803	0.4988	0.6310	0.7691	0.9056	1.0533	1.2279	1.4488	1.7220	2.0187	2.3359	2.7196	2.5860	2.8953	3.2220	3.5661	3.9276
TOTAL	0.0004	0.0009	0.0042	0.0080	0.0685	0.0028	0.0471	0.1641	0.2804	0.3803	0.4988	0.6310	0.7691	0.9056	1.0533	1.2279	1.4488	1.7220	2.0187	2.3359	2.7196	2.5860	2.8953	3.2220	3.5661	3.9276

SF_6

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
													Gg													
Production of magnesium	0.0058	0.0058	0.0070	0.0101	0.0099	0.0101	0.0097	0.0127	0.0101	0.0098	0.0103	0.0095	0.0122	0.0147	0.0170	0.0191	0.0216	0.0260	0.0260	0.0130	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Use of HFCs, PFCs and SF_6	0.0042	0.0040	0.0040	0.0040	0.0041	0.0041	0.0041	0.0042	0.0047	0.0049	0.0050	0.0051	0.0053	0.0056	0.0060	0.0061	0.0063	0.0064	0.0081	0.0075	0.0077	0.0080	0.0083	0.0086	0.0089	0.0092
TOTAL	0.0100	0.0098	0.0110	0.0141	0.0140	0.0142	0.0138	0.0169	0.0148	0.0147	0.0153	0.0146	0.0175	0.0203	0.0230	0.0252	0.0279	0.0324	0.0341	0.0205	0.0077	0.0080	0.0083	0.0086	0.0089	0.0092