Executive Summary

THIRD NATIONAL COMMUNICATION OF BRAZIL TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Executive Summary

THIRD NATIONAL COMMUNICATION OF BRAZIL TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

Ministry of Science, Technology and Innovation
Secretariat of Policies and Programs of Research and Development
General Coordination of Global Climate Change
Brasília
2016

FEDERATIVE REPUBLIC OF BRAZIL

PRESIDENT OF THE FEDERATIVE REPUBLIC OF BRAZIL

DILMA VANA ROUSSEFF

MINISTER OF SCIENCE, TECHNOLOGY AND INNOVATION

CELSO PANSERA

EXECUTIVE SECRETARY

EMÍLIA MARIA SILVA RIBEIRO CURI

SECRETARY OF POLICIES AND PROGRAMS OF RESEARCH AND DEVELOPMENT

JAILSON BITTENCOURT DE ANDRADE

GENERAL COORDINATOR OF GLOBAL CLIMATE CHANGE

MÁRCIO ROJAS DA CRUZ

MCTI TECHNICAL TEAM

DIRECTOR OF THE THIRD NATIONAL COMMUNICATION
MÁRCIO ROJAS DA CRUZ

COORDINATOR OF THE THIRD NATIONAL COMMUNICATION
MARCELA CRISTINA ROSAS ABOIM RAPOSO

TECHNICAL COORDINATOR OF THE THIRD BRAZILIAN INVENTORY OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES
EDUARDO DELGADO ASSAD

TECHNICAL COORDINATOR OF THE CLIMATE MODELS AND CLIMATE VULNERABILITIES AND ADAPTATION ON KEY-SECTOR STUDIES
JOSE ANTONIO MARENGO ORSINI

SUPERVISORS OF THE THIRD NATIONAL COMMUNICATION
BRENO SIMONINI TEIXEIRA
DANIELLY GODIVA SANTANA MOLLETA
MAURO MEIRELLES DE OLIVEIRA SANTOS

TECHNICAL ANALYSTS OF THE THIRD NATIONAL COMMUNICATION
CINTIA MARA MIRANDA DIAS
GISELLE PARNO GUIMARÃES
JULIANA SIMÕES SPERANZA
RENATA PATRICIA SOARES GRISOLI

TECHNICAL TEAM
ANDRÉA NASCIMENTO DE ARAÚJO
ANNA BEATRIZ DE ARAÚJO ALMEIDA
GUSTAVO LUEDEMANN
JERÔNIMA DE SOUZA DAMASCENO
LIDIANE ROCHA DE OLIVEIRA MELO
MOEMA VIEIRA GOMES CORRÊA
RICARDO ROCHA PAVAN DA SILVA
RICARDO VIEIRA ARAUJO
SANDERSON ALBERTO MEDEIROS LEITÃO
SONIA REGINA MUDROVITSCH DE BITTENCOURT
SUSANNA ERICA BUSCH
VICTOR BERNARDES

ASSISTANT OF THE THIRD NATIONAL COMMUNICATION
MARIA DO SOCORRO DA SILVA LIMA

ADMINISTRATIVE TEAM
ANA CAROLINA PINHEIRO DA SILVA
ANDRÉA ROBERTA DOS SANTOS CAMPOS
RICARDO MORÃO ALVES DA COSTA

TRANSLATION
MARIANE ARANTES ROCHA DE OLIVEIRA

MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION
ESPLANADA DOS MINISTÉRIOS, BLOCO E
PHONE: +55 (61) 2033-7923
WEB: http://www.mcti.gov.br
CEP: 70.067-900 – Brasília – DF

B823t Brazil. Ministry of Science, Technology and Innovation. Secretariat of Policies and Programs of Research and Development. General Coordination of Global Climate Change.

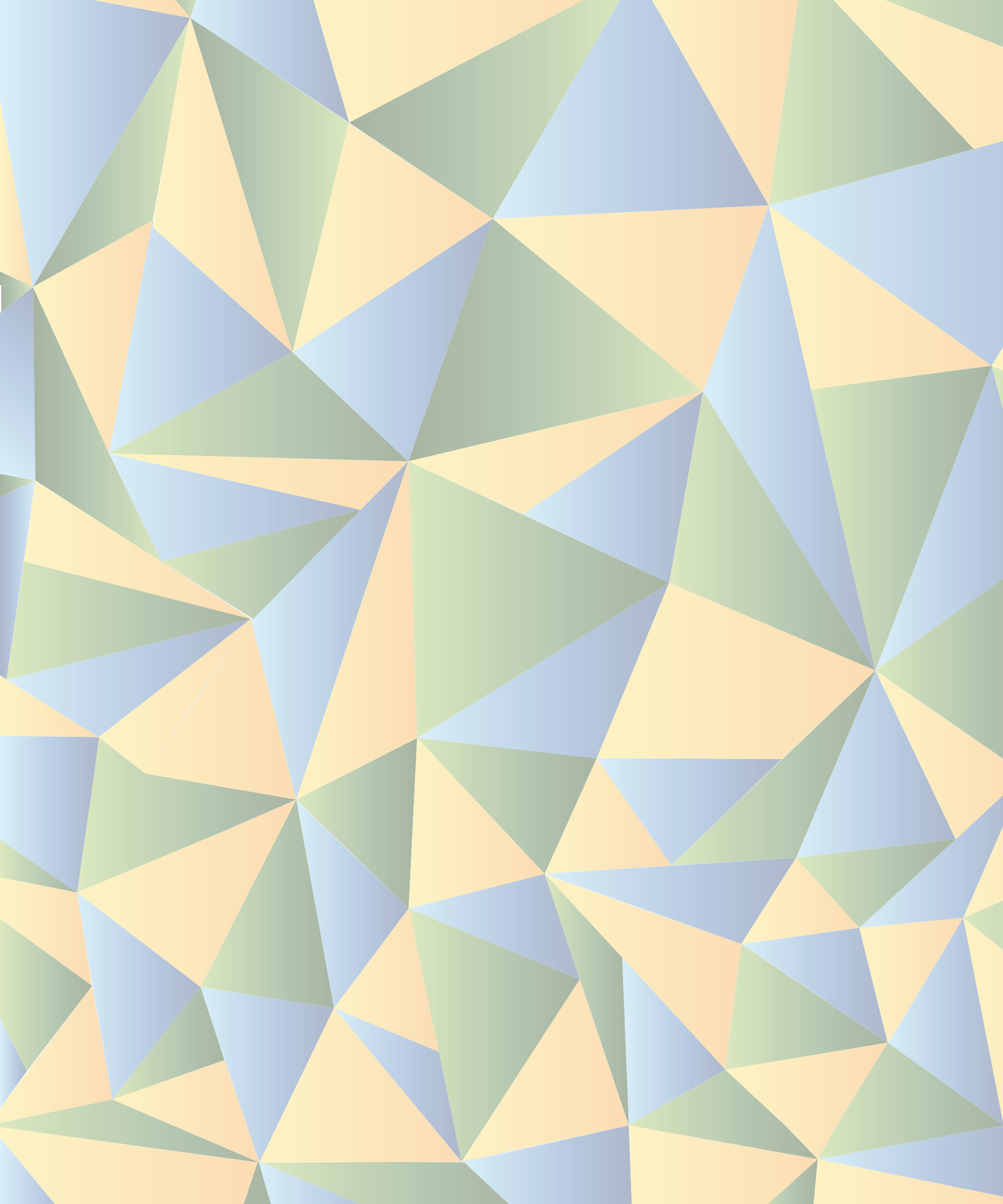
Third National Communication of Brazil to the United Nations Framework Convention on Climate Change – Executive Summary/ Ministry of Science, Technology and Innovation. Brasília: Ministério da Ciência, Tecnologia e Inovação, 2016.

42 p.: il.

ISBN: 978-85-88063-22-8

1. Climate Change. 2. UNFCCC. 3. National Communication. I. Title.

CDU 551.583



FOREWORD

FOREWORD

The Third National Communication of Brazil to the United Nations Framework Convention on Climate Change (UNFCCC) fulfills the country's commitment, as a Party to of the Convention, to prepare, update and provide the Conference of the Parties with national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHG) not controlled by the Montreal Protocol. Moreover, it presents scientific advances on the regional modeling of climate change and the current status of public policies toward GHG emissions and adaptation to climate change.

The first point to be highlighted in the methodology and content of this Communication is that Brazil has been making an unparalleled effort to contribute to the objectives of the Convention.

A vigorous national science and technology research program and field actions have been underway in order to reduce greenhouse gas emissions. Brazil passed an ambitious legislation that rules efficient procedures to deliver a reduction between 36.1% and 38.9% of projected emissions by 2020. Ahead of the legal obligations assumed by the most polluting industrialized countries, the National Policy on Climate Change stands out as one of the boldest and most promising voluntary programs to respond to the objectives of the Convention.

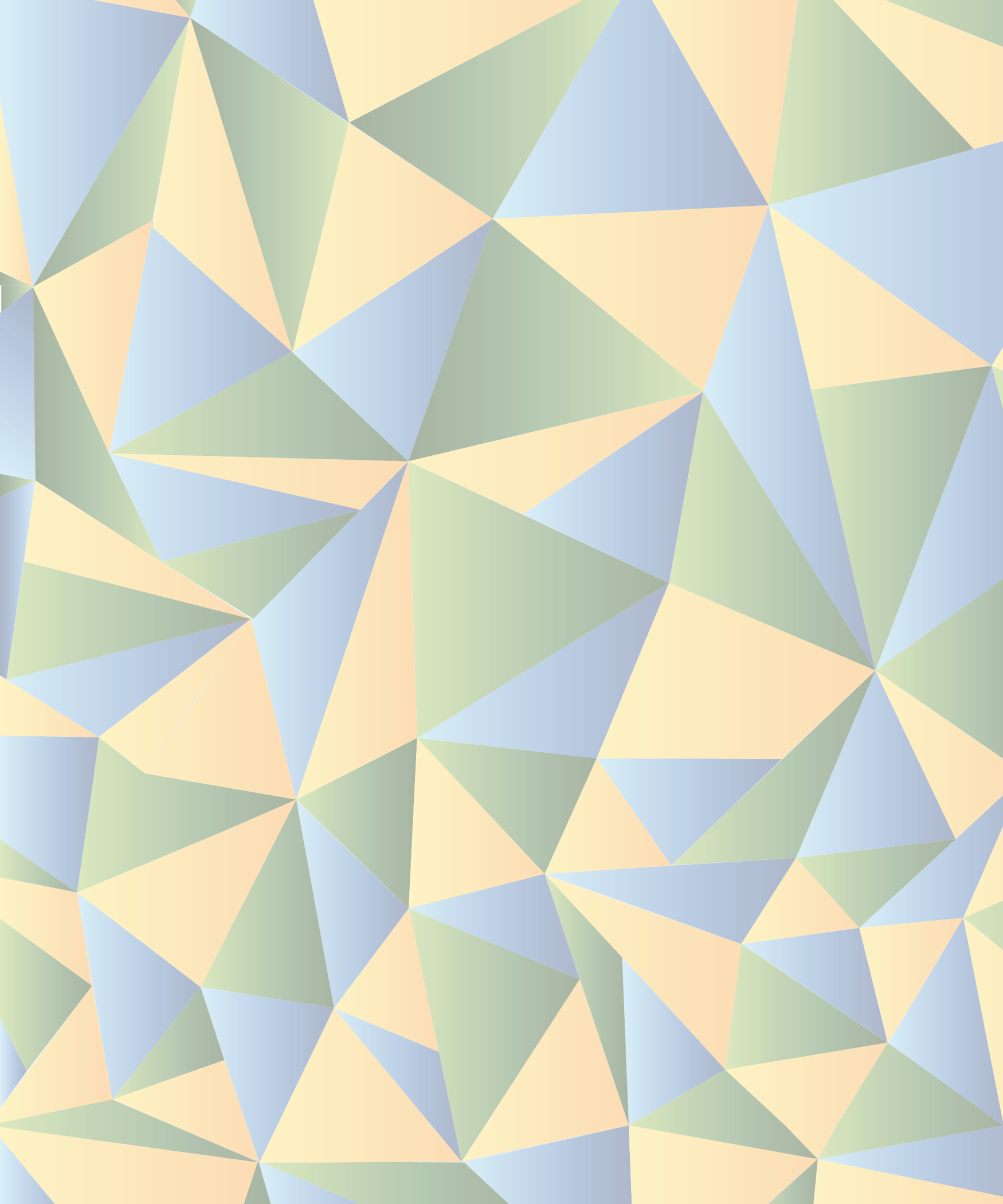
This Communication is a detailed and consistent survey of the Brazilian efforts to mitigate climate change while adapting its society's diversified production and consumption patterns along the way, in order to protect society, development and the environment. Actions are carried out in the recommended areas of land use and forestry, agricultural practices, power generation and use, industrial activities and waste treatment. Most indicators show very positive results in the reduction of greenhouse gas emissions, mainly carbon dioxide, between 2005 and 2010.

By means of these arrangements, Brazil is convinced that the promotion of the National Policy on Climate Change, established by Law, is positively compatible with economic growth and the task of simultaneously reducing greenhouse gas emissions, poverty and social inequalities.

By embracing its role, Brazil integrates cooperatively into the international movement on climate as a whole, reaffirms its tradition to strengthen multilateralism as the most suitable regime to tackle the challenges imposed to the international community, and contributes to a better understanding of the global problem and the progress of science. To that effect, Brazil will not waive its sovereignty and development, based on competitiveness, aiming at increasing the material and social well-being of its people and the protection of its ecosystems and natural resources.

CELSO PANSERA

Brazilian Minister of Science, Technology and Innovation



OVERVIEW

OVERVIEW

Climate change – human interference in earth system by changing the composition of the planet's atmosphere, adding to the natural climate variability – is proving a major challenge today. Brazil is not immune to climate change and may present significant socioeconomic and environmental vulnerability to it. It is therefore strategic and imperative that the possible impact of climate change, projected for this century and beyond is known for every sector, systems and regions of the country, especially on agriculture, water resources, renewable energy, human health, ecosystems and biodiversity, coastal zones and oceans, infrastructure, cities and industry. By knowing the main vulnerabilities, it is possible to elaborate and implement public policies to reduce them, and to increase the adaptive capacity of the population, the economy and the ecosystems.

Many and various have been the advances achieved at the frontiers of scientific knowledge in the last years. At the international level, the Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) is one good example, bringing a specific warning to Brazil: the increase of the risk of water shortage due to less rainfall and to more evapotranspiration in the semiarid regions, affecting water supply and power generation in cities, with impacts on agriculture as well — according to the report by the Working Group 2, which deals with impacts, adaptation and vulnerabilities.

At the national level, it is highlighted the National Assessment Report, of the Brazilian Panel on Climate Change (PBMC in the Portuguese acronym), which, also according to the Working Group 2, indicates that vulnerabilities associated with climate change in the northeastern semiarid region may affect water supply, regional subsistence and population health. The most vulnerable agents would be those with fewer resources and less adaptive capacity, and this will deepen the existing social problems in the region. Big cities in the country are also vulnerable to an increase in the occurrence of natural disasters caused by extreme weather events.

Achieving the purpose of the United Nations Framework Convention on Climate Change involves global policies to considerably reduce emissions and increase the removal by sinks of greenhouse gases, as reiterated strongly by COP21 results in December 2015 in Paris. Brazil has greatly contributed to achieving the primary objective in reducing future risk, emblematically advocated in the 2ºC maximum global temperature rise target and efforts not to exceed 1.5°C. Due to the significant fall in deforestation rates in the Amazon, Brazil has been managing to steadily reduce its emissions since mid-last decade, and has been implementing sectoral public policies – for instance, the Low Carbon Agriculture Plan – in order to guarantee compliance with its voluntary commitments by 2020. New challenges are imposed for the design of new national mitigation policies, as emission patterns have been rapidly changing towards a more relative contribution from the energy and agriculture sectors.

The global importance of climate change in the context of sustainable development requires a continued application of scientific knowledge about the phenomenon as well as mitigation and adaptation technologies. On that point important initiatives and contributions of bodies and entities related to the Ministry of Science, Technology and Innovation, ought to be recognized.

>> The Brazilian Network on Global Climate Change Research (*Rede CLIMA*), which, at the national level, involves dozens of research groups in universities and institutes throughout the country. Its scientific focus covers all relevant issues on climate change, notably: i) the scientific basis of climate change: detection and assignment of causes; understanding of the natural variability versus human-induced climate change; hydrological cycle and global biogeochemical cycles and aerosols; modeling capacity of the climate system; ii) impact, adaptation and vulnerability studies for relevant systems and sectors: agriculture and forestry, water resources, biodiversity and ecosystems, coastal zones, cities, economy, renewable energy, health; and iii) development of knowledge and technologies to mitigate climate change. It is currently addressing the integrative scientific themes such as climate change and food, water and energy safety; human health, cities and natural disasters.

>> The Center for Natural Disaster Monitoring and Alert (CEMADEN in the Portuguese acronym), whose mission is to develop, test and implement a system to predict natural disasters in susceptible areas in Brazil and provide alerts on natural disasters. The Center not only helps with preventive actions, it also helps identify vulnerabilities in the use and occupation of land, with particular emphasis on urban planning and implementation of infrastructure. It is also responsible for awareness-raising and consequent population promptness, inducing effective and early prevention and harm-reduction actions. Currently, 795 municipalities in the South, Southeast, Central West, North and Northeast regions are monitored, besides all municipalities in the Northeastern semiarid region in relation to the impacts of intense droughts. It is international consensus that endowing a country with early-warning capacity is one of the most effective adaptation policies to the foreseeable increase of frequency and intensity of extreme weather events.

>> System for Monitoring and Observation of Impacts of Climate Change (SISMOI in the Portuguese acronym), a project to define the architecture and governance mechanisms of a modern system for observation of the growing impacts of climate change in Brazil, testing concepts and implementing systems at pilot-scale.

>> National Emissions Registry System (SIRENE in the Portuguese acronym), which consists of a computer platform which aims to optimize information management processes related to the National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases Not Controlled by the Montreal Protocol, conferring security and transparency to the Inventory's preparation process, and providing support to decision-making processes within the scope of policies, plans, programs and projects in the area of climate change.

>> Brazilian Earth System Model (BESM), one of the main products of the *Rede CLIMA*, has as its goal the establishment of an advanced computer system of the Earth System, suitable for projections of global climate change, empowering the country in the generation of future scenarios and also in contributing to the capacity-building of a new generation of researchers of the Earth System's various components and their complex interactions.

>> The Earth System Grid Federation (ESGF), which will connect the National Institute for Space Research (INPE in the Portuguese acronym) to the other world centers for the generation and dissemination of global climate change scenarios.

>> The National Communication, laid out herein, which has deepened knowledge production in the area of impacts, risks and vulnerability to climate change, by means of new and unprecedented studies, with methodology and data that are more robust, which, therefore, reduce the uncertainties of computer models

and increase precision of estimates of the expected social impacts resulting from climate change. These studies are important input for the adaptation and climate change national plans. At the same time, they mean more national capacity building for the collection of information to support the drafting of public development policies in Brazil.

The National Communication is an important tool for the fulfillment of Brazil's commitments within the UNFCCC. In search for better coverage, the Third National Communication introduced new methodological approaches, new activity data and emission factors to estimate greenhouse gas emissions and removals, particularly in the sector Land Use, Land-Use Change and Forestry (LULUCF).

Thus, in line with the documents that have been previously submitted to the Convention by the Brazilian Government, the TNC provides information that will be considered in future submissions of reference levels and REDD+ results, in order to receive results-based payments. The steady improvement of National Communications will provide further input for the new commitments the country will take on within the context of the Paris Agreement, including the preparation of successive nationally determined contributions aiming at the highest possible level of ambition.

Had the knowledge we have today about how the global climate systems work been available for previous generations, that of our parents and grandparents, and a response had happened, maybe there would have been time to avoid most of the climate changes. If the journey is not altered, human experience will lead the future generations a planet with an incomparably deeper environmental crisis in relation to the one we have inherited.

This generation's challenge is to innovate and build a new sustainable development paradigm for Brazil, based on Science, Technology & Innovation, recognizing that the rational use of our abundant natural resources and biodiversity may be the biggest lever for national development.

CARLOS NOBRE

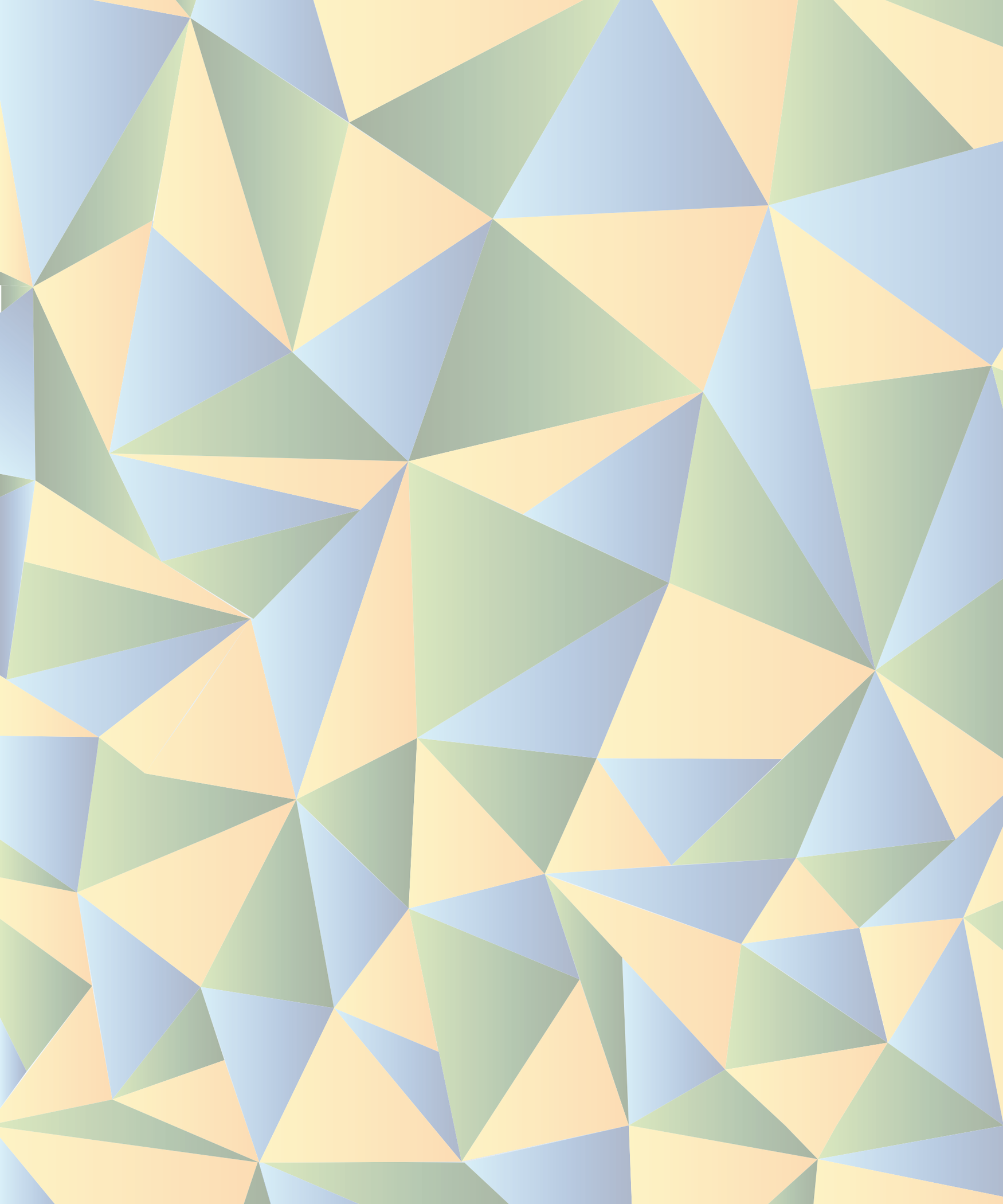
Secretary of Policies and Programs of Research and Development

(January 2011 to February 2015)

JAILSON DE ANDRADE

Secretary of Policies and Programs of Research and Development

(Since March 2015)



INTRODUCTION

INTRODUCTION

As it is known, concentrations of greenhouse gases in the atmosphere (mostly carbon dioxide, methane and nitrous oxide) have been increasing significantly because of human-induced activities initiated around 1750. Such activities include, primarily, fossil fuel combustion, land-use changes (in the case of concentration of carbon dioxide in the atmosphere) and agriculture (in the case of methane and nitrous oxide).

Every single day, studies are published indicating that global warming, which has been noted in the past decades, is somehow unusual, when the reference is the period before the human influence on the environment, as observed with the advent of the Industrial Revolution.

In this context, the Brazilian Government is making considerable effort towards tackling climate change, thus contributing unequivocally to the success of the United Nations Framework Convention on Climate Change (UNFCCC), hereinafter referred to as Climate Convention, without losing track of its goals and principles.

A relevant step forward is the drafting of the Third National Communication of Brazil to the Climate Convention, laid out herein in compliance with the guidelines for the preparation of national communications from Parties not included in Annex I to the Convention. The commitments undertaken by Brazil as a member of this international agreement include development and periodical update of national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol, submission of a general description of steps taken or envisaged to implement the Convention, and submission of any other information that the country considers relevant for achieving the objective of the Convention.

The Third National Communication (TNC) is composed of three volumes, other than this Executive Summary. The **first volume** provides a general overview of the main socioeconomic aspects to be considered in relation to the implementation of the Climate Convention in Brazil, in a section entitled National Circumstances. This section relied on the preliminary compilation of the first Report of the Brazilian Panel on Climate Change, which shows an important evolution of the knowledge production on the theme throughout the Brazilian territory. The Relevant Institutional Arrangements for the Preparation of a National Communication on Permanent Bases are also described in the first part and indicate the consolidation of a policy dedicated to the commitments of the Climate Convention.

The **second volume** of National Communication of Brazil begins with the legal framework, which is direct and indirectly related to climate issues, in particular initiatives under the National Policy on Climate Change (PNMC in the Portuguese acronym), ruled by Decree No. 7,390/2010, which in turn refers to Sectoral Mitigation and Adaption Plans. These Plans are subsequently listed, with a description of their actions, indicators and specific goals towards

reducing emissions to achieve the voluntary commitment undertaken by the country. This part also comprises a number of initiatives that resulted in the significant reduction of national emissions on the Convention framework. These initiatives seek not only to explore national characteristics, such as abundant renewable energetic resources, but also to promote cultural and technological development in relation to Brazil's participation in the global climate policy.

The National Policy on Climate Change also established that Sectoral Plans should include adaptation actions, such as initiatives and measures to reduce the vulnerability of natural and human systems facing the current and expected climate change effects. Along these lines, the efforts of the Ministry of Science, Technology and Innovation to qualify the studies of sectoral vulnerabilities presented in the second volume, both for its depth, is the multidisciplinary approach obtained from the institutional approach and the increasing integration of the work of the entities of the Brazilian Network on Global Climate Change Research (*Rede CLIMA*). Thus, the sectoral analyses encompass state-of-the-art knowledge of eight different areas, among which agriculture, biodiversity, energy and natural disasters.

The **third volume** of this document encompasses the Brazilian Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases not Controlled by the Montreal Protocol for the period 1990-2010. Bearing in mind the principles that guide the preparation of inventories (comparability, consistency, completeness, transparency, accuracy and quality control), a review of the estimates for the period 1990-2005 (already addressed in the previous inventory) and the increase of estimates for the 2006-2010 period was carried out, seeking methodological improvement at the edge of knowledge.

In addition, two highlights are necessary.

The first one refers to the previous National Communications. Notwithstanding the fact that the most recent version, as a general rule, shows improvements that go beyond the mere updating of the previously-addressed information, there is no question about the value of the Initial and Second National Communications. Therefore, they both have been taken into consideration in several stages of the drafting of the Third National Communication.

The second refers to the role played by *Rede CLIMA*. Involved with the preparation of the TNC since the beginning of the tasks – particularly providing estimates of the Brazilian Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases not Controlled by the Montreal Protocol and the modeling of future scenarios and subsequent impact and vulnerability studies in strategic sectors of the Brazilian society –, *Rede CLIMA* has contributed significantly from a scientific point of view. The inputs of *Rede CLIMA* for the drafting of the Third National Communication allow Brazil to consolidate and advance the already-achieved scientific knowledge gained during the period it has been part of the Climate Convention, favoring the generation of positive externalities towards improving, building and consolidating institutional and technical capabilities.

MÁRCIO ROJAS DA CRUZ

General Coordinator of Global Climate Change

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The submission of the Third National Communication of Brazil to the United Nations Framework Convention on Climate Change (UNFCCC) (henceforth Convention on Climate Change or, simply, Convention) confirms the importance Brazil attaches to the commitments it undertook under this treaty. UNFCCC is the suitable institutional framework through which the international community should fight global climate change and its adverse effects. Moreover, it is a clear signal that Brazil will make every effort to enhance understanding of the global problem and to advance the science of climate change based on the national circumstances described in this Communication by means of the actions and programs developed in the country.

NATIONAL CIRCUMSTANCES

Brazil is a continent-sized country (8.5 million square kilometers), with a population of 190 million inhabitants (2010), most of them (84.4%) living in urban centers.

Brazil is also home to an extremely rich flora and fauna. In addition to harboring over a third of the Earth's tropical forests – the Amazon forest –, there are phyto-ecological regions of great extensions in the country, such as the Cerrado, the Atlantic Forest, the Caatinga and the Pantanal wetlands. The country has extremely varied vegetation and flora resources, sheltering one of the richest flora in the world, with 44,149 known and registered species[1]. The Brazilian fauna is also quite rich, although knowledge about its diversity is still incomplete. It is estimated that less than 10% of the existing total is actually known.

Since Brazil is a country with large territorial extensions, it has differentiated rainfall and temperature regimes. From north to south, a great variety of climates with distinct regional characteristics can be found, which has shaped the occupation of its territory and partly justifies socioeconomic differences.

Brazil is a developing country with a complex and dynamic economy, which is ranked seventh in the world. It is an urban-industrial country, with a leading agricultural position in the world economy. Brazil is also among the largest and most efficient producers in the world of many manufactured products, including cement, aluminum, chemicals, among others.

1 *Forzza, R. C. et al. (2014). Introduction. In:* **Lista de Espécies da Flora do Brasil**. *Rio de Janeiro: Jardim Botânico do Rio de Janeiro. Available at: <http://floradobrasil.jbrj.gov.br>. Last seen on: 15 Aug 2014.*

Regarding the share of economic sectors in the Gross Domestic Product (GDP), in 2013, the distribution was as follows: 69.3% for the service business, 25.0% for industry, and 5.7% for agriculture.

In 2013, Brazil's GDP was US$ 2,243.0 billion, and the GDP *per capita* was $11,158.00. For the 2000-2013 period, while the average *per capita* GDP reported an average annual growth of 1.97 %, the national population grew at an average annual rate of 1.14%.

In recent years, the country has experienced important advances in terms of improvements in the opportunities of access to the education system, health care, basic sanitation, and in the fight against hunger, poverty and income inequality. Brazil showed significant performance, with international recognition, in combating poverty and extreme poverty. The important factors for these results were the improvements in working conditions and household income and the impact of social programs, especially the Family Allowance Program (*Bolsa Família)*. Together, these results have contributed to the reduction of income inequality, which, consequently, has contributed to poverty reduction. Nevertheless, in 2012 Brazil still had about 6 million people living in extreme poverty (3.5% of the population), and up to 15 million people living in poverty (8.5% of its population). There are still major disparities among regions and social groups: poverty is more concentrated among Afro-Brazilians and rural dwellers. Certain localities in Brazil still undergo major deficits with respect to living conditions, healthcare and transport. These are challenges to be overcome to ensure the material welfare and protection of their ecosystems and natural resources.

OTHER INFORMATION CONSIDERED RELEVANT FOR ACHIEVING THE OBJECTIVE OF THE CONVENTION

Education, Training and Public Awareness

Although the issues related to climate change are complex and difficult to be understood by laypersons, and in light of the limited reading material on the subject available in Portuguese, an effort has been made to expand education, public awareness and training on issues related to climate change.

In particular, initiatives like the Brazilian Forum on Climate Change (FBMC in the Portuguese acronym), the work of the Brazilian Panel on Climate Change (PBMC in the Portuguese acronym), as well as disclosure and public awareness via the Ministry of Science, Technology and Innovation's webpage (http://www.mcti.gov.br/clima), besides initiatives from non-governmental organizations in the country, are worth mentioning.

Transfer of Technology

Brazil considers the expression "transfer of technology" to have a more comprehensive meaning, encompassing the different stages of the technological cycle, including research and development (R&D), demonstration, increase in scale (deployment), diffusion and the transfer of technology per se, in relation to both mitigation and adaptation.

The country believes that the development and transfer of technologies related to global climate change should support mitigation and adaptation actions in order to achieve the Convention's ultimate objective. In the quest for this objective, identification of technological needs must be determined at national level, based on national circumstances and priorities.

Capacity Building

The Third National Communication presents excellence initiatives undertaken by research institutes and groups that are contributing to the scientific progress of climate change in Brazil. The progresses help bridge scientific gaps and improve methodologies, leading to results of modeling of the climate and of impact and vulnerabilities of the climate risk, as well as mitigation options, with lower uncertainty and more robustness. They represent, therefore, national and regional capacity building for the promotion of adaptation and mitigation actions.

A common aspect of such initiatives is collaboration with the government, aiming at contributing to the efficiency of the Brazilian climate change policy by means of networks, including international ones, and the multi-sector and interdisciplinary perspective that dealing with scientific knowledge requires.

RELEVANT INSTITUTIONAL ARRANGEMENTS FOR THE IMPLEMENTATION OF THE CONVENTION IN BRAZIL

In order for Brazil to fulfill its commitments under the Convention, a set of institutional frameworks and management tools has been created, among which: the National Policy on Climate Change (PNMC)[2], the National Plan on Climate Change and a set of sectoral plans on mitigation and adaptation presented in this Third National Communication.

The National Policy aims, among other points, at the reconciliation of social and economic development with protection of the climate system; reduction of anthropogenic greenhouse gas emissions in relation to their various sources; strengthening of anthropogenic removals by sinks of greenhouse gases in the national territory; and implementation of measures to promote adaptation to climate change by the three branches of government, with the participation and collaboration of the economic and social stakeholders, particularly those especially vulnerable to its adverse effects. Moreover, the National Policy provides for voluntary targets for reducing the projected emissions by 2020 in relation to the projected for this year.

The National Policy institutional instruments, provided for in its Article 7, are: the Interministerial Committee on Climate Change (CIM in the Portuguese acronym); Interministerial Commission on Global Climate Change (CIMGC in the Portuguese acronym); Brazilian Forum on Climate Change (FBMC); Brazilian Research Network on Global Climate Change (*Rede CLIMA*); Brazilian Commission for Coordination of Meteorological, Climatological and Hydrological Activities (CMCH in the Portuguese acronym).

2 *Created by Law No. 12,187/2009, regulated by Decree No. 7,390/2010.*

One assumption of the National Policy on Climate Change is its multi sectoral and cross-cutting nature, as laid down in law, based primarily on the performance of sector-specific agencies and relevant governmental bodies.

With regard to institutional arrangements for the drafting of national communications on a permanent basis, it was up to the MCTI to coordinate the preparation of the Third National Communication of Brazil to the Convention, performing its role as Executing Entity of the Brazilian Government, responsible for the technical implementation of the project as a whole, through the General Coordination on Global Climate Change (CGMC the Portuguese acronym). Because the TNC is a project funded by the Global Environment Facility (GEF), it counted on the support of the United Nations Development Programme (UNDP) in order to achieve the project's objectives. The UNDP team works directly with MCTI. Besides those entities, the project also counted on the support and endorsement of the Brazilian Cooperation Agency (ABC in the Portuguese acronym).

With respect to the academic and research contribution for the TNC, *Rede CLIMA* had a significant participation in the preparation of studies and data collection in relation to impacts and vulnerabilities of ecosystems and the Brazilian population to global climate change, as well as in the preparation of the national inventory of greenhouse gas emissions.

FINANCIAL, TECHNICAL AND CAPACITY DIFFICULTIES ASSOCIATED WITH THE PREPARATION OF THE NATIONAL COMMUNICATION

The work of the technical team involved with the drafting of the Third National Communication demanded efforts to overcome challenges up to the ambitious goals.

Difficulties have been identified along the cooperation works with national partner agencies, usually as a result of the additional steps that were planned, with significant information increment and subsequent analysis of the data generated.

Finally, it is important to highlight that, possibly due to the difficulties faced, the TNC's managing team was able to take in and document critical information to maintain the level of excellence of the National Communications of Brazil that have been published so far and that will certainly contribute to a more fluid and robust process in the future editions.

PROGRAMS THAT INCLUDE MEASURES RELATING TO CLIMATE CHANGE MITIGATION AND ADAPTATION

In Brazil, several initiatives have been taken to deal with the concerns related to climate change mitigation. These initiatives encompass programs, plans and projects specifically towards these issues, promoted by the Federal

Government at its several levels, and measures aimed at other objectives, but which also have as an indirect effect the decrease of net greenhouse gas emissions and/or improvements in the country's capacity to adapt to the harmful effects of climate change.

The National Policy on Climate Change (2009) is implemented by means of several action and sectoral plans for the mitigation and adaptation to climate change, in compliance with the principles and provisions of the Convention.

- >> Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm in the Portuguese acronym);
- >> Action Plan for the Prevention and Control of Deforestation and Burning in Cerrado (PPCerrado in the Portuguese acronym);
- >> The Ten-Year Energy Expansion Plan (PDE in the Portuguese acronym);
- >> Sectoral Plan for the Mitigation and Adaptation to Climate Change for a Low Carbon Emission Agriculture (ABC Plan in the Portuguese acronym);
- >> Sectoral Plan to Reduce Emissions in the Steel Industry;
- >> Sectoral Plan for the Mitigation and Adaptation to Climate Change for the Consolidation of a Low Carbon Emission Economy in the Manufacturing Industry (Industry Plan);
- >> Sectoral Plan for the Mitigation and Adaptation to Climate Change in Low-Carbon Emission Mining;
- >> Sectoral Transport and Urban Mobility Plan for the Mitigation and Adaptation to Climate Change (PSTM in the Portuguese acronym) and
- >> Health Sectoral Plan for the Mitigation and Adaptation to Climate Change (PSMC-Saúde in the Portuguese acronym).

Several components of these plans, such as the use of renewable energies and the fight against deforestation, are also essential parts of the Brazilian sustainable development strategy.

Submitted to the Convention as a Nationally Appropriate Mitigation Action (NAMA), the National Policy on Climate Change provides that the country will adopt voluntary actions to mitigate greenhouse gas emissions at the national level with a view to reducing its projected GHG emissions by 36.1% to 38.9% by 2020. The achieved goals are recognized, including by non-governmental entities, as one of the most ambitious contributions undertaken by a single country to fight climate change.

Plans and Actions Related to Mitigating Emissions from Land Use

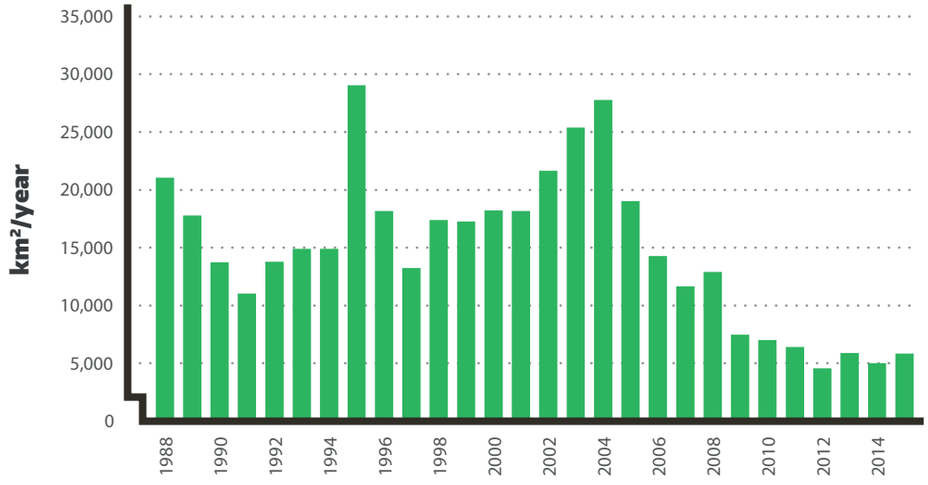
The Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm) has been, since 2004, seeking to reverse the deforestation progression in the Legal Amazon, which, in 2004, accounted for 18% of the original area. The national voluntary commitment is to reduce deforestation in the Legal Amazon by 80% by 2020 in relation to the period between 1996 and 2005. Now, in its third implementation stage (2012-2015), the plan involves the following set of issues: i) Land and Territorial Planning, ii) Monitoring and Control, and iii) Development of Sustainable Productive Activities. Nevertheless, the active participation of state governments, by means of State Plans for the Prevention and Control of Deforestation (PPCD in the Portuguese acronym), is crucial, mainly because of their proximity with local problems and greater facility to coordinate with municipalities, thus increasing the scope of actions envisaged by the Federal Government, besides including specificities that are not provided for in federal plans. Amongst the results achieved between 2004 and 2013 are the creation of 25 million hectares of Federal Protected Areas (also called Conservation Units in Brazil) at state and municipal levels, the confirmation

of another 10 million hectares as indigenous land, hundreds of integrated law-enforcement and monitoring improvement operations have been conducted, settlement of 13,852 families in natural resources management projects of land reform, concession of some 225,000 hectares of forests for sustainable forest management, among others. It is estimated that, together, the policies adopted have avoided the deforestation of 62 thousand km² of forest areas, representing 32% to 52% of the total deforestation projected for the period.

Brazil has recently been the first country to submit Forest Reference Emission Levels to the Convention. The document that was delivered registered impressive figures in terms of deforestation reduction (-79%) in the national territory (Figure I), between 2005 and 2015, placing Brazil at a prominent position among the countries that have decreased their emissions and deforestation rates the most in the past few years.

FIGURE I

Annual deforestation rate in the Legal Amazon



In May 2014, the government regulated procedures for the integration, execution and harmonization of the Rural Environmental Registry System from the Rural Environmental Registry (CAR in the Portuguese acronym). CAR is an environmental management instrument established the new Brazilian Forest Code that supports the recovery of degraded areas as it allows for the identification of whether a certain deforested area has a license from the relevant body to be explored. By means of an electronic registry, landowners or squatters must inform their properties total area, areas of use, Permanent Preservation Areas and Legal Reserve Areas. Hence, the crossing of spatial information, such as deforestation rates, authorizations to suppress vegetation and property limits will allow for the rapid identification of possible irregularities. In addition, the CAR might contribute for landscape planning, recovery of degraded areas and the establishment of ecological corridors. The implementation of CAR in national territory is expected to increase efficiency of deforestation control and prevention.

The Action Plan for the Prevention and Control of Deforestation and Burning in Cerrado (PPCerrado), in force since 2010, has similar objectives, but with greater focus on forest fires and burning. The identification of priority municipalities is an important action, given that only 4% of the total municipalities within the biome accounted for 44% of deforestation. The plan's efficiency is identified in the reduction by 60.5% of deforestation in 2010 (6,469 km²) in relation to the average deforestation rates in 1999-2008 (15,701 km²), which is more than what Decree No. 7,390/2010 established: a

reduction by 40% by 2020, based on the estimated deforestation for the period 1999-2008.

Much of the success in implementing these measures is due to the fact that Brazil has one of the most modern systems for monitoring forest areas in the world, such as is the case of the remote sensing-based monitoring system for the Amazon by the National Institute for Space Research (INPE). It encompasses four operating and complementary systems: the Project for Estimating Gross Deforestation of the Brazilian Amazon (PRODES in the Portuguese acronym); the Real Time Deforestation Detection System (DETER in the Portuguese acronym); the Mapping Project of Selective Logging Activities (DETEX in the Portuguese acronym); and the Mapping of forest degradation in the Brazilian Amazon (DEGRAD in the Portuguese acronym). A fifth system has recently been added, by initiative of Embrapa: the TerraClass Project (aimed at collecting information on land use and coverage in the Amazon).

Brazil has also been a pioneer in the use of meteorological satellite data to monitor burnings in the country, which culminated in the creation of the Program for the Prevention and Control of Burnings and Forest Fires (PROARCO in the Portuguese acronym) implemented by the Brazilian Institute of the Environment and Natural Resources (IBAMA in the Portuguese acronym), in collaboration with the National Institute for Space Research (INPE), with a view to preventing and controlling fires in the country, thus avoiding forest fires.

In addition, there is a large number of Federal Protected Areas in the country to protect and conserve the existing flora and fauna. Financial and tax measures (the Green Protocol, environmental responsibility of banks, rural credit restrictions on environmental offenders, ecological value-added tax on the circulation of goods, among others) have also proven to be of great importance in promoting sustainable development and controlling deforestation.

Brazil also counts on the Amazon Fund, which aims at raising donations for non-reimbursable investments in efforts to prevent, monitor and combat deforestation, as well as to promote the preservation and sustainable use of forests in the Amazon Biome. The Amazon Fund is the main national financial instrument to reward for deforestation reduction results, and has raised donations from the Norwegian and German Government and Petrobras. The funds will support activities in the following areas: management of public forests and protected areas; environmental control, monitoring and inspection; sustainable forest management; economic activities created with sustainable use of forests; ecological and economic zoning, territorial arrangement and agricultural regulation; preservation and sustainable use of biodiversity; and recovery of deforested areas.

Plans and Actions Related to Mitigating Emissions in the Energy Sector

Some of the programs and actions related to sustainable development are related to the use of renewable energy and energy conservation and/or efficiency. These programs contribute towards Brazil having a "clean" energy mix, with low greenhouse gas emissions in the energy sector, to stabilize the concentrations of these gases in the atmosphere and for long-term sustainable development.

The Ten-Year Energy Expansion Plan (PDE) is the main sectoral plan for the Brazilian energy sector, whose main objectives are to take actions that comply with the National Policy on Climate Change upon the adoption of a low-carbon emission scenario in relation to energy production and use, aiming at mitigating future emissions. It takes into consideration aspects related to the expansion of the hydroelectric supply and the supply of alternative renewable sources, notably: wind-farms, small hydroelectric plants, and bioelectricity, bio-fuels and

solar energy and increase of energy efficiency.

Domestic energy supply in Brazil in 2013 reached over 296 million tonnes, out of which 41% is from renewable sources. With regards to electric power, 570 million MWh were produced. Renewable resources account for a relevant share of Brazil's energy mix, with highlight to hydro-electricity generation, which corresponded to 64.9% of domestic supply in the same year. Renewable sources represent 79.3% of the domestic electricity supply in Brazil, resulting from the sum of national production figures and imports, which are essentially from renewable origin.

Among the programs related to sustainable development, the use of liquid bio-fuels, in compliance with the legislation in force is highlighted, such as sugarcane ethanol as vehicle fuel (hydrated and anhydrous), and biodiesel, with a series of raw material, for the mixture of diesel derived from petroleum.

Brazil is currently among the world's largest producers of ethanol, only falling behind the United States[3]. In addition to the blending mandate for *anhydrous ethanol* into the motor *gasoline* sold domestically (up to 27.5%[4]), the introduction of flexible fuel vehicles in 2003 leveraged the sector again and allowed for the increase in ethanol consumption.

Brazil is the world's third largest producer of biodiesel, after the United States and Germany. After the launching of the National Biodiesel Production and Use Program (PNPB in the Portuguese acronym) by the Federal Government in 2004, the biodiesel productive chain was leveraged in the country, and after a gradual extension, as at 1st November 2014, the mandated blend of biodiesel into diesel oil was increased to 7%.

It is worth pointing out that the cultivation of raw material and industrial production of biodiesel shows great potential to generate jobs and income, thus promoting social inclusion and economic development, besides reducing emissions of greenhouse gases.

In Brazil, it is always important to bear in mind the contribution of hydroelectric power generation for the reduction of GHG emissions, given that it is a low emission source, presents an extended operation period and is one of the most efficient technologies in terms of energetic conversion. Its regularization capacity by reservoirs allows for the expansion of intermittent complementary sources, such as solar energy, wind power and biomass, minimizing the system's vulnerability as well as favoring other uses, such as flood control, fish farming, tourism, navigation, irrigation, supply and downstream flow regulation, thus reflecting incentives to sustainable development.

Promising and important initiatives in relation to new sources of renewable energy include solar energy, wind energy and the modern use of biomass, which has been increasing its share in the national energy mix.

In 2013, wind energy generation corresponded to 1.1% of the domestic energy supply, and was the energy source with the largest growth in the country, with very competitive prices. The external scenario, technological and productive chain development, synergies with hydroelectricity and regulatory, tax and financial aspects can be pointed out to have contributed in that regard.

In relation to solar energy, the use of water heaters by solar panels in buildings is increasingly widespread; Brazil is also ranked prominently in the solar-heating market positioning. The country is the world's fifth largest in terms of operating installed capacity, after China, the United States, Germany, Turkey and India[5].

---

3 REN21 – Renewable Energy Policy Network for the 21st Century (2014). Global Status Report 2013. REN21 Secretariat, Paris, France.
4 Law No. 13,033, of 24 September 2014.
5 REN21 – Renewable Energy Policy Network for the 21st Century (2014). Global Status Report 2013. REN21 Secretariat, Paris, France.

Biomass corresponded to 7.6% of domestic electricity supply in 2013[6], with particular reference to cogeneration plants from sugarcane bagasse, besides the use of charcoal, agro-industrial and forest waste and biogas.

Other important Federal Government programs aim at reducing losses and eliminating wastage in energy production and use, in addition to adoption of enhanced energy-efficient technologies, and they help postpone investments in new power plants or oil refineries. Major programs include the National Electric Energy Conservation Program (Procel in the Portuguese acronym), a government program that has been developing a series of activities to combat electricity wastage in areas of street and industrial lighting, sanitation, education, construction, public buildings, municipal energy management, technological development and disclosure since 1985.

Plans and Actions Related to Mitigating Emissions from Agriculture, Steel Industry, Transformation Industry, Mining and Transport

The Sectoral Plan for the Mitigation and Adaptation to Climate Change for a Low-Carbon Emission Agriculture (ABC Plan) aims at promoting a reduction of GHG emissions in agriculture, as provided for by the National Policy, improving efficiency in the use of natural resources and increasing resilience of productive systems and rural communities, making it easier for the agriculture sector to adapt to global climate change. This plan is based on six structuring programs, in addition to Climate Change Adaptation actions, which seek to strengthen technical assistance, capacity-building and technology transfer information and strategies, which aim at reducing GHG emissions from agriculture.

The application of low-carbon technologies is expected to be expanded in terms of covered area by 2020 in order to fulfill Brazilian commitments, respectively: Recovery of Degraded Pastures – 15.0 million ha; Crop-livestock-forest (iLPF in the Portuguese acronym) and Agroforestry Systems (SAFs in the Portuguese acronym) integration – 4.0 million ha; No-till agriculture (SPD in the Portuguese acronym) – 8.0 million ha; Nitrogen Biological Fixation (NBF) – 5.5 million ha; Planting of commercial forests – 3.0 million ha; Animal Manure Treatment – 4.4 million m^3.

In order to assist in the process, a credit line was created within the ABC Plan to stimulate farmers to invest in the implementation of production systems with technologies that reduce associated GHG emissions. Rural producers (whether individuals or companies) and their cooperatives, may request funding – including lending to cooperative associates – for undertakings related to the development of projects that will establish production systems based on the technological arrangements proposed by the ABC Plan, including the possibility of some financing to recover preservation and legal reserve areas.

The Sectoral Plan to Reduce Emissions in the Steel Industry (Steel Industry Plan) commissioned some studies aiming at fostering the use of sustainable charcoal. Brazil is one of the few countries in the world that maintain the use of charcoal from planted forests in the metallurgical sector's production process, especially in the steel industry, with a focus on pig iron and steel.

Specific sectoral plans have also been elaborated for other sectors of the Brazilian industry. The Sectoral Plan for the Mitigation and Adaptation to Climate Change for the Consolidation of a Low Carbon Emission Economy in the Manufacturing Industry (Industry Plan) aims at reducing GHG emissions from industrial processes and from the use

6 *EPE – Energy Research Company (2014). National Energy Balance 2014: base-year 2013. Rio de Janeiro: EPE.*

of energy in the industry, by increasing energetic efficiency and the use of materials, and preparing the sector for the challenges and opportunities of a low-carbon economy, establishing a reduction target of 5% for the transformation industry according to the business-as-usual target in 2020. The Sectoral Transport and Urban Mobility Plan for the Mitigation and Adaptation to Climate Change (PSTM) aims at contributing to mitigate GHG emissions in the sector, by means of initiatives that lead to the expansion of cargo transport infrastructure and use of more energy-efficient modes; and in the sector of urban mobility, increase the use of efficient systems of public transportation of passengers, contributing to the achievement of the commitments undertaken voluntarily by Brazil.

The Sectoral Plan for the Mitigation and Adaptation to Climate Change in Low-Carbon Emission Mining (Mining Plan) presents assumptions and calculations of current GHG emissions, future scenarios, and potential reduction actions to foster knowledge, the development of environmental indicators and technological research on associated GHG emissions, and stimulate GHG emissions reduction at a national level, thus contributing to national voluntary commitments within the scope of the PNMC.

The Health Sectoral Plan for the Mitigation and Adaptation to Climate Change (PSMC-Saúde) aims at strengthening intersectoral actions toward the reduction of vulnerabilities of the populations, establishing national targets and strategies to contribute to mitigation measures and to guide adaptation measures from processes and services of the Unified Health System (SUS in the Portuguese acronym) to cope with the climate change impacts. It is based on four axes, the Health Surveillance Axis, the Health Intervention and Attention Axis, the Health Promotion and Education Axis and the Health Research Axis.

VULNERABILITIES AND CLIMATE CHANGE ADAPTATION

Regarding the actions to be submitted to the Climate Convention, in relation to the measures to facilitate the adequate adaptation to climate change, the Brazilian efforts are worthy of mention, especially the actions undertaken by the Secretariat of Climate Change and Environmental Quality of the Ministry of Environment, which aims at providing input for the drafting and implementation of public policies towards adaptation to climate change.

The main activities and projects since 2013 have been:

- >> An analysis of vulnerabilities towards public policies – studies to map vulnerabilities and methodological variations; creation of climate scenarios and projections; development of vulnerability and resilience indicators; development of local and participative approaches;
- >> An analysis of climate change in socio-environmental and economic systems – studies on the costs of impacts and adaptation; losses and damages, macroeconomic projections, discussions on territorial dynamics; synergies and trade-offs of sectoral action, among others;
- >> Promotion of public policies and their instruments to reduce vulnerability – including the identification, discussion, categorization, evaluation and prioritization of public policies towards adaptation, aimed at local, regional and national scales due to vulnerabilities and their identified consequences; development of tools to analyze the climate risk, Government plans and programs incorporating climate risk management, and capacity-building for public and private managers, at national and subnational levels;

>> Development of a system for monitoring, evaluating, and disseminating information on public policies on adaptation;

>> Development of the elaboration process of the National Adaptation Plan (PNA in the Portuguese acronym) to Climate Change and support to sectoral Ministries for the build up and implementation of specific strategies.

The PNA is an important implementation tool of the National Policy on Climate Change and has been drafted with the participation of several ministries under the co-coordination of the Ministry of the Environment (MMA in the Portuguese acronym) and the Ministry of Science, Technology and Innovation (MCTI in the Portuguese acronym).

The Third National Communication, seeking for improvements on the inputs in the PNA in Brazil, has commissioned new studies on the development of climate scenarios by means of mathematical modeling, in an attempt to deepen knowledge production on the impacts, risks and vulnerabilities to climate change. It is worth highlighting the contribution of these studies to national capacity-building for the preparation of such information, which can base the formulation of public development policies in Brazil.

Volume II of the Third National Communication also approaches the efforts undertaken by Brazil in this regard and the progresses and improvements achieved. Therefore, downscaling or regionalization (scale reduction, that is, improved resolution) from global models was performed, encompassing all South and Central America.

Strategic sectors and issues, such as biodiversity, agriculture, water resources, energy, natural disasters and human health have been analyzed from the emissions scenarios created by RCP 8.5 and RCP 4.5, of the IPCC's AR5 (2014) and the development of regionalized modeling. The evaluation was conducted by experts from each sector, who developed studies from climate variables (e.g. rainfall, atmospheric temperature, wind, among others) extracted from performed modeling.

Thus, the studies presented herein are not only an important input to decision-making about adaptation measures to be planned for Brazil, but also evidence the importance of continuing to receive support to analysis on this issue, which is expected to become a critical element for future sectoral plans and policies in a such a vast and diverse territory.

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

Emissions from 1990 to 2010

Brazil, as a Party to the Convention on Climate Change, assumed, based on its Article 4, paragraph 1, the commitment to "develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties".

The **National Emissions Registry System (SIRENE)** is a tool to support the development of information relating to the National Inventories, is under operationalization process. This platform will optimize not only the management processes of results of calculations, but also the disclosure of such information by means of graphics and tables. Such initiative aims at contributing to the continuity of the work directed to the quantification of greenhouse gas emissions, therefore providing greater security and transparency to the whole process of decision-making support in the context of policies, plans, programs and projects in the field of climate change.

This inventory includes carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The emissions of so-called indirect greenhouse gases, such as nitrogen oxides (NO_x), carbon monoxide (CO) and other non-methane volatile organic compounds (NMVOCs) have also been estimated. The said gases were estimated according to the emission sources, which are called sectors: Energy; Industrial Processes; Use of Solvent and Other Products; Agriculture; Land Use, Land-Use Change and Forestry; and Waste.

As basic technical guideline, the preparation of the Inventory was based on the guidelines of the Intergovernmental Panel on Climate Change (IPCC): "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"; "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories"; and "Good Practice Guidance for Land Use, Land-Use Change and Forestry". Some of these estimates already take into account information published in the document "2006 IPCC Guidelines for National Greenhouse Gas Inventories".

Preparation of the Inventory involved a significant share of the Brazilian business and scientific community, in addition to various government sectors, with direct participation of 230 experts with 98 institutions represented. The results of this effort are shown in Table I, which summarizes the estimates of greenhouse gas emissions for five years – 1990, 1995, 2000, 2005 and 2010. In relation to the years 1990 to 2005, this Inventory updates the information presented in the Second Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases not Controlled by the Montreal Protocol[7].

In relevant sectors in Brazil, such as agriculture and land use, land-use change and forestry, there are no methodologies easily applied to the national characteristics, given that emission factors suggested by IPCC largely reflect the conditions of developed countries with a temperate climate and do not necessarily fit Brazilian reality. Therefore, a great effort has been undertaken to obtain information corresponding to the national circumstances, thus allowing for the application of more detailed IPCC methodologies and obtaining more accurate and precise estimates.

7 *Ministry of Science and Technology. General Coordination of Global Climate Change (2010). Second National Communication of Brazil to the United Nations Framework Convention on Climate Change. Brasília: MCT.*

TABLE I

Greenhouse Gas Emissions in Brazil (1990, 1995, 2000, 2005 and 2010)

SECTOR	Year	Unit	CO_2	CH_4	N_2O	HFC – 23	HFC – 32	HFC – 125	HFC – 134a	HFC – 143a	HFC – 152a	CF_4	C_2F_6	SF_6	NO_x	CO	NMVOC
Energy	1990	Gg	169,985	545.8	14.08										1,639.8	9,592.6	1,167.5
	1995		209,124	473.6	15.03										1,977.5	9,636.3	1,104.8
	2000		267,646	511.8	18.99										2,273.3	8,181.0	987.4
	2005		290,621	684.8	24.96										2,346.4	8,194.7	1,061.5
	2010		347,974	629.1	31.97										2,567.1	7,695.9	900.5
	Var. 90/05	%	71	25	77										43	-15	-9
	Var. 05/10		20	-8	28										9	-6	-15
Industrial Processes	1990	Gg	43,551	47.1	11.83	0.1202	-	-	0.0004	-	-	0.3022	0.0263	0.0100	42.1	900.8	345.0
	1995		54,643	41.2	18.57	0.1530	-	-	0.0028	-	-	0.3060	0.0264	0.0142	53.2	778.0	426.2
	2000		65,991	43.7	21.14	-	-	0.0071	0.4988	0.0075	0.0001	0.1465	0.0117	0.0153	94.9	790.5	532.8
	2005		68,016	54.9	24.27	-	-	0.1249	1.2279	0.0929	0.1748	0.1239	0.0104	0.0252	125.2	1,022.4	616.6
	2010		80,786	45.3	2.15	-	0.1059	0.5012	2.7196	0.4671	-	0.0767	0.0059	0.0087	100.8	809.6	736.8
	Var. 90 / 05	%	56	17	105	-100			306,875			-59	-60	152	197	13	79
	Var. 05 / 10		19	-17	-91			301	121	403	-100	-38	-43	-65	-19	-21	19
Use of Solvent and Other Products	1990	Gg															2,338.9
	1995																2,286.9
	2000																3,154.0
	2005																2,982.2
	2010																4,749.9
	Var. 90/05	%															28
	Var. 05/10																59
Agriculture	1990	Gg		9,185.6	303.5										98.6	3,627.6	NE
	1995			10,058.2	340.2										109.9	4,045.8	NE
	2000			10,382.3	355.9										97.2	3,576.4	NE
	2005			12,357.7	429.0										126.2	4,644.4	NE
	2010			12,415.6	472.1										171.6	6,313.5	NE
	Var. 90/05	%		35	41										28	28	NA
	Var. 05/10			0	10										36	36	NA
Land Use, Land-Use Change and Forestry	1990	Gg	756,970	1,041.5	42.56										526.7	18,429.4	NE
	1995		1,837,508	2,895.7	106.98										1,196.0	48,855.6	NE
	2000		1,197,175	2,048.8	81.96										993.8	35,879.9	NE
	2005		1,797,842	3,237.9	125.25										1,470.3	55,810.0	NE
	2010		310,736	1,135.5	47.08										589.9	20,231.4	NE
	Var. 90/05	%	138	211	194										179	203	NA
	Var. 05/10		-83	-65	-62										-60	-64	NA
Waste	1990	Gg	19	1,173.7	4.32												
	1995		78	1,418.7	4.83												
	2000		95	1,754.2	5.68												
	2005		128	2,062.0	6.61												
	2010		175	2,462.7	7.21												
	Var. 90/05	%	574	76	53												
	Var. 05/10		37	19	9												

SECTOR	Year	Unit	CO_2	CH_4	N_2O	HFC – 23	HFC – 32	HFC – 125	HFC – 134a	HFC – 143a	HFC – 152a	CF_4	C_2F_6	SF_6	NO_x	CO	NMVOC
TOTAL	1990	Gg	970,525	11,993.7	376.33	0.1202	-	-	0.0004	-	-	0.3022	0.0263	0.0100	2,307.2	32,550.4	3,851.4
	1995		2,101,353	14,887.4	485.57	0.1530	-	-	0.0028	-	-	0.3060	0.0264	0.0142	3,336.6	63,315.7	3,817.9
	2000		1,530,907	14,740.8	483.70	-	-	0.0071	0.4988	0.0075	0.0001	0.1465	0.0117	0.0153	3,459.2	48,427.8	4,674.2
	2005		2,156,607	18,397.3	610.06	-	-	0.1249	1.2279	0.0929	0.1748	0.1239	0.0104	0.0252	4,068.1	69,671.5	4,660.3
	2010		739,671	16,688.2	560.49	-	0.1059	0.5012	2.7196	0.4671	-	0.0767	0.0059	0.0087	3,429.4	35,050.4	6,387.2
	Var. 90/05	%	122	53	62	-100			306,875			-59	-60	152	76	114	21
	Var. 05/10		-66	-9	-8			301	121	403	-100	-38	-43	-65	-16	-50	37
Greenhouse gases emissions for information only (not included in the inventory):																	
Bunker Fuels	1990	Gg	6,086	-	0.13										1.6	0.9	2.9
	1995		8,667	-	0.16										2.1	0.9	7.3
	2000		13,639	0.1	0.20										3.2	0.9	14.9
	2005		14,766	0.1	0.21										3.4	1.2	16.9
	2010		18,550	0.2	0.27										4.3	1.1	21.4
	Var. 90/05	%	143		62										113	33	483
	Var. 05/10		26	100	29										26	-8	27
Biomass Fuels	1990	Gg	165,792														
	1995		168,791														
	2000		166,435														
	2005		228,285														
	2010		303,170														
	Var. 90/05	%	38														
	Var. 05/10		33														

EMISSIONS OF THE MAIN GREENHOUSE GASES

FIGURE II

Sectors and sub-sectors shares of net CO_2 emissions in 2010

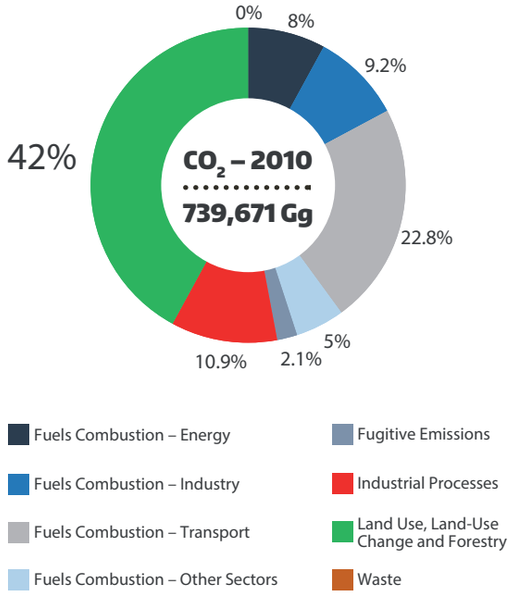


FIGURE III

Evolution of net CO_2 emissions per sector, from 1990 to 2010

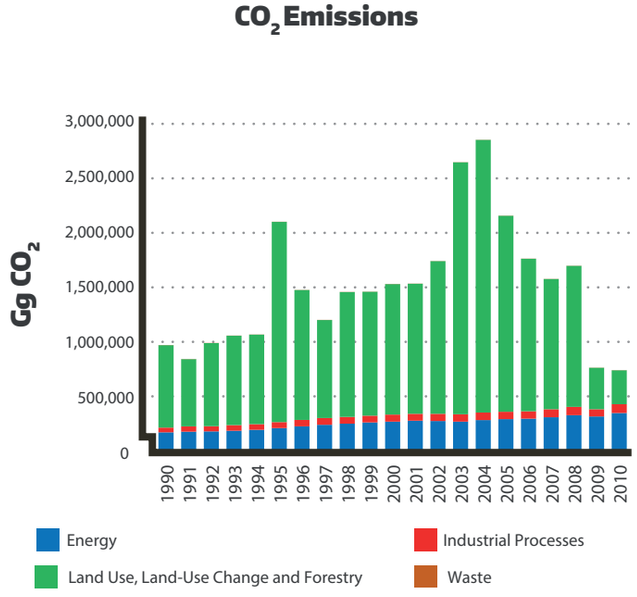


FIGURE IV

Sectors and sub-sectors shares of CH_4 emissions in 2010

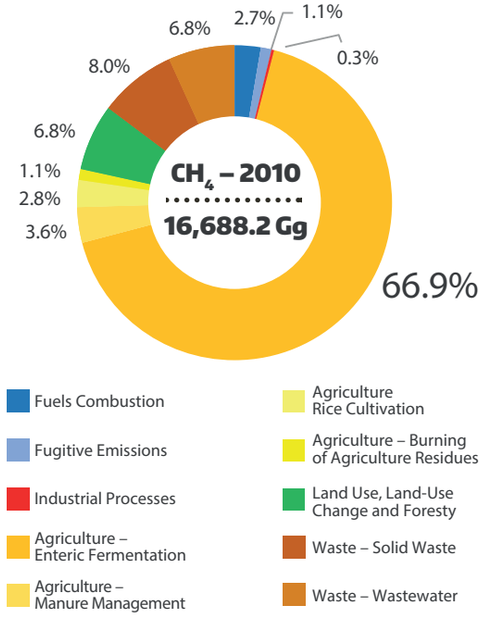


FIGURE V

Evolution of CH_4 emissions per sector, from 1990 to 2010

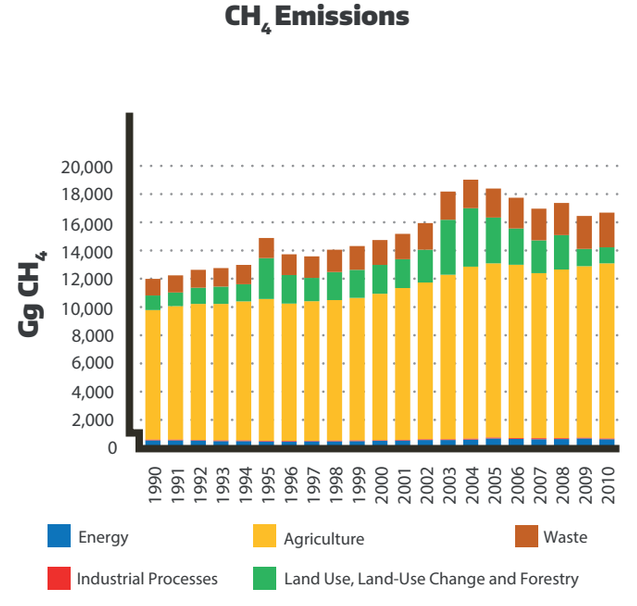


FIGURE VI

Sectors and sub-sectors shares of N_2O emissions in 2010

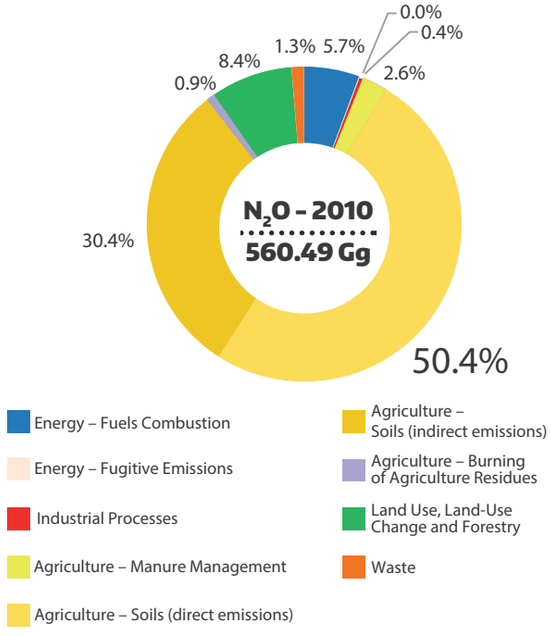


FIGURE VII

Evolution of N_2O emissions by sector, from 1990 to 2010

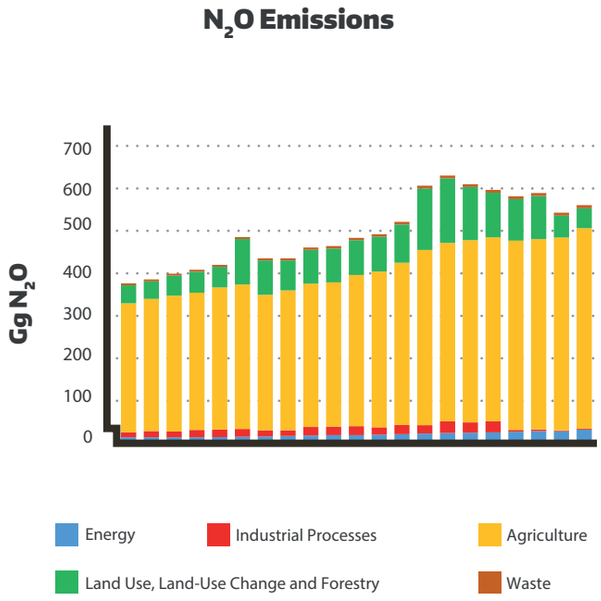


TABLE II

Factors for GWP (100 years) and GTP (100 years)

GAS	GWP 100 YEARS SAR-1995	GWP 100 YEARS AR5-2014	GTP 100 YEARS AR5-2014
CO_2	1	1	1
CH_4	21	28	4
$CH_{4\ fossil}$	21	30	6
N_2O	310	265	234
HFC-23	11,700	12,400	12,700
HFC-32	650	677	94
HFC-125	2,800	3,170	967
HFC-134a	1,300	1,300	201
HFC-143a	3,800	4,800	2,500
HFC-152	140	16	2
CF_4	6,500	6,630	8,040
C_2F_6	9,200	11,100	13,500
SF_6	23,900	23,500	28,200

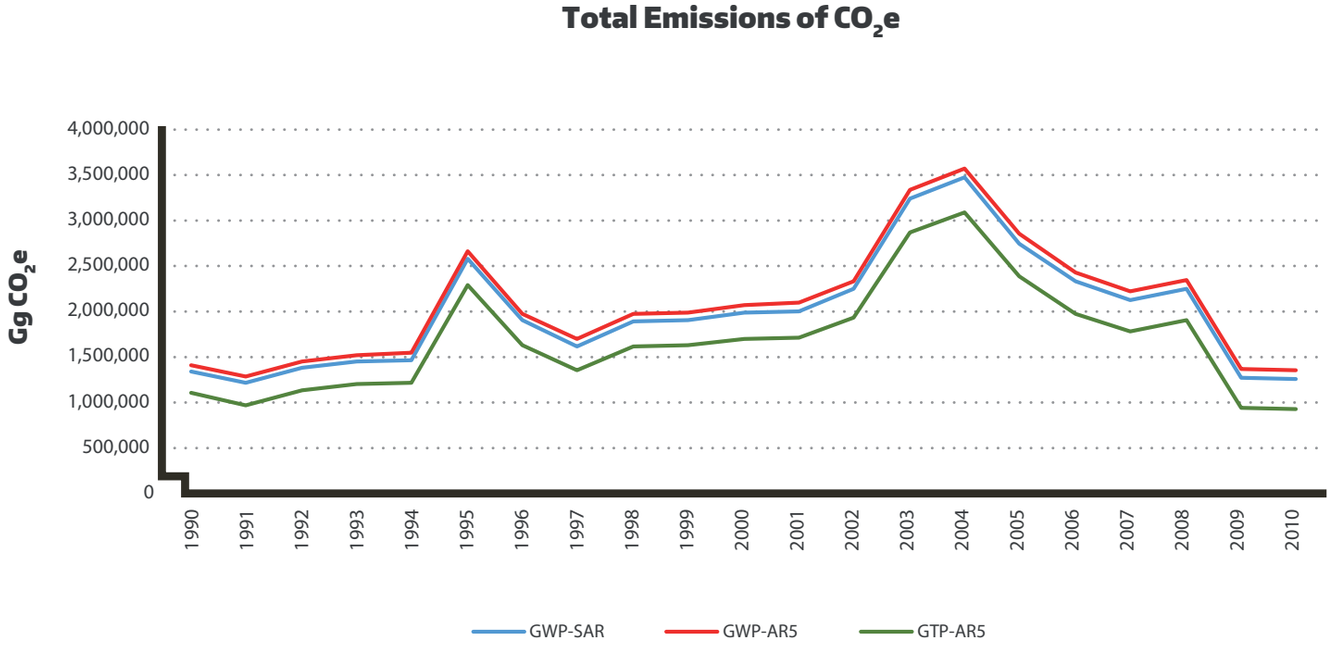
TABLE III

Anthropogenic emissions by sources and removals by sinks of greenhouse gases in CO_2e converted by means of the GTP and GWP metrics, by sectors

GWP – SAR	CO_2e (Gg)				
	1990	1995	2000	2005	2010
ENERGY	185,808	223,727	284,273	312,747	371,086
INDUSTRIAL PROCESSES	52,059	65,625	75,581	80,517	89,947
AGRICULTURE	286,998	316,671	328,367	392,491	407,067
LAND USE, LAND-USE CHANGE AND FORESTRY	792,038	1,931,478	1,265,606	1,904,666	349,173
WASTE	26,006	31,370	38,693	45,476	54,127
TOTAL	1,342,909	2,568,872	1,992,520	2,735,898	1,271,399
GWP – AR5	CO_2e (Gg)				
	1990	1995	2000	2005	2010
ENERGY	189,319	226,707	287,395	316,985	374,554
INDUSTRIAL PROCESSES	52,038	65,283	75,000	79,972	90,866
AGRICULTURE	337,636	371,773	385,027	459,692	472,734
LAND USE, LAND-USE CHANGE AND FORESTRY	797,413	1,946,934	1,276,260	1,921,694	355,002
WASTE	34,027	41,084	50,717	59,613	71,041
TOTAL	1,410,434	2,651,780	2,074,399	2,837,956	1,364,197
GTP – AR5	CO_2e (Gg)				
	1990	1995	2000	2005	2010
ENERGY	175,786	214,877	274,522	299,773	358,464
INDUSTRIAL PROCESSES	51,110	64,324	73,021	76,380	84,644
AGRICULTURE	107,774	119,828	124,817	149,809	160,125
LAND USE, LAND-USE CHANGE AND FORESTRY	771,096	1,874,123	1,224,546	1,840,104	326,293
WASTE	5,725	6,883	8,440	9,921	11,713
TOTAL	1,111,490	2,280,035	1,705,347	2,375,987	941,239

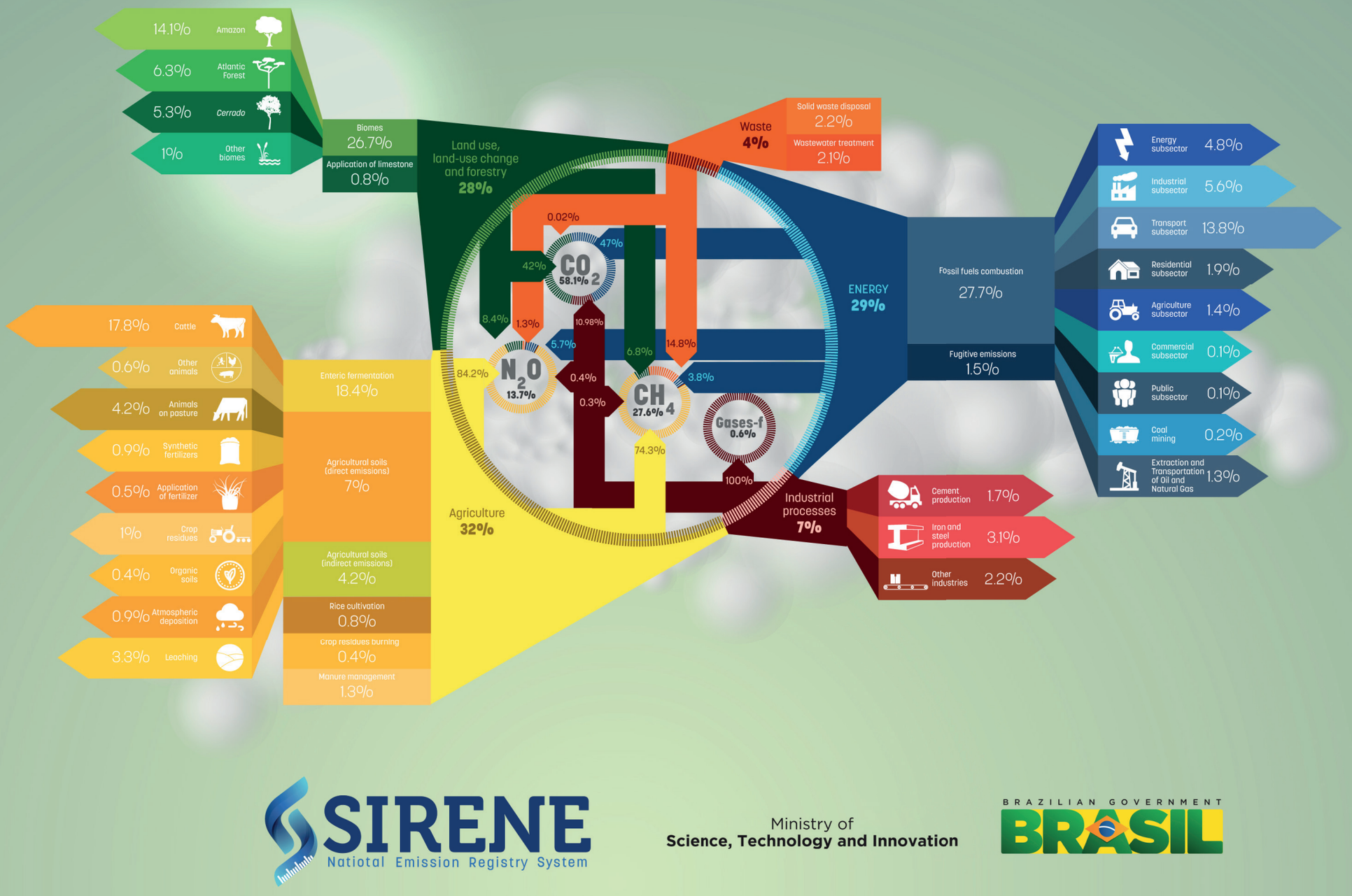
FIGURE VIII

Evolution of CO_2e emissions by different metrics, from 1990 to 2010



YEAR 2010

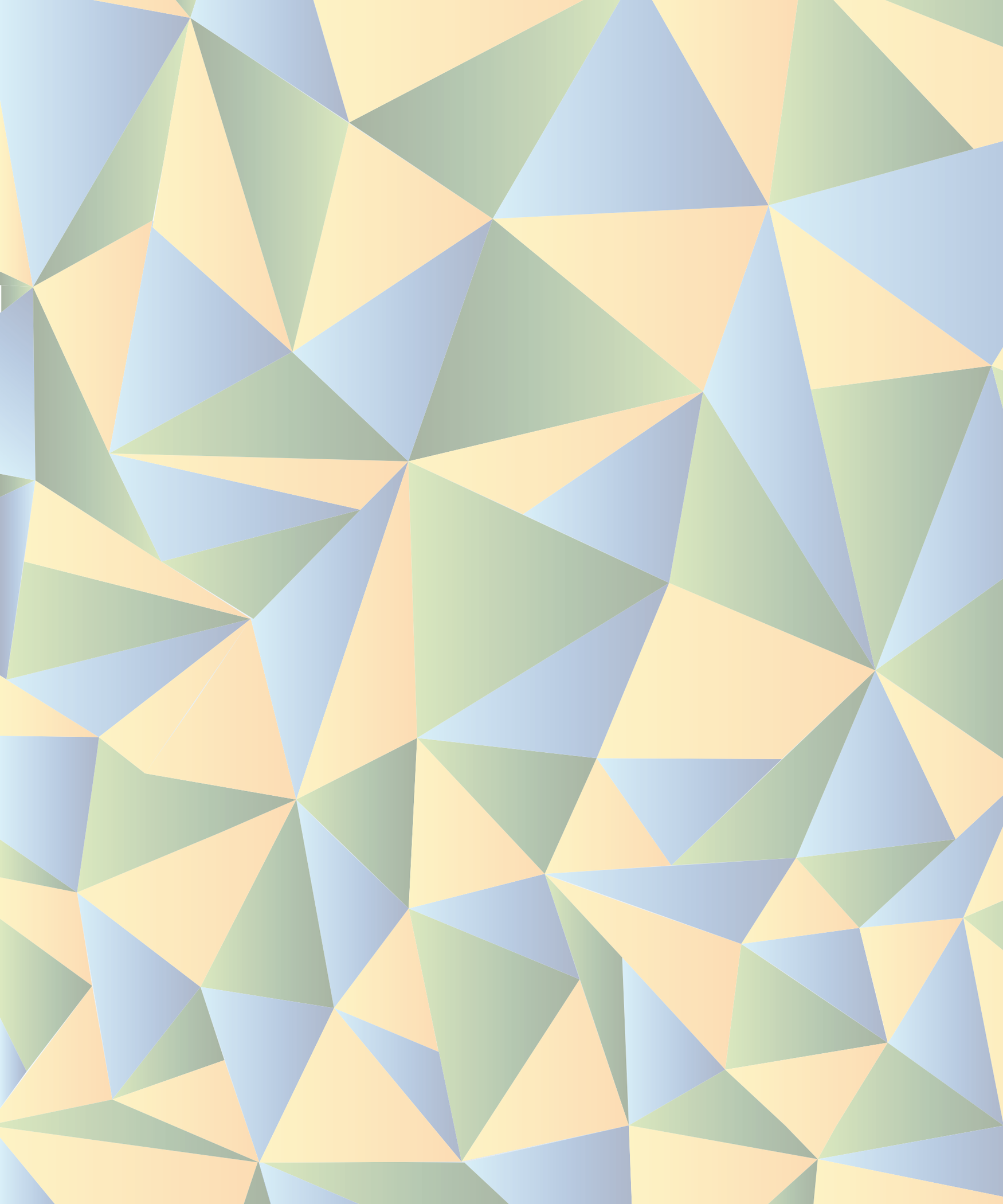
total emissions (Gg CO_2e - GWP SAR) = 1,271,399



SIRENE
Natiotal Emission Registry System

Ministry of
Science, Technology and Innovation

BRAZILIAN GOVERNMENT
BRASIL



Empowered lives.
Resilient nations.

GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

Ministry of
Foreign Affairs

BRAZILIAN GOVERNMENT
BRASIL

Ministry of
Science, Technology and Innovation

BRAZILIAN GOVERNMENT
BRASIL

ISBN 978-85-88063-22-8