PUBLIC POLICY PROPOSALS BY THE BUSINESS SECTOR FOR A LOW CARBON ECONOMY IN BRAZIL: ENERGY, TRANSPORTATION, AND AGRICULTURE

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LOW CARBON ECONOMY IN BRAZIL

ENERGY, TRANSPORTATION, AND AGRICULTURE

BY

FGV GVces Centro de Estudos em Sustentabilidade da EAESP

EPC EMPRESAS PELO CLIMA

PUBLIC POLICY PROPOSALS BY THE BUSINESS SECTOR FOR A

LOW CARBON ECONOMY IN BRAZIL

ENERGY, TRANSPORTATION, AND AGRICULTURE

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PREFACE

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The studies presented here aim to contribute to the debate on the challenges for the creation of a low-carbon economy in Brazil in three relevant sectors: Energy, Transportation, and Agriculture. They focus on the analyses and proposals of economic instruments, which are fundamental for creating the necessary conditions for a competitive Brazilian economy in the context of GHG emissions management.

The studies were produced and published by the Businesses for Climate Platform (EPC in Portuguese), created by the Fundação Getulio Vargas (FGV) in 2009 as a permanent Brazilian business forum to stimulate dialogue, capacity building, and the construction of partnerships for the transition towards a low carbon intensity economy. This effort has the objective of strengthening the competitiveness of the Brazilian economy, guaranteeing access to increasingly social and environmentally conscious international markets, allowing for the creation of a domestic market propitious to technical development, to innovation and to the adoption of business practices with a lesser potential of emissions of greenhouse gases (GHG), and of promoting Brazilian energy security by fostering the new renewable energies.

The EPC is structured by means of capacity-building activities for business managers and the support of companies in the creation of their corporate policies and strategies for the management of GHG. Another objective of the program is to present public policy recommendations for a low carbon economy. The program is part of the Corporate Leaders Group on Climate Change, a global network founded by Cambridge University in the U.K., and works in partnership with other international initiatives, such as those promoted by the World Resources Institute (www.wri.org), by the Fundación Avina (www.avina.net) and by the Plataforma Climática Latinoamericana (www.plataformaclimaticalationoamericana.org).

The EPC positions itself in a context of the construction of a regulatory framework on climate change, with the passing of the laws of the National Policy on Climate Change and of the Federal Fund on Climate Change. Beyond the debate over the implications of federal norms, the program has brought attention to the pressure for regulations and policies regarding climate change currently in progress in various states and municipalities, all with a potential impact on economic activities.

Another prominent aspect of the program is its interaction with the organized sectors of civil society, as is the case of the Observatório do Clima ("Climate Watch"), a network of NGOs and social movements on climate change (www.oc.org.br), created to provide oversight of international negotiations and advocacy of domestic regulations, in addition to establishing the frameworks for a qualified debate and supporting the formulation of the National Policy and the National Plan for Climate Change.

The Brazilian Program GHG Protocol should be highlighted as well, an initiative of the Fundação Getulio Vargas complementary to the EPC, launched in 2008 in partnership with the World Resources Institute, which trains businesses in the application of the GHG Protocol tool—the most utilized tool worldwide in understanding, assessing, and managing GHG emissions. The Brazilian Program GHG Protocol has brought together 60 large businesses, officially published 58 inventories, and on June 22, 2010 launched the first Public Registry of Corporate Inventories of GHG emissions in the country.

A relevant factor for a low-carbon economy to be taken into consideration by the actors involved with the EPC is the need for greater public and private investment towards research and development of technologies associated with mitigation and adaptation to climate change, essential to guarantee the competitiveness of our economy. In addition, it is necessary to center our attention and efforts on the implementation of a carbon market, an idea that has been at the center of a debate between actors such as the Ministry of Agriculture, CNI (the Brazilian national confederation of industries), and FIESP (the federation of industries of the state of São Paulo), in which the FGV has taken part. Other important instruments in this context are the Corporate Sustainability Index (ISE) and the Carbon Efficient Index (ICO2) of BM&FBOVESPA, and the Carbon Disclosure Project (CDP), which allows for the evaluation of the businesses' performance in managing their GHG emissions. Relevant economic actors such as BNDES (the Brazilian development bank), Caixa and Banco do Brasil (national state-owned banks), and the Agência de Fomento Paulista (the development agency of the state of São Paulo), have initiated actions for financing low-carbon projects and initiatives, and their actions have been evaluated and discussed within the scope of the EPC. These movements reveal the level of attention of the country to issues regarding climate change, and should guide the stance taken by businesses on the matter.

The studies developed and presented here dialogue with the trends described above, and constitute only the beginning of an analytical process that should be followed over the course of the next several years, in order to stimulate a debate for the collective construction of proposals for public policies for the repositioning of the Brazilian economy in the face of the challenges presented by the climate change.

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EXECUTIVE SUMMARY

01

Climate change is a scientifically proven fact, and constitutes the most serious threat to human well-being and natural ecosystems in this century. Urgent action is necessary to reduce emissions from fossil fuels and to control deforestation and land-use change. This challenge imposes common, but differentiated responsibilities, for all nations. Brazil, given its economic importance, its leadership in power generation from renewable sources and its huge biodiversity, can and should have a leading role in the construction of an economy of low carbon intensity.

Domestically, this task should be a joint effort between public and private sectors, in a positive agenda, centered on the development of economic instruments to foster investments in activities that allow for the reduction of Brazil's emissions of GHG.

In this context, the Businesses for Climate Platform (EPC), a permanent Brazilian business forum for dialogue, capacity-building, and the construction of partnerships for the transition path to a low carbon economy, taking on Brazil's leadership in the field and expressing genuine business responsibility, comes forward to present a set of public policy proposals for a low-carbon economy in Brazil.

The aim of this endeavor is to contribute the following: **(i)** strengthening of the competiveness of the domestic industry in the new context of the global economy; **(ii)** guaranteeing Brazilian products access to international markets, increasingly social and environmentally conscious; **(iii)** fostering a domestic market for technological development, innovation, and the adoption of business practices with a lesser potential of GHG emissions; and **(iv)** promoting energy security in Brazil.

With this in sight, the EPC undertook a series of sector-specific studies in 2010, focusing on the diagnosis and analysis of climate-related challenges within the national context, with the goal of producing policy papers to subsidize public policies and offering tools for the implementation of the National Plan for Climate Change, the National Policy for Climate Change, and the sector-specific plans.

In this document, we present the result of the studies on the Energy, Transportation, and Agriculture sectors. Studies for the financial sector and industrial emissions are in progress, and should be presented in 2011. With this document, the businesses that compose the EPC are advancing an extremely urgent and necessary dialogue on a complex subject, with the vision of contributing to the promotion of a low-carbon economy and of sustainable development in Brazil.

CHALLENGES FOR BRAZIL

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2.1. THE ENERGY SECTOR

In the medium to long term, Brazil is expected to increase its GHG emissions due to its economic growth. This is based on current GHG emissions from the consumption of products and services and considering the current model of economic and technological growth (i.e., business as usual). From the environmental perspective, maintaining this model implies a Brazilian contribution to global climate change above the levels that would guarantee the maintenance of the quality of life on the planet. Economically, the persistence of this model could undermine the competiveness of Brazil and compromise its energy security. The current challenge is to find a development model that is distinct from those of the richest countries and pursue solutions to combine economic growth with reduced emissions.

In this manner, and in consonance with the National Policy on Climate Change, the main paths for reducing GHG emissions in the energy sector without sacrificing economic development are the **increased use of renewable sources and the conservation and more efficient uses of available energy resources.**

The diversification of the Brazilian energy grid is imperative to guarantee the **maintenance of access** to markets and, principally, to **energy security**. The comparative advantage and available opportunities for Brazil in the field of solar and wind generation, in addition to the production of biomass and biofuels, are evident. Confidence in the unlimited offer of power generation from hydroelectric sources can be put into question for its seasonality and potential vulnerability to the availability of water resources as a consequence of climate change. Its complement should not be concentrated in thermal generation by either coal, fossil fuels or natural gas, given that they are non-renewable sources and large GHG emitters, their energy offer is volatile and subject to political and economic instability, both domestically and abroad. Considering the technology race for new, cleaner energy sources in industrialized countries, this will become an increasingly important competitive factor in a low carbon economy.

Furthermore, given the cost reductions per MWh, energy conservation and efficiency can be considered as the most **cost-effective** investment for the country.

2.2. THE TRANSPORTATION SECTOR

The Transportation sector presents big challenges for the next 20 years, not only considering the projected GHG emissions, but also the bottlenecks for the sector in Brazil and its dependency on fossil fuels as energy source.

The largest challenge is in respect to the increased efficiency of the transportation sector by way of **intermodal integration**. The continental dimensions of Brazil and its geographic conditions (extension of oceanic coastline, river basins etc.) are incompatible with a matrix for freight transport concentrated in the road mode. A more diversified matrix, with greater participation from the rail and waterway (inland and coastal) modes, is of strategic importance for the country, not only for the lower energy expenditure of ton kilometer transported, but also for the increased national competiveness by reducing logistics costs and delays, making sure that the transportation infrastructure in the country does not represent a bottleneck to the expected economic growth of Brazil in the upcoming decades.

In parallel, the rise of the concept of sustainability for the systems of **urban mobility** require integrated policies including transportation, urban planning, technology (low or zero emission vehicles), and improvements in traffic flow, with the resulting reduction in the average commuting time. Urban congestion is not only a problem for drivers and passengers; it also represents immense losses for the Brazilian economy in terms of lost productive hours, in energy waste and in public health issues. In addition, it also affects the productivity of businesses and the national economy as a whole.

Lastly, the **increase of the use of biofuels** in the energy matrix of Brazilian transport can reduce GHG emissions as well as our dependency on fossil fuels. This topic, given its amplitude, complexity, and crosscutting nature, will not be discussed in this document, and will be covered in-depth by forthcoming studies.

2.3. THE AGRICULTURAL SECTOR

The agricultural regions of the country represent a significant carbon stock incorporated in soils, a carbon sink, as its biological cycle removes CO_2 present in the atmosphere, and an emitter of GHG. Through livestock activities and the expansion

of the agricultural borders over areas of natural vegetation, the sector accounts for a considerable portion of the Brazilian GHG emissions.

Despite the enormous potential for mitigation of GHG in agribusiness, many available techniques have not yet been fully adopted, in function of various obstacles that have rendered difficult the agricultural sector's movement to lessen its impact on climate. In general, it is possible to identify the barriers and the solutions in aspects related to the **development and diffusion of agricultural technology for decreasing carbon intensity** and its respective financing. While some practices, such as the elimination of the burning of residuals from sugar cane, have incentives defined by law, the majority of the activities still depend on further incentives in order to be implemented.

The barriers involve policies **(i)** of research and development **(R&D)**, aimed at the development of new equipment, plant varieties, cultivation techniques and pasture management; **(ii)** of **technical assistance and rural extension**; **(iii)** of **capacity-building for farmers**, which requires the technical assistance by the local departments of Agriculture, for the continuous improvement and professionalization of the sector; **(iv)** **financial mechanisms** that demand clear and objective public policies to facilitate access to specialized credit and foster adaptation and mitigation efforts described above; and **(v)** **clearer regulation** for reducing emissions from deforestation and forest degradation **(REDD)** and for a mechanism of payment for environmental services **(PES)** that can contribute to the development of GHG mitigation projects in agriculture.

Lastly, the role of Agriculture stands out in the issue of biofuels, which includes the articulation of this sector with the Energy and the Transportation sectors, in order to equalize supply and demand for biofuels and for biomass.

PUBLIC POLICY PROPOSALS BY THE BUSINESS SECTOR FOR A LOW CARBON ECONOMY IN BRAZIL

03

In order to address the issues previously and briefly described, the Business for Climate Platform (EPC), representing a significant portion of the Brazilian business sector, presents a set of public policy proposals that aim to stimulate the creation of a low carbon economy in Brazil.

These proposals has the objective of contributing to the strengthening the competitiveness of the Brazilian industry, securing access of our products to global markets, creating a domestic market prone to technological development and to innovation, and promoting energy security in Brazil on a sustainable basis. Such proposals include the promotion of and investment in: **(i)** renewable sources of energy; **(ii)** conservation and efficient use of energy resources; **(iii)** transport modes which are more efficient and with lower relative costs; **(iv)** sustainability in urban mobility; and **(v)** large scale adoption of sustainable agricultural techniques.

For a better understanding, we have divided the set of proposals in two groups:

1. **Incentive policies for conservation and/or more efficient use of natural and energy resources**, including rational land use and incremental growth in the productivity of the Agricultural sector.

2. **Incentive policies for the use of renewable energy sources** in transportation and in power generation.

The proposals presented here depend on short, medium, and long-term actions and

on intersectoral policies. Furthermore, it is necessary to provide regulatory stability with long-term guarantees for investments made now and in the future through the establishment of a legal framework for the issues addressed here. As such, it is necessary to seek integration between the different government branches at the federal, state and municipal levels. The proposals also depend on an ample discussion among the relevant sectors of civil society, as well as with other affected stakeholders. This can be done by guaranteeing access to quality information to support the decision-making process, and through inclusive and participatory mechanisms, providing a "reality check" for the feasibility and compatibility with the needs for social and economic development on a sustainable basis.

3.1. INCENTIVE POLICIES FOR CONSERVATION AND/OR MORE EFFICIENT USE OF NATURAL AND ENERGY RESOURCES, INCLUDING RATIONAL LAND USE AND INCREMENTAL GROWTH IN THE PRODUCTIVITY OF THE AGRICULTURAL SECTOR

The promotion of **energy and production efficiency** is not necessarily conditional on technological hold ups, since efficient technologies are available, many of which with proven economic viability. Conservation and the more efficient use of energy resources present smaller costs in MWh than additional power generation by any source, and the incremental growth of agricultural productivity present the best cost-benefit ratio when compared with the costs of expanding to new lands.

The main challenge lies in promoting public policies that give scale to the use and continued development of these technologies. Thus, the barriers to implementation of projects that improve energy and production efficiency are more closely related to the political priority by the government, and to the existing economic incentives for business action and for consumer behavior.

This premise becomes all the more relevant considering the future scenarios that project the increased carbonization of the Brazilian energy matrix for the electricity and transportation sectors, as well as the expansion of the agricultural border to areas of natural vegetation, which have unquestionable value not only for the protection of biodiversity, but also for maintaining the climate equilibrium for Brazil and for the planet, security in food production and energy in Brazil.

Conscious that the most efficient use of natural and energy resources is fundamental for establishing a low-carbon economy in Brazil, the Businesses for Climate Platform (EPC) proposes the following:

Integrated **policies** for the stimulus and prioritization of efficiency in the use of natural and energy resources in the national agenda, through:

- **Promotion of energy and production efficiency in the industrial sector, ensuring access to external markets and meeting the increasing global demands for environmental efficiency.**
- **Increase efficiency of consumption of natural and energy resources in the civil construction sector, by way of differentiated credit lines for the promotion of retrofit as well as for efficiency projects in new developments.**
- **Promotion of efficiency in transmission, distribution and the consumption of electrical power by incentives for the research and development of new technology of energy transmission and distribution, as well as for materials and equipment, smart grids, and creation of incentives for distributed generation.**
- **Creation of minimum efficiency standards for electric equipments that, together with labeling programs, identify the most efficient choices and help eliminate less efficient alternatives in the market.**
- **Promote the work of energy services companies (ESCO), whose role is fundamental for the development of energy efficiency projects, to diagnose and assess potential improvements and to help the dissemination of best practices.**
- **Carrying out "auctions" for energy efficiency projects, considering the reduction of the demand for electricity through investments for the improvement of efficiency of the industrial consumption.**
- **Creation of new lines of credits with differentiated and directional rates for energy efficiency.**

Policies for the incentive of more efficient energy use in the transportation sector, through:

- **Expansion of the infrastructure of more efficient modes, as well as the upgrade of existing infrastructure.**
- **Stimulus for railway transportation, by investment in the expansion of its network and upgrade of the existing structure.**
- **Improved regulation on access and network sharing rules, and guarantee of regulatory stability for the operators of railway concessions.**
- **Stimulus for the development of regional transport routes for passengers.**
- **Stimulus for waterway transportation, by the development of inland waterways by the construction of locks in dams and/or parallel canals, and policies to stimulate the cabotage mode.**
- **Construction of connection and transshipment terminals between the modes in strategic integration points.**
- **Policies for the promotion of sustainability in urban mobility, by means of incentives for large capacity public transportation, structuring of a bus rapid transit (BRT) system, with incentives for its adoption in Brazilian municipalities, and the expansion of railway networks and quality improvement of the urban railway mode (trains and subways).**
- **Investment in R&D for new technologies for motors and materials utilized in the automobile industry, in order to increase energy efficiency and reduce emissions.**

Incentive policies for the more efficient use of natural resources, considering the challenges of each productive sector, including technological dissemination in agricultural activities for increasing productivity. Such policies should contemplate:

- **Tax incentives and access to credit that allows for the adoption of good agricultural practices with low GHG emissions. For example, the recovery of degraded pastureland and cogeneration of electric energy from biomass.**
- **Increase of productivity per hectare of pasture by means of incentives for the improvement of pasture management.**
- **Involvement and mobilization of the agribusiness sector in discussion on climate change.**
- **Effective use of public funds tied to climate change for the development of agricultural production.**
- **Development of financing and market mechanisms for the promotion of sustainable agricultural practices, among them a regulated and voluntary carbon market, the Reduction of Emissions from Deforestation and Forest Degradation (REDD) and the Payment for Environmental Services (PES) mechanisms.**

Additionally, incentive policies for the more efficient use of natural and energy resources in industry, trade, and households, by means of incentives and/or subsidies for the development and adoption of efficient technologies and practices, as well as the creation of lines of credit and financing and the use of the financial system for such end.

It should be noted that the above-listed proposals depend heavily on the articulation between the various instances of government, given that the energy policies depend on the agricultural and transportation policies, which in turn are dependent upon adequate fiscal policies for the promotion of energy efficiency and productivity.

In this context, the role of the private sector is fundamental for the agility in the expansion of the country's infrastructure, by means of public-private partnerships and private operation of public infrastructure through concessions, which mutual gains to the business sector and to society as a whole.

3.2. INCENTIVE POLICIES FOR THE USE OF RENEWABLE SOURCES OF ENERGY IN TRANSPORTATION AND IN POWER GENERATION.

Similarly to the policies for the conservation and the more efficient use of energy and natural resources, the promotion of the use of renewable sources of energy for the transportation sector (biofuels) and the generation of electricity (biomass, wind and solar, among others) present intersectoral benefits, and require articulated action between decision makers involved in their conception.

Energy policies that promote the use of renewable resources for the production of biofuels, solid and liquid, depend on a conjunction of agricultural policies for increase in production which, in turn, depend on investment in R&D and capacity building.

It is worth noting that investments in renewable sources of energy present additional gains for the energy security of a country, given that it reduces dependency on fossil fuels which, in addition to representing a significant contributor to climate change on a global level, are subject to oscillations in prices and supply in the global market.

Considering the relevancy of this topic for the competiveness of the productive sectors and its role in the transition towards a low-carbon economy in Brazil, the Businesses for Climate Platform proposes the following:

Integrated incentive policies for the use of renewable energy sources for the transportation sector (biofuels) and power generation (biomass, wind, solar, among others), through:

- **The payment of differentiated or subsidized tariffs for technologies in earlier stages of maturation (feed-in tariffs) and long-term power purchase agreement, as well as incentive for R&D for clean energy technologies.**
- **The maintenance of specific auctions for the generation of renewable energy.**
- **Lines of credit directed at renewable energy, offering the least costly credit for projects and for the development of a domestic industry of components for its supply chain.**
- **The development of new ventures for generation of renewable energy, including its supply chain, by means of fiscal incentives.**
- **Incentives for operations in the financial and capital market aimed at the development of new technologies in renewable energy, considering the important role of venture capital funds.**
- **Stimulus for distributed generation and for the consumption of renewable energy by means of specific credit lines and by fostering the use of equipments for generating renewable energy in micro-scale, and for the creation of a trade system for renewable energy.**
- **Improvement in the calculation of the Cost Benefit Index (ICB in Portuguese), in order to internalize the socio-environmental benefits (positive externalities) of ventures based on renewable energies.**

The Platform proposes the promotion of an integrated agricultural policy including:

- **Planting and increased productivity of agricultural commodities that serve as input for the production of biofuels.**
- **Fiscal incentives and purchase agreements for production and commercialization of biodiesel.**
- **Revision of the capacity of indebtedness of the agricultural sector, allowing producers to benefit from the fiscal mechanisms abovementioned.**
- **Capacity-building of producer by means of technical assistance by rural extension agencies.**

Additionally, the platform proposes:

- **Fiscal incentives for freight transport using low emission fleets.**
- **Incentives for the production and sale of vehicles that run on renewable fuel.**
- **Investment in R&D policies for production of second and third generation ethanol, as well as new prime materials for the production of biodiesel.**

FINAL CONSIDERATIONS

04

The proposals herewith aim at contributing to the transition towards an economy of low carbon intensity in Brazil by addressing three relevant sectors: Energy, Transportation, and Agriculture. They focus on the analysis and proposal of fundamental instruments for making the necessary conditions for the Brazilian economy to remain competitive in the context of managing GHG emissions.

Global climate change represents the most serious threat to human well-being and to natural ecosystems in the current century. Urgent actions are necessary for reducing the impact of anthropogenic actions on the planet's climate. This task should be shared by public and private efforts in a positive agenda, which requires responsible leadership in a participatory and innovative manner from the private sector, as well as integrated actions from governmental bodies—from the three levels of government—, in a systematic way, for the mitigation of GHG emissions, adaptation, technological development, and public-private investment in the various sectors of the Brazilian economy. The establishment of a legal framework is fundamental to create a fertile environment for investments, and to generate regulatory stability for the businesses committed to proactively engaging in a low-carbon economy.

By incorporating sustainability concerns into Brazil's economic development model, by means of an integrated vision of public policies, it is possible to reach the desired results of reducing the effects of climate change on human well-being and on natural ecosystems.

The proposals presented here represent only the beginning of an process that is expected continue in the coming years, seeking to stimulate the debate as well as to receive contributions to the collective construction of proposals for public policies to support a shift of the Brazilian economy facing the challenges of climate change.

INTRODUCTION

Climate change is a scientifically proven fact, and constitutes the most serious threat to human well-being and natural ecosystems in this century. While temperature changes, patterns of precipitation, and the frequency of extreme events have not been homogenous in all points around the globe, in the course of the 20th century the average surface temperature increased by 0.7 °C, with the highest increase concentrated in the last 3 decades. Eleven of the twelve years between 1995 and 2006 stood out as the hottest ever recorded in the global temperature registry (since 1850) (Pachauri and Reisinger, 2007; Stern 2006).

Such changes in climate patterns can cause innumerous consequences for life and economic activity on the planet, varying from effects in water availability to the increased incidence of tropical diseases, forest fires, loss of biodiversity, and shocks in agricultural production worldwide.

Science demonstrates that the degree of climate change can be diminished if States and economic actors take immediate action to mitigate the emissions of greenhouse gases (GHG) in the atmosphere. The report Stern Review: The Economics of Climate Chang (2006) maintains that the risks of the worst impacts of climatic changes could be considerably reduced if the level of GHG in the atmosphere were stabilized at a concentration of 450 and 550 ppm (CO_2). The current level of CO_2 in the atmosphere is at 430 ppm, which is increasing annually at a rate of more than 2 ppm. Researchers in the field cite the necessity of a global reduction in the projected GHG emissions of 80% by 2050, by keeping emissions at current levels thus maintaining the average temperature increase at no more than 2 °C by 2100 (Stern, 2006).

The Stern Review revolutionized the debate surrounding climate change by expressing for the first time, in a quantitative manner, that the total costs and risks of climate alterations will be equivalent to a minimum permanent annual loss of 5% of the global GDP. And if a series of larger risks and impacts were also accounted for, the estimated damages could increase up to 20% of the global GDP (Stern, 2006). The central conclusion of the study is that inaction is considerably more costly than action, for the costs of adopting mitigation techniques, which would stabilize emissions at 550 ppm and the increase in temperature at less than 2 °C until 2100, would in turn generate 1% to 3% of the global GDP. In other words, the benefits of strong and immediate action to confront climate change exceed the long-term costs of postponing action or not acting at all.

It is known that investments in the next 10–20 years will profoundly impact the climate in the second half of the 21st century. It is necessary to equate economic growth and environmental sustainability—something that can be done through the development of a low-carbon economy. Massive investments in technologies of low climate impact in the agricultural, industrial, energy—including transportation—and forestry sectors, allied to the promotion of an integrated agenda between the various actors of civil society, governments, businesses, NGOs and academia, are indispensable factors in the construction of a low-carbon economy. Individual efforts are also important, but insufficient by themselves. It is in this reality that the studies presented here within and the activities developed by the Businesses for Climate Platform (EPC) take place, as is seen below.

THE BRAZILIAN CLIMATE AGENDA

Urgent actions are necessary to reduce the emissions from fossil fuels and put an end to deforestation, the two principle sources of global GHG emissions. This challenge presumes common but differentiated responsibilities for all nations on the planet. Brazil, given its economic importance, its leadership in energy generation from renewable sources and its immense biodiversity, can and should have a protagonist role in the construction of a low-carbon global economy.

In 2009, the Brazilian government demonstrated an attitude of leadership in combating climate change within the emerging economies by promulgating the Law no. 12.187 of December 29, 2009, which institutes a National Policy on Climate Change (PNMC in Portuguese), which lists the diverse governmental initiatives at the federal level related to combating climate change already in existing or in the planning stages within the various economic sectors in Brazil. The government advanced the discussion by imposing voluntary targets to reduce GHG emissions in the order of 36.1% to 38.9% in relation to a business as usual scenario of emissions projected for Brazil up to 2000.

The year 2010 was crucial for the first steps in the materialization of the PNMC.

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In the beginning of 2010, the allocation of voluntary targets was proposed by sector and mitigation action, accompanied by a proposal to revise the National Plan on Climate Change. It created an agenda of discussion and workgroups in the scope of the Brazilian Forum on Climate Change and within the respective Ministries involved in constructing strategies of implementation for mitigation actions, with the participation of civil society, NGOs, the private sector and state and municipal governments. To implement the voluntary emission reduction targets for GHG proposed in the PNMC, the Executive Inter-ministerial Committee on Climate Change, in partnership with the Brazilian Forum on Climate Change, proposed the following distribution of quotes for action on mitigation. ***(Table)***

As such, the activities in the energy sector, livestock activities, and land use were the most targeted in the context of the PNMC.

However, the construction of a low-carbon economy in Brazil requires much more than the allocation of voluntary GHG emission reduction targets for only some sectors. A priority in the national agenda for private sector and government is the introduction of agenda with the generation of: **(i)** Business opportunities and investment; **(ii)** Incentives, especially economic ones, in a manner that guarantees the competitiveness of the sectors of Brazilian production, in the internal and external markets; and **(iii)** Public policies that make the above items viable and still include the allocation of efforts and resources in research and development of new "low carbon" technologies.

Internally, the work should be shared between public and private efforts, in a positive agenda. This should be realized in a manner that contemplates the opportunity for ample construction of public-private partnerships, where all of them are called upon to deal with the challenge of constructing a new economy of least carbon intensity. That is the proposal elaborated by the Businesses for Climate Platform and presented in the sectoral studies brought together in this publication, "Business public policy proposals for a low-carbon economy in Brazil: Energy, Transportation, and Agriculture".

THE BUSINESSES FOR CLIMATE PLATFORM (EPC)

In 2009, the disposition of an important portion of the Brazilian business community in stimulating an economy of lower carbon intensity in the country and act in partnerships with the State in the construction of a new sustainable development framework was evidenced by the creation of the Businesses for Climate Platform (EPC), a permanent Brazilian business platform for setting the transition course towards a low-carbon economy. With the support of the British Embassy and the coordination of the Center for Sustainability Studies in the School of Business Administration of the Fundação Getulio Vargas in São Paulo, the EPC platform has focused on the capacity-building of the private sector on issues related to climate change, in the promotion of dialogue between the various actors involved in the solution for the challenge imposed by climate change, in the generation of opportunities for the exchange of good practices among the member businesses an also in fostering collaboration for the positioning of the private sector in international and national negotiations on climate change.

The EPC platform aggregates business actors that are looking for leadership in a low-carbon economy and a relevant role in the debate and action in the face of global climate change in the Brazilian context. It brings together 27 pioneering organizations in the fight against climate change, among founding members of the Brazilian Program GHG Protocol and business representatives for different segments of the economy, with the objective of discussing practical solution for the reduction of corporate GHG emissions, management of risks and opportunities in climate change and adaptation to its effects, and contributions to a legal framework in the country, with the intention of maintaining competitiveness in national industry, and to promote business opportunities generated by a low-carbon economy.

The 27 businesses that make up the EPC (2010) are: AECOM, Alcoa, AmBev, Anglo American, Banco do Brasil, BM&F Bovespa, Bradesco, Camargo Corrêa, CNEC WorleyParsons, EcoRodovias, EDP, Grupo Abril, Grupo AES Brasil, Grupo Orsa, Grupo Santander Brasil, Grupo Ticket, Itaú-Unibanco, Klabin, Monsanto, Natura, O Boticário, PepsiCo, Shell, Suzano, TIM, Vale, and Whirlpool.

The EPC has supported businesses in the mapping of their emissions on the following fronts:

NATIONALLY APPROPRIATE MITIGATION ACTION (NAMA)	2020 (TREND) ($MtCO_2$)	REDUCTION BY 2020 ($MtCO_2$)		% REDUCTION	
LAND USE	**1084**	**669 (min.)**	**669 (max.)**	**24.7% (min.)**	**24.7% (max.)**
Reduction of deforestation in the Amazon (80%)		564	564	20.9%	20.9%
Reduction of deforestation in Cerrado (40%)		104	104	3.9%	3.9%
AGRICULTURE	**627**	**133**	**166**	**4.9%**	**6.1%**
Recovery of degraded pastureland		83	104	3.1%	3.8%
Crop-livestock integration		18	22	0.7%	0.8%
No-tillage system		16	20	0.6%	0.7%
Biological fixation of nitrogen		16	20	0.6%	0.7%
ENERGY	**901**	**166**	**207**	**6.1%**	**7.7%**
Energy efficiency		12	15	0.4%	0.6%
Increased use of biofuels		48	60	1.8%	2.2%
Expanded supply of hydroelectric power		79	99	2.9%	3.7%
Alternative sources (small hydro, bioelectricity, wind)		26	33	1.0%	1.2%
OTHER	**92**	**8**	**10**	**0.3%**	**0.4%**
Steel (replacing deforestation coal for planted forests)		8	10	0.3%	0.4%
TOTAL	**2703**	**975**	**1052**	**36.1%**	**38.9%**

(i) The continuous formation of leadership in climate change:

Formation of leadership in climate change and the low-carbon economy in institutions, with a focus on the development of business policies and systems of GHG emissions management, commitment and continuous action in the fight against the problem of global climate change, as well as taking advantage of the best opportunities that exist in the market.

(ii) Exchange of experiences and good practices among the members

Spaces for debate and discussions created by the EPC place businesses in touch with practical solution to common problems encountered by organizations that undertake the management of emissions—a pioneer network of construction, sharing, and distribution of the best practices.

(iii) Research, Discussion, and Dissemination

Development of studies and promotion of dialogue through round tables with the participation of specialists and representatives from different sectors (agriculture, energy, forestry, industry, services, and transportation), with the objective of constructing business proposals of incentive policies for a low-carbon economy in Brazil, though policy papers.

(iv) Mobilization and training for participation in international negotiations

The mobilization of the business sector for international climate negotiations and interaction with Brazilian negotiators for the proposition of suggestions and demands. Participation in the international network Corporate Leaders Group, which has as its patron His Royal Highness, the Prince of Wales and support in signature, by Brazilian businesses, of Communiqués promoted annually by His Highness.

(v) Communication and distribution of activities

Strategy for communication, dissemination

of knowledge, and distribution of EPC activities and its members through the events and publications, news and international seminars.

With respect to its structure, the Businesses for Climate Platform (EPC) is organized in three levels of governance: Workgroups, Strategic Forum, and CEO Forum.

The Workgroups bring together business representatives that meet periodically for the purposes of sharing information, exchanging experiences, and the formation of leadership for climate change. By means of workshops, the organizations are supported in the adoption of strategies and policies, adapted to their respective realities, that guarantee competitiveness and innovation associated with the mitigation of GHG gases, and the management of coming risks of climate changes. It stimulates business members to participate actively in the construction of a regulatory framework for a low-carbon economy in Brazil, through the proposition of public policies reasoned by policy papers constructed by the EPC and amply discussed among the businesses and civil society representatives in sector-specific round tables.

The Strategic Forum is a level of governance composed by representatives of organizations and specialists, in which the structure of proposals generated by the Workgroups are worked out in integrated policies and consistent with the National Policy on Climate Change.

The last level of governance in the EPC Platform is the CEO Forum, which meets annually to verify the principle advances of the Platform, to have conversations on strategies and promote the adoption of direct actions by their organizations, and to offer institutional support to the business proposals of public policies elaborated by the Workgroup and validated by the Strategic Forum. In this space, the engagement of businesses leaders is also fostered in the process of GHG emissions management and other risks associated with this issue in their organizations.

The EPC still counts on an Advisory Board that brings together the best specialists on climate change in the country, from diverse sectors, to discuss the course of the Platform and delineates, in conjunction with the management and member businesses, the strategic course of operation for the Platform.

SECTOR-SPECIFIC STUDIES OF THE EPC: "PUBLIC POLICY PROPOSALS BY THE BUSINESS SECTOR FOR A LOW-CARBON ECONOMY IN BRAZIL: ENERGY, TRANSPORTATION, AND AGRICULTURE"

The Businesses for Climate Platform (EPC), a permanent Brazilian business forum for dialogue, capacity-building, and the constructions of partnerships for a transition course towards a low-carbon economy, justifying Brazil's role as protagonist on the issue and expressing genuine business responsibility, comes to the public to present to the Brazilian society a conjunction of proposals for public policies for a low-carbon economy in Brazil.

The series of sectoral studies sponsored by the EPC encapsulates the diagnosis and analysis of climate challenges, in the national context, in three key sectors for the Brazilian economy: Energy, Transportation, and Agriculture. The choice of the sectors reflects the short proposal in the National Inventory. Studies with a focus on climate and the financial sector, and industrial processes, are in progress and should be presented in 2011. The studies have a scope of producing policy papers to inform public policies and offer tools for the implementation of the National Plan for Climate Change, of the National Policy on Climate Change and the Sector-specific Plans for the three sectors analyzed.

The process of conducting the studies counted on the participation of various specialists from the respective sectors, representatives from business, government, and civil society, in a process of continuous dialogue and revision of results of the partial reports, through the participation of these actors in round tables that took place in the Fundação Getulio Vargas from June to September 2010.

With this document, the businesses that make up the EPC look to support an extremely

urgent and necessary dialogue, on a complex theme, with views to contribute to the promotion of a low-carbon economy and of sustainable development in Brazil.

The analyses look to indentify obstacles in the Brazilian economy that should be covered by public policies, specifically or integrally, in a form to create the necessary conditions to promote a low-carbon economy and guarantee the best competitiveness in the different Brazilian economic sectors. Once the issues are defined, future studies can go further in detail (instruments, costs, deadlines, etc.) of the proposals of the three sector-specific studies, in a way that permits an effective reduction of GHG emissions at the national level.

In this manner, the objective of the efforts by the EPC in the studies is to contribute to:

(i) The strengthening of the competiveness of national industry in the new context of the global economy.

(ii) The guarantee of Brazilian products' access to international markets, which are increasingly more demanding in terms of socio-environmental norms.

(iii) The construction of an internal market propitious to technological development, to innovation, and to the adoption of business practices with the least GHG emissions potential.

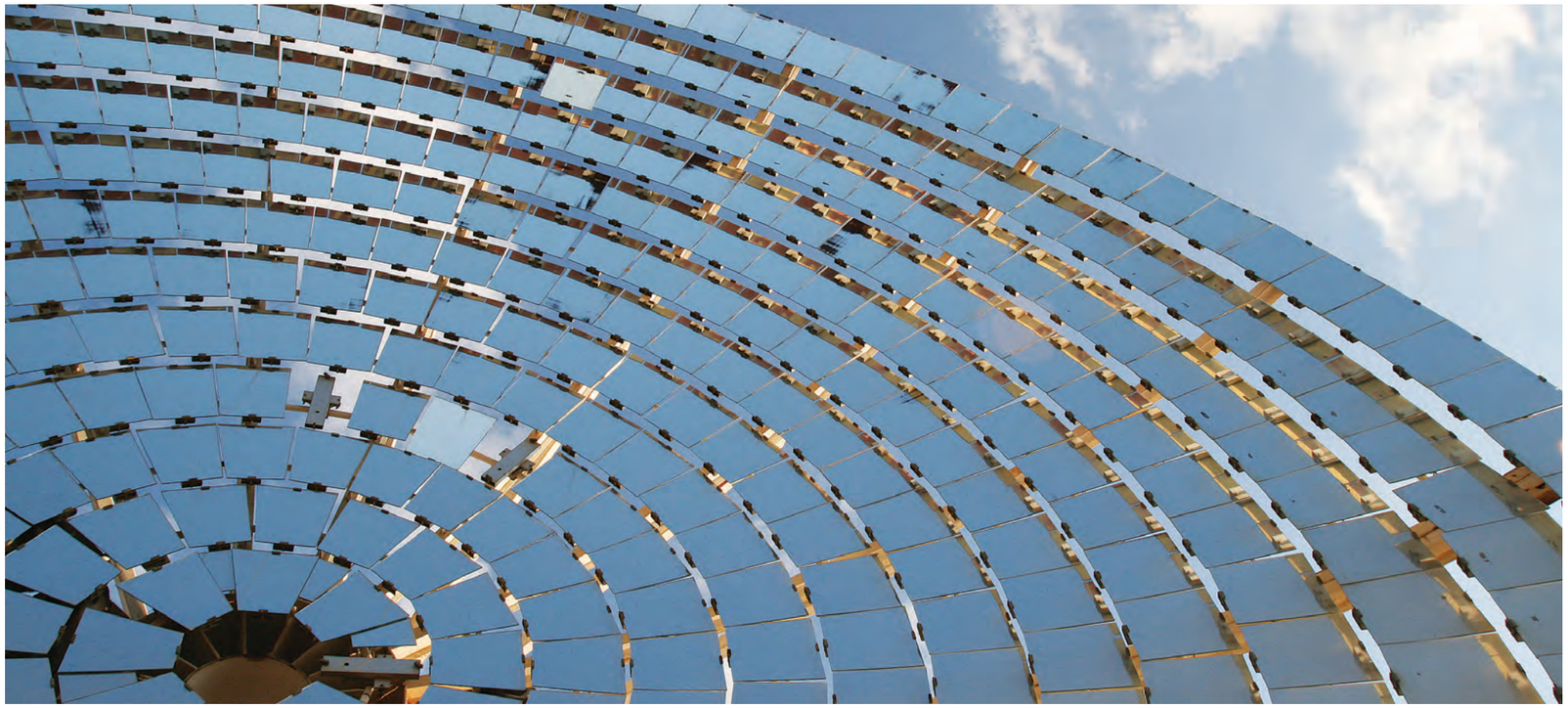
(iv) The promotion of energy security in Brazil.

To specify this objective, the EPC Platform, which represents an important part of the Brazilian business sector, introduces a set of public policy proposals that encourages the creation of incentives and promotion of investment for a low-carbon economy in Brazil.

These proposals contemplate the promotion of investments in: **(i)** renewable energy sources; **(ii)** conservation and the efficient use of energy and natural resources; **(iii)** intermodal integration, with modes of efficient transport of lower relative cost; **(iv)** sustainability in urban mobility; and **(v)** the large-scale adoption of sustainable agricultural practices.

For the purposes of instruction, the conjunction of proposals for public policies was brought together in two large groups:

1. Incentive policies for the **conservation or more efficient use of energy and natural resources**, including the rational use of soil and development of productivity in the agricultural sector.
2. Incentive politics for the **use of renewable energy** in the transport sector and power generation.



The proposals introduced by the sectoral studies of the EPC depend on short, medium, and long-term actions that should be integrated by means of intersectoral public policies. Furthermore, it is necessary to create regulatory stability with long-term guarantees for investments currently or soon to take place, through the development of a legal framework for questions covered here. As such, integrated action is necessary between ministries, in addition to Congress, as well as among the three government levels.

The fight against climate change is an enormous challenge and the time to act is now. Moving forward and taking advantage of the opportunities created by a low-carbon economy will be a competitive advantage for the businesses willing to invest in this course. It is also a competitive advantage for the country, which aims to establish itself as one of the major economies of the world. We conclude that over the course of the studies it is most advantageous to act proactively and in partnership between the public and private sector, instead of waiting for a regulation that could demand more ample actions from economic agents in a shorter amount of time and therefore increase the costs of transaction.

There is an opportunity for Brazil in moving forward and leaving the role of traditional commodities exporter behind by instead amplifying its role as exporter with services and technologies. Energy, Transport, and Agriculture are strategic areas for Brazil, and questions of planning and investments in these sectors for the upcoming decades should bring academia, the private sector, and civil society to the debate.

Through infrastructure planning, long-term investments, and the creation of economic instruments, a new path can be established in Brazil. A favorable moment for cooperation among the various productive sectors in Brazil is emerging, in the sense that a new model of economic development is being created—one that is more adjusted for a scenario of scarce natural resources and the necessity of a more responsible interaction and harmony with the environment. The studies presented here should be seen as an invitation for cooperation between the public and private sectors, and the Brazilian society, to come together in order to create this new reality.

ENERGY

TRANSPORTATION

AGRICULTURE

01 FUNDAMENTALS

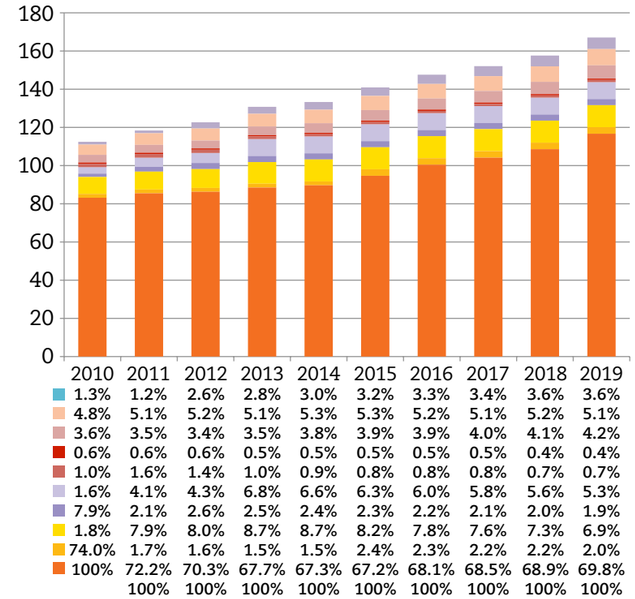
1.1. MOTIVATION FOR THE WORK

In Brazil, the Internal Energy Offer (OIE in Portuguese) reached close to 243.93 millions of ton of oil equivalent (toe) in 2009. From this amount, approximately 47.3% is represented by renewable energy sources, 15.2% from hydroelectric and electricity, 10.1% from wood and charcoal, 18.2% derived from cane and 3.8% from other renewable sources. Of the 52.7% of the OIE concerning non-renewable energy, 37.9% corresponds to petroleum and its derivatives, 8.7% to natural gas, 4.7% to mineral coal and coke and 1.4% to uranium. This industry leads from the perspective of final consumption by the energy sector, with 34.6%, followed by transportation with 28.3%, the energy sector, with 11%, residences, with 10.5%, agriculture, with 4.3%, and trade, with 2.8%, among others (EPE, 2010).

In this context, the Brazilian energy matrix represents a politically valuable environmental asset for the country in global discussions on climate change: in 2009, almost half of the energy offer was generated by renewable energy sources and close to 85% of electrical energy in Brazil provided from hydroelectric plants, a renewable source with low GHG emissions.

This favorable condition, however, could change, due to the urgent need for the increase in the electrical energy offer of the country—until 2019, the demand in TWh should increase by close to 56%, considering the current average growth rate of 5.1% (EPE, 2010)—whether it be done by means of thermal coal or fossil fuel plants, which have elevated GHG emissions. According to the Ministry of Mines and Energy (EPE 2007), there is the expectation of growth in the participation of fossil fuels (carbon, oil, and natural gas) and nuclear energy in the energy matrix, and the consequential reduction of the relative participation of hydraulic generation in the Brazilian electric mix: the incorporation of new generated units based in fossil fuel sources of energy will increase in participation in this segment of emissions from 6% in 2010 to 8% in 2019 (EPE, 2010), as is shown in *Figure 1*.

FIGURE 1: EVOLUTION OF THE INSTALLED CAPACITY OF POWER GENERATION BY SOURCE SOURCE: EPE (2010).



NOTES: Amounts refer to the installed capacity in December of each year, considering the motorization of hydropower plants; (a) Includes an estimate of imports from the Itaipu hydropower plant not consumed by Paraguay.

To corroborate, it has been verified that the same long-term planning—PNE 2030—provides a percentage increase of the resources of fossil fuel energy that is superior to those from renewable resources. *(Figure 2)*

Behind the energy planning there is

FIGURE 2: STRUCTURE OF POWER SUPPLY

SOURCE: EPE (2007).

SOURCE	2005	2030
Hydro	89.5%	77.4%
Thermal – natural gas	3.8%	8.7%
Nuclear	2.7%	4.9%
Coal plants	1.7%	3.0%
Cogeneration – sugarcane biomass	0%	3.2%
Wind	0.2%	1.0%
Thermal – urban waste	0%	0.6%
Thermal – other	2.7%	1.2%

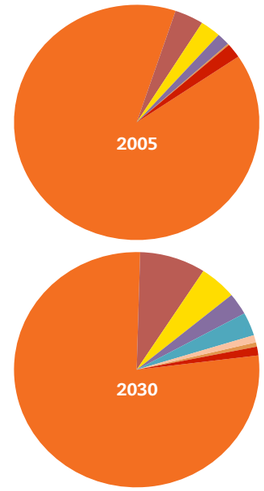
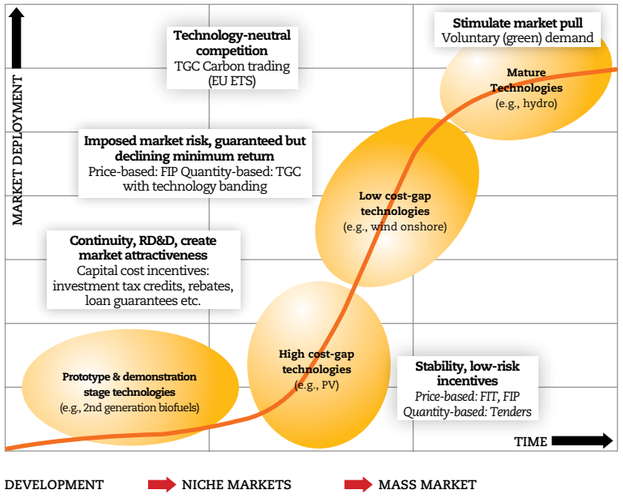
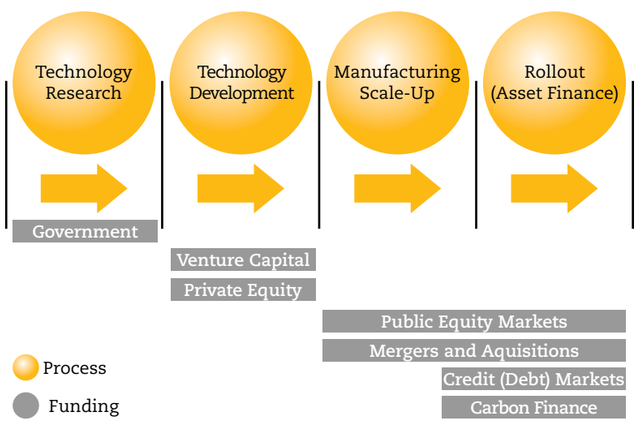


FIGURE 3: THE SUSTAINABLE ENERGY INCENTIVE CONTINUUM SOURCE: IEA APUD IEDI (2010).



an important variable: energy security, usually defined as "reliable supplies at a reasonable price" (Proninska apud Baumann, 2008). According to the same definition, the management of energy security of a country should be attentive to two factors: (i) predictability, availability (present and future) and complementarity of the energy offer, which favors higher diversification—and as such, less risk—of the energy mix; and (ii) the price of energy, which considers the concerns of the system manager in offering energy to industry and to the general population at a price that does not pressure inflation indexes or create a barrier for the country's growth.

FIGURE 4: THE SUSTAINABLE ENERGY FINANCING CONTINUUM SOURCE: PEW (2010).



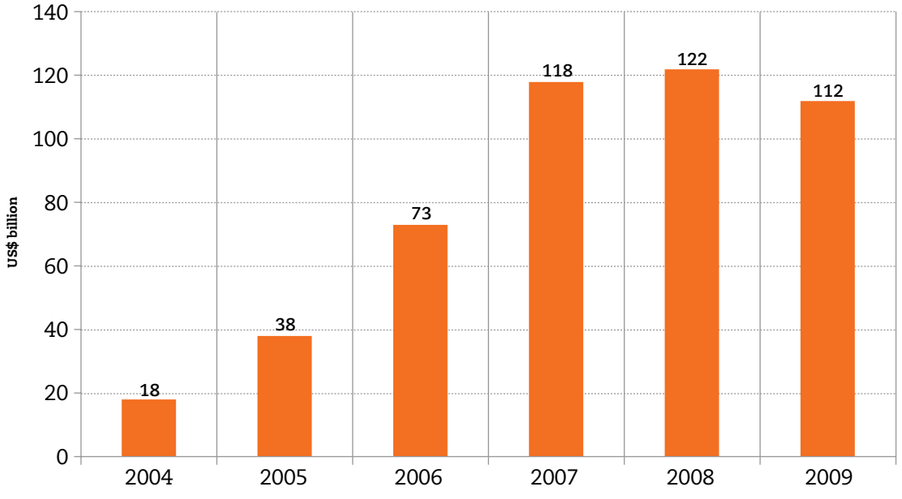
The proposal of this work is to introduce the variable of sustainability into the concept of energy security and the process of strategic decision-making in Brazil, or more specifically, the question of climate change, which can considerably impact: (i) investments in renewable sources and a system of relative energy prices; and (ii) the predictability and availability of the energy offer.

(i) Investment in renewable sources and the system of relative energy prices.

The regulation that has been put forth, especially by the Kyoto Protocol, in the global context and by the European Union Emissions Trading Scheme (EU ETS) in the European scope, demonstrates that economic instruments are beginning to transform externalities into outputs of real cash flows. The burning of fossil fuels can be regulated by market mechanisms and produce two effects: (i) an increase of costs in activities of GHG emissions; and (ii) a migration of capital to alternative sources of energy production, which begin to gain scale and in turn reduce marginal costs, which become more and more competitive and less dependent on incentives. *Figure 3* illustrates, in a non-exhaustive way, the continuum of incentives for renewable energies vis-à-vis the market maturity of the technology employed. In addition, *Figure 4* points out the financing alternatives for this industry in function of its developmental stage.

This migratory movement of capital towards renewable sources can be illustrated by *Figure 5*. In 2008, global investments in renewable energies were in the order of $160 billion, of which $40 billion (25%) were in large hydroelectric plants. The investment in renewables surpassed that of technologies based in fossil fuels (close to $110 billion) for the first time in history. This was also the first year that more energy from renewable sources was added to the generating capacity for electricity in the U.S. and EU than from traditional sources.

FIGURE 5: GLOBAL INVESTMENT IN RENEWABLE ENERGY (2004–2009) SOURCE: UNEP SEFI & NEF (2010).

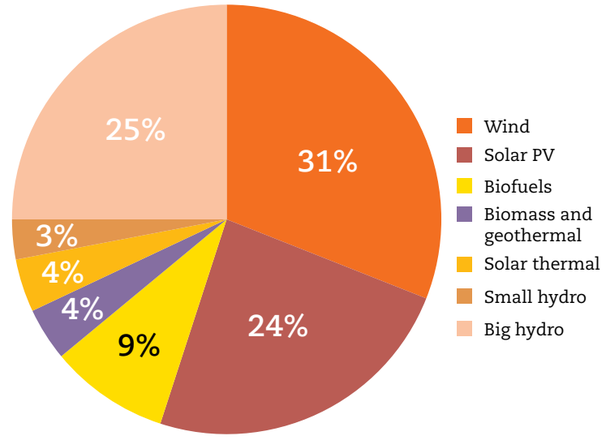


Of the $120 billion invested, 87% was concentrated in wind and solar energy, and refineries for biofuels. Still, the recent economic crisis had an impact on the renewables sector and in 2009 there was a drop of 8.6% compared with 2008, not considering investments in large hydroelectrics (UNEP, SEFI, & NEF 2010).

In accordance with the Global Wind Energy Council (GWEC), "the global capacity to generate wind energy increased 28.2% in 2008, and the United States became the country with the highest installation potential". According to the Secretary General of GWEC, Steve Sawyer, "the numbers speak for themselves: there exists an ample and growing global demand for wind energy, free of emissions, which can be installed rapidly in virtually any part of the world". For the president of the GWEC, Arthouros Zervos, "the wind energy is frequently the most attractive option for energy generation, both in economic terms and in terms of increasing energy security, not to mention the benefits for economic development and for the environment" (AFP, 2009).

According to the Agence France-Press (AFP), citing the GWAC, "in 2008, China doubled its installation capacity, adding at least 6.3 GW and reaching 12.2 GW overall. At this rate, the Asian giant is on course to surpass Germany and Spain and become the second largest country in terms of wind production, in 2010" (AFP, 2009). *Table 1* illustrates this new scenario.

FIGURE 6: GLOBAL INVESTMENTS IN RENEWABLE ENERGY BY SOURCE (2008) SOURCE: UNEP SEFI & NEF (2010).



To exemplify the impact of diverse sources of energy on relative prices—accounting for the tendency of price convergence and consequent increase of competitiveness of renewable sources—we present the prices of generation

TABLE 1: INSTALLED POWER CAPACITY FROM RENEWABLE SOURCES SOURCE: REN21 (2010) E EPE (2010).

	WORLD	DEVELOPING COUNTRIES	EU-37	CHINA	USA	GERMANY	SPAIN	INDIA	JAPAN	BRAZIL
Wind	121	24	24	12.2	25.2	23.9	23.9	9.6	1.9	0.3
Small hydro	85	65	65	60	3.0	1.7	1.7	2.0	3.5	4
Biomass	52	25	25	3,6	8.0	3.0	3.0	1.5	>0.1	1
Solar PV	13	>0.1	>0.1	>0.1	0.7	5.4	5.4	~0	2.0	~0
Geothermal	10	4,8	4,8	~0	3.0	0	0	0	0.5	0
Solar thermal	0.5	0	0	0	0.4	0	0	0	0	0
Tidal	0.3	0	0	0	0	0	0	0	0	0
TOTAL RENEWABLE EXCLUDING BIG HYDRO	280	119	119	76	40	34	34	13	8	5
Big hydro	860									81
Total capacity	4.700									102

from renewable sources observed in the energy auctions of reserve A-3, which took place in August of 2010, in *Table 2*.

For comparison, the newspaper Valor Economico reported that there were no buyers for the plants in Jirau, on the Madeira river, in the auction that took place on October 18, 2010: "The prices proposed, between R$ 130 and R$ 136 [approx. $75 and $78.5, respectively] per MWh, were considered very high given the expectations that businesses will have on energy in the future". Without any closed contract on the energy free market, at less than two years since the start of operations, the profit that the project proportions to its actions is unknown and is at the mercy of the behavior of rain and of increase of demand, factors that will eventually push the prices of the free market up" (Goulart, 2010).

(ii) Predictability and availability of the energy offer

TABLE 2: PRICES OF POWER GENERATION FROM RENEWABLE SOURCES IN BRAZIL SOURCE: REUTERS (2010).

TECHNOLOGY	PRICE (R$/MWh)
Wind	130.86 ($75.50)
Small hydro	141.93 ($82.85)
Biomass	144.20 ($83.35)

NOTE: Prices from the renewable energy auction held on August 26, 2010.

Considering the perspective of the highest use of electricity, the vulnerability of the actual model of power generation in Brazil is concerning. Close to 70% of the current hydroelectric potential to be used is located in the Amazon or in the Cerrado (EPE, 2007). That said, the superficial hydro availability in watersheds, among them the Amazon basin, will be considerably impacted as a consequence of changes in the climate region, according to Salati et al. (2008). The projection of hydrological flows between 2011 and 2100, considering two distinct climate scenarios, points to a significant reduction in the flows of bodies of water, most of all in the Northern region, where they are trying to increase the efforts for hydroelectric energy generation. In this context, maintaining an excessive concentration of exploration of hydroelectric potential in the regions of the North and Central-West can put the energy security of the country at risk. (*Table 3*)

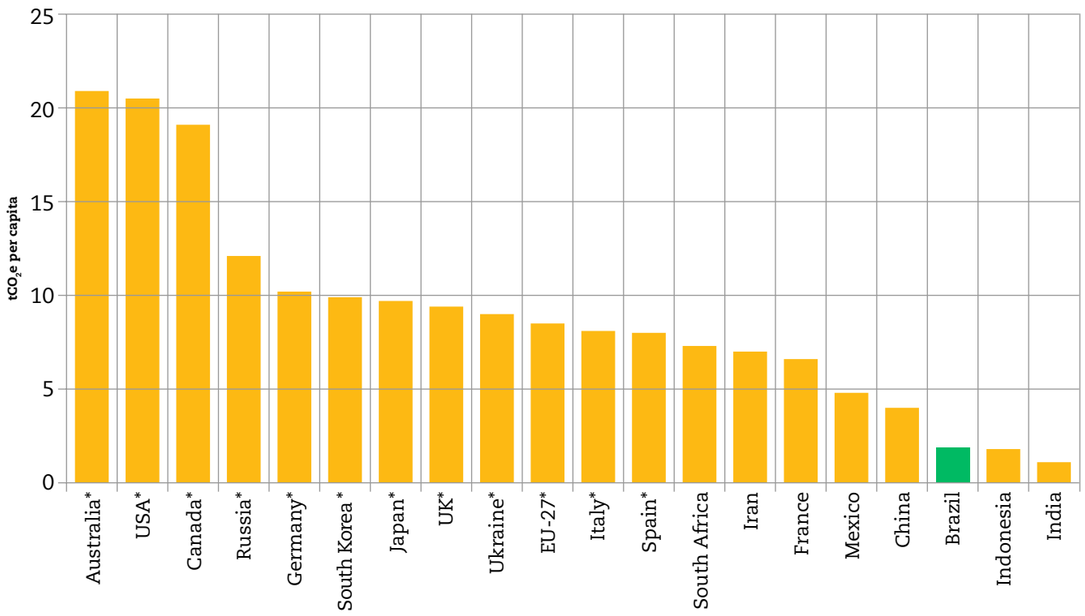
In addition, the models project that the increase in flows in the Southeast region of the country without considering the impact of climate changes, a scenario that could generate extreme situation for the existing reservoirs.

For reasons associated with energy security, several countries are promoting the expansion of the renewable component in their energy matrixes by means of incentive policies and the development of projects based in alternative sources. Ignoring their vocations does not make sense in terms of energy security given the potential for energy generation from wind and solar matrixes. This also would affect the energy security of the country and its businesses, given that the most important countries on the international stage are increasing investments in R&D and renewable energy generation. Businesses in these countries have also increased their participation in these segments. Considering the transition to a green economy on the

TABLE 3: WATER FLOW IN THE MAIN BRAZILIAN RIVER BASINS SOURCE: MARGULIS & DUBEUX (2010).

RIVER BASIN	HISTORICAL SURPLUS (FLOW) (m^3/s)						
	ANA	B2-BR SCENARIO			A2-BR SCENARIO		
	1961-1990	2011-2040	2041-2070	2071-2100	2011-2040	2041-2070	2071-2100
TOCANTINS	13,264	9,825	9,091	7,376	9,945	7,545	6,434
AMAZON	131,047	122,911	111,609	98,944	123,238	97,197	91,930
PARAGUAY	2,368	1,915	2,169	2,175	2,145	2,023	3,470
ORIENTAL ATLANTIC NORTHEAST	779	119	83	14	133	67	2
ATLANTIC EAST	1,492	381	375	99	423	328	88
PARANÁ	11,453	9,700	9,649	10,699	10,764	10,038	12,669
PARNAIBA	763	241	150	108	261	98	75
SAO FRANCISCO	2,850	1,088	1,227	1,331	1,223	1,273	1,504
ATLANTIC SOUTH	4,174	4,643	4,496	4,832	4,659	4,239	4,599
URUGUAY	4,121	4,577	4,511	4,783	4,435	4,084	4,342
SOUTHEAST ATLANTICT	3,179	2,547	2,674	2,779	3,174	2,966	3,036
OCCIDENTAL ATLANTIC NORTHEAST	2,683	1,935	1,670	1,570	1,915	1,395	1,250
TOTAL	**178,173**	**159,882**	**147,704**	**134,710**	**162,315**	**131,253**	**129,399**

FIGURE 7: PER CAPITA EMISSIONS FROM THE 20 BIGGEST EMITTERS IN THE ENERGY SECTOR SOURCE: WRI (2010).



NOTE: * Countries in the Annex I of the Kyoto Protocol

TABLE 4: AVERAGE EMISSION FACTOR BY TECHNOLOGY, IN CO_2e SOURCE: ADAPTED FROM KELMAN E VEIGA (2010).

TECHNOLOGY	EMISSION FACTOR (tCO_2/MWh)
Hydro, solar, tidal, wind, biomass and nuclear	Zero
Diesel and fuel oil	0.65
Natural gas	0.45 to 0.55
Coal	1.00

global scale, it is essential that the country create conditions for the development of technological solutions based on renewable energies. (*Table 4*)

1.2. EMISSIONS PROFILE OF THE SECTOR

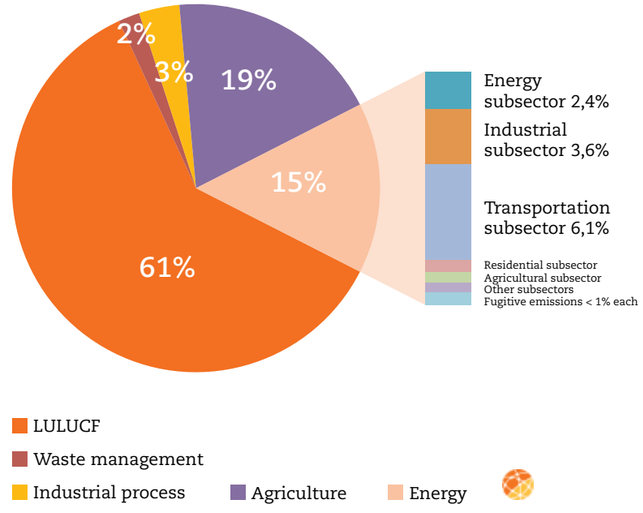
Brazil stands out in reduction indexes of emissions from the energy sector compared to the rest of the world. The emissions per inhabitant in the country still do not compare to other more industrialized economies and are more inclusive than those of South Africa, Mexico, China, and Iran. *Figure 7* presents a list of 20 major emitters of GHGs per inhabitant in the context of energy.

This scenario is the result of an energy matrix with relatively high participation of renewable resources (47.3%), notably in its hydroelectric generation, which according to *Table 4*, presents low or no GHG emissions.

According to the national inventory of 2005 recently published by MCT, the energy sector in Brazil, which includes transportation as a subsector, is responsible for 15% of CO_2 emissions and the participation of electrical energy generation in total GHG emissions is only 2.4% including its own consumption in the system of generation, transmission, and distribution.

In relative terms, *Figure 8* also shows that the emissions from the energy subsector are less significant that those resulting from the use of energy in the form of diesel/fossil fuels in industry (3.6%) and in transportation (6.1%). Energy generation from renewable sources is only part of the solution for the moment. It is so important that the more the potential for increasing generation becomes, the more energy efficient that energy generation on the whole becomes. The term energy efficiency is generally associated with new technologies and better organization and management of resources in respect to the least consumption of energy for the same final product. Consuming efficient energy is an imperative in the context of the challenges faced by the energy sector in any country, especially in regards to energy security.

FIGURE 8: EMISSIONS BY SECTOR IN 2005, IN CO_2 SOURCE: MCT (2010).



02

CHALLENGES FOR THE ENERGY SECTOR

Considering the current model of economic and technological development (business as usual), Brazil will tend to increase its GHG emissions proportionally to its economic growth in the medium and long-term. From the environmental point of view, maintaining this model implies a Brazilian contribution to global warming above levels that guarantee the maintenance of quality of life on the planet. Economically, the insistence of this model can undermine Brazilian competitiveness and compromise its energy security. The current challenge is to look for a distinct development norm from those promoted by the richer countries and pursue solutions that simultaneously grow the economy while reducing the rate of increasing emissions.

The transition to a more renewable global energy grid will not happen suddenly, given that the forces that sustain the current non-renewable model are difficult to reverse for various reasons such as: (i) the high level of material and energy consumed in developed countries, which also is seen in higher or lower levels in emerging countries; (ii) the non-renewable energy infrastructure already established in a capital-intensive form with long-term horizons; (iii) the rising demand for energy-related services around the world; and (iv) population growth (FAPESP, 2010).

On the other hand, Brazil cannot rest on decisions made three or four decades ago that place the country in the position of the main protagonist in the international energy stage and lie comfortably in the face of challenges and opportunities brought up by the question of energy in the 21st century. Brazil presents great potential for development of renewable energies and cannot be satisfied with only the exploration of its hydroelectric potential and with its leadership in biofuels on the international stage.

The diversification of the sources of the Brazilian energy grid is essential for its energy security. The comparative advantages and available opportunities for Brazil in the field of solar and wind use, beyond the production of biomass and biodiesel, are evident. Though hydroelectric energy generation is clean and renewable, it cannot be concentrated only in thermal generation of coal, fossil fuels, and natural gas, given that beyond non-renewable sources of high GHG emissions, its offer is volatile and subject to political and economic swings in both the domestic and international arena.

At the same time, the awaited growth for the nation's industry will increasingly demand more energy from non-renewable sources for the production processes and civil construction. The advance of energy efficiency in industrial processes, construction of buildings and homes, and transportation looks attractive because it is a cost-effective option (any investment will generate returns, in this case by means of future economies of energy). This will come with results that have the same level of quality of any other available service for contract, given that the final product is not altered (mobility, lighting, environmental comfort, etc.) and can only obtained through less energy consumption (FAPESP, 2010).

For a country, the costs associated with the transition to a more efficient energy model, more than just being competitive, are cheap when compared with the costs of dependency on fossil fuels in the long term. In calculating the costs of extraction, production of equipment, combustibles, residuals and the restoration of areas due to inefficient use of fossil fuel energy, the energy efficiency becomes a significantly cheaper alternative.

For a consumer of energy, such as an industry for example, the cost of additional energy obtained by means of efficient energy can be competitive with an energy offer from the grid. In general, these benefits are still more perceivable in developing countries that show higher growth in demand for energy.

The Decennial Plan presents extremely modest scenarios for the conservation

of energy (*Table 5*), though the method of reduction in electricity consumption (3.2% in 2019) is sufficient enough to slow the construction of a hydroelectric plant to approximately 4,800 MW of its nominal capacity. As a comparison, the hydroelectric facility of Belo Monte provides an installed capacity of 11,233 MW and an average generation of 4,500 MW because of the loss of flow from the Xingu River in the summer, which is a drier season for the region.

The methods in which the very same Decennial Energy Plan 2010–2019 makes explicit the potential for conservation of energy by means of energy efficient initiatives are modest. In presenting the result of the implemented programs since 1996, the Business of Energy Research (EPE in Portuguese) observes the following:

> *"These results show that it is possible to 'remove' one portion of consumption by means of initiatives in the area of energy efficiency. By treating it as a continuation of actions that were already being taken for many years this possibility is already considered in projections as autonomous progress. The potential for energy efficiency is much greater than the expansion of consumption." (EPE, 2010)*

1 Term officially used by EPE, referring to the effective reduction of power consumption and not to its conservation in physical terms (EPE, 2010).

According to the EPE, "complementary actions, in the sense of increasing the effort of energy efficiency, are desirable and necessary".

The PDE 2010–2019 classifies the potential of energy efficiency in three levels (EPE, 2010):

- **Market potential, which includes the result of methods that could be introduced "for themselves", or in other words, those whose adoption would bring a reduction of cost to the user.**
- **Economic potential, which includes the conjunction of methods that are economically viable, but require conditions that require effective implementation.**
- **Technical potential, which establishes a theoretic limit for the penetration of methods of energy efficiency, given the substitution of all the uses of the considered energy by equivalents to more efficient and available technology.**

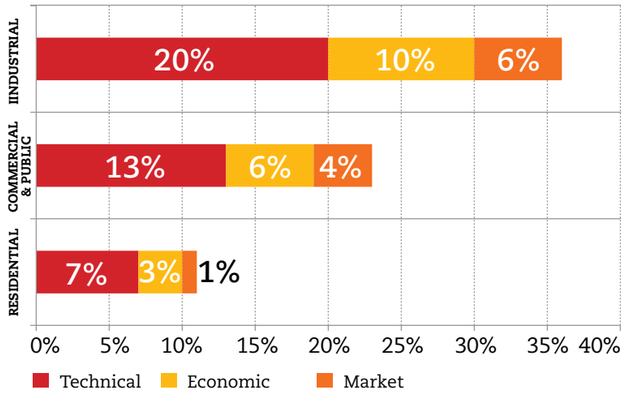
TABLE 5: ENERGY CONSUMPTION (POWER AND FUEL) FORECAST IN BRAZIL, 2010–2019 SOURCE: EPE (2010).

TECHNOLOGY	2010	2014	2019
Consumption – w/o conservation (103 toe)	184,110	235,628	309,229
Conserved energy (103 toe)	1,467	5,481	13,325
Conserved energy (%)	0.8%	2.3%	4.3%
Consumption – with conservation (103 toe)	182,644	230,148	295,904

Using this classification, the reduction potential of Brazilian emissions by efficient energy use is considerable — in the order of 36%—, in particular for the industrial sector. (*Figure 9*)

The little attention dedicated to the benefits of energy efficiency by the Brazilian government still does match the elevated potential for mutual economic gains with the promotion of eco-efficient technologies, given that the average cost of MW conserved per project of energy efficiency in industry were R$ 79/MWh (approx. $45.5) (CNI & Electrobrás, 2009), a lower value to the marginal cost of expansion predicted in the last PDE of R$ 11/MWh ($6.5) (EPE, 2010). The numbers for Brazilian industry show that to be energy efficient is the most viable solution, both economically and socio-environmentally. This is delaying large investments in infrastructure of electricity generation and the obtaining of fossil fuels. It also means that there is less time for return on investments with the utilization of technologies already commercially available. Similar reasoning can be applied to the transportation and civil construction sectors, for which Brazil presents very weak initiatives in energy efficiency.

FIGURE 9: ENERGY EFFICIENCY POTENTIAL THROUGH 2030 SOURCE: EPE (2007).



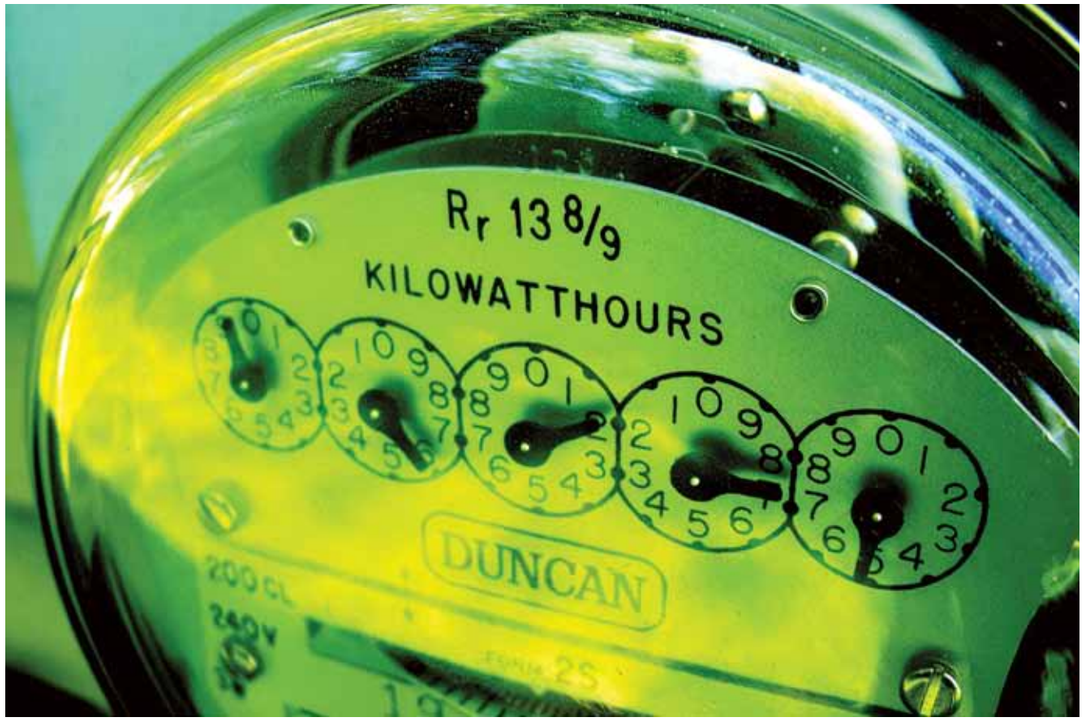
Beyond avoiding GHG emissions, investments in energy efficiency create other benefits for:

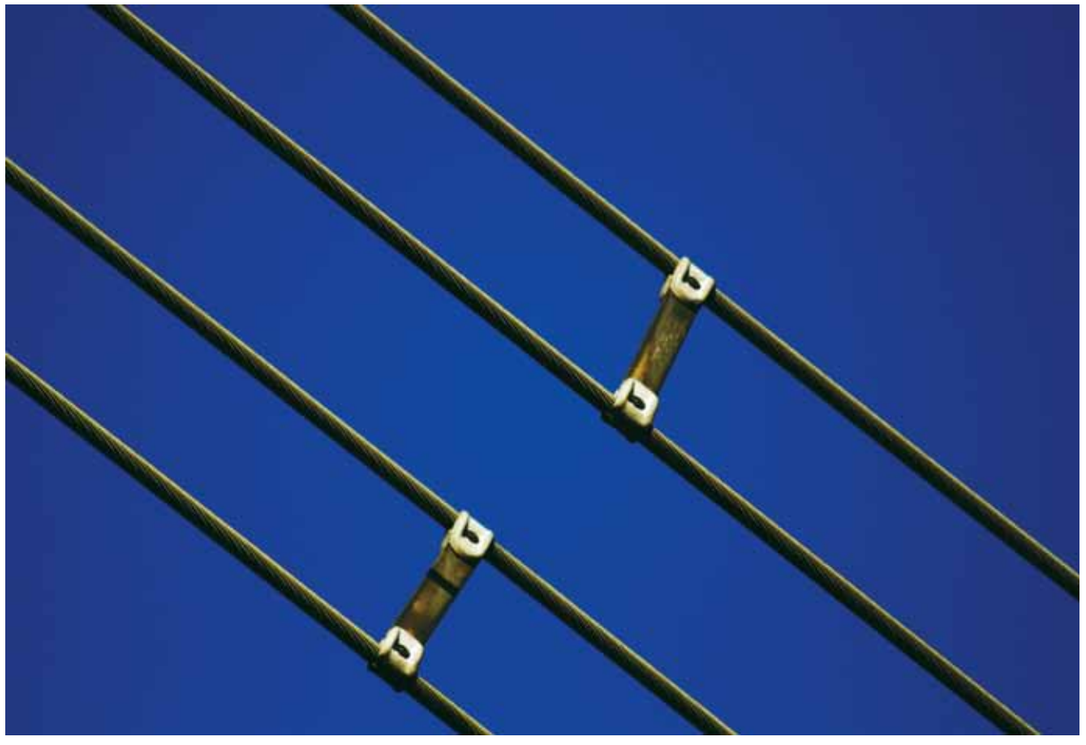
- **Industries, by diminishing their need for inputs and residuals, reducing their costs and becoming more competitive, beyond the reduction of environmental impacts of their operations.**
- **Governments, by contributing to the energy security of the country and reducing the necessity for investment in the expansion of energy generation.**
- **Society as a whole, by means of reducing negative externalities that are attributed to the process of energy generation from non-renewables sources, resulting in better environmental quality.**

All of these aspects confer the growing role of efficiency in matching the demand for energy, allowing the energy supply to a higher number of consumers with the same installed capacity. At the same time, it reduces the necessity for expansion of the energy offer from non-renewable sources. Energy efficiency policies represent a cheap option for the country's transition to a low-carbon economy.

Thus, and in line with the National Policy on Climate Change and with the listed reasons above, the main challenges for the maintenance of the Brazilian global hegemony in power generation of renewable energy, access to increasingly more demanding markets in terms of socio-environmental aspects, and its energy security, are:

- **The increase in the generation and use of renewable sources of energy.**
- **The conservation and more efficient use of all energy forms available (energy efficiency).**





03

DIALOGUE WITH REALITY: REGULATORY FRAMEWORK

The formulation and implementation of an agenda of sustainability in the Brazilian energy sector requires a dialogue with a regulatory framework, in the scope of public policies in progress. This agenda needs to be supported in the context of the reality to respond to challenges and take advantage of the opportunities that this reality offers.

At least two references need to be analyzed and incorporated in the sustainable trajectory of the energy sector in Brazil: Energy policies presented by the Decennial Energy Plan (PDE 2010–2019) and in the National Energy Plan (PNE 2030, and the National Plan on Climate Chang (PNMC).

An analysis in the sub-national context is important since the scope of work has not been contemplated and given that the energy necessities of each state end up been dealt with by regional actions with state impacts. We will pass then to an analysis of the instruments listed above, which are important for the implementation of good practices in sustainability for the energy sectors.

3.1. CURRENT POLICIES

3.1.1. INCENTIVE POLICY FOR RENEWABLE ENERGIES

▸ Incentive program for alternative sources of Electric Energy (Proinfa)

Proinfa is a feed-in mechanism for the development of industry in renewable energy that entered into operation in 2004 with the objective of building generation plants using three types of technologies of renewable energy for Brazil: wind, biomass and small hydro.

It is worth mentioning that the predicted growth for installed capacity in the country for small hydroelectric facilities (4.2%), biomass (5.1%) and wind (3.6%) will come to be 12.9% en 2019. In 2010, this number was 9.7%. These three sources were contemplated by the

Incentive Program for Alternative Sources of Electrical Power (Proinfa), an initiative instituted in 2002 by the Ministry of Mines and Energy to foster the alternative technologies that initially presented 144 contracted projects (of those, 7 were canceled), totaling 3,155 MW of additional capacity until the end of 2010—1,181 MW in 62 small hydro, 550 MW in 21 thermoelectric and biomass plants and 1,423 MW in 54 wind plants (EPE, 2010).

► **Discount in wireless rates**

Since December of 1996 there have existed specific incentives for the sale of renewable energy through contracts in the free market. These incentives assume the form of discounts on transportation and distribution tariffs for consumers that buy energy by means of contracts are backed by projects of non-conventional renewable energy of up to 30 MW. In practice, the incentive functions like a subsidy cross over for investments in transmission and distribution networks. Regulated consumers pay proportionally more, while the free consumers that contracts renewable energy pay less.

► **Auctions for specific technologies**

Auctions for specific technologies function like complementary incentive policies to the feed-in tariffs. They have a determining role in the development of technology and cost reduction in generation of energy from renewable sources. In August of 2010, by means of a new Auction for Alternative Sources of Renewable Energy, 2,892.2 MW of installed potency were contracted at an average price of R$ 130.86/MWh (approx. $75.5), which is relatively less than the R$ 148/MWh ($85.5) of the previous auction that took place in 2009.

The volume of energy contracted and the variation of the negotiated tariff demonstrated that the investment that initially took place was a determining factor for the competitiveness of the three technologies for the generation of energy.

► **Auctions for distributed generation**

Energy auctions from the generation distributed are alternatives that aim to increase the acquisition capacity of renewable energy for concessionaries. As such, the current norm for payment has been an obstacle for the application of this mechanism until this moment. This is because it is based in the average price of newly contracted energy in regular auctions for entry in the year in question.

3.1.2. INCENTIVE POLICIES FOR ENERGY EFFICIENCY

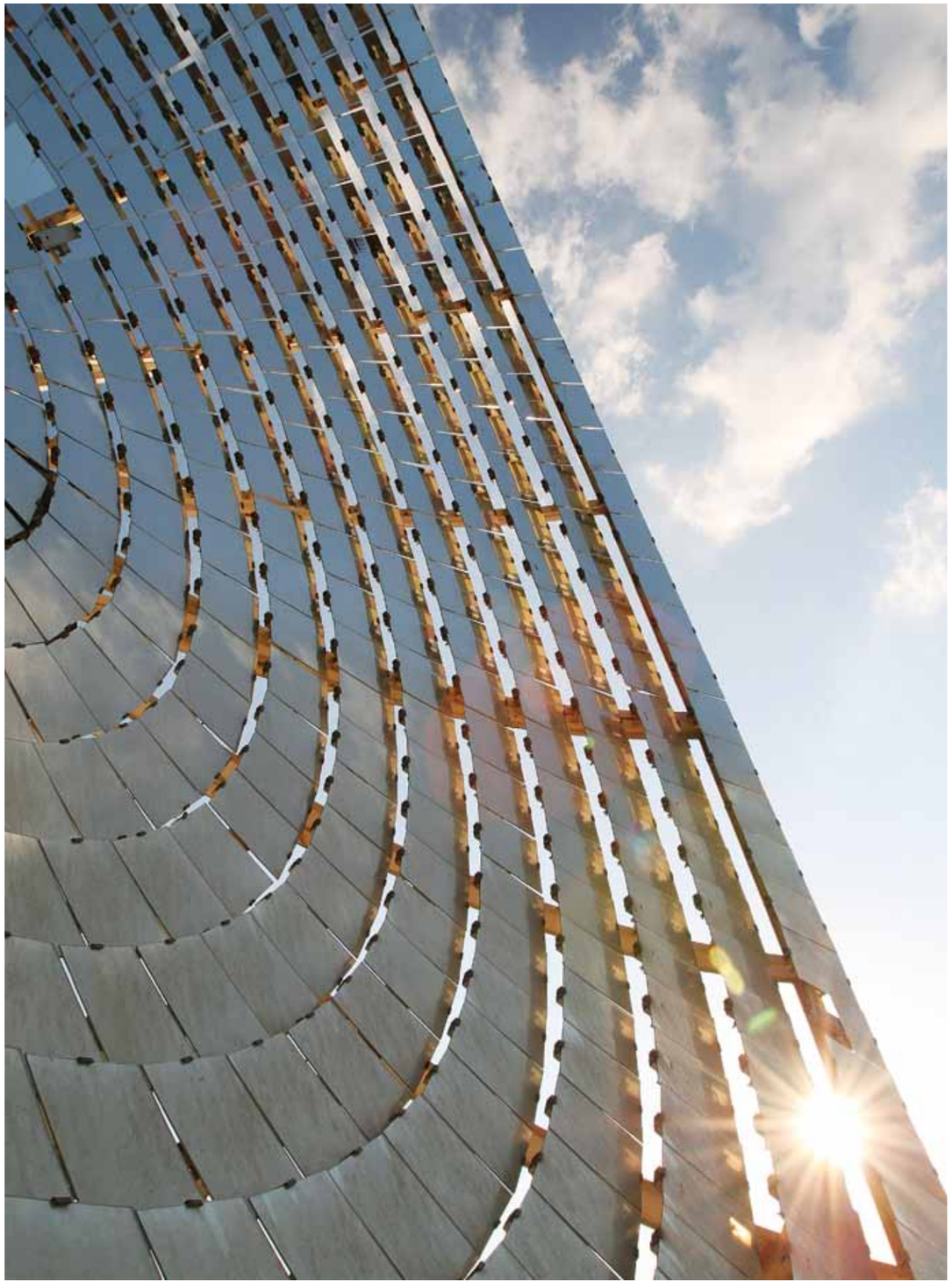
► **National Conservation Program of Energy Efficiency (PROCEL in Portuguese)**

Implanted in 1985 by the Ministries of Mines and Energy and the Ministry of Industry and Trade, PROCEL's principal initiative is the promotion of energy efficiency in Brazil. Its three principal objectives are: a reduction in technical losses from concessionaries, the rationalization of the use of electrical energy, and the increase of energy efficiency in electrical appliances. PROCEL also has the goal of reducing the technical losses from the transmissions and distribution from concessionaries for a value close to 10%.

Within the diversity of subprograms of PROCEL, the PROCEL Seal stands out. The Seal was created in 1993 in partnership with INMETRO to indicate which products that are made from the highest energy efficiency within a certain category of products. Also of not is the PROCEL RELUZ, created in the 2000, which promotes the development of efficient systems for public lighting and street light signals beyond the expansion of a system of public lighting.

► **Program for energy efficiency of distributors (1998)**

In July of 1998 after the restructuring of the electric sector, the recently created ANEEL determined through Resolution 242/1998 that all the concessionaries of distribution were to pay out at least 1% of their revenue in programs for improving electricity efficiency. After various alterations, the distributing concessionaries of electricity can now annually apply 0.5% of their liquid operations revenue in programs of energy efficiency that include the



substitution of electric showers for solar water heaters, the substitution of refrigerators and lighting systems, more adequate residential installations, and performance contracts, among other areas.

3.1.3. PLANNING FOR THE LONG-TERM

The National Energy Plan (PNE 2030) presents three principle lines of actions in the Energy sector, considering the convergent issues with the EPC: energy efficiency, GHG emission, and technological development.

In complement, the PNMC introduced three priority issues for the mitigation of emissions in the electricity sector:

- **Improvement of efficiency in the distribution and offer of energy.**
- **Substitution of more carbon-intensive fossil fuels for those with less carbon content or for combustibles from renewable sources (GHG emission).**
- **Carbon capture and storage.**

The first two issues stand out and converge within this study. The third treaty (CCS) specifically deals in the thematic study "Contributions of the sector of Industrial Processes for a low-carbon economy in Brazil", which will be presented in the future.

Even though the actions in the three priority issues are theoretically recommendable, there is no policy articulation for actions of energy efficiency to become applicable in the short term (for up to five years). The model for meeting the demand by making the largest offer still persists.

A national energy efficiency policy should contemplate incentives for the development of the nation's industry of energy efficiency. For example, the ESCOs have the necessary expertise to for the identification of points for improvement for energy efficiency in industrial, commercial, and residential installations, as well as ambitious goals of energy efficiency for the transportation sector and for the generation, transmission, and distribution of electrical energy.

There is a shortage of policies that help the sector with regard to the inclusion of new sources of energy of lower emissions, notably renewable energies. Given that the current proposals do not introduce increased capacity for development of new sources in higher proportion to the growth for the energy demand in the country. This should be the focus of action in presented proposals, given that they will become the energy matrix for a greener Brazil in the medium term.

In this scenario, the proposal should contemplate incentives for the incorporation of new sources of additional renewable energy generation to the hydroelectric sources that proportion a favorable environment for the maintenance of Brazil as a leader in the sector—including as an exporter of technology—with a medium-term horizon. As such, incentive programs for power generation from renewable sources, and for all of the industrial change, can include: feed-in tariffs for the development of new technologies, specific auctions for renewable energies in the advanced stage of development, differentiated lines of financing and, in the long-term, direct subsidies and fiscal incentives, Renewable Portfolio Standard (RPS), goals of installed capacity in renewable energies, incentives and demand and commercialization of new renewable sources and promotion of energy efficiency in building.

The adoption of a combination of integrated policies that aim to create a culture of energy efficiency is suggested by means of diverse incentives, as well as the inclusion of a portfolio for more varied power generation that is less dependent on hydroelectric resources. This will guarantee the energy security of the country and the competitiveness of the business sector by means of a strengthening of energy security and quality.

04 PROPOSALS

4.1. INCENTIVE POLICIES FOR CONSERVATION OR MORE EFFICIENT USE OF ALL FORMS OF ENERGY (ENERGY EFFICIENCY)

The promotion of energy efficiency and production are not necessarily conditional on technological bottlenecks, given that more efficient and economically viable. In Brazil the fact stands out that the conservation and more efficient use of energy resources present lower costs in MWh when compared with the costs of incorporating new generating sources in the national energy matrix (IEDI, 2010). Complementarily, "the methods of energy efficiency demand usually lower investments and shorten terms of returns, beyond the internal rates of elevated returns. Normally, the costs of CO_2 abatement are negative, indicating economic conditions for spontaneous implementation (or in other words, they are characterized as methods without repentance)" (Schaeffer, 2010).

The principal challenge is to promote public policies that give scale to the use and continuous development of such technologies. As such, the barriers to implementation of projects that increase energy and production efficiency are higher political priority given the issue for governments and the economic incentives established for business operation and for consumer behavior. This premise is made even more relevant considering future scenarios projecting that the carbonization of the Brazilian energy matrix for the electrical energy, industrial, and transport sectors.

Conservation and more efficient use of natural and energy resources are fundamental for the establishment of a low-carbon economy in Brazil, and so the Businesses for Climate Platform proposes:

- **The promotion of energy and production efficiency in the industrial sector, looking to enter external markets and to meet the growing demands present by increasing more demanding norms of environmental efficiency. As such, we propose the incentive for energy efficiency in industry by means of differentiated lines of financing and subsidized tariffs, among others, in the form of making investments more attractive in the Brazilian industrial sector.**
- **The increase in efficiency of consumption in natural and energy resources in the civil construction sector, by means of differentiated lines of financing to promote retrofitting installations of low energy efficiency. Also, an increase in the use of solar energy for heading and supplying electricity, given that between 80% and 90% of energy used in the sector is concentrated in the use of buildings.**
- **The promotion of efficiency in transmission, distribution, and consumption of energy through incentives for research and development of new models of transmission and distribution of energy, as well as of materials and equipments, implantation of smart grids and creation of incentives for distributed generation.**
- **Creation of minimum indexes of efficiency for electric equipments that, in combination with labeling programs (efficiency stamps), make a goal for the improved use of energy resources and the elimination of less efficient alternatives in the market. New preferential lines of financing should be created and tax exemptions that impulse the market of energy efficiency. In this way, the expansion of existent policies for sectors like automotive and civil construction is proposed by means of inter-ministerial articulation. For example, with the intuition to proportion information to the consumer more efficiently for the post-consumption conservation of energy.**
- **The incentive of Energy Service Companies (ESCOs), whose role is fundamental for the development of projects of energy efficiency, for the diagnosis and measurement of potential improvement and for distribution of better practices to be made. The increase of existing resources in current lines of financing are proposed, as well as a more rapid approval process together with financial agents. In addition, a new line of financing specific**

to residential sectors should be created, with differentiated interest rates that make investment in energy efficiency for said sector more attractive.

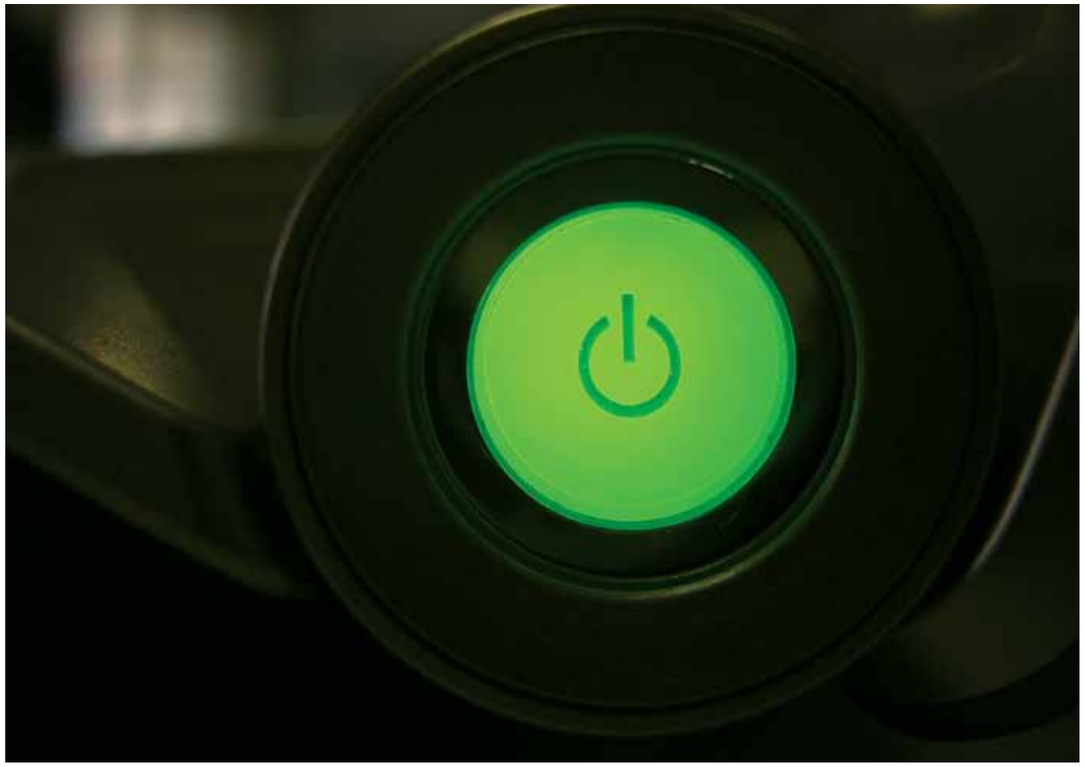
- The promotion of auctions in projects of energy efficiency, considering a reduction of demand by means of investments for efficiency improvement in industrial consumption. The proposal considers the question that the cheapest current MWh in the national market is that which originates in actions of efficiency, to be financed in the long-term by differentiated lines of credit, as commercially reduced energy by concessionary business invested in the project
- The creation of lines of financing with differentiated and directional rates to energy efficiency, offering cheaper credit for conservation or efficient use of energy.

4.2. INCENTIVE POLICIES FOR THE PRODUCTION AND USE OF RENEWABLE SOURCES

Brazil can and should go beyond the hydroelectric-ethanol binomial by developing its participation of other renewable energy sources in the energy matrix. Special attention should be given to the exploration of its ample the potential for the generation of onshore and offshore wind and solar power generation, both of which are in the process of expansion on the global scale. Such diversification contributes to the environment as they substitute generation from fossil fuel, and for the energy security of the country, given that wind energy has a rather complementary role to the seasonality in the level of the reservoirs in the hydroelectric system.

Mindful that this question is crucial for the competitiveness of the national industry in the long-term, the Businesses for Climate Platform proposes:

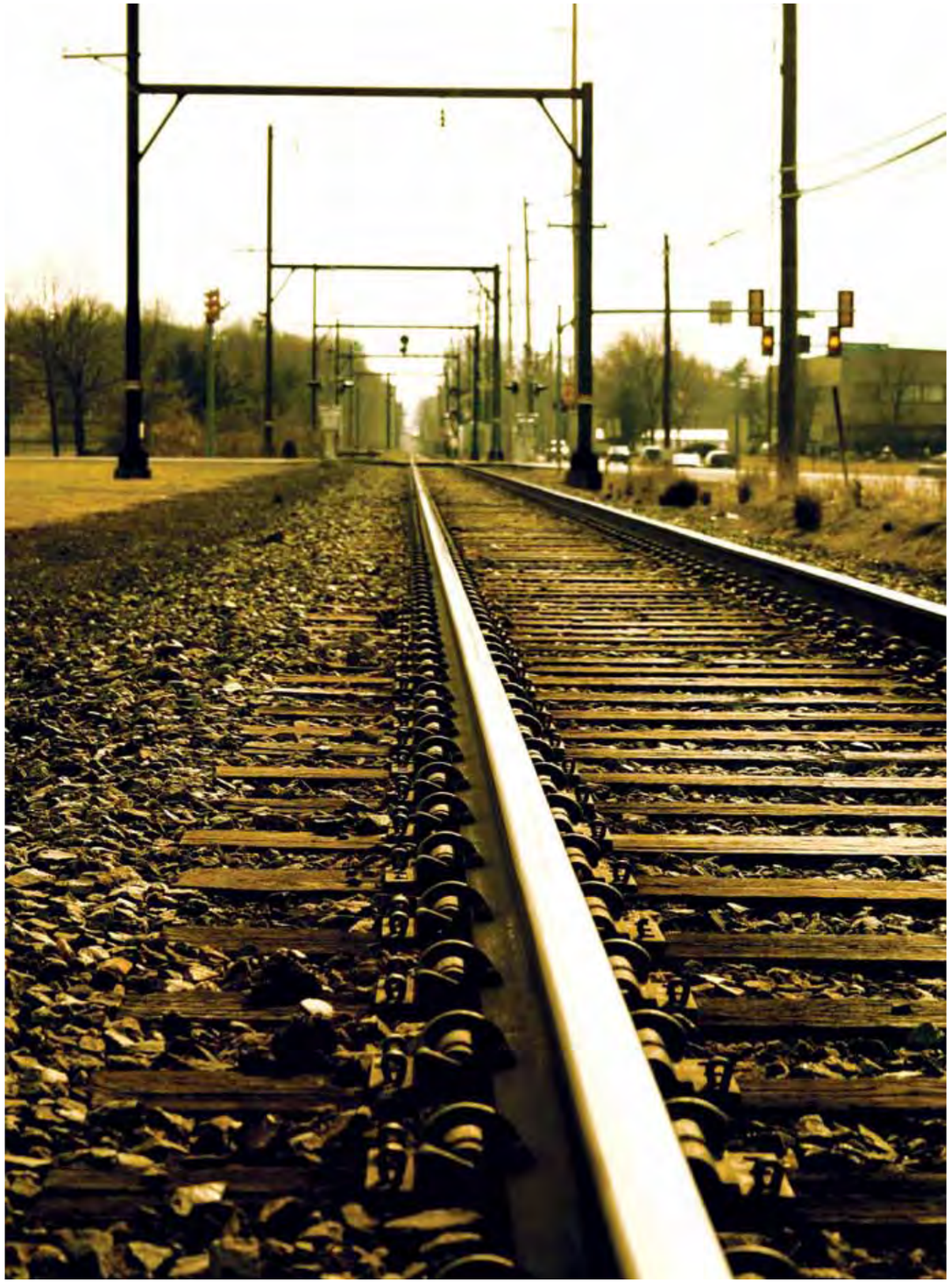
- The payment of differentiated tariffs or incentives for technologies in maturation (feed-in tariffs) and the guarantee of purchase in long-term contracts. Feed-in tariffs were recognized as a an extremely efficient policy to promote renewable energies in more than 50 countries and were used with success during the development of Proinfa, which permits a significant reduction in the price of MWh in wind energy ventures, on top of biomass and small hydro.
- The maintenance of specific auctions for the generation of renewable energy, considering technologies of higher grade of maturation and competitive prices. Specific auctions have the advantage of paying a different price on top of the practiced values for the mature technologies. They should depend on specific long-term contracts that come with a guarantee for buying the energy produced.
- The creation of direction lines of financing for the renewable energy sector, offering cheaper credit for renewable energy projects and for the installation of a national industry of components for this chain of productivity, having the objective of increasing competitiveness of the sector before mature technologies.
- The incentive for operations of the financial market and capital for the development of new technologies in renewable energy, considering the important role that venture capital funds (angel investors, seed capital, venture capital, private equity) offer for the financing of businesses and technology incipient. Incentives, fiscal or tributary, are an important tool for investments in projects that are still not financed by investment banks, and in the manner of making possible their development through research centers and technology incubators.
- The promotion of development of new ventures of renewable energy generation, including their supply chain, by means of fiscal incentives that are not reflecting in the increased tax burden.
- The stimulus of distributed generation and the consumption of renewable energy by means differentiated financing and by incentivizing the use equipment from the generation of renewable energy in micro-scale. For example, solar panels (photo-voltaic and solar-thermal) and small wind turbines in industrial installations, commercial and residential, from commercialization of production surplus and for the creation of a system for the commercialization of renewable energy by the Commissionaires of Transmission and Distribution of Energy that permits the purchase of "green energy", whose offer should be screened together with the generators by means of certificates.
- The high level training of the calculation of the Cost Benefit Index (ICB in Portuguese), by way of internalizing the socio-environmental benefits of ventures based in renewable energies and to consider environmental externalities of the units generated that use fossil fuels as promoters of global climate change.



The role of the government in increasing the participation of renewable sources of energy is fundamental to guaranteeing the necessary resources for its execution, as well as for the development of educational programs with a focus on the creation of the necessary qualified human capital for the exploration of opportunities in a low-carbon economy.

Such processes depend on the creation of courses in technical schools and in universities, as well as international exchange for the transfer of existing technology from research centers at the forefront of renewable energy, energy efficiency, and greener products.

Lastly, it is worth remembering the importance of the role of the State, in all levels of government. They should serve as promoters of energy efficiency and the generation and use of renewable sources of energy, by means of sustainable public procurement policies that consider the minimum price offered in the solicitation processes and the environmental impacts throughout the life cycle of the contracted products.



ENERGY

TRANSPORTATION

AGRICULTURE

01 FUNDAMENTALS

1.1 MOTIVATION FOR THE WORK

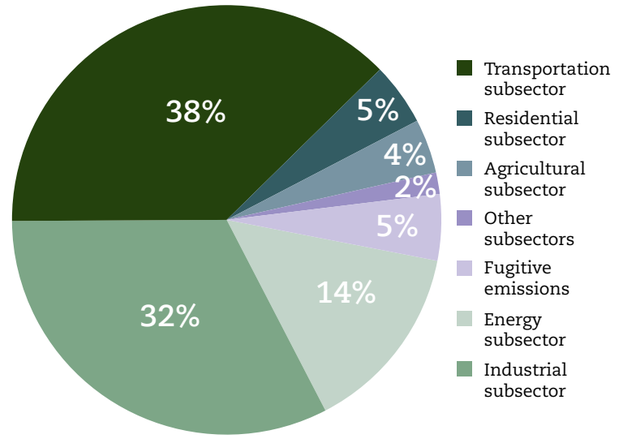
Unlike the electrical sector, which places Brazil among the "cleanest" electrical networks in the world, the Brazilian transportation sector is extremely carbon-intensive. In being profoundly characterized by the use of highways and individual transportation, the sector's emissions per ton of freight and by passenger transported are extremely high. According to the national inventory of emissions for 2005, the sector's emissions totaled 134.57 $MtCO_2e$, representing 6.1% of all CO_2e emissions in Brazil (8.1% of all CO_2 emissions), greater than industrial emissions from the energy sector. From 1990 to 2005, the transportation sector's absolute CO_2 emissions grew 67%, faster than the average growth of Brazilian emissions in the period (65.2%), even though average emissions were equivalent to those in 1990, in relative terms. Around 92% of this total comes from the transportation of freight or passengers by road (*Figure 1*).

The sheer size of the Brazilian territory and its geographic conditions (extension of ocean coastline, river basins) are not consistent with a freight transportation network heavily based on road transport. A more diversified mix, accomplished through **intermodal integration**, with increased participation of railroad and waterway (inland and cabotage), is strategically important for the country, given that it reduces the consumption of energy per ton transported, thereby reducing logistical costs and increasing the competitiveness of national industry.

The high concentration of road transportation of freight represents a bottleneck for Brazil's development, making it vulnerable to a "logistics blackout," given the fact that the country has a limited capacity to expand its road network in order to meet the expected growth in demand for freight transport in the coming years. Moreover, maintenance of the road network is extremely expensive, the price of which is then transferred to the final price to consumers.

FIGURE 1: ENERGY SECTOR EMISSIONS BY SUBSECTOR (2005)

SOURCE: MCT (2010).



Degraded or inadequately maintained highways can lead to accidents, delays and additional logistical costs. According to research by CNT – National Confederation of Transport (2009), the conditions of pavement and signaling of nearly 30% of the Brazilian road network can be classified as either poor or terrible. The loss of operational velocity reduces the energy efficiency of this mode of transportation and increases fuel consumption. Another factor that influences greenhouse gas (GHG) emissions is the old age of vehicles in circulation, especially those used for transporting freight. The average age of the country's truck fleet is 14 years and nearly 75% of the fleet is over 10 years old (Schaeffer, 2009).

Historic public and private investments in the road network have contributed to a dampening of co-modality and of the development of other modes of transportation. As a large commodity producer and exporter, Brazil must urgently improve the balance of its transport mix by increasing the use of **railways and waterways**. Furthermore, renovation of its road network and the constant maintenance thereof are essential. The National Logistics and Transportation Plan (PNLT –

Plano Nacional de Logística e Transportes) establishes recommendations for substantial investments in Brazilian transportation infrastructure into 2025, an important step in reducing costs in Brazil and toward a low carbon economy.

Rail transport is characterized by the high cost of implementing the rail network and terminals, and an extremely high volume of fixed capital. Even so, variable costs such as labor, fuel and energy are comparatively low. Thus, this mode is well prepared for transporting goods with low added value and large in volume and weight. With increasing economies of scale, on the medium-term basis the fixed costs of rail transport can be amortized.

Brazil has great, unexplored potential for **waterway** transport via **river** (inland navigation) that was previously inhibited by the lack of integration between public policies in the energy and transport sectors, particularly in relation to hydroelectric projects that today stand as barriers to long distance inland navigation. The vast expanse of the country's maritime border, tied to the strategic location of large centers of production and consumption along the Atlantic coast, also represents an opportunity for **cabotage**.

At the same time, the incorporation of sustainable concepts into **urban mobility systems** requires improvements in urban planning and in the flow of commercial, public and private transport vehicles, thereby reducing average time of transit. Urban congestions are not only a problem for drivers and passengers, but also results in an incalculable loss of productivity, waste of energy and public health problems—which, if not serious enough on their own, also affect the productivity of companies and the country's economy. The disorderly growth of Brazilian cities, coupled with economic stability and an increase in the average income of the population, has led to an increase in demand for private transportation, thereby increasing problems related to the sector in what could be called a vicious cycle: each new car added to the urban road network (with a relatively stable number of roads) reduces the average speed of cars and buses, stimulating the use of cars and motorcycles over buses, the engines of which are inefficient in comparison with the engines of buses. The motorcycle fleet already surpasses the fleet of cars in about half of the country's cities, and doubled from 2005 to 2010 (Izidoro, 2010).

Finally, the soil quality, vast size of its territory and historic investments in research and development of **biofuels**, particularly the production of ethanol, have placed Brazil on the cutting-edge of full scale use of this renewable source of energy in transportation. Nevertheless, the potential for improved exploration of this huge comparative advantage and expansion of the existing competitive advantage is still quite great. The **increased use of biofuels** and alternative fuels—electricity and hydrogen—in the energy mix of Brazilian transportation will enable both the consumption of fossil fuels and GHG emissions to be reduced.

In 2005, **biodiesel** was incorporated into the energy mix with the disclosure of Law 11,097, which mandated the addition of biofuel to diesel oil at an initial ratio of 2% and set the foundations for a progressive increase to the current 5%. Any increase in this percentage will lead to greater supply. According to the National Petroleum Agency (ANP), nearly 80% of biodiesel in the country is produced from soybean, therefore, there is an opportunity for other raw materials to be explored, leading to greater social gains, as provided for in the sector's own policies. To do so, public policies that provide economic stimulus, in addition to investments in research, are needed in order for these projects to make large scale gains.

Ethanol is a liquid fuel distilled from biomass, most commonly sugarcane or corn. As biomass is renewable, alcohol has the potential to substantially reduce GHG by offsetting carbon dioxide emissions through the growth of new biomass. Moreover, sugarcane bagasse, a byproduct of alcohol

production, is an important source of renewable energy used to generate both heat and electricity. With the ability to produce ethanol from sugarcane bagasse and leaves, the amount of ethanol produced from a hectare of sugarcane can be increased by up to 40% (Macedo, 2005). The corroboration of such a prominent position, however, depends on Brazil's success in research, into lignocellulosic ethanol produced from several types of plants, the production of enzymes and equipment, in a highly disputed field that has already seen strong competition from countries like Canada, Sweden and the United States, where investments in this field already surpass those from Brazil.

In addition to the call for investments in research and development (R&D) in lignocellulosic ethanol technology, there is a range of opportunities that have yet to be explored in relation to first-generation sugarcane ethanol. International goals to expand the use of biofuel in transportation provide Brazil with more than just opportunities to exploit sugarcane ethanol, which is already recognized as an advanced biofuel, but also related technology, machines and equipment. The recent increase in internal consumption of ethanol resulting from the boost in sales of flexible-fuel cars, however, has already saturated the supply chain, which tries to keep up with the internal demand for new production plants, which currently takes up to four years. More important still, we must take into consideration the fact that the process is set to become more intense upon the consolidation of the country's ethanol supply chain and the maturation of second-generation technology.

The movement toward alternative and less polluting fuels is a strategic option with a high level of investment in research. Electric cars produce zero emissions in urban areas, but when they are charged using electricity generated by coal or oil, merely export pollution to the location where the energy is generated. The hybrid solution—electric and gasoline powered vehicles—is already a commercially proven reality. On a long-term basis, there is also the promising possibility

FIGURE 2: TOTAL CO_2 EMISSIONS BY MODE OF TRANSPORTATION SOURCE: ADAPTED FROM SCHAEFFER (2009).

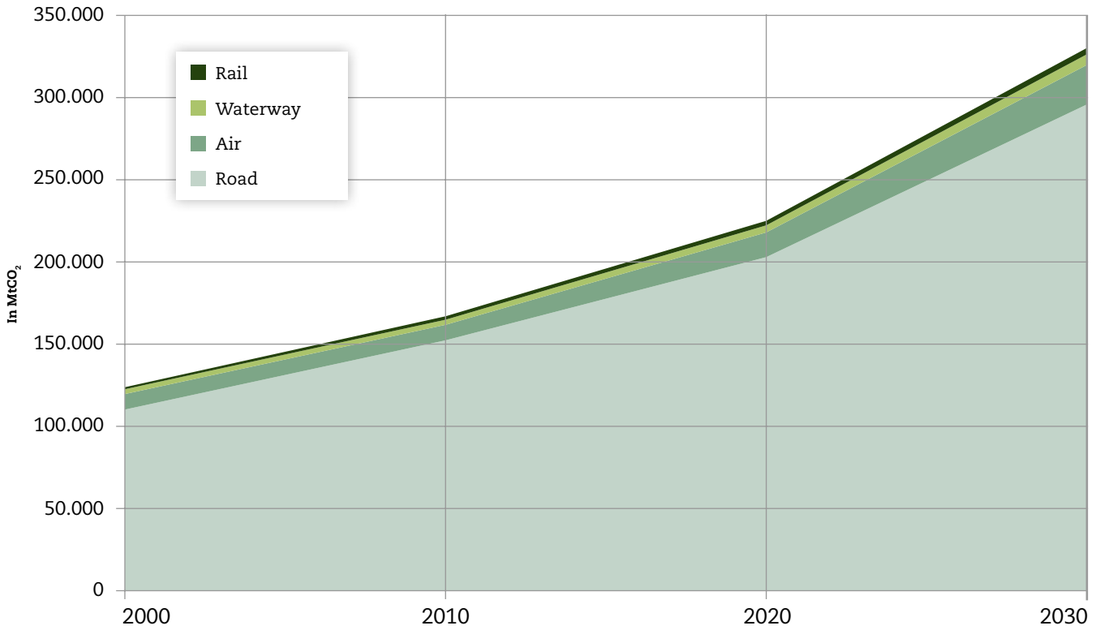
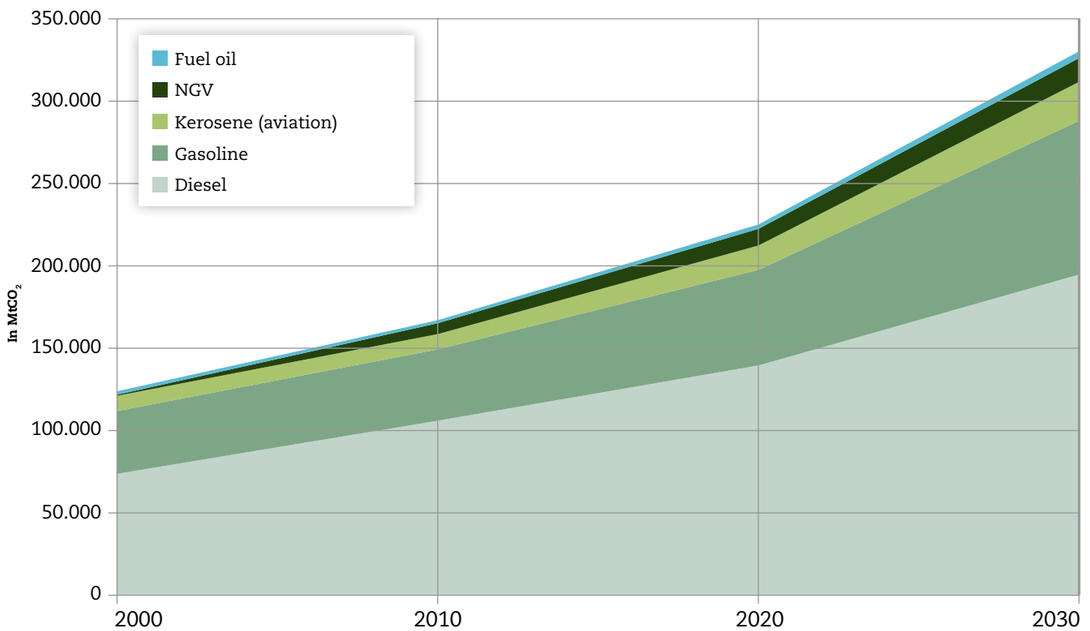


FIGURE 3: TOTAL CO_2 EMISSIONS BY SOURCE SOURCE: ADAPTED FROM SCHAEFFER (2009).



of using hydrogen cells as fuel, the main by-product of which is water.

IMPORTANT: In view of its vastness, complexity and transversality, this theme is not dealt with in depth in this document, and will be object of further study in the future.

1.2 EMISSIONS PROFILE OF THE SECTOR

According to the Brazilian Ministry of Mines and Energy (MME), in 2009, the transportation sector accounted for 51.2% of Brazil's demand for petroleum derivatives and for 28.3% of total final energy consumption, equal to 62.7 million tons of petroleum equivalent, 90% of which was consumed by road transport. Diesel fuel accounts for nearly 50% of consumption of petroleum derivatives in the country due to the elevated use of heavy vehicles, mass transit and freight vehicles. Use of gasoline has been decreasing in favor of ethanol and, in 2002, compressed natural gas was introduced, responsible for 3.9% of energy consumed by the sector in 2009 (MME, 2010).

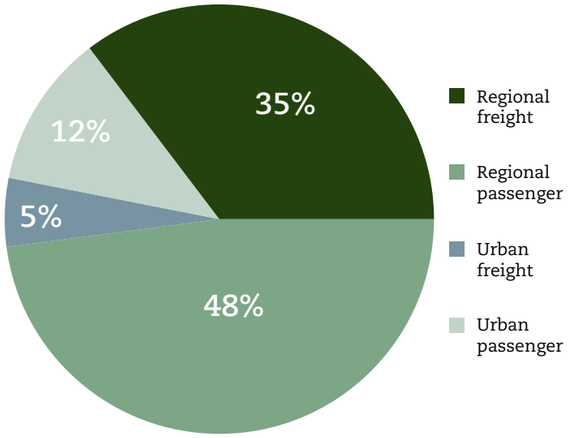
The *Figures 2 and 3* show the projected evolution of emissions from different modes of transportation and types of fuel in accordance with the National Energy Plan 2030 (PNE – Plano Nacional de Energia) projections.

Broken down by segment, CO_2 emissions from the transport sector are mainly the result of the regional and **urban transportation of freight** by road, mostly powered by diesel combustion and its high relative emissions, and activities involving the **urban transportation of passengers**. (*Figure 4*)

Regional and urban transport of freight in Brazil has a unique characteristic in relation to other countries: an imbalance in the transport mix, weighing towards the intensive use of road transport. The expanse of the Brazilian railroad network is quite limited in comparison with rail networks in other countries similar in size to Brazil. The country's rail capacity is relatively unexplored, and therefore, a window of

FIGURE 4: DIRECT CO_2 EMISSIONS BY TRANSPORT TYPE

SOURCE: ADAPTED FROM GOUVELLO ET AL. (2010).



opportunity exists as a result of the urgent need for new railways in Brazil. The lack of an adequate railroad network, particularly in Brazil's Midwestern and Northern regions, and the advance of the agricultural frontier into these regions, generates demand for alternative means to transport production (*Figure 5*).

Thus, policies seeking to reduce GHG emissions in this sector must focus on intensifying the use of railroad and waterway transport, which present greater energy efficiency per ton of freight transported.

Figure 6 shows the economic and environmental inefficiency of Brazil's

FIGURE 6: : ENERGY EFFICIENCY BY MODE

SOURCE: ADAPTED FROM GOUVELLO ET AL. (2010) E MCT (2010).

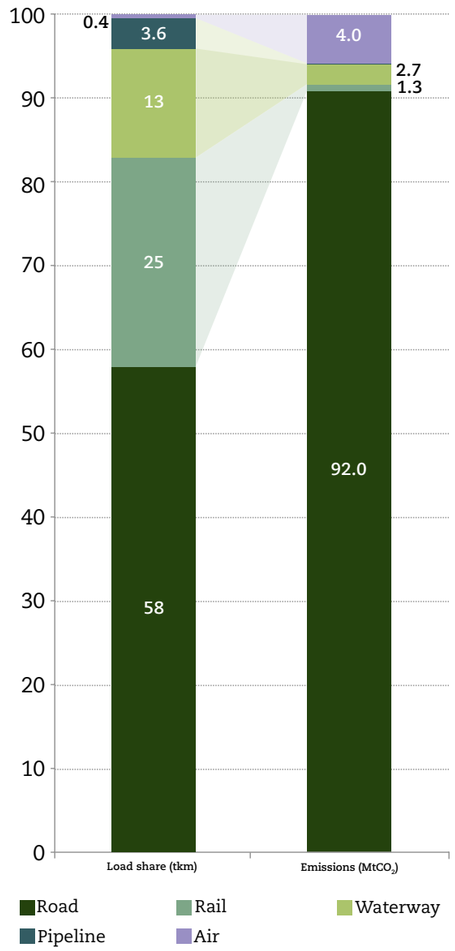
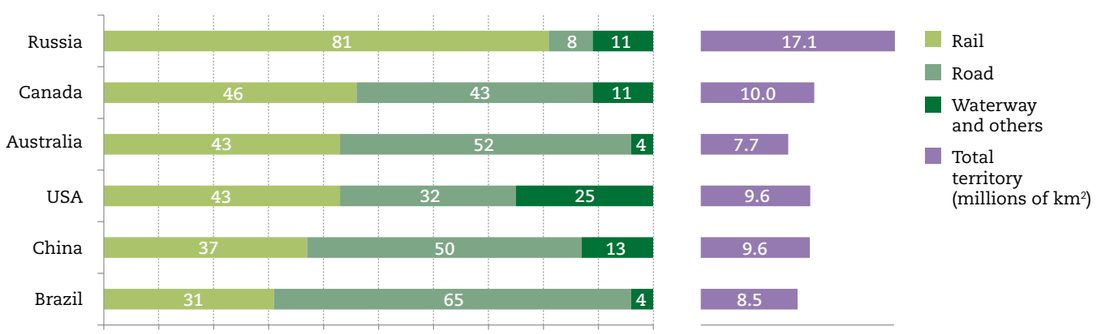


FIGURE 5: COMPARISON OF THE TRANSPORT MATRIX IN LARGE COUNTRIES

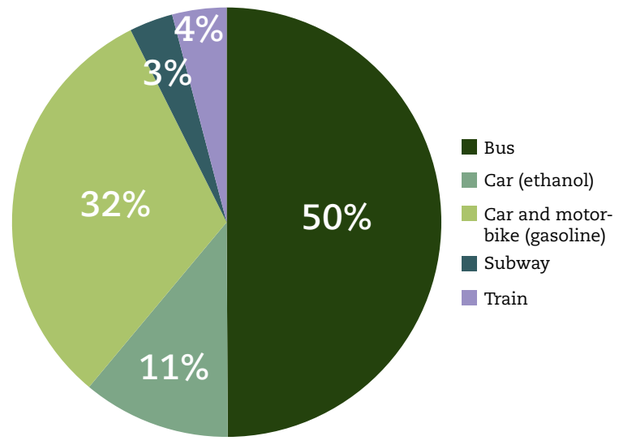
SOURCE: ADAPTED FROM COSTA (2010); GOUVELLO ET AL. (2010).



current model. In 2005, road transport was responsible for 58% of all freight in the country, and accounted for 92% of all emissions resulting from regional transport of freight. Just as there is a direct relationship between emissions and energy consumption, economic and environmental efficiency also come hand-in-hand. At the same time, an analysis of the figure also shows that 25% of all cargo transported via railroads is responsible for a mere 1.3% of emissions.

The urban transport of passengers in Brazil is concentrated around the use of private vehicles (43%) and buses (50%) when considering passenger-kilometers (Gouvello *et al.*, 2010). Rail transport is responsible for only 7%, according to *Figure 7*.

FIGURE 7: SHARE OF URBAN TRANSPORT MODES IN BRAZIL SOURCE: ADAPTED FROM GOUVELLO ET AL. (2010).



02

CHALLENGES FOR THE TRANSPORTATION SECTOR

The transport sector presents a series of challenges for the coming years. The "business as usual" scenario, focused on **regional road transport of freight** and **individual urban transport** of passengers, is expected to double the sector's emissions by 2030 (*Figure 2*). The establishment of a large public-private partnership committed to extensive investment in diversification of modes of transport and their integration is absolutely necessary.

2.1 REGIONAL ROAD TRANSPORT OF FREIGHT

Dependence on road transport of freight places Brazil's competitiveness in check due to the cost of energy inefficiency, and the resulting economic inefficiency. Moreover, dependence on this mode of transport also implies the incorporation of "carbon intensity" in the supply chain, and potential restricted access to global markets, with increasingly strict environmental standards. *Figures 8 and 9* illustrate the high cost of road freight vis-à-vis the rail and waterway alternatives. On the other hand, the figures also show the advantages provided by **intermodal integration**, which would significantly reduce costs and thereby increase the competitiveness of Brazilian businesses.

Thus the question to be asked is: if the gains involved are so obvious, why has this not happened earlier? In interviews with entrepreneurs from twenty productive sectors considered to be potential users of railroad transport, the main obstacles mentioned against that mode of transport were as follows: unavailability of routes (65%), reduced flexibility in operations (58%), low speed (50%), costs (48%) and unavailability of railroad cars (34%) (Fleury, 2007). (*Figure 10*)

The question concerning the unavailability of routes is associated with strategies used by concessionaires to define services, the lack of infrastructure (such as lack of road and railroad transshipment terminals and between railways with different track gauges) and the insufficient number of rail lines or lack of capacity of an existing line (IPEA, 2010).

The slow speed and unavailability of railroad cars leads to both an increase in costs

FIGURE 8: FREIGHT CAPACITY BY TRANSPORT MODE SOURCE: USACE (2009).

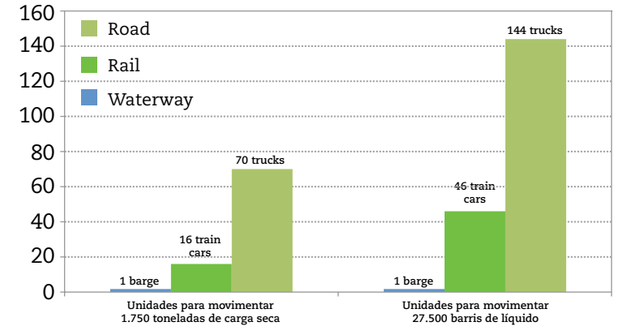


FIGURE 9: UNIT COST BY TRANSPORT MODE

SOURCE: COPPEAD/UFRJ APUD LESSA (2009).

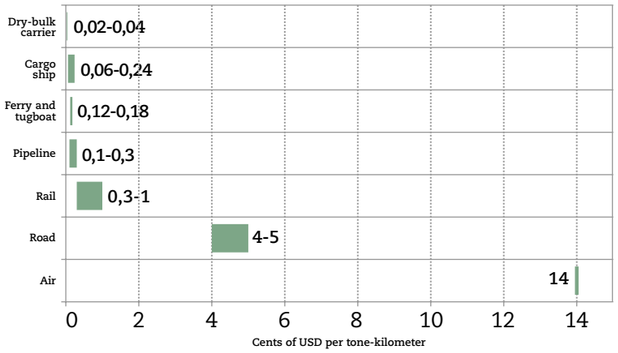
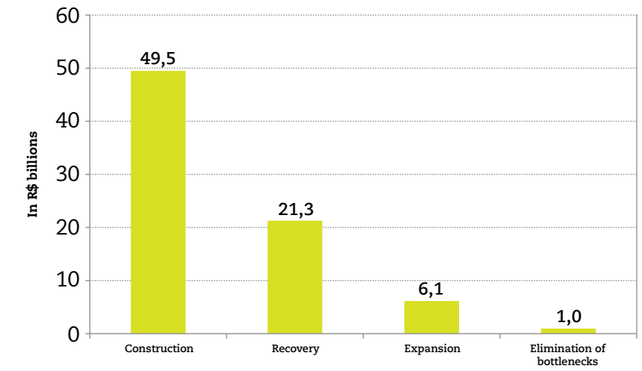


FIGURE 10: MAIN DEMANDS OF THE BRAZILIAN RAILROAD SECTOR SOURCE: IPEA (2010).



and a loss in operational flexibility among users. Investments to improve lines should enable the cost of railroad transport to be reduced, increase speed and lead to more productive railroad cars and terminals. More than 50% of all requirements are related to small stretches of railroad meant to transport freight from cities throughout the country to ports. According to research prepared by IPEA (2010), nearly R$ 50 billion were allocated to the construction of new railroads, enough to solve only 44% of the problems found with the system.

As indicated by the National Association of Railway Companies (ANTF – Associação Nacional de Transportadores Ferroviários) (Vilaça, 2010), the following factors have jeopardized the competitiveness of railroad transport:

- **Illegal constructions along the railways that cause trains to reduce their speed to 5 km/h (speeds may vary between 5 and 20 km/h, while they may reach up to 80 km/h under the right conditions).**
- **Excessive number of crossings amongst cities.**
- **The limited distribution capacity of ports.**

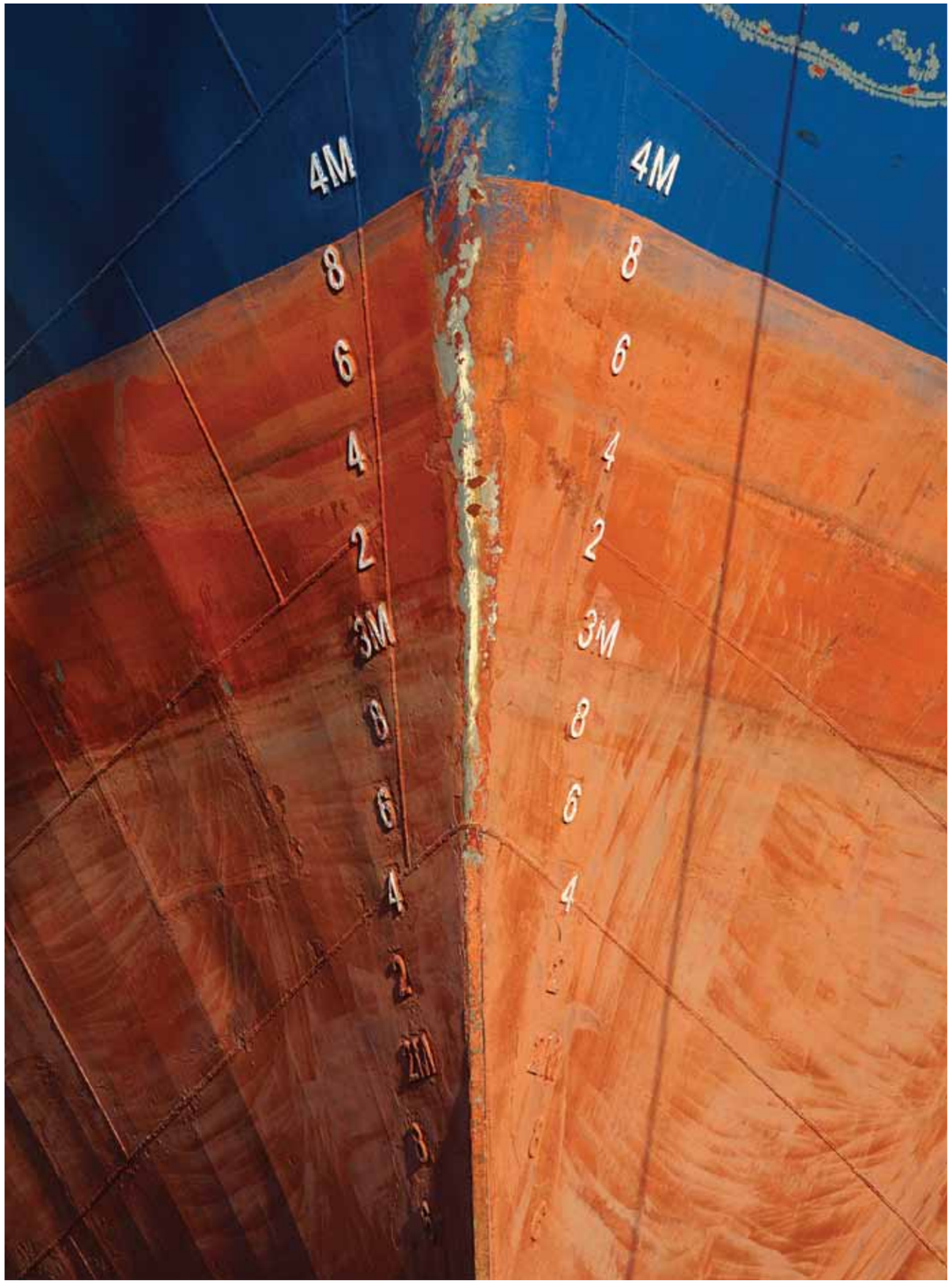
According to mapping by IPEA (2010), close to R$ 22 billion would be required to eliminate bottlenecks and renovate railroad stretches.

Finally, a fundamental question in the development of railroad transportation in Brazil lies in the institutional field, and is related to the manner in which the Brazilian rail network would be shared: a regulatory framework is required to establish rules for accessing and sharing lines, similar to "interconnection rules" in the telephone sector, in order to guarantee increased use and reduced operational costs, as well as increase competitiveness by diluting maintenance and system operation costs by dividing them up among a large number of users.

Given the expanse of the Brazilian coastline (nearly 7,500 km of coastline) and the number and size of its drainage basins (12 major basins), Brazil does not make use of its potential for waterborne transportation, whether it be inland or by cabotage.

In addition to the railroad alternative, inland navigation also has an immense potential to integrate intermodal networks. There are many challenges to this mode, including poorly navigable plateau rivers and the need for periodic dredging to ensure that the depth of canals is within requirements for navigation, as well as manmade barriers, particularly the existence of dams associated with hydroelectric generation. Locks are absent in both currently operating hydroelectric dams and projects that are currently under construction, proof of the lack of integration between the country's energy and transportation policies. The country is in need of hydroelectric projects that include the construction of locks from their inception, undergo engineering projects and environmental licensing processes. Poorly designed locks represent a barrier to the use of this model because they require that fleets of barges be disconnected in order to pass through locks one by one, leading to greater loss of time. In situations where the construction of locks is unfeasible, an alternative would be the construction of parallel navigable canals.

As for the use of cabotage, which offers the lowest operational cost per TKU, IPEA (2010) considers the lack of port infrastructure to be the greatest obstacle to the sector's growth. The only products involving intensive use of cabotage are petroleum derivatives, this being a result of investments made by Petrobras in marine terminals in several coastal states and the company's fleet of oil tankers. For other manufacturers, the number of routes offered is still quite limited (IPEA, 2010), even though the National Agency of Marine Transport (Antaq, in Portuguese) states that, due to the lack of alternatives and high prices of other forms of transport, considerable frequency of theft of cargo transported by road and high toll prices, cabotage has seen an average growth rate of 29% per year since 1997 (Antaq apud IPEA, 2010).



2.2 URBAN TRANSPORT OF PASSENGERS

Parallel to the questions of intermodal integration that effect the regional transport of freight, the abuse of incentives for individual passenger transport in urban centers has also led to a great amount of waste of efficiency of energy resources, with economic, social and environmental consequences that include restricted mobility, traffic, accidents, impacts on quality of life and human health, difficulty in accessing public equipment and air and noise pollution, among other costs to society.

The greatest challenge is increasing investment in the infrastructure of less carbon-intense forms of public transit, such as trains and subways. The bus rapid transit (BRT) system is half as carbon-intensive as common buses and, economically speaking, is a more cost-effective alternative. In comparison with a gasoline-powered automobile, the BRT model is four times more efficient in relation to CO_2 emissions per passenger-kilometer. Notwithstanding the mode of transportation, public policies must ultimately seek to provide access to quality public transit, which, in addition to increasing network offerings and renewing the fleet, would significantly reduce transit time, comply with international recommendations for rush hour density (passengers/m2), improve the quality of points of departure/arrival—improving everything from availability of information on schedules, lines and routes, night-time illumination and shelter from rain, to the conservation of public sidewalks—, thereby guaranteeing the migration of private vehicle users to public transit.

In the urban freight transport subsector, one of the main challenges is reducing the average age of the fleet in order to improve energy efficiency and decrease traffic congestion caused by breakdowns or poorly maintained vehicles.

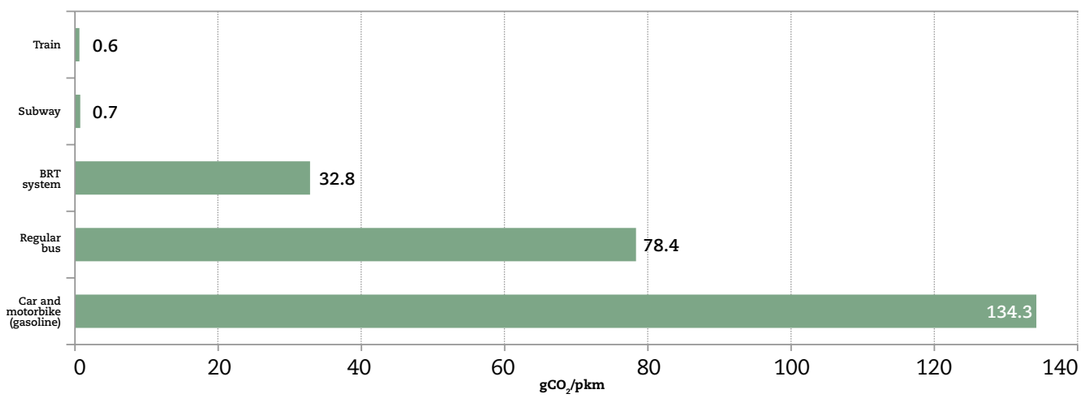
2.3 CHALLENGES FOR THE BRAZILIAN TRANSPORT SECTOR

Essentially, the main challenges to putting Brazil on the road to a new economy involve:

- **Increasing the efficiency of energy consumption and specific emissions[1] per (i) TKU regional freight and urban transport and (ii) passenger-kilometer in urban centers, guided by:**
  - **Intermodal integration**
  - **Incorporation of sustainability concepts into urban mobility systems**

FIGURE 11: CARBON INTENSITY OF URBAN PASSENGER TRANSPORT IN BRAZIL BY MODE

SOURCE: ADAPTADO DE GOUVELLO ET AL. (2010).



1 Efficiency of energetic consumption in both freight (ton-kilometer) and, particularly, passenger transportation (passenger-kilometer) undergoes the expansion in the use of renewable energy sources in the transport mix, through the incentive to biofuels (sugarcane ethanol and biodiesel) and the introduction of new combustion technologies and alternative and/or more efficient fuels. However, as is already mentioned in this document, given the Brazilian leadership in biofuels, this theme is not dealt with in depth in this document and will be object of further study in the future."

03

A DIALOGUE WITH REALITY: REGULATORY FRAMEWORK

The formulation and implementation of an agenda for sustainable transport are in no way based on ready-made models. The preparation of a proposal compels us to confront reality within the scope of public policy on a national, state and city level. Any proposal must be based on current contexts in order to face challenges and take advantage of the opportunities that reality offers.

At least three levels of reality must be analyzed and incorporated into the construction of an effective path to sustainable transport in Brazil:

(i) Citywide initiatives, especially aspects of urban transport tied to climate policies that are already in place in some Brazilian cities.

(ii) State initiatives, especially proposals for the integration of transportation in metropolitan areas and the production of bioenergy, also tied to state climate policies that are already in force in many Brazilian states.

(iii) The **National Climate Change Plan** (PMNC) and **National Logistics and Transport**

Plan (PNLT), to serve as the main source of proposals for the transport sector.

This document prioritizes the PNMC and PNTL, given their national coverage, which places them in a position to enable a conversation on proposals for intermodal integration and sustainable urban transport in Brazil. Moreover, the PNMC presents the PNLT as the principal document on issues impacting the transport sector. The PNLT's main objectives and plan for actions are as follows:

The purpose of the PNLT is to prepare data of interest to the sector, in relation to both supply and demand, based on a georeferenced base of information; to consider costs throughout the logistics chain, seeking an optimization and reduction thereof; to improve the country's freight transport mix, fueling the growth of transportation via railway and waterway, which are comparatively more energy efficient considering advantages in long-line transportation of heavy freight.

Emphasis was given to projects to improve and expand railway and waterway (interior navigation, cabotage and long-line), seeking to better integrate them with road transport—which will undergo renovation, maintenance and construction—through the advanced shipping and distribution at integration and transshipment terminals.

Within 15 to 20 years, use of railway freight transport should increase from 25% to 32%, while use of waterways should increase from 13% to 29%. The pipeline and airway modes should increase to 5% and 1%, respectively, and the use of road transport would thereby decrease from its current 58% to 33%.

As stated above, the PNLT is made up of a set of long-term actions for the Brazilian transport sector that, if applied correctly, will fulfill a portion of the proposals presented in the **intermodal integration** section of this document. The document points out the need for networking of national railroad infrastructure in order to better take advantage of investments and reduce demand for new projects.

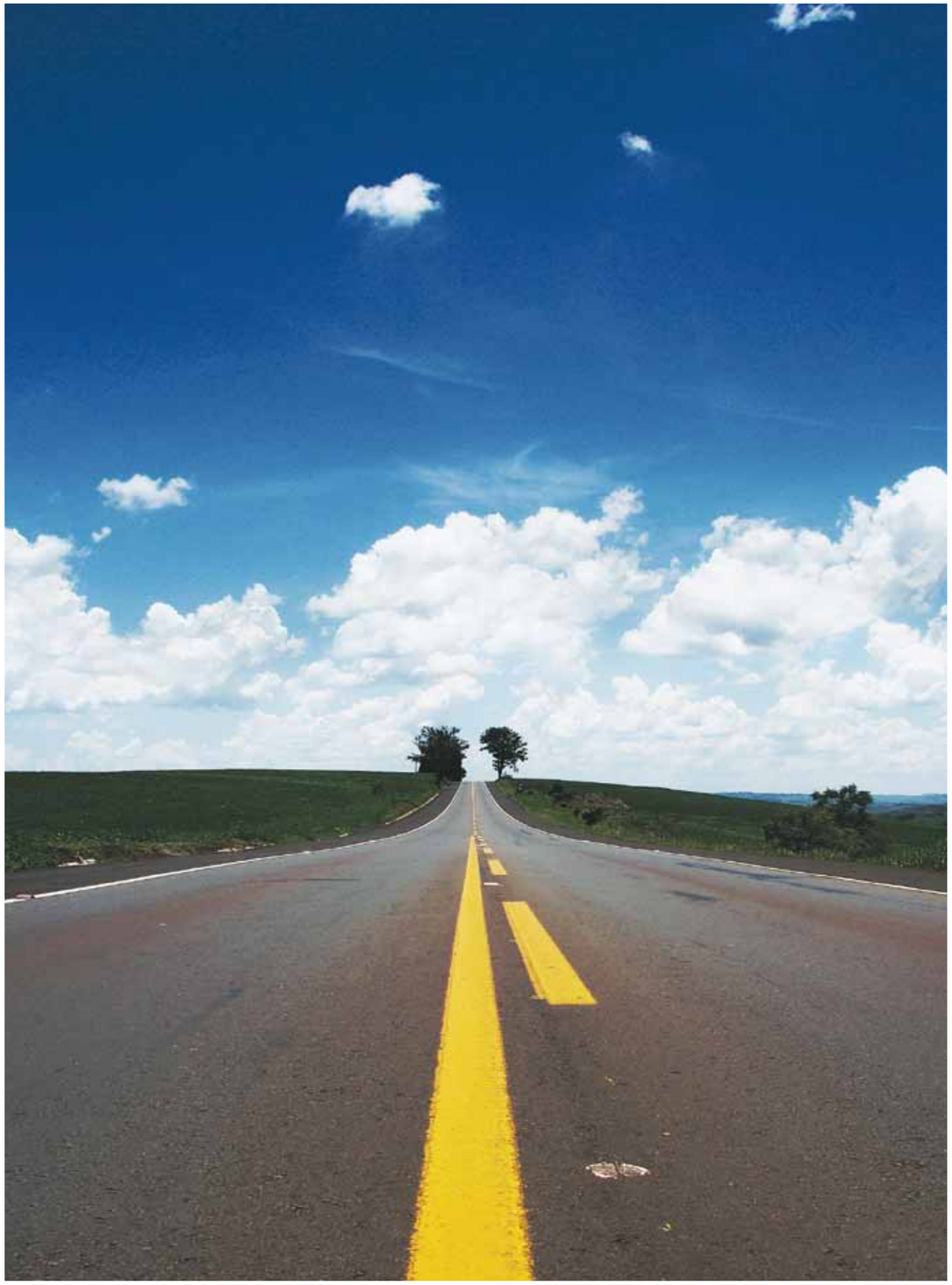
Additionally, the PNMC presents the **Mobility Plan**, which:

[…] should reverse the current mobility model, integrating it with urban management instruments and giving special attention to non-motorized forms of transportation (bicycle and pedestrian) and motorized transit.

Although this action is theoretically a coherent recommendation, it does not contain any further details or description of resources and parties involved, how to apply ideas or gains expected after implementation. Furthermore, there is a lack of information on the participation of companies in investments to install infrastructure, as well as the operation thereof through public-private partnerships or temporary concessions.

Proposals for the **incorporation of biofuel into the transport energy mix** are presented in Sector Plans for Energy and Agriculture, just as the government's selection includes fuels under this theme. Even though the government is focused on actions in the sector, its main concern is with the increase in biofuel supply through greater production of ethanol, and pays little attention to the expansion of biodiesel or second and third generation ethanol.

The incorporation of "climate proposals" into the PNLT is quite a natural step, given that alternatives to road transport promote lower emissions of CO_2 per unit of freight or passenger transported and, in this case, consist of alternatives that would improve the quality of freight and passenger transport with systemic economic and environmental gains, leading to positive social reactions due to possible reductions in the cost of sold and exported products, mainly the result of reduced logistics costs in the supplying and distribution of production. In summary, the PNLT, despite proposing logistical solutions for the country, will lead to the stimulation of modes of transport that will theoretically generate considerable environmental gains and thereby lead to lower costs on behalf of their users.



04 PROPOSALS

4.1 INTERMODAL INTEGRATION

The modes used for regional freight transport—roadways, railways, waterways and pipelines—have fundamental differences that lead them to be more complementary than competitive. If waterways have a greater capacity for freight per unit of energy, railways have greater reach. Additionally, the cost of each mode of transport varies with the distance to be covered, favoring roadways (up to 400 km), railways (from 400 to 1,500 km) or waterways (more than 1,500 km) (Log-In, 2009). The public policies presented herein, therefore, focus on taking advantage of all existing modes of transportation and the best that each one has to offer, thus optimizing the country's transportation mix.

First, it is essential to remember that intermodal integration fundamentally implies an expansion of the current railroad and waterway network, as well as the installation of connection and transshipment terminals. The intermodal transport option will depend on the efficiency of each mode of transport and mechanisms for integration between each, in order to guarantee the greatest total efficiency of the intermodal option in relation to long-line routes currently covered exclusively by road transport. Therefore, a drastic increase in offer is needed, which will require significant investment in the following, ordered by priority:

4.1.1 RAILROAD TRANSPORT

Complete adaptation of the current railway network (i.e. transshipment terminals, railroad cars and tracks), which increase the speed of trains, flexibility, the number of lines available and thus give greater value to intermodal transport. Doing so involves:

- **The elimination of irregularities along the margins of train tracks, such as constructions that reduce the speed of trains to as low as 5 km/h.**
- **The standardization of track gauges used by railways throughout the country, the lack of which currently impedes the integration of the existing railroad network. The use of a wide track gauge (1.60 meters) on newly implemented lines, when possible, is essential, as well as the use of a mixed gauge in stretches that currently utilize narrow gauges in order to ensure greater integration of networks. This will allow the average distance traveled by freight trains to be increased from the current 500 km, to distances at which railroads are more competitive (Reis, 2010).**
- **Shared use of the Brazilian railroad network through a regulatory framework that clearly establishes rules for access and sharing of lines—similar to interconnection rules in the telephone sector—so as to guarantee increased use and reduced operational costs, increasing competitiveness for users by diluting maintenance and system operation costs among a large number of users.**

Public-private partnerships are an essential step to guaranteeing an increase in funds invested in the improvement and expansion of the Brazilian railroad network.

4.1.2 WATERWAY TRANSPORT

In addition to the railroad alternative, waterway transport, particularly **inland navigation** also has a great potential for integrating intermodal networks through a strict policy of lock construction in current dams and mandatory implementation of locks in new dams, as well as the creation of parallel navigation channels.

Similar to rail transport, stimulating waterway transport involves the construction of connection and transshipment terminals and areas to warehouse products. Intermodality will depend on the efficiency of each mode of transportation and the mechanisms for integration between each, in order to ensure access to the increased efficiency of all options that have been adopted.

Cabotage is also an excellent alternative to reduce logistical costs, even though growth of this mode of transportation depends

on investments in port infrastructure and improved warehousing periods for products in Brazilian ports.

4.2 SUSTAINABILITY IN URBAN MOBILITY

Considering the **urban transportation of passengers** and depending on local demand, this proposal focuses on:

4.2.1 PROMOTING LARGE CAPACITY MODES OF TRANSPORT

Metropolitan subways and trains represent modes of public transport with extremely low GHG emissions—together, they were responsible for 0.04 $MtCO_2$ in 2007 (Gouvello *et al.*, 2010). Underground subway is quite popular with the public as it does not compete for road lanes used by private vehicles and buses and due to the frequency with which trains circulate between stations. The main limitation to the use of subways is the high cost per kilometer of construction, which is often out of reach for many Brazilian cities.

The main obstacle to the use of urban surface trains is the difficulty of expansion in cities that are already very densely populated—according to the São Paulo City Department of Transportation, train lines in the city are "practically identical to those at the beginning of the last century" (SMT/SPTrans, 2006). In these cases, the main points for improvement are investment in the quality and quantity of trains (comfort, speed) and improvements to stations (nocturnal illumination, security).

In both cases, the fundamental point in the planning of urban rail transportation is its integration with other modes of transport: integration with bus stations, extended-stay parking lots for private vehicles and bicycle storage in all stations, among other solutions.

Additionally, BRT (bus rapid transit) is a mode of transportation that utilizes buses more efficiently than standard models, providing a service equal in quality to that of rail transport. This is accomplished using dedicated, high-performance lanes that allow buses to pass vehicles stopped at departure and arrival stations (considerably increasing their average speed), right of way—on the surface, elevated or underground, with integration with other modes of urban transport—and terminals with high transshipment capacity that enable tariffs to be paid in advance, reducing departure time.

This mode of transport is different from "bus lanes" found in many Brazilian cities, which are generally restricted to a single lane exclusively for buses, but often do not allow vehicles to pass one another, and in some cases, are shared by other vehicles such as taxis with passengers.

The main advantage of BRT over subways and trains is its low cost and speed of implementation when utilizing preexisting routes in the city. By taking advantage of a more expanded network than that of railroads, buses are also more flexible in accompanying changes (in direction or intensity) in the flow of passengers between several of the city's regions. By competing with cars and motorcycle for space on the road, however, BRT encounters strong resistance from private vehicle users.

The participation of the corporate sector through concessions or public-private partnerships can play an important role in improving the quality of transportation in urban centers. The results of these benefits include, among others, improved quality of life for the population, reduced time spent in transit and logistical gains from reduced traffic congestion.

4.2.2 ENERGY EFFICIENCY IN THE TRANSPORT SECTOR

Even though the many options for public transport are able to remove dozens of cars from the streets and thereby reduce the transport sector's emissions, the majority of buses are still powered by diesel fuel. It is possible to move in the direction of vehicles with reduced or zero GHG emissions, such as biofuel, electricity or other clean technologies.

Brazil already has some local pilot projects involving electric- (diesel-electric hybrids), ethanol- and hydrogen-fueled buses. Financing and partnerships with research institutions are essential to guaranteeing that these technologies become feasible on a commercial scale and thus become a part of bus fleets in Brazilian cities.

Therefore, there is a great need for R&D policies in the Transport sector that involve the automobile industry, its supply chain, agencies that promote scientific studies, universities and research centers.

Furthermore, an Industrial Development Policy based on incentives and subsidies is essential for establishing technological and industrial centers that can supply the domestic and global markets, enabling the country to be self-sustaining, and to become an export center of industrial technology.

ENERGY
TRANSPORTATION
AGRICULTURE

01 FUNDAMENTALS

1.1 MOTIVATION FOR THE WORK

In accordance with the 4th International Panel on Climate Change (IPCC) report, agricultural practices were responsible for 13.5% of the global GHG emissions converted to CO_2 in 2004, while the emissions from LULUCF (land-use, land-use change, and forestry) totaled 17.4% of emissions in 2004 (Pachauri and Reisinger, 2007). In Brazil, which has distinct geographical and economic characteristics from other countries, the second national inventory (MCT, 2010) demonstrates that emissions from the agricultural sector correspond to 19% of total emissions, while emissions from deforestation add up to 61%.

As a fundamental component of the Brazilian economy since colonial times—responsible for 25% of the national GDP in 2008 (Cepea-USP, 2010)—the agribusiness contains a production chain that involves everything from the production of fertilizers and seeds to the commercialization of industrialized foods. In accordance with the defined section of the national inventory methodology, this work will be limited to evaluating the challenges faced in "agricultural"—not on the agribusiness change as a whole—directly and indirectly from this activity on climate and its consequences for climate change.

It is important to point out that, beyond the direct participation of agricultural practices in the volume of GHG emissions in Brazil and the world, especially from enteric fermentation, the sector is indirectly responsible, in part, for the emissions from deforestation of the Amazon due to the expansions of agricultural and livestock activities on this biome. On the other hand, the agricultural areas of the country represent an expressive stock of carbon in the soils, a sink, given the manner in which its biological cycle removes the CO_2 present in the atmosphere, thus contributing to the reduction of global climate change.

Lastly, it is important to remember that the agricultural sector is strongly affected by the increase in temperature and by alterations in the patterns of participation and the impacts of extreme events, given that the activity is intrinsically related to the natural environments and depends on an equilibrium with the environment to subsist. Changes in the climate patterns in Brazil make agricultural activity subject to a range of climate consequences, such as the change in water availability, soil erosion, and the appearance of new plagues and diseases, etc. As a consequence, this will have a negative impact on production, which makes adaptation to the new climate reality

FIGURE 1: AGRICULTURE AND THE CLIMATE SOURCE: ICONE (2010A).

THREATENED	THREAT	OPPORTUNITY
		
► Temperature rise ► Droughts and floods ► Higher incidence of plagues and disease ► Loss of productivity ► Salinization	► Change of Land Use ► Deforestation ► Degradation of the soil ► Agriculture emissions ► Excessive use of nitrogen fertilizers	► Sequestration of GHG by different cultures ► Agricultural best practices (e.g., no-till farming) ► Avoided emissions: legal reserve, areas under permanent protection, conservation units

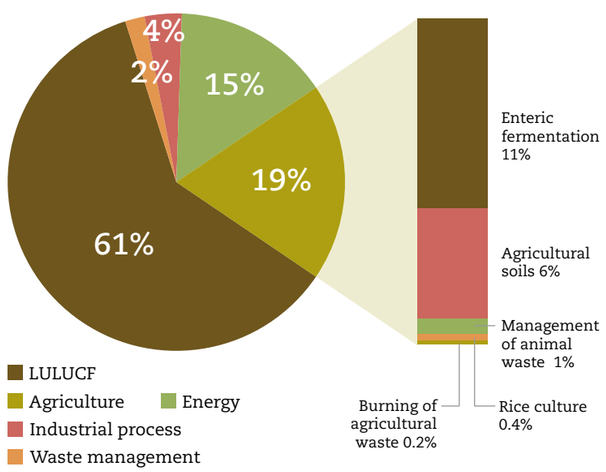
a challenge for the sector.

This being the case, agriculture relates to climate change in three ways. ***(Figure 1)***

Various opportunities for GHG emissions are presented in this study, many with considerable economic gains for producers. Proposals for public policies are also presented that make partnership work possible between the private and public sector in the search for solutions and proposals that reduce the vulnerability of the sector to climate change and guarantees their stronghold in the national economy, with positive implications for the food security of the country and world.

Finally, it is necessary to analyze sustainable agriculture in regards to its competitiveness. With markets increasingly more demanding in socio-environmental terms, especially for products coming from developing markets and with consumer demands for the traceability of product consumed, several opportunities become open to the business community of a sector that corresponds to a significant segment of Brazilian international trade. Be it in the process of adapting adequately to international norms (with consequent differentiated labeling and certificates) or in the production of differentiated goods (e.g., organic products), Brazil has the chance to stand out in front of the international commodities market, aggregating value of goods that suffer immense price fluctuations at each harvest and whose vulnerability should be reduced in all possible ways. The availability of the Brazilian business community to offer products and to adapt designed products and technologies for the new reality of the low-carbon economy improves business performance, brings financial gains in the short and medium term, and promotes security for long-term investments.

FIGURE 2: EMISSIONS BY SECTOR IN 2005 SOURCE: MCT (2010).



1.2 EMISSIONS PROFILE OF THE SECTOR

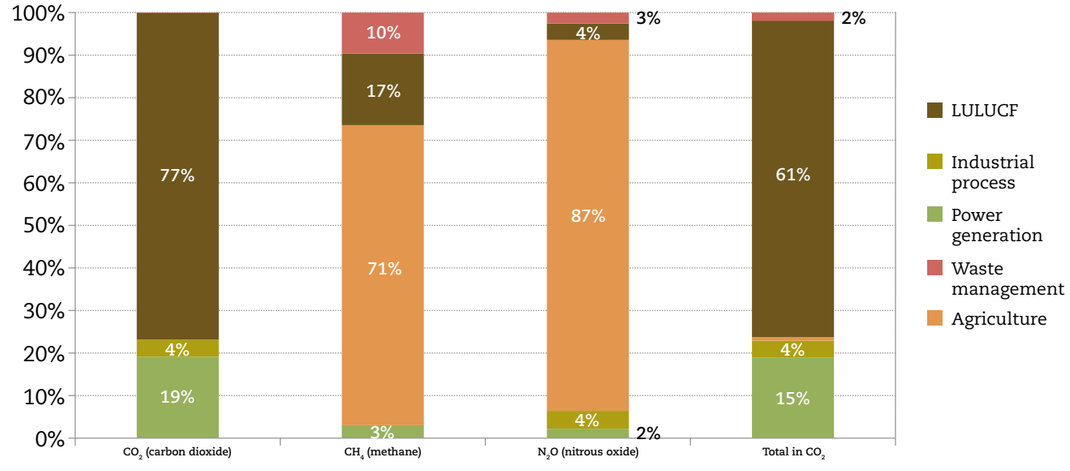
The Agricultural Census of 2006 indicated that agricultural activities, forestry, and livestock activities employ 16.4 million people and covers nearly 30% of the nation's territory, or 254.6 million hectares in 2006. According to the Brazilian Emissions Inventory (from the base year 2005), the Brazilian agricultural sector is responsible for approximately 19% of CO_2 emissions in the country (MCT, 2010), behind only the emissions from land use change and forests (deforestation). ***(Figure 2)***

Agricultural emissions (2005) are concentrated in enteric fermentation (11% of total emissions), resulting from the digestive process of cows; agricultural soils (6%), and from the deposit of animal waste in pastures; management of waste (1%), principally from bovines, pigs, and confined birds; the rice culture; and the burning of residual agriculture (less than 0.5% each).

Just as the relation to the types of GHG emitted, as well as from the activities from the change in land and forest-use, represents a major source of CO_2 (76%), agriculture is responsible for the major part of methane emissions (CH_4) (71%) and nitrous oxide (N_2O) (91%), gases with the highest greenhouse gas potential (GWP). ***(Figure 3)***

The use of land for agriculture is pointed out to be one of the largest vectors of the principal source of Brazilian emissions,

FIGURE 3: GHG EMISSIONS BY GAS TYPE AND SECTOR (%), 2005 SOURCE: ADAPTED FROM ICONE (2010A).

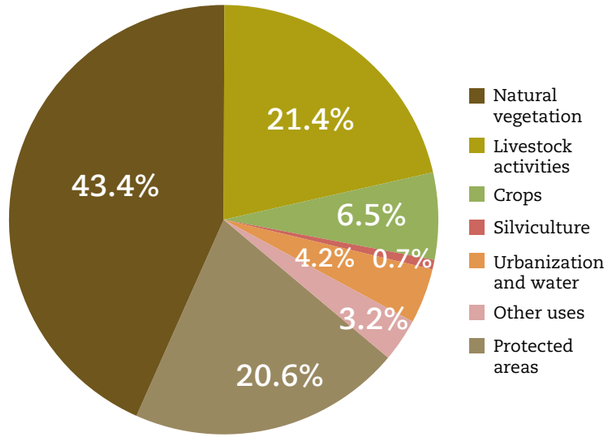


deforestation (the change of land and forest use corresponds to 61% of Brazilian emissions in 2005). Studies show that livestock activity, in its extensive nature, occupies an area three times larger (6.5%) and forestry (0.7%) of land use in Brazil. ***(Figure 4)***

Brazil has witnessed a large increase in its agriculture sector in the last few years. Between 2006 and 2009, the offer of a few of its principal agricultural products increased considerably: ethanol (18% per year), corn (14%), cotton (12%), milk, sugar and pork (6% each) and chicken (5%) (Icone, 2010b). Between 2000 and 2008, Brazil increased its global participation in agribusiness exports from 4.1% to 7%, having grown to a rate of 19% in the period, behind only Indonesia. Today it is the 3rd major agricultural sector exporter in the world, after the U.S. and the 27-member group of countries in the European Union (FAO, 2010).

The absence of incentive policies in the market for rural producers to increase productivity in the field, using a metric of heads/acres, ended up generating perverse incentives that intensified the expansion of the agricultural frontier as the pastures were being degraded. Without any direct incentive and without ample technological diffusion to

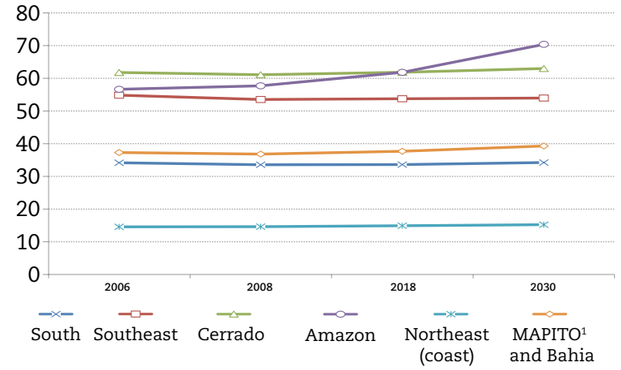
FIGURE 4: LAND USE IN BRAZIL SOURCE: ADAPTED FROM ICONE (2010A).



recover the degraded areas, rural producers continued expanding production to new areas over the course of decades, motivated by cheap and abundant lands.

The large forest areas in Brazil, just like the private area in the Conservation Units and in indigenous lands, constitute and important carbon sink that contributes significantly to climate regulation in other regions of the country. ***(Figure 5)***

FIGURE 5: PROJECTED EXPANSION OF LAND USE FOR AGRICULTURE (CROP AND LIVESTOCK) SOURCE: ICONE APUD GOUVELLO ET AL. (2010).



1 Region comprised by the states of Maranhao, Piaui and Tocantins.

2 In yellow, actions directly related to the agricultural sector; in gray, those indirectly related.

"The reaction of the pollution chain transformed the burning and destruction of the Amazon forests into a problem in the South and Southwest of Brazil. The scientific experiments that took place in the last years by the LBA [Large Scale Biosphere-Atmosphere Experiment in the Amazon, under the scientific coordination of INPA] revealed that a reduction of rains in the South and Southwest regions is intimately linked to the existing environmental in the northern region of the country." (Ottoboni, 2004)

In the absence of private policies and initiatives that would bring about change, rural producers tend to aggravate the situation. The World Bank projects growth of 7% in the utilized area by the agricultural sector of the country between the years 2006 and 2030, strongly influenced by the expansion of the Amazon region, with 24%. In the other areas the expansion projected is not as significant. (***Figure 5***)

The Agricultural Census of 2006 revealed a progressive substitution in pastoral areas for crops since 1996. In the period of 1996–2006 the area for crops increased 83.5%, while the areas for pastureland has retreated 3%. In spite of this retreat of pastureland, a tendency for an large movement of livestock activities was observed towards the interior of the country in search of cheap lands, principally in the direction of the North of the country (a growth of 80.8%), while the more traditional areas of the Central-south of the country had a tendency of intensification of livestock, resulting in an increase in the density of bovines.

In summary, confronting the facts from the Agricultural Censuses from 1996 and 2006, it is generally observed that the pastoral areas in the Center-South of the country are not growing, but ceding space for more intensive, short-cycle cultures, which are of more value in the international market. They are also responding to more demand from the internal and international markets for grains and products for purposes of animal nutrition, biofuels and human nutrition. This reduction in pastureland in the Center-South responded with an increase in productivity. Already in the North region, and principally in the states of Pará and Rondônia, there were strong growths in area with herds (PNMC, 2008).

If livestock activities are part of the problem (Brazil is 4th largest emitter of GHG in the world (WRI, 2010), the sector can also be part of the solution. Brazil is seen as one of five countries in the world with the highest potential to reduce emissions, according to an analysis by McKinsey, with a horizon of 2030 (McKinsey, 2009). According to the Brazilian Communiqué to the Convention on Climate of January 2010, and the Plan for Mitigation and Adaptation to Climate Change (2010) for the agricultural sector, the majority of avoided emissions in the Brazilian commitment in the Copenhagen Accord (between 88% and 86% of the minimum and maximum scenarios, in relation to 2005 respectively) should occur through national actions of mitigation (NAMA) associated with the use of soil directly or indirectly related with agriculture. (***Table 1***)

In respect to the GHG emissions reduction costs in Brazil by sources, estimates from McKinsey place activities tied to mitigation of emissions from soil use as having the best cost-benefit relationship for a Brazilian commitment to reduce GHG emissions, given that they have the highest potential for reduction for the least cost of abatement, as is shown in ***Figure 6***.

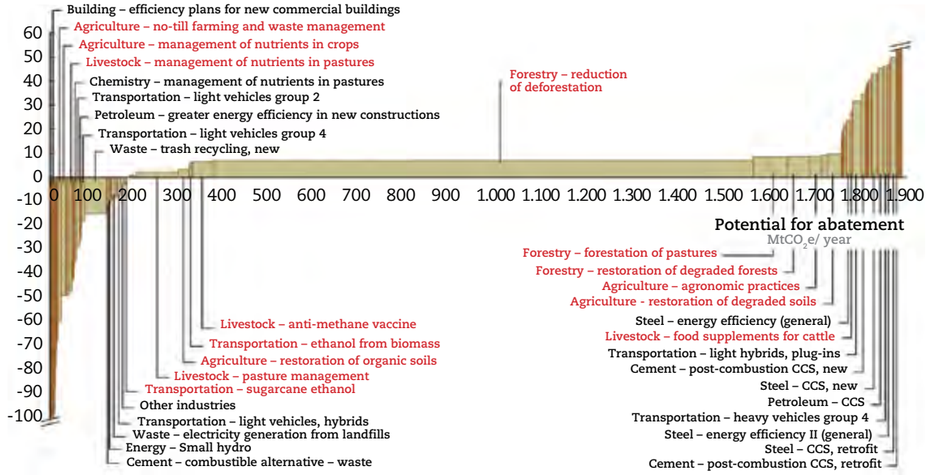
The use of these mitigation opportunities translates into a reduction of emissions in

TABLE 1: NATIONALLY APPROPRIATE MITIGATION ACTIONS PRESENTED IN THE COPENHAGEN AGREEMENT SOURCE: ICONE (2010A).

NATIONALLY APPROPRIATE MITIGATION ACTION (NAMA)	2020 (TREND) ($MtCO_2$)	REDUCTION BY 2020 ($MtCO_2$)		% REDUCTION	
LAND USE	**1084**	**669 (min.)**	**669 (max.)**	**24.7% (min.)**	**24.7% (max.)**
Reduction of deforestation (80%) in the Amazon		564	564	20.9%	20.9%
Reduction of deforestation (40%) in Cerrado		104	104	3.9%	3.9%
AGRICULTURE	**627**	**133**	**166**	**4.9%**	**6.1%**
Recovery of degraded pastureland		83	104	3.1%	3.8%
Crop-livestock integration		18	22	0.7%	0.8%
No-till farming		16	20	0.6%	0.7%
Biological fixation of nitrogen		16	20	0.6%	0.7%
ENERGY	**901**	**166**	**207**	**6.1%**	**7.7%**
Energy efficiency		12	15	0.4%	0.6%
Increased use of biofuels		48	60	1.8%	2.2%
Expanded supply of hydroelectric power		79	99	2.9%	3.7%
Alternative sources (small hydro, bioelectricity, wind)		26	33	1.0%	1.2%
OTHER	**92**	**8**	**10**	**0.3%**	**0.4%**
Steel (replacing deforestation coal for planted forests)		8	10	0.3%	0.4%
TOTAL	**2703**	**975**	**1052**	**36.1%**	**38.9%**

Actions strictly related to Agriculture Actions indirectly related

FIGURE 6: GREENHOUSE GAS ABATEMENT COST CURVES (IN €/tCO_2e) SOURCE: MCKINSEY (2009).



Brazil, as a signatory party of the UN Framework Convention on Climate Change (UNFCCC), but also in a reduction of carbon intensity as a Brazilian agricultural product. Products with less carbon intensity (lower emissions volume per unit produced, for example) can, in a distant scenario, be privileged with access to markets and public and private investment funds for climate actions; obtain differentiated prices in the international commodities market and still generate economic and financial gains for businesses that were proactive in their operation. In impacting the economic bottom line, the gains from engaging in a low-carbon economy will become more evident for rural producers.

02

CHALLENGES FOR THE AGRICULTURAL SECTOR

In spite of enormous potential for the mitigation of GHG in the agricultural sector, many available technologies have not been adopted in their plenitude. This is because a diversity of barriers that makes it difficult for the migration of agriculture to a have a low-impact on climate. While a few practices, like the elimination of the burning of residuals from sugar cane, have defined incentives by law, the majority of activities still need to be fostered before they can be implemented.

Table 2 lists the practices with potential to reduce GHG in Brazil, divided in three areas: agriculture, livestock, and forestry.

TABLE 2: MANAGEMENT PRACTICES FOR CROP, LIVESTOCK, AND SILVICULTURE WITH GHG REDUCTION POTENTIAL IN BRAZIL SOURCE: ICONE (2010A).

PRACTICE	AMOUNT OF MITIGATED GHG
AGRICULTURE	
No-till farming	0.5 tCO_2/ha/year
Crop rotation	0.32 tCO_2/ha/year
Mechanism harvest of sugar cane	1.5 tCO_2e/ha/year (accumulated in the soil) 0,48 $MtCO_2$e/year sequestered 0,05 $MtCO_2$e/year avoided)
Bio-coal	30 tCO_2e/ha in the case of applying the norm of 1 kg/m^2
Bioelectricity: sugar cane	0.2677 tCO_2e/MWh; 1,000 t waste = 5.5 to 8.25 MWh = 1.47 to 2,2 tCO_2e
Bioelectricity: rice husk	2.37 t of rice husk = 1 MWh (1 t = 0,42 MWh)
Bioelectricity: coconut	n/a
Bioelectricity: orange	Could go down energy consumption of processing industries of oranges up to 75%
Inoculantes para fixação biológica de nitrogênio	Could result in the fixation of up to 102.9 kg of N/ha
LIVESTOCK	
Increase in livestock production	Reducing time of slaughter and raise more productive animals, reduces emissions of GHG per kilo of meat produced
Pastoral management	Well-managed pasture: stock of 54.41 tCO_2e/ha Poorly-managed pasture: 32 tCO_2e/ha
Pasture rotation	Influence of intensity of pasture use in emission of non CO_2 gases not well-defined
Voisin grazing management	99 tCO_2e/ha
Bioengineering of animal rations: ionophores	Monensin can reduce methane emissions by 25% (might vary from 4 to 31%)
Bioengineering of animal rations: supplementation with fatty acids	Decrease in production of methane by 22%
Biodigestors	According to a PDD from Perdigao, in the capture and combustion of methane in production of swine: 4,430 tCO_2/year/2,000 animals
Livestock-crop integration	1.67 tCO_2/ha/year for consortium pastures with legumes in the Cerrado biome
SILVICULTURE	
Minimum cultivation	115 tCO_2/ha/year
3x2 spacing	In 7 years: 164.83 tCO_2/ha w/o litter, 213.82 tCO_2/ha with litter. Total sequestration for 3x3 spacing in 7 years: 158.87 tCO_2/ha w/o litter, 199.11 tCO_2/ha with litter.
Agrosilvopastoral systems	Carbon sequestration: 1st year: 21.8 tCO_2/ha/year; 5th year: 180.55 tCO_2/ha/year; 10th year: 291.41 tCO_2/ha/year
Economic rotation in agrosilvopastoral systems	Carbon sequestration: technical rotation (6 years): 193.33 tCO_2/ha/year; economic rotation (7 years): 216.84 tCO_2/ha/year
Substitution of mineral coal for renewable vegetable coal	For each ton of pig iron allowed to emit 3 tCO_2, being that 1 t of pig iron requires 0.725 t of vegetable coal. Coke releases 1.65 tCO_2 and fixes 1.536 tO_2 for 1 t of steel produced. Vegetable coal sequesters 16.336 tCO_2 and regenerates 1.536 tO_2 per 1 t of steel produced.

ENERGY, TRANSPORTATION, AND AGRICULTURE

The barriers for implementation of the above mentioned practices in the agricultural sector are caused by the absence of consistent policies that incentivize cooperation of the public and private sector to create synergies between the productive sector and the scientific community for:

(i) Research and Development (R&D), for new equipment, plant varieties and planting technologies for pastoral management**.**

(ii) Technical assistance and rural extension.

(iii) Capacity-building for farmers, which requires the accompaniment for techniques from state agricultural secretaries in cooperation with agricultural schools and institutes for a continuous improvement of professionalization in the sector.

(iv) Financing mechanisms, which demand clear public policies and objectives to facilitate access to differentiated and directional credit for actions of mitigation and adaptation, which were previously described**.**

(v) Clearer regulation of emissions reduction from deforestation and forest degradation (**REDD**) and for payment mechanisms for environmental services (**PES**) that can contribute to the development of mitigation projects of GHG in agriculture, given that an approach is used that puts a premium on adopting sustainable agricultural practices and protects the environment.

Finally, the role of agricultural activity stands out in development, in the production and utilization of biofuels, beyond potential suppliers of input and bioenergy on their own. Agricultural producers can find a sustainable solution in bioenergy for their own energy consumption and generation for sale of excess energy on a small scale. The issue of bioenergy requires the same questioning as above and also the articulation of the sector with an energy chain and the transportation sector. It needs integrated policies in a way that makes supply and demand compatible for biofuels and for biomass. The incentive for consumption of alternative energy from biomass can be innocuous if it does not come with production incentives of sufficient input to cover the demand.

In sum, upon analyzing the practices with the highest potential for GHG reduction in agriculture and their respective barriers to implementation, the biggest challenges for the sector to reduce its direct emissions and stop being one of the vectors of emissions from deforestation in Brazil should consider:

- **Efficiency in the use of soil, be it (i) by increasing the productivity of agriculture; or (ii) by the improved management of pastures, that can be addressed by:**
  - **Diffusion, by means of technical capacity-building and rural extension, by better agricultural practices**
  - **Research and development of agriculture technology of lower carbon intensity**
  - **Development of biofuels and other sources of renewable agro-energy**
  - **Appropriate financing.**
  - **Economic instruments that incentivize good practices for soil use and environmental protection, reducing pressure to expand the agricultural frontier.**

03

DIALOGUE WITH REALITY: REGULATORY FRAMEWORK

The formulation and implementation of a sustainability agenda in agriculture requires a dialogue with a regulatory framework and national public policies in line with the sector, which includes initiatives in the field of sustainability like the National Plan for Climate Change (PNMC). The PNMC responds adequately to challenges and takes advantage of opportunities offered by agriculture.

At least two large institutional references need to be analyzed for the construction of an effective path towards sustainability in agriculture in Brazil:

(i) The Agricultural Plan (PAP in Portuguese) as the principal document for proposals in the agricultural sector.

(ii) Policies of incorporation of sustainability in agriculture, contemplated in the National Plan on Climate Change (PNMC).

Even though working in this context is very important given that the frameworks deal with the use of soil and/or the management of agricultural and forested areas, state policies and legislations will not be analyzed here. Given the present specificities in the states of the Federation, this work dialogue is only with the principal reference established in the national framework.

3.1 THE AGRICULTURAL PLAN (PAP)

The Agricultural Plan (PAP), launched at each harvest by the federal government, is an important instrument in agricultural policy and is already being used in directing agricultural production towards sustainable practices. The financing executed by BNDES makes up part of this Plan, just like the financing from other federal banks (Banco do Brasil and Caixa).

Among the public financing options predicted in the PAP 2009–2010 for the implementation of low-carbon agricultural practices, the **Stimulus Program for Agricultural Production (Produsa in Portuguese)** stands out. Produsa finances various sustainable agricultural practices, such as the environmental adaptation of property and conversion to organic systems, with rates of 6.75% per year. In this harvest, Produsa included the growth of palm when cultivated in degraded areas, with an interest rate of 5.75% per year and a financing term of up to 12 months with forgiveness of up to six months. Produsa encompasses the financing of “green practices” and incorporates the pre-financed practices through programs like Propasto, Prosolo, Provarzea, among others. In the last harvest, R$ 1.5 billion went to Produsa.

BNDES also makes available a **credit lined for agricultural machinery (Finame)** that creates incentives for the conversion of some systems proposed. The **Commercial Planting and Forest Recovery Program (Propflora)**, also executed by BNDES, finances the implantation and maintenance of forests for economic purposes, the recovery and maintenance of Areas of Permanent Preservation (APP) and Legal Reserve.

Also in the scope of PAP, the **Program for Modernization of Agriculture and Conservation of Natural Resources (Moderagro)** finances the construction and modernization of equipment for waste treatment, environmental adaptation projects for sanitation, the correction and fertilization of soils, the recovery of degraded cultivated pastoral areas, and the systemization of flood plains to increase the production of grain, as well as actions tied to apiculture, aquaculture, aviculture, sericulture, and swine. In spite of the fact that this program does not have a focus on practices of reducing emission, it is worth highlighting that it permits investment in actions that can lead to GHG mitigation and sequestration, and as such, should be better exploited by producers.

The Agriculture Plan 2010–2011 published in June of 2010 created the **Low-carbon Agricultural Program (Programa ABC in Portuguese**) as a way to incentivize practices for lower emissions, adapted technologies, and efficient production systems to foster sustainable agriculture in the country. The predicted resources to be invested by the Programa ABC are in the order to R$ 2 Billion, with financing rates of 5.5% interest per year.

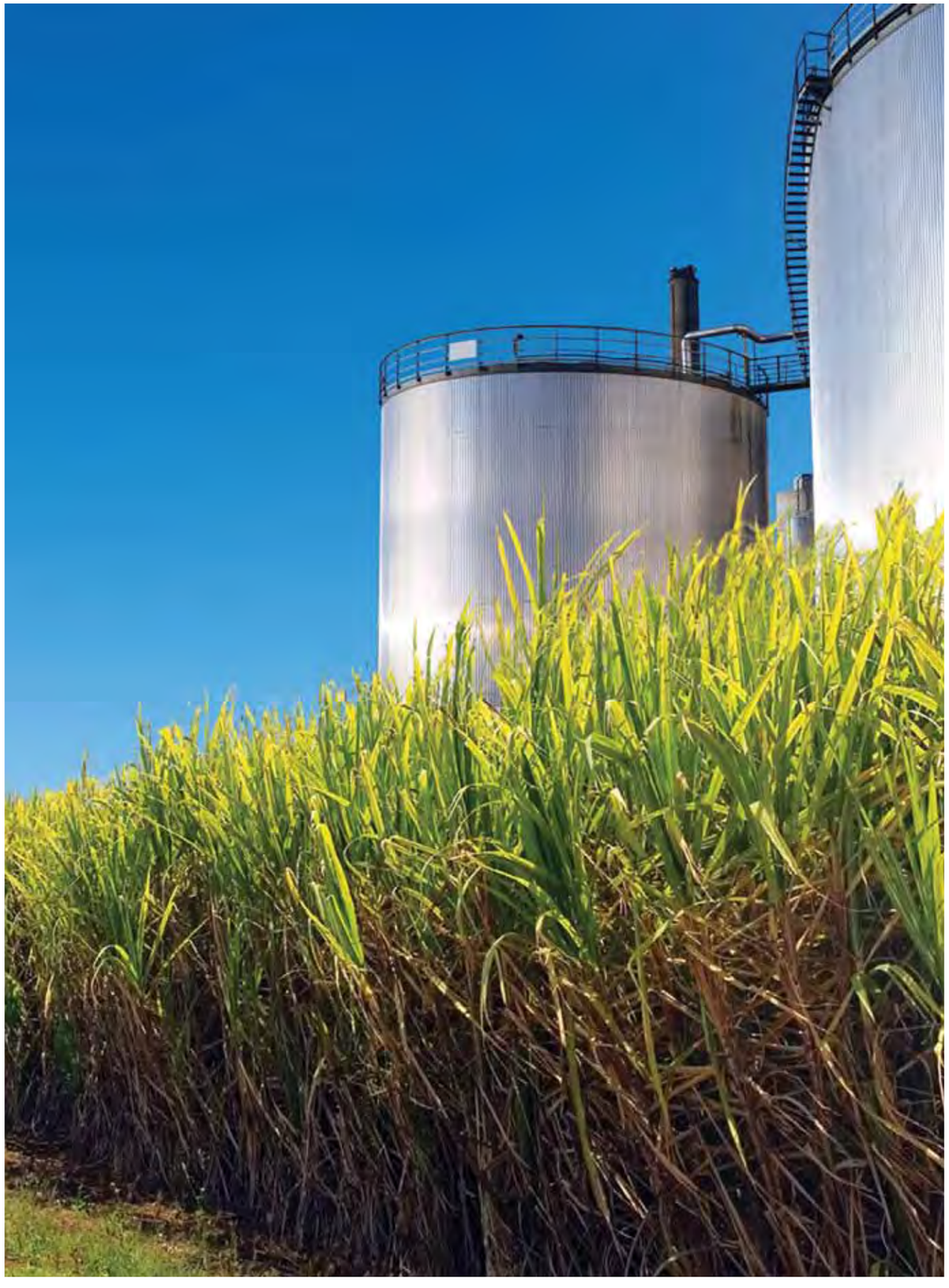
Federal programs that look to incentivize low emission practices and technologies—ABC, Produsa and Propflora—bring together funds for investment in the range of R$ 3.15 billion (approx. $1.8 billion), in the 2010/2011 Plan. This amount is a major initial step that needs the support and capillarity of various banks, cooperatives, and sectoral associations, among others, so that it is effectively applied. It is not uncommon to see steps towards agricultural credits of this nature remain stalled until the next session, be it due to a lack of projects and credit applications; difficulties of debt capacity of a sector that already depends on credit to sustain itself; or the difficulty of compliance of the various listed requirements, which is many times more demanding for rural credit and not for environmental and sustainable actions.

Finally, it is important to point out that, despite the advances that have occurred in the availability of resources for investment in sustainable agriculture, Embrapa demonstrates in studies that resources will need to be in the range of R$ 56 billion (approx. $32.7 billion)[1] to adopt the actions of mitigation presented by the Brazilian government in the field of agriculture by 2020. This clearly indicates the necessity for synergy in operations by the public and private sectors. This is required in 1) the government's commitment to sustainable and practices of lower emissions in future agricultural plans and in 2) the capacity for a quick response from the private sector to effectively adopt these practices. These are indispensable in transforming the national agricultural production into a pioneering and successful case of responsible management of natural and agricultural resources, with consequent benefits from the access to global markets in production efficiency and competitiveness. *(Table 3)*

1 Embrapa's estimates to restore 15 billion acres of degraded pastures until 2020 amount to R$ 19.6 billion (approx. $11.3 billion). To implement crop-livestock integration in 4 million acres, it would be necessary R$ 34.2 billion ($19.8 billion). For 8 million acres of no-till farming, R$ 2.4 billion ($1.4 billion). Finally, to adopt biological nitrogen fixation in over 11 million acres of soybean crops, R$ 302 million ($174.2 million) would be required.

TABLE 3: ESTIMATED RESOURCES FOR SELECTED PROGRAMS SOURCE: ICONE (2010A).

PROGRAM	2009/2010 PLAN	2009/2011 PLAN	CREDIT LIMIT PER PRODUCER	INTEREST RATE (% PER YEAR)
Low Carbon Agriculture (ABC)	–	R$ 2 bn	R$ 1 m	5.5%
Stimulus Program for Agricultural Production	R$ 1.5 bn	R$ 1 bn	R$ 300–400,000	6.75% or 5.75%
Program for Commercial Plantation and Forest Restoration	R$ 150 m	R$ 150 m	R$ 300,000	6.75%
Program for Agriculture Modernization and Conservation of Natural Resources	R$ 850 m	R$ 850 m	R$ 300,000	6.75%



3.2 NATIONAL PLAN ON CLIMATE CHANGE (PNMC)

The National Plan on Climate Change (2008), which is currently under revision, lists a series of programs and activities already developed by the government or in the implementation phase, under the axes of **(i)** protection and conservation of biomass and **(ii)** increase in sustainability in agriculture.

For the protection and conservation of biomass, the PNMC lists **(i)** Policies for the Caatinga and **(ii)** a Plan of Action for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAM), structured for **(a)** land and territory ordering; **(b)** environmental monitoring and control; and **(c)** the fostering of sustainable production activities.

In the axis of increasing sustainability of agriculture, the PNMC lists a serious of initiatives that represent the primary step of the agricultural sector on course towards a low-carbon economy.

3.2.1 GRADED REDUCTION OF THE BURNING OF SUGAR CANE STRAW

Federal decree n. 2.661, July 8th, 1998, regulated by one paragraph of art. 27 of Law 4.771 of September 15th, 1965 (Forest Code). establishes norms of relative precaution to the use of fire in agro-pastoral and forest practices, among other steps.

3.2.2 SUSTAINABLE PRODUCTION PROGRAM FOR AGRIBUSINESS (PRODUSA)

Finances the recovery of degraded pasture areas, rendering them once again productive. The resources are destined for the adoption of sustainable practices, just as the agrosilvopastoral (crops–livestock–forests) integrated systems, correction and soil management, and projects of environmental adaptation in rural properties.

3.2.3 NEW AGRICULTURAL PRACTICES

The agricultural sector must adopt short and long-term solutions for the implementation of practices that prevent the advance of deforestation to open new areas of planting and other practices. As such, the following issues should be studied:

- **Recovery of degraded pastures, so that there is no need for expansion to new agricultural areas: this decelerates the advancement of deforestation for planting. The close to 100 million hectares of degraded pasture existing today in the country, if well used, could house the agricultural expansion without the need to deforest.**
- **The adoption of systems that can remove carbon from the atmosphere, such as the integration of crops and livestock, agroforest and agrosilvopastoral: the impacts of global warming can be minimized if the productive system were capable of more intensely exploiting the apt areas for cultivation. The Crops-Livestock-Forests integration can help the recovery of soil and has a high potential for carbon sequestration. Researchers also bet on the efficiency of agroforest and agrosilvopastoral systems—a combination of species of trees, in the first case, and of pasture with agriculture and short cycle trees, in the second. The combination of trees is interesting because they have a role in the maintenance of carbon sequestration over time.**
- **The adoption of zero tillage and reduction of the use of nitrogen fertilizers: good management practices of soil also contribute to carbon sequestration. The most commonly used is no-till farming, which promotes the cultivation over straw left on the soil from the previous harvest without the necessity of removing the soil.**
- **Improvement of pastoral management to capture carbon in the soil and increase the productivity of livestock activities, thus reducing emissions per kilogram of meat.**

3.2.4 ZONING PROGRAM FOR SUGAR CANE

This program aims to provide the federal government with necessary information for the country to grow in the development of sugar cane production by sustainable means and in accordance with each state in the Federation. It aims to promote a discussion on development of energy cultures and grains.

3.2.5 NATIONAL AGRIBUSINESS

This plan aims to organize and incentive proposals for research, development, innovation and technology transfer to guarantee sustainability and competitiveness in the agribusiness chain. It establishes institutional arrangements to structure the research, a consortium of agribusiness and the creation of the Embrapa Agribusiness Unit.

04 PROPOSALS

To deal with the challenges and opportunities previously described, the Businesses for Climate Platform (EPC) presents a conjunction of public policy proposals with the objective of the adoption of large scale sustainable agricultural practices with the aim to reduce the direct and indirect emissions from the sector.

4.1 EFFICIENCY IN THE USE OF SOIL AS A NATURAL RESOURCE, BE IT FOR (I) THE INCREASE OF PRODUCTIVITY IN LIVESTOCK ACTIVITIES; OR (II) FOR THE BETTER MANAGEMENT OF PASTURELANDS

The more efficient use of soil and the increase in production of the agricultural sector is fundamental for the establishment of a low-carbon economy in Brazil. In the meantime, the promotion of efficiency in the agricultural production is not necessarily conditional on technological bottlenecks, given the more efficient and diverse technologies that are available, many of which are of proven economic viability.

The principal challenge is then the promotion of public policies that give scale for better practices, by means of building technical capacity and rural extension, like the continuing development of technologies that promote increased productivity in the sector.

4.1.1 INCENTIVE POLICIES FOR RURAL EXTENSION AND CAPACITY BUILDING

According to data from the Agriculture Census of 2006, of the close to 5.1 million rural properties in the country, 78% do not receive regular technical orientation, 13% receive occasional orientation, and only 9% receive it regularly. Within the universe of properties that use no-till farming — 316 thousand properties covering close to 15.6 million hectares in 2006 according to the Census—31% regularly receive technical orientation, 27% occasionally, and 42% do not receive any orientation. ***(Figures 7a and 7b)***

Based on the above, a policy of rural extension that promotes the application of different researched techniques in regions of different edaphoclimates is necessary and in line with research and development policies. Access to information on agriculture is expected to expand and simplify with the commitment of research, rural extension and capacity-building on climate change. The creation of informational networks is a step for disseminating information for different public audiences in an easy way. A database, or other analogous means, to bring together the research and practices in the sector would be very useful in making low-carbon practices measureable, reportable, verifiable, and still

FIGURE 7A: TECHNICAL ASSISTANCE TO PRODUCERS (TOTAL OF RURAL PROPERTIES) SOURCE: IBGE (2006).

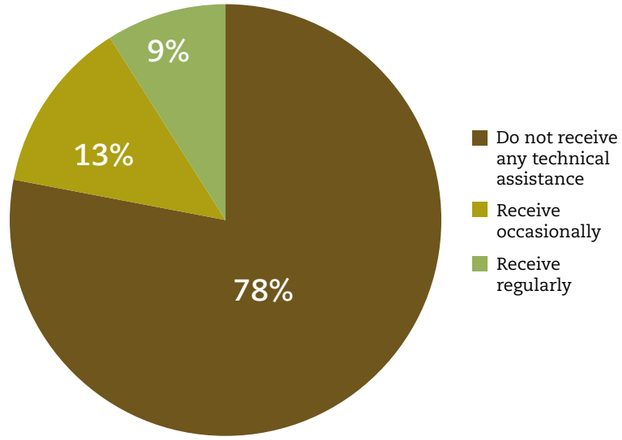
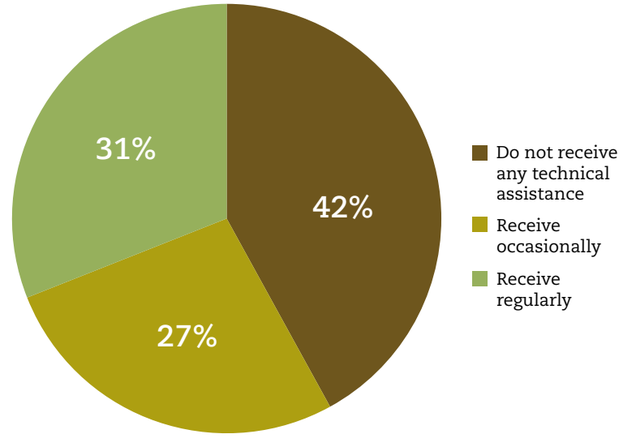


FIGURE 7B: TECHNICAL ASSISTANCE TO PRODUCERS (PROPERTIES WITH NO-TILL FARMING) SOURCE: IBGE (2006).



replicable. This would facilitate the adoption of public incentive policies and the participation of rural producers in initiatives for low carbon markets.

A shift in paradigms of production and break with traditional means of growing and cultivation is necessary. Changes are not always easy to implement because a reaction of resistance from those who have been producing the same way for decades is natural. It is necessary to admit that the practices and policies discussed in this study could require technical training for producers and for governmental authorities, and that the lack of qualified labor and dissemination of knowledge could become important obstacles.

4.1.1.1 INCENTIVE POLICIES FOR THE POLITICAL PARTICIPATION AND MOBILIZATION OF THE AGRICULTURAL SECTOR

Politically, there are already some initiatives that look to include agriculture, livestock activities, and forestry, and all forms of terrestrial carbon in the discussion for finding solutions to climate change. In Brazil, climate change still has to reach a higher level on the agenda for leaders in the agricultural sector. Despite a few relevant cases—especially in the sectors of sugar cane and forests planted for steel production—a greater effort to mobilize leadership and bases in the agricultural sector is necessary to advance a proactive agenda for sustainability. Such an agenda for the sector should be seen as a competitive opportunity and could represent new businesses for agricultural products.

A widening of the channels for dialogue and the mobilization of the agricultural sector for participation in international negotiations is proposed. Also, we propose the growth of the rural extension program for the inclusion of informed discussions on the issue of climate change in the sector.

The inclusion of agriculture on the agenda in climate negotiations is already a reality. And negotiations on land use reflect the fact that productive agricultural practices (the management of different soil types, the management of forests, and no-till farming, among others) can significantly impact the reduction of emissions from a country on the whole.

4.1.1.2 CERTIFICATES

Certificate systems are valid economic instruments that aim to differentiate a final product according to its compliance with established norms or market preferences. Certificates show that products have considered socio-environmental questions into the price and economic activity of their production. As such, socio-environmental certificates have risen to become one of the mechanisms that promote and incentivize change in the quality of agriculture, livestock activities, and forestry towards sustainability.

Public and private incentive policies for certification will become a factor in the promotion of differentiation of products and productive processes in the market. The search and use of certificates by an enterprise are one demonstration of the commitment of an organization to certain market practices that are subject to pre-determined specifications and monitoring from independent bodies. Beyond the distinction a product gains in the market by obtaining an environmental certificate or label, a label can be a value-add since it can open access to new markets that accept certified products.

4.1.2 INCENTIVE POLICIES FOR RESEARCH AND DEVELOPMENT (R&D)

To overcome the challenges in the adoption of low-emission agricultural activities, efforts for research and development with the best orientation possible are necessary. Human and financial resources are limited and urgently needed.

Brazil can currently count on a strong network of R&D in the agricultural sector. This network is called the National System for Agricultural Research (SNPA), which aggregates Embrapa and its regional research units, the State Organizations for Agricultural Research (OEPA), and Research Universities and Centers.

In the age of network-wide cooperation, **Rede Agrogases** deserves to be highlighted. It oversees four central projects, which are: Stocks and Balance of Carbon in the Soil, Carbon Stocks in Native Vegetation formation and perennials, the Evaluation of GHG in Land Use Systems, and the National Inventory of Greenhouse Gases. Another initiative with the potential to significantly contribute to the sector with analysis is the Brazilian Research Network on Global Climate Change (Climate Network), instituted by MCT at the end of 2007. Embrapa Environment oversees the Climate Network's coordination on agricultural issues.

In spite of this diverse national structure, the organizational model needs to be revised to accommodate the changes brought by globalization and digitalization of economic activity. With the rising demand for food and bio-energy resources, it is essential to bring in additional efforts in the dissemination of knowledge on sustainable agricultural practices, whether they are innovative or traditional, for the rural producer. This should be done by means of policies of extension and rural capacity-building.

It is also important to mention that all agricultural research that raises that productivity of land has a potential positive impact on the reduction of GHG emissions. In this regard, investment in an increase of agricultural productivity is an indirect investment in climate change mitigation. The management and adopted uses of soil are determining factors in GHG emissions from its use. In this sense, a permanent advancement in knowledge is necessary. Research and development is fundamental for the implementation of effective policies that aim to improve rural productivity.

Policies for **research and development** for the agricultural sector should contemplate the **more efficient use of natural and agricultural resources** by way of better use and management of soil. This can result increased productivity and higher carbon stock in the soil, as well as the **development of new varieties** of plants and seeds that are more resistant to extreme climate events and are **more productive**.

As such, the construction of an incentive policy is proposed for research and development within various scopes that considers:

AGRICULTURE: the implementation of no-till farming, crop rotation and inoculants for the biological fixation of nitrogen, among others.

LIVESTOCK ACTIVITIES: increase productivity per hectare, the diversification of management techniques and pasture rotation, bioengineering of animal feedstock and the integration of crops and livestock activities.

SILVICULTURE: techniques for increasing productivity, the adoption of agrosilvopastoral systems and their economic rotation, as well as the application of vegetable coal for use in steel-production.

The "life cycle analysis" (ACV in Portuguese) of agricultural products is considered increasingly more important as a useful tool for defining the mitigation specifics in policy. The ACV is a tool that can support the management and strategic decision-making for agricultural organizations that are trying to improve their performance along the production chain by gaining competitiveness in the sector.

4.2 INCENTIVE POLICIES FOR THE USE OF RENEWABLE ENERGY SOURCES IN TRANSPORT AND POWER GENERATION

Similarly to conservation, the more efficient use of natural and energy resources and the increase of agricultural productivity, the promotion of using renewable energy in the transport sector (biofuels) and electricity generation (from biomass or wind and solar among others), presents intersectoral benefits. And as such, it requires articulated action between the decision-makers involved and the conception of such ideas.

Energy policies that promote the use of agricultural resources for producing solid and liquid biomass depend on a conjunction of policies (agricultural and non-agricultural) that proportion the increase of inputs. And this development in itself depends on an investment policy for research, development and capacity-building with a focus on the improvement of productivity.

In this context, investment in renewable energy sources stands out by presenting additional gains for energy security in the country, given that it reduces the country's dependence on fossil fuel resources, which not only represent a significant contribution to the acceleration of global warming, are also subject to international price oscillations and supply from foreign markets.

Considering the relevance of this issue for the competiveness of the productive sector and for the installation of a low-carbon economy in Brazil, the Businesses for Climate Platform proposes that the government create an investment policy in R&D for the production of ethanol (2nd and 3rd generation), as well as for research on new prime material for large-scale biodiesel production.

4.2.1 INCENTIVE POLICIES FOR DEVELOPMENT OF BIOFUELS AND OTHER RENEWABLE ENERGY SOURCES

The production of biofuels is another way that agriculture can contribute to climate and energy security. As such, it is important that the climate benefits of renewable energies from agricultural sources are made known by means of research on the issue. A lot can still be done to foster new technologies for prime materials with energy potential, such as castor, jatropha, and palm oil (dendê in Portuguese). Several native species still need to be domesticated and analyzed for their energy potential, such as babaçu, macaúbu, pequi and

tucumã. Furthermore, the use of agricultural residuals (solids and liquids, especially organics) for the purposes of energy also presents enormous potential for the country. The investment in R&D is fundamental for the country.

Important relationships are observed between **agricultural policies** and **energy policies** in the development of biofuels and at this intersection there are three proposals with potential to contribute to the reduction of GHG emissions: the increase in **cogeneration** of residuals (solids, liquids, especially organics) for electricity; the promotion of the use of **biodiesel** with diversified prime materials; and the increase in production from **planted forests**, especially for use in steel-production.

4.3 FINANCING AND CREDIT POLICIES

The agricultural sector is traditionally considered a sector dependent on credit for development. In this context, we propose the creation of differentiated financing mechanisms for the promotion of sustainable agricultural practices, as well as the improvement of productivity in livestock activities and the production of liquid and solid biofuels.

4.3.1 CREDIT POLICIES

There are many practices that offer better results in terms of retention and/or GHG emissions that present other benefits to the producer that adopts the from the economic point of view. In the meantime, in the majority of cases there is a need for considerable initial investment with long-term returns, which is often risky for an investor that is used to a Brazilian culture in which the prevailing logic is the maximization of profits in the short term. It is necessary to create a culture of investment that considers medium and long-term returns with planning and mechanisms for the capitalization and reduction of risks in ventures.

The agricultural sector is traditionally dependent on credit, both from the public and private sector. The promotion of low-carbon agriculture supposes the necessity to both foster new and sustainable practices while maintaining traditional agricultural policies in an intelligent way, especially in terms of credit for R&D.

It is important to highlight that the guarantee of availability of funds for low-carbon practices is not enough. It is necessary to adjust regulations that determine the capacity for debt in the sector **in a way that insures the capacity to get credit to invest in low-emissions practices for producers**, whether from official lines of credit from the government or from the private sector.

4.4 ECONOMIC INSTRUMENTS FOR THE PROMOTION OF SUSTAINABLE AGRICULTURAL PRACTICES AND ENVIRONMENTAL PROTECTION

One of the most remembered options for the promotion of low-carbon economies is the use of economic instruments, such as

fiscal incentives for sustainable agricultural practices and the adoption of a carbon market. The National Policy on Climate Change provides the use of economic instruments, albeit in a generic way. They include fiscal incentives for public administration as a way to foster changes in the conduct of economic agents on course to implementing practices of lower emissions.

4.4.1 TAX AND FISCAL INCENTIVES

Reducing taxes and the concession of fiscal incentives are economic instruments that can serve as incentives to producers who adopt practices that lower emissions. The reduction of taxes on machines, equipment, inputs and low-carbon technologies in way that increases demand for said products and processes is an option that should be considering when crafting sectoral policy with respect to fighting climate change. This can happen at the federal level and the state and municipal levels by means of reducing various taxes (IPI and ICMS for the purchase of agricultural machines, for example). For example, a State can concede a fiscal exemption with the objective of expanding a forested area in order to develop the use of renewable vegetable coal produced locally in that State. Or this can take place through all-embracing policies, like the Incentive program for Alternative Sources of Electricity (Proinfa).

4.4.2 FUNDS TIED TO CLIMATE CHANGE

With the approval of laws on climate change in Brazil, the creation of funds to capture resources and finance projects and projects for climate change is another important instrument. The Amazon Fund, operated by BNDES, is already a reality and the National Fund on Climate Change (FNMC or Climate Fund)[2] was just signed by President Lula. This uses resources from the special participation of profits from the petroleum production chain to finance mitigation and adaptation climate actions.

4.4.3 VOLUNTARY CARBON MARKET

The voluntary carbon market is an important way that groups and sectors can reduce their emissions and commercialize their reductions, subject to some market regulations. These commercialized reductions are known as carbon credits. The transaction of these credits is made in currency with the commercialization of CO_2e certificates directly between the interested parties or via intermediaries (e.g., banks and stock exchanges).

In some cases, less demanding norms than those adopted by the Clean Development Mechanism (which exists in the scope of the UN) are easier for commercializing credits in the voluntary carbon market, beyond the reduced costs, when comparing with the official market. They generate opportunity for businesses to engage in projects for reduction and sometimes compensation for GHG emissions. Furthermore, the voluntary market can compensate with other associated benefits, such as biodiversity and conservation of hydro sources.

4.4.4 REDUCING EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION (REDD)

Another financial mechanism that can indirectly benefit agriculture is REDD (Reducing Emissions from Deforestation and Forest Degradation). REDD aims to compensate the avoidance of deforestation and pay for the conservation and increase in forest stocks, which represents great benefits for conservation and biodiversity. There are three principal types of financing mechanisms under consideration for REDD: the markets themselves, funds from voluntary donations and initiatives based in the market (such as from the resources that come from auctions for the rights to emit GHG). Despite the lack of a financial mechanism in accordance with Convention on Climate, there already exist several national and voluntary initiatives with regard to this issue.

Meanwhile, until there are advances in international climate negotiations on LULUCF, very little can come from these markets for agricultural activities given the legal insecurity or the fault of comprehensive methods for calculating GHG emissions and emission reductions in the sector. To increase the participation of the sector in the carbon market new methods need to be developed, which require the availability of large-scale financial and human resources

4.4.5 OTHER SCHEMES OF PAYMENT FOR ENVIRONMENTAL SERVICES (PES)

PES functions as a source of monetary retribution for activities for the reestablishment, recuperation, maintenance, and improvement of ecosystems that generate environmental services and are supported by specific programs. Various models of Payment for Environmental Services (PES) can serve as economic incentive mechanisms for GHG emissions mitigation practices, including the payment for practices of sustainable soil use.

2 Law 12,114/2009 created the National Fund on Climate Change (FNMC in Portuguese), with federal resources, royalties from the exploration of oil fields, donations from domestic and international organizations, reinvestment of unused balance from previous years, and interests and credit amortizations as revenue sources for the implementation of the National Policy on Climate Change.

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06 GLOSSARY

ENERGY

- **Cost Benefit Index (ICB in Portuguese):** the Cost Benefit Index (R$/MWh) of each generation undertaking is defined as the ratio between the total cost—investment costs, socio-environmental costs and operating costs and maintenance—and the energy benefit—an increase observed in the Energy Assurance (EA) of the existing system due to the inclusion of such an undertaking (a gain of EA in the first addition), which can be calculated on a monthly or yearly basis.
- **Energy efficiency:** an activity that seeks to optimize the use of energy sources in order to employ less energy to provide the same amount of energy value.
- **Feed-in tariff:** A mechanism that ensures that renewable energy has guaranteed access to the transmission grid through long-term contracts and prices that allow competition with other energy sources that add to the network. One aim is to make the supply of renewable energy economically viable and competitive with less clean but cheaper alternatives. It can be understood as a minimum price system.
- **Solar thermal:** Unlike solar photovoltaic (PV) energy, which converts solar energy directly into electricity, solar thermal technology converts solar energy into heat. On a small scale, is commonly used to heat water for residential or commercial. A large-scale technology called "concentrated solar thermal" is used in thermal power generation.

TRANSPORTATION

- **Air transport:** Transport performed by aircraft powered by kerosene, mainly for regional passenger transport.
- **Dredging:** Maintenance or clearing the depth of rivers and canals, making the approach to ports and wharves.
- **Lignocellulosic ethanol:** fuel produced from the fibrous residue of sugarcane production.
- **Pipeline transport:** Regional freight transport through pipelines (gas and oil pipelines).
- **Rail transport:** Transport on rails, including the urban passenger transport (subway train and metro) and regional freight transport (train). Commuter trains and subways are most likely to be powered by electricity, while regional cargo trains are usually powered by diesel.
- **Road transport:** Transportation by road on wheels, including passenger transport (buses, cars, trucks, and motorcycles) and cargo (mainly by trucks). Vehicles are powered mainly by diesel (trucks, buses), ethanol (cars) and gasoline (cars, motorcycles and some small trucks).
- **Sluice:** A channel in a river or canal, with doors at each end, used to raise or lower boats from one level of water to another.
- **Ton-kilometer (tkm), passenger-kilometer (pkm):** units of measurement used in statistics and planning in Transportation. It considers the amount being transported (in the case of passenger transport, the number of boardings) and the distance covered.
- **Transshipment:** Movement of goods between modes or within a mode.
- **Waterway transport:** Transportation by boats, on rivers or canals (fluvial or inland navigation) or along the coast between ports (cabotage). Generally powered by diesel.

AGRICULTURE

- **Edaphoclimatic:** Related to the conditions of soil and climate.
- **Enteric fermentation:** fermentation that occurs during carbohydrate metabolism of plant material ingested by ruminant herbivores, which results in the emission of methane (CH_4) and other gases.
- **No-till farming:** a technique that promotes the cultivation of the straw left on the ground the previous crop, without the need for soil removal. The soil is plowed only in the groove where they are deposited seeds and fertilizers. Through this process weeds are controlled by herbicides. There is no soil preparation in addition to the handling of the groove.


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