OPPORTUNITIES AND CHALLENGES OF THE BRAZILIAN NDC COMMITMENTS FOR THE BUSINESS SECTOR

Executive Summary

WE MEAN BUSINESS
economic opportunity through bold climate action

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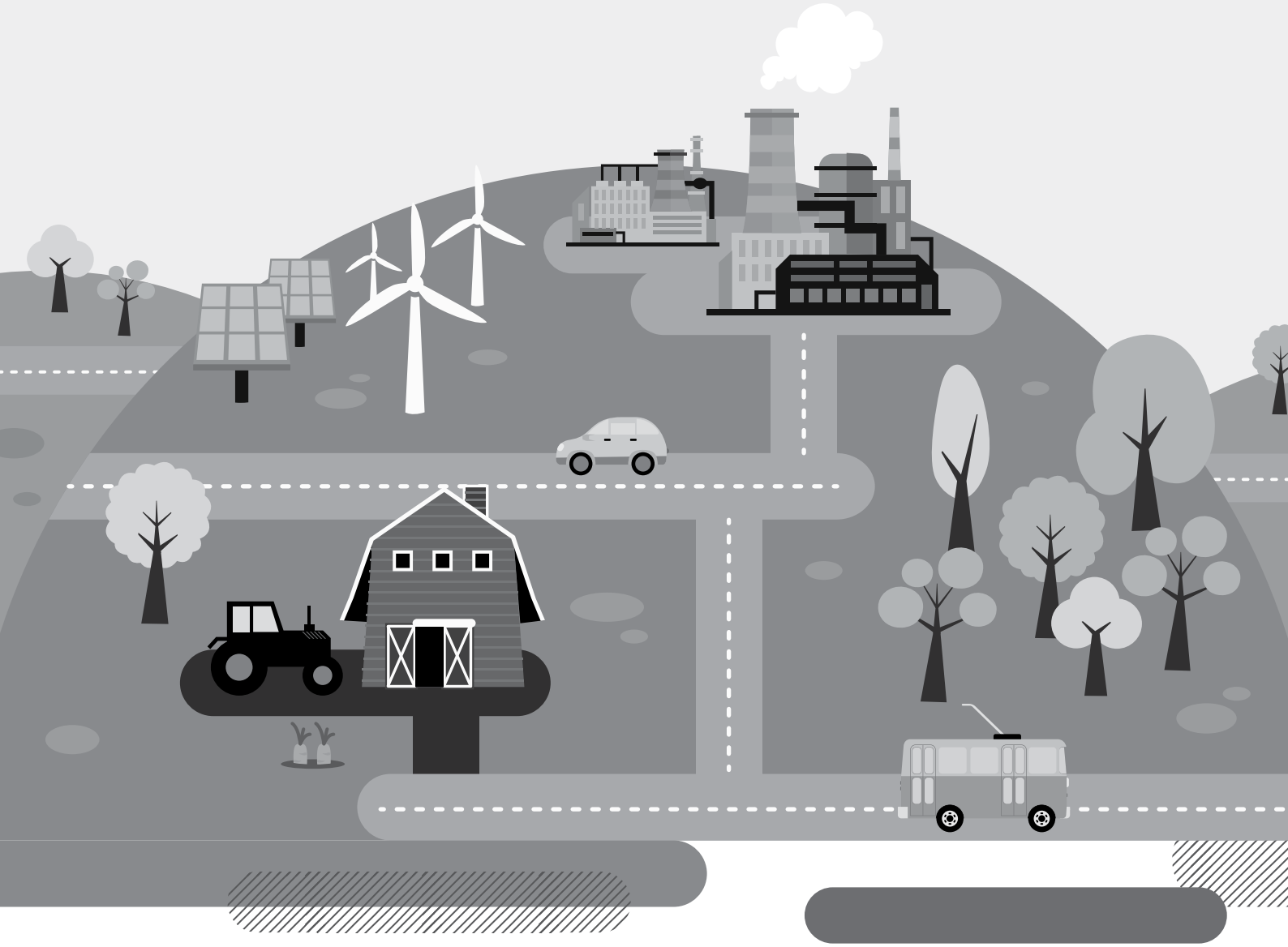
Brazilian Business Council for Sustainable Development (BCSD-Brazil)



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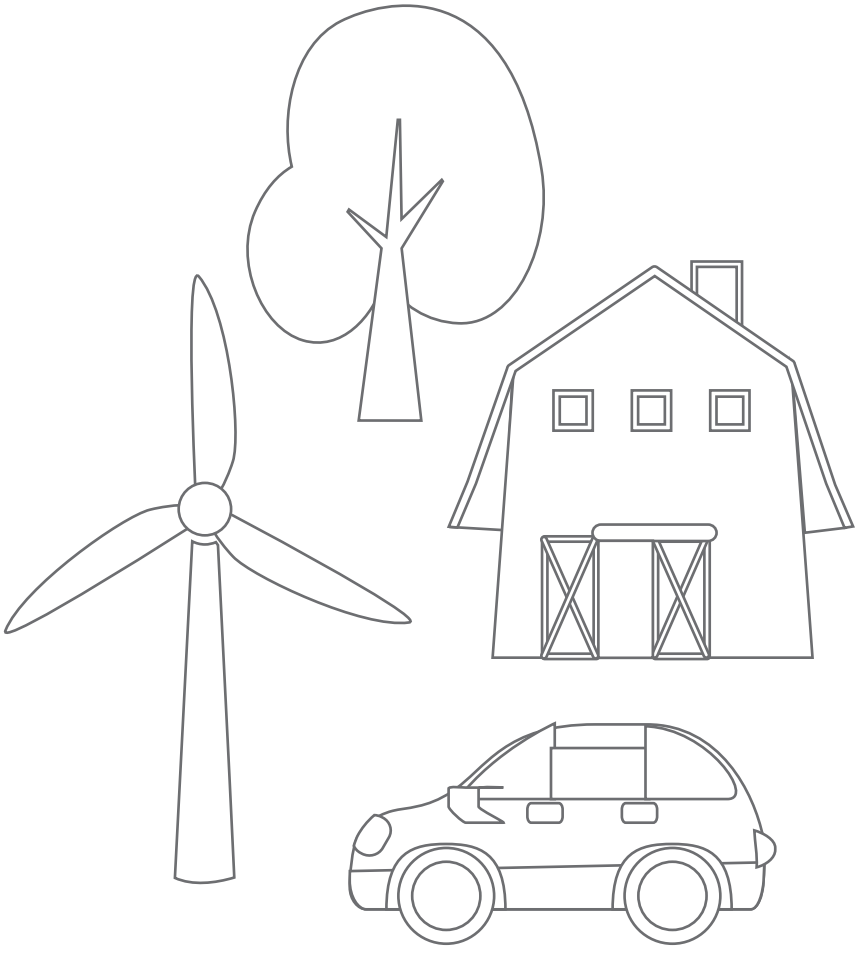
SUMMARY



MESSAGE FROM THE PRESIDENT OF CEBDS

For those who have followed the national and international debates on climate change for a long time, the achievement of the Paris Agreement, in November 2015, was equivalent to the victory sensation of a marathon runner. Since then, the processes have accelerated. Just one year after its signature, the agreement came into effect. For comparison, the Kyoto Protocol took eight years to accomplish the same milestone.

This is an unmistakable sign to companies and investors that the global transition to a low carbon economy is urgent, inevitable and runs faster than we thought possible. Therefore, we should be prepared for the intense pace of competition.

From the day after the ratification of Brazil's commitments under the Paris Agreement (Brazilian NDC), the Brazilian Business Council for Sustainable Development (CEBDS), as well as several of its partners in this journey, emphasized that this subject went beyond the diplomatic dimension and should become concrete. It was time to take advantage of this "momentum" to embark on a new development model, with a view to an economically sustainable agenda, socially committed and capable of strengthening our business competitiveness.

By giving practical meaning to our convictions, we focus on the Brazilian commitments and, with the magnifying glass of business, we seek the opportunities and challenges contained therein. As a result, we have the first large-scale study on the extraordinary possibilities open to Brazil after the Paris Agreement.

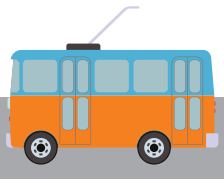
The study "Opportunities and Challenges of the Brazilian NDC goals for the Business Sector", which we are now pleased to launch, brings an integrated approach and an assessment of the goals assumed by Brazil from a macroeconomic perspective. But it also unravels the main issues to be addressed by companies in five sectors: forestry, energy, agriculture, industry and transport.

With this publication, supported by the We Mean Business coalition, we intend to give companies the conditions to assess risks, design business solutions and collaborate with the definition of the agenda that should guide the country towards a low carbon economy. To society, in general, and to the government, in particular, we intend to offer qualified input for frank and purposeful dialogue. We have no time to lose.

Good reading to all!

Best regards,

Marina Grossi
President of CEBDS



WHAT IS CEBDS?

Founded in 1997, the Brazilian Business Council for Sustainable Development (CEBDS) is a civil association that is leading the business sector's efforts to implement sustainable development in Brazil, bringing together government, business and civil society.

CEBDS currently brings together around 70 important corporate groups in the country, with a combined revenue of 40% of GDP and responsible for more than one million direct jobs. CEBDS was the first institution in Brazil to discuss sustainability in terms of the concept of the Triple Bottom Line—which proposes that business action should be based on three key pillars: the economic, the social and the environmental. Besides, it is the country's representative of the World Business Council for Sustainable Development (WBCSD) network, the most important business sector entity in the world, with almost 60 national and regional councils in 36 countries, covering 22 industrial sectors and 200 multinational companies on all the continents of the globe.

A pioneer in its field, CEBDS was responsible for the first Sustainability Report in Brazil, in 1997, and, as of 2008, has helped to implement, in partnership with the FGV (Getúlio Vargas Foundation) and the WRI (World Resources Institute), the main tool for measuring greenhouse gas emissions, the GHG Protocol, in Brazil.

The institution has represented its associates at all United Nations Party Conferences on Climate Change since 1998, and those on Biological Diversity, since 2000. It is also a member of the Sustainable Development Policy Commission and Agenda 21; the Genetic Heritage Management Council; the Brazilian Climate Change Forum; the Rio de Janeiro Climate Change Forum, the World Water Council and the National Sustainable Consumption Plan Steering Committee.

At Rio+20, CEBDS launched Brazil Vision 2050, a forward-looking document that aims to present a vision of a sustainable future and the way to achieve it. This platform for dialogue with businesses and various sectors of society, built up throughout 2011 with the participation of more than 400 individuals and around 60 corporations, has provided a source of inspiration for the strategic planning of numerous companies in Brazil.

INTRODUCTION

The study "Opportunities and Challenges of the Brazilian NDC Commitments for the Business Sector" is an initiative of the Brazilian Business Council for Sustainable Development (CEBDS). The intention, with this work, is to offer for the business sector in Brazil an assessment on how the contribution presented by Brazil in the Paris Agreement could, in a minor or greater scale, restructure the Brazilian productive system by business opportunities oriented to a low carbon economy. However, the pursue of mitigation place the economic sectors responsible for the biggest part of GHG emissions in the country before new challenges, which must be properly acknowledged and discussed for an accurate planning of NDC implementation.

This study is structured by the following mode: the sections cover independently the sectors comprised in the Brazilian NDC, as Forest, Energy, Agricultural[1], , Industrial and Transportation. In each one, the respective sectorial proposal by NDC is presented and examined, focusing on the risks and opportunities related to the commitments and bringing an analysis of available alternatives for the goal achievement.

At the end, major topics for debate between the government and business sectors are highlighted with focus on the implementation of the NDC. Finally, it is expected that this publication contributes to the fulfillment of a gap between the mitigation commitments assumed by the country and to the development of necessary means and strategies to implement them all.

[1] The term "Agricultural", mentioned along the text, also includes cattle-raising activities.

BRAZILIAN NDC AND ITS RELATIONS WITH NATIONAL CLIMATE POLICIES

The 21st Conference of the Parties (COP 21) of the United Nations Framework Convention on Climate Change (UNFCCC) held in 2015 was a milestone in the history of international politics withthe adoption of the Paris Agreement. Driven by long-term visions for development and sustainability, it aims to strengthen the global response to the challenges posed by climate change. To this end, it establishes the goal of limiting the increase in the average temperature of the planet to a level well below 2 °C in relation to pre-industrial levels, with an indication of efforts so that the limit of 1.5 °C is not exceeded.

In order to achieve its goal, the Paris Agreement lays found the basis for international co-operation, starting in 2020, through the adoption of national commitments - Nationally Determined Contributions (NDCs) and the adoption of a systematic process of increasing the ambition of these commitments. The Brazilian contribution was presented to the General Meeting of the United Nations (UN) in September 2015, still with INDC (*Intended Nationally Determined Contribution* - given the character of intention it had at that time) status. This includes a reduction of 37% in Brazilian greenhouse gas emissions by 2025 (equivalent to the emission of 1,346 million tonnes of carbon equivalent - tCO_2e), in addition to an indication of a reduction of 43% in National emissions by 2030 (equivalent to the emission of 1,208 million tCO2e), based on 2005 levels. It also presents commitments aimed at promoting adaptation to climate change.[2]

At the international level, NDC corresponds to an effort for the Brazilian economy as a whole. This ensures flexibility for national implementation without exposing specific policies and sectors to undue international scrutiny. In addition, the text clarifies the implementation of Brazilian NDC is not conditional on international support, although it is open to the use of the Convention's financial mechanism and supported by developed countries with the objective of generating global benefits (BRAZIL, 2015).

It is important to note that the National Contribution represents a progression in relation to current mitigation efforts. The commitment to reduce emissions assumed by Brazil at COP 15, which covers the period between 2005 and 2020, is voluntary. It is expressed in the National Policy on Climate Change (PNMC), formalized by Law No. 12.187/2009 and regulated by Presidential Decree No. 7.390/2010, which also presents the means to achieve this goal. However, the PNMC is, so far, silent on the goals of the post-2020 in the country.

Among the challenges associated with achieving NDC's goals, we also have those related to the development of a strategy for its financing and implementation.

[2] The decision 1/CP21, Paragraph 25 lays down the Enhanced Transparency Framework, so nationally determined contributions are assessed on a pre-determined basis (Global Stocktake) the increased ambitions presented by the Parties of the Convention in the form of a review of NDCs every 5 years. The revised NDC submission should occur between 9 and 12 months before the relevant CMA meeting (CMA: Conference of the Parties serving as the Meeting of the Parties)

On the other hand, the PNMC establishes, as one of its guidelines, the commitments made by Brazil to the UNFCCC, the Kyoto Protocol and other documents on climate change to which it is signatory (BRASIL, 2009). Now therefore, all policies, measures and actions to implement the Brazilian Contribution are conducted within the scope of the PNMC, as well as the Law on Protection of Native Forests (Law No. 12.651/2012, the Forest Code), the Law of the National System of Conservation Units (Law No. 9.985/2000) and instruments related to it (BRAZIL, 2015).

An assessment of the adherence of the Brazilian NDC to the PNMC and the voluntary commitment that it makes official can be found in Table 1.

TABLE 1 ASSESSMENT OF THE ADHERENCE OF THE BRAZILIAN NDC TO OTHER LEGAL AND REGULATORY FRAMEWORKS RELEVANT TO THE MITIGATION OF GHG IN BRAZIL

	National Policy on Climate Change	Nationally Determined Contribution
REGULATORY FRAMEWORK	Established by Law No. 12.187/2009 and regulated by Decree No. 7.390/2010	Filed at the UNFCCC as a form of compliance with the Paris Agreement, an international agreement in force since November 4, 2016.
ACT OF LAW	Yes, it is.	Although the Agreement is already in force and has already been ratified by Brazil, it will only have act of statutory law after promulgation of Presidential Decree.
TYPE OF COMMITMENT PRESENTED	Voluntary commitment of emission reductions.	Commitment legally valid before the UNFCCC.
AMOUNT OF EMISSION REDUCTIONS	Between 36.1% and 38.9% in 2020, compared to a pre-established baseline.	37% compared to 2005 (for 1.3 $GtCO_{2e}$)
DATE OF COMPLIANCE	2020	2025 (first assessment cycle)
BASIS OF COMPARISON	Baseline scenario projected for 2020, marked by an economic growth rate between 2005 and 2020 of 5% per year in real terms, by the continuation of deforestation at rates similar to those that occurred until 2005, and by hypotheses for the composition of the energy matrix, which disregard the execution of the mitigation actions foreseen in the PDE.	Emissions inventoried for 2005 according to the second national communication (2010). Following the presentation of iNDC, the 2005 inventory was updated in the third national communication (2016), which presents larger numbers for change emissions of the land use.

INDICATION OF SUBSEQUENT CONTRIBUTIONS	None.	Reduction of 43% compared to 2005, in 2030
INITIALLY ENVISAGED MEANS OF IMPLEMENTATION	- National Plan on Climate Change; - National Climate Change Fund; - Brazil's Communication to the United Nations Framework Convention on Climate Change; - Sectorial plans (initially PPCDAM, PPCerrado, PDE, ABC Plan, Steel Industry, and later Industry Plan, PMBC, PSTM, Sectorial Health Plan), with emphasis on the following actions (article 6 of Decree No. 7.390/2010): I - eighty percent reduction in annual deforestation rates in the Legal Amazon in relation to the average between 1996 and 2005; II - reduction of forty percent of annual deforestation rates in the Cerrado Biome compared to the average verified between 1999 and 2008; III - expansion of hydroelectric supply, supply of alternative renewable sources, notably wind power plants, small hydropower plants and bioelectricity, biofuels supply, and increased energy efficiency; IV - recovery of 15 million hectares of degraded pastures; V - expansion of the crop-livestock-forest integration system in 4 million hectares; VI - expansion of direct seeding practice in straw in 8 million hectares; VII - expansion of biological nitrogen fixation in 5.5 million hectares of cultivated areas, replacing the use of nitrogen fertilizers; VIII - expansion of forest planting by 3 million hectares; IX - expansion of the use of technologies to treat 4.4 million m3 of animal waste; and X - increase in the use of charcoal from planted forests in the steel industry and improvement in the efficiency of the carbonization process.	Specific measures for the sectors of bioenergy, forestry, agriculture, renewable energy and energy, industrial and transport efficiency, not yet officially detailed.

Source: (MMA, 2015)

The Brazilian NDC details, in an indicative way, sectorial contributions to the achievement of the aggregate target submitted to the UNFCCC, as presented below.

TABLE 2 PROPOSALS PRESENTED BY BRAZILIAN NDC

SECTOR	NDC PROPOSAL
FOREST	• Strengthen compliance with the Forest Code, at federal, state and municipal levels; • Strengthen policies and measures aimed at achieving zero illegal deforestation by 2030 in the Brazilian Amazon and offsetting greenhouse gas emissions from legal suppression of vegetation by 2030; • Restore and reforest 12 million hectares of forest by 2030 for multiple uses; • Expand the scale of sustainable forest management systems through georeferencing and traceability systems applicable to the management of native forests, in order to discourage illegal and unsustainable practices.

POWER	• Increase the share of sustainable bioenergy in the Brazilian energy matrix to approximately 18% by 2030, expanding the consumption of biofuels, increasing the supply of ethanol, including by increasing the share of advanced biofuels (second generation), and increasing the share of biodiesel in the diesel mixture.
	• Achieve an estimated 45% share of renewable energy in the energy matrix by 2030, including:
	  • expand the use of renewable sources, in addition to hydropower, in the total energy matrix for a share ranging from 28% to 33% by 2030;
	  • expand domestic use of non-fossil energy sources, increasing the share of renewable energy (in addition to hydropower) in supplying electricity to at least 23% by 2030, including increasing wind, biomass and solar share;
	  • achieve 10% efficiency gains in the electricity sector by 2030.

TRANSPORT	• Promote efficiency measures, improvements in transport infrastructure and public transport in urban areas.
INDUSTRY	• Promote new standards for clean technologies and expand energy efficiency and low-carbon infrastructure measures;
AGRICULTURE	• Strengthen the Low Carbon Agriculture Plan (ABC Plan) as the main strategy for sustainable development in agriculture, including through the further restoration of 15 million hectares of degraded pastures by 2030 and an increase of 5 million hectares of crop-livestock-forest integration systems (iLPF) by 2030.

Source: (MMA, 2015)

Notwithstanding the fact that NDC does not explicitly mention the source of emissions data used to define the target for 2025 and the preliminary target for 2030, additional information published in conjunction with the National Contribution indicates the targets are consistent with the absolute levels of 1.3 GtCO2e (in 2025) and 1.2 GtCO2e (in 2030) (BRAZIL, 2015). It is thus inferred that the targets were based on an emissions volume equivalent to 2.1 GtCO2e in 2005.

TABLE 3 EMISSIONS BY SECTOR (IN $MTCO_{2E}$ – GWP 100)

SECTOR		1990		2005		2025		2030	
Power		194	14%	332	16%	598	44%	688	57%
Agricultural		356	25%	484	23%	470	35%	489	40%
Forest and Land Use	Emission	826	58%	1,398	66%	392	29%	143	12%
	Removal			211	10%	274	20%	274	23%
	Net			1,187	56%	118	9%	-131	-11%
Industrial Processes		48	3%	77	4%	98	7%	99	8%
Waste treatment		12	1%	54	3%	61	5%	63	5%
Total		1,436		2,133		1,346		1,208	
Reduction compared to 2005						37%		43%	

Source: (MMA, 2015)

It should be noted that the figures reported in the document Brazilian Nationally Determined Contribution (iNDC) in the context of the Paris Agreement under the UNFCCC (in portuguese "Fundamentos para a elaboração da Pretendida Contribuição Nacionalmente Determinada (iNDC) do Brasil no contexto do Acordo de Paris sob a UNFCCC") are not identical to those published in the Second National Communication (MCTI, 2010). Although there is a similar total volume of emissions (the Second National Communication reports emissions equal to 2,193 $MtCO_2$and for 2005), there are significant variations between the two data sources when the sectors are individually assessed. In addition, the recent launch of the Third National Communication of Brazil to the UNFCCC presents a total volume of emissions in the base year of the NDC higher than previously published, as a result of methodological revisions used in the preparation of the National Inventory for the calculation of emissions by deforestation (MCTI, 2016). According to the Third Communication, emissions in 2005 reached 2.74 $MtCO_2e$. Due to these discrepancies, some studies have chosen to evaluate Brazilian NDC in terms of absolute values of 1.3 GtCO2e and 1.2 GtCO2e (IDDRI, 2015).

PERSPECTIVE OF THE BRAZILIAN NDC

The perspective for achieving the Brazilian target in 2025 is based, above all, on a significant reduction in emissions from changing the land and forests use, a category that reached its peak in 2004 and historically concentrates the largest volume of GHG emissions in the country. It is expected that in 2030 GHG removals by forests have already exceeded emissions due to land-use change and deforestation, resulting in negative net emissions in this sector.

It should be noted that the reconfiguration of the emissions standard in Brazil is a process, which is already being implemented. The main factor behind this transformation is the improvement of governance in the Amazon, with the advance of deforestation control (a reduction of 79% in the national territory between 2004 and 2015) and the consequent reduction of GHG due to the deforestation of this biome (BRAZIL, 2016). From the measures proposed by the NDC, the transition to a context in which the energy sector emissions will predominate in the country (44%), followed by the agricultural sector (35%) is expected until 2025, and where the land-use

change category is equivalent to approximately 9% of national emissions.

Although the mitigation already achieved puts the country on track to meet its voluntary target for 2020, maintaining the gains already achieved in recent years cannot be considered a trivial task. The latest available data show that the rate of deforestation in the Amazon has increased since mid-2014 (INPE, 2016). In the period from August 2015 to July 2016, the index grew 29% in relation to the previous period, the highest increase in eight years. Although it still represents a substantial drop in emissions from deforestation in relation to the base year, additional efforts are required to enable compliance with NDC.

Among the challenges associated with achieving NDC's goals, we also have those related to the development of a strategy for its financing and implementation. After all, it is estimated that the investment necessary to comply with NDC will be in the range of R$ 890 to R$ 950 billion. In this sense, the preparation of a base document by the Ministry of the Environment, within the framework of a project financed by the Inter-American Development Bank (IDB), identified points of interest for the orientation of the debates to be undertaken starting in 2017 about the implementation of NDC - the Structured Dialogues (IDB, 2016).

As recognized in the base document, Brazilian NDC has an ambitious character, since it establishes an absolute reduction of emissions in an expected context of continuous increase of population and GDP. In addition, its ambition is also evidenced by the consistency between the Brazilian targets and the global limit target of temperature increase at a level below 2 °C. The feasibility of the targets, however, depends on a consistent implementation strategy that seeks to keep low emission intensity indicators compared to the global average (IDB, 2016).

Among the points presented in the base document, we highlight the strong relations between actions related to the forestry sector and low-carbon agriculture, which have the potential to transform the dynamics of land use in Brazil, based on the balance between production and conservation and sustained by the effective implementation of the Forest Code. Energy efficiency is also highlighted as a key issue for NDC's targets to be met. Its promotion in the industrial, energy generation and transportation sectors is, at the same time, a condition and opportunity for increasing the productivity and competitiveness of Brazilian companies.[3] With regard to the agricultural sector, the achievement of targets in terms of pasture and iLPF recovery depends on overcoming bottlenecks such as insufficient rural extension, lack of skilled labor, restricted access to rural credit and the need to disseminate good agricultural practices among rural producers (IDB, 2016).

The basic document also proposes the promotion of NDC should include awareness-raising and training actions and be based on the reconciliation of short, medium and long-term actions. In addition, an integrated perspective is proposed for the Brazilian NDC analysis, considering not only the country's commitment refers to the reduction of emissions of the economy as a whole, but that numerous relationships of interdependence can be identified between sectors and actions under consideration (IDB, 2016). In addition, NDC's consideration from a broader perspective, integrated with a social and economic development project for the country, is critical to meet this proposal.

Similarly, this report sought to employ an integrated NDC approach to the sectors and measures in which it is organized. The next chapters, which present the challenges and opportunities associated with the National Contribution from the perspective of Brazilian companies, also explore the conditions that must be fulfilled by each sector so that others are capable of implementing the mitigation measures assigned to them. Theretofore, an NDC assessment is undertaken from a macroeconomic perspective.

[3] It should also be remembered that energy efficiency commitments at NDC also extend to the residential and building sector in general, with which other opportunities can also be glimpsed.

EXECUTIVE SUMMARY

The Brazilian Nationally Determined Contribution (NDC[1]) aims at 37% reduction of greenhouse gas (GHG) until 2025 (1,346 million tCO_2e), plus an indication of 43% reduction in emissions until 2030 (1,208 million tCO2e), based on the levels measured in 2005. In this context, this study aims to identify challenges and opportunities of the NDC's goals for Brazilian companies and contribute to the development of a plan of action in order to implement these goals by the Federal Government.

Globally, emissions reduction initiatives presented by the NDCs, submitted to UNFCCC[2] are below the goal of limiting global warming to 2° C. If we keep the current trend of emissions, the climate budget of 2° C will be consumed in 20 years and the 1.5 °C in 5 years (*Global Carbon Budget*, 2016). In order to ensure that the implementation of NDCs stabilize global emissions of greenhouse gases, the Paris Agreement provides for gradual and continuous progress of national mitigation ambitions. Therefore, the Brazilian NDC is a set of initial commitments that certainly will evolve more ambitious goals.

NDC is an important element of renewal of Brazilian development towards a low carbon economy. However, efforts to achieve the goal must be supported by a political, regulatory and economic framework that provides the conditions and incentives for investment, cooperation and technological innovation.

NDC is structured on actions to five economic sectors: forestry, energy, agricultural[3], industrial and transportation. It is noteworthy that the perspective of achieving the goal in 2030 is based on a significant reduction in emissions by land use change. It is projected that the Forest Industry and Land Use account for 143 $MtCO_2e$ emissions and 274 $MtCO_2e$ removals in 2030 (MMA 2015). To put in another way, in order to achieve the NDC's goal, it is expected that this sector provides significant net removals of -131 $MtCO_2e$. Since, in order to achieve the goal, we depend heavily on Forest Sector, with which compliance is uncertain, it is a great challenge for the other sectors of the economy the possible need to increase their efforts towards emission mitigation.

The set of challenges and opportunities identified by this study within the NDC, is made up of a myriad of economic, industry, regulatory and technological elements, some of them quantifiable, others in a qualitative type, but which present market trends. It is also noted an important characteristic to national commitments, i.e., a strong interdependence between sectors, a fact that enables synergy and coordinated actions among companies, but that, in turn, increases the complexity and creates uncertainty with respect to the achievement of the NDC commitments.

The most relevant challenges and opportunities identified by this study for each sector are summarized below.

FOREST SECTOR

The Forest Sector will have the central role in the development of a low carbon economy for Brazil. In order to make an effective reduction in deforestation, it will be necessary controlling illegal practices in conjunction with the development of a production chain based on forest. The expansion of planted forest area, also expected to enable the achievement of the goals of the Industrial and Energy sectors, should bring the infrastructure required to increase the profitability of Sustainable Forest Management (MSF).

- The sector's emission mitigation options are cost-effective. By way of example, we can mention (a) planted forests, which have a negative abatement costs between -0.18 US$/$tCO_2e$ (Soares-Filho *et al.*, 2016) and -23.27 US$/$tCO_2e$ (La Rovere *et al.*, 2016) with a reduction potential of 541 $MtCO_2e$; and (b) forest restoration, which abatement cost stays between US$ 9.22/tCO_2e (Soares-Filho *et al.*,

[1] NDC records the commitments made by the signatory countries to the Paris Agreement after 2020.

[2] 137 NDCs submitted to the COP in Marrakesh - http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf

[3] NDC adopts agricultural terminology, however, the study considers that the most appropriate term for the sector is agricultural, comprising livestock farming, in accordance with the classification used by the National Communication.

2016) and 16.00 US$/$tCO_2e$ (La Rovere *et al.*, 2016) with their potential mitigation of about 414 $MtCO_2e$.

- The strengthening of the Forestry Code needs to be qualified by the Federal Government because it represents one of the major challenges posed by the NDC. The rules of the Code are a priority in order to achieve the NDC's goals for the reasons listed below:

    a. the mitigation potential of the Code is estimated at 9.1 billion tCO_2e (INPUT, 2016);

    b. the deforestation control remains as the major challenge in the sector. In the Amazon forest there was an increase of 29% in the deforestation rate between 2015 and 2016, and is also fundamental to expand the real-time monitoring for biomes beyond the Amazônia Legal (Legal Amazon);

    c. the area that can be legally deforested in the Amazon is 12 Mha, at Cerrado 40 Mha, at Caatinga 39 Mha and at the Atlantic Forest 3.4 Mha. Even in a zero illegal deforestation scenario, the loss of forest coverage can reach 19 Mha to 2030 (Rajão and Soares-Filho, 2015a), setting a major regulatory challenge;

    d. the Environmental Reserve Quota (CRAs) have a cost-effective regulation chance. However, there may be a disincentive for forest recovery in the event of their market values are low. At this conjuncture, CRAs originated in protected areas (14 Mha) and Legal Reserve (RL) of small property (38 Mha) can flood the market without any real impact for additional conservation of the desired forest areas (Rajão and Soares-Filho, 2015a). It is estimated that the CRA may cover 56% of the National RL deficit.

- Another challenge pointed out refers to the restoration and reforestation of 12 Mha. This measure is equivalent to 121% of the current existing forestry area in the country and will require, on conservative estimates, investments of about R$ 31-52 billion (Kishinami and Watanabe Jr., 2016) depending on the participation of regeneration, enrichment and planting adopted, whereas:

    a. there is an optimization opportunity of these investments by aligning this goal to the commitment of the Forest Code, on the restoration of 16 Mha in RL and 5 Mha in Permanent Preservation Areas (APP);

    b. six credit lines applicable to the restoration and reforestation activities were identified, but even together they do not have sufficient resources to cover the projected financing demand. The lowest interest rate is 2.5% per year. (PRONAF Forest) and the biggest is 13.18% per year. (BNDES Forest). Furthermore, it is widespread among the farmers, the paradigm that the restoration is just cost, which constitutes a significant barrier to its effectiveness in RL and APP;

    c. the multiple use of forests allows the promotion and strengthening of a Forest-Based Economy in the country. The demand for inputs for the restoration can contribute around R$ 13,000/ha restored during the period of 30 months, as from the implementation of the forest (IPEA, 2015).

- The Payment for Environmental Services (PSA) is a regulatory opportunity and has gained scale in the country. It is noteworthy that:

    a. eight (8) states have PSA laws and two (2) have bill of law. In addition, the Water Producer Program of the Federal Government has over 20 active projects, affecting 1,200 landowners and covering an area of over 40 thousand ha. However, the PSA for now has little effect, due to its very low payment amounts (for example, R$ 600.00 per producer per year in the North region) or extend over very long cash flows (Terranova *et al.*, 2014);

    b. on the other hand, we can expand the use of PSA mechanisms through their

integration to other economic instruments provided for by the Code, as the CRA.

- The purpose of expanding the area of Sustainable Forest Management (MFS) can avoid emissions of about 435 $MtCO_2e$ creating the foundation for a chain of sustainable forest value. The biggest challenge of MSF is associated with the low cost of illegal timber production in the country and the vast bureaucracy for validation of the Management Plan. Indeed, there is 98% probability of negative financial return (loss) for legalized logging activities in the domestic market (Vendramini, *et al.*, 2016).

- Immediately thereafter, technologies for monitoring and traceability are part of the solution to the production and trade of legal timber (Moura Costa *et al.*, 2016). In this sense, we highlight large databases (*Big Data*) originated by remote sensors, RFID systems (*Radio Frequency Identification*) used in "chip sets" of trees, machine learning algorithms to combat fraud through processing of invoices and other documents used in the traditional monitoring of forest chain.

- Together, the NDC's goals establish the groundwork for the development and strengthening of a forest-based Economy in the country. In this way, it provides opportunities for the establishment of a forest-based industry focused on biomaterials, biochemical, bioresins and the expansion of the energy use of solid biomass. It is noteworthy, for example, the rapid expansion of the bioplastics market in Europe (+ 45% by 2020). It is estimated that the global market for chemicals of biological origin reaches EUR 515 billions over the next five (5) years (Hetemäki, 2014).

ENERGY SECTOR

Increasing the supply of renewable energy will require significant planned expansion of the current installed capacity, especially for production of ethanol. The expansion of participation of renewable electric generation beyond the hydropower, will be aided by an expected reduction in photovoltaic and wind technology costs and the upgrading of electricity generation and distribution infrastructure, which will facilitate decentralized generation and management with respect to the demand.

- The Energy Sector has mitigation potential of 340 $MtCO_2e$, associated with an abatement cost of about R$ 30 billion (Schaeffer *et al.*, 2016). It is noteworthy that 41% of the sector's mitigation technologies have negative abatement cost.

- NDC planned an expansion of ethanol production to 45 billion gallons by 2025 and 54 billion in 2030, however it should be noted that:

  a. if, on the one hand, flex-fuel technology has removed the barrier from the perspective of demand, because they are used by 88.1% of licensed vehicles in the country, on the other hand, despite the liberalization of petroleum prices, government interference in the recent period maintained an artificial competitive advantage of gasoline compared to ethanol via price controls. Therefore, the guarantee of free competitiveness of biofuels in the market is an opportunity for the country, and is fundamental to remove subsidies and other distortions establishing such advantages to fossil fuels;

  b. in this context, it constitutes a challenge to meet the NDC's goal, the need to build 75 new ethanol plants (UNICA, 2016). In turn, the expansion of sugarcane facility has potential to generate 250 thousand direct jobs and will require investments of about US$ 40 billion by 2030.

- For biodiesel, NDC provides the achievement of 10% of blend mixture with petrodiesel by 2030, with investments of about R$ 200 million. From a technical point of view, the fraction in the mixture can exceed the NDC's goal, indicating that this opportunity could be better exploited for the following reasons:

a. there is an idle capacity in the country (Pinto *et al.*, 2016). Therefore, an expansion of the market in the short term does not require high capital investments and contribute to economies of scale to established Industrial facilities;

b. in turn, there is a challenge of diversification of raw materials for production of biodiesel, requiring investments and economic incentives in order to such inputs gain scale. Currently, 80% of the biodiesel produced in Brazil uses soybeans as raw material, followed by beef tallow (16%).

- Synergistically with the objectives of the Forest Sector, the expansion of planted forest areas creates favorable conditions for the implementation of thermal biomass, associated with areas of energy forests. Long-term agreements (*Power Purchase Agreements* - PPAs) and auction systems are relevant instruments to mitigate risks such as the prices fluctuation on the free market and the need to provide guarantees for access to credits associated with such investments.

- The expansion of non-hydro renewable sources is an opportunity and benefits from systematic cost reductions in recent years. Between 2010 and 2015, the wind generation fell by 30% in generation costs and solar, 65% reduction (IEA, 2016). By 2021, it is expected a further cost reduction of 15% in wind systems and 25% in photovoltaic systems (IEA, 2016). It is noteworthy, however, the following barriers:

  a. unlike wind power chain, which has an established national industry, the production of photovoltaic equipment in Brazil has faced obstacles to their establishment. Policies for promotion and support R&D can contribute to the consolidation of an industrial facility of solar energy in the country. It should be noted in this context the importance of tax incentives for the importation of cells and for production and marketing of domestic equipment, and programs for technology development, research, innovation and international cooperation;

  b. moreover, the risk mitigation of investment involves greater predictability of demand, estimated at 1,000 MW per year to enable the domestic industry (Ribeiro, Nahur and Camargo, 2015). The measures to stimulate the demand include feed-in tariffs and simplification for network access and net metering

  c. despite regulatory advances, the expansion of distributed generation in the country is impaired due to the need of high investment for deployment and the difficulty of micro-generators find some type of financing. The foreign funding faces foreign exchange risk and securitization barriers. Moreover, despite the growth of the green bonds market in Brazil, such an instrument is still used with large-size agents (CEBDS, 2016b).

- The goal of 10% earnings in electrical efficiency implies a decrease of 24% of the operating costs of the National Interconnected System (SIN) and reduced demand for investment in new energy supply of approximately 42% (CEBDS, 2016a). Although there is a huge economic potential, it is emphasized that this objective of the NDC is modest and could reach up to 23% efficiency levels. At this conjuncture, energy efficiency auctions could promote efficiency gains in a systematic way, serving as an alternative to expand the generation system.

- Energy efficiency measures have negative abatement costs, however, they are not systematically implemented. Among the identified barriers we can list:

  a. the need for changes of the regulatory framework towards the establishment of legal standards for performance and economic incentives;

  b. debt and internal competition for capital in companies, creating a vicious circle of postponement of investments;

c. the inadequacy of existing funding instruments, especially the high interest rates and lack of grace periods lower than the return on investment.

AGRICULTURAL SECTOR

For the 2030 horizon, the agricultural sector will have the challenge of increasing production without expanding the total area already available. Although Brazil already have a high degree of technological innovation in this sector, there is a wide range of areas to increase productivity. In addition to the efficiency gains, brought by Recovery of Degraded Pastures (RPD) and Integration of Forest Livestock (iLPF), the application of these practices and the imminent creation of new markets such as CRA and PSA make it less expensive to eliminate the deficit of RLs and APPs.

- The mitigation measures proposed by the NDC to the Agricultural Sector has abatement potential of up to 258 $MtCO_2e$ (MAP/MDA, 2012 and MMA, 2016). From this potential 208 $MtCO_2e$ are associated with the RPD and 50 $MtCO_2e$ with iLPF. Additionally, the forest component has potential removal of 70 tCO_2e/ha in iLPF systems with 250 individuals per ha, for a period of eleven years (PBMCs, 2015). In order to achieve the goal, it is estimated investments of about R$ 197 billion.
- The measures proposed by NDC generate opportunities for allowing the mitigation of emissions associated with efficiency gains in the field, the diversification of the rural producer revenue and reductions in production cost, more specifically:
  a. the RPD allows quadruple livestock productivity through the intensification of production. In extensive systems, the productivity varies between 3-6 arroba/ha/year in low productivity pastures, between 6-12 arrobas/ha/year on average productivity pastures and between 12-18 arrobas/ha/year in recovered pastures (Harfuch *et al.*, 2016).;
  b. iLPF systems increase financial resilience of the producer allowing cost reduction through less dependence on external inputs and the diversification of steadily income sources. For example, reducing the livestock production cost per arroba in iLPF systems is estimated between R$ 46.00 and R$ 62.00 and the lesser dependency of nitrogen fertilizers (Vilela *et al.*, 2012.);
  c. it should be noted the benefits of the combined adoption of these measures. In pilot studies, financial returns observed in the recovery of pastures using iLPF systems reached R$ 1,336/ha (Strassburg, 2012). Indeed, there is a clear financial argument to adopt the iLPF and RPD synergistically because they have together approximately 170% return on investment.
- Other opportunities emerge from the indirect positive impacts associated with deploying the RPD and iLPF as improvement of soil quality, increased water availability and greater climate resilience. Other attributes resulting from the implementation of low-carbon farming concern the contribution to environmental suitability of the property, maintenance and/or recovery of APPs and RL, and the introduction of technologies to reduce environmental impacts.
- The lack of a monitoring system for impact of low-carbon technologies is a barrier for mitigation of cost-effective emissions in the field and should be addressed to allow the establishment of incentive structures in the medium- and long-term, to farmers who, demonstrably, use the low-carbon practices (Terranova *et al.*, 2014).
- The financing of low-carbon agriculture is aimed at production systems, creating challenges for expansion of activities due to the increased complexity for taking credit, increased transaction costs and, hence, the reduction of attractiveness of credit lines.
- Finally, challenges have been identified related to technical gaps and qualification in rural areas, impairing the implementation of the

RPD and iLPF. Such bottlenecks are known by ABC Program and need to be addressed to ensure the fulfillment of the NDC's goals, such as low qualification of financial agents and technical assistance (Terranova *et al.*, 2014 and Strassburg *et al.*, 2014).

INDUSTRIAL SECTOR

Investment in innovative practices, necessary for the achievement of the goals for reduction of proposed GHG emissions, meets the same challenges posed by the current global economic scenario; do more with less. The energy and process efficiency, and the reuse of by-products as raw materials in different production lines will have an even more critical role in the medium- and long-term economy.

- The industry has abatement potential of 1.09 billion tCO_2e by 2050 and an estimated cost of US$ 50 billion (Pinto et al., 2016).
- it is an opportunity the fact that 40% of the industry's mitigation potential present negative abatement cost. Specifically, for cement, steel, lime, chemical and glass sector, the abatement potentials associated with negative costs are 46 $MtCO_2$, 34 $MtCO_2$, 17 $MtCO_2$, 13 $MtCO_2$ and 5 $MtCO_2$, respectively (Pinto, 2016).
- There are several technological options available for reducing emissions in the industry. We can mention the opportunities associated with the following low-carbon technologies:
    a. automation and sensing systems (Industry 4.0) have potential for energy efficiency gains between 10% and 25%, without requiring high capital investment or process changes (CNI, 2016);
    b. process improvements and efficiency technologies have a substantial mitigation potential and are commercially available. For example, efficient combustion systems have the potential to mitigate 105 $MtCO_2e$, heat recovery system of 68 $MtCO_2e$ vapor recovery technology of 37 $MtCO_2e$, new recovery processes of 135 $MtCO_2e$ and recovery systems in furnaces of 283 $MtCO_2e$ by 2030 (PBMC, 2015).
- Explore energy efficiency measures in industry involves reducing emissions of about 661 $MtCO_2e$ by 2030, at a cost of US$ 27 billion. This opportunity is particularly important for steel industries and cement sector, as these one house 50% of mitigation potential (La Rovere *et al.*, 2016).
- Competitive advantage can be exploited for mitigating emissions associated with the replacement of raw materials. This measure positively impacts on Cement, Aluminum, Chemical, Glass and Steel Industry. However, there are barriers associated with the logistics costs and competitiveness of alternative inputs.
- The country may benefit from the industrial development view based on circular economy, resulting in emission reductions related to competitiveness gains. In Europe, circular production systems will have a revenue of EUR 1.8 trillion by 2030, compared to EUR 900 billions in revenues in a linear economy (Ellen Macarthur Foundation, 2015). In Brazil there is a large market to be exploited, since only 2% of the residues return to the productive chain (Azevedo, 2015).
- The study also identifies cost reduction opportunity associated with mitigation measures. Specifically gains can result from:
    a. internal improvements of industrial plants, due to lower consumption of raw materials, whether as energy, due to the implementation of more efficient equipment, fuel, due to the optimization of the process or raw materials, due to the use of more economically viable, more cost-effective and renewable source options;
    b. infrastructure for a low-carbon industry, such as expanding access to less intensive carbon fuels (pipelines) and the integration of cargo transportation modals.
- Challenges include the high cost, the early stage of some technologies, the need for adaptability

to Brazilian plants and the difficulty of borrowing and financing by companies.

- The implementation of low carbon technologies in the industry, due to (i) the broad competition among investment opportunities in companies and (ii) the high cost of capital opportunity for investments in emissions mitigation are significant barriers. In this context, new funding instruments (Green Bonds) and regulation instruments (Carbon pricing) can contribute to the internalization of the carbon cost in making private investment decision.
- Transversally to the sector, there are regulatory opportunities, including policies to encourage efficient processes and technological innovation (R&D), the implementation of specific regulatory instruments such as Carbon Pricing, and the establishment of technological standards, all key drivers for development of a low-carbon industrial facility in Brazil.

TRANSPORTATION SECTOR

Changing the modal profile in the sector faces the challenge of overcoming the high cost of capital involved in the expansion of the railway and water transport infrastructure. Overcoming the Brazilian dominant road tradition in the country, with decreasing participation of modal, may represent big savings for the country and a significant reduction in total cost of freight to the companies. In addition, the increase in electricity as a vector in various modals can further reduce the total energy consumption and GHG emissions.

- The transportation sector has mitigation potential of about 2.05 billion tCO_2e, with a total cost estimated at R$ 202 billion by 2050 (Borba *et al.*, 2016).
- In the short-term, the increased use of biofuels is a major opportunity for the sector because it allows immediate action and does not require large volumes of investment, to the extent that the country benefits from an existing infrastructure for production, transportation and distribution of biofuels.
- Ensuring the competitiveness of biofuels goes through a complex set of factors, including market distortions, competition with sugar and logistics costs for delivery.
- There is opportunity to use the of technologies that ensure incremental efficiencies gains in vehicles and can reduce up to 30% of CO_2 emissions (Howley *et al.*, 2010 and Borba *et al.*, 2016). Such technologies are commercially available, such as downsizing of engines and hybridization. However, the lack of policies, such as the requirement for compensatory measures in the automotive sector, in efficiency gains associated with exemptions and/or incentives, to promote the nationalization and increased competitiveness, is relevant barrier.
- Internationally, the low carbon agenda in the sector focuses on electrification (IEA, 2016). In Brazil, the debate on electrification remains incipient, particularly:

  a. it is necessary to establish a strong development agenda and supporting R&D for electric vehicles in the country. Despite the Brazilian leadership in biofuels, the current technological agenda should be focused on electric vehicles and the development of batteries;

  b. Brazil has 11.76% of world reserves of lithium and can benefit from the expansion of the energy storage market (Castro *et al.*, 2013). Overall, the market for high-density and durable batteries is growing. The economies of scale in the battery production resulted in price reductions up to four times between 2008 and 2015 (IEA, 2016), contributing to the increased competitiveness of electric vehicles;

  c. with respect to cargo transportation, the electrification of railway cargo modal can reduce power consumption between 19% and 33% (UIC, 2016). In vessels, hybrid propulsion systems show a reduction in fuel consumption of about 33% (Borba *et al.*, 2016).

- Concurrently to support the expansion of the electric fleet in the country, it will be needed investments and incentives for the expansion of electro-supply station network. In this context, it constitutes a significant barrier to regulatory gap for commercialization of electricity in charging-supply stations.
- Another challenge relates to the reduction in the demand for transportation. Managing the transport demand is complex, it involves the expansion of public transport and requires the participation of the private sector, especially to change the culture of enterprise mobility, which is still focused on benefits that foster individual motorized transport (CEBDS, 2016c).
- The main opportunity for the private sector concerning the integration of cargo transportation modals, which implies reducing emissions of up to 2.9 times per tkm and freight price of about 3.8 times (DEFRA, 2016 and CNT, 2016).
- It is estimated that a more competitive and efficient transportation sector will require an investment of about R$ 133 billion over the next 25 years (Pêgo, 2016). However, it is unclear what is the prioritization of investments and availability of resources.
- BRT (Bus Rapid Transit) systems and LRT (Light-Rail Vehicles) are relevant to the Brazilian context due to lower cost of deployment. They can achieve the same efficiency of subway systems in intervals between 20,000 to 40,000 trips per hour per direction (Pereira, 2009).
- In the technology realm, opportunities arise from the implementation of Intelligent Transport Systems (ITS), capable of reducing the travel time between 15% and 20% and reducing emissions by 10% and increase the capacity of the transport systems between 5% and 10%, without demand for additional investment (European Commission, 2016). It is projected that the SIT/IoT market for cities will reach US$ 2.5 trillion by 2025 (UNECE, 2016).
- Hyundai, Toyota and Honda have launched series of vehicles powered by fuel cells, signaling market opportunities for hydrogen vehicles. This technology is important to GHG mitigation in the sector because it introduces energy efficiency up to 60% compared to efficiencies of about 28% by otto-cycle engines (*Borba et al.*, 2016).

DIALOGUE FOR IMPLEMENTATION

NDC represents an opportunity for the re-qualification of the country's development, creating synergies for the construction of a short, medium and long-term political agenda. From the assessments presented by this study, it is understood that NDC's dialogue and implementation actions need to be composed of objective and short-term measures that begin the transition towards a low-carbon economy, as well as through planning and medium- and long-term reforms to deepen structural change and ensure there are no setbacks. In this sense, we highlight:

1. **The legal uncertainty represents a challenge identified in all sectors covered by the NDC. Private action and increased investment will require government efforts to ensure the review, clarity, and enforcement of standards. An agenda for short-term action can be initiated through measures already in the dialogue agenda between the public and private sectors. At the heart of this issue is the regulation of the Forest Code and the process of revision of the Environmental Licensing rules.**

2. **Sectorial investments run up against financing barriers, especially in the long run. Recognizing the limitation of public resources, the establishment of secondary markets for private credit, the extension of instruments for the securitization of foreign exchange hedges for external funding, and the stimulation of capital markets apart from BNDES, are relevant. Specifically, priority is given to NDC's financing agenda: expanding non-hydroelectric power generation, expanding biofuel supply, implementing new forest areas (12 Mha), low-carbon agriculture practices and efficiency measures in the industry.**

3. **The role of market regulation instruments, in particular carbon pricing, will be central to the internalization of NDC's risks and opportunities for private sector decision-making. This agenda is advancing in the Ministry of Finance and it is important to build an advocacy process and positioning of the private sector with a focus on revenue recycling and fiscal neutrality.**

4. **The transition to a low-carbon economy will require the establishment of infrastructures, which has been postponed for decades. The medium and long-term agenda should be focused on measures that profoundly change the way we move people and cargo in the country. In this context, the integration of the modals of cargo transport generates positive externalities to the entire private sector, with priority being given to improving and expanding rail infrastructure and internal and coastal navigation (cabotage).**

Carbon pricing, will be central to the internalization of NDC's risks and opportunities for private sector decision-making.

5. The prioritization of measures should consider the sectoral interdependencies and the positive externalities of certain investments, exploiting synergies and efficiency gains in scale. A convergent business agenda will allow the establishment of a hierarchy of measures in the NDC implementation agenda aimed at gaining competitiveness and economic growth. From this assessment, it is understood that the prioritization of measures in the energy and transport sector tends to benefit broadly the other sectors covered by NDC.

6. Finally, the transition to a low carbon economy is based on new technologies. Technological risk is a major NDC implementation challenge. Its mitigation depends on direct government action through grants, R&D policies, and economic instruments that allow for scale gains. A range of opportunities can be exploited by all sectors from commercially available technologies, provided that funding barriers are removed and incentives for carbon pricing are established.

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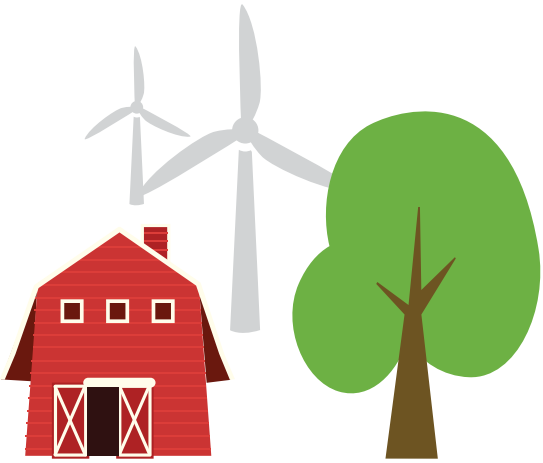

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