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Brazilian goals in the Paris Agreement: reflections on the role of universities

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ABSTRACT

Objective: to discuss the role of universities in supporting the implementation of the Brazil's Nationally Determined Contributions (NDC) goals in the Paris Agreement.

Methodology: exploratory and descriptive approach, based on the analysis of 13 experts' testimonials.

Originality: the Brazilian government, unilaterally, will not be able to implement mitigation actions in several sectors to achieve its NDC. The academy presents has potential to contributing to the development of a low carbon economy through technological innovation and initiatives that contribute to the governance of a complex system such as climate change. Recommendations are proposed so that universities are empowered to lead by example, through an agenda of proactive research and aligned with Brazilian mitigation goals up to 2030.

Main results: the lack of integration between universities' research agenda and priorities for government and the private sector is pointed by experts as the main constraint to advance science.

Conclusions: the role of universities, especially public ones, should focus on an integrated multidisciplinary education and research agenda that address the challenges and needs of government and society aiming at a new low-carbon economy, based on economic and social development, in which economic growth is not linked to the unsustainable use of natural resources. Disruptive technological innovations, governance, institutional arrangements for implementation and capacity building are needed.

Keywords: Climate change; Climate governance; Climate policy; Mitigation; Paris Agreement; NDC.

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Metas brasileiras no Acordo de Paris: reflexões sobre o papel das universidades

RESUMO

Objetivo do estudo: discutir o papel das universidades no apoio à implementação das metas brasileiras no Acordo de Paris, por meio de sua Contribuição Nacionalmente Determinada (NDC na sigla em inglês).

Metodologia: abordagem exploratória e descritiva, baseada na análise de 13 depoimentos de especialistas.

Originalidade: o governo, unilateralmente, não conseguirá implementar ações de mitigação em diversos setores para atingir as metas de sua NDC. A academia apresenta considerável potencial de contribuição para o desenvolvimento de uma economia de baixo carbono no país, por meio de inovações tecnológicas, e iniciativas que contribuam com a governança de um sistema complexo como as mudanças climáticas. Recomendações são propostas nesse artigo para que as universidades liderem pelo exemplo, por meio de uma agenda de pesquisa propositiva e alinhada com as metas brasileiras de mitigação até 2030.

Principais resultados: a falta de integração da agenda de pesquisa das universidades com as demandas do governo e do setor privado é apontado por especialistas como o principal entrave para o avanço da ciência.

Conclusão: o papel das universidades, especialmente as públicas, deve ter como foco uma agenda integrada de ensino e pesquisa multidisciplinar, que considere os desafios e as necessidades do governo e da sociedade para o fomento de uma nova economia de baixo carbono, pautada no desenvolvimento econômico e social, no qual o crescimento econômico não seja atrelado ao uso insustentável dos recursos naturais. Isso demanda inovações tecnológicas disruptivas, governança, arranjos institucionais de implementação e capacitação.

Palavras-chave: Mudanças climáticas; Governança do clima; Política climática; Mitigação; Acordo de Paris; NDC.

Metas brasileñas en el Acuerdo de París: reflexiones sobre el papel de las universidades

RESUMEN

Objetivo: discutir el papel de las universidades en el apoyo a la implementación de las metas brasileñas en el Acuerdo de París, a través de su Contribución Nacionalmente Determinada (NDC por sus siglas en inglés).
Metodología: enfoque exploratorio y descriptivo, basado en el análisis de 13 testimonios de especialistas.

Originalidad: el gobierno, unilateralmente, no logrará implementar acciones de mitigación en diversos sectores para alcanzar las metas de su NDC. La academia presenta un considerable potencial de contribución al desarrollo de una economía de bajo carbono en el país, a través de innovaciones tecnológicas, e iniciativas que contribuyan con la gobernanza de un sistema complejo como el cambio climático. Las recomendaciones se proponen en este artículo para que las universidades lideren por

ejemplo, a través de una agenda de investigación propositiva y alineada con las metas brasileñas de mitigación para 2030.

Principales resultados: la falta de integración de la agenda de investigación de las universidades con las demandas del gobierno y del sector privado es señalada por especialistas como el principal obstáculo para el avance de la ciencia.

Conclusión: el papel de las universidades, especialmente las públicas, debe tener como foco una agenda integrada de enseñanza e investigación multidisciplinaria, que considere los desafíos y las necesidades del gobierno y de la sociedad para el fomento de una nueva economía de bajo carbono, pautada en el desarrollo económico y social, en el cual el crecimiento económico no sea vinculado al uso insostenible de los recursos naturales. Esto demanda innovaciones tecnológicas disruptivas, gobernanza, arreglos institucionales de implementación y capacitación.

Palabras clave: Cambio climático; Gobernanza climática; Política climática; Mitigación; Acuerdo de París; NDC

1 Introduction

Global warming and the resulting problems related to climate change are challenging since they result from interactions between different players with different interests based on a complex global system, which requires a multilevel governance and the implementation of national and local policies. International policies on climate change are characterized by fragmentation of power, divergent political and economic interests, and a complex energy-geopolitical agenda based on fossil fuels.

Scholars argue that an effective climate governance system requires a complex of regimes through a flexible approach based on the polycentrism, and involving multiple institutions and players at different levels. The search for solutions focused on mitigation should involve experimentation with different approaches to deal with complex problems based on a high level of uncertainty about the consequences of global warming with the focus on developing innovative solutions and potential for scale (Abbott, 2017; Cole, 2015; Hoffmann, 2011; Keohane & Victor, 2011; Ostrom, 2009, 2010; Prins & Rayner, 2007; Rayner, 2010).

The design of climate policy at international, national and local levels is influenced by the perception of individuals and organizations about the risks and uncertainties involved in global warming caused by anthropogenic actions. Climate change impacts, although with different levels of certainty, have already presented consequences related to the availability of

freshwater, biodiversity loss, rising sea levels, food security, human health and economic impacts in several sectors (IPCC, 2014; 2018).

The World Economic Forum Report on the major global risks in 2018, which may have a significant negative impact on a number of countries and industries over the next 10 years, points to increasing risks related to the environment. Such risks refer to: climatic extremes; failure of governments and companies to ensure and implement effective mitigation and adaptation measures; loss of biodiversity and collapse of marine and terrestrial ecosystems, natural disasters; destruction and man-made disasters such as oil spills and radioactive contamination (WEF, 2018). These risks bring threats and opportunities to Brazil.

The Paris Agreement, ratified by 175 of the 197 Parties of the United Nations Framework Convention on Climate Change (UNFCCC), has as main objective to limit the increase in global average temperature below 2 °C, considering the pre-industrial levels, with the ambition to limit the increase in temperature to 1,5°C (UNFCCC, 2015; 2018, April 8). Unlike the top-down approach adopted in the Kyoto Protocol that determined mandatory mitigation and adaptation targets for developed countries, and did not impose emission limits for developing countries under the principle of common but differentiated responsibilities (Falkner, Stephan, & Vogler , 2010, Rayner, 2010), the Paris Agreement is a hybrid model of international cooperation. Such an Agreement presents a different approach to climate diplomacy based on a flexible strategy, with elements of top-down and bottom-up approaches where each country committed itself to voluntary and individual targets for reducing greenhouse gas emissions (GHG) according to its institutional, technological, economic, political, and national priorities (UNFCCC, 2015).

The goals of the countries that have ratified the Paris Agreement have been formalized through Nationally Determined Contributions (NDC), which are supposed to be reviewed every five years in order to increase countries' ambitions by setting more aggressive targets. Although the 'reporting and reviewing' mechanism does not ensure that countries comply with their mitigation and adaptation targets, this flexible approach provides greater transparency and legitimacy to the process, as well as providing greater political willingness on the part of governments in fulfilling their voluntary commitments in the UNFCCC climate regime (Victor, 2015).

However, the recent IPCC Special Report (SR15) on the impacts of global warming of 1.5°C above pre-industrial levels, emphasizes that NDCs presented by countries are insufficient to meet the Paris Agreement objective. According to the scientists analysis, the

scale of transformation in the economy and society aiming at preventing a catastrophic scenario with warming above 1.5°C demands a reduction of anthropogenic CO^2 emissions by 45% until 2030, compared to 2010 levels. Such a scenario implies a radical change in the global energy matrix and consumption. Costs of likely damages are estimated at US$ 54 trillion over 1.5°C until 2050 (IPCC, 2018).

This special report was demanded by UNFCCC member countries during negotiations in Paris in 2015 to subsidize governments' decision-making regarding the implementation of the Paris Agreement rules and to improve national mitigation and adaptation commitments. Although report has been approved by governments of 195 countries (IPCC, 2018, December 20), the final text of COP24 - the Katowice climate conference held in December 2018 - has not incorporated the SR15 as a guide to increase countries' ambition; the text is limited to 'inviting' countries to make use of SR15 information to discuss their mitigation targets and implementation schedule to detain the catastrophic scenario presented by the IPCC with the increase above 1.5°C until 2050.

The political scenario in Brazil is uncertain as regards the implementation of NDC's goals with the government of Jair Bolsonaro due to his policy of denial on the climate, through statements that climate change is an ideological issue and does not recognize its impacts, in addition to the view that environmental preservation is an obstacle to the country development. The dismantling of the country socio-environmental governance reached an unprecedented level in few months. In an unprecedented mobilization, all former environment ministers, since the Ministry of the Environment was created in 1992, signed a collective manifesto on May 8, 2019, accusing the government of Jair Bolsonaro of putting into practice a systematic and deliberate policy of destruction of environmental policies, through the institutional dismantling of the main protective and supervisory bodies, such as Ibama and ICMbio (Observatorio do Clima, 2019, June 22). Other current government actions include reducing civil society participation in federal councils, attempts to weaken the Forest Code, cutting 95% of the budget for climate change in the Ministry of Environment, the agreement to reduce the value of the fines imposed or facilitate their payment in installment for a long period or even the forgiveness of these fines already imposed, weakening the fight against deforestation, the unfounded attacks on the BNDES in the management of the Amazon Fund and an attempt to change the governance rules of the billionaire fund, even against its donors – the governments of Norway and Germany.

The main objective of this article is to discuss the role of universities, specially the public ones, in supporting the implementation of Brazil's NDC. The study is organized as follows. The next section presents the Brazilian goals in the Paris Agreement. The methodological procedures are presented in section 3. Section 4 presents the current NDC implementation status. Section 5 addresses the main players who have been contributing with a preliminary and purposeful agenda for the development of NDC's implementation strategy. Section 6 discusses the role of universities, especially those publicly funded. Section 7 presents the context of climate change related to universities. Initiatives that may inspire other universities are presented in section 8. A set of recommendations is presented in section 9, followed by the final remarks.

2 Brazil and the Paris Agreement

Brazil stood out in the international negotiations under the Paris Agreement due to its ambition, as it was the only developing country that has submitted absolute mitigation goals, economy wide and not conditioned to international support for climate financing. Brazil's NDC aims to reduce GHG emissions by 37% below 2005 levels in 2025. And a subsequent indicative contribution to reduce GHG emissions by 43% below 2005 levels in 2030. These targets will depend on the implementation of cross-cutting public policies focused on the development of a low carbon economy.

Specific targets were set to be achieved until 2030 in specific carbon-intensive sectors. In the energy sector, Brazil aims to achieve 45% of renewable energy, and increase the share of bioenergy to 18% in the composition of the energy matrix until 2030. In the forestry sector and in the land use change sector the goals are to zero illegal deforestation in the Amazon, restore and reforest 12 million hectares until 2030. In the agricultural sector, the main focus is to strengthen the Low Carbon Emission Agriculture Program (ABC) as the main strategy for sustainable agriculture development such as restoring of 15 million hectares of degraded pastures and an increase of 5 million hectares of crop-livestock-forest integration systems. In the industrial and transportation sectors, more generic targets were established based on the increasing level of technological development aiming at energy efficiency and improvement in transportation infrastructure (Brazil, 2015).

Several strategic players are fundamental for supporting the Brazilian government in the elaboration of the NDC's strategy for implementation, including civil society organizations, the private sector and universities.

3 Methodological procedures

The present study is characterized as exploratory and descriptive. The narrative of the article was constructed from lectures and speeches given by experts. In addition, secondary data from interviews with public universities deans and documents of university projects were used as evidence. Primary data collection took place in March 2018, involving 13 experts, including representatives from the federal government, academia, civil society and the private sector (see mini bios in Appendix A). Participants were selected for convenience – experts invited to participate in research seminars organized by Professors Jacques Marcovitch and Claudio Machado Filho, in the discipline EAD-5978 Environmental Governance, of the Postgraduate course at the School of Economics, Managing and Accounting of the University of São Paulo (FEAUSP). Textual analysis of the transcribed primary data, in addition to the secondary data, was used.

4 The implementation of the Brazilian NDC

The implementation of the NDC will be an unprecedented challenge for Brazil in the coming years, and will involve major opportunities driven by conservation, mitigation and adaptation activities that foster sustainable and economic development toward a low carbon economy. The federal government has not yet presented its implementation strategy, governance structure and institutional arrangements needed to meet mitigation targets.

The Ministry of the Environment (MMA in the Portuguese acronym) is responsible for articulating and developing a national strategy to finance and implement its NDC. The first baseline document to support structured dialogues between the federal government and key stakeholders on the NDC implementation was drafted at the request of the MMA to the Inter-American Development Bank (IDB) through the technical cooperation agreement entitled 'Strengthening Financing for the mitigation in Brazil oriented to the management of results'. The document presents a set of recommendations on the necessary arrangements for the

strategy implementation, including some investment estimates and mitigation potential in the priority areas covered by Brazilian NDC: biofuels, land and forestry use change, agriculture, energy, industry and transportation (IDB, 2017; MMA, 2018, April 8).

Although the study has been contracted under a consultancy project and therefore does not represent the MMA position, it was used in the public consultation process with the government at all levels (national, state and local), and involving the private sector, sectoral entities, civil society organizations, and academia.

5 The involvement of strategic players

The Brazil Coalition on Climate, Forests and Agriculture is currently the leading multi-sectoral network of private organizations, civil society and academic leaders focused on proposing actions and influencing public policies for the development of a low carbon economy. The Coalition believes that Brazil's NDC should be based on an agenda of economic development, with positive results in agriculture and environmental preservation, and not only as the fulfillment of an international commitment (Coalition, 2018, April 26).

During 2017, the Coalition promoted a broad debate with cross-cutting proposals for the implementation of NDC, including dialogues with representatives of the executive and legislative powers, closer ties with academic leaders and the financial sector via FEBRABAN, and active participation in the Brazilian Forum of Climate Change (FBMC in the Portugue acronym) through the co-leadership of the thematic council 'Forests, Biodiversity, Agriculture and Livestock'.

Several Coalition members worked for months to consent on a set of recommendations in response to the MMA public call to contribute to the IDB-coordinated study on the implementation of the NDC. The lack of transversality between proposed actions and sectoral agendas was identified as the main fragility of the base document presented by MMA. The Coalition, which put itself at the Federal Government disposal in order to contribute to the NDC planning and implementation, discusses seven aspects in its position: 1) NDC's economic opportunities; 2) transversality of strategy; 3) economic instruments needs; 4) strengthening of regulatory frameworks and public policies; 5) investments in energy, logistics and infrastructure, 6) governance, transparency and monitoring, and 7) innovation and technology (Coalition, 2018, May 1).

Currently, the FBMC is the main forum that discusses and articulates with the official bodies on climate governance in the country, involving players from Brazilian society and members of the Brazilian State. Between March 2017 and mid-2018, the FBMC promoted structured dialogues in nine thematic chambers with the objective of contributing to a propositional agenda for structuring NDC's national implementation strategy, including definition of priority actions, cost-benefit criteria, technological development, and projected impacts on climate change in Brazil (FBMC, 2018, May 1). This participatory process involved about 500 people in workshops, several meetings, and public consultation through the internet. The FBMC adopted the MACBETH method (Measuring Attractiveness by a Categorical Based Evaluation Technique) to define the actions proposed, considering criteria such as mitigation potential, long-term compatibility, social and environmental impact, political and economic feasibility.

The analysis carried out in the draft of April 2018 on the NDC's Initial Implementation Proposal (FBMC, 2018) suggests a set of actions needed to focus on mitigation, including an indication of the potential for emission reduction in seven major areas: 1) forests ; 2) agriculture and livestock; 3) transportation and mobility; 4) cities and waste; 5) electric power; 6) industry, and 7) instruments 'off the economy'.

The proposal is robust and includes the priority sectors for mitigation and adaptation actions in Brazil. Although the recommended actions are duly justified, and many of them are fundamental to Brazil's compliance with the commitments made in the Paris Agreement, the document does not address the prospects of implementation means required for each proposed action, including, for example, recommending the necessary institutional arrangements, governance structure, cost and funding sources. In this sense, the proposal is presented as a long-term view because of its scope, complexity and diversity of actions. Our analysis suggests that the implementation schedule is even more fragile in that important civil society players focus on discussing the goals set forth in the Brazilian NDC and in the ambition increase, rather than focusing efforts to discuss the implementation agenda. This has been occurring exceedingly in recent years.

Other important contribution is the study produced by WRI Brazil that analyzes the implementation of the Brazilian climate policy associated with the strategies involved in the NDC implementation. The study suggests the appropriateness of the current governance structure of climate policy, and the establishment of evaluation and monitoring systems as fundamental pillars for the NDC implementation. The Brazilian Market for Emission

Reductions (MBRE) and the system for monitoring and evaluating the results of climate policy have not yet been developed, although its establishment is foreseen in the regulatory framework. It is highlighted the low amount invested in important tools focused on climate financing in order to reduce emissions, including the Climate Fund and the Loan Program for Low Carbon Agriculture. Social mobilization and effective participation of several stakeholders in the climate agenda must be improved and decisions should be more transparent, considering bodies as FBMC, and public consultation process on plans for mitigation and adaptation. The participation of civil society players should be broadened through more transparent, participatory processes and co-management opportunities of climate policies. Other important recommendation is to resume the work of the Executive Group on Climate Change in the intersectoral and interministerial coordination of climate policy. One of the main limits of climate policy in Brazil is the lack of an MRV system (measure, report and verify) to monitor the implementation (Speranza, Romeiro, Betiol, & Biderman, 2017).

6 The Role of Universities

The origin of the first universities dates back to the Middle Ages in Bologna and Paris. They emerged as a universalizing knowledge space of all knowledge, of respect for the integration of people and knowledge, outlining social and scientific identities. Universities are spaces of action, where teaching and learning take place, development of present and future scientific and human knowledge (Oliveira, 2007). They are institutions that have adapted and learned how to reinvent themselves to the reality of each time aiming at keeping their relevance.

Universities, particularly the public ones, are characterized by a complex network of contradictory constraints and incentives established by governments and development agencies, which can often hamper their efficiency (Weber, 2012). Additionally, it is expected that public universities establish partnerships with several sectors of society through specialization strategies and productive and technological complementation aimed at reflecting on the region's problems and priorities (Kawasaki, 1997), and it is also expected that they discuss their role in the process of socioeconomic development and progress of nations, based on innovation (Audy, 2017).

Some argue that the technical advances made in the digital age have fundamentally changed the way knowledge is constructed and disseminated, which has consequences for universities which start a competition with other knowledge providers. Universities, therefore, play an eminent role of knowledge curator in the digital age, where new empirical knowledge is needed to create a new order that offers new perspectives to existing arrangements and encourages new interpretations (Weber & Newby, 2018).

Currently, higher education institutions are included in a systemic and complex dimension in which, multiple world views and different knowledge, coexist and confront each other (Marcovitch, 2018). There must be a greater closeness of universities with different groups of society to propose transformative solutions in the economic, social and environmental systems, concurrently, acting as change agents in the development of new ideas and best practices according to the society demands (Knobel, 2018, May 21). On the other hand, it is still considered a challenge for universities to put into practice this new thinking based on a multidisciplinary logic in teaching and research, where the subjects are often connected and professionals from several fields need to interact. One of the contemporary roles of universities is to form individuals capable of leading with the changes, and who possibly must be grounded in a clash of modernity in higher education (Agopyan, 2018, May 23).

The big challenge is how universities will be prepared to respond dynamically and creatively to the current demands of society in an increasingly polarized and connected world. Difficulties such as training individuals for an evolving labor market, where new professions will be created and many others will cease to exist in the coming decades (Knobel, 2018, May 21). In addition, the demand for a well-qualified higher education has been growing. The increase in the number of vacancies requires new processes and innovative actions of university managers to deal with an expanding faculty with the deepening of the critical view of the new generations of students who are faced with the democratization of information in the digital age. This new context demands new pedagogical approaches and advanced methods of teaching, where knowledge is constructed in the classroom through the students' protagonism, who become agents in the educational process (Marcovitch, 2018).

University managers hold many responsibilities, where many activities are becoming increasingly complex and challenging in today's polarized and uncertainty-based world. Science and technology advance rapidly on a global level, and population growth coupled with an aging population are some of the factors that have implications for the mission and

governance of universities, in teaching and learning system, and in the research agenda. Academic leaders are following these changes, and are aware that their institutions should not only be responsive to changes in society but should also be responsible for finding social and technical solutions to current problems (Weber & Newby, 2018).

On the other hand, it is important to consider in this discussion the weaknesses and obstacles that may limit universities, especially those focused on research, in the accomplishment of their missions in the best possible way.

Weber (2012) highlights four main aspects. First, universities are conservative institutions, and on several occasions, it is difficult for managers to promote changes. Second, universities often have an outdated academic organization, whose leaderships are not conducive to the development of interdisciplinary approaches that are indispensable for studying current social problems. Third, most of the high-potential researchers focus their work on a personal research agenda, therefore, making it difficult to attract their research efforts aimed at solving priority social problems. This criticism is valid for educational programs in which research groups tend to be conceived according to the preference of its faculty and its thematic research. Although this is acceptable and beneficial in the basic intellectual and teaching exercise, it is needed a more comprehensive view that aims at training individuals with critical values in a changing and globalized society. And finally, the lack of involvement of academics in solving social problems and in the participation in public and political debates is another crucial issue. As members of a higher education institution, or recipients of a research scholarship, scholars have a duty to report the results of their research, and collaborate with other interdisciplinary scientists. Especially in the search for solutions in multidisciplinary areas, based on uncertainties and complexity, such as the problems arising from climate change.

7 The context of climate change and universities

The world is undergoing profound societal changes. Globalization, the digital revolution have transformed economies, industries and processes at unprecedented scales, including how people interact with each other. Higher education institutions are faced with increasingly delicate and complex processes, also considering the challenges related to the training of individuals for a labor market that is likely to be quite different in the coming

decades. There is a growing expectation of society that higher education institutions are a major source of innovation and knowledge crucial to the competitiveness of national and regional economies. The modernization of universities should be guided by disciplinary skills related by an interdisciplinary approach and engagement through collaborative processes. More than that, it is expected that universities contribute to solutions to many societal problems such as climate change, scarcity of natural resources, social cohesion, and income distribution. In complex systems universities are part of the solutions (Weber & Newby, 2018).

Some argue about the changes and adaptations that universities must go through in relation to the imperatives of global sustainability, for example, in relation to social diversity, resource management, academic, research and extension programs. The urgency to address the problem related to sustainable development has increasingly challenged higher education institutions to innovate in curriculum development, to promote student experiences, new research paradigms, social engagement and international alliances to meet the challenges of global sustainability, concurrently with the formation of global citizens (Weber & Duderstadt, 2012).

What really happens is that economies are acting in such a way that the exploitation of the Earth's environment by humans is so deep that it is moving towards non-resilient and unsustainable boundaries. Moreover, many research-focused universities, have actively debated for many years, a large number of the issues related to global sustainability. For example, the 'green revolution', which transformed agricultural practices and increased food production in the world through technological initiatives, had the fundamental contribution of university programs in agricultural science. It was also at the academy that scientists warned the world about the impact of human activities on the environment and climate, such as the depletion of the ozone layer with the emission of CFC gases, and the accumulation of gases causing the greenhouse effect in the increase of global warming and its consequences with climate change (Weber & Duderstadt, 2012).

In climate change, solutions to the various problems related to the increase of CO2 emissions of anthropogenic origin, require collective actions of several players. The central argument of this article is that academia, especially public universities, which are funded by governments and citizens, should play a critical and purposeful social role in this area. Public universities have to promote efficient and effective processes in the training of individuals, culture and extension activities, and to carry out researches with an innovative approach and

connected with the demands of government and society in search for solutions to the challenging problems related to global warming and the consequences of climate change, considering the implementation of mitigation and adaptation actions.

The UN 2030 Agenda for Sustainable Development, adopted in 2015 by 193 Parties, provides an opportunity for universities to align themselves with key players targeting initiatives focused on poverty reduction, prosperity and well-being for all, protection the environment and tackling climate change. This Agenda is supported by 17 Sustainable Development Goals (SDGs) and 169 goals (UN, 2015). All SDGs have a direct or indirect relationship with the environment and climate change. Although everyone recognizes the SDGs importance, to insert strategically these goals in university teaching, research and extension activities is still a complex issue, as it demands, for example, the articulation of aspects related to access, diversity, excellence, internationalization and innovation (Knobel, 2018, May 21).

It is not surprising that universities and other research or educational institutions play a key role in providing the appropriate environment to analyze the conditions required for global sustainability and to support the formulation of appropriate policies. Public higher education institutions have research infrastructure and expert faculty (Weber, 2012). Therefore, universities can contribute significantly if they have an integrated teaching and research agenda, with approaches based on the principles of multidisciplinary collaboration and public-private partnerships. The knowledge frontier must be explored in order to seek innovative solutions that contribute to the development of a low carbon economy which meets social and environmental demands. Opportunities to be explored can be supported by several sources of public and private funding focused on collaborative research projects, development and training of human resources.

8 Initiatives that inspire

Some universities present ongoing initiatives that contribute to GHG emission reductions and that somehow are aligned with global efforts aiming at achieving the goals assumed by Parties to the Paris Agreement. One of these inspiring initiatives is the 'Deep Decarbonization Initiative' (https://goo.gl/U7qhQH) of the University of California San Diego (UCSD), whose mission is to contribute to the transition of the global low carbon

economy through initiatives that bind best science and technology to politically realistic economic strategies for deploying low carbon energy systems that meet humanity's energy demand. In practice, an interdisciplinary group of senior scholars and managers of the institution's physical plants has been working collaboratively since 2013 with the senior university leadership and private funders on an integrated teaching and research agenda, including large areas such as social sciences, engineering , physical and biological sciences (UCSD, 2018, May 24, 2018).

Researches are carried out with the involvement of professionals from the energy sector, government, public policies makers and influencers. The main distinguishing feature of this initiative is the way the economic, political and social aspects are integrated into a research agenda focused on the search for solutions to problems related to climate change, considering the political and global economic situation and feasibility of decarbonization initiatives (UCSD, 2018, May 24, 2018).

The University of California (UC) system has 10 campuses and 250,000 students and is committed to becoming carbon neutral until 2025. The initiative, which also meets this public commitment, is funded by the university and partners private partnerships such as the TomKat Foundation. Partner with the private sector is essential for scientists to understand the transforming potential of the ideas and the commercial viability of new technologies, including investment in the development and testing of new projects (UCSD, 2018, May 24).

In addition to this program, UCSD has several other sustainability initiatives on the campus focused on reducing their emissions. For example, the zero-waste program (recycling, reuse and composting), encouraging alternative transportation (sharing cars and bicycles, hitchhiking and charging stations for electric vehicles), use of clean energy (solar, fuel cell and cogeneration) and green buildings (LEED certifications).

The Paris Agreement highlights the need for local leaders in climate governance and implementation arrangements through a decentralized approach and to find and promote solutions to climate change. To comply with this need it is required institutions that are willing and able to quickly achieve a deeper decarbonization. This UCSD initiative highlights the enormous contribution potential of public universities, where there is often strong political and social pressure for action, through efforts that combine academic insights with practical solutions in energy efficiency, alternative fuels and electrification (Victor et al., 2018).

Although the UC system represents only 0.005% of global CO2 emissions from fossil fuel combustion, the Institution leads by the example through a concrete and purposeful

approach, which is organized and evaluated in a way that it can inspire, be learned and adopted by other institutions (Victor et al., 2018).

Another inspiring initiative, led by the Graduate Institute Geneva (2018, May 8), is a internet portal (https://goo.gl/iPj17K) that brings together all research projects, publications, events, education activity (academic courses and extension, training and workshops), and other initiatives of the institution connected with the Agenda 2030 for Sustainable Development of the UN. This Portal is focused on consolidating and giving more visibility to the initiatives, linked to the respective SDGs that they relate in a propositive way, and to improve collaboration between teachers, researchers and students. This approach can be easily adapted and implemented by higher education institutions to consolidate their research, projects and initiatives that can contribute to the implementation schedule of the Brazil's NDC.

In Brazil, FEAUSP has made efforts to improve the energy efficiency of its buildings. Through a partnership with Origo Energia Company, an energy efficiency project was developed for FEAUSP main building aiming at the implantation of a photovoltaic system (connected to the grid of the distributor), and replacement of conventional light bulbs with LED. The proposal was submitted to a public call for energy efficiency projects of Eletropaulo (01/2017). The project, if implemented, should generate an average annual energy savings of 480.64 MWh/year and a reduction of 44.55 tons CO2 (Órigo Energia, 2017), in addition to making the intitution self-sufficient, and sell the surplus energy to Eletropaulo. Initiatives such as these are in operation at some locations on the main campus of the University of Sao Paulo (USP) such as the solar panels at the Brasiliana Library Guita and José Mindlin and the solar power plants of the Institute of Energy and Environment (IEE/USP), which produces 1% of the electricity consumed in the campus.

Another relevant example at the USP is the Gas Innovation Research Center (https://goo.gl/zjvYMU), based at Poli/USP and with the support of the Sao Paulo Research Foundation (FAPESP) and Shell, which launched a group discussion focused on carbon capture and storage technologies (CCS) The group relies on participants from diverse fields including engineering, psychology, history, geology, biology and international relations. The work front is rooted in three pillars: advanced research, innovation, and knowledge dissemination. The research agenda focuses primarily on solving technological and gas industry policy issues, seeking to reduce greenhouse gas emissions through sustainable use of

natural gas, biogas, hydrogen and management, transportation, storage and use of CO2 (FAPESP, 2018, 11 May).

The Incline initiative, a core research support in climate change at USP, also stands out in enhancing multidisciplinary collaborations between faculty and researchers from several areas through a proposal for integrated research on climate change that considers the physical, chemical, biological, socioeconomic and health aspects. The initiative has 33 research projects submitted, approved and running, and an investment of R$ 65 million coming from development agencies and international cooperation (Incline, 2018, May 30). It is an initiative with great potential to contribute to the structuring and implementation of Brazil's NDC. It is only unclear to what extent this core research support actually contributes to and impacts the implementation of public policies on climate, since no public evidence was found.

9 How to build the future?

The implementation of Brazil's NDC must be based on the development of a low carbon economy that promotes sustainable development concomitantly with economic development. The challenge is huge. Although the national government has the leadership of the implementation strategy, specifically the MMA, it refres to the implementation of a cross public policy and multi-sectorial that evolve several Ministries, government levels, civil society entities, the private sector, academia, indigenous peoples and traditional communities. The complexity of the problems related to climate change and the diversity players that are involved or impacted demand a multi-stakeholder governance through a participatory process for the implementation of the national strategy of policies related to climate and the NDC's goals.

The transition to a new low-carbon economy requires institutional arrangements, implementation of cross-cutting policies, and a lot of political will to enable the implementation of short, medium and long-term actions. The academy must play a key role in this process of preparing the NDC strategy and implementation through the production of relevant scientific studies that can support technical and structured dialogues between government officers, policy makers, and experts with practical experience. Thus, the academia will be contributing to the players instrumentalization in the measurement and

verification processes of the results of public policies and actions that will be implemented, development of new less intensive disruptive technologies in carbon, and proposition of economic mechanisms, such as payment for environmental services and taxation of the carbon.

Some government leaders and practitioners have the perception that the academy does not contribute systematically, meaningfully and in line with the 'real world'. According to a representative of civil society, active in policies focused on climate and the environment, "the university today is out of the reality of businesses and government. We need to work closer, because communication is scarce and there is a strong corporatism. "

Universities must be recognized by governments and the private sector as a strategic partner in innovation and competitiveness in the context of knowledge-based economies. The academy should focus on an agenda of advanced research and teaching focused on the implementation of the Brazil international commitments, assumed in the Paris Agreement. It is well known the ability of the academy, civil society entities and even the government to make assessments and scenarios that can lead to the solution of many complex problems, such as climate change. On the other hand, it is also notorious the inability of government players to implement long-term public policies that solve complex and systemic problems in several sectors. There are several causes, including the country circumstances, divergent interests, hidden agendas, lack of long-term vision to build a Nation project, lack of political will to undertake efforts, and establish institutional arrangements with a focus on the implementation of programs and strategies and low technical and technological capabilities.

Brazil has been making efforts and launching robust plans with mitigation targets, as the Sector Plan for Mitigation and Adaptation to Climate Change Aiming at consolidation of Economy Low Carbon in Agriculture (ABC Plan), the National Plan for the Recovery of the Native Vegetation (Planaveg) and the National Biofuel Policy (RenovaBio). However, there is a huge gap between the strategy and the implementation plan. This is reinforced by another representative of civil society who explains that "we are living a moment of non-implementation in Brazil", especially related to policies focused on climate and on unprecedented environmental setbacks in recent years. This is evidenced by the increase in GHG emissions and shrinkage of Gross Domestic Product (GDP). In 2015 and 2016, Brazil increased its CO2 emissions by 12.3%, with a decline of 7.4 points in GDP in the same period. According to the Climate Observatory, based on data measured by SEEG initiative,

Brazil became the only major world economy that increased pollution levels without generating wealth for its society (Observatorio do Clima, 2018, May 18).

It is argued that universities, especially those financed with public funds, must lead by example, through an agenda of proactive and multidisciplinary research, in line with educational needs and demanded research by government leadership and private about what is relevant and of practical application, whether in life sciences or applied social sciences. The purpose is not only to popularize the knowledge produced at the university unilaterally, but also to establish structured dialogues with different players for the establishment of an agenda of research and teaching which is innovative and in line with contemporary challenges, of practical application and of commercial viability of disruptive technologies. According to a representative of civil society, "there are so many studies with different approaches and tools that it is very difficult to identify the most appropriate approaches to test their applicability. It is necessary to consolidate the several studies in a format that can be understood and used by governments, legislators and public policy makers".

Suggestions like the ones given by the above mentioned representative of civil society are research opportunities for academia with practical application and in line with what the government and society need to work aligned and efficiently. The following is a set of recommendations and opportunities, according to the view of some experts, for public universities to reflect on their role in the implementation of the Brazil's NDC, through effective actions in the production of knowledge with practical application:

a. Developing studies to understand the social impact of initiatives focused on mitigation;
b. Mapping the various knowledge gaps related to environmental economy, and propose the compilation of several studies that have been published in line with the IPCC working approach;
c. Preparing studies on the impact of subsidies according to the criterion of the carbon intensity, fixation of carbon in the soil, methane, and other gases that cause the greenhouse effect;
d. Proposing an integrated research agenda on reforestation about the economic and biodiversity impacts aiming at technological developments;
e. Conducting studies on climate governance and effectiveness of institutional arrangements for the implementation of public policies on the environment or that affect the climate;

f. Working together with the Ministry of Finance team, through an applied research agenda, in the development and structuring of the Brazilian carbon market, which should become a mechanism to encourage environmental preservation;
g. Supporting the team responsible for the ABC Plan of the Ministry of Agriculture, Livestock and Food Supply in the development of monitoring metrics and impact of the initiatives supported by the plan;
h. Integrate a multidisciplinary research agenda with a focus on the development of economic instruments that support the transition to a low carbon economy.

These recommendations are only a starting point for what would be relevant in terms of contributing to NDC's implementation. The challenge lies in the articulation and coordination of multidisciplinary and interdisciplinary work and study groups, involving faculty staff, researchers, private sector, government and experts. Advanced study centers at public universities could lead research groups focusing on critical problem solutions related to the promotion of a low carbon economy and the implementation of the Brazil's NDC.

This recommendation applies to the Institute of Advanced Studies at USP (IEA/USP), whose mission is to carry out studies on public policies in the several levels by increasing the scientific exchange between USP and Brazilian and international institutions, including universities, research institutes , government, and society institutions. A group of research and study could be created, involving in a multidisciplinary way teachers and researchers from USP Schools and institutes that have a research agenda focused on different aspects of the problems related to climate change, such as FEA, Polytechnic School (Poli) School of Arts, Sciences and Humanities (EACH), School of Architecture and Urbanism (FAU), School of Law (FD), School of Philosophy, Languages and Human Sciences (FFLCH), School of Public Health, Institute of Astronomy, Geophysics and Atmospheric Sciences (IAG), Institute of Biosciences (IB), Institute for Energy and Environment (IEA), Institute of Physics (IF), Institute of Geoscience (IGc), Institute of International Relations (IRI), and Oceanographic Institute (IO). USP is the Brazilian university with the largest number of postgraduate courses, and brings together faculty and researchers excellence, internationally renowned for the impact of their research related to climate change, as is the case, for example, of Professor Paulo Artaxo from the IF/USP, and Professor Tercio Ambrizzi from IAG/USP. Through a multidisciplinary working group focused on proposing solutions to contribute to the NDC's implementation strategy, institutionalized in the IEA and bringing together renowned

scientists, USP could engage in major innovative projects that contribute to the development of a low carbon economy.

10 Final remarks

This article aims to support an academic and practical reflection on the role of universities, especially those public-funded ones, in the implementation strategy of the Brazil's NDC. This requires strategic governance focusing on climate and environment, capacity for innovation, and continuous repositioning of organizations across sectors. Many consider that there is a great dissociation between the science and the implementation of the Brazil's NDC. Mitigation and adaptation actions on climate change demand diverse solutions and the involvement of multiple players and sectors in the transition to a low carbon economy. The lack of integration of the research agenda of public universities with the demands of government and the private sector is pointed out by many as a major constrain to the advancement of science in line with the needs of the world in the 21st century. The role of universities in the context of climate change, should be focused on an integrated agenda of teaching and multidisciplinary research that considers the challenges and needs of the government and society for the promotion of a new low carbon economy, based on the economic and social development, where economic growth is not linked to the unsustainable use of natural resources. This requires disruptive technological innovations focusing on energy efficiency and emissions reduction, governance, institutional arrangements for implementation and capacity building. Some recommendations were presented for universities to lead by example through a purposeful research agenda aligned with Brazilian mitigation targets until 2030 under the international climate regime at the UNFCCC.

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Appendix A - Mini Biography of Research Participants

1. Adalberto Luís Val
A Biologist who has a postdoctoral degree from the University of British Columbia, Canada. He studies the biological adaptations to environmental changes. At the National Institute for Amazon Research (INPA) since 1981, he has been dedicated to the study of Amazon needs related to education, science and technology. He has written the book "Fishes of the Amazon and their Environment", among others. He currently coordinates the INCT/ADAPTA (National Institute of Science and Technology Studies Center of Aquatic Biota of Adjustments to the Amazon). He is a full member of the Brazilian Academy of Sciences.

2. Alfredo Sirkis
Environmental and urban planning manager, journalist, writer and screenwriter of Brazilian TV and cinema. He is currently executive director of the think tank Brazil on Climate Center (BCC) dedicated to climate change. Until the end of 2014 he was a federal deputy and chair of the National Congress Climate Change Commission (CMMC) and one of the vice presidents of the Committee on Foreign Relations and National Defense of the Chamber of Deputies. He was a councilman for four terms, municipal secretary of urbanism and president of the Municipal Institute of Urbanization Pereira Passos (IPP), between 2001 and 2006 and municipal secretary of environment, between 1993 and 1996, in the city of Rio de Janeiro.

3. Ana Maria de Oliveira Nusdeo
Associate Professor in the Department of Economic, Financial and Tax Law of the School of Law of the University of São Paulo. Professor of Environmental Law at the School of Law /USP, she holds a BA, has a PhD and is an Associate Professor of the same University. She has written the book "Payment for Environmental Services: Sustainability and Legal Discipline", winner of the Jabuti Prize. She is focused on researching the relationship between law, economy and environment.

4. Carlos Eduardo Lessa Brandão
Advisor to entities linked to the capital market and sustainability and has held executive positions in the Andrade Gutierrez and Vale groups. He is a trustee of third party asset authorized by Brazilian Securities and Exchange Commission - CVM - and board member certified by the Brazilian Institute of Corporate Governance - IBGC. Civil Engineer, Master in Energy Planning and PhD in History and Philosophy of Science at UFRJ (Federal University of Rio de Janeiro), he also holds an Executive MBA in Finance from IBMEC and Automatic Data Processing - ADP from the London Business School.

5. Cláudio Antonio Pinheiro Machado Filho
Professor and Ph.D. at FEAUSP. He develops researches related to the following topics: Corporate Governance, Governance and Succession in Family Business Control, Agribusiness, Strategy and Corporate Responsibility. Visiting Professor at the University of Wageningen (Netherlands), 2008. Coordinator of the General Administration Area of the Administration Department of FEAUSP since June 2014. Coordinator of the Research Group "PENSA" - THINK (Studies Program of the Agroindustry System Business), recorded in the CNPQ - National Council for Scientific and Technological Development.

6. Eduardo Amaral Haddad

Full Professor of the Department of Economics FEAUSP. He teaches Regional and Urban Economics and Applied General Equilibrium. He studies the regional analysis, focusing on the specification, implementation and application of interregional economic models. Author of "Regional Inequality and Structural Changes: Lessons from the Brazilian Experience". He was President of the Regional Science Association of Americas. He is a member of the Brazilian Panel of Climate Change.

7. Jacques Marcovitch
Professor Emeritus of FEAUSP. He has studied the business pioneering, strategy and innovation focused on economic growth, income distribution and environmental sustainability. Since 2002, he has researched the implementation policies of the Climate Convention with emphasis on reduction of greenhouse gases in the atmosphere. Master of Management from Vanderbilt University (USA), Ph.D. in Business Management from FEA / USP, and postdoctoral degree from the International Management Institute (Switzerland). He was Dean of USP from 1997 to 2001, Prorector of Culture and University Extension of USP from 1994 to 1997, Director of the Institute of Advanced Studies and of FEA / USP, President of the Energy Companies of the State of São Paulo (CESP, CPFL , Eletropaulo and Comgás) and Secretary of Economy and Planning of the State of São Paulo. Currently, in addition to academic activities, he is a member of the Higher Council of the Graduate Institute of International and Development Studies (IHEID) in Geneva. He has received several awards, among them: L'Ordre Nationale de la Legion d'Honneur (France), Jabuti Award (1998, 2008, 2012), Grand Cross honor of the Order of Rio Branco and Grand Cross honor of the National Order of Scientific Merit.

8. João Paulo Cândia Veiga
Professor of the School of Philosophy, Languages and Human Sciences and of the Institute of International Relations (IRI/USP). He holds a master's and PhD in Political Science from USP. He has research experience in International Relations in the areas of Political Economy and Institutions. Researcher at the International Negotiations Studies Center (Caeni), he currently conducts research on the impact of environmental certification for Brazilian foreign trade.

9. João Paulo Ribeiro Capobianco.
Biologist and Environmentalist. PhD in Environmental Science from USP with the thesis "Socio-environmental Governance, in the Brazilian Amazon in the decade of 2000". He was National Secretary of Biodiversity and Forests and Executive Secretary of the Ministry of the Environment. He founded and led non-governmental organizations, including the SOS Atlantic Forest Foundation and the Socioenvironmental Institute. He currently chairs the Democracy and Sustainability Institute (IDS).

10. José Domingos Gonzalez Miguez
Economist and Electronic Engineer, with post-graduation degree in Electronic Engineering (COPPE-UFRJ). He was the chairman of the Clean Development Mechanisms – CDM – in the Executive Board at the United Nations Framework Convention on Climate Change Secretariat, Executive Secretary of the Interministerial Commission on Global Climate Change and General Coordinator of Global Changes of the Ministry of Science and Technology. He is currently Director of Climate Change Policy at MMA.

11. Julyana Yokota

She joined S & P Global Ratings in 2013 as Director of the Infrastructure Ratings Group in Latin America. Prior to joining S & P Global Ratings, she worked for 15 years in the banking industry, including Itaú, Credit Suisse and BNP Paribas. She graduated in Engineering from the Polytechnic School of the University of São Paulo with a postgraduate degree in finance from Insper. Julyana is a specialist in financial analysis, focusing on environmentally sustainable projects eligible for "Green Bonds" investments.

12. Viviane Romeiro
Climate Manager at the World Resources Institute - WRI Brazil. PhD in Energy from the University of São Paulo, with specialization from the School of Public Policies at the University of Maryland (UMD) in the United States. She holds a master's degree in Energy Systems Planning and a Law Degree. Her academic and professional area of expertise is focused on environmental law, policy and regulation of greenhouse gas emissions and national and international climate policies.

13. Wagner Costa Ribeiro
Full Professor of the Department of Geography and the Graduate Program in Environmental Science, University of São Paulo. PhD in Human Geography from USP. Author of the books "The international environmental order" and "Political geography of water". His main research topics are: public environmental policies, international relations and environment, water resources management, international environmental order and city and environment.