FEDERAL UNIVERSITY OF BAHIA
INTERDISCIPLINARY CENTER FOR ENERGY AND ENVIRONMENT
POSTGRADUATE PROGRAM IN ENERGY AND THE ENVIRONMENT

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COOPERATION IN RENEWABLE ENERGY: THE CHALLENGE OF BRAZIL AND INDIA IN THE MULTI-POLARIZED WORLD

Salvador
2018

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Thesis submitted to the Postgraduate Program in Energy and Environment of the Federal University of Bahia as a requirement for obtaining a doctorate degree of Sciences, Energy and Environment.

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Annotated Catalog Card made by the University Systems of Libraries
(SIBI/UFBA), with data provided by the author

M932 Mousinho, Maria Cândida Arrais de Miranda
Cooperation in renewable energy: the challenge of Brazil and India in the multi-polarized world. / Maria Cândida Arrais de Miranda Mousinho. Salvador, 2018.
307f.: il.

Advisors: Ednildo Andrade Torres.
Silvio Alexandre Beisl Vieira de Melo.
Co-advisor: DinabandhuSahoo.

Thesis (Doctorate – Postgraduate Program in Energy and Environment) -- Federal University of Bahia, Polytechnic School, 2018.

1. Cooperation. 2. Renewable Energy. 3. Brazil. 4. India. 5. Emerging Countries
I. Torres, Ednildo Andrade. II. Melo, Silvio Alexandre Beisl Vieira de. III. Sahoo, Dinabandhu. IV. Título.

DISSERTATION APPROVAL

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Divine Ethernal Father, the source of energy.

My family, the source of love.

Dagildo Arrais Mousinho (*in memoriam*).

Raimundo Peregrino de Miranda and Raimunda Ribeiro de Souza (*in memoriam*).

Leovegildo Mouzinho and Candida Arrais Mouzinho (*in memoriam*).

The Brazilian and The Indian societies.

ACKNOWLEDGMENTS

Energy is the bridge that unites all things and the engine that propels them in the most varied possible forms. Personally, I believe that human relationships are also part of this concept: we know people who drive us to become better human beings because they contribute to broaden our horizons, our way of understanding the world of which we are part.

Simply, but with an immeasurable feeling of gratitude, I want to thank (and at the same time I dedicate this work to) the Divine Eternal Father, the inexhaustible and unconditional source of love, truth, grace and energy. My mother Yolanda Mousinho my inspiration, my joy, my love. My aunts Rita de Cássia, Maria Tereza, great-aunt Maria whom I devote a precious affection. To my fiancé Godoy, for the dedication, I love you. My family and friends: thank you very much for the support.

Many thanks to my advisors, Professor Ednildo Andrade Torres, Professor Silvio Alexandre Beisl Vieira de Melo and Professor Dinabandhu Sahoo for the decision to lead me through paths different from the ones that I once imagined to tread and for sharing with me their knowledge and experiences. My gratitude to Professor Luciano Amaral Oliveira for all the suggestions and essential teachings for the writing of this thesis. Professor Elsa Kraychete and Professor Edgard Leite for the comments and conversations about Brazil and India and also Professor Gaudêncio Freires and Marcelo Santana Silva, all of whom have supported me since the qualification of this work. Thank you all for contributing to my personal and professional growth.

I have to mention here my gratitude to Ambassador Ana Amorim, to my friends André Meyer Coelho, Neeraj Khera, Archna Negi and her family; to the German Development Institute and to the MGG Program for the immense support given to my professional life; to the diplomats Hugo Freitas Peres and Paula Rassi; to the Ambassador Reinhard Bettzuege for supporting my idea of taking a PhD; to Professor Nanda Kumar Janardhanan and his students, Miss. Pooja Tyagi and Mr. Oliver Gonsalves. To Father George Manimala of the Parish of Our Lady of Healh, Masihgarh and Mme. Jaqueline Mary for the help in the transcriptions of the interviews held in India. I also thank Professor Gabriela Cerqueira and the English teacher Uenderson Brittes.

I would like to thank the Brazilian Embassy in New Delhi, the Brazilian Ministry of Foreign Affairs, the Brazil-India Chamber of Commerce located in Minas Gerais, the

Ministry of Foreign Affairs of India, the Gesselchaft für Internationale Zusammenarbeit (GIZ), the Institute of Bioresources and Sustainable Development (IBSD), Jawalahral University Nerhu (JNU), the Indian Renewable Energy Development Agency (IREDA) and all the institutions that were directly or indirectly so willing to answer the research questions.

Special thanks to all the respondents of the questionnaire and to all those who kindly gave me an interview: together we contribute to promoting dialogue and research on the bilateral relationship between these two very unique countries on which this thesis has focused.

I also want to thank the indispensable support from the Federal Institute of Bahia (IFBA), particularly the Valença campus and the Institute Academic Administration (Rectory) for being always cooperative and supportive. I would like to cite the name of the member of staff Bonifácio Chaves de Almeida, who followed the evolution of this work more closely through the reports sent to the institution.

Thanks to the Laboratory of Energy and Gas (LEN), and to my friends and colleagues who work there for the support and the partnerships made particularly to Airton Carneiro, Marcia Luna, Keila Badaró, Felipe Cunha, Alexandre Nascimento, Vera Araújo, our angel. Thanks to Professor Heloysa Andrade who introduced me the Postgraduate Program; thanks to Graduate Program in Energy and Environment in the person of Professor Caio Castilho and the Federal University of Bahia. Thanks to Silvana Pereira and Interativa team for patience in formatting this thesis.

Thanks to my first teacher Maria Maria Mota de Miranda.

I thank José Prado Alves State School, where a six year old girl who wrote books to sell began to dream - and continues to dream.

Only those who dialogue can build

bridges and bonds.

(Papa Francisco).

Our ability to reach unity in

diversity will be the beauty and the

test

of our civilization

(Mahatma Gandhi).

MOUSINHO, Maria Cândida Arrais de Miranda. **Cooperation in Renewable Energy: The challenge of Brazil and India in the multi-polarized world.** 307 il. 2018. Thesis (Doctorate) - Federal University of Bahia, Postgraduate Program in Energy and Environment, Salvador, 2018.

ABSTRACT

The search for an understanding of the phenomena or for the challenges related to the contemporary world can not follow a systematic, productive and coherent path if we do not take into account the States whose actions can have global implications. This is the case of Brazil and India, key nations for the understanding of the global structures of production and consumption of energy. Facing the challenges of increasing energy demand, environmental issues related to CO_2 emissions, the need to diversify the energy matrix of these two countries, the emergence of the countries of the South in the global political and economic scenario – turning the international arena into a multi-polarized environment - cooperation in renewable energy rises as an element that can help Brazil and India overcome these challenges. Particularly since the 2000s, Brazil and India have shown interest in cooperating in the field of renewable energy. However, the data found showed that this cooperation is still considered incipient. In this context, the overall objective of this work was to propose strategies to expand such cooperation. Thus, it was necessary to learn about the energy profiles of the two countries under study and to contextualize Brazil and India in the area of energy cooperation, verifying documents that proved the official interest of both countries in cooperating in this area. In addition, the main renewable energy policies established by the two countries were identified in order to know the types of renewable sources in which they have been developing their policies. The scientific and technological data-mapping of both countries was also carried out to learn the types of renewable energy on which they focus their scientific and technological production and verify existing partnerships in scientific production established by Brazil and India. This has helped to identify in which type of renewable energy these countries hold expertise or interests. In order to identify elements that may limit or promote cooperation in renewable energy between the two countries, a questionnaire was applied with officials from the foreign ministries of the two countries and interviews were conducted with professionals working in the area studied. The results obtained made it possible to propose strategies that could help to promote cooperation between the two states in the field of renewable energy, either through the scientific and technological via or through the strengthening of the political dialogue in the field of renewable energy between the concerned ministries of each of these countries. Solar energy and biofuels are presented as sources with greater possibility of cooperation between the two States under study.

Keywords: Cooperation; Renewable Energy; Brazil; India; Emerging Countries.

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INTRODUCTION

1.1 CONTEXTUALIZATION OF THE THEME

In this contemporaneity, the relationship between energy and the environment has been the subject of complex debates. After all, the intensification of economic activities demands an increase in energy production, which, in turn, implies an increasing use of natural resources. Inevitably, the conservation of the environment is threatened. It is enough to note that carbon dioxide (CO_2) emissions increase with each analysis carried out and that, despite actions to be taken in the coming years to reduce countries' dependence on fossil fuels, emissions are expected to keep rising until 2040, with obvious impact on global temperature.

However, curbing CO_2 emissions is not the only challenge. Access to energy resources is also a crucial challenge as there are still millions of households without access to basic energy services. Forecasts show that 1.2 billion people will remain without access to electricity until 2030, most of them living in Asia and Africa (EXXONMOBIL, 2014). It is noteworthy that accessibility does not only refer to access to electricity or more sustainable means of cooking, but it is also related to per capita consumption when comparing countries like India with countries like Japan or the United States, for example. In addition, considering the energy resources and their heterogeneous distribution in the globe, accessibility is also a strategic issue.

In this context, the South-South panorama, which is characterized, in particular, by the establishment of new relations of forces among countries of emerging economies with a view to establishing partnerships to achieve common objectives, is becoming one of the key elements for the socioeconomic balance amongst countries. Energy interdependence among countries requires them to cooperate with one another in order to achieve energy security.

Before this scenario and considering their respective energy profiles, Brazil and India stand out as important players. Emerging leaders of the South-South axis, it is important to consider the ways in which they make use of energy resources to engender their economic and social development processes.

Thus, South-South cooperation is seen as a strategy of integration in the light of the current situation in which developing countries stand out. The panorama that previously favored the Northern countries has changed, and emerging economies, such as Brazil and India, have been seeking to align themselves. For these reasons, it is essential to know the reality of Brazil and India and where they stand regarding the energy issue.

For India and Brazil, intensifying the rapprochement between them is more than a strategy of visibility and a search for greater leadership in the political scenario of the South and internationally: this intensification expands the status of these countries before the international community, considering that their unique traits and their similarities make them, more and more, relevant players and a balancing force in North-South relations. However, in spite of the approximation efforts, particularly in recent years, established by the two countries, it was found that the cooperation in renewable energy between them is incipient. This is evidenced by the literature and the initial search that was carried out in the Integrated Consular System.

A mapping of the scientific production in the Web of Science platform was then carried out to verify if there were publications covering specifically the cooperation between Brazil and India in the field of renewable energy. No publication was found. This fact became the main driver for the scientific, and unprecedented, contribution of this work, which sought an answer to the question that emerged from this scientific gap and from the concern about why this cooperation is still incipient: in what ways is it possible to contribute to the increase of the cooperation in renewable energy between Brazil and India?

1.2 OBJECTIVES

The general objective of this thesis was to analyze the cooperation between Brazil and India in the field of renewable energy in order to identify opportunities and propose cooperation strategies for their intensification. The research also had the following specific objectives:

(a) to present a comparative study of the energy profiles of Brazil and India at the global scope with a focus on renewable energy;

(b) to verify if there are more agreements signed between Brazil and India in the field of renewable energy identifying and analyzing them critically;

(c) to identify the main policies for renewable energy established in Brazil and India;

(d) to comparatively analyze the scientific and technological profile of Brazil and India in the field of renewable energy, based on indicators of academic and industrial production;

(e) to comparatively analyze the competitiveness indicators of Brazil and India as well as the and factors that make difficult to do business as a support to identify elements that may contribute to or limit cooperation between the two countries;

(f) to identify the barriers or constraints and the elements that contribute to promote or may provide opportunities for cooperation in renewable energy between Brazil and India;

(g) to propose strategies for intensifying cooperation in renewable energy between Brazil and India.

1.3 THESIS STRUCTURE

This thesis is organized in seven chapters. After the Introduction, the first three chapters are of a theoretical nature and make up the referential basis for conducting the research.

The second chapter, Energy at the global level: notes on the crisis, the diversification of matrices and geopolitics brings a historical approach on the environment and the process that triggered the energy crisis. Next, to justify the need to invest in an energy matrix based on renewable energy sources, the thesis addresses the challenges imposed by this crisis. Then energy geopolitics is discussed to highlight how energy is a basilar element of the relationship between National States and how understanding about geopolitics, particularly in the field of energy, is essential for an understanding about the position of the countries in the international scenario. Thus, it was considered that, given the needs and expertise in the energy area, cooperation emerges as a relevant element for the balance of the energy system.

In chapter 3, International Cooperation for Development, the two main theoretical strands that deal with this theme are presented and the one that privileges the interdependence among states is chosen. Then it follows to the understanding of international cooperation in the globalized sphere as something that cannot be analyzed within the framework of a static model once it translates the adaptation by which the environment itself passes and adapts according to time. Then, South-South cooperation is discussed to contextualize the rapprochement of Brazil and India, particularly in the context of energy cooperation.

The fourth chapter, *Brazil and India: key countries for global energy structures*, addresses the general aspects of the two countries, highlighting the commonalities between them. In this chapter, a comparative study is presented between the energy profiles of each of these States with a focus on renewables.

Chapter 5, Empirical Overview: Renewable Energy Cooperation between Brazil and India, which presents the results of the research, is divided into six sections, which reflect the objectives proposed for the research. The first section presents data collected on the international acts signed jointly by Brazil and India concerning renewable energy. It also provides an analysis of documents resulting from the South-South cooperation meetings (BRICS and IBAS) of which Brazil and India participated, as these meetings helped to strengthen ties between the two countries. The second section presents the renewable energy policies established by the two countries. 32 policies were mapped and compared in the field of renewable energy. The third section brings the results of the scientific and technological mapping of Brazil and India in the field of renewable energy. Brazilian and Indian scientific publications were collected and studied. In addition, the patents filed by Brazil and India in the area of renewable energy were also mapped and a comparison was made between the scientific and technological production of the two countries. The fourth section presents the competitiveness indicators of the two countries under study based on the analysis of the competitiveness reports in the period of nine years. 126 indicators were compiled, compared and analyzed to identify elements that could promote or limit cooperation between the two countries. The fifth section presents the discussion of the results of the questionnaire that was applied to the officials of the foreign ministries of Brazil and India. The sixth section presents the results of the interviews conducted with professionals from the academy, technical and political areas related to the theme of this work.

Chapter 6 presents proposals for expanding cooperation between Brazil and India in the field of renewable energy. And Chapter 7 brings the final considerations of the research.

2 GLOBAL ENERGY: NOTES ON CRISIS, DIVERSIFICATION OF MATRICES AND GEOPOLITICS

To think about the use of resources as sources of energy is to reflect not only on nature itself and its conception but also on how it has been transformed over the course of history by technological advances. Thus, the act of expanding territories, initially stimulated by basic survival needs, began to incorporate the objective of the search for political and economic power. The consequence of this search was the fight for hegemony that was based on the yoke of the peoples and in the domain of the natural resources of the territories conquered, evidencing asymmetric relations of power and foreshadowing the modern geopolitics.

Europeans expanded their economic power and geopolitical power through the extermination of indigenous peoples and the conquest and exploitation of new territories. The term exploitation is emphasized because, once the European colonialist onslaughts began, the first and most significant impacts to the environment, hitherto, recorded were originated. Examples of these impacts are the devastation of the Brazilian Atlantic Forest and predatory hunting that has led some animal species to the brink of extinction in African countries.

It was not by chance that the competition for power and territory that was established among the colonizing countries was incompatible with the idea of environmental conservation. The relationship between human society and the natural environment has become more complicated with Cartesianism, which began with the Scientific Revolution, and is still present.

War conflicts in the 20th century contributed to accelerate the process of exploitation of natural resources. The most emblematic case is that of World War II, whose impacts affected not only those countries directly involved in the conflict, but also those not involved or partially involved. National states needed to rebuild areas that had been destroyed in the conflict, which called for economic growth, which took precedence over the conservation of natural resources.

In the post-World War II period, developed countries and underdeveloped countries intensified the consumption of their natural resources. The former sought to rebuild themselves; the latter needed to overcome that unfavorable international context through accelerated (and belated) industrialization. Inevitably, the intensification of the exploitation of natural resources has raised concerns, first in academic-scientific circles and later in society as a whole.

Attentive to this issue, developed countries have sought to "gradually transfer their industries that require the intensive use of natural and energy resources to peripheral countries" (RODRIGUES FILHO, 2004). Actually, the transferring of industries to peripheral countries does nothing but transfer to these countries the environmental and energy problems caused by the intensive use of natural resources.

The increase in the production and consumption of industrialized goods impacts the environment because of the increase in energy consumption. However, the way in which energy is consumed can modify the impacts generated by the increase in industrial production. For this reason, as Ignacy Sachs (1993) explains, the choice would not be between development and the environment, but between sensitive forms of development and insensitive forms of development.

It is in this context that the concept of sustainable development, published by the document entitled Our Common Future, also known as the Brundtland Report, the fruit of the World Commission on the Environment and Development of the United Nations, has become relevant and observed, especially , by all UN member countries. The concept can be seen from the following passage: “Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs”. (UNITED NATIONS, 1987, p. 16).

However, the idea that humankind could achieve sustainable development in a homogeneous way should be reflected upon, due to the diverse and complex realities of different regions of the planet. Thus one can perceive in the discourse for sustainable development the danger of a simplistic interpretation of the complex global reality.

This discourse also faces a linguistic problem underlying the term sustainable. The semantic vagueness of this modifier ends up giving rise to several interpretations, since it is also used to refer to the economic, social and environmental dimensions. Likewise, due to the imprecise term sustainability, different types of sustainability, such as economic, environmental and social have emerged.

Nevertheless, it is important to emphasize that, although sustainable development is a relatively new concept under construction, and therefore subject to criticism, its emergence and its dissemination have provoked discussions and debates which, in turn, have generated new social, economic and political attitudes in different countries. These new attitudes have provided different, not necessarily new, readings of human reality, popularizing them. For example, according to Jorge Santos (2010), for issues concerning religious aspects, "Indians have a worldview where all things are intertwined as part of human existence."

This vision is not new in the Eastern world, but it was fundamental in the West for the creation of the concept of sustainable development, whose basis is precisely the notion of system, the idea that everything is interconnected. However, the fragmented vision of reality, based on the process of accumulation, was imposed by the colonizing countries, which later would be the industrialized countries. It can not be denied, therefore, that the emergence of this concept marked on the world stage the beginning of a new human consciousness about the construction of the present and its decisive influence on the future.

The environmental issues inherent in the production and consumption of goods, and therefore the production and consumption of energy, show that the way to reach an agreement on how to improve the quality of life of populations and the conservation of natural resources is difficult. In this context, the concept of resilience emerges as an important point of reflection because it points to the ability to adapt or evolve in the face of an adverse situation or simply to recover the balance after an adverse event. It is no coincidence that resilient regions are better prepared to deal with energy crises while being sustainable (SANTOS, 2009).

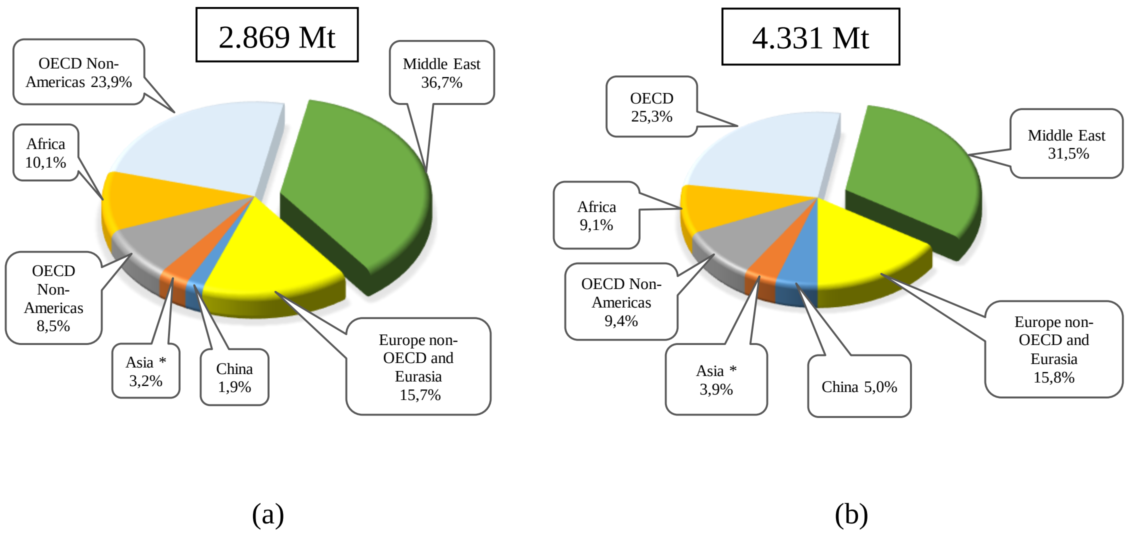
But what challenges does the current energy crisis impose on the world? The next section seeks to answer that question.

2.1 THE CHALLENGES OF THE ENERGY CRISIS

Concern about the energy issue emerged more specifically because of the oil crises of 1973, 1979 and 1990, which drew the attention of the entire world to the geopolitics of energy established in the post-World War II period, in which large part of the oil reserves had gone under control of private companies. Undoubtedly, oil is the most important element in energy discussions and will continue to play a leading role in the global energy matrix for a long time (EXXONMOBIL, 2017).

With regard to the world's oil-producing regions, countries members of the Organization for Economic Cooperation and Development (OECD), Eurasia countries and the Middle East region have been recognized as the major ones. It can be seen from Figure 1 that these groups of countries were the major producers both in the year of the first oil crisis and in the year 2015. Asia had a percentage increase of 21.8% and China had an increase of 163% in relation to the percentage of 1973, relative increase greater than the world production of oil, which was of 50.95%.

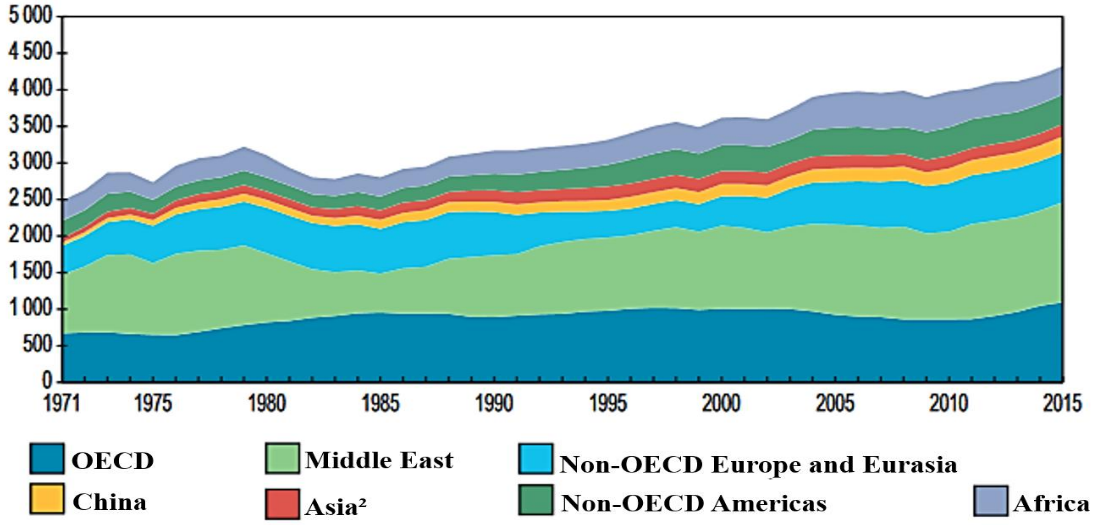
Figure 1 - Oil production by region* percentages 1973 (a) and 2015 (b)



Source: IEA, 2016a, p. 10.
*Asia excludes China.

Figure 2 below shows the evolution of oil production since 1971. Despite some falls, production is upward. In addition, the regions, in Figures 1 and 2, that stood out in the years 1973 and 2015, are the same that stood out in the evolution of oil production over 42 years:

Figure 2 – Oil production from 1971 - 2015 by region* (Mt).



Source: IEA, 2016a, p. 10.
*Asia does not include China.

Despite the importance of oil for the global economy, investing in a more diversified matrix is a real need due to environmental, economic or even security-related implications. After all, being dependent on a source of energy whose largest reserves belong to few countries that are embedded in a territory of political instability is extremely dangerous. Not surprisingly, Michael Klare (2002, 2008) argues that oil is the raison d'être of wars in the Middle East region involving Western countries in the search for geostrategic control of this resource.

Still in relation to oil and, more broadly, fossil fuels, it should be noted that, due to the risk of fossil fuel depletion because of the prolonged and intense use, there is growing awareness of the responsibility of each country for the increase in global environmental pollution, *i.e*, the greenhouse effect, which is particularly discussed in Conferences of the Parties at the United Nations Framework Convention on Climate change (COP)[1]. The IEA predicts that, by 2040, even if the world energy matrix is divided into four roughly equal parts (including oil, gas, coal and low-carbon sources), policy measures and the development of markets that will reduce the proportion of fossil fuels in energy demand by a quarter will not be sufficient to reduce the increase in CO_2 emissions, which will increase by 20% (IEA, 2014).

Climate change is a borderless concern, as there is no longer any doubt about the close relationship between climate change and energy issues. It is not by chance that the quest for a balance between the quality of life of the world population and the mitigation of CO_2 emissions is a complex challenge. There is a tendency for such emissions to begin to fall only after 2030. However, this does not mean that they will reach the zero point or that climate change remains within the scope of the United Nations Intergovernmental Panel on Climate Change forecast, for which the temperature increase should be limited to 2^oC (IEA, 2014).

According to ExxonMobil (2017), energy-related CO_2 emissions rose between 2000 and 2015 by approximately 40%, peaking in the 2030s and then starting to decline - despite the expectation that world GDP will double in 2015 by 2040. Improved energy efficiency and reduced use of CO_2 help reduce emissions even with population growth and with GDP growth. One example of this is China, there was a 1000% increase in GDP from 1990 to 2015. However, promoting energy efficiency in that country has made emissions grow at a slower pace - about 300% (EXXONOMOMOBIL, 2017).

[1] Cf. historic about COPs in UNFCCC (2015).

Global demand for energy is projected to continue to increase, and ten emerging economies alongside with China and India will account for approximately half of all growth in world energy demand. In the United States and other OECD countries, where per capita energy consumption is already high, energy efficiency and lower population growth are expected to combine to maintain global energy demand stable by 2040 (EXXONMOBIL, 2014, 2016).

The United States Energy Information Administration (EIA) projects that world energy consumption growth will increase by 48% between 2012 and 2040 and will come mostly from non-OECD countries, as member countries should have a stable consumption pattern between period of 2010 to 2040 with a rate of 0.5% per annum, while the average of non-OECD countries should be 2.2% per annum. Add to that the fact that the percentage of energy use in these countries is expected to rise from 54% of total energy consumption in the world to 65% by 2040 (US ENERGY INFORMATION ADMINISTRATION, 2013, 2016).

Besides the fact that the projection of higher energy consumption is linked to non-OECD countries, the highest rate of population growth is expected for these countries, thus increasing energy consumption. It is worth noting that the world population went from approximately 3 billion people in 1960 to 7 billion people in 2011 (UNITED STATES CENSUS BUREAU, 2016a).

According to the United Nations Population Fund (UNFPA, 2011), even considering the fact that birth rates are declining in most countries, the world population continues to increase. The most exponential growth is that of the population of the Asian continent, followed by the population growth of the African continent. According to the US Energy Information Administration (EIA, 2014), population growth in African countries does not reflect increased per capita energy consumption, which will remain low across the continent and is projected to remain practically constant until 2040. However, in India, which will account for the largest number of world population growth, contributing more than twice the number of people across the OECD group of countries between 2010 and 2040, per capita energy consumption will tend to grow over this period.

According to projections by the Population Division of the United Nations Department of Economics and by Social Affairs of the United Nations Population Fund (UNFPA, 2011), in 2025 India will have 1.46 billion people and will have surpassed China, which will have 1.39 billion people; thus becoming the most populous nation in the world. It should be noted that India population growth in 10 years, in terms of number of people, is close to the total number of the current Brazilian population, estimated at 207 million inhabitants (IBGE, 2017).

In face of the world population growth forecasts, it is clear that accessibility to energy is a crucial issue, as there are still many households without access to basic services. It is estimated that approximately 1.2 billion people do not have access to electricity in the world and another 2.7 billion depend on the traditional use of biomass for cooking (IEA, 2016b). There is a projection that by 2020, 1.2 billion people will remain without access to electricity, 87% of whom live in rural areas, with most of them living in sub-Saharan Africa, India and other developing countries in Asia (EXXONMOBIL, 2014).

The number of people who will depend on the traditional use of biomass for cooking will rise to 2.8 billion (IEA, 2010). It is worth noting that the traditional use of biomass, especially in poor countries, is a portrayal of the lack of access to more modern and less polluting means of generating energy. That means billions of people still use agricultural waste, animal droppings, and firewood in the most primitive way to cook or warm up. According to the IEA, these energy sources account for more than 90% of total domestic energy consumption in many countries.

Obviously, the inefficient and unsustainable use of biomass has harmful consequences for health, the environment and economic development (IEA, 2006). It is no coincidence that approximately 3.5 million people in the world died from exposure to air pollution from their own homes, using wood or other solid fuel for cooking or kerosene in lighting. Of this total, one million are in India, where life expectancy is reduced by 23 months because of this way of using the energy source (IEA, 2016c).

From what has been mentioned above, it is clear that the energy crisis presents the world with challenges related to either the production of energy itself and the consumption of it or the way the energy resources are being consumed. The growing demand for energy and the growing CO_2 emissions, the environmental implications of unsustainable resource use, the increasing world population, and accessibility to energy resources are pressing and disturbing issues and a call for change.

In this context, alternative sources of energy appear as a north to a process of change towards a sustainable society. The diversification of energy matrices is the focus of the next section.

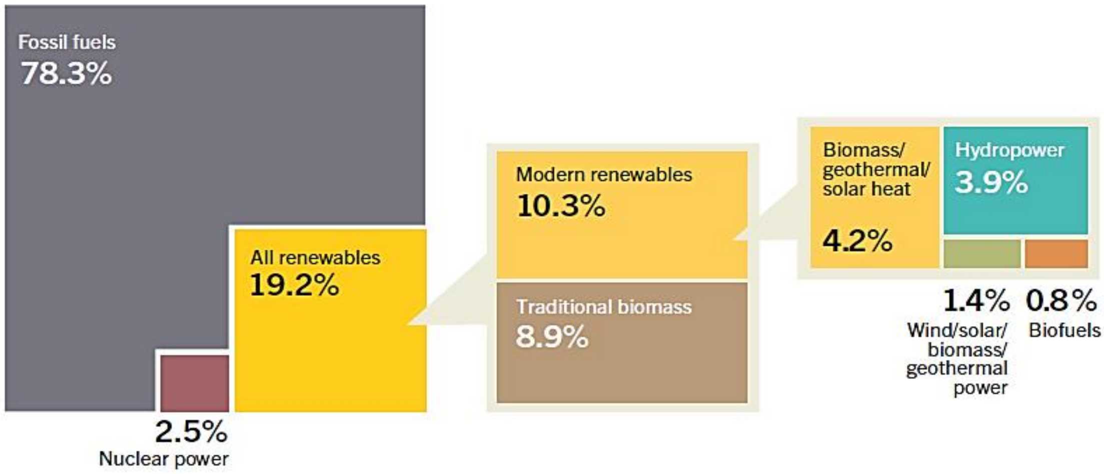
2.2 THE NEED TO DIVERSIFY ENERGY MATRICES: RENEWABLE ENERGY

The crisis in the energy field is not a crisis of energy itself or of the amount of energy but rather a crisis of paradigm *i.e.* the way in which energy resources have been used over time. The change of this paradigm can contribute to the redefinition of global geopolitics, since the promotion of alternative sources of energy, while helping to promote investments, affects more traditional forms under way for more than a century.

The energy crisis show the need to diversify the energy matrix by investing in the promotion of renewable energy sources, understood here as those derived from natural processes (*e.g.* solar and wind) that are more quickly renewed than they are consumed[2]. According to Camiotto (2013), "a source of energy is considered renewable when the natural conditions allow its replenishment in a short time span," or in a period of time that is compatible with human consumption.

Renewable energy still accounts for less than 20% of the world energy matrix. Figure 3 below illustrates that dependence on non-renewable sources of energy in the world is still high and that nuclear energy accounts for 2.5% of the final energy consumption in the world. It can be seen that, within the percentage of renewable energy, approximately 10% refers to modern renewable energy while the remainder represents the use of biomass in a traditional way, such as wood or agricultural residues (REN, 2016).

Figure 3 - Renewable energy in the world: final consumption, 2014

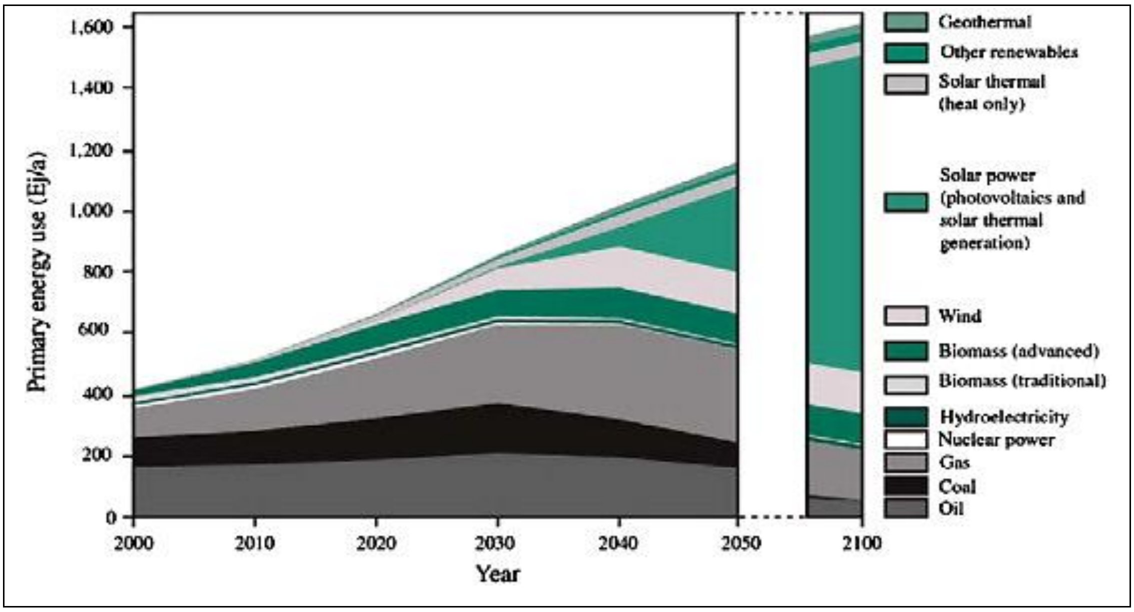


Source: REN (2016).

[2]APPENDIX A - Types of Renewable Energy and their Characteristics.

However, it is expected that there will be an increase in the share of renewable energy in the world energy matrix, as shown in Figure 4. According to the IEA (2014), they will represent almost half of the increase in total electricity generation in 2040. In addition, the use of biofuels will increase more than triple (4.6 mb / d) and the use of renewable energy for the production of heat will more than double. And the electricity sector will play an important role in this context because, according to the IEA (2014), it is the one that will most contribute to the reduction of the percentage of fossil fuels in the world, since a total capacity of about 7.200 gigawatts (GW) will be built to meet the growing demand for electricity and at the same time, the current power stations planned to be shut down by 2040 (about 40% of the current park) should be replaced."

Figure 4 - Renewable energy: evolution in one century.



Source: TOKLU (2013, p. 547). Adapted.

Although global subsidies to renewable energy technologies reached $ 135 billion by 2014, fossil fuel subsidies represented about three times that amount, i.e., $ 490 billion over the same period (REN, 2016). This is undoubtedly one of the barriers faced by the promotion of renewable energy in the world.

The IEA provides some examples of this. In the Middle East, about 2 mb / d of crude oil and oil products are used to generate electricity, but the absence of subsidies means that the main renewable energy technologies can not compete with oil-fired power stations (IEA, 2014).

In fact, subsidies given to fossil fuels can be seen as a barrier that prevents, in a broader and more definitive way, the development of renewable energy in the world. Public policies are then essential to leverage the processes of change: the market and technological barriers and production costs for the diversification of the energy matrix for renewable sources can only be effectively reduced through public policies that help to promote investments in the sector.

Energy is at the heart of global debates, both as regards the appropriation of natural resources as the basis of production, and economic and social sustainability of the States, as well as with regard to solutions for growth based on the sustainable paradigm. Energy has woven historical relationship among the countries and regions of the globe in which they are inserted.

The interpretation of the international scenario regarding the control or access of resources has been crucial throughout history: there was and there will always be a thread connecting the National States, energy resources and power relations.

2.3 GEOPOLITICS OF ENERGY

The capacity of the State to plan and control the generation and the use of energy influences its competency to transform energy resources into wealth and power. This is what Lucas Oliveira (2012) states, whose multidimensional conception of energy is adopted in this work: a set of processes, which include the extraction, captation, transformation of natural resources (into energy resources), aimed at the system of consumption (or use) of the different forms of energy that occur in productive activities.

Thus, understanding of the control of the geographic space[3], and more precisely the control over the energy resources of this space, becomes the basis for an adequate interpretation of the countries' positioning and the possibilities of their political, social, economic and environmental development. Therefore, the understanding of geopolitics and its representativeness in the field of energy is fundamental not only to highlight the

[3] The geographic space is understood in this work as more than a simple physical cut or a region of the terrestrial globe. Considering society and nature itself as dynamic, geographical space is also understood as synonymous with continued socio-spatial relations. According to Henri Lefebvre (1991), these relations are conceived as economic, political and symbolic-cultural. Thus, geographic space takes on forms beyond what can be called physical space.

importance of energy in the international scenario (in terms of its strategic role in the economic as well as the military and national defense), but also to understand how countries have positioned themselves on the international context.

Some scenarios exemplify how power relations can be translated by energy transport routes or be directly connected to areas which possess energy resources. Europe and its dependence on natural gas from Russia, which traverses Ukraine, China and Japan, can be emphasized; Bolivia and its relations with the South American countries in relation to gas; and the new route of the Chinese silk project that will certainly increase its geopolitical influence in Asia and Africa and Europe.

2.3.1 **Energy and geopolitics: a timeless and challenging relationship**

Energy and geopolitics have always walked side by side and certainly there has never been a historical moment in which energy was not viewed from a strategic point of view. According to Oliveira (2012, p.77) energy geopolitics can be defined as the "analysis of the geopolitical and strategic elements that influence the exploration, infrastructure, transport and end-use of energy resources". It is worth noting that the complexity of energy relations, translated into political relations and power dynamics , makes all countries, regions and areas interconnected (CRIEKEMANS, 2011) making energy geopolitics a relevant topic in international negotiations, in which discussions are focused mainly on trade strategies, access, control and control of natural resources (JANUZZI, 2014).

Location is an inherent factor to the geopolitics and, of course, to the geopolitics of energy. According to Melvin Conant and Fern Gold (1981), energy geopolitics, in addition to highlighting the importance of location factors for the relations of States and for the access to raw materials and for energy resources, considers the geographical factors determinant to governmental policies and to the position that countries occupy in the international scenario.

This is evidenced by the fact that the primary sources of energy are transformed and transported in order to be properly used. Crude Oil (petroleum) is an example of this: after its extraction, it is transported through oil and gas pipelines, which can be terrestrial or submarine, or by oil tankers, and to be processed. This process also applies to the extraction of gas, see the example of the pipeline that transports natural gas from Russia to the European market.

A central issue for the geopolitics of energy is energy security. It can be defined as the situation in which a nation or region are in terms of "energy availability sufficient to maintain reasonable rates of economic growth and development, maintaining or preferably gradually improving the living conditions of the population" (OLIVEIRA, 2012). Energy security has only become an obvious issue thanks to its historical relationship with oil.

The fact which evidences this relation was the decision of Winston Churchill. England had a very strong navy, particularly until the early twentieth century. Its fleet was powered by coal though. Germany, however, had its fleet powered by fuel oil, which gave it more agility. Thus, in the imminence of World War I, Churchill made a historical decision: he decided to replace coal with oil as the energy source for the navy to make his fleet faster than the Germans.

This change also meant that the Royal Navy would not rely on Wales´s coal, but on the supply of oil from an unsafe region, Persia (YERGIN, 2006). Energy security has therefore become a matter of national strategy.

Mastering the production, distribution, and use of oil has become strategic priority of hegemonic states. It should be noted that coal played a prominent role in the Industrial Revolution and in the process of capital accumulation. These two energy sources have converged to directly influence the balance of relations among countries over the past two centuries.

Oil became the driving force behind the process of capitalist accumulation, the base of contemporary society. It is not by chance that discussions about the oil crises (especially after the Second World War, 1973 and 1979) were responsible for drawing the world's attention to the geopolitics of energy. According to José Goldemberg (2014), the problem of oil supply is geopolitical, since it is not consumed in the countries where it is produced, and "half the world's production is traded whereas only 10% of food items are traded and the rest is produced in the countries where it is consumed".

However, the issue of energy security should not be restricted to the oil issue. The discussions on energy security cover a range of subjects, including terrorism, growth and economic development, geopolitical instability and rivalry, and the relations countries have with one another, as stated by Yergin (2006).

The growth of developing countries is undoubtedly contributing to the broader understanding of energy security, since it raises concern for emerging countries, which need more energy to maintain their accumulation process, as well as for the other countries, in view of the fiercer competition for energy resources. For the IEA (2013), the center of gravity of energy demand is shifting towards emerging economies.

For Russia, the objective of energy security lies in guaranteeing the control that the government has over energy resources and in controlling the main channels and the main pipelines market. For China and India, the ability to adapt to their dependence on the world markets and on self-sufficiency commitments is of great importance as far as energy security is concerned (VERMA, 2007). Brazil seeks to adapt to the challenges in the international arena and to deal with an energy matrix based on hydroelectricity. Furthermore, Brazil has to deal with the possibility of becoming a world leader in the production of energy by the recent pre-salt discovery, which, according to the IEA (2013), requires a complex capital-intensive extraction process, with investment levels higher than those in the Middle East and in Russia.

Coal is the most used fuel in developing countries with the exception of Brazil (SAMPAIO; FREITAS, 2013). And, despite the decrease in use in the OECD countries, its global demand will be 17 % higher in 2035, according to IEA; two third of this increase will occur by 2020. This demand will increase a third in the countries outside the OECD, and India, Indonesia and China will account for 90 % of the growth of coal production (IEA, 2013).

As for natural gas, the largest growth in its demand will come from emerging markets, especially China, where the use of gas will quadruple in 2035, and the Middle East (IEA, 2013). Gas will become the main fuel of the energy matrix of the OECD countries, supported by the new regulations in the United States. Differently from what will happen to oil, gas production will substantially increase throughout the world, except Europe. And unconventional gas will account for about 60% of world output growth. The need for gas import will increase in parts of Asia and Europe.

And the greater uncertainty, outside of North America, is whether gas can be made available at attractive prices for consumers while there still are incentives for investments in the field of gas supply. This is a matter of domestic legislation in many countries emerging from non-OECD markets, including India and the Middle East and a concern in the context of international trade (IEA, 2014).

In presenting a comparative analysis between China and India on the performance of cross-border pipeline projects, Kulkarni and Nathan (2016) emphasize that India's success in building strategic relations with neighboring countries is minimal; underlining the fact that this country has a complex geopolitical environment due to disputes linked to water, territory and terrorism. For the authors, the success of cross-border projects depends crucially on the political relationships among supplier, consumer and transit countries or those countries where routes will be built. Undoubtedly, this context expands the energy-cooperative horizon of countries with high energy needs and a complex geopolitical context, such as India.

According to Freitas (2013), because coal, oil and natural gas are relatively finite, they grant a significant power to the States and to the energy companies that control them. Moreover, the articulation of productive elements to generate resources causes tension between the nations that compete for them or need them.

According to Oliveira (2012), there are three strategies that the States should adopt in order to increase energy security.

The first is energy self-sufficiency once the need to import energy is a fact, particularly between the major world powers. This strategy can be implemented through the diversification of energy sources. Thus, problems with a particular source, such as shortage effects, could be avoided. However, it is important to note, according to Oliveira (2012), that the diversification of the matrix may not reduce the risk of high dependence on a single type of generation and distribution system of power or of a single mode of transport, for example. Yergin (2006) understands that the diversification of energy sources will remain as the main starting point of energy security, but not as the key point or the only one. Therefore, without proper and integrated strategic planning in the sector, diversification of energy sources would not be an effective instrument for energy security.

There are two other ways of operating the energy self-sufficiency strategy. One is the decentralization of power generation and distribution infrastructure with a view to reducing the likelihood that infrastructure damage will result in a collapse of the power supply. The other is energy innovation based on the development and promotion of new technologies, both in generation, distribution and consumption (OLIVEIRA, 2012). In the context of energy innovation, technologies in the area of biofuels including alternative or renewable energy can also be highlighted. These modes of operation are directly related to energy efficiency, which is usually linked to the use of new technologies and more efficient structures.

The second strategy the State can put into practice in order to increase its energy security is the increase in the security of external energy supply. It can be achieved, according to Oliveira (2102), through diversification of external suppliers, through trade agreements, political and diplomatic influence, market mechanisms or the militarization of the control of energy resources abroad.

The last strategy the State can make use of is regional integration, which refers to the integration of infrastructure and supply chains of energy in a region or a continent usually permeating regional integration processes (OLIVEIRA, 2012), which began to be seen with more attention because of the process of globalization, which demanded from the states actions that would increase their competitiveness. Thus, integration has a broader meaning than simply integrating the infrastructure and production chains of a particular region or of a continent: it aims to link and expand global production systems and systems related to the financial sector and to the rest of society, which goes beyond pre-established geographical boundaries.

Regional and energy integration can be understood from one of two possible perspectives (NIIR, 2004). The first is the Market and Institutions perspective, in which integration would focus on increasing the competitiveness of member countries through the participation of institutions and multilateral agreements that would give the countries concerned access to energy resources, and regulation would be carried out through contracts. The second view is that of Regions and Empires, in which a group of countries led by a hegemonic country or satellite region seeks advantages before other countries: energy resources can be exploited within the framework of political agreements primarily under the "invisible hand" of the market (NIIR, 2004).

Yergin (2006) presents a line of reasoning similar to that previously quoted. It is about principles (or strategies) that countries must respect to maintain their energy security, within, of course, the geopolitical context of energy. The first one is the diversification of energy sources, which helps to reduce disruption impacts of a source and provides alternative sources. The second principle is integration, whose best example is oil: there is only one market, a complex system and the security lies in the stability of that market, which is already integrated. The third principle is resilience, which guarantees a margin of safety against crisis because of the country’s capacity to replace the production, adoption of strategic reserves, adequate storage capacity along the supply chain, storage of critical parts of the production, and distribution of electricity. The fourth principle is information because, in times of crisis, false information and rumors contribute to intensify the crisis.

According to Yergin´s understanding, as important as these four principles are the two critical dimensions that should be part of the energy security concept: the recognition of the globalization of the security system (which can be achieved especially engaging India and China) and the fact that the entire chain of energy supply must be protected. Although the author does not go into the details of how to protect the whole chain, considering the globalized system, it is implied that information should be managed at the global level only to sustain the system, since each State and each institution act following the rules of the market of information and strategic disinformation in order to protect itself.

The increase in the energy consumption of emerging countries, driven by economic and population growth, among other factors, pressures the global energy system as well as the environment (JAFFE, WILSON; FELLOW, 2004) due to the need to use natural resources. Because of that, the challenge of energy security will become increasingly urgent as the scale of world trade and world markets become more integrated (YERGIN, 2006).

Let us highlight that geopolitics undergoes a remarkable change due to the international situation marked by global warming linked to a crisis of natural resources seen as energy sources, by the pressures of global economy, and population growth. This change relates to the fact that the location of energy resources, although it is still relevant, begin to share space with other technologies of energy generation. In other words, the location becomes no longer the only limiting factor to energy generation.

Geopolitics moves amidst significant changes and becomes more complex as it becomes more diverse, embracing new themes and challenges. For Michael Klare, "The old international energy order was organized around oil production in the Middle East, secured by U.S. protection. The new order will be more fragmented and unstable" (KLARE, 2008) [4]. In this context, Freitas (2014, p. 123) observes that there is a process of transition from " energy geopolitics based on the energy resources of power or fossil fuels to a geopolitics of

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[4] Cf. original: The old international energy order was organized around oil production in the Middle East, secured by U.S. protection. The new order will be more fragmented and unstable.

energy that is in the process of structuring and that embraces the so-called 'renewable' and low carbon energy."

The ability to integrate the amounts of renewable energy safely and reliably into the existing energy system helps National States free themselves, in some way, from the dependence on fossil energy supply; helping to change the concept of geopolitics. Even though the different regions have different potential for the development of renewable energy, technological development can make it feasible to use practically all of them (JANNUZZI, 2014). This raises the question of the role of renewable energy in the field of energy geopolitics, which, according to Sholten and Bosman (2016), is a new topic, despite the abundant literature on energy geo-chemistry, renewable energy technologies and energy transition.

This transition in geopolitics brings, for the discussions on the subject, challenges such as those concerning imbalances in places where renewable resources can be developed. A particular place may have the capacity to promote more than one type of renewable source while other has capacity only for one type of source (similar to what happens with conventional energy sources).

For this reason, Yergin (2006) believes that Brazil and India are increasingly dependent on global markets and these countries´ main concern is to generate enough energy to support their economic growth and avoid energy shortages, which could provoke social and political turbulence.

Consequently, these countries should be aligned with the energy security system within the IEA so that they can have their interests protected in the event of turbulence and ensure that the international system operates more effectively.

It should be noted that the regional geopolitical context in which India is inserted is more complex than the one in which Brazil is inserted. The geographical position of that country to the south of the Asian continent and to the north of the Indian Ocean, and its area of regional influence clashes with the Chinese "power lines" (REIS, 2010, p 110). Apart from the historic conflict between India and China, there is India's difficult relationship with Pakistan, which, in addition to the dispute over the Kashmir region, involves ethnic and religious issues and issues related to oil and gas discoveries in maritime areas disputed by the two countries. China tries to take advantage of the situation by giving Pakistan support in the construction of a port that, in the future, Chinese ships will use. India also faces problems with Bangladesh, linked to natural and energy resources and migration issues.

Energy interdependence and the increasing scale of energy trade require ongoing cooperation to ensure the security of the entire supply chain. Thus cross-border areas are becoming increasingly relevant to the global energy trade. In an interdependent world, energy security will depend largely on how countries manage their relationships with each other, either bilaterally or multilaterally (YERGIN, 2006).

In spite of the obvious interdependence between countries, the capitalism economic crises, such as the 2008 financial crisis, which shook the neoliberal structures jeopardizing the ideas of minimum State and free market, from the clear interference of the US Government in the fight against it, brought up protectionist actions and policies. The crisis of the European Union and the timid repercussion of Mercosur have weakened the idea of socio-political and economic integration within the unit in which it was designed. In this sense, the individual importance of the emerging countries has a considerable rise in the international scenario.

Knowing the dynamics of the relations between countries is essential due to their complexity and the transition from a geopolitics based on geographical location to the geopolitics of energy, which is based on the sustainability paradigm linked to the expertise related to technology, to the integration of markets and to the form of dialogue between the countries. After all, in the face of local and global needs and local expertise, choices through cooperative dialogues appear as an essential element for the balance of the energy system and, because of the relevance of that system, for the balance of the whole global system.

Dialogue and synchronism of actions can decisively contribute to the strategic strengthening of states by favoring the environment so that they can assume privileged positions in the global scenario. International cooperation, then, comes as a fundamental element. This is what the next chapter is about.

3 INTERNATIONAL COOPERATION FOR DEVELOPMENT

Cooperation is a synchronous movement of actions with the purpose of attainment of materially or morally valuable things. Within the international system, cooperation has been thought of as a strategy aiming at decomposing certain socio-cultural structures and economic ones, such as those related to poverty or even the transferring of technology, that the system or the current mode of production allows modifying, in a way that complex challenges within the international scene can be better faced.

Reflecting on cooperation among countries has been relevant, as many of the problems, such as socioeconomic inequality or environmental problems, are common to many countries. Therefore, collaboration can be more than a tool to overcome these challenges, becoming a strategic element for developing countries, as it is the case of Brazil and India.

3.1 INTERNATIONAL COOPERATION FOR DEVELOPMENT: A MILESTONE ON THE WORLD STAGE

The institutional and legal milestone of international cooperation was established by the UN in the Charter of the United Nations, which has as one of the annexes the Statute of the International Court of Justice in 1945. In the first chapter, international cooperation appears as a fundamental instrument to face economic, social, cultural or humanitarian issues, and also to promote respect for human rights and fundamental freedoms for all (ONU, 1945).

This points to a world with increasingly complex challenges after the Second World War as well as to the desire of UN member states to resolve such problems through synergistic interaction among them. No doubt, at the time, it was in itself a challenge, since, for the first time in a legitimate way, the world had begun to witness a large group of countries, more than fifty, willing to cooperate, a priori, for peaceful ends.

The current international cooperation system (or simply cooperation) for development has its origins in the post-Second War period; a moment in which aid as something that would occur only in emergency crises was abandoned; in favor of a more dynamic and institutionalized co-operation" (MILANI, 2012).

And the Cold War is also on the historical foundation of cooperation as a legitimizing instrument of the dominant powers in their respective blocs. It was seen a mechanism to mitigate the differences between the North and the South, contributing to the development of the South countries but maintaining the influence of the colonizing countries in their former colonies and gaining influence in the new independent States (IGLESIA-CARUNCHO, 2005). Thus, the cooperation was based, mainly, on the North-South (or center-periphery) perspective.

Interestingly, the military competition environment established during the Cold War boosted cooperation among developed and underdeveloped countries. The support of the United States and of the then Soviet Union to various poor countries, both in the process of their independence and also in technical assistance projects, attests to this fact, which does not mean that this support has been without interests.

In the context of the polarization between the dominant powers at the time (USA and USSR), it cannot be forgotten that cooperation can also be conceived as a tool for transferring economic models operating in hegemonic countries to those of lesser influence, since the intention was to increase their respective interference in the world, institutionalizing the multilateralism of cooperation for development, as Milani (2012) reminds us.

According to Robert Keohane (1984), hegemony and cooperation are not opposing elements, but rather part of a symbiotic relationship: cooperation can be promoted by hegemony, and hegemonies require cooperation to enforce the rules. For the author, it is necessary to consider coercion as a fact in world politics because conflicts of interest do not disappear even when there are important common interests.

The author stresses that cooperation requires that non-harmonious actions between States be brought into conformity through a process of political negotiation or coordination, which implies an adjustment of social, political and economic preferences among those who cooperate.It should be asked whether these "preferences" are adjusted in a transparent way. After all, through the strategy of each state, policies of common or seemingly common interests are defined to achieve the purpose that each State wishes to achieve.

The dynamism of contemporary society makes cooperation the subject of discussions about how it should be carried out. If, in the past, the forms of cooperation established by the hegemonic states were clearly based on criteria such as countries that were their former colonies or nations that supported capitalism or socialism, the criteria have now varied, depending on each country’s agenda and interests.

Theoretical discussions about cooperation have been polarized into two viewpoints: the realist and the liberal. For the realist position, cooperation is seen as based on interests of donor countries in an anarchic scenario, in which the state is the pivot of discussions. On the other hand, liberals conceive cooperation under ethical, human values and interdependence among states (JERVIS, 1999; AYLLÓN, 2006; RAMOS, 2006; LEITE, 2011; MILANI, 2012).

The realists understand the distribution of power as a factor that determines international events. According to this understanding, states are the main players and the main units of analysis. Anarchy is seen as the principle that orders the international system, which implies that there is not, above the States, an authority capable of imposing order. Thus, the only existing order is that born out of the competition for anarchy. For the realists, the main objective of the states is to ensure their survival and, in order to do so, to seek to maximize their power and their security, even if it means that the use of force is necessary (RAMOS, 2006).

In Hans Morgenthau's view (2003), realism is synonymous with the morality of political action and the inevitable tension between the moral command and the demands of successful political action. The realist school holds that universal moral principles cannot be applied to the actions of states: they must be filtered through the circumstances of time and place.

Morgenthau explains that although an individual may claim that justice is done even if the world perishes because of this, the nation has no right to say the same in the name of its citizens. In other words, the moral laws that govern the universe cannot be the aspirations of a nation.

The corollary of this, regarding the moral values implicated in the acts of the States, is that flexibility is a standard, which vary according to the strategies adopted aiming at the determined goal. Morgenthau (2003) illustrates this idea with a contemporary case: the rise of China in the international arena, which elucidates two questions of moral and political order. The first is as to whether the nature and policies of the Chinese government would be in line with the moral principles of Western governments. The second question is as to whether the Western world should establish relations with this government.

The simplest and most effective answer to these questions is the fact that China is the largest creditor of the country which is the world symbol of democracy and hegemonic power, the United States. According to the theory of democratic peace, democratic countries would not wage wars among themselves. Therefore, there would be chances of conflicts with the rise of China, since this Asian country does not fit like a democratic country. And the answer to reversing this would be the implementation of a democratic regime. However, in the context of John Mearsheimer's conception of realism (2014), for example, this question would a priori have no connection with ideological values, but rather with the question of power or the balance of power.

It is interesting to note that, according to Ramos (2006), realism was the most influential school not only in the academy but also in the US government for more than 40 years and continues to influence the American way of thinking in international relations. Thus, a question must be asked: knowing that China does not comply with the Western standards and moral principles, in general, how to oppose and condemn its practices? Moreover, what would be the consequences for the American political and military sovereignty and other Western states, should a political or economic confrontation take place?

Economic matter override all others. The conflict would surely be so economically costly for the American power that it would not be worth getting involved in. Geopolitics has incorporated new challenges and gone beyond the narrowly military or power-driven view of military force; thus making decisions in the field of relations among countries more challenging.

In the realist conception, cooperation is not habitual since the States act in an autonomous and selfish way. For the realists, cooperation happens within the framework of hegemonic stability, characterized by an order created by a dominant power whose maintenance depends on the continuity of hegemony. It follows that international institutions do not have the autonomy to promote cooperation between states, as they are only a reflection of the distribution of power in the international system, created by powerful states to achieve goals established by them (RAMOS, 2006).

Unlike realism, the liberal school sees interdependence as the main axis of its theoretical-methodological argumentation. According to Robert Keohane and Joseph Nye (1977), there are two dimensions of interdependence. The first is that of sensitivity, which concerns how the decision of one state can affect another. The second is that of vulnerability, which concerns the most appropriate way to address sensitivity. Thus, Keohane and Nye assert that the use of military force, from the liberal point of view, becomes limited and conflicts can be resolved through the presence of supranational bodies.

The position of these authors elucidates the divergence between those who follow the theory of interdependence and the defenders of the realist theory, for whom there is no instance greater than the state power and for whom the international institutions are auxiliary in the synergic process between the countries.

According to Ramos (2006), interdependence has as its main characteristics the multiple channels that connect society, such as informal ties between governmental and non-governmental elites, formal arrangements between chancelleries and transnational organizations, interstate channels and those among governmental entities within the structure of the states themselves and between any entity within the State.

Two other features refer to the subtle difference or lack of hierarchy between international and domestic issues and the failure of governments to use military force in matters where interdependence issues prevail. The recent case of the crisis between Ukraine and Russia illustrates this last feature: the crisis led the European Union to rethink its dependence on Russian gas and its relationship with these two countries, causing the greatest tension between Washington and Moscow since the end of the Cold War.

Although energy resources have been the geostrategic focus of countries throughout history, this theme has become more significant since its close relationship with environmental issues was acknowledged by the strategic interests of States, bringing for the debate, for example, energy alternative sources. Thus economic and environmental interdependence between countries put military conflict aside.

In the context of liberalism or complex interdependence, as in the realist view, hegemony appears as an important part in the formation of cooperative arrangements; although the ones who defend the view of interdependence disagree that this is the only condition for cooperation to take place and that cooperation depends on the durability of the hegemony so that it can continue to exist. Moreover, even in an anarchic and self-help environment, the players have the capacity to develop beneficial cooperative relationships (RAMOS, 2006). Added to this is the influence that international institutions have on creating a reality more prone to cooperation. The United Nations itself has been born with the desire to stimulate cooperation among countries.

The characteristics of the theory of interdependence bring a closer approximation to the theoretical line adopted in this work, which is supported by the discourse of sustainability, which necessarily values interdependence. After all, it is necessary to recognize the importance of the state not as a sovereign agent and unique in decisions, but as the sum of several players (their own reflection).

Sharing challenges and common issues among countries broadens the perspective of cooperation so that developing or poor nations can cooperate with one another. There is no need for the imposition of a hegemonic power for cooperation to happen, which allows the interpretation that, states that are at the same level of development, can establish cooperative arrangements.

Obviously, one cannot be totally sure about the real interests of hegemonic states when accepting the cooperation among developing countries and poor countries. Although, in the face of a fact like the process of strengthening cooperation among the Southern States, the options for the hegemonic ones are adaptation and resilience.

According to Bruno Ayllón (2006), for cooperation to be an effective instrument for sustainable development and a fairer balance between North and South, it must seek solutions to the challenges posed by the post-Cold War international scenario, which is controlled by the forces of globalization and, therefore, characterized by complex transnational problems. Moreover, globalization has changed the conditions of access to investment capital by reducing the capacity of governments and jeopardizing essential elements, such as sovereignty, limiting the possibilities and the reach of state foreign policies.

Cooperation is not a static model. For instance, it cannot be detached from the recent global economic situation, which can be understood as an extension of the crisis of the seventies; nor from the energy crisis that demand new and urgent actions from countries. . The cooperation is, therefore, a representation of society itself: dynamic and procedural. The developing countries have then articulated the intention to create new relations of power in a multipolarized world.

3.2 SOUTH-SOUTH COOPERATION

The universe of cooperation has become multipolarized and multifaceted: power and a wide range of interests, such as sustainability, set the tone for the process of cooperating. Some emerging countries have established state-owned agencies or institutions that help regulate cooperation. Brazil, for example, created the Brazilian Cooperation Agency linked to the Ministry of Foreign Affairs in 1987, and in 2012, India created the Development Partnership Administration linked to the Ministry of Foreign Affairs.

The changes in the international order and the emergence of states that are driving a new cooperation based on the strengthening of the developing and southern states suggests a more careful, analytical and empirical look at this reality of cooperation (MILANI, 2012) . In this context, it should be noted that in 1987 the Brundland Report stated that it was necessary to think about new forms of international cooperation because it was crucial to foster forms of cooperation capable of breaking with existing standards (those imposed by rich countries on the poor or developing countries) (COMISSÃO MUNDIAL SOBRE MEIO AMBIENTE E DESENVOLVIMENTO, 1991).

Considering the strategic importance of cooperation, developing countries have begun to include strategies regarding South-South cooperation through alliances signed by multilateral organizations or in regional integration spaces or through financing projects and cooperation in the most varied areas. These countries are considered emerging powers[5], i.e., South Africa, Brazil, China, India, Russia, Mexico and Turkey, which have been seeking to establish partnerships with other developing countries in different regions of the world (MILANI, 2012).

It should be noted that BRICS is a political and cooperation group that emerged from the articulation between Brazil, Russia, India, China and South Africa. Its objective is to leverage South-South cooperation by creating new relations of forces in a multipolar world, establishing sporadic coalitions to achieve common goals among Latin Americans, Asians and Africans (BADI, 2011).

According to Leite (2011), since the 1970s, the narrative that promotes the union of the countries of the South in the scope of cooperation has been positively influenced by three factors. The first of these is the fact that the United States, during that decade, faced a number of crises, which has contributed to diminish its influence in the regional and global spheres at the same time as - and this is the second factor - the so-called third countries have achieved some victories within the UN, such as the Declaration and Program of Action for the Establishment of a New International Order, the Charter of Economic Rights and Duties of States and the holding of the 1st North-South Conference. The third factor is the functioning of the post-World War II international system, which is directly related to the theory of dependency, which, in general, sought to understand why countries (initially and basically those in Latin America) that had achieved progress in the area of urbanization and in its productive structures remained in difficulties as the central countries continued to lead and command the world economy. Thus, a new type of relationship emerged: "the dependence of peripheral nations on capital, technology and

[5] Also called emerging powers (CHATURVEDI; FUES, 2012), emergent (GABAS, 2010), intermediates (RODRIGUES, 2010), new powers (NARLIKAR, 2010).

on the decisions made by multinational companies at their headquarters in the central countries" (LEITE, 2011).

It is worth noting that dependency theorists dispute the view that underdevelopment would be an earlier stage of development and that the premise that economic development would be an eminently domestic challenge. For them, according to Leite (2011), underdevelopment and development are faces of the same universal process, and they function as structures that make up the same system, being therefore historically simultaneous and in constant interaction.

It was in the 1970s that the narrative in favor of cooperation on the South axis was intensified. The First Conference of Asian and African Countries in Indonesia, better known as the Bandung Conference (1955), represents a milestone for the countries of the South since the meeting of the participating States aimed at confronting the imperialism of the great powers through the promotion of cooperation and recognition of equality among races and nations (LEITE, 2012). For Milani (2012), this conference was the "central point and a historical landmark to the further development of this form of cooperation among developing countries", as it aimed to:

> [...] influence the mentalities of the ruling elites in the Third World countries, many of which recently emancipated, in order to put aside their differences for a common platform called for denouncing the calamities of colonialism. These were the first steps of political cooperation among countries with similar characteristics, inserted in the periphery of the international system. In addition, as a consequence of these first steps, some diplomatic and geopolitical positions of balanced distance between the two superpowers occurred. [...] (MILANI, 2012, p. 226).

Despite the importance and recognition of the Bandung Conference in Argentina in 1978, the UN held the Conference on Technical Cooperation among Developing Countries. The 138 countries which took part in it agreed on the Plan of Action to Promote and Implement Technical Cooperation among Developing Countries (TCDC), endorsed in the same year during the United Nations General Assembly (UNOSSC, 2017).

South-South cooperation has been evolving formally in the sphere of bilateral relations and in the field of international institutions. Emerging States have sought to design a new articulation based on addressing international inequalities and solving common problems. According to Milani (2012), South-South cooperation seeks to introduce a new way of looking at the economic development of developing countries, both in relation to the role of the State, in terms of alliances among countries of the South, and also in relation to the principle of non-intervention.

The complementarities among the nations of the South overcome, *a priori*, the competition factors. The emerging powers have basic problems that are common to poor countries. According to Lima (2005), the characteristics these countries share enable the existence of a different kind of cooperation in comparison with the cooperation between the North and the South, which does not occur frequently in the South-South partnerships. This is a positive factor, since it generates a mutual identification among the emerging southern nations.

The rapprochement among the countries of the South has delineated the panorama of international institutions, such as the UN, cradle of cooperation. It is no coincidence that United Nations Secretary-General Ban Ki-moon has stated that he encourages countries in the South and all the development partners to come together to share, disseminate and expand successful development technologies and solutions (UNITED NATIONS , 2014). The presence of these States is also highlighted in debates about the Security Council, and at the World Trade Organization (WTO) in more profitable negotiations for the Southern States.

The presence of intermediate countries on the world stage has been emphasizing their importance before the industrialized countries, consolidating, along with their respective societies and the international community, the leading role they play in the global structures of power among states. The economic and social dynamism undergone by them, particularly from the beginning of the 21st century, has intensified and brought new dynamics to these nations, reiterating the connection between these dynamics and the energy scene. Thus, as Matthew Hulbert and Christian Brütsch (2012) argue, trying to find the balance between established and emerging markets and a common energy formula will be the key to their success - or even failure - and energy will be responsible by cementing the BRICS or separating them, and the rest of the world will have to cope with the consequences. In this context, Brazil and India stand out as important players.

3.3 BRAZIL AND INDIA: RAPPROCHEMENT BETWEEN THE TWO NATIONS AND THE ROAD TO ENERGY COOPERATION

A few decades ago, one could not imagine, in the sphere of global geopolitics, the representativeness that states such as Brazil and India could acquire in the political and economic world landscape. In the 1980s, in the midst of the effervescence caused by various events, such as the conflicts that engulfed countries on several continents, Brazil suffered an economic recession and India, political changes and the emergence of its foreign trade. However, until recently, these two countries were among those that boosted the world economy, even after the recent crisis, considered by many as the most rigorous since 1929.

Brazil and India are two leaders in the south axis. Both their unique characteristics and their similarities have turned them into balancing forces of the North-South relations, which expands their economic and political status in the international community and favors rapprochement. They are culturally diverse democracies and regional leaders with global range; they have extensive territorial dimensions; they have relevant social problems and income distribution problems; They are emerging active markets in international politics; and share aspirations on several matters, such as a desire for a vacancy in the United Nations Security Council, as well as being constituent bodies for political groups of dialogue (INDIAN EMBASSY, 2017a; MRE, 2016a; CIA, 2017a; 2017b; VISENTINI, 2010).

In relation to their shared visions, it is worth mentioning two points. The first is that Brazil and India were the main interpellators and questioned in the Dispute Settlement Body (CSO/WTO) from 1995 to 2008. The second point is that, between 1994 and 2004, in all voting processes in the United Nations General Assembly, there was an average of 88.50% agreement in the positions taken by these two countries. Currently, Brazil and India together represent approximately 18% of all WTO disputes. Both countries are listed as third party in 61% of cases and directly involved in about 30% of all WTO disputes (WTO, 2016a, 2016b, 2016c). Therefore, at the same time that they have autonomy, they align strategically.

When considering the strengthening tactic of the South, there is a range of strategically common interests for emerging or developing countries to strengthen. However, a more active participation within the WTO implies, among other issues, a greater visibility of these States as well as a search for greater legitimacy and prestige before the international community.

The ties between Brazil and India are not new. The diplomatic mission of India in Brazil was inaugurated in Rio de Janeiro in 1948 and transferred to Brasilia in 1971. The Brazilian embassy in India has operated since 1949 (INDIAN EMBASSY, 2015). However, one of the first contacts between the two countries goes back to the conquest of the Brazilian lands to the sea route to the India:

> Between the 16th and 18th centuries, Brazil and Goa, both warehouses of the Portuguese Empire, kept an exchange, reflected in the flora and fauna, the way of dressing, the food and the folkloric traditions of Brazil. The interesting similarities between the folklore of Bumba Meu Boi in northern Brazil and the Poikam Kudharai in southern India, for example, call attention to the cultural traits cultivated over the centuries. [...] Although this is a little known reality of the bilateral relationship, India's contribution to Brazilian livestock production is significant. [...] The Ongole lineage from the Andhra Pradesh region led to the production of the zebu variety known in Brazil as Nellore. (INDIAN EMBASSY, 2015).

Brazil and India obviously have many differences, some of them linked to their respective historical processes of development. For example, India has been inspired by the Soviet model of economic development while Brazil has adopted one that is driven by the consumer goods sector. Another difference is that, despite the various cross-border, religious and regional conflicts faced after its independence from the British empire, India never gave up its choice for democracy while Brazil had a strong authoritarian regime in its modernization process (FIORI, 1997).

An episode that is rarely mentioned was the support that Brazil gave Portugal shortly after Indian independence from Goa, Damão and Diu, which lasted until 1961 when India militarily invaded the territories (VIEIRA, 2007), leaving Brazil with a image of subservience to the old metropolis. A divergence between Brazil and India occurred in the 1990s: Brazil signed the Nuclear Non-Proliferation Treaty, which was not signed by India, highlighting the geopolitical context in which India is inserted, particularly because of Pakistan.

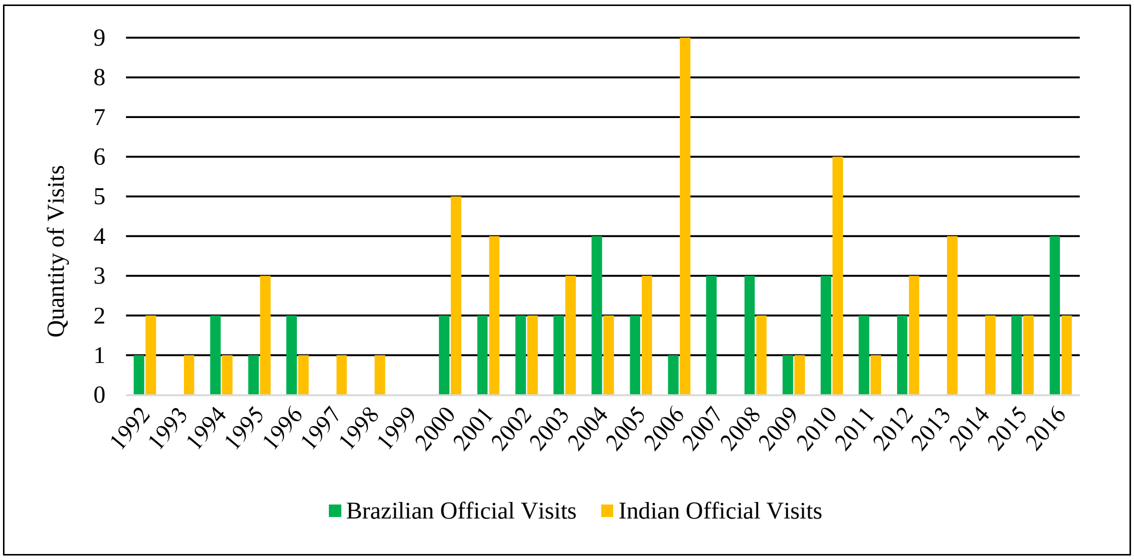
With the end of the Cold War the outlines for the rapprochement between Brazil and India were beginning to be drawn (FIORI, 1997). The end of bipolarity, the advance of globalization and the very openness and interdependent nature of the new order contributed to the promotion of a international joint presence of the two country (FIORI, 1997). Following specific events, such as those mentioned previously, after the turn of the millennium, Brazil and India began to articulate themselves in South-South cooperation more consistently with both poor countries and emerging countries (ABDENUR, 2014).

Adriana Abdenur (2014) cites two factors that have helped to strengthen Brazil-India relations. The first concerns the wave of globalization in the 1980s when large multinational corporations began to relocate the low and medium technology activities from countries with high costs and wages to lower cost and wage countries, such as India. Secondly, the growth of the Chinese economy and the growing internationalization of its enterprises in various parts of the developing world showed that South-South cooperation could be more than ideological solidarity (ABDENUR, 2014).

In the late 1990s José Luís Fiori stated that Brazil and India would only converge in the future if they were to become "a subset of nations with some degree of homogeneity or affinity" and this would only exist if designed "from the political decision of their governments to face it in a coordinated way "(FIORI, 1997). At the beginning of the new millennium, a new era came for Indo-Brazilian relations.

A study was conducted on the number of bilateral official visits between Brazil and India since the 1990s. Only the high-level visits[6] of the two countries were considered, and it was verified that, from the year 2000, they intensified, as it can be seen in the graph below. The total number of Indian visits to Brazil (61) surpassed Brazilian ones to India (41) and, from 2000, each year, at least one representative from India or Brazil made official visits, except for the year 2007 on the Indian side and 2013 and 2014 on the Brazilian side, which, in 2016, repeated the record of official visits to India that occurred in 2004.

Graph 1 - Bilateral Visits Brazil-India 1992-2016



Source: Vieira (2007); Indian Embassy (2017a); MRE (2017c).

Relations between Brazil and India were strengthened by their participation in the early 2000s in "coalitions created to coordinate positions and strategies among emerging countries" (ABDENUR, 2014). In 2003, in his inaugural speech, then-President Luiz Inácio Lula da Silva stressed the importance of South-South cooperation in his government and said that alongside with China, Russia and South Africa, India would be one of the countries with which Brazil would establish priority partnerships (ABDEBUR, 2014).

[6] Head of State or Government, Ministries, Governors.

The IBSA, a forum for dialogue among Brazil, India and South Africa, created in 2003, is a milestone in relations between Brazil and India regarding the stimulus to cooperation in various areas such as defense, energy, trade, investment and human settlements (MRE, 2017a). This forum is one of the most important cooperative efforts of the South after the Cold War and must be considered in the areas of convergence and political approximation, affirmation of the interests of developing countries and an attempt to build a multipolar order (VISENTINI, 2010). The initiative, according to Abdenur (2014) lost its brilliance after 2013 with the cancellation of its annual meeting.

However, the strategic dialogues between Brazil and India extended beyond the IBSA. Another way to strengthen the rapprochement between these countries was through the BRICS group. According to Brazil Ministry of Foreign Affairs (MRE, 2017b), coordination among Brazil, Russia, India and China began informally in 2006 through a meeting ahead of the opening of the U.N. General Assembly.

In 2007, Brazil was responsible for organizing the meeting during the General Assembly, and in this meeting, in addition to reiterating the interest in deepening the dialogue among the countries in the group, the goal was to establish a specific and formal meeting for the BRIC chancellors, which was held in 2008 in Russia. Two years later, South Africa would become part of the BRICS group. Since then, the acronym, created by the financial market, "no longer limited itself to identifying four emerging economies", it came to identify a new political-diplomatic entity. Since 2009, BRICS heads of state and government meet annually and its activities revolve around two main strands: coordination in meetings and international organizations and the construction of a multisectoral cooperation agenda among its members. In 2014, the agreements establishing the New Development Bank (NDB) were signed with a contingency reserve of US $ 100 billion (MFA, 2017b).

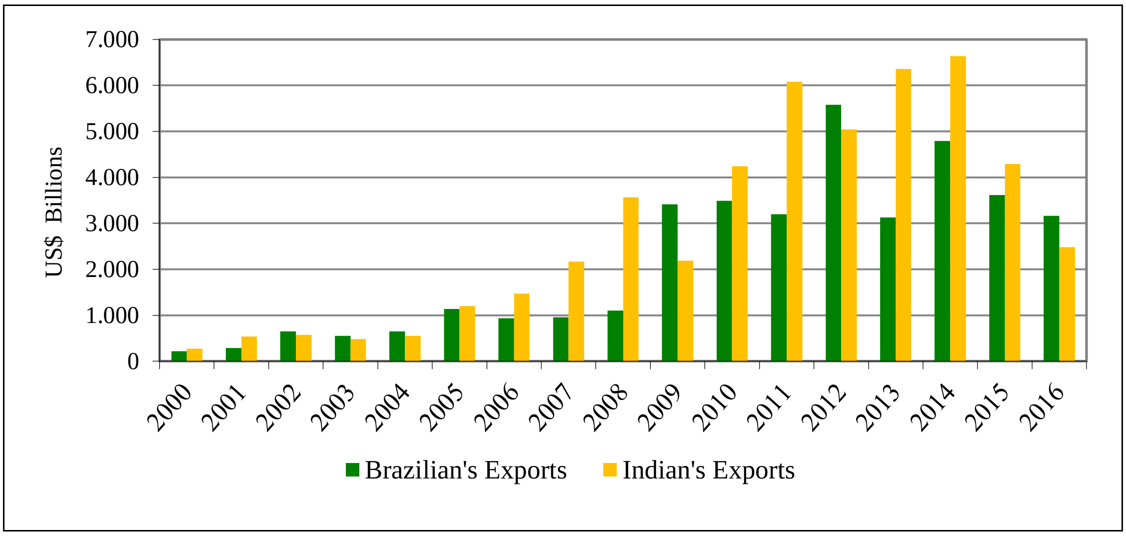
Although the BRICS helps to highlight Brazilian and Indian demands for changes in global governance, the democratic identities of these two countries are mitigated in discussions of the issues related to democracy and human rights due to the presence of governments with profiles of authoritarian regimes within the group. Moreover, while the group wants a reform of the UN Security Council, which Brazil and India wish to be a part of, the group itself has not found a common strategy for this issue. As a result, Brazil and India began to cooperate outside BRICS, forming the G-4 with Germany and Japan (ABDENUR, 2014).

It is also noted that China instigated the BRIC group to insert South Africa and lobbied to dissolve the IBSA because of the unnecessary overlap to the BRICS. However, the introduction of South Africa into the BRIC gives a comparative ideological advantage to India (and Brazil) over China, potentially creating an IBSA block within the BRICS (MANCHERI; SANTANU, 2011). These issues help bring Brazil and India closer together in both political and socioeconomic fields.

In the mid- 1980s and early 1990s, Brazil had returned to the democratic regime and its political elite was concerned with macroeconomic stability in the country. At the time, India, with the collapse of the then USSR, had lost ideological and defense support. In this way, Brazil and India began to liberalize their economies from the 1990s, looking at other countries, especially regional powers, with some interest (ABDENUR, 2014). In this context, in 1996, the then President Fernando Henrique Cardoso was the first Brazilian head of state to visit India. The following year, the Indian minister of industry and trade, Omar Abdullah, said the following phrase: "Now diplomacy is not so much security oriented, as it is trade oriented[7]". Known as a relationship enthusiast with Latin America, especially Brazil, because he believed that India should focus its trade on less saturated markets, he uttered that phrase referring to the trend of forming a single trade bloc with Latin America establishing free trade agreements with some countries, including Brazil. According to him, China had been working with some geographically distant countries and had been successful (VIEIRA, 2007).

Despite some attempts, it was from the new millennium that a new phase was established between Brazil and India[8]. Bilateral trade between them began to grow systematically, as evidenced by the data in the chart below.

Graph 2 - India-Brazil Bilateral Trade, 2000-2016.



Source: MDIC (2017).

[7] Cf. Original: "Now diplomacy is not so much security oriented, as it is a trade oriented".
[8] In 1998, Asian crises took place and in 1999 Brazil's Real devalued, slowing global trade.

Interactions and political dialogue have helped to increase bilateral trade between Brazil and India. Bilateral trade between the two countries has increased substantially in the last two decades, especially since 2005, when Indian exports to Brazil went from US $ 1.2 billion to US $ 6.6 billion in 2014 while Indian imports of Brazilian products went from US $ 1.1 billion to US $ 4.7 billion in the same period (MDIC, 2017). Imports from India to Brazil include several value-added products such as diesel, engineering products and textiles. Brazilian exports to India are predominantly composed of commodities such as crude oil, sugar and soybean oil, among other products (INDIAN EMBASSY, 2017b; MDIC, 2017).

The global fall in commodity prices and the economic recession in Brazil in 2015 affected Brazilian trade and Brazil-India trade fell by approximately 1.6 billion in relation to Brazilian exports to India and 4.2 billion in imports of Indian products by Brazil. According to the Embassy of India, although Brazil-India trade remained low in 2016, this figure should be considered in the overall decline of Brazil's overall trade, which was even lower than in 2008. Total Brazilian exports and imports fell approximately 3% and 20%, respectively. Despite this fact, India maintained its position among the main commercial partners of Brazil. However, bilateral trade between the two states has never returned to what it was at the beginning of the millennium, which revolved around two hundred million US dollars (for both sides).

The number of Brazilian companies operating in India and the number of Indian companies operating in Brazil have increased in recent years, which is certainly due to the intensification of the political dialogue between the two countries. According to data provided by the Brazil-India Chamber of Commerce, there are thirty-one Indian companies in operation in Brazil and nine Brazilian companies operating in India. It was observed that from the 2005-2006 period Brazilian and Indian companies started their respective installation processes. Brazilian companies operate mainly in the areas of steel, energy, automation, electronic management, mining, aeronautics and engineering; Indian companies focus their efforts in the fields of information technology, pharmaceuticals, energy, agricultural business, mining, engineering, hospitality and marketing (INDIA BRAZIL CHAMBER OF COMMERCE, 2017).

The dialogue between Brazil and India deepens certain common international positions. One of them is their position concerning maritime routes. According to Renato Flores Jr. (2014), a revolution will occur in sea routes and both Brazil and India are interested in the subject: “at some point in the not so distant future […] there will be a radical restructuring of the ocean governance” and "along the Pacific-Indian continuum, China and India will be the major players as Brazil will be in the South Atlantic. As it is in every business nation's interest that access to routes is safe, Brazilian and Indian navies’ preparation, according to a concept of security and defense, are already evident. In addition, it is necessary to make a joint effort within intelligence bodies and commercial energy routes in order to program the needs and adaptations that the new reality will bring (FLORES, JR 2014).

In this context, joint maritime exercises involving the navies of Brazil, of India and of South Africa shows the interest of these countries in increasing the geostrategic articulation in the Southern Hemisphere. This initiative, known as IBSAMAR, has been carried out since 2008 and the Brazilian and Indian seaports considered more robust, compared to the South African, may be responsible for the coordination in the future (KHURANA, 2008).

The scope and complexity of IBSAMAR's operations have intensified in 2016. The main scope of this military exercise is to increase interoperability between the three navies and to develop common understandings and procedures for maritime safety (INDIAN NAVY, 2017). It is clear that the primary interest of these countries lies in the area of "immense energy resources" located in the South Atlantic and Indian Ocean (VISENTINI, 2010).

The southern hemisphere, i.e. the South Atlantic and the Indian Ocean, increasingly becomes a relevant geostrategic space. Both have gas and oil deposits. The South Atlantic receives waters from four major watersheds and holds the largest reserves of tropical rainforests in the world. Commercial routes in this area have intensified over the years. Half of the world's container traffic and 70 percent of the oil traffic take place in the Indian Ocean (from the Middle East to the Pacific).

Although the Suez Canal is a shorter route to Europe, for example, the Cape of Good Hope has been increasingly used because of the size of the vessels that this channel can support - the number of oil tankers passing through the site ranged from 30 and 50 a month, but after a decade that number is between 90 and 100. In addition, international pressures on Antarctica should be intensified (REIS, 2010; VISENTINI, 2010). Therefore, planning coordination actions that can overcome the "complacent vision" that prevails in each of these countries alone is essential (VISENTINI, 2010).

For Celso Furtado, "economic systems with large territorial dimensions and marked regional and structural disparities," such as Brazil, India and China, will have difficulty surviving if they lose their cohesive force. No matter how relevant the international insertion is, it alone is not enough to energize the economic system. In addition, considering the world dominated by transnational organizations, these heterogeneous systems "survive and grow by political will based on a project with historical roots" (FURTADO, 1992).

Although, in the midst of changes in the Brazilian political landscape in the last two years, including the impeachment of the then president in 2015, Brazilian foreign policy continues to see South-South cooperation and the search for partnership with India as relevant strategies of development. The Institute of Research on International Affairs has published a speech by the current president of the republic on foreign policy in which he asserts the importance of South-South cooperation and the priority in establishing partnership with India and China. In addition, the President highlighted the relevance of the BRICS to promote trade, investment and share experiences (IPRI, 2016).

Brazil projects itself as a regional leader and as part of an interlocution project in the developing world (PACHECO, 2010). In addition, Asia presents itself to Brazil as a large economic space to be occupied and consolidated and, because of its "economic dynamism and civilization diversity, offers synergies and complementarities in various fields of activities" (FUJITA, 2004).

India's foreign policy also seeks to establish the country as a leader of the South and its goal is the pursuit of international prestige, the redesign of its bilateral relations, the consolidation of the status of regional power through its rapprochement with the West, as well as energy security and leadership between emerging countries. In this context India is "a rapidly growing economy, as an emerging country with great potential for action in the sphere of international relations, mainly in the construction of an international multipolar system and South-South cooperation" (PACHECO , 2010)

In 1997, Rajendra Pachauri, writing about strategic perspectives between Brazil and India, saw with enthusiasm the search for various fields of possible cooperation between the two nations. The author affirms that it would be "very important, for Brazil and India, to cooperate in the environmental areas, focusing, for example, on climate change, biodiversity regarding the mapping or the genetic characterization of species, deforestation and in the areas of biotechnology and energy. According to Pachauri (1997), energy is a frontline area in which the countries could cooperate effectively in the future. He adds that, in addition to the non-renewable area (petroleum), biofuels, biogas and wind energy are opportunities for cooperation, and argues that collaboration between the countries will be of strategic value only if it included research and development along with technologies.

As far as renewable energy is concerned, it is undoubtedly one of the most promising areas of cooperation between the two countries. The Strategic Plan for the New and Renewable Energy Sector (2011-2017), defined by the Ministry of New and Renewable Energy of India, categorically states that one of the ministry's functions is to promote cooperation in renewable energy (MNRE, 2011).

The Ministry of Foreign Affairs of Brazil makes clear that the country's foreign policy in the area of energy has as one of the main objectives the promotion of partnerships and cooperation, especially South-South, in the field of renewable energy, in order to seek creative solutions that can both meet their local needs and contribute to expanding access to energy for development (MRE, 2017d)

The two countries have been increasing their investments in renewable energy for more than ten consecutive years. In addition, official visits and various meetings in international forums and participation in political groups such as IBSA and BRICS have given the subject renewable energy differentiated status for the agendas of the two states. These facts have contributed to make Indo-Brazilian relations more intense and more mature over time.

In 2010, the Renewable Energy and Energy Efficiency Initiative commissioned a research on renewable energy development (DRE) and energy efficiency (EE) in the so-called BASIC countries[9] in the business sector. One of the inferred conclusions is that the Brazilian and Indian organizations have been participating more actively in the DRE and EE processes, and the main motivations of the companies to invest in these areas are based on the reduction of energy costs, regulation, internal politics and energy security (CARBON DISCLOSURE PROJECT, 2010).

Since the 1980s, India has shown an interest in Brazilian ethanol technology, justified by India's historical dependence on oil. In relation to the fossil source, there were frequent cases in which Petrobrás was sought by the Indian government to participate in oil prospecting projects in India. It refused to do so: in 2002, the reason given was that the state's focus was on Latin America, West Africa and the Gulf of Mexico. However, in 2006, an agreement was signed between Petrobrás and the Indian company ONGC for

[9] Brazil, South Africa, India and China.

deepwater oil exploration. A few months later, when asked about the agreement, Petrobras said that it was constantly evaluating opportunities with other countries, but that there was no news regarding India. In India, the news was that Petrobras had agreed to share its considerable experience in deepwater oil exploration (VIEIRA, 2007).

In 2013, during the meeting the Sixth Meeting of the Joint Commission for Political, Economic, Scientific, Technological and Cultural Cooperation Brazil-India, it was reiterated and established that the Indian company ONGC, which already has investments in oil blocks in Brazil and cooperation with Petrobras, would be level A bidder in the next auction of the Libra field in the pre-salt and that both Brazil and India expect the success of this initiative to boost bilateral cooperation in oil and gas. In the same context, it was pointed out that the Brazilian company Andrade Gutierrez was considering investment alternatives in the Indian hydropower sector (MRE, 2013b).

In 2001, the Indian energy minister submitted a request to Brazil regarding the reforms that India needed to make in the energy sector, and offered opportunities for consulting services to be provided by Brazil to India as it faced serious problems in the loss of energy, transmission, distribution and obsolescence of its capacity. Brazil was not the only country contemplated by the Indian request. In that year, the Indian energy minister met with the Brazilian Minister of Mines and Energy and the president of Eletrobrás to learn about this institution and the privatization processes associated with it (VIEIRA, 2007).

Getting back to renewable energy, the focus of this study, in 2001, the Minister of Petroleum and Gas of India came to Brazil to learn about Pro-Alcohol with plans to promote the use of ethanol in India. In the same year, the minister sanctioned six pilot projects and announced that India would soon be able to use a 5% ethanol blend of gasoline from its pilot plants and hoped that it would expand on the basis of technical cooperation and Brazilian consulting. In 2002, the Indian government authorized the 5% blend. In 2003, Brazil's then foreign minister, Celso Amorim, traveled to India for the First Brazil-India Comission[10] along with several other ministers, where sectoral meetings were held and one of the six topics of the meetings addressed renewable energy, particularly biofuels (VIEIRA, 2007).

[10] Joint commissions are characterized by the meeting of foreign ministers accompanied by delegations (VIEIRA, 2007).

According to Reginaldo Reis (2010), the geopolitical forces of the contemporary world present, even to geographically distant countries, a situation of interdependence and the propagation of events in a way never seen before, thanks to the process of globalization and new technologies. For the author, in the case of Brazil and India, the "non-existence of geopolitical frictions" between these countries makes cooperation in the scientific and technological fields feasible.

Undoubtedly, the integration of Brazil and India into the IBSA and the BRICS, over a decade ago, has brought to these States expertise in joint political coordination by strengthening ties between these nations and by facilitating dialogue and underpinning a common culture of political integration. However, in view of the objective of this study to investigate the cooperation in renewable energy between Brazil and India, it is necessary to know the peculiarities of these countries with regard to the production and the use of energy and then to verify what the situation cooperation between them in this area is like.

Following this line of reasoning, the next chapter initially presents the general characteristics of the two countries, and then discusses the energy profiles of both in the international context with a focus on renewable energy.

4 BRAZIL AND INDIA: KEY COUNTRIES FOR GLOBAL ENERGY STRUCTURES

The search for an understanding of the phenomena or of the challenges in the contemporary world cannot follow a systematic, productive and coherent path if those States whose actions can have global implications are not taken into account. This is the case of Brazil and India, fundamental nations for the understanding of the global structures of production and consumption.

Undeniably, there is no way to make any global analysis or forecast without considering them. Therefore, this chapter addresses not only the general aspects of these two countries, but also the aspects that bring them closer together. Following the line of reasoning imposed for this work, this section initially presents a very brief approach on the two nations with some general data and, afterwards, a comparative study between their respective energy profiles in the international context, focusing on the traditional sources of energy and renewable energy

4.1 BRAZIL AND INDIA: GENERAL ASPECTS AND THE ENCOUNTER OF SIMILARITIES

The pluralities of Brazil and India make them singular. One of them rejoices in the historical fact of having one of the oldest and millenarian civilizations in the world. Exploited by the Portuguese in the early sixteenth century (PRANGE, 2017), India became a British colony in the nineteenth century and conquered its independence in 1947 (KENNEDY, 2016; SOUZA, 2009). The other State also became colony of the Portuguese crown in century XVI reaching its independence in 1822 (PEIXOTO, 1944). Its historical threads were interwoven by Portuguese hands. Trade routes, the metropolis-colony relationship, biodiversity, ethnic and cultural mixtures, all of them, obviously in different proportions, are themes inherent to these two countries.

4.1.1 India

The Republic of India is the seventh largest country in territorial extension of the world with 3.3 million km2, occupying the largest portion of the Asian subcontinent and ranging from the peaks of the Himalayas to the tropical forests of the south; giving it a distinct geographical identity. With a coastline of more than 7.000 km, India is geographically delimited by the Himalayan Ridge to the North (which separates it from the rest of Asia). To the east, it is surrounded by the Gulf of Bengal and to the west by the Arabian Sea and the Indian Ocean to the South. The country's climate can be generally classified as tropical monsoon and marked by high temperatures and dry winters, entailing risks such as monsoon floods, droughts and landslides (GOVERNMENT OF INDIA, 2017; CIA, 2017b)

It should be noted that India is bordered by Afghanistan, Pakistan, China, Bhutan, Nepal, Myanmar, Bangladesh and Sri Lanka, from which it is separated only by a narrow sea channel (GOVERNMENT OF INDIA, 2017). These border regions remind us of geopolitical concerns even with historical territorial disputes[11], which makes India a diverse state even in its political relations. The type of government adopted in India is democratic, which led to its division into twenty-nine states and seven territories of the Union, which adopt the parliamentary system of government (GOVERNMENT OF INDIA, 2017). It is the most populous democracy in the world.

India has twenty-two languages recognized by its Constitution, Hindi and English being the official ones (GOVERNMENT OF INDIA, 2017). It is the second most populous country in the world with approximately 1.3 billion people and ranks 10th in the world GDP ranking (CIA, 2017b, WORLD BANK, 2016a). However, in relation to GDP per capita, India is in the 158th position in the world ranking, evidencing the concentration of wealth before a large population. In 2011, the percentage of the Indian population below the poverty line was 21.9%, or about 300 million people (CIA, 2017b). The Human Development Report (UNDP, 2016) reflects the country's economic and social inequalities placing India in the 131st position in the world ranking of human development, ranking it in the category of "medium human development" falling behind Iraq and Honduras, which occupy respectively 52nd and 102nd countries in the world GDP (WORLD BANK, 2016a).

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[11] For example, conflicts with China (Sino-Indian War of 1962) and with Pakistan (1947, 1965, 1971 and 1999).

A holder of an immemorial and multifaceted civilization, possessing contradictions common to any developing country, India has sought prestige and visibility vis-à-vis the international community through participation in various plurilateral platforms such as IBSA, BRICS, G-4 and G-20[12], and has also tried to occupy multilateral spaces linked to the UN system, such as the WTO and UNESCO.

4.1.2 Brazil

Formed by the union of states, municipalities and the Federal District, and governed by the democratic system, the Federative Republic of Brazil is the fifth largest country in territorial extension of the world, with an area of approximately 8.5 million km^2 and a coastline of 7.4 thousand km^2 (CIA, 2017a). With tropical climate, its territorial dimension and its peculiar natural conditions give it a great diversity of ecosystems and the greatest biodiversity in the world (MMA, 2017a). In addition, it has a significant complex of river basins, such as the Amazon River, the largest in the world.

The only Lusophone language of the American continent, Brazil is bordered by all the countries of South America except Chile and Ecuador. The countries with the greatest territorial extension bordering Brazil are Bolivia, Peru and Venezuela (CIA, 2017a). Possible frontier disputes were ended by an idea of economic communion, considering particularly in this scenario Brazil, a leader among the other South American economies.

The Brazilian population consists of approximately 207 million people (IBGE, 2017). Formed by diverse ethnicities, Brazil has become a diverse country also with regard to its culture. This characteristic certainly brings benefits in terms of its social visibility in forums and international dialogues.

Despite more than three centuries as a colony of Portugal, and, until the 20th century, being merely recognized as an agro-exporting country (FURTADO, 2005), Brazil has been occupying space in the international scenario, assuming a more diversified form of action both in the political sphere and in the economic development. Brazil's GDP ranks ninth in the world ranking (WORLD BANK, 2016a). In terms of GDP *per capita*, this country is in 111th place with 3.7% of its population, or about 7 million people living below the poverty line (CIA, 2017a). In the Human Development Index,

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[12] Group formed by finance ministers and central bank presidents of the world's 19 largest economies and by the European Union.

Brazil occupies the 79th position, classified in the category of "high human development" (UNDP, 2016).

In the face of the challenges and changes that have taken place throughout its history and through the principles of self-determination of peoples, Brazil has sought to be internationally recognized as an interlocutor within the UN system, even claiming permanent seat in the Security Council as well as in several plurilateral spheres such as IBAS, BRICS, G-4 and G-20.

4.2 BRAZIL AND INDIA IN THE WORLD ENERGY CONTEXT

Growing economically with quality of life, with a more egalitarian distribution of income or, at least, less unequal, is the biggest challenge for developing countries, such as Brazil and India. And energy is directly related to development. Therefore, access to energy or the means that make it productive or efficient is critical, as it means the first step in development.

The fact that approximately half of the world's population does not have access to electricity or rely on traditional biomass use (IEA, 2016b) highlights the urgency of adopting measures to overcome this problem. Access to more modern means of generating energy and electricity is still a goal to be achieved for Brazil, but even so more for India: the electrification rate in this country up to 2005 was 55.5% as the International Energy Agency (2006) stated.

Based on Table 1, it can be observed that, in six years, India has advanced 20% in electrification in its territory. However, the number of people without access to electricity is greater than the total population of Brazil, which is approximately 207 million people (IBGE, 2017). The most current Renewable Global Report (REN, 2017) stated that by 2014 the population without electricity in India was about 244 million. There is, therefore, a great work to be accomplished.

Table 1 - Electricity access: Brazil, India and regions (2005, 2011 e 2014).

Country/Region	Electrification rate (%) 2005	People without electricity (million) 2005	Electrification rate (%) 2011	People without electricity (million) 2011	Electrification rate (%) 2014	People without electricity (million) 2014
India	55.5	487.2	75.3	306	81	244
Developing Asia	51.8	706.2	83	615	86	526
Brazil	96.5	6.5	99	1.4	99.6	0.8
Latin America	90.0	44.9	95	24	95	22

Source: IEA (2006); REN (2014; 2017).

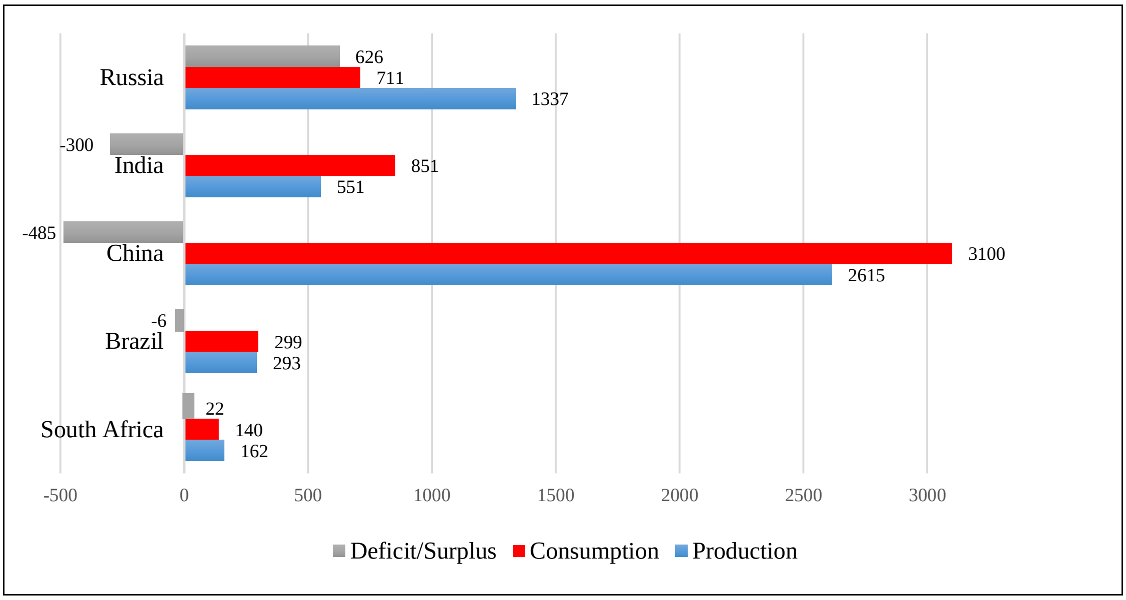
According to the EIA (2017c), the lack of electricity in some parts of India results in a substantial use of biomass and waste (especially firewood, animal manure, agricultural waste), mainly for domestic uses in rural areas. Biomass and waste are estimated as the second largest source of primary energy consumption. In 2011, about 66% of India's total population used traditional biomass for cooking; in 2014 the percentage was 63% (EIA, 2017c, REN, 2014, 2017). India also uses biomass in the energy sector (5.9 GW) and has potential for 23 GW. This country aims to increase the use of biofuels, although use is still timid (EIA, 2017c).

In Brazil, according to the Energy Research Company (EPE), firewood corresponds to 25% and charcoal to 12% of final energy consumption in homes. While the consumption of firewood tends to fall in the forecast made by EPE until 2014 the consumption of coal will rise, although the use of gas (LPG) caused both the use of firewood and charcoal and other waste used for the consumption decreased (EPE, 2015). According to REN (2017), in 2014, 5% of the Brazilian population used biomass in the traditional way for cooking. That means more than ten million Brazilians.

When it comes to consumption, India was, in 2016, the third largest energy consumer in the world after China and the United States. And the country's need for energy supply continues to rise as a result of dynamic economic growth over the last few years, which has proved resilient even after the global crisis of 2008 and the slowdown in growth among emerging countries (EIA, 2016b). Among BRICS, India, after China, is the country that demands more energy: its production represents 11% of world energy production and its consumption 16.6% (MME, 2016a). Brazil was the eighth largest energy consumer in the world and the third largest in the Americas, behind the United States and Canada (EIA, 2017b). Brazilian energy production represents 6% of global production (about half of Indian production) and consumption in the country represents 5.8% of the global.

While the deficit between production and consumption in India is 300 Mtoe (in 2015 was 281), in Brazil the deficit is 6 Mtoe, lower than the previous year, which was 33 Mtoe (MME, 2015, 2016a). Brazil, China and India are the only ones among the BRICS with a deficit between production and energy consumption as can be seen in the graph below.

Graph 3 - Energy in BRICS by country: Production, Consumption, Deficit e Surplus (Million of Tep)



Source: MME (2016a).

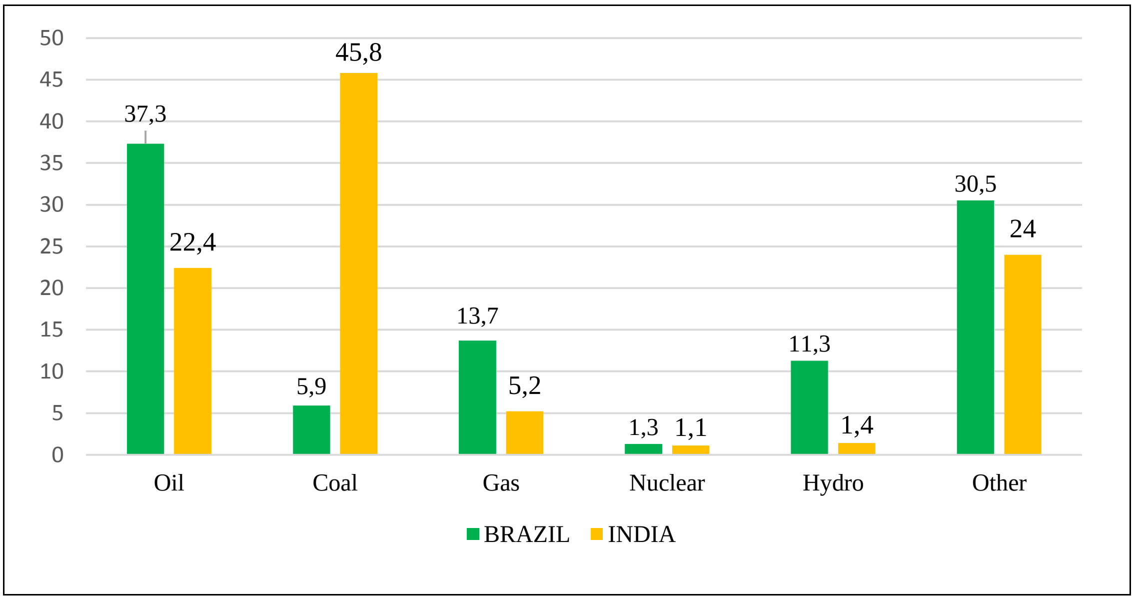
Per capita energy use in both Brazil and India doubled over the 43-year period. Brazil, even in the ascending line, suffered some declines in the time period analyzed, especially after 1979; once again increasing its use in 1984. It suffered a new fall in 1990, growing again between 1993 and 2009, when energy use fell again, intensifying again in the following year. In India, there were slight falls, practically imperceptible (WORLD BANK, 2017a; 2017b).

Fossil fuels have a preponderant role in the Brazilian energy matrix with the current 57% of representation. Most of Brazil's total energy consumption converges around oil, natural gas and coal. In 1973, the Brazilian energy matrix had a consumption of 82.2 Mtoe and, in 2014, it went to 305.5 Mtoe with an annual growth rate of 3.26%. In 1973, the consumption of fossil fuels in Brazil was 49%. However, the increase in the use of coal and, more predominantly, of natural gas was responsible for the increase in the forty-one years (MME, 2016b) during which the Brazilian electricity matrix showed, in 41 years, an annual growth rate of 5.68%, from a consumption of 64.7 TWh to 624.3 TWh. The most used source since the 1970s is hydraulics, with 89.4% and currently with a value corresponding to 61.9% of the matrix.

In India, as well as in Brazil, fossil fuels are predominant in their energy matrix, representing 74% of the total. Most of India's total energy consumption is also based on oil, natural gas and coal. In 1973, the Indian energy matrix showed consumption of 164.5 Mtoe going to 824.7 Mtoe in 2014, with an annual growth rate of 4.01%. The consumption of fossil fuels in India had a percentage difference of 25% in 41 years: the most significant increase was for coal, which doubled its percentage, and for natural gas, which had its use increased by almost five times (MME, 2016b). With regard to electricity generation, India went from a consumption of 72.8 TWh to 1,287 TWh at an annual growth rate of 7.26% in the same period analyzed. Coal is predominantly the most prominent source in India's electricity generation since the 1970s, currently accounting for 75% in the respective matrix (MME, 2016b).

Following are the representations of the energetic and electric matrices of Brazil and India.

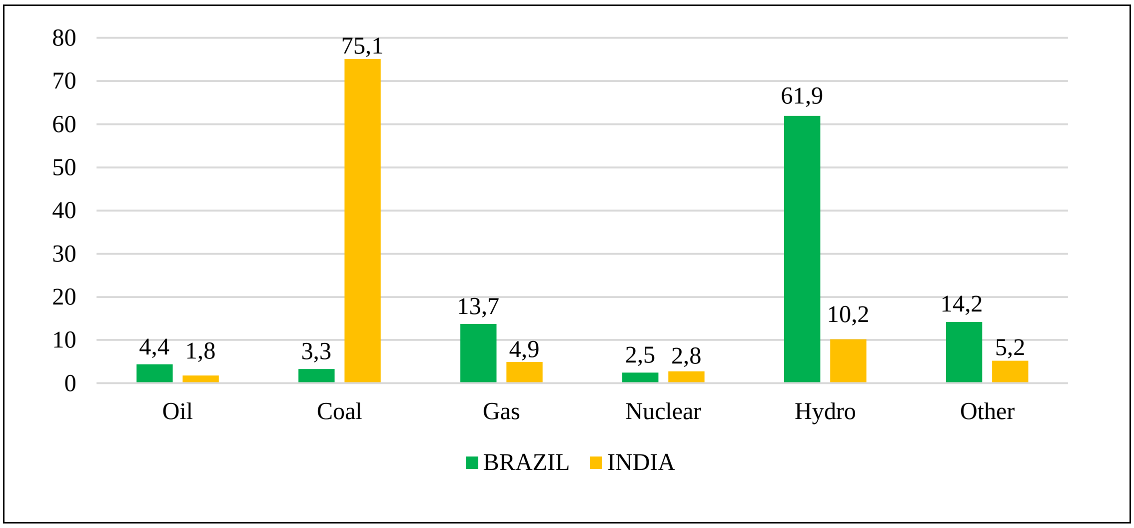
Graph 4 - Brazil and India: Energy Matrices* (%)



Source: MME (2016b).

* Brazilian and Indian data refers respectively to the years 2015 and 2014. Other: include biomass, biodiesel, wind, solar, geothermal, other renewable (*i.e.*, ocean) and other non-renewable (*i.e.*, industrial gas).

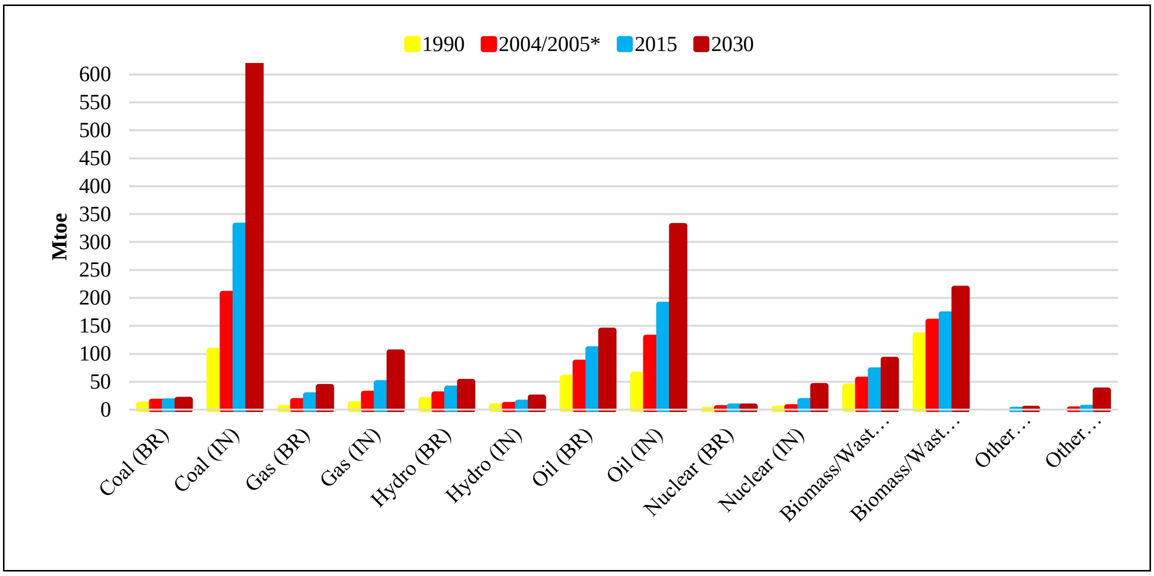
Graph 5 - Brazil and India: Electrical Matrices* (%)



Source: MME (2016b).
Brazilian and Indian data refers respectively to the years 2015 and 2014.
*Other: include biomass, biodiesel, wind, solar, geothermal, other renewable (*i.e.*, ocean) and other non-renewable (*i.e.*, industrial gas).

In terms of demand for energy, the increase in Brazil and India is significant. Obviously, when designing demand, uncertainties must always be taken into account, such as those related to economics, consumption, competitiveness and raw materials, for example, which make any projection merely an indicator or guiding for policies and actions. In the two countries in question, the relevance for fossil fuels between 1990 and 2030, still draws attention: oil plays a prominent role. In India, in addition to oil, coal assumes a prominent position, as can be seen in the following graph:

Graph 6 - Energy Demand Evolution Brazil and India



Source: IEA (2006; 2007; 2015).

According to the IEA (2013), the center of gravity of energy demand is shifting to emerging economies. Fossil fuels will still dominate the world's energy matrix and coal will be the second energy resource used just behind oil by at least 2030. The three largest coal consumers, accounting for 70% of world consumption, are China, the United States and India (EIA, 2016b). For IEA, coal will play an important role because it is a cheaper option than gas, for example to generate electricity (IEA, 2013). Therefore, political actions will be fundamental to determine their long-term perspectives, since alternatives to coal use are directly related to energy efficiency and climate change.

India has the third largest coal reserves in the world, but growing demand will make it the world's largest importer of coal by 2020. Given that coal production does not keep up with demand, India has met most of its coal needs with imports from Indonesia, South Africa and Australia. Not coincidentally, the coal shortage in India is one of the main factors responsible for the consequent blackouts throughout the country (IEA, 2016b; 2017c).

According to the International Energy Agency (IEA, 2015), the use of coal in this country involves several problems. Coal deposits are generally considered to be of poor quality since, in this case, coal has a calorific value ranging from low to medium, and a high ash content. This means that low heat power causes more coal to be burned per unit of production, generating more CO_2 emissions. In addition, many plants are designed to use a certain grade of coal and, if not available, operators might mix different types of coal, which can affect the generation of electricity.

When it comes to coal use in Brazil, coal does not have the same relevance as in India, occupying 3.3% of the country's electricity matrix. However, for Tolmasquim (2016), in view of the exhaustion of the Brazilian hydroelectric potential, its use becomes an important option in the energy mix in the future. In terms of proven reserves, Brazil, behind Colombia, is the country with the highest proven reserves of 6.63 billion tons, representing approximately half of all reserves in Central and South America and 0.7% of the world total. India, on the other hand, holds 60.6 billion tons of proven reserves or 6.8% of the world total (TOLMASQUIM, 2016).

Oil consumption worldwide increased by 1.6% compared to the year 2015. India was the third largest consumer in the world (behind the United States and China) with 4.6% of total world consumption and the twenty-fourth producer of that source.

The gap between oil demand and supply in that country is aggravated: in 2016 the demand reached around 4.4 million barrels per day and its production, 856 thousand barrels per day, 2.3% less than that produced in the previous year (ANP, 2017). The volume of oil produced in the world in 2016 increased 0.5% compared to 2015. Brazil ranks as the third largest producer of oil in Latin America, behind Mexico and Venezuela, being the thirteenth in the world ranking producers and the seventh largest consumer of oil. The consumption of this source in Brazil surpasses its production: in 2016, Brazilian demand was around 3 million barrels / day, while production reached 2.6 million barrels / day (ANP, 2017).

The increase in domestic oil production has been a long-term objective of the Brazilian government, and the discoveries of large offshore oil deposits have placed Brazil among the world's largest energy producers. The International Energy Agency predicts that Brazil will be the second largest contributor to oil growth in the world and will have a leading position in oil deep water (IEA, 2013). Poor economic growth and corruption scandals have led to the investigation, both in Brazil and in the United States, of the state-controlled company Petróleo Brasileiro S.A. (Petrobras), which, in turn, has reduced short-term production growth prospects (EIA, 2017b).

In 2016, proven oil reserves in the world reached the mark of 1.7 trillion barrels, a growth of 0.9% over the previous year. Venezuela has the largest volume of reserves or 17.6% of the world total. Brazil ranked 15th in the world ranking of proven oil reserves, with a volume of 12.6 billion barrels. India has 5.7 billion barrels of oil in proven reserves, occupying the 22nd position in the world ranking (ANP, 2017).

Refining capacity in the world in 2016 was 0.5% higher than in 2015. The countries that stood out were India and the United States, which increased their refining capacity per day. In the world ranking of the countries with the largest refining capacity, the United States ranked first, with 19.1% of world refining capacity, followed by China (14.6%), Russia (6.6%), India (4.7%) and by Japan (3.7%), accounting together for almost half of the world's refining capacity. Brazil ranked seventh in the ranking with around 0.5% of world capacity (ANP, 2017).

The International Energy Agency projects that India will need to import 7.2 million barrels of crude oil per day by 2040, making it the second largest importer in the world, behind China, but ahead of Europe Union and the United States.

Indian oil imports depend largely on producer countries located in regions with geopolitical tensions: in total, approximately 60% of crude oil imported from India comes from countries in the Middle East. Supply disruptions in several countries, such as Iran and Libya, coupled with India's growing reliance on imported oil, have forced India to diversify its imports. In addition, Indian refineries are trying to reduce the costs of importing crude oil by buying less expensive crude oil. The search for diversification of its matrix appears as an important alternative to reducing its dependence on oil (EIA, 2017c; 2016b).

To meet its demand and the refining industry's, which suffers from low investments, Brazil needs to import oil. In 2015, that country imported 118.3 million barrels. Africa, especially Nigeria, remained the continent that exports the most oil to Brazil, corresponding to 64.5% of the total imported oil by Brazil. The second continent that exports the most to Brazil is the Middle East, with emphasis on Saudi Arabia, with 30.2% of the total. Of the total oil products imported by Brazil, 12.2% come from India, making it the third largest exporter of petroleum products to Brazil, after the United States and Algeria (ANP, 2016).

Brazilian oil exports stood at 268.9 million barrels, about 40% higher than in 2014. China is the largest importer of Brazilian oil (92 million barrels), followed by the United States (44 million barrels) and by India: exports to India went from 982 thousand barrels to 29 million barrels in nine years (ANP, 2016).

Natural gas is the third most important source in the world energy matrix, behind oil and coal (TOLMASQUIM, 2016). According to the IEA (2015), natural gas production in India will increase from 35 billion m3 in 2013 to almost 90 billion m3 by 2040, but this still leaves a considerable gap, which will need to be met by imported gas. Gas production in India went from 30.1 billion m^3 in 2007 to 26.7 billion m^3 in 2016. Conventional land production consists of many small projects, contributing about 5% of total supply. There is potential for new ground gas discoveries. However, the greater potential lies in waters and the wells are technically challenging, giving rise to relatively high development costs (IEA, 2015).

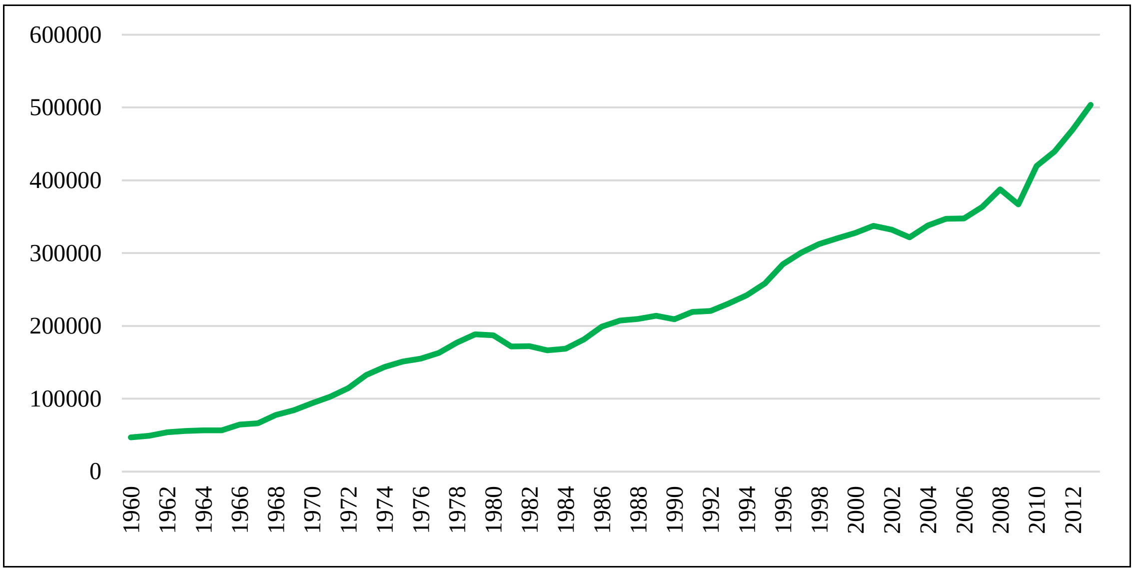
Global consumption of natural gas increased by 1.8% worldwide. In the global ranking of natural gas consumers, the United States, as well as production, are in the top position, accounting for 22% of world consumption, followed by Russia with 11% of the global total. Brazil, whose consumption rose from 21.2 billion m^3 in 2007 to 36.6 billion m^3 in 2016, is the nineteenth in the ranking representing 1% of world consumption. To meet its domestic demand, this country needs to import gas, most of which is imported from Bolivia, Nigeria and Qatar. India rose from a consumption of 40.3 billion m^3 to 50.1 billion m^3 in nine years, ranking sixteenth in the global ranking of gas consumption, accounting for 1.4% of world consumption (ANP, 2017).

In terms of proven gas reserves, they totaled 186.6 trillion cubic meters in 2016, up 0.6% compared to the previous year: Iran ranks first in the world ranking of proven reserves of gas, followed by Russia and Qatar, which together account for approximately

50% of global natural gas reserves. Brazil, whose majority of the reserves are located at sea, ranked thirty-third in the ranking and India ranked 20th (ANP, 2017).

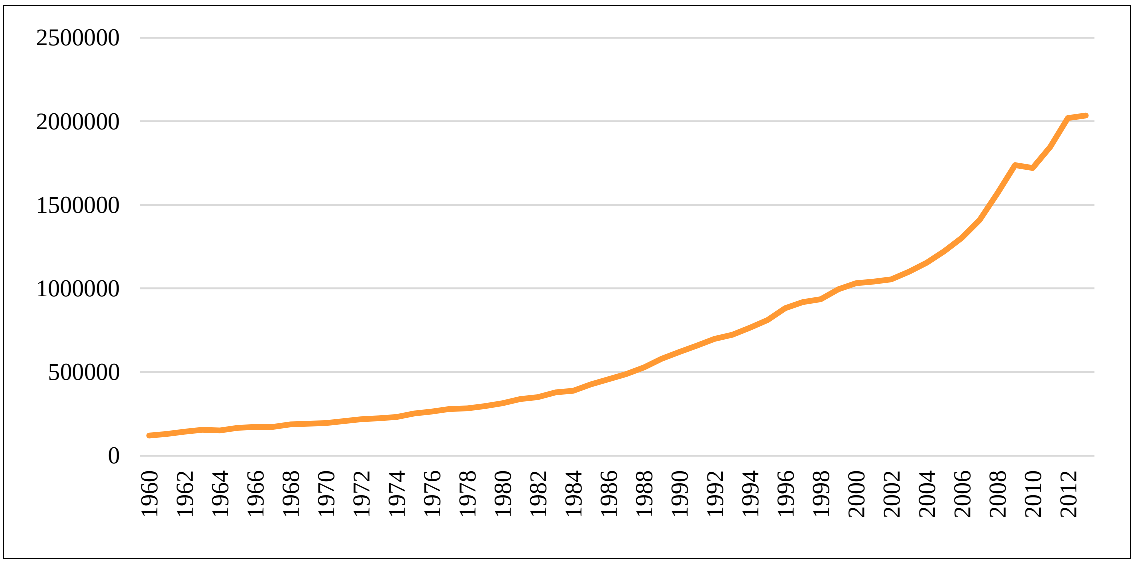
In the context of production and consumption of the main non-renewable energy, it should be noted that CO_2 emissions from both Brazil and India increased consecutively over more than half a century (WOLD BANK, 2017d; 2017e), as it can be seen in the following graphs.

Graph 7 - Evolution of CO_2 Emissions (kt) in Brazil (1960-2013).



Source: World Bank (2017d).

Graph 8 - Evolution CO_2 Emission (kt) in India (1960-2013)



Source: World Bank (2017e).

India's high dependence on coal is one of the reasons for the growth of CO_2 emissions in that country; although, expressed in per capita figures, it is approximately 20% below the world average (IEA, 2015). As they try to grow economically, Brazil and India deal with issues related to the effects of economic growth on the environment (WRI, 2016, MMA, 2017b).

Both Brazil and India presented, within the framework of the Conference of the Parties of the United Nations, their Nationally Determined Contributions (INDC) with targets to reduce the level of CO_2 emissions. By 2030, India aims to reduce emissions by 33-35% to reach numbers comparable to 2005, while Brazil aims to reduce emissions by up to 37% by 2025 to levels comparable to previous years to 2005. Brazil plans to expand them by 28% to 33% by 2030 and India plans to triple its capacity by 2022, to create international architecture for the diffusion of technologies and also a joint collaborative research structure and development for future technologies (WRI, 2016).

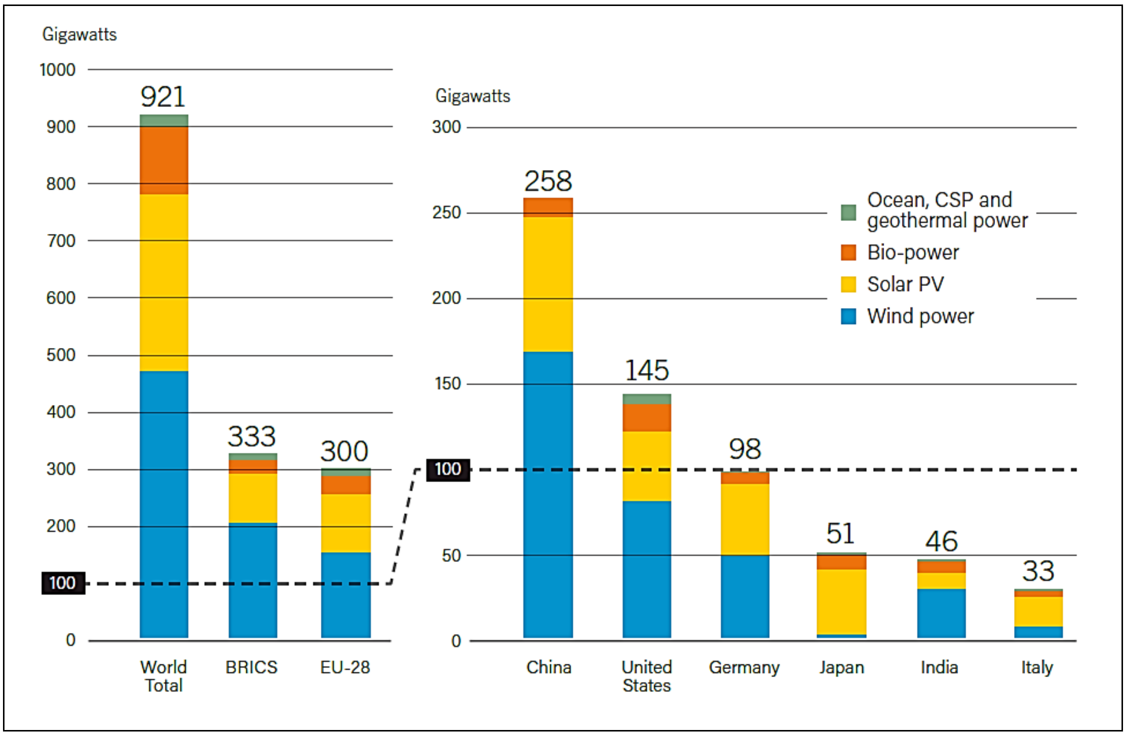
4.3 BRAZIL AND INDIA IN THE GLOBAL CONTEXT OF RENEWABLE ENERGY

Despite the fact that renewable energy on the world stage still appear timidly compared to traditional sources of energy, they have continued to grow in recent years, even in the face of increased energy consumption and falling oil prices. The power sector in 2014 had the most significant growth in renewables in the world and by 2016 had the highest annual growth ever seen, with an estimated increase of 161 gigawatts (GW) of added capacity.

The total renewable energy capacity to generate electricity in the world increased by approximately 9% compared to 2015. For the first time, solar photovoltaic energy had an additional capacity superior to any other renewable energy: in 2016 represented about 47% of newly installed renewable energy capacity. Wind power and hydropower, although more robust in installed capacity, had an increase inferior to the solar power increase in the referred year, contributing an increase of 34% and 15.5% respectively (REN, 2017)

The world started to add more renewable energy capacity annually than all of the combined fossil fuels. Renewable additions accounted for 62% of additions to global power generation capacity and accounted for approximately 24% of global electricity, with hydropower accounting for 16% of that total. China, the United States, Brazil, Germany, Canada, India and Japan are the countries with the highest installed electrical capacity of renewable energy. However, when excluding hydroelectric energy, the ranking would be made up of China, the United States, Germany, Japan, India and Italy (graph 9), evidencing the strong presence (and dependence) of hydroelectricity in the generation of electricity in Brazil (REN, 2017).

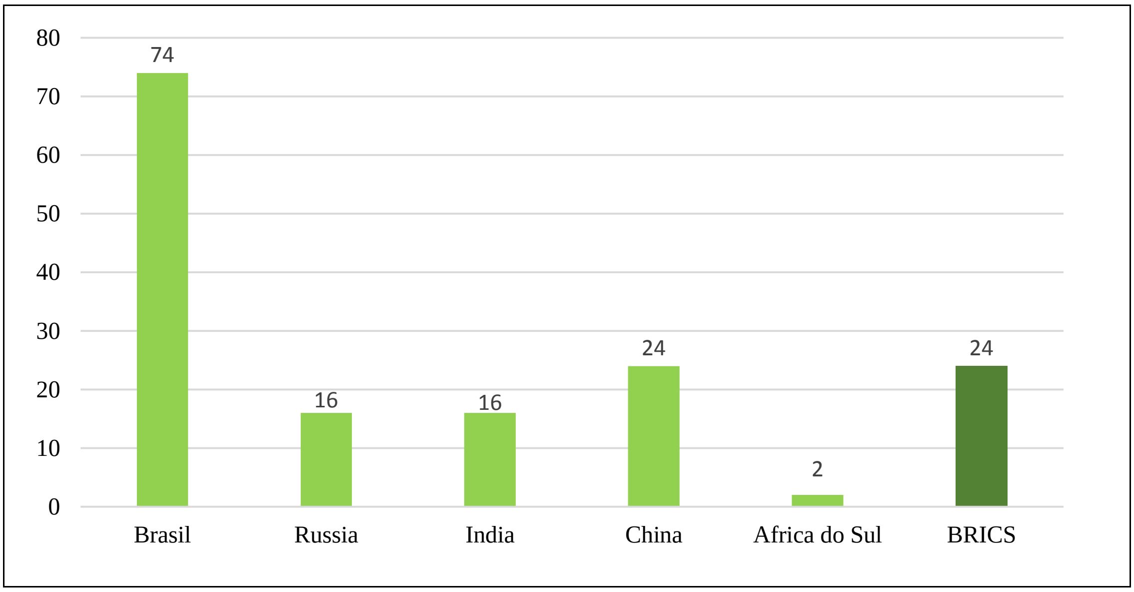
Graph 9 - Renewable power capacity (excluded hydropower): 2016.



Source: REN (2017. p. 34).

When visualizing the share of renewable sources in the BRICS electrical matrix (graph 10), Brazil is perceived as having a 74% share, above the BRICS total, being therefore in the lead, particularly conditioned to hydraulic generation. India, along with Russia, holds the second place, with 16% of renewables in its electrical matrix. In the generation of electricity by source (Table 2), India, South Africa and China present about 75% of fossils.

Graph 10 - Sources of renewable in BRICS electrical matrix by country in percentage (2016).



Source: MME (2016a).

Table 2 - BRICS electricity generation by source in percentage (2015).

Country	Coal	Oil	Gas	Nuclear	Hydro	Other*	Total TWh
Brazil	3	4	14	3	62	14	581
Russia	15	1	50	18	16	0	1.076
India	74	2	5	3	10	6	1.340
China	71	0	2	3	19	5	6.035
South Africa	94	0.08	0	4	0	1.6	266
Total BRICS	62	1	9	5	19	5	9.299
% / World	60	7	15	17	45	26	38

Source: MME (2016, p. 5).
* Other biomass, wind, solar, geothermal, non-renewable industrial gas.

The use of energy for heat (*i.e.*, for heating water and environment, cooking and industrial processes) accounted for more than half of total energy consumption in 2016. Global demand for thermal energy was driven mainly by rising demand heat in industry and buildings in developing countries. The demand for energy for cooling is significantly lower, but it is increasing (60% during the first decade of the 2000s) as a result of improved access to energy and rising global temperatures (REN, 2015, 2017).

Although renewable energy for heating are distributed around the world in different ways and sources, there are regional peculiarities. In Latin America, renewable energy accounts for 35% of the heat demand: a quarter of this is represented by traditional biomass with significant variations between countries. For example, some Latin American countries depend primarily on renewable sources of industrial heat (such as sugarcane bagasse and charcoal), including Paraguay (90%) and Brazil (54%). In India, about 10% of the demand for heat is served by modern renewable energy (bagasse, rice hulls, straw and cotton carvings) used in industry. In 2016, several solar thermal systems were installed in India, supported by international programs of the United Nations Environment Program (UNEP) and UNIDO. It is important to recall that in India a large portion of the population depends on the traditional biomass for cooking (REN, 2017).

As far as the transport sector is concerned, there are three points to be considered. The first concerns the use of biofuels or liquid biofuels mixed with conventional fuels; second, the growing role of natural gas; and the third, the increased electrification in transportation. Each of these trends has contributed to the evolution of renewable energy in this sector. However, the main focus of policies, markets and industries in this area has been substantially on liquid biofuels (REN, 2017).

Liquid biofuels, mainly ethanol and biodiesel, account for the majority of the share of renewable energy in global demand for energy in transportation. In 2016, global demand for ethanol grew by 2% over the previous year, especially in the United States, China and India, and biodiesel production grew by around 9% compared to 2015. The United States and Brazil are the largest producers of biofuels in the world, responsible for 70% of global production (REN, 2015, 2017).

It is interesting to note that, for the first time in four decades, global carbon emissions associated with energy consumption have remained stable, even with the growth of the world economy, a fact attributed especially to the greater penetration of renewable energy. Although Europe remains a major market and innovation hub, China has led the world in new renewable energy facilities and has been the largest developer of renewable energy for eight consecutive years. Brazil, India and South Africa played a significant role in their respective regions. Advances have been made, although there is still a long way to go before reaching the goals of SE4ALL[13] (REN, 2015; 2017).

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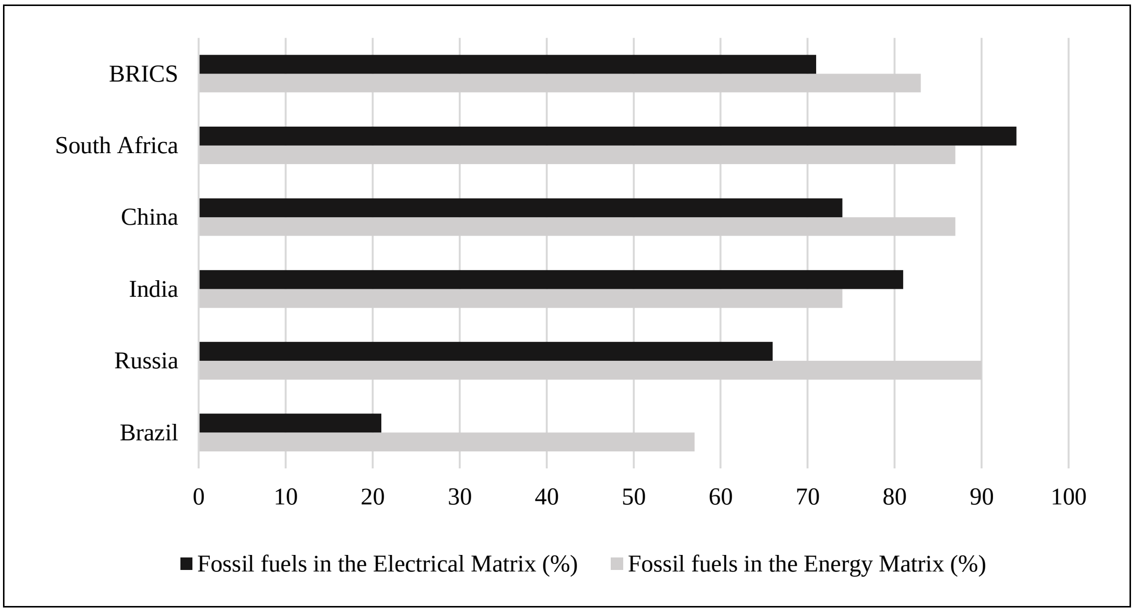
[13] The Sustainable Energy for All is a government, private sector and civil society initiative launched by the UN in 2011, with the objectives of ensuring universal access to modern energy services by 2030, doubling energy efficiency and the share of renewable energy in the global energy matrix.

It should be noted that the BRICS energy matrix, with the exception of the Brazilian matrix, is highly dependent on fossil fuels, with coal being the main energy source in China, India and South Africa. The percentages in the respective energy and electric matrices of each member country (Graph 11) indicates that the use of renewables is still small compared to the use of fossil sources. Of this block, Russia is the country that uses the most fossil fuels; Brazil is the one which stands out with the smallest percentage, and India is the one which uses 74% and 81% of fossil fuels in its energy and electric sources (MME, 2016a).

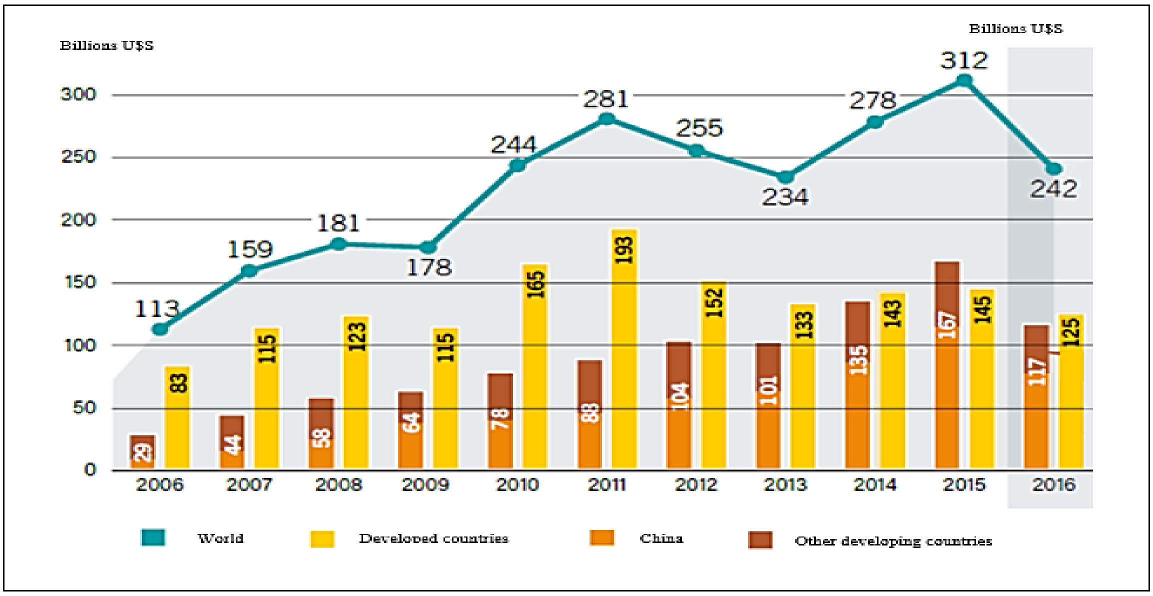
Graph 11 - Percentage of fossil fuels in the BRICS energy and electric matrices by country 2016.



Source: MME (2016a, p. 5).

Although the use of fossil fuels still dominates the matrices of India and Brazil (excluding the production of electricity in the Brazilian case), investments in renewable energy have been growing all over the world, particularly in developing countries. Global investments in renewable energy reached $ 242 billion in 2016, despite a 23% decline compared to the previous year due to the slowdown of emerging economies and falling prices of solar and wind technologies. Developing countries, including Brazil and India, increased from US $ 9 billion in 2004 to US $ 117 billion in 2016 (REN, 2015; 2017). The following graph shows the evolution of investments made by developing and developing countries over ten years.

Graph 12 - Global investments in renewable energy (2006-2016).



Source: Adapted from REN (2017, p. 112).

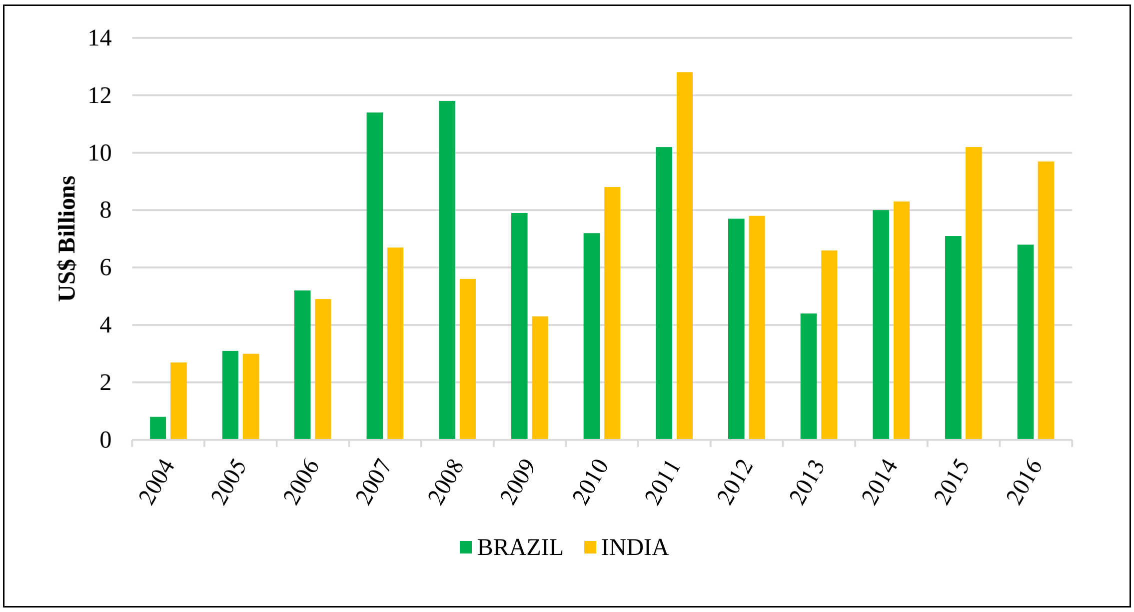
Investments in renewables in developed countries were growing exponentially until 2008, when they fell by around 10% reflecting the global economic crisis. However, investments in developing countries, although not at rates similar to those of previous years, continued to grow, still in the context of the crisis, and only declined in 2013, resuming growth in 2014 and, for the first time in 2015, exceeded the values invested in developed countries (REN, 2017).

China, the United States, the United Kingdom, Japan, Germany, Brazil and India are among the ten countries that have invested in renewable energy for at least three consecutive years (REN, 2015; 2016; 2017). The presence of the emerging ones in this list also evidences the capital search for new business opportunities.

In Brazil and in India, investments had been increasing from 2004 to 2008, year when they start to fell, certainly due to the global economic crisis. It is noteworthy that in the first decade (2008-2009), Brazil had a deficit of 4.2 billion dollars and India, 1.3 billion dollars. However in this period, the investments made in Brazil were more than double of those in India. Between 2012 and 2013, the two countries again experienced a decline in their investments in renewable energy, returning to increase their investments in 2014 and on. In that year, India invested more than twice as much as Brazil did. Brazilian investments grew steadily, and four years later Brazil started to invest almost twice as much as India. But as of 2011, India has been surpassing Brazil in terms of investments in renewable energy (Graph 13).

In 2016, of all investments made by developing countries, Brazil's and India's investments accounted for 5.8% and 8.2%, respectively; and 2.8% and 4% of all investments in energy in the world.

Graph 13 – Brazilian and Indian investments in renewable energy, 2004-2016.



Source: REN (2015; 2017).

Solar and wind energy were the ones with the most investments, both in developed and developing countries, followed by biomass, hydroelectricity and biofuels. Despite investments in the areas of biofuels and hydropower, both in Brazil and in India, investments have been concentrated in recent years in wind and solar energy.

Brazil, the third emerging economy among the 10 largest investors in 2016, invested US $ 6.8 billion in renewable energy, which shows a drop compared to 2015. Of this total, approximately 72% was invested in wind energy and 14% in energy solar. In India, investments remained stable in relation to 2015, with a total of US $ 9.7 billion. Approximately 56% of this total was invested in solar energy and 38% in wind energy (REN, 2014; 2015, 2016; 2017).It should be noted that, in the calculation of these investments, data on research and development in the area, which grew by only 2% in global terms in 2015, were not computed. Europe is still ahead in this line (joined by the United States and, more recently, China). India and Brazil were not even mentioned in the REN report because they did not have significant numbers of investments in the renewable energy sector (REN, 2015).

Regarding biomass, its use is multifaceted since the diversity of raw materials that are transformed by means of various techniques and technologies generates energy for the electric, heating and transportation sectors. There are well established bioenergy technologies in the market such as pellets and others like the production of advanced liquid fuels that is maturing rapidly. Bioenergy in traditional uses (i.e. firewood, coal, agricultural wastes and manure) and modern (*i.e.*, pellets and biofuels) is the major contributor to the global supply of renewable energy.

The share of bioenergy in total energy consumption has remained relatively stable since 2005, at around 10.5%, despite a 21% increase in global demand over the last 10 years. The contribution of bioenergy to generating heat in buildings and industry is superior to its use for electricity and transportation. The leading regions in the use of biomass to generate heat are Asia and South America. In addition to these regions, Canada stands out as the leading country in the use of bioheat, mainly in the pulp and paper industry. Table 3 shows data on biomass:

Table 3 - Biomass Evolution: Brazil and India GW (2007-2016).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Asia	12	13	15	16	17	20	23	25	29	35
India	1.5	2.1	2.5	3.1	3.7	4.2	4.6	5.1	5.6	9.1
South America	5.1	6.1	7.4	9.7	10	12	14	14.5	15.6	16.5
Brazil	4.1	5	5.7	7.9	9	9.9	11	12	13	14
World	52.4	56.8	63.7	69.4	74.7	81.4	88.7	94.5	101	109

Source: Irena (2017).

Regarding biogas, Asia stands out, leading small-scale biogas digesters for the production of cooking and heating gas. In 2014, to produce heat, China had 43 million residential biodegraders. In India, there are about 4.9 million biogas plants for homes and villages, biodigesters fed mainly by cattle manure and agricultural waste. In Brazil, six landfill plants account for 68% of the country's biogas production. Two industrial plants represent an additional 26% and the rest is produced by agricultural plants, bio-waste and minor sewers (REN, 2015; 2017).

The generation of bioelectricity increased from 396 TWh in 2013 to about 504 TWh in 2016. The countries that stand out in bioelectricity are the United States, China, Germany, Brazil, Japan, India and the United Kingdom. In India, bioelectricity generation capacity grew 8% in relation to 2015, reaching 30 TWh. Brazil, where 80% of the bioelectricity generation comes from the sugarcane bagasse, is the largest consumer of bioelectricity in Latin America and its generation capacity increased by 5% in 2016 reaching 51 TWh.

With regard to the production of bioenergy for transport, the highlight is biofuel. Global biofuel production is up 2 percent from 2015. The main biofuel producing countries are the United States, with 57 percent of global ethanol production and 18 percent biodiesel, and Brazil with 27 percent and 12 to the production of ethanol and biodiesel, respectively. It is estimated that 72% of the biofuel produced was ethanol, followed by 23% biodiesel and 4% hydrotreated vegetable oil (HVO). In Brazil, ethanol production in 2016 fell and, in India, increased due to support policy. However, despite the established target, biodiesel production in that country has decreased, probably due to the drop in demand related to the reduction of economic activity (REN, 2017).

Both Brazil and India have targets linked to the use of biofuels. In Brazil, the blend of ethanol and gasoline increased to E27 that is 27% of ethanol in gasoline in the beginning of 2015. As for diesel, in Brazil, the mixture went from B5 to B7, that is, 7% of biodiesel in diesel in 2014. India has a goal of establishing E10 and putting 5% biodiesel in its fleet of trains (REN, 2015; 2016).

The year 2016 showed initiatives for the development of advanced biofuels. The Italy's Beta Renewables company has shown interest in joint projects with the United States, Brazil and China. Another company, India Glycols started the first cellulosic plant in India to use wood chips, cotton stalks, sugarcane bagasse, corn flour and bamboo. In addition, the country signed memorandums of understanding regarding five additional cellulosic ethanol plants (REN, 2017).

It should also be noted that aviation biofuels have also been highlighted. In Europe, the supply of aviation biofuels at airports has become more available; in the United States, new contracts have been signed for the development of this fuel in the coming years. In addition, some of the first commercial flights based on biofuels were carried out in Europe and Brazil. In the United States, Boeing completed the world's first green diesel flight. The Chinese subsidiary of state-owned Sinopec Corp. in partnership with Boeing have partnered to launch a pilot project that will transform kitchen-used oil into more than 1.8 billion liters of jet fuel (REN, 2015).

Geothermal resources provide energy in the form of electric and thermal energy, and in 2016 its use was estimated at 157 TWh. Indonesia and Turkey were leaders in developing new facilities of this source. The countries with the largest geothermal power generation capacity were the United States (3.5 GW), the Philippines (1.9 GW), Indonesia

(1.6GW), Mexico (1.0 GW), New Zealand (0.9 GW), Turkey (0.8 GW), Iceland (0.7 GW), Kenya (0.6 GW) and Japan (0.5 GW). India, and especially Brazil, do not show any prominence in this type of energy source (REN, 2015; 2017).

Tidal or oceanic energy is little explored in relation to other renewable technologies. With about 536 MW of operational capacity by the end of 2016, more than 90% of tidal power generation was represented only by two facilities: one in the Republic of Korea (completed in 2011) and another in France (built in 1966) (REN, 2017). Brazil and India do not have representative numbers in this energy source (IRENA, 2017).

Regarding hydroelectricity, it is estimated that the overall total capacity of this source is currently 1,096 GW. The countries with the highest installed capacity and generation of hydroelectric power are China (305 GW), Brazil (97 GW), the United States (80 GW), Canada (79 GW), Russia (48 GW) and India (47 GW), which together accounted for around 60% of the world's installed capacity. Global hydropower generation was estimated at 4,102 TWh in 2016, an increase of 3.2% over the previous year. It should be noted that hydroelectric power generation varies according to the hydrological conditions, which, between 2013 and 2014, have decreased in several countries due to droughts, mainly. Among these countries are China, which recovered after a decline in 2013, and Brazil, with a highly dependent electricity matrix in hydroelectricity, which also faced problems related to the drought (REN, 2015; 2017).

New increments were designed or incorporated to the already installed capacity in several countries. Among them, China stands out with a higher percentage of increase (8.9%). The countries that have stood out over the last few years as the ones that have increased the most are those who are among the leaders in hydroelectricity, in terms of installed capacity, among which are Brazil and India. Brazil went from 76 GW in 2007 to 98 GW in 2016, while India went from 36 GW to 47 GW in the same period (IRENA, 2017).

In Brazil, the addition of 5.3 GW, in 2016, included 5 GW in large-scale hydroelectric plants. In India, the addition was approximately 0.6 GW and 65 MW in small hydroelectric dams, and electricity production in that country was 129 TWh, while in Brazil, it was 410 TWh, thanks to improved weather conditions in 2016. In that year, in Brazil, several projects were in the final phase or were inaugurated, as was the case of the Jirau plant with capacity to generate 3.75 GW. In the world, several projects were delayed or canceled due to concerns about social and environmental impacts in several countries and this was no different in Brazil and India. In India, the construction of the Lower Subansiri hydroelectric plant faced several problems such as landslides, flooding of forest areas, local opposition and project redesign. In Brazil, the Madeira River Complex (Usina Jirau) had to revise its environmental impact assessments for floods after torrential rains (REN, 2015; 2017). In addition, several protests occurred at the construction site of the Madeira River complex, in the northern region of the country, widely publicized by the national media.

Every country in the world has some photovoltaic power plant in operation. The total installed capacity in photovoltaic solar energy went from 6 GW in 2006 to 303 GW in 2016, a year in which the equivalent of more than 31 thousand solar panels per hour were added. For the fourth consecutive year, Asia has eclipsed all other markets, accounting for about two-thirds of global additions. The leading countries in capacity and increment in photovoltaic solar energy are China, the United States, Japan, India and the United Kingdom. Germany, which was in first place, now occupies the sixth. India in 2016 ranked fourth overall for additions and seventh for total capacity. This country added approximately 4.1 GW to a total of 9.1 GW. Demand for solar projects in India has been boosted especially by falling prices combined with political support at the national level since 2014. The solar market in India has expanded. However, this country remains far from its goal of 40 GW until 2022: logistical challenges are some of the factors that hindered growth (REN, 2017). India has increased its photovoltaic capacity by about eight times between 2012 and 2016 (Table 4). It should be noted that in 2007, Indian installed capacity was 4 MW (IRENA, 2017).

In Latin America, although no country is among the ten largest in photovoltaic solar energy, the regional market is booming, although growth is uneven from country to country. Brazil carried out the first contracting of large photovoltaic projects at the end of 2014, totaling 1 GW.

However, the only renewable energy auction scheduled for 2016 was canceled and most of the projects submitted in bids up to 2015 were paralyzed by several factors (REN, 2015, 2017). Regarding the potential of solar energy, it corresponds to 750 GW in India and it can reach 30 thousand GW in Brazil (NICE, 2016a; GOVERNO DO ESTADO DE SÃO PAULO, 2016).

Brazil has increased its photovoltaic capacity 800 times in the period 2012-2016 (Table 4). These values, though, are well below Indian capacity (IRENA, 2017).

Table 4 - Brazilian and Indian solar and photovoltaic installed capacity (2012-2016).

Year	**Installed Capacity solar energy (MW) India**	**Photovoltaic Installed Capacity (MW) India**	**Installed Capacity solar energy (MW) Brazil**	**Photovoltaic Installed Capacity (MW) Brazil**
2012	1281	1277	2	2
2013	2322	2269	15	5
2014	3373	3144	218	15
2015	5499	5271	848	23
2016	9887	9658	1603	23

Source: IRENA (2017).

Solar thermal energy contributes to the production of hot water in many countries, and its use is increasingly significant for both heating and air-conditioning environments, including in this context industrial processes. Most of the world's capacity in solar thermal collectors for water heating is from China. Brazil occupies the fifth place with 2% and India, the sixth with 1.4%. These two countries are among the four with the highest capacity added in 2016, occupying the third and fourth places respectively. In Brazil, there was a drop in the solar thermal market caused by the economic crisis, the policy and the slowdown of the housing program *Minha Casa, Minha Vida*, since demand in this country is driven, in large part, by the economic competitiveness of solar thermal and by social housing programs such as the mentioned above. In India, the market has also somewhat eclipsed, due to the temporary reduction of demand by the suspension of government support (REN, 2015; 2017).

In 2016, 55 GW were added to wind power generation, representing an increase of 12% over the previous year, bringing the global total to 487 GW. By way of comparison, it should be noted that, in 2006, total installed capacity was 74 GW. Ten countries account for approximately 80% of the global installed capacity and, by the end of 2016, more than 90 countries had some type of wind activity. Asia continued to be the largest market for the seventh consecutive year, accounting for half of the added capacity, followed by the European Union and North America (REN, 2015).

There was a downturn in relation to wind energy in China, which is the main reason for the downturn in the market as a whole. In spite of this, China continued to lead the installed capacity and additions, accounting for 35.7% of global wind power additions in the year 2016. It is followed by the United States and Germany. India ranks fourth among those who increased their wind capacity the most in 2016 and Brazil comes next, despite falling one position. However, in the ranking of countries with total installed capacity, India, occupying the fourth place with 28.7 GW, stands out more significantly than Brazil, which occupies the ninth place with 10.7 GW of total installed capacity. It should be noted that, of the 10 countries with the largest capacity and that added most to wind energy, three of them are from emerging economies (BRICS). In relation to the wind potential, it is estimated that Brazil will reach 350 GW and India 320 GW (MME, 2016c; GWEC, 2016). The following table presents the ten countries with the largest installed capacity and the largest addition in wind energy in the world.

Table 5 - Wind energy: the top 10 countries in the world in installed capacity and addition.

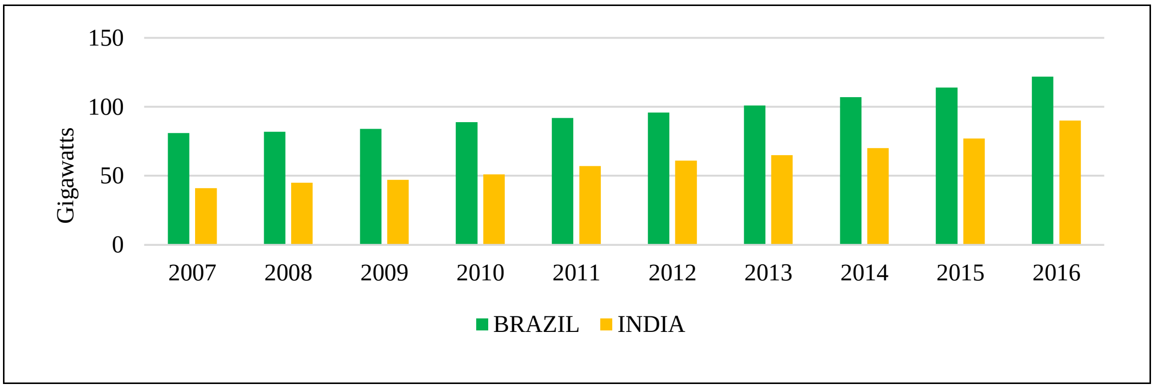
Top countries by additions	**End 2015 (GW)**	**Added in 2016 (GW)**	**Total 2016 (GW)**
China	145.4	23.4	168.7
United States	74	8.2	82.1
Germany	44.5	5	49.5
India	25.1	3.6	28.7
Brazil	8.7	2	10.7
France	10.5	1.6	12.1
Top countries by total capacity			
China	145.4	23.4	168.7
United States	74	8.2	82.1
Germany	44.5	5	49.5
India	25.1	3.6	28.7
Spain	23	0	23.1
United Kingdon	13.8	0.7	14.5
France	10.5	1.6	12.1
Canada	11.2	0.7	11.9
Brazil	8.7	2	10.7
World	**433**	**55**	**487**

Source: Ren (2017, p. 173).

Energy costs vary widely and started to fall due to the production of more standardized turbines and factors such as turbine size, efficiency and capacity. The land wind was the most economical option in many markets, including Brazil and India (IRENA, 2017; REN, 2017). The wind industry has also shown growing interest in hybrid facilities and companies are starting to develop hybrid solar projects such as Suzlon (India) which has announced plans to increase its focus on hybrid wind and solar energy.

Even though fossil energy are a prominent presence in Brazil and India, both countries have been investing systemically in renewable sources, especially in the last 15 years. In terms of installed capacity in renewable energy, Brazil shows more robust figures than India (Graph 14).

Graph 14 - Evolution of installed capacity in renewable energy in Brazil and India (2007-2016).



Source: IRENA (2017).

Although India presents quantitatively installed capacity in GW in solar and wind energy superior to Brazilian, hydroelectricity raises the Brazilian participation in the total capacity in renewable energy in the comparison between the two countries. It should be noted that Brazil and India are among the countries that generate the most jobs in renewable energy. The world recorded a total of 9.8 million jobs in renewable energy in 2016 as shown in the following table, an increase of 1.1% over the previous year. Photovoltaic solar energy, biofuels followed by hydroelectricity and wind power were responsible for the largest number of jobs (Table 6).

Table 6 - Jobs positions on renewable energy by technology and by country in 2016.

Renewable Energy Sources	**Thousand Jobs**						
	World	**China**	**Brazil**	**United States**	**India**	**Germany**	**Japan**
Photovoltaic Solar	3,095	1,962	4	241,9	121	31,6	302
Biofuel	1,724	51	783	287,3	35	22,8	3
Wind	1,155	509	32,4	102,5	60,5	142,9	5
Solar heating/cooling	828	690	43,4	13	13,8	9,9	0,7
Hydropower (small scale)	1,519	312	183	28	236	6	18
Hidropower (large scale)	211	95	11,5	9,3	12	4	
Solid biomass	723	180		79,7	58	45,4	
Geothermal	182			35		17,3	2
CSP	23	11		5,2		0,7	
Biogas	333	145		7	85	45	
Total	**9,824**	**3,955**	**1,058**	**806**	**621**	**340**	**330**

Source: REN (2017).
*According to the source there is no data for the blank spaces.

The number of photovoltaic solar jobs increased by 12% in 2016. In India, annual plant growth increased by 17% while in Brazil the number remained stable. Employment in the area of biofuels increased by around 3%, although mechanization reduced labor requirements in Brazil. In India, the number of employees in this area remained the same in the previous year. With regard to wind power, approximately 1.2 million people worked in the sector in 2016, an increase of 7% over 2015. In China, wind energy jobs accounted for about half of the global total. Germany, the United States, India, Turkey, the United Kingdom and Brazil followed China in the ranking of those that generated the most wind power. As for hydroelectricity, China, India and Brazil were the main employers in relation to hydroelectricity. Considering all renewable energy technologies, the main employers remained China, Brazil, the United States, India, Germany and Japan (REN, 2016; 2017).

5 EMPIRICAL PANORAMA: RENEWABLE ENERGY COOPERATION BETWEEN BRAZIL AND INDIA

The first section of this chapter brings the data collected on the international acts signed jointly by Brazil and India regarding renewable energy. It also provides an analysis of documents resulting from the South-South cooperation meetings (BRICS and IBAS) in which Brazil and India participated, as these meetings helped to strengthen ties between the two countries.

In its second section, this chapter discusses the renewable energy policies established nationally by Brazil and India. 32 policies in the area of renewable energy created by these countries over forty years have been mapped, which have been compared, evidencing on which renewable energy sources they focus and pointing out similarities between them.

The third section brings the scientific and technological mapping of Brazil and India in the field of renewable energy. Brazilian and Indian scientific publications were reviewed considering six types of renewable energy. In addition, the patents deposited by Brazil and India in the area of renewable energy were also mapped and a comparison was made between the scientific and technological production of the two countries.

The fourth section addresses the competitiveness indicators of the two countries under study based on the analysis of the competitiveness reports over the ten-year period. 126 indicators were compiled, compared and analyzed to identify problems and opportunities in Brazil and India that may or may not contribute to the process of cooperation between the two States.

The fifth section presents the results and the discussion about the questionnaires that were applied with officials from the foreign ministries of Brazil and India. The sixth section presents the results of the interviews conducted with professionals from the academic, technical and political areas related to the theme of this work.

The next chapter presents proposals for strategies to expand cooperation between Brazil and India in the field of renewable energy.

5.1 INSTITUTIONALIZING THE INTEREST IN THE FIELD OF RENEWABLE ENERGY: INTERNATIONAL ACTS BETWEEN BRAZIL AND INDIA

Despite the mutual traditional interest in building a closer relationship in the field of renewable energy, a study was needed to verify if there were documents that formally institutionalized the interest of these two countries to cooperate. It also showed what types of renewable energy sources would be prioritized. With that aim in mind, the Integrated Consular System (ICS) was used, since it is a specific platform for this type of search and it includes all the international acts of which Brazil has been a signatory since 1823. Initially, the counting of the documents was done manually, considering that the virtual collection is not numbered, totaling 2,530 documents. After a change, the search strategy was improved because the keyword search option was made available; the count continued manually though. In the case of this study, "India" was adopted as a key word, which can be found both in the title and in the text of the available documents. The "All Acts" option was chosen to show not only the bilateral acts between the two countries but also those established in the multilateral sphere.

Besides the SIC search, in order to double check the findings of the study, a visit was made to the Ministry of Foreign Affairs of Brazil (MRE), based in Brasília, and a research on the website of the Indian Ministry of Foreign Affairs (MEA) was carried out. The documents on this site were made available not before the year 2006, and are not limited to international acts which made mining data very time consuming. On the MEA website, 144 documents related to Brazil and India were found, ten of which are signed acts. During the visit to the MRE[14], data was recorded by the internal system with the help of a diplomat[15], which counted 27 bilateral agreements between Brazil and India from the 2000s.

In order to identify the presence of the theme "renewable energy" in the acts established between Brazil and India in the Integrated Consular System (ICS), both in the title and in the body of the document itself, it was necessary to read all the international acts in which Brazil and India are joint signatories, for in many cases the theme or type of energy does not appear in the title of the document but in the body of the text only.

After checking the documents, 54 international acts were recorded, of which Brazil and India are jointly signatories, and three memoranda of understanding were

[14] On August 25th 2017.

[15] As there was not an authorization until the end of this research, I did not mentioned the name of the public server.

focused on biofuel, wind and solar sources. There is also an agreement and three memoranda that are not specifically about renewable energy, but that bring it as part of their objectives.

It should be noted that there are documents that do not have the theme "renewable energy" (or any specific type of renewable source), neither in the title nor in the text. However, they are so comprehensive that the theme "renewable energy" (like any other) can be included as part of the agreement. For this study, only the first two cases were considered, *i.e.*, those that directly address the theme and those that mention it among their main objectives.

The following chart presents the international acts between Brazil and India in the field of renewable energy.

Chart 1 - International acts in renewable energy between Brazil and India.

Year	Situation	Theme	Goals
2006	In force	Science and technology	Promote cooperation in science and technology in several areas including renewable energy.
2007	In force	Wind (ibsa)	Cooperate in the evaluation of wind resources, employment and development of systems and projects considering the strengthening of South-South cooperation.
2009	In force	Biofuels (ibsa)	Establish a trilateral task force to explore possibilities for cooperation in the area of biofuels and their technologies.
2010	In force	Solar (ibsa)	Cooperation in the development and commercial application; in identifying institutions, experts and industry partners to strengthen links and cooperation.
2010	In force	Science and tecnology (ibsa)	Promote cooperation between countries in the field of science and technology and innovation further improvement of friendly relations. Renewable energy as one of the seven priority areas.
2012	In force	Biotechnology	Cooperate in the area of biotechnology. Biofuels and bioenergy are areas that should be promoted.
2014	In force	Environment	Cooperate in the area of environment including renewable energy biofuel.

Source: SIC, 2006; 2007; 2002; 2014 2017; MEA, 2017a; 2017b; 2012; IBSA, 2010.

It is noteworthy that many of these acts mark a history of relationship between the two countries. The agreement in the area of science and technology, for example, has its roots in 1985. However, it had to be revised because it was considered only an agreement of intentions and also for not considering the needs of groups and programs of work, among other aspects that would support the cooperation process[16]. Thus, in 2006, Brazil and India signed a new agreement for scientific and technological cooperation between the two countries.

India's initial interest in the area of biofuels resulted in 2002, in the Memorandum of Understanding Concerning Technological Cooperation in the Field of Combustion for Transport. For the Interministerial Council on Sugar and Alcohol, the memorandum overloaded the Brazilian side with demands for consultancy and technological sharing without clearly mentioning what the Indian counterpart would be. However, the advantage of this agreement for Brazil consisted in the fact that the surplus ethanol produced would be exported to India: this operation would provide more concreteness to the relationship between the two countries and long-term political dividends (VIEIRA, 2007). In fact, in the 2002 memorandum, Brazil would be responsible for providing advice on eight topics in the area of biofuel (ethanol). However, the memorandum stated that there would be financial compensation for the use of know-how or the use of patents, the creation of conditions to promote commercial production and the development of joint projects that could generate new patents, which could counterbalance the Council. In addition, the memorandum was the first concrete step towards consolidating government relations between Brazil and India.

In 2006, this memorandum came into force, being entitled "Memorandum of Understanding to Establish a Trilateral Task Force on Biofuels". This time, at the IBSA Summit, Brazil and India decided to include South Africa in the memorandum. The three countries committed themselves to facilitating the technological transfer, production and consumption of biofuels with a view to promoting market in this area.

Perhaps because the 2002 agreement was criticized by the Interministerial Council on Sugar and Alcohol (VIEIRA, 2007), for its focus on the possible consultancies that Brazil could offer to India, with no counterparts to the same extent for the Brazilian side, the memorandum of understanding on biofuels that came into force in 2009 was revised and its main objective was to establish a task force to explore possibilities for cooperation in the field of biofuels and their technologies (BRASIL, 2009). Thus, the proposal is to facilitate technological transfer and promote the production and consumption of biofuels (ethanol and biodiesel) in order to establish a world market. In addition, it was agreed that countries should invest in training and qualification for the sustainable production of

[16] BRAEMB NOVA DELI [Telegrama 094] 20 feb. 2003, New Delhi [to] MRE, Brasília, 1 p. Brazil-India. Agreement of Cooperation in Science and Technology. Need to review it.

biofuels, stimulate joint research programs, exchange information on policy formulation and technological development for the biofuels sector, and information on engine development to promote the use of biofuels.

Despite the interest in cooperation between Brazil and India in the area of biofuels, there is still a long way to go so that concrete actions can be developed. An example of this was the interest of Prime Minister Manmohan Singh in the model of production and use of biofuels in Brazil and in the technology of "flex" engines. In April 2014, the director of the Heavy Industry Department of the Ministry of Heavy Industries and Public Enterprises of India visited Brazil to obtain information on Brazilian policies for the automotive and biofuels sector. The Narendra Modi government has demonstrated that it will expand its biofuels policy by showing that it will present a national policy for the development of "flex" engines, with a capacity of up to 85% ethanol in the gasoline or diesel blend, for industry automotive, while wanting to implement the previous government's 10% mix target (verbal information)[17].

Two other memoranda of understanding covering renewable energy were signed between Brazil and India (SIC, 2007, IBSA, 2010). The first one, entitled Memorandum of Understanding among the Government of the Federative Republic of Brazil, the Government of the Republic of India and the Government of the Republic of South Africa on Cooperation in Wind Resources, was signed in 2007. Its main objective, besides the promotion of renewable energy in their respective matrices, is to strengthen South-South cooperation in strategic areas, energy resources included.

Thus, recognizing the common interests shared by Brazil and India, these two countries and South Africa decided that they should cooperate to carry out an evaluation of their respective wind energy resources. This assessment would be made through specific measurement and modeling methodologies that would help identify the technical potential and economic potential of these resources. In addition, there should be cooperation in the areas of standards and testing facilities and certification procedures for systems, and the design and development of wind power systems projects, including systems for low wind regimes. The parties have also committed themselves to identifying research institutions and other relevant specialized organizations for the strengthening of cooperation ties.

In order to promote cooperation in solar energy, the Memorandum on Solar Energy Cooperation was signed among Brazil, India and South Africa in 2010. The main

[17] Conversation with Brazilian ambassador at the beginning of the development of this thesis. There was no authorization to mention her name formally.

objective of this memorandum is for National States to encourage and facilitate cooperation in development and commercial application of solar energy through the evaluation of solar energy resources and technologies, identifying the technical and economic potential of this source and promoting the exchange of information for the development of cooperation in the area. Countries have also committed themselves to identifying research institutions, expert organizations and industry partners to strengthen ties and cooperation in solar energy. In 2015, representatives of the Indian government and some of India's leading energy companies, such as Power Grid of India and Solar Energy Corporation of India, were in Brazil interested in promoting cooperation between the two countries (ITAIPU BINACIONAL, 2015).

It should be noted that wind and solar energy were the sources on which Brazil and India have most focused their investments in recent years. In 2015, India launched the Solar International Alliance with the goal of promoting solar energy in the countries with the highest incidence of sunlight, located between the tropics of Cancer and Capricorn. This initiative has been ratified by 120 countries, amongst which is Brazil. The idea is that member countries can develop actions and programs on a voluntary basis to promote solar energy in their territories (UNFCCC, 2015b; EMBAIXADA DA ÍNDIA, 2017; BRASIL, 2016; ISA, 2017). These facts undoubtedly indicate that the two countries are converging at the multilateral level with actions to promote this energy source.

In the face of international discussions on climate change and environmental issues in the various UN conferences, and certainly as a pre-alignment to COP 21, which was to take place in the city of Paris in the following year, another memorandum between Brazil and India was signed.

Entitled Memorandum of Understanding between the Government of the Federative Republic of Brazil and the Government of the Republic of India on Cooperation in the Environment its main objective is to promote cooperation between the two countries in protecting and improving the environment. In it, ten priority areas were listed, among which is biofuels. The memorandum establishes that cooperation between the parties should be conducted through the exchange of information and documentation; visits by experts, scholars and delegations; seminars, workshops and jointly organized meetings; collaborative projects; and other mutually agreed forms of cooperation.

There are three other international acts between Brazil and India that also address the theme "renewable energy" as a priority area to be explored by the two countries through cooperation. The Agreement on Scientific and Technological Cooperation anticipates the need for scientific and technological information exchange, as well as the joint identification of scientific and technological problems and the application of knowledge to solve them.

Renewable sources are amongst the ten areas listed for cooperation between the two countries. The Memorandum on Science, Technology and Innovation 2010, already incorporating South Africa (IBSA), also brings alternative or renewable energy as an area of interest for cooperation among the three countries. This memorandum is less detailed than the one signed between Brazil and India. It focuses on holding workshops and other events in the area, setting up a working group, short-term exchanges among researchers, formulating programs and trying to organize "IBSA technology days".

The third international act is aimed at cooperation in science and technology in the area of biotechnology between Brazil and India. The document asserts that the two countries should encourage research, development and transparency through the exchange of information. They should also promote joint projects, the exchange among researchers and students, and the creation of patents and publications in partnership. Five priority areas, including biofuels and bioenergy, in which the two countries can collaborate were highlighted.

It should not be forgotten that this thesis does not have the objective of identifying and mapping the projects coming from the international acts, but, rather, of verifying and identifying if there were agreements between Brazil and India in the area of renewable energy, which would indicate an interest of approximation between the two States in the area and also show the types of renewable energy that interest could focus on. In spite of this, data provided by the Ministry of Science and Technology of Brazil (MCTIC)[18] shows that there have been three calls for joint bilateral research projects between the National Council for Scientific and Technological Development (CNPq/Brazil) and the Department of Science and Technology (DST / India) and the Department of Biotechnology (DBT / India). In all the calls for projects, the theme "renewable sources" was highlighted in the following specifications: bioenergy, renewable energy, energy efficiency and low carbon technologies, sugarcane and second and third generation biofuels.

Under the IBSA, in 2013, a call was made for the Trilateral Scientific and Technological Cooperation Program among India, Brazil and South Africa, and in 2016, under the BRICS, a call for research involving a minimum of three of the five countries that make up the group. On the Brazilian side, the representatives were MCTIC and the

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[18] ASSIN/MCTIC. **Brasil-Índia Cooperação** [personal message received]. Message received <mcadmm@yahoo.com.br> in April 25th 2017.

CNPq; on the Indian side, the DST. In the two calls for joint projects the topic of renewable energy was one of the priority lines for the development of joint projects. We attempted to contact the researchers whose projects were contemplated in the calls. One of the professors selected for the Federal University of Rio Grande do Sul CNPq/DST call carried out a project with the Indian Institute of Technology of Mumbai that lasted two years (2015-2017). According to the professor, the experience was positive, as it resulted in some publications, and there is the prospect of publishing in collaboration even after the project is completed[19].

Regarding the IBSA a researcher said that the project is finishing and a paper was published on the scientific journal and there is a perspective of future works[20]. Regarding to BRICS call for submission of proposals, a researcher said that, despite the project being approved, no resource was allocated so it could be carried out[21].

A study was also conducted at the Brazilian Cooperation Agency (ABC, 2017) e no MEA (2017b) to verify if there were projects in partnership between Brazil and India. At the ABC, two results were found involving Brazil, India and South Africa: a project to share Brazilian experiences in ethanol and another to analyze possibilities for cooperation in housing, both completed. At the MEA, the same project found in the MCTIC, and already mentioned, and a cultural exchange program to promote cooperation in the artistic area were found. Also, a search was conducted, in the Ministry of Mines and Energy of Brazil through the Electronic System of the Citizen Information Service of Brazil, to see if there was any cooperation project between Brazil and India in the area of renewable energy, which was denied officially by the Ministry of Mines[22].

Regarding hydroelectricity, India is interested in learning about the Brazilian experience in the area. In 2003, a delegation from the Indian Ministry of Water Resources visited Brazil to learn about environmental programs related to people displaced by the construction of hydroelectric dams (VIEIRA, 2007). In 2015, representatives of the Indian government and some entrepreneurs in the area of renewable energy were in Itaipu with the intention of establishing cooperation. The delegation attended the presentation of the Superintendent of Renewable Energy of Itaipu and visited all the governmental

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[19] CLARKE, Thomas. Brasil - Índia [personal message received]. Message received by mcadmm@yahoo.com.br in October 23th 2017.

[20] Information given throough telephone contact on October 23th 2017.

[21] GASPARY, Luciano P. – Brasil-Índia [mensagem pessoal]. Message received by mcadmm@yahoo.com.br in October 24th 2017.

[22] SISTEMA ELETRONICO DO SERVIÇO DE ATENDIMENTO AO CIDADÃO (e-SIC). Detail of request. Available in: https://esic.cgu.gov.br/sistema/Pedido/DetalhePedido.aspx?id=BIXaPNc9eO0=

institutions of the Brazilian electric sector, seeking to understand the energy planning for renewable energy and for the entire energy system. After all, India intends to install 150 GW of hydroelectricity in the next ten years. Because of this, on the occasion, they had a particular interest in learning what Brazilians do to guarantee reliability in supply. According to Ashish Khanna, an energy expert of the International Bank for Reconstruction and Development, India has a potential of 60 GW to be explored in cooperation with other countries. For this reason, Itaipu would be an example for India (ITAIPU BINACIONAL, 2015).

It is important to note that in 2002 the Memorandum of Understanding between the Government of the Federative Republic of Brazil and the Government of the Republic of India establishing the Joint Political, Economic, Scientific, Technological and Cultural Cooperation Committee (SIC, 2002) was signed. Although it does not mention the areas in which countries should cooperate, this document is relevant because it creates the commission, chaired by the respective foreign ministers, which will try to examine the possibilities or areas of cooperation between the two countries.

It were collected the declarations from the meetings of the aforementioned committee, which take place every two years since 2009. At the last meeting, held in 2015, ministers pointed out that renewable energy sources should be increased in the energy matrix. And both Brazil and India have shown interest in cooperation in hydropower, solar, wind and biomass sources. They also agreed to explore second-generation ethanol and other biofuels.

It should be emphasized that, Brazil and India have been working in other spheres (not only bilateral), such as in the IBSA and BRICS, which certainly helps to reinforce established links. Additionally, it was considered necessary to go beyond the international acts to verify if, in the sphere of these groups, there was interest in the subject renewable energy as well as in cooperation in this area. As Brazil and India participate simultaneously in IBSA and BRICS, this interest would reinforce the importance of renewable energy for both countries.

From the summits at the India-Brazil-South Africa Dialogue Forum (IBSA), conducted between 2006 and 2011, five documents in a total of 57 pages when transcribed in the word processor were examined. This study showed that these documents are based on the intentions of the three countries to strengthen trilateral relations and cooperation in several areas. Renewable energy are mentioned at all summits, and at the Fourth Summit, the three countries signed two memoranda of understanding: one on science and technology (which also addresses renewable energy) and the other on solar energy. At the last summit in 2011, the countries emphasized that studies to promote cooperation in alternative energy should be encouraged (IBSA, 2006; 2007; 2010; 2011).

Brazil and India made efforts to ensure that the IBSA initiative would cover the interests that had already been articulated between the two States. An example of this is the memorandum of understanding on biofuels that was initially signed by the Brazilian and Indian joint interest.

After this memorandum was reviewed and some changes applied to it, the two countries joined South Africa and created a new document establishing this country as a third partner. The other memos on solar energy and wind power issues, following the biofuel memorandum, have now come to view the three countries as partners. Although it has been six years since the last IBSA summit, which in a way evidences a slowdown in the process, the IBAS initiative continues. Formal meetings took place again: in 2017 there was a meeting in September on the margins of the United Nations General Assembly and another meeting to sign an agreement on the IBSA Fund, which took place in October 2017 and which established that next summit to be held in 2018 in India (MRE, 2017f; MRE, 2017g).

Under the BRICS scope, all the declarations of the summits held since 2009 were analyzed (STF, 2011; MRE, 2010; 2012; 2013a; 2014; 2015a; 2016b; 2017h; 2017i). This led to the study of eight documents with a total of 121 pages. The declarations (instruments of intent) make clear the interest of countries in promoting renewable energy and in encouraging cooperation in this area. This is particularly evident from the Fourth Summit. With regard to renewable energy, the declarations recognized the importance of diversifying energy matrices, promoting renewable energy and international cooperation among member countries in this area, including exchange of experiences in alternative sources, technologies and policies in the area of biofuels, training and research and development. The action plan of the Fourth Summit defined energy cooperation within BRICS as a new area to be explored.

During the 2013 Summit, the Declaration of Thekwini (held in Africa) was signed. Energy was considered a relevant area for cooperation among the countries of the South.

From 2014, the meetings more clearly outlined the energy issue in the framework of cooperation between the countries of the South with a focus on renewable energy. In the declaration of the Sixth BRICS Summit, held in 2014, in Fortaleza, Brazil, energy appears as one of the central topics of discussion. Countries recognized that climate change is one of the greatest challenges facing humanity and called on each other to rely on the decisions of the United Nations Framework Convention on Climate Change

(UNFCCC), [23] which would have an impact on the energy area. In addition, they reiterated that renewable energy, research and development of new technologies can be an important engine for promoting sustainable development, leading to economic growth, reduction of energy costs and increased efficiency in the use of natural resources, in view of their respective policies and natural resources.

In 2015, the declaration from the 7th BRICS Summit, held in the city of Ufa, Russia, highlighted the importance of renewable energy sources, placing investments in renewable energy sources as a priority. Countries have committed themselves to have their energy regulators seek ways of cooperating with one another and have called on their political authorities to consider the possibilities for cooperation between them reaffirming once again that developing international energy cooperation between BRICS is necessary.

In Goa, India, at the eighth BRICS summit (2016), countries recognized the relevance of renewable energy, as it had occurred in previous meetings, and once again highlighted international cooperation in this area. In 2017, in China, during the ninth summit, in addition to re-echoing the same intentions from previous summits on renewable energy, they encouraged dialogue on establishing a BRICS energy research cooperation platform.

The IBAS, as asserted by Visentini (2010), is one of the most relevant cooperative efforts of the South after the Cold War. This idea can also be applied to BRICS. Although the outcomes of the summits among these countries consist substantially of texts that extol the participants' intentions to dialogue or cooperate in a particular area, these documents not only represent a historical value because of the relevance of the two groups, but also certify areas of relevance in which these countries intend to intensify the cooperative dialogue. In addition, areas of collective interest intersect with those of individual interest, reinforcing that actions should not be thought and executed only in the bilateral sphere, but also impelled in the plurilateral scope.

The most expressive and concrete fact of the dialogue among the five BRICS member countries was the creation of the New Development Bank, which was legally in existence in 2015, although its creation took place the previous year during the Summit held in Brazil. In 2016, at the VIII Summit, Brazil, Russia, India, China and South Africa celebrated the approval of New Development Bank's first set of loans. The bank has the function of financing projects in the areas of infrastructure and sustainable development in the BRICS countries and in other emerging countries.

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[23] United Nations Framework Convention on Climate Change (UNFCCC).

The approval of the loans for the development of projects meant a practical advance of the group to concretize, in a more effective way, the development of renewable energy in their countries. A search was made to learn the number of projects approved, the thematic areas of each of them and which countries were contemplated.

Of the total financial contribution, approximately US $ 3 billion, Brazil will receive 10.3% and India will receive 36.7% of the total available, that is, the largest contribution among the five countries. Six of the 11 projects with financing are focused on renewable energy, one in Brazil and the other in India, as it can be seen in the chart below.

Chart 2 - NDB first projects: Brazil and India (2016).

Projects	**Millions US$**	**Borrower/ Guarantor**	**Goal**	**Impact**
Canara (Índia)	250	Canara Bank/Governo da Índia	Renewable Energy	500 MW (renewable energy)
BNDES (Brasil)	300	BNDES	Renewable Energy	600 MW (renewable energy)
Madhva Pradesh (Índia)	350	Governo da Índia	Roads improvements	About 1,500 km of roads improved
MP Water	470	Indian Goverment	Water supply, sanitation and rural development	About 3.400 of villages benefited

Source: NDB (2017).

It can also be emphasized that, besides the bilateral initiatives and those of the IBSA and BRICS, Brazil and India also seek to cooperate on other fronts. The initiatives launched by the two countries within the framework of the Conferences of the Parties of the United Nations are an example. Brazil created the Biofuture Platform in 2016 to leverage the biofuels market (BIOFUTURE PLATFORM, 2016), which was ratified by twenty countries, among which is India, which in turn launched the Solar Alliance in 2015, also supported by Brazil.

In October 2017, the first conference of the Biofuture Platform took place with the participation of 28 countries, among them India. The Brazilian Minister of Foreign Affairs stressed the need to implement the use of biofuels in the fleet and in the infrastructure of existing automobiles in order to achieve the climate objectives and for the combination of policies and technologies, for example, to contribute to the production of more food and more energy. The director of the International Renewable Energy Agency during the event said that bioenergy for transportation is fundamental, reiterating the importance of biofuels for light vehicles and for aviation, navy and freight. The president of the biofuels working group of the Indian Ministry of Natural Gas Oil said, at the conference, that India is betting on second generation technologies and that India's goal is to quickly achieve a 10% bio blend ethanol in gasoline and 5% biodiesel by 2022. He also said that the Indian oil company should install 12 second- generation plants in the country (BIOFUTURE PLATAFORM, 2017).

The diversification of the energy matrix with the increase in the use of renewable sources is relevant not only for promoting energy security, but also for the democratization of access to energy, mitigation of CO_2 emissions and economic dynamism through technology transfer. All these issues are fundamental to Brazil and India, even if they have to be worked on different priority scales.

In 2016, following the BRICS annual meeting, Brazil and India issued a joint statement (MRE, 2016a) reiterating the need to deepen bilateral engagement and cooperate in what they consider to be key areas for both, including energy. And, acknowledging the Brazilian experience in ethanol, they have identified a potential to cooperate in research and development in second generation biofuels and in renewable energy in general.

The reciprocal interest of Brazil and India in cooperating in renewable energy sources have signalized institutionalized actions between both countries. However, the development of actual actions in this direction is still incipient. The memoranda in renewable energy still waiting for concretes actions and the most recent joint declaration of the two countries, which looks more like a document of intentions to "build a forward-looking relationship" (MRE, 2016a), are examples that demonstrate this fact. Thus, in an attempt to propose strategies to expand cooperation between these two states, only the search to verify the official approach between the two countries in the area of renewable energy is not enough.

Given the interest of the two countries in cooperating in the field of renewable energy, especially drawing attention to the scientific and technological memoranda signed by the two countries, it is worth asking about the countries national scenarios in terms of scientific and technological production in the field of renewable energy. However, before examining the interest of the Brazilian and Indian scientific community in this area, it is necessary to examine the political framework or the development of policies in the field of renewable energy in Brazil and India.

5.2 BRAZIL AND INDIA: RENEWABLE ENERGY POLICIES

This section presents and compares the main policies for renewable energy sources established in Brazil and India. The idea is to highlight the renewable energy on which the two countries focus their efforts, taking into account that the common interests, plus the countrie's expertise, can help foment the process of cooperation. The time horizon of forty-two years was established, considering that, in 1975, Brazil assumed a leading position in relation to India, creating its first policy in the area. Thirty-two policies on renewable energy were mapped based on searches conducted on the websites of the Brazilian Ministry of Mines and Energy (MME), the International Renewable Energy Agency (IRENA), the International Energy Agency (IEA) and the Ministry of New and Renewable Energy (MNRE) in India. It should be noted that some professionals from the Indian Renewable Energy Development Agency (IREDA), Jawalharal Nerhu University (JNU), Deutsche Gesselschaft für Internationalle Zusammearbeit (GIZ / India) and the Brazilian Embassy in New Delhi also collaborated in the search for the main Brazilian and Indian policies on renewable energy.

5.2.1 **Policies in Brazil and India in the field of renewable energy**

In order to mitigate the effects of climate change or to create new economic opportunities or reduce dependence on fossil fuels, the development of renewable energy takes place through the support of policies established by the National States. In 2016, renewable energy policies were present in 176 countries, a number higher than 2015 (145 countries) and about 11 times higher than the number of countries in 2005, when only 15 countries, including Brazil and India, adopted promotion policies to renewable energy (REN, 2016; 2017).

These data bring to the market a clear signal that states are committed to promoting renewable energy by creating new technologies or by developing those that are already being used.

The major policies were the ones related to the electricity, the heating and cooling and the transportation sectors, which have maintained the leading position for at least four consecutive years (REN, 2015; 2016; 2017).

Brazil and India have targets for the development of renewable energy. The Brazilian objective, besides being a world reference in relation to its electrical matrix, which is the most renewable among BRICS (73% of its total), is to reach, up to 2024, 8 GW in small hydroelectric plants (SHPs), 18 GW in bioenergy, 24 GW in wind energy and 7 GW in solar energy (REN, 2017). India, on the other hand, has set to achieve, by 2022, 10 GW in bioenergy, 5 GW in small hydropower plants, 60 GW in wind and 100 GW in solar energy, which is an ambitious goal (REN, 2017).

According to the IEA (2013), Brazil will double its production of renewable sources by 2035, maintaining a 43% share in its energy matrix. Hydroelectricity will remain important, although dependence on it will decline. Brazil, already the world's second largest producer of biofuels, will increase its production of ethanol from sugarcane by more than triple. Still according to the IEA, the current crop areas are more than enough to absorb this increase without affecting the environmentally sensitive areas. By 2035, Brazilian biofuels are expected to meet one third of domestic demand for transportation fuels and its net exports to account for about 40% of world biofuel trade.

Although there are national policies concerning the promotion of renewable energy, it should be emphasized that there are also those at the provincial level that can complement those established by the National States. Several cities in Brazil and India promote such policies. The city of São Paulo, in Brazil, is an example of this with regard to the adoption of building codes that promote renewable thermo-technologies in building . Other examples are the Indian cities of New Delhi, Bengaluru and Guragon, which have stimulated photovoltaic solar power generation and the city of Mumbai which has eliminated taxes on ethanol production (REN, 2017; IRENA, 2017).

Policies are, in essence, the foundation for actions that are taken at the same time as they also shape themselves as the compatibilizers of interests, including national interests. Public policy, thus, can be understood as a set of norms, actions and programs aimed at serving the various sectors or at meeting the demands of society (LYNN 1980, PETERS 1986, DYE 1984).

India and Brazil have been developing policies to support renewable energy for decades. Brazil took the lead in the development of biofuel with the creation of Proálcool in 1975. Initially an alternative to the oil crisis and a reaction to the fall in sugar prices in the international market, this program sought to stimulate the production of alcohol to meet domestic and foreign demands by encouraging the production of alcohol from sugarcane and from other inputs to the automotive market (BRASIL, 1975). Ten years later, the country created the National Program for the Conservation of Electric Energy (Procel) with the objective of rationalizing the production and consumption of electricity and combating its waste. This program also created a label to guide consumers in choosing products that are more energy efficient (ELETROBRÁS, 2015). In 1986, Brazil launched the Program for the Control of Air Pollution by Automotive Vehicles (Proconve) with the objective of reducing and controlling the gases emitted by mobile sources (automotive vehicles) that contribute to polluting the atmosphere (ICCT, 2016; BRASIL, 1986).

In the early 1990s, the Brazilian government created the National Program for the Rationalization of the Use of Petroleum and Natural Gas Derivatives (Conpet) with the objectives of rationalizing the consumption of oil and natural gas derivatives and providing technical support to the increase of energy efficiency in the use of energy (CONPET, 2016). Although the program is not focused on renewable energy, it has reinforced Proncove and underlined as one of its objectives the reduction of greenhouse gases. It should be noted that it was launched a year before the Eco-92 United Nations Conference on Environment and Development held in Brazil.

Although some of the initiatives for Brazilian policies were established in the 1970s, 1980s and 1990s, it was only from the 2000s that the development of policies to promote renewable energy began to intensify in Brazil, coinciding with the period in which investments in renewable energy have also begun to intensify. The following chart presents some of the main policies established in Brazil, the year of creation and the summary of their main objectives.

Chart 3 - Brazilian policies in the field of renewable energy (1975-2016).

Year	Policy	Main objectives
1975	**National Alcohol Program – Proalcool**	Replace petroleum-derived vehicle fuels through the production of alcohol (BRASIL, 1975).
1985	**National Electrical Energy Conservation Program– Procel**	Eliminate waste and reduce costs. Labels to guide the consumer; stimulate the manufacture and commercialization of more efficient products (ELETROBRÁS, 2015).
1986	**Air Pollution Control Program for Motor Vehicles (Proconve)**	Reduce pollutant emission levels; promote national technological development and population awareness (ICCT, 2016, BRASIL, 1986)
1991	**National Program for the Rationalization of the Use of Petroleum and Natural Gas Derivatives – Conpet**	Develop and integrate actions aimed at rationalizing the use of oil derivatives and natural gas (CONPET, 2016).
2000	**Energy Efficiency Program – PEE**	Force distribution companies to invest a minimum percentage of funds in Energy Efficiency Programs (BRASIL, 2000).
2001	**Emergency Wind Energy Program – Proeólica**	Enable the implementation of 1,050 MW generation of electricity from a wind power source by December 2003 (BRASIL, 2001).
2002	**The Incentive Program for Alternative Energy Sources – Proinfa**	Increase the share of electricity based on renewable sources (BRASIL, 2002; BRASIL, 2004).
2003	**Light for All Program**	End the electric exclusion in the country and provide access to electricity (BRASIL, 2014a).
2004	**National Program for the Production and Use of Biodiesel**	Implement, in a sustainable way, the production and use of biodiesel, with a focus on social inclusion and regional development (MME, 2016).
2005	**Law no. 11,097**	Introduce biodiesel into the Brazilian energy matrix (BRASIL, 2005).
2007	**Decree no. 6,048 electricity auctions**	Address market growth in the regulated environment and increase the share of renewable sources (BRASIL, 2007).
2009	**Law no. 12.187 (National Policy on Climate Change)**	Reducing GHG; promote international cooperation; promote renewable energy sources, low energy consumption and energy efficiency (BRASIL, 2009a).
2012	**Resolution no. 482**	Establish general conditions for access to micro-generation and to distributed mini-generation of electric energy; focus on renewable energy (ANEEL, 2012).
2014	**Law no. 13,033 addition of biodiesel**	Make it mandatory to add biodiesel to the diesel fuel sold to the final consumer (BRASIL, 2014b).
2015	**Resolution no. 1 of March 4th**	Require that 27% ethanol be added to gasoline (BRASIL, 2015).
2016	**Law no. 13,263**	Make it mandatory to add 8% biodiesel to diesel in 2017 and 10% in 2019 (BRASIL, 2016).

Source: Author's elaboration.

Since the 2000s, India has also begun to intensify the promotion of renewable energy through the establishment of policies in the area. In 1998, 23 years after Brazil created its first policy on renewable energy, India launched *Policy on Hydro Power Developmen*t, which aimed to promote hydroelectricity in the country through, for example, research funding. But it was in 2003 that India took the most important step in the development of renewable energy policies by creating the Electricity Act, which aimed to pursue a more coordinated development of the energy sector and provide a comprehensive framework for the development of energy, emphasizing that renewable energy in general should be considered in the National Electricity Policy, which was launched in 2005 and one of its main objectives is to promote electricity through non-traditional sources of energy. In 2003, India launched the National Auto Fuel Policy, which mandated that all new four-wheeled vehicles in 11 Indian cities must meet the emission standards called Bharat Stage III (equivalent to Euro III standards) for conventional air pollutants (Ministry of Law and Justice, 2003; Ministry of Petroleum and Natural Gas, 2015). In 2003, India began to adopt about one policy a year, as it can be seen in the following chart.

Chart 4 - Indian policies in the field of renewable energy (2001-2016).

Year	Policy	Main objectives
1998	**Policy on Hydro Power Development**	Promote hydroelectricity in the country. Increase private investment, funds for research in the field, promote institutional mechanism to deal with areas of risk (MINISTRY OF POWER, 1998).
2003	**Electricity Act**	Coordinate the development of the electric sector in India; promote competition between industrial and environmental policies; prepare the national electricity policy and the national tariff policy (MINISTRY OF LAW AND JUSTICE, 2003).
2003	**National Auto Fuel Policy**	Require all new four-wheelers to follow Bharat Stage emission standards for conventional air pollutants (MINISTRY OF PETROLEUM AND NATURAL GAS, 2015).
2005	**National Electricity Policy**	Promote unconventional energy sources and competition between renewable energy; increase the share of purchased electricity in non-conventional resources; put "maximal emphasis" on the development of hydropower (MINISTRY OF POWER, 2005).
2006	**Integrated Energy Policy**	Demand the production of energy "at the lowest cost in a technically efficient, economically viable and environmentally sustainable way" (GOVERNMENT OF INDIA, 2006).
2006	**Rural Electrification Policy**	Provide access to electricity for all households; provide a reliable and high quality source of energy at reasonable prices (MINISTRY OF POWER, 2006a).
2006	**Tariff Policy 2006**	Encourage unconventional energy technologies (MINISTRY OF POWER, 2006b).
2007	**Energy Conservation Building Code (ECBC)**	Specify the energy performance requirement of commercial buildings in India; minimum requirements for the construction of envelope components such as lighting (MINISTRY OF POWER, 2016).
2008	**National Action Plan on Climate Change – NAPCC**	Ensure that participation of renewable energy in the national mix will reach 15% by 2020 (MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE, 2009).
2009	**National Policy on Biofuels – NPB**	Make the production of ethanol guarantee 20% of the blend of biofuels; introduce incentives; develop R & D (MNRE, 2009).
2010	**The Finance Bill**	Create the National Clean Energy Fund to invest in entrepreneurial ventures and research in the field of clean energy technologies (LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE; THE GRANTHAM RESEARCH

		INSTITUTE ON CLIMATE CHANGE AND THE ENVIRONMENT, 2015).
2010	**JNU Solar Mission**	Establish India as the global leader in solar energy (MNRE, 2010).
2011	**Strategic Plan for the New and Renewable Electric Sector**	Promote the implementation of interactive renewable energy; promote renewable energy in rural areas and enhance it in urban areas; develop renewable energy technologies; encourage the development of a manufacturing industry in the renewable energy sector (MNRE, 2011).
2012	**National Electricity Plan**	Ensure reliable access to electricity; keep CO_2 in decline; expand rural access and power generation; modernize hydroelectric power projects (MINISTRY OF POWER, 2012).
2015	**National Offshore Wind Energy Policy**	Enable better exploitation of offshore wind energy; promote investment in energy infrastructures, spatial planning and management of renewable marine resources; reduce carbon emissions; promote energy security (MNRE 2015a).
2016	**Policy for Repowering of the Wind Power Project**	To promote a better use of wind energy resources, creating a facilitative framework for repowering (MNRE, 2016b).

Source: Author's elaboration.

Despite the difference in time between the actions promoted, both countries have similarities in the understanding of their policies. The interest of the countries in sources such as biofuels, wind energy, solar energy and hydroelectricity is well known. Both Brazil and India have established specific policies on the subject of climate change, which, although having the main focus on the mitigation of greenhouse gases, also have specific characteristics: in the case of Brazil, it is foreseen, for example, the increase in the supply of cogeneration electric energy, mainly that derived from sugarcane bagasse; in the case of India, the establishment of a solar energy research center.

However, although there are some differences, the approaches are more convergent, once, for example, both countries are interested in increasing participation of photovoltaic solar energy and solar water heating for the generation of energy. Another aspect not less relevant is that, in the policies analyzed, there is a stimulus to international cooperation, which should be promoted to enhance technological development and the transfer and diffusion of knowledge in the renewable energy areas.

The National Electric Energy Conservation Program, in Brazil, and the Domestic Appliance Labeling Program in India (The Standards & Labeling Program), both focused on energy efficiency, are policies that have similarities. Although the Brazilian initiative is older, it was established 20 years ago, and more complete, because it addresses other topics, such as the proposal to financing low-cost projects for energy efficiency, the two programs have created a labeling system with the goal of guiding consumers in choosing more energy efficient products.

In addition, Brazil and India have similar policies in relation to reducing vehicle emissions, the Indian one being established in 2003 and Brazilian one in 1986. Brazil has decided to limit emissions from diesel vehicles and has set emission standards for all vehicles marketed from 2015 (Brasil, 1986, MMA, 2017b, ICCT, 2016), which is equivalent to the EURO V standard. In India, the National Fuel Auto Policy indicated that the government should adopt the equivalent to Euro VI in 2020 (Ministry of Petroleum and Natural Gas, 2015). Undoubtedly, this reflects not only the demands of the international community on global warming, but also the possible chronic deficiency of transport systems in Brazil and India. One must not forget that in India this type of policy is also as an attempt to reduce air pollution, which contributed to reduce India's life expectance in 23 months (IEA, 2016c).

Both States have policies aimed at promoting biofuels. In India, for example, the blend of biodiesel in diesel is still 5%. However, the country has set a 20% target for the biofuel blend (ethanol and biodiesel) to traditional fuel. At the end of 2012, the Indian government announced the increase of the ethanol blend from 5% to 10%. In Brazil, Law 11,097 / 2005 established as mandatory the introduction of biodiesel in the Brazilian matrix (BRASIL, 2005). In 2014, the blend of biodiesel in diesel in Brazil rose from 5% to 7% and, in 2015 that of ethanol, after a technical feasibility study, increased to 27.5%. India has also established that state-run India Railways would include 5% biodiesel in the diesel that supplies its locomotives. The policy also states that engine manufacturers must also modify engines to ensure compatibility with biofuels whenever necessary (MNRE, 2009).

In the Indian biofuels policy, there is a specific topic on international cooperation in the areas of production and use of this source. This policy refers to the implementation of cooperation modalities that would include technology research and development, field studies, establishment of project partnerships, and involvement of research institutions and industry. In addition, the policy further emphasizes that bilateral and multilateral cooperation to share technologies and funds should be promoted (MNRE, 2015).

Brazil, on the other hand, in the field of renewable energy in its foreign policy, aims to increase the use of biofuels. To this end, it has sought to influence other peers during the discussions on policies in the field of renewable energy at the multilateral level, while understanding the importance of the diversification of regional and extra-regional partnerships for the theme (MRE, 2017d).

There are other similarities between Brazilian and Indian policies, such as the initiative to promote electricity in communities without access to electricity or with deficiency access to electricity, *i.e.* Light For All in Brazil and Rural Electrification Policy in India. Although the focus of the Light for All is not on renewable energy, this program also contemplates, for communities located in areas of difficult access, the generation of electricity through solar and wind energy. In the case of the Indian policy, the focus is to promote, in poor communities without access to electricity, electricity through the use of solar, wind, biomass and small hydroelectric power stations.

By studying renewable energy policies established in Brazil and India, it was possible to notice that since the 2000s, there has been a greater growth in the number of these policies in the two countries, certainly due to the macroeconomic indicators of these countries which, since that decade, have come to stand out in the international scenario. Environmental issues related to climate change, increased demand for energy and the need to diversify their energy mix, especially in India, have also helped to give more impetus to policy-making in the area.

As was pointed out, it was not intended to present in this section an evaluation and an exhaustive comparison of each of the identified policies, but rather to present the results of the established question, which was to verify if Brazil and India developed policies in the field of renewable energy and whether there was any similarity between them, which together with the expertise of each of these countries could help the process of cooperation in renewable energy between the two countries. Thus, it was evident that both Brazil and India show an interest in stimulating renewable energy sources by promoting investments and developing policies to promote them, particularly hydro, solar, wind and biofuel sources. In this context, it should only be pointed out that, although Proeólica in Brazil is no longer active and Brazil does not have a specific policy in the area of wind energy, Brazil has adopted other actions that have in their scope the incentive to promote energy wind in its territory.

Despite the promotion of renewable energy policies in Brazil and India, it is possible to emphasize that prospects for success also depend on political collaboration, which is necessary to ensure that technical knowledge can help implement ideas that help respond to global and national challenges.

Although renewable energy investments in Brazil and India have increased steadily over the last 12 years, their installed capacity in renewable energy has increased by 50.6% and 119%, respectively, in approximately 10 years, and the two countries have developed policies in the field of renewable energy in particular since the 2000s. A question arises: has the interest of the Brazilian and Indian scientific communities also grown in the area of renewable energy?

The next section addresses this question using the results of scientific and technological mapping and bringing a series of data, such as renewable energy on which Brazil and India are concentrating efforts over time in relation to scientific and technological production.

5.3 SCIENTIFIC AND TECHNOLOGICAL MAPPING IN BRAZIL AND INDIA

This section presents the results obtained from the scientific and technological mapping in Brazil and India in the field of renewable energy. The results and analysis underline which country has published the most in this area and also the energy on which they are focusing their publications, which indicates, in addition to the specific interest in a particular source, the vocation for a particular type of renewable energy. In addition, it was considered relevant to show not only the partnerships established between the two countries, but also their main partners in scientific production. The data obtained from the technological production of Brazil and India revealed the number of patents in the area and which country is the most competitive in terms of the number of deposits made. A comparison was also made between the number of scientific publications and the number of patents for renewable energy of the two countries under study. In addition, the cross-referencing of these data indicated the country's expertise in certain areas, which can help promote the cooperation process.

5.3.1 **Scientific mapping**

The quantitative data of the Brazilian and Indian scientific production in renewable energy were extracted from the scientific base Web of Science (WoS). This base was chosen due to its recognition on a global scale as one of the research platforms that cover the most used databases in the world that are "sources for the construction of scientific production indicators" (FAPESP, 2011).

In addition to grouping documents from more than 90 countries in all subjects and in all areas of knowledge, for a document to be indexed on the Web of Science, a prior evaluation is made to avoid that, in the collection of data, publications without scientific reliability are selected. Among the bases that perform quality assessment, the Web of Science presents an error of less than 15% when it comes to capturing documents outside the search scope. This means that there is a greater reliability that the results found, in fact, correspond to the content that is sought (QUINTELLA, 2006).

The search for the data was performed between August and September 2017. The year 1945 was considered the beginning of the search period, for being the year provided by the platform to begin the search for the data of scientific production. This made it possible not only to verify the date of the first publication of the selected themes for this prospection in each country studied, but also to give consistency to the analyzed data. The search period, therefore, comprised approximately seventy-two years (1945-2017).

Once the database was defined, the next stage consisted in determining the keywords to be used in the mapping of the documents. They were defined according to the search objectives and the characteristics of the theme. It is worth noting that the keywords were defined in the English language to enable the capture of as many documents as possible. Thus, for each type of renewable energy, words that can express each type of energy established, either in the title or in the document summary, have been defined, as can be seen in the table below. It is emphasized that the use of the asterisk used in search words will be explained on the next page.

Chart 5 - Types of renewable energy and keywords.

Types of renewable energy	**Search words**
Biomass	Biomass energ*
Ocean or tidal energy	Marin* energ*; Ocean energ*; Marin* power.
Hydroelectric power	Hydro* energ*; Hydro* power; Hydroele*.
Biofuel	Biofuel; Ethanol; Biodiesel;
Solar energy	Solar energ*;Photovoltaic energ*; Solar panel.
Wind energy	Wind energ*; Eolic energ*.

Source: Author's elaboration.

From the choice of keywords, combinations were made in order to identify the number of Brazilian and Indian publications according to themes or types of renewable energy. Thus, 78,873 documents were found concerning the scientific production of Brazil and India in the field of renewable energy. Out of this total, 241 documents were produced in partnership between Brazilian and Indian institutions. This means that 0.30% of the total scientific production of these countries that address renewable energy is the result of the partnership between Brazilians and Indians.

The Chart 6 shows the adopted search strategy and the results, expressed in numbers, with the total of Brazilian and Indian publications on each type of renewable energy through the combination of the parameters used. The representation of the combination of parameters is indicated by the letter "x", which indicates the parameters being considered. Next to the column that displays the numeric totals for each combination, the search expressions used to represent the desired combination are indicated.

It is necessary to explain some terms used in the mapping process to find the results. In addition to the keywords, we used, through the advanced search in the database, the Logical Operators, which are words that have the objective of defining, for the search system, how the combination among the terms should be done or among the search expressions. One of these operators is "and", which restricts the search, equivalent to the expression "with all words". Thus, the generated results must contain one term "and" the other. The second Logical Operator is represented by "or", which broadens the search and is equivalent to "with any of the words". Thus, the results should contain one term "or" the other. Other terms are "TS", which means "topic" and is used to map the search words in titles and summaries of documents, and "AD", which means "address" and indicates the results mapped at the authors' registration address.

For example, for the analysis of documents that have been published by institutions with the address in Brazil, in the topic of Ocean or Marine Energy, the following expression was assembled: TS = (marine energ * or ocean energ * or marine power) and AD = Brazil.Thus, the terms marine energ *, ocean energ * and marine power are being prospected in the titles and abstracts of all documents indexed in the base, the logic between them being alternative (one term or another). These terms or search words must represent the intersection of publications with the addresses of Brazilian authors or institutions, as indicated by the "and" connector and the "AD" topic.

It is important to consider terminological variations and synonyms of the words established for the search. After all, there are different ways of describing a study object, and it is critical that the search scope account for as many documents as possible. In this way, it was possible to consider, in the search, only the radical of the term used and to add an asterisk ("*") at the end of the radical, to cover all variations of the term caused by prefixation and suffixation.

The data was exported to Microsoft's Excel program and was archived in the form of individual spreadsheets (by renewable energy and by country) so they can be tabulated and analyzed.

Chart 6 - Search strategy for scientific prospecting

Brazil	**India**	biomass energ*	marine energ*	ocean energ*	marine power	hydro* energ*	hydro* power	hydroele*	biofuel*	ethanol*	biodiesel*	solar energ*	photovoltaic* energ*	solar panel	wind energ*	eolic* energ*	**Total de Publicações**	
x			x	x	x												**509**	**TS= (marine energ* or ocean energ* or marine power) and AD = Brazil**
	x		x	x	x												**1106**	**TS= (marine energ* or ocean energ* or marine power) and AD = India**
x						x	x	x									**8166**	**TS= (hydro* energ* or hydro* power or hydroele*) and AD= Brazil**
	x					x	x	x									**21332**	**TS= (hydro* energ* or hydro* power or hydroele*) and AD= India**
x									x	x	x						**12681**	**TS= (biofuel* or ethanol* or biodiesel*) and AD= Brazil**
	x								x	x	x						**16659**	**TS= (biofuel* or ethanol* or biodiesel*) and AD= India**
x												x	x	x			**1629**	**TS= (solar energ* or photovoltaic* energ* or solar panel) and AD= Brazil**
	x											x	x	x			**8132**	**TS= (solar energ* or photovoltaic* energ* or solar panel) and AD= India**
x															x	x	**1111**	**TS= (wind energ* or eolic* energ*) and AD= Brazil**
	x														x	x	**3232**	**TS= (wind energ* or eolic* energ*) and AD= India**
x		x															**1298**	**TS= (biomass* energ*) and AD= Brazil**
	x	x															**2018**	**TS= (biomass* energ*) and AD= India**
x	x		x	x	x												**3**	**TS= (marine energ* or ocean energ* or marine power) and AD= (Brazil and India)**
x	x					x	x	x									**112**	**TS= (hydro*energ* or hydro*power or hydroele*) and AD= (Brazil and India)**
x	x								x	x	x						**62**	**TS= (biofuel or ethanol* or biodiesel*) and AD= (Brazil and India)**
x	x											x	x	x			**30**	**TS= (solar energ* or photovoltaic* energ* or solar panel) and AD=(Brazil and India)**
x	x														x	x	**26**	**TS= (wind energ* or eolic* energ*) and AD= (Brazil and India)**
x	x	x															**8**	**TS= (biomass* energ*) and AD= (Brazil and India)**

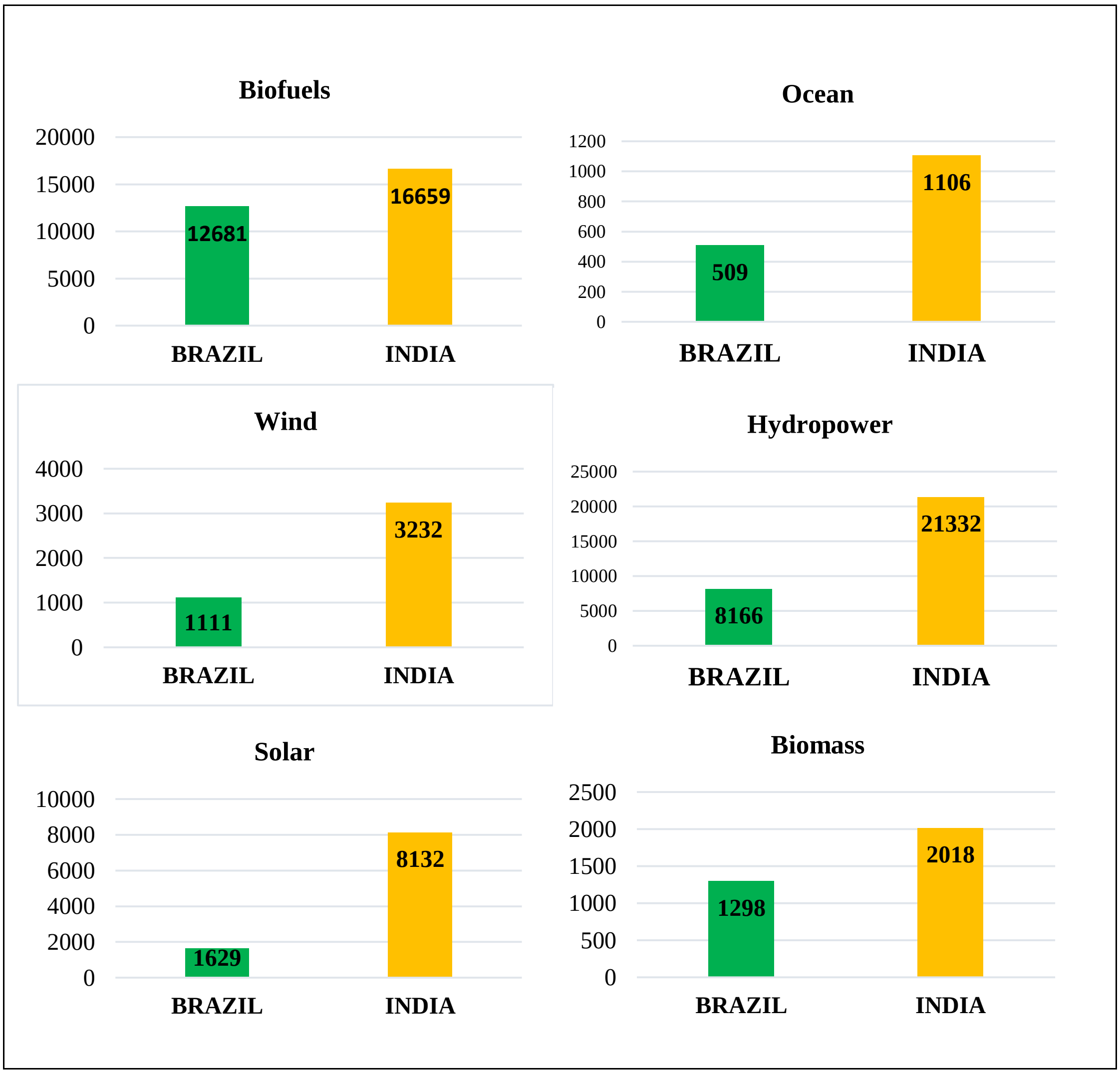
Source: Author's elaboration.

5.3.1.1 Results and discussion

The scientific survey conducted in the WoS database counted a total of 78,873 Brazilian and Indian documents or publications, which cover six types of renewable energy. In addition to the wind energy, solar energy and biofuel sources, which are objects of the memoranda signed jointly by Brazil and India, were considered the ocean or tidal energy the hydropower and the biomass energy.

The Graph 15 show the numbers of Brazilian and Indian publications found by renewable energy types: hydroelectric power, ocean or marine energy, solar energy, wind energy, biofuels and biomass.

Graph 15 - Number of publication of Brazil and India per renewable energy (1945-2017).



Source: Author's elaboration.

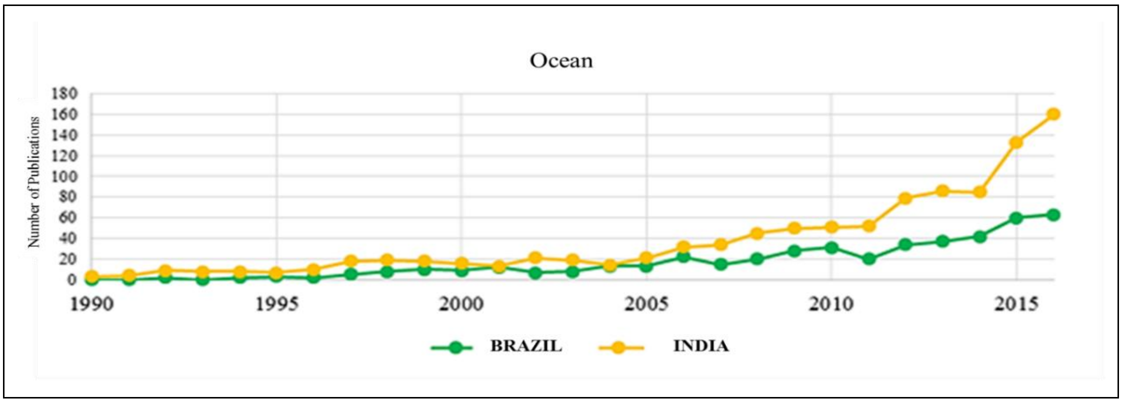
The graph show that India has twice as many publications as Brazil with respect to all renewable energy: Brazil totaled 25,394 publications and India, 52,479. Considering each type of renewable energy, India has a higher quantity in terms of the number of publications. The subjects related to hydroelectric and solar energy are the ones presenting the greatest discrepancy between the two countries in quantitative terms. Over the period analyzed, it was on hydroelectricity and biofuel that the two countries most published.

While the number of documents expresses the scientific strength in the theme, this indicator does not express the maturity in relation to the time of publication of the country on the type of renewable energy. The publications' evolution in time shows when, in terms of scientific publications, each of these countries is interested in a particular type of renewable energy.

5.3.1.2 Evolution in time by thematic area

The following graphs show the publications of Brazil and India on an annual scale, considering records from 1945 to 2016[24]. The year 1945 is the first year in which the database provides data on registered indexes. The purpose of the evaluation of these evolutions was to identify, in particular, the growth of the number of publications over time, the growth peaks and the variation in behavior of the publication profile of each country.

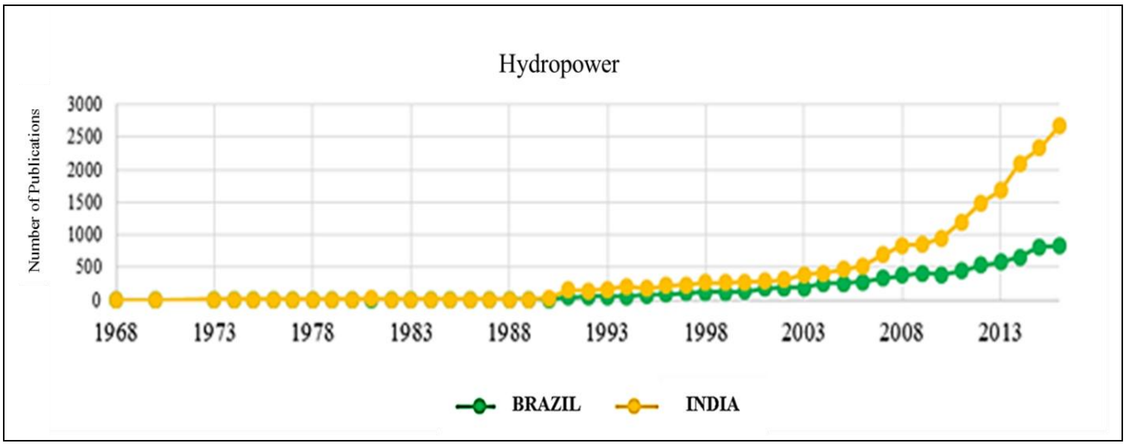
Graph 16 - Annual Evolution of the Publications of Brazil and India (1945-2016): oceanic or marine energy.



[24] For the evolution of the publications, the year of 2017 was not considered, because, as the research was carried out in September, when the contingent found was placed, when the graph was visualized, there was a false impression that the number of publications was in decline.

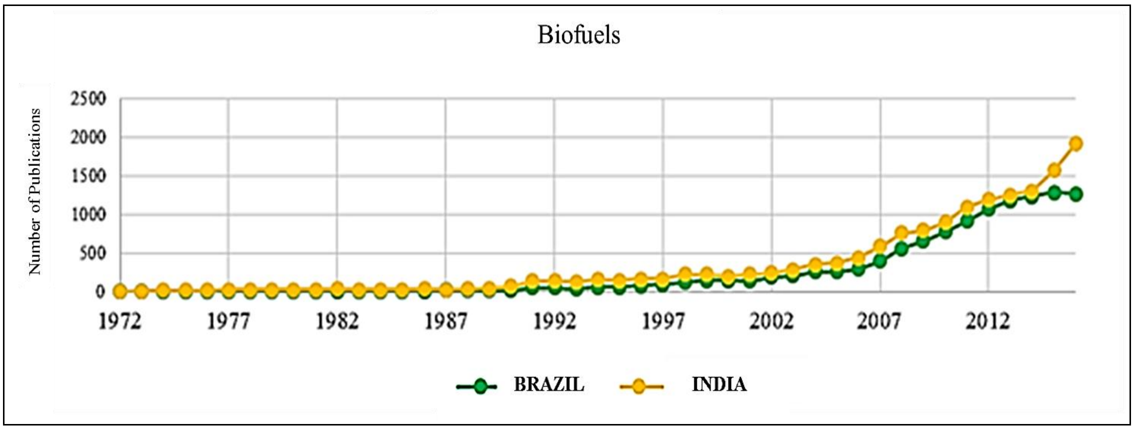
Source: Author's elaboration.

Graph 17 - Annual evolution of Brazilian and Indian publications (1945-2016): hydropower.



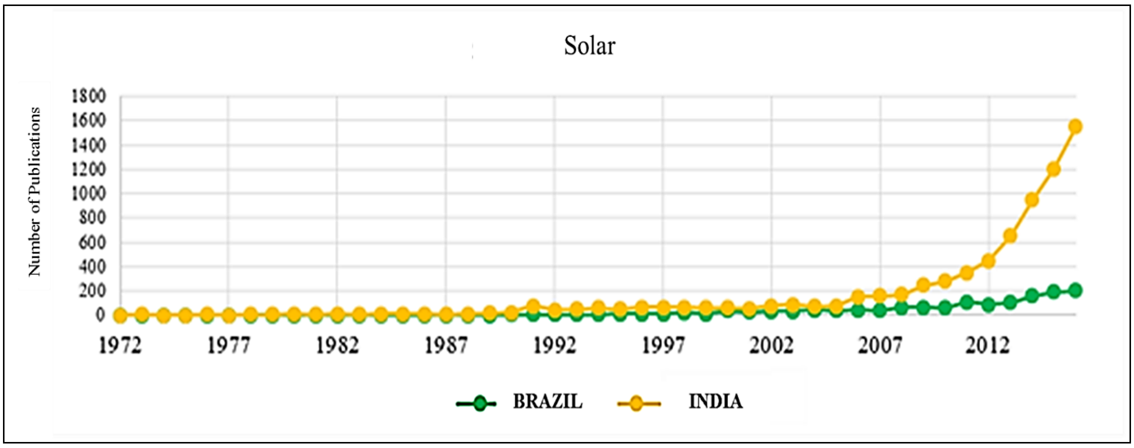
Source: Author's elaboration.

Graph 18 - Annual evolution of the Brazilian and Indian publications (1945-2016): biofuels.



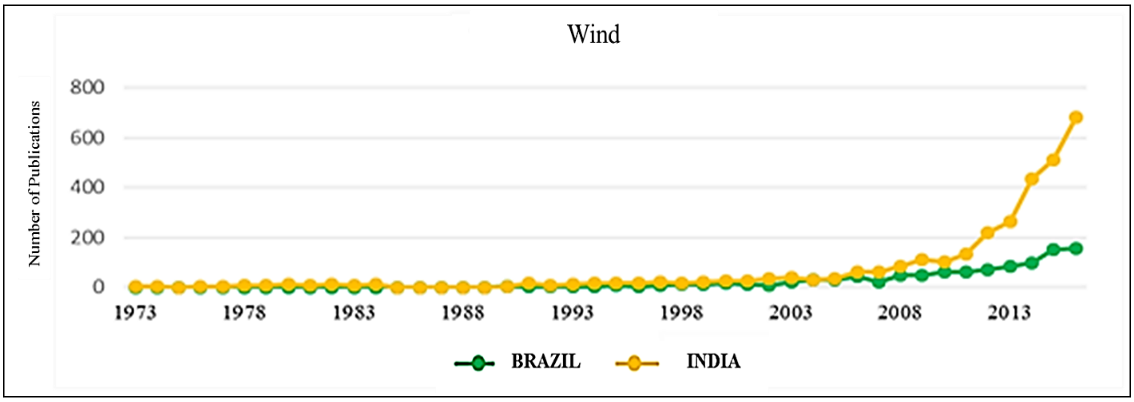
Source: Author's elaboration.

Graph 19 - Annual evolution of the Brazilian and Indian publications (1945-2016): solar energy.



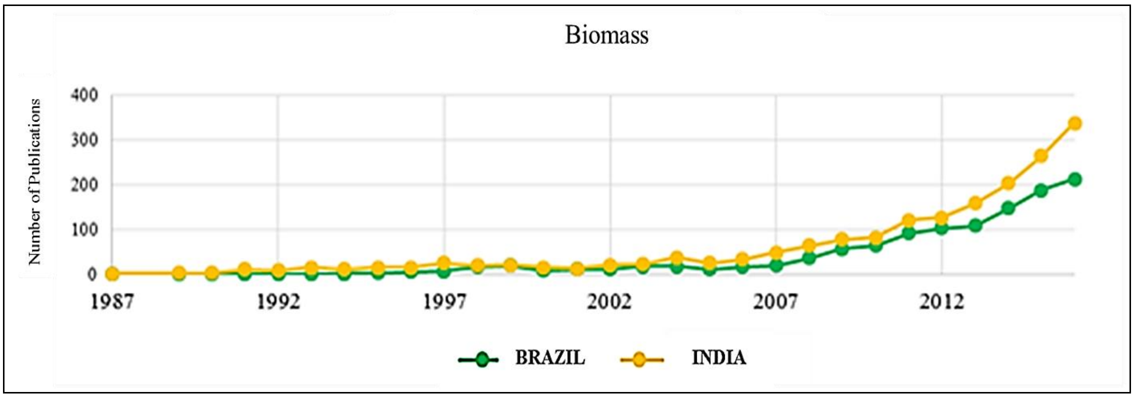
Source: Author's elaboration.

Graph 20 - Annual evolutions of the Brazilian and Indian publications (1945-2016): wind energy.



Source: Author's elaboration.

Graph 21 - Annual evolutions of the Brazilian and Indian publications (1945-2016): biomass energy.



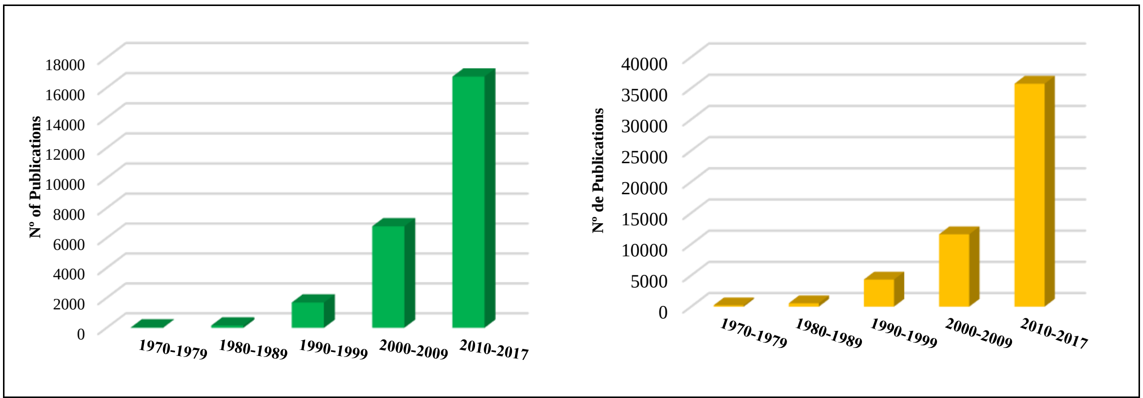
Source: Author's elaboration.

In the graphs above, solar, wind, hydroelectric and oceanic are the ones that present the greatest discrepancy between the two countries in view of the behavior of the curves over the years, particularly from 2011, the year in which India most invested in renewable energy. It is noteworthy that, for these types of energy, the number of Brazilian publications in 2016 is what India had already achieved about five years before that. For example, in relation to solar energy, which has the biggest difference in relation to the number of publications between the two countries, in 2016, Brazil published 205 documents, while India in 2009 had already reached the number of 248 publications in the year. Regarding biofuels and biomass, the growth profiles remained similar or with less discrepancy, according to the behavior of the curves.

The time period within which the publication profile began to change with respect to the increase in the number of publications in the two countries studied is relatively short (less than 10 years) to deem them as scientifically mature in the themes. It can be stated from the data comparing the evolution of the number of Brazilian and Indian publications that, if these countries continue to present the evolutionary profiles such as those presented so far, India will show a greater tendency to reach maturity in scientific research than Brazil. After all, the more you publish, the more knowledge you can spread and the greater the chances that knowledge will become consistent over the years.

Considering all types of renewable energy, the number of publications has grown steadily in both Brazil and India. The first works in the area of renewable energy were published in the seventies, which were certainly stimulated by the oil crisis, which led the academic circle to learn more about new sources of energy. It can be seen in the following graphs, showing the number of publications per decade, that in seven years (2010-2017), both Brazil and India published more than in all previous decades.

Graph 22 - Brazilian (a) and Indian (b) publications in renewable energy by decade.



(a) (b)

Source: Author's elaboration.

Publications on hydroelectricity and biofuels, both in Brazil and in India, had a greater increase over the period studied.

Hydroelectricity scientific production in Brazil increased about 800 times and, in India, 2.500 times. When it comes to biofuel scientific production, Brazil increased 640 times; India, 480 times, despite that number, India has more publications in that field than Brazil.

The most significant increases in scientific production in Brazil and India were concentrated on the following types of energy: hydroelectricity, biofuels, solar, biomass, wind and ocean. According to the data found, the years in which scientific production started to emerge in both countries coincided with the period in which Brazil and India most invested in renewable energy, developed policies in this area and also signed the memoranda together (solar, 2010, wind, 2007 and biofuels in 2006[25]), with the exception of hydroelectricity, which began to emerge in Brazil from 2001, probably as a result of the electric crisis, and in India in 2003, certainly because of the implementation of the policy framework in the renewable area in that country.

It should be noted that the increase in the publications of Brazil and India from 2007 matches with the period in which WoS began indexing more journals from emerging countries, which became more representative on the platform (TESTA, 2009). It can also be emphasized that WoS is a database that includes a wide and varied range of scientific publications. However, obviously, it does not cover one hundred percent of all publications in a particular country.

Thus, without considering the scientific quality, the number of publications in both Brazil and India on renewable energy would surely be higher than the number of indexed publication found in the databases and presented in this work.

5.3.1.3 International Partnerships

The advance of science has become unimaginable without any level of cooperation (LETA; THIJS; GLÄNZEL, 2013). In other words, cooperation has become one of the most important attributes in global scientific production. This was no different for the Brazilian and Indian scientific productions, which did not develop in isolation. For each type of renewable energy, the usual Brazilian and Indian partnerships were evaluated to identify whether there have been collaboration between the two countries in renewable energy publications and to identify the occurrence of some pattern of behavior that would characterize the Brazilian and Indian productions.

The reasons for collaborating in scientific production involve a variety of geopolitical, economic and cultural issues, as well as other issues, such as access to expertise, resources and funding, the challenges posed by interdisciplinary work and globalization (THIJS; LETA; GLÄNZEL, 2013). Collaboration networks entails, therefore, the improvement of the techniques developed through the exchange of

[25] Started operating in 2009.

experiences and expertise among the collaborating countries, which not only contributes to enrich scientific production, but can also take the form of geopolitical or strategic instrument. After all, certain National States can turn partnerships into a way to know how a topic is treated by another National State and, being a country with a greater purchasing power, to use the advantages obtained from that partnership to dictate how the research must be directed through financing.

Out of the total of Brazilian scientific production, 45% correspond to publications made in partnerships. Brazil has collaborated with 117 countries in publications dealing with the types of renewable energy presented in this work. Among the twelve main Brazil's partners, only two are not developed countries: Argentina and India. In the overall ranking of the main Brazilian partners, India is in the twelfth position. Considering all six types of renewable energy, 32 countries have collaborated with Brazil, of which 72% are developed countries; the other 28% represent countries that have cooperated with Brazil in publications on one or up to five types of renewable energy. Brazil's main partner in scientific production is the United States, followed by Spain, France, Germany, England, Portugal, Italy, Canada, Argentina and India.

Regarding the renewable energy studied, India cooperated with 137 countries in the scientific production. Among India's twelve major partners, eleven are developed countries. In the overall ranking of the main Indian partners, Brazil ranks seventeenth. Thirty-one countries, of which 74% are developed, cooperated with India on all six types of renewable energy. India's main partners in its scientific production are the United States, South Korea, Germany, Japan, England, France, Saudi Arabia, Canada, Italy, Malaysia and Australia.

Brazil's and India's partnerships in scientific production show a similar pattern of cooperation. The United States, Germany, England, France, Spain, Italy, Canada and Australia are Brazil's and India's main partners in all publications dealing with the types of renewable energy analyzed. Although India has a larger collaboration network than Brazil in total publications (it established partnerships with 137 countries while Brazil with 117), the percentage of partnerships established in relation to the total amount of its scientific output was lower than that of Brazil, that is, while 45% of Brazilian production was the result of collaboration, in India this percentage was 29%. However, it should be noted that 29% of Indian production corresponds, in terms of volume of publications, to more than the total of Brazilian publications made in partnership with other countries.

India and Brazil have cooperated with each other in publications dealing with all types of renewable energy analyzed. Collaboration with India represents approximately 1% of the total Brazilian scientific production. For India, the collaboration with Brazil represents approximately 0.5% of its scientific production on renewable energy. The three types of renewables that Brazil and India most developed partnerships in their joint publications are hydroelectricity, biofuels and solar energy.

Even though Brazil is India's main partner in Latin America and India is Brazil's main partner in Asia, the representation of this partnership is still small. The developed countries are among the main collaborators in Brazilian and Indian scientific production. Even considering the BRICS, it can be noted that China, South Africa and Russia occupy the 13th, 15th, and 19th places in the ranking of countries that most cooperate with India in their scientific production in the area of renewables. In relation to Brazil, these countries are even further in the ranking: China in 19th, Russia in 20th and South Africa in 29th.

Regarding renewable energy scientific publications, The United States is the largest partner of Brazil and India. As a comparison, cooperation between Brazil and the United States in scientific production represents 8.7% of the total Brazilian scientific production, above the total percentage of partnerships established between Brazil and the Latin American countries, which is 4.78%. India's cooperation with the United States accounts for 4.7% of total Indian scientific output. The percentage of India's cooperation with Asian countries is 6.8%.

The United States and Europe have been at the forefront of international scientific cooperation, although partnerships among countries at the global level have grown over the years. For some specialists, the growing number of researchers seizing the scientific development opportunities for the BRIC[26] nations is seen as a threat, as there is concern that these countries collaborate as they grow (ADAMS, KING, 2009).

Undoubtedly, partnerships with those nations that are considered centers of excellence in terms of scientific production become relevant not only because of the visibility that research can acquire but also because of the potential for enhancement that such partnerships can generate. The scientific production of these nations is certainly a reflection of the investments in research and development carried out by them. The forecast for investments in Brazil for 2017 was US $ 22 billion or 1.22% of GDP while in India it was US $ 77 billion or 3.4% of Indian GDP (IBEF, 2017, CIA, 2017a, CIA 2017b).

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[26] The authors did not consider South Africa in this context, only Brazil, Russia, India and China (BRIC)

5.3.2 **Technological Production of Brazil and India**

For the mapping of patent documents, the strategy adopted consisted in the use of the International Patent Classification (IPC) codes. The IPC, established by the Strasbourg Agreement in 1971, is legitimized by more than 100 countries and coordinated by the World Intellectual Property Organization. This classification adopts a hierarchical system and symbols for the classification of patents (MCTIC, 2015) and allows an efficient search for the retrieval of patent documents in intellectual property offices (INPI, 2017a).

Patents are initially classified into sections ranging from A to H according to each technology area. Thus, each letter has a group of documents with specific content. Sections are the highest level of the ranking hierarch. Sections are the highest level of the ranking hierarchy. Each section is subdivided into classes that are numerically identified ranging from 00 to 99, which are the second hierarchical level of the classification and in turn cover one or more subclasses, which are the third hierarchical level of the classification, in order to define a better sorting and pooling of patents.

Each subclass holds subdivisions, called groups, which are either major groups (*i.e.*, the fourth hierarchical level of classification) or subgroups (*i.e.*, lower hierarchical levels dependent on the level of the main group of the classification). Each symbol in the group consists of the subclass symbol followed by two numbers separated by a slash. The main group title defines precisely a field of matter within the scope of its subclass considered useful for research purposes. The main group symbols and titles are printed in bold in the classification. Each subgroup symbol consists of the subclass symbol followed by a one to three digit number of its main group, the slash and a number of at least two digits other than 00.

Deciding on the database to be used was also necessary for technological mapping, just as it was for scientific mapping. Choosing the database to search for patent documents first took into account its search goal, checking if the chosen database allows to find documents that best meet the needs. It was necessary then to know the characteristics of each base. Thus, the collection, the coverage, the language, the number of fields allowed for the search, the accessibility, the update time, the thematic coverage, the time-related coverage, the geographic coverage and the document availability were evaluated.

For this thesis, the chosen database was the European Patent Office (EPO) for it contains more than 90 million patents indexing documents from more than 90 countries, for not duplicating documents in the search result and for allowing searches through international classification codes (INPI, 2016). The advantage of carrying out a search using classification codes is the reliability of the result presented. The classification code of a patent is assigned by a team of experts who evaluate the content of the document and fit it into a certain classification code. Thus, whoever performs a search using the codes is not vulnerable to the subjectivity of the author, who can put a very broad keyword for his invention or even a keyword that does not have direct correlation with the document.

To determine which codes would be selected, keywords were used corresponding to each type of energy. Through them, in the search-by-classification section, the IPC codes that represent them were found. The chart below shows the types of renewable energy and the codes that identify them.

Chart 7 - Renewable energy and codes of patents classification.

Types of Energy	Code according type of renewable
Hydroelectric	F03B7/00: Water wheels
	E02B9/00: Water-power plants; Layout, construction or equipment, methods of, or apparatus for, making same
	Y02E60/723: Enabling technologies or technologies with a potential or indirect contribution to GHG emissions mitigation. the elements or equipment being or involving electric power substations
	Y02E10/20: Energy generation through renewable energy sources. Hydro energy
Solar	Y02E10/40: Energy generation through renewable energy sources. Solar thermal energy
	F24J2/00: Use of solar heat, e.g. solar heat collectors
	H02S50/00: Monitoring or testing of PV systems, e.g. load balancing or fault identification
	H02S20/00: Supporting structures for PV modules
	H02S40/00: Components or accessories in combination with PV modules
	Y02E10/50: Energy generation through renewable energy sources. PV
Wind	Y02E10/70: Energy generation through renewable energy sources. Wind energy
Biofuel	C10L1/00: Liquid carbonaceous fuels
	C10L2200/00: Components of fuel compositions
	C12P19/00: Preparation of compounds containing saccharide radicals
	C12P2201/00: Pretreatment of cellulosic or lignocellulosic material for subsequent enzymatic treatment or hydrolysis
Biomass	Y02B10/60: Integration of renewable energy sources in buildings. Biomass
	C10L5/447: Biomass degradation
Ocean	Y02E10/30: Energy generation through renewable energy sources. Energy from sea

Source: Author's elaboration.

Once the classification codes have been defined, combinations have been made to find the number of documents for each type of energy. In order to limit the search scope to protected patent documents in Brazil and India, the advanced search mode was used, filling the Priority Number field with the abbreviation of the country in question, in case BR or IN. It consists of a country code (two letters), the order year (four digits) and a sequential number (variable, up to seven digits). By proceeding this way, it becomes possible to identify the country in which the patent was filed as a priority.

The chart 8 shows the combinations made and the number of documents found for each of the combinations.

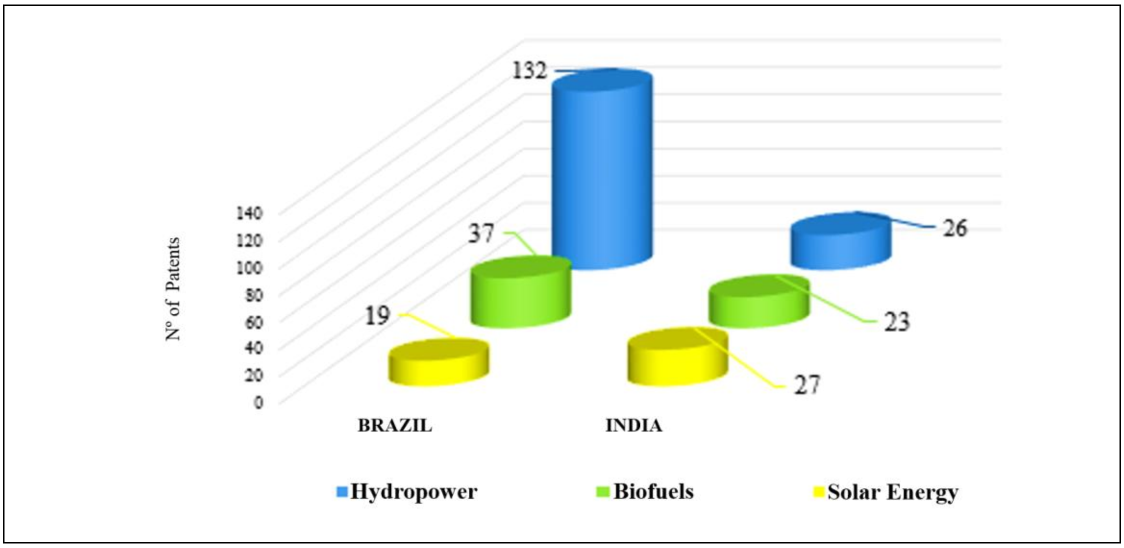
Chart 8 - Scope of searching patents.

Hydro				Solar						Wind	Biofuels					Biomass		Ocean			
F03B7/00	E02B9/00	Y02E60/723	Y02E10/20	Y02E10/40	F24J2/00	H02S50/00	Y02E10/50	H02S20/00	H02S40/00	Y02E10/70	C10L1/00	C10L2200/00	C12P19/00	C12P2201/00	Y02E50/10	Y02B10/06	C10L5/447	C1/00	BR	IN	No. of patents
x	x	x	x																x		138
x	x	x	x																	x	25
				x	x	x	x	x	x										x		91
				x	x	x	x	x	x											x	53
										x									x		0
										x										x	0
											x	x	x	x	x				x		54
											x	x	x	x	x					x	39
																x	x		x		0
																x	x			x	0
																		x	x		0
																		x		x	0
																				TOTAL	400

Source: Author's elaboration.

To demonstrate the importance of the classification code in terms of reliability, a neurolinguistic programming evaluation (through the software used in this methodology) of the titles and abstracts of the patents found was performed. It can be seen in the graph below that the words used by patent authors do not always correspond exactly to the type of energy in which they believed their inventions would be framed. For example, in relation to hydroelectric power, the software found 138 patent documents for Brazil while the analysis of the neurolinguistic programming found 132, which means that six of the authors of the patents did not put in the title or in the abstract of their works something that indicated that their inventions were related to hydroelectric power. Thus, only after the analysis of the experts in the field, the inventions concerning patents filed can be classified in the category of hydroelectricity. The energy that most presented a discrepancy between the real number (through the codes) and the number found through the neurolinguistic programming was solar energy, it may be implied, for example, an ignorance on the part of the inventors about the area in which they seek to patent their inventions.

Graph 23 - Types of renewables by neurolinguistc programation.



Source: Author's elaboration.

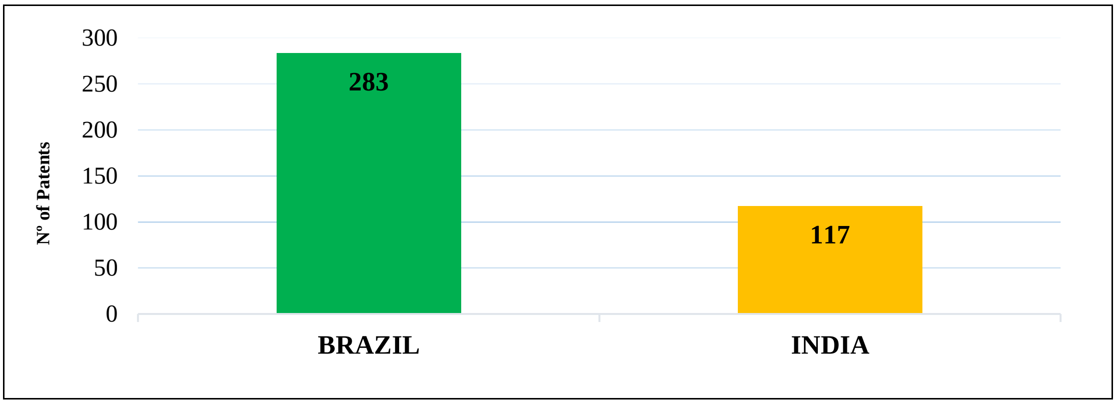
5.3.2.1 Results and discussion

For the evaluation of the technological development of Brazil and India focusing on renewable energy, 400 patent documents were analyzed in a data mining work with the help of VantagePoint® software. No duplicate works were identified, and the analysis of the same 400 documents was kept for the characterization stage. This assessment was necessary because, when conducting a search for codes, the same patent may be associated with more than one code; for instance, a patent, from biomass, for a biofuel production process, codes associated with biofuels and biomass would appear for the same document. Thus, when mapping the set of documents by codes, these documents could appear in duplicate. That did not occur, because it was considered as biomass only the solid raw material.

Of these 400 documents, 283 refer to inventions filed in Brazil as a priority and 117 were patents filed in India as priority address, as shown in the following graph.

It is worth clarifying that the analysis of the country by the priority factor is relevant, since, even if these technologies are of Indian and Brazilian nature, they can be protected in other countries in order to guarantee the right to industrial property and exploitation of technology beyond national territories.

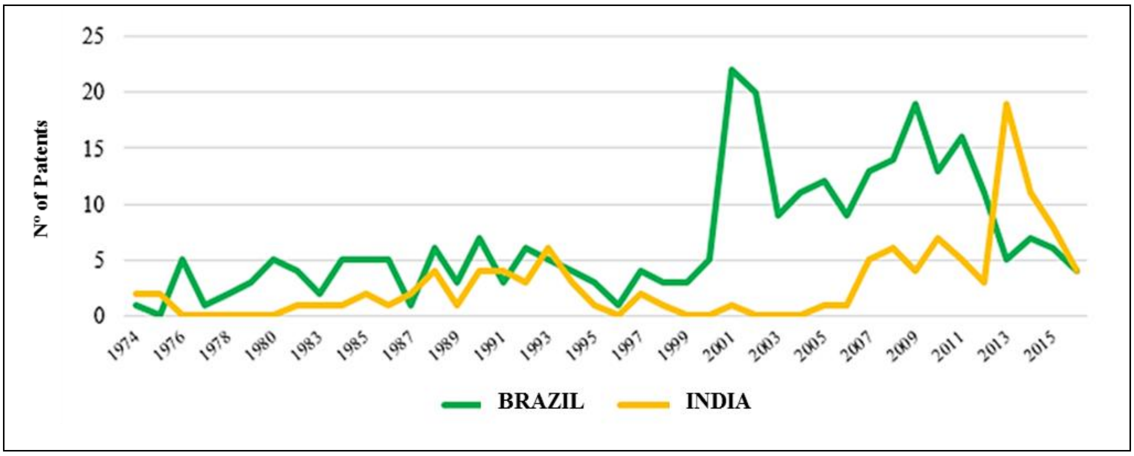
Graph 24 - Production of patents of Brazil and of India in renewables.



Source: Author's elaboration.

In addition to measuring the amount of patents filed, it has been verified how long the two countries under study, in relation to the invention processes, have been filing patents in the types of renewable energy studied. The following graph the annual evolution of the number of patent applications in Brazil and India since the 1970s, when the first ones were made.

Graph 25 - Comparison of the evolution annual number of patents deposit of Brazil and of India.



Source: Author's elaboration.

By the end of the 1990s, both countries had a similar profile with regard to the number of patents. In the early 2000s, Brazil emerged in the development of patents in the field of renewable energy, maintaining an average of 14 filings per year by 2012, while India filed, between 2000 and 2012, an average of 2.75 patents per year. Brazil's growth, however, started decreasing in 2012, while India had a peak of patent applications in 2013.

Brazil´s growth period can also be understood as a reflection of the implementation of innovation policies. The Law of Innovation in Brazil (Law 10.973 / 04) was sanctioned in 2004 and established measures to encourage innovation and research in science and technology in the productive environment to stimulate technological autonomy and Brazilian industrial development (BRASIL, 2004) .

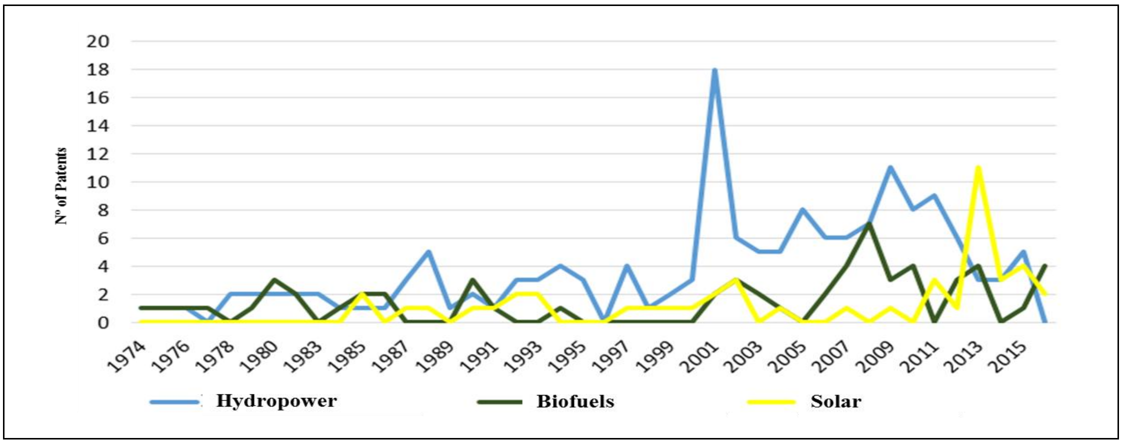
Among other principles, the Brazilian federal law provides for cooperation and interaction between public and private entities, the encouragement of international research networks and projects and, for example, authorizing the sharing of scientific and technological labs of institution (ICTs) by companies. ICT is defined as an entity that is part of the direct or indirect public administration or as a non-profit legal entity whose mission is to carry out basic or applied research activities of a scientific and technological nature (BRASIL, 2004).

In India in 2013, the government launched the policy of science, technology and innovation to try to put India among the top five countries in the global scientific scenario. The policy has a number of objectives, such as connecting the contributions of science, research and innovation with the growth of the economic agenda; stimulate careers in the area of science, research and innovation; and facilitate private sector participation so that it can invest in research and development (MINISTRY OF SCIENCE AND TECHNOLOGY, 2013). Soon after the launch of this policy, it was observed that there was a peak with regard to the filing of patents in the country.

It could be highlighted that for both Brazil and India, this evolution is being analyzed taking as a parameter the year of filing the document in the patent offices, and these remain confidential for an average of 18 months. Thus, the values found for the last two years presented in the chart can still be modified.

The data show that Brazil has a higher number of patents in relation to the number of Indian patents with respect to all types of renewable energy presented. The volume of patent deposits in the hydroelectricity segment is massive to the extent that it is the factor that justifies the period of growth of Brazilian deposits, as can be seen in graph 26, where it is noted that the profile of patent production in Brazil is similar to the development profile of hydroelectric technologies.

Graph 26 - Annual evolution of patents deposits by renewable.

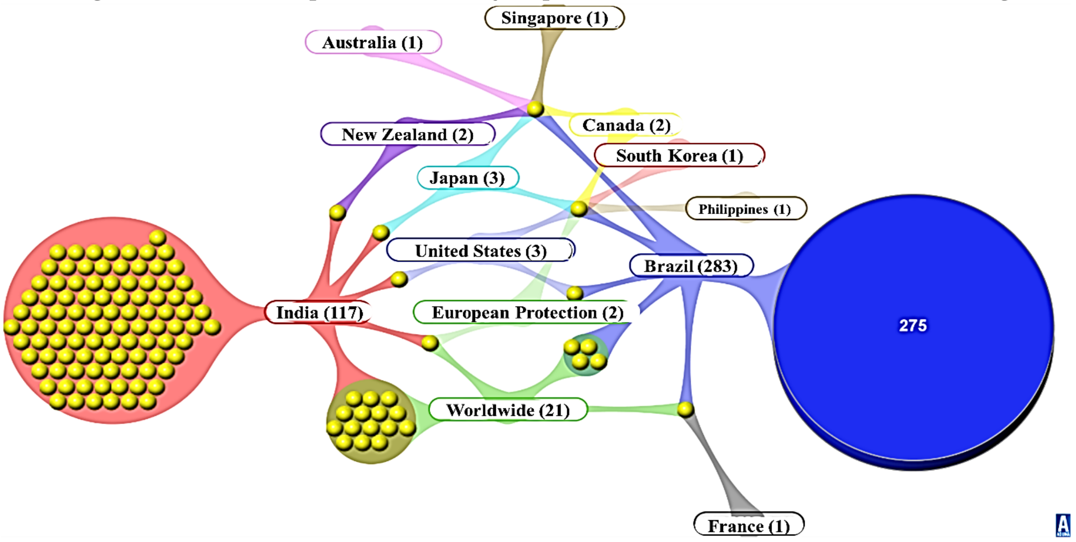


Source: Author's elaboration.

The patent documents are of Brazilian and Indian priority, but they have been protected in other countries, as shown in Figure 5. This type of action is due to the interest in exploring such technologies in the country in which the invention has also been protected, or it may be the result of an interaction between countries in the development of that technology.

Brazilian technologies are also protected in France, Japan, Australia, Singapore, Canada, New Zealand, USA, under the PCT (Internationally Protected Patents) regime and the European Patent Office (Patents Protected in European Territory). India protects its technologies in countries such as New Zealand, USA, Japan, under the PCT regime and the European Patent Office.

Figure 5 - Clustermap of countries by deposits of Brazilian and Indian technologies.

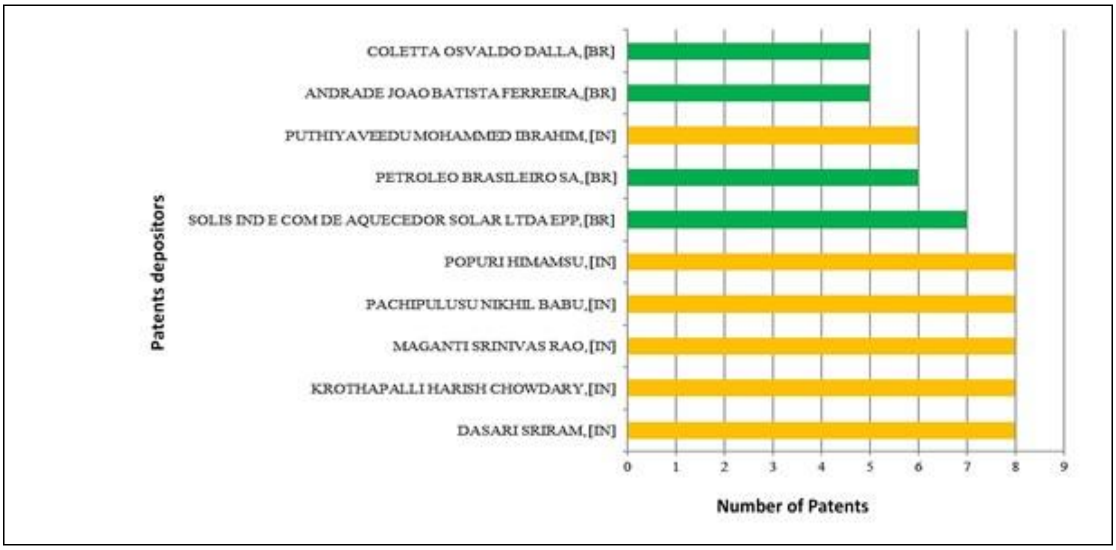


Source: Author's elaboration.

This characterization may be related to the technologies potential commercialization in the countries of protection or to the result of scientific cooperation, as hypothesized above. The (Figure 5) is the configuration of a network. Each "ball" in yellow represents the amount of documents deposited in that country. So the "balls" that are at the intersection connecting countries represent documents that are protected in those countries. Consider as Worldwide patents of PCT scheme. The value shown in parenthesis next to the country name indicates the total number of patents, while the number displayed inside the cell, either digits or in the number of "ball", indicates the number of individual patents, or in group, if it is within the intersection.

Graph 27 shows the main patent applicants in the types of energy analyzed. In relation to the main applicants of the data collected, the Indian applicants stand out individually, since among the 10 main applicants, 6 are Indian. This could initially mean that Indian production, although smaller in quantity (117 patent documents), would not be as concentrated as it is the case in Brazil, considering that among the top ten patent applicants, four are Brazilian. However, five of the Indian applicants are partners in companies from different renewable energy sectors, which implies a concentration of patents by partner companies. The Brazilian Petrobras S.A, with 6 patent documents, is in the list of the main Brazilian and Indian patent applicants.

Graph 27 - Top ten Brazilian and Indian patents depositors in renewables.



Source: Author's elaboration.

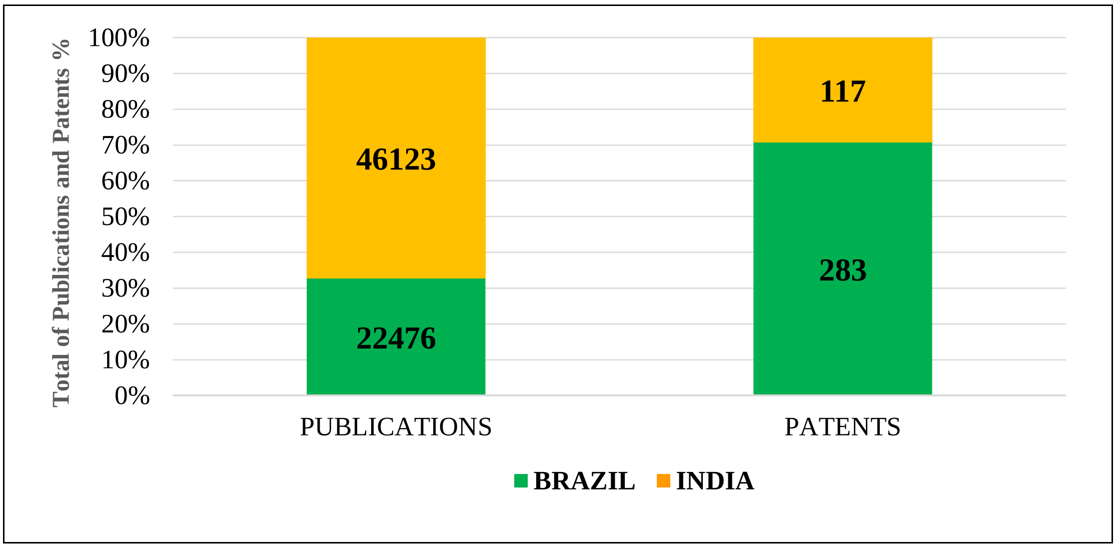
5.3.3 **Scientific and Technological Production**

The potential of technological innovation is intrinsic to the effectiveness of scientific production. The number of publications of articles, although it expresses scientific routes or directions in which the interests of the scientific community walk, does not show the technological results of a research. The conversion of scientific results into patent documents is what shows this in an efficient way.

Patents bring benefits to society through the technology transfer processes that an invention can provide. This has implications for a country's competitiveness. However, it is emphasized that the patent is not an end in itself: it belongs to the strategic context of each National State.

Although India has a large number of scientific publications, Brazil surpasses that country in terms of the number of patent filings expressed in the totality of the types of renewable energy, i.e. hydroelectric, solar and biofuels, according to the data obtained in the patent search. In the analysis, only the three types of renewable energy mentioned were considered, since the total number of articles (including publications dealing with other sources of renewable energy) could not be compared with the total number of patents, since Brazilian and Indian patents related to other sources of renewable energy were not found.

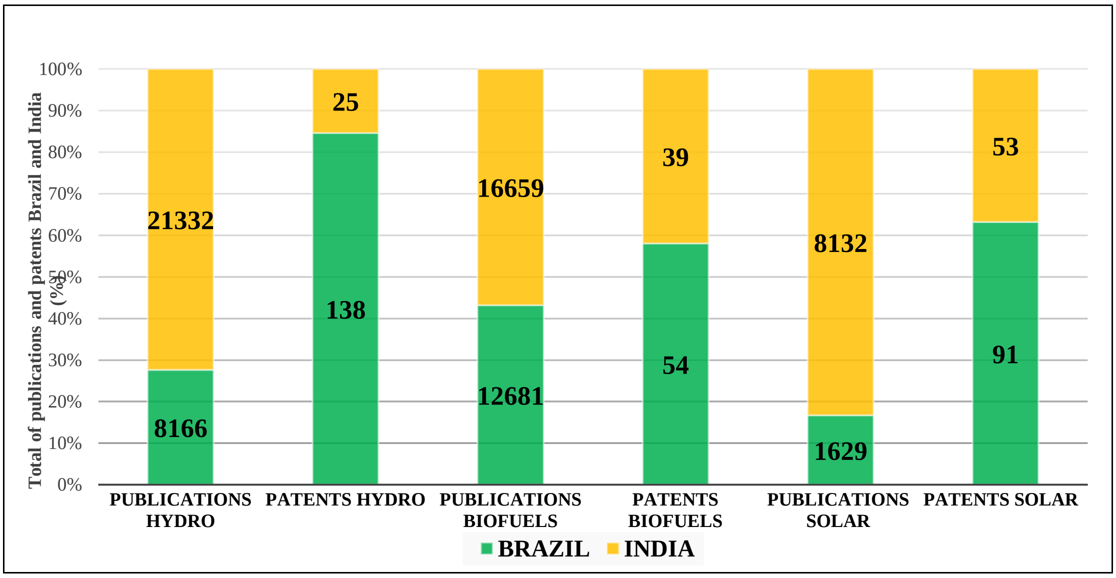
Graph 28 - Number publications and patents by country.



Source: Author's elaboration.

When analyzing the relationship between the number of scientific publications and the number of patents per type of energy, it is verified that, in hydroelectricity, solar energy and biofuels, Brazil has a greater number of patents, and the greatest discrepancy occurs in the case of hydroelectric power, considering that the number of Brazilian patents is five times the number of Indian patents in this area. The graph below shows the productivity by energy type.

Graph 29 - Number of publications and patents by renewables.



Source: Author's elaboration.

Several factors may be responsible for the decline in the number of patent filings from 2014 both in Brazil and in India and for the fact that India has had fewer patents than Brazil. Undoubtedly the cost of filing a patent can be a barrier to technological development. In India, this cost reaches US $ 1004 (PANTENTININDIA, 2016), which corresponds to approximately 58% of total Indian per capita income (CIA, 2017b).

It is, therefore, a significant value considering that this country occupies 131º in the ranking of human development and has more than 20% of its population living below the poverty line. This fact certainly does not generate a stimulus for the development of patents and makes the technological production restricted to those who have greater purchasing power. In Brazil, this figure is lower, corresponding to approximately 11% of the country's per capita income (INPI, 2017b, CIA, 2017a), which can be a facilitator for the generation of patents compared to India.

Another relevant factor in this context is that companies' investment on research and development in both Brazil and India fell during the period 2014-2015 / 2015-2016. In Brazil, the drop was more pronounced than in India. This may certainly explain the fall in technological production in these countries (WEF, 2015; 2016).

According to Nature magazine, which annually publishes the ranking that measures the impact of science in global terms, in 2016, Brazil and India suffered a fall in the field of science: Brazil fell 0.7% and India fell 3.7 % but, in the overall ranking, India is in a better position than Brazil, ranking thirteenth, while Brazil (the best positioned in Latin America) is in the twenty-fourth place (NATURE INDEX, 2016).

Another fact in relation to Brazil that may explain the decrease in patents and even the slowdown of publications, increasing the distance to India in terms of the volume of scientific publications, may be linked to political decisions that have been made since the year 2015. According to Elizabeth Gibney, in an article published in the journal Nature, budget cuts in Brazilian science have had a disastrous impact on scientific and technological development in the country, prompting institutions such as the Brazilian Academy of Sciences to vehemently oppose such decision (GIBNEY, 2015). In addition, in 2016, the Brazilian government decided to merge the Ministry of Science and Technology with the Ministry of Communications, which led several renowned researchers, in different media vehicles, to protest against this decision.

The next section, which addresses the competitiveness of Brazil and India, brings other variables also related to the field of science and technology and show how science and innovation go hand in hand with the development process of a country. It was the massive public investment in education and research that made South Korea an innovative country, an exporter of technologies and, therefore, a more competitive nation in the world (FERNANDES; GARCIA; CRUZ; WILLEMSENS, 2013). This helps other countries at different stages of development to cooperate with South Korea in order to exchange or improve experiences in different areas of knowledge, considering their respective expertise.

Policies aimed at promoting renewable energy certainly stimulate or cause the scientific community to reflect, debate and seek answers for the challenges that each country may face or the opportunities that each of them can offer with regard to the promotion of these energy sources. According to the scientific data collected, the years in which scientific production began to emerge in Brazil and India matches with the period in which these countries invested more in renewable energy, developed policies in this area, and also signed the memoranda together , such as the memoranda on solar energy (2010), wind energy (2007) and biofuels in 2006[27]. The exception was only the hydroelectricity scientific production which began to intensify a little earlier: in Brazil from 2001, certainly reflecting the water crisis; and in India in 2003, certainly by the implementation of the policy framework in the area of renewable in that country.

International cooperation is also motivated by public policies. It is no coincidence that, in the renewable energy policies established by Brazil and India, international cooperation is encouraged.

The volume of Indian scientific production in renewable energy may also be the result of the energy need or the energy demand, which is higher than the Brazilian one, as it was discussed in the previous chapter. The deficit between energy production and consumption in India in 2016 was 50 times greater than the Brazilian deficit. In addition, the geopolitical context of India with regard to energy is much more complex than the Brazilian one, as it has already been shown. These issues contribute to motivating researchers seeking, through scientific knowledge, responses to improve the country's energy security.

Considering the scientific and the technological mapping, the Brazilian and Indian interest in hydraulic energy, solar energy and biofuels can be highlighted. This is because, in addition to the greater volume of publications, both Brazil and India also developed patents in these types of energy. From the data obtained, it can be shown that Brazil has a special vocation for the area of hydroelectricity and for the area of biofuels.

Although India has more publications on hydroelectricity, both Brazil and India began to publish in this area with a slight time difference favorable to India. However, in the 1970s, Brazil was building hydroelectric power plants of worldwide importance, such as the Itaipu Power Plant, considered the largest in the world[28] while the largest Indian power plant is approximately six times smaller in terms of power generation capacity than the Brazilian power plant and it took twenty-eight years to be built, that is, four times as long as the construction of Itaipu. In addition, the Brazilian electricity matrix has essentially been based on hydroelectricity for at least 45 years. The largest number of patents in Brazil is on hydroelectric power, which indicates greater technological effectiveness comparing to India in this area.

[27] It entered into force in 2009.
[28]Currently the Three Gorges Plant in China is considered the largest in the world.

Although India surpasses Brazil in terms of the number of publications on biofuels, the scientific production on this type of renewable source represents the largest volume of scientific production in Brazil in the field of renewable energy. In addition, Brazil is superior to India in terms of the number of patent applications in biofuels. Brazilian expertise is globally acknowledged in this area.

The literature has shown that since the 1980s, India has shown an interest in learning about the technology adopted by Brazil in biofuels. Let´s not forget that, in the 1970s, Brazil launched Proálcool as the world's largest biofuel promotion program. Flex engines used in Brazil also had global prominence, especially considering the role of Brazilian science in the development of a software created specifically for these engines. In 2005, Brazil launched the biodiesel program, which contemplates the mixing of biodiesel in diesel oil. The highlighted position and the worldwide recognition of Brazil in this area was only possible by "a profound synergy between universities, research institutions, companies and government", as it was evaluated by some researchers participating in the meeting "Proalcool, universities and companies: 40 years of science and technology for Brazilian ethanol "held at the end of 2016 by FAPESP (AGÊNCIA FAPESP, 2016). Brazil, as already mentioned, has launched the Biofuture platform with the objective of promoting biofuels in the global market.

Indian scientific production, in numerical terms, is approximately the double of the Brazilian scientific production. Considering the results of scientific and technological mapping together, India stands out in solar energy. Considering total of Brazil's and India's scientific publications on solar energy, approximately 84% is Indian. Besides, it is in solar energy the greatest number of patents deposited by India.

In 2010, India decided to become a global leader in solar energy creating a policy aimed at reaching this goal. Indian investments have largely focused on this energy source, and the targets are reaching 100GW of installed capacity by 2022, producing critical components and products for development in this area, and increasing investments in research and development. In 2013, India created the National Institute of Solar Energy, linked to the MNRE, which aims to establish itself as one of the main centers in the field of solar energy through research and development, testing, certification, evaluation of technologies, planning and policies, and training in human resources in the area (NICE, 2016b). Moreover, India established the Solar Alliance in 2015 bringing several countries together with the aim of promoting solar energy in global terms.

It can also be emphasized that, with regard to partnerships for scientific production in the field of renewable energy, Brazil cooperates with fewer countries than India and has fewer publications. However, when the total percentage of Brazilian publications is analyzed in relation to the percentage of publications made in partnerships, it was noticed that Brazilian production is 16% more internationalized than the Indian, despite being smaller in terms of quantity of publications.

Collaboration makes countries more competitive considering, especially, the improvement of techniques or the exchange of experiences related to the topic of interest, in this case, renewable energy. Undoubtedly, emerging economies such as Brazil and India, in seeking to develop their scientific and technological production, promote a less unequal science in the production of knowledge or expertise, since the science that is conceived in the South can serve as a benchmark for research in the North or in developed countries as well as contribute to making sustainability issues a competitive advantage for developing States.

In order to identify the factors that may or may not help the process of cooperation between Brazil and India in the field of renewable energy, the next section presents the study of the competitiveness indicators of the two countries, many of which have implications for scientific production and technological.

5.4 INDICATORS OF COMPETITIVENESS IN THE COOPERATION SCENARIO

Competitiveness can be defined as the ability of a state to create conditions or to adapt to certain conditions to produce well-being to its citizens more quickly and successfully in relation to the capacity of other countries. The understanding of competitiveness, therefore, involves several components. However, there is one, in particular, without which, one cannot talk about competitiveness: energy. After all, quoting the United Nations Secretary-General Ban Ki-Moon, "energy is the golden thread connecting economic growth, increasing social equity and enabling the world to thrive" (SUSTAINABLE ENERGY FOR ALL, 2015). Renewable or sustainable energy entails new opportunities: it enables businesses to grow, generates jobs, creates new markets, generates positive impacts on education and health, and helps countries grow more resilient and more competitive (SUSTAINABLE ENERGY FOR ALL, 2015).

This perception shows that the studies on competitiveness extrapolate the concept of sectoral or business competitiveness and shows that the evaluation of the economic, political and social environments of a country serves as a reference for the creation of partnerships based on a country's capacity for growth and development (ARRUDA; FERREIRA; ARAÚJO, 2007). Thus, indicators that reflect the competitiveness of a country may or may not contribute to the process of cooperation between two states, once it may attract, if the country is a reference in innovation, interest from another country that is less competitive in this area.

Thus, it was decided to analyze and compare the competitiveness indicators of Brazil and India as a support to identify elements that may contribute to or limit cooperation between the two countries. The Global Competitiveness Report (WORLD ECONOMIC FORUM) was used, which, through the adoption of 126 indicators, offers us a view of the performance of the competitiveness of 144 economies, being the most comprehensive assessment of this type in the world.

The ranking of competitiveness was built on the basis of 12 pillars (shown in Chart 9), which are the factors that determine the competitiveness level of the countries. Competitiveness reports were analyzed over a period of nine years (2008 to 2016). Data from Brazil and India were compiled, organized into a spreadsheet (Windows/Excel), analyzed and compared. Spreadsheets were generated for the twelve pillars: a total of 126 indicators which were based on the 2.556 data presented by the reports and analyzed over the nine-year period.

Chart 9 - Pillars of competitiveness.

Pillar	Approach
Institutions	It refers to transparency, the degree of corruption, the efficiency of the public sector, the quality of public safety, the protection of intellectual property rights and the ethics of companies. It directly influences investment decisions and plays an essential role in the elaboration of development strategies and policies. They contribute to leverage or retard the competitiveness of a country, the government's activities in the direction of markets (*e.g.*, the choice of a greater interaction between markets in the South as in the case of Brazil and India), its transparency in the elaboration of policies indicating to the international market possible investments (*e.g.*, the establishment of policies in a certain source in the area of renewable energy) and even the corruption.
Infrastruture	It refers to the quality of the transport infrastructure, communication and energy supply. A country with advanced infrastructure can reduce the effect of distance between regions by helping to integrate markets belonging to other countries or regions. The infrastructure suited to the good supply of energy is essential for competitiveness, a structure free of interruptions and of shortage of energy is necessary for the operation of industries and fundamental for the improvement of the quality of life of the population.

Macroeconomic Environment	Refers to the importance of having economic stability. It is composed of interest rates, inflation, foreign currency regulations, tax regulations, among other aspects that contribute to a sustainable growth of the economy.
Primary Education and Health	It refers to the comprehensiveness of the primary education system, to the quality of primary education in the country. In relation to health, it refers to the incidence of diseases and their impact on the economy. It is obvious that a healthy workforce is critical to a nation's productivity and competitiveness. The opposite has negative consequences regarding the cost increase for both the private sector and the public. Investment in energy and energy efficiency are also directly linked to this pillar, as they imply, for example, the adoption of pollution reduction measures through the implementation of less polluting means of transportation or the supply of electric energy to hospitals and health centers in distant regions.
Higher Education and Training	Refers to the comprehensiveness and quality of the educational system at the secondary and tertiary levels, and to specialized training and research services. The current globalized context requires workers to able to perform complex tasks and adapt quickly to the changing environment and the growing needs of the production system. Training was also taken into account in the process of analyzing competitiveness because of its professional and personal importance in constantly improving the skills and abilities of workers.
Goods market efficiency	Refers to the impact of government regulations such as number of taxes. This pillar takes into account aspects such as internal and external competition and governmental intervention. In addition, market efficiency also depends on demand conditions, such as cultural or historical reasons that can make consumers more demanding, which may represent a competitive advantage that forces the country to invest in innovation.
Labor market efficientcy	It reflects the degree of flexibility of labor laws. Labor regulations. It must be based on the assurance that workers are placed for their efficient use in the economy. The labor market must have the flexibility to shift workers from one economic activity to another quickly and at low cost.
Financial Market Efficiency	It assesses the quality of the banking market and of practices and resources that facilitate access to capital for project development and the availability of capital for the private sector through loans, for example. Access to financing.
Technological readiness	It is related to the diffusion of new technologies, that is, the speed of the country and its institutions to adopt and absorb new technologies and use them efficiently.
Market Size	It refers to the size of the market by which companies conduct themselves. The country with a large market enables companies to explore large-scale economies, such as India. In the era of globalization, international markets may even function as a substitute for domestic markets, especially for poor countries.
Business sophistication	Refers to the quality and quantity of local suppliers in the country, measured through their extension and their interaction with the entire global network.
Innovation	Refers to the innovation that can arise from technological and non-technological knowledge related to know-how, skills and working conditions. Technological advances are on the basis of productivity gains in economies. In addition, living standards can be greatly enhanced or improved through technological innovation. It should be noted that the development of renewable energy is an example of this. Collaboration in research and technological development between universities and industry is an important factor in this indicator.

Source: Arruda; Ferreira; Araújo (2007); WEF (2017).

The problematic factors for doing business, from the competitiveness report, were also used. These primary data were obtained through an opinion survey with executives working in the countries studied. Once these factors can limit cooperation between states, a compilation of factors regarding business in Brazil and India, referring to the period of nine years, was made.

It should be noted that our aim here was not to delve specifically into each of the competitiveness indicators or into each of the problematic factors, that is, the factors that make doing business difficult in both countries: the aim was to analyze and compare these indicators and these factors regarding Brazil and India by crossing them with data from the primary research carried out for this thesis as a support to identify elements that can contribute or limit the cooperation between the two countries. The competitiveness indicators and the factors that hamper business were considered in two questions of the questionnaire applied and in the interviews conducted so that both the respondents and the interviewees could express their opinion as to whether these elements could limit or promote cooperation between Brazil and India in the field of renewable energy.

5.4.1 **Brazil and India in the competitiveness ranking**

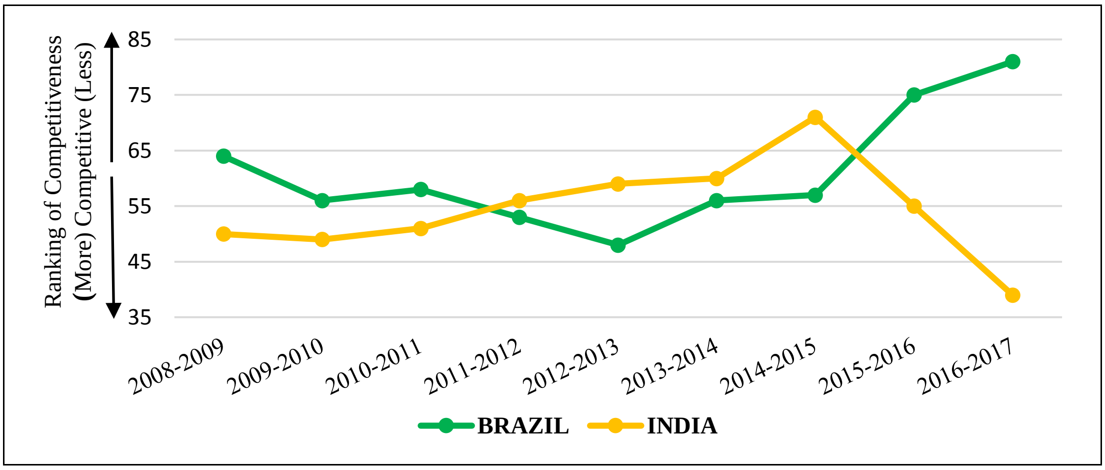
The data analyzed show that India, from 2008 to 2010, was more competitive than Brazil. This was due in particular to the improved performance in the indicators "macroeconomic environment", "size of the market" and "financial market efficiency". Although India performed better than Brazil in all indicators (with the exception of "primary education and health", "higher education and training" and "technological readiness"), the other India´s indicators showed a decline.

As of 2011, Brazil surpassed India in the overall ranking of competitiveness and remained more competitive for four years. This was due to Brazil's better performance against India in the indicators "macroeconomic environment", "primary education and health", "higher education and training". The indicator "market size" also had a good performance from 2011 to 2014 and was better than in India. The size of the Indian market is the only indicator in which India has the best rating since the competitiveness report began to be published. The indicators "technological readiness" and "infrastructure" practically remained in the same position in the ranking during these four years. Therefore, these indicators did not have the same influence as the ones which improved and helped Brazil become more competitive than India in that period,

Starting in 2015, Brazil fell again in the general ranking of competitiveness: it fell 18 positions, inverting its position from 57th to 75th, the worst to date. India has gone from 71st to 55th. In 2016, Brazil fell to 81st position while India improved its performance reaching 39th place in the general ranking of competitiveness. Between 2015 and 2016, Brazil worsened its performance in all indicators except for the indicator referring to the size of the domestic market, which continued to be considered competitive, and the indicator referring to the country's infrastructure, which remained practically the same as in previous years. Based on the year 2014, when Brazil was better than India in the general competitiveness ranking, the indicators in which Brazil most worsened were "macroeconomic environment", "higher education and training", "financial market efficiency ", which concerns the country's ability to facilitate access to finance, and "innovation". India, on the other hand, improved its performance in all indicators.

The graph below shows the evolution of Brazil and India in the ranking of competitiveness and the comparison between these two countries in the period of nine years. It should be noted that in the graph, the closer the line is to the horizontal axis, the more competitive the country.

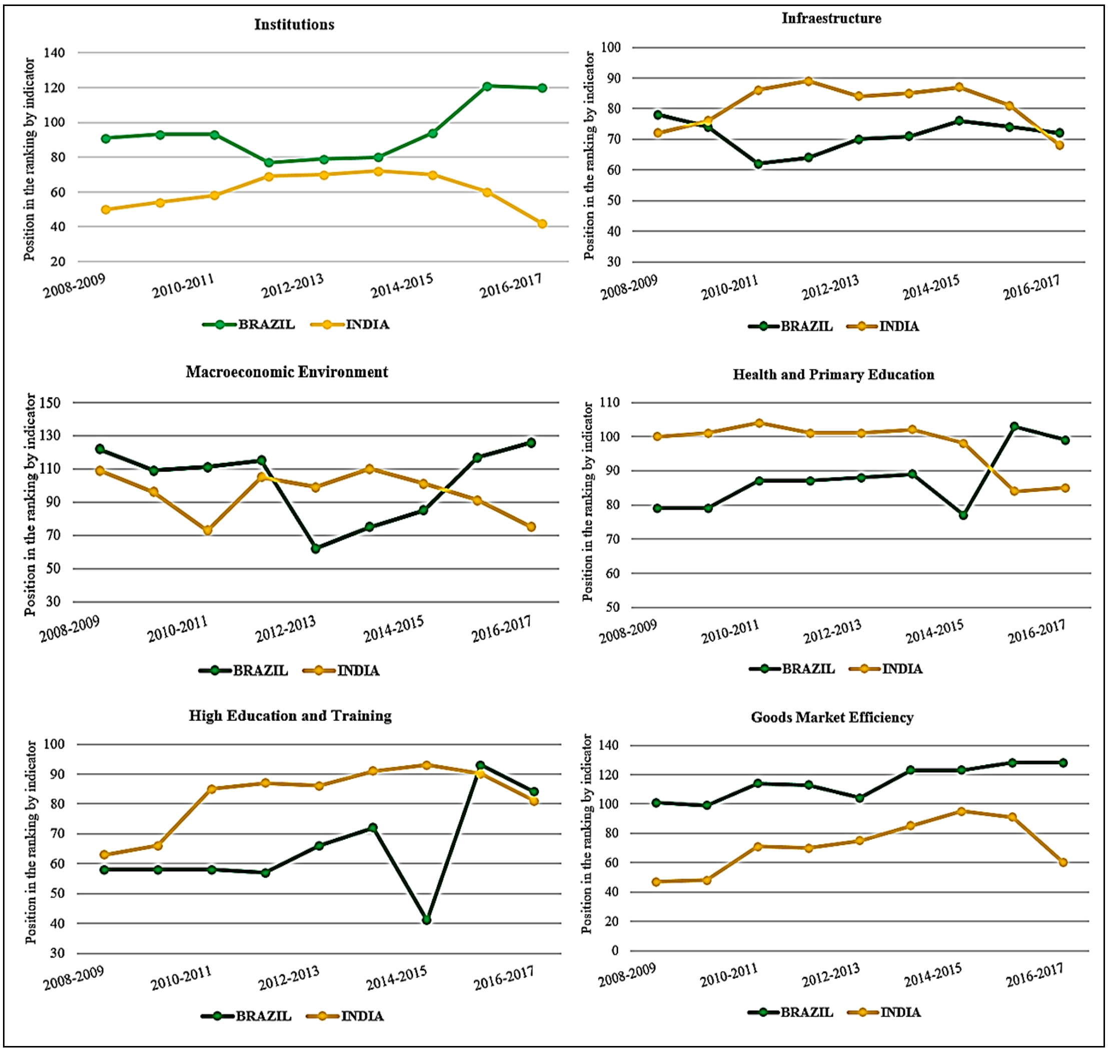
Graph 30 – Evolution and comparison between the competitiveness pillars of Brazil and India (2008-2009/2016-2017).



Source: Author's elaboration.

The following graphs provide the performance of each indicator for Brazil and India comparing them over the nine years analyzed. Like the previous graph, the closer the line is to the horizontal axis, the more competitive the country is.

Graph 31 – Indicators of competitiveness in Brazil and in India: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training and efficiency and goods market. (2008-2009/2016-2017).



Source: Author's elaboration.

Graph 32 - Brazil and India competitiveness indicators: labor market efficiency, financial market efficiency, market size, market sophistication, technological readiness and innovation (2008-2009/2016-2017).

Source: Author's elaboration.

Over the nine-year period, India has performed better in the following indicators: institutions, goods market efficiency, financial market efficiency, and size of the domestic market. Brazil was performing better in the indicators of infrastructure, health and primary education, higher education and training and sophistication of the market, but from 2015 it began to perform poorly in all these indicators, while India improved its performance in all of them. India, then, in 2016 ranked better than Brazil in competitiveness.

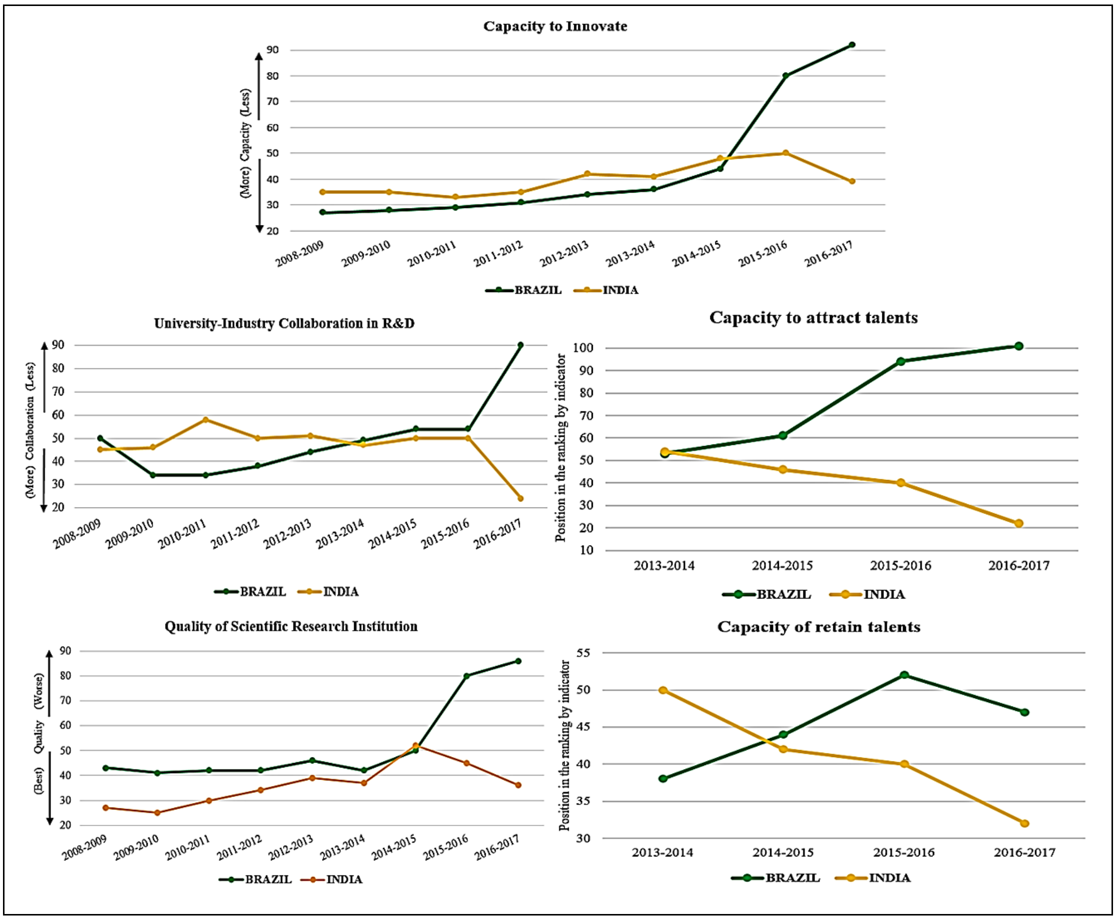
In relation to the indicators "macroeconomic environment" and "labor market efficiency", India and Brazil showed a similar pattern of behavior until the year 2015, when Brazil also began to perform poorly.

The "technological readiness" pillar was the only one in which Brazil was able to maintain a performance superior to that of India in the whole analyzed period. This means that, even facing economic and social difficulties during the period analyzed, which are reflected in the data collected and analyzed, the diffusion of new technologies and the speed with which the country and its institutions adopt and absorb new technologies in order to use them efficiently have remained stable and more competitive than those in India.

The "innovation" pillar, which is directly related to what was discussed in section 5.3 of this chapter, shows that India, regarding the capacity to innovate, was a little ahead of Brazil. This distance increased from the period 2015-2016, when Brazil began to perform poorly in this indicator. It became clear that Brazil, for a number of factors already exposed, suffered a decline in the area of science and technology from 2015.

The indicator related to innovation brought other variables that deserve to be mentioned here, since it complements or accentuates the discussion made in the previous section on the scientific and technological production of the two countries under study. The following graphs show that the 2015 really was a critical year for science in Brazil due to the poor performance compared to previous years, while India improved on the innovation variables presented in the following figure. It is worth mentioning that the closer the line is to the horizontal axis, the better is the country's performance in the presented variable.

Graph 33 - Brazil and India in the pillar of innovation.



Source: Author's elaboration.

It was noticeable in the compilation of the data that, from 2015, Brazil's capacity to innovate has been low. Brazil has had a poor performance also in collaboration between universities and industries in research and development and in the quality of scientific institutions. This was reflected in Brazil's underperformance in the "labor market efficiency" indicator, as both Brazil's ability to retain its own talents and its ability to attract new talent has declined, making it less attractive than India.

As already mentioned, an opinion poll with senior executives, which is done annually by the World Economic Forum and published in the Global Competitiveness Report, was compiled. This research brings the most problematic factors for doing business in countries; factors such as inefficient government bureaucracy or political instability, which can certainly bring limitations to cooperation between two states.

After compiling the data it was noted that, in a listing with five problematic factors for doing business, those that occurred repeatedly, in different proportions in Brazil and India, over the nine years analyzed were insufficient supply of infrastructure, inefficient government bureaucracy, restrictive labor regulations, taxes, political instability and corruption. It must be observed that corruption appeared for the first time among the five most voted elements in Brazil in the survey conducted in 2016. In India, corruption was present among the five most voted elements during the nine-year period in which the research was carried out. Over the past nine years, among the five factors that make doing business harder, access to finance and inflation occurred repeatedly only for India and did not appear among the top five in Brazil. Precarious public health, crime and theft were among the top five elements hindering business in India only once over the course of nine years.

Competitiveness brings, in its core, essential aspects when the interaction between countries is brought into discussion. The indicator linked to education, for example, directly reflects the skills that the workforce may or may not have in relation to the insertion or development of new technologies in a country and to the interaction between university and industry. Excessive bureaucracy is a factor that may limit the implementation of new partnership.

Identifying strengths and weaknesses in some areas can help understand processes of interaction or cooperation between countries. Thus, the next section brings the results of the primary research conducted in this thesis through a questionnaire applied to employees of the foreign affairs ministries of Brazil and India. More precisely, Questions 10 and 11 reflect the issues addressed in this section. The objective was to know if, in their opinion, the elements brought here and present in their countries may limit or foster cooperation between the two states in the area of renewable energy.

5.5 QUESTIONNAIRE

This section presents the results and the discussion on the questionnaire applied to employees of the foreign ministries of Brazil and India.

This data collection instrument had the main objective of identifying barriers as well as opportunities for cooperation in the field of renewable energy between the two countries.

The questionnaire was applied to representatives of the Ministry of Foreign Affairs in Brazil responsible exclusively for the Energy issues (Department of Energy and Renewable Energy Division belonging to that department) and Asia (South Asia Division of the Department of Central and South Asia and Oceania) and two divisions of the Indian Ministry of Foreign Affairs responsible for Energy and Economic Affairs (Latin America & Carribbean Divison). The divisions were chosen based on a comparison between the areas of activity of the Ministries of Foreign Affairs of the two countries, identifying the ones that approach them, such as the area of energy, Latin America (in India) and Asia (in Brazil). In addition to the two divisions mentioned, the questionnaire was also applied to representatives of the agencies responsible for cooperation in the two countries - in the case of Brazil, the Brazilian Cooperation Agency (ABC) division responsible for Asia and, in the case of India, the Development Partnership Administration (DPA II), which works with Latin America, both linked to their respective Ministries of Foreign Affairs.

It should be noted that the questionnaire was sent to all employees of the aforementioned divisions and cooperation agencies of both countries through an electronic mail (e-mail) through the SurveyMonkey® virtual collection platform. The contacts concerning the electronic addresses of the employees who received the questionnaire were acquired on the Internet pages of the Ministry of Foreign Affairs of India (MEA) and the Ministry of Foreign Affairs of Brazil (MRE).

After sending the questionnaire to respondents who did not respond within eight days, reminders were sent through their respective e-mail addresses. Once received, the data was transported to spreadsheets (Windows/Excel) and then analyzed. The questionnaire had twenty-one questions, as can be seen in Appendix D.

Collecting responses from the Indian divisions and from the cooperation agency was very difficult. Considering the Brazilian sample, of the total of the questionnaires sent, only one was not answered.

As for the Indian respondents, only one of them answered the questionnaire despite the insistence on the part of the researcher, who sent several reminders through the electronic addresses, a cross-platform message exchange and voice calls so that the questionnaire could be answered. This caused, in addition to promises that the questionnaire would be answered, two employees to suggest that their bosses should respond the questionnaire. In an attempt to collect answers, a professor at Jawahalral Nerhu University in New Delhi, would have helped contacting the heads of energy and Latin American divisions and the Indian Cooperation Agency. There was then the promise that one of the two heads of the divisions would respond to the questionnaire, which did not happen. Thus, of all Indian respondents to whom the questionnaire was sent, only one answered it - one of the three general directors. Other employees from the same divisions, said, informally, that once one of the general directors had already answered it, there was no need for more people to do so.

Thus, the data treatment was divided as follows: item 5.5.1, below, presents the characterization of the sample in terms educational level of the respondent and his or her position, including all respondents (from Brazil and India). From item 5.5.2, each question and the results referring to it are presented. For each question, the content of the question (or what it addresses) is presented first; then the statistical treatment of Brazilian respondents; and, soon after, the results of the questionnaire answered by the Indian.

Some hypotheses can explain the low adherence of respondents in India. One is the possibility that those employees simply do not like or are not in the habit of participating in academic research. Another hypothesis is the possibility that the hierarchy in the work environment has influenced the behavior of other employees, cause them to wait for the person in higher ranks to answers the questionnaire. However, the most likely hypothesis, raised, at first, by two Brazilian diplomats, would be that Indian employees were overburdened.

To check this last hypothesis, the number of employees working in Brazil[29] and the number of employees working in India[30] in their respective foreign ministries were counted: Brazil has approximately three times the number of employees that India has. Thus, the hypothesis raised informally by the two Brazilian diplomats proceeds. It can be emphasized that the division responsible for energy is considered essential in the Indian Ministry of Foreign Affairs, considering that this division, called Economic Diplomacy, represents the ministry in other areas such as in the area of commerce, foreign investment including technology management and transfer and even in all matters relating to agriculture, which would in fact overburden the seven employees that comprise it.

The following item presents the general characterization of the respondents.

5.5.1 **Sample Characterization**

The data analyzed in this sample characterization are the results of a questionnaire applied to a total of twelve employees of the Brazilian Ministry of Foreign Affairs, that is, the target population, able to provide the required information in the questionnaire. It corresponds to the total sample size, since the questionnaire was sent to all employees of the divisions and the cooperation agency chosen for the research. Of the total mentioned above, only one of the employees did not respond to the questionnaire sent. This implies that 92% of the employees answered the questionnaire applied in Brazil.

In India, the questionnaire was sent to 21 employees, who represent 100% of the respondent population, from the selected divisions, which belong to the Indian Ministry of Foreign Affairs, as mentioned above. Of this total, only one questionnaire was answered, corresponding to approximately 5% of the target population.

However, it should be noted that this single questionnaire was answered by the head of the division, which gives representativeness to the results.

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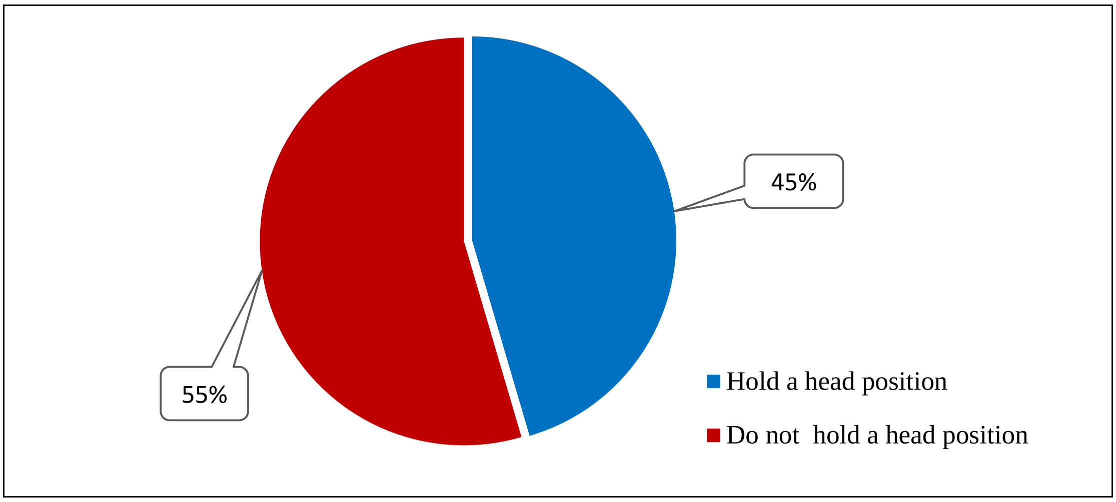
[29] ELECTRONIC SYSTEM OF THE CITIZEN INFORMATION SERVICE (e-SIC, 2017). Response provided by the Ministry of Foreign Affairs of Brazil in accordance with protocol number 09200001002201791 on December 7, 2017 at 5:30 p.m.

[30] A count of the number of staff working in the Indian Ministry of Foreign Affairs was made through the information collected on the website at this address:http://www.mea.gov.in/divisions.htm

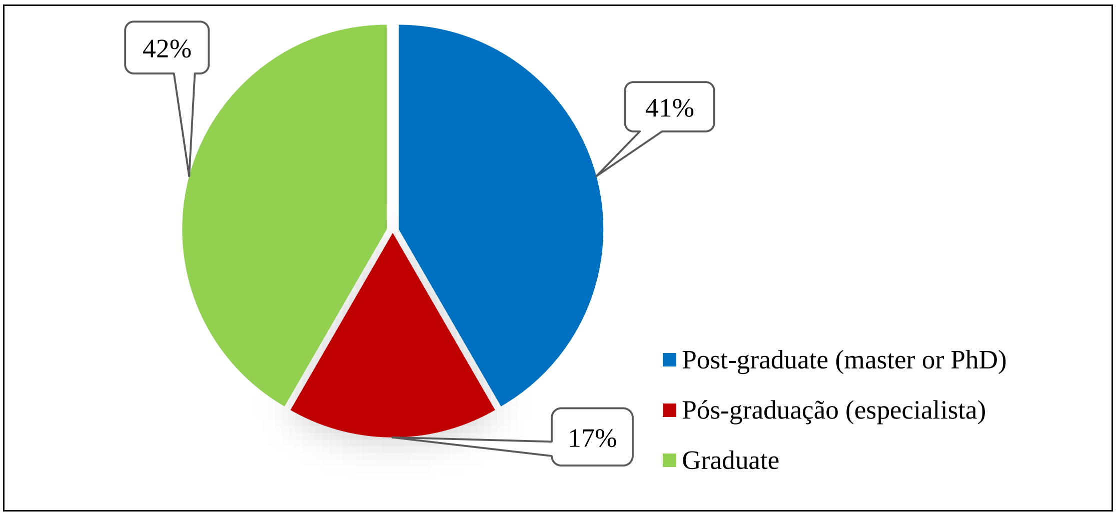
The sample characterization presents data regarding the level of education of the respondents and their position in the institution in which they work. Among the respondents, 45% are heads of their divisions. In addition, 41% have a master's degree or a doctorate´s degree. 17% have a post-graduate course (specialization course) and 42% have graduate degrees. The following graphs illustrate the general characterization of the sample.

Graph 34 - Characterization of the respondents regarding occupation.



Source: Author's elaboration.

Graph 35 - Characterization of the respondents regarding education.



Source: Author's elaboration.

The results of the statistical treatment are presented below according to the evaluation questions of the questionnaire applied.

5.5.2 **Results of the questionnaires**

As mentioned before, the questionnaire has 21 questions. The first two focus on the general characterization of the sample as presented in the previous subsection. The following five questions focus on the interpretation of the institutional view made by the respondent regarding South-South cooperation and Brazil-India cooperation. The next two questions address public policy. Question 10 to question 15 focus on the elements that can promote or limit cooperation, on opportunities and on barriers to cooperation between Brazil and India in the field of renewable energy. The other six questions turn to suggestions or proposals about Brazil-India cooperation in renewable energy. For the answer to the last question, a blank space was made available for the respondent to add additional comments if he / she wished.

5.5.2.1 Question 3

Question 3 asks the respondent to mark the items that represent the way the institution conceives of International Development Cooperation (ICD). The objective of this questions is to learn if these institutions contemplate the interests of the countries of the South.

Chart 10 -Alternatives for question 3.

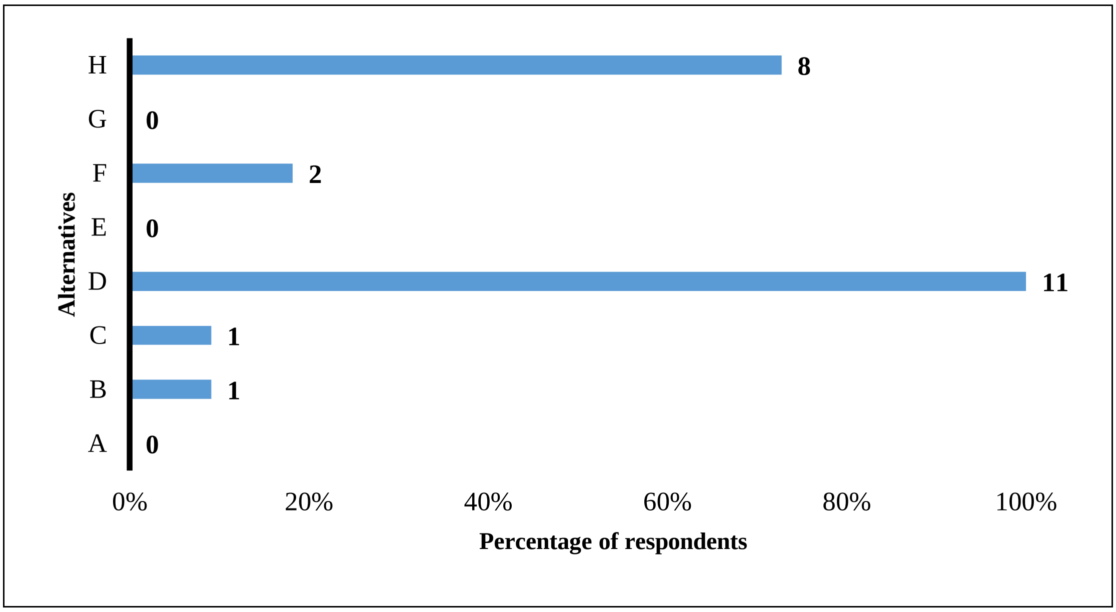
A	Cooperation is a medium/long-term domination strategy between countries.
B	The moral values of the states vary according to the strategies and their positions.
C	The environmental and economic interdependence between states is real and puts any conflicts aside.
D	Sharing challenges and common issues among emerging countries extends the possibility that they can cooperate with one another.
E	In the North-South cooperation, the strategies adopted do not favor the development of the least developed nations, which increases regional contradictions and inequalities.
F	The universe of cooperation has become multi-polarized and multifaceted. However, the linkage with developed countries must be strengthened and the form of cooperation adopted by emerging countries should be mirrored the way the developed ones cooperate, as they have a leading position in cooperation.
G	There is no need for a state to regulate cooperation: it must take place within international organs and regional spaces.
H	For scientific and technological cooperation to occur, not only regulation but also interaction between governments, markets and research centers is necessary.

Source: Author's elaboration.

For 18 percent of respondents, their institutions see ICD as an instrument through which linkages with developed countries need to be strengthened, and emerging countries' cooperation should mirror the way developed countries cooperate. However, for 100% of respondents, their institutions see, in sharing challenges and common issues among emerging countries, a way of expanding the possibility of cooperation between these countries. Moreover, for 73% of the respondents their institutions see as necessary the interaction between governments, the market and the research centers. It should be noted that no respondent has marked the option that the State should not participate in the organization or regulation in the process of cooperation between countries, that is, the presence of the State in the cooperation process is seen as essential.

Graph 36, below, shows the percentages of the answers provided by Brazilian respondents. The responses of the Indian respondent are just after graph, with the alternatives presented to the respondents.

Graph 36 - Conception of the institution regarding international cooperation for development according to Brazilian respondents.



Source: Author's elaboration.

The Indian respondent chose the same alternatives marked by the Brazilian respondents and, similarly, did not choose the ones that were not marked either by the respondents from Brazil. Thus, according to the Indian respondent's interpretation, his institution views international development cooperation not as a strategy of domination, but rather as an instrument that, in the face of environmental and economic interdependence between states, would put conflicts aside; although the moral values of the State may vary according to the strategy adopted by each country. In addition, the sharing of challenges among emerging countries is a factor that increases the possibility that these countries cooperate with each other. However, the link with the developed countries must also be strengthened and the emerging ones should mirror the way the developed countries cooperate because it represents a vanguard position with regard to the actions that promote cooperation. For the Indian respondent, the interaction among governments, market and research centers is essential for the promotion of cooperation among countries

5.5.2.2 Question 4

Question 4 asks the respondent to explain the objectives of his or her institution with regard to international cooperation. The following alternatives are presented:

Chart 11 -Alternatives for question 4.

A	Avoid conflicts.
B	Mitigate regional differences.
C	Build trust among cooperation agencies and institutions.
D	Promote international cooperation policies.
E	Promote trade.
F	Improve people´s life quality through economic, environmental and social balance.
G	Others

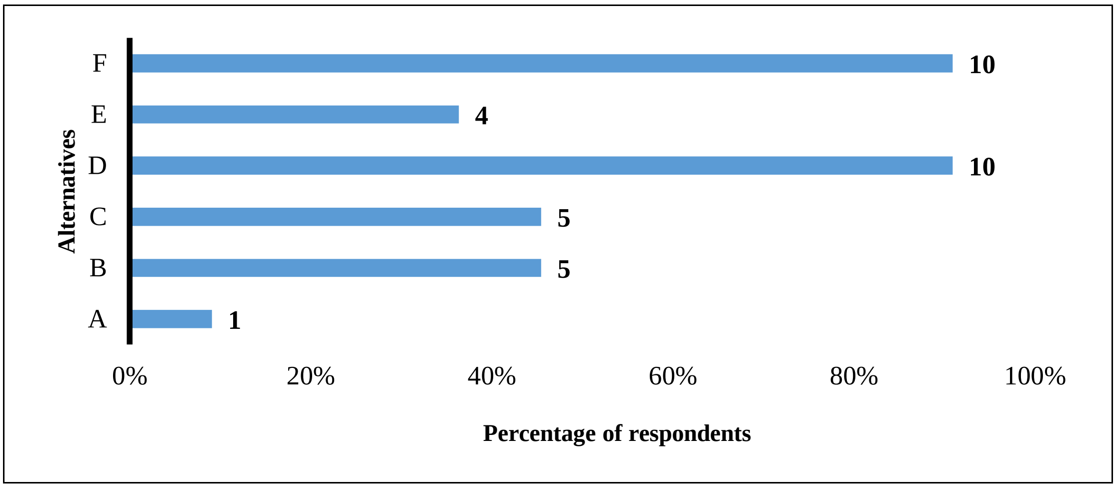
Source: Author's elaboration.

Among the alternatives offered (Chart 11), two objectives of the institution were highlighted: "Improving people's quality of life through economic, environmental and social balance" and "Promoting international cooperation policies". 91% of the respondents chose these two alternatives. The alternatives "Mitigating regional differences" and "Building trust between cooperation agencies and institutions" ranked second among those chosen, with 45%. Although they are in second place, these choices show the interest of the institution in investing in South-South cooperation, such as a way for developing countries to exchange experiences among them in order to mitigate the differences between developed and developing countries.

Choosing the option "Improving the quality of life of people through economic, environmental and social balance" as one of the objectives of the institution refers to the concept of sustainable development, which stresses that natural resources must be used by the current generation, without compromising future generations to use them and this must be sought through the balance between the economic, environmental and social pillars. Thus, this concept is present in the institution perception of international cooperation.

Despite the blank space destined to the respondent to cite other objectives, if necessary, none was given. The following graph illustrates the responses of Brazilian respondents in percentages. Right after the picture, follow the Indian's answers.

Graph 37 - Conception of Brazilian respondents regarding to the objectives of their institutions with respect to the international cooperation.



Source: Author's elaboration.

The Indian respondent chose four of the six options that were also checked by the Brazilian respondents.

Thus, the objectives of his institution in relation to international cooperation would be to build trust between institutions and agencies of cooperation among countries, to promote policies of international cooperation, to promote trade among States and to improve quality of life through economic, environmental and social balance. This implies a more systemic view of reality underlining the importance of interdependence, which was evidenced in the answers to the previous question. For the Indian respondent, avoiding conflicts or even mitigating regional differences would not be the aim of international cooperation.

5.5.2.3 Question 5

Question 5 asks the respondent to explain the institution´s most common form or forms of cooperation. The options are set out in the table below.

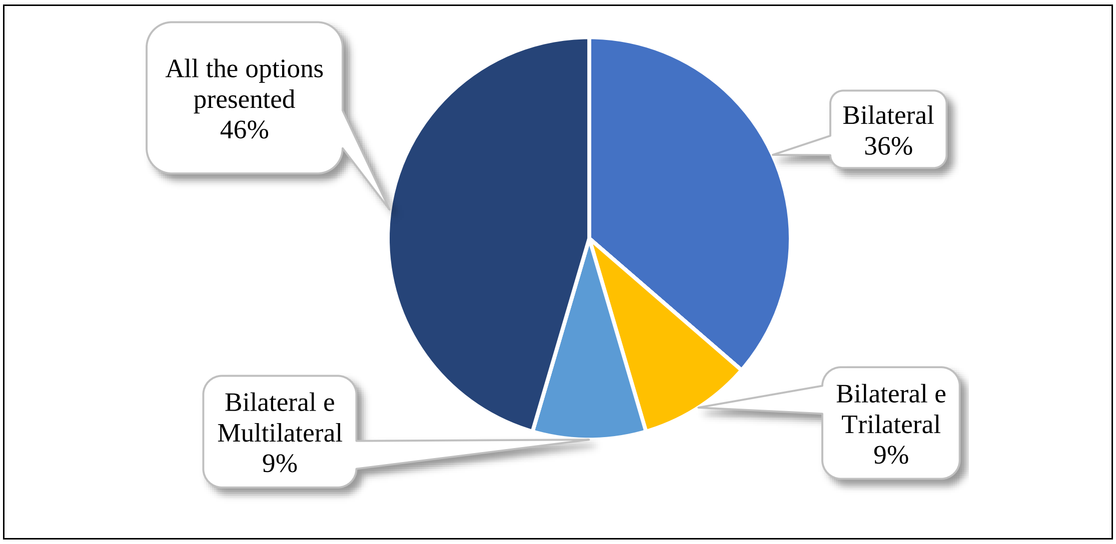
Chart 12 - Alternatives for question 5.

A	Bilateral
B	Trilateral
C	Multilateral
D	Bilateral and Trilateral
E	Bilateral and Multilateral
F	Trilateral and Multilateral
G	All the options given

Source: Author's elaboration.

Among the Brazilian respondents, 46% chose "all options given", 36% chose "bilateral" and 9% chose "bilateral and trilateral" and the other 9% chose "bilateral and multilateral", as can be seen in the following graph.

Graph 38 - Form of cooperation that is most utilized according to Brazilian respondents.



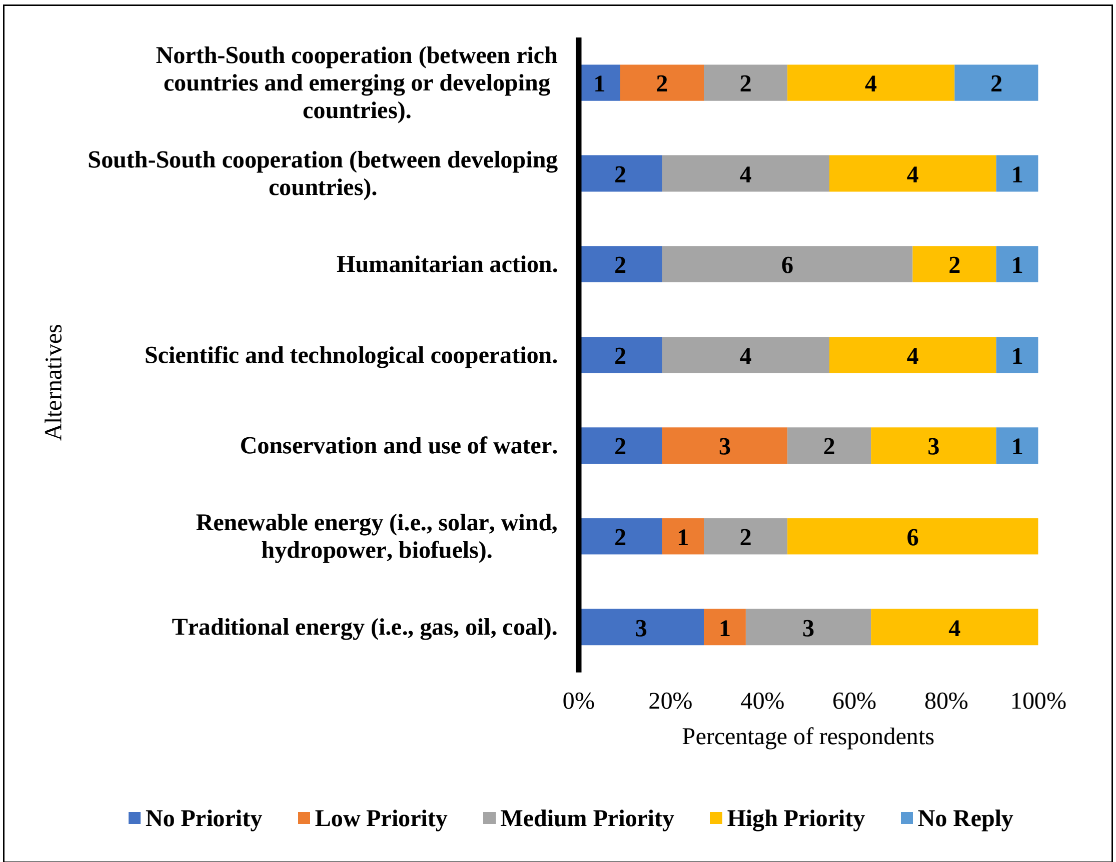
Source: Author's elaboration.

In this question, the Indian respondent also checked the option that contemplates all forms of cooperation, i.e. bilateral, multilateral and trilateral. The answers indicate that most of the respondents are aware of and work with all types of cooperation given. This question was asked to support the answers to Question 16 in which the respondent is asked to indicate how it would be better for Brazil and India to cooperate in terms of laterality.

5.5.2.4 Question 6

Question 6 asks the respondent to indicate the level of priority that his institution gives to certain topics. There are four levels of priority: high, medium, low or none. There is a blank space if the respondent wishes to indicate a topic that is not given as an option and their level of priority. The themes and the answers can be visualized in this graph:

Graph 39 - Priority of the institution regarding the themes presented according to the Brazilian respondents.



Source: Author's elaboration.

54.5% of the Brazilian respondents considered the theme "renewable energy" a "high priority". Still regarding the Brazilian respondents, the theme "traditional energy" was considered a "high priority" by 36.3% of them and as "non-priority" by 27.2% . The topics "South-South Cooperation between the Emerging" and "North-South Cooperation" were considered "high priority" by 36.3% of the respondents. However, the theme of "South-South cooperation among emerging countries" had a prominent position in relation to the "North-South cooperation" theme when considering the "medium" and "high priority" alternatives together, since the respondents' choices are more focused on "South-South cooperation among emerging countries", which reveals a dominance of this theme in relation to the other regarding the level of priority given by the institution. Scientific and technological cooperation also had the same "high priority" percentage (36.3%) as "South-South Cooperation among emerging countries", "North-South Cooperation", "Traditional Energy" and "Renewable Energy".

When considered "medium” and "high" priorities together, the theme "scientific and technological cooperation" will have the same number of choices as the themes "renewable energy", "South-South cooperation between the emerging ones" and "humanitarian action". The Brazilian respondents did not mention other themes as priorities in their institutions.

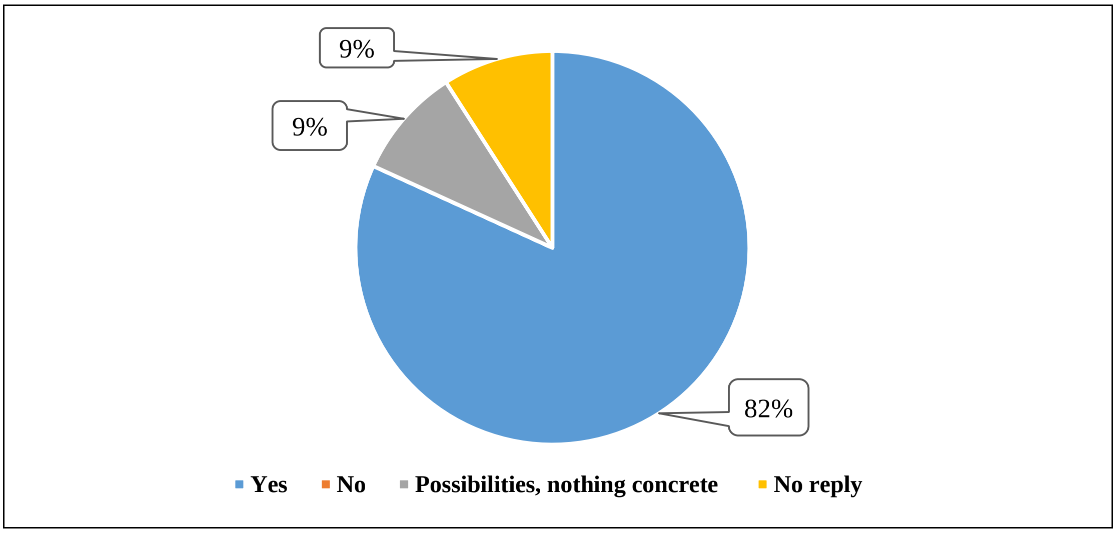
The Indian respondent checked high priority for all items presented. As the respondent’s division also deals with areas other than the energy area, this justifies his choice. Despite the freedom to mention other priorities if he wished, he did not.

The aim of Question 6 was to find out whether the themes this thesis addresses are considered as priorities in the institutions in which the questionnaire was applied and, in particular, also to collect information regarding the level of priority given to the themes "South-South cooperation" and "renewable energy" . The theme "renewable energy" is not only a priority, but a high priority for the majority of respondents, *i.e.*, 58.3% of them, including the Indian respondent. If high and medium priorities are placed together, the percentage goes to 75%. South-South cooperation and renewable energy were considered a high priority by 41.6% and 58.3% of respondents, Brazilians and Indian respectively. However, when "medium" and "high" priorities are considered together, South-South cooperation was chosen by 75% of the respondents.

5.5.2.5 Question 7

Question 7 is: "Do you think your institution is currently interested in the Brazil-India cooperation?”. For 82% of the Brazilian respondents, the institution in which they work is interested in cooperation between the two countries. None of the respondents said that their institution had no interest in such cooperation. The following graph shows the responses in percentages.

Graph 40 - Priority of the institution regarding the themes presented according to the Brazilian respondents.



Source: Author's elaboration.

For the Indian respondent, his institution is interested in cooperation between Brazil and India. None of the respondents stated that they saw no interest from their institutions in the cooperation between Brazil and India. This indicates that there is not only an interest in the institutional sphere, but also a considerable interest in cooperation between these two countries, since 82% of the Brazilian respondents and the Indian respondent chose "yes" to answer the question. It should be noted that the Indian respondent is the head of the division, which means that the weight of his response must be taken into account.

When reviewing the literature, it was clear that the two countries are interested in getting closer. In section 5.1 of this chapter, the institutional documents analyzed show that there is an institutional interest formalized by Brazil and India to cooperate with each other. This interest was also confirmed by the responses of the questionnaire applied.

5.5.2.6 Question 8

Question 8 is: "Regarding public policies, mark what you deem to be true." Options given are presented in the following chart.

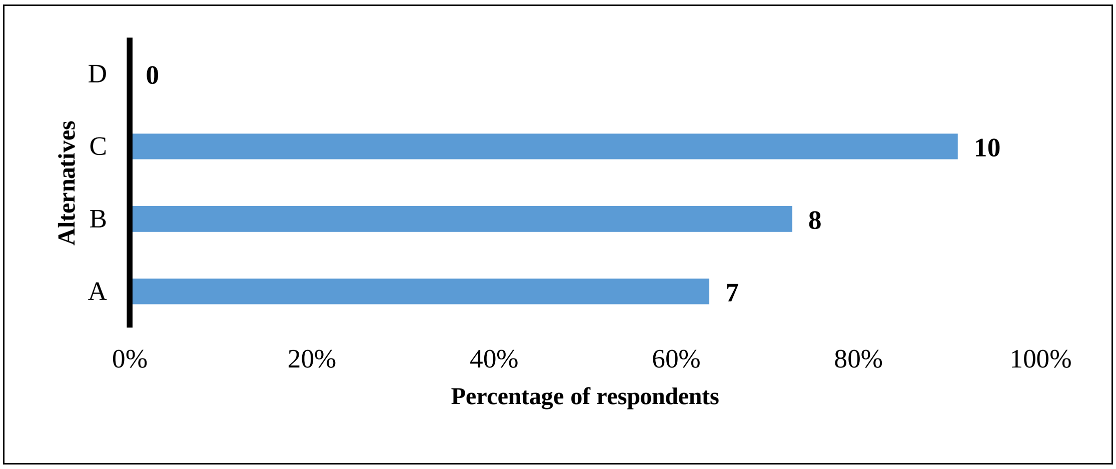
Chart 13 - Alternatives for question 8.

A	The creation of public policies helps to promote cooperation, which helps to promote the market, which promotes trade between two States.
B	The increase in the number of public policies focusing on renewable energy facilitates the rapprochement between the two countries in this area.
C	The creation of policies that seek to promote renewable energy is essential to support the process of cooperation in renewable energy between two countries.
D	The development of policies in one given area does not favor the process of cooperation between two countries or more.

Source: Author's elaboration.

One of the Brazilian respondents did not answer this question. For those who responded, the highest percentage of responses (*i.e.* 91%) was for the alternative that the creation of public policies for the promotion of renewable energy is essential to support the process of cooperation between Brazil and India in this area. 64% of respondents point out that the creation of public policies not only helps promote cooperation between the two countries, but also stimulates the market and trade between them. And 73% of responses indicate that increasing the number of public policies on renewable energy helps to bring the two countries closer together in this area. Graph 41 below illustrates the results collected from respondents in Brazil.

Graph 41 - Public policies and renewable energy according to the Brazilian respondents.



Source: Author's elaboration.

The Indian respondent also checked the alternative that got the highest percentage among Brazilians: that the creation of renewable energy policies is fundamental to support the process of cooperation between the two countries in this area. In addition, for the Indian respondent, policy-making helps not only to promote cooperation, but also the market and trade between states.

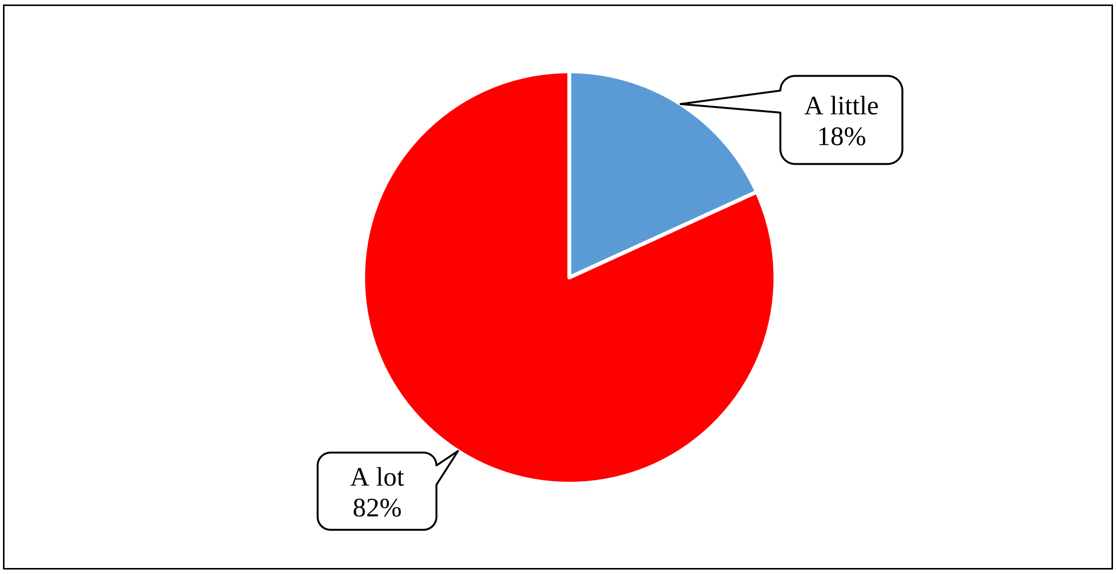
This question was specially considered due to the results presented in section 5.2 of this chapter, dedicated to the main policies in the area of Brazilian and Indian renewable energy. Thus, it was necessary to verify, collecting information from the respondents, if they believe that policies in the field of renewable energy would contribute to the process of cooperation between the two countries. According to the results of the application of the questionnaire, the consensus about the relevance of public policies is evident. In other words, for both Brazilian and Indian respondents, renewable energy policies are essential to support cooperation between the two countries under study.

5.5.2.7 Question 9

Question 9 focuses on the theme of the previous question, public policies: "It was verified that there are similarities between several Brazilian and Indian public policies that seek to promote renewable energy. To what extent can the similarities between their policies contribute to cooperation in renewable energy between these two countries?" The respondent was given three options: "no contribution", "contribute a little" or "contribute a lot". In addition, a blank space was provided in which the respondent could, if he so wished, justify his answer or add something.

For 82% of Brazilian respondents, the similarities between renewable energy policies can greatly contribute to facilitate cooperation between Brazil and India in this area. The following graph illustrates the results.

Graph 42 **-** Similarities between renewable energy policies between Brazil and India according to the Brazilian respondents.



Source: Author's elaboration.

Although the Indian respondent has indicated that policy-making in renewable energy is essential to support the cooperation process, similarity between them, he says, contribute only a little.

A blank space was provided so that the respondent could, if he wished so, justify his response. Three of the Brazilian respondents made contributions. The respondent who said that similarity would help contribute "little" to cooperation between Brazil and India said that "Even if there is similarity in the policy of both countries, with regard to the subject in question, I wonder if the will to cooperate in renewable energy is a state interest or a commercial interest, or whether it is for the development of the population suffering from the lack of energy or the payment of high tax rates and other massive taxes, which only add to these countries' coffers, taking advantage of cooperation as a mechanism of softlaw".

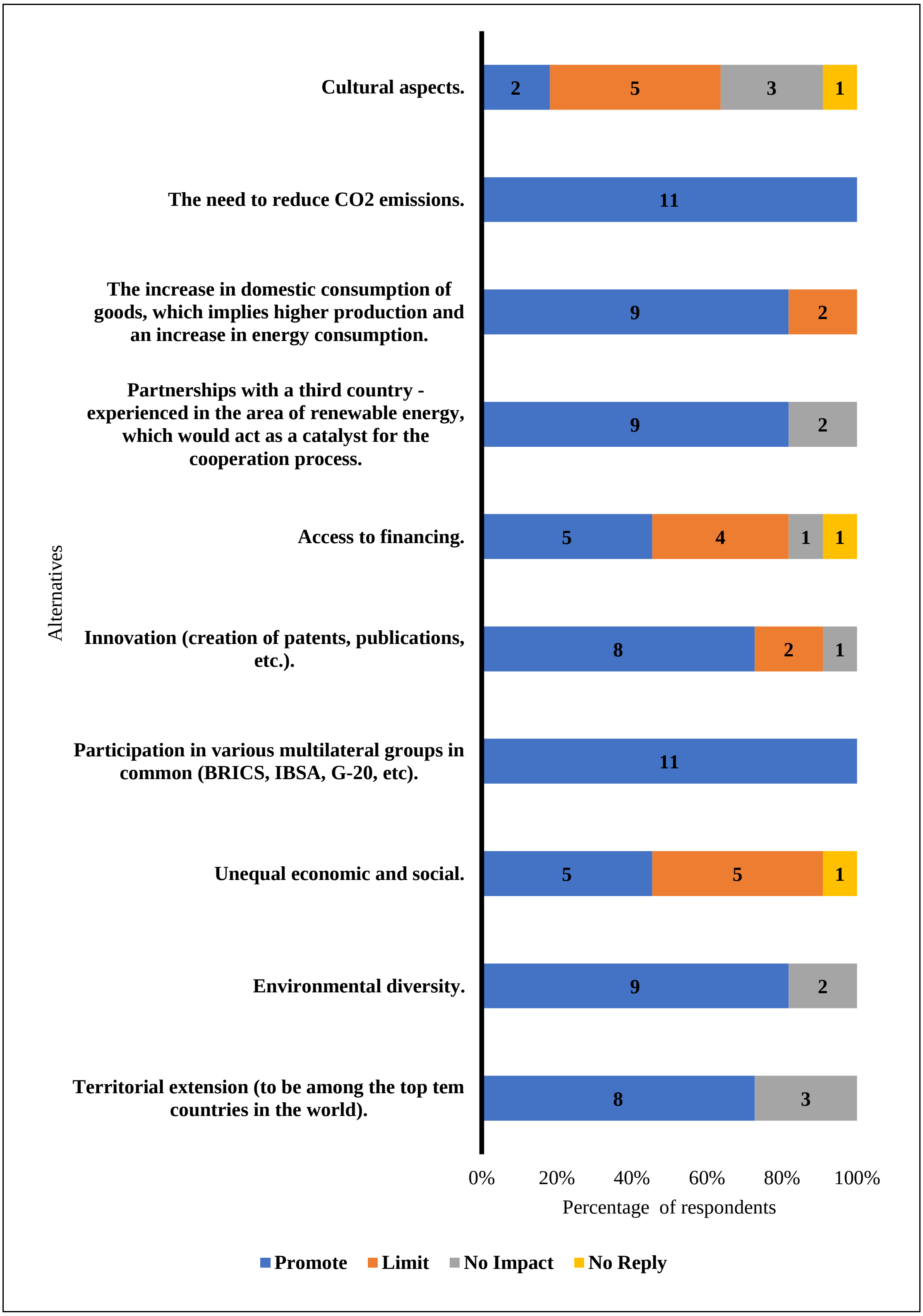
The other two respondents who contributed are among those who considered that the similarities between policies contribute "a lot" to the process of cooperation between the two countries in focus. The first respondent stated that "Similarities in public policies indicate convergence of interests and challenges. Cooperation, in this case, can help solve common problems. "For the second respondent, "Both countries have policies to promote the development of renewable energy. Opportunities for cooperation in the field of second-generation biofuels and in the field of solar energy are available, among others. Brazil and India have shared interests in these fields. "

Question 9 complements the previous question. In section 5.2 of this chapter, the existence of similarities in the Brazilian and Indian public policies, whether in a type of renewable energy or in the type of action developed, was evidenced. For this reason, Question 9 aimed to verify with the respondents if the similarities would contribute positively to the cooperation process between the two countries. None of the respondents check “no contribution”; the majority (82% of Brazilians) and the Indian respondent said that similarity contributes "a lot" to this process. One respondent said that similarity between policies would help "a bit" the cooperation process. Thus, in general, it can be concluded that, for respondents, the similarities help to foment the process of cooperation in renewable energy between the two countries.

5.5.2.8 Question 10

Question 10 asks the respondent to "Check the elements that may limit or promote cooperation in renewable energy between Brazil and India". The idea underlying this question is for the respondent to decide whether the element selected by him promotes, limits or has no impact on the above mentioned cooperation. The elements and the answers can be visualized in this graph:

Graph 43 - Elements which may limit, promote or have no impact to the Brazil-India cooperation on renewable energy according to the Brazilian respondents.



Source: Author's elaboration.

Brazilian respondents were unanimous in choosing the alternatives "need to reduce CO_2 emissions" and "participation in various multilateral groups (BRICS, IBAS, G-20, etc.)" as elements that help promote cooperation in renewable energy between the two countries under study. Regarding the limiting factors, cultural aspects and economic and social inequality stood out, with 45% respectively, of the total responses, although not as marked as the elements that help to promote the cited cooperation. As for economic and social inequality, for 45% of the respondents, it would help promote cooperation in renewable energy between Brazil and India. For another 45%, it would be a limiting element. One respondent did not check any option.

For this question, the Indian respondent also chose the alternatives that Brazilian respondents chose as the ones that can promote cooperation in renewable energy between Brazil and India, such as the need to reduce CO_2 emissions, participation in various multilateral groups, environmental diversity and innovation linked to the creation of patents and publications. For the Indian respondent, cultural aspects promote cooperation between the two countries. For 45% of Brazilian respondents, they limit it, and for 18%, they promote it. Economic and social inequality according to the Indian respondent also helps promote cooperation in renewable energy.

Question 10 presents ten elements covered throughout this thesis for respondents to say which of them could limit or promote cooperation in renewable energy between Brazil and India. Considering the elements highlighted by the Brazilians, which were the same as those highlighted by the Indian respondent, the need to reduce CO_2 emissions is considered as one of the elements that would promote cooperation between the two countries, since both need to work to reduce such emissions. In addition, participation in multilateral groups is also seen as promoting cooperation between Brazil and India. The fact that these two countries participate in several groups in common, as has already been shown, certainly makes this element important, since it is one more factor of approximation between the two States.

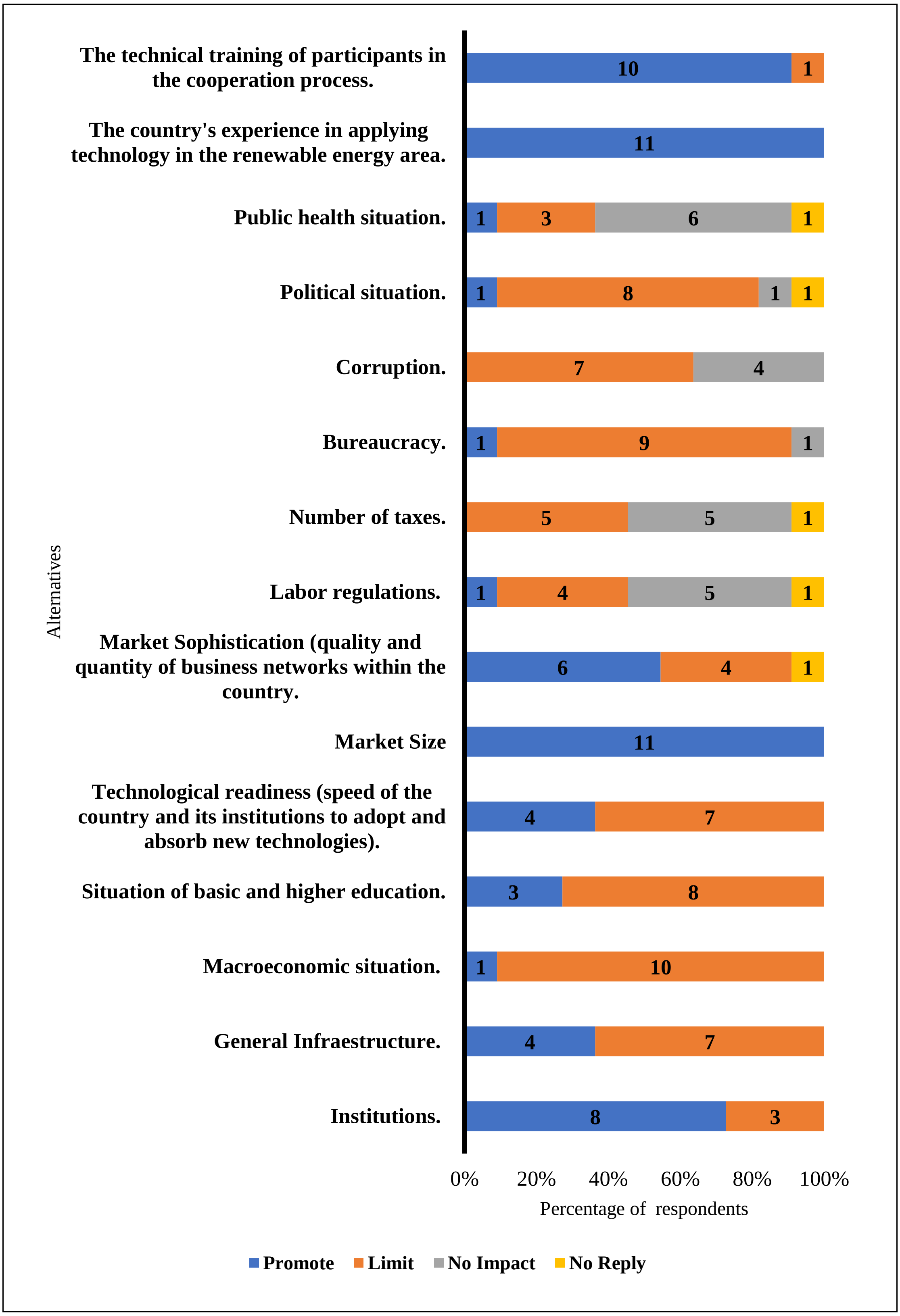
With regard to economic and social inequality, a common challenge for both countries, respondents' answers certainly focused on two issues.

The first one, for those respondents who consider economic and social inequality as an element that may limit cooperation, is that social and economic inequality may cause governments to put renewable energy (and cooperation in this area) aside to invest in areas such as education, public safety and health, for example. The other one, for those respondents who considered economic and social inequality (including the Indian) as an element that helps promote cooperation in renewable energy between the two countries under study, is that governments can seek, through investments , increase capacity building in the energy sector, exchange information and even stimulate the setting up of industries or companies in their countries.

5.5.2.9 Question 11

Question 11 is "Check the elements in your country that can limit or promote cooperation in renewable energy between Brazil and India." The respondent could also check the "no-impact" option if he judged that the option had no impact on cooperation. The elements and the answers are in this graph:

Graph 44 - Elements in your country which promotes or limits the Brazil-India renewable cooperation according to the Brazilian respondents.



Source: Author's elaboration.

The size of the domestic market was unanimously highlighted among the Brazilian respondents as an element capable of promoting the country's cooperation and experience (in the case of Brazil) in the field of renewable energy. The technical training of participants in cooperation processes, institutions and market sophistication are the other elements that were not unanimously chosen among Brazilians but were highlighted as elements present in Brazil that could help to promote cooperation between Brazil and India. All other elements were considered by Brazilian respondents as limiting, with emphasis on the country's macroeconomic and political situation, bureaucracy, basic and higher education, corruption and general infrastructure.

To this question, most of the Indian respondent's choices were different from the Brazilian group, with the except of the following elements: institutions, size of the domestic market and sophistication of the market, country experience in applying technology in the renewable energy area and the technical training of participants. For him, these elements are present in his country and can help promote cooperation in renewable energy between Brazil and India. The other elements that he marked and that differ from the choices made by Brazilian respondents are mostly focused on socioeconomic issues, such as the macroeconomic situation, which the Indian respondent marked as an element in his country that would help promote the cooperation between the two countries. For 90.9% of Brazilian respondents, however, this element would limit cooperation. The same was true for other items highlighted: political situation, education and health and corruption.

The elements in Question 11 were based on the indicators of the annual competitiveness report published by the World Economic Forum (WEF). The choices of the Brazilians respondents privileged the elements that can limit (rather than promote) cooperation in renewable energy between Brazil and India.

The general infrastructure, corruption, political situation and what can be called "Brazil cost" (such as the number of taxes, bureaucracy, labor regulations) can, for example, make entrepreneurs in the area of renewable energy give up investing in the country. The education, which may interfere with the quality of energy professionals, has also been considered as an element in Brazil that may limit cooperation in renewable energy between Brazil and India. The macroeconomic situation was considered a limiting factor by 91% of the respondents. The choices made by Brazilian respondents are certainly consequence or reflection of the last two years of the Brazilian socioeconomic situation. Respondents' choices matches with Brazil's results in the WEF report, according to which the country´s performance was inferior to India´s in the last two years, dropping 24 places in the most competitive rankings while India has climbed 32 positions.

5.5.2.10 Question 12

Question 12 is "What are the main barriers to cooperation between Brazil and India in the field of renewable energy?". The options listed in the chart below were given, but also a blank space was provided for the respondent to mention other barriers if he wanted to.

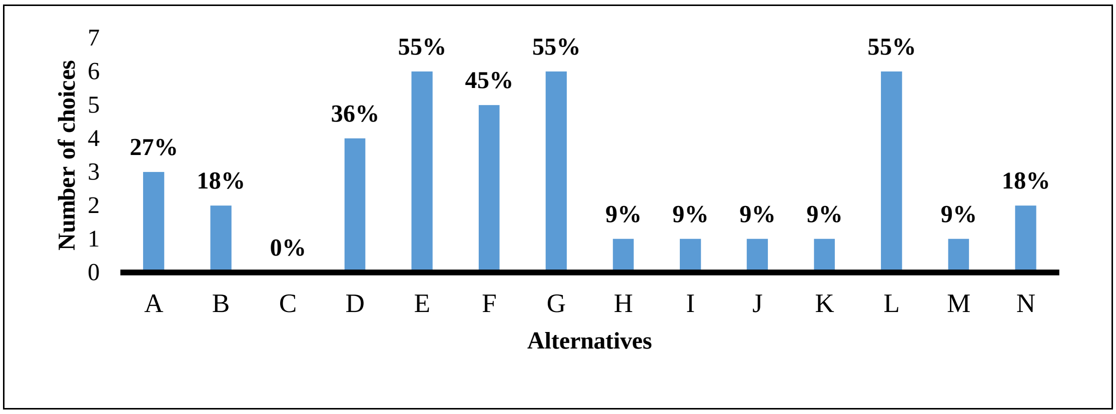
Chart 14 - Alternatives for question 12.

A	Lack of government investments in renewable energy.
B	Lack of knowledge on renewable energy by the cooperating agency staff.
C	Lack of trust among partners (governments, agencies and other institutions).
D	Insufficient of legal ties in the agreements and memoranda.
E	Absence of political will
F	Follow-up required after the signing of the agreements/memorada.
G	The need for greater commitment among the institutions participating in agreements/memoranda.
H	Prioritizing to cooperate with neighbors or with countries in their geographic region.
I	Cultural differences.
J	Language differences.
K	The absence of single database to monitor the projects or actions of cooperation after the signing of memoranda/agreements.
L	Need for more investment in science and technology.
M	Need for professional experts in South-South cooperation.
N	Fear that Brazil/India would prefer cooperating with the South countries to the North ones, fearing impositions of the North countries.

Source: Author's elaboration.

According to the Brazilian respondents, the main barriers are the lack of political will, the need for greater commitment among the institutions involved in the memoranda and agreements, the need to monitor post-signature agreements and the need for more investments in science and technology. The following chart shows the results.

Graph 45 - Barriers to the Brazil-India renewable energy cooperation according to the Brazilian respondents.



Source: Author's elaboration.

The three barriers to Brazil-India cooperation in renewable energy, each representing 55% of the Brazilian respondents' choices, were not chosen by the Indian respondent. Alternative L reflects the reduction of financial investments in Brazilian science (discussed in the previous section), which certainly reduces the possibility of exploring the country's potential in the area of renewable energy. The choice of the alternatives "lack of political will" and "need for greater commitment among institutions participating in agreements / memorandums" may reflect the political and economic uncertainties experienced by Brazil in the last two years.

Marked by 45% of the Brazilian respondents, that is, the second most marked, the option F was also chosen by the Indian respondent. This means that the lack of follow-up to agreements and memoranda after its signature is a barrier to cooperation in the respondents' opinions. The total absence of or lack of legal ties in the agreements and the memoranda was chosen by 36% of the Brazilian respondents, which emphasizes the need to review the way the memoranda and agreements are drawn up. The other alternatives chosen by both Brazilian and Indian respondents were the employees' lack of knowledge about renewable energy in both cooperation agencies, the prioritization of cooperation with neighboring countries, and cultural differences. Lack of trust between partners was not considered a barrier by any of the respondents.

A blank space was provided for the respondent to mention another barrier (s), if desired. One respondent stated that "the need to meet a broad cooperation agenda with a number of developed and developing countries, as well as follow-up in the different fora on the subject" would be another barrier to consider.

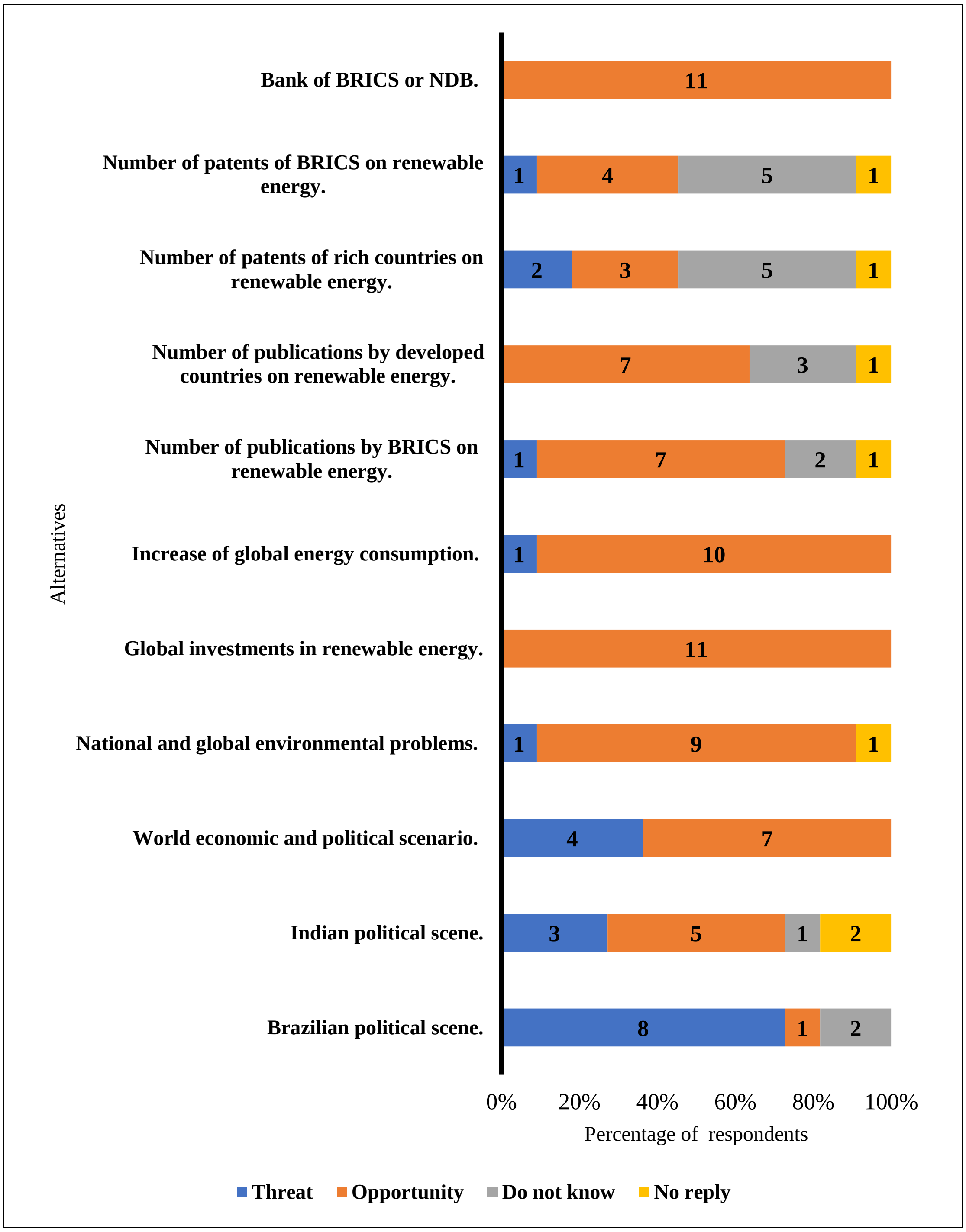
Two other respondents added that "the lack of greater technical and concrete interest in each country, especially the Ministries of Energy" and the "lack of interest of the Brazilian private initiative in India and lack of knowledge of the national entrepreneurs towards the South- Asian "would also be barriers.

5.5.2.11 Question 13

Question 13 is "With regard to threats and opportunities, identify what constitutes threats (T) and what represents (O) opportunities for cooperation in renewable energy between Brazil and India." It was also left a blank space in case the respondent wanted to cite other barriers.

The respondent can classify each factor by choosing among the options: threat or opportunity. In addition to these options, the respondent had the option of marking "do not know" if he did not know how to classify the factor as a threat or an opportunity. The graph below shows the threats, opportunities and responses:

Graph 46 - Threats and Opportunities for the Brazil-India cooperation on renewable energy according to the Brazilian respondents.



Source: Author's elaboration.

All Brazilian respondents pointed two opportunities for cooperation between Brazil and India in the area studied: global investments in renewable energy and the BRICS bank (NDB). The increase in global energy consumption and environmental problems were identified as opportunities by, respectively, 91% and 82% of Brazilian respondents. The threat highlighted by the Brazilian respondents was the political scenario in Brazil, which represented 73% of the choices. The options related to patents had the greatest number of "do not know" in response, evidencing the respondents' lack of knowledge (45% of them) regarding the extent to which innovation can be a competitive differential in the area of energy. However, the number of patents in the BRICS renewable energy area was seen as an opportunity by 36% of Brazilians and as a threat by 9% of them. With regard to the number of publications, both BRICS and those published by developed countries, 64% of Brazilian respondents see them as an opportunity, which may mean that publications are seen as a source of access to information or knowledge, not necessarily as an element that can make a country stand out in a certain area in view of the knowledge produced, which can make the country a reference. The Indian respondent, in relation to the number of publications, checked the option "do not know" if it would be an opportunity or a threat. However, in relation to the number of BRICS patents, the Indian respondent classified it as an opportunity for Brazil-India cooperation while considering the number of patents from developed countries as a threat to such cooperation.

The Indian respondent, as well as the Brazilian respondents, saw opportunities for renewable energy cooperation between Brazil and India in the political and economic scenario of the world, in the environmental problems, in global investments in renewable energy, in the increased global energy consumption and in the BRICS's bank. But the Brazilian political scenario was seen as a threat by both 73% of Brazilian respondents and the Indian respondent. The Indian political scenario is seen by 45% of Brazilian respondents as an opportunity, although it is seen as a threat by the Indian respondent.

The Indian's choice is certainly the result of the regional geopolitical issues that India has to deal with, including those closely related to the energy field.

5.5.2.12 Question 14

Question 14 asks the respondent to indicate the elements that contribute to promoting cooperation in renewable energy between Brazil and India. The alternatives given are found in the following chart:

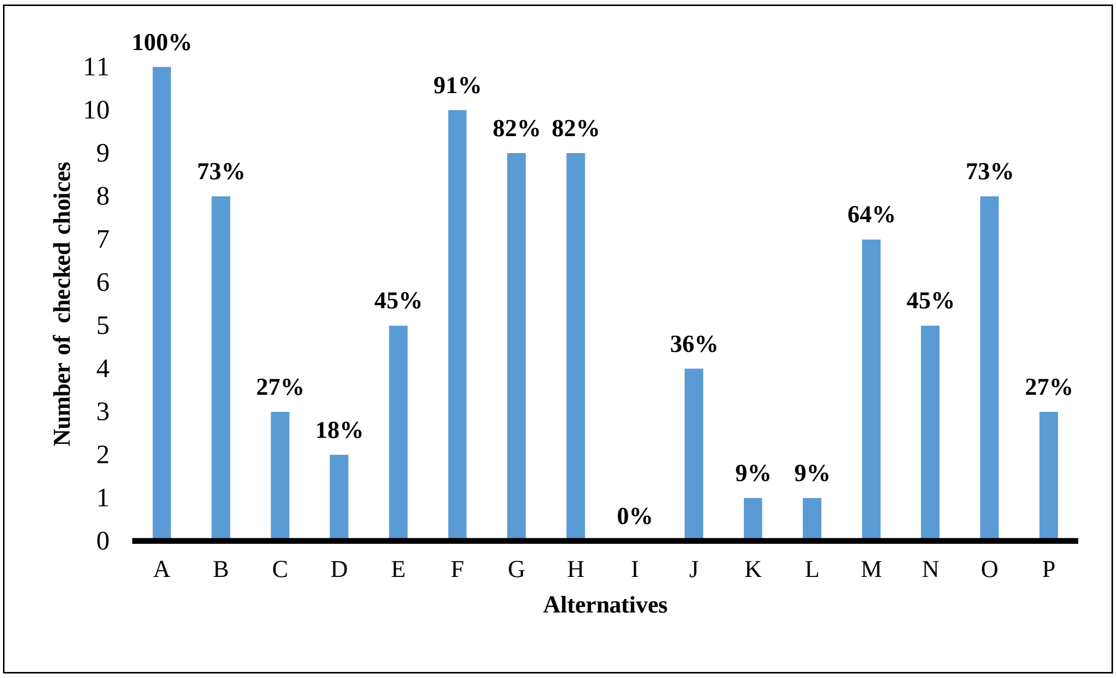
Chart 15 - Alternatives for question 14.

A	The existence of public policies on renewable energy.
B	Technical expertise in the cooperation area in the field of renewable energy.
C	Number of scientific articles written in partnership between Brazilian and Indian researchers.
D	Partnership between Brazil and India for patent creations.
E	Level of global competitiveness of each country
F	Investments in renewable energy in both countries.
G	Development of both countries' renewable energy own market.
H	Natural resources of each country with regard to the development of renewable energy.
I	Bilateral trade between the two countries in different areas.
J	Bilateral trade between the two countries in renewable energy
K	Number of Indian companies established in Brazil.
L	Number of Brazilian companies established in India.
M	Government official visits.
N	Missions of entrepreneurs or investors.
O	Agreements/memoranda signed between the two countries.
P	Agreements established by Brazil and India with other countries.

Source: Author's elaboration.

Brazilian respondents marked the following alternatives, in the order of the most chosen ones, as those that contribute to promoting cooperation in renewable energy between Brazil and India: the existence of public policies on renewable energy, investments in renewable energy, the development of the internal market in the area of renewable energy and the existence of natural resources in each country that are potential for the development of renewable energy. Bilateral trade between the two countries in different areas was the only alternative not chosen by the respondents. The following chart shows the results for the Brazilian respondents.

Graph 47 - Elements which may contribute to promote renewable energy cooperation between Brazil and India according to the Brazilian respondents.



Source: Author's elaboration.

The Indian respondent chose six alternatives as those that contribute to promoting cooperation in renewable energy between Brazil and India. Two of these alternatives are among the most chosen by Brazilian respondents: the existence of policies in the area of renewable energy and investments in renewable energy, chosen, respectively, by 100% and 90.9% of Brazilian respondents. The other elements chosen by the Indian respondent and the Brazilian respondents were the technical capacity in the area of cooperation in renewable energy (73% of Brazilians' choices), the agreements signed between the two countries (73% of Brazilians' choices), the level of global competitiveness of each country (45.4% of Brazilians 'choices) and bilateral trade in renewable energy (36% of Brazilians' choices).

The recognition of the elements chosen by the respondents as those that contribute to the cooperation in renewable energy between the two countries highlights the path that both have been following with the creation of policies that promote renewable energy and with the investments in renewable energy that have been occurring for the last 13 years. Of course, these actions are not enough. However, respondents corroborate the importance of these elements as factors that can strengthen relations between Brazil and India through cooperation in renewable energy.

Other elements were chosen only by Brazilian respondents: 27% chose the number of articles in partnerships between Brazilians and Indians and 18%, the number of patents in partnership between the two countries. This may indicate that some respondents are not aware of how scientific research activity can be a relevant factor in the rapprochement between the two States.

5.5.2.13 Question 15

Question 15 is "Check the option (s) that you consider necessary for South-South cooperation in the field of renewable energy to be promoted." The options presented are set out below:

Chart 16 - Alternatives for question 15.

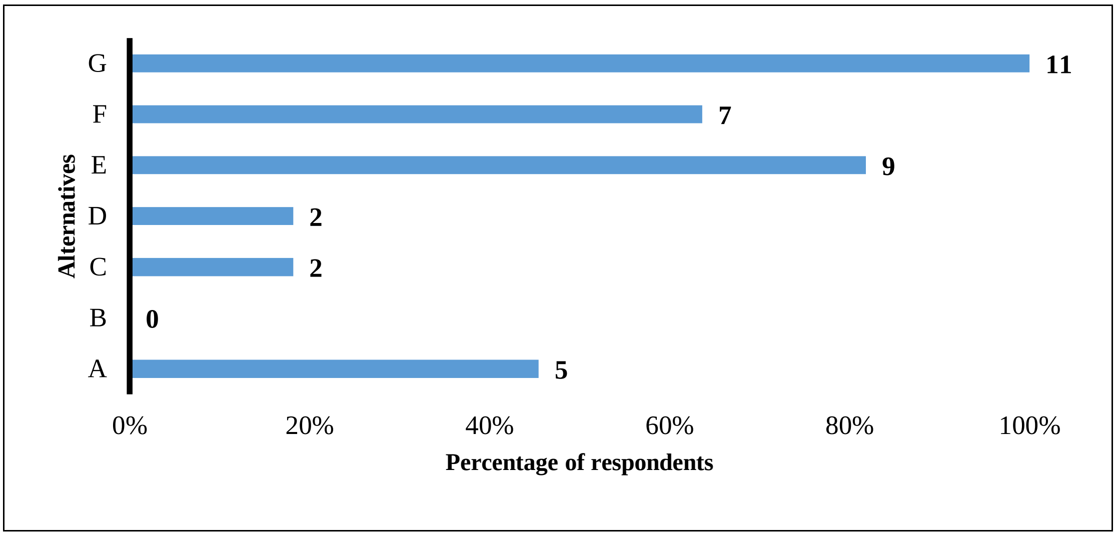
A	The countries of the South (emerging) countries should adopt more transparency in the actions among them, whether in trade, in the academy or politics.
B	The countries of the North should not interfere in the processes of cooperation between the countries of the South.
C	Investments in science and technology in the countries of the South must be carried out or promoted without the collaboration of the countries of the North.
D	Investments in science and technology in the countries of the South must be carried out or promoted with the collaboration of the countries of the North.
E	The training of professionals in the area of cooperation in renewable energy should be increased..
F	The increase in trade among the countries of the South in several areas is fundamental.
G	Investments in science and technology and in knowledge of renewable energy market should be increased.

Source: Author's elaboration.

Of the Brazilian respondents, 100% indicated that investments in science and technology and knowledge of the market in renewable energy should be increased. 82% indicated that the training of professionals in the area of cooperation in renewable energy should be increased. To 64%, the increase in trade between the countries of the South in several areas is fundamental for South-South cooperation in renewable energy. Alternative B was not checked, which refers to the non-interference of Northern countries in cooperation among the countries of the South, which may mean that the presence of developed countries may be considered important by respondents to the process of cooperation between South.

The importance of the countries in the North was reflected in the fact that 18% of Brazilian respondents stated that investments in science and technology in the countries of the South should be promoted with the collaboration of the countries of the North. For 18% of them, investments in science and technology must be made without the collaboration of the countries of the North. The following graph shows the results in percentages.

Graph 48 - Measures for South-South cooperation in the field of renewable energy to be promoted according to Brazilian respondents.



Source: Author's elaboration.

For the Indian respondent, all the measures presented are necessary for South-South cooperation to be promoted, except that one stating the countries of the North should not interfere in the cooperation processes between the countries of the South. This option was also not chosen by the Brazilian respondents, which may indicate that, for all respondents, the participation of the countries of the North is still important in the cooperation processes of the countries of the South.

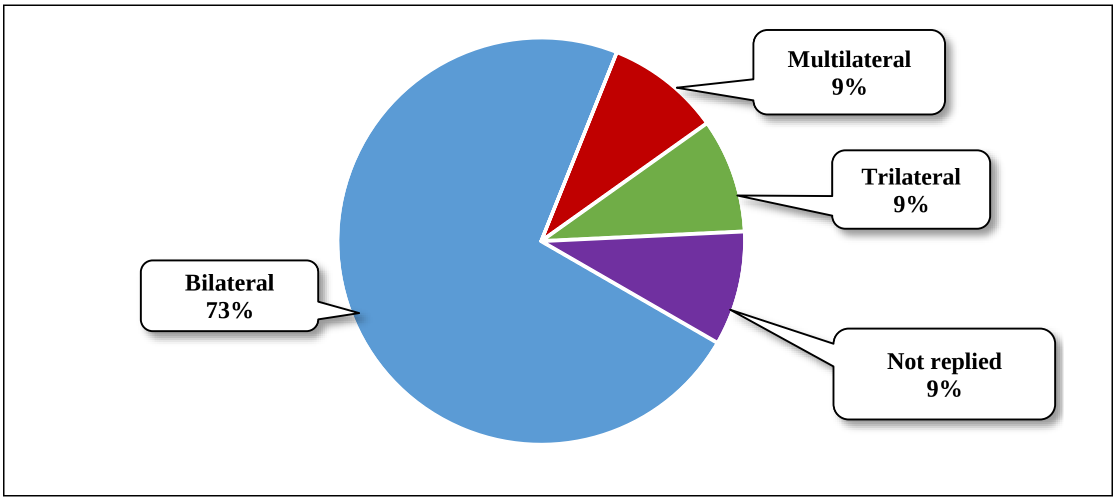
5.5.2.14 Questions 16 and 17

Question 16 is "How should Brazil-India cooperation be developed in the field of renewable energy?".

The alternatives given are "bilateral", "multilateral", "trilateral" and "through agreements between companies and without any participation of the State". More than one option could be marked.

For 73% of Brazilian respondents, Brazil-India cooperation must be bilateral. The following graph shows the results in percentages:

Graph 49 - How cooperation in renewable energy between Brazil and India must happen regarding laterality.



Source: Author's elaboration.

Respondents who did not choose "bilateral" had to answer Question 17: "If you did not choose bilateral, please answer if, in the case of trilateral cooperation, the best option for cooperation in renewable energy to develop between Brazil and India would be". Of the three respondents who did not choose "bilateral", two of them feel that Brazil and India should cooperate alongside with one more country belonging to the BRICS.

The Indian respondent did not respond to Question 16. In response to Question 17, he stated, through the marked alternative, that cooperation in renewable energy between Brazil and India should occur alongside with a country belonging to the BRICS, and implied that it should be trilateral.

Question 5 showed that 46% of Brazilian respondents and the respondent works with all forms of cooperation (*i.e.*, bilateral, trilateral, multilateral).

Undoubtedly, the respondents are aware of the advantages and disadvantages of each one of them and, because they work in the Ministry of Foreign Affairs, in the areas related to the subject of this work, they are also supposed to know the characteristics and the challenges that are present in the energy field and in the countries. The fact that 73% of Brazilian respondents chose "bilateral" may mean a discredit in relation to IBSA, which may be the result of the cancellation of IBSA meetings since 2013. On the other hand, for those who answered Question 17, the cooperation between Brazil and India must happen with a country belonging to the BRICS.

5.5.2.15 Question 18

Question 18 is "Seven international acts (agreements and memoranda of understanding) covering renewable energy were signed between Brazil and India. What can be done so that these agreements / memos can trigger concrete actions? " The options presented to the respondent are listed in the Chart 17. A blank space was provided in which the respondent could indicate other measures if he wished.

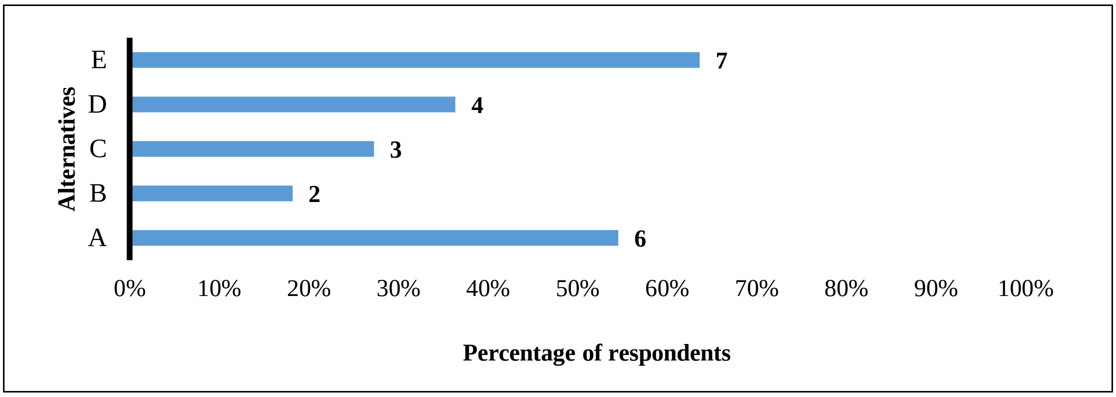
Chart 17 - Alternatives for question 18.

A	The clear definition of commitments and targets in the memoranda and agreements.
B	The establishment of legal ties clearly outlined in the memoranda.
C	The existence of financial ties and commitments specifically defined and set out in the memoranda.
D	Clearly and objectively naming institutions that will initially be involved in the actions established in the memoranda.
E	The follow-up of all post-signature actions of memoranda (and agreements) through working groups with goals.

Source: Author's elaboration.

For question 18, the following alternatives stood out as most checked: the follow-up measures of all the post-signatures of the memoranda (and agreements) in working groups with goals (chosen by 64% of Brazilian respondents), the clear definition of commitments and targets in the memoranda (chosen by 55% of them) and clearly stating the names of the institutions that will initially be involved in the actions established in the memoranda (chosen by 36% of the Brazilian respondents). The following graph shows responses in percentages.

Graph 50 - Measures to trigger concrete actions after the signing of agreements / memoranda of understanding between Brazil and India according to Brazilian respondents.



Source: Author's elaboration.

The Indian respondent chose the three alternatives which were the most chosen by the Brazilians respondents, as can be seen in Graph 50, that is, a clear definition of commitments and goals in memoranda and agreements, clearly and objectively stated the names of institutions that will be participating initially in the actions agreed upon in the memoranda and the follow-up of all actions after the signatures of the memoranda through working groups.

The purpose of Question 18 was precisely to know from the respondents what could be done so that cooperation in renewable energy between Brazil and India could be expanded or could be launched after the signing of the memoranda and the agreement. The marked alternatives elucidate the lack of specificity of the memoranda or the fact that they are generalists to the point where they do not bring together clearly the established ties, since they did not explicitly state goals or did not mention which institutions should initiate or begin the cooperation process. Nor does the agreement cite targets to be met. These issues contribute to hampering the cooperation process, making it more complex.

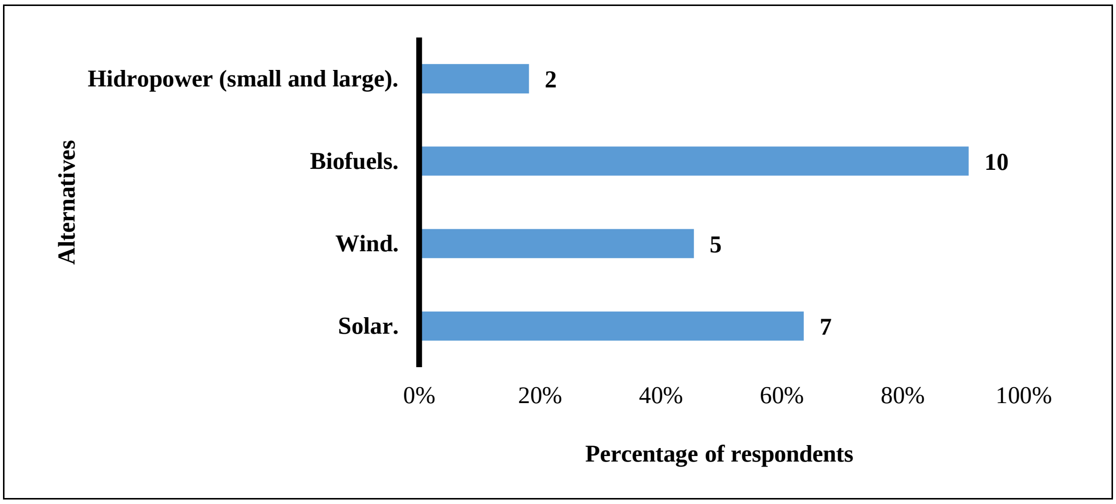
As it can be seen from Question 12, one of the barriers to cooperation between Brazil and India in the field of renewable energy is the need to follow up agreements and memoranda after their signature or validity. Thus, in Question 18, the Brazilian respondents and the Indian respondent confirmed their responses choosing the alternative that states that monitoring all post-signatures actions of memoranda and agreements through working groups is a necessary measure so that concrete actions can be triggered for Brazil-India cooperation in the field of renewable energy.

5.5.2.16 Question 19

Question 19 asks the respondent to "Check the type of renewable energy source that would offer the greatest potential for cooperation between Brazil and India." Five alternatives were available: "solar", "wind", "biofuel", "hydroenergy" and "I do not know".

According to 91% of Brazilian respondents, the type of energy that would offer the greatest possibility for cooperation between Brazil and India would be biofuel. Followed by solar, wind and hydroelectric energy, chosen, respectively, by 64%, 45% and 18% of the respondents. The decision to present these four types of renewable energy to the respondents was based on the agreements and memoranda signed by Brazil and India in the area of renewables and by the Indian and, especially, by the Brazilian interest in hydroelectricity. A blank space was also provided in case the respondents wanted to cite another type of energy that was not within the options or write some comments. One respondent pointed out that second-generation biofuels (*e.g.*, straw and sugarcane bagasse) are the types that would offer the greatest potential for cooperation, but did not explain why he believed so.

Graph 51 - Types of renewable energy that would offer greater possibility of cooperation between Brazil and India according to the Brazilian respondents.



Source: Author's elaboration.

According to the Indian respondent, the type of source that would offer the greatest possibility of cooperation in renewable energy between Brazil and India would be biofuel, which was also chosen by 91% of Brazilian respondents.

In spite of the investments that have been made in the renewable energy sources mentioned in Question 19, the Brazilian interest in biofuels can be highlighted, considering the policies directed to this source, the investments made, the scientific and technological production developed and the recent initiative called Biofuture, which seeks to promote biofuels globally. India, on the other hand, investing more robustly than Brazil in all renewable energy, demonstrated, through its established goal of reaching 100 GW and the Solar Alliance initiative, that solar energy is the focus of renewable energy by at least 2022

5.5.2.17 Question 20

Question 20: "With regard to proposals to extend renewable energy cooperation between Brazil and India, mark the one or the ones that would be most important." A blank space was provided in case the respondent wished to suggest other proposals that could help to extend cooperation between Brazil and India in the field of renewable energy. The alternatives given appear in the chart below.

Chart 18 - Alternatives for question 20.

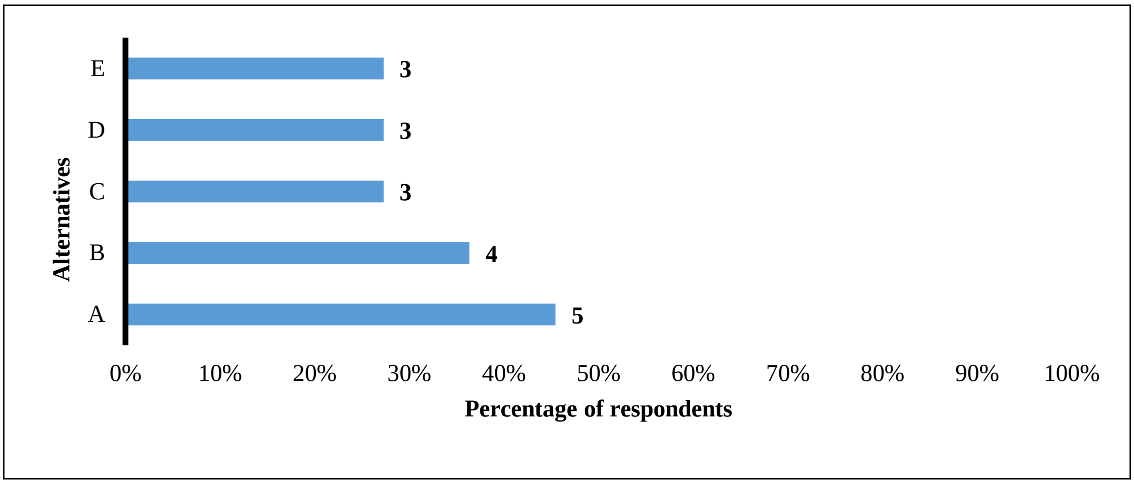
A	The creation of an integrated virtual research platform between governmental institutions and universities.
B	The creation of a virtual research platform among companies, universities and government institutions.
C	The development, made by the two countries, of a database for follow-up of agreements/memoranda and cooperation projects.
D	The creation within BRICS of an entity whose function is to articulate cooperation between the countries belonging to the group.
E	The creation, in the plurilateral spheres (i.e., IRENA, IBAS), of a working group with the aim of promoting cooperation between countries.

Source: Author's elaboration.

45% of the Brazilian respondents chose creating an integrated virtual research platform between government institutions and universities.

Then, representing 36% of the choices, is the creation of a virtual platform of research that, besides contemplating universities and governmental institutions, would also include companies. The other proposals were also chosen and had a close percentage to one another (equal in full numbers) and smaller than alternatives A and B, as can be seen in the following graph.

Graph 52 - Proposals for the promotion of cooperation between Brazil and India in renewable energy.



Source: Author's elaboration.

The Indian respondent chose the creation of a virtual research platform that would encompass universities, companies and government institutions and the creation of a database to follow the cooperation agreements, memoranda and projects and a BRICS entity that could articulate cooperation between the countries belonging to the group. Even with room to suggest other ideas, he restricted himself to choosing among the options presented.

From Question 16 onwards, suggestions on how to promote and enhance cooperation in the field of renewable energy between Brazil and India were collected. It was clear, bilateral cooperation was the most suggested among respondents as an ideal way of promoting cooperation in renewable energy between Brazil and India, followed by the trilateral form alongside with a BRICS country. Follow up on the memoranda and agreements has also been considered important so that cooperation in renewable energy can be expanded and biofuels and solar sources stood out as the most suggested for the two countries to cooperate.

Still in the responses, in order to promote cooperation between the two countries in renewable energy, the following proposals stood out: the creation of a virtual research platform that congregates governmental institutions and universities, and the second alternative which adds companies to this platform, the creation of a BRICS entity to articulate the cooperation among the countries of the group and a database to follow the agreements, memoranda and cooperation projects between the two countries. This highlights the need for a formal structuring of the follow up of the cooperation process and even articulation and promotion of cooperation through research or interaction between the scientific community and the private sector.

5.5.2.18 Question 21

Question 21 is "If you have additional comments on Brazil-India renewable energy cooperation, please use the space below to share them." None of the respondents filled in that space.

The next section presents the results of the interviews.

5.6 INTERVIEWS

Especially with the intention of helping to identify barriers, opportunities and suggestions or propositions for cooperation in renewable energy between Brazil and India, it was also decided to use the interview. This section, therefore, presents the results of the interviews conducted to compose this thesis.

The interview was classified as a mixture of a topic-oriented interview and the semi-structured interview. The topic-oriented interview character is due to the fact that the topics related to the interests of this thesis were explored throughout the interview and it was preferred that the interviewee spoke freely as he referred to each of the topics. The semi-structured interview character came about because there was also the application of a fixed list of questions whose order and whose writing was exactly the same for all the interviewees.

In order to compare the interviewees' answers with the answers provided by the questionnaire respondents, the interview questions were the same as the questions in the questionnaire.

The interviews were carried out with professionals working on the Brazil-India theme or working in one or more of these areas: energy, renewable energy, international politics, international cooperation and foreign relations. The interviewees were chosen from a comparison of professionals who work in these areas and according to the availability of the interviewee. The interviews were conducted in Brazil and India. 19 professionals from the technical area and from the academic area were interviewed, of which 17 had a managerial position and/or a PhD course. The interviewees' names can be found in a list in Appendix B.

In the treatment of the interviews each of the professionals, when necessary, was identified by the word *interviewee* followed by a number, that is: interviewee 1, interviewee 2, and so on. The list in Appendix B is organized in alphabetical order and not in the order in which each interviewee is presented in the data treatment.

The interviews began in April 2016, during the time the researcher visited the Indian capital. Despite the occasional limitations in some of the interviewees' schedule in India, to the surprise of the researcher, the theme "cooperation in renewable energy between Brazil and India" aroused curiosity among the people. The theme was very well received by the interviewees; to the point of creating opportunities of other interviews or invitations for the researcher to participate in events. In Brazil, scheduling dates with the interviewees was also difficult and it took some time to get the questions submitted answered. This was not due to lack of interest of the interviewees, who were motivated to contribute to the research, but rather due to their busy schedule.

It should be noted that the interviews[31] began before the questionnaire was applied, since the information collected could help to reformulate questions, which would even contribute to confront information and opinions, which in fact happened. As it was emphasized, the interviews occurred according to the availability of the interviewees. Thus, there were eight one-on-one interviews, which were recorded with an audio recorder and for the other interviews there was a face-to-face contact, or the initial contact was virtual and, especially due to the interviewee's schedule, the other questions were sent through electronic mail.

The treatment of the information collected in face-to-face interviews occurred in two ways: from hearing followed by transcription and the data collected transported to spreadsheets (Windows / Excel) and then analyzed. For the remote interviews and for those interviewees who received the questions only through their electronic addresses, the data were transferred to spreadsheets for later analysis.

[31] APPENDIX C – Script of the Interview

5.6.1 Interview Results

It was considered relevant to ask the interviewees about the level of priority that their institution gives to the themes "renewable energy" and "South-South cooperation". Renewable energy have a high priority level for 83% of the interviewees. If medium and high priority are considered together, this percentage rises to 100%. Regarding the theme "South-South cooperation", four interviewees provided no answer regarding the level of priority given by their institution to this topic; for those who answered, 57% indicated this topic as being of high priority, 29% as medium priority and 14% as low priority. For none of them, this theme is not a priority.

Eight of the interviewees spoke about their professional experience and their institutions. Interviewee 1 pointed out that his institution has been working with technical cooperation in India for more than 50 years and that they have been working particularly with energy, the environment and development of the private sector. In the energy sector, the main political partner of his institution is the MNRE. The focus of Interviewee 1's working routine is the renewable energy sector in India, where he has been working for some years.

Interviewee 2 had a long career in the Indian energy sector, which contributed to corroborate the data already obtained and presented in Chapter 4 of this thesis. For the interviewee, when looking at the Indian energy scene ten years ago, the share of renewable energy was very small, since India conventionally relied essentially on fossil fuel. Even faced with fuel supply challenges (such as those in 1973 due to the Arab oil embargo and in 1991 because of the Gulf War), the country was able to manage its supplies and, according to Interviewee 2, this was the reason India did not invest heavily in the renewable energy sector.

For him, "things have changed" recently: "the last decade has been crucial for the development of India's renewable energy, not only in terms of goals but also political decisions that have contributed to the development of the renewable energy sector." Data gathered for the construction of this thesis corroborated this assertion: it was found that from the 2000s, India started to intensify the promotion of renewable energy in its territory through the establishment of policies and investments in the area. This was the result of a number of factors, including the growth of the Indian economy which led to an increase in energy consumption. For Interviewee 2, these are the main factors for the development of renewable energy in the country: China's competition with India for oil imports; the beginning of the growth of the Indian domestic economy; liberalization of the Indian economy; which began to happen from the 1990s; and the increased demand for oil in the Asian region.

After presenting a brief history on the development of renewable energy in India, Interviewee 2 spoke about his professional experience. He stressed that he has been working for more than 15 years in the areas of oil, gas, renewable energy and climate change. In addition, he stressed that he has experience in teaching, in the energy area of the Ministry of Defense and in the Atomic Energy Agency, in which he provided training. He also worked in the fields of energy and climate change in Japan.

Interviewee 3 highlighted his knowledge of the energy sector, particularly considering his period of professional activity in the energy and environment sectors in India. For him, there is a scenario full of opportunities in the renewable energy field, Brazil-India cooperation being one of them because of the several similarities and common interests between these two countries.

Interviewee 3 stressed that the foreign strategic partnership, in his institution, focus on two fronts. The first is the search for partners who are reference or who have advanced knowledge in the areas in which his institution lacks. The second is what the interviewee called "logic principle alignment[32]", that is, things that unite countries through their political signals (something that Brazil and India have been doing over the years). For him, the most striking difference between Brazil and India is the lack of or energy need, since India has a very large energy deficit.

This situation, according to the interviewee, ends up creating an environment of permanent energy insecurity in India and the need to import energy, at the same time increasing investments occur, not only financial, but investments related to the time in the establishment of policies to expand their energy sources. For Interviewee 3, political signaling or government actions are the first steps towards a rapprochement between the two countries. However, what may occur concurrently with political signaling is the rapprochement between the ones working with science and technology, among researchers, which helps to give substance to cooperation.

Interviewee 10 emphasized his experience in Indo-Brazilian relations and asserted that the interest in Brazil-India cooperation, in a general way, increased and that this is

[32] Cf. original: “alinhamento principiológico”

due to numerous political, commercial and cultural factors, fact also evidenced by Interviewee 3. Interviewee 10 [33] stated that "I would not like to summarize this analysis but, to contribute to the research", I would like to highlight a few factors such as "the rapprochement of these two countries in multilateral forums", "political and diplomatic missions, businessmen from Brazil to India and vice versa, "the strong performance of India-Brazil Chamber of Commerce, the growth of Indian GDP in recent years, which has aroused the interest of businesspeople and Brazilian authorities; the opening of both economies in the 90's decade. These factors match with those that have already been commented on in this thesis, particularly in Chapter 3, in which they are presented as those that contributed to bring Brazil and India closer over the last decades.

Interviewee 4 spoke initially about his engineering background and his work on renewable energy in the Indian public sector, which he has been doing for more than twenty years. The function of the institution in which he works is to finance and promote renewable energy: they analyze projects, check their economic and technical viability, and finance projects of up to 25 megawatts. Projects above this value are analyzed by the Ministry of Energy. "We are like a bank," "we are a financial institution," and that's why "everyone is now willing to finance renewable energy projects, but when we started, nobody wanted to finance. Slowly, slowly, looking at our performance and achievements, other banks have started funding renewable energy projects. Now we have competition. We created the competition. But, our main objective was to promote renewable energy. So now we are happy to have other banks financing because that's our role."

Interviewee 5 pointed out that he belongs to an institution that has been working for more than 50 years with development policies and international cooperation around the world. In Brazil, according to the interviewee, projects in the area of renewable energy are among the main sources of funding. The activity of the interviewee is, fundamentally, to advise partners throughout the life cycle of the projects, to supervise the correct use of the funds and to examine the progress of the projects.

Interviewee 6 is responsible for the marketing activities and also for the operation and maintenance of all the solar plants of a private institution located in India.

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[33] Cf. original: [...] Não gostaria de resumir esta análise, mas para contribuir com a pesquisa, vale destacar [...] a aproximação destes dois países nos fóruns multilaterais; a realização de missões diplomáticas, políticas e, precipuamente, empresarias de brasileiros para a Índia e vice e versa; a forte atuação da Câmara de Comércio Índia Brasil [...] crescimento do PIB indiano nos últimos anos, o que despertou o interesse dos empresários e das autoridades brasileiras; a abertura de ambas as economias na década de 90;

This institution provides solar energy solutions all over India: they sell energy generated in solar power plants and sell power plants.

Interviewee 7 highlighted some points that Interviewee 3 pointed out and were also presented in Chapter 4 of this thesis, such as the fact that India has recently invested in developing renewable energy, stressing that the Indian economy is growing and people's standard of living is increasing. Another point highlighted by Interviewee 7 is that most of the Indian population lives in small villages and lacks energy, which makes them use biomass as a traditional way of cooking. As shown in Chapter 4, the total number of people using biomass in India traditionally represents 63% of the population in India. This shows that India has the challenge of improving the quality of life of people through the use of less polluting energy sources, which highlights the relevance of renewable energy in this country, particularly in the poorest communities.

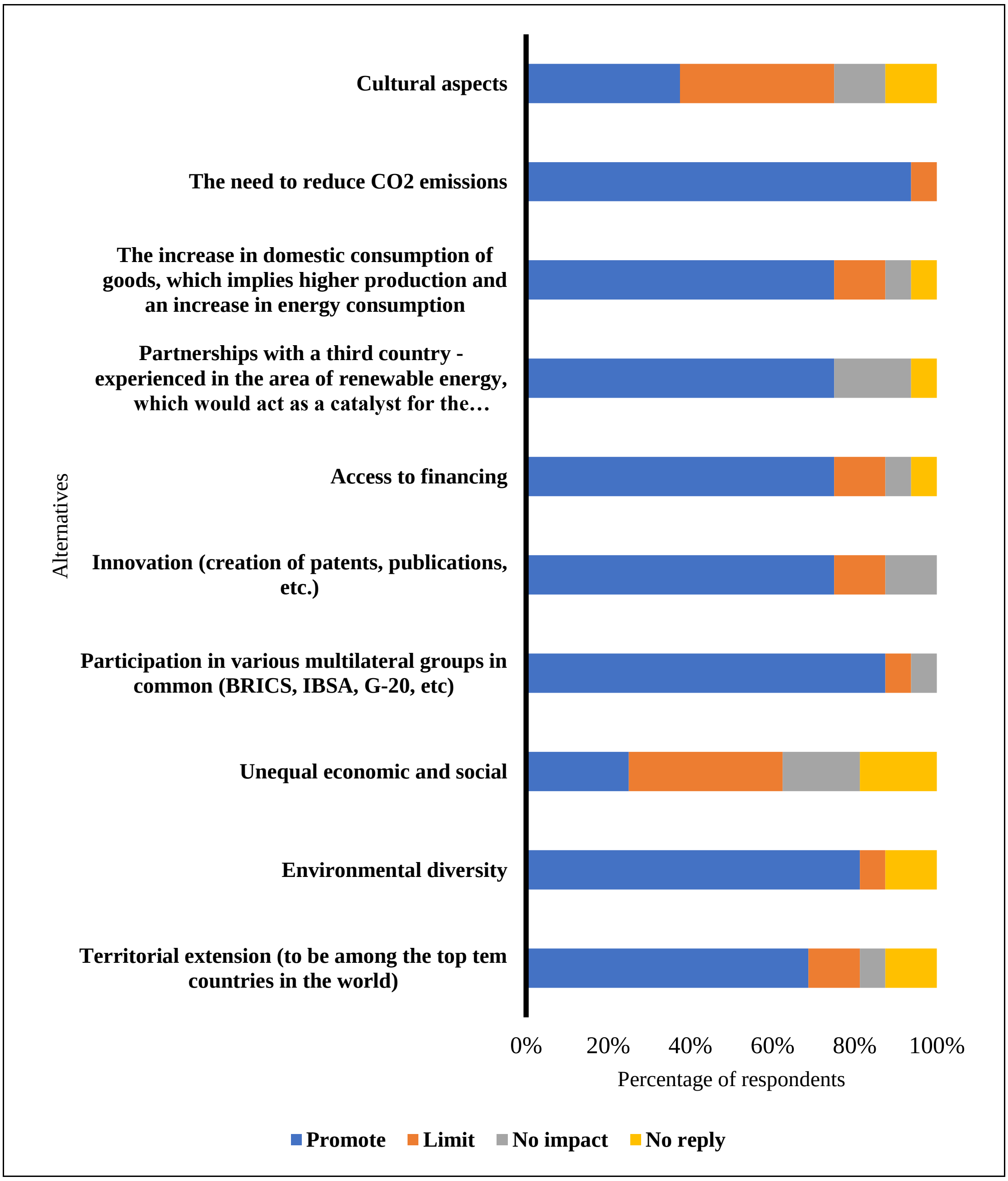
Twelve of the same questions on the questionnaire were also asked in the interviews as mentioned before. Other different questions were also asked depending on the interviewee´s line of work and also depending on how comfortable the interviewee would feel talking about a specific subject. The question all interviewees were asked was "In which ways Brazil and India could contribute with each other regarding cooperation in renewable energy?".

This questions was not in the questionnaire though. If one of the interviewees mentioned the role of private initiative in the context of renewable energy cooperation between the two countries or if the interviewee's activity was focused on private initiative, he was also asked if companies would play a relevant role in the cooperation process between the two countries.

The interviewees also had a greater space to discuss a certain topic addressed during the interview and, even after the interview was conducted, there was some electronic message exchange. Due to the very nature of the interviews, the one-on-one interaction made it possible for the researcher to hear about topics that the respondents did not address in the questionnaire. It should be noted that when asked which type of renewable energy source would offer the greatest likelihood of cooperation between Brazil and India, it was also asked about how each country could contribute with each other in terms of cooperation in renewable energy. In the question about propositions, the interviewees offered additional comments or suggestions.

After the initial interaction with the interviewees and the question about the priority given by their institution to the topics "renewable energy" and "South-South cooperation", they were asked about the elements that can promote or limit cooperation between Brazil and India in the field of renewable energy. The interviewees were presented with the same alternatives that are found in Question 10 of the questionnaire. The results:

Graph 53 - Elements that may limit, promote or not have an impact on the cooperation between Brazil and India in renewable energy, according to the interviewees.



Source: Author's elaboration.

For the interviewees, the two elements that most help promote cooperation in renewable energy between Brazil and India are the need to reduce CO_2 emissions (94%) and the participation in multilateral groups (88%). These alternatives were also the ones most chosen, in the questionnaire, by the Brazilian and Indian respondents. The environmental diversity was the third most chosen element with 81% of the interviewees. This number is very close to that one referring to the choices of the Brazilian respondents of the questionnaire (82%) in relation to the same element; the Indian respondent also chose this element as one which helps to promote cooperation.

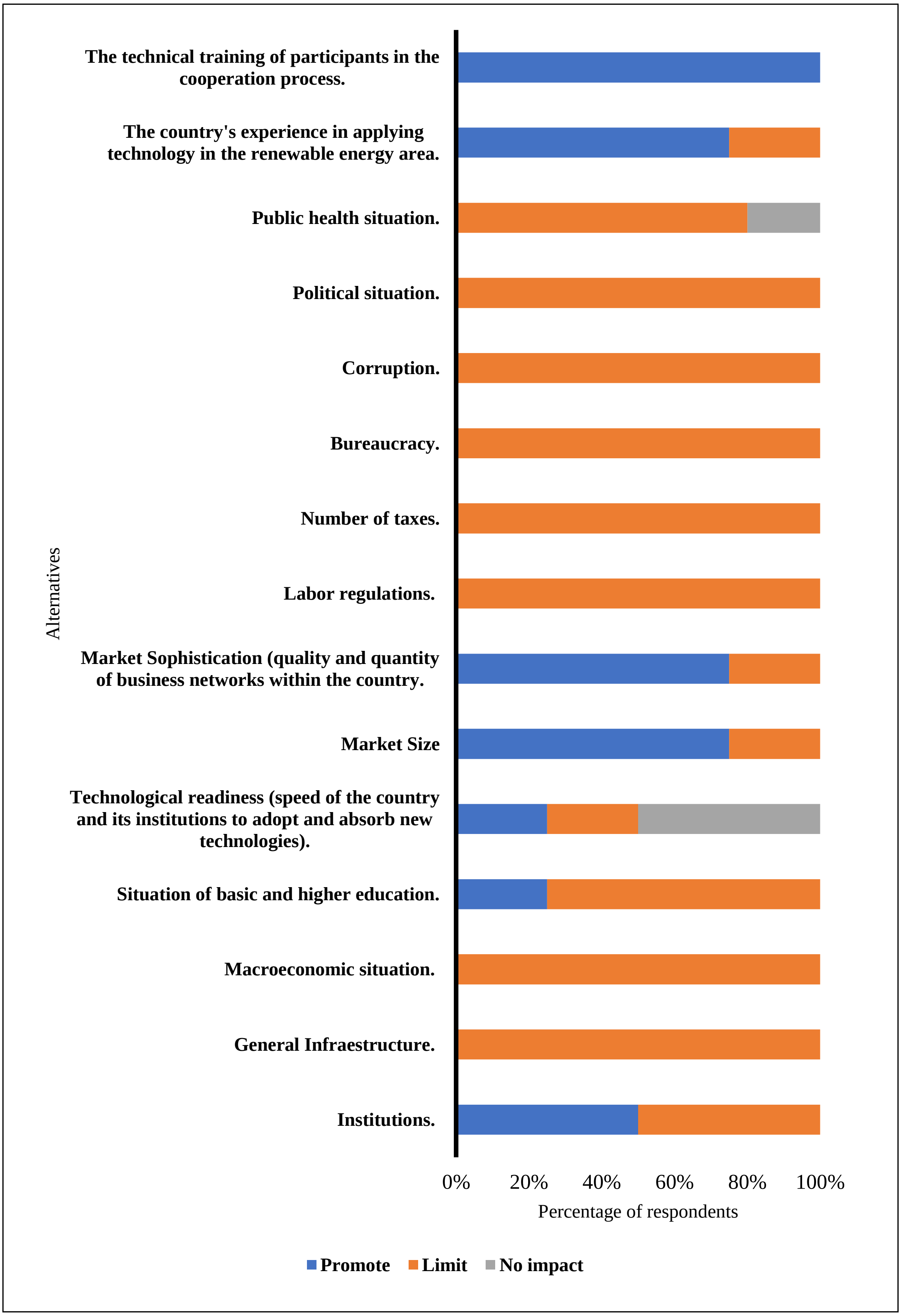
These choices, the interviewees´ and the questionnaire respondents', show something common to both countries: the need to reduce emissions, which, as can be seen in the previous chapter, has grown systematically in Brazil and India over the last decades. In addition, these choices highlight the importance of the two countries in participating in multilateral groups. Participating in joint groups increases the chances that cooperation in renewable energy between Brazil and India will be promoted, once interests between them are similar, in several fields, facilitating their rapprochement.

The increase in consumption of goods, which implies an increase in energy consumption, and the partnerships with a third country that could play a catalytic role in the cooperation process between the two countries were pointed out by 75% of the interviewees as elements that may help promote cooperation between the two countries. In the questionnaire, each of these elements was chosen by 82% of the Brazilian respondents and by the respondent from India. The presence of a third country, one with experience in the field of renewable energy, as a catalyst in the process, draws attention to the fact that somehow the presence of a developed country in the cooperation process is relevant. According to Interviewee 5, when referring to the partnership involving Germany, Brazil and India, it would be interesting to exchange experiences with these countries in the energy area, since the German state has strategic cooperation with both countries in the energy field: the challenge is to bring highly-recommended people or specialists together.

The innovation related to the creation of patents and publications was chosen by 75% of the interviewees and, in percentage terms, was near the choice of the Brazilian respondents of the questionnaire (73%) as an element that helps promote cooperation in renewable energy between the two countries. The Indian respondent also chose innovation as one of the elements that help promote such cooperation. This implies that innovation is a reflection of the knowledge produced in the country, which translates into the expertise that each country can have in a given area and, as Interviewee 3 emphasized, this may represent a preponderant factor to bring countries to cooperate with one another, since there is a tendency to seek partners who are reference or who have advanced knowledge in a certain area. In the interviews, economic and social inequality was the most chosen element as one that could limit cooperation between the two countries, with a percentage of 38% of the interviewees. This element had the same percentage of the alternative referring to cultural aspects as a limiting element. However, for the latter, the percentage of the interviewees' choices as an element that could limit and as an element that could promote cooperation between Brazil and India in the studied area was similar

Interviewees were asked to indicate, among the elements suggested in a table, those in their country that could limit or promote cooperation in renewable energy between Brazil and India. This request was also made in the questionnaire (Question 11). The responses of the Brazilian and Indian interviewees are shown in the two graphs below.

Graph 54 - Elements in Brazil that promote or limit the cooperation in renewable energy between Brazil and India, according to the interviewees who work in Brazil.



Source: Author's elaboration.

The technical training of participants in the cooperation process, the size of the internal market, the sophistication of the internal market (*i.e.* quality and quantity of business networks in the country) and the country's experience in renewable energy technology were the four most chosen elements, by Brazilian interviewees, among the ones that can contribute to promote cooperation in renewable energy between Brazil and India. These choices coincided with those elements that were also the ones most chosen by the respondents, except for the item "institutions", which represented the choice of 73% of Brazilian respondents as the element that promotes cooperation. For 50% of interviewees, this element promotes cooperation, while for 50% of the interviewees, it can limit cooperation in renewable energy between Brazil and India.

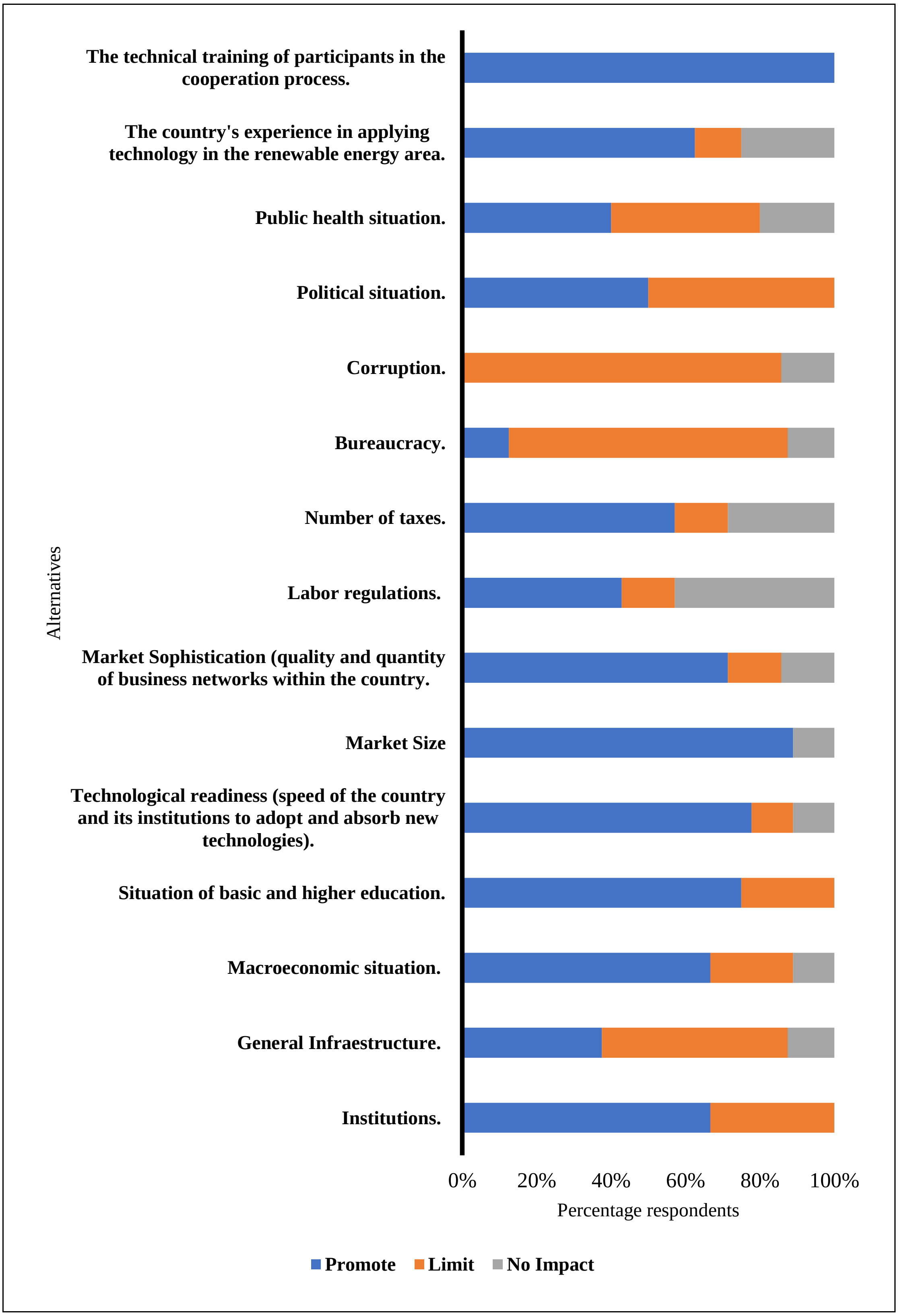
If, on one hand, the results of the questionnaire show some credibility given to the Brazilian institutions; for the interviewees, these institutions may not be an element capable of promoting cooperation. This may indicate a weakening of the image of Brazilian institutions or the way they relate to society, which may highlight a need for Brazilian institutions to review their way of acting within society.

Among the elements most chosen by the interviewees (also among the most chosen by the Brazilian respondents of the questionnaire) is the recognition of the country as experienced in the application of technology in renewable energy. Although no specific renewable technology was mentioned in this question, it is well known that biofuels and hydroelectricity are renewable sources in which Brazil has a global presence, and the responses show such recognition.

As for the limiting factors that are present in Brazil, the most chosen among the interviewees were macroeconomic situation, bureaucracy, political situation, corruption, taxes, labor regulations and general infrastructure got the same numbers, being placed together in the rank as limiting factors. These elements are also among the most chosen by the respondents of the questionnaire, as can be observed in the previous section. Therefore, changes in the country must be made so that they are not seen as constraints for the cooperation process any longer. It is not necessary to enter into a deep discussion to show that these factors can be in the way of the process of cooperation; excessive bureaucracy can make this process slower, for instance.

It should be noted that, in both interviews and questionnaires answered by Brazilians, the elements that limit cooperation between Brazil and India outweigh those that promote cooperation.

Graph 55 - Elements in India that promote or limit the cooperation in renewable energy between Brazil and India, according to the interviewees who work in India.



Source: Author's elaboration.

Among the interviewees who work in India, the technical training of the participants in the cooperation process and the size of the internal market were the two most chosen as the elements that most help promote cooperation between Brazil and India in the field of renewable energy. These elements were also chosen by the Indian respondent of the questionnaire, the Brazilian interviewees and the Brazilian respondents of the questionnaire. This demonstrates that, both in the view of the respondents of the questionnaire acting within the ministries of foreign relations of both countries and in the view of the interviewees (working in various academic and technical institutions), both in Brazil and in India, the professionals who participate in the process have the appropriate knowledge to help promote cooperation in renewable energy between the two countries. In addition, both interviewees and respondents see the internal market of both countries as an element of cooperation, which means, for example, that there is potential to be exploited in the area of renewable energy. On the other hand, corruption and bureaucracy were the two most chosen by the interviewees who work in India as the elements that may limit cooperation between Brazil and India. The Indian respondent of the questionnaire also chose these two items as factors limiting the cooperation.

Interviewee 1 highlighted the importance of training in relation to renewable energy and the need to strengthen it both individually and institutionally. In India, according to Interviewee 1, this training across all three levels has been improving. For him, in spite of the training in his institution to help employees understand the bureaucracy in India "[...] in practice, it is a problem to understand bureaucrats. In India, different bureaucrats, different mandates, everything [...] I do not see this as a barrier, is a challenge".

According to Interviewee 2, "Nothing goes without challenge in any country, especially in a democratic country, everything is questioned, debated", as is the case of Brazil and India. In relation to bureaucracy, this interviewee does not see it in India as a barrier because "I feel that the bureaucracy is supporting renewables" because the government has set targets regarding renewables.

For Interviewee 2, the biggest challenge is in small regions or villages in India, *i.e.*, in rural areas: "You are introducing solar technology – a solar lantern. You distribute it in a village. Now the village has a responsibility to take care of it properly because the moment it falls or breaks, they can not afford to get it repaired. They do not have people around who knows about renewable and who can fix it. So that is actually a challenge. So what happens you give a renewable energy lantern to a person, he get stuck and the moment something goes wrong with it, he will say that the government thing does not work and we don’t like renewable energy. Therefore, the government has a big challenge in the management of public perception regarding renewable energy".

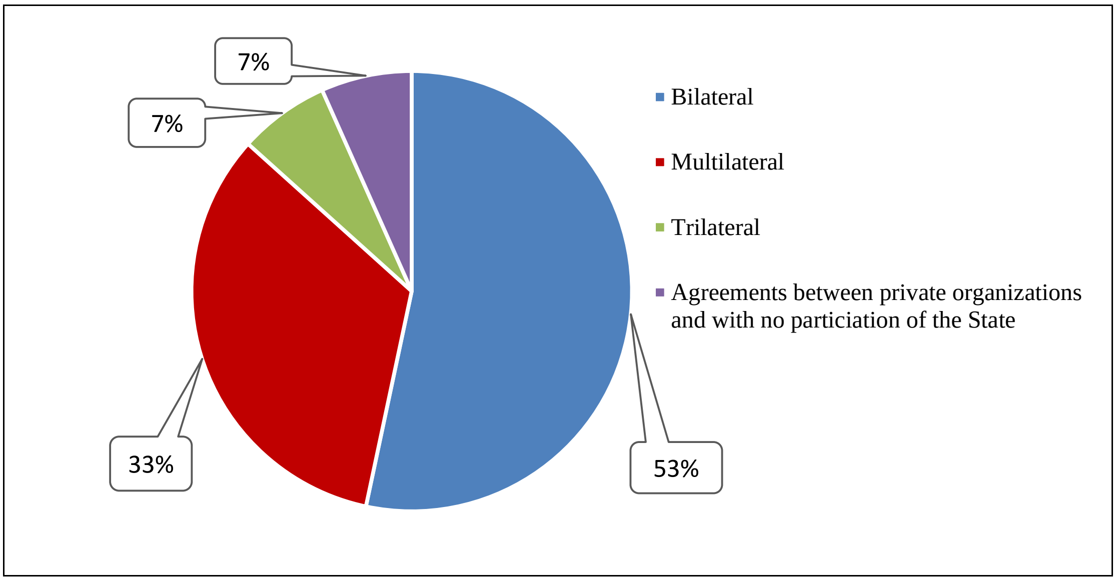
In Brazil, in an evaluation of the Light for All Program, whose objective is to provide electricity to communities that do not have access to electricity, in the region of the São Francisco River Valley, more precisely in the region of São Francisco, the residents said that, when the equipment broke or had a technical problem, the support was offered by the state power company that outsourced the service. However, it took some time to repair the equipment causing great disappointment. The testimonies of local residents, residents of the islands and remote communities of San Francisco, showed the lack of knowledge of solar energy as less polluting than other conventional types of energy and also of how solar energy would contribute to environmental conservation. Despite the technical support offered, the perception of these communities regarding the importance of solar energy beyond the generation of energy itself was not taken into account by the program during its installation (MOUSINHO, 2014) [34].

Question 16 of the questionnaire was also made to the interviewees: how should Brazil-India cooperation in the field of renewable energy happen with regard to laterality?

For 53% of the interviewees, it should happen bilaterally in spite of considering that a third more experienced country in the field of renewable energy could help promote cooperation between Brazil and India (as shown above). Brazilian respondents (73%) also indicated the bilateral form of cooperation as one that should be preferable between Brazil and India. The Indian respondent indicated trilateral cooperation with a country belonging to the BRICS. In any case, bilateral cooperation was the most chosen.

[34] Volunteer work conducted by me, as a researcher, in partnership with Albright College (USA) and Partners of the Americas Bahia-Pennsylvania Committee.

Graph 56 - How Brazil and India should cooperate, according to the interviewees

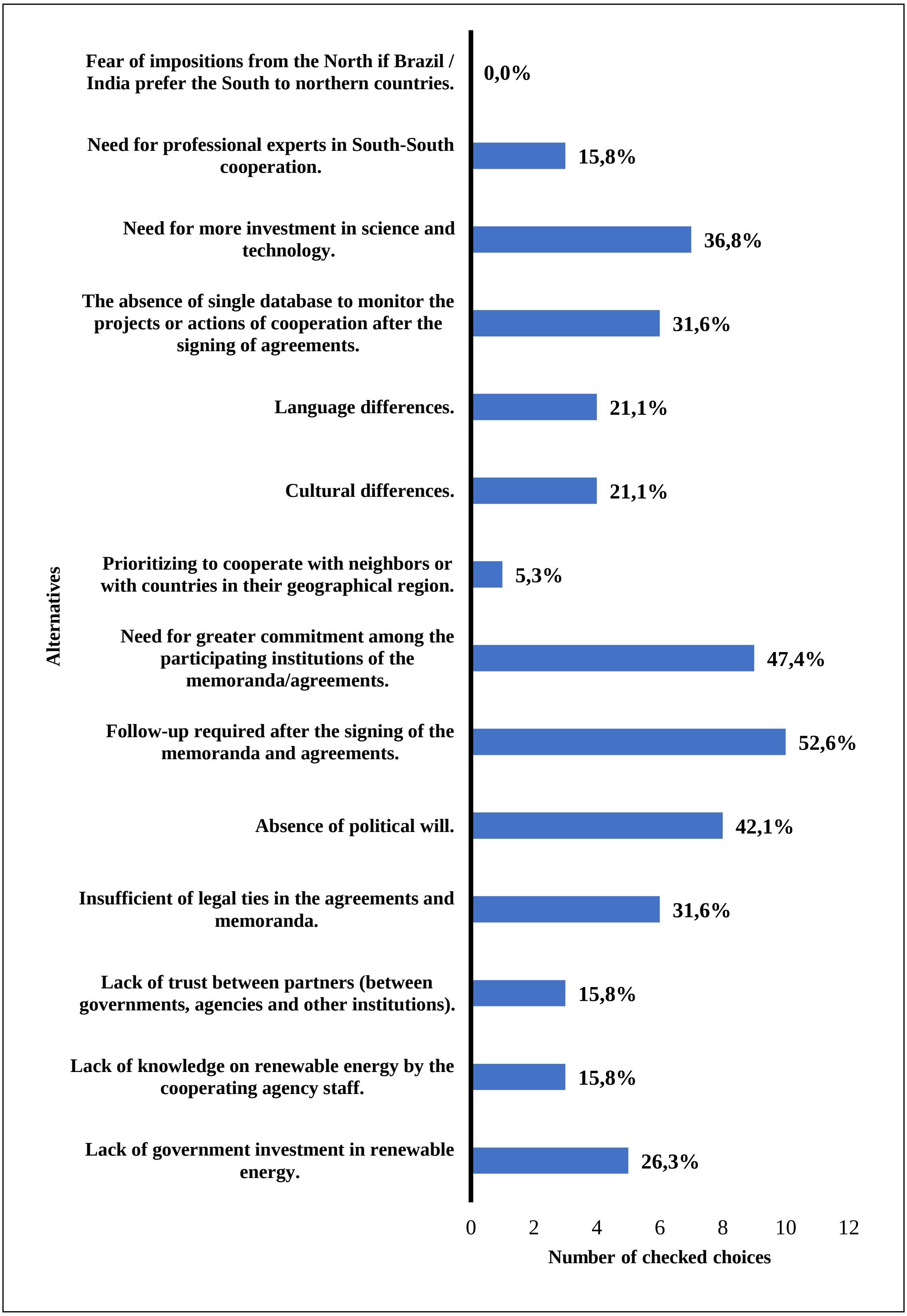


Source: Author's elaboration.

Interviewee 18 justified his choice by emphasizing that cooperation between Brazil and India must take place between companies and without any participation of the state because of the bureaucracy between the governmental spheres (his commentary was based on his knowledge of the Indian reality). The interviewee once again spoke about bureaucracy in the question about threats to Brazil-India cooperation in renewable energy.

The interviewees were asked to mark among the given elements which they considered as barriers to Brazil and India cooperation in the field of renewable energy. They were presented with the same alternatives as in Question 12 of the questionnaire. The following graph illustrates the results of the responses given by the Brazilian and Indian interviewees.

Graph 57 - Barriers to the Brazil-India cooperation in renewable energy, according to the interviewees.



Source: Author's elaboration.

The follow up of the actions after the signing of agreements and memoranda was the most chosen among the Brazilian and Indian interviewees. It should be emphasized that this choice is among the four most chosen by respondents (Brazilian and Indian together) of the questionnaire. This certainly evidences that this alternative or necessity is a fact observed in the daily life by those who work in the ministries of foreign affairs or act as a researcher and have to deal with this question. The researcher, for example, learned that the follow-up of the actions after the signing of the agreements and memoranda is necessary. She was able to observe during the survey of the international acts signed between the two countries that information on agreements and memoranda or of the actions after the signatures of these international acts are "lost" in the ministries, once the officials themselves do not have data on the agreements and memoranda, and often do not even have a copy of the agreement that generated a particular project. This could lead to another barrier, which was the second most chosen among the interviewees: the need for greater commitment between the institutions participating in the agreements and memoranda, that is, a greater commitment among the ministries involved in the agreement. This has undoubtedly been considered a barrier because, if there is a lack of follow-up to agreements and memoranda signed, there may be a lack of commitment or even priority over other issues that may arise within the ministries involved. The lack of political will and the need for more investments in science and technology are among the four most chosen by the Brazilian respondents of the questionnaire and were the other two most chosen by the interviewees.

Interviewee 1 pointed out that a person who participates in a cooperation project for three to six years and then leaves is different from a person who continues to study or work for 20, 30 years and can begin to understand the culture, the society, the dynamics of India. That is why, according to him, cultural differences will always remain.

Still regarding cultural differences, for Interviewee 2, they would not be a barrier to cooperation between Brazil and India in the field of renewable energy because the relations between "India and Brazil […] will not be about regular interactions like any of the South Asian countries. Our relations will be like business oriented, technology collaboration, policy exchanges, mutual learning (…) Here the cultural element, such as people to people interaction, is not going to happen. If you are asking the same question about the South Asian countries, say Bangladesh and India, I would say that people to people interaction is going to happen there because it is geographically a closer society. So regarding Brazil and India, people to people interaction is not going to happen much but we still have to notice whether the business communities of Brazil are feeling comfortable in India. Some of the smallest issues, I can say, has a far reaching implication. Say, Brazilian hotels, I haven't found any here. Maybe there are some. This is one of the points told to me by one of the Japanese when I went to Japan. He said if we come to India and we have to stay for 30 days, we can't get any Japanese food and I can't survive without Japanese food. I don't prefer to go there because the food is an issue. So there are some of the smallest nuances which has got far reaching implication and that is something which has to be taken care of. But that will happen only with regular interaction. These are not pro-active development, these are reactive. You have lot of interaction, you get to see more Brazilians here, people will offer Brazilian restaurants here. I think people to people interaction is not going to be a big factor here because interaction is going to happen between the communities and government".

Interviewee 3 said that the cultural issue would not be a barrier to disrupt Brazil-India cooperation because the Indian people, like the Brazilian, like to receive the foreigner. According to the interviewee[35], what exists is an ignorance: "I bet, when you presented your research in Brazil, a lot of people asked you why not Brazil and the United States? Brazil and Germany? Even China? So there's still that 'Incredible India' thing, there's still a lack of knowledge". The need to bring countries closer together culturally favors cooperation not only in renewable energy, but in all areas.

Interviewee 18 added two barriers to cooperation in renewable energy between Brazil and India that were not among the alternatives presented to the interviewees: travel costs and geographical distance between the two countries. Undoubtedly, geographic distance involves a number of logistical processes that can be considered a competitive advantage, such as the possibility of a renewable energy company being able to deliver or assemble the products more quickly. However, the negative impacts of geographical distance can be minimized through strategies such as the use of communication technologies (virtual meetings to mediate agreements prior to signing, for example). The influence of geographical distance depends on each type of action or institution involved in the cooperation process.

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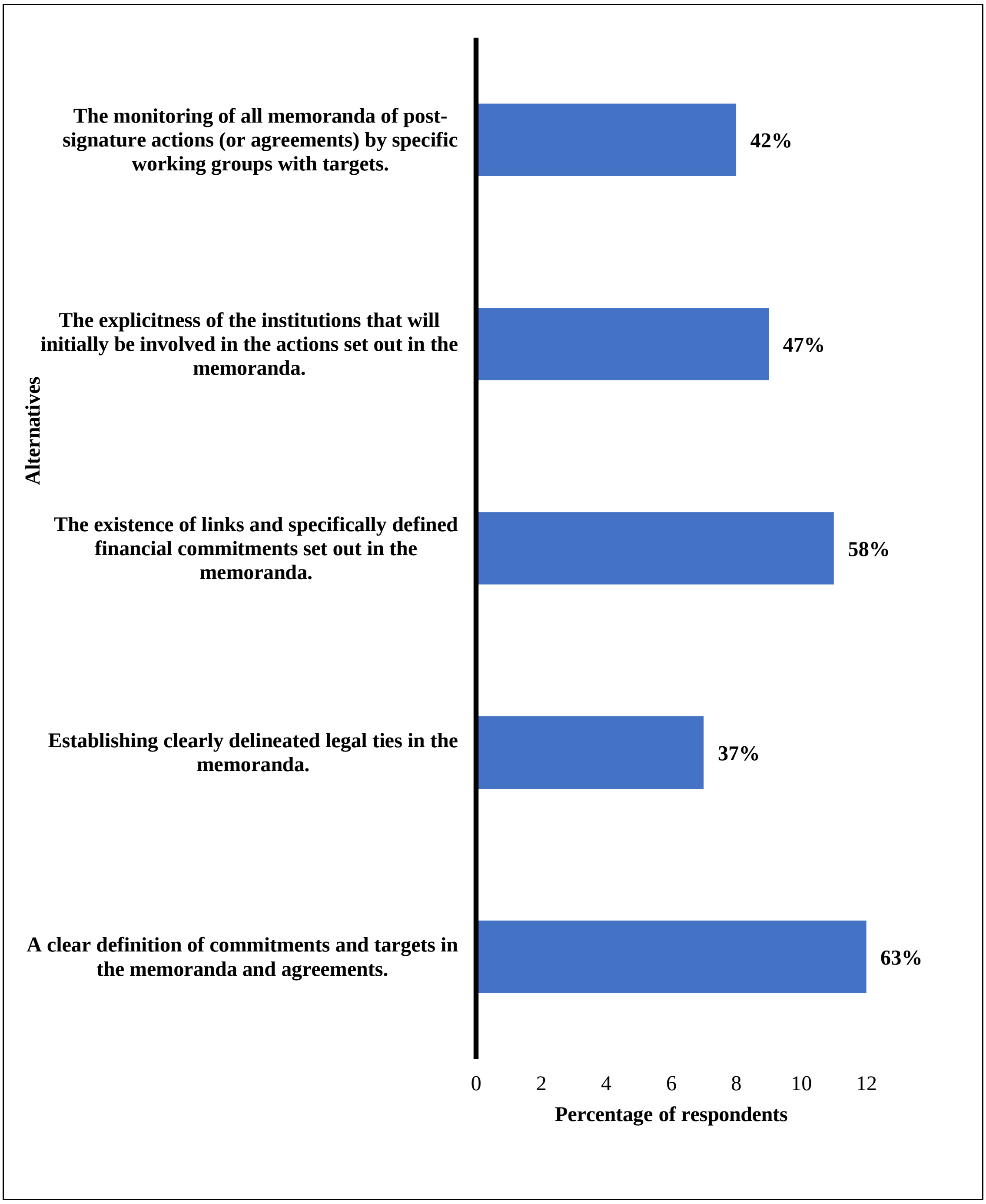
[35] Cf. Original: „Eu aposto que, quando você apresenta sua pesquisa no Brasil, muitas pessoas te perguntam por que não Brasil e Estados Unidos? Brasil e Alemanha? Até mesmo China? Então ainda há aquela coisa de "Incredible India", ainda há um desconhecimento"

Regarding the theme "memoranda and agreements", the interviewees were asked what could help to ensure that the memoranda and agreements signed between Brazil and India regarding renewable energy could trigger concrete actions. Interviewees were given the same alternatives listed in Question 18 of the questionnaire. The following graph shows the interviewees' responses.

Graph 58 - Alternatives and responses of the interviewees regarding the concrete actions after agreements and memoranda.



Source: Author's elaboration.

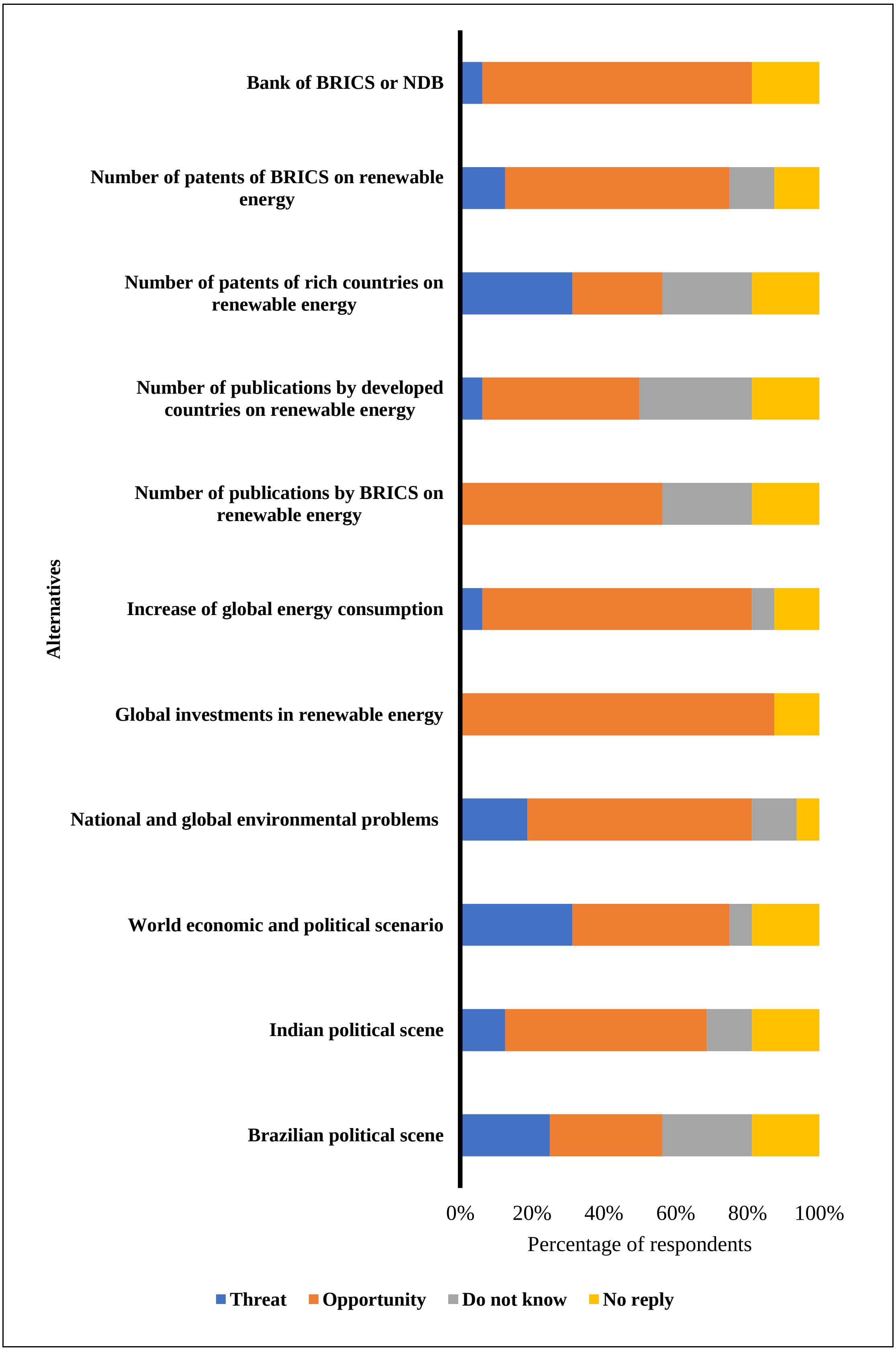
All of the alternatives were chosen by the interviewees, including the follow-up of actions after the signing of the agreements and memoranda, which was considered a barrier by the interviewees in the previous question, precisely because it must be part of a regular routine of the cooperation between Brazil and India. The elements that could most contribute to triggering concrete actions after the signing of the memoranda and agreements, according to the Brazilian and Indian interviewees, are the clear definition of commitments and targets in the agreements and memoranda and the existence of links and specifically defined financial commitments set out in the memoranda.

By complying with these two actions, it is much easier to monitor the actions born out of the agreements and memoranda. The establishment of financial ties would certainly be a more effective action if it had already been established in the implementation of agreements and memoranda at the time of their signatures. In this context, for Interviewee 17 "defining areas for cooperative activities along with targets that can be monitored would help increase the effectiveness of MOUs". For Interviewee 3[36], in addition to the actions presented, stimulating entrepreneurial missions can also help to trigger concrete actions in relation to the memoranda and agreements on renewable energy signed between Brazil and India. In addition, "looking for creative ways" to implement the rapprochement, such as creating specific groups to work on the topic by videoconference: "At the time the memorandum was signed, the reality was X. Today the scenario changed, what to do?”. The interviewee added that "perhaps, instead of four memos for each energy, creating or establishing one for all, would rationalize the process."

With regard to threats and opportunities for Brazil-India renewable energy cooperation, interviewees were asked to identify what makes a threat and what makes an opportunity for such cooperation. This question corresponds to Question 13 of the questionnaire. The following graph illustrates the results of the interviews:

[36] Cf: original: “No momento em que o memorando foi assinado a realidade era X. Hoje mudou o cenário, o que fazer?” [...] “talvez, ao invés de quatro memorandos para cada energia, a criação ou o estabelecimento de um só para todos, racionalizaria o processo”.

Graph 59 - Threats the opportunity for Brazil-India cooperation in renewable energy, according the Brazilian and the Indian interviewees.



Source: Author's elaboration.

Among the interviewees, global investments in renewable energy (88%), the increase in global energy consumption (75%) and bank of BRICS (75%) were the three most chosen as opportunities for cooperation between Brazil and India in the field of renewable energy. Among respondents to the questionnaire, the 3 alternatives were also the ones most chosen as opportunities. Regarding the Bank of BRICS, Interviewee 2 pondered a negative point about the bank: "[...] is that, if you look at the emissions that happen around the planet since the moment of the industrial revolution, the greater part of the issue comes from few developed countries in the world. So the whole world wants the developed world to pay for it or give us more carbon space. The moment we say we have to fund ourselves to develop it, you're really diluting your own argument by asking them to fund you".

Despite this comment, Interviewee 2 considered the bank as an opportunity for cooperation between Brazil and India in the field of renewable energy. It can be seen in section 5.1 of this chapter that renewable energy are particularly the focus of BRICS Bank financing. However, its recent creation, which took place more precisely in 2014, certainly contributes to bring more speculation than certainty about funding in partnerships among the five BRICS countries.

For the interviewees, the number of BRICS renewable energy patents (63%) and the number of BRICS publications (56%) also represent an opportunity. In the questionnaire applied, the Indian respondent also chose this alternative as an opportunity. However, he checked the "I do not know" alternative when referring to the number of BRICS renewable energy publications. 45% of the Brazilian respondents chosen alternative "Do not know" about the number of patents being an opportunity or a threat to the cooperation between the two countries in the field of renewable energy. This shows that the interviewees, compared to the majority of the respondents of the questionnaire, have a greater knowledge of the topics "patents" and "publications" or of what these elements may represent to the country.

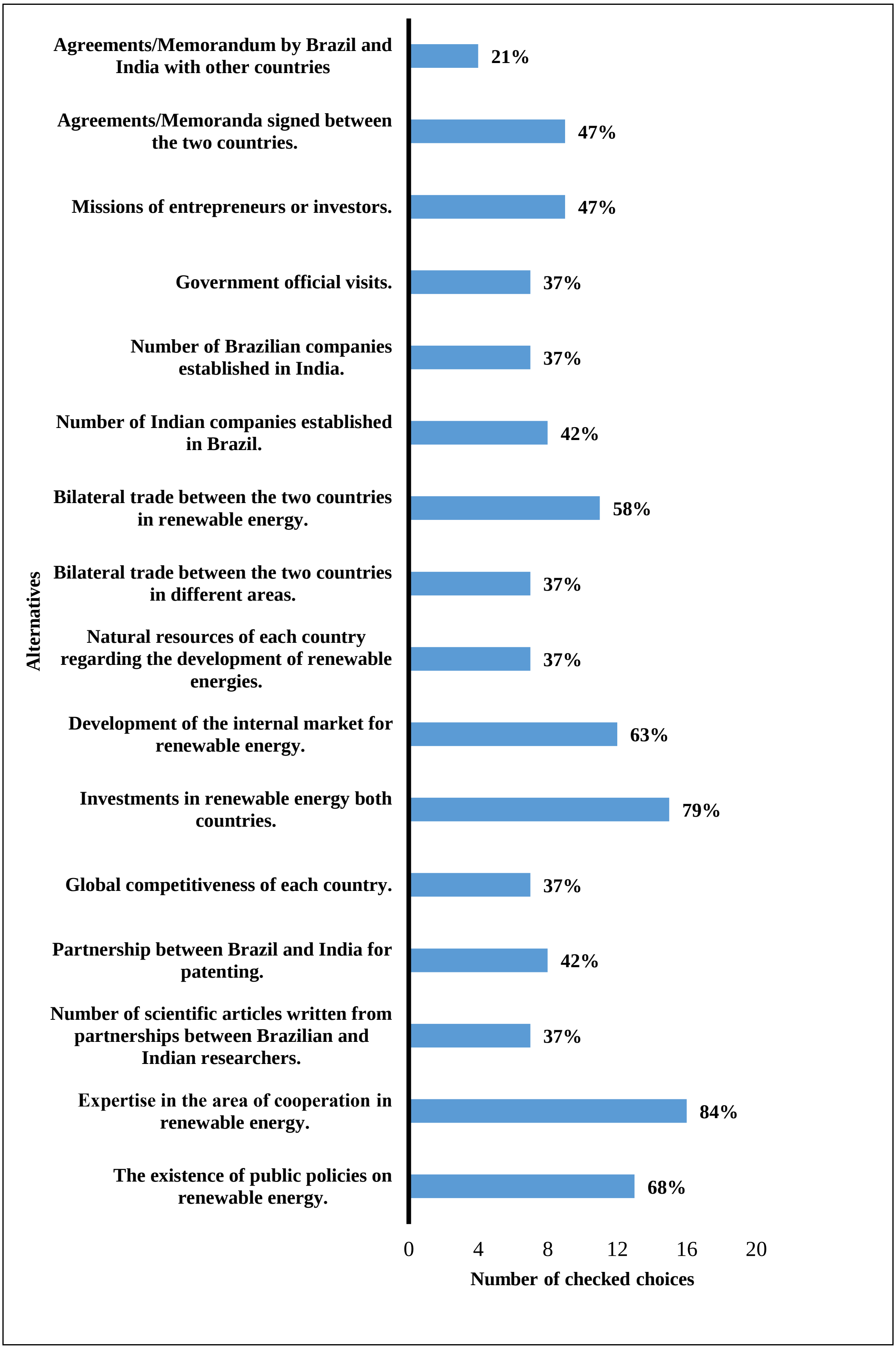
If a BRICS country has more publications on a particular topic in the area of renewable energy and has more patents in this area, it shows that this country has knowledge or even technical capacity in the area, which increases its competitive potential among the others. This would also be a factor in attracting partnerships or cooperation between this country and others. As interviewee 3 pointed out, one of the fronts for a strategic partnership between countries is the search for partners who have advanced knowledge in a given area. The interviewees (31%) pointed out that the number of patents from rich countries would be a threat to Brazil-India cooperation.

63% of interviewees also placed environmental problems among the four elements seen an opportunity for Brazil and India to cooperate in the field of renewable energy. This undoubtedly relates not only to problems such as deforestation, but also to those linked to air pollution, such as CO_2 emissions. Let us not forget that 82% of the Brazilian respondents of the questionnaire also considered environmental problems as an opportunity and the Indian respondent also considered this item as an opportunity for Brazil-India cooperation.

As for the threats, the interviewees chose the number of patents on renewable energy in the rich countries (31%), the world economic and political scenario (31%) and the Brazilian political scenario (25%). For 31% of interviewees, the Brazilian political scenario is an opportunity and 25% declare that they do not know if it would be an opportunity or a threat, which shows the presence of uncertainty among the interviewees about the Brazilian political scenario. It is worth noting that the Brazilian political scenario was considered a threat by 73% by the Brazilian respondents and by the Indian respondent of the questionnaire. These responses certainly reflect the Brazilian political-economic scenario of the last two years, as presented by the World Economic Forum in its annual reports from 2015 to 2017, in which it demonstrated Brazil's low performance in relation to economic and political indices. Regarding the threats, Interviewee 18 added that the imposition of centralized decisions of the ministries of New Delhi and impositions of the federal authorities would be a threat to the cooperation between Brazil and India. The interviewee stated that the difficulty or the threat exists because the international cooperation projects in India usually go through prior authorization from the government. This means that projects have to undergo successive administrative and bureaucratic barriers which impose a series of clauses. Depending on the magnitude of the projects, compliance with the clauses would make execution or even the project viability difficult.

The interviewees were asked to check the elements that contribute to promoting cooperation in renewable energy between Brazil and India (Question 14 of the questionnaire). The following graph shows the results obtained in the interviews:

Graph 60 - Elements which can promote cooperation between Brazil and India in renewable energy, according to the interviewees.



Source: Author's elaboration.

For the Brazilian and Indian interviewees, the elements that can most contribute to promote cooperation in renewable energy between Brazil and India are the technical capacity in the field of cooperation in renewable energy and the investments in renewable energy in both countries. These elements were also the most chosen by the respondents of the questionnaire. The existence of public policies on renewable energy was the third element most chosen by the interviewees and by 100% of the respondents of the questionnaire. The development of the domestic renewable energy market and bilateral trade between the two countries in the field of renewable energy also stood out as the most chosen by the interviewees.

It should be noted that, although trade between Brazil and India has increased steadily since 2005 as discussed in Chapter 4 of this thesis, it still focuses on commodities and, in the area of energy, the focus is on fossils, i.e. oil. For the interviewees, the two countries should focus on bilateral trade in renewable energy and the development of the internal market as elements capable of promoting cooperation between them. To do this, it is clear that both countries should intensify investments in their expertise or in their technical capacities (training) according to their vocations in the area.

Currently, it is the developed countries that dominate the market in the field of renewable energy, although, more recently, China has emerged in the solar energy market. According to Interviewee 1, although India produces solar panels and batteries, China is the largest exporter of these materials to India because of the large-scale, lower-priced production. He believes that the quality of materials produced in India for the generation of energy is of better quality than those produced in China, but the Chinese price is more competitive. Interviewee 6 cited that Germany is India's leading supplier of solar inverters. According to this interviewee, "Indian players are now encouraged by the government". He highlighted Vikram Solar, India's second largest solar energy company, which has been standing out in the production of solar energy materials.

Although the alternatives related to the presence of the number of Brazilian companies and Indian companies are not among the four most chosen by the interviewees, missions of entrepreneurs and investors was the sixth alternative chosen by the interviewees as the one that can contribute to the cooperation between Brazil and India in renewable energy.

In addition, there is recognition of the importance of the presence of companies in the process of cooperation between the two countries is acknowledged. Interviewee

10 emphasized that "the simple presence of Indian companies in Brazil, from any sector, already facilitates the dialogue between businessmen, researchers and authorities of both countries.[37]" Dialogue can undoubtedly contribute not only to cooperation in renewable energy, but also to a number of areas, as highlighted by Interviewee 2, who cited his experience in Japan to make a comparison. For him there is the diplomatic part and the part of the business organizations, which can play a "the huge role". He mentions his experience in Japan: “The number of people from Brazil in Japan is very high. I don’t know how that exchange happened. There are a lot of people from Brazil in Japan. I stayed in Japan for three years. Also lot of Japanese in Brazil. It is really surprising for me. Though we may be having a good Brazilian community, but still not as big as some of the Asian communities here. Certainly, the geographical barrier plays a role. Nevertheless, we have business communities in these two countries. So they have a huge role to play. Only thing is that what usually the government does is that they tap business communities which are working in other areas even non-energy sectors. For example: when I was in Japan, Indian government used to be in touch with some of the big tea business people, basically Indians doing tea business in Japan, to get support on various other issues. Certainly business community can play a big role”.

This shows that the business community certainly infiltrates various parts of local society and, depending on the power it exerts or the size of its influence, it can facilitate dialogue in the process of cooperation in various areas. For Interviewee 3, entrepreneurs have an essential role in renewable energy cooperation between the two countries. Thus, it is necessary to hold business forums so that businesspeople can visit bioenergy plants in Brazil and solar parks in India.

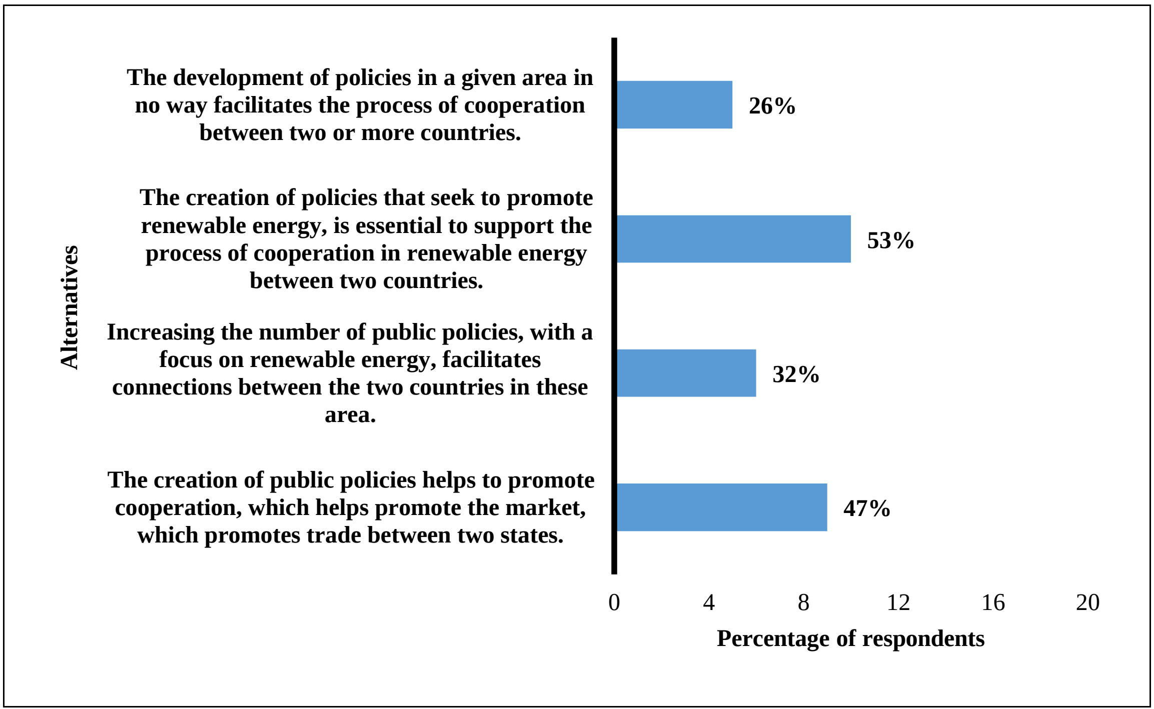
Interviewee 3 just stressed that it is easier to put a Brazilian company and an Indian company to work together than a Brazilian company alone settles in India. In her view, support from a local Indian to a Brazilian company helps. The same happens in Brazil, because the cultural, market and legal issues pertinent to the country are obviously more familiar to those who already work or have experience in the country.

[37] Cf. Original: “a simples presença de empresas indianas no Brasil, de qualquer setor, já facilita o diálogo entre os empresários, pesquisadores e autoridades de ambos os países”.

Interviewee 4 adds to this discussion the fact that the Government creates or provides the environment for cooperation to take place. Of course, cooperation between governments takes place, but from the governmental signals the private sector plays an important role in this process. According to the interviewee, you cannot leave everything in the government companies' hands.

Interviewees (as in Question 8 of the questionnaire) were asked to mark the alternatives they believed to be true about renewable energy policies and the cooperation process. The results of interviewees' responses can be seen in the following graph.

Graph 61 - Public policies, renewable energy and cooperation, according to the interviewees.

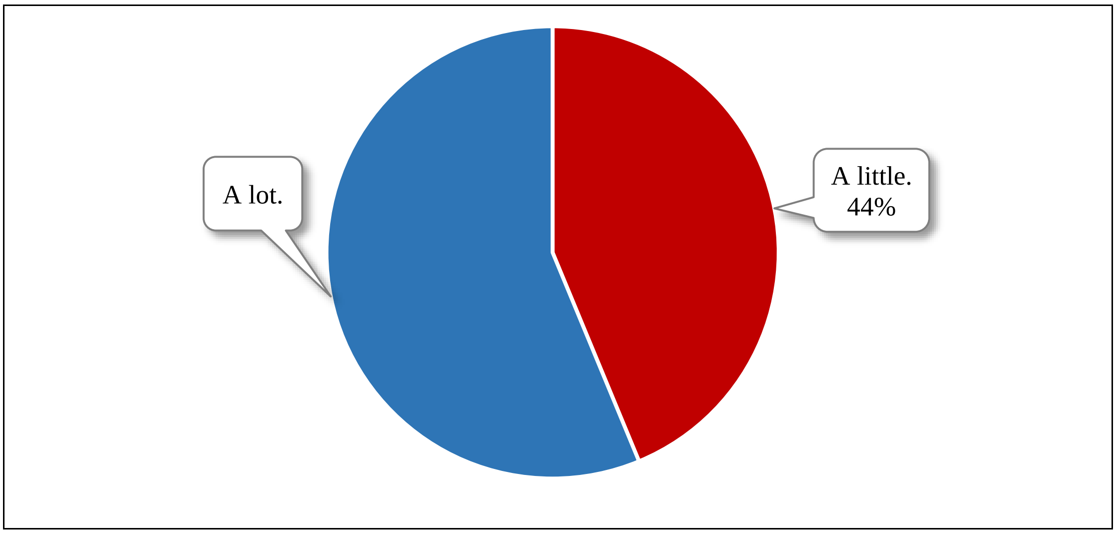


Source: Author's elaboration.

For the interviewees, the creation of policies in renewable energy is fundamental to support the process of cooperation between the two countries in this area. This response coincided with the one chosen by the respondents in the questionnaire.

As can be seen in section 5.2 of this chapter, both Brazil and India have been adopting policies to promote renewable energy more intensively since the 2000s. In addition, they have invested in promoting renewable energy that have also been intensified. Undoubtedly, the responses of interviewees and respondents to the questionnaire reflect the importance of establishing policies on renewable energy as an essential factor in the cooperation process. As in Question 9 of the questionnaire, interviewees were asked how similarities between public policies can contribute to facilitating the process of cooperation between the two countries under study, given that similarities were found between Brazilian and Indian policies in renewable energy both in relation to the themes and in actions proposed by the policies. For most of the interviewees (56%), similarities can help "a lot" the cooperation process between Brazil and India. Similarities indicate convergence of interests in a given area. The following chart illustrates the results obtained from interviewees' responses.

Graph 62 - Similarities between policies in the area of renewable energy between Brazil and India, according to the interviewees.



Source: Author's elaboration.

None of the interviewees agrees with the alternative the similarities between policies on renewable energy do not contribute to the cooperation process at all; for the majority, the similarities contribute a lot; for 44% of the interviewees, contribute little.

For 82% of respondents of the questionnaire in Brazil, similarities between policies can contribute "a lot" to the cooperation process between Brazil and India. For the Indian respondent to the questionnaire, the similarities may contribute "little" to the process of cooperation in renewable energy between Brazil and India.

Interviewee 1 stated that the similarities between policies contribute a lot to the cooperation process. According to him, the installation of solar panels on residential roofs and commercial establishments began to be promoted with the help of Germany's cooperation because that country began to develop this kind of policy 20 years ago.

According to Interviewee 1, the Germans "are masters in it. Under this cooperation, since Germany has already experimented and it was a super successful in Germany, it helped. When we decided, India will also promote solar roof top in the country and under technical cooperation it was agreed that government of Germany will support India in promotion of solar roof top […] they are sending their experts and which is helping Indian companies, Indian government".

For Interviewee 15, India still focuses on traditional energy as the pillar for its economy. In this sense, "I also agree that increased external cooperation could help promote this change". However, it is important to highlight a relevant aspect raised by Interviewee 16: similarities should be associated with technological status and synergistic actions at the same time so they succeed. The example mentioned by Interviewee 1 about India's cooperation with Germany in the field of solar energy makes this point clear; although, India has established a recent solar energy policy compared to Germany and has mirrored itself in German policy on some points, such as the application of solar energy to the roofs of homes and commercial establishments. The results only began to appear when India went beyond establishing the policy in the area and start investing massive financial resources in solar energy and the country's scientists intensified their studies in the area, which can be evidenced by the increase in the number of solar publications, which took off from the year 2010.

It should be noted that Germany is one of India's main partners in scientific publications on the topic of solar energy. Thus, similarities are necessary, but not enough, as Interviewee 14 stated. In addition, lack of geographical proximity and lack of economic interests are also a limitation in cooperation, according to Interviewee 2. Therefore, for Interviewee 7, India and Brazil need to collaborate more, cooperate more, join forces and not just focus on the policies or the similarities between them. For Interviewee 10, in addition to the similarities of viewpoints, there are common challenges that are very similar and help to strengthen the process of cooperation between the two countries.

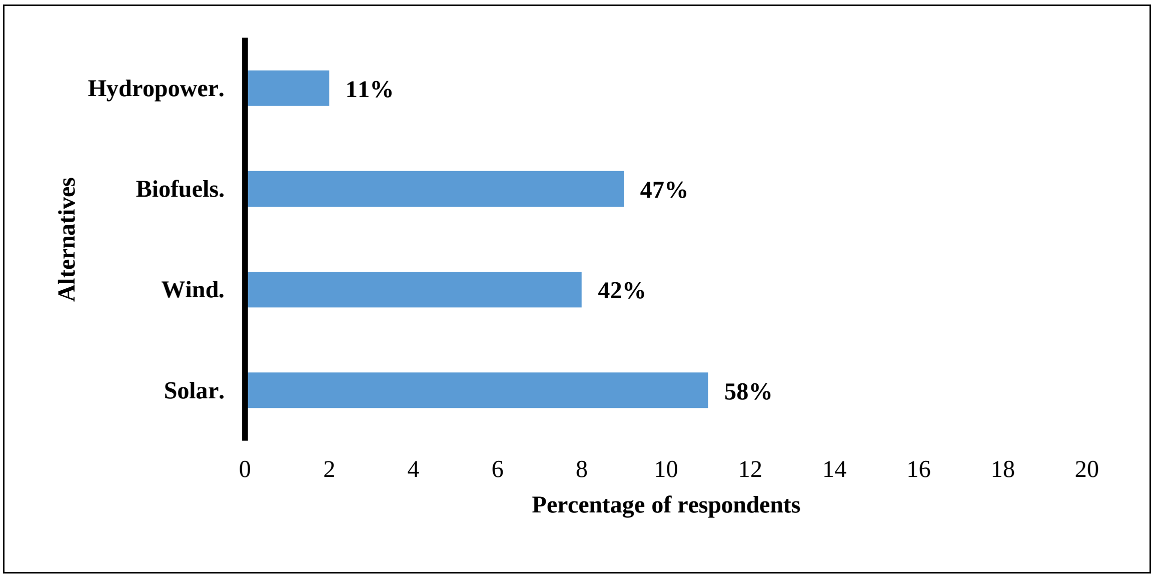
Interviewee 18's opinion was quite different from the others'. For him, cooperation involving megaprojects and large state companies or companies is not efficient: it should have popular support and take place between NGOs and institutions such as universities.

Therefore, he said, the similarities between policies in the area of renewable energy could only help "a little" the cooperation between Brazil and India in this area.

However, for most interviewees and questionnaire respondents, policies are essential to support the process of renewable energy cooperation between the two countries and the similarities between them can greatly help this process. It was not possible to evaluate here whether policies or similarities between them would be more efficient in large or small organizations, between state-owned or non-state-owned enterprises, or between non-governmental organizations and universities.

Regarding the source in which Brazil and India are most likely to cooperate (question number 19 in the questionnaire), the results of the interviews showed that, for 58% of the interviewees, it is in solar energy that cooperation is more likely to happen between the two countries, followed by biofuel (47%), wind (42%) and hydroelectricity (11%). For Brazilian respondents of the questionnaire, who are more closely involved in the decisions and strategies of the Brazilian and Indian governments, the source of energy that offers the greatest potential for cooperation between the two countries is biofuel: it was the choice of 91% of Brazilian respondents and Indian respondent, followed by solar energy (64%), wind energy (45%) and hydroelectricity (18%). The following graph shows the interviewees' responses in percentage terms for the type of renewable energy that offers the greatest likelihood of cooperation between the two countries.

Graph 63 - Types of renewable energy which would offer the greatest probability of cooperation between Brazil and India, according to the interviewees.



Source: Author's elaboration.

During the interviews, in relation to the question about the type of energy that offers the most probability of cooperation between the two countries, solar energy and especially biofuels were the most discussed by the interviewees. Regarding biofuels, the interviewee realized during interviews in India that there is a recognition that Brazil is a reference in this area and that there is an understanding that this type of energy source should be developed or promoted in India in partnership with Brazil.

In addition to asking about the type of source that offers the greatest likelihood of cooperation between Brazil and India, it was also asked how one country could contribute with the other country, with a view to cooperation in renewable energy. Interviewee 2, for example, said that he chose biofuel because he considers Brazil a reference in biofuel. At that point, the interviewee was asked about issues involving land use, whether that would not be a barrier to the production of biofuel in India. According to the interviewee, land use is not a barrier. To show this, he said he had already written about it: “in this one, I had quoted Dr. A.P.J. Abdul Kalam, who had emphasized that without affecting the agricultural land, we can still go for developing bio-fuel. The way is that you look at the wastelands or those areas, which are not good for arable or cultivable land. They can still be utilized for cultivation of bio-fuels. So he had actually given some calculation also which said that the country has about 30 million hectares of usable wasteland out of the total of around 60 million. So 30 million hectares of usable wasteland is there. We have a total of 60 million hectares of wasteland.

We must actually produce at least minimum of two tonnes from one hectare. If you produce two tonnes per hectare per year, from 30 million hectares we will be producing 60 million tonnes of liquid fuel. This is the maximum productivity. Probably with better technology, we can expand this. So there is a way of doing it. I think this is an area where India can learn from Brazil. How Brazil has successfully managed the pro-alcohol policy, and how they have successfully implemented it. It is a good lesson for India. By studying this topic, you are not only studying for Brazil but you are contributing something for India”.

According to Interviewee 3, the area in which Brazil would most contribute to India is second-generation biofuels. For him, the debate on food safety limited the promotion of biofuels a bit, but changed with the second generation biofuels, because, from that technology, that point of divergence disappears and the avenue of cooperation remains open.

In this sense, Interviewee 9 states that India is in the process of installing lignocellulosic ethanol projects:

> We are in the process of installing all this units in India and I came to know one unit is already working in Brazil. I am not aware of the technology but that is successfully running in Brazil. If the technology is successfully running in Brazil, probably that will be a role model for India to have similar kind of technology, equipment, machinery to be installed in India so that we can use our lot of non-food bio-mass. I'm telling this because in many states where huge quantity of agricultural waste is generated is burnt in the open. So here a regulation has come from the National Green Tribunal that no more this bio-mass is allowed to be burnt. So all the farmers are in a dilemma, what to do with this bio-mass. So this is the one solution we could get – production of ethanol from lignocellulosic bio-mass. Only that will solve the problem of burning bio-mass in the atmosphere.

The interviewee says that he is not aware of the technology, but that he was in Brazil and saw that the technology works successfully here. The sharing of knowledge between the two countries is certainly a potential to be explored.

Interviewee 4 says India can benefit from Brazil's vast experience in ethanol, which can help India replace conventional automotive fuels. For him, this will help India not only reduce oil imports but also save the environment and reduce global warming.

Interviewee 1, after highlighting some similarities between Brazil and India, such as the fact that they are developing countries and are undergoing an economic transition, said that biofuels are a source of cooperation between these two countries. For him, in addition to biofuels, solar energy represents another type of energy source in which both countries could invest cooperative efforts. This was corroborated by Interviewee 4 by stating that India and Brazil can gain from the experience of others in photovoltaic solar energy.

According to Interviewee 2, India's current focus is on solar energy because it believes that this source can help his country end energy problems. Although he does not know the availability of wind in Brazil, he believes that cooperation in solar technology may be because India is the fifth largest producer of wind energy in the world and because the biofuels sector is one where the two countries can exchange experiences.

With regard to solar energy, according to Interviewee 2, India can help Brazil by providing technologies or even by importing elements. He cites, for example, the "Make in India" program, aimed at expanding production activities, which is investing in the renewable energy sector, and consequently high-tech components, parts and equipment are receiving special attention in this program. For the interviewee, two areas of collaboration between Brazil and India would be trade in finished products or raw materials in solar energy to produce more efficient technology in the area. India has been investing heavily in solar energy, as has already been shown in Chapter 4 of this thesis. The interviewer stressed that Brazil occupies a highlighted position in the world production of silicon (raw material used in the manufacture of solar panels), but this country has no refinery to purify it and thus use it in the production of plates.

It should be noted that the University of Rio Grande do Sul has created a solar energy Chart more efficient and cheaper than the world average, which could be a stimulus to scientific and technological cooperation between the two countries.

Interviewee 6 believes that, because they are two democracies, there are similarities between the Brazilian and Indian markets. For him, the highlight of collaboration between the two countries is solar energy, which is his field of professional activity:

> India can help Brazil in going solar because India is leading right now. [...] but I believe mainly the thing that can be shared is mainly technology transfer [...] some lessons from Brazil's solar energy development or growth then it can be shared via common platform. India can also share on that common platform.

It has already been mentioned that, for Interviewee 3, biofuels are the source in which Brazil and India have a greater chance of cooperation. However, for the interviewee, these two countries can cooperate in all sources of renewable energy. In the solar source, for example, Brazil can help India find a way to make the Indian system more stable. "India is evolving in solar energy, Brazil is still timid, India certainly can collaborate, be it in equipment or in machinery[38]."

Regarding wind energy, for Interviewee 3, Brazil has parks in the Northeast and India has parks located on the coast and, through the research done, he learned that Brazilian wind farms are more efficient than Indians and it is not only because of the regimes of the winds. For him, this should be investigated. This would be a further opportunity to establish a cooperation project between the two countries, which, as discussed in Chapter 4, are among the ten most wind potential in the world.

Interviewee 17, as well as Interviewee 3, believes that Brazil and India can cooperate in the area of biofuels and in other sources. For him, despite Brazil being strong in the area of biofuels and having experience in a mass transportation system based on ethanol, it carries out significant activities in solar and wind energy. Because of this, he believes that India's cooperation with Brazil in renewable energy can be

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[38] Cf. original: "A Índia está evoluindo em energia solar, o Brasil ainda timidamente, certamente a Índia pode colaborar, seja em equipamentos ou em maquinário".

focused on biofuels and other areas of renewable energy. Interviewee 4 also shares the same reasoning, highlighting four points:

(1) that the New and Renewable Energy Ministry has set ambitious goals related to solar and wind power, hydroelectricity and biomass;

(2) that Brazilian investors can see how India can achieve these goals and mirror them;

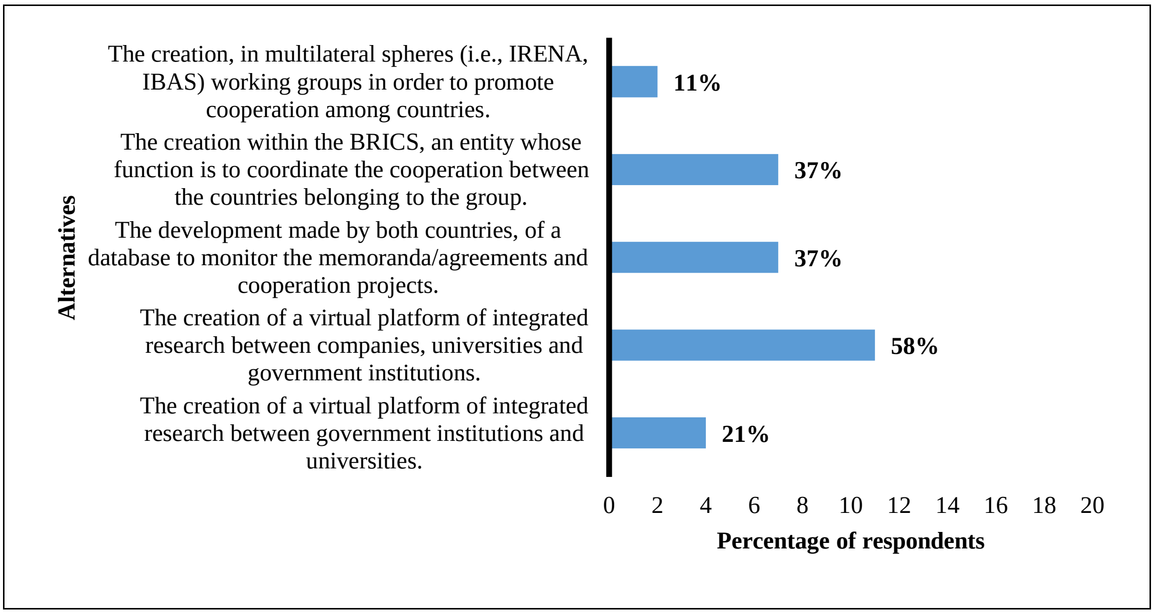
(3) that there are investors (manufacturers and suppliers) from all over the world who come to India to participate in pursuit of these goals;

(4) and that Brazil can also contribute through cooperation.

As for hydropower, or hydroelectricity, Interviewee 4 pointed out that it is facing many difficulties in India because of the high cost and geological, environmental and accessibility issues. For him, Brazilian experts can go to India to show how to build hydroelectric projects in a more efficient way. For Interviewee 3, hydroelectric plants can complement solar energy in India.

Regarding the propositions related to how to extend cooperation between the two countries in the field of renewable energy, the interviewees were asked to choose more relevant elements (which corresponds to Question 20 of the questionnaire). The interviewees also provided additional suggestions and comments on this question.

Graph 64 - Proposals to expand Brazil-India cooperation in renewable energy, according to the interviewees.



Source: Author's elaboration.

The most chosen alternative among the interviewees was the creation of an integrated virtual research platform between companies, universities and government institutions. The other two alternative most chosen were the creation within BRICS of an entity that articulates cooperation among its member countries and the development of a database to follow the memoranda and agreements as well as the cooperation projects established by the two countries.

Interviewee 18 didn´t favor state participation. Therefore, he suggested that the platform should be created by companies and universities without the interference of the government. This interviewee was the same person who cited bureaucracy as a barrier to cooperation between the two countries. For the interviewee, India has a strong centralized government with too much bureaucracy and a strong connection with political parties.

Interviewee 2 added that given the relevance of facing climate change, and considering that the two countries are already part of different groups like BRICS, BASIC and that all these groups address or approach the debate on climate negotiation, Brazil and India can, if they use this narrative of climate negotiation, lead the organization of other countries of the group, such as China and Russia, to promote renewable energy. For Interviewee 2, renewable energy plans are slowly becoming centric in the global arena and the role of developing countries is very limited. Thus, BRICS, BASIC and other groups under the leadership of India and Brazil can contribute to the development of renewable energy. According to the interviewee, "there is a lot of room for this". For interviewee 2, innovation would be a second way to expand cooperation between Brazil and India in the area of renewable energy. He questioned himself: "How are India and Brazil investing in innovation?" and "what are the main areas to invest in innovation? ". For him, these are actually areas of interest. "He believes there is an opportunity for both governments to collaborate in this".

Regarding the scientific and technological mapping of Brazil and India, for the Interviewee 2, publications and patents reflect strong government policies: patents reflect how government is promoting or encouraging inventions, scientific inventions; therefore, a growing number of patents show that the government is promoting scientific activities. According to the interviewee, publications and patents are a method of measuring how things are progressing in society. For the majority of the interviewees, both the number of patents and the number of BRICS publications represent an opportunity for cooperation between Brazil and India, which shows the importance of "innovation" for the promotion of cooperation between countries. Interviewee 2 also suggested that the joint research should be intensified as a way to expand cooperation in renewable energy between the two countries. Thus, he suggested the exchange of know-how in areas in which they stand out, taking as an example the development of biofuels in Brazil, which could be used in India. In addition, the interviewee added that Brazil and India could also jointly carry out investments in countries less developed than them in this area.

Other interviewees also mentioned the importance of developing research jointly as a way to expand cooperation. For Interviewee 17, for example, joint R & D projects in the area of biofuels between institutions from the two countries and other renewable energy would strengthen cooperation in renewable energy between them. Interviewee 7 stated that India and Brazil are very strong in the research and in the use of biofuels, which can be strengthened even more through the exchange of ideas, visits, research and implementation. Interviewee 11, on the other hand, emphasized the importance of creating joint research projects, financed by private initiative or by public funds. For Interviewee 14, the two countries should invest in exchange of knowledge and in joint training. Interviewee 11 suggested that development institutions be clearer about their priorities and interests in relation to Brazil-India relations.

Interviewee 2 proposed a specific comparison study that identifies common domestic policies and a study on how public perception and public acceptance of renewable energy are shaped in India and Brazil. Interviewee 12 believes that there is a growing trend in the number of joint research in bioenergy by 2030.

This is undoubtedly related to the goals set by the United Nations, which also refer to the implementation of renewable energy worldwide, to the demands from climate agreements and to the energy needs of both countries, which tend to increase in the coming years, particularly in India.

Interviewee 2, concluding his interview, said that, at the moment, the geographical issue is a factor that may limit the interaction between the two countries. However, the opportunities for collaboration between India and Brazil are numerous and there is work to invest in sharing technologies, experiences and expertise between the two countries. Moreover, since Brazil and India are part of the BRICS and other political interest groups, they can lead all developing countries and promote renewable energy not only in them, but also in less developed countries. For Interviewee 7, the great opportunities for cooperation in renewable energy between Brazil and India need to be explored and executed in a scientific way. Interviewee 3 pointed out that cooperation cannot be achieved overnight and that the developed countries would not try to create obstacles, but would try to join the cooperation when they realized Brazil and India were achieving a higher level in the field of renewable energy.

It can be observed that the results of the questionnaire and the results of the interviews have similarities in several aspects. One example is the type of renewable energy in which there is a greater likelihood of cooperation between the two countries in which biofuels and solar energy stand out. In relation to the elements that can promote cooperation between the two countries, the items that stood out, similarly, both for the respondents of the questionnaires and the interviewees in common were the need to reduce CO_2 emissions, the participation of both countries in common multilateral groups, the increase of domestic consumption of goods which implies a higher consumption of energy, the partnerships with a third country that could help in the cooperation process and environmental diversity. As for the elements which limit cooperation, social inequality and cultural aspects were the common alternatives among the Brazilian and the Indian respondents and the interviewees.

When asked in a more specific way about the elements present in each country that could contribute to the cooperation between Brazil and India in the field of renewable energy: in Brazil what was common to the interviewees and respondents of the questionnaire were the country's experience in the application of technology in the field of renewable energy, the size of the domestic market, technical training of participants in the cooperation process and the sophistication of the internal market that represents the quality of business networks in the country.

It should be noted that the size of the domestic market and the sophistication of the domestic market were also elements in which Brazil was getting excellent marks (at least until 2016, especially in the case of the second element) in the competitiveness indicators discussed in section 5.4 of this chapter.

Regarding the limiting factors or elements in Brazil that could limit cooperation between Brazil and India, the alternatives chosen in common between the interviewees who work in Brazil and the Brazilian respondents of the questionnaire were the macroeconomic situation, political situation, bureaucracy, corruption and general infrastructure. The choice of such items as factors that may limit cooperation between the two countries also coincided with those who either presented poor performance as an indicator of competitiveness or are also among the five most problematic factors for conducting business in the country as shown by the study done in the section 5.4 of this chapter.

The alignment between the answers of the interviewees and the respondents of the questionnaire regarding the elements that may limit or promote cooperation between Brazil and India showed what the survey of data on competitiveness indicators and problems for doing business in the country in the last nine years have shown: the limiting factors for cooperation chosen by respondents and interviewees are also among the most cited factors, either as limiting factors for doing business in Brazil or as those elements where Brazil had poor performance in the indicator that measures competitiveness in the country. This has helped to identify whether they can contribute to or limit cooperation between the two countries in the area of renewable energy.

As for factors or elements present in India that could promote cooperation between Brazil and India, the Indian respondent of the questionnaire checked all given alternatives present in his country as factors that can help promote cooperation between Brazil and India, except for corruption. Among the interviewees that work in India the most checked alternatives were the technical training of participants in the cooperation process, the size of the internal market and the speed of technology (the speed with which the country and its institutions adopt and absorb new technologies).

As for the limiting factors in India the alternatives most checked by the interviewees were corruption, bureaucracy, infrastructure and political situation were the most chosen by the interviewees who work in India, the same elements highlighted in Brazil, with the exception of the macroeconomic environment, which, in India, was not chosen as a limiting factor.

The same analysis about Brazil suits India. It can be argued that in India, the difference between the opinion of the interviewees and the respondent of the questionnaire is that the speed or readiness of technology was an indicator in which India did not stand out against Brazil in the competitiveness ranking, for the interviewees who work in India and the Indian respondent this element present in their country is a positive factor that can help in the cooperation between the two countries.

Regarding the limiting factors most chosen by interviewees and respondents as those that may limit cooperation between Brazil and India in the field of renewable energy coincided with the ones that were among the five most chosen over the nine-year period as problematic factors regarding business endeavors in the country; corruption was among the five most chosen during the nine-year period.

Among the barriers to cooperation between Brazil and India in the area of renewable energy, the need to follow up the memoranda and agreements after signing was highlighted as alternatives chosen by all interviewees and respondents. In addition, the lack of investment in science and technology, the lack of political will and the need for greater commitment among institutions participating in the memoranda and agreement were the three alternatives highlighted by both the interviewees and the Brazilian respondents of the questionnaire.

Regarding what can be done so that the memoranda and agreement on energy signed between the two countries can trigger concrete actions, the clear definition of commitments and targets in the memoranda and agreement was the alternative chosen by all the interviewees and respondents. In the agreement signed between the two countries for example in the area of science and technology, and in which renewable energy are part of its overall goal, there is no financial goal or commitment, for example, that can make it more efficient or easier to be monitored.

The elements that stood out in the choices by the interviewees and questionnaire respondents (Brazilians and Indian) as the ones that can promote cooperation in renewable energy between Brazil and India were the investments in renewable energy, existence of public policies in renewable energy, technical capacity in the area of cooperation in renewable energy.

Regarding threats and opportunities, the three elements chosen common to interviewees and respondents as opportunities were global investments in renewable energy, increased global energy consumption and the BRICS bank.

The number of BRICS patents on renewable energy and the environmental problems were also highlighted. As a common threat, according to all interviewees and respondents, was the Brazilian political scenario.

Regarding the public policy theme, the majority of the interviewees and respondents from Brazil and India pointed out that the creation of public policy on renewable energy is essential to support the process of cooperation between the two countries. And that the creation of public policies also helps to promote not only cooperation but the market and trade between the two countries. According to the interviewees and respondents, the similarities in renewable energy policies between the two countries can help "a lot" the cooperation process between Brazil and India.

For the interviewees and for the Brazilian respondents of the questionnaire the way Brazil and India should cooperate is bilaterally. The renewable energy sources most chosen by all interviewees and respondent of the questionnaire as the one that offer greater possibility for cooperation were biofuels and solar energy. Among the proposals presented those that were common responses and were the most chosen by all interviewees and respondents of the questionnaire were the creation of a virtual platform of research among companies, universities and governmental institutions, the development of a database made by the two countries to follow the memoranda and signed agreements and the creation within BRICS of an entity whose function is to articulate cooperation among its member countries.

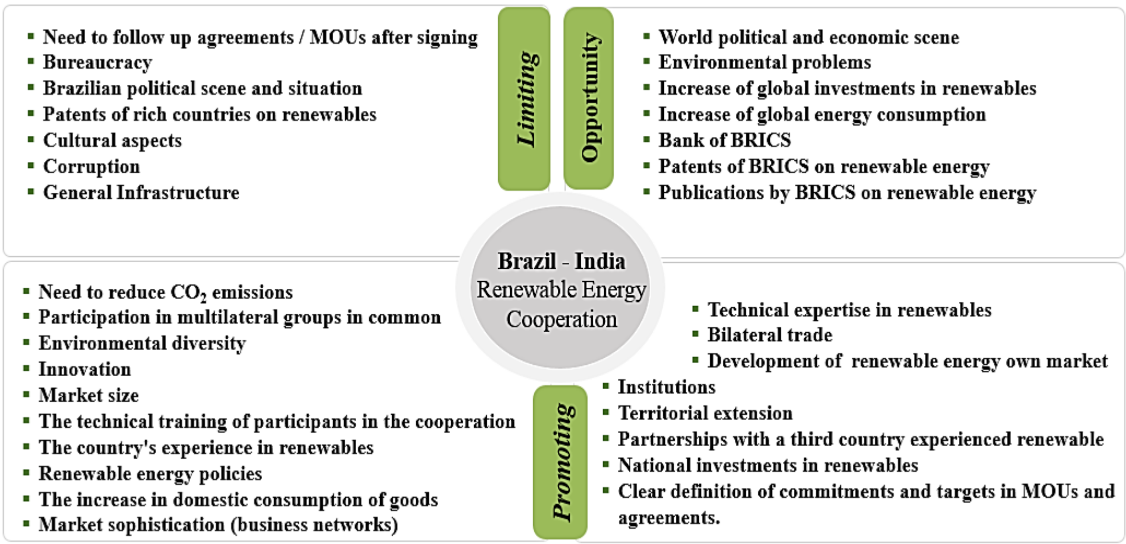
Based on the data obtained, the next chapter presents proposals to expand cooperation between Brazil and India in the field of renewable energy.

6 PROPOSITIONS: STRATEGIES TO ENLARGE THE PATH TO COOPERATION BETWEEN BRAZIL AND INDIA

From the results presented in the previous sections, it is possible to propose strategies so that cooperation in renewable energy between Brazil and India can be extended. To do so, it is worth going over some points from those sections again. It should be emphasized that the objective here is to identify, based on the results of the primary research, the elements that can contribute to foment or to restrict the cooperation between the two States to use them as a support for proposing strategies to expand this cooperation in the area of renewable energy.

The following figure summarizes the most cited elements or those who were chosen by 50% or more of the respondents (interviewees and respondents of the questionnaire) as elements that can promote cooperation, be a barrier to it or still be an opportunity for cooperation to be established. Elements that were not chosen by 50% or more of the research participants as factors that could promote or be an opportunity for Brazil-India cooperation in renewable energy were considered as constraints or a threat to such cooperation.

Figure 6 - Summary of the elements that may promote or limit Brazil-India cooperation.



Source: Author's elaboration.

6.1 ELEMENTS THAT ARE OPPORTUNITIES FOR BRAZIL-INDIA COOPERATION

The increase in global investments in renewable energy, the increase in global energy consumption, the environmental problems related to the emissions of greenhouse gases and the world political and economic scenario were the elements most cited in the primary research as factors that could promote opportunities for cooperation between Brazil and India in the field of renewable energy. Indeed, these elements show that not only the countries need to invest in renewable energy, but also take advantage of the growing investments around the world in renewable sources to increase their installed capacity in renewable sources and take advantage of these opportunities as stimuli for cooperation between them.

The number of patents and publications of the BRICS countries is also in the list of elements seen as opportunities for cooperation in renewable energy between the two countries. This is due to the fact that the expertise or areas that demand the greatest scientific and technological interest of a given country may be areas in which another country belonging to the group is interested in developing itself or investing. In Brazil, these areas are biofuels and hydroelectricity; in India, solar energy.

The BRICS bank or the New Development Bank is also seen as an opportunity. In fact, renewable energy has proved to be a priority issue for the bank. The fact that this institution was created three years ago certainly appears as opportunities to be explored by its member countries in order to intensify the economic integration among them.

6.2 ELEMENTS LIMITING BRAZIL-INDIA COOPERATION

The elements present in both Brazil and India that were considered the most likely to limit cooperation between the two countries are corruption, bureaucracy, general infrastructure, political situation in Brazil and the Brazilian political scene, which was the most chosen among the respondents and the second most chosen among the interviewees.

Regarding the Brazilian political scenario, in order to have an idea of its influence on the discussions about cooperation between Brazil and India, it is worth mentioning the case of one of the Brazilian professionals who participated in the interviews: one week after the interview, he requested that his name not be mentioned in any way. Therefore, it was decided that his interview would not be considered in this work. He expressed a certain fear of making statements at a time he considers politically complex. It should be noted that, from 2015 to 2017, the Ministry of Foreign Affairs of Brazil had four ministers; the Ministry of Mines and Energy replaced ministers four times and the Ministry of Science, Technology, Innovation and Communications had three ministers. This shows a political inconstancy motivated initially by the impeachment of the president of the republic in 2015 and by other factors related to corruption. It should also be remembered that the political situation in Brazil was considered by all the respondents of the questionnaire and by 73% of the interviewees as an element in the country that could limit cooperation between the two countries. In India, the political situation was considered as an element that could promote such cooperation.

Other elements, among the ones most cited by the research participants as limiting factors, are the cultural aspects and the need to follow up agreements and memoranda once there are signed. It is worth mentioning the economic and social inequality here. The percentages related to this element were shown to be divided, since, while the interviewees considered this element a limiting factor, the Indian respondent considered it an element that promotes cooperation. Half of the Brazilian respondents believe that this element promotes it.

It can be seen that economic and social inequality can be an obstacle to cooperation in renewable energy between Brazil and India or an incentive depending on the point of view adopted. It is worth noting that for 48% of the Brazilian respondents and for the Indian respondent, sharing challenges and common issues increases the possibility that the two countries can cooperate with each other. And economic and social inequality is a common challenge for both countries.

The number of patents on renewable energy belonging to rich or developed countries was considered a threat to cooperation between Brazil and India. It is implied that, for the participants of the research, this element is seen as a promoter of cooperation amongst the developed countries, holders of a certain technology; and the developing countries, that may want to specialize in a certain area in which the developed countries are a reference.

6.3 ELEMENTS THAT CAN PROMOTE BRAZIL-INDIA COOPERATION

The size of the Brazilian market, the size of the Indian market and the development of the domestic market in renewable energy in both countries were also considered as elements that could contribute to the cooperation between the two countries. Considering the potential to be explored both in Brazil and in India with regard to solar and wind energy, it is clear why these elements are among the most chosen by the participants of the research. The institutions in each country were also considered as one of the elements that can contribute to the cooperation between the two countries.

The country's experience in the use of technology in the field of renewable energy, evidenced especially by the interviewees and the Brazilian respondents of the questionnaire, was highlighted as one of the elements that can contribute positively to the cooperation in renewable energy between the two countries. Let us recall one of the statements of one of the interviewees who said that one of the strategies for finding partners is the choice of countries that are references or that have advanced knowledge in a given area. It is not by chance that the technical training of participants in the cooperation process has also been considered as an element that can promote cooperation between the two countries. Technical training in renewable energy was also considered as a factor that can contribute to cooperation between Brazil and India in the area of renewable energy.

Although primary research has pointed out that Brazil and India should cooperate bilaterally, establishing partnerships with a third country that can play a catalytic role in the cooperation process between the two countries was also pointed out as one of the elements that can help promote cooperation between the two countries under study. The presence of a third country with experience in the field of renewable energy as a catalyst in the cooperation process, to some extent, implies that the participation of a developed country may be relevant to the cooperation between Brazil and India.

The respondents and the interviewees considered innovation as the element that can contribute to cooperation between Brazil and India. It can be emphasized that the participants also pointed out the number of patents and the number of BRICS publications in renewable energy as opportunities to expand cooperation between Brazil and India. In addition, the number of patents on renewable energy of the developed countries was considered a threat to this cooperation.

The increase in domestic consumption of goods which implies a higher consumption of energy has also been chosen as an element that can promote cooperation in order to meet the increasing demand for energy and also to reduce CO_2 emissions, which has been increasing systematically in both countries over the years. The need for CO_2 reduction and participation in joint multilateral groups were two of the elements unanimously identified among the interviewees and the questionnaire respondents as those that can contribute to the cooperation in renewable energy between the two countries under study. Two other elements cited were environmental diversity and territorial extension, certainly for the recognition of these countries as those among the largest in territorial extension and with greater biodiversity.

It was not surprising that the existence of renewable energy policies, investments in renewable energy, signed memoranda and agreements and the need for a clear definition of commitments and targets in the agreements and memoranda were also highlighted as elements that could help promote cooperation in renewable energy between Brazil and India, for these two countries have been developing policies to promote renewable energy and increasing their investments in this area; in addition, they have signed three memoranda dealing specifically with renewable energy.

Bilateral trade, which is another element that can contribute to cooperation between Brazil and India according to the interviews and the questionnaire responses, has grown systematically over the last decade. However, all these initiatives have not yet been enough to turn cooperation between Brazil and India in the field of renewable energy into something more substantial.

It could be noted that the number of elements that can be opportunities for or promote cooperation between Brazil and India in the area of renewable energy have surpasses the number of limitations. This does not mean that the way to expand cooperation is easy, for elements which are considered promoters, such as the existence of renewable energy policy, can not function as an element that promotes cooperation between the two countries if there is no political dialogue between these countries.

In addition to seeking to identify the elements that can promote, be an opportunity for or a limiting factor for the cooperation between Brazil and India, strategies were designed that could help to increase this cooperation, which were exposed both in the questionnaire and in the interviews so that the position of respondents and interviewees about them was known. It is worth remembering that in both instruments of data collection, a space was made available so that the participants of the research could, if they wished or thought necessary, also suggest propositions. Strategies are considered ways for cooperation in renewable energy between Brazil and India to be expanded. That is what the next section is about.

6.4 BRAZIL AND INDIA: STRATEGIES TO EXPAND COOPERATION IN RENEWABLE ENERGY

The strategies presented here were based on the difficulties encountered during the research that resulted in this thesis and elaborated from the data presented in Chapter 5. It should be emphasized that both in the questionnaire and the in interviews, there was a question about propositions to increase cooperation in renewable energy between Brazil and India, in which a blank space was provided in case participants wanted to suggest something. Initially, of the propositions presented in the questionnaire and in the interviews, the two most chosen ones would be the base for the strategies presented in this section. However, after the data treatment, it was verified that two of the suggested propositions were chosen by the same number of participants of the research. Thus, it was decided that these two propositions and the most chosen proposition would support the strategies presented here.

Two of the propositions placed as alternatives in the questionnaire and in the interviews were not among the most chosen ones. One is the creation of an integrated virtual research platform between government institutions and universities. This idea, to a certain extent, was contemplated in the first proposition presented in subsection 6.4.5, which includes the participation of companies in the creation of this platform, which would not only involve governmental institutions and universities.

In addition, the participation of the private sector was cited many times in the interviews as being important to expand cooperation between Brazil and India in the area of renewable energy. As for the other proposal not considered, it refers to the creation, in the plurilateral spheres, such as IBAS and IRENA, of a working group with the objective of promoting cooperation between countries. In addition to the fact that this proposal was the least chosen by the interviewees and the respondents, the researcher verified that there are already many thematic working groups in these spheres and the creation of another working group would certainly not have such a significant impact. Most certainly, these groups are useful for identifying and bringing together the common interests of countries and for stimulating cooperation among them. In order to justify this proposition, it would be necessary to map not only all the existing working groups of which Brazil and India are part of, but also the results of their actions to stimulate or promote cooperation in renewable energy. However, such mapping was not performed due, in particular, to the time horizon established for conducting the research.

6.4.1 **Creation of a Data Repository**

The first strategy is to create a common data repository for Brazil and India so that the memoranda and agreements as well as the cooperation projects resulting from these international acts signed between them in the field of renewable energy can be followed up and monitored. The need to propose the creation of this repository was clear from the difficulty that the researcher found to collect the data referring to agreements and memoranda signed between the two countries.

Brazil's Consular Integrated System (SIC) is a useful tool for seeking agreements between the two countries because it contains all the agreements signed by Brazil since 1823. However, in India, no similar tool was found. A search was made on the websites of the ministries related to the research theme that gave rise to this thesis, and 10 signed agreements were found between India and Brazil and other documents involving the two countries, which made research tiresome and time-consuming.

The SIC also presents its difficulties, already discussed in section 5.1. One of them is that it is not enough to just read the title to know what the international act is about: it is necessary to access the document and read it. In addition, the international acts available to the public in the SIC, when crossed with those that were collected during the visit paid by the researcher to the MRE, showed incongruity, that is, some acts that appeared in the previous research were not in the research done during the visit to the MRE and vice versa.

During the search of the international acts signed between the two countries, it was found that the information on the agreements and the memoranda and on the actions after the signatures of these international acts are not easily located in the ministries. After all, even the ministries’ employees themselves do not have all the data on the agreements and memoranda in the government sphere, and often do not even have in their database a copy of the agreement that generated a particular project. This shows a fragility of the system.

In view of this, the researcher decided to probe, both through the questionnaire and through the interviews, if these difficulties could lead to a strategy for cooperation between the two countries in the area studied. To this end, interviewees and respondents were asked to choose, among some propositions presented, the one they considered most important in order to increase cooperation in renewable energy between Brazil and India. Among the different proposals presented, the creation of a database to follow up the memoranda, agreements and cooperation projects between Brazil and India was among the most chosen by interviewees and respondents.

Other responses provided by the interviewees and by the respondents helped to reinforce the idea of proposing the creation of a data repository. One of these is the need to follow up the agreements and memoranda after its signature, since non-monitoring was pointed out as a barrier to cooperation between Brazil and India in the area of renewable energy. Another response was the need to follow up all the post-signatures actions of the memoranda and agreements through working groups as a way to help trigger concrete actions stemming from the international acts signed between the two countries.

It was therefore decided to propose the creation of a data repository to do the follow up of agreements, memoranda and cooperation projects in renewable energy. We have just changed the name of "database" to "data repository" because "repository" conveys not only the sense of data repository, but also the sense of a portal, that is, a space in which to insert and to check information.

The data repository would be created within the ministries of foreign affairs of Brazil and India, in which the agreements between the two countries are initially concluded and in which, at least in Brazil, there is already a base on which agreements signed by this country are kept. The idea is that, in addition to the provision of the international acts signed by Brazil and India in the area of renewable energy, there would be, for each act signed between these countries, a summary with the keywords to facilitate the search. Access would be made available within the ministries of foreign affairs in the energy and renewable energy sectors and by the respective sectors dealing with Asia and Latin America in each country. In addition, the data repository would be made available to the respective cooperation agencies of Brazil (ABC) and India (DPA).

The data repository should also include the ministries responsible for the actions or projects triggered by the agreements signed at the governmental level so that these institutions carry on the follow-up of these agreements, inserting in the repository information and data about the actions developed after the signatures of the memoranda and agreements. These institutions would be the Ministry of Mines and Energy (Brazil), the Ministry of New and Renewable Energy (India) and the ministries of science and technology of both countries.

An example is useful to illustrate how this repository would work. Consider the case of the joint call for research projects mentioned in section 5.1 of the previous chapter by the Ministry of Science, Technology, Information and Communications (Brazil) and the Ministry of Science and Technology of India through the National Council for Scientific and Technological Development and the Indian Science and Technology Department, which supported projects in various thematic areas, including renewable energy. These ministries would be responsible for inserting in the "Brazil-India data repository" the project call announcements and data about their progress and their conclusion.

The suggestion is that this data repository be developed and created through a partnership or a cooperation project between the Federal Data Processing Service in Brazil and the National Informatics Center in India, which are the responsible government institutions for developing solutions in the area of information technology that enable the strategic actions of these countries in the most diverse areas. The creation of this repository, besides facilitating the organization of the already existing data about the international acts signed between the two countries and the access to them, will help to make the process of cooperation in renewable energy between the two countries more transparent and, of course, less bureaucratic.

In addition, the creation of the repository will help to minimize another barrier raised by primary research: the need for institutions involved in international actions to have a greater commitment. After all, the fact that all institutions involved in the cooperation process have access to the data repository can create a monitoring environment, which will stimulate the collection and development of concrete actions.

6.4.2 Modification in the form of elaboration of the international acts to be signed between Brazil and India in the area of renewable energy

The second strategy for expanding cooperation proposed here refers to the way in which memoranda and agreements are drawn up. Without entering into the merits of the legal discussion on the difference between agreement and memorandum, it is known that both are instruments of international law. However, the memorandum can be defined as an act of lesser formality than an agreement, not binding the parties involved with legal obligations. It is a pre-agreement.

From the data obtained with the questionnaire applied and the interviews, the need for a clear definition of the commitments and targets to be established in the memoranda and agreements signed in the area of renewable energy between Brazil and India was stressed. Even in the Agreement on Scientific and Technological Cooperation which does not specifically address renewable energy, although this theme is one of its main objectives, there are no bonds or financial commitments defined and established.

In a publication on India and its relationship with Latin America, the Inter-American Development Bank also highlights the need for change in the drafting of memoranda (MOREIRA, 2011). This institution says that they have been the preferred vehicle in the cooperation initiatives between Brazil and India, but lack specific and clearly outlined obligations, which has generated years of delay.

The second proposed strategy for expanding cooperation between Brazil and India in the field of renewable energy is the insertion of the financial commitments that the two countries must make and the targets they must reach in an established time horizon.

In this way, cooperation in renewable energy can benefit from a more solid institutional context that stimulates concrete actions in view of goals with deadlines besides the established financial commitments. This new structure in the memoranda and agreements would hold the countries accountable for the execution or development of actions concerning the memoranda or agreement signed.

6.4.3 Creation of a division to articulate the cooperation in the area of renewable energy

The third strategy for expanding cooperation between Brazil and India in renewable energy is the creation within BRICS of a "division" whose function is to articulate cooperation between the countries belonging to the group. The results of primary research have shown that the ideal way for Brazil to cooperate with India is bilateral. However, bilateral ties are strengthened by the participation of these countries in groups such as the BRICS, once the deepening of the dialogue on issues about the international scene or about ways to mitigate the challenges common to these nations shows the convergence of interests between them.

It is no coincidence that the joint participation of Brazil and India in multilateral groups was one of the three alternatives most chosen by the respondents and by the interviewees as elements that can promote cooperation between Brazil and India in the field of renewable energy. After all, the existence of common interests and common challenges facilitates dialogue in a number of areas including energy.

It is worth mentioning, for example, that BRICS continues to maintain its annual meetings since its inception, even with the slowdown in economic growth in Brazil and Russia. This shows that the group is not merely a meeting or a simple grouping of countries considered as emerging economies: BRICS is a political grouping. In addition, the analysis of the documents resulting from the summits showed that renewable energy are a priority area for the member countries of the group. Therefore, the idea of creating a division within BRICS to articulate cooperation among its member countries was presented to interviewees and respondents and was the second most chosen proposition.

The proposal is that this division articulates cooperation among the countries belonging to the group and that it is linked to the BRICS Bank or the New Development Bank (NDB). It would be composed of professionals from each of these countries who are specialists in the different types of renewable energy and who work in the economic area, in the socio-environmental area and in international cooperation. They would have the task of presenting at least one renewable energy cooperation project that included at least two of its members alongside in a rotation format with deadlines defined jointly by them. What is currently happening in the NDB is a loan for governments to invest funds in a given area. Therefore, in the strategy proposed here, the bank would finance directly these projects, from their elaboration to execution and monitoring, in partnership with a Brazilian institution and an Indian institution.

Financing these projects would not evidence a weakness in Brazil and India's argument regarding the discourse that emerging countries, by financing their own carbon emissions reduction through renewable energy projects, would not need to ask developed countries to help the financing of projects in this area or giving them more space to generate CO_2 emissions (as was raised by one of the interviewees). On the contrary, both Brazil and India would be showing their efforts to contribute to the reduction of these emissions at the global level and would be making efforts to enter the renewable energy promotion market, which is a path without a return, given the global need for reduction of CO_2 emissions.

6.4.4 **Strengthening scientific and technological cooperation**

Cooperation in renewable energy between Brazil and India can be enhanced by strengthening the scientific and technological development of both countries in the energy sources identified as the most likely for cooperation and by strengthening the scientific partnerships established between them. The results of the scientific and technological data mapping carried out for Brazil and for India in this area indicated in which areas such cooperation should concentrate. The data obtained with the application of the questionnaire and the conduction of the interviews brought some reflections so that this strategy could be proposed.

The scientific and technological data mapping showed the interest of Brazil and India for hydropower, solar energy and biofuels, because, in addition to the greater volume of publications found, these two countries also developed patents focusing on these types of energy sources. The data collected show three relevant facts: (1) Brazil has a vocation particularly in hydroelectricity and in biofuels; (2) India excels in solar energy; (3) these are the three energy sources in which Brazil and India most published in collaboration and more created patents.

Although India has more scientific publications on hydroelectricity than Brazil, since the 1970s, Brazil was already building world-class hydropower plants while India's largest hydroelectric power plant, which is six times smaller in terms of power generation capacity than Brazil's, took 28 years to build, quadruple of the time needed to build Itaipu.

Not surprisingly, the largest number of patents in Brazil focuses on hydroelectric power, which gives Brazil, compared to India, greater expertise in this area. In addition, the Brazilian electrical matrix has been essentially based on hydroelectricity for at least 45 years, despite creating, as a downside of this experience, dependence on a source of energy conditioned to meteorological conditions or on rainfall.

In relation to biofuels, India also had a larger number of publications than Brazil. However, it should be emphasized that the scientific production on this type of renewable source is the one that represents the largest volume of scientific production in Brazil.

With respect to the number of patents on biofuels, Brazil has proved superior to India. This is not by accident. After all, the first policy in the area of renewable energy established by Brazil occurred in the area of biofuel, twenty-three years before India established its first policy to promote renewable energy. In addition, the flex engine used in Brazil also have global recognition, especially considering the software created in Brazil, which makes it possible for vehicles run on alcohol, gasoline or any mixture of the two fuels. Brazil also launched the biodiesel program, which contemplates the mixing of biodiesel in diesel oil. Recently, Brazil launched the Biofuture platform with the objective of promoting biofuels in the global market. In short, Brazil has more expertise than India in the area of biofuels.

Regarding India, the results of the scientific and technological data mapping show solar energy as the highlight. Approximately 84% of all scientific publications on solar energy in Brazil and India are Indian. This energy source also concentrated the largest number of patents filed by India. This is due to some facts. India has adopted the goal of reaching 100GW of solar installed capacity by 2022 to become a leader in this area. In addition, the Indian Government has established a policy to support the set targets and intends to produce components and increase investments in research and development in the field of solar energy. It is noteworthy that India created, four years ago, the National Institute of Solar Energy, with the expectation of becoming one of the main global centers of research in the area of solar energy. Also, India created the Solar Alliance in 2015, bringing together several countries with the goal of promoting solar energy.

The results of the research, especially the results of the primary research (through questionnaires and interviews), corroborate the data found in the data mapping. For the respondents of the questionnaire and for the interviewees, cooperation between Brazil and India is most likely to happen in biofuels and solar energy. Even during the interviews, the discussions focused mostly on these two sources.

With regard to partnerships in scientific production in the field of renewable energy, let´s bear in mind that, despite the fact that Brazil cooperates with fewer countries than India, Brazilian production is more internationalized than Indian production. 45% of Brazilian scientific output was the result of scientific collaboration, while in India this percentage was 29%; despite being smaller than India in terms of number of publications and, though, India has established partnerships with 137 countries in its publications (Brazil has established partnerships with 117).

Brazil is India's main partner in Latin America, India is Brazil's main partner in Asia and these countries cooperate with each other in publications on all types of renewable energy surveyed. Nonetheless, the representation of this partnership is still small. In percentage terms, the collaboration with India represents approximately 1% of the total Brazilian scientific production. For India, collaboration with Brazil represents approximately 0.5% of its scientific production on renewable energy. The main countries with which Brazil and India collaborate with are developed ones: Brazil's collaboration with the United States, for example, is greater than the partnership between Brazil and Latin American countries. The United States is also India’s largest partner in its scientific production.

There are more than one way to expand scientific cooperation in the field of renewable energy between Brazil and India. One is the strengthening of dialogue between the two countries in the field of solar and biofuel sources by the intensification of partnerships in scientific production in these themes, by increasing the bonds between the scientific communities of both countries and by fostering means of collaboration among their research institutions. This could be done, for example, through the increase of joint projects that could be financed by both governments and private initiative (of Brazilian and Indian companies that work in the energy sector or want to expand in this area), with the creation of research focusing on Brazil-India cooperation in renewable energy in Brazilian and Indian research centers.

The other way to expand scientific cooperation in the area of renewable energy between Brazil and India is the exchange of researchers. Given the potential of Brazil in the field of solar energy, Brazilian researchers could explore what has been developed at the National Institute of Solar in India, which would certainly be an important step to trigger new actions and partnerships between Brazilians and Indians. Under the Biofuture initiative, created by Brazil and ratified by India and other countries, an international biofuel fund could be created that could grant scholarships to researchers in Brazil and India and finance research related to second generation biofuels and top notch technologies in the area of biofuels and to the process of engine conversion, for example. The joint action of the Brazilian and Indian scientific communities can generate solutions that become references and expand the development of innovative products through the creation of patents, for example.

6.4.5 **Creation of an integrated virtual research platform**

The creation of an integrated virtual platform connecting companies, universities and governmental institutions was the most chosen proposition in the primary research as one that can help expand cooperation between Brazil and India.

The idea of proposing this platform arose during the elaboration of the section dealing with the scientific and technological data mapping of the two countries, in the face of the Brazilian and Indian fall in the ranking that measures the impact of science in the world published by the journal Nature. The platform would be a way to bring together the private sector, universities and government institutions of the two countries in the area of renewable energy as a stimulus to increase their scientific and technological output.

The idea behind this strategy is that the platform be created by a group formed by the Brazilian and Indian Ministries of Science and Technology, the Ministry of Mines and Energy of Brazil and the Ministry of New and Renewable Energy of India and by Brazilian and Indian professors and researchers working on renewable energy themes and Brazil-India relations, as well as the Brazil-India Chamber of Commerce. The specific objectives of the platform will be to share information about the energy, cultural and business profiles of the two countries; connect scientists, researchers, entrepreneurs and policy makers by engaging partner institutions in the platform; create an interdisciplinary environment for the development of joint projects; share what is being developed in partnership between Brazil and India in the business sector; to share the renewable energy policies that the two countries have been developing over the years; share what has been done by the two countries in relation to the scientific and technological production in the area of renewable energy including work in partnerships; share opportunities for fellowships and joint research between the two States; and to promote online courses and lectures especially in the areas of renewable energy and in the cultural area.

6.4.6 **Intensification of the political dialogue on renewable energy between the ministries concerned**

This thesis presents the main policies in renewable energy established by Brazil and India over 43 years comparing them within the scope of their objectives and showing similarities found between them and on which renewable energy sources they focus. The Brazilian and Indian interest in the sources of biofuels, wind energy, solar energy and hydroelectricity were pervasive. In the policies analyzed, there was also the stimulation of international cooperation.

Primary research has shown that the creation of renewable energy policies is essential to support the cooperation process and that similarities between policies in this area can greatly contribute to facilitating the process of cooperation between the two countries. After all, as one interviewee pointed out, they indicate a convergence of interests and of common challenges.

The prospects of success for cooperation in renewable energy undoubtedly depend on the process of dialogue and political collaboration in the construction of memoranda and agreements. But, of course, that alone is not enough. Thus, intensifying the political dialogue between the Ministry of Mines and Energy of Brazil and the Ministry of New and Renewable Energy appears as fundamental to expand the cooperation in renewable energy between these two countries.

The idea of this strategy is that the renewable energy policies that were created, developed and implemented nationally in Brazil and India can be discussed by both countries through the creation of a renewable energy agenda to be established by the two countries through videoconferences or face-to-face events in which each country would present a policy or action triggered by it, successful cases involving the development of these policies as well as the challenges in their implementation. In addition, the suggestion is to promote the exchange of employees among the ministries aiming at not only the *in loco* study of the experiences of each country in the area, but also create opportunities for real practices or exchange of experiences such as trainee programs.

The implementation of this strategy is important because the diffusion of technical knowledge regarding these policies in both countries may be the basis of new ideas, new projects and new possibilities for interaction in the field of renewable energy.

6.4.7 **Brazil and India cultural approximation**

Brazil and India scientific and technological approximation will undoubtedly collaborate to promote dialogue between the two States and is closely related to another strategy to increase cooperation in renewable energy between the two states: cultural approximation.

To increase cooperation, it is necessary to know the reality of the country with which one cooperates or intends to cooperate. Knowledge about a country also helps to diversify the areas in which one can cooperate. Cultural differences were cited in the primary research as an element that may limit cooperation in renewable energy between Brazil and India. One interviewee stressed that cultural differences are not a limiting factor, but what actually exists is mutual ignorance, from Brazil to India and vice versa; and because of that opportunities to cooperate in the field of renewable energy may not be explored.

An example may illustrate this lack of knowledge about countries. According to data from the National Council of Scientific and Technological Development of Brazil between 2006 and 2015, 10,335 Brazilian students (doing doctoral, postdoctoral and senior training) went to the United States while only seventeen Brazilian students went to India in the same period. Of course, ignorance about a country may generate a lack of interest in knowing the opportunities it can offer. In other cases, this lack of knowledge can stimulate scientific or economic curiosity in researchers, students and entrepreneurs seeking new research or investment opportunities. It should be noted that the fact that developed countries have an advanced scientific and technological production and numerical representation also contributes as a factor of attractiveness to these countries.

In this context, Edgard Leite (2014) suggests that the process of internationalization of universities in Brazil and India should be stimulated in the same way as in the central countries, that is, reinforcing the importance of knowing new cultures and the experience of plurality. In the case of these two countries, this reinforcement would be through a university policy focused on relations between the countries of the South, which would help to promote the exchange process among them. However, what appears to be happening in Brazil and India is an underutilization of South-South collaboration as a tool to address common problems and opportunities for cooperation between the two countries, not only in the field of renewable energy but also in other areas.

Brazil has an agreement in the cultural area with India and, under this auspices, four projects were carried out and finalized in 2014, as mentioned in chapter 5. What represented an initiative by the Brazilian and Indian governments needs continuity. Therefore, the promotion of debates, seminars and other events on Brazil-India relations would help to stimulate the rapprochement between the two countries.

The creation of a Brazilian cultural center in the Indian capital would not only help to increase the knowledge of Indians about Brazil, but also to hold events and seminars on the cultures of the two countries. Recently the University of São Paulo held a meeting to discuss how to expand cooperation between Brazil and India, focusing on the business sector, and the First Brazil-India Conference on Research in Journalism. The Indian Studies Program of the State University of Rio de Janeiro also presents itself as an important space for a greater integration of Brazil-India relations.

These are examples of important initiatives that begin to form part of the academic set of actions of Brazilian universities, which contribute not only to the promotion of the debate on Brazilian-Indian relations, but also to stimulate new opportunities to emerge from these events.

6.4.8 **Promoting the Brazilian business sector in India and the Indian business sector in Brazil**

Promoting Brazilian companies in India and Indian companies in Brazil is another strategy to be adopted so that cooperation between these two States in the area of renewable energy can be expanded. As noted by one of the interviewees, the presence of Brazilian and Indian companies in both countries facilitates dialogue among entrepreneurs, researchers and authorities in Brazil and India, contributing to increase cooperation in renewable energy, even if these companies are not necessarily in the renewable energy sector. As another interviewee put it, government creates the environment and gives the signals, which enable the private sector to play an important role in the cooperation process. In addition, the Brazilian and the Indian business networks were both considered important elements for promoting cooperation in renewable energy.

In order to increase the participation of the business sector in the expansion of cooperation in renewable energy between Brazil and India, it is necessary to promote business forums for entrepreneurs and opportunities for them to visit bioenergy plants in Brazil, solar parks in India and the research centers of both countries that work with these energy sources. It is worth mentioning that, among developed countries, the participation of the private sector in national R & D activities accounts for 50% of the financial contribution and this is important for scientific and technological development (GURUZ, 2008), as well as increasing the chances of partnerships.

This points to one of the barriers to cooperation in renewable energy between Brazil and India as evidenced in primary research: the need for both countries to increase their investments in science and technology. This means that expanding cooperation becomes more difficult as long as there is such a need, as it implies the existence of low levels of investment in science and technology. It is important then that the government and the private sectors of each country seek to understand, when it comes to internationalizing in the South context, the interests of Brazilian and Indian companies in the area of renewable energy and what strategies they would adopt in this regard. After all, would a company in the Indian solar sector, for example, have an interest in investing in Brazil in view of the market to be exploited in India? Would it be more advantageous for a Brazilian company to enter the Indian market by partnering with an Indian company rather than going into that market alone?

Greater participation of Brazilian companies in the Indian market and Indian companies in the Brazilian market is also fundamental for the diversification of products traded between Brazil and India, since "trade encourages cooperation and cooperation creates new opportunities for trade "(MOREIRA, 2011); though trade between the two countries has grown steadily, it is essentially based on the oil sector. Partnerships between companies from Brazil and India with research institutions in these countries can trigger the discovery of new business opportunities as well as generate partnerships in the development of products in the form of patents.

To finish this chapter, it is worth emphasizing that in the interviews it was suggested that the number of joint projects between the two countries be intensified, that visits and exchanges programs in the areas in which the two countries stand out be promoted, and that cooperation between the two countries in the area of innovation is promoted. These suggestions were considered in the elaboration of the presented strategies.

The strategies were proposed based on the interest of Brazil and India in building a closer relation in the field of renewable energy. This interest is evidenced, particularly and formally, in the establishment of memoranda and agreement between the two countries. The results found made it possible to propose strategies to increase the cooperation between the two countries insofar as the data obtained by the analyzes made possible to create a basis for such strategies.

It is necessary to emphasize that the presented strategies are not an end in themselves, but the beginning of a way to promote the cooperation in renewable energy between Brazil and India. In addition, future studies, such as those suggested in the next chapter, can contribute to the development of these strategies or even generate new ideas to expand cooperation between the two countries.

7 FINAL CONSIDERATIONS

A beginning. This is how this chapter crosses the lens of the one who writes it with the arduous task of finishing this work. The marriage of curiosity, the scientific gap and a dose of adventure does not end with a conclusion, but with a new path to walk. This is the scientific spirit.

The research was done through an interdisciplinary trajectory weaving an innovative plot since it combined the theme of renewable energy with the theme of cooperation between two singularly diverse countries: Brazil and India. The scientific gap found at the beginning of this paper was taken as a challenge. This is due to the fact that the scarce literature on the subject, while being an opportunity for the scientific contribution of this work, brought some difficulties since there were no parameters or a scientific basis from which to start the search. After all, what does a researcher do but get out of a comfort zone? What drives a researcher but the desire to contribute with something, even if it is only with a drop in the immensity called knowledge?

In addition, the research area was also a novelty for the researcher, particularly because her unique experiences with the energy theme had been, tangentially, in her master's degree and during her stay at the United Nations University during a probationary period during a course on global governance held in Germany. The researcher also had to delve into this more Cartesian universe and seek to answer seemingly simple questions like "what are biofuels?", "What is energy security?" And "how the choice for cooperation between countries in the energy field can contribute to the balance of the global energy system?”

The methodological effort was made especially in the application of a questionnaire and in the carry out of interviews with the objective of obtaining data that could serve as a basis for the elaboration of strategies that can contribute to broaden the cooperation between the two countries under study. One may recall here the need evidenced in a publication by the Inter-American Development Bank (MOREIRA, 2011, p.91) that the effort to collect data, given its scarcity, would be useful both to Brazil and to India so that they could "design more efficient cooperation mechanisms to optimize the use of scarce resources".

Maurício Moreira (2011) further states that one of the few data collections and quantitative assessments made in this regard was a study of the number of articles produced in partnership between India and Latin America between the 1990s and 2000s. According to the author, such measures are fundamental for the understanding and evaluation of international acts that have been signed by India and Latin American countries over the years.

The problem that led to the research was precisely to find out how it would be possible to contribute to extend cooperation in renewable energy between Brazil and India since such cooperation is still incipient. In order to respond to this questioning, a general objective and seven specific objectives were set, all of which were met.

The first specific objective was reached as the energy profiles of the two countries were presented, compared and contextualized in the development of renewable energy around the world. This made it possible to highlight the needs and potential of these countries as well as their investments in renewable energy.

The second specific objective was also met. It was possible to identify how many international acts Brazil and India jointly signed in the field of renewable energy showing the interest of these two countries to cooperate in this area. Here too it went beyond what was initially expected. Declarations of the Joint Commission on Political, Economic, Scientific, Technological and Cultural Cooperation of Brazil and India signed since 2009 and the first IBSA and the BRICS summits were mapped and studied to see whether there was, expressed in these documents, an interest in cooperating in the field of renewable energy. This was corroborated.

The third specific objective was also reached as it was verified that Brazil and India had established policies in the field of renewable energy, the main policies they have established in this area and the similarities between these policies in relation to type of energy and established actions.

Another objective reached was the carry out of the scientific and technological mapping of Brazil and India to verify on which type of renewable energy the scientific communities of these countries focus their interest, in what type of renewable energy they have expertise and which partnerships they have been developing in the scientific field.

The fifth specific objective, also reached, was to verify and compare the competitiveness indicators and the problematic factors for doing business in the countries under study as a support to identify elements that may or may not contribute to the cooperation in renewable energy between Brazil and India.

The objective of identifying the barriers or constraints and elements that contribute or are opportunities for cooperation in renewable energy between Brazil and India was achieved thanks to the data collected through the questionnaire and interviews.

It was possible to contextualize Brazil and India in the sphere of energy cooperation concluding that the Indo-Brazilian relations had more advances in the last twenty years than in the decades between 1948 and 2000, the year in which their bilateral relations were established. Despite of it, the cooperation in renewable energy between both countries showed incipient. Meeting specific objectives made it possible to propose strategies to contribute to extend the cooperation in renewable energy between Brazil and India. We were thus able to respond to the problem that gave rise to the research.

Although the results of the research provided important subsidies for the study of renewable energy cooperation between Brazil and India, it also presented difficulties and limitations. Obviously, it is necessary to accept the choices made as part of the process of building knowledge. Therefore, difficulties and limitations can be seen as stimuli for conducting new research.

The scientific gap was undoubtedly an opportunity for this work to fill this void with a study that addresses the cooperation in renewable energy between Brazil and India. The gap to be filled with specific work on cooperation between Brazil and India in renewable energy coupled with the scarcity of studies on Indo-Brazilian relations as well as studies on cooperation in renewable energy, particularly among southern countries, proved to be a challenge.

Data collection through the questionnaire was a difficult task, especially among Indian respondents. From the total of the questionnaires sent to the Brazilian respondents only one was not answered. However, it should be noted that the responses were not sent back promptly, which caused the researcher to send reminders to those who had not yet responded, which took some time. As for the Indian respondents, as soon as the questionnaire was sent, a response was received in about a week, which generated a great expectation in the researcher.

However, this initial expectation turned into a big headache because, despite the fact that the response received was from one of the heads of the three divisions to which the questionnaire was sent, the other answers did not come. For this reason, it was sought to contact people who had not yet responded to the questionnaire through their e-mail addresses and through Indian professors who volunteered to help by sending messages to the division heads asking them to have the questionnaire answered. One of the professors even made two of his students available to arrange a time with the Indian Foreign Ministry and go there personally to apply the questionnaire, but despite the insistence that lasted months, only promises were made. This caused a delay in the schedule foreseen for the research. Possible reasons for the difficulty in obtaining a return of the questionnaire from the Indians were already given in Chapter 5.

Thus, the fact that only one Indian answered the questionnaire did not allow the statistical treatment of the data provided by the Indian respondent; something that was only possible with the data provided by the Brazilian respondents.

The interviews also presented difficulties. One was the obvious fact of depending on the availability of other people's schedule. No matter how great the interest of the people in collaborating, which the researcher considered an extremely positive fact, the interviewees' schedule was not always able to match with what had been agreed in terms of dates arranged. Thus, some interviews had to be canceled or rescheduled. Another difficulty was the duration of the interview: some interviewees granted more time; others, with a tight schedule, provided less time for the interview. Another difficulty was the impossibility of carrying out all the interviews face to face. These difficulties made some interviews more detailed than others.

Still regarding interviews, another difficulty can still be mentioned. The researcher realized that some interviewees were afraid to answer certain questions because of the possibility of their answers having some implication in their work environment. One fact, already reported, that demonstrated this was the case of the interviewee who asked to cancel the interview because, due to the political scenario in Brazil , he did not feel comfortable to express some opinions that he had voiced. Thus, not all interviews could be validated.

During the research, the idea of a sandwich doctorate was considered. The researcher received a letter of acceptance from a German institute, but it was then considered that the ideal was to go to India. A research project was prepared and submitted to an institution of the Brazilian government that finances this type of study. The researcher had already been accepted by the professor and director of the Institute of Bioresources and Sustainable Development (IBSD) in India. Despite the attempt, due to a political and economic crisis that occurred in Brazil at that time, the government canceled the analysis and judgments of the submitted projects. Even so, the researcher decided to make a visit to the Indian capital to have the opportunity to at least, within what was possible, have a closer contact with the reality of India. The IBDS director gently met the researcher in New Delhi and offered her accommodation and local transportation if the researcher wanted to return and develop part of her studies in India, but the researcher's lack of own resources at the time did not allow her to accept the proposal. Almost a year after receiving the first response regarding the research project submitted to the institution of the Brazilian government that grants scholarships to university students, the researcher got an answer from the institution expressing that, if she wanted to submit a new proposal, there was already a new calendar and funds available. However, there was no time for such an attempt. The possibility of a sandwich doctorate could have brought other data, other analysis to the research whose results are presented here.

Another difficulty for the research was the fact that the research object was occurring. And analyzing something that is happening is not simple. Interviewee 3 made an important comment regarding this fact: this thesis presents a pioneering research, and to think of ideas to extend cooperation between Brazil and India is very challenging because "all this is happening, the question is that your research is so contemporary, so current, so now ... and this is all very stimulating".

As underlined in the theoretical framework, a few decades ago, it was not even possible to imagine the representativeness that Brazil and India could acquire in the political and economic world landscape. Thus, the comprehension of contemporary global challenges also involves the contextualization of these two nations, which have become relevant voices in the energy area, not only because of their characteristics, but also because of their respective needs and potentialities.

Although the bilateral relations between Brazil and India celebrate their 70th anniversary in 2018, they began to evolve essentially with the arrival of the new millennium. In renewable energy, there is a formal and mutual interest in establishing cooperation in this area. Let´s recall that efforts to promote cooperation in renewable energy between the two countries began to intensify from 2002 onwards with the signing of the first memorandum of understanding on biofuels. However, the results of the research showed that cooperation in renewable energy between Brazil and India may be considered incipient, since the memorandums, despite their signature, have not yet evolved to agreements in the area. In addition, cooperation in renewable energy still appears in the joint statements issued by the two countries as something to be explored, something with a future perspective. There is not even a scientific study on the subject of renewable energy cooperation involving the two countries.

Undoubtedly, promoting cooperation in renewable energy between Brazil and India is more than a strategy of visibility and a search for greater leadership in the political landscape of the South. It is the possibility of seeking joint alternatives to meet their energy needs in the face of requirements for CO_2 reduction, to increase their capacities in renewable sources in the face of increasingly restricted use of fossil fuels, to exploit their potential in renewable sources and to enhance their potential or their expertise by promoting scientific and technological partnerships.

Meeting these demands would also contribute to strengthening bilateral trade, as Maurício Moreira (2011, p. 145), chief economist of the IDB, in a publication on trade between India and Brazil recalled, "cooperation creates new opportunities of trade ". In addition, considering a broader context, Daniel Yergin (2006) asserts that energy interdependence between states requires cooperation between them in this area.

In this context, strategies have been presented as a way to contribute to the expansion of cooperation between Brazil and India in renewable energy. They are based on the data collected and on the interest of Brazil and India in tightening relations in the field of renewable energy. As mentioned in Chapter 6, strategies are just the beginning of a path. It should be admitted that new research, based on the issues indicated in this paper, can advance to face the challenges encountered.

Therefore, the need for further research has been identified, without the pretense that other studies or ideas not thought of can not arise. Suggestions for future studies can originate from three fields: business and trade, scientific and technological research, and politics.

In relation to the first field, business and trade, a study on the profile of Indian and Brazilian companies operating in both countries would certainly add to what is discussed in this thesis. The suggestion is to carry out a research that seeks to clarify what led these companies to expand their markets to Brazil (in the case of Indian companies) and India (in the case of Brazilian companies); determine the strategies they have used to settle in those countries; to verify if these companies have an interest in diversifying their investments in renewable energy projects; and to check the difficulties and opportunities encountered by companies already active in the field of renewable energy to establish themselves in Brazil or India. It would also be interesting to map Brazilian and Indian companies working in the renewable energy sector to know their interest in investing in research and development in partnership with government institutions and universities in Brazil and India. In addition, conducting a study on how to diversify the import and export network between Brazil and India and how renewable energy could contribute to increasing and diversifying this network would be relevant, since "trade stimulates the increase of cooperation" (MOREIRA, p. 92, 2011).

With regard to the field of scientific and technological research, it is possible to emphasize, initially, the suggestion of a study based on the opinion of one of the interviewees. This study concerns the social perception regarding renewable energy in Brazil and India, which would serve as a tool to learn the level of knowledge that the population of these countries has regarding renewable energy. Making use of a case study, a comparison could be made between two communities, one Brazilian and one Indian, which presented similar characteristics as the level of purchasing power and the lack of access to the traditional electricity in order to investigate how their members see renewable energy.

Something that could contribute to complement the research in this thesis would be a study by type of renewable energy. Hydroelectricity and wind energy deserve attention in spite of being the least chosen as the most likely sources of cooperation between the two countries.

The suggestion of a comparative study on the use of hydroelectricity in Brazil and India based on more than 112 scientific articles written in partnership between Brazilian and Indian researchers may help to find opportunities for cooperation between these two countries or to increase the knowledge of these countries in an attempt to overcome the obstacles identified in the development of these sources.

Such a study is justified for several reasons. Brazil is the third country with the greatest potential in this source. In addition, this country has the second largest installed capacity in the world and recognized experience in the construction of hydroelectric plants. The technological data mapping carried out in the research that originated this thesis showed that the largest number of patents on renewable energy in Brazil is concentrated in this source. However, the dependence of the Brazilian electricity matrix on hydroelectricity raises concerns, since this source of energy generation depends on hydrological conditions, which may not always contribute favorably to energy security in that country, as evidenced by the recent decrease of rainfall , which caused an increase in the use of thermoelectric plants. India, on the other hand, has the fifth largest water potential in the world and is the sixth country in installed capacity in that source, despite the fact that the percentages are still far from the Brazilian percentage in terms of potential and installed capacity. However, it is clear the Indian interest in diversifying its electrical matrix so that it can meet an increasingly growing demand is clear. In addition, as already mentioned, representatives of the Indian government and businessmen have already come to Brazil to learn about the Brazilian experience in the development of hydroelectricity.

Regarding wind energy, Brazil and India have also been increasing their respective capacities installed in this source, which allowed them to be among the ten largest in the world. In addition, in the last two years, this source, alongside with solar energy, has concentrated the largest investments in renewable energy in Brazil as well as in India. In relation to this source, one of the interviewees suggested a study that deserves to be mentioned in view of the potential to be explored by both countries: a study of the efficiency of wind farms in Brazil and India. It would be a comparative study of Brazilian and Indian wind farms to know if one is more efficient than the other and why. What motivated the interviewee to suggest this was a study that he carried out, without scientific deepening, which revealed that Brazilian wind farms would be more efficient.

Such a study could certainly stimulate Brazilian and Indian cooperation in this area. It would also be interesting to conduct research on how wind power could make up for a generation shortage of hydroelectricity during critical periods of rainfall.

Obviously, still emphasizing scientific and technological research by type of renewable energy, other studies can be developed, focusing particularly on those energy sources that this work highlights as those that would offer greater possibility of cooperation between the two countries. For example, a study could be conducted on solar energy presenting the profiles and characteristics for the development of this energy in Brazil and India. This study would be done by identifying the geographic areas with the greatest potential for the development of this type of energy, pointing out which technologies are most used in the solar energy area in these countries or which ones could be used. In addition, it could be explored how these countries could cooperate in terms of equipment and technical materials used by them in the development of solar energy. The same kind of study could be done in relation to biofuels. Still in relation to biofuels, another suggestion would be that of a study on other forms of biofuel production; for instance, the use of agricultural residues such as sugar cane bagasse and other materials and, considering the vast coastline that both Brazil and India have, seaweed.

Another study that can be developed concerns patents. It would be a research on the patents developed by Brazil and India that could study the similarities or the differences between the technologies patented with the objective of stimulating joint projects of cooperation between these two countries. One criterion to be taken into account in such a research would be, for example, the type of renewable energy source: a study of patents in this area would be carried out in Brazil and India, and the similarities and differences between patents would be analyzed, highlighting how one complements the other, which could stimulate joint cooperation projects.

Another study that could be carried out would be on the Brazilian and Indian electrical systems comparing them and studying opportunities for cooperation in this area between the two countries. The Indian electrical system suffers from problems with the intermittent supply of electricity.

In addition to being cited by one of the interviewees as one of the challenges to be overcome in India, the researcher could witness this during her visit to New Delhi, where she was able to see that, at certain times of the day, electric power was interrupted and the generators were automatically turned on to supply this lack of electricity; an event that the people with whom the researcher had the opportunity to interact with were already used to. Certainly a study could point out the weaknesses that the Indian system presents and in what ways Brazil, which has an allegedly less intermittent electrical system than India, could contribute by helping to answer questions such as how to insert the solar energy in an electrical system that presents intermittent problems in its network.

In relation to the political field, a more in-depth study of the renewable energy policies established by Brazil and India could be made comparing them and explaining the results obtained with the development of these policies. The study could be carried out considering policies focused on a specific type of renewable energy. This thesis presents the main policies established by the two countries in renewable energy and explains the similarities between them, which indicate a convergence of interests of Brazil and India both in relation to the types of energy and in relation to some actions carried out. However, a study to verify the differences or discrepancies between these policies and in what aspects they could complement each other would be very of great value.

It was not intended here to enter into the political issues of each country, but, through the scientific approach, present a study focusing on Brazil and India in the field of renewable energy and propose strategies so that the cooperation between these two countries in the area of energy can be extended. Therefore, other issues can be deepened and new studies such as the relationship between social inequality and renewable energy can be developed, and how cooperation in this area could contribute to mitigating this common challenge to the two countries studied. In addition, the relationship between corruption, bureaucracy and the process of cooperation in renewable energy in these countries can also be explored more closely.

Regarding the cooperation between Brazil and India in renewable energy, the lack of political will, though not among the elements most chosen by the participants of the research as a whole, represented the choice of more than fifty percent of respondents to the questionnaire applied in Brazil.

Although this element is not the only one, nor is it among the main elements pointed out by the primary research as those that may limit cooperation between the two countries, attention must be drawn to it, especially due to the lack of more concrete actions in the last years to strengthen the cooperation in this area between the two countries.

In this context, considering the intensification of the rapprochement between the two countries from the 2000s onwards, it should be noted that the political crisis experienced by Brazil in recent years, which included the impeachment of the then president in 2016, triggered a series of political and economic changes. One of these changes refers to budget cuts in a number of areas, including science and technology. It should be noted that for 55% of the Brazilian respondents in the questionnaire, the need to increase investments in science and technology is a barrier to cooperation between the two countries under study. However, if such investments are reduced in this area, consequently, the opportunities for conducting research aimed at improving the efficiency of certain renewable sources and also for new discoveries decrease. Another change concerns the substitution of ministers from both the Ministry of Foreign Affairs and the Ministry of Mines and Energy and the Ministry of Science, Technology, Innovation and Communications.

Certainly these facts were in the professionals' mind when they highlighted the lack of political will in the questionnaire applied in Brazil. It is no wonder that the Brazilian political scenario was considered an element that could limit the cooperation between the two countries in renewable energy by most of the participants of the primary research (interviewees and respondents of the questionnaire applied in Brazil and even the one applied in India). In this way, stimulating political dialogue in the area of renewable energy between the two countries, as well as greater participation of other spheres, such as the academy and the business sector in promoting renewable energy cooperation between Brazil and India, are essential to mitigate the barriers or limitations.

The scientific and technological world promoted by the academy and the private sector plays an important role in this context because both the academy and the private sector can stimulate the development of joint work such as the development of scientific articles and the creation of patents.

It can also be emphasized that the increase in the demand for energy in Brazil, and especially in India in the coming decades, must certainly contribute to replacing the lack of political will for the urge to meet their social, economic and environmental needs.

Other factors are also associated with the increase in energy demand and stimulate the development of more concrete actions in the field of renewable energy cooperation by the two countries under study, such as the deficit between energy production and consumption or the need to reduce CO_2 emissions.

Brazil and India have become, in different proportions, major energy consumers, ranking among the ten largest in the world. Although fossil fuels play a significant role in the energy matrixes of both countries, they have made efforts to increase the share of renewable sources in their territories. In this context, it should be noted that the deficit between Indian energy production and consumption is 50 times higher than the Brazilian one, evidencing that this country can not meet its social and economic demands in the energy area. Moreover, while almost the entire Brazilian population has access to electricity, millions of Indians do not have access to electricity or modern sources of energy, which has, for example, generated negative impacts on the health of its inhabitants.

Energy demand in Brazil and India will continue to rise, and the promotion of renewable energy in these countries, a reality without a return, will contribute to meeting the demands of the international community regarding CO_2 emissions or to reducing energy demand in a given source or to reducing their subjection to the geopolitics of energy, dependence on fossil fuels, or to exploiting their potential in renewable sources.

In fact, the two countries, especially since the 2000s, have been systematically increasing investments in renewable energy and their respective installed capacity in renewable energy sources. In addition, Brazil and India have established policies that support the development and promotion of renewable sources. Brazilian and Indian investments focused particularly on wind and solar energy, although biofuels and hydropower also have a representative share in investments. Brazil continues to play a significant role in the production of biofuels in the global sphere and, like India, aims to achieve the promotion of this source.

India, on the other hand, in recent years has taken a stand in solar energy with ambitious goals, including taking the lead in the initiative called Solar Alliance, which brings together more than 100 countries, among them Brazil. These actions from Brazil and India in an attempt to promote a more diversified energy matrix or with a higher percentage of renewable sources impact labor market, since both are among the ten countries that employ the most in the area of renewable energy in the world.

Cooperation in the field of renewable energy between Brazil and India can be considered incipient, but promising. For Fiori (1997), in addition to some degree of affinity between the two countries being important for the promotion of a process of convergence between them, this process can only exist from a political decision of their governments to act in a coordinated way. From the new millennium, Brazil and India have been attempting to get closer, taking advantages of their similarities, and using similar strategies to face common problems, whether through the participation of these countries in regional coalitions such as IBSA and BRICS, or through bilateral initiatives. Evidence of this are the needs and energy profiles of both countries connected to the international context of promoting renewable energy, the intensification of trade between them and the number of bilateral visits over the last few years, the establishment of policies in the area, the memoranda signed between the two countries, multilateral discussions, historical interest in common renewable sources and the discourses that have been aligned between the two countries in recent years to promote cooperation in this area. It should be noted that the presence of the State has been fundamental in the development of renewable energy, both in the creation of policies and in the promotion of investments and in the search for cooperation with other States.

The results of the research presented here, particularly those related to the memoranda signed between Brazil and India, the scientific and technological mapping carried out, the questionnaires and the interviews showed biofuels and solar sources as being those on which cooperation between Brazil and India can focus. In addition, it was noticed that the number of opportunities, of elements that can promote Indo-Brazilian cooperation in the renewable area were superior to those elements that can limit it.

However, this in no way means that the path to renewable energy cooperation is easy. On the contrary, what has been shown is that cooperation in renewable energy between Brazil and India is fertile ground, which implies exploring a range of possibilities.

Thus, the proposed strategies meet the objective of suggesting ways that can contribute to increase the cooperation in renewable energy between Brazil and India, reinforcing the dialogue between them. Actions parallel to the signatures of the memoranda and to the investments made in the area, for example, are relevant in order to broaden the process of cooperation between these two States. The effort to collect data, evaluate results, and increasingly make strong political and economic commitments would maximize cooperation between these two countries (MOREIRA, 2011).

Investments in the field of renewable energy can undoubtedly be synonyms with interaction and integration in the global market network, democratization and access to more efficient energy sources and knowledge in the field of renewable energy. These factors have implications for improving the quality of life of populations in Brazil and India. The present scenario does not have to be the one that will be left for the next generations. After all, there are opportunities so that the Indo-Brazilian cooperation in renewable energy can be expanded.

Brazil and India are countries that, considering their differences, be it the remarkable discrepancy between the total number of their populations, or the regional geopolitical scenario of which they are part of, have complex energy contexts because they undoubtedly reflect the diverse situations of their socioeconomic and environmental scenarios. In this web of interests, in this web of common challenges, renewable energy and cooperation between India and Brazil appear as irrefutable elements in the quest for knowledge, innovation, energy security and the improvement of energy consumption patterns in these two States, which meet on the path to balancing relations between countries in this multipolar world.

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APPENDIXS

APPENDIX A - TYPES OF RENEWABLE ENERGY AND THEIR CHARACTERISTICS.

Types of Renewable Energy	Characteristics
Solar	Energy from sunlight. It can be used directly for heating the environment, heating water and for the production of electricity, as a source of thermal energy, for heating fluids and places and for generating mechanical or electrical power. In addition, it can also be converted directly into electrical energy by means of effects on certain materials, including thermoelectric and photovoltaic.
Hydropower	Kinetic energy from the water bodies of the rivers, which flow from high altitudes to the seas. Water energy derives from the use of water for the production of electricity. It is energy with renewable characteristics. It depends on the water cycle.
Biomass	It is the chemical energy produced by plants in the form of carbohydrates through photosynthesis. Plants, animals and their derivatives are biomass. Its use as a fuel can be made in its crude form or through its derivatives. Wood or its residues, agricultural products and wastes, forest waste, animal excrement, charcoal, alcohol (ethanol), animal and vegetable oils (biodiesel), landfill gas, urban solid waste are forms of biomass used as fuel.
Wind	Kinetic energy of air masses (winds) is basically caused by uneven heating of the earth's surface by the sun. Because the surface of the Earth is made of different types of soil and water, it absorbs the heat of the sun at different rates. It is a renewable energy source and available everywhere. The use of this energy source for electricity generation on a commercial scale began in 1992 and, through knowledge of the aeronautical industry, wind power equipment has rapidly evolved in terms of ideas and preliminary concepts for high technology products.
Geothermal	Geothermal energy is the heat of the earth's interior. We can collect this heat as steam or very hot water and use it to heat buildings or to generate electricity. Geothermal energy is a renewable energy source because the heat is continuously produced inside the earth. People all over the world use geothermal energy to heat their homes and to produce electricity by digging deep wells and pumping heated groundwater or steam to the surface. People can also make use of stable temperatures near the surface of the earth to heat and to cool buildings.

Source: Pacheco (2006); EIA (2016b).

APPENDIX B – LIST OF PROFESSIONALS INTERVIEWED

Interviewees	
Name	**Professional information**
Aurobindo Xavier	Professor Ph.D. and President of the Lusophone of Goa (LSG).
Carlos Alexandre Principe Pires	Director of the Department of Energy Development of the Ministry of Mines and Energy (MME).
Dinabandhu Sahoo	Professor Ph.D of Delhi University and Director of the Institute of Bioresources and Sustainable Development (IBDS).
Edgard Leite	Professor and Coordinator of the Brazil-India Program State University of Rio de Janeiro (UERJ).
Elia Elisa Cia Alves	Professor of the Department of International Relations of the State University of Paraíba (UEPB).
Erik Ribeiro	Doctoral student in International Strategic Studies by the Federal University of Rio Grande do Sul and visiting researcher at the Institute for Defense Studies and Analysis in New Delhi.
José Antonio Perrella Ballestieri	Professor of the Department of Energy (Energy Engineering and Energy Planning) at the Paulista State University (UNESP).
K. P. Philip	Manager at the Indian Renewable Energy Development Agency (Ireda).
Leonardo Ananda	President of the Brazil-India Chamber of Commerce and the Honorary Consul General of India in Rio de Janeiro.
Mauro Donizeti Berni	Professor of the Interdisciplinary Nucleus of Energy Planning (NIPE) State University of Campinas (UNICAMP).
Nanda Kumar	Professor at the Energy Departament at Jawalarhal Nehru University (India).
Onkar	Technical Expert, Access to Energy/Indo-German Energy Programme at the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
Paula Rassi	Head of the Energy, Environment and Science Technology & Innovation section at the Brazilian Embassy in New Delhi, India.
Pedro Ivo	Head of the Energy, Environment and Science Technology & Innovation section at the Brazilian Embassy in New Delhi, India.
Prakash Chandra Maithani	Adviser/Scientist and Director at the Ministry of New and Renewable Energy (MNRE/India).
Rajendra Singh	Manager (Projects and Tecnologies Services) at the Indian Renewable Energy Development Agency (Ireda).
Sidhant Lalla	Bussiness Development at the SunAlpha Energy in India.
Sushant Kumar Dey	Assistant General Manager at the at the Indian Renewable Energy Development Agency (Ireda).
Tabea Von Frieling	Project and Energy and Energy Efficiency Manager and Sector Coordinator for German Cooperation (KFW in Brazil).

APPENDIX C – INTERVIEW SCRIPT

Interview Script

INTRODUCTION

This interview is part of a range of methodological tools adopted for a doctoral thesis developed at the Federal University of Bahia (Brazil). The general scope of the doctoral researchh is to propose strategies that could help Brazil and India to increase cooperation in renewable energy.

The main objective of this tool is to help identify barriers and opportunities, as well as to gather suggestions and proposals for cooperation in renewable energy between Brazil and India.

Your participation is critical to the success of this work. You will help to compose an essential part of the research in this pioneering work.

Your contribution is much appreciated, because you will be helping to share knowledge.

If you have any doubt or additional information about the questions, please e-mail to mcadmm@yahoo.com.br

Thank you for participating.

Interview Script

1. Please

Name

Company/Institution

Occupation

Education

E-mail

2. Would you tell us a little bit about your institution, mainly about the actions it develops linked to the theme of this research?

3.
Please select which priority level of your institution gives the following topics:

	No Priority	Low Priority	Medium Priority	High Priority
Renewable energy (ie solar, wind, hydropower, biofuels).	○	○	○	○
South-South cooperation (between developing countries).	○	○	○	○

Other (please quote, if any)/ Comments

4. Would you comment about your professional experience related to the subject of this research?

5.
Select the elements that could limit or promote cooperation in renewable energy between Brazil and India:

	Promote	Limit	No Impact
Territorial extension (to be among the top ten countries in the world).	○	○	○
Environmental diversity.	○	○	○
Unequal economic and social.	○	○	○
Participation in various multilateral groups (BRICS, IBSA, G-20, etc.).	○	○	○
Innovation (creation of patents, publications, etc.).	○	○	○
Access to financing.	○	○	○
Partnerships with a third country - experienced in the area of renewable energy, which would act as a catalyst for the cooperation process.	○	○	○
The increase in domestic consumption of goods, which implies higher production and an increase in energy consumption.	○	○	○
The need to reduce CO2 emissions.	○	○	○
Cultural aspects.	○	○	○

6.

Mark the elements present in your country that may limit or promote cooperation in renewable energy between Brazil and India:

	Promote	Limit	No Impact
Institutions.	○	○	○
General infrastructure.	○	○	○
Macroeconomic situation	○	○	○
Situation of basic and higher education.	○	○	○
Technological speed (speed of the country and its institutions to adopt and absorb new technology).	○	○	○
Size of the domestic market.	○	○	○
Sophistication of its market (quality and quantity of business networks within the country).	○	○	○
Regulations work.	○	○	○
Number of Tax.	○	○	○
Bureaucracy.	○	○	○
Corruption.	○	○	○
Political situation.	○	○	○
Public health situation.	○	○	○
The country's experience in applying technology in the renewable energy area.	○	○	○
The technical training of participants in the cooperation process.	○	○	○

7.

How should the Brazil-India cooperation, in the area of renewable energy, continue to develop?

- ◯ Bilateral.
- ◯ Multilateral.
- ◯ Trilateral.
- ◯ Through agreements between companies and without any participation of the state.

8.

If bilateral <u>was not</u> chose, please answer if, in the case of trilateral cooperation, the best option for the development of the cooperation in renewable energy between Brazil and India would be:

- ◯ With the participation of another emerging country belonging to the BRICS.
- ◯ With the participation of another emerging country other than the BRICS.
- ◯ With the participation of a developed and rich country.
- ◯ With the participation of a poor country.

9.

Please select the main barriers for cooperation between Brazil and India in the field of renewable energy?

- ☐ Lack of government investment in renewable energy.
- ☐ Lack of knowledge on renewable energy by the cooperating agency staff.
- ☐ Lack of trust between partners (between governments, agencies and other institutions).
- ☐ Insufficient of legal ties in the agreements and memoranda.
- ☐ Absence of political will.
- ☐ Follow-up required after the signing of the agreements ans memorada.
- ☐ Need for greater commitment among the participating institutions of the agreements/memoranda.
- ☐ Prioritizing to cooperate with neighbors or with countries in their geographical region.
- ☐ Cultural differences.
- ☐ Language differences.
- ☐ The absence of single database to monitor the projects or actions of cooperation after the signing of agreements.
- ☐ Need for more investment in science and technology.
- ☐ Need for professional experts in South-South cooperation.
- ☐ Fear that Brazil/India would prefer cooperating with the South countries to the North ones, fearing impositions of the North countries.

Other (please quote, if any)

10.

Seven international acts (agreements and memoranda of understanding) covering renewable energy were signed between Brazil and India. What can be done so that these agreements / memoranda can trigger concrete actions?

- [ ] A clear definition of commitments and targets in the agreements/memoranda.
- [ ] The establishment of legal ties clearly outlined in the memoranda.
- [ ] The existence of financial ties and commitments specifically defined and set out in the memoranda
- [ ] Clearly and objectively naming institutions that will initially be involved in the actions established in the memoranda.
- [ ] The follow-up of all post-signature actions of memoranda (and agreements) through working groups with goals

Other (please quote, if any)

11.

Regarding the threats and opportunities, identify what are threats (T) and what represents opportunities (O) for cooperation in renewable energy between Brazil and India:

	(T) / (O) / (Do Not Know)
Brazilian political scenario.	
Indian political scenario.	
World economic and political scenario.	
National and Global environmental problems.	
Global investments in renewable energy.	
Increase of global energy consumption.	
Number of publications by BRICS on renewable energy.	
Number of publications by developed countries on renewable energy.	
Number of patents of rich countries on renewable energy.	
Number of patents of BRICS on renewable energy.	
Bank of BRICS.	

Other (please name)

12.

Please indicate from the items below those which can contribute to promote cooperation in renewable energy between Brazil and India:

- [ ] The existence of public policies on renewable energies.
- [ ] Technical expertise in the cooperation area in the field of renewable energies.
- [ ] Number of scientific articles written in partnership between Brazilian and Indian researchers.
- [ ] Partnership between Brazil and India for patent creations.
- [ ] Level of global competitiveness of each country.
- [ ] Investments in renewable energies in both countries.
- [ ] Development of both countrie's renewable energy own market.
- [ ] Natural resources of each country with regard to the development of renewable energies.
- [ ] Bilateral trade between the two countries in different areas.
- [ ] Bilateral trade between the two countries in renewable energy.
- [ ] Number of Indian companies established in Brazil.
- [ ] Number of Brazilian companies established in India.
- [ ] Government official visits.
- [ ] Missions of entrepreneurs or investors.
- [ ] Agreements/memoranda signed between the two countries.
- [ ] Agreements/memoranda by Brazil and India with other countries

13. Could companies or the private sector play an important role in the process of cooperation between Brazil and India in the field of renewable energy? Why?

Interview Script

14.

In relation to public policy, choose the sentence(s) you judge to be true:

- [ ] The creation of public policies helps to promote cooperation, which helps promote the market, which promotes trade between two states.
- [ ] Increasing the number of public policies, with a focus on renewable energy, facilitates connections between the two countries in renewable energy area.
- [ ] The creation of policies that seek to promote renewable energy, is essential to support the process of cooperation in renewable energy between two countries.
- [ ] The development of policies in a given area in no way facilitates the process of cooperation between two or more countries.

15.

It was found that there are several similarities between Brazilian and Indian public policies which seek to promote the development of renewable energy. How much do the similarities between their policies facilitate scientific and technological cooperation between the two countries in the field of renewable energy?

- ◯ Not at all.
- ◯ A little.
- ◯ A lot.

If possible, briefly justify your answer.

Interview Script

16.

Select the type of renewable source that can offer greater possibility of cooperation between Brazil and India:

- ☐ Solar.
- ☐ Wind.
- ☐ Biofuels.
- ☐ Hydropower (or hydroelectric small hydroelectric plants).
- ☐ Do not know.

Other (please quote)

17. Where could Brazil and India contribute to each other in renewable energy cooperation? And why?

18.

Regarding proposals to extend cooperation in renewable energy between Brazil and India, select the one or ones that would be most important:

- [ ] The creation of an integrated virtual research platform between government institutions and universities.
- [ ] The creation of a virtual research platform among companies, universities and government institutions.
- [ ] The development, made by the two countries, of a database for follow-up of agreements/memoranda and cooperation projects.
- [ ] The creation within the BRICS, of an entity whose function is to articulate the cooperation between the countries belonging to the group.
- [ ] The creation, in plurilateral spheres (i.e., IRENA, IBAS) of a working group with the aim of promoting cooperation between countries.

Please if you have another proposal / suggestion to expand cooperation in renewable energy between Brazil and India, share it:

19.

Would like to add any additional comments on the Brazil-India cooperation in renewable energy?

Interview Script

Please, click on SUBMIT.

APPENDIX D – QUESTIONNAIRE

QUESTIONNAIRE ENGLISH

INTRODUCTION

This questionnaire is part of a range of methodological tools adopted for a doctoral thesis developed at the Federal University of Bahia (Brazil). The general scope of the doctoral research is to propose strategies that could help Brazil and India to increase cooperation in renewable energies.

The target audience this questionnaire are representatives of cooperation agencies and foreign ministries - both in Brazil and India. The main objective of this tool is to help identify the barriers and opportunities regarding cooperation in renewable energy between Brazil and India.

Your participation is critical to the success of this work. You will help to compose an essential part of the research in this pioneering work.

The identity of the respondent is to be confidential information, which is why there is no personal identification on the questionnaire.

Your contribution is much appreciated, because you will be helping to share knowledge.

If you have any questions or additional information on the questionnaire, please e-mail to mcadmm@yahoo.com.br

Thank you.

QUESTIONNAIRE ENGLISH

1. **What is your educational level?**

- ◯ PhD.
- ◯ Masters.
- ◯ MBA.
- ◯ Certificate program.

2. **Do you occupy a management position?**

- ◯ Yes.
- ◯ No.

3.

Check the items that represent the way your institution conceives International Cooperation for Development:

- [ ] Cooperation is a medium-domination strategy / long term between countries.
- [ ] The moral values of states vary in strategies and in their positions.
- [ ] The environmental and economic interdependence between states is real and thus puts conflicts into the background.
- [ ] Sharing challenges and common issues among emerging markets increases the possibility of cooperation with each other.
- [ ] In the context of North-South cooperation, the strategies adopted do not favor the development of less developed nations, which increases the contradictions and regional inequalities.
- [ ] The universe of cooperation has become multipolar and multifaceted. However, the link with the developed countries should be strengthened and the means of cooperation, adopted by emerging countries, should be reflected in the way they cooperate since they are in the forefront of this area.
- [ ] There is no need for regular state cooperation: it should take place within the framework of international organizations and regional areas.
- [ ] For scientific and technological cooperation to happen, it is necessary not only to regulate, but to ensure the interaction between government, market and research centers.

QUESTIONNAIRE ENGLISH

4.

With regard to international cooperation, the objectives of your institution would be more focused on:

- [ ] Avoiding conflicts.
- [ ] Mitigating regional differences.
- [ ] Promoting trust between institutions and cooperation agencies.
- [ ] Promoting international cooperation policies.
- [ ] Promoting trade.
- [ ] Improving the quality of life through economic, environmental and social balance.

If other, please name

[   ]

5.

Your institution works strongly with which of the following:

- ☐ Bilateral cooperation.
- ☐ Trilateral cooperation.
- ☐ Multilateral cooperation.
- ☐ Bilateral and Trilateral cooperation.
- ☐ Bilateral and Multilateral cooperation.
- ☐ Trilateral and Multilateral cooperation.
- ☐ All the options presented.

QUESTIONNAIRE ENGLISH

6.

Please select which priority level of your institution gives the following topics:

	No Priority	Low Priority	Medium Priority	High Priority
Traditional energy (ie gas, oil, coal).	○	○	○	○
Renewable energy (ie solar, wind, hydropower, biofuels).	○	○	○	○
Conservation and use of water.	○	○	○	○
Scientific and technological cooperation.	○	○	○	○
Humanitarian action.	○	○	○	○
South-South cooperation (between developing countries).	○	○	○	○
North-South cooperation (between rich countries and emerging or developing countries).	○	○	○	○

Other (please quote, if any)

____

7.
Currently, do you see interest in your institution for the Brazil-India cooperation?

- ◯ Yes.
- ◯ No.
- ◯ Only possibilities, nothing concrete.

If the third alternative, please briefly explain what this is due to

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8.
In relation to public policy, choose the sentence(s) you judge to be true:

- ☐ The creation of public policies helps to promote cooperation, which helps promote the market, which promotes trade between two states.
- ☐ Increasing the number of public policies, with a focus on renewable energy, facilitates connections between the two countries in renewable energy area.
- ☐ The creation of policies that seek to promote renewable energy, is essential to support the process of cooperation in renewable energy between two countries.
- ☐ The development of policies in a given area in no way facilitates the process of cooperation between two or more countries.

9.
It was found that there are several similarities between Brazilian and Indian public policies which seek to promote the development of renewable energy. How much do the similarities between their policies facilitate scientific and technological cooperation between the two countries in the field of renewable energy?

- ◯ Not at all.
- ◯ A little.
- ◯ A lot.

If possible, briefly justify your answer.

10.

Select the elements that could limit or promote cooperation in renewable energy between Brazil and India:

	Promote	Limit	No Impact
Territorial extension (to be among the top ten countries in the world).	○	○	○
Environmental diversity.	○	○	○
Unequal economic and social.	○	○	○
Participation in various multilateral groups (BRICS, IBSA, G-20, etc.).	○	○	○
Innovation (creation of patents, publications, etc.).	○	○	○
Access to financing.	○	○	○
Partnerships with a third country - experienced in the area of renewable energy, which would act as a catalyst for the cooperation process.	○	○	○
The increase in domestic consumption of goods, which implies higher production and an increase in energy consumption.	○	○	○
The need to reduce CO2 emissions.	○	○	○
Cultural aspects.	○	○	○

11.

Mark the elements present in your country that may limit or promote cooperation in renewable energy between Brazil and India:

	Promote	Limit	No Impact
Institutions.			
General infrastructure.			
Macroeconomic situation			
Situation of basic and higher education.			
Technological speed (speed of the country and its institutions to adopt and absorb new technology).			
Size of the domestic market.			
Sophistication of its market (quality and quantity of business networks within the country).			
Regulations work.			
Number of Tax.			
Bureaucracy.			
Corruption.			
Political situation.			
Public health situation.			
The country's experience in applying technology in the renewable energy area.			
The technical training of participants in the cooperation process.			

12.

Please select the main barriers for cooperation between Brazil and India in the field of renewable energy?

- [ ] Lack of government investment in renewable energy.
- [ ] Lack of knowledge on renewable energy by the cooperating agency staff.
- [ ] Lack of trust between partners (between governments, agencies and other institutions).
- [ ] Insufficient of legal ties in the agreements and memoranda.
- [ ] Absence of political will.
- [ ] Follow-up required after the signing of the agreements and memorada.
- [ ] Need for greater commitment among the participating institutions of the agreements nd memoranda.
- [ ] Prioritizing to cooperate with neighbors or with countries in their geographical region.
- [ ] Cultural differences.
- [ ] Language differences.
- [ ] The absence of single database to monitor the projects or actions of cooperation after the signing of agreements and memoranda.
- [ ] Need for more investment in science and technology.
- [ ] Need for professional experts in South-South cooperation.
- [ ] Fear that Brazil/India would prefer cooperating with the South countries to the North ones, fearing impositions of the North countries.

Other (please quote, if any)

13.

Regarding the threats and opportunities, identify what are threats (T) and what represents opportunities (O) for cooperation in renewable energy between Brazil and India:

	(T) / (O) / (Do Not Know)
Brazilian political scenario.	
Indian political scenario.	
World economic and political scenario.	
National and Global environmental problems.	
Global investments in renewable energy.	
Increase of global energy consumption.	
Number of publications by BRICS on renewable energy.	
Number of publications by developed countries on renewable energy.	
Number of patents of rich countries on renewable energy.	
Number of patents of BRICS on renewable energy.	
Bank of BRICS.	

Other (please name)

14.

Please indicate from the items below those which can contribute to promote cooperation in renewable energy between Brazil and India:

- [ ] The existence of public policies on renewable energies.
- [ ] Technical expertise in the cooperation area in the field of renewable energies.
- [ ] Number of scientific articles written in partnership between Brazilian and Indian researchers.
- [ ] Partnership between Brazil and India for patent creations.
- [ ] Level of global competitiveness of each country.
- [ ] Investments in renewable energies in both countries.
- [ ] Development of both countrie's renewable energy own market.
- [ ] Natural resources of each country with regard to the development of renewable energies.
- [ ] Bilateral trade between the two countries in different areas.
- [ ] Bilateral trade between the two countries in renewable energy.
- [ ] Number of Indian companies established in Brazil.
- [ ] Number of Brazilian companies established in India.
- [ ] Government official visits.
- [ ] Missions of entrepreneurs or investors.
- [ ] Agreements/memoranda signed between the two countries.
- [ ] Agreements/memoranda by Brazil and India with other countries

15.

Select the options you feel is/are necessary to promote South-South cooperation in the field of renewable energy:

- [ ] Southern countries (emerging) should adopt greater transparency in the actions between themselves, whether in business, academia or politics.
- [ ] Northern countries should not interfere in the processes of cooperation between countries of the South.
- [ ] Investments in science and technology in the South should be conducted or promoted without the cooperation of the North.
- [ ] Investments in science and technology in the South should be conducted or promoted with the collaboration of the North.
- [ ] The training of professionals in the field of cooperation in renewable energy should be increased.
- [ ] Increased trade between the southern countries in various areas is the key.
- [ ] Investments in science, technology and knowledge of the market in renewable energy should be increased.

16.

How should the Brazil-India cooperation, in the area of renewable energy, continue to develop?

- ○ Bilateral.
- ○ Multilateral.
- ○ Trilateral.
- ○ Through agreements between companies and without any participation of the state.

17.

If bilateral was not chose, please answer if, in the case of trilateral cooperation, the best option for the development of the cooperation in renewable energy between Brazil and India would be:

- ○ With the participation of another emerging country belonging to the BRICS.
- ○ With the participation of another emerging country other than the BRICS.
- ○ With the participation of a developed and rich country.
- ○ With the participation of a poor country.

18.

Seven international acts (agreements and memoranda of understanding) covering renewable energy were signed between Brazil and India. What can be done so that these agreements / memoranda can trigger concrete actions?

- ☐ A clear definition of commitments and targets in the agreements/memoranda.
- ☐ The establishment of legal ties clearly outlined in the memoranda.
- ☐ The existence of financial ties and commitments specifically defined and set out in the memoranda
- ☐ Clearly and objectively naming institutions that will initially be involved in the actions established in the memoranda.
- ☐ The follow-up of all post-signature actions of memoranda (and agreements) through working groups with goals

Other (please quote, if any)

19.

Select the type of renewable source that can offer greater possibility of cooperation between Brazil and India:

- ☐ Solar.
- ☐ Wind.
- ☐ Biofuels.
- ☐ Hydropower (or hydroelectric small hydroelectric plants).
- ☐ Do not know.

Other (please quote)

20.
Regarding proposals to extend cooperation in renewable energy between Brazil and India, select the one or ones that would be most important:

- [ ] The creation of an integrated virtual research platform between government institutions and universities.
- [ ] The creation of a virtual research platform among companies, universities and government institutions.
- [ ] The development, made by the two countries, of a database for follow-up of agreements/memoranda and cooperation projects.
- [ ] The creation within the BRICS, of an entity whose function is to articulate the cooperation between the countries belonging to the group.
- [ ] The creation, in plurilateral spheres (i.e., IRENA, IBAS) of a working group with the aim of promoting cooperation between countries.

Please if you have another proposal / suggestion to expand cooperation in renewable energy between Brazil and India, share it:

21.
If you have additional comments on the Brazil-India cooperation in renewable energy, please use the space below to share them:

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Please, click on SUBMIT.