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INTERNATIONAL COOPERATION BETWEEN BRAZIL AND GERMANY IN THE FIELD OF RENEWABLE ENERGY

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ABSTRACT: The fifth anniversary of the Paris Agreement (2015) is part of a context where climate change and energy efficiency matter. Bearing that in mind, this case study seeks the driving factors of the Brazilian-German bilateral cooperation on energy in an inter-connected scenario. The objective is to understand international cooperation between Brazil and Germany in renewable energy through the lenses of strategic diplomacy. In addition, identify opportunities and challenges for those two actors in the recent past and in the near future.

Keywords: Brazil, Germany, international cooperation, renewable energy, energy transition, climate change

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Electrical Units

Name	Symbol
Volt	V
Watt	W
Farad	F
Henry	H
Hertz	Hz
Coulomb	C

Introduction: sustainability, energy efficiency and international cooperation

The reason for the choice of this theme is energy security and the challenges that arise with cleaner energy sources, both in the socio-environmental and economic spheres. In this light, the fifth anniversary of the Paris Agreement (2015) and the strength of the sixth article of the document, which deals with implementation mechanisms, are also motivations.

International relations in the first decades of the 21st century have two important conjoined factors: an increasingly narrow policy space and the intersectionality of issues such as energy security, climate change and sustainability. In this context, strategies are necessary to minimise uncertainty (Goh & Prantl, 2017:37).

According to Goh and Prantl (2016), the word *strategy* englobes means to specific goals, while *diplomacy* is a tool that actors adopt to achieve their policy. Thus, the concept of *strategic diplomacy* is the process by which actors set their positions, elaborate their agendas and negotiate diverse interests and goals; in other words, their *endpoints* (Goh& Prantl, 2016). Therefore, strategic diplomacy represents a useful approach to the framework of the past few years.

This academic paper asks which factors drive Brazilian-German bilateral cooperation on energy, bearing in mind the inter-connectedness, the non-linearity and the emergence of the 21st century. On the one hand, the strategic diplomacy analyses this through the main actors, profile, objectives and favourable set of circumstances based on entry points and energy itself as a strategic matter. On the other hand, strategic diplomacy also considers new disposal of circumstances based on tipping points, such as the collapse of Lehman Brothers in 2008 (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018: 70-71)

For instance, Brazil and Germany have compatible diplomatic convergences for sustainability, energy efficiency, international cooperation and Sustainable Development Goals (SDG), which give coherence to foreign and domestic policies and to their respective financial instruments (Tomanzini, 2018:60). The common key-points from their agendas are:

1- Partnership;

2- Energy transition;

3- Infrastructure;

4- Agenda 2030;

Brazil highlights the importance of bilateral partnerships and uses diplomacy as its major tool for promoting Brazilian interests and perspective on global issues. Despite being self-sufficient in energy, Brazil has problems in its infrastructure and acknowledges that the international community is a source of investments and resources for development (Belli & Nasser, 2018:85-120).

Germany is committed to affairs with its European neighbours and developing countries from Asia- Pacific, Africa, and Latin America. The country wishes to lead actions and investments on climate change, sustainability, technology, trade, infrastructure, and development but fears to lose space to emerging players in those fields, especially China (Beste & Gugel, 2018:121-136).

Moreover, since 2014, Brazil has been regarded as a "graduated country" by the European Union and as an upper middle-income country by the Organization for Economic Cooperation and Development (OECD), following the 2011 Agenda for Change. This is a tipping point where Brazil is no longer qualified to receive funds for bilateral development cooperation; but there are still other aspects of International Cooperation for Development (ICD) available, such as thematic lines, and the Partnership Instrument (PI). To borrow Tomanzini (2018) words, the PI aims to promote financial support for operations within the scope of Strategic Partnerships (SP) between the EU and non-EU countries, as well as with non-eligible countries for Development Aid (Tomanzini, 2018:51-67). However, recent events and tipping points, such as the COVID-19 pandemic, jeopardize investments in renewable energy due to the global socioeconomic insecurity brought by the virus (IEA, 2020).

The Covid-19 pandemic encompasses a global socio-economic crisis with enduring impacts for the next few years. It deeply interferes in the current development model, and the international community is focusing on immediate solutions for the problem. Within this context of profound uncertainties, the object of this research, bilateral cooperation between Brazil and Germany in the field of renewable energy, primarily analyses the pre-coronavirus world and secondly looks forward to a world after the socio-economic recovery process. A projection based on the year 2020 would be rapidly lagging (WFDFI, IDFC & AFD, 2020:3-6).

In light of strategic diplomacy, the chart below illustrates the opportunities and challenges that have been arising since 2014 for Brazilian- German bilateral affairs on cooperation, sustainability and energy efficiency.

Table 1: Opportunities and Challenges for Brazilian- German Bilateral Affairs

	Brazil		**Germany**	
	Challenges (tipping points)	**Opportunities (entry points)**	**Challenges (tipping point)**	**Opportunities (entry points)**
Cooperation	→ Political instability, as cooperation often requires a stable political environment; →The difficulty of enforcing current legislation; → Size of the country; → The country has a high public debt; → COVID-19 Pandemic;	→ Traditional partner of Germany. → Receiving foreign investment; → Brazil is the entry point to Latin America;	→ Economic recovery for the European Union; → COVID-19 Pandemic;	→ Traditional partner of Brazil in different industrial sectors; → Positive economic outcome;
Sustainability	→ Revoking of Conama resolution	→ Decrease the emission of GHC gas.	→ Relationship with the Brazilian government, particularly on the	→ Decrease the emission of GHG gas.

	302/303[1].		environmental agenda.	
Energy efficiency	→ Need to diversify the energy grid and infrastructure; → Lack of resources to invest;	→ The northeast region has large wind and solar capacity and could be further exploited;	→ The Chinese presence in the solar panel sector and its growing influence in private segments of technology; → Need to diversify the energy grid; → Distance from Brazil.	→ Green Hydrogen;

Source: The author, based on Ministério da Economia,29/01/2020, CNI, 2018, CEW, 2017, Agência Brasil, 28/09/2020

The Brazilian challenges are the high public debt (Ministério da Economia, 2020)[2], high dependency on hydroelectricity, thus a non-diverse energy grid (National Energy Plan 2050,2018:1), a weakened infrastructure (CNI, 2018)[3] and lack of resources. The German challenges are the economic recovery for the European Union, the competition against China on technology (CEW, 2017), and dialogue with the Brazilian government. Among those challenges, there are some tipping points as setbacks in environmental legislation, such as the revoking of Conama resolution 302/303 (Agência Brasil, 2020) and political instability, for example (Tomanzini,2018:66). Both Brazil and Germany have to face the COVID-19 pandemic and its outcomes.

The Brazilian entry points are the possibility of foreign investments, the capacity for wind and solar power production throughout the whole year in the Northeast region (Bezerra, 2018:5) and being a strategic player in Latin America. The German entry points are the possibility to decrease the Chinese presence in Brazil regarding clean energy

[1] The National Council for the Environment (Conselho Nacional do Meio Ambiente - CONAMA) is an advisory and deliberative body with the power to establish new guidelines that the law does not provide. Resolutions 302 and 303, both from 2002, disposed on the areas of permanent preservation.

[2] https://www.gov.br/tesouronacional/pt-br/divida-publica-federal/sobre-a-divida-publica/por-dentro-das-contas-da-divida

[3] http://www.portaldaindustria.com.br/cni/canais/mapa-estrategico-da-industria/fatores-chave/infraestrutura/

technology and access to the Brazilian energy market and to a viable source to green hydrogen production. Bearing in mind that energy production can occur in those areas within Brazilian-German joint work, there is plenty of room to improve bilateral cooperation and international partnership.

Research question

The primary question of this essay is:

- What are the key factors behind the bilateral energy cooperation between Brazil and Germany?

From this standpoint, one must be able to understand both how these factors are classified, the agencies and companies involved, and in what ways cooperation in the field of renewable energies may be expanded. Thus, there are secondary questions such as:

- What are the entry points for bilateral energy cooperation between Brazil and Germany?
- What are the tipping points for bilateral energy cooperation between Brazil and Germany?
- What are the key agencies and companies behind the bilateral energy cooperation between Brazil and Germany?
- What are the endpoints for sustainable energy cooperation between Brazil and Germany?
- How to achieve those endpoints?

Objectives and justification

This study intends to look at policies regarding the energy grids of Brazil and Germany and possible ways of developing partnership initiatives between the two countries under the concept of strategic diplomacy. The objective is a possible expansion of joint work, reduction of environmental impacts and greater commitment to energy transition, especially bearing in mind the Agenda 2030 and the Sustainable Development Objective 7 (SDG 7 - Affordable and Clean Energy), Sustainable Development Objective 13 (SDG 13 - Climate Action) and Sustainable Development Objective 17 (SDG 17 - Partnerships to achieve the Goals).

The reason for this research is the attention that this theme fosters, as seen in the World Economic Forum (WEF) of January 2020. The central role played by the reduction in the emission of greenhouse gas (GHG) is of utmost importance. In addition, the economic debate about the energy shift and the active participation of Germany were key elements of the forum. Besides that, Brazil holds high potential for energy production. One should bear in mind how to reduce dependence on oil without compromising the national energy security.

Review of the sources

In this academic paper, primary and secondary sources of data collection are key tools. The first group includes documents from the Energy Research Company (EPE), the Brazilian government, the German government, the Brazilian Ministry of Mines and Energy (MME), the Brazilian Ministry of Foreign Affairs (MRE), the Instituto de Pesquisa Econômica Aplicada (Ipea), the Federal Ministry for Economic Affairs and Energy of Germany (BMWi), the German Society for International Cooperation (GIZ), the International Energy Agency (IEA), the Agenda 2030 and the Paris Agreement. There are also interviews with the German Minister-Counselor Dr Annette Windmeisser and the first Brazilian Secretary Clarissa Maria Forecchi Gloria. In conjunction with this, the talk "Renovabio: implementation in the Covid-19 crisis" (11/04/2020) was a primary source. This material helps to understand technical data on the energy matrices of Brazil and Germany and the evolution of renewable sources in recent years.

Concerning secondary sources, it is worth mentioning authors who have made contributions in the theoretical field of strategic diplomacy, energy governance and international cooperation. First, Goh & Prantl (2017) provided the theoretical basis for this academic work, supplemented by Barros-Platiau, Oliveira & Soendergaard (2018). The core concepts of strategic diplomacy, such as tipping points, entry points and endpoints, were borrowed from these authors. This work is likewise shaped by classical liberalism, especially by the set of naturalist principles proposed by Immanuel Kant (1797) and the advocacy of cooperative pacifism. Secondly, Roehrkasten (2015) was a valuable source for the practical use of the idea of global governance in energy and to understand how the views of the Brazilian and German governments contrast. Thirdly, Milner's (1992) approach towards international cooperation was useful for this text.

Methodology

Robert Yin (1994) writes that the case study is useful in situations where the subject of research is contemporary. The definition of the case, therefore, must follow criteria to select relevant information. Concerning this work on bilateral cooperation between Brazil and Germany in the field of renewable energies, the methodology applied was a case study and was divided into two stages.

This research had its roots in my experience as an intern in the Division of Non-Renewable Resources of the Brazilian Ministry of Foreign Affairs, where I perceived considerable convergence between Brazil and Germany in the energy theme. The use of technical data is noteworthy, bearing in mind the analysis of the bilateral cooperation between Brazil and Germany. It was an extensive survey of the energy matrices and the changes in recent years. The first moment of the method is thus an analysis of data on production, consumption, installed capacity and growth of energy sources, with a greater focus on green energies.

Research on international cooperation marks the second moment. In this process, strategic diplomacy stood out as a theoretical tool capable of explaining the interests and gains of Brazil and Germany within a partnership. The weight of bilateral cooperation in a post-coronavirus economic recovery scenario is an object of study as well, due to its pre-eminence and urgency. The long-term impacts of the Brazil-Germany partnership, especially for the energy infrastructure, are also subject of research.

1. Theory

Traditional IR theories such as classical liberalism are instruments to understand individuals, States and organizations in the global system. The progressive and optimistic perception of human nature, the sharing of responsibilities for cooperation, the normative power of multilateral institutions, international regimes and rules among peoples (Castro, 2012: 337) are the sketch of this work. Strategic diplomacy is the body, which is not a conceptual framework but a theory. According to Aron (2016: 196-202), hypotheses in which alliances arise from the rational pursuit of national interests are theories to political science. Bearing in mind that strategic diplomacy seeks ways to achieve interests, goals and build agendas of state and non-state actors (Goh & Prantl,2016:1-3), this work applies this term as a theory.

1.1 Global Governance on Renewable Energy

Global governance represents cooperation with many levels of institutionalization. This concept holds the idea that different policy degrees are intertwined (Roehrkasten,2015: 34). To borrow the words of Finkelstein (1995:369), global governance is ruling, without sovereign power, relations that cross frontiers. On the one hand, Finkelstein (1995:369) advocates that global governance is flexible, approaching affairs beyond national borders. Other scholars, such as Zürn, Koenig-Archibugi (2006: 237-239), Schuppert (2008: 16) and Kaul (2008:91), hold that global governance tackles transcontinental boundaries. Rosenau (2009:11), on the other hand, believes that global governance does not require only one control mechanism, but the "sum of mechanisms driven by different histories, goals, structures, and processes". In other words, both transnational and transcontinental borders, as well as others.

According to Roehrkasten (2015:34), states are the key actors; however, they are not the only ones in global governance. As such, the theoretical underpinnings of global governance are concerned with state and non-state players among distinct political levels, which encompass various governance mechanisms and spheres of authority (Dingwerth, Pattberg, 2006a: 196-198, Finkelstein, 1995:369, Rosenau, 1999 : 295).

The outlook for global governance on renewable energy is an emerging topic both in policy and scholarly discussions. Thus, it is worth bearing in mind that renewable energy cannot be pursued independently, but rather within the broader context of global energy governance, as policy actions on different energy sources are closely interrelated (Roehrkasten,2015:73). This first part analyses four key-points to understand the International Relations of renewable energy in the 21st century and the contributions of Brazil and Germany:

1-Historical background to the dialogue on renewable energy in the international context;

2- Major conferences held after the 20th century;

3-Strategic Diplomacy of Brazil on Renewable energy;

4- Strategic Diplomacy of Germany on Renewable Energy;

The first key point addresses 20th-century events that shaped global governance in renewable energy. Following the oil price shocks of the 1970s, policymakers worldwide started to seek ways to reduce dependence on fossil fuels and to explore alternative sources. In 1980, the Independent Commission on International Development Issues, chaired by Willy Brandt, launched a report criticizing world reliance on oil for industrial development. The paper emphasized the threat of running out of oil resources and advocated promoting the use of sustainable energy such as solar, biomass, wind and tidal power, new forms of nuclear, hydroelectric and geothermal energy. The Brandt Report appealed for an international energy strategy, highlighting the common interests of the international community for an energy shift (Roehrkasten,2015:79).

In the following year, the UN hosted an intergovernmental conference on renewable energy. The UN Conference on New and Renewable Sources of Energy in Nairobi, as it is known, debated how to do the transition from fossil fuels to green energy sources. It is noteworthy that the Nairobi Plan of Action pinpoints research, development, transference of advanced technologies, education and financial measures as strategies for achieving the energy shift (Odingo,1981:106, United Nations, 1981:689).

Environmental themes acquired greater international prominence in the 1990s amidst the relative stability of oil prices. However, it did not lead to further emphasis on the energy issue. In 1992, the UN Conference on Environment and Development (UNCED) held in Rio de Janeiro did not focus on the question of renewable energy. The final summit statement, the Rio Declaration on Environment and Development, does not address renewable energy (Roehrkasten,2015: 81).

The second key point is related to thematic conferences in the 21st century. In 2004, Germany hosted the first of a series of thematic international conferences on green energy, Renewables 2004[4]. In that conference, 154 countries and players such as representatives of governments, intergovernmental organisations, non-governmental organisations, the scientific community and the private sector attended and discussed how to encourage the growth of renewable energy in both developing and developed countries. Moreover, one of the most important outcomes of this conference was the creation of the Renewable Energy Policy Network for the 21st Century (REN21)[5], which is a tool for

[4] See REN21, IREC Selection Guidelines, http://www.ren21.net/REN21Activities/IRECs/IRECSelectionGuidelines.aspx

[5] Ren21, Mission and Concept, http://www.ren21.net/Portals/97/documents/Media%20Resources/REN21_Mission_and_Concept_060310.pdf

promoting clean energy in low, middle and high-income countries (Roehrkasten,2015:84).

At the 2005 G8 Summit in Gleneagles, leaders of the G8[6], as well as representatives from Brazil, India, China, Mexico and South Africa, agreed to the Action Plan "Climate Change, Clean Energy and Sustainable Development". This paper consists of a declaration of commitment to renewable energies and their commercialization. In the Action Plan referred to, the G8+5 governments endorsed the REN21, appointed the IEA to work on alternative energy scenarios and advisory on green energy strategies, and the World Bank to set up a framework for investments in green energy and financing tools (Roehrkasten,2015:84).

In the two following years, the meetings of the UN CSD turned their focus to energy issues, notably on the role of clean energy for the achievement of the Millennium Development Goals (MDGs). In 2008 the German government launched the creation of IRENA, which aimed at the global progress on renewable energy instead of relying on an UN-wide consensus. In this way, it created a new intergovernmental organization outside the UN system. Besides that, in 2009 the International Renewable Energy Agency (IRENA) emerged as the first intergovernmental organization solely focused on the promotion of green energy. In stark contrast to the IEA, IRENA is open to all UN member states, whilst the IEA is restricted to the OECD members. At the time of its foundation, seventy-five countries signed the charter of IRENA; however, a handful of key players, such as Brazil, have neither signed nor supported IRENA. In the case of Brazil's abstention, representatives of the country argued that they feared restrictions on the energy policies of its member states and sovereignty problems[7] (Roehrkasten,2015:85).

In 2011, in the wake of the United Nations Year of Sustainable Development (2012), the then UN Secretary-General Ban Ki-moon announced Sustainable Energy for all (SE4All), the most prominent renewable energy related initiative launched by the UN. In 2012, notwithstanding the rising focus on energy issues within the UN, the 2012 United Nations Conference on Sustainable Development in Rio de Janeiro (Rio+20) failed to make significant progress on energy-related challenges. The final declaration once more shows general support for promoting access to energy and renewable energy; it lacked

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[6] G8, Action Plan "Climate Change, Clean Energy and Sustainable Development", http://www.g8.utoronto.ca/summit/2005gleneagles/climatechangeplan.pdf

[7] IRENA, IRENA membership, http://www.irena.org/Menu/Index.aspx?mnu=Cat&PriMenuID=46&CatID=67

means of implementation. It also did not expressly declare its endorsement of SE4All, as it only " records " the launch of the initiative. Yet the Rio+20 Summit had indirect outcomes in the overall promotion of renewable energy. The Summit has endorsed the drafting of Sustainable Development Goals (SDGs) that also cover the increasing share of renewable energy use (Roeherkasten,2015:87-89).

The third key point is the strategic diplomacy of Brazil on renewable energy, which will be further explored in the following part. Overall, the country is committed to global stability and the strengthening of green energy sources through bilateral agreements, multilateral mechanisms and the rule of the law. Climate action, development, sustainability, and both the domestic and international market are relevant for Brazilian diplomacy[8]. As for partnerships, the country believes that they are meant to achieve endpoints, bearing in mind shared interests and benefits (Belli & Nasser, 2018:85-120).

The fourth and last key point is related to the strategic diplomacy of Germany and will be addressed later as well. The German State recognizes institutions of regional and international governance as major actors in the promotion of stability and defends the idea that the UN is currently the most important forum for international cooperation. Therefore, Germany is committed to working as a leading player in the UN system. Regarding renewable energy, the country shows efforts to support research and technology and the Sustainable Development Goals (Beste & Gugel, 2018:121-136).

1.2 Strategic Diplomacy

The theory of strategic diplomacy englobes two primary concepts: strategy and diplomacy. The former seeks paths to achieve interests, whilst the last is a means by itself towards defined goals. Together, those ideas build agendas, set communications and world views of state and non-state actors (Goh & Prantl,2016:1-3). It is an analytical tool to understand the systemic outcomes of diplomacy. In this academic work, strategic diplomacy is a lens used to see the Brazilian- German cooperation on sustainable energy and its implications for global governance on the subject.

According to Goh & Prantl (2016), the notion of strategic diplomacy is inside a context that is inter-connected, non-linear and emergent. The interconnectedness of this state of affairs is the strong interdependence between the pieces of a convoluted order.

[8] Aliança Francesa Brasília, Onde Estamos? 5 anos do Acordo Climático de Paris, https://www.youtube.com/watch?v=Cvs19It5ZYQ

Moreover, it is important to bear in mind that the interconnections within a system result in not only direct effects, but indirect and delayed outcomes as well. Non-linearity, by its turn, constitutes the underlying asymmetrical relation between cause and effect. Thus, minor episodes may fuel the creation of tipping points with major outcomes, such as the oil price shocks of the 1970s and the subsequent international interest for alternative energy sources (Dalgaard,2017:190). Emergence represents new events created from the interactions of the units of a complex system (Goh & Prantl,2016:1-3).

In this approach, the affairs among two or more actors in the system are shaped by interactions and how the other factors in the system respond (Goh & Prantl,2016:1-3). The Brazilian-German cooperation on the renewable energy case is therefore influenced by sovereignty interests, divergent actions, national responses and external and internal elements.

The mentioned factors are essential to achieve the actors goals, or as Goh & Prantl (2016) call it, end points. In the strategic diplomacy theory, the major players, interests and encouraging scenarios are known as entry points. This term consists of favourable set of circumstances to accomplish endpoints. However, strategic diplomacy bears divergent actions, uncertainty and new events as tipping points, which might change the current set of circumstances (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018: 70-71).

1.3 International Cooperation

International Cooperation, to borrow Robert Keohane's words, is a process of policy coordination where actors rearrange their conduct to the bias of other actors. This undertaking suggests that the policies of each party seek to decrease adverse outcomes and increase the chances of achieving their objectives. This perception of cooperation presents two outstanding elements: that each behaviour goes towards endpoints and that it implies gains for the actors involved. According to Milner (1992), the goals are not necessarily identical for all the parties; however, rational behaviour is fundamental to the idea. Regarding the gains, they do not need to be of the same significance, yet the rewards must be mutual. In other words, each actor contributes to others to achieve their endpoints by adapting its policies (Milner, 1992:467-468).

Historically, the idea of organized International Development Cooperation (IDC) emerged in the aftermath of the Second World War and the early Cold War, as from 1945

East-West rivalries were a highlighted factor in the cooperative efforts. The process has the norms, speeches, practices, agendas and behaviours of actors as its core elements; Before 1945, what had been a set of temporary experiences, driven by political, diplomatic or humanitarian interests, became a means for states to act in international relations. This " architecture of aid " was strongly influenced by events such as the reconstruction of Europe as part of the Marshall Plan, the advent of decolonization in Africa, Asia, the Caribbean and the Pacific in 1950-1970, and the rise of national-development models, particularly in Latin America. The process of institutionalization of the IDC followed the very process of legitimizing multilateralism. Yet, that does not mean that states gave up their national strategic interests in pursuing international cooperation agendas with countries of the North or the South (IPEA, 2014:33-35).

This early period of the IDC was called the "incubation of development" by the theoretician Gilbert Rist (Rist, 1996:148), with particular emphasis on the creation of international bodies such as the 1948 Organization for European Economic Cooperation (OEEC) and the related United Nations (UN) agencies. For the traditional donor countries, the time frame was also marked by the formation of their own bilateral development cooperation agencies (IPEA, 2014: 35).

In the 21st century, the traditional IDC and its concepts of donors and recipients, aid agencies, allocations based on per capita income do not apply in the current international community. According to Orliange (2020), this is due to the growing role of local governments and development banks, and middle-income countries such as Brazil. For the past five years, there has been a new scenario for international development cooperation. The 2015 framework is the outcome of the adoption of the Sustainable Development Goals (SDG) of the Agenda 2030, the global commitment with the Nationally Determined Contributions (NDC) of the Paris Agreement and the endorsement of the Addis Ababa Action Agenda, known as AAAA (Orliange, 2020).This additional complexity sets the background for the cooperation between Brazil and Germany, which is noteworthy in this academic work.

1.3.1 North- South Cooperation

International cooperation may fall into triangular (TrC), South-South (SSC) and North-South (NSC) formats. The former entails development partners, countries, and organisations which are providers of financial and technical support (WHO, 2020). The SSC, for its part, represents cooperation between the countries of the global South and is rooted in the 1978 Buenos Aires Plan of Action for the Promotion and Implementation of Technical Cooperation among Developing Countries (BAPA) (UN DESA, 2019). The NSC, as a concept, rose in the resolution no. 1.383/1959 of the UN General Assembly. At the occasion, the term technical assistance was replaced by that of technical cooperation, which implied a bond of exchange and mutual interest. Thus, developing countries achieved recognition in an equal position regarding cooperation, considered as a tool to drive their development efforts, and not purely technical assistance linked to political-strategic endpoints or the passive taking of resources (IPEA, 2014:59).

1.3.2 Brazilian-German Cooperation on renewable energy

Cooperation is a component of both Brazilian and German strategic diplomacies. In the scope of the thematic partnership on renewable energy, it is not hard to see that the endpoints on the respective sides are to reduce the environmental footprint and increase energy security in a sustainable and economically rational way (Milner,1992:467). This following part will address three points to understand the NSC between Germany and Brazil:

1- Agencies of cooperation;
2- German- Brazilian Energy Partnership;
3- Comparative table between the two actors;

The first topic, which concerns cooperation agencies and institutions adopted by Brazil and Germany, outlines the institutional foundations for the bilateral North-South partnership between these actors. On the Brazilian side, cooperation as foreign policy category is managed not by the Ministry of Foreign Affairs (MRE), more precisely by the Brazilian Cooperation Agency (ABC). Until 1987, the agenda was carried out by the Technical Cooperation Division of Itamaraty and by the Sub-Secretariat for International Economic and Technical Cooperation (Subin) of the Planning Secretariat (Seplan). The main reason for this dual approach was a growing number of official cooperation programmes and projects were being implemented in Brazil by donor countries and international organizations. However, this type of cooperation diminished as Brazil gained status as a developing country and was therefore no longer eligible to receive such contributions in the standards that applied hitherto (IPEA, 2014:9).

On the German side, federalism and subnational entities play a significant role in the country's diplomatic strategy, which is a "paradiplomacy" of municipalities, states, provinces and departments. Although there is no regulatory law, the sixteen Bundesländer hold local autonomy and have the capacity to finance their cooperation projects. Moreover, they can act in partnership with the Federal Ministry for Economic Cooperation and Development (BMZ) on issues such as energy and sustainable economic development (IPEA, 2014:130). The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) also plays a role as the German International Cooperation Agency. The company specialises in cooperation and sustainable development projects on a global scale (GIZ, 2020).

The second topic is a perspective of the German-Brazilian Energy Partnership and its implications for strategic diplomacy. Since 2008, the German-Brazilian Energy Partnership has been commissioned by the German Federal Ministry of Economy and Energy (BMWi), which is supported by GIZ concerning implementation and conceptual development, and implemented mainly by the Brazilian Ministry of Mines and Energy (MME). It is part of the global project "Support to Bilateral Energy Partnerships in Developing Countries and Emerging Economies" and has a permanently established secretariat in Brasilia to provide organisational and technical support to the Partnership. Furthermore, the Secretariat is a reporting platform and connection point for all stakeholders in the spheres of politics, industry, science and civil society. The project has established two thematic working groups, which exchange information on renewable energy, bioenergy and energy efficiency. These working groups are open committees where business, research and civil society can debate with government representatives (GIZ; MME, 2020). It implies an entry point for further cooperation between the two actors, bearing in mind the strategic position of Brazil as a gateway to Latin America and as an emerging economy. Moreover, as traditional partners, the structures for IDC are already in place.

The third topic illustrates the main differences among the Brazilian and German energy grid regarding renewable energy based on data from the MME and ISE Fraunhofer (2017). The table below, where the colour green represents a good scenario for renewables and red represents a negative one, is a tool for comparison:

Table 2: Differences among the Brazilian and German energy grid[9]

	Brazil	Germany
Installed Capacity (Renewables)	128.53 GM	111.70 GM
Share of electricity generated from renewables	80.40%	36%
Electricity produced from Solar and Wind	43 TWh	145 TWh

Source: The author, based on the MME and ISE Fraunhofer, 2017

According to the table above, Brazil has an advantage in installed capacity for renewable energy production compared to Germany. Renewable energy is also more present in the Brazilian grid than in the German grid; however, the latter still produces more solar and wind electricity.

2. Brazilian energy grid

In the 60s, when the International Development Cooperation (IDC) system first emerged, developing countries did not take part in the elaboration of this concept. In other words, state-actors from the global south did not have an active role in the IDC. At the time, there were "donors" from the global North and "recipients" from the global South. This worldview led to several answers, such as the Declaration on a "New Economic International Order" of UNGA, in 1974 (Resolution 3201). For the past few decades, middle-income countries such as Brazil are the majority of "developing countries", with their own "specificities" as recognized by the Addis Ababa Action Agenda (Orliange,2020).

In light of this, the strategic diplomacy of Brazil has manifested in its condition as a middle-income country, in its principles, and its capacity for coordinated policy (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018: 70-71). The Brazilian energy grid has a crucial role to play in this agenda, which aims to promote development, improve social indicators and increase productivity under the rule of law. In the 1970s,

[9] MME, 2017, "Relatório Final BEN 2017". *Brasília: EPE*https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-46/topico-82/Relatorio_Final_BEN_2017.pdf .

ISE Fraunhofer, 2020 "Energy Charts." n.d. *Energy-Charts.Info.* https://energy-charts.info/charts/installed_power/chart.htm?l=en&c=DE

Brazil initiated a more structured cooperation with major foreign powers by establishing a series of Memoranda of Understanding on Diplomatic Consultation with other Foreign Ministries such as the Auswärtiges Amt (Belli & Nasser, 2018:5-12 ,85-120).

The Federative Republic of Brazil has witnessed an expansion of primary energy demand in its territory in the past five decades. It is widely believed that this can be attributed to industrialization (alongside the installation of energy-intensive projects), population growth and the rising rate of urbanization. Tomasquim, Guerreiro and Gorini (2007) point out that the demand for primary energy rose from less than 70 million toe[10] to 190 million toe in the period from 1970 to 2000, followed by an uprising from 93 million inhabitants to 170 million. Despite the macroeconomic crises of the Cruzado and Real plans, energy consumption grew (Tomasquim, Guerreiro & Gorini, 2007:1).[11]

At the time the Brazilian pre-salt was discovered, the international setting was one of economic growth, followed by a significant increase in global demand for oil and rising oil barrel prices (Correa & Pedrosa, 2016). The emergence of a favourable international outlook along with the exploitation of the pre-salt was an entry point for Brazil, and the country was able to reach its endpoint of economic growth.

The financial crisis of 2008 came as a tipping point for international affairs and produced an impact on the oil industry. However, as economic growth resumed, the commodity prices reached levels above US$ 100 per barrel, thus making the pre-salt projects an entry point for economic growth according to Goh and Prantl's (2016) concept. Nevertheless, this course shifted as prices collapsed in late 2014. Alongside the global crisis, Petrobras' corruption scandals impacted the oil industry in Brazil (Correa & Pedrosa, 2016).

The Brazilian oil production grew 3% in 2016, reaching an average of 2.52 million barrels per day, of which 94.0% are of maritime origin. Rio de Janeiro was responsible for more than half of that year's production, around 67%. In terms of onshore exploitation, Rio Grande do Norte led Brazilian production in 2016 with 33% of the total onshore.

[10] Toe: Tonne of oil equivalent.

[11] The energy flow of each primary and secondary source is represented by the following equations: TOTAL OFFER = PRODUCTION (+) IMPORT (+) OR (-) STOCK VARIATION GROSS INTERNAL OFFER = TOTAL OFFER (-) EXPORT (-) UNUSED (-) REINJECTION.

Shale production, on the other hand, decreased by 0.4% over the same period (BEN, 2017: 16-17).

Besides that, Brazil produced 103.8 million m^3/day of natural gas on average in 2016 and imported around 32.1 million m^3/day. As a result, the share of natural gas in the national energy grid reached a level of 12.3%. Industrial demand for natural gas registered a decline of 4.5% compared to 2015, but remained stable regarding demand for coal (BEN,2017:18-19). About nuclear energy, Brazil dominates the technology to enrich uranium. However, it does not produce nuclear fuel for its plants because of insufficient scale demand to economically justify such activity (FGV, 2019:6).

The imports, exports, research and efforts to invest in the energy sector are part of the diplomatic strategy of Brazil towards this agenda. Energy is an important matter for the country and is interconnected with environmental and economic factors. In Smith's view, strategic diplomacy is directly linked to approaches to achieve "principles and guidelines" for a more long-term oriented policy formation and development process (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018:70).

The role played by green energy sources in the Brazilian grid is of utmost importance as well. Until 2018, those clean types of energy production were growing towards reducing Brazil's environmental footprint and providing affordable electricity, thus allowing social and economic development as proposed by the 2030 Agenda (BEN, 2019). The country was known for its strategies for cooperation in this field with other countries and advocacy of multilateralism (Belli & Nasser, 2018: 85-120).

In the past few years, more attention to the energy shift and energy security has been paid. Three new elements were added to the Brazilian strategy: Climate action, environmental impacts and sustainability, alongside the economic aspect of the domestic and international market. Each of those points interconnects to one another in a long-term oriented policy formation process, and strategic diplomacy in those terms has a coordinated endpoint, a stable institutional basis, a common narrative and the capacity to adjust to external transformations (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018:70)

Climate action is not only related to the Brazilian commitment to the Paris Agreement, but also to its strategic diplomacy on protecting the environment and development. The last topic, sustainability, tackles proposals to mitigate the emission of Greenhouse gas, pollution, radiation waves, improving living standards and economic growth. All three are linked to the Brazilian energy shift and are shared points among the Brazilian energy agenda and the German energy agenda (Belli & Nasser, 2018: 85-120) (Beste & Gugel, 2018:121-136).

Energy production has always had some effect on nature, yet each of these processes presents its own peculiarities. Renewable energy sources such as water, solar power, wind and biomass (sugarcane bagasse, charcoal, alcohol), on the other hand, are considered the most social-environment-friendly forms of generation, even though they may also present negative externalities (BEN, 2019: 8). In this regard, especially in the production of solar energy, Brazil is a country favoured for having the incidence of solar energy throughout the whole year, in almost all its territorial extension [12](Osava,2020).

Sustainable development encompasses both the environment and the economy. In fact, Brazil's energy grid is mostly sustainable, considering the relevant percentage of renewable sources in the last three years. In comparison, Germany still presents a mostly non-renewable energy grid, especially regarding coal, despite its efforts to transition to cleaner sources (Federal Ministry for Economic Affairs and Energy, 2018:5).

Bearing in mind those three topics, one could say that the Brazilian energy production encompasses those concepts in a manner that is noteworthy to Germany. In 2016, according to data from *Balanço Energético Nacional* (BEN) 2018, the Brazilian energy grid had 43. 5% participation from sustainable sources while the world grid had an average of 14%. As it consumes more energy from renewable sources than the world average, by dividing the Greenhouse effect gas emission by the total number of inhabitants in Brazil there is less GHG emission per inhabitant than the majority of the other countries.

2.1 The Brazilian energy grid in 2017-2019

Brazil is mostly self-sufficient in energy, and strongly acknowledges the importance of bilateral partnerships to achieve the endpoints of its strategic diplomacy. Moreover, Brazil wishes to contribute to world stability and the strengthening of

[12] http://www.ipsnews.net/2020/07/solar-energy-expands-brazil-despite-pandemic/

renewable energy. In other words, Brazil aims at a virtuous self-reinforcing cycle with positive outcomes for both Brazilians and its partners for IDC (Belli & Nasser, 2018: 85).

Yet there is still the presence of non-renewable sources in the Brazilian energy grid, such as oil. Brazil's oil production grew 4% in 2017, peaking at an average of 2.62 million barrels per day, 95% of which was of maritime origin, according to BEN 2018. Concerning the producing states, Rio de Janeiro was responsible for 68% of the annual amount, the largest portion recorded in 2017. On the other hand, land production remained headed by the State of Rio Grande do Norte, with 33% of the total onshore production. In terms of diesel oil, consumption increased by 0.6% and 2.6% in automotive gasoline (BEN, 2018:16-17).

Regarding natural gas production, the daily average for 2017 was 109.9 million m3/day and the volume of imports was 29.4 million m3/day. Accordingly, the participation of natural gas in the national energy grid reached a level of 12.9%. The demand for natural gas in the industrial sector grew 1.4% compared to 2016, mainly due to the growth in steelworks. The consumption of natural gas in a thermal generation (including self-producers and public service plants) increased 15.3%, to a level of 65.6 TWh. In 2017, natural gas allocated to electricity generation reached an average of 40.1 million m3/day, which represents an expansion of 15.3% compared to 2016 (BEN, 2018:21).

The following three tables cover the year 2017 and rely on data from the BEN 2018. The first table looks at oil and natural gas production in that period, while the second and third illustrate a few aspects of oil and natural gas exploitation.

Table 3: Oil and Natural Gas production in 2017

	Oil	**Natural Gas**
Production	2.62 million barrels per day	109.9 million m3/day

Source: The author, based on BEN 2018

Table 4: Oil exploitation in 2017

	Oil
Offshore production	Rio de Janeiro was responsible for 68% of the annual amount of offshore production.

Onshore production	Rio Grande do Norte was responsible for 33% of the total onshore production.

Source: The author, based on BEN 2018

Table 5: Natural Gas exploitation in 2017

	Natural Gas
Participation in the national energy grid	The participation of natural gas in the national energy grid reached a level of 12.9%
The demand in the industrial sector	The demand for natural gas in the industrial sector grew 1.4% compared to 2016, mainly due to the growth in steelworks.

Source: The author, based on BEN 2018

In 2018 there was a decline in the supply of oil and derivatives in Brazil, as well as an 1.4% downturn in barrel production per day if compared to 2017 data, totalling an average of 2.59 million barrels per day, of which 96% are of the maritime source. For consumption, there was a 1.3% decrease in fossil diesel oil and a -13.1% drop in automotive gasoline, which represents the entrypoint of less participation of unclean sources and environmental impact in the short run. The reduced consumption of automotive gasoline was caused by higher prices of this fuel when compared to hydrous ethanol. It is worth noting that even though consumption of fossil diesel has dropped, the sum of diesel and biodiesel consumption has grown 1.1% relative to 2017 (BEN, 2019:19).

In that same year, natural gas production in Brazil also shrank. Average daily production was 111.9 million m3/day and the volume of imported natural gas was 29.0 million m3/day. Natural gas at the time represented 12.5% of the national energy grid and the demand decreased -4.6% in comparison to 2017, mostly due to the fall in gas-fired thermoelectric generation. The consumption of natural gas in thermal generation (including self-producers and public service plants) decreased -16.9%, corresponding to -7 million m3/day (BEN, 2019:19).

According to Adriano Pires (2019), nuclear energy makes up approximately 3% of Brazil's electricity generation, with most of its use being directed towards electricity production, with lesser use in medicine and agriculture. The World Nuclear Association reports that Brazil has nearly 5% of the global uranium reservoir, despite not having invested much in exploitation since the 1990s. However, ever since the closure of the Caetité (BA) mine and the decline of this mineral production after 2014, Brazil imports uranium to supply the national plants Angra I and Angra II, which are the result of Brazilian-German cooperation (FGV, 2019:4-6).

The Brazilian energy grid has shown a satisfying outcome in terms of participation from renewable sources in the last three years (BEN 2018:5). Due to the intertwined agendas of climate change and development, bearing in mind the SDGs and the Paris agreement (Orliange, 2020), the Brazilian strategy is following a long-term policy-making process to achieve the endpoint of sustainable growth.

The Brazilian electric system is undergoing an important energy transition that has been driven by the loss of capacity to regulate the reservoirs of hydroelectric plants and the considerable expansion of intermittent and seasonal renewable sources in the past few years (EPE, 2016:19). From 2017 to 2018, the country witnessed an increase in wind, solar and biodiesel energy production, thus contributing to Brazil's energy transition process. In addition, there has been a steady generation of electricity from the hydroelectric source. In 2019, the Brazilian government sought greater transparency and publicity in regard to the Brazilian grid and pursued a balance between exploitation of non-renewable resources and use of clean energy (EPE, 2016:20).

According to the Energy Research Company (EPE), Brazil presented a growth of 0.9% in final electricity consumption during 2017. The sectors that have contributed the most to this increase are the commercial (1.5%) and the industrial (1.1%) ones. Meanwhile, the residential sector had a 0.8% rise in electricity consumption when compared to 2016. Data from PNAD (IBGE, 2017) shows that approximately 99.8% of the Brazilian population had access to electric power in 2017, which partly demonstrated commitment to the SDG 7. In the baseline year of 2017, total anthropogenic emissions associated with the Brazilian energy grid reached 435.8 million tons of carbon dioxide equivalent (Mt CO2-eq), most of which (199.7 Mt CO2eq) was generated in the transportation sector (BEN, 2018).

In the base year of 2017, on average each Brazilian citizen emitted 2.1 t CO2-eq, or about 7 times less than an American and 3 times less than a European, as reported by the International Energy Agency (IEA,2018). Additionally, the Brazilian economy was 17% less carbon intensive when compared to the European economy on the basis of IEA data for 2015. On average, the Brazilian electricity sector emitted no more than 104.4 kg CO2 to produce 1 MWh, a level that is very low when making comparisons with the EU countries. That same year the contribution from renewables in Brazilian Energy grid continued to be among the highest in the world. The progress of natural gas was counterbalanced mainly by wind power, and biodiesel sources (BEN, 2019:8).

The year 2018, on the other hand, accounted for a share of 416.1 million tons of carbon dioxide equivalent (Mt CO2-eq) in terms of total anthropogenic emissions associated with the Brazilian energy grid , the majority (192.7 Mt CO2-eq) being from the transport sector (BEN, 2019:10). In that same year, the percentage of Brazilians with access to electricity decreased by 0.1% (IBGE, 2018), a signal that Brazil still has to work on its access to energy. Regarding emissions per inhabitant, in 2018 each Brazilian emitted on average 2.0 t CO2-eq, approximately 7.5 times less than an American and 3 times less than a European, as shown by the International Energy Agency (IEA) for the year of 2016. As of 2018, the Brazilian economy remained on average 17% less carbon intensive than the European economy, according to data from the IEA.

According to *Ministério das Relações Exteriores* (Ministry of Foreign Relations), the Brazilian government is engaged in strategies to curtail climate change (2017). Following a speech by Minister of Mines and Energy Bento Albuquerque on January 21, 2019, energy demand in Brazil encompasses issues of foreseeability, regulatory and legal stability and governance. Firstly, Minister Alburquerque plans to improve governance over the course of his administration by cutting down on bureaucracy and reinforcing finalistic structures in order to increase Brazil's energy efficiency. Secondly, he endeavours towards the full application and improvement of the rules and regulations in place. Thirdly, the Minister aims at publishing data related to the Brazilian Energy grid as a priority so as to attract investors to the electricity sector in the coming years.

The prospects for wind power generation capacity in the country, which is a leader in Latin America (Losekann & Tavares,2019:23), are also worth highlighting according to the Minister.

2.2 The participation of renewable sources and the energy shift

The high proportion of renewable sources is an aspect that characterizes the Brazilian shift, as the new renewable sources, wind and solar, play the role of offsetting the loss of hydroelectric power. But spearheading sustainable development does not mean that there are no challenges in terms of maintenance and strengthening of a low-carbon approach. (Losekann & Tavares,2019:23).

As a great producer of biofuels, the country holds a comparative advantage in this field, which is echoed in its National Policy for Biofuels (RenovaBio) designed to further develop the production and use of biofuels in its national energy grid. It is part of its strategic diplomacy, to borrow Roehrkasten (2015) words, in the sense of "the right to development and the needs of poorer communities" (Roehrkasten, 2015:5). However, the IRENA does not include biofuels in its strategies.[13]

For the past few years, Brazil made great effort to turn ethanol into a more competitive commodity. According to Vidal (2019), the main strategies of Brazil to boost biofuels, among them ethanol, in the commodities market are the bilateral contracting of ethanol fuel and auctions. It is also important to emphasize RenovaBio, which has as objectives the fulfilment of the commitments made under the Paris Agreement, the expansion of biofuels in the energy grid on a regular basis in the supply and assurance of predictability, thereby fostering efficiency and reduction of emissions in the production, trading and use of biofuels (Losekann & Tavares,2019: 2-15).

The Brazilian energy grid is diverse in terms of both electricity generation and final consumption of liquid, gaseous and solid fuels (e.g. ethanol, biodiesel, sugarcane bagasse, biogas, etc.). The variety of the energy grid of Brazil is an entrypoint to foreign investments, bearing in mind its high production capacity and versatility, yet weak infrastructure (Bezerra, 2018:5). It can be understood that the electric power generation is a relevant strategy in the decarbonization of the sector, since electricity generation has low emission technologies, as in the case of solar and wind sources, and greater flexibility in final uses. In the Brazilian context, which is still in the course of being structured, electricity seems the most suitable option for increasing access and quality in energy use for the population (Losekann & Tavares,2019:12).

Regarding the Paris Agreement, there is a goal to reduce Brazil's Greenhouse gas emissions by 37% in 2025 and 43% by 2030. This undertaking applies to the whole

[13] IRENA, http://www.irena.org/Menu/Index.aspx?mnu=Cat&PriMenuID =46&CatID=67

economy including wildlife and indigenous areas. One challenge arising from this commitment is to maintain and improve the Brazilian energy framework from a low carbon-intensive level (Losekann & Tavares,2019:18-24). However, for the past two years, environmental tipping points such as the increase in fires in Brazilian ecosystems[14] and denialist statements on global warming emerged (Deutsch Welle, 2020)[15]. It characterizes uncertainty in the current scenario of commitment with the Paris Agreement (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018: 70-71).

The Decennial Energy Expansion Plan (PDE) 2027, drafted by the Energy Research Company (EPE), suggests that because of the slack installed capacity from the years of recession in the Brazilian economy, the level of output expansion will likely be minor in the coming years (MME/EPE,2018:21).

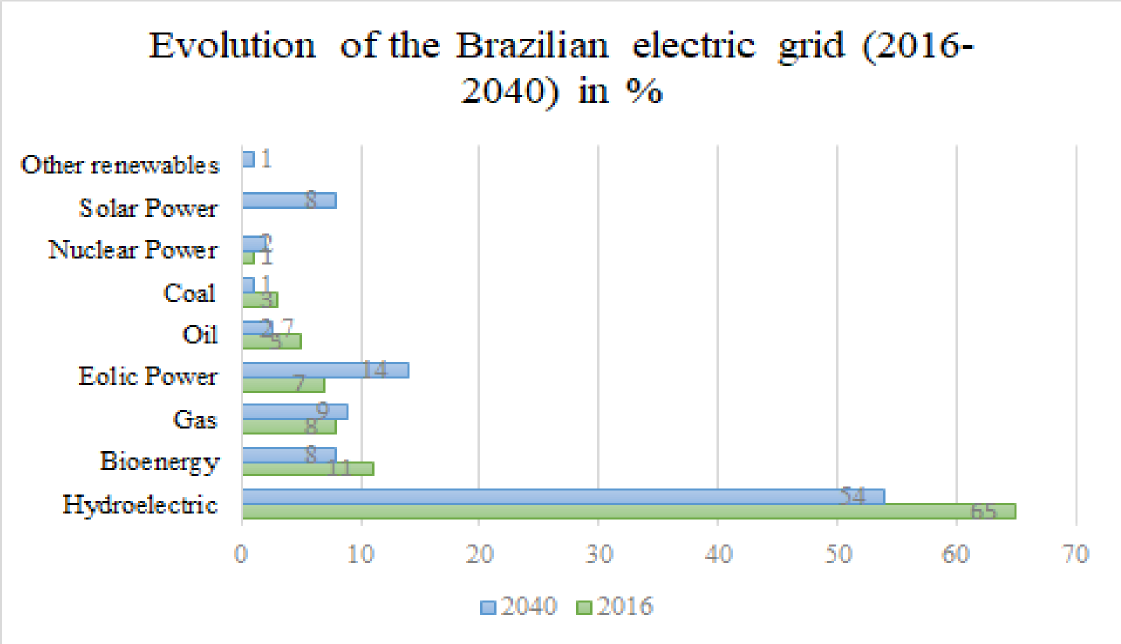
The electrical expansion in itself demands other options, including the possibility of fossil sources (e.g. natural gas), which conflicts with the goals of mitigation of CO2 emissions, yet still consistent with the objective of security in supply (Losekann & Tavares,2019:28).

In addition to the celebration of auctions ensuring new capacity in the field of renewable sources, Brazil offers differentiated financing programs for renewable sources such as wind and solar. Particularly, financing is favorable for projects with high levels of national content. As can be seen in the projections of the graph 1, these two sources could possibly be the ones that would prevail in the new capacity that is to be installed until 2040 (Losekann & Tavares,2019: 28).In the theoretical lenses of strategic diplomacy, this represents an entry point for further cooperation for development on wind and solar sources.

Figure 1. Brazilian Electrical Grid (2016-2040)

[14] https://noticias.uol.com.br/colunas/jamil-chade/2020/12/02/desmatamento-no-brasil-ameaca-seguranca-nacional-alerta-conselho-militar.htm

[15] https://www.dw.com/en/brazil-amazon-rainforest-fires-surge-in-july/a-54405259



Source: WEO/IEA 2018

2.2.1 Water Power

The interconnected Brazilian electric grid consists mostly of Hydroelectric Plants (UHEs or HPPs), many of them with regularization reservoirs, and thermal power plants. This hydrothermal system is linked to the wide transmission network that connects a large part of the country thus allowing the dispatch by the National Electric System Operator (*Operador Nacional do Sistema Elétrico*, ONS). Besides that, it considers the needs related to system safety and quality of the electric power supplied (National Energy Plan 2050 ,2018:1).

The Brazilian governance on energy greatly benefits from hydropower due to its large territory and water potential. Thus, it is not hard to see that in the economic sphere, hydropower is a strategic way to follow the country's electricity demand[16].

Hydropower accounts for 65% of the installed capacity of Brazil's generation park, in addition to 80% of total generation in 2017. Bearing in mind that it is a renewable and economically competitive energy generator, HPPs have operational flexibility, making it an important element to demand fluctuations. It is worth noting the low gas emissions from the hydropower plants (National Energy Plan 2050 ,2018:1).

As for the installed capacity of the hydroelectric plants and hydroelectric projects smaller than 30 MW, the Brazilian territory presents an inventory and unexploited

[16] Interview with first secretary Ms. Clarissa Maria Forecchi

hydroelectric potential of 52 GW, in a total of 196 HPPs (EPE, 2018). It is worth noting that such potential accounts for about half of the actual installed capacity of hydroelectric plants in Brazil, of approximately 100 GW. Taking the HPPs into account, about 77% of these 52 GW interfere in legally protected areas, such as indigenous lands (TI), quilombola territories (TQ) or units of integral protection conservation (UC PI) or sustainable use (UC US) (National Energy Plan 2050,2018:7).

In terms of installed capacity expansion, the hydraulic plants added 3,350 MW or 49.5% of the total. Nevertheless, in 2017, hydroelectric generation had its share reduced by 2.6% compared to 2016 (BEN, 2018, pp. 15-19). In 2018, water power generation increased 4.9% in Brazil compared to 2017 and was equivalent to 66.6% of the domestic supply. In the expansion of installed capacity, hydraulic power plants contributed to 3,864 MW or 67.5% of the total added (BEN, 2019:15-18).

Meanwhile, challenges such as the exploitation of the remaining potential in the Amazon (development of projects on the Xingu/ PA River, Tapajós and its affluents Juruena and Teles Pires, Madeira/RO and its affluent Aripuanã, Jari, Branco, as well as revisions of hydroelectric inventory studies of the Araguaia and Tibagi); the high investment costs of large-scale projects and the gap between new hydroelectric plants and large consumption centres are matters that Brazil needs to deal with. Moreover, the lack of operational flexibility and energy storage, the effect of climate change on hydrological regimes, and the system's vulnerability to fluctuations are elements that make water power generation less attractive (National Energy Plan 2050,2018:1).

Most of the water potential in Brazil is in the North, where the projects are *"fio d'água"*[17] ("thread of water") and have a high level of dependence on the rainfall regime. This means that there are no significant earnings from energy flexibilization in these conditions. Despite the hydroelectric source being relatively stable, there is a slight tendency to decrease its growth[18]. The following chart 2 illustrates this argument by showing data from 2016 to 2018:

Table 6: Allocation of domestic energy supply - OIE

[17] Unlike the Itaipu Power Plant, where a series of waterfalls manage to regulate the electricity generation, *"fio d'água"* power plants are those located on flat land (Forecchi,2020).

[18] Interview with Ms.Clarissa Forecchi on 26/03/2020

Year	Hydraulic Power
2016	12.6%
2017	12.0%
2018	12.6%

Source: The author, based on Relatório Síntese BEN 2017, Relatório Síntese BEN 2018 and Relatório Síntese BEN 2019.

On the one hand, some projects sound feasible for the country's energy security and the maintenance of a low-carbon power grid, such as the Belo Monte power plants. On the other hand, these projects sharply aggravated the opposition to new Hydro projects due to negative externalities on biodiversity, the precarious public governance; the lack of structure in municipalities in the North and the vulnerability of indigenous peoples and traditional communities (National Energy Plan 2050,2018:2). Those negative externalities are tipping points due to their capacity to change general support to hydropower projects of Brazil (Barros-Platiau, Soendergaard, Barros & Oliveira, 2018:70-71).

2.2.2 Solar Power

Brazil possesses a high potential for solar energy generation due to large territory and geographical location. Besides that, the country is a strategic player in Latin America regarding its market for solar panels (Bellini, 2018). However, this potential is not adequately developed (Bezerra, 2018: 4). In this regard, both Brazil and Germany could benefit from bilateral cooperation, bearing in mind Brazil's geographical location, German investments and energy production efficiency. This is a promising Brazilian market for Germany, which is already competing with China.[19]

It is worth noting that over the past three years one of the largest growth expansions of energy generation, alongside wind and biofuels, has been solar generation, which grew significantly between 2017 and 2018 (Anuário 2018, 2019: 7). In 2017, for example, the installed capacity in Brazil was 935 MW. The year 2018, in turn, presented photovoltaic power corresponding to 1.798 MW (BEN,2019).

In 2017, the solar power source accounted for 46.2% of the energy derived from Micro and Mini Generation Distributed. Driven by regulatory actions that enabled the

[19] https://www.cleanenergywire.org/factsheets/key-stakeholders-germanys-energiewende

compensation for the excess energy produced by smaller systems (net metering), these minor generations reached 359.1 GWh with an installed capacity of 246.1 MW (Relatório Síntese BEN, 2018:19).

The installed capacity of photovoltaic (PV) energy in Brazil had a modest growth until 2017; it increased in 2018, doubling the share of the electric capacity between the two years, from 0.7% to 1.4% in the energy grid. This rise in solar energy is likely the result of the decline in the price of solar modules and the implementation of plants for photovoltaic system components in Brazil. A research conducted by Ipea (2018) shows that, on average, the cost of photovoltaic generation is lower than the cost of energy supplied by distributors in the residential tariff with taxes in all Brazilian municipalities (IPEA, 2019:11-21).

Concerning distributed generation[20], three of the states with the highest installed capacity (MW) are in the South and Southeast regions, as shown in Table 3. The centralized generation, in turn, has 64.5% of its installed capacity in the Northeast region. According to Dr Francisco Diniz Bezerra (2018), the Northeast is the region that has the best conditions for the generation of photovoltaic energy because it has the lowest variability of solar irradiation during the year (Bezerra, 2018:5). It implies an entry point for partnership between Brazil and Germany, bearing in mind the strategic position of the former to produce solar energy.

Mindful of this, the installation of solar panels is a viable and sustainable alternative for remote communities. It would expand the structure required to modernize the energy supply in these communities, in other words, improve the quality of life and meet the goals proposed by SDG 7(UNDP,2016:15).

Table 7: Installed Power (MW) of Distributed Solar Photovoltaic Generation per Federative Unit(2018)[21]

Federative Unit	**Installed Power (MW)**	**Percentage**
MG	62.0	21.9%
RS	40.3	14.4%
SP	36.8	12.9%
SC	18.2	6.41%

[21] https://www.aneel.gov.br/documents/656877/16832773/4+-+ABSOLAR+GD+Solar+Fotovoltaica.pdf/f0d41ea4-4bba-8cf8-fb02-b864dc83c293.

CE	17.7	6.23%
PR	16.3	5.75%
RJ	15.1	5.31%
GO	9.3	3.29%
PE	8.5	3.01%
BA	6.8	2.40%
RN	6.5	2.31%
MT	6.0	2.13%
PI	6.0	2.11%
ES	5.3	1.87%
DF	5.2	1.86%
PB	4.9	1.74%
MS	4.8	1.71%
MA	3.9	1.40%
PA	2.5	0.90%
SE	1.9	0.68%
AL	1.4	0.52%
TO	1.1	0.40%
RO	0.7	0.27%
AC	0.3	0.13%
AM	0.3	0.13%
AP	0.3	0.12%
RR	0.2	0.09%

Source: The author, based on ANEEL/ABSOLAR, 2018.

2.2.3 Wind Power

Within the clean energies, the wind power source is the one that has shown the greatest development in Brazil. In 2013, it accounted for only 1.7% of the Brazilian energy grid, approximately 2,202 MW of installed capacity. By December 2018, it witnessed an increase to 8.8%, that is, it reached 14,401 MW of installed capacity (IPEA, 2019:14).

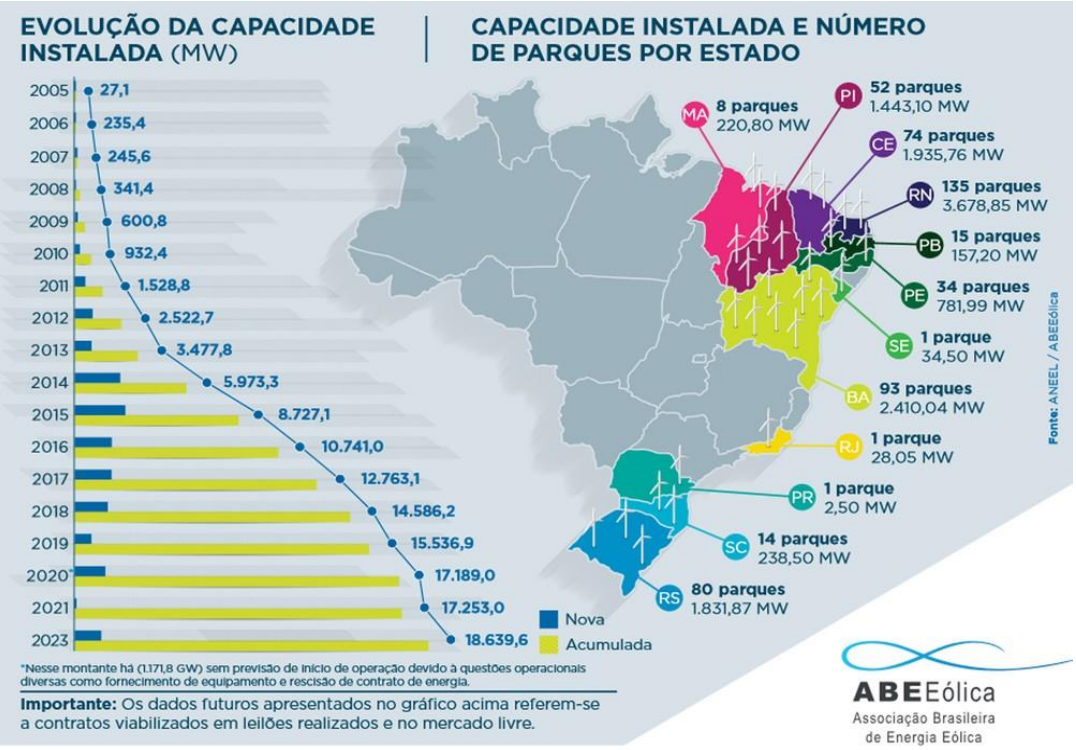
On a national basis, Brazilian generation is distributed in over 642 plants, with more than 7,000 wind turbines, in twelve states with a major presence in the Northeast region of the country, where 83% of wind farms are installed (IPEA, 2019: 23). The mentioned region is suitable to exploit Eolic energy, thus being an entry point for foreign investments. Globally, Brazil is the eighth largest producer of wind energy on the planet, according to the Global Wind Energy Council (GWEC) ranking of 2018 (IPEA, 2019:14).

The Brazilian wind farm greatly expanded by the end of 2017 (BEN, 2018:19-20). In 2017, the percentage of renewables in the electricity grid reached 80.4% due to the rise in wind power supply, which grew by 26.7% if compared to 2016 (Sintese Report, 2018: 6). In general, the production of electricity from wind power amounted to 42.373 GWh in 2017. Meanwhile, wind energy generation in 2016 was lower, hitting 33.489 GWh. In 2018, wind generation had a less expressive growth than the previous year, reaching 48.475 GWh - 14.4% growth in energy generation. While the wind plants expanded about 21.3% in 2017, the installed power for wind energy in Brazil rose only 17.2% in 2018 (BEN, 2019:20).

This growth in wind power sources in the last few years can be attributed to Brazilian economic strategies, such as the tax exemptions in support of the wind industry. That encourages the construction of wind farms and promotes the wind turbine production chain since taxes on wind investments make wind power generation more expensive by ranging from 25.7% to 32% (IPEA, 2019, p.16). Besides, another strategy is the policy of encouraging auctions for the purchase of electricity, coordinated by the federal government, which have contributed to achieving the targets for reducing emissions assumed by Brazil in the Paris Agreement (IPEA, 2019, p. 17). The state of Pernambuco, for example, allows exemption from the Tax on the Circulation of Goods and Services (ICMS - 13.6% to 17%) for companies involved in the assembly and supply of components for wind turbine producers. The government of Maranhão also grants ICMS exemption on the purchase of equipment for the use of wind energy (IPEA,2019:17).

The number of wind farms in the Northeast region, which has 412 wind farms, is noteworthy, as shown in the graph below from the Associação Brasileira de Energia Eólica. The Northeast has considerable potential for electricity generation. Nevertheless, national resources are lacking (Ministério da Economia,29/01/2020)[22]. Thus, there is room for a diplomatic strategy that seeks financial funding to exploit regional capacity.

Figure 2. Map of Wind Energy Installed Capacity in Brazil (2018)[23]



Source: Globo and ABE Eólica, 2018

2.2.4 Biofuel

Brazil has been substituting oil for ethanol since the 1970s, thus playing a pioneering role in the promotion of biofuels. Regarding its actions on the field of global renewable governance, biofuel is the spearheading theme for the Brazilian strategic diplomacy (Roehrkasten,2015:170). Brazil sees bioenergy as a State policy, which makes investments in the agro-industrial sector easier and stimulates research in clean energy sources and development Biofuels International, 2020). This is one of the national endpoints.

The strategic diplomacy of Brazil strongly emphasizes the importance of biofuels to climate protection, sustainability and socio-economic development for countries from

[22] https://www.gov.br/tesouronacional/pt-br/divida-publica-federal/sobre-a-divida-publica/por-dentro-das-contas-da-divida

[23] https://g1.globo.com/ultimas-noticias/noticia/brasil-atinge-8o-lugar-em-ranking-mundial-de-energia-eolica.ghtml

the global South, because those countries often have favourable natural conditions for the production of biofuels. Thus, biofuels are a promising sphere for South-South cooperation and enhance the partnerships between Brazil and other developing countries, particularly on the African continent (Roehrkasten,2015:.174-175).

In 2017, biodiesel (B100) production in Brazil grew 12.9% over 2016, reaching 4,291,294 m3. According to data from the Ministry of Agriculture, Livestock and Supply (MAPA), sugarcane production in 2017 was 635.6 million tons, which represented 5.2% less than in 2016, when milling amounted to 670.6 million tons. In 2017, domestic sugar production was 38.1 million tons, down 2% from the previous year, while ethanol production fell 2.1% to 27,693.7 thousand m3. From this total, 57.8% concerns hydrous ethanol, or 15,998.5 thousand m3 (BEN, 2018:14).

The following year recorded a 24.7% growth in B100 production, amounting to 5,350,036 m3. The percentage of B100 compulsorily added to mineral diesel reached 10%. The main raw material was soy oil (63%), followed by beef tallow (12%). MAPA estimates that sugarcane production in 2018 reached 624.5 million tons, a drop of -1.7% compared to 2017 when milling was 635.6 million tons. Brazilian sugar production also declined by 23.1%, while ethanol production increased 19.9% to a total of 33,198,000 m3. In comparative terms, there was a significant 48.1% increase in the production of this fuel over 2017. Production of anhydrous ethanol, which is blended with A gasoline to form C gasoline, fell 18.7% to 9,505,000 m3 (BEN, 2019:14-15).

The consumption of fossil diesel oil shrank - 1.3% that same year, in addition to the reduction of -13.1% in automotive gasoline. The Transportation sector accounted for 76% of the final energy consumption of diesel oil in 2018. It is noteworthy that although fossil diesel consumption decreased, the sum of diesel and biodiesel consumption grew 1.1% compared to the previous year. (BEN, 2019:19). The table below illustrates the growth of biofuels consumption in the Brazilian market between 2017 and 2018.

Table 8: The growth of biofuels consumption (2017-2018)

	2017	**2018**
Firewood	16.687 10^3 tep (toe)	16.758 10^3 tep (toe)

Sugar cane bagasse	29.126 10^3 tep (toe)	27.52910^3 tep (toe)
Biodiesel	3.313 10^3 tep (toe)	4.17410^3 tep (toe)

Source: The author, based on BEN 2019

Because of this expansion of biofuels in Brazil, the country has contributed to the spread of bioenergy production in the world, since the substitution of fossil fuels contributes to the reduction of pollutants, the generation of income in rural areas and the incorporation of technologies in agriculture, which are endpoints. It is also important to point out that Brazilian action has already resulted in a series of feasibility studies for the production of biofuels, carried out in African and Central American countries as a result of bilateral, trilateral or regional cooperation initiatives, as well as the receipt and sending of numerous bilateral technical missions (Cadernos ODS 7, 2019:13).

One of the most important state policies for the expansion of biofuels is RenovaBio, instituted by Law 13.576/2017. This policy aimed at developing a joint strategy to recognize the role of all types of biofuels (ethanol, biodiesel, biomethane, biokerosene, second generation, etc.) in the Brazilian energy grid, both in terms of their contribution to energy security, with predictability, and mitigation of greenhouse gas emissions reduction in the fuel sector (Presidência da República, 2017, art.1 -art.3).

The agro-industrial yield is intrinsic to RenovaBio. In 2019, sugarcane ethanol production in Brazil surpassed that of corn ethanol in the United States, the world's largest producer of ethanol, which is approximately 4,157 litres of anhydrous ethanol per hectare, equivalent to 4,309 litres of hydrous ethanol per hectare (Explanatory Note to the Proposal for the Creation of the National Biofuels Policy, 2017: 117). It is noticeable that the direct cost of manufacturing sugarcane ethanol is directly related to the investment in the foundation of the plantation, to the crop treatments carried out annually to maintain the crop; and to the costs of cutting, loading and transportation (CCT) from the field to the mill (Explanatory Note on the Proposal for the Creation of the National Policy on Biofuels, 2017:118).

In 2019, 46% of automotive gasoline consisted of ethanol in gasoline-equivalent. This was achieved by blending ethanol with gasoline in the proportion of 27% and using ethanol in the flex-fuel fleet, which already represents 80% of the lighter vehicle fleet. In the field of biodiesel, as of March 1, 2020, the ANP allowed the introduction of a mandatory blend of 12% biodiesel in all fossil diesel in Brazil, which represented a great example worldwide. In 2020, Brazil and the international community face a moment of economic, social and health crisis. According to ANP Director, Aurélio Amaral, it is natural that economic agents try to reduce costs, which could affect the consumption of biofuels (Renovabio: implementation in the crisis Covid-19 11/04/2020)[24].

2.2.5 Others

The energy shift and Agenda 2030 are subjects of major importance in the current international scenario given the need for a global response to climate change. Brazil contributes to this response with massive investments in green energy within its energy grid. Furthermore, the country shows interest in other forms of renewable energy besides hydroelectric plants, solar panels, wind turbines and biofuels. Of these other options, ocean energy and the feasibility of implementing hybrid plants on the national territory are noteworthy.

In the first place, ocean energy includes tidal power, omnomotriz, thermoceanic, hydrokinetic and osmotic, all of which are technically feasible in Brazil according to the Working Group of the Electric Sector (Ordinance no. 187/2019), taking into consideration the Brazilian coastal extension of more than 7,400 km. In the last years, the debate concerning the exploration of these forms of energy has been gaining space. The Maremotriz potential available along the Maranhão-Pará-Amapá coast (Eletrobras, 1981), for example, is 27,000 MW in 41 hydroelectric plants. In other words, the stretch cited represents a high potential for Maremotriz energy production and can contribute to access to clean energy in the region.

There are an estimated 87 GW of domestic power in Brazil. The thermo-oceanic energy potential, in contrast, is located in the intertropical zone, where there is great potential for energy generation, especially in the Brazilian exclusive economic zone. It is the ocean energy source of higher disposition; OES indicated it as a promising technology with the capacity to cause disruptions in the energy sector. Marine and Osmotic Hydrokinetic energies, on the other hand, are still in an incipient stage of development (Ordinance nº 187/2019 Report of the Thematic Group Insertion of New Technologies, 2019: 12).

[24] http://www.ceisebr.com/conteudo/renovabio-implementacao-na-crise-covid-19.html

Secondly, several proposals for the implementation of hybrid plants in Brazil are gathering prominence, even with some initiatives such as the Auction nº01/2019 - ANEEL. A hybrid power plant is a plant that uses more than one primary source for the generation of energy to provide economic, operational and socio-environmental gains. The combinations among the sources can be diverse and can be wind with solar photovoltaic, coal and biomass or biomass among others. In many cases, it is noted the presence of some complementarity between the sources, the possibility of optimization of operating and investment costs, especially in connection, and the reduction of socio-environmental impacts, especially in combinations of wind and photovoltaic plants (Ordinance No. 187/2019 Report of the Thematic Group Insertion of New Technologies, 2019: 6).

Lastly, since 2008, China's presence in the Brazilian electricity sector has been growing. The pioneering Chinese companies consolidated as investors in the Brazilian electricity sector are Zhejiang Electric Transmission Power & Transformation Corporation of China, China Cable Corporation and Zhejiang Shengda Steel Tower Company (Urrejola,2018:137). The participation of China Three Gorges Corporation (CTG) is also considerable[25].

2.3 Major bodies and companies involved

The participation of companies and institutions in Brazil's energy transition is of extreme importance, bearing in mind the country's energy security. Companies, institutions, ministries and collaborative projects are key factors in Brazil's energy grid in the face of the reduction of greenhouse gas emissions and, consequently, observance of the duties assumed in the Paris Agreement (2015).

At the federal level, Brazil has a variety of energy efficiency programs/actions, among which is the Brazilian Labelling Program (PBE), coordinated by the National Institute of Metrology, Standardization and Industrial Quality (Inmetro). Besides, there

[25] According to Urrejola (2018):
"In 2017, considering the association or purchase of assets from other companies in the electricity sector around the world, China Three Gorges Corporation (CTG) is the world's leading producer of hydroelectric power, present in 40 countries, also investing in wind and solar energy. In 2011, the acquisitions promoted by CTG in Portugal have a direct impact on the generation market in Brazil, since the company Energias de Portugal - EDP, present in the country since 1999, had already consolidated a relevant number of projects in the area of generation in Brazil" (Urrejola,2018:148).

is the National Program for the Conservation of Electrical Energy (Procel), an initiative of the federal government linked to the MME and executed by Centrais Elétricas Brasileiras S.A. (Eletrobras) who, through the Procel Seal, indicates the most efficient equipment in energy consumption.

Regarding non-renewable resources, the National Program for the Rationalization of the Use of Petroleum Derivatives and Natural Gas (Conpet) is noteworthy, whose objective is the efficient use of fuels. The Energy Efficiency Indexes Management Committee (CGIEE) is responsible for establishing minimum energy efficiency indexes in equipment sold in Brazil, coordinated by the MME; established by Law 10,295/2001. It is also important to highlight the Energy Efficiency Program of ANEEL, established by Law 9,9991/2000, which defines resources for application in energy efficiency projects to be developed within the concession area of each electric energy distributor.

When it comes to the economy, it is important to bear in mind that the country's energy capacity reflects on productivity. It is a widely used indicator as a proxy for energy efficiency of the economy as a whole. In other words, the lower the energy intensity, the higher the efficiency in converting energy into products and services. This indicator is useful for conducting international comparisons, such as between Brazil and Germany.

The energy efficiency of systems, structures, processes and equipment accounts for cuts in energy consumption and thus in long-term costs, lower spending on the energy production park and lower environmental impacts. At the present moment, there are several players involved in the maintenance, research and improvement of the current Brazilian energy grid. Those major bodies and companies are from the public sector, the private sector and civil society.

The public sector is primarily active in the development of policies for energy consumption and supply, the implementation of power plant/park projects in the states of the Federation (large scale), international cooperation within the framework of foreign policy and technical research in the field of energy sources. From this sector, the most prominent agents are the National Electrical Energy Agency (ANEEL) / PEE, the Electric Energy Research Center (Cepel), Centrais Elétricas Brasileiras S.A., Eletrobras/ Procel, the Energy Research Company (EPE), the Ministry of Science, Technology, Innovation and Communications (MCTIC), the Ministry of Regional Development (MDR), the Ministry of Economy (ME), the Ministry of Environment (MMA), the Ministry of Mines and Energy (MME) and the Ministry of Foreign Affairs (MRE).

Another major player on the Brazilian scene is civil society. According to the publication "Who is Who of Energy Efficiency in Brazil" (2019), by the Ministry of Mines and Energy in partnership with the German Cooperation for Sustainable Development, the International Energy Initiative (IEI Brazil) and the Institute for Climate and Society (iCS) are leading figures. The impact of civil society can also be seen in academia, such as the Laboratory for Energy Conservation and Environmental Comfort (LabCECA), the Center of Excellence in Energy Efficiency in the Amazon (CEAMAZON) and the Center for Innovation in Energy Efficiency (InovEE).

2.4 Installed Capacity

The legal competence of the Federative Republic of Brazil is perceived as the regulatory basis of the Brazilian energy grid. In the last two decades, Brazil implemented a wide range of bodies, policies and programs to increase investments in renewable energy for electricity generation.

Following data on the performance of the National Electrical Energy Agency (ANEEL) in the concession, regulation and inspection of the power generation, there was an increase of 7,246.41 megawatts (MW) of installed capacity in Brazil in 2019, surpassing the target of 5,781 MW. Overall, the power monitored in that year was 170,071 MW, of which more than three quarters were from renewable sources (ANEEL,2020).

It is noteworthy that the hydroelectric capacity of the rivers was one of the largest propellers of a major part of the energy generated in Brazil in 2019, reaching a total of 4,839 MW. From this total, 4,755 MW was generated by large hydroelectric plants, such as Belo Monte. Regarding other renewable sources, there was an increase of 971 MW in wind power generation and 551 MW generated by large photovoltaic plants. Thermoelectric plants, in turn, added 776 MW to the Brazilian energy matrix (ANEEL,2020).

3. German Energy Grid

In the last 50 years, the energy policy of Germany has fluctuated from enthusiasm for nuclear power plants and coal to a growing concern with sustainability. This newly found scepticism represents a reaction to nuclear accidents, such as the incident at Three Mile Island in the United States, the nuclear meltdown at Chernobyl and the accident in Fukushima, Japan. In the 1960s, concerns about the effects of coal pollution in the atmosphere and the "Waldsterben" (dieback of forests) also influenced changes in the German energy policies at the time (Renn & Marshall, 2016: 1)

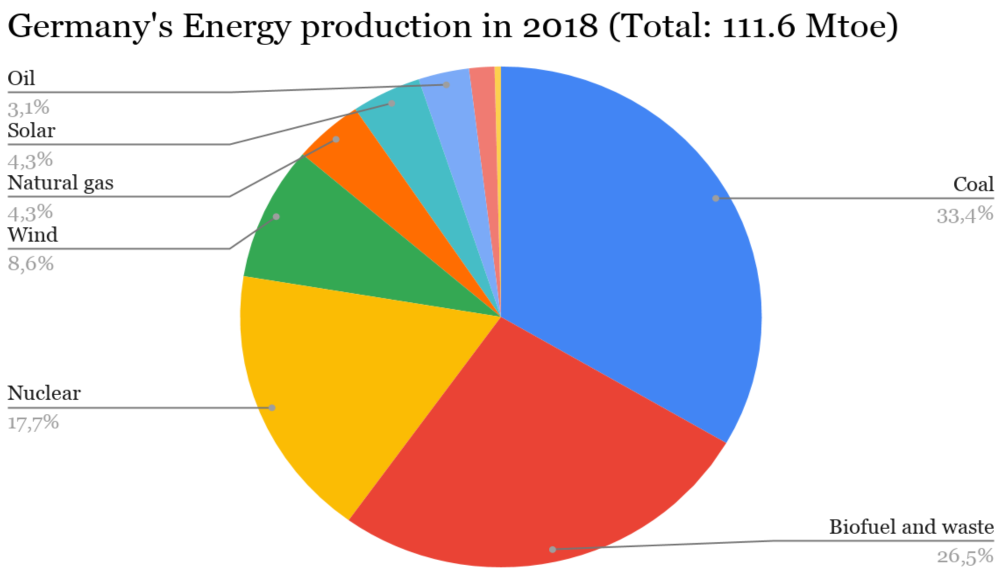
The Federal Republic of Germany is currently investing in its energy transition to cleaner sources. For the past decade, the "Energiewende" ("energy shift" in German) has been an important part of Germany's energy policy and strategic diplomacy. It is a plan to increase the share of renewable sources in the country's energy grid and decrease electricity generation from nuclear power plants by the end of 2022; so far, this has been successful (IEA Energy Policy Review, 2020).

According to Roehrkasten (2015), the environmental debate, especially concerning climate protection, is the leading aspect of the strategic diplomacy of Germany on energy. It is also a key point of the country's position on global renewable energy governance. Former Foreign Minister Guido Westerwelle (FDP, 2009–2013), in his speech at the third IRENA Council meeting, argued that renewable energy is intertwined with mitigating climate change – to borrow his words, "a matter of high political priority in Germany" (Roehrkasten, 2015: 138). It is then not hard to see that the German government highlights the improvement of regulatory frameworks within countries for the promotions of green energy sources (Roehrkasten, 2015:152).

Yet coal still represents nearly one-third of Germany's electricity, in which more than half of that depends on burning lignite (BBC,2020)[26]. The chart below illustrates this information.

Figure 3: Germany's Energy Production in 2018

[26]https://www.bbc.com/news/world-europe-51133534#:~:text=The%20German%20government%20and%20regional,depending%20on%20the%20progress%20made.



Source: The author, based on IEA,2020

The Energiewende is based on the 2010 Energy Concept, which was a guiding set of principles such as affordability, energy security and environmental protection (IEA, 2020:26). In nearly a decade, the Energiewende has been changing the German energy system into a more sustainable one. In other words, Germany aims to achieve its endpoint of a low-carbon, nuclear-free energy grid by the middle of the century (IEA Energy Policy Review, 2020). Besides that, the European internal energy market and the German security supply are driving economic forces for the green transformation of the country's energy grid, following the SDG 7, the SDG 13 and the SDG 17 (Federal Foreign Office,2020).

Regarding the European internal market, Germany is developing strategies to enhance efficiency and increase the share of renewable energy in Europe, which in turn stimulates the German domestic growth of green energy sources (IEA, 2020: 133). Bearing in mind that security of supply is intertwined with the share of underground electricity cables, it is not hard to see why it is another key point for the energy system. According to the Council of European Energy Regulators (CEER), the German security of supply is one of the best in Europe, second only to Switzerland. In Germany, most of its 1.8 million kilometres of cables - around 80% -are buried, whereas, in Brazil, there are three of the world's longest power transmission lines (Power Technology,2020). This type of electricity cable largely used in Brazil is more vulnerable to being disrupted, (Clean Energy Wire, 2020).

Since November 2016, the German government has been actively engaged in the Climate Action Plan 2050. Another endpoint is to become extensively greenhouse gas-neutral by 2050, based on the target in the Paris Agreement to achieve global greenhouse gas neutrality in the second half of the century. For the Climate Action Plan 2050, there are three levels to be addressed to achieve the transformation to a low-carbon economy in Germany. The first is related to innovations to maximise sustainability; the second outlines path dependencies and interdependencies; and the third one highlights goals, especially such as the Agenda 2030 and the target of at least 55% reduction of GHG emissions in 2030 when compared to 1990 (BMU, 2020).

Yet, despite optimistic results on lowering overall emissions, it is still not enough for its near-term emissions reduction targets, partly due to challenging sectors in Germany, such as transport and heating. The country is highly dependent on oil, natural gas and electricity supply security. Whilst there is a decline in nuclear power generation, that could possibly increase the country's reliance on natural gas (IEA Energy Policy Review, 2020).

On the one hand, to borrow the words of the German Environment Minister Svenja Schulze, Germany is committed to exiting from nuclear and coal; the country also aims to generate at least 65% of its electricity from renewables by 2030. On the theoretical lenses of strategic diplomacy, this goal might represent an entrypoint to bilateral partnerships with countries that hold a mostly sustainable energy grid, such as Brazil. On the other hand, Germany is the world's biggest lignite producer, which is a high pollutant type of coal (BBC, 2020). According to the EU's Eurostat agency reports, consumption of lignite in Germany was 44% of the total in the EU in 2017, followed by Poland (16%), the Czech Republic and Greece (both 10%), Bulgaria (9%) and Romania (7%) (BBC, 2020). Overcoming this challenge requires cooperation with other countries, as proposed by the SDG 17. Between 2008 and 2018, Germany was among the largest net energy importers in absolute numbers in the EU. According to Eurostat data (2020)[27], Russia is the EU's main supplier of major primary energy products.

[27]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_production_and_imports/pt#A_UE_e_os_seus_Estados-Membros_s.C3.A3o_todos_importadores_l.C3.ADquidos_de_energia

3.1 The German energy grid in 2017-2019

Over the past three years, renewable energy sources such as wind power grew in Germany. However, the German population still heavily relies on fossil fuels. In 2017, oil accounted for 41% of total final consumption (TFC), whilst natural gas was 24% of TFC and electricity accounts for 20% out of 227 Mtoe of 2017's TFC. The residential and commercial sectors consumed 40% of TFC, the industry sector 35% and, lastly, the transport sector consumed 25% (IEA, 2020:19).

In the base year 2018, the total domestic energy production of Germany was 112 Mtoe, which represents over a third of the total primary energy supply (TPES- was 298 Mtoe) of that year. Despite coal being the most produced energy source in the country, it is not enough to supply the domestic demand, hence half of the country's coal supply is imported. In that same year, bioenergy and waste were one of the largest shares of domestic production, second only to coal. Half of this generation was applied in the transport sector (8% of total bioenergy supply), in the industrial sector (13%) and for heating (28%) (IEA, 2020:19).

Regarding energy transition, wind and solar are the fastest-growing renewable sources in Germany, followed by biomass and hydropower (IEA, 2020: 29). In 2017, wind power became the second-largest source of electricity generation before both nuclear and natural gas (IEA, 2020:13). It is noteworthy that a considerable amount of Eolic electricity is generated in the north and the east of Germany, as well as at sea because of proper environmental conditions. However, the main electricity consumers – such as large industrial operations – are in the German south and west (BMWi, 2020). It is not hard to see that coal, nuclear and most renewable energy sources are used in power generation, while oil and gas are used mostly in final consuming sectors.

Moreover, in 2017 the Federal Government of Germany invested nearly 1.01 billion euros on research and development of technologies for sustainable energy production, following the SDG 7 and SDG 13. This represents a larger funding volume compared to the previous year (2016: 876 million euros) according to the Federal Ministry for Economic Affairs and Energy (Federal Ministry for Economic Affairs and Energy, 2018, 6). In the following year, Germany spent €1.06 billion in the Energy Research Programme (Federal Ministry for Economic Affairs and Energy, 2018:5).

The increase in investments in energy is partly due to the Paris Agreement and partly due to the 2017's Renewable Energy Sources Act, which sought to stimulate the financing of renewable energy towards more competition and greater cost efficiency. This narrowed the previous system of flat rates to smaller installations in Germany; thus, becoming more expensive and less required given that the costs of wind and solar energy fell rapidly. Higher capacity renewable energy sources such as onshore and offshore wind, large photovoltaic systems and biomass are currently needed to compete in auctions (BMWi, 2019).

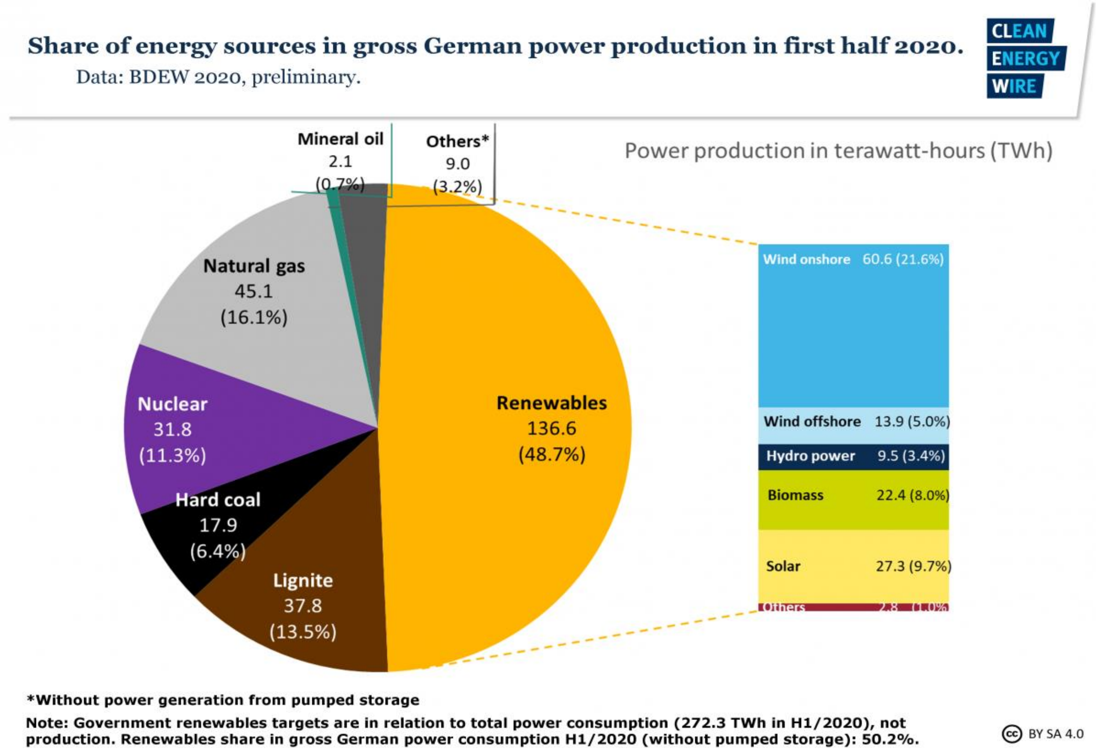
In 2019, the maintenance costs of the German electricity grid decreased to 1.2 billion euros in comparison to 1.4 billion euros in 2018, according to data from the Federal Network Agency (BNetzA). Approximately 2.8% of all the generated renewable energy got contained and Germany paid 709.5 million euros to renewable operators in return. Besides, onshore wind power plants were unable to supply the German grid with the entire electricity generated, due to the risks of overloading the grid, which led to 78% of electricity being suppressed. Offshore wind power, in turn, got 18% suppressed. The so-called re-dispatch measures required to balance the grid when electricity cannot flow freely due to grid constraints cost 291.9 million euros - about 38% less than in 2018 (Eriksen,2020).

3.2 Participation of renewable sources and the energy shift

In the past few decades, the share of renewable energy grew in the German grid, especially solar and offshore wind sources. Overall, the most significant increase was in electricity generation, in which clean energy emerged from below 5% in 1998 to 35% in 2018. It is important to point out that Germany is spearheading the development of rooftop solar photovoltaics (PV) and has been investing in biogas power and offshore wind power. However, despite the fast growth of green energy sources in its territory, Germany still needs to decrease the share of non-renewable in transport, buildings and industries (IEA, 2020:83).

Overall, the gross power production of the mentioned country in the first half of 2020 was 48.7% (136.6 TWh) made up of renewables. From that total, onshore wind represented 21.6% (60.6 TWh), offshore wind accounted for 5% (13.9 TWh), hydropower 3.4% (9.4 TWh), biomass 8% (22.4 TWh), solar 9.7% and other green sources 1% (2.8 TWh), as shown by the chart below:

Figure 4: Share of energy sources in gross German power production in first half 2020



Source: Clean Energy Wire, 2020

According to Hansen, Mathiesen and Skov (2018), previous ideas for the German energy transition were more focused on the Energiewende policy development than on the energy infrastructure. Policies are essential elements in shaping the future energy development; However, the 2018 legislation, for example, is not suitable to achieve the Energiewende targets until 2030, especially bearing in mind the current heating market (Hansen, Mathiesen & Skov,2018:1). It represents a tipping point on the strategic diplomacy of Germany, due to the 2018 legislation being a divergent action from the international position of the country. Thus stronger actions are necessary to decrease 55% of GHG emissions until 2030 (BMU, 2020).

Fortunately, there are signs that such measures will be applied. In 2020, Germany holds the chairmanship of the Council of the EU from July 1st to December 31st. The German presidency will propose ways to overcome the COVID-19 pandemic, bearing in mind the fighting against the spread of the virus, recovery of the economy, social cohesion and the European Green Deal (Federal Ministry of Finance, 2020). The latter, following the Agenda 2030, SDG 7, SDG 13 and SDG 17, has caught considerable attention. From a $145 billion recovery budget, Germany intends to allocate $46 billion in areas such as renewable power and electric vehicles (Kretchmer, 2020).

As part of the Energiewende and the European sustainable economic recovery, the German Bundesregierung is investing $10 billion on hydrogen technology and promoting this “petroleum of tomorrow” in the domestic sphere and regionally, aiming at carbon neutrality. Hydrogen has a noteworthy storage capacity as an industrial and vehicle fuel. Moreover, the Bundesregierung plans to allocate $9 billion for electric vehicle (EV) subsidies (Kretchmer, 2020).

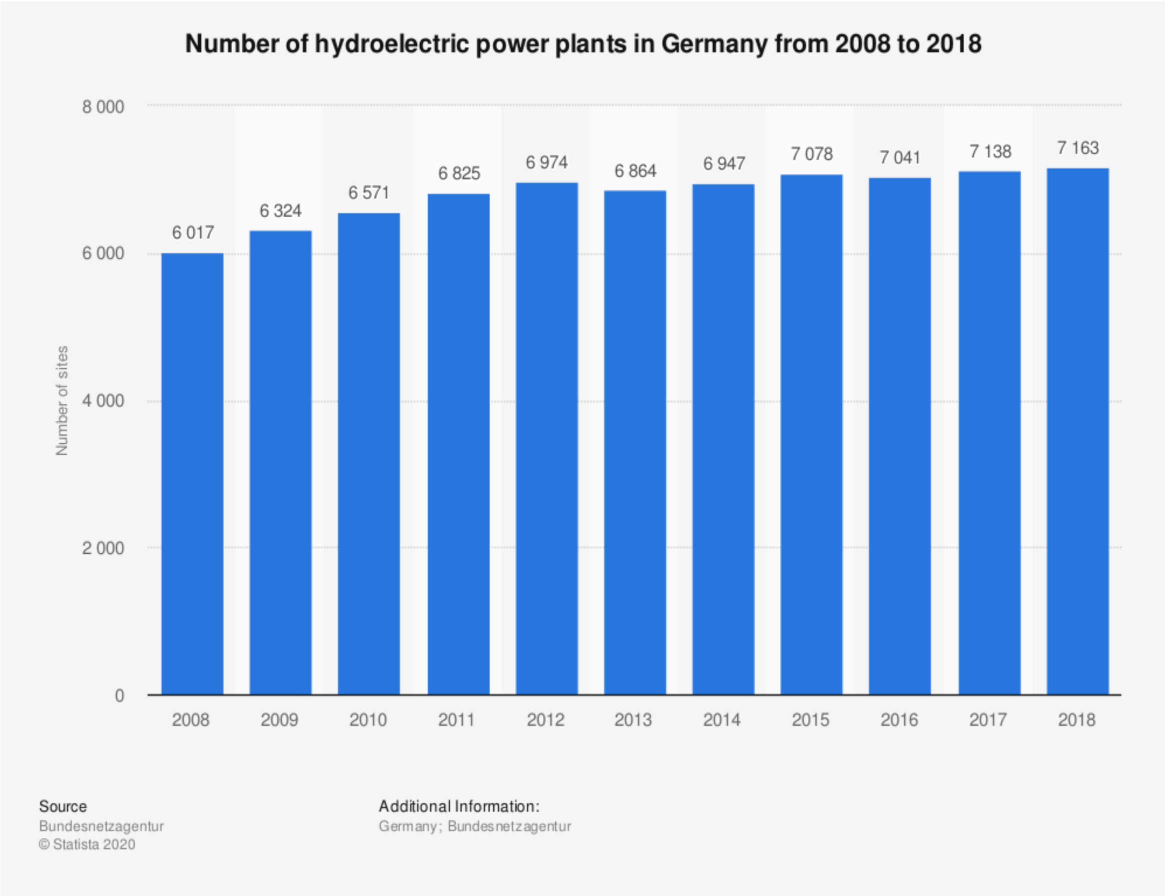
3.2.1 Water power

Germany is a major player in global hydropower development and is spearheading the shift to renewable power systems, bearing in mind the decrease of CO2 emissions and the Paris Agreement. For the past century, German companies have been building and operating hydroelectric power plants and sharing their technologies worldwide. It is noteworthy that German technology influences nearly half of all hydroelectric power plants (IHA, 2019). Currently, the coronavirus pandemic accentuated the flexibility of the hydropower sector and its capacity to produce clean and affordable energy.

Most of the potential for the exploitation of hydropower resides in the southern federal states, such as Bavaria and Baden-Württemberg, where the foothills of the Alps provide a suitable slope. In fact, the mountainous southern provinces hold the majority of the hydropower resources of Germany, bearing 50 per cent of all projects in Bavaria and 20 per cent in Baden-Württemberg; it is then not hard to see that these two states represent over 80 per cent of annual German hydropower generation (IHA,2019). The key- points for hydropower investments in Germany are the replacement, modernisation and reactivation of existing facilities as well as in the construction of new plants on existing transverse structures. In this regard, the Federal Government plans to increase output and improve the hydro-ecological situation, following the Agenda 2030 and the Paris Agreement (BMWi, 2020).

In total, there are almost 7,300 hydropower stations as shown by the chart below, from which nearly 6,900 have less than 1 MW capacity and about 6,000 have less than 100 kW (IHA,2019). Regarding storage capacity, according to data from 2019, Germany has 6.4 GW of installed pumped storage capacity (IHA,2020:13). In 2018, despite outdated regulatory frameworks, both the companies Engie Germany and RWE employed batteries associated with their pumped storage systems. Apart from enhancing the Pfreimd project[28], Engie installed a 12.5 MW lithium-ion battery on-site to supply additional fast frequency balancing services (IHA,2019).

Figure 5: Number of hydroelectric power plants in Germany from 2008 to 2018



Source: Bundesnetzagentur, 2020

Hydropower represents only a small share of the German energy grid, but will likely remain an important source because of its clean and reliable capacity. However, according to the Federal Ministry for Economic Affairs and Energy, growth rates for hydropower fall are slower than solar and wind energy growth rates due to geographical and environmental conditions, especially for large-scale plants (BMWi,2018:14). This means that hydroelectric plants do not have the same strategic weight as solar and wind sources.

[28] https://blog-tractebel.lahmeyer.de/2018/10/11/inaugurating-the-future-of-energy-storage/

3.2.2 Solar power

The photovoltaic power capacity of Germany has been growing for the past seven years. From 2013-2018, power plants with a nominal output of 1.8 GWp/a were installed in Germany. In 2019 this output grew to 3.9 GWp/a. It is noteworthy that in this same year, the annual target of the German Federal Government for PV expansion was surpassed and PV modules with a nominal output of 49 GWp were installed in the country, distributed over 1.8 million systems (BSW1). Overall, PV generated 8.2% of gross electricity consumption in that period, with an electricity generation of 46.5 TWh. (ISE Fraunhofer, 2020:5). The table below illustrates this data:

Table 9: Solar power expansion

	2013-2018	**2019**
Nominal Output	1.8 GW p/a	3.9 GW p/a
Gross electricity consumption	----------------------	8.2%
Electricity Generation	---------------------	46.5TWh

Source: The author, based on ISE Fraunhofer, 2020

The German strategic diplomacy is intertwined with its energy policy. Despite representing less than three percent of energy consumption on a global scale, the policy-making of Germany is spearheading incentive programs for renewable energy. However, the country might lose its leadership position in PV technology and production to China, since the last has a larger annual installed power than Germany (ISE Fraunhofer, 2020:51). The Chinese PV technology spur a competition on the Latin American market and is a tipping point due to its implications to the current set of circumstances (CEW, 2017).

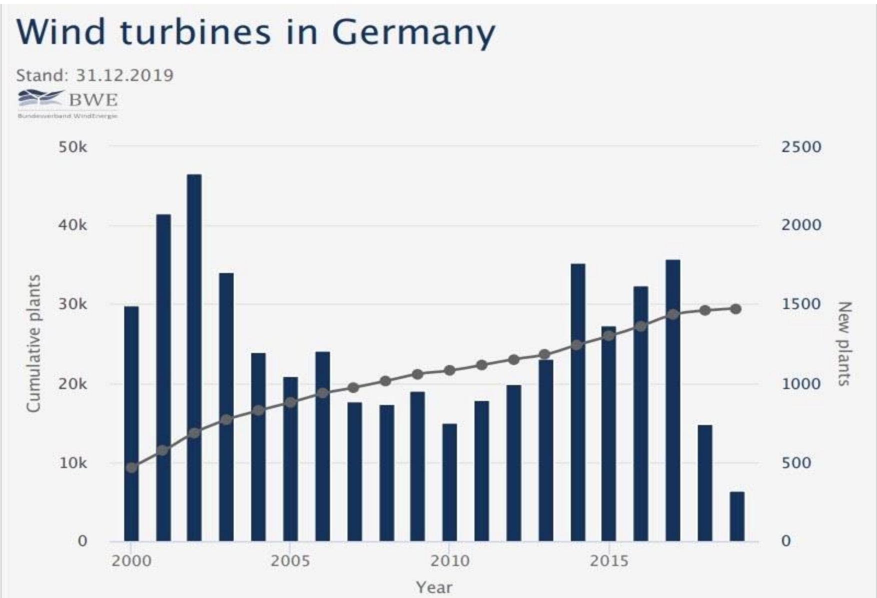
Concerning the German government position on strategic diplomacy, Roehrkasten (2015) argues that it is a win-win frame. Moreover, the BMZ (2008:28-30) defends the idea that solar energy has positive outcomes for enhancing access to energy in remote areas. Due to the low maintenance requirements, solar energy can be a reliable option in regions without connection to the national grid. Other advantages of solar energy, according to the German discourse, are the broad scope of application and low environmental impacts (Roehrkasten,2015: 146-147).

3.2.3 Wind Power

Germany is a central player in wind energy generation. According to Martin Robinus (2020)[29], the Head of Department Jülich Research Centre, eolic power is the central backbone of the energy transition. Thus, it plays a role in German strategic diplomacy on renewable energy. However, to accomplish this as cost-effectively as possible, wind turbines will have to supply more than half of green electricity in 2050 to achieve energy transition by 2050. In other words, Germany would need twice as many wind farms. In this scenario, the tipping point of frequent legal disputes and approval procedures are making expansion difficult. As with solar energy, eolic energy generation is also a win-win framework for the German government (Roehrkasten,2015:146-147).

In 2019, eolic energy accounted for the largest share of German electricity production, a total of 20.9% (AG Energiebilanzen, 2020). It is then not hard to see that wind energy is an important renewable source for the electricity generation of Germany, in front of nuclear energy and brown coal (BWE, 2020). The graph below illustrates the gross electricity production from onshore and offshore wind energy:

Figure 6: Wind Turbines in Germany



Source: BWE, 2020

Regarding onshore wind power, there were 29,456 onshore wind turbines in Germany by the end of 2019(Windguard Gmbh,2020). In that same year, 325 new

[29] https://www.youtube.com/watch?v=Qr5PEAK1t3U&t=20s

onshore wind turbines with a capacity of 1,078 MW were installed and the asset base increased to a total of 29,456. According to data from the Deutsche Windguard GmbH, the total installed capacity of onshore wind energy is 53,912 MW. The wind capacity of Germany is mostly in the northern part of the country, whilst the highest demand comes from the industrial areas of the German south and west. The former is dealing with power surpluses and the latter two are facing deficits due to network constraints to transmissions and delays in grid expansion (IEA, 2020:13).

3.2.4 Biofuel

Germany has concerns about the environmental consequences and outcomes for food security that biofuels production can cause. Thus, the country does not strongly promote this renewable source in its strategic diplomacy. Besides that, Brazil is not keen on Germany's policy on biofuels (Roehrkasten, 2015:5).

Nearly half of the bioenergy consumed in Germany comes from solid biomass (510 PJ) of which 245 PJ is used in the residential sector. Regarding biogas, it accounts for 339 PJ (31%) whilst biodiesel and bio gasoline account for 81 PJ and 31 PJ, respectively (IEA,2018:6).

3.2.5 Others

Among non-traditional renewable energy sources, Germany shows interest in green hydrogen technology. From 2006 to 2016, the country approved 700 million euros in funding under the National Innovation Programme on Hydrogen and Fuel Cell Technology. Moreover, between 2016 and 2026, the German Government plans to spend a total of 1.4 billion euros in funding of green hydrogen. Germany aims to establish a global hydrogen market due to their potential for renewable energy. At international level, cooperation with potential suppliers and other importers is seen as a tool to, on the one hand, decrease GHG emission and, on the other hand, promote sustainable development. (BMWi, 2020:3).

3.3 Major Bodies and Companies Involved

The Federal Foreign Office (AA) and the Federal Ministry for Economic Cooperation and Development (BMZ) are important bodies to promote cooperation and partnerships worldwide. Furthermore, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) also plays a role in international development and is responsible for programmes in the field of energy (Egenter,Russell & Wettengel, 2017).

Regarding financing, the KfW Development Bank is a major body for international development cooperation among Germany and other countries such as Brazil. It works for the Federal Foreign Office (AA), the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and the Federal Ministry of Education and Research (BMBF). However, its main client is the BMZ (KFW, 2020).

3.4 Installed Capacity

In 2015, Germany had the highest installed power plant capacity in Europe (BMWI, 2015). Years later, the country still retains a substantial installed capacity. According to data from the AGEE, the BMWi and the Bundesnetzagentur, the total installed capacity of Germany in the first half of 2020 is 213.70 GW. From that amount, solar energy accounted for 52.69 GW, whilst wind onshore represented 54.35 GW and wind offshore accounted for only 7.74 GW. Biomass, seasonal storage and run-of-river accounted for 8.23 GW, 0.98 GW, and 3.80 GW, respectively. Regarding non-renewable energy-sources, hard coal and brown coal together represented 43.49 GW. Besides that, mineral oil contributed with 4.36 GW to the total installed capacity of Germany, natural gas accounted for 29.93 GW and uranium, 8.11 GW (ISE Fraunhofer,2020). The table below illustrates this information:

Table 10: Installed Capacity of Germany (2020)

	2020
Solar energy	52.69 GW
Wind onshore	54.35 GW
Wind offshore	7.74 GW

Biomass	8.23 GW
Seasonal storage	0.98 GW
Run-of-river	3.80 GW
Hard coal and brown coal	43.49 GW
Mineral oil	4.36 GW
Natural gas	29.93 GW
Uranium	8.11 GW
Total	213.70 GW

Source: The author, based on ISE Fraunhofer, 2020

4. Conclusion

This study sought the factors behind the bilateral renewable energy cooperation between Brazil and Germany. From the standpoint of strategic diplomacy, the research has identified not only what are the tipping points and the entry points of both actors, but their different approaches to similar endpoints as well. In light of International Relations, it is possible to see that both governments place a high value on energy, which is a strategic subject. They bear interest in economic competitiveness, efficiency, energy security and environmental approach to advance in renewable energy.

The strategic diplomacies of Brazil and Germany concerning the promotion of green sources are inside an interconnected, non-linear and emergent global scenario. The Brazilian-German cooperation on renewable energy is shaped by interactions of external and internal elements. Their policies and actions towards climate change and the environment hold interdependence with energy transition.

Despite having similar criteria (such as economic competitiveness, affordability and environmental friendliness) and endpoints (such as energy efficiency, climate change mitigation, low-carbon economy and energy security), those actors adopt different approaches. Whilst Germany highlights economic growth, Brazil emphasizes economic development and competitiveness. On the one hand, the Brazilian government believes that the market should guide which policies will be adopted, not government subsidies. On the other hand, the German government states that sustainability and technological innovation are the primary conditions for supporting renewable energy.[30]

Both countries should bear in mind the entry points mentioned throughout this work to achieve their goals through bilateral cooperation. From the Brazilian view, the entry points are the possibility of foreign investment, wind and solar energy production capacity throughout the year in the Northeast region (Bezerra, 2018:5) and tax exemption incentives (IPEA, 2019: 17). This is clear since the installed capacity of photovoltaic (PV) energy in Brazil had a noteworthy growth between 2017 and 2018, especially in the Northeast. From the German perspective, entry points are the greater participation in the Latin American market for clean energy technology and access to and a viable source for the production and import of green hydrogen.

Nonetheless, this study takes as a baseline the year 2014 and the period from 2017 to 2019. Analyses and data concerning the year 2020 show considerable instability due to the COVID-19 pandemic, which affected the cooperation model adopted by Brazil and Germany until then (WFDFI, IDFC & AFD, 2020: 3-6). Additionally, the increase in deforestation in Brazil under the Bolsonaro government damage the international image of the country and increase uncertainties. In this context, climate and the security of national infrastructures, such as hydroelectric power plants, are at serious risk[31].The questions not answered in this essay require future research.

On energy transition, it is not hard to see that Brazil and Germany were committed to the pace and coverage of investment in renewable energy, energy efficiency and equitable access to clean energy before the COVID-19 pandemic. The promotion of

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[30] Roehrkasten , 2015: 229.

[31] https://noticias.uol.com.br/colunas/jamil-chade/2020/12/02/desmatamento-no-brasil-ameaca-seguranca-nacional-alerta-conselho-militar.htm

sustainable alternatives to fossil fuel is a long-term strategy for the near future after the coronavirus crisis.

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