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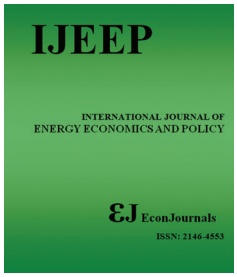

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Provoking Energy Cooperation in the South Countries: Renewable Energy in Brazil and India

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ABSTRACT

In the current global context where developing countries try to articulate actions to deal with the energy crisis the dialogue appears as a fundamental element. The objective of this paper, through a convergent methodology based mainly on the literature review, is to provoke a reflection about the renewable energy cooperation between emerging countries bringing for that purpose the example of Brazil and India. The results show through a careful analysis that there are more elements in common to promote renewable energy between Brazil and India than suggested the hypothesis. The conclusion brings renewable energy cooperation as a way to be traced by developing countries, in this particularly case, Brazil and India, in search for a sustainable society.

Keywords: Renewable Energy Cooperation, Brazil, India
JEL Classifications: F59, P28, Q42

1. INTRODUCTION

The economic growth of the emerging countries in the last years presents itself as an irrefutable evidence of the growth of the demand for energy, since the improvement of the quality of life implies the increase of goods consumption. Not surprisingly, Perkins et al. (2006), categorically stated that per capita energy consumption in industrialized countries increases exponentially in relation to the economic growth of these countries if it is measured by Growth of National Income per capita and by Purchasing Power Parity. In 2016, the emerging countries such as Brazil, China, India and Russia are within the largest economies in the world (CIA, 2017).

In 2035, the world demand for energy will be 35% higher than in it was in 2015 (Exxonmobil, 2014), which reflects the challenge of growing economically through the sustainable use of energy resources. Considering the relevance of the energy sector to conserve and increase the environmental and economic conditions of competitiveness, dialogue seems to be a fundamental element. That is why industrialized countries have sought to intensify the debate with emerging countries, which shows the importance of the latter in the global scenario. In this discussion, the South countries, notably Brazil and India, are important players. The international framework has shaped the South-South scenario as one of the key elements in the energy crisis, requiring a movement of physical integration and investments in renewable energy to redesign the map of the world energy sector.

This paper highlights the importance of energy cooperation in the South axis in which Brazil and India stand out. For this purpose, this article is divided into three sections besides the Introduction. The first one brings general, concise information about the two States in focus. The second section presents the energy scenario in which India and Brazil are inserted as well as the main characteristics of these countries with regard to both traditional and renewable energies. In addition, it brings their main policies in the field of renewable energy. The last section brings the final

considerations emphasizing the role that the dialogue between Brazil and India plays in overcoming the challenges they face in the quest for social and economic development, which it could be seen as an example for the emerging powers.

2. BRAZIL AND INDIA

The search for understanding the challenges pertinent to the contemporary world cannot follow a systematic, productive and coherent path if those States whose actions generate global impacts are not taken into account. This is the case of Brazil and India, which play an important role in the political and economic global scenario, but which face challenges common to nations that do not have the same economic relevance they do.

Brazil was a colony of Portugal for three centuries and, until the 20th century, was considered as a merely agro-exporting country. Nevertheless, it has occupied space in the international arena, taking varied actions in the political and in the economic spheres. Currently, Brazil's gross domestic product (GDP) ranks 8th in the world. However, in terms of per capita GDP, this country ranks 103th with 21% of its population, about 42 million people, below the poverty line (CIA, 2015).

Regarding the Human Development Index, Brazil occupies the 75th position according to the United Nations for Development Program (UNDP, 2015). In 2010, Brazil occupied the 73rd position (UNDP, 2014). This data reflects the challenge that the country has to face in order to improve the quality of life of its population.

Over the 69 years of its existence as an independent nation, India has achieved remarkable prominence in the international scene. Recognized for its cultural and natural diversity, it is the second most populous country in the world with approximately 1.3 billion people and its GDP ranks 10th in the world. As for its GDP per capita, India occupies the 158th position in the world, evidencing the unequal concentration of wealth given its very large population. The percentage of the Indian population below the poverty line is approximately 30%, or about 390 million people (CIA, 2015). Concerning the human development index, India appears in the 130th position in the world, which characterizes it as a country in "medium human development," behind nations like Iraq, which occupies the 120th position (UNDP, 2015). In 2010, India ranked 121st (UNDP, 2013).

Undoubtedly, one of the great challenges for Brazil and India is to grow economically and, at the same time, to promote quality of life. And energy, of course, is directly related to development.

3. THE ENERGY PANORAMA AND RENEWABLE COOPERATION APPROACH

India's economy has grown at an average annual rate of about 7% since 2000 and has proved relatively resilient following the global financial crisis of 2008. Despite its remarkable fossil fuel resources, the country has become increasingly dependent on fossil fuels, coal being the most important source in Indian energy consumption. On the other hand, Brazil, in 2013, was the 8th largest energy consumer in the world and the third in the Americas behind the United States and Canada. Most of Brazil's total energy consumption is oil and other liquid fuels, followed by hydroelectricity and natural gas. Brazil was the 10th largest producer of energy in the world in 2013 (Energy Information Administration [EIA], 2016b).

The increase of energy demand in Brazil and India is relevant. Obviously, when demand is projected, uncertainties must always be remembered, such as those related to economy, consumption, competitiveness and raw materials, which make any projection a guiding for policies and actions. In the two countries in question, the relevance of fossil fuels in the period analyzed by the International Energy Agency (IEA), between 1990 and 2030, still draws attention. In both countries, oil plays a key role. In India, in addition to oil, coal assumes a prominent position. Tables 1 and 2 show the Brazilian and Indian energy demand and its projections.

According to the IEA (2013), coal will play an important role in several regions of the planet since it is a cheaper option than gas to generate electricity. Among OECD countries, its use will decrease, but it will increase by one third in non-OECD countries, especially in India, China and South-East Asian countries. India, Indonesia and China account for 90% of the growth in coal production. Despite occupying the fifth position in the world in terms of coal reserves, India is the third largest coal importer (EIA, 2016a). As for oil, India has 5.7 billion barrels in proven reserves. The US EIA projects that Indian demand will more than double to 8.2 million barrels per day by 2040, while domestic production will continue to be around 1 million barrels per day. Thus, India also needs to import oil in order to meet its demand. Dependence is expected to rise (EIA, 2016a; ANP, 2014).

On the other hand, Brazil has reached the status of the largest oil producer in South America and the seventh world consumer,

Table 1: Energy demand: Brazil (Mtoe)

Energy source	1990	2004	2015	2030
Coal	9.7	14.2	15.1	18.0
Oil	57.7	84.8	108.4	141.7
Gas	3.2	15.8	25.9	41.2
Nuclear	0.6	3.0	6.3	6.3
Hydro	17.8	27.6	38.0	50.0
Biomass and waste	41.6	54.4	70.6	89.8
Other renewables	0.0	0.0	0.5	1.9
Total	130.6	199.8	264.8	348.8

Source: IEA, 2006, p. 455

Table 2: Energy demand: India (Mtoe)

Energy source	1990	2005	2015	2030
Coal	106	208	330	620
Oil	63	129	188	328
Gas	10	29	48	93
Nuclear	2	5	16	33
Hydro	6	9	13	22
Biomass and waste	133	158	171	194
Other renewables	0	1	4	9
Total	320	537	770	1299

Source: IEA, 2007, p. 465

after India, which occupies the fifth position in the world ranking (EIA, 2015; ANP, 2014). With regard to proven oil reserves in the world, Brazil ranks 15th with 15.6 billion barrels (ANP, 2014). Considering its refining sector, Brazil needs to import oil, especially from Africa, which remains the continent that most exports oil to Brazil, corresponding to 71.7% of its total imported oil (ANP, 2014).

Brazil and India have to take advantage of the opportunity to discuss their energy needs and to identify sustainable responses to the environment of which they are part. Therefore, the diversification of the energy matrix is relevant not only to increase energy security, but also to create opportunities for democratization of access and sustainable development. In this context, renewable energy seems to be not only a necessity to meet the global demands of reducing CO_2 emissions, but also a way to meet their respective energy needs in terms of consumption and demand.

Although renewable energy still appears timidly in the world in comparison to traditional sources of energy, it has continued to grow in recent years, even facing the increase of energy consumption and the fall of oil prices. The electricity sector in 2014 had the most significant growth in renewables in the world and reached an estimated capacity of 1.7 GW, which is 8.5% more than it was in the previous year. China, the United States, Brazil, Germany, Canada, India and Japan are the seven countries with the largest installed capacity. However, by excluding hydroelectric power, the ranking would be this: China, the United States, Germany, Italy, Spain, Japan and India, which shows the Brazilian dependence on electricity generation through hydroelectric dams (REN, 2015).

The BRICS electricity matrix Graph 1 shows that Brazil takes the lead with 73%, particularly due to hydropower generation, while India, together with Russia, holds the second place with 16% in renewables.

It should be noted that, with the exception of Brazil's energy matrix, the BRICS energy matrix depends on almost 90% of fossil fuels, with coal being the main energy source in China, India and South Africa. Considering the percentages in both energy and electric matrices of each BRICS member, Russia is the one that most uses fossil fuels with 90.5%; China comes second with 87.3%, and India comes third with 74%. On the other hand, Brazil stands out with the lowest percentage in the group regarding the use of fossils (58.7%) in its energy matrix, as can be seen in the following Table 3 (IEA, 2013, MME, 2014).

Global investments in renewables totalized US$ 270 billion in 2014, representing an increase of 17% over the previous year. In the same year, developed countries increased their investments only in 3% while developing countries increased them in 36%. China, the United States, Japan, the United Kingdom, Germany, Canada, Brazil, India, the Netherlands and South Africa were the ten largest investors - four BRICS are among them (REN, 2015).

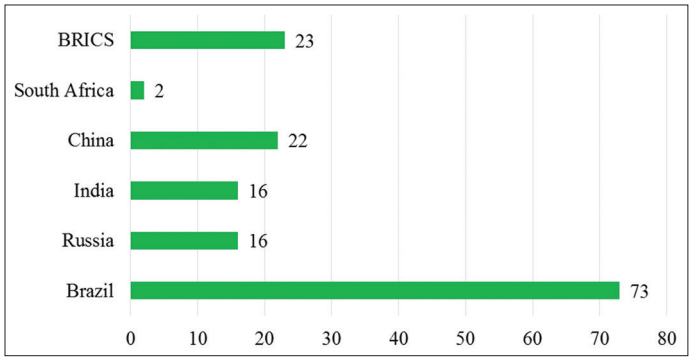
Investments in renewable energy have been growing in Brazil and India since 2004 with some decreases but never reaching the same level they were in that year. In 2014, Brazilian investments reached US$ 8 billion and Indian investments were US$ 8.3 billion - both countries concentrated their investments in wind, solar and biofuels (REN, 2015).

Regarding the energy-political relationship, both Brazil and India have been adopting policies that strategically and innovatively direct the energy development in their territories. In the 1970s, Brazil assumed the foremost position of polices related to renewable energy with the ethanol fuel program known as Proálcool (Brasil, 1975). Then, in 1985, Brazil adopted the National Conservation Policy in Electric Energy with the objective of rationalizing the use of electricity, promoting low-cost financing for energy efficiency projects and creating a label to guide consumers to acquire more energy-efficient products (Eletrobras, 2015).

Another initiative was launched in 2000 by the Brazilian government: The Energy Efficiency Program for Distribution Companies, establishing obligations and charges to the granting authority. One of the obligations is to apply, annually, the amount of at least 0.5% of its net operating revenue to actions aimed at combating the waste of electricity. In 2002, Brazil launched the Incentive Program for Alternative Electric Energy Sources - PROINFA, in order to promote renewable sources (Brasil, 2000; Brasil, 2002; Brasil, 2004). Since 2000, Brazil has intensified its policies on renewable energy.

In India, renewable energy policies started to be established in 2003 when the government created the electricity act (Ministry of Law and Justice, 2003). Then, other policies were created. One of them was the Energy Conservation Building Code, which established

Graph 1: Percentage of renewable sources in the BRICS electric matrix by country, 2014



Source: MME, 2014

Table 3: Percentage of fossil fuels in the energy and electric matrices of BRICS, 2014 (%)

Energy supply	Brazil	Russia	India	China	South Africa	BRICS
Internal energy supply	59	90	74	87	86	84
Internal electricity supply	22	66	81	76	92	74

Source: MME, 2014

minimum requirements for new and major construction related to construction components, lighting, electrical systems, water heating and pumping systems. Another one was the tariff policy, aiming at improving the competitiveness of non-conventional energy resources and reducing capital costs related to projects with incentives such as preferential tariffs (Ministry, 2006b; 2016). The Table 4 shows the main renewable energy policies developed in Brazil and in India.

The policies for promoting renewable energy in Brazil and India share some similarities, such as the creation of the seal to guide consumers and the initiative to promote electricity in communities where accessibility is precarious, using renewable energy. In Brazil, an initiative to bring electricity to communities where accessibility is precarious has been developed through the National Program for Universal Access and Use of electricity, known as light for all. Launched in 2003, this program is coordinated by the Ministry of Mines and Energy (operated by Eletrobrás and executed by the energy concessionaires) with the goal of bringing electricity to hard-to-reach locations and solving the electric exclusion in Brazil. Therefore, it can be said that, fundamentally, the target population of the program is composed by the population residing in rural areas (Brasil, 2014). In India, Remote Village Electrification is a program that provide financial support for the electrification of remote villages without electricity under the Rural Electrification policy that promotes electricity by several sources from renewables: Small hydroelectric power stations, biomass energy generation systems and photovoltaic panels (MNRE, 2016).

Another similarity between Brazil and India in the political energy context is that both countries have established specific policies on climate change with convergent approaches, whose main objective is to reduce greenhouse gases emissions. The two countries aim to increase the share of photovoltaic solar energy and solar water heating, the recycling of municipal solid waste, including the generation of energy (Brasil, 2009a; Ministry of Environment, Forest and Climate Change, 2009).

The rapprochement between Brazil and India means more than a strategy of visibility and the search for leadership in the South political landscape. Despite some divergences in the 1990s related, in particular, to the nuclear issue, after the turn of the millennium, Brazil and India began to invest in the South-South cooperation more consistently not only with poor countries but also with the objective to strengthen relations with other emerging countries (Abdenur, 2014).

Since the 1980s, India has already shown an interest in the Brazilian ethanol technology. And since the early 2000s, it has also shown interest in the Brazilian hydroelectricity experience, especially in relation to its cooperation with other countries, since India has the potential of 60 GW to be explored jointly with other countries, as Brazil does with Itaipu (Vieira, 2007; REN, 2015). In the period between 2002 and 2014, Brazil and India has signed four memoranda of understanding regarding renewable energy in solar, wind and biofuel sources (IBSA, 2010; DAI, 2007; 2014; MRE, 2002). In the context of the BRICS, there is a clear intention of strengthening the energy cooperation between its members (MRE, 2014; 2015), which increases the possibilities of Brazil and India cooperate in the field of renewables.

4. CONCLUSIONS

The increase of the demand for energy is also synonymous with economic growth. Thus, Brazil and India need to meet their energy demands. In addition, the environmental issue related to the production of the greenhouse effect brings challenges to all countries. Therefore, Brazil and India, two emerging economies that also face challenges common to poor countries, have to develop economically through the sustainable use of their energy resources.

Table 4: Main Brazilian and Indian policies on renewable energy

Year	Country	Policies
2003	Brazil	Light for all Program (Brazil, 2014a)
	India	Electricity act (Ministry of Law and Justice, 2003); National Auto Fuel Policy (Ministry of Petroleum and Natural Gas, 2015)
2004	Brazil	National Biodiesel Production and Use Program (MME, 2016)
2005	Brazil	Law No. 11.097 ruling on biodiesel (Brazil, 2005)
	India	National Electricity Policy (Ministry of Power, 2005)
2006	India	Integrated Energy Policy (Government of India, 2006); Rural Electrification Policy (Ministry of Power, 2006a); Tariff Policy 2006 (Ministry of Power, 2006b)
2007	Brazil	Decree No. 6.048 ruling on electricity auctions (Brazil, 2007)
	India	Energy Conservation Building Code (Ministry of Power, 2016)
2008	India	National Action Plan on Climate Change (Ministry of Environment, Forest and Climate Change, 2009)
2009	Brazil	Law No. 12.187, National Policy on Climate Change (Brazil, 2009a)
	India	National Policy on Biofuels (MNRE, 2009)
2010	India	The Finance Bill (London School of Economics and Political Science; The Grantham Research Institute on Climate Change and the Environment, 2015); JNU Solar Mission (MNRE, 2010)
2011	India	Strategic Plan for the New and Renewable Electric Sector (MNRE, 2011)
2012	Brazil	Resolution No. 482 (ANEEL, 2012)
	India	National Electricity Plan (Ministry of Power, 2012)
2014	Brazil	Law No. 13.033 ruling on biodiesel addition (Brazil, 2014b)
2015	Brazil	Resolution No. 1 of March 4th (Brazil, 2015)
	India	National Offshore Wind Energy Policy (MNRE 2015)
2016	Brazil	Law No. 13.263 (Brazil, 2016)
	India	Policy for Repowering of the Wind Power Project (MNRE, 2016b)

Indisputably, India has a higher energy demand than Brazil. It is not by chance, then, that the consumption of fossil fuels and the importation of energy are essential to the Indian socio-economic development. On the other hand, even though Brazil needs to import less energy and has more renewable energy sources than the other BRICS countries, it cannot continue to depend excessively on hydropower to generate electricity.

Renewable energy cooperation is a fertile scenario. The policies in renewable energy established by Brazil and India signal actions in the search for diversification of their respective energy and electric matrices and the investments made by these two countries over the last ten years corroborate this fact. It is clearly important that the cooperation between Brazil and India in renewable energies become stronger. The presence of memoranda of understanding in the areas of solar energy, wind energy and biofuels indicate these three are the most explored sources in this path. Renewable energy cooperation is essential for the development of a more harmonious society in the use of its energy resources.

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