


The Role of the State in Diversifying and Expanding the Brazilian Energy Matrix: an Analysis of Legislation

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Abstract

Despite having an essentially renewable electricity matrix, the dependence on hydropower, in the current climate risk scenario and the associated environmental and social impacts, point to the need to diversify energy generation in Brazil. To this end, state action is fundamental for designing and implementing public policies for the country's energy matrix. However, this diversification does not occur at the desired speed and scale. Thus, this article analyses the Brazilian regulatory environmental policies to assess the participation of the Federal constituencies, States, and municipalities in scaling renewable sources in the national electricity matrix. The research revealed that specific legislation on energy is scarce, and much of what is applied is taken from the general environmental legislation. We noticed that, by constitutional imposition, the Federal constituencies have the legislative competence on the theme and, therefore, establish norms and general rules, while States and municipalities act marginally, especially in fiscal matters and environmental licensing. The need for more objectivity, standardization, and the non-existence of specific technical criteria in the norms about energy use. We also verified that most of what was legally established constitutes government programs, not state policies. It is necessary to extend the participation of states and Municipalities in elaborating national energy use plans and in the revision and technical standardization of the licensing norms. These gaps must be filled so sustainable development, a principle established in the Constitution, is strengthened and made possible, with the participation of States and Municipalities.

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INTRODUCTION

In the 20th century, many countries, including Brazil, encouraged the inclusion of renewable sources in their respective electricity matrices, especially after the oil crises of the 1970s (Pietrosemoli; Rodríguez-Monroy, 2019). By 2020, around 84% of the Brazilian matrix was made up of renewable sources, with hydraulic power accounting for 63.8% of this total (EPE, 2021). However, the water crisis that occurred in 2020 forced the System Operator to activate thermal power plants more frequently, which represented a 9.1% increase in generation from oil derivatives compared to 2019, interrupting a sequence of falls (EPE, 2021). This shows the dependence on water resources in Brazilian energy generation.

The Ministry of Mines and Energy (MME), together with the Empresa de Pesquisa Energética (EPE), which is the federal office responsible for researches about national energy planning, has drawn up the Ten-Year Energy Expansion Plan 2030 (PDE 2030 – Plano Decenal de Energia, in Portuguese), which presents scenarios for the national energy sector between 2021 and 2030. Electricity demand is expected to grow by an average of 3.1% per year (EPE, 2021b). Installed power in Brazil's power station is expected to grow by approximately 53.3 GW, with an increase in wind and solar sources estimated at 102% and 187% respectively. By 2030, the share of hydraulic power in the energy matrix should be reduced to 58%, while other renewable sources will account for 28%. However, the PDE 2030 also indicates that the growth of these sources could be slowed down, or even reduced if there are political and economic incentives for thermoelectric plants (EPE, 2021b).

Among the main benefits to the population, the diversification of the energy matrix promotes job creation and the receipt of credits through the distributed generation compensation system (Reis *et al.*, 2021). Therefore, it is prudent to analyze the regulatory environment of the Brazilian energy sector from the perspective of state incentives to expand renewable sources as an alternative to hydropower.

Thus, this article aims to: (i) identify the main regulatory documents governing energy generation in Brazil; (ii) analyze the role of federal entities in expanding renewable resources in the Brazilian energy matrix; (iii) point out possible gaps in national legislation; and (iv) suggest ways of increasing the participation of States and Municipalities in the planning and implementation of renewable energy generation in Brazil.

This article is structured as follows: section 2 presents the methodology, section 3 presents the results and discussions, the main gaps identified are dealt with in section 4 and in section 5 we bring the final considerations.

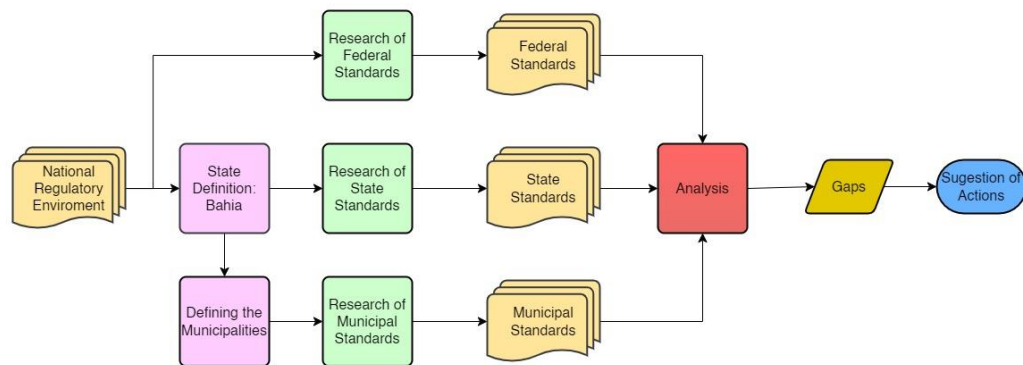
METHODOLOGY

The federative form of the Brazilian State guarantees the states a certain amount of autonomy to draft legal standards that must be complied with in its respective territories. Thus, federal, state, district, and municipal standards coexist respecting the constitutional limits.

Given the number of states, we restricted our research to Bahia, northeast of Brazil. At the municipal level, we selected the 5 municipalities in Bahia with the highest installed renewable energy generation capacity in February 2022, according to Aneel (2022): Sento Sé, Pindaí, Campo Formoso, Morro do Chapéu and Caetité.

We searched for regulatory instruments on the official websites of the federal entities, according to the methodological flowchart below (Figure 1). We consulted the websites of the Federal Government, the Chamber of Deputies, the Federal Senate, the Agência Nacional de Energia Elétrica (Aneel), which is the federal agency responsible for the implementation of Brazilian energy management, the bodies responsible for environmental licensing, the Bahia State Government, the Legislative Assembly of Bahia, the State Secretariat of Infrastructure, the City Governments and City Councils and the Audit Court for Municipalities of Bahia (TCM-BA, Tribunal de Contas dos Municípios da Bahia in Portuguese).

Figure 1 - Methodological flowchart used.



Source: The authors (2023).

After identifying the main applicable rules, we look at the type and nature of the action that each one promotes. From there, we looked for contradictions in the texts and the effects caused by the implementation of the standards. In this way, we look at the main existing gaps and suggest alternative actions to overcome them.

RESULTS AND DISCUSSION

The Federal Constitution (FC) of 1988 gives the Federal Government exclusive power to legislate on energy. Regarding the environment, the Federal Government, the States, and the Federal District are

concurrently competent and the Municipalities are added to the common competence for environmental protection (Brasil, 2020). In this section, we present the main legal standards applicable to the Brazilian energy generation sector.

Federal Standards

With the 1988 FC, provisions were introduced in the national regulatory environment to regulate the use of energy sources. These laws can be understood in terms of the actions they promote in four categories: (i) setting general rules, (ii) administrative structuring of the sector, (iii) incentive policies and programs, and (iv) environmental licensing (Chart 1).

Chart 1 - Main regulatory documents in the energy sector at the federal level.

Standard	Main Purpose	Provisions	Type of Action
Federal Constitution of 1988 (Brasil, 2020)	It establishes the environment as a constitutional right and general standards for the regulatory environment.	Art. 22, IV; 23, VI; 24, VI and VIII; 225.	
Law No. 10,257 of 2001 (Brasil, 2001)	City Statute.	Art. 2, IV, XII, XIII.	
Law No. 12,187 of 2009 (Brasil, 2009)	National Policy on Climate Change.	Art. 11	Establishes general standards
Complementary Law 140 of 2011 (Brasil, 2011)	Standards for cooperation between federal entities on environmental protection.	Art. 3; 7 to 9 and 15	
Law No. 12,651 of 2012 (Brasil, 2012)	Forest Code.	Art. 5	
Law No. 14,300 of 2022 (Brasil, 2022b)	Legal framework for distributed microgeneration and mini-generation.	Art. 1	
Law No. 9,427 of 1996 (Brasil, 1996a)	Establishes Aneel.	Art. 1	
Law No. 9,478 of 1997 (Brasil, 1997)	Provides for the National Energy Policy, and establishes the Conselho Nacional de Política Energética (CNPE – National Council for Energy Policy, in English, the responsible for establishing the national energy policy) and the National Agency of Petroleum (ANP – Agência Nacional do Petróleo, the federal agency responsible for the implementation of Brazilian oil and fossil fuels management).	Art. 1; 2 and 7.	Administrative structure of the sector
Decree 3,520 of 2000 (Brasil, 2000b)	Provides for the structure and operation of the CNPE.	Art. 1 et seq.	
Law No. 9,991 of 2000 (Brasil, 2000a)	Investment in energy efficiency research and development by utility companies.	Art. 1.	
Law No. 10,438 of 2002 (Brasil, 2002)	Creates Programa de Incentivo às Fontes Alternativas de Energia Elétrica (PROINFA – Incentive Program for Alternative Electricity Sources, in English).	Art. 3.	
Law No. 11,488 of 2007 (Brasil, 2007)	Creates Regime Especial de Incentivos para o Desenvolvimento da Infraestrutura (REIDI – Special Incentive Regime for Infrastructure Development, in English).	Art. 1; 2 and 26.	
Law No. 13,169 of 2015 (Brasil, 2015a)	Zeroes the Programa de Integração Social / Programa de Formação do Patrimônio do Servidor Público (PIS/PASEP – (Social Integration Program/Government Employee Fund, in English) and Contribuição para o Financiamento da Seguridade Social (COFINS – Contribution to Social Security Financing, in English) contribution rates levied on the active energy injected into the distribution network corresponding to the same quantity by the same consumer unit.	Art. 8.	Incentive policies and programs
Presidential Decree of 1994 (Brasil, 1994)	Creates Programa de Desenvolvimento Energético de Estados e Municípios (PRODEEM – Energy Development of States and Municipalities Program, in English).	Art. 1.	
Decree 2003 of 1996 (Brasil, 1996b)	Regulates energy production by independent producers and self-producers.	Art. 1 et seq.	
Decree 5,025 of 2004 (Brasil, 2004)	Regulates PROINFA.	Art. 1 et seq.	
Decree 9,578 of 2018 (Brasil, 2018)	National Climate Change Fund.	Art. 1 and 5 to 26.	
Aneel Res. 482 of 2012 (Aneel, 2012)	General conditions for distributed microgeneration and mini-generation.	Art. 1 et seq.	
Aneel 687 of 2015 (Aneel, 2015)	Revision of Resolution 482 of 2012.	Art. 1 et seq.	
Decree 10,946 of 2022 (Brasil, 2022b)	Assignment of physical spaces and use of natural resources owned by the Federal Government for offshore wind power generation.	Art. 1 et seq.	
Interministerial Ordinance 60 of 2015 (Brasil, 2015b)	The role of federal public administration bodies and entities in environmental licensing processes.	Art, 1; 3 and Annex I.	
Aneel Res. 876 of 2020 (Aneel, 2020)	Authorization and expansion of the installed capacity of generation projects using alternative sources.	Art. 1 et seq.	
CONAMA Res. 006 of 1987 (CONAMA, 1987)	Licensing of works in the energy generation sector.	Art. 1 et seq.	Environmental licensing
CONAMA Res. 279 of 2001 (CONAMA, 2001)	Simplified environmental licensing for electricity projects with little environmental impact.	Art. 1 et seq.	
CONAMA Res. 462 of 2014 (CONAMA, 2014)	Environmental licensing procedures for wind power generation.	Art. 1 et seq.	

Source: The authors (2023).

We note the scarcity of specific regulatory documents on energy. Therefore, much of what is applied comes from general environmental regulation. It is clear that the Brazilian State's stance has changed since the beginning of the 2000s, coinciding with the energy crisis in 2001. The Federal Government realized the need to diversify the energy matrix.

Until 2001, Brazilian legislation was generic when it came to renewable energies and did not set any deadlines or objective targets for spreading the use of these sources. Even so, the creation of the PRODEEM in 1994 (Brasil, 1994), the creation of Aneel and the figure of the independent producer and self-producer in 1996 (Brasil, 1996a; Brasil, 1996b), and the creation of the National Energy Policy and the CNPE in 1997 are noteworthy (Brasil, 1997).

From the 2000s onwards, the rules became more objective and set targets to be met. We would highlight the PROINFA established in 2002 (Brasil, 2002), the REIDI, created in 2007 (Brasil, 2007), and Aneel Resolution No. 482 of 2012, which established Distributed Generation (DG) (Aneel, 2012). PROINFA brought quantitative generation targets, REIDI brought tax incentives as a catalyst for the expansion of renewable electricity generation, and, through DG, ordinary consumers can become energy generators and be financially compensated for it.

Although the Federal Government's stance after the 2001 energy crisis is beneficial for the diversification of renewable sources, we note that most of the initiatives are government programs and not state policies. In this way, they are susceptible to the political and ideological inclinations of the government of the day. This contributes to maintaining the country's dependence on water for energy generation.

Standards of the State of Bahia

The constitutional limitation on energy, which is necessary to a certain extent, restricts the actions of the state entity. Added to this is the legislator's slowness in establishing actions for sustainable development. The Constitution of Bahia of 1989, for example, provided for the establishment of the State Environmental Policy within six months, which was only established in 2006 through state law No. 10,431 (Bahia, 2021; Bahia, 2006).

We identified 10 regulatory documents applied to the energy sector in the state of Bahia (Chart 2). We noticed the state government's efforts to organize environmental licensing actions within its territory and to attract investment through tax incentives.

Chart 2 - Regulatory documents applied to the energy sector in the state of Bahia.

Standard	Main Purpose	Provisions
State Constitution of 1989 (Bahia, 2021)	Environmental preservation and general standards within the permitted scope.	Art. 11, VII; 12, VI; 212 to 226.
Law No. 10,431 of 2006 (Bahia, 2006)	Environmental and Biodiversity Protection Policy of the State of Bahia.	Art. 1 and 3, III.
Law No. 11,612 of 2009 (Bahia 2009)	State Water Resources Policy.	Art. 1 and 25.
Law No. 13,914 of 2018 (Bahia, 2018)	State Policy to Encourage the Generation and Use of Solar Energy in the State of Bahia.	Art. 1 et seq.
Decree No. 14,024 of 2012 (Bahia, 2012)	Regulates Laws 10,431/2006 and 11,612/2009.	Art. 2; 78, XIV; 79, VI.
CEPRAM Resolution No. 4.145 of 2010 (CEPRAM, 2010)	Approves the Technical Standard on integrated environmental analysis for hydroelectric use.	Art. 1 et seq.
CEPRAM Resolution No. 4.180 of 2011 (CEPRAM, 2011)	Approves the Technical Standard on the Environmental Licensing Process for Wind Energy Generation Projects.	Art. 1 et seq.
CEPRAM Resolution No. 4.327 of 2013 (CEPRAM, 2013)	Activities with a local impact are the responsibility of municipalities.	Art. 1; 3 and 12.
ICMS (State Goods and Services Tax) Agreement 101 of 1997 (CONFAZ, 1997)	ICMS exemption on operations with equipment and components for harnessing solar and wind energy.	Clause one.
ICMS Agreement 16 of 2015 (CONFAZ, 2015)	ICMS exemption on transactions relating to the circulation of electricity subject to billing under the Electricity Compensation System.	Clause one et seq.

Source: The authors (2023).

Main Standards at the Municipal Level

Regarding municipalities, we note that legislative action is even more incipient. Notably, these federal entities focus on granting tax incentives to attract investment. Only in Campo Formoso did we find mention of clean energy generation in the Municipality's Organic Law (Campo Formoso, 1990). No specific regulatory documents on

environmental licensing for generation projects were found in the municipalities analyzed.

We found no regulatory documents on energy in the municipality of Pindaí, which may indicate that federal and state incentives have been enough to increase renewable energy generation in the municipality. Here are the standards applicable to the energy sector in the municipalities analyzed in this article (Chart 3).

Chart 3 - Regulatory documents in the municipalities analyzed.

Municipality	Regulatory Document	Action
Sento Sé	Municipal Environmental Code (Sento Sé, 2015)	Applicable to environmental licensing.
	Law No. 244 of 2011 (Sento Sé, 2011)	Reduces the ISS (Service Tax) tax rate on wind energy works to 3%.
Campo Formoso	Municipal Organic Law of 1990 (Campo Formoso, 1990)	It provides for the use of urban waste to generate energy.
	Law No. 36 of 2017 (Campo Formoso, 2017)	Establishes the IPTUverde (public policy to encourage more sustainable buildings).
Morro do Chapéu	Law No. 1,185 of 2018 (Morro do Chapéu, 2018)	Reduces the ISS tax rate for renewable energy projects by up to 40%.
Caetitê	Law No. 812 of 2016 (Caetitê, 2016)	Reduces the amount of ISS owed to legal entities in the solar energy sector by 30%.

Source: The authors (2023).

MAIN GAPS

The main gaps in the national regulatory environment on energy generation are found in environmental licensing. There is a lack of objective technical standards, such as maximum slope limits or types of soil allowed for each source. In general, the standards only provide bureaucratic guidelines, leaving the technical analysis to the specific case. As an example, we name Resolution 462 of 2014 of the Conselho Nacional do Meio Ambiente

(CONAMA –National Environment Council, in English, which is the responsible for overseeing the implementation of Brazilian environmental policy), which grants the licensing body the classification of the project in terms of environmental impact but does not define the degrees of impact in the text (CONAMA, 2014).

Another gap is found in the Forest Code. A priori, Permanent Preservation Areas (PPAs, Áreas de Preservação Permanentes – APPs in Portuguese) are exempt from human intervention. However, the Code allows that if the project is declared a public utility, it can be

installed in a PPA, provided that the developer submits an impact mitigation plan approved by the licensing body (Brasil, 2012).

The Conselho Estadual do Meio Ambiente (CEPRAM – Bahia standards of the State Environment Council, in English) follow the general model of the national CONAMA standards when they should be more specific in their provisions. The most they do is set the polluting potential according to the scope of the project, determine the competence of inspection and the list of documents to be submitted to obtain the licenses.

When it comes to impacts other than environmental ones, such as on traditional peoples' lands, cultural and historical heritage, and potential damage to public health, we also see a lack of standardization of technical assessment criteria. Interministerial Ordinance 60/2015 sets out the distance limits that must be complied with when preparing studies of these impacts. However, these limits are merely guidelines and do not restrict the implementation of projects. Furthermore, in the case of energy generation, the ordinance only deals with thermoelectric and hydroelectric plants (Brasil, 2015b).

The decision on the degree of impact, the effectiveness of the mitigating measures proposed by the developer, and, therefore, the granting of the environmental license, is most often left to local bodies. However, as there are no rules on environmental licensing in the municipalities studied, state and federal rules are applied where applicable.

The closer to the site of the project, the greater the expertise of the licensing authorities for the assessment; however, these bodies are more susceptible to external pressures, often leading to decisions that are more political than technical. When there is a clash between economic development and environmental protection, governments usually choose the former (Myszczyk; Silva, 2019).

Another point observed in the licensing standards is the lack of standardization. As states and municipalities have a certain degree of regulatory freedom, the criteria may differ in similar situations. The lack of objectivity and standardization can be considered a barrier for both investors and environmental protection (ELETROBRÁS/EPE, 2021). However, the participation of these entities in the standardization process is crucial, since without them local issues may be overlooked

and the solutions found will not be the most beneficial (Costa *et al.*, 2021).

Increasing the use of clean energy sources depends on the efficiency of public policies in the sector (Krell; Souza, 2020); however, Brazilian legislation presents loopholes so that this efficiency is not achieved. PROINFA, for example, included non-renewable energy sources in its text (Brasil, 2002).

Another important issue is the State's stance on sustainability issues. According to Krell and Souza (2020), by including environmental protection as one of the constitutional principles of the economic order, the constituent legislator intended to establish a sustainable economic model in Brazil. However, according to the same researchers, the players in power often impose their vision of sustainability on society, negatively interfering with political guidelines.

The Role of States and Municipalities

The current Brazilian Constitution has elevated the municipalities to the category of federation units, alongside the Federal Government, States, and Federal District. This allowed for a better distribution of competencies but increased the complexity of the legal framework.

Constitutional limits mean that States and Municipalities act mainly in the fiscal area in an attempt to attract investment to their territories. In addition, they also work in licensing.

To enable greater diversity in the national energy matrix, the participation of all federal entities in the formulation of structuring policies for the sector must be ensured. One possibility is a reform of legislative powers on the subject of energy.

Another point that needs to be addressed is the lack of uniformity and objectivity in licensing rules. The Federal Government, in partnership with the other entities, should set the general technical criteria for licensing, leaving it up to the licensing bodies to analyze the specific case, restricting the flexibility of the technical limits established. This action, if implemented, will enable uniformity in the regulatory environment and should have environmental conservation as its guiding principle.

FINAL CONSIDERATIONS

The state of Bahia and some of its municipalities were used as an example in this study, but the centralization of competencies in the Federal Government, defined in the Constitution, allows us to infer that the reality in the other states is similar. Similar studies need to be carried out in other federative units to compare local realities.

It is clear from the legislation that the principle of sustainable development must be pursued at all levels of government and must guide political actions and decisions. From this point of view, we can see that the Federal Government's participation in formulating public policies, especially those to promote and regulate the energy sector and those of a fiscal and tax nature in all federative entities, has created a promising environment for the development of renewable energy generation in Brazil.

However, the diversification of Brazil's energy matrix is not happening as quickly as it should. We can see that a large part of the policies to encourage renewable sources are characterized as government programs and are at risk of being interrupted by the change of political power. There is an urgent need to draw up a federal pact on sustainable development, which involves increasing the participation of renewable sources in the Brazilian energy matrix, to reduce dependence on hydropower.

In this respect, it is up to the states and municipalities to carry out studies of the potential for renewable energy generation in their respective territories, pointing out the best investment options. As for the Federal Government, it should play the role of facilitator of this process, guaranteeing an attractive environment for new investments, ensuring environmental conservation, and respecting regional particularities.

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AUTHOR CONTRIBUTION

Paulo Roberto Ribeiro Morais conceived the study, collected and analyzed the data, wrote and edited the text. Carlos Moreira de Souza Júnior and Jocimara Britto Souza Lobão supervised the research, reviewed and edited the text. Carlos Alexandre Domingos Lentini evaluated, reviewed and edited the text.



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