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Comparisons between Brazilian-Germany Legal Framework about in Mini and Microgeneration Regulatory Policies

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HIGHLIGHTS

- Mini and microgeneration Brazilian market
- Brazil micro and mini generation legal framework.
- Comparison between Brazil and Germany regulation.
- Suggestion for Brazil's regulation.

Abstract: This article proposes a comparative analysis between public and regulatory policies for implementing microgeneration and mini generation in Brazilian and German markets. The research was developed based on scientific texts and legal orders. Distributed microgeneration and mini generation are becoming a reality in Brazil. The current regulatory framework for distributed generation, effective from January 2022, promises to update the legislation and promote renewable energy. Since Brazilian legislation is still in its infancy, it is essential to compare it with other places where laws and regulations have already undergone several changes so we can learn from its mistakes and successes.

Keywords: regulation; distributed generation; regulatory framework; mini and microgeneration; distribution operation; planning.

INTRODUCTION

Before we enter the subject of this article, it's essential to understand how the legislative process works in Brazil. Here we have three powers: legislative, executive, and judiciary. All of them can create a project of

law. Beyond that, a project of law can be requested by a popular initiative. After the presentation of the bill, in one of the house chambers, deputies, or senators, and the approval in that chamber, the bill will be sent it to the other chamber for approval. After that, the bill will be sanctioned or vetoed by the president of the republic. It seems that is a rapid process, but we are talking about years of the project to be analyzed in the chambers of the politician, for example, Law nº. 14.600/2022 [1] was presented to the house of the deputies on 5th November of 2019, in an urgent procedure, and it took almost three years for approval. So, as we can see, the time for a change of the regulation in Brazil can take a long time, therefore this is important to learn about the hits and misses from other countries, so Brazil doesn't lose time in creating a law doomed to fail.

Therefore, for the elaboration of this work, it was necessary to use the regulation from Brazil and Germany, conducting a comparative study in the regulatory environment of micro and mini generation, with the objective of verifying the main policies that help to boost the sector, making a parallel between Brazil and Germany in the solutions to reduce dependence on non-renewable energy.

Current Brazilian market situation about mini and microgeneration

In Brazil, according to the Law nº. 14.300/2022 [1], the distributed microgeneration are power generating plants, with installed power, equal to less than 75 kW, while distributed mini generations have an installed power greater than 75 kW and equal to or less than 5 MW. The latter values apply to dispatchable sources; otherwise, this value may not exceed 3 MW. These values always apply to energy sources classified by ANEEL as qualified.

Qualified cogeneration is an attribute granted to generating units that meet the certain requirements defined in ANEEL Normative Resolution No. 235, November 14, 2006 [2], which respects aspects of energy rationality, and may participate in policies to encourage Brazilian cogeneration. The minimum requirements of energy rationality can be expressed by two inequations. The first inequation is a relation between the heat utility energy (*Et*) and the source energy (*Es*), which must be greater than or equal to 15%, it means:

$$Et / Es \geq 15\% \quad (1)$$

The heat utility energy (*Et*) is the "liquid" energy transferred by the co-generating power plant, in its average operating regime, in kWh/h; while the source energy (*Es*) is the total energy supplied to the production of electricity.

The second inequation is expressed by the following expression:

$$[(Et / Es) / X] + (Ee / Es) \geq Fc\%. \quad (2)$$

Where, energy of the electromechanical utility (*Ee*) is the "liquid" energy transferred by the co-generator power plant, in its average operating regime, in kWh/h. The two other factors, *X* and *Fc*, existing in this inequation change according to the type of generation as shown in Table 1. The factor *X* is a dimensional weighting factor expressing a relationship between the installed power and the cogeneration source, obtained from the relationship between the reference efficiency of heat utility and electromechanical, in conversion processes to obtain separate these utilities. The *Fc*% factor is a cogeneration factor defined according to the installed power and the source of the co-generator power plant, which is close to the concept of exegetic efficiency.

Table 1. Factors *X* and *Fc*.

Types of generation	*X*	*Fc*
Petroleum, Natural Gas, Coal, or their Derivatives	2.14	41
Other fuels	2.50	32
Heat recovered from process	2.60	25

The potential of mini and microgeneration in Brazil is quite large. The ANEEL forecasts 1.23 million systems connected to the grid by 2024 (4,557 MW); while the Energy Research Company (EPE) estimates that 78 GWp will be installed in distributed generation systems by 2050, with great emphasis on residential microgeneration.

Analysis of Brazil situation

Brazil is recognized worldwide for its hydroelectric matrix, but this fact has been changing in recent years with new forms of energy. It is a country of continental dimensions with an enormous potential for generating photovoltaic, wind, and biomass energy. However, it is little explored; according to data provided on the

Ministry of Mines and Energy website, the hydraulic electric matrix represents 65.2 %, while biomass has only 9.1%, the wind has 8.8%, and solar with 1.7%. The rest come from non-renewable sources; it is still a little-explored market, and the reason can be from the absence of regulations or even incentives [3-4].

It is essential to understand the country's potential in micro and mini distributed generation. According to the president of the Brazilian Association of Photovoltaic Solar Energy - ABSOLAR, of more than 89 million electricity consumers, only 1.1% make use of solar energy. Still, the industrial sector is tiny, as few industries in the photovoltaic sector are registered in the BNDES' FINAME. For instance, until 2021, only 72 companies produce the photovoltaic solar system kit, nine companies have the photovoltaic inverter, seven companies produce the solar tracker, seven companies produce the photovoltaic module, two companies produce string boxes, and one company produce batteries [5].

It is essential to highlight that until 2012, public investment policies were aimed at energy distributors, and with Normative Resolution no. 482/2012 of ANEEL [6]. The first regulations for micro and mini-generation systems emerged, having been revised through Normative Resolutions no. 687/2015 [7], 786/2017 [8], and nowadays by Federal Law no. 14,300 [1].

The government has leveraged the renewable energy market through credit policies and regulations. However, it is possible to verify that these incentives are only applied in some regions in our country, mainly for photovoltaic systems.

As provided for in the Federal Constitution of 1988, §6, in article 150 [9]:

“(...) any subsidy or exemption, reduction of the calculation base, granting of presumed credit, amnesty or remission, related to taxes, fees or contributions, may only be granted by specific federal, state or municipal law, which regulates exclusively the matters listed above or the corresponding tax or contribution, without prejudice to the provisions of art. 155, §2, XII, item “g.””.

Only a specific law can create income taxes or tax incentives be granted, highlighting which taxes or tax incentive is the object of the concession.

During the development of this study, it was possible to find some tax incentives, such as:

I) Agreement 16/15 of the Finance Policy Council - ConFaz [10], which aims to grant exemptions to operations related to the circulation of electricity, subject to billing under the electricity compensation system dealt with in ANEEL resolutions [11].

II) Law No. 12,350/10 [12], which established tax exemptions for government subsidies aimed at promoting technological research activities and the development of technological innovation in companies, and suspension of the import tax for the construction and renovation of sustainable stadiums, with the use of photovoltaic energy during the period of the Confederations Cup (2013) and World Cup (2014).

III) Law no. 11,077/04 [13] establishes tax exemption for IT and automation goods used in micro and mini-generation systems.

Public banks also have financial incentives, such as the National Development Bank (BNDES), Banco do Brasil, Banco do Nordeste, and Caixa Econômica, which provide credits to legal entities and individuals. Among these, the FNE SOL from Banco do Nordeste [14] program stands out, which consists of a credit line for financing distributed micro and mini-generation energy systems from renewable sources (photovoltaic, wind, biomass, or small hydroelectric plants). This program has as objective the environmental sustainability of the energy matrix in the region through financing all the components of the systems and their installation.

In 2022, Law no. 14,300 [1] came into force, the Legal Framework for distributed micro and mini generation. However, this law project has been generating controversy since the justification for its existence is to update the legislation and encourage the use of renewable energies. To this end, it intends to create a form of compensation for prosumers' benefit of transmission lines. That is, the incidence of a tax for the use of transmission lines, exempt until December 31, 2045, who already has the distributed generation system installed—applying the same exemption to those who install the referred system within 12 months of publication of the law. As for new prosumers, the transition rule will be six years, and from the year 2023 onwards, they will start paying for 15% of the costs associated with electricity, with a gradual increase in the percentage. And in 2029, prosumers would be subject to the distribution rules established by ANEEL.

The defenders of this compensation system allege that prosumers do not pay for the use of the electricity grid nor all the charges charged to consumers in the regulated market, except the public lighting fee. So that

other consumers of energy end up paying the bill for these subsidies through the tariff for the use of the distribution system.

Critics of this timeframe system claim that this new subsidy harms other consumers, affecting mainly the poorest since they cannot install a photovoltaic plate.

However, the bill itself brings the Figure of the Social Renewable Energy Program. This program will allocate resources for installing photovoltaic systems and other renewable sources, in the local or remote shared modality, for the benefit of low-income consumers. The budget forecast will come from the Energy Efficiency Program, from complementary sources of funds, or portions of revenue from electricity distribution companies.

It is important to note that the prosumer is currently only allowed to offset the excess energy generated, either in the exact location or from the same person or company. According to ANEEL rules, sales of this extra energy to other consumer units are not allowed. However, a significant change arose from article 24 of Law no. 14,300 [1]. This article that brought the electric distribution concessionaire or licensee must promote public calls for the accreditation of those interested in selling their surplus energy provided by micro and mini generation projects in their concession areas. For that, they will need to follow the guidance from ANEEL.

Thus, we can conclude that even with the approval of the Legal Framework for Micro and Mini Distributed Generation, Brazil still has a long way to go in investments and new regulations to explore its full potential in this sector.

Analysis of Germany situation

In contrast to the Brazilian national system, we have Germany as one of the leaders in the world in the use of micro and mini distributed generation. This change in thinking, from less dependence on energy generated by non-renewable sources, took place in the 1970s; with the oil crisis, the government began to adopt policies to make the most less dependent on oil.

An interesting fact is that it was in Germany in 1987 was built the Westküste 100, located in Kaiser-Wilhelm-Koog. The introduction of the first wind farm was created with 30 wind turbines and 1,000 kW of power, mounted on an area of 21 hectares, with a production target of 2 million kWh of electricity achieved in the first full year of operation in 1988 [15]. However, it was also possible to observe the problems surrounding the wind farms of the harsh climate of the mouth of the Elbe. And more, together with the salty air and average wind speed in 6.5 m/s, affected the operation, causing corrosion on metal parts, insulation failures in generators, and problems in the hydraulic system. It was also possible to verify the noise emission problems caused by the wind farm.

In 1990, the Program of 1000 roofs was instituted, involving private households in the process of power generation. It was considered large-scale testing, but many viewed as the initial stage of a market launch in Germany [16]. A photovoltaic system on roofs was installed throughout the national territory, where the government would be responsible for financing 70% and the rest by the companies responsible for the installation. However, the costs to generate energy through this system were higher than the incentive offered, data from ABSOLAR, the price for installing the equipment was above 12 thousand euros, and the benefit of only 6,8 cents of euro per kWh. And more, a much lower cost than the production cost, which was 90 cents per kWh, and for that reason, the number of installations was decreasing [17].

In 1991, the Electricity Feed-in Act (Stromeinspeisungsgesetz) [18] was approved, an essential precursor to the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz EEG). It guaranteed access to the distribution network for energy generated from renewable sources. In addition, it forced the concessionaires that operated the public grid to pay premium prices (special power tariffs) for the electricity supplied by these renewable energy plants. Since the law placed an excessive burden on some utilities, especially those located near the coast, where most wind turbines are found, the law was amended in 1998, introducing a limit on the amount of renewable energy electricity that should be reimbursed. However, when something is limited and reached, the incentives to create new technologies end. In 2000, the limit imposed by law was reached, creating a barrier to implementing new wind energy technologies in Germany. Therefore, replacing the Electricity Feed-in Act, the Renewable Energy Act (EEG) emerged.

As mentioned, the first EEG appeared in 2000 [19] due to three main factors: the growing increase in wind turbines, the obligation assumed under the Kyoto Protocol to reduce greenhouse gas emissions by 21% by 2010, and the coupling of energy tariffs through the Electricity Feed-in Act. This last factor no longer guarantees the economic operation of generation plants from renewable sources. The EEG 2000 represented a new quality in promoting renewable energies; with only 12 paragraphs, it established the objective of doubling the share of renewable energies in electricity consumption by 2010. The priority was established by law for renewable electricity over conventionally generated electricity for the first time.

In 2011 the German government adopted the official policy to increase the share of renewable sources in the energy matrix known as “Energiewende” [20].

The 2012 EEG [21] established that the share of renewable energy in electricity consumption should be at least 35% by 2020, 50% by 2030, 65% by 2040, and 80% by 2050, and a market, network, and systems integration must exist.

However, the system's rapid expansion compromised the jeopardizing of the stability of electrical networks and the security of supply, established by the 2014 EEG [22]. The limits for renewable energy systems was delimited by 2025 between 40 and 45%, and 55 and 60% for 2035. And also it was setting the maximum limit for the expansion of the system per year.

Solar energy could grow up to 2.5 GW (gross) per year, onshore wind power up to 2.5 GW (net) per year, biomass, with annual construction up to 100 MW (gross), and the installation of “offshore” wind power of 6.5 GW by 2020 and 15 GW by 2030. In this way, there will be an advance in the production of renewable energy in a planned way, and in return, the reduction of subsidies.

Another significant milestone in German regulation was the 2017 EEG [23], which defined that the compensation system would no longer be governmental but determined by market bids. Two new types of “services” emerged to meet this new demand, Electricity Rental and Roof Rental, through the Tenant Electricity Act.

The Electric Energy Rental consists of the energy generated by generation distributed in residential buildings; the energy not consumed will be injected into the grid and remunerated. And the Roof Rental in which investors, usually companies, look for roofs from individuals for the installation of solar panels, some advantages that individuals can have is an income in the form of rent, absence of the investment cost, and acquisition of the photovoltaic system at the end of the contract. Another is that compared to electricity purchased from the grid, electricity from distributed generation does not incur specific cost components such as grid fees, grid-side surcharges, electricity taxes, and concession fees. In this way, in addition to the landlord and tenants being able to benefit from electricity from their roof under attractive conditions. It is also helping to promote the expansion of renewable energies. In 2016, a third of renewable energy production belonged to private individuals [24].

Finally, the German parliament approved in December 2020 the EEG 2021 [25] to expand the use of renewable energy and the energy transition in Germany and achieve greenhouse gas neutrality by 2050. However, such a law is not without criticism [26] as the first subsidized plants will lose EEG funds. The German government has been asked how the renewable energy surcharge could be abolished in favor of an alternative, budget-neutral financing model. Further legislative changes to facilitate the repowering of existing wind farms and better framework conditions for energy purchase contracts between renewable energy operators and private consumers are also discussed.

In recent events, the German government announced that they are aiming to get 100% of energy from renewable sources by 2035, their focus is to become less dependent on Russian fossil fuel supplies [27].

Suggestions for Brazil about Germany’s experience

For more than 30 years, the German government has encouraged the micro and mini distributed generation sector and its integration into the national energy market. Starting with the Program of 1000 roofs and with the EEG’s, which from the beginning subsidized research and development projects, they have encouraged the creation of new technologies that could improve and expand the use of renewable energy sources 14. Furthermore, they paid for part of the investment for their citizens who wanted to install the technology for generating photovoltaic solar energy in their homes. And finally, it even becomes a national policy to use renewable energy sources.

Unlike Brazil, it is important to note that the prosumer can sell the generated electricity to the grid at a fixed price. This price compensates for the cost of installing the solar panel or wind turbine. Every citizen pays this price through a surcharge built into the electricity bill. However, this surcharge has given Germany one of the more expensive electricity bills in Europe.

Although Brazil is a country of continental dimensions and with more significant potential than Germany for exploring renewable energy sources, Brazil lacks a national policy for the use of these sources. In addition to the complete absence of public policies for investment in the development of new technologies and the lack of subsidies for micro and mini-distributed generation projects installations.

We can say that the main rules that regulate distributed generation are:

a) Normative Resolution no. 482/2012 [6] instituted distributed generation, with the limit of own generation of up to 1MW of capacity. It could be discounted on the consumption billed at the end of the month, within a limit of up to 3 years.

b) Normative Resolution no. 687/2015 [7] increased the limit from 1MW to 5 MW, the validity of credits from 3 years to 5 years, and created new modalities (developments with multiple consumer units, shared generation, remote self-consumption).

c) Law no. 14,300/2022 [1] established the legal framework for microgeneration and distributed mini generation, the Electric Energy Compensation System (SCEE), and the Social Renewable Energy Program (PERS).

With the approval of the Legal Framework for Distributed Micro and Mini Generation, it brought essential changes and transparent rules for this type of energy generation. It guarantees legal certainty for companies operating in the sector since they must follow ANEEL's normative resolutions.

Although the text of the law assures the prosumers that until December 31, 2045, they remained under the aegis of the current rules, even those who enter within 12 months of the publication of the law. In other words, today, those who undertake via distributed generation operate in a compensation system and are exempt from paying some tariff components, such as the tariff for the use of the distribution system.

The law created a class of privileged prosumers and failed to treat everyone equally, which could give rise to lawsuits since the law provides for a staggered charge to prosumers who enter after 12 months of enactment of the law, article 27 of Law no. 14,300/2022 [1].

I - 15% (fifteen percent) from 2023;

II - 30% (thirty percent) from 2024;

III - 45% (forty-five percent) from 2025;

IV - 60% (sixty percent) from 2026;

V - 75% (seventy-five percent) from 2027;

VI - 90% (ninety percent) from 2028.

Although the law creates a stable and balanced framework for using clean and renewable sources, it also fails to encourage a larger share of consumers to install these distributed micro and mini-generation systems in their homes, given the absence of a policy promotion in this sense.

Contrary to what was seen in Germany, which paid for the development, installation, and maintenance of these projects for several years, in Brazil, the law stipulates fees for those who don't join the program until 2023. This fact can scare potentially interested parties since it is not cheap to acquire the necessary equipment, and the cost to install a residential solar energy generator of 1.78 kWp alone has an installation value of approximately R$3,396.60 (around US$ 653 in February 2022). It can easily reach the value of 15 thousand reais (purchase and installation of equipment) [28].

Therefore, Brazil can learn from the German model to create public investment policies, creating goals so that more citizens can use the distributed micro and mini-generation system. A flexible industrial policy, where the entrepreneur is not burdened in the development and production of components and equipment, through exemptions, subsidies, and favorable policies, the entrepreneur can have an attractive profit that compensates for this investment. And finally, through international cooperation, whether in the development of technologies or learning from the mistakes and successes of other countries.

CONCLUSION

In this article, we discussed the Brazilian regulations in the micro and mini generation, whose main innovation was the legal framework for a distributed generation approved in 2022 [1], which, together with Aneel's resolutions [2,6-8], will provide the necessary legal certainty so that investments can be made in this sector that has a vast potential for clean energy.

Because Brazil still has a long way to develop the regulations in the micro and mini generation sector, it was necessary to study the German regulation that, since 1990, they are aiming to become a "clean energy state" [16], and we could verify the development of laws focusing on their photovoltaic sector, at the

government level through policies, and for the prosumer to become possible to sell the excess or rented their roof to some company to explore the sunlight, and now with the goal to achieve 100% clean energy by the year 2035 [27].

After that, it was made a brief comparison between Brazil's and Germany's regulations, and how Brazil can learn with Germany's experience, like focusing on public policies for the sector, more investments, and international cooperation.

Although Brazil is still developing its legislation in the photovoltaic sector, it has enormous potential compared to Germany, given its continental dimension, and having a large part in the tropical sector where the sun predominates during the year.

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