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Energy Commercialization Models: Dynamism, Opportunities, and Expansion

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ABSTRACT
The Brazilian electricity sector plays a strategic role in the economy and the sustainable development of the country, characterized by the coexistence of two main energy trading environments: the Regulated Contracting Environment (ACR) and the Free Contracting Environment (ACL). In the ACR, energy is supplied to captive consumers through distributors, while the ACL offers greater flexibility to consumers, enabling bilateral negotiations regarding price, quantity, supply period, and payment conditions. The methodology adopted in this study followed a qualitative approach, recognized as essential in the scientific field for the in-depth understanding of social, economic, and environmental phenomena. To achieve the proposed objectives, two complementary research procedures were employed: bibliographic research, which provides a solid theoretical foundation for understanding the topic, and documentary research, which enables the analysis of official documents and regulations issued by institutions such as GNPW Group®, COPEL, CCEE, ANEEL, ABRACEEL, and the Brazilian government. The general objective of this study is to analyze the energy trading models in Brazil, highlighting their dynamism, the opportunities provided, and the possibilities for expansion, with an emphasis on normative aspects, the different contracting environments, and the dynamics of the energy market. The research also explores the advantages and challenges associated with the ACL and ACR, as well as the impacts of regulations on the development and evolution of the Brazilian energy sector. The findings of the study highlight that the evolution of the Brazilian electricity sector, with the expansion of the Free Contracting Environment (ACL) and the continuation of the Regulated Contracting Environment (ACR), reflects a pursuit of greater competitiveness, flexibility, and sustainability.

Keywords*: Energy trading; Free Contracting Environment; Regulated Contracting Environment; Brazilian electricity sector.*

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I. INTRODUCTION

The regulatory evolution of the Brazilian electricity sector reflects a continuous effort to modernize and make the market more competitive and efficient, aligning it with global decarbonization goals. Brazil, in pursuing a more equitable energy transition, seeks to consolidate its leadership on the global stage by promoting a more sustainable and innovative environment.

This process has been fundamental for the development of an electrical system capable of meeting the growing demand for renewable energy sources, in addition to incorporating advanced technologies such as smart meters and energy management systems. The commercialization of the Brazilian electricity sector is characterized by its complex operational structure, which functions within two frameworks: the Regulated Contracting Environment (RCE) and the Free Contracting Environment (FCE). The RCE, predominantly utilized by the general population, aims to ensure tariff predictability and stability, whereas the FCE offers greater flexibility, especially for large-scale consumers, granting them more autonomy to negotiate contracts.

The expansion of the FCE in Brazil has been one of the sector's main trends, driven by recent regulations such as Ordinance 50/2022 and Bill 414/2021. These regulatory changes aim to simplify the migration process between energy commercialization models, making it more accessible and attractive to new consumers. Additionally, they seek to increase market competitiveness and promote the inclusion of new renewable energy

sources, aligning the sector with current needs for energy efficiency and sustainability, and moving towards global goals for a more sustainable system.

This study aims to analyze the energy market in Brazil by presenting its main concepts. It seeks to contextualize the normative resolutions governing energy commercialization, which consolidate the sector. Furthermore, it compares the contracting environments, including the Regulated Contracting Environment (RCE) and the Free Contracting Environment (FCE), the latter currently expanding due to reduced entry barriers. Moreover, it discusses the market landscape, which highlights the advancement of renewable energy sources and the role of technologies, such as smart meters, in enhancing system efficiency and sustainability.

The methodology adopted in this study followed a qualitative approach, recognized as essential in the scientific world for a deeper understanding of social, economic, and environmental phenomena. To achieve the proposed objectives, two complementary research procedures were employed: bibliographic research and document analysis.

The general objective of this study is to analyze the energy commercialization models in Brazil, highlighting their dynamism, the opportunities they provide, and their expansion potential, with an emphasis on normative aspects, different contracting environments, and energy market dynamics.

The specific objectives are as follows: 1. To identify and discuss the main normative resolutions regulating energy commercialization in Brazil, evaluating their impact on the organization and functioning of the energy market; 2. To examine the characteristics and differences between the free contracting environment (FCE) and the regulated contracting environment (RCE), highlighting their advantages, challenges, and expansion potential in the Brazilian context; 3. To analyze the main dynamics and trends in the Brazilian energy market, focusing on the involved agents, commercialization mechanisms, and opportunities generated by the sector's evolution.

This article is organized into five sections. The first section, the introduction, presented the research objectives. The second section, the methodology, explained the approach and research procedures employed in developing this study. The third section, the theoretical framework, engaged in a debate among authors researching this theme. The fourth section was dedicated to analyzing the results obtained after the theoretical framework development. Finally, the fifth section presented the concluding remarks.

II. MATERIAL AND METHODS

The methodology adopted in this study followed a qualitative approach, recognized as essential in the scientific community for its capacity to provide an in-depth understanding of social, economic, and environmental phenomena. This approach enables the exploration of meaning, relationships, and contexts associated with energy commercialization models, contributing to analyses that go beyond quantitative figures and data, thereby expanding the interpretative and critical perspective on the subject (Pitanga, 2020).

To achieve the proposed objectives, two complementary research procedures were employed: bibliographic research and documentary analysis. The bibliographic research was conducted based on an extensive literature review, utilizing books, scientific articles, theses, dissertations, and other relevant academic sources. This procedure is fundamental in the scientific field, as it provides the theoretical foundation necessary to comprehend the state of the art of the studied topic, identify gaps in existing knowledge, and establish the groundwork for new investigations. Furthermore, the bibliographic review facilitates a dialogue with accumulated knowledge, fostering the construction of a critical and well-founded perspective on energy commercialization models (Guerra, 2023).

The documentary research complemented the bibliographic analysis by examining and interpreting documents from various institutions relevant to the energy sector. Materials from the following organizations were analyzed: GNPW Group®, Companhia Paranaense de Energia (COPEL), Câmara de Comercialização de Energia Elétrica (CCEE), Agência Nacional de Energia Elétrica (ANEEL), and Associação Brasileira dos Comercializadores de Energia (ABRACEEL).

Additionally, official documents from Brazil, such as laws, ordinances, and resolutions, were examined. Documentary research is of great importance in the scientific community, as it provides primary and up-to-date information, enabling the analysis of institutional and regulatory practices in the studied context. It allows for the validation of data and a deeper understanding of normative and structural aspects that influence the energy commercialization market in Brazil, thereby providing inputs for more robust and detailed analyses (Guerra, 2023).

Thus, the integration of the qualitative approach with bibliographic and documentary research procedures ensured a comprehensive and critical analysis, offering a significant contribution to understanding the dynamism, opportunities, and expansion of energy commercialization models.

III. THEORETICAL FRAMEWORK

The Brazilian electric sector adopts a dual energy commercialization model, consisting of the Regulated Contracting Environment (ACR) and the Free Contracting Environment (ACL) (Lezana et al., 2017). This structure reflects the complexity and diversity of the country's energy demands (Araujo & Mendes, 2018; Santana et al., 2020), allowing different consumer profiles to be served more effectively through contracts tailored to their specific needs.

Among these models, the ACR is predominantly adopted by the majority of the population, while the ACL is designed for consumers with higher energy demand and greater negotiating capacity, offering a strategic approach to meet their needs (Silva, 2021). In the ACR, captive consumers purchase electricity directly from distribution companies under conditions dictated by government regulations (Teberge & Sodré, 2019).

This model ensures predictability and accessibility, making it particularly advantageous for small-scale consumers. However, regulated tariffs may limit competitiveness and restrict access to renewable energy sources, an increasingly relevant issue given global sustainability agenda. In contrast, the ACL grants consumers the freedom to negotiate directly with energy suppliers, allowing customized contractual conditions, including payment methods, supply terms, pricing, and volume (Teberge & Sodré, 2019; Teixeira, 2025).

Due to this flexibility, medium- and large-scale consumers seeking cost optimization and energy source diversification have increasingly migrated to the free energy market. Furthermore, the ACL allows greater access to renewable sources, supporting environmental responsibility practices and decarbonization goals (Araújo et al., 2022).

The growing demand for the ACL in the Brazilian energy landscape compels both the market and the government to understand its dynamics and impacts (Balestra, 2022). Understanding the commercialization structure, including incentives for renewable energy generation in both the Free Contracting (Loureiro, 2021) and Regulated Contracting (ANEEL, 2021) environments, is foundational to fostering dynamic planning within the country's electric sector. The regulatory evolution of Brazil's electric sector reflects a continuous effort to modernize the market and make it more competitive and efficient (Bacellar & Gonçalves, 2022; Brasil, 2021).

From the milestone Law 9.074/1995 to recent regulations such as Bill 414/2021 and Ordinance 50/2022, the country is advancing towards a more inclusive and dynamic model aligned with contemporary demands for sustainability and energy efficiency (Brasil, 1995; Castro et al., 2023). Decarbonizing Brazil's electric sector, gradually replacing fossil fuels with renewable sources, is one of the main goals of the national energy policy (Nascimento, 2024). The implementation of renewable energy, such as solar and wind power, has proven to be a viable solution for both contracting environments (Alves et al., 2022; Bonfim, 2023; Stopfer et al., 2021).

In this context, the advancement of the free energy market, coupled with policies promoting the use of renewable sources and energy efficiency, positions Brazil on a promising path to address economic, social, and environmental demands, contributing to a more sustainable and inclusive energy future. This study conducts a bibliographic review addressing the functioning of the regulated market and the specificities of the free market. Fundamental concepts of both models, their advantages, and their challenges are explored. The analysis also considers the regulations that have shaped the sector, regulatory trends, and the expected effects of expanding the free market to smaller consumers. By examining these issues, the study seeks to provide a comprehensive view of energy commercialization options in Brazil, considering the specific needs of consumers of various scales.

3.1 Regulatory Resolutions on Energy Commercialization

The Brazilian electricity sector has undergone a series of legislative and regulatory transformations over the years to meet growing demand and promote greater competitiveness (Figure 1). The starting point of this trajectory was Law 9,074/1995, which enhanced the differentiation between captive and free consumers (Brazil, 1995). This measure allowed large consumers with higher energy demands the freedom to negotiate contracts directly with generators or traders, marking the beginning of the energy market's liberalization in the country (Brazil, 1995; Nascimento, 2024).

The implementation of the Free Contracting Environment (ACL) was designed to establish clear rules for energy commercialization. For this purpose, the Commercialization Rules were pivotal, regulating aspects such as price formation, responsibilities among market agents, and ensuring reliability in energy supply. These rules provided a foundation for free market transactions to be conducted fairly and transparently (Cíntia H. Flesch et al., 2018).

Complementing these rules, the Commercialization Procedures were developed to detail the operational and administrative processes required for executing energy purchase and sale transactions. These procedures ensure standardized practices and operational efficiency, avoiding conflicts between agents and promoting greater predictability in transactions. Another essential point for the declarations in the free market was the establishment of criteria to ensure the financial security of transactions.

Normative Resolution No. 622/2014 introduced technological regulations related to financial guarantees and the formalization of contracts for buying and selling electricity (Brazil, 2014). This resolution ensures that

market agents fulfill their contractual obligations, mitigating default risks and strengthening the system's reliability. With the increasing complexity of the market, the Electricity Commercialization Convention, formalized through Normative Resolution No. 957/2021, became fundamental (Brazil, 2021).

This convention establishes guidelines regulating the relationship between various market agents, promoting greater stability and legal security. Moreover, it defines the rights and obligations of each participant, contributing to confidence in the business environment of the electricity sector. In parallel, Draft Bill 414/2021 emerges as an initiative to expand and democratize the free energy market in Brazil. The bill proposes the complete opening of the ACL, allowing all consumers, regardless of their consumption profile, access to the free choice of their energy suppliers (Brazil, 2021).

In other words, this proposal aims to enable all consumers, irrespective of their profile or demand level, to freely select their electricity suppliers. The primary goal of this bill is to foster market competitiveness, creating a more dynamic and diversified environment. By expanding access to the ACL, it is expected that residential consumers, small businesses, and smaller sectors will be able to negotiate directly with generators or traders, seeking better tariff conditions and personalized services. This change would provide greater autonomy to consumers and stimulate new business opportunities in the energy sector.

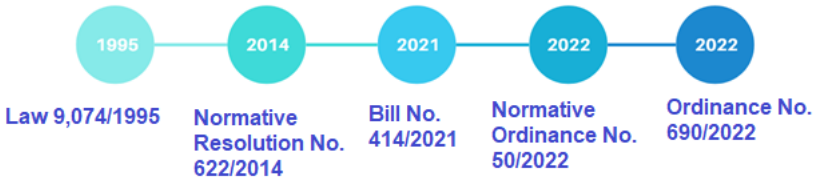


Figure 1: Major Advances in Energy Market Regulation
Source: Data from the researchers.

Another relevant aspect of the project is the forecast for greater transparency and regulation in the market. Full liberalization demands the strengthening of rules that ensure the reliability and security of transactions. To this end, the project includes mechanisms aimed at protecting consumers and ensuring a balance between market agents, preventing abuses and tariff distortions. The implementation of Bill 414/2021 is also seen as a stimulus to investment in the electric sector (Brazil, 2021).

The opening of the market is expected to attract new domestic and international players, increasing competition and diversifying energy supply options. This movement has the potential to generate economic benefits, create jobs, and make the Brazilian electric sector more competitive in the global arena. In a more recent development, Normative Ordinance No. 50/2022, published by the Ministry of Mines and Energy (MME), detailed the requirements for the migration of consumers to the Free Consumer Market (ACL), encouraging the participation of new entrants in the free energy market (Brazil, 2022).

This supplementary regulation made the process more accessible and organized, expanding opportunities for consumers seeking greater autonomy and better negotiation conditions. Lima et al. (2024) highlighted that opening the market to new participants also means more options for consumers and greater incentives for innovation in the energy sector, especially in relation to efficiency and the adoption of cleaner and more sustainable technologies (Lima et al., 2024).

One of the main points of Ordinance 50/2022 is the clear definition of the conditions under which captive consumers, also linked to energy distributors, can opt to negotiate directly with suppliers in the ACL (Brazil, 2022). This regulation establishes technical and operational requirements that must be met, ensuring a safe and organized transition for both consumers and other sector agents. Furthermore, the ordinance reflects the MME's commitment to modernizing the Brazilian electric sector, aligning with the guidelines for the gradual opening of the energy market. By detailing the steps necessary for migration, it contributes to a more transparent and competitive business environment, offering opportunities to consumers, reducing costs, and providing more tailored solutions for their energy demands. In conjunction with other regulations, such as ANEEL Normative Resolution No. 957/2021, Ordinance 50/2022 promotes the standardization and strengthening of the free market, ensuring legal and operational security for all involved. This normative integration is essential to meet the growing demand for flexibility and efficiency in the electric sector, in addition to stimulating the use of renewable sources and sustainable practices (Nascimento, 2024).

In their study, Rocha et al. (2024) emphasize that Normative Ordinance No. 50/2022 is a milestone in the evolution of the ACL, standing out as a crucial instrument for democratizing access to the free energy market and for building a more competitive, innovative, and sustainable electrical system. In summary, the regulatory evolution of the Brazilian electric sector reflects a continuous effort to modernize the market and make it more

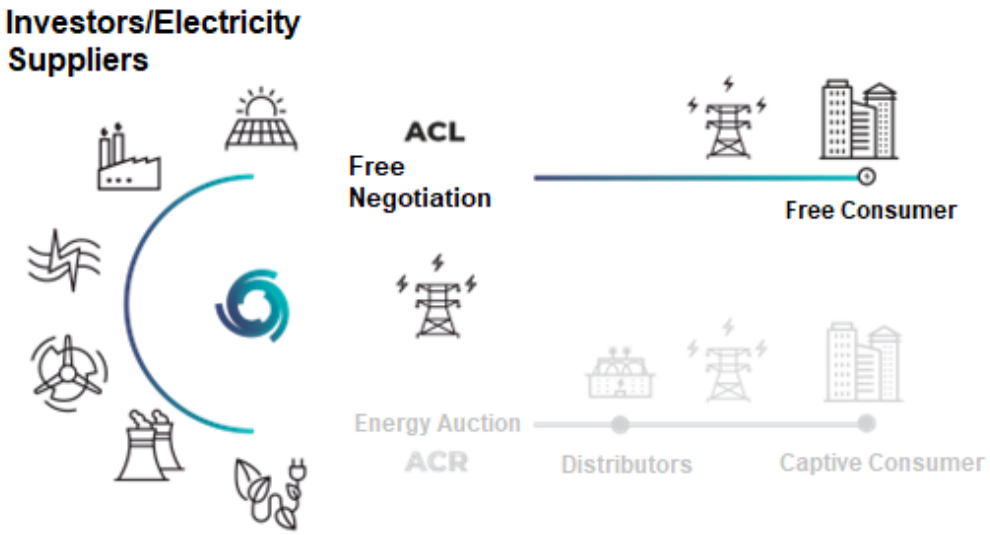
competitive and efficient. From the initial milestone of Law 9.074/1995 to the most recent regulations, such as Ordinance 50/2022 and Bill 414/2021, the country is moving toward a more inclusive and dynamic model, aligned with contemporary demands for sustainability and energy efficiency (Brazil, 1995).

3.2 Contracting Environments: Free (ACL) and Regulated (ACR)

According to Farias (2021), the energy market in Brazil is structured into two distinct environments: the Regulated Contracting Environment (ACR) and the Free Contracting Environment (ACL) (Teixeira, 2025). Each of these markets caters to different consumer profiles and plays an essential role in the electricity sector, regulated by the National Electric Energy Agency (ANEEL). Both environments have complementary roles in the national energy system, offering different energy contracting models, with their respective benefits and challenges for consumers, generators, and distributors.

According to Silva et al. (2018), the differentiation between these environments is crucial for understanding the dynamics of the electricity market in Brazil, especially in light of global trends towards decarbonization and sustainability.

Figure 2: Free Contracting Environment (ACL)



Source: GNPW (2024).

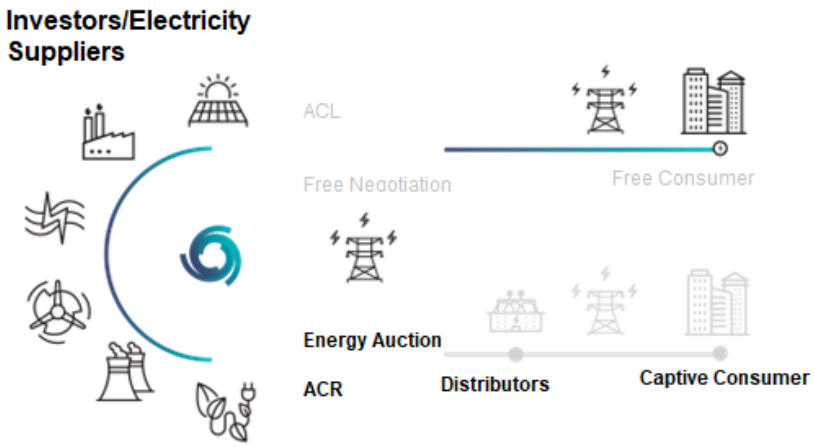
According to Farias (2021), the Free Contracting Environment (ACL) is characterized by greater freedom of negotiation between consumers and suppliers. In this environment, large consumers, such as industries and large businesses, can directly choose their energy suppliers, whether for conventional energy supply or for renewable sources (Figure 2) (GNPW Group®, 2024).

Furthermore, in this environment, contracts allow for the customization of prices, terms, and volumes between consumers and generators. As explained by Muñoz, Souza, and Silva (2019), the ACL has expanded in recent years, with increasing adoption of renewable energy, driven by its competitiveness in terms of cost and the search for more sustainable solutions. Companies have opted for bilateral contracts, which offer greater flexibility and security in supply.

Additionally, the free market has become an important driver of the energy transition, allowing companies to align with sustainability goals and ESG (Environmental, Social, and Governance) criteria. The growth of the ACL reflects a global trend of liberalization and digitalization in the energy sector, with an emphasis on the growing share of renewable energies in the energy mix. Migration to the ACL offers several advantages, including cost reduction, long-term expenditure predictability, and the option to choose renewable energy, aligning with sustainability practices. However, the transition requires planning and technical knowledge, as it involves joining the CCEE, managing contracts, and monitoring energy consumption (Flesch et al., 2018).

On the other hand, in the Regulated Contracting Environment (ACR), energy is purchased by distributors through auctions organized by the Electric Energy Commercialization Chamber (CCEE), which pass on the costs to final consumers (captive consumers, such as households and small businesses, who pay regulated tariffs and cannot choose their supplier) based on tariffs regulated by ANEEL (National Electric Energy Agency) (Teberge; Sodré, 2019) (Figure 3).

Figure 3: Regulated Contracting Environment (ACR)



Source: GNPW (2024).

In his work, Baierle (2021) argued that the Regulated Contracting Environment (ACR) plays a significant role in ensuring universal access to electricity, maintaining a balance between supply and demand, and ensuring tariffs that reflect market conditions. However, the ACR faces challenges related to its reliance on more expensive energy sources, such as thermal power plants, and the need to adapt to new sustainability and energy transition requirements. The regulation of the ACR aims to balance the interests of consumers and distributors, considering both operational costs and the decarbonization goals of the electricity sector. However, while the ACR offers simplicity and predictability, it may present higher costs due to the inclusion of system charges and the absence of options for direct negotiation.

The choice between the Free Contracting Environment (ACL) and the Regulated Contracting Environment (ACR) depends on the specific characteristics and needs of each type of customer, presenting both advantages and disadvantages in its adoption. Figures 4 and 5 present the main pros and cons of contracting by customer size in both environments.

Figure 4: Pros and cons of participation in the Free Contracting Environment (ACL) for large, medium, and small customers.

Ambiente de Contratação Livre (ACL)

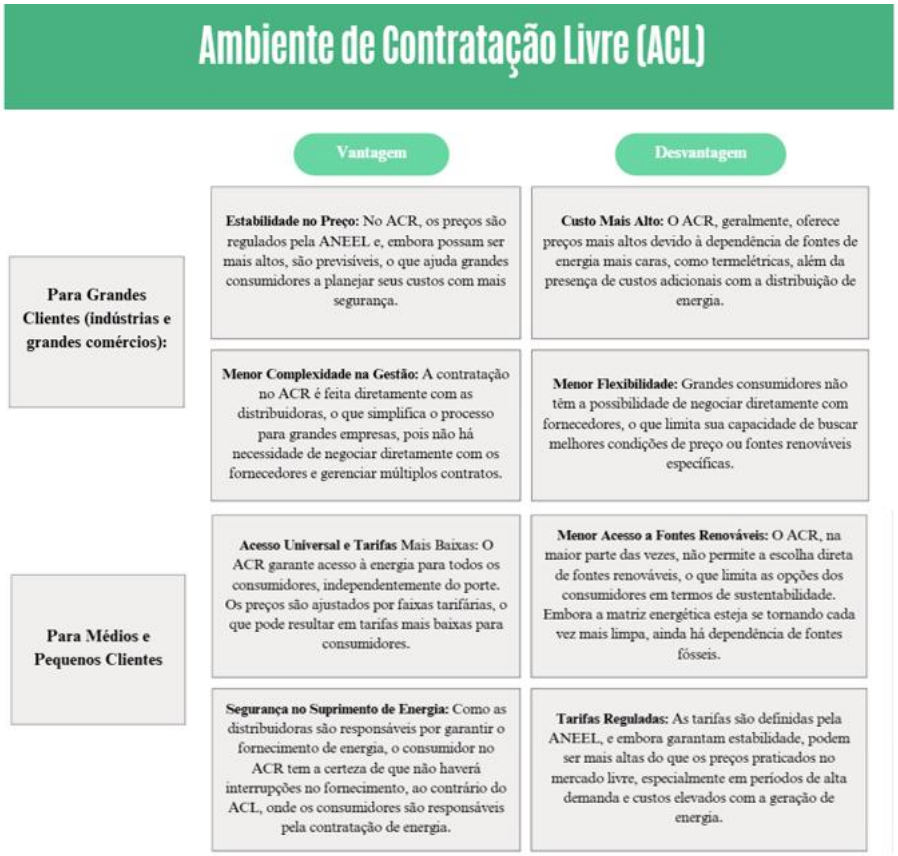
	Vantagem	Desvantagem
Para Grandes Clientes (indústrias e grandes comércios):	**Flexibilidade na Negociação:** O ACL oferece liberdade para grandes consumidores negociarem diretamente com os fornecedores, permitindo a escolha das melhores condições de preço, volume e fontes de energia, o que pode resultar em economia significativa.	**Risco de Incerteza no Preço:** Embora o preço no ACL possa ser mais baixo, ele também pode ser volátil, sujeito a flutuações no mercado de energia. Isso pode resultar em custos imprevisíveis, especialmente durante períodos de alta demanda.
	Acesso a Energia Renovável: Com a crescente adoção de fontes renováveis como solar e eólica, as grandes empresas podem investir em contratos de energia limpa, alinhando-se com metas de sustentabilidade e responsabilidade social (ESG).	**Necessidade de Gestão e Planejamento:** Grandes consumidores precisam de um gerenciamento mais complexo de contratos, o que exige conhecimento técnico e recursos especializados para monitorar e otimizar o uso de energia.
	Preço Potencialmente Mais Baixo: A possibilidade de negociações diretas e a maior competitividade no mercado livre podem levar a preços mais baixos, já que as distribuidoras não intervêm nos contratos.	
Para Médios e Pequenos Clientes	**Economias de Escala:** Embora os médios consumidores não tenham o mesmo poder de negociação das grandes empresas, ainda assim podem obter preços mais baixos e condições mais personalizadas por meio do ACL.	**Barreiras de Acesso:** Para consumidores de médio e pequeno porte, o ACL pode ser difícil de acessar devido à exigência de uma demanda mínima de energia e ao custo elevado de operação e manutenção de contratos bilaterais. possuem.
	Contratação de Fontes Renováveis: Como as fontes renováveis são cada vez mais competitivas no mercado, os consumidores médios podem acessar energia limpa a preços mais vantajosos do que no ACR.	**Complexidade de Contratação:** O processo de negociação e a gestão dos contratos podem ser complexos e demandar recursos que nem todos os consumidores médios e pequenos possuem.

Source: Data from the researchers.

Rocha, Camboim, and Rocha (2024) emphasize that the choice between the Free Contracting Environment (ACL) and the Regulated Contracting Environment (ACR) depends on several factors, such as the size of the company, the level of interest in renewable sources, the capacity for contract management, and the pursuit of more competitive prices. For large consumers, the ACL offers flexibility and potential cost reduction, but it requires a higher level of management and greater risk tolerance.

On the other hand, the ACR provides stability and security, making it ideal for small and medium consumers, who lack the ability to negotiate directly with suppliers or handle the complexity of the free market. The ACR is more accessible but may result in higher prices and fewer renewable options. The decision should be made by considering the specific needs of each client and the characteristics of the energy market at any given time.

Figure 5: Pros and cons of participation in the Regulated Contracting Environment (ACR) for large, medium, and small customers.



Source: Data from the researchers.

It is important to discuss that the energy transition is a shared challenge between both environments, requiring coordinated efforts between the government, regulators, and the private sector. In terms of regulation and governance, Brazil has made progress in creating a more competitive and efficient energy market, with the implementation of mechanisms such as energy auctions and renewable energy purchase and sale contracts. Addressing challenges such as the cost of energy in the Regulated Contracting Environment (ACR) and managing the increase in demand in the Free Contracting Environment (ACL) are central issues for the coming years.

In the regulated market, tariff regulation and the definition of subsidies for low-income consumers remain crucial issues. In the free market, the role of energy commercialization has been expanded, with the creation of mechanisms to facilitate the entry of new suppliers and greater transparency in negotiations, contributing to a more dynamic and competitive environment. Furthermore, with recent changes in the sector, there is an expectation of expanded access to the free market, particularly for medium- and high-voltage consumers, which should increase competitiveness and reduce costs for companies.

3.3 Energy Market

The free energy market is a contractual environment where consumers can directly negotiate with generators and traders regarding the conditions of electricity supply, such as prices, terms, and volumes (Vinícius; Cardoso; Rocha, 2017).

Unlike the regulated market, where tariffs are set by government bodies, the free market offers greater freedoms to consumers who meet specific criteria, such as minimum contracted demand levels. In Brazil, the free market operates within the Free Contracting Environment (ACL), regulated by the National Electric Energy Agency (ANEEL) and the Electric Energy Trading Chamber (CCEE). It was created with the objective of increasing competitiveness, reducing costs for consumers, and promoting energy efficiency and the use of renewable sources (Flesch et al., 2018).

The free market is accessible to two main types of consumers: - Free Consumers Companies with contracted demand above 1 MW (or 0.5 MW in specific segments), who can choose any supplier. - Special Consumers: Companies with demand between 0.5 MW and 1 MW, who can only purchase energy from incentivized sources, such as solar and wind (Brasil, 2022b).

The free energy market in Brazil has undergone significant regulatory changes, driven by policies aimed at sector democratization, sustainability promotion, and increased competitiveness. These changes seek to expand consumer access and prepare the market for full opening. Since 2022, there has been a gradual increase in the minimum demand limits for participation in the free market.

Consumers with contracted demand of 0.5 MW have become eligible, expanding the reach to small and medium-sized enterprises. This policy aims to integrate a larger number of consumers into the market, which was previously accessible only to large consumers, promoting greater competitiveness in the sector. The regulation of renewable sources in the free market has also been strengthened.

ANEEL's Normative Resolution No. 878/2023 established clear criteria for the certification of renewable energy, encouraging consumers to opt for contracts aligned with decarbonization and sustainability goals. This is essential for attracting companies with environmental commitments and promoting the use of clean sources in the country. Another significant change was the introduction of rules that simplify negotiations within the Free Contracting Environment (ACL).

Measures such as contract standardization and increased price monitoring transparency have limited operational barriers, making the market more accessible and less complex for new entrants. The total opening of the free market remains one of the sector's main objectives.

The proposal to allow all consumers, regardless of demand, to opt for the ACL has been discussed in legislative projects, such as Bill No. 414/2021, which is progressing in Congress. If approved, the market will become fully accessible to residential consumers and small businesses by 2026. The adoption of smart grids has been encouraged by new regulations. Technologies such as smart meters and consumption management systems have been regulated to facilitate consumer participation in the free market, allowing greater control over consumption and energy costs. Strengthening governance has also been a priority.

ANEEL and CCEE have promoted changes to increase regulatory security and predictability, such as revising criteria for the certification of traders and conducting regular audits to prevent fraud and enhance trust. New pricing rules, such as the modernization of the Settlement Price of Differences (PLD) calculation, have been groundbreaking, reflecting more accurately the generation costs and the conditions of the electric system. This brings greater efficiency to the market and reduces distortions that could encourage participation.

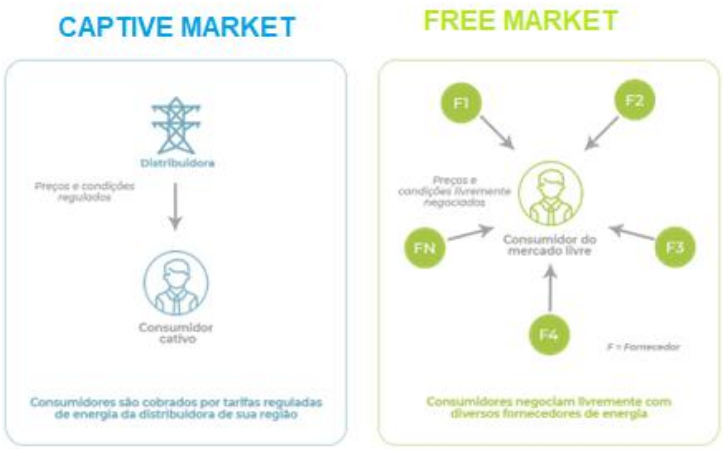
The regulatory changes between 2022 and 2025 have been pivotal in strengthening the free energy market in Brazil. They have paved the way for the full opening of the market, with greater integration of technologies and alignment with sustainability goals. These advancements consolidate the ACL as a key component of the country's energy future.

IV. RESULTS ANALYSIS

The Free Energy Market is a direct negotiation environment between electricity generators and consumers, providing greater ease and freedom of choice for businesses and industries (Figure 3) (ABRACEEL, 2023). In other words, consumers can choose their own supplier, the type of energy source, and negotiate prices and terms. This model has existed in Brazil since 1996, but the rules for migration were more rigid (Copel, 2022).

In this market, both energy generators and consumers must be linked to the Câmara de Comercialização de Energia Elétrica (CCEE), which organizes transactions and performs the financial settlement of contracts. According to the Brazilian Association of Energy Traders (ABRACEEL), the Free Energy Market already accounts for 38% of electricity consumption in Brazil and is expected to continue growing in the coming months, reflecting its impact on the country's energy sector (ABRACEEL, 2023).

Figure 6: Comparison between the Captive and Free Markets.

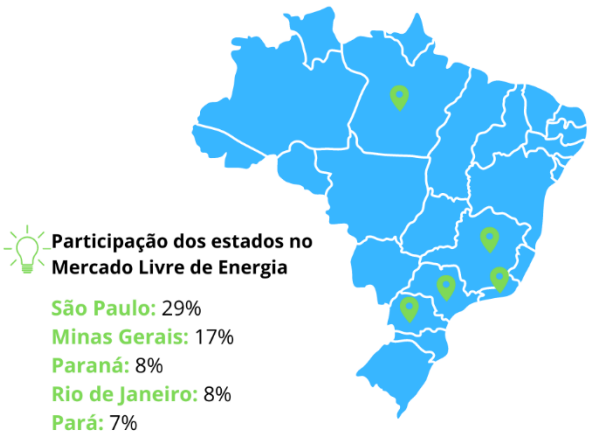


Source: ABRACEEL (2023)

In this market, both energy generators and consumers must be affiliated with the Electric Energy Trading Chamber (Câmara de Comercialização de Energia Elétrica - CCEE), which organizes transactions and ensures the financial settlement of contracts. According to the Brazilian Association of Energy Traders (Associação Brasileira dos Comercializadores de Energia - Abracel), the Free Energy Market is already responsible for 38% of electricity consumption in Brazil and is expected to continue growing in the coming months, reflecting its impact on the country's energy sector (ABRACEEL, 2023).

Over the past 12 months, the number of consumer units in the Free Energy Market has grown significantly, increasing by 18%. Currently, more than 29,000 units are registered, with the industrial sector being the primary driver of this adoption—88% of industrial consumption is supplied through this trading model. States such as São Paulo, Minas Gerais, and Rio de Janeiro are the largest participants, highlighting the strong presence of the Free Energy Market in regions with higher economic and industrial activity (Figure 7) (CCEE, 2024).

Figure 7: State Participation in the Free Energy Market



Source: CCEE (2024).

As of January 2024, groundbreaking changes were introduced to the Free Energy Market with its full opening to high and medium voltage consumers, categorized as Group A. These consumers can now migrate to the Free Energy Market without any restrictions on contracted demand volume. However, low-voltage consumers, such as homeowners and small businesses, remain restricted to the regulated market, with migration to the Free Energy Market anticipated only in 2028.

Currently, Group A consumers with a minimum demand of 500 kW can choose to negotiate directly with suppliers, detaching themselves from energy distributors. In the Free Energy Market, consumers can negotiate prices and terms, enabling significant energy cost reductions.

Conversely, captive consumers (Teberge & Sodré, 2019), who remain in the regulated market, continue to be served by local distributors, unable to select their suppliers or negotiate prices. According to regulations from the Ministry of Mines and Energy (Ministério de Minas e Energia - MME), all Group A consumer units with a connection voltage equal to or greater than 2.3 kV can purchase energy directly from any concessionaire, licensee, or authorized generator within the National Interconnected System (Sistema Interligado Nacional - SIN).

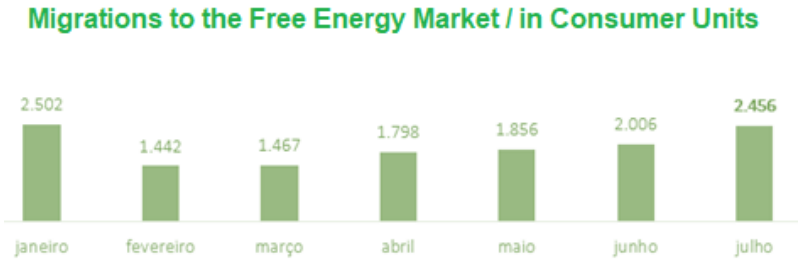
Group A is further divided into categories based on connection voltage, such as A1 (above 230 kV), A2 (88 kV to 138 kV), A3 (69 kV), among others. For consumers with loads below 500 kW, representation by a retail agent will be required to facilitate migration. The retail agent plays a crucial role as an intermediary between the consumer and the CCEE, simplifying the migration process and enabling small and medium-sized enterprises to access the Free Energy Market.

This figure democratizes market access by offering more negotiation options, particularly for businesses with lower energy demands. As more companies enter the Free Market, increased competition among energy suppliers is expected. This competition could result in lower prices for consumers, more flexible and advantageous contractual terms, and incentivize suppliers to offer differentiated services to attract clients.

According to Abraceel, the Free Energy Market reached 60,767 consumer units (ABRACEEL, 2023). In 2024, 22,236 new consumers migrated to this market, representing a 58% increase compared to 2023. Additionally, 72,000 units are eligible for migration, and 93,000 have opted to adopt distributed generation. These numbers reflect the market's continuous growth and the increasing adoption by consumers seeking greater control over energy costs and sources while pursuing sustainable practices.

According to the CCEE, despite the exponential growth in consumer migrations to the Free Energy Market driven by the effects of Ministry of Mines and Energy Ordinance 50/2022 (MME, Brazil, 2022), which authorized all medium- and high-voltage energy consumers to choose their suppliers, July 2024 saw a particularly significant migration compared to previous months (Graph 1). Approximately 2,500 companies and individuals gained the ability to choose their suppliers—nearly four times the volume recorded in the same month of 2023 (CCEE, 2024).

Graph 1: Migration to the Free Energy Market



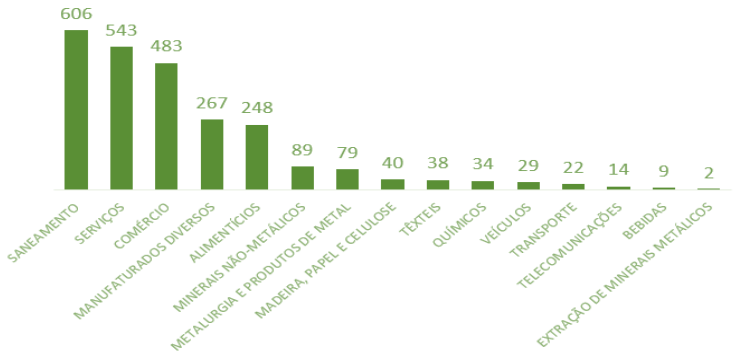
Source: Adapted from CCEE, 2024.

Despite the changes and advancements in the Free Energy Market, most Brazilian consumers, especially those in Group B (residential, rural, and public lighting), are still unable to migrate to the free market. Migration to the Free Energy Market for these consumers is estimated to become feasible only after 2028, following the implementation of new regulatory policies.

Until then, the regulated market continues to serve this majority. However, the ongoing changes represent an important step towards modernizing Brazil's electricity sector and democratizing access to energy across the country. According to CCEE data, 77% of new consumers are small and medium-sized businesses, such as bakeries, supermarkets, pharmacies, and offices, which have adopted the retail contract model (CCEE, 2024).

In this model, consumers purchase their energy from a trading company responsible for representing them in the market and supporting their day-to-day operations with the Electric Energy Trading Chamber. In Graph 2, a significant difference in the progress of the free market across economic sectors can be observed. Among the 15 sectors monitored by the CCEE in July, the Sanitation (606), Services (543), and Commerce (483) sectors demonstrated much higher migration rates compared to Transportation (11), Telecommunications (14), and Beverages (9).

Graph 2: Progress of the Free Energy Market Across Economic Sectors



Source: Adapted from CCEE, 2024.

The difference in the pursuit of lower costs and greater operational efficiency in the energy sector can be explained by the fact that it is a market undergoing modernization and expansion. Additionally, many of these companies are now privately funded investments rather than state-owned enterprises.

It is important to highlight that the anticipated changes in the sector, such as the opening of the free energy market to small consumers, promise to democratize access to the Free Contracting Environment (ACL), enhance competitiveness, and encourage the use of renewable energy sources. However, these developments also present challenges, such as the need to modernize regulations to protect consumers and ensure a balanced energy supply.

Companies transitioning from the regulated market to the Free Energy Market benefit from numerous advantages. Chief among them is significant cost savings, with reductions of up to 30% on electricity bills compared to the regulated market. Furthermore, these companies gain greater predictability regarding their energy costs, which provides enhanced security throughout the contractual period, which can be adjusted to meet their needs. Contract terms, such as prices, durations, volumes, and seasonality, can be negotiated in a customized manner. Another significant advantage is the possibility of acquiring clean, renewable, and certified energy, reinforcing the companies' commitment to environmentally responsible practices and the ESG agenda (Environmental, Social, and Corporate Governance). According to Ministry of Mines and Energy Ordinance No. 50/2022, all Group A consumers will be able to migrate to the Free Energy Market, expanding access to these opportunities (Brazil, 2022a).

The full opening of the Free Energy Market to all consumers, including residential ones (Group B), is still under discussion. Ordinance No. 690/2022, from the Ministry of Mines and Energy (currently under public consultation), proposes the gradual inclusion of all Brazilian electricity consumers in the Free Market. This process is slated to begin on January 1, 2026, for consumers served at low voltage, excluding residential and rural classes, and to fully include all consumers, including residential and rural ones, by 2028.

The Free Energy Market represents a significant transformation in the Brazilian electricity sector, offering greater autonomy, flexibility, and opportunities for consumers by 2028. It allows consumers to enjoy benefits such as cost reductions, energy expense predictability, and the option to acquire renewable energy aligned with ESG practices. These changes not only benefit companies but also signify progress toward a more liberalized, sustainable, and innovative energy market.

IV. DISCUSSION AND CONCLUSION

The research highlighted that the evolution of the Brazilian electricity sector, with the expansion of the Free Contracting Environment (ACL) and the continuity of the Regulated Contracting Environment (ACR), reflects the pursuit of greater competitiveness, flexibility, and sustainability.

The promotion of renewable energy sources and regulatory changes, such as Ordinance No. 50/2022 and Bill No. 414/2021, have been crucial in aligning Brazil with global decarbonization goals, driving energy efficiency and the adoption of innovative technologies.

The expansion of the ACL, by facilitating access for new consumers and enabling greater contractual autonomy, contributes to the market's modernization. By fostering the integration of renewable energy sources and the adoption of advanced technological solutions, the Brazilian electricity sector is positioning itself as a leader in the global energy transition.

Ongoing regulatory reforms aim to establish Brazil as a pioneer in sustainable development, balancing economic, social, and environmental interests. Thus, Brazil is advancing toward a more sustainable and inclusive energy future, making it essential to continuously monitor market trends to ensure the effectiveness of these transformations and the successful implementation of a clean and efficient energy matrix.

To deepen knowledge in the field, future research could explore the impact of emerging technological innovations, such as smart grids and energy storage, on strengthening the ACL and integrating renewable energy sources.

REFERENCES

[1] Alves, J. L., Chagas, M. J. R., Faria, E. de O., & Caldeira-Pires, A. de A. (2022). Circular economy and renewable energies: A bibliometric analysis of the international literature. *Interações (Campo Grande)*, 23(2), 267–297. https://doi.org/10.20435/inter.v23i2.3034.

[2] ANEEL. (2021). *Normative Resolution No. 1.000/2021*, of December 7, 2021.

[3] Araujo, G. S. de, & Mendes, L. F. R. (2018). Renewable energy or "clean" energy? A search for conceptual perception among students of the technical course in Environmental Studies. *Revista Vértices*, 20(3), 408–427. https://doi.org/10.19180/1809-2667.v20n32018p408-427.

[4] Araújo, R. S. de, Sousa, F. L. N. de, Vanderley, P. S., Bentes, S. O. da S., Gomes, L. M., & Ferreira, F. C. L. (2022). Renewable energy sources: Research, trends, and perspectives on sustainable practices. *Research, Society and Development*, 11(11), e468111133893. https://doi.org/10.33448/rsd-v11i11.33893.

[5] Bacellar, R. R., & Gonçalves, O. O. (2022). Regulation of the electricity sector: Between monopolies and freedom of contracting. *Revista de Direito Brasileira*, 29(11), 342. https://doi.org/10.26668/IndexLawJournals/2358-1352/2021.v29i11.6294.

[6] Baierle, E. E. (2021). Modernization of the electricity sector: Opportunities for the agribusiness sector [Master's thesis, Universidade Federal do Pampa].

[7] Balestra, G. da C. (2022). Business models for electric power distribution companies to create, deliver, and capture value from distributed generation [Doctoral thesis, Universidade Estadual do Oeste do Paraná].

[8] Bonfim, V. B. (2023). The potential of renewable energy for the global energy transition. *Revista Científica Multidisciplinar Núcleo do Conhecimento*, 102–117. https://doi.org/10.32749/nucleodoconhecimento.com.br/engenharia-eletrica/potencial-da-energia.

[9] Brasil. (1995). Law No. 9.074, of July 7, 1995. Available at https://www.planalto.gov.br/ccivil_03/leis/l9074cons.htm

[10] Brasil. Ministry of Mines and Energy. (2022). Ordinance No. 50, of September 28, 2022 - Guidelines for energy contracting. Available at https://www.gov.br/mme/pt-br/acesso-a-informacao/legislacao/portarias/2022/portaria-normativa-n-50-gm-mme2022.pdf

[11] Brasil. (2021). Bill No. 414/2021. Available at https://www.camara.leg.br/proposicoesWeb/prop_mostrarintegra?codteor=1962928

[12] Brasil. (2014). Normative Resolution ANEEL No. 622, of August 19, 2014. Available at https://www2.aneel.gov.br/cedoc/atren2014622.pdf

[13] Brasil. (2021). Normative Resolution ANEEL No. 957, of December 7, 2021. Available at https://www2.aneel.gov.br/cedoc/ren2021957.pdf

[14] Castro, N., Braga, S. L., Pradelle, F., & Chaves, A. C. (2023). The hydrogen economy: Transition, decarbonization, and opportunities for Brazil. GESEL.

[15] CCEE. (2024). CCEE registers new record of migrations of consumers to the free energy market in July. Available at https://www.ccee.org.br

[16] Copel. (2022). History of the free energy market in Brazil. Available at https://copelmercadolivre.com/historia-do-mercado-livre-de-energia-no-brasil/

[17] Farias, F. C., & B. B. S. (2021). Free energy market: An analysis of its use by large industrial consumers. *Revista Eletrônica Gestão e Serviços*, 12(3), 3517–3536.

[18] Flesch, C. H., Dallepiane, P. G., Cambambi, C. A. C., & Canha, L. N. (2018). Analysis of the feasibility of migration to the free contracting environment and the economic impact with recharges of an electric vehicle fleet. Proceedings of the *IX Brazilian Symposium on Electrical Systems*. https://doi.org/10.20906/sbse.v2i1.3086.

[19] GNPW Group®. (2023). Free energy market guide. Available at https://abraceel.com.br

[20] Guerra, A. de L. R. (2023). Scientific and academic research methodology. *Revista Owl*, 1(2). https://doi.org/10.5281/zenodo.8240361

[21] Lezana, R., Mendonça, A., Vaz, C., & Uriona Maldonado, M. (2017). Entrepreneurship, innovation, and sustainability: Origins, evolution, and trends.

[22] Lima, F. M. de, Naspolini, H. F., Silva, C. H. A. da, & Rüther, R. (2024). Management of electricity in consumer units with photovoltaic generation and energy storage systems using business intelligence tools. https://doi.org/10.59627/cbens.2024.2437.

[23] Loureiro, G. K. (2021). *Energy contracts in the free market environment – Understanding assumptions*. FGV CERI - Center for Studies in Regulation and Infrastructure.

[24] Muñoz, R. R., Souza, R. V. X. de, & Silva, A. S. da. (2019). LabVIEW development for an intelligent management system of the electrical energy free market. *Advances in Science, Technology and Engineering Systems Journal*, 4(2), 83–90. https://doi.org/10.25046/aj040211.

[25] Nascimento, A. dos S. P. A. (2024). *Energy law, energy transition, and climate change*. Letra Capital.

[26] Pitanga, Â. F. N. (2020). Qualitative research or quantitative research: Reflecting on decisions in selecting a certain approach. *Revista Pesquisa Qualitativa*, 8(17), 184–201. https://doi.org/10.33361/RPQ.2020.v.8.n.17.299.

[27] Rocha, A. V., Camboim, G. C., & Rocha, F. A. F. (2024). Analysis of the economic feasibility impacts with the enforcement of Law 14.300/2022 in photovoltaic solar generation projects: A case study in a consumer from Rio Grande do Norte. *EmpíricaBR - Brazilian Journal of Business Management and Information Technology*, 4(1), 22. https://doi.org/10.15628/empricabr.2024.17319.

[28] Santana, J. C. S., Ribeiro, M. E. de O., Souza, P. R. de A., Souza, J. P. S. de, & Peres, S. M. (2020). The use and production of clean energy as a method for sustainable environmental preservation. *Portos Journal: For a More Sustainable World*, 99–111. https://doi.org/10.47879/ed.ep.2020144p99.

[29] Silva, A. B., et al. (2018). Electricity contracting in Brazil. In Proceedings of the *Brazilian Congress of Mechanical Engineering* (pp. 1–10).

[30] Silva, M. L. da. (2021). *Challenges of the energy transition process in Brazil*: The role of the Brazilian government in expanding electricity supply and the potential of renewable sources [Master's thesis, University of Brasília].

[31] Stopfer, N., Soares, A., José de Castro, N., & Rosental, R. (2021). Electric mobility in Latin America: Trends, opportunities, and challenges.

[32] Teberge, C. R., & Sodré, E. (2019). Feasibility study: Free market vs captive market. *Journal of Engineering and Applied Research,* 4(2), 81–89. https://doi.org/10.25286/repa.v4i2.1223.

[33] Teixeira, M. C. (2025). *The transition to the free contracting environment in the Brazilian electric sector:* Historical contributions and future perspectives (1st ed.). Insigne Acadêmica.

[34] Vinícius, M., Cardoso, B., & Rocha, J. F. (2017). Feasibility study on migration to the free energy market. *Feasibility Study on Migration for Free Market Electricity*, 29(1), 37–46.