Chapter 16

Electric energy acquisition model in the free energy market for public administration

https://doi.org/10.56238/methofocusinterv1-016

Paulo Roberto Duailibe Monteiro
Professional Master in Industrial Assembly, Federal University Fluminense, Niterói, Brazil
E-mail: pauloduailibe@id.uff.br

Katia Silene de Oliveira Maia
Professional Master in Industrial Assembly, Federal University Fluminense, Niterói, Brazil
E-mail: ksdom@uol.com.br

Luiz Adalberto Philippsen Júnior
Department of Technology, Federal University of Alagoas, Maceió, Brazil
E-mail: luiz.philipssen@fau.ufal.br

Carlos Vitor Coelho Aragonc
State University of Maringá, Paraná, Brazil
E-mail: cv.aragon@gmail.com

ABSTRACT
The objective of this article is to demonstrate the electric energy acquisition model in the free contracting environment (ACL), pointing out possibilities of financial and non-financial gains that public administration bodies can earn if they migrate to ACL, also known in Brazil, as a free energy market. The research method was a case study. The public financial institution, object of research. it was the first public administration body to acquire energy in the ACL through a bidding process. The free energy market offers the possibility of exchanging a high expense for a lower cost, with a significant reduction and with environmental gains with the purchase of energy from a renewable source. Because it is a high-risk market, public administration bodies have difficulties in being able to buy energy at the right time, through a bidding process, that is, there is an operational difficulty in matching the moment of purchase with the best price on the market. The institution managed to acquire electricity from renewable sources for 24 consumer units distributed in all submarkets, obtaining considerable savings. This work intends to demonstrate the methodology used by the institution and the results achieved, with the possibility of replication in the public administration.

Keywords: Energy efficiency, Acquisition of electric energy, Electric energy market, Renewable energy, Bidding

1 INTRODUCTION

Expenses with electricity expenses directly impact the budget of all consumers, including public administration. According to Ref. [1], the federal public administration set aside a budget of R$2.88 billion for electricity in 2019, of which R$2.34 billion was executed. In subsequent years, the expense was BRL 1.37 billion (2020), BRL 1.65 billion and BRL 1.66 billion was reserved for 2022. This impact reflects on all economic activities and on the homes of Brazilian families, as well as on the premises of public bodies.

The electric energy that reaches the final consumer passes through the activities of production, transport, commercialization and distribution, which make up the energy market of the Brazilian electric sector.

This energy that reaches the consumer is produced in generating plants, which are normally far from load centers. Then it is necessary to raise the voltage and transport it through the transmission lines, passing through voltage lowering substations that distribute the energy through the distribution networks, thus making the interconnection between these two components, the plants and the consumers.

The increase in voltage made by the substations in the plants is necessary to overcome large distances, reducing electrical losses, thus ensuring transmission efficiency.

The National Interconnected System (SIN) is composed of a range of plants from different sources, such as hydroelectric, wind, thermoelectric, among others, located in different parts of the country. This large generation and transmission network is controlled in real time at the national system operation center. In this system there is no excess production of energy, that is, there must be a balance between consumption and production, and there may be deviations. The path of electrical energy starts at the generator, then passes through the transmitter, goes through the distributor, and ends at consumers.

In Brazil, the electricity sector has undergone profound changes in recent decades. Ref. [2] made major changes, leading to the unbundling of the sector through the separation of transmission/distribution services from energy production and commercialization activities, but also the creation of new institutions to control the activities of the sector.

According to Ref. [3], the creation of a model with a competitive bias in the electro-energy sector led to the separation of the sector's activities, which were previously horizontally and vertically integrated. The transmission, distribution and operation of the system started to be carried out under a monopoly regime, and the production and commercialization activities started to be carried out under a competition regime. This separation promoted greater transparency to the electricity system, ensuring the absence of cross-subsidy between activities, and provided greater credibility and efficiency for the benefit of companies and consumers.

In this new regime, the Electric Energy Commercialization Chamber – CCEE was created in 2004, by Ref. [4], with the objective of permanently evaluating the security in the electric energy supply in the country and the energy commercialization, which now has two negotiation environments: the Regulated Contracting Environment (ACR) and the Free Contracting Environment (ACL). There is also the short-term market, known as the difference market or spot market [1], in which contracted volumes and measured energy volumes are adjusted.

The objective of this article is to present, through a methodology of financial analysis, the case of a public financial institution, which had 100% of its consumer units (UC) in regulated contracting environment (ACR), distributed throughout the national territory, and which migrated 24 UC to ACL between 2019 and 2021. Additionally, it presents structural notions of the ACL, the bidding process and migration of CUs.

[1]The “Spot” market carries out commercial transactions where there is a single shipment of energy for a limited time, almost always serving to supply an unforeseen demand.

2 METHODS

This is a case study, with a qualitative approach to data and a confirmatory objective with the presentation of the results. The research was based on the public bidding process, public notice nº 2018/01019, of migration of the 24 UCs to the ACL, carried out in the period from 2018 to 2021.

The data are exposed in 3 sections: bibliometric analysis and literature review, case study and the conclusion with the demonstration of results.

To verify the relevance of the theme of this article, a bibliometric research was carried out, followed by the historical and literary about the free energy market in Brazil, through this review the object of study was based to help the reader to know the theme better. In the third section presents the case study, profile of the institution's general consumption and of the 24 selected CUs and finally the conclusions of the study with demonstration of the results.

3 RESEARCH ANALYSIS

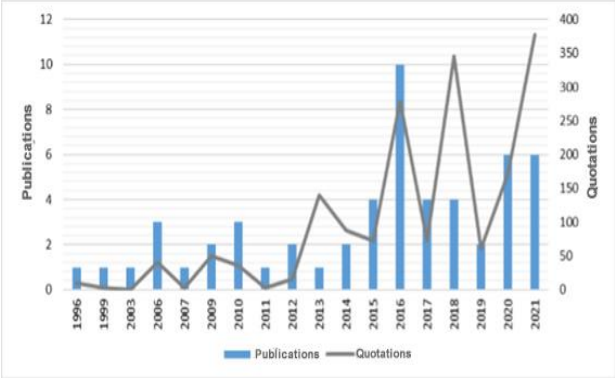
3.1 BIBLIOMETRIC ANALYSIS

To verify the current relevance of the topic of this article, a bibliometric research was carried out, in the "Web *of Science"* (WoS) database in September 2021 [5], analysis bibliometrics brings quantitative indicators that measure the contribution of knowledge derived from other works and publications in a given period.

After defining the base, it is necessary to determine the algorithm to be used in the search, that is, which filters should be chosen in the delimitation of the search. Thus, three algorithms were defined to compare the results, with specific keywords: "free *energy Market"*, *"commercialization energy"* and "Brazil".

In the "Web *of Science"* database, the following result was obtained: 54 works, distributed between the 90s and the present day, as shown in Figure 1. The year with the largest publication was 2016, which coincides with the peak of adherence to the ACL [6, 7, 8].

Fig. 1. Historical series of publications on energy trading in Brazil



Although the location filter limits the results so that the search is directed to works related to the Brazilian market, it does not mean that these publications are exclusively Brazilian, 24 of the totals of 45 documents

When the filter is defined for "bid*", "bidding process", "public tender" and "commercialization energy"* no publication appears, which proves the originality of this article.

3.2 FREE CONTRACTING ENVIRONMENT (ACL) OR FREE ENERGY MARKET

Energy trading in Brazil is carried out in two ways: in the ACR (regular hiring environment) and in the Free Contracting Environment (ALC).

The ACR is Market segment in which electric energy purchase and sale operation are carried out between selling agents and distribution agents, preceded by a bidding process, except in the cases provided for by law, according to specific commercialization rules and procedures.

According to Ref. [9], the free energy market is a business environment where sellers and buyers can voluntarily trade electricity, allowing consumers to contract their electricity supply directly from generating companies and traders.

There are two types of consumers in the free market: conventional free consumers and special consumers.

The conventional free consumer is the UC that has at least 3,000 kW of contracted demand, and can purchase energy from any generation source. On the other hand, the special free consumer is the UC or the set of consumers gathered by load sharing, belonging to the same submarket, who have a contracted demand equal to or greater than 500 kW and less than 3,000kw, independentize of the voltage level, can only contract incentivized energy. from renewable sources.

Examples of shared interests:

- right: units (branches) with the same CNPJ root within the same submarket;
- fact: the same or different CNPJs located in contiguous or adjacent areas, can aggregate their loads to reach the minimum demand of 500kW.

In January 2021, the minimum contracted demand to be a free energy consumer became 1500Kw. Until 2020, the limit was set at 2000 Kw.

One of the biggest advantages of the free market is the option to choose the energy supplier, the price you pay, contracting period, any flexibilities according to your needs. With prices established in contracts, free consumers become predictable, they are no longer subject to price fluctuations, captive market readjustments and tariff changes [11].

However, the free energy market is a risky market, since there is an oscillation in the price of energy and the formation of the Price for Settlement of Differences (PLD) that influences the prices of contracts, remembering that the rainy seasons also impact the energy market. energy. The PLD, calculated in R$/MWh, is used to settle energy in the spot market (MCP).

If the free consumer, due to bad sizing of the necessary energy consumption or inadequate management, needs electricity, he will have to purchase it at the MCP, being uncontracted in this environment is the greatest risk that a consumer can take. Being exposed to PLD can result in expenses, as its value has already exceeded twice the cost practiced in the captive market.

The purchase of incentivized or conventional energy is carried out through contracts. In the purchase of incentivized energy, consumers receive a reduction, between 50% and 100%, in the portion of the tariff referring to the use of the system, the Tariff for the Use of Transmission Services (TUST) and the Tariff for the Use of Distribution Services (TUSD). Conventional energy comes from large hydroelectric plants and thermal plants, only conventional free consumers can purchase this type of energy.

This freedom to buy from any supplier is not allowed for public administration that is under the aegis of the Bidding Law [12], as well as the institution that is under the regime of Ref. [13].

Public bodies are exempted from the bidding process to contract energy in the ACR, since it is a monopoly and the consumer is obliged to purchase energy only from the authorized concessionaire, that is, there is no option to choose, there is a single supplier.

In the free energy market, as there are several electric energy producers and traders, the purchase by public bidding is mandatory. Therefore, coinciding the day of the bidding contest with the best energy price on the market is undoubtedly the biggest obstacle for public bodies to participate in the ACL.

3.3 THE TRADERS

Energy traders, unlike generation agents, do not have plants, they purchase energy from different suppliers, creating a diversified portfolio of products to be offered to consumers. They need authorization from ANEEL to operate and prove aptitude for the activity.

In the free energy market, there are two types of traders, traditional and retail. Table 1 shows their main characteristics.

Table 1. Characteristics of the marketing modalities

	Traditional	**Retailer**
Be an CCEE agent	Mandatory	It is not necessary
Power management	Consumer option	Already included
Payment of the amount of energy	Contractual differences are settled at the CCEE at the PLD value	Same as measured
Contract validation at CCEE	Mandatory	It is not necessary
Have a team to represent the CCEE	Mandatory	It is not necessary

The retail trader was created to serve small consumers and reduce the complexity of joining the ACL [14]. Since, when choosing to migrate to the ACL, in the retail model, the consumer will be represented by the trader, which will be responsible for the technical qualification for modeling the consumer and intermediary with the CCEE, in addition to the financial obligations [15].

3.4 MIGRATION REQUIREMENTS

To migrate to ACL, some requirements are necessary. A prior analysis of structural and contractual feasibility is essential, in addition to the economic feasibility study, comparing the captive market and the free market.

In addition, it is necessary:

a) Adaptation of consumer meters to the CCEE standard, with telemetry installation that allows remote measurement of data;

b) forecast of energy consumption, calculation of flexibility and seasonality of the amount of electric energy;

c) provision of guarantees;

d) being a CCEE agent in the traditional modality, in the retail model is not necessary;

e) terminate the contract with the regulated market distributor with an official communication (contract termination).

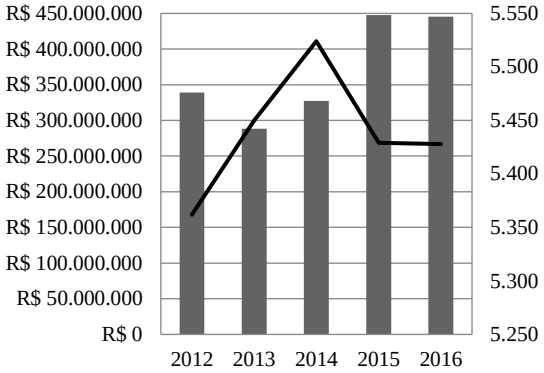
It should be noted that if a free consumer wants to return to the captive market, the concessionaire must be informed 5 years in advance, this is the customer's return period, this period can be negotiated with the company.

4 THE PUBLIC FINANCIAL INSTITUTION CASE (IF)

A public financial institution was the object of research. According to the 2016 annual report, the year in which the study for migration of CUs was carried out, the institution had 5,428 facilities and 96,889 employees.

In 2016, expenditure on electricity was R$445.54 million, with a network of 5,428 branches. Figure 3 shows the total expenditure on electricity and the variation in the branch network in the period 2012-2016.

Fig. 2. Expenditure (R$) with electricity and variation of the IF's network of dependencies (2012-2016)



Among the studies carried out to achieve the established goal of reducing expenses, the migration of the largest medium and high voltage[2] consumer units to the ACL is presented as a viable procedure and adherent to the institution's strategy.

Three preliminary studies were carried out by the institution's technical team through the hiring of different specialized companies to infer the financial gains arising from the migration. Table 1 summarizes the results for the 60-month period.

Table 2. Economic-financial analysis studies conducted within the institution

ID	Year	Consumer units analyzed	Consumer viable units	∑ Economy (R$/60 months)	Economy (%/average)
1	2013	100	41	29,742,020.40	18.16
2	2017	200	196	46,169,241.07	10.41
3	2017	200	188	92,529,417.60	15.50

In the study developed in 2013 (ID1) the double criterion of economic-financial viability consisted of savings above 6% and at least R$ 4,000.00/month. In the 2017 study (ID2) the feasibility criterion was the positive financial result. The revision in the criterion occurred, among other aspects, as a result of a survey of the meters of the 200 largest consumer units that showed a large amount of existing adequacy, reducing costs resulting from its replacement/modernization for migration to the ACL. In the second study in 2017 (ID3) the feasibility criterion was maintained as in the last study carried out (ID2). The difference in savings inferred in the ID2 and ID3 studies was influenced by the more optimistic energy scenario[3].

[2] Ref. [13] determined a voltage of 2,300 Volt as a limit to differentiate the voltage supply levels: consumer units with lower voltage make up Group B (that is, low voltage) and those consumer units with the same voltage or higher make up Group A (ie medium and high voltage).

[3] The scenarios are developed based on variables that influence the Brazilian energy sector, such as hydrological risk (reservoirs operating at full capacity or at the minimum limit), Federal Government incentives in investment projects aimed at producing electricity via renewable sources, forecast of readjustments of the concessionary distributors and market demand for the electric energy input.

Among the requirements for migration to the ACL is the analysis of the contracted demand of the consumer unit. Among the 200 largest consumer units, 31 meet the classification requirement – demand equal to or greater than 500kW and minimum voltage of 2,300 Volt [4].

Of these 31 consumer units, 24 were considered eligible for migration within a period of 60 months, considering contractual terms for the supply of electricity, existing infrastructure and because there is no forecast of returning the property. The average expenditure on electricity in these 24 eligible facilities is R$6 million/month. In the migration of the 24 largest consumer units, the expectation of savings for the period 2018-2022 was in the range between 12.1% and 19.6%.

Based on the results of the three previous studies, a market research was carried out to estimate the cost of acquiring electric energy, specifically focused on the retail commercialization modality. The procedure was based on an expedited assessment [5], due to the available consumption data and the limitation of companies operating in the retail market and, consequently, the low number of proposals expected to be received [6]. That year there were only 4 retail traders registered with the CCEE.

The UC consumption profile varies throughout the year, due to the thermal amplitude of each period and geographic location. The costs are influenced by the value (R$) of the MW charged by the concessionaires in each service region. As an example, the financial expenditure on electricity in January 2016 was BRL 43 million, while in July 2017 it was BRL 27 million. In February 2016, the average value of electricity was R$643.00/MWh and in June of the same year, the average value of electricity was R$560.00/MWh[7].

The consumption of the 24 UCs linked to the project is 79,321.32 MWh, equivalent to 9.05 $_{\text{average}}$ MW. For the purpose of estimating costs, a safety factor of 21.5% was applied, due to the imprecision existing in the monitoring and manual control of consumption of the CUs. Thus, the maximum value considered for the acquisition of electricity is an $_{\text{average}}$ of 11 MW. The average price of MWh presented in the proposals sent by retail traders, considering the variation between each of the submarkets existing in the country [8], was R$ 216.00 (two hundred and sixteen reais).

[4] It is important to highlight that consumer units with the same CNPJ can be migrated by adding up their contracted demands, as long as they reach a minimum of 500kW.

[5] At the beginning of this project, during the first half of 2016, the criterion for expedited calculations was used, standardized by ABNT NBR 12721:2005 – "Evaluation of construction costs for real estate development and other provisions for condominiums". In this way, the cost of the contract was calculated based on general magnitudes, as it sought to analyze the feasibility of the event, in this case, the migration from UC to ACL.

[6] Among the requirements for qualifying a retail trader in the CCEE, a minimum operating history of 12 months is necessary and a minimum amount of 10MW on $_{\text{average has been traded}}$, in addition to not having incurred in any breach of obligations under the CCEE in the 12 months prior to the granting of your license. The $_{\text{average}}$ MW is the unit of measurement of energy consumption used within the CCEE for the commercialization of large amounts of electric energy. It is an operation of converting the MWh divided by the number of hours in a day and days in the year.

[7] Information extracted from the institution's Portal, on 09.16.2016. Data available in the public bidding process.

[8] Considering that, many times, large amounts of resources are invested in basic projects to verify the unfeasibility of a given project, it was decided, at this stage of the project, to use the preliminary study format for decision making regarding the feasibility of UC migration to the ACL. Therefore, a margin of error was considered proportional to the low precision in the survey of the consumption information of the PAs).

In order to calculate the total expenditure, for a period of five years, a migration schedule was estimated based on preliminary information on the closing date of the current contracts for each of the UCs object of the study linked to the regulated contracting environment (ACR) [9]. For 2018, an $_{\text{average}}$ migration of 5.91 MW (or 51,771.60 MWh) was estimated, equivalent to 9 UC. In 2019, the migration of the other 15 UCs is estimated, totaling the average $_{11\ \text{MW}}$ (or 96,360.00 MWh) planned for migration to the ACL. To support the decision making of IF three models for energy acquisition were presented in the ACL:

Table 3. Characteristics of the marketing modalities

Model	Rights	Obligations
Model A: The Institution as an agent of the CCEE Type: Acquisition of energy directly from the producer as an agent of the CCEE.	○ Participation and voting in the general meetings of the CCEE ○ Access to the CCEE measurement, accounting and financial settlement system ○ Participation in electricity auctions promoted by CCEE ○ Request and receipt of information related to energy trading operations ○ Request to convene general meetings of the CCEE	○ Adhesion to the CCEE is mandatory through a process of technical and commercial qualification as an agent ○ Register the contracts signed in the ACR and ACL ○ Contribute financial guarantees to carry out short-term purchase and sale operations ○ Bear the financial repercussions arising from any default in the short-term market, not covered by the financial guarantees provided, in proportion to their net credits resulting from the accounting, in the period considered ○ Open and maintain a current account at Bradesco Trianon; ○ Collect contributions and fees related to the functioning of the CCEE ○ Respond to audit requests developed at CCEE ○ Keep with the CCEE the proper updating of registration and technical data ○ Adopt measures related to the measurement, accounting and financial settlement process, auctions and other ○ Adequacy of the measurement system
Model B: The institution as an agent of the CCEE Type: Acquisition of energy through a trader or producer with advice from a specialized company (manager).	○ Rights according to Model A	○ Obligations according to Model A
Model C: The institution as a retail consumer. Type: Acquisition of energy through the retail trader.	○ BB would be represented by the retail trader before the CCEE ○ The rights will be owned by the merchant.	○ All obligations before the CCEE are the responsibility of the retail trader.

From the description of the three models, the favorable points and risks for each model were described.

[9] The information regarding the termination of the contract of each UC with the concessionaire in the ACR is relevant because, in case of validity, the migration to the ACL may result in the collection of fines and charges for breach of contract to the concessionaire

Table 4. Analysis of electric power acquisition models in ACL

Model	Favorable points	Risk implications
	○ Lower energy price ○ without intermediation ○ Absence of contracting services for commercialization ○ Increase in the energy production market ○ Conventional or incentivized energy contracts (solar, wind, biomass)	○ High risk ○ BB assumes obligations arising from its association with CCEE ○ Have their own team to represent the Chamber. ○ All adhesion, migration, management and control procedures will be performed by the institution
	○ Two purchase options: with intermediation or directly from the producer with greater flexibility in price negotiation ○ Mitigation of risks by hiring a company that has knowledge and experience in the segment ○ The entire process of joining migration, market intelligence, post-migration management and control is the responsibility of the contracted company ○ Conventional or incentivized energy contracts (solar, wind, biomass) ○ Most used model on the market	○ Moderate risk ○ Even with the hiring of the company, BB continues as an agent of the CCEE, assuming all the obligations ○ The management and commercialization of energy will be carried out by the contracted company, reducing the risk in accordance with the clauses listed in the contract and guarantees required ○ Cost with the expenditure of contracting services
	○ There is no obligation for BB to join the CCEE ○ The retail trader would represent BB in the Chamber, assuming the rights and obligations with the CCEE ○ Flexibility in negotiating prices depending on the amount of energy purchased ○ Conventional or incentivized energy contracts (solar, wind, biomass) ○ The entire marketing, advisory and post-migration management process will be the responsibility of the marketing company	○ Lower risk ○ The institution does not assume the obligations as an agent of the CCEE ○ Prices for marketing, advisory and management services will be added to the price of purchased energy.

Based on the study, the institution's admission to the ACL was approved in 2018 with the acquisition of 11MW for 24 largest consumer units of BB in the form of model C - retail trader.

The public notice was published in April/2018 with the following purpose: acquisition of up to 10.09 average MW of electricity in the ACL.

The strategy used to coincide the best time of purchase with the day of the electronic dispute, the technical team left the entire bidding process ready. When the rainy season started, between December/2017 to February/2018, the public notice was published.

For this first tender, national or foreign companies qualified to operate as a retail trader in Brazil could participate.

The bidding was opened at the lowest price of the overall value of the 5-year contract. To assign the global value, the following equation was considered:

$$\text{VT} = \sum_{m=1}^{12} P1m * QSECm + P2m * QNEm + P3m * QSm + P4m * QNm \qquad (1)$$

To support the preparation of the proposal by the bidder, the notice presented table 5:

Table 5. Amount of energy by submarket

m	Start	End	SE/CO Average MW	South Average MW	North Average MW	NE Average MW	Total Average MW	Total in MWh
1	01/01/19	31/01/19	0,00	0,15	0,00	0,31	0,46	342,24
2	01/02/19	28/02/19	0,00	0,33	0,00	0,50	0,83	557,76
3	01/03/19	31/03/19	0,16	0,33	0,00	0,50	0,99	736,56
4	01/04/19	30/04/19	0,54	0,33	0,00	0,50	1,37	986,40
5	01/05/19	31/05/19	0,54	0,50	0,16	0,50	1,70	1.264,80
6	01/06/19	31/08/19	1,29	0,83	0,30	0,96	3,38	7.461,32
7	01/09/19	31/12/19	3,77	0,83	0,30	1,10	6,00	17.565,73
8	01/01/20	31/05/20	7,63	0,83	0,30	1,10	9,86	35.966,45
9	01/06/20	31/12/20	7,86	0,83	0,30	1,10	10,09	51.818,25
10	01/01/21	31/12/21	7,86	0,83	0,30	1,10	10,09	88.381,60
11	01/01/22	31/12/22	7,86	0,83	0,30	1,10	10,09	88.381,60
12	01/01/23	31/12/23	7,86	0,83	0,30	1,10	10,09	88.381,60

To consider the following table:

Being:
VT = Total value
P= MWh price by period and submarket
Q = amount of MWh
SEC = Southeast and Midwest Submarket
NE = northeast submarket
S = south submarket
N = North Submarket
m = acquisition period

The amounts in 'average MW' and 'MWh' cover the consumption of the 24 consumer units considering the start of the acquisition from 2019.

The first dispute, which had the participation of 3 bidders, held in January/2018 was unsuccessful due to an error by one of the participants. Due to administrative appeals, the bidding was suspended and only in February 2018 was the bidding concluded with the participation of the same retail traders.

The contract was formalized in the amount of R$ 88 million for a period of 5 years. The risks highlighted in the project:

a) this is an unprecedented project in the public administration because it is a volatile market with a lot of price variation;

b) electricity acquisition operation within the CCEE does not allow the possibility of accuracy in defining the best time for migration, since there are sensitive variables that influence the sale price, such as, for example, related to hydrology or political situation in the country;

c) inadequate contracting of electricity (volume contracted above or below average consumption) due to failures in the survey of consumption history of consumer units

d) after contracting and registering the contract with the CCEE, the value of the electric energy (MWh) is “locked”, not allowing changes during the period determined in the contract;

e) risk of the bidding being unsuccessful and not achieving economic viability for not being able to buy with a better period at the time of the dispute;

f) the validity period of the proposal is quite short, therefore, the contract necessarily needs to be formalized in a timely manner in order to maintain the offered price.

Main benefits:

a.) reduction in expenditure related to the payment of electricity through negotiation of price, term and energy matrix that best fit the profile and location of each consumer unit;

b.) financial predictability with the expenditure of electricity from the migrated facilities (negotiated and "locked in" prices after signing the contract with the producer);

c.) possibility of selling excess electricity from consumer units migrated to the ACL in case of consumption lower than the amount contracted through the instrument of the settlement price of differences (PLD);

d.) competition between electricity producers willing to supply electricity within the ACL to the institution; non-existence of extraordinary installments (avoided cost), such as tariff flags and hours of energy use by consumer units (there is no difference between peak and off-peak hours, however, the tariff for use of the distribution system continues to be charged with differentiated value for the period of the day);

e.) execution of bilateral contracts, with option for short, medium and long term contracts;

f.) guarantee of electric energy supply, even in case of rationing of the HPP;

g.) inexistence of prior disbursement since all accounting in the ACL is made after consumption;

h.) guarantee of purchasing energy from renewable sources (such as wind, solar and biomass) whose environmental impact is less than that caused by energy sources originating from non-renewable fossil fuels (coal, oil and gas, for example) and hydroelectric plants (whether UHE or PCH);

i.) reduction of CO_2 emissions;

j.) acquisition of renewable energy, enabling discounts by concessionaires, which can reach up to 100% in the tariff for use of the distribution system; and

k.) improvement in the *Down Jones Sustainability Index* (DJSI) and Corporate Sustainability Index (ISE – BM&FBovespa) indicators due to the use of electricity from renewable sources, especially non-hydraulic sources

l.) non-existence of extraordinary installments (avoided cost), such as tariff flags and hours of energy use by consumer units (there is no difference between peak and off-peak hours.

5 CONCLUSION

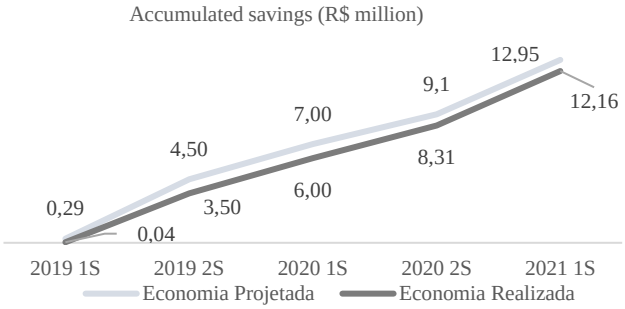
After the internal procedures and with the energy concessionaires for the process of denouncing the demand contracts, the first migrations to the ACL started in January 2019, ending the year with 20 migrated consumers, with the result shown in the table 6.

Table 6. Savings R$/per year

2019	2020	2021
1,961,641.27	5,721,291.58	17,013,243.88

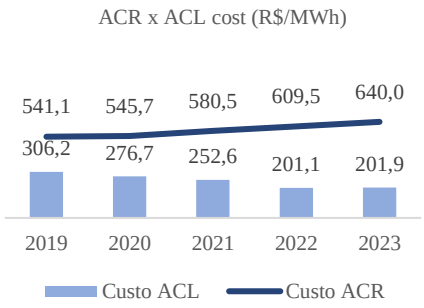
Over 2 years, the realized and projected savings can be verified ino Graphic 1:

Graph 1. Accumulated savings (R$ million)



It is important to note that the project's savings consider the cost of energy (R$/MWh) sold in the free environment compared to the regulated environment, according to the projected distribution in graph 2.

Graph 2. ACR x ACL costs.



Important impacts on the project resulted from the actions of emergency residential work in the COVID-19 pandemic, displacing the functionalism of administrative buildings and thus reducing the projected energy demand.

In the ACL, the sale of the balance of energy purchased and not consumed in the short term subjects the customer to market cost variations, which may cause losses or increase projected results. In the case of the institution, despite marginal losses that occurred throughout 2020, the balance for the period was positive due to the strategic sale of surplus energy at times when the short-term cost was above the contracted cost.

With the evident characterization of a positive result for the project, the institution announced the expansion of the modality of the

Even in the face of the Coronavirus pandemic, the project continued to generate positive results for the institution, even with the reduction in consumption due to the remote work of the employees, the energy that was left was sold on the market and in view of the high prices of electric energy (PLD) in Due to the water crisis, the institution had a financial return from the sale. To use leftover energy, it added more, totaling 46 units, with savings of R$ 54 million in 5 years.

The free contracting environment is a risky market, but this characteristic is not an obstacle for the public administration to be able to enter this negotiation environment, where it is possible to purchase electricity at a much lower price than those offered in the regulated environment. The legal knowledge allied to electrical engineering allowed the success of this project, proving that it is possible for a public agency to acquire electricity in the free market, bringing positive results to the public coffers, and can be widely replicated.

REFERENCES

[1] General Controllership of the Union, 2022. *Transparency Portal*. Budget with electricity expenses [online database]. Available from: https://www.portaltransparencia.gov.br/funcoes/25-energia

[2] Brazil. Law no. 9,074, of July 7, 1995. Establishes rules for the granting and extension of concessions and permissions for public services and other provisions. Brasilia: Chief of Staff of the Presidency, 1995. Available from: http://www.planalto.gov.br/ccivil_03/leis/l9074cons.htm

[3] P. Mayon, and M. Parodi. "Brazilian Electricity Sector 2012-2018 – Resilience or Transition?". *Synergia*. Rio de Janeiro: Synergia, pp 95-98, 2018.

[4] Brazil. Decree No. 5,177, of August 12, 2004, which operates under the authorization of the granting authority and regulation and inspection by ANEEL. Brasilia: Chief of Staff of the Presidency, 2004. Available from http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/decreto/d5177.htm

[5] P. B. Soares, T. C. J. Carneiro, J. L. Calmon, and L. O. Castro. "Bibliometric analysis of Brazilian scientific production on Construction and Building Technology in the Web of Science database". *Built Environment*, Porto Alegre, vol. 16, no. 1, pp. 175-185, January-March 2016. Available from: https://www.scielo.br/j/ac/a/7CmZ3n8FT8R5g93DkW5kzMJ/?lang=pt#

[6] Web of Science. Consult the survey on Photovoltaic *Generation Renewable Energy Consumption Solar*. 2021. Available from: https://www.webofscience.com/wos/woscc/summary/f02c4836-d3e4-4d78-ace3-6adfbe51b03a-049874ff/relevance/1.

[7] Web of Science. *Consult the survey on Free Energy Market Photovoltaic*. 2021. Available from: https://wwwwebofscience.ez24.periodicos.capes.gov.br/wos/woscc/summary/4b4a8d70-19c8-4332-a673-eaa7c7e77f97-0492d4c5/relevance/1

[8] CCEE Consult the marketing procedures. 2021 Recovered https://www.ccee.org.br/portal/faces/oquefazemos_menu_lateral/procedimentos?_adf.ctrlstate=jvfnnygm3_42&_afrLoop=570302522633685#!%40%40%3F_afrLoop%3D570302522 633685%26_adf.ctrl-stategm3%

[9] ABRACEEL. Consult the Free Consumer Handbook. 2020. Available from: https://abraceel.com.br/wp-content/uploads/post/2020/10/Cartilha-do-Consumidor-Livrevers%C3%A3o-mobile-2.pdf.

[11] ABRACEEL. Consult the procedures related to the Bill to open the free energy market. 2021. Available from: https://abraceel.com.br/blog/2021/03/aprovacao-do-pl414-21-levara-o-brasil-para-a-4a-posicao-no-ranking-internacional-da-liberdade-of-electricity/

[12] Brazil. Law no. 8,666, of June 21, 1993, art. 37, item XXI, of the Federal Constitution, establishes rules for public procurement and contracts and makes other provisions. Brasilia: Chief of Staff of the Presidency, 1993. Available from: http://www.planalto.gov.br/ccivil_03/leis/l8666cons.htm

[13] Brazil. Law n.13,303, of June 30, 2016. Provides for the legal status of public companies, mixed capital companies and their subsidiaries, within the Union, States, Federal District and Municipalities. Brasilia: Chief of Staff of the Presidency, 2016. Available from: http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/lei/l13303.htm

[14] ANEEL Electricity Market Regulation – Commercialization – (2021) Available from: https://www.aneel.gov.br/mercado-de-eletricidade .

[15] A. Almeida. *Approach to the entertainment trader in the Brazilian Electric Energy market*. [undergraduate thesis] 2018. Florianópolis: Energy Systems Technology Course, Instituto Federal de Santa Catarina, Florianópolis, 2018.