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THE BRAZILIAN ELECTRICITY SECTOR REGULATORY FRAMEWORK: THE EXPANSION COST OF THE SECTOR

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ABSTRACT

In 2001, Brazil experienced a crisis of electricity supply as a result of a model that has proved ineffective in stimulating and maintaining investments in the electric sector.

The Brazilian economic policy imposed the need to reduce costs, which decreased investments in public companies that generate power. As a consequence, the expansion of installed capacity in Brazil was also affected, since these companies accounted for almost 90% of the installed capacity in the country at that time.

Considering the uncertainties and risks that the industry faced in that period, private investments in the electric sector were also low. Thus, there was the need to establish a new regulatory framework, which should be more transparent, consistent and stable in order to guarantee the necessary investment in the electric sector. Therefore, in 2004, Congress passed the new Regulatory Framework Act for the Electric Sector, dated March 15, in an attempt to correct possible deficiencies of the previous model.

The new institutional model is based on four basic principles, namely: (i) low tariffs, (ii) continuity and quality of service, (iii) fair return on investment, and (iv) universal service.

Regarding low tariffs, the understanding behind this model is this objective would be achieved by structuring the planning, setting transparent rules for the operation of the electric power distribution and lowest-fare-type procurement auctions of electricity.

Hence, the central objective of this study is to assess whether the new regulatory framework established in 2004 produced the desired effects throughout its implementation with respect to low tariffs, specifically in relation to the effectiveness of planning to hire power plants as well as the efficiency of Contracts for Energy Availability in procurement auctions of electricity which have been carried over by the government for nearly ten years.

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1. INTRODUCTION

In 2001, Brazil experienced a crisis of electricity supply as a result of a model that has proved ineffective in stimulating and maintaining investments in the electric sector.

The Brazilian economic policy imposed the need to reduce costs, as a way of financing the deficit of the Balance of Payments and keeping the debt controlled, which decreased investments in public companies that generate power. As a consequence, the expansion of installed capacity in Brazil was also affected, since these companies accounted for almost 90% of the installed capacity in the country at that time.

Considering the uncertainties and risks that the industry faced in that period, private investments in the electric sector were also low. There was too much uncertainty in the sector. Thus, it emerged a need to establish a new regulatory framework, which should be more transparent, consistent and stable in order to guarantee the necessary investment in the electric sector. Therefore, in 2004, Congress passed the new Regulatory Framework Act for the Electric Sector, dated March 15, in an attempt to correct possible deficiencies of the previous model.

The new institutional model imposed on the electricity sector is based on four basic principles, namely: (i) low tariffs, (ii) continuity and quality of service, (iii) fair return on investment, and (iv) universal service.

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To achieve the objective of this paper, the new regulatory framework has to be discussed, since the environment in which it was established, its foundations and objectives. The first chapter brings about this issue and discusses the main changes in the Brazilian Electricity Sector.

The second chapter is about procurement auctions of electricity in Brazil, not only the way they were establish, but specially the types of contracts which have arisen from those auctions since there are many characteristics that affect the real cost of the energy bought at those auctions.

In the third chapter, an analysis of the database of real costs related to the Contracts for Energy Availability originated from the Brazilian procurement auctions of electricity. This paper aims at analyzing the real cost of those contracts.

Finally, the last chapter summarizes the results and brings up some conclusions and ideias about the future of the Brazilian electricity market.

2. THE NEW REGULATORY FRAMEWORK FOR THE ELECTRICITY SECTOR

The new Brazilian regulatory framework for the electricity sector was established in 2004. It was the result of a diagnosis of what was wrong in the earlier institutional model. Therefore, for a better understanding of this article, the next section is going to describe the environment of the Brazilian electricity market before the crisis in 2001. After that, the basis of the new institutional model will be discussed.

2.1. THE BRAZILIAN CRISIS OF ELECTRICITY SUPPLY

In the 1990's, the Brazilian economy experienced several changes, such as: the opening of the economy, the privatization process and the Real Plan, which brings the prices stability [Pinheiro, Giambiagi and Gostkorzewicz (1999)]. The country grew in that period, although less than expected.

Despite the economy growth during the period 1991-2000, as observed by Pires, Gostkorzewicz and Giambiagi (2001), the Brazilian installed capacity of electricity generation did not follow the rate of electricity consumption. Although both had reached lower rates, in comparison with the previous decade, the consumption experienced higher rates than the installed capacity of electricity generation.

The result of this scenario was a depletion of the idle capacity of the electricity generation. According to Pires, Gostkorzewicz and Giambiagi (2001) the Brazilian Government did not prioritize investments in electricity generation, maybe because of the fiscal situation, which prevented new investments. Moreover, the increase in demand for electricity brought a necessity to start a privatization program in order to ensure the required investment. The authors argue that this decision was taken too late. In addition, it is important to note that the regulatory environment was very unstable; for this reason, new private investments was discouraged and the transition for the sector was very hard.

As observed by the *Comissão de Análise do Sistema Hidrotérmico de Energia Elétrica* (Commission for Hydrothermal System Analysis), despite of the years preceding the crisis, the drought was presented. Regardless of its influence, the drought itself was not sufficient to explain the severity of the crisis. The argument is that the crisis would not have happened if the investments had been concretized. In other words, as reported, the plants which had never been implemented by then corresponded to two-thirds of the lack of electricity supply in that period, which means that this is the most relevant factor to determine the crisis.

According to Pires, Giambiagi and Sales (2002), the roots of the crisis of electricity supply are related to four main reasons. The first one is the exhaustion of the state-based model for the Federal Government fiscal crisis prevented the execution of the necessary investments in electricity generation and the regulatory environment was not adequate.

The second reason is related to failures in planning for the transition between the state model and the private one. There was not a second plan in case of delay of investments, what did happen. Some plants were constructed in delay and others were not constructed: altogether, these plants were likely to have avoided the electricity rationing. Of course, the unfavorable hydrology contributed for the scenario.

The third reason highlighted by the authors is related to the regulation of the sector and the contracts: the lack of a strong regulatory framework contributed for a delay in private investments.

The last reason is about a lack of coordination between the different government agencies, which prevented them from realizing how severe the crisis was at that time to take measures in order to minimize its effects.

According to Pires, Giambiagi and Sales (2002), in May 2001, the forecasting of the National Operator System (ONS) indicated a need to reduce the electricity consumption by 20%, immediately, as the only way to prevent from a complete deflation of the reservoirs. The Federal Government chose, instead of determining cuts of consumption, to give the consumers the responsibility to reduce their consumption voluntarily.

The rationing program was successful, at the expense of lower economy growth as a side effect of the decision made by the Government. Nevertheless the Gross Domestic Product (GDP) grewn about 1.5% that year.

After that, many measures were taken in order to reorganize the electricity sector in Brazil and avoid new crises as of that one in 2001. The most important goal to achieve was the recovery of investments.

According to Castro (2001), the priority of former president Lula and its administration was, since the beginning of his mandate, making the economy more reliable. He needed to keep his predecessor's macroeconomic policy, in order to keep financing the deficits of the Balance of Payments. However, after the 2001 crisis, the electricity sector was claiming for structural changes, as those brought up by a new regulatory framework.

2.2. THE NEW REGULATORY FRAMEWORK ESTABLISHED IN 2004

In December 2003, the Brazilian Government published two new regulations, the Provisory Act n. 144 and 145. The first one deals with the electricity trading and the reorganization of the whole electricity market. The second creates the Empresa de Pesquisa Energética – EPE, which became responsible for the Brazilian energy planning. These regulations were later converted into Federal Laws n. 10,848 and 10,847, respectively, both published in March 2004. They were regulated by Decrees: n. 5,163, published in July 2004, and n. 5,184, published in August 2004.

According to Barros (2005), the new institutional model for the electricity market was based on the ideia that the previous model was incapable of creating incentives to investors to build new plants. Thus, the model implemented in 2004 was based on this planning.

This idea is proven by the Explanatory Memorandum n. 95, related to the Provisory Act n. 144, published on December 11th, 2003. The main objective was the correction of deficiencies observed in the Brazilian Electric System – SEB, which committed the planning and limited the investments in the sector.

The basic principles of the new regulatory framework, as seen on the Explanatory Memorandum n. 95, 2003, are: (i) low tariffs, (ii) continuity and quality of service, (iii) fair return on investment and (iv) universal service.

In relation to low tariffs, it was believed that they could be reached via planning restructuring and devising greater transparency in the rules of distributor's operation, besides including the idea of biddings and centralized purchase of electricity for all companies, which will be discussed in more details below.

Still on low tariffs, it was made possible for large consumers to purchase electricity directly from hydro plants, in order to provide cheaper electricity to the Brazilian industry, in an attempt to make it more competitive and help the country develop.

In terms of continuity and quality of service, it was determined to all consumers a full purchase of their necessities in terms of electricity. Furthermore, it was demanded that the biddings would define new plants concessions besides the power purchase. So that, in the long run, contracts would afford the construction of those plants, making the investment even more attractive.

The third principle also deals with the investment attractiveness: ensuring fair remuneration by purchasing electricity through procurement auctions and long-term contracts, as well permitting the sellers to make contracts directly with large consumers, in order to provide for the opportunity of portfolio diversification.

The last principle is about universal service, and this objective was reached through the *Luz para Todos* Program. Generalizing, the program consists in granting subsidies for construction of distribution power lines to provide electricity to consumers away from the centers of distribution.

As part of this restructuring, two new institutions were created in order to provide instruments for the consumers' protection and to propose solutions to ensure the security of the market: the *Empresa de Pesquisa Energética* – EPE (Energy Research Company) and the *Câmara de Comercialização de Energia Elétrica* – CCEE (Chamber of Electric Energy Commercialization). The second one, besides other important tasks beyond the scope of this paper, became an important agent in the auctions achievement.

As stated by the Law n. 10,848/2004, the Brazilian electricity market now has two different contracting environments, called the Free Contracting Environment and the Regulated Contracting Environment (ACL and ACR, respectively). The first one deals with the large consumers that buy electricity directly from the plants, in a private negotiation. The second one deals with the distributors of electricity, which sell it to small consumers, charging regulated tariffs.

In other words, the ACR is formed by all other consumers that buy electricity from monopoly distributors. The distributors aforementioned, in order to supply those consumers, have to buy electricity through regulated procurement auctions, as assigned by Law n. 10,848/2004. The purpose of this rule was to reach lower tariffs, and the objective of this paper is to verify if this goal has been met, by analyzing the results of the main auctions in the following chapters. Before the data analysis is carried out, it is important to mention what kinds of auctions the grantor has executed and what kinds are going to be analyzed.

3. THE BRAZILIAN PROCUREMENT AUCTIONS OF ELECTRICITY

The Brazilian Government adopted the procurement auctions system in order to provide the final, small consumers with lower electricity tariffs. To achieve this goal, the option was to select the winners by lower bids, unlike the previous model, which favored the investors that offered the highest price for the plant (CASTRO, 2004).

Other two characteristics highlighted by Castro (2004) were the pool of buyers and the division between new and old plants. The first one aims at taking advantage of the economies of scale, since all electricity demanded by the distributors are bought at the same time, for the same price. In this system you can share the risks and the benefits, and still equalize tariffs between distributors. The second one is related to the idea of the "old" plants that are already amortized and, consequently, can sell cheaper electricity, since the investment is already paid. The electricity bought from new plants involve a high amount of new investments.

Those ideas are expressed in two regulations: the Law n. 10,848, published on March 15th, 2004, and the Decree n. 5,163, published on July 30th, 2004.

As observed in the Law n. 10,848/2004, there are four types of auctions. The first one is called Existing Energy Auction (LEE in Portuguese abbreviation), which consists of short and medium-term contracts between electricity distributors and built plants. The second type is called New Energy Auctions (LEN in Portuguese abbreviation), which consists of long-term contracts in order to ensure investment in plant construction. The third one is called Alternative Sources Auctions (LFA in Portuguese abbreviation), whose objective is to promote the construction of power plants that use alternative energy sources. The last one is called Reserve Energy Auction and its objective is to provide more security for power supply.

The Brazilian Electricity Regulatory Agency (Aneel in Portuguese abbreviation) was designated to be responsible for the electricity procurement auctions. So, this agency can carry them out by itself or delegate the organization to CCEE, which has been done since the beginning.

As it has been shown in the article entitled *Modelo Institucional do Setor Elétrico* (Institutional Model for the Electric Sector], published by the Ministry of Mines and Energy in December 2003, the model was designed to have two types of acquisitions of electricity by the distributors: the initial auction, concluded five years before the initial term of the contracts, and the complementary auction, three years before the initial term of the contracts. The ideia behind this structure is that the distributor make its demand projection in order to buy the required electricity five years in advance, which is the necessary period to have a new hydro plan constructed. Considering the uncertainty associated with the demand projection, it is necessary to provide the companies with an additional chance to buy electricity, which is the auction accomplished three years before the initial term of the contracts. In both cases the auction takes place to select new plants to provide the electricity.

Additionally, the LEEs are accomplished one year before the initial term of the contract, because the plants that will provide the electricity are already built. Those kinds of plants can also sell electricity in the Adjustment Auctions, the form of dealerships complement your purchases, which are accomplished up to four months before the initial term of the contracts, and the maximum term of the contract is two years.

The Brazilian procurements auctions of electricity are Descending Clock Stage followed by Pay-as-Bid, and the ceiling price is defined by MME. The only exception is for the Adjustment Auctions, which are Ascending Clock Stage type[1].

According to Maurer and Barroso (2011),

> *"The first phase of these auctions follows the design of a classical simultaneous descending clock auction, in which the auctioneer sets a purchasing price and bidders declare the quantity they are willing to sell at*

[1] Since the Adjusment Auctions are not object of this work, for more information see www.aneel.gov.br and www.ccee.org.br.

> *that price. As long as total supply is greater than demand by a percentage factor unknown to bidders—an essential point for promoting competition in the second phase of the auction—the price is further reduced. Once total supply reaches this threshold, the first phase ends and the second phase begins. In the second phase, bidders who have remained in the auction up to this point must submit their final offer price following a pay-as-bid design. At this point, the fact that total supply is still greater than demand provides an incentive for bidders to further reduce their bids with respect to the final price of the first phase."*

The contracts originated from the auctions are called Contracts of Electricity Sale in the Regulated Environment (CCEAR in Portuguese abbreviation). There are two types of CCEARs, the Contracts for Energy Delivery (CCEAR-Q) and the Contracts for Energy Availability (CCEAR-Disp). During the auction process for new plants, in general, there are different demands for those kinds of contracts, defined by MME based on the distributors' statements. Normally, hydro plants compete for Contracts for Energy Delivery, and thermal plants compete for Contracts for Energy Availability. More recently though, wind power plants have competed for Contracts for Energy Availability, too.

There are significant differences between those contracts and the way each auction process selects the winners.

For the first type, CCEAR-Q, the winners are selected by the exact price they will receive for each Megawatt-Hour delivered. The structure of the contract is also simpler: the sellers are responsible for delivering some monthly amount of electricity as well as for any lack of energy generation, which means they support the hydrological risk.

The bidding process for the selection of CCEAR-Disp winners is pretty different. They have to bid a Fixed Revenue, in Reais per year; this is related to the construction costs added to the fixed costs of the plant operation, including the fuel costs linked to the inflexible generation. Based on this data, the system calculates the benefit cost ratio, called ICB, for each bidder. The winners are selected based on those numbers. In this case, the consumers support the hydrological risk.

For calculating the ICB for each plant the auction system considers other variables: the 'Firm Energy Certificate' (MAURER and BARROSO, 2011), the economic short run cost (CEC in the Portuguese abbreviation), and the operating cost (COP in the Portuguese abbreviation).

According to Maurer and Barroso (2011), the Firm energy Certificates – FeC, issued by MME and defined in GWh/year,

> *"(…) reflects the sustained energy production of each generator when inter-connected to the grid. The FeC of a plant is the maximum volume of energy that can be sold through contracts and establishes the reliability assured by the generator backing up the contract."*[2]

Since the Brazilian electricity system is based on a centralized dispatched of the plants, CEC is related to the differences between the forecasted dispatched of the plant and its FeC. This accumulated difference corresponds to the value to be paid or received for the consumer in the wholesale market associated with the dispatched of this plant.

The COP is function of the inflexible generation and the Operation and Maintenance (O&M) variable cost. Those variables determine the dispatched of the plant by the central operator.

According to Maurer and Barroso (2011),

> *"One of the fundamental elements of any power market is the process through which plants are dispatched and the energy spot price is established in the wholesale market. In order to preserve hydrothermal coordination, the system scheduling is centrally carried out by the Independent System Operator (ONS), which uses a multi-stage stochastic optimization model that takes into account the plants' operating characteristics and inflow*

[2] For more information, see 'Garantia Física dos Empreendimentos Termelétricos – Premissas e Procedimentos de Cálculo', Technical Report n. EPE-DEE-RE-052/2005-R3. Available at www.epe.gov.br.

> *uncertainties. The least-cost dispatch does not take into account any bilateral contracts or other commercial arrangements and, as a result, determines the dispatch of every plant in the system and also the short-run marginal cost, which is used as the clearing price in the short-term energy spot "market"."*

Thus, the ICB can be defined as the ratio between the total cost of a plant and its energetic benefits and this is the reason to be used as the selection criteria of the plants at the Brazilian auctions.

As observed by Melo, Neves, and Pazzini (2011),

> *"Energy availability contracts signed in Brazil foresee capacity payment clauses but may not be understood as capacity market mechanisms, as they are restricted to thermoelectric plants and aim at dealing with fuel price volatility and dispatch uncertainties. Therefore, they constitute rather an instrument to confer predictability to the cash-flows of thermoelectric plants which have signed long term contracts.*
>
> *Hydropower plants, on the other hand, have only contracts for energy amounts and must incorporate risk premiums in their selling prices in order to cope with additional reliability costs. This approach recognizes that generators possess better pricing mechanisms for exposure risks and that competition in long term auctions enable the valuation of the utility of reserve capacity necessary to ensure supply of a specific amount of energy. Nevertheless, auctions designed to buy energy from new plants enabled expansion of generation capacity through market signals in a time horizon compatible to maturation lags required by new investments, which are important to mitigate the risk of long periods of scarcity."*

Although ICB has been used as the selection criteria in the Brazilian procurement auctions (CCEAR-Disp), it is important to highlight that this "price" is not the effective cost of those contracts. In fact, the real live dispatched can be totally different from that one used to estimate the ICB, which means the real cost of those plants are pretty different. Since ICB is an approach, it is what is expected. On the other hand, it is not possible to have the real cost at the moment of the auction process, so an approach is necessary. The question is whether this number is a good approach or not; this is the goal of the next chapter, which brings an analysis of the adherence of this value to the real cost of these plants.

4. DATA ANALYSIS

Since 2005 until early November 2013, sixteen New Energy Auctions have been held in Brazil. The total amount of electricity purchased in those auctions is about 18,000 Megawatts, from about three hundred new plants[3]. Further three auctions were held for specific infrastructure projects, called Structuring Auctions, for the Santo Antonio, Jirau e Belo Monte Hydro Plants.

In addition, eleven Existing Energy Auctions (LEE), two Alternative Sources Auctions (LFA), five Reserve Energy Auctions (LER) and seventeen Adjustment Auctions (LA) have been held since the new regulatory framework was established[4].

Many different kinds of plants have been selected for all those auctions, as hydro plants, wind plants, and thermal plants using multiple types of fuel: Natural Gas, Regasified Liquefied Natural Gas, Process Gas, Fuel Oil, Diesel Oil, Biomass, and Coal.

Since the object of analysis of this article is the LENs[5], the Table 1 summarizes those auctions by type of contracts, initial term of the contract and years of supply.

[3] Some of those plants have not been constructed and some have lost their operating permit because of several kinds of irregularities, as construction's delays or market defaults.

[4] For more information, see http://www.ccee.org.br/portal/faces/pages_publico/o-que-fazemos?_afrLoop=1271533459343000&_adf.ctrl-state=1aes9jsz39_17.

[5] Though the Structuring Auctions are a type of new energy, they do not take place in the analysis presented in this article, because they are specific auctions that involve strategic projects for Contracts for Energy Delivery.

Table 1. Brazilian New Energy Auctions: Amounts (GWh) and Sell Prices (R$/MWh) by Types of Contracts, Initial Term and Years of Supply

Auction	Contract	Amount (GWh)[1]	ICB
1LEN	2008H30	18,672	106.95
	2008T15	73,769	132.26
	2009H30	12,097	114.28
	2009T15	112,409	129.26
	2010H30	233,779	115.04
	2010T15	113,350	121.81
2LEN	2009H30	270,331	126.77
	2009T15	85,983	132.39
3LEN	2011H30	149,642	120.86
	2011T15	70,350	137.44
4LEN	2012T15	171,471	134.67
5LEN	2012H30	188,039	129.14
	2012T15	209,999	128.37
6LEN	2011OF15	141,490	128.42
7LEN	2013H30	31,819	98.98
	2011OF15	394,942	145.23
8LEN	2012H30	263	144.00
	2012OF15	1,315	144.60
10LEN	2015H30	85,998	99.48
11LEN	2015H30	254,576	67.31
12LEN	2014H30	230,767	102.09
	2014OF20	54,743	102.00
13LEN	2016H30	21,513	91.20
	2016OF20	82,996	105.02
15LEN	2017H30	21,513	91.20
	2017OF20	82,996	105.02
16LEN	2018H30	83,098	114.48
	2018OF25	82,135	135.58

[1] The amount refers to all electricity to be delivered during the term of the contract.
Source: CCEE, 2013.

For the purpose of this article, the analysis is restricted to the plants contracted for availability in the first, second, third, fourth and sixth LENs. The period of the data analyzed is from January 2011 to September 2013. This choice is due to the fact that during this period the market has experimented both high and low spot prices, what influences the dispatch of the thermal plants. Thus, only the contracts from the auctions selected were in effect in this period. The data are part of the CCEE public database[6].

It is important to highlight that some auctions' winners plants were excluded because they have lost their operating permit. Moreover biomass plants are not part of the analysis because their information is not available for the public.

Because of the restricted information available, some assumptions were made. At first, all data is presented in monthly data. This is a simplification since all CCEE database for settlement of spot market is hourly.

Additionally, for those plants that have bidden inflexible generation, it assumes they have produced the correct amount declared; in other words the monthly amount of inflexible generation was added to the given monthly generation.

Since some thermal plants are dispatched for energy security purposes, the generation amount taken ignores the electricity generated for those purposes, because this electricity is paid for all consumers in the system through System Service Charge (Encargos de Serviço do Sistema – ESS), so not only by the distributor's consumers that hold the contracts. As the purpose of this article is to analyze the cost of the contracts, it does not make sense merge those costs.

In order to split the contracts' electricity generation and the generation paid by charges, it was made a comparison between the monthly variable cost of operation (Custo Variável Unitário – CVU in Portuguese abbreviation) and the spot price. The ideia is based on the dispatched rule: a thermal plant is dispatched when its variable cost of operation is under the spot price.

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[6] Available at http://www.ccee.org.br/portal/faces/pages_publico/o-que-fazemos/como_ccee_atua/receita_vendas?_afrLoop=18510290523000#%40%3F_afrLoop%3D18510290523000%26_adf.ctrl-state%3D5v1zzno8p_55.

The spot price used is the average of the four average submarkets prices, calculated and published by CCEE[7], as well the CVUs.

Summarizing the real cost of the Contracts for Energy Availability is the Fixed Revenue (same as bidden by the seller on auction process) plus the dispatched cost, defined on the plant CVU, and the cost of the exposure to the spot market. The exposure cost is related to the idea of buying from the spot market when the plant's CVU is higher than the spot price: it is the difference between the amount contracted and the plant generation. So, the total electricity bought from the spot market valued at spot prices defines the exposure cost.

As previously mentioned, the ICB is defined as the ratio between the total cost of a plant and its energetic benefits. The costs are pretty clear at this moment, so it is necessary to clarify the idea of the benefits. As already mentioned, when a thermal plant is dispatched by ONS, the dispatched is based on the capacity of the plant, wich is bigger than its Firm energy Certificate – FeC, witch means that the distributors that hold this contract will receive more electricity than the contracted, since they receive a proportion of the total generation. The distributors on the spot market sell this difference between the contracted and electricity generated. Therefore, this "profit" makes the contract cost less, in other words this is the exposure revenue, that has to be added in order to evaluate the real cost of the CCEAR-Disp.

The sample consists of forty-two plants, divided as shown on Graph 1. The Graph 2 shows the sample by type of plant in terms of amount contracted.

Although the majority of the sample are diesel plants, in terms of traded electricity the gas natural plants are more relevant. Furthermore there is only one coal plant, while it represents more than 10% of the traded electricity.

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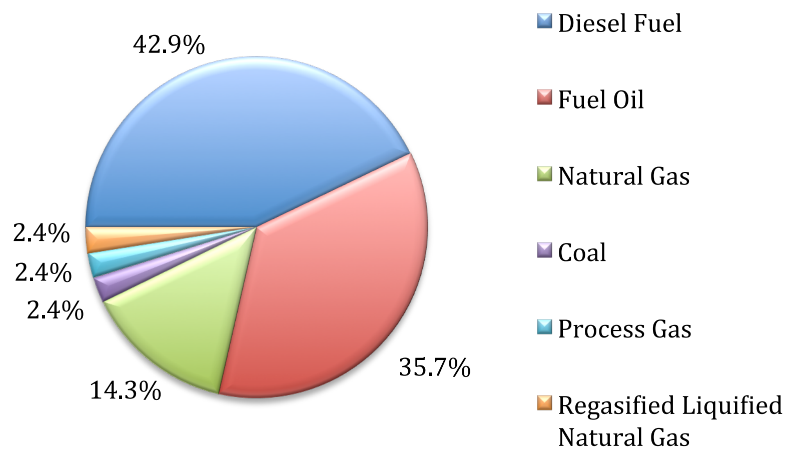
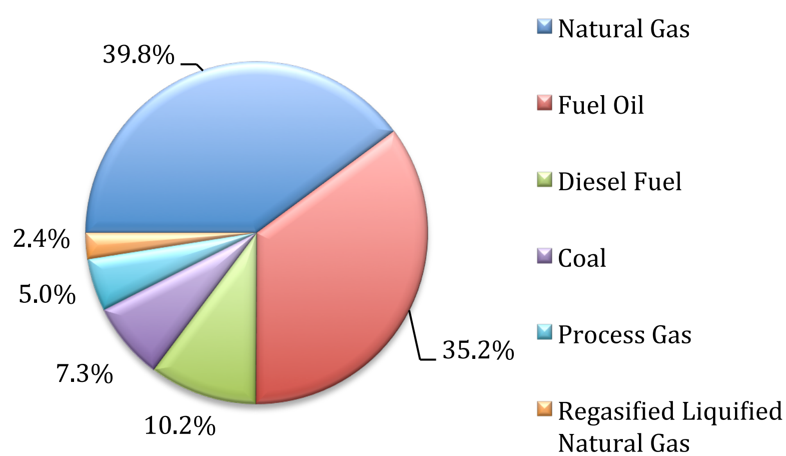
[7] Available at http://www.ccee.org.br/portal/faces/pages_publico/o-que-fazemos/como_ccee_atua/precos/precos_medios?_afrLoop=23619446013000#%40%3F_afrLoop%3D23619446013000%26_adf.ctrl-state%3D5v1zzno8p_127.

Graph 1. Number of Plants Sample by Type of Plants



Graph 2. Electricity Contracted Sample by Type of Plants



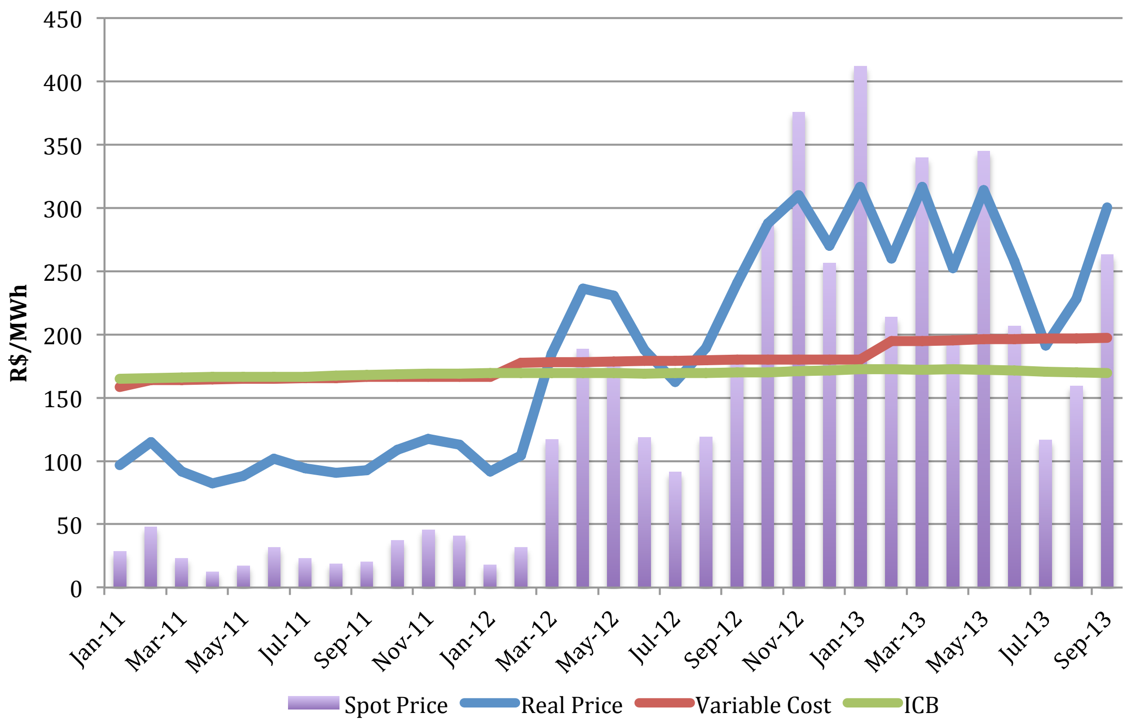
The next six graphs show the calculated average real costs by type of plant. In order to compare, the graphs also shows the average variable cost of the plants, the average ICB[8] and the spot price.

As can be seen on Graph 3, for Gas Natural Plants the real cost is most of time bigger than the spot price. But when the spot price is low, the real cost is lower than ICB; on the other hand, as the spot prices gest higher, the real cost also goes up, getting higher

[8] In other to compare the ICB with other monthly variables, it was adjusted by the Índice Nacional de Preços ao Consumidor Amplo – IPCA, which consists in the Brazilian Official Inflation Rate.

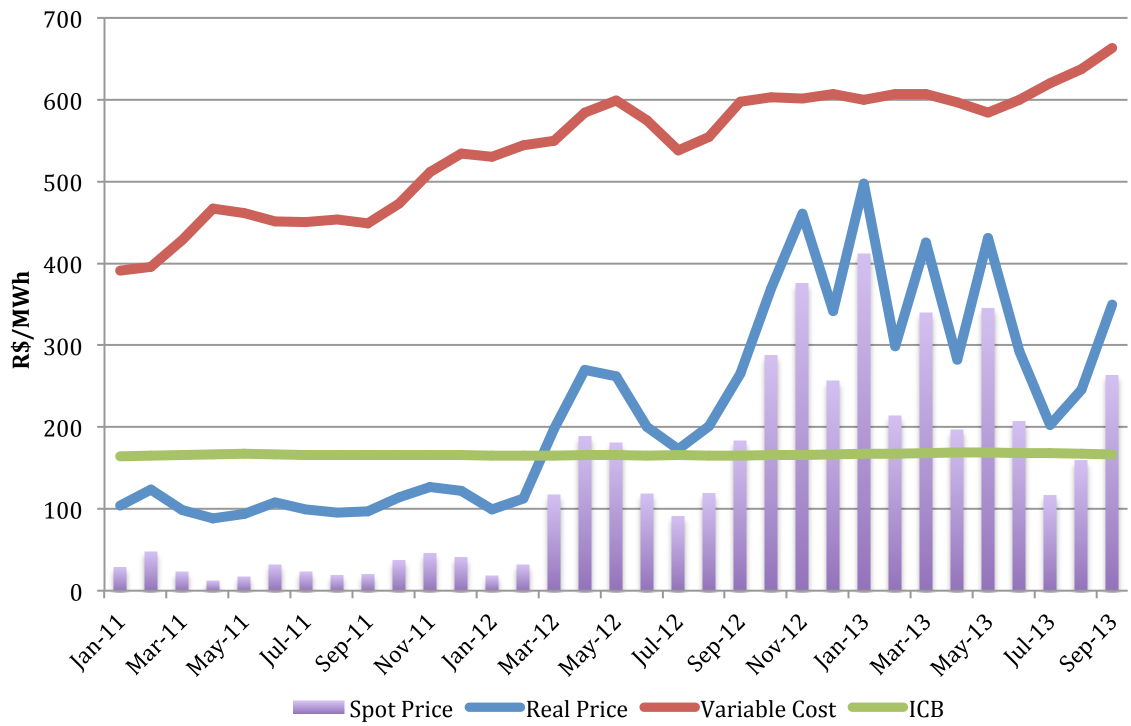
than the ICB. In four different months (Nov-12, Jan-13, Mar-13 and May-13) the real cost is lower than the spot price: on those months the generation is high, because most of plants were dispatched since Brazil experimented a very bad hydrological scenario. So, in those months it is possible to see the benefits of the contracts, in other words the consumers could buy electricity for a better price than the sport market.

Graph 3. Natural Gas Plants: Average Real Cost, Average Variable Cost, Average ICB and Spot Prices



The graph 4 shows the results for fuel oil plants. As can be seen, the real cost is always higher than the spot price. Since the variable cost is very high, those plants are dispatched rarely. During the period of this analyzes, as can be seen, they were not dispatched, even the spot price got very high, it was not enough to be higher than the variable costs. Because of that, it is not possible to get some benefits from the contracts, the real cost is never lower than the spot price.

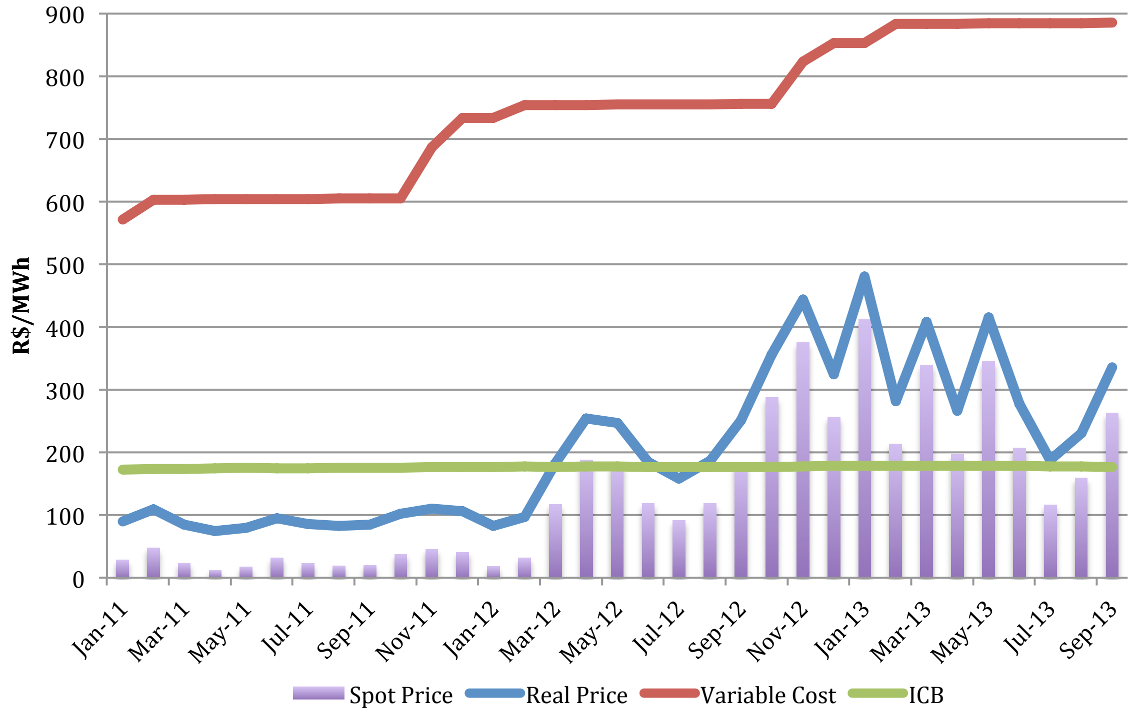
Graph 4. Fuel Oil Plants: Average Real Cost, Average Variable Cost, Average ICB and Spot Prices



As the diesel plants also presents a very high variable cost, their results are pretty similar to the fuel oil results. The results are presented on Graph 5.

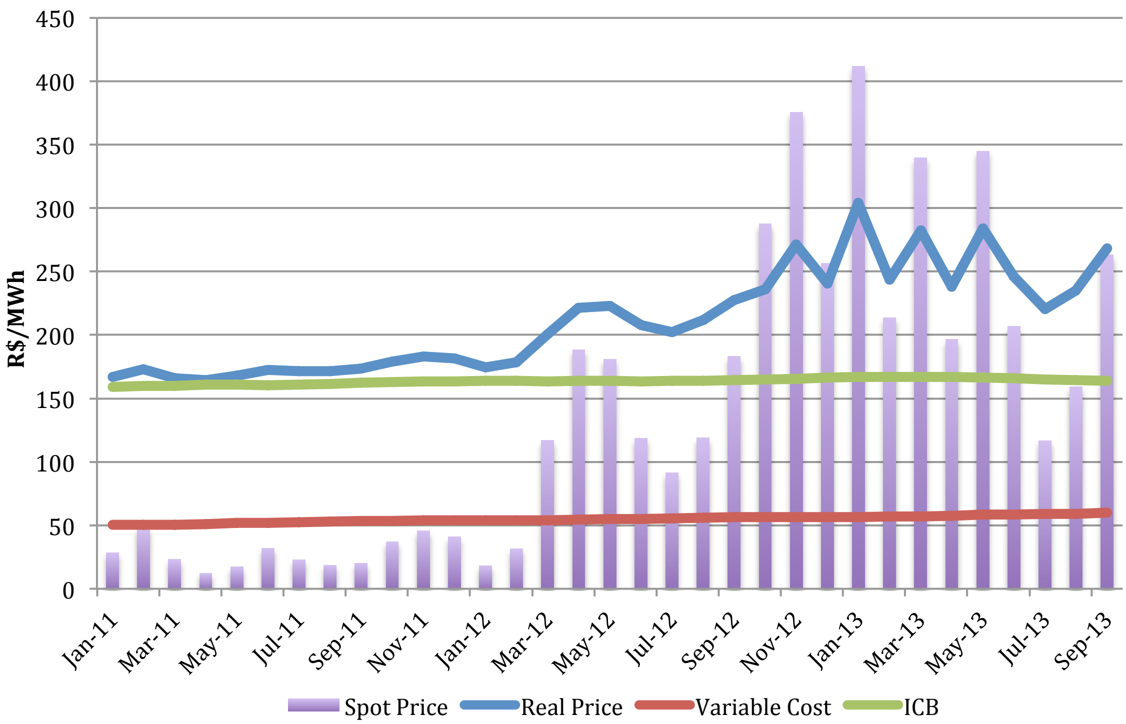
The Graph 6 presents the results for the coal plants. Since the variable cost is smaller than the fuel oil and diesel oil, and even for the natural gas plants, now it is possible to observe more cases of benefits. It is interesting to observe that when the spot price is low, the real cost is pretty similar to the ICB. Even when the spot price gets higher, the difference between them is smaller than other types of plants.

Graph 5. Diesel Fuel Plants: Average Real Cost, Average Variable Cost, Average ICB and Spot Prices



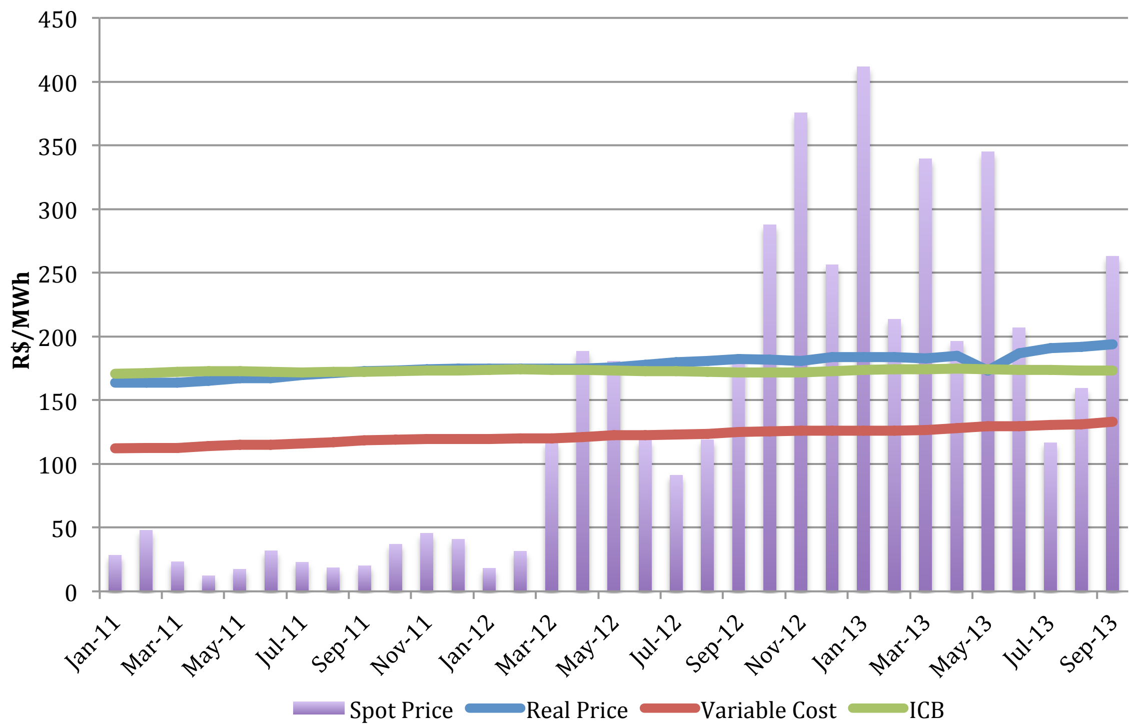
The results for Process Gas are presented on the Graph 7. Since the variable cost is also lower than other plants, this type of plant presents benefits most of time when the spot price is high. Also, it is interesting to observe that this is the only case that the real cost is much similar to the ICB, for all period analized. It is important to highlight this plant presents high level of inflexible generation, what suggests that the ICB is a good average for plants presents this restriction.

Graph 6. Coal Plants: Average Real Cost, Average Variable Cost, Average ICB and Spot Prices

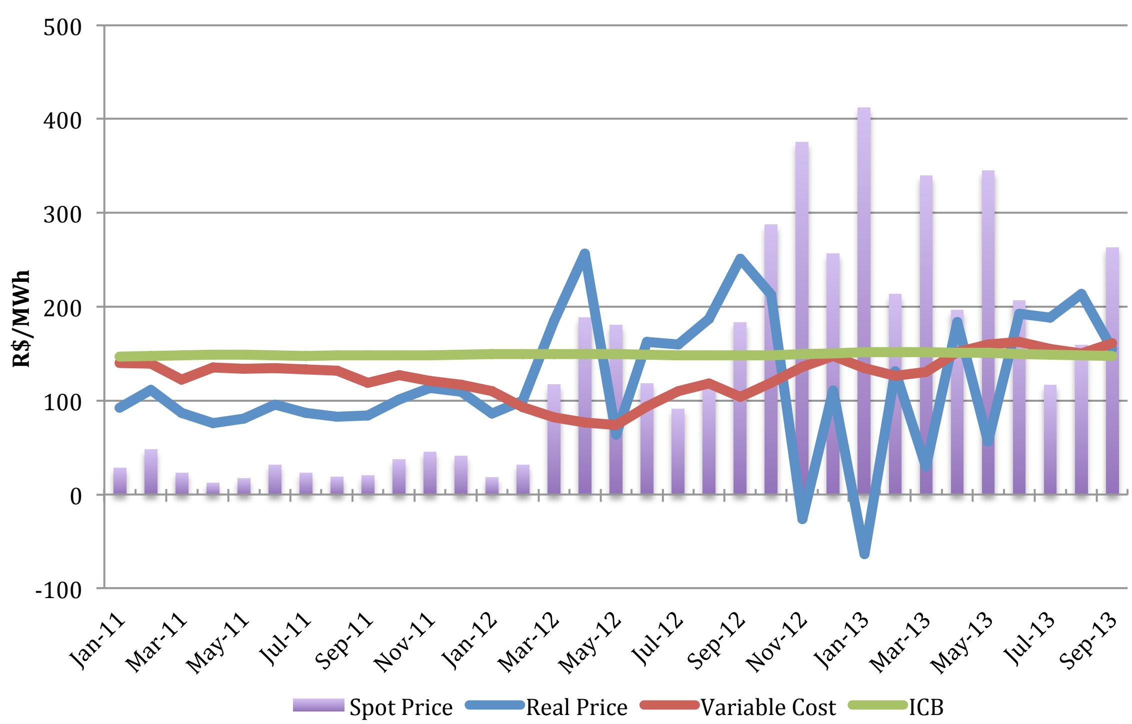


The results for Regasified Liquified Natural Gas Plants are presented on Graph 8. Those are much different from the others. In most time the real price is lower than the ICB, and it is possible to observe even negative real prices. It is important to highlight, however, that the dispatch rule for this type of plant is different from the others. Because of the liquified natural gas is imported, the dispatch is ordered two months in advance, in order to enable the import process. The dispatch is held even if the spot market changes after that, in other words the dispatch is ordered based on projections and is held even if the terms are changed.

Graph 7. Process Gas Plants: Average Real Cost, Average Variable Cost, Average ICB and Spot Prices



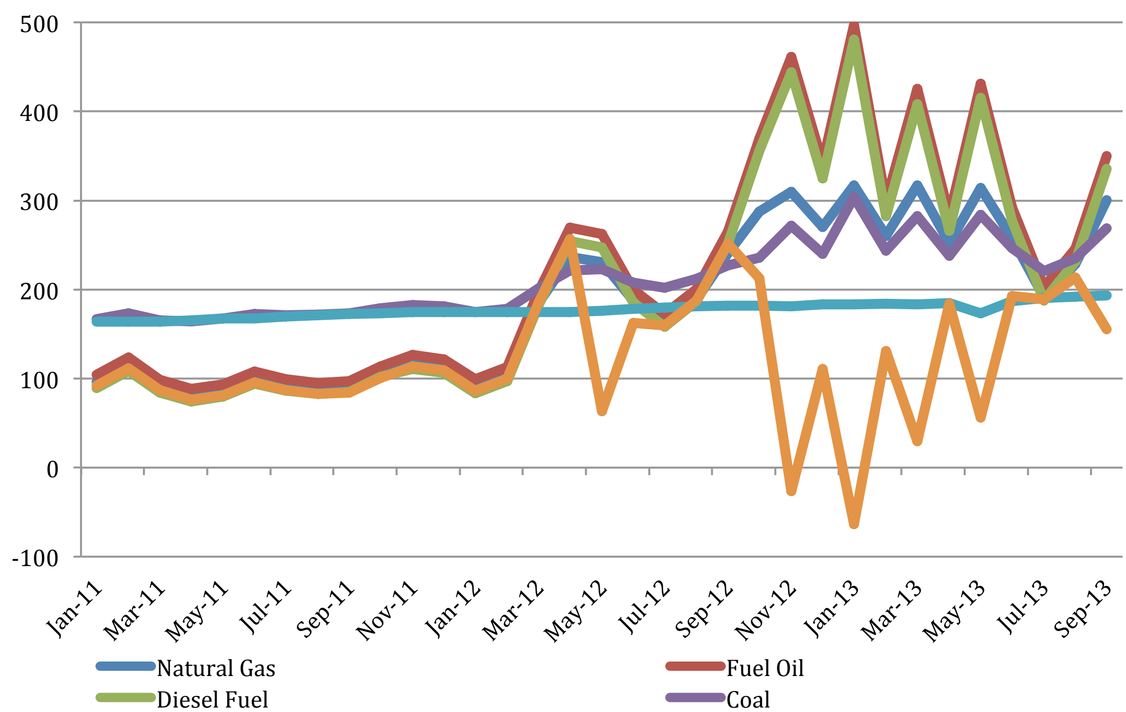
Graph 8. Regasified Liquified Natural Gas Plants: Average Real Cost, Average Variable Cost, Average ICB and Spot Prices



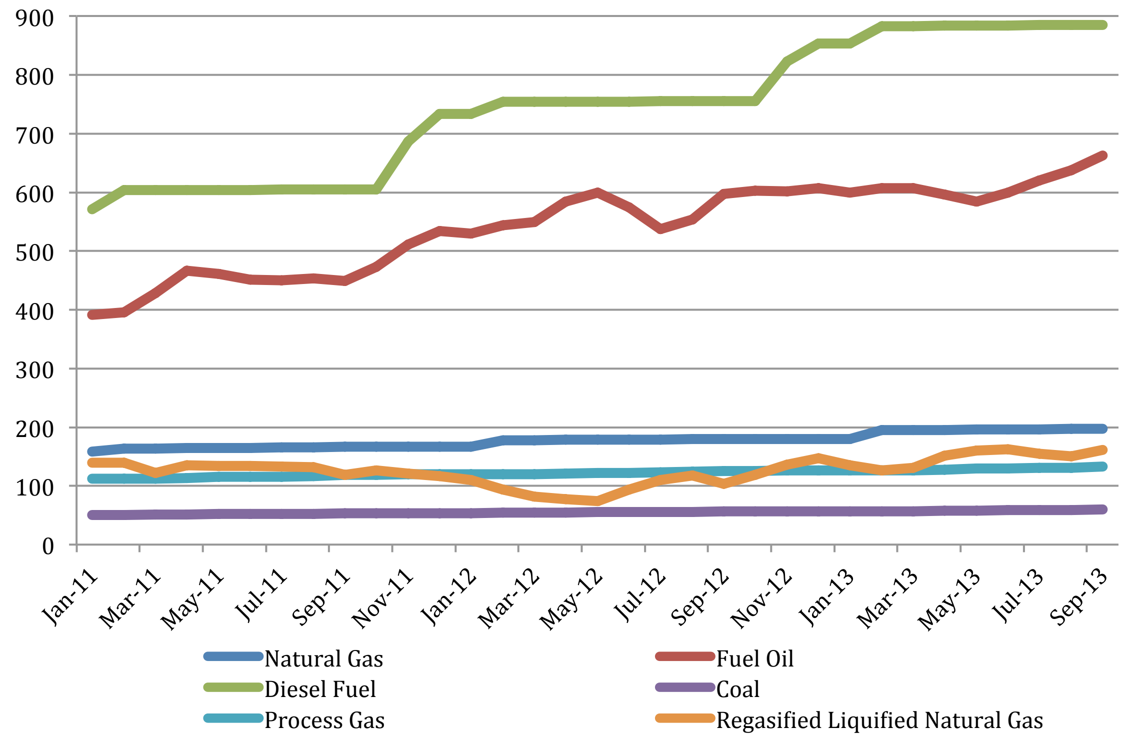
The Graph 9 summarizes all types of plants, in order to compare their real costs. Both fuel oil plants and diesel fuel are the most expensive plants. As already discussed, the reason for that is they present a very high variable cost, witch means they do not get dispatched, and consequently do not provide any benefits for the consumers. The Graph 10 shows the differences between the variable costs of all types of plants.

It is interesting to observe even the coal plants present a lower variable cost, the regasified liquified natural gas plants are cheaper. Furthermore this type of plant presents a different behavior when the spot price is high: while the most plants have a higher price, the regasified liquified natural gas plants presents a very low cost.

Graph 9. Thermal Plants: Average Real Cost by Type of Plant

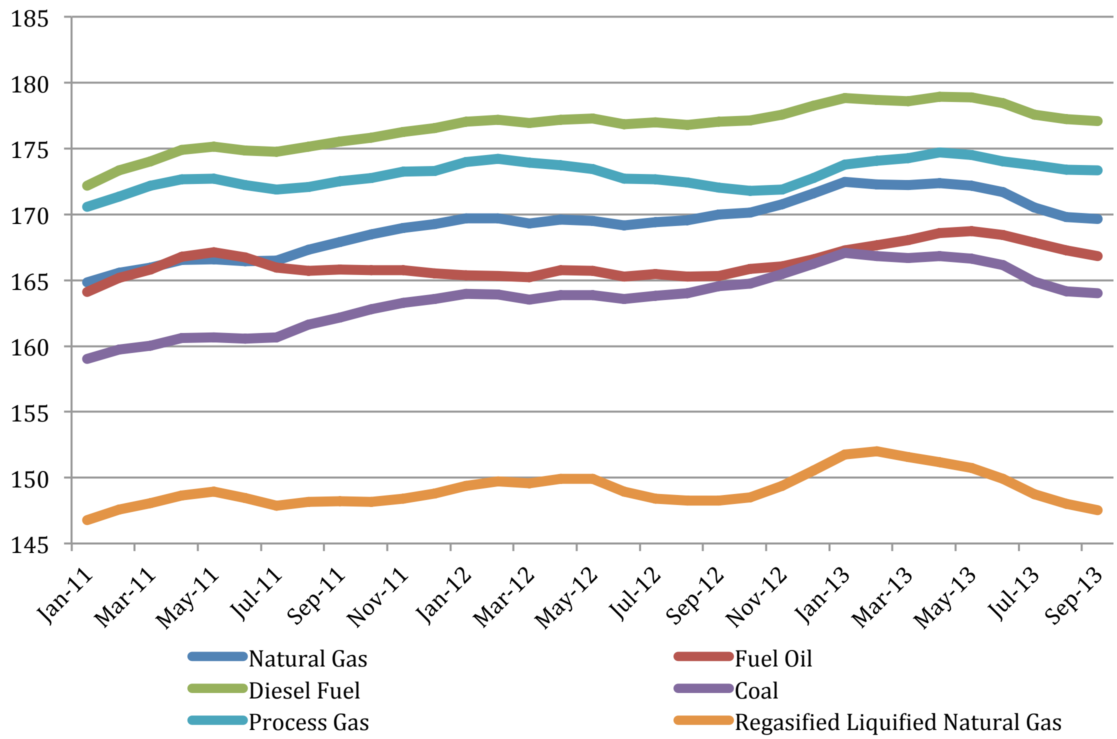


Graph 10. Thermal Plants: Average Variable Costs by Type of Plant



Finally, the Graph 11 shows the average ICB by type of plants. The interesting point is that the fuel oil plant can be considered, when this parameter is used, only the fourth more expensive plant in terms of ICB. However, as seen on Graph 9, they are one of the two most expensive types, much more than the others. This result suggests that maybe ICB is not a good parameter to be used in order to compare different types of plants, as it has been used since the new regulatory framework was established.

Graph 11. Thermal Plants: Average ICB by Type of Plant



Other interesting point is that for all types of plants, excluding the regasified liquified natural gas plants, in most of time the real cost is much higher than the ICB. This result suggests that maybe some adjustments have to be made, in order to have a more adjusted parameter to be used as auctions criteria.

Lastly the central question is if these costs can be justified by the diversification of power matrix, in order to bring more confidence to the system, making it more protected from other cases of rationing.

5. FINAL CONSIDERATIONS

Since 2004, after the new regulatory framework was implemented, the Brazilian Electricity Sector has been experimented many changes and challenges.

One of the new regulatory framework objectives, maybe the most important, was the reduction on tariffs and, was believed, could be reached with planning and procurement centralized auctions.

Many auctions were accomplished since 2005, many different types in order to attend different objectives. One of the most important types is the New Energy Auction – LEN, witch is responsible to provide new investments on generation plants and guarantee the supply to the crescent demand.

The objective of this article was to analyze if the proposed Contract For Energy Availability is contributing to reduction on tariffs and if the ICB is a good parameter to be used as the selection criteria.

As the data has shown, some observations have to be made about this index. Since the result for different types of plants has been much plural, it is possible to assert that ICB is not the better parameter to select the winner's from different types of plants. The result for similar plants, as fuel oil and diesel fuel, indicates that even in this case ICB is not a good parameter, since their ICBs are much different even though the real cost is much similar.

Since the higher benefits for this kind of contract are achieved when the plant is dispatched, it is possible to assert that those plants, which have sold electricity on those auctions, were not the best option, inasmuch as they never got dispatched, even if the spot price is higher. This issue probably is overcome for the future, since MME has been imposing limitations on the variable costs in order to plants participates on auctions.

In this paper only the plants that have variable costs were analyzed. Thus, the results suggests that the next step is to compare those results with those for plants not centralized dispatched, in other words those that presents variable cost equals to zero, as biomass plants. This comparison is interesting since all types of plants are competing in the same auctions.

Finally, it is important to highlight that is a MME's prerogative the definition of what type of plants can participates in an auction. So, it possible to assume that not only costs criteria's have been used, since this is a tool to perform the energy policy. Even the argument has been used is the diversification of the power matrix, in order to bring more confidence to the system, it is not clear if the country is in the correct way to achieved the first and most important objective of the new regulatory framework established in 2004.

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