Reform in Brazilian Electricity Industry: 
The Search for a New Model

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Introduction

During the 1990s, market-oriented reform was introduced in the Brazilian electricity industry. The main objective of this reform was to increase the investment rate in the energy sector through the attraction of the private capital. This policy was in line with the recommendations of IMF and other multilateral agencies that aimed at changing the role of the State in the economy. Concerning specifically the energy sector, one of the main objectives of these reforms was to diversify the energy matrix by inducing investments in gas-based thermal generation (more adapted to private investments). According to a strategic report published by Eletrobras in 1999 (10-Year Expansion Plan, 2000-2009), gas-based generation should account for about 20% of total power capacity by 2005. Based on this assumption, Petrobras estimated that thermal plants would consume about 35 mcm/d of natural gas in 2005.

The privatization of public-owned power companies and the opening of the oil and gas industry to private investment paved the way for private participation in these industries. Nevertheless, the new market-oriented regulatory framework in Brazil did not properly considered important specificities of the Brazilian power industry in terms of the institutional complexity and the cost structure. Given these specificities, the new market-oriented regulatory framework was not capable to induce the required investments. Market and regulatory risks remained significant resulting in a low rate of private investment and in the consequent power shortage in the years 2001-2002. Following the energy crisis, Brazilian society arrived at the consensus that the reform process was inadequate, principally because it had failed to guarantee security-of-supply. The victory of the Workers Party in the 2002 elections marked a turning point in energy policy for the gas and power industry. In 2003, a new policy was proposed for the electricity industry and discussions for changing the regulatory framework for the gas industry have already started.

The objective of this paper is to analyze the background of the reform process in the Brazilian electricity industry and to examine the adequacy of the new energy policy under consideration as a way to restore the level of investment, in particular private investment, in the sector. The first session of the paper is dedicated to the analysis of the main obstacles encountered in the implementation of the market-oriented reform. The second will be dedicated to the analysis of the institutional and regulatory changes that are being implemented by the current government. Finally, the third session will discuss if the new model for the Brazilian electricity can contribute to boost the level of investments in the industry.

1 - The Electricity Sector
Brazil has a modern electricity industry that supplies most of the country’s households. Currently, 93% of Brazilian households have access to electricity. Practically, the whole of urban population has access to power supply services.

The Brazilian electricity industry has important specificities as compared to other countries. As shown in Figure 1, hydropower accounts for 80% of the 83 GW of installed capacity in the sector and for 90% of the total electricity generated. Gas-based generation represented only 6.5% of total capacity in 2003. Diesel is an important source of energy for power generation (5% of total capacity) in isolated systems, located mainly in the Amazon Region. The country counts with significant amount of generation capacity based on biomass (2.4 GW), coal (1.5 GW) and has two nuclear power plants with 2 GW of capacity (see figure 1). An important consequence of the dependence on hydropower is the relatively high risk of shortage of supply in dry periods.

Figure 1 - Generation Capacity by Source (GW) - May 2003

![Graph showing generation capacity by source.](image)

Source: ANEEL

The Brazilian hydroelectric system is also unique. It has the largest capacity for water storage in the world. On average, Brazilian hydroelectric dams can store enough water to produce electricity during 6 months if all rivers dry out. Given the large distance of the most important dams from the power markets, Brazilian electricity industry has built one of the largest transmission networks in the world (see Figure 2). Therefore, electricity flows between different Brazilian regions and the system is operated as a unique market. Besides the interconnected system, there are hundreds of isolated electricity systems in the Amazon Region based in diesel oil.

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1 Actually, there are important transmission restrictions between different interconnected regions of the country (Northeast, Center-southeast and South). Therefore, Brazilian interconnected transmission system has three sub-markets.
The structure of the Brazilian electricity industry is also quite unique. The historical pattern of the electricity industry development resulted in a very complex industrial structure. Today 59 companies operate in the generation sector and 64 utilities in the distribution segment (Figure 3). Historically Federal government concentrated its operations in the generation and transmission companies, while almost all States created their own electricity distribution companies. The publicly-owned Eletrobras owns and controls the three biggest generation and transmission companies plus Itaipu\(^2\). Eletrobras’ market-share in the generation segment sums approximately 40%. The other 60% of the generation market is composed state-owned vertically integrated companies (11%) and by private or mix capital companies (49%). On the other hand, most of the distribution segment (70%) has been privatized in the 1990s. The majority of the utilities are not vertically integrated. However, some integrated utilities play a very important role in Centre-South Brazilian grid. This is the case of CEMIG (Minas Gerais) and COPEL (Paraná).

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\(^2\) This large hydropower plant (13,600 MW) is a bi-national company. Brazil and Paraguay each own 50% of the plant. Eletrobras owns 50% of Itaipu stocks. Eletrobras president is on the board of Itaipu. Nevertheless, Itaipu responds directly to the federal government.
1.1 - Supply and demand growth rate

An important feature of the BEI is the fact that demand is still growing at a rapid pace (see figure 4). Between 1980 and 2000, while the average economic growth rate was about 2.4%, electricity demand increased at an annual rate of 5.4%. Between 2001 and 2003, Brazilian GDP increased 3.5%, while electricity demand decreased 2%. This decrease in electricity demand was due to the rationing program imposed by the government in response to the power shortage in 2001. Nevertheless, electricity intensity of Brazilian economy is still high, as compared to developed countries. Similarly, the elasticity of demand to GDP growth of BEI is quite significant. In the second half of the 1990s, this elasticity was about 2. In other words, in average, each percentage point in economic growth meant a 2 percentage point increase in electricity demand.

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3 This elasticity can be explained by relatively low level revenue of average Brazilian household. Economic growth still has an important impact in the acquisition of electric equipments. The share of energy intensive industries in Brazilian economy is also quite significant.
During the 1990s the electricity market was characterised by an important supply-demand unbalance. The market-oriented reforms did not induce a sufficient level of investments. Between 1990 and 2000, electricity demand increased by 45% while the installed capacity expanded only 28% (see figure 5). For several years, the insufficient expansion in generation capacity was partially compensated by the depletion of water reservoirs (see figure 6). However, in 2001 a very dry summer contributed to put the reservoirs to a critical level. Energy authorities were forced to adopt a rationing program where most consumers had to reduce demand by 20%. The rationing program had an important impact on electricity demand. The demand reduced significantly and, still in 2003, its level has not reached the level prior to the rationing program.
Figure 5 – Evolution of electricity demand and installed capacity (index 1990=100)

Source: Ministry of Mines and Energy

Figure 6 - Evolution of the level of water reservoirs in the Southeast Region (%)

Source: ONS
In parallel to the rationing program, the federal government launched an emergency program for increasing the electricity supply by the construction of gas-based power plants (this program will be detailed further below). The reduction in demand as a consequence of the rationing program and the increase the installed capacity after 2001 has created a situation of oversupply in the market (see Figure 5). This excess capacity has reduced the risk of shortage for the next two-to-three years. Nevertheless, the rate of investment in the electricity sector needs to increase significantly if electricity supply is to cover the demand generated by the expected growth of Brazilian economy.

The Federal 4-years plan for the period 2003-2007 (PPA) plans to increase investment rate in the electricity sector by will increase 2.3 times. During the 1990s, the average increase in the generation capacity was 1.5 GW. The PPA expects the generation capacity to increase by 3.5 GW yearly. The transmission system is planed to expand 15% in the period, with 12,000 kilometers of new transmission lines. In addition, the PPA plan intends to supply electricity to 1.7 million homes currently without access to electricity.

Even though the PPA plan intends to accelerate significantly the rate of investments, the investments needed to avoid restrictions to the potential growth rate of the Brazilian economy can be even higher. Recently the International Energy Agency has published the World Energy Investment Outlook - WEIO. According to this publication, Brazil’s electricity demand will increase by two-and-a-half times from 2000 to 2030, growing at an average rate of 3.2%. According to the WEIO, this growth would require investments of about 330 billion dollars, of which 156 billion dollars for the expansion of the generation capacity and about 175 billion for the expansion of the distribution and transmissions systems.

1.2 - Market-oriented regulatory reform in the electricity sector

Before the reform process started in the first 1990s, the regulatory framework of BEI was characterized by the presence of cross-subsidies, central planning for expansion, cost of service pricing policy, and the presence of publicly-owned companies in all segments of the industry. The financial deterioration of the public owned utilities in the 1980s stimulated the reform process. In 1993, the government of Itamar Franco enacted Law 8631 to improve the financial situation of the utilities and prepare them for privatization. This was accomplished by allowing utilities to raise prices and terminating the cross subsidies policy. In addition, the price-cap tariff system was adopted allowing utilities to appropriate efficiency gains as profits. Most importantly, the federal treasury assumed US$ 26 billion of the excess debt of the utilities.

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4 This is the four years plan for the Brazilian economy elaborated by the Ministry of Planning that establishes the main strategies for public police and expenditures.

5 If this plan is implemented, almost all Brazilian households will have access to electricity supply by 2007. Today, about 2 million homes have no access to electricity.

6 During this period, electricity prices were held down in order to fight inflation. The system of cross-subsidization from low cost utilities to high cost utilities did not create incentives for efficiency gains (Oliveira and Pinto Jr, 1995). Consequently, distribution companies started failing to pay generation companies.
In 1995, Law 9074 created Independent Power Producers - IPPs. In addition, large power consumers (more than 10 MW) were allowed to buy electricity from the supplier of their choice, including IPPs. This reduced with captive markets in the utilities’ concession areas. In 1996, Law 9427 created ANEEL (National Electric Power Agency), the regulator for the electricity sector. A “price-cap” tariff scheme replaced the “cost-of-service” scheme in all concessions in the sector. Finally, generation, transmission and distribution functions of existing utilities was unbundled, through separate accounting systems.

After the creation of the regulation agency, negotiations took place for the creation of a wholesale market. In 1998 the government created an independent system operator (ISO)\(^7\) responsible for the technical coordination of the dispatching and for the management of the transmission services. The MAE (Mercado Atacadista de Energia) was created in order to oversee competition in the future wholesale market. Long-term power supply contracts from generators to distribution companies were cancelled and replaced by the so-called initial contracts. Under these contracts, generation companies continued to sell electricity on a historical-cost-of-service basis, which are much lower than long-run marginal cost. Currently, the average initial contract’s price is about US$ 15 per MWh, while the marginal cost for thermal generation is about US$ 35-40 per MWh. The regulator dictated that after 2001, the initial contracts would expire progressively, and the share of the wholesale market in total electricity transactions would increase 25% annually. Therefore, by the year 2006 all electricity exchange was supposed to be done through the wholesale market.

Though Brazil has stopped short of full market reforms, the government has implemented a very important privatization process. When the privatization process began in 1995, the players and the government were quite optimistic about the pace of the reform. When ANEEL was created in 1996, 10 distribution utilities had already been privatized. Because of its enormous macroeconomic implications, the government did not wait for the completion of the new regulation framework to begin privatizing utilities (Almeida and Pinto, Jr., 1999).

As far as the auction processes were concerned, the privatization process was very successful, at least until the 1999 exchange rate crisis in Brazil. The relatively high liquidity in the international financial market fuelled the interest of national and international players, resulting in high prices paid for privatized utilities. This price has been on average 50% higher than the minimum price established by the government. Nineteen utilities had been privatized by July 1999 for about US$ 19 billion. These were mostly publicly-owned distribution utilities, the reason for this being that the economic

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\(^7\) Operador Nacional do Sistema - ONS.

\(^8\) In 1997 and 1998, following privatization, foreign investment in the power industry represented roughly 40% and 30% of all foreign direct investment in Brazil, respectively. These figures illustrate the macroeconomic impact of privatization in the electric power sector.
risks in the distribution segment are less important, while the potential to improve productivity is larger.

The changes in the national and international macro-economic scenario after 1999 created important barriers for the complete implementation of the BEI reform process. The exchange rate devaluation in January 1999, and the economic instability in the domestic and international economy afterwards, reduced the political capacity of the government to negotiate and implement the market-oriented reform in the BEI. One of the most important unfinished works was the decision regarding the industry structure. The government was not able to reach an agreement with shareholders concerning the appropriate industry structure in the generation sector, which is dominated by Itaipu Binacional Plant and four other large hydropower generators. The five generation companies are controlled by the same holding company, Eletrobras. Two main proposals have been debated: preserve this market structure and privatize the companies; or break these companies into several small ones before privatization in order to induce greater competition. The government faced strong political opposition both to break up the companies and to privatize them with the current structure.

When the government made the decision to privatize the generation companies while preserving the industry structure, several interests in favor of the alternative use of the reservoirs showed up. It quickly became clear that one necessary condition for continuing the privatization process was to create appropriate regulation for the water segment. It was necessary to establish clear rules for the alternative water uses and the coordination of the electricity generation by different hydropower plants located in the same river basin. In order to do so, the government created the National Water Agency (ANA) in the year 2000. However, these rules were not yet fully established by the end of the administration of President Cardoso.

The difficulty in defining the industry structure and an adequate regulatory framework taking into account the peculiarity of the Brazilian electricity industry affected other dimensions of the reform. The most important was the definition of clear rules for the wholesale electricity market. The price of electricity traded at the MAE was fixed at the short-term marginal cost. The system operator, through a very complex mathematical model, calculated this cost. How the price was fixed and its trends were not transparent for the market. In the absence of such transparent rules, it was not possible to anticipate future price levels.

Furthermore, most of the electricity generated by the hydroelectric companies was being sold on a historic cost basis through the initial contracts. These costs were very low compared to current marginal costs. One important decision that should be taken was the rules and timing for the commercialization of the cheap electricity, once the contracts that linked this production to historic costs end. Therefore, the regulatory framework was not sufficiently developed to forecast future electricity price levels. The amount of electricity negotiated through the wholesale market, furthermore, has not been significant.

Another important undefined point concerning the wholesale market was the rules to allow the coexistence of hydro and new thermal power generation. Since more than 90%
of electricity generated is hydro-based, it is crucial to determine how the thermal plants will compete with the hydropower plants, given that the hydro plants have much lower short-term marginal costs. It is very difficult to anticipate the volume of water available in the dams’ reservoirs in Brazil, and these reservoirs have a high storage capacity. Thus, the thermal generation plants run the risk of being uncompetitive for relatively long periods. In short, thermal generation plants cannot beat the short-term marginal cost of hydro plants during periods of normal rainfall.

The uncertainties mentioned above affected both private and public investment in the electricity sector. The belief that the generating companies would be privatized led the government to suspend its own investment program. At the same time, private companies were not interested in investing in greenfield projects until the privatization process was completed. This is because privatization meant the definition of a new cost level and price for the electricity being sold through the initial contracts. As a consequence, investments fell sharply relative to historical levels.

It is clear that there was a lack of understanding of the impact of the peculiarities of the Brazilian Electricity System for the definition of the model of market-oriented reform. This problem induced the players to underestimate the difficulties in the reform process, resulting in a crucial mistake concerning the timing of the privatization process.

1.3 - The Electricity Supply Crisis and its effects

Recognizing that electricity supply growth was insufficient, the government launched the Priority Plan for the Thermal Power plants (PPT) in 2000. In doing so, the government hoped to induce investments in gas-based thermal plants, avoid electricity shortages and develop the gas market. On the other hand, the Bolivia-Brazil gas pipeline started to operate in 1999, and soon it became clear that something should be done to boost gas demand. The increase in the oil price and the devaluation of the Real which implied an increase in the price of the gas of about 80% between 1997 and January 1999, made the development of industrial gas demand very difficult. There was a growing concern that gas demand would not correspond to the take-or-pay contracts signed with Bolivia.

The principal incentives were: i) granting Eletrobras authority to give Power Purchase Agreement - PPA contracts for qualified gas thermal generation projects (reducing the market risk); ii) offering special credit lines (in reais) through the national development bank (BNDES) as a means of reducing the exchange rate risk; iii) offering, through Petrobras, reduced natural gas prices for the qualified projects (US$ 2.57 per MMBTu). In order to qualify for the benefits, thermal plants should be commissioned before the end
of 2003. The Ministry of Mines and Energy received 49 project proposals totalling about 15 GW in installed capacity.

Considering the regulatory uncertainties mentioned above, the PPT incentives were not sufficient to make viable most of the project proposals. From the 49 power plants, only 15 were built, adding about 4 GW in new generation capacity. In addition, most of these new power plants came on stream too late to avoid the power shortage. An unusual dry season in the year 2001, together with the recovery of the Brazilian economy in that year, resulted in a scenario of shortage of electricity for the period from July to December 2001. This scenario encouraged the government to form a special commission to manage the energy crisis (Câmara de Gestão da Crise de Energia Elétrica-CGE). This commission had responsibilities that usually belonged to the Ministry of Mines and Energy and to the regulatory bodies ANEEL and the ANP.

In order to tackle the energy shortage and avoid blackouts, the CGE made the following decisions:

- establishment of the target for saving 20% of electricity consumption relative to the months of May-June-July 2000 all consuming segments;
- creation of a penalty of 50% increase in electricity tariffs for the electricity consumed on top of the established quotas for domestic consumers of 200-500 KWh/month;
- creation of a penalty of 200% increase for the electricity consumed on top of the established quotas for domestic consumers consuming more than 500 KWh/month;
- consumers with lower level of consumption (less than 200 KWh/month) were encouraged to save electricity by means of discount rates for each KWh saved;
- development an emergency program for power generation.

The emergency program for power generation consisted in additional incentives for short-term power supply projects. The government created a dedicated company - Companhia Brasileira de Comercialização de Energia Emergencial (CBCEE) - for buying electricity with special contracts paying high prices for this type of power supply (barge-mounted generators, small-scale diesel-based power projects and gas-based merchant power plants). About 2.1 GW of power capacity was bought by the CBCEE and automatically sold to all distribution companies. A special tax was created to help financing CBCEE and charged to all power consumers. This new tax, together with the penalties applied on consumers that have not managed to reach the saving targets, were used to pay for the emergency energy bill.

These measures, together with an intense information campaign on television, were very effective to change consumers’ behavior. As we can see in Figure 7, electricity demand fell rapidly, contributing to avoid blackouts. Rationing measures were withdrawn on February 28 2002, but the energy saving program had lasting impacts on demand. The electricity demand continued lower than the level of before the rationing program. This

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11 Some consuming segments had savings goals of less than 20%. This is the case of some specific industrial sectors and public services (hospitals).

12 Emergency power capacity tax.
happened because industries and households had replaced equipments (power generators and appliances) for more cost-efficient types. For example, there has been a widespread adoption of fluorescent compact lamps. The energy crisis also had important impacts on consumer behavior in the residential sector. In December 2002, residential demand was the same as in December 1994. In 2002, Eletrobras revised downwards its demand projections for electricity demand by 10%. Therefore, the impact of the energy crisis on the utilities’ cash flows will extend for far longer than the rationing period.

The unexpected reduction of electricity demand had significant financial impacts on the electricity sector. The distribution companies were negatively affected by reduction of the demand and revenues. In addition, the devaluation of Real in 2001 and 2002\(^{13}\) (in part due to the effects of the energy crisis on the national financial market) deteriorated even further the utilities’ results (CERA, 2003). Several utilities had loans to pay in US dollars.

![Figure 7 – Evolution of Electricity Demand (Mw)](image)

The reduction in demand had also an important impact on the PPT program. Economic and regulatory uncertainties produced a very difficult environment for new projects. Few generators managed to get PPAs, necessary to arrange the financing. Nevertheless, about US$ 6 billion was invested in generation and transmission projects\(^{14}\), adding about 4 GW in new generation capacity. These plants received incentives but unfortunately found no available market when ready to start operation. Companies that bought this new capacity are facing serious financial hurdles to honor these contracts.

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\(^{13}\) In 2001 the average exchange rate in Brazil was about R$ 1.9 /US$. In 2002 this rate reached a peak of R$ 3.9/US$. Currently, (march 2003) the dollar is trading for about R$ 2.90.

\(^{14}\) Petrobras was responsible for about 60% of these investments.
25% of the “initial contracts” were due to expire in January of 2002. Nevertheless, the government of the time decided to postpone these contracts until 2003 because of the rationing program. In 2003, the new government decided to not postpone these contracts once again fearing that the market should interpret this measure as disrespect to contracts. With such a big amount of electricity supply becoming uncontracted, summed with the reduction of the electricity demand, electricity prices reduced significantly. As a consequence, several-low cost generation companies are facing difficulties to sell their electricity, while distribution companies have to honor PPT contracts at relatively high prices. Most of thermal power plants are not operating because of lack of market. In the current market situation, thermal power plants can deliver the electricity they have sold, by buying electricity in the spot market at very low prices and reselling it at their PPA contract price rather than generating it. This type of unbalance in the electricity supply contracts is triggering conflicts and regulatory instability. It can be said that several companies and agents are struggling to avoid paying the “bill of the rationing program”.

Given the difficult situation in the electricity sector, Petrobras in his new strategic plan has revised down its investments in gas thermal generation. The company is facing a serious financial setback in its gas thermal generation projects. In 2002, the company’s loss in this business segment was about US$ 300 millions. In 2003, the company has already reserved US$ 450 millions for covering losses in the gas thermal generation. Given these financial hurdles, the company has given up six of its 16 planned thermal generation projects. The new strategic plan (2003 – 2007) reserved only US$ 0.5 billion for investing in gas-based power plants for the conclusion of ongoing projects.

Hydro-based generators are also facing a difficult economic environment. The decision of the current government to maintain the programmed expiration of the “initial contracts” forced generators to resell this non-contracted electricity in an oversupplied market. In 2003 and 2004, 50% of the electricity sold by “initial contracts” became non-contracted. In January 2004, there were about 6 GW of excess generation capacity. Given this market context, generators were forced to give significant discounts to resell electricity that were already low as compared to the long-run marginal cost. Therefore, the rationing program has also affected the incumbent hydro-generators.

1.4 – The New Model for the BEI

The victory of the left-wing candidate Luis Inacio Lula da Silva, in October 2002, changed radically the scenario for the electricity sector. The negative effects of the electricity shortage on the economy and its political impacts impelled the new government to revise the institutional organization and regulatory framework of the electricity sector. The most important objective of this revision was to provide the Federal Government with new instruments to guarantee security of supply. In order to reach this objective, a new model of the electricity sector was proposed based on the following orientations:

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15 One of the most important electricity distribution companies (Copel) is not honoring the PPA contract given to the Araucaria power plant.
i) construction of a more centralized institutional design, reinforcing the role of the Ministry of Mines and Energy;

ii) reduction of the importance of operational competition, with priority given to competition for new investments;

iii) freezing of the privatization process in the sector with the return of the publicly-owned utilities as important players in the expansion of the electricity sector.

In July 2003, the new government disclosed its proposal for reforming the electricity sector. This proposal was approved in March 2004 by the congress. The main points of the new model are:

a) creation of a pool for electricity procurement by the electricity distribution companies;

b) creation of two contracting environments: regulated and free;

c) creation of new institutions for supporting the task of coordinating and planning the system expansion.

In addition to the three main measures described above, the new model will promote total separation between the generation and distribution segments. Currently distribution companies are allowed to buy up to 30% of their electricity from their own subsidiaries (self-dealing). In addition, Cemig and Copel, the distribution companies from Minas Gerais and Parana, are vertically integrated. In the new model, self-dealing is prohibited. Copel and Cemig will have to unbundle their assets into different companies. Nevertheless, the regulation concerning these aspects of the new law is not yet in place. The government will have to decide what to do with current self-dealing contracts and the deadline for the unbundling of vertically-integrated companies.

The electricity Pool

The most important difference of the Brazilian pool from the other electricity market environment based on a pool (the former UK electricity pool, the Nordpool) is the fact that Brazilian pool is based on long-term contracts. In the former UK pool (NETA, the new UK electricity market does not work in this way), distribution companies and free-consumers used to buy electricity for the next day (specifying the amount for every hour). In Brazil, distribution companies will buy generation capacity for several years ahead. The most important advantage of the Brazilian pool is the fact that once generators get the PPA contracts, they eliminate market risks for the duration of the project.

The new model intends to guarantee security-of-supply by requiring distribution companies to contract electricity for 100% of their market, as projected five and three years in advance. The idea is to guarantee that all expected demand for electricity will be contracted in the long-run through this mechanism, avoiding the mismatch between supply and demand.

Captive and non-captive consumers (more than 10 MW) will continue to co-exist. Power distribution companies will be responsible for procuring electricity for the captive
consumers through the pool, which is a regulated market environment (see figure 8). Non-captive consumers will be allowed to buy electricity through bilateral contracts at the non-regulated market.

The Pool’s electricity price will be formed by the average price of all long-term contracts and will be the same for all distribution companies. It is important to mention that the current electricity procurement contracts will be still be applicable. Therefore, each distribution company will have different contracts’ portfolio, with a different share of pool contracts and average price.

The existing generation capacity and the new generation capacity will be tendered separately in the pool. This separation aims at allowing depreciated power plants to have a lower tariff than the new capacity. Existing generation capacity will be tendered in the pool as their contracts end. Most of this capacity is currently sold with long-term contracts and about half of these contracts will expire in the next two years. In the initial auctions, only the capacity not contracted will be auctioned. It is not yet clear how the market for existing capacity will function. Most of the existing generation capacity is hydropower plant owned by public-owned companies. The owners of the depreciated generation assets will no longer be able to capture the difference between their cost and the market price. Price ceilings will be imposed on the old generation capacity in the biddings. However, the mechanism to fix the ceilings is not yet clear.

Note that “new generation capacity” includes all power plants commissioned since 2000. This was done so that the thermal power plant recently built and not yet contracted would not have to compete with the already depreciated hydropower plants. It is expected that only when all these “new but existing” capacity has been contracted through the pool, new projects will be auctioned. Of course, contracting for existing capacity and then for new capacity will depend on demand projections.

Existing generation capacity will be bided as their contracts ends. Most of this capacity is currently sold with long-term contracts and about half of these contracts will expire in the next two years. In the initial auctions, only the capacity not contracted will be auctioned. It is not yet clear how the market for existing capacity will function. Most of the existing generation capacity is hydropower plant owned by public-owned companies. The owners of the depreciated generation assets will no longer be able to capture the difference between their cost and the market price. Price ceilings will be imposed on the old generation capacity in the biddings. However, the mechanism to fix the ceilings is not yet clear.

The Non-regulated Market

A non-regulated market of electricity will continue to function in parallel to the regulated long-term contracts market. Eligible consumers will be allowed to buy electricity with long-term bilateral contracts. Nevertheless, these consumers will not be allowed to buy hydro-based electricity at lower price than the pools’ price. The same applies for the self-generation hydro-projects. The idea is that since this producer is not selling its power through the pool, it is appropriating the rent of the nation’s hydro resource. If an IPP
produces power for self-consumption and/or sells to non-captive consumers, it has to pay to the pool the difference between the pool price and its own price. This rule is only applicable to hydro-based generation. Nevertheless, in Brazil thermal generation is usually more expensive than hydro-generation. As consequence, the only economic incentive left for auto-production and to the free-consumers will be security-of-supply.

The free market will also be used for balancing the regulated-market. If the distribution companies are too conservative in their estimation of future demand, and their long-term contracts do not cover all the demand, they will have to buy electricity in the free market with short-term contracts. On the other hand, if the companies are too optimistic, they will have to sell electricity in the short-term market. If the unbalance is lower than 5%, the distribution companies will be able to pass to end-consumers the eventual higher costs of purchasing electricity. If the imbalance is greater than 5%, the distribution company will take all the market risk of the short-term market. In other words, if the short-term market offers prices more expensive than the pool, the distribution company will not be allowed to recover the price difference in the tariffs.

The free market for electricity tends to be a residual market. The main reason is the fact that the electricity sold at the regulated market will cost less than the electricity sold by the free market with long-term contracts. Hydro-based generators will not be allowed to sell their electricity at the free market at lower prices than the pool. The new electricity law obliges these generators to pay for the price difference. On the other hand, the gas-based thermal power plants will have a much higher cost than the pool. The only opportunity of the free market will be the short-term contract market. However, distribution companies and free consumers will buy electricity with short-term contracts only for complementing their long-term contracts. The short-term electricity price will continue to be very volatile given the variations in supply (hydrology) and demand.

As shown, the main measures adopted by the new model try to make the electricity market more stable, reducing the size of the short-term electricity market. As a consequence, price volatility and risks will tend to be very high in the short-term market, making this environment very risky. As shown before, the short-term market is supposed to be a residual of the long-term contracts.

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16 The share of the power supply on hydro-generation and the rain instability of Brazil’s tropical climate contributes to increase the volatility of the short-term electricity market.
Planning in the new model

Public planning in the electricity sector has been practiced during most of the 1900s, before the liberalization of the network industries. One of the main motivations for introducing market-oriented regulatory framework was to avoid the problems associated with public sector planning in the sector. One of the most important problems with public planning was a tendency to overestimate electricity demand and hence generating capacity needs. In the traditional regulatory framework, demand over-estimation was not a problem for the power companies. Their investment remuneration was guaranteed by a cost-of-service tariff scheme. Their profits depended on the amount of investment. Therefore, there was an incentive for over-estimation of demand.

The return of public planning in the electricity sector in Brazil is a consequence of the general concern with security of supply after the 2001 shortage. Brazilian voters believe that the government is responsible for security of supply (as most of the voters all over the world). However, in Brazil it is very difficult to ensure security of supply without government involvement in the planning for the sector. The most important problem about ensuring security of supply using only market incentives is the fact that marginal cost of expansion is increasing in Brazil. New generation capacity is much more expensive than the current installed capacity. Investors in new generation capacity face a huge market risk. If demand growth does not materialize, these investors are the first to be affected. Therefore, short-term competition is simply too risky for new investors in countries with increasing marginal cost for expansion.
To make new investments viable, long-term contracts are necessary. However, in a competitive market environment, long-term contracts involve serious market risks for the buyers (distribution companies and large users). The solution to make long-term contracts acceptable to distribution companies is to guarantee that they will be able to pass the cost to end-consumers. However, if this is allowed, without at the same time accurately estimating future demand, distribution companies have the incentive to contract for more generation capacity than they actually need (because they will be penalised if there is a shortage, but not if there is a surplus). To avoid this problem, distribution companies in the new electricity model will be responsible for estimating the amount of energy that they need to buy with long-term contracts in the pool. This is the most important role of planning in the new electricity model.

Note that it is not the Government who will be responsible for making demand projections, but the distribution companies. This is an important difference with traditional planning in the electricity sector. In addition, with this new scheme, if companies do not estimate accurately future demand, the consumers will not be the only to pay for the mistake. The companies will assume the consequences of any estimation error larger than 5%.

While demand planning is under the responsibility of distribution companies, a new planning institution (Empresa de Planejamento Energético) will be created to be in charge of the planning for the supply of power sector\(^{17}\). The EPE will receive the demand estimation from all distribution companies and will calculate amount of capacity that the Ministry of Mines and Energy will bid every year through the pool. Additionally, the EPE will make feasibility studies for the supply side. The EPE will suggest to the ministry the best technological option (share of hydro, gas-based and renewables) and a list of suggested projects to be offered in the bidding process in the pool. The EPE will also suggest to the Ministry projects to be considered strategic for the sector. Based on this information, the Ministry will suggest a list of mandatory projects to the CNPE\(^{18}\). Once being approved by the council, these projects will be bided with priority by the pool and this capacity cannot be replaced by other projects.

Concerning public planning for the supply side, there are indeed some risks related to the public planning. Based on the distribution companies’ demand projections, the EPE will make an indicative plan of the amount of capacity needed and propose a list of projects to be auctioned. The projects proposed by the EPE will benefit from already having an environmental license approved.

Two types of projects will be proposed by EPE. The strategic and non-estrategic projects

\(^{17}\) In fact, this planning institution will be in charge of planning activities in all energy sectors.

\(^{18}\) The National Energy Policy Council – CNPE is responsible for determining the main focus for national energy policy. Actually, according to the model proposed, the CNPE will make the political decision on what projects should be mandatory for technical, political and/or strategic reasons.
the cheapest option. If other projects proposed by the companies offer the same capacity for a cheaper tariff, they can replace projects proposed by EPE. Strategic project, on the other hand, can not be replaced by other cheaper projects. Therefore, public planning of contestable projects does not represent a big risk for the consumers. Nevertheless, given the existence of non-contestable projects there is room for bad planning. Therefore, as far as planning is concerned, there are some risks related to public planning in this model, but they are much less important than the risks of traditional public planning.

The New Institutional Arrangement

The only change in the established institutional arrangement of the electricity sector is the creation of the EPE and CMSE - monitoring committee for the electricity sector. The EPE will be responsible for long-term planning (10 and 20 year horizons) and will suggest a list of projects to be auctioned and their ceiling tariffs. The CMSE has the function a monitoring the power supply and demand in order to identify problems concerning security of supply. The CMSE will monitor the evolution of new projects. If any problem is identified, the CMSE will suggest mitigation measures to avoid energy shortage, such as special price conditions for new projects and reserve of generation capacity. The Ministry of Mines and Energy will host this committee.

It is important to mention that EPE will not have executive power. It will provide the Ministry with the necessary information to make important energy policy decisions. The CCEE (Electricity Commercialization Chamber) will manage the pools contracts. The CCEE will be organized using the staff and organization structure of the currently existing MAE (Wholesale Electricity Market), which will no longer be in operation. The ONS and ANEEL will keep most of their current responsibilities. ANEEL is currently responsible for organizing the auctions on the transmission segment and will do the same for the generation segment. The Ministry will be in charge of elaborating the energy policy, which will be presented and discussed by the CNPE, a multi-ministerial institution, that will legitimize politically the Ministry’s energy policy.
The new model of the Brazilian electricity sector was motivated not only by the shortcomings of the previous model, that resulted in low investment rate and contributed to the 2001 power shortage. But also by the difficulties faced by other liberalized electricity markets in ensuring security of supply (California, Ontario, New Zealand, etc). The experience of these countries showed that the decentralised institutional environment frequently was not able to create adequate economic incentives to induce the required investments in capacity expansion. Therefore, Brazilian energy authorities looked for a new type of institutional environment that would ensure investment in new generating capacity and security of supply. The new Brazilian electricity model is not meant as a step back to the experience of before the 1990s, but as an innovation building on the experience of the 1990s. The new institutional arrangement is the result of the need for the government to regain control over important variables for ensuring security of supply.

Brazilian new electricity model is inspired on the single-buyer model. This model was considered in the reform debate in several countries with a very concentrated electricity sector (for example, France, Mexico and Germany). Up to now, the single-buyer model was not adopted as the organizational model in any country (except for very small countries, e.g. one of the Central American countries and perhaps in Asia). The most important advantage of the single-buyer model is the reduction of the market risks for generators. The buyer, on the other hand, faces a lower market risk since it can aggregate all the supply and demand. Another important advantage is the fact that the electricity price is formed by the average cost of electricity acquisition by the single-buyer. This feature is very advantageous for electricity systems with increasing marginal cost of expansion. (There are experiences that show that in systems with increasing marginal cost of expansion, prices based on marginal costs will produce electricity price increases that consumers are not ready to pay for, with important political consequences – see Ontario).

The current Brazilian electricity model tries to make use of the advantages of the single buyer model (tariffs formed by the average cost and reduced risk for generators), while simultaneously maintaining the current institutional diversity. Instead of creating a public company to function as a single-buyer, it creates a pool. The pool allows the market risk to be divided between the agents instead of transferring all the risk to the public-owned single buyer. The disadvantage of the pool is the multiplication of companies’ interdependence: if one distribution company has financial problems, all generators will be affected, even though at a reduced level.

The new policy recognizes important changes in the international energy market. The reduction of liquidity in the international financial market, on the one hand, and the financial turbulence in the energy sector, on the other, have reduced companies’
propensity to invest in developing countries’ infrastructure. Important multinational power and gas companies are facing a difficult economic environment in their homeland. As a result, the available resources for investing in emerging energy markets have decreased.

It is important to mention that, contrary to the oil sector, multinational gas and electricity companies are a quite recent phenomena. These companies internationalized during the 1990s, together with the process of liberalization of these markets in the developed and developing countries. In the first half of the 1990s, these companies have competed for position in the fast growing energy markets. During the first period of market positioning, these companies were ready to accept risky projects to get access to these markets. However, once positioned, the companies become more risk averse.

Given the scarcity of resources for investing in countries like Brazil, reducing projects risks is essential to attract private capital. Operational competition in the electricity sector clearly increases risks for investments in the sector. In Brazil, this problem is intensified by the power sector specificities mentioned above: i) large share of hydro-generation capacity, making the level of power supply quite unstable; ii) economic instability in the country and the still high energy intensity of the economy, making the level of demand also unstable. The consequence of these two problems is price volatility and market risk. For this reason, investors in the new generation capacity in Brazil in the last five years require long-term contracts for going ahead with their projects. The perspective of market liberalization induces distribution companies to avoid buying long-term electricity contracts. Projects faced a difficult economic environment and the investments in the sector have been lower than necessary.

The new policy for the electricity sector directly tackles the main obstacle for investing in the electricity sector: the market and regulatory risk. By winning a long-term contract in the pool’s bidding process, the investor assures the price level for the electricity produced and thus the projects’ profitability. This mechanism can be very powerful for inducing new investments in the Brazilian electricity industry. The long-term contracts can mitigate risks and reduce the required return rate for investing in the sector.

Another important dimension of the new model in the electricity sector is the fact that the distribution companies are obliged to contract electricity in advance based on the expected demand. The coordination of the expansion of the electricity supply will help guarantee security of supply and avoid excess or lack of generation capacity. The imbalance in electricity supply/demand has been one of the main sources of financial crisis in the power sector internationally. Though no one wants to pay the costs of unused capacity in liberalized markets, huge price increases due to lack of capacity is socially unacceptable, driving government and regulators to interfere in the market during shortages. Coordination to avoid excess or shortage of capacity can improve the market environment, reducing instability.

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19 The end of operational competition can lower the risk for investments, however the price is the reduction of incentives for efficiency. An important point for further investigation is a detailed cost-benefit analysis of the new policy.
Even though the new model eliminates operational competition, companies will have to compete for investing in the generation and transmission segments. The competitive bidding of long-term contracts by the pool will reduce barriers-to-entry in Brazil’s electricity sector. Private companies will have the same opportunity as state-owned companies for disputing long-term contracts. It is also important to mention that private companies already positioned in Brazilian gas and electricity sector have no restrictions to sell all or a part of their participation.

Despite the fact that the auctions for investing in generation reduces barriers to entry, the lack of operational competition represents a risk of economic inefficiency. The only opportunity for guaranteeing competitive prices for the consumers is in the moment of the auction. Afterwards, the market cannot contest these contracts anymore. Of course, this type of market for electricity results in important risks for deviation of the competitive energy market. These risks will depend on the quality of the bidding rules, the number of competitors, and the government strategy to avoid companies’ anti-competitive behaviours.

It is important to mention that the approval of the new model does not solve all problems in the Brazilian electricity sector. The attractiveness of new investment will depend on the quality of complementary regulation as well as on the implementation of the model. As shown, the State has an important role in coordinating the sectors’ expansion. As government’s role in the sectors increases, so does the risk of regulatory failure. Therefore, it is very important to reinforce the Ministry of Energy and Mines’ technical capabilities, and avoid political interference in the new institutions to be created.

The approval of the new model for the electricity sector represents an important step to reduce regulatory and market risks for new investments in the power sector. Nevertheless, important questions are still open for regulation. The level of risks in the power and gas sector will depend on the quality of the complementary regulation referred to above. One of the most important questions is the transition between the old and new model. Rules for the transition will have to be carefully designed to allow current investments to be rewarded adequately. The investment capacity of companies positioned in Brazil’s electricity industry will depend on the profitability of investments already in place. In addition to the transition rules, the new model for the gas sector under discussion will have an important role in the attractiveness of investments in Brazil’s energy sector. Large gas reserves are available in Brazil and neighboring countries. Investing in gas-based generation represents the most important opportunity for monetizing these reserves in the region. The coherence between gas and electricity policies will be essential for taking advantages of the investment opportunities in the gas-based generation projects.

Another important question to be defined is how the regulated electricity market will effectively function. The new model for the electricity sector separates the market for old generation plants (plants built before 2000) and new plants. Since the marginal cost of expansion is much higher than the average costs of the old plants, the government decided to separate these markets in order to avoid bringing the price of all generation capacity to the marginal cost level. Remember that most of the old generation capacity
was being traded by the “initial contracts” that should expire by 2006. If this old capacity should be traded in the same market as the new capacity, prices would tend to reach the marginal cost of expansion. However, much of the cost difference between the old and new capacity is due to hydro rent. The government decided that this rent should not be appropriated by electricity producers but by the end-consumers. Therefore, by separating the two markets (old and new generation), the price of the old capacity should remain lower than the marginal cost of expansion.

The rules and operation of the regulated electricity market will be essential to avoid that the old electricity capacity cause delays in the projects for new generation plants. As mentioned before, the reduction of electricity demand has resulted in overcapacity. However, it is very important to avoid that contracts for new projects displace lower cost existing plants. Therefore, bidding for selling new and old capacity should be carefully planned to allow market balancing.

The rules concerning the contracts that will be offered by the pool have not yet been disclosed. These rules, together with the new regulatory framework for the electricity sector (dispatching rules, rules for calculating firm and interruptible capacity, transmission pricing, rules, etc) will be essential for determining how thermal generation will cohabit with the hydro-generation. The objective of the government is to have a certain share of thermal capacity in order to improve security of supply. How this will be promoted, it is not yet known, but what is sure is that thermal power plants cannot face all the hydrology risks.

5 - Conclusions and Recommendations

This paper has shown that an important reform process is underway in Brazil’s gas and electricity sectors. The main objective of this reform process is to boost investment in these sector, by reducing risks associated with the intrinsic market instability of Brazil’s power industry. Though the new model eliminates operational competition, there is still room for private investment in the sector. The changes in Brazilian electricity sector cannot be considered a rupture with international OECD practices. In fact, operational competition in the electricity sector is far from a consensus in the international market. Specialists diverge on the possibility of creating favorable market conditions for new investments in completely liberalized electricity markets (Banks, 2003 and Watts 2001).

The lack of consensus regarding the possibility of competitive markets to ensure long-term security of supply stems from the following. The attractiveness of investments depends on the competitiveness of the new projects. However, this competitiveness depends on the costs structure of the power sector. In some countries, new generation projects have much lower costs than the established generation capacity based on inefficient coal based or oil-based thermal power plants (UK, Argentina are good examples). However, the power sector in other countries is based on cheap nuclear or hydro-based generation capacity (France, Brazil, Canada, New Zealand and Norway are examples). In those countries, in general the new projects for electricity generation have

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20 Higher productivity of the old plants’ water reservoirs.
higher costs than the installed capacity. When the marginal cost of expansion tends to
grow the difficulty for implementing a free market for electricity is very important. Since
the new capacity tends to cost more than the installed capacity, new projects have
difficulties in getting PPA contracts. On the other hand, government tends to hesitate in
letting all electricity produced to be priced at the marginal costs level. The result is that
new investment tends to decrease and the reserve margin decreases, exposing the country
to high risk of power shortage.

Shortage in electricity supply drives government and regulators to interfere in the market.
However, ad-doc incentive measures to increase electricity supply tend to not consider
market mechanisms and to increase the risks of liberalized markets. Therefore, an
important condition for the success of liberalized market is to avoid temporary shortages.
This problem raises an important question for all countries that have liberalized their
electricity sector.

Electricity shortage, price volatility, financial turbulence and government interference has
been frequent in liberalized electricity market in developed countries. Some
countries/regions have liberalized the electricity markets and revised these policies after
investment/price crisis (California and Ontario, example). Ontario is a good example of
the difficulties in liberalizing electricity markets with increasing marginal costs. The
Ontario government liberalized the market to all consumers in May 2002. Electricity
prices increased 30% after liberalization due to a short market situation. The reserve
margin was not sufficient to cope with a hot summer, boosting electricity prices. Given
the political consequences of the electricity price increase, the government backed with
the liberalization process in November 2002, only 6 months later after the liberalization.
The government decided to cap the retail price below costs for about 50% of the market
until 2006. The conclusion we can draw from this case, is that a successful liberalization
in the electricity market depends on the impacts competition can have on prices. If prices
decrease, government can build the political support for going forward with the
liberalization process. On the contrary, price increase and volatility is not acceptable for
most of consumers given the essential character of the product. The difficulty of
liberalization is that the impact on prices do not depend only on the quality of the
competition rules, but on the cost structure of the electricity sector.

In Brazil, the long-run marginal cost is increasing, given the fact that BEI is hydro-based.
Therefore, distribution companies and free-consumers have no interest in contracting the
bulk of the electricity needed in spot markets knowing that this price tends to increase.
Price increases tend to create strong opposition to market liberalization. Another point to
be considered is the macro-economic instability of Brazilian economy. This instability is
already an important risk for investment in capital-intensive sectors such infrastructure. If
other risks have to be added, the energy price required to give an adequate reward to
private investment is simply not affordable for a developing country like Brazil.

Based on the questions analyzed above some recommendations can be made. The most
important point is that government should make explicit an energy policy contemplating
all energy sectors. As far as the power and gas energy sector is concerned, the most
important points to be clarified are:
- The role of private capital in the new investments;
- The role of gas-based generation in the expansion of the electricity sectors;
- The scope for competition in the gas sector.

Considering the fact that competition for new investments in the electricity sector is allowed, we assume that competition in the gas supply should be emphasized. Gas costs represent about 50% of the gas-based electricity generation and is the most important factor in price differentiation. Petrobras and international gas companies have a large volume of gas reserves in the region, and there is no room for significant price increases in Brazil. Therefore, it would be illogical to promote competition for new investments in the electricity sector and not allow competition in gas supply.

If the new market-oriented policy for the gas sector is accepted, two basic questions should be tacked in the gas sector: i) definition of the degree of liberalization in the end-market; ii) reduction of barriers-to-entry.

The liberalization of the end market is a condition for introducing competition in the gas supply. If all end-market is captive to the distribution companies, there is very little room for competition in the gas-supply. As shown, there are few gas distribution companies in Brazil (18 companies operating) and most of them are controlled by Petrobras. If large consumers, in particular gas-based power plants, are allowed to choose their gas suppliers, companies that hold gas reserves could dispute the end-market with Petrobras.

The reduction of the barriers-to-entry is another key point for inducing gas-to-gas competition. These barriers-to-entry are related to the slow pace of market expansion and Petrobras’s dominant market-power. Considering the pace of market expansion the following questions should be faced:

- Current gas prices should be reduced to boost gas competitiveness relative to other fuels. Given Petrobras’s dominant role in the market, temporary price-limits for gas prices should be considered. It is important to take into account the fact that Petrobras is also the dominant supplier of the fuels that compete with gas.
- Obstacles to new investment in transmission and distribution pipelines should be mitigated. PPP contracts can have an important role to make viable investments in strategic projects with a low rate of return (for example gas supply to markets located far from reserves)\(^{21}\). Credit obstacles for distribution companies should be reduced. It is important to reduce risks for transmission pipelines with territorial monopolies through concessions. Similarly, it is important to reduce the risks of shippers that buy transportation capacity in advance to make viable the financing of the pipeline.

- Finally, it is essential to reduce the obstacles for gas-based generation, since it represents 50% of the total potential gas market in Brazil. As mentioned, changes

\(^{21}\) Brazilian congress has approved the law nº 10.438/02 that authorizes the utilization of resources from the Energy Development Fund in order to subsidize projects bring natural gas to states with no gas supply until December 2002. The Energy Development Fund is financed by a tax on the electricity consumption. The fund is a tool for promoting the national energy policy.
in the operational rules of the electricity sector are important to improve the competitiveness of the gas-based power plants. Current electricity dispatching rules are unfavorable to these plants. In addition, important economic advantages of these plants for the electricity sector are not recognized: positive impacts on the transmission system and improvement in the security of supply.

As far as Petrobras dominant role is concerned, the new gas policy should make a clear decision on the expected industry structure. If the energy policy maintains the current industry structure, heavy-hand regulation should be implemented to reduce dominant player’s ability to discriminate against new gas suppliers. The implementation of effective unbundling in the gas sector is a necessary step. In addition, regulated third party access to the transmission and distribution network is essential.

In brief, this paper has shown that the reform process in Brazilian electricity and gas industry opens the way for a more coherent energy policy. If well implemented, the new model can help reduce the risks for new investments, preserving a central role for the private sector in the industry’s expansion. Nevertheless, we have made clear that fundamental decisions need to be made concerning the country’s energy policy. Only this will induce private companies to invest in the electricity and gas sectors.
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