

## Classifying Brazilian Energy Crisis and Its Mechanisms

[HERMANO, T.B.Q., UFF, thayanabqh@id.uff.br]

[HALLACK, M., PPGE-UFF, michellehallack@gmail.com]

[VAZQUEZ, M., PPGE-UFF, Miguel.vazquez.martinez@gmail.com]

### OVERVIEW

This study aims at defining the most used crisis management mechanisms for the electricity sector and discussing whether they have been applied to Brazilian energy sector recently. Firstly, we define crises and how it has been historically applied to the energy industry. This concept started focusing in geopolitical problems in the oil industry, however, in the last 30 years, electricity crises become a key issue, however, it is fuzzily defined. An electricity crisis may be very expensive, not just because of the energy sector costs itself, but also because of the costs that it may bring to the society (other industries and final consumers). Besides the financial costs, there are political costs that may raise, as electricity is perceived as a public service, a sense of crises impact negatively on the popular opinion. It explains why the policy makers avoid the most to declare a crisis.

This issue become a key in many energy policy documents and its dynamic (BORENSTEIN; BUSHNELL, 2000), however, electricity crisis definition and its management tools are scarcely covered in the literature. Notwithstanding, market players and policy makers only face the problem when they are forced to lead with it. Based on the most famous international examples of perceived electricity crises described by the literature, we propose an analytical framework to classify the elements of electricity crises and the mechanisms used to deal with them. We use this framework to analyze the Brazilian electricity sector's distortions and challenges (between 2013 and 2015) and the applied tools to deal with them.

Recently, there were controversies between researchers, industrial players and policy makers about how to classify the problems of the energy sector in Brazil and what should be the tools applied. Our framework contributes by structuring the debate about the meaning, the causes and the tools to deal with electricity crises.

### METHODOLOGY

We define a crisis based on infrastructure literature, and from this general framework, we focus on the electricity sector based on studies of the Californian, Chilean, and South African cases. We show that there are three central variables to describe electricity crisis: power shortage (associated with system reliability), energy shortage (associated with energy security) and pricing disequilibrium (associated with the firms' economic-financial equilibrium). Second, we describe and classify the mechanisms used to face perceived crises. We show that there is the short-term mechanism to avoid eminent disruption (physical or economic). The middle-term mechanism includes investment decisions, but does not change the industry structure. The long-term mechanism used to change industry structures and aims at avoiding new crises episode.

When analyzing the Brazilian case, we collected available data from 2001 (a declared energy crises), and between 2012 and 2016 (when there was a discussion about the energy crises perception). We analyze the physical security from the generation plants, the evolution of the installed capacity, demand growth, spot market trades, its prices, and the hydroelectric market's stocking water. We also analyze the mechanism adopted after the perceived crises in order to better understand how we could classify the challenge observed in Brazil and its consequences.

### EXPECTED RESULTS

It is difficult to identify the main element responsible for the crisis, because all three are intertwined. Nevertheless, we can highlight the main perception for each case studied.

Power shortage is the most visible face of the crisis. However, it can be associated with the lack of investments. When dealing with it, we can mention South African case. In 2008, Eskom, the state-owned energy company, declared a critical situation due to lack of spare capacity to meet peak demand (MAASDAM, 2008). The energy shortage can be illustrated by the Chilean case, when, in 1998, the country went through the worst drought of the century. Given its market composition based on hydroelectricity, this country suffered with energy shortages (WATTS; ARIZTIA, 2002). Furthermore, for the last category element, the price disequilibrium, we can mention the Californian case. The low hydrologic conditions, during the 2000's summer, the high demand, and the liberalization process (that allowed few companies detained large portion of the Californian market) enable to export energy of these significantly lower areas to other regions, which affected directly California. Therefore, California had to import energy from those regions (WOLAK, 2003).

To each case studied, we realized that the countries used some tool to overcome the crisis. Moreover, when analyzing the mechanisms, we were able to categorize it into three elements: short-term to avoid disruption, middle-term to overcome the critic situation, and long-term to avoid a new crisis. We observe that in the most cases the industries reforms follow a perceived system crisis. However, the process of learning about the crises

is not just the dynamic of industry reform but also the creation of an action plan to deal with this kind of situation faster. The potential of a crisis will always exist, however the cost associated with it depends on the answering capacity.

For instance, in the short-term, both South African's and Chilean's policy makers reduced the loads to prevent a total collapse of the energy system, while Californians forced a decrease of the market price by a stabilization plan to the gas rate. On the other hand, in the long-term to pull out from the crisis, in South Africa, there was a stimulation for the private investments on the power plant. Whereas, the Chileans invested in thermal generation while importing Argentina's gas. Then again, in California, the state became an activate participant in industry, as the elaborate a plan to protect the final consumers from volatile markets, increasing the supply plant and improving energy conservation in order to stabilize their electricity sector. An illustration to the long-term to avoid a new crisis mechanism can be observed in Chile where there was a changed its electric market laws to eliminate the limitation of compensation, and also created the Decree Rationing mechanism, an administrative approach to manage its exposure to shortage of medium-term fuel supply that may affect the power sector. In California, the long-term measure, besides the change of market design they also created an emergency response plan, so when this situation occurs again, they, now, should be able to have a faster response.

In Brazil's case, a variety of factors contributed to a critical situation of the electricity market, such as the adverse hydrologic conditions, which resulted in a significant reduction of the water storages, as well as the activation of more expensive power plants. Moreover, the utilities' concession renewals and the low supply at their annual auction collaborated to their financial exposure.

We show that even if there was not an important power shortage, there was a perceived menace of energy shortage. The simple comparison of physical security evolution from the generation plants, the installed capacity evolution, and the demand growth is inconclusive. However, since the utilities had not had enough supply (as they asked) in the annual auction, they should buy the missing energy from the spot market. It means that they were exposed to its prices. The peak pricing which was not immediately passed through to consumers caused an economic-financial disequilibrium in many firms (especially distribution companies selling energy for regulated consumer). Furthermore, the disequilibrium in the industry was aggravated by the government message to the costumers and investor by its imposition to renew the utilities concessions earlier.

Noticing the perceived water shortage, the thermal generation was more utilized than historically observed. In addition, the utilities had not had enough supply (as they asked) by the annual auction. Therefore, they had to resort the spot market. High thermal generation added to the raised demand caused a price growth. To avoid this situation, ANEEL determined a price cap. This mechanism follows the same principle of Californian case by avoiding a pricing disruption. Moreover, what concerns the power shortage, we could realize some new investments on the generation plant with different sources, besides the new kinds of auction for the utilities, like the emergency auctions (these are examples of long-term mechanism to deal with power shortage). To illustrate the long-term mechanism to avoid a new crisis, we can mention the tariff flags, which changes the price to the end customers by charging extra when the thermic plant is in action, giving them the right signalization about the generation costs through the tariff flags. Because of all the changes in this sector, such as the technological improvements and the participants' interactions, ANEEL and MME published a document to a systematic study to propose improvements to the current model with mechanisms that promote the expansion and efficient operation of the electricity system and effectively contribute to the low tariffs and full social integration.

## CONCLUSIONS

It is very important a more detailed definition of crisis, and its instruments. When analyzing the Brazilian case, using the three elements categorization of a crisis, it is hard to define if the country went through it. We only can say for sure that, in what concerns the second element, the price problem, the country had an electricity crisis. However, when analyzing the others elements, we cannot claim that that was, neither that that was not, a crisis in the sector.

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