



Electricity sector in Ecuador: An overview of the 2007–2017 decade

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ABSTRACT

The Ecuadorian electricity sector has undergone several changes during the past decade. The objective of this paper is twofold: a) to show how the Ecuadorian electricity sector has evolved from 2007 to 2017, and b) to discuss the relationship between energy policies and their impacts on electricity supply, management, tariffs, and the country's economy. Although oil remains as the main energy source and the leading driver for economic revenue, several hydropower projects have been built or are under construction intending in part to reduce the country's dependence on oil. The installed hydropower capacity in the country in 2017 is approximately 81% higher than in 2007 and it is expected that, by 2018, approximately 93% of the electricity will be produced from hydropower. Currently, biomass and biogas contribute with 1.8% of the total electricity generation, but only 0.6% of the electricity is produced in wind and solar farms. Adoption of smart grid technologies is key to transform the Ecuadorian electricity network and to positively impact the quality of the electricity supply. The future of the Ecuadorian electricity sector relies on the successful implementation of the new Organic Law of Public Service of Electricity and on external financing for new energy projects.

1. Introduction

Historically, the Ecuadorian electricity sector has undergone several changes on its management and operation model. These changes have heavily depended upon oil prices, since oil has been the major source of exports, and thus, a key source of revenue for the Ecuadorian State. For instance, during the oil price boom (2007–2014) the revenues of oil exports reached an average of 56% of the total exports of the country (BCE, 2017). Part of the oil profits have been invested on developing other energy areas, particularly the electricity sector.

The evolution of the electricity sector in Ecuador, from a management and operation point of view, can be divided into three periods: 1961–1999, 1999–2007, and 2007–2017. In the first and third periods, the Ecuadorian electric sector has been operated and controlled by public institutions owned by the State. The first period corresponded to a vertical model of state-owned monopoly, and the third one has been characterized by the existence of a regulated wholesale market model, where the vertical model was partially disintegrated but the influential role of the Ecuadorian State has remained intact. The period from 1999 to 2007, conversely, ended the State monopoly of the first period and established a liberalized wholesale market model. The history before 2007 and its description have been presented by Peláez-Samaniego and

colleagues in their study on the Ecuadorian energy sector (Peláez-Samaniego et al., 2007).

Since the left-wing political party Alianza País won the elections in 2007, Ecuador has taken a variety of political and economic steps, motivated in part by the necessity of embracing some social policies to reduce inequality in the country (IWGIA, 2008). Those steps have led to important changes in the Ecuadorian energy sector. Besides economic changes, the energy policies in the country have promoted the development of new hydroelectricity plants at different scales, which aim to reduce the dependence on oil and the onerous costs associated to thermoelectric generation. As a result, the matrix of electricity generation has been changing constantly since 2007. At the same time, new energy sources, including solar and wind, have been explored with the intent of diversifying the electricity generation mix (MEER, 2017a).

Table 1 shows the main differences between the characteristics of the Ecuadorian electricity sector in the period 1999–2007 and the period 2007–2017. These differences are analyzed in detail on the following sections. Every adjustment can be tied to shifts in the Ecuadorian energy policies. The objective of this paper is twofold: a) to show how the Ecuadorian electricity sector has evolved from 2007 to 2017, and, b) to discuss the relationship between the Ecuadorian new energy policies and their impacts on electricity supply, management, tariffs,

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Table 1

Characteristics of the Ecuadorian electricity sector in periods 1999–2007 and 2007–2017, Adapted from: (Peláez-Samaniego et al., 2007; CONELEC, 2009; ARCONEL, 2016a).

Features	Period 1999–2007	Period 2007–2017
Laws and regulations	Law of Regime of the Electricity Sector (LRSE), promulgated in 1996.	The LRSE (2007–2015) was amended. Later, the Organic Law of the Public Service of Electrical Energy (LOSPÉE) was promulgated in 2015.
Governing Structure	The electricity sector was integrated by CONELEC (in charge of regulating and controlling the electricity sector), CENACE (in charge of managing the commercial transactions of the Wholesale Electricity Market), as well as private and state-owned companies for generation, transmission and distribution of electricity.	The new governing structure is integrated mostly by State-owned institutions and companies: MEER [*] , ARCONEL, CENACE, public Corporations such as CELEC and CNEL and their business units (in charge of the generation and distribution of electricity), and a few private companies in charge of electricity generation.
State intervention	The State regulated and controlled the electricity sector.	The State administers, regulates, controls and manages the whole electricity sector (i.e., generation, transmission, and distribution). Regulated wholesale market.
Market model	Liberalized wholesale market.	Determined by ARCONEL (annually).
Electricity Prices	Determined in a “spot market”.	

* Nomenclature (all by their Spanish acronyms): CONELEC – National Electricity Council, ARCONEL – Electricity Regulation and Control Agency, CELEC – Electricity Corporation of Ecuador, CNEL – National Corporation of Electricity, MEER – Ministry of Electricity and Renewable Energy, CENACE – National Energy Control Center.

and the country's economy. In order to reach these goals, in [Section 2](#) we examine historical and socio-political factors that influenced the dissolution of the Law of Regime of the Electricity Sector (LRSE, for its acronym in Spanish), the main energy policy framework active until 2015, and that led to the establishment of the Organic Law of the Public Service of Electricity (LOSPÉE, for its acronym in Spanish). In [Section 3](#) we discuss and compare the current status of the electricity sector in Ecuador with the previous period. We also present a projection of the evolution of the power generation capacity until 2022. Finally, in [Section 4](#) we describe the current status of non-conventional renewable energies (NCRE) and Smart Grid (SG) initiatives in the country and a brief discussion on the driving forces that are encouraging the adoption of such initiatives is presented.

2. Evolution of the structure of the Ecuadorian electricity sector

2.1. Background

The promulgation of the LRSE in 1996, effective with amendments until 2015, did not provide a solid basis for establishing a liberalized wholesale market model in the electricity sector (CONELEC, 2007a). This law was part of a worldwide trend of commercial, economic and financial globalization, which focused on the liberalization of the market with the intention of privatizing public energy utilities by attracting private capital. According to the LRSE, the Ecuadorian State abandoned its planning role in the electricity sector and the new strategy was the promulgation of the Electrification National Plan. The belief that promoted this new Plan was that the market, through its own forces, principles and dynamism, would encourage new companies to invest in electricity generation. However, the results were not satisfactory in Ecuador due to both insufficient interest of new companies and lack of fresh capital (CONELEC, 2007a).

Other types of barriers were additionally identified since this model started operating. One of these barriers was the huge tariff deficit encountered in April 1999. The cost of electricity for end consumers at domestic, industrial and commercial level was up to 44% lower than the real electricity tariff of US\$ 8.24 cent/kWh (CONELEC, 2009). Due to that deficit, the country was forced to establish a monthly adjustment plan until the real was reached on October 1999. Nevertheless, the Ecuadorian economic crash of 1999 worsened this scenario, causing a strong tariff reduction to a minimum value of US\$ 2.5 cent/kWh. This tariff was maintained until May 2000, as seen in [Fig. 1](#). Since then, the electricity tariff was steadily increased throughout different readjustment plans, but it never reached the target (real) tariff, thus producing a critical financial situation on the electricity sector (CONELEC, 2009). The application of a real tariff was complex, especially due to the large asymmetries in the levels of income of the Ecuadorian population. Therefore, governments in the period 1997–2007 had chosen to establish tariffs that have been below the costs of production (especially

because electricity produced from thermopower plants is expensive), via subsidies to electricity. This deficit affected the cash flow of distribution companies, which were forced to accumulate huge debts to the wholesale electricity market (i.e., to the State, since most companies were State owned). Consequently, debt was the only available mechanism for distribution companies to recover economic resources for their operation (CONELEC, 2007b).

In addition to the tariffs problem, other barriers such as high levels of both technical and non-technical losses (23.4% in 2006), lack of recovery of debts from final electricity buyers (i.e., costumers) (67.3%), high dependence on the use of fossil fuels (450 million gallons/year), long drought periods (especially from 2004 to 2006), increasing dependence on electricity imports (up to 9.6%), as well as overload levels in facilities, were some of the causes that led the electric power system to an economic crisis (CONELEC, 2007b). [Fig. 2](#) summarizes the main factors that caused this crisis.

As a consequence of the urgency to solve the crisis in the electricity sector, a new paradigm was considered by the Ecuadorian State in 2007. This paradigm basically required the State to recover its planning role in new electricity generation projects in order to expand the electricity supply, as one of the tools to promote economic development. According to this new vision, the State would be in charge of developing and managing large-scale power plants by using part of the State budget or by promoting public-private partnerships. The MEER was created by Executive Decree No. 475, on July 2007, in order to strengthen the governing role of the State on the electricity sector and to diversify the energy mix (MEER, 2014a). The Electrification Master Plan (PME, for its acronym in Spanish) was required to be compulsory rather than indicative, and the CONELEC was the institution responsible of ensuring that this requirement was accomplished. Legally, these changes were possible after reforming the LRSE in 2006 (Ecuador, 2006). This reform helped the State to create and strengthen legal frameworks and to generate a new institutional structure. All these policies were supported by the first National Development Plan (2007–2010), as part of a national political transformation proposed by the Government (MICSE, 2016a). One of the first steps related to the electricity sector was the approval of the Constitutional Mandate No. 15 on July 23rd, 2008, by the National Constitutional Assembly. The most important guidelines of this Mandate (Ecuador, 2008a) were:

- A unique electricity tariff was established for each type of electricity consumer (i.e., residential, commercial, and industrial).
- The State would be the only institution in charge of investing in generation, transmission and distribution of electric utilities. The budget for this purpose will be included in the State's Annual Budget.
- The Ministry of Finances would be responsible of covering any difference between the unique tariff and the costs of generation, transmission and distribution.

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