

Title: A comparative analysis of renewable energy auctions in Latin America: design and results

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1. Overview: brief presentation of the topic including its background and potential significance

Sustainable energy development is currently one of the world's greatest challenges. In this context, the deployment of renewable energy plays a noteworthy role in securing the energy supply of the current and the next generations. In this context, renewable energy auctions are an increasingly popular tool for governments to procure renewable electricity at moderate costs. While more and more countries in Europe, Africa and Asia are recently adopting auctions as the main support policy, Latin America has an extensive history with adopting auction schemes for procuring both conventional and renewable electricity.

The region's vast experience and the many recent developments in renewable energy auctions place Latin America as one of the richest and most dynamic environments. Brazil and Peru are among the countries with the greatest experience in renewable energy auctions worldwide, while Mexico and Argentina have just organized their first renewable energy auctions in 2016. The Chilean and Brazilian auctions have been especially relevant for showing the competitiveness of renewable technologies against conventional energy in a technology neutral auction – and in particular, Chile's August 2016 represented an important milestone, setting a new low record for solar price: 29.1 US\$/MWh.

The present paper aims to shed light on the recent developments of auctions for procuring renewable energy in Latin America, on the specific design elements of the auction, how they fit the countries' energy policy objectives, and their results. The paper aims to gather the most relevant experiences in renewable energy procurement through auctions in Latin America and to compare mechanism designs and outcomes, drawing conclusions and lessons to be learned and providing a comprehensive reference for renewable energy auctions in Latin America.

2. Methodology: how the matter was addressed, what techniques were used

The article consists in two main parts: a qualitative analysis that compares the auction design in different countries, and a quantitative analysis that explains the auction results. The analysis is conducted for onshore wind and solar energy technologies. A horizontal approach will be adopted for analysing auctions in five countries: Brazil, Peru, Chile, Mexico and Argentina.

The qualitative analysis will be structured around three main auction categories: (i) Exclusive auctions, referring to auctions in which a certain demand has to be covered by renewable energy only, so that renewable technologies do not compete with conventional technologies (the case of auctions in Peru, Argentina and reserve auctions in Brazil); (ii) Incentivized auctions, in which there is partial competition between various technologies but in which renewable sources are given certain advantages when competing with conventional power in order to promote their development (the case of auctions in Mexico and new energy auctions in Brazil); (iii) True technology neutral auctions, where renewable energy technologies compete against conventional technology with no competitive advantage (the case of auctions in Chile).

The design choices for the auction process will be analysed given the context in which they were implemented and the auction's objectives. The criteria considered in analysing and comparing the auction designs are: the level of policy guidance, qualification requirements, the transparency of the whole process and its consistency with welfare maximisation, the risk allocated to investors. It is important to highlight that there is no "one-size-fits-all" formula for success, and each design

choice must take into account the country's specific characteristics, the policymakers' key goals and priorities, and how the various design elements interact with each other.

The quantitative analysis aims to shed light on the results of the auctions. The analysis is structured around three main results: (i) the level of competition in the auctions, (ii) the quantities contracted and (iii) prices. First-order factors such as CAPEX, capacity factors and cost of capital (including financing) are considered to analyse and compare prices among countries.

The analysis is based on the official auction documents published by the relevant institutions in each of the studies country (CMMESA in Argentina, ANEEL in Brazil, CDEC-SIC in Chile, Osinergmin in Peru, CENACE in Mexico). A financial model is used for the price analysis, to explain the main factors behind the price levels.

3. Expected results: Key findings

The paper aims to provide a comprehensive overview on the renewable energy diffusion policies, design and results in Latin America. A high correlation is found between the country's energy market context and objectives and how the auction is designed, as well as between the auction design and the auction results. In countries with high share of large hydro generation, for example, the integration of variable renewable energies such as solar and wind comes at less costs and security of supply concerns than in thermal based countries, and this aspect can be reflected in the auction design. We also seek to explain the biggest similarities and contrasts between countries with large experience in auctions (such as Peru, Brazil, and Chile) and in emerging markets for renewable auctions (such as Argentina and Mexico).

In our quantitative analysis, the low prices resulting from the auctions are mainly explained by technology advancements, very good wind and solar resources in Latin American countries, as well as a seemingly decreasing trend for the weighted average cost of capital (especially in Peru and Chile). An increase in the cost of capital is witnessed in the case of Brazil, chiefly explained by a recent decline in the availability of cheap public loans in the energy sector. Argentina has as well a higher than average cost of capital, which is attributed to its troubled electricity market history and a high perceived risk of investors. In most countries evaluated, renewable energy has reached grid parity, being already competitive with conventional energy.

4. Conclusions: Lessons learned and implications

Solar and wind power auctions have been carried out on a semi-regular basis in various countries in Latin America, recently reaching very low prices. Even though there is a general distrust that the equilibrium prices obtained from the auctions are in fact at a healthy level for continued investments in renewable energy, it is noteworthy that the lower price outcomes seem to be quite robust, as similar auction results were obtained in several countries, despite very different environments and auction schemes. Therefore, it seems increasingly unlikely that these results are merely an accident: rather, they reflect a real aspect of the current conjuncture.

Ultimately, Latin America is one of the regions with the richest experience in renewable energy procurement through auctions, with very dynamic and different environments, from very mature to emerging electricity markets, from more established to less stable economies, all blessed with very good wind and solar resources. Auctions are the main instrument used to procure renewable energy in the region, and this analysis provides a detailed outlook of this experience, from design to outcomes.