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# How to achieve full electrification: Lessons from Latin America

Albert Banal-Estañol[a,b], Joan Calzada[c,*], Jacint Jordana[a,d]

[a] Universitat Pompeu Fabra, Ramon Trias Fargas 25-27, 08005 Barcelona, Spain
[b] City University London, Department of Economics and Business, United Kingdom
[c] Department d' Economia, Universitat de Barcelona, Avinguda Diagonal 696, 08034 Barcelona, Spain
[d] Institut Barcelona d'Estudis Internacionals, Ramon Trias Fargas, 25-27, 08005 Barcelona, Spain

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ABSTRACT

Electricity coverage in Latin America has increased substantially in recent decades, rising from 50% of the population in 1970 to more than 95% in 2015. Growth, however, slowed in the 1990s as many countries experienced difficulties in extending their networks further, in particular to serve those living in isolated and rural areas. In spite of this, the process of electrification was not interrupted and at the beginning of the 2010s decade most countries in the region were able to provide access to electricity to almost all of their populations. In this paper, we examine the main strategies used in Latin America to increase coverage and argue that only a combination of policy efforts has made it possible to achieve the current situation. We also examine the remaining obstacles, at policy and institutional levels, to achieving full coverage.

## 1. Introduction

Around 95% of the population living in Latin America (LA) by 2012 enjoyed access to electricity (Fig. 1). This degree of coverage can be considered a success, given the low levels existing in some countries of the region already in 2000, when the UN Secretary-General's Advisory Group on Energy and Climate Change established the Millennium Development Goals (MDGs). Yet, the International Energy Agency (IEA) has calculated that still some 28 million people in LA remained without access to electricity in 2012, many of whom live in the rural areas of Haiti, Peru, Guatemala, Nicaragua, Argentina, Colombia, Bolivia and Honduras. Moreover, the high electrification levels throughout the region hide important differences in per capita consumption of the service. Thus, while consumption is high in Argentina, Uruguay, and Venezuela, for example, it is markedly lower in Bolivia, Nicaragua and Peru.

Most studies analyzing the factors that determine the electrification process of developing countries have focused on economic and geographic conditions. For example, Lipscomb et al. (2013) study the development effects of electrification in Brazil in the period 1960–2000 based on the geographic placement of hydropower plants. They show that placement depends on factors that are exogenous to the government and which can be predicted based on topographic characteristics, such as river gradient, water flow, and distance from the Amazon. However, electrification is also determined by demand characteristics, including concentration of industrial plants and population density. Wolfram et al. (2012) examined the patterns of electrification across the developing world and found that electrification is consistently correlated with GDP per capita. Other papers have stressed the importance of political institutions. Brown and Mobarak (2009) analyzed a group of 57 countries in the period 1973–1997 and showed that in poor countries democratization has meant an increase in the proportion of residential consumption of electricity in relation to that of industrial consumption. This suggests that democratic governments better reflect the preferences of the population and dedicate more resources and efforts to electrification. Wolfram et al. (2012), in contrast, fail to find a correlation between electrification and the level of democracy, and suggest that if China has been more successful than India in electrifying the country it is because the strong pressure of the government in China has facilitated infrastructure roll-out.

Differences in levels of electrification and consumption not only reflect disparities in geographic, economic and political conditions, but also point to the adoption of different policies and regulations aimed at reducing the electrification gap. Taking this into account, the objective of this paper is to provide an overview of the electrification policies implemented in LA in recent decades, a subject that has received very little attention in the literature. On the one hand, we examine the *universal access policies* that have been adopted in most LA countries to extend the coverage of the electricity to all national territories. These policies have mainly involved extending existing electric systems to densely populated areas and promoting renewable energies, such as solar panels and mini-grids, in areas that cannot benefit from scale

* Corresponding author.
*E-mail addresses:* albert.banalestanol@upf.edu (A. Banal-Estañol), calzada@ub.edu (J. Calzada), jacint.jordana@upf.edu (J. Jordana).

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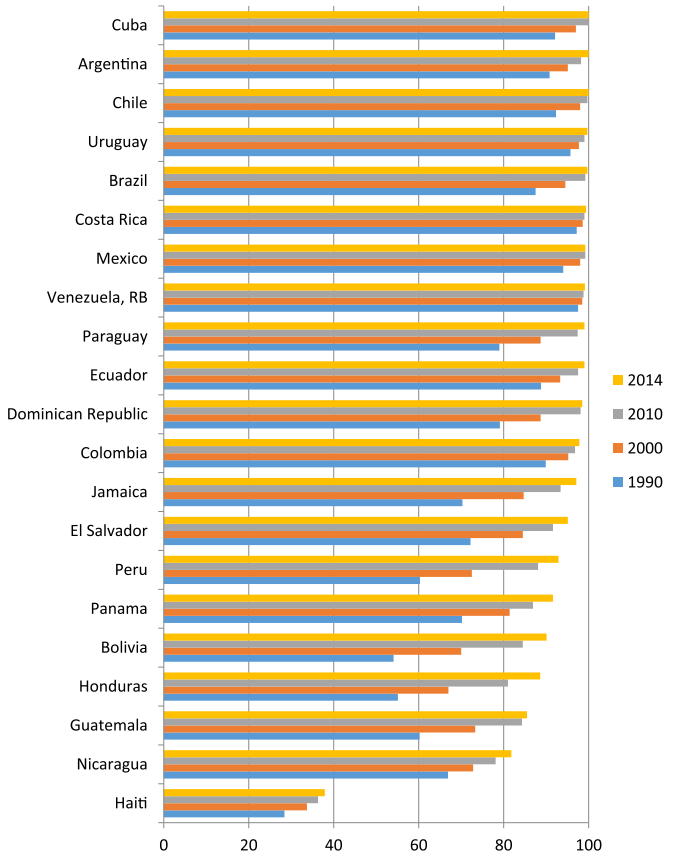


**Fig. 1.** Access to electricity in Latin America, 1990–2014 (%).
Source: World Bank Open Data (http://data.worldbank.org/).

economies. On the other hand, we explain the adoption of universal service policies, which aim to make electricity affordable and to promote its use by low-income households (living in poor rural communities or in the suburbs of large cities) that are connected to the service. Specifically, we explain the design and the effects of the subsidy schemes implemented by most LA countries to make consumption affordable, and discuss problems of territorially isolated communities.

Our paper proceeds as follows. Section 2 documents levels of electrification in LA. We show that most of the expansion of the service in the last couple of decades has taken place in urban areas, with current electrification rates rising above 95% of the population in most of the countries. However, there are also significant differences in the level of electricity consumption across countries, implying that access to the service does not guarantee its use. In Section 3, we describe the main features of the process of liberalization and privatization in LA in the 1990s. We report some of the mixed opinions held about the overall outcome of these reforms. Drawing on recent evidence in Balza et al. (2013), we also underscore the importance of the creation of regulatory frameworks and the establishment of independent agencies to supervise competition.

Sections 4 and 5 discuss the process of electrification in the rural areas of LA. We first introduce the stages in the evolution of the electrification programs of developing countries: namely, donor, market-oriented and participation paradigms (Martinot et al., 2002; Kruckenberg, 2015a, 2015b). We then describe the various business models adopted to promote the creation of energy markets, including the dealer, concessionary and the community-led models (Glemarec, 2012). Finally, we emphasize the role of off-grid technologies, such as solar panels and micro-grid systems, as essential mechanisms for completing the electrification process in rural areas.

Section 6 reviews the universal service policies that are used in LA countries to complement policies of electrification (Pantanali and Benavides, 2006; OLADE, 2013). Specifically, most countries use subsidy schemes that help low-income users meet their connection costs and the price of the service. We also report some of the difficulties of designing social subsidies that incentivize consumption by the poor.

Section 7 presents the case of Peru to illustrate some of the electrification policies implemented in LA. Peru's experience is especially interesting because it combines direct funding and regulatory innovations to stimulate private-sector participation as well as community involvement. In common with many other countries in LA, Peru's current coverage is very high in urban areas, but it has encountered many obstacles to completing the electrification of rural areas. Finally, the last section of the paper offers our main conclusions of the LA experience.

Needless to say, guaranteeing access to electricity for all is a key element of development.[1] In the rural areas of developing countries, the main application of electricity is for light and watching television, given that most households are too poor to be able to afford other appliances, such as fridges or heating (Nieuwenhout et al., 1998; Khandker et al., 2012, 2013). Many studies have identified the benefits of these applications for children's education, as a result of the increase in the number of study hours, the acquisition of knowledge attributable to television, and the increase in the number of hours that parents dedicate to their children (Asaduzzaman et al., 2010; Barkat et al., 2002; Barron and Torero, 2015). Electricity also allows households to spend more time on leisure and productive activities, as women tend to work more hours outside of the home while children can attend school more frequently (van de Walle et al., 2013; Khandker et al., 2009, 2013; Dinkelman, 2011). Likewise, electricity allows beneficiary households to increase their income and welfare, and to dedicate more time to non-agricultural activities (Grogan and Sadanand, 2013; Lipscomb et al., 2013; Chakravorty et al., 2014).

Increased access to light and electricity also contributes to improving communications and the diffusion of information in remote locations, which in turn helps reduce poverty (Beuermann et al., 2012). In communities with electricity, inhabitants can spend more time talking with their neighbors at night, acquiring more knowledge – for example, on health-related issues – and they can begin to plan the organization of collective service provisions. Electrification also has health-related benefits, reducing the use of biomass for cooking and moderating levels of household indoor pollution (Bruce et al., 2011). Indeed, pollutants emitted by solid fuels in inefficient cookstoves are a major factor in respiratory infections and infant mortality in LA.

## 2. Electrification rates in Latin America

Since the eighties, governments, international donors and cooperation agencies have actively worked to boost the electrification of LA. Most of the resulting increase in coverage, as experienced in countries such as Bolivia, Peru and Honduras (Fig. 1), has been generated in urban areas, where per capita income is higher, and the costs of expanding the grid are low. But electrification rates have remained low in rural areas, especially in Central America and the Andes. Indeed, more than 28 million people in LA remain without access to electricity, many of whom live in Haiti, Peru, Guatemala, Nicaragua, Argentina, Colombia, Bolivia and Honduras (Fig. 2). Low coverage levels can be explained by the poverty of the population and the geographic conditions of some regions, but also by delays in the introduction of electrification policies and their inappropriate designs. On the other hand, it should be stressed that service provision in many rural areas is inefficient and unreliable. This means that major investment is still

[1] Since the seminal work of Aschauer (1989), several studies have analyzed the impact of infrastructure on the growth of developing countries (Canning and Bennathan, 2000; Esfahani and Ramirez, 2003; Yeaple and Golub, 2007).