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Context analysis for a new regulatory model for electric utilities in Brazil

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HIGHLIGHTS

- Necessary changes in the Brazilian regulatory framework towards energy efficiency.
- How to incorporate demand side management, behavioral strategies, and smart grids.
- Proposition of a market for negawatts at public auctions.
- Measures to attain a more sustainable electricity distribution industry in Brazil.

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ABSTRACT

This article examines what would have to change in the Brazilian regulatory framework in order to make utilities profit from energy efficiency and the integration of resources, instead of doing so from traditional consumption growth, as it happens at present. We argue that the Brazilian integrated electric sector resembles a common-pool resources problem, and as such it should incorporate, in addition to the centralized operation for power dispatch already in place, demand side management, behavioral strategies, and smart grids, attained through a new business and regulatory model for utilities. The paper proposes several measures to attain a more sustainable and productive electricity distribution industry: decoupling revenues from volumetric sales through a fixed maximum load fee, which would completely offset current disincentives for energy efficiency; the creation of a market for negawatts (saved megawatts) using the current Brazilian mechanism of public auctions for the acquisition of wholesale energy; and the integration of technologies, especially through the growth of unregulated products and services. Through these measures, we believe that Brazil could improve both energy security and overall sustainability of its power sector in the long run.

1. Introduction

Since the end of the 19th century, electricity has been produced, transmitted and distributed mostly in the same way, i.e., from distant large scale generation power plants to end users located in concentrated areas. Despite major advances in technology, two constraints have prevented the core business of the electricity industry from experiencing major changes: the lack of economic viability for direct electricity storage and the consequent need for physical networks of conductors and other elements to deliver large amounts of electricity to consumers. Every time a light bulb is turned on, the whole system behind the outlet has to be instantly prepared to make up the additional demand. In most cases, this is the most efficient way of supplying electricity, but it also makes interconnectedness so valuable that the so-called "wires" segment of the industry, i.e., electric utilities, is considered a natural monopoly (Viscusi et al., 2005).

The good news is that even in the absence of any major expected breakthroughs in wireless transmission of electricity, new forms of indirect storage, like pumped storage hydropower, or compressed air and flywheels (Landry and Gagnon, 2015), advances in information technology and big data (Schuelke-Leech et al., 2015; Ma et al., 2010), and distributed generation (Cossent et al., 2009; Ackermann et al., 2001) have the combined potential to revolutionize the landscape of the industry in the next decade or two. As will be discussed in this paper, those tendencies could be used to redirect the utility business towards greater energy efficiency and increased integration of distributed resources, in

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addition to the criteria of reliability and universality that have guided the utility sector in the past.[1]

The question of energy efficiency has been tackled in many ways and for a long time, either through the setting of standards and incentives for the acquisition of more efficient appliances, or, to a much lesser extent, through utilities' strategies and business models. We think the latter might be more effective at the present moment because of the potentially large impact of the innovations mentioned above, but also the possibility of influencing consumer behavior towards less consumption growth in new ways, and the need for greater integration of renewable resources and new information technologies.

The renewed potential for energy efficiency improvements matters for important reasons. It is well understood and accepted by now that conventional and non-renewable energy consumption growth cannot continue unabated on our planet, not only in developed countries with high standards of living, but also in developing countries, which are increasingly running into resource and environmental limits (Dincer and Rosen, 2007). Fortunately, it is now plausible that with more efficiency in the use of electricity, mainly through behavioral changes and technology, economic growth can be decoupled from energy consumption growth. According to The Economist Magazine (Economist, 2015a) the decoupling might be already happening in some countries due to actions taken by regulators and also as a spontaneous consequence of advances in technology. As pointed out in the article, "in 2014 advanced industrialized countries used 0.9% less electricity than in 2013, and slightly less even than in 2007, since when their combined economies have grown by 6.3%."

From a regulatory and policy perspective, government intervention is increasingly accepted as a way to address not only market failures like natural monopoly, but noneconomic objectives as well (Dees, 1996), such as environmental and social responsibility or the public interest more generally. Therefore, regulation of energy prices should reflect not only economic welfare, but also incentives towards the much more subjective goal of inducing an "appropriate" behavior of consumers and utilities.

The value of this alternative approach is underscored by growing evidence from behavioral experiments (such as those described by Pollitt and Shaorshadze, 2011) showing that traditional regulatory policies can actually worsen social and environmental outcomes. As an example, when people are overcharged to discourage damage to the commons, they may feel less responsible for the commons and stop responding through a decrease in consumption, contrary to what the regulator sought. In addition, it is also increasingly clear that the more energy efficiency and energy conservation actions are taken by consumers, the more probable is the so-called "rebound effect" as consumers compensate for their "good behavior" by consuming more energy in other ways (Herring, 2006).

With regard to technology, the advances mentioned above may be forging a new business model paradigm for utilities, focused on energy efficiency, that will lead to a "creative destruction wave" for the industry. The business of electricity distribution faces increasing challenges, such as revenue losses, micro generation competition, the advent of economically viable electricity storage, and a great variety of information technologies applicable not only to the more intelligent use of appliances, but also to energy metering and control, that are shifting the core business of utilities from "pushing electricity" on to consumers, to helping consumers better manage their electricity needs (Economist, 2015b).

[1] For reasons of space and focus on regulatory aspects, we have left out further considerations about advances in energy storage. However, the regulatory and business models proposed in the remainder of the paper can easily incorporate energy storage too.

In the scenario of increasing social and environmental concerns with energy efficiency and new revolutionizing technologies, utilities and regulators have the choice to either stand still as passive observers, or to become active players in the development of a new business model that embraces and even spurs the new paradigm, while balancing economic efficiency and ethical issues more effectively. In this regard, (Lester and Hart, 2012) argue that the utilities of the 21st century should become "smart integrators", i.e., central actors in facilitating the growth and interaction of distributed generation, energy management services and technologies, and energy consumers.

Hence, the main questions addressed in this paper are relatively straightforward: How can utilities create economic value from energy efficiency and integration of resources in emerging countries like Brazil instead of doing so, as they do nowadays in many such countries, from energy consumption growth? What is the role of regulatory policy in making this transformation strong and lasting? We argue that demand side management, behavioral strategies, and smart grid technology, attained through a new business and regulatory model for utilities, provide valuable, if partial, answers to these questions for Brazil and potentially for many other countries. In doing so, our contribution is twofold: first, we show the importance of taking an integrated approach that considers rate design, the behavioral patterns of energy consumers, and technological advances, in inducing significant energy efficiency advances; and second, we show that energy efficiency is not only a matter for advanced countries, but can also play a very important role in emerging countries like Brazil.

The remainder of this paper is structured as follows. In Section 2, we introduce the basic aspects of the Brazilian power system, particularly the central role of large, cascading hydroelectric generators and the severe drought it has experienced since 2013, which together have highlighted the potential of energy efficiency to meet some of the country's growing energy needs. Sections 3 and 4 offer the theoretical underpinnings of the paper, first presenting key findings in behavioral economics regarding energy efficiency and consumer response, and then showing how a traditional price cap mechanism like Brazil's could be modified to eliminate disincentives for utilities to invest in energy efficiency. In Section 5, we apply these ideas to the Brazilian case, focusing on the potential to transform the prevailing utility business model into a dynamic, efficiency-oriented one that could provide some answers to the current challenges. Section 6 offers empirical evidence about the potential for energy efficiency in Brazil, and the final section concludes.

2. On a wing and a prayer

The southeast of Brazil, the most economically developed region in South America, with a population of 85 million people and nearly half of Brazil's GDP, has been facing (as of this writing) an unprecedented drought since 2013 (Escobar, 2015), which, combined with poor governance and lack of transparency in the public management of demand for both water and electricity, has put Brazil in a very challenging situation.

For the last ten years, an average of 87% of Brazil's electric energy has come from hydroelectric sources, followed by thermal generation (10%), nuclear (2%), and other sources (1%). After a severe power crisis in 2001 (Economist, 2002), partly caused also by a drought, Brazil's thermoelectric capacity has grown by over 160% since 2002, considerably increasing, apart from environmental impacts, the country's security of electricity supply. Despite the expansion of capacity, however, Brazil is facing again a very high risk of power rationing or localized power cuts, which could hamper even more the country's current economic woes.