Renewable and Sustainable Energy Reviews 54 (2016) 704–722

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

An overview of electricity prepayment experiences and the Brazilian new regulatory framework

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ARTICLE INFO

Article history:
Received 12 January 2015
Received in revised form
2 August 2015
Accepted 1 October 2015
Available online 11 November 2015

Keywords:
Electricity prepayment
Electricity meters
Vending systems
Electricity billing

ABSTRACT

Brazil recently established a new regulatory framework contemplating the use of prepayment methods by electricity distribution utilities. The assessment of the benefits and risks associated with the introduction of prepayment schemes in Brazil, both for users and electricity companies, requires understanding and evaluating the international experiences. Both developed and developing countries have relevant international experience on this matter, so confronting international experience with the Brazilian regulatory framework provides a relevant standpoint for the analysis of possible risks and bottlenecks of electricity prepayment in Brazil.

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1. Introduction

Providing "*electricity for all*" has been pursued by regulatory agencies and governments (stakeholders) all over the developing and developed world during the last decades, as a way to fulfill social and economic needs and also improve the population quality of life. These stakeholders have played an active role in the definition of policies and regulatory frameworks to foster the process and design solutions to facilitate the overall access to electricity. In recent years, the electricity sector has witnessed a significant share of innovations, ranging from technological developments to market design, also including the empowerment of consumers (or *prosumers*, i.e. simultaneously producers and consumers). New technologies in the realm of smart grids are currently being introduced at a faster pace, namely Advanced Smart Metering (AMI) solutions enabling bidirectional communication between users and suppliers, which lay the technological

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http://dx.doi.org/10.1016/j.rser.2015.10.002
1364-0321/

foundations for value-added energy services and the integrated optimization of energy resources (grid, loads, storage and microgeneration).

In this context prepayment systems gain an increased importance both for consumers and suppliers. Prepayment systems offers advantages not just for the users but also to the distribution and retail companies, because they lead to the reduction of operational costs, guarantee upfront firms' revenue, and enable the consumers doing better management and control of their electricity bills [1–4]. According to Khalid et al. [1] prepayment methods increase companies' revenue in approximately 20% in comparison with postpayment (credit) methods. However, some relevant concerns are at stake concerning the use of prepayment methods, because consumers unable to cope with their electricity costs tend to self-rationing below the comfort threshold or even self-disconnect [5–7].

In most international experiences, prepayment systems have been introduced to provide electricity mainly for fuel poor population, low income households, minorities and households with high debts on electricity bills, as well as to reduce theft [6,8,9]. Especially in African countries, prepayment systems were also a way to reach the population lacking electricity supply, mostly located on isolated and dispersed areas [4,6]. In these countries prepayment systems can be defined as the technology used to disseminate and promote electrification. The introduction of prepayment systems was one of the strategies to face the vast challenges to rural electrification in a group of small islands in the Pacific, in areas where the levels of energy poverty are comparable to the ones found on sub-Saharan countries [10].

The two pioneer countries testing and implementing prepayment systems and where the technology is nowadays significantly spread were the United Kingdom and South Africa. In United Kingdom, the first prepayment meters used coins in the slot systems and presently, after 45 years, almost 3.6 million consumers, i.e. about 14%, have prepaid meters with token technology installed at their households [11–13]. In South Africa, the prepayment system was introduced through the "*energy for all*" program, presently reaching out around 54% of its 7.3 million electricity customers. Other countries like United States, France, Northern Ireland, New Zealand, Australia, Ghana, Kenya, Rwanda, Mozambique, India and Argentina have already piloted or introduced prepayment systems as a billing option in some areas as well as created a regulatory framework. According to Villarreal et al. [7], there were in 2011 around 20 million prepaid metering services installed worldwide and it is expected that by 2017 this number would be around 34 million.

Each country has had its particular motivations and drivers for introducing prepayment systems, and therefore has faced different obstacles, problems and advantages. Moreover, each country had its target consumers and intrinsic objectives for stimulating the use of prepayment systems according to distinct development strategies. In some countries, like South Africa, Rwanda, Mozambique and India, it was a way to promote and disseminate electricity supply [1,14–16]; in other countries, like the United Kingdom, Australia, New Zeeland and Northern Ireland, the main objective was to reduce non-technical losses and revenue collecting problems, as well as give fuel poor households additional management tools to avoid high bills that they were not able to cope with, thus empowering the consumers [2,6,12,13,17] .

In Brazil, there is a growing interest on prepaid meters but the amount of prepayment systems installed is still incipient, and in most cases their deployment results from pilot or R&D projects. Even though Brazil still lags behind on the dissemination of prepayment systems, including technology development, regulatory authorities have made a substantial effort to build an environment favorable to develop and improve their use among the distribution companies, especially the ones with a high number of clients living on remote or isolated areas. During the last four years, work has been done to create a regulatory framework both for prepayment systems and smart metering, placing this topic under public discussion all over the country and stimulating/authorizing pilot and R&D projects. To make this effort more effective, it is crucial learning from the extensive international experience, analyzing and getting expertize to enable a successful penetration of this regulatory and technological innovation into the Brazilian power sector, also preventing or mitigating the occurrence of the same hindrances already experienced in other contexts.

In this context, the main purpose of this article is presenting and analyzing the most representative international experiences on prepayment systems, focusing on both qualitative and quantitative aspects, and then establishing the links with the ongoing Brazilian prepayment experience trying to focus on issues that might represent risks for their successful diffusion. The article is divided in four sections, besides the introduction in which the interest and motivation of the study were established. The second section briefly presents a typical prepayment system and its main components. The third section is dedicated to present and analyze international prepayment experiences, focusing on five main issues: the motivations for implementing the system, its main obstacles and bottlenecks as well as the advantages associated with the introduction of a prepayment option, the system technical characteristics and some examples of promotion mechanisms. The fourth section presents the efforts currently underway in Brazil to develop its prepayment model, from the regulatory, technical and R&D points of view. Based on the main insights provided by the third and fourth sections, the fifth section offers a set of proposals on how Brazil, or other country aiming to introduce prepayment systems, should address the challenges ahead while mitigating going through the same problems and barriers faced abroad.

2. Prepayment systems and its components

A prepayment system differs from a (credit) postpayment system mainly on the time lapse between the bill payment and electricity usage. In the postpayment system the consumer first uses the electricity, i.e. receives the "service", and later receives the bill to pay for its usage [18–20]. In the prepayment system the consumer first buys credits, i.e. pays for the electricity, and then can use it [18–20]. The postpayment billing is the traditional system and involves different staff from the distribution and/or retailer companies (meter readers, personnel to manage and deliver the bills, connect and disconnect consumers, and in some cases personnel to collect the bill). The prepayment system cuts off all those operational costs because there is no need to read meters, deliver bills or disconnect clients. Clients may exert better control of consumption according to their budget, but this system can put fuel poor users into burden, especially the ones with children, elderly and seriously ill people, increasing the risk of self-rationing below a well-being threshold or even self-disconnection [5,6,21]. Therefore, when introducing prepayment systems governmental stakeholders need to establish rules and protected consumer's rights. In most of the prepayment programs rules against disconnection during weekends, at night and during periods of intense heat or cold were implemented. Providing emergency credits can also work as a tool to protect consumer's rights.

A prepayment system generally consists of four main components: the electricity meter, vending points, a communication unit and a central server (Fig. 1).

The vending points are the locations and appliances where the users can buy credits. The central server is the component of the