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To regulate or not to regulate off-grid electricity access in developing countries

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HIGHLIGHTS

- Provides a critical analysis of regulation of off-grid electricity supply.
- Considers both product-based delivery and collective solutions and analyses the need for regulation.
- Finds that some form of regulation is required for collective solutions and suggests a light-handed approach.
- A number of regulatory issues and challenges are discussed as well.

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ABSTRACT

As off-grid electrification receives global attention in the Sustainable Energy for All initiative, the role of regulation for this alternative form of electricity delivery requires a careful investigation. This paper asks whether the activity has to be regulated or not. It then tries to find out where regulation can be used and what type of regulation is appropriate. It suggests that for product-type delivery options, there is no justification for regulatory intervention in the sense of utility regulation but such intervention makes sense in the case of mini-grid-based off-grid delivery options. The paper considers the pros and cons of a generic license waiver, a simplified regulatory arrangement and a full-fledged regulatory supervision and suggests that a light-handed approach is appropriate in general to promote the activities of the sub-sector but more formal approaches may be required if the players do not abide by the rules. The paper also highlights some regulatory challenges and issues.

1. Introduction

The Sustainable Energy for All initiative of the Secretary General of the United Nations (UN) in 2012 has crystallized the global attention on the energy access challenge. It is estimated that about 1.3 billion people in the world in 2010 did not have access to electricity and 2.6 billion did not have access to clean cooking energies (IEA, 2012). It was further suggested by IEA (2011) that the universal access to sustainable energy will not be achieved unless significant investment is targeted towards energy access provision. In its New Policy scenario the International Energy Agency (IEA) estimates that $15 billion per year will be invested between 2010 and 2030 to provide energy access, yet such a level of investment will not be sufficient to ensure energy access to all – by 2030, about 1 billion people will still lack access to electricity and 2.7 billion will not have access to cooking energies. IEA (2011) suggests that to achieve universal energy access by 2030 requires an annual investment of $48 billion, a five-fold increase in the investment compared to that in 2009.

The investment need for energy access is dependent on assumptions of technology choice but cooking energy provision tends to be less capital intensive than electricity access provision. Accordingly, IEA (2011) estimates that more than 90% of the investment will be targeted to electricity supply. Given that South Asia and Sub-Saharan Africa are the two prominent regions without energy access, the investment will have to flow to these regions. Sixty percent of the investment for electricity access will be needed in Sub-Saharan Africa. Although grid extension and off-grid/decentralized systems will be deployed, the share of decentralized solutions is likely to dominate. IEA (2011) suggests that 70% of the electricity access investment will go to off-grid applications, with a 63:35 split between local mini-grids and other off-grid solutions.

Given the potential for such a prominent role for off-grid applications in the future in poorer developing countries, the issue of developing proper regulatory arrangements for governing off-grid electrification or decentralized electrification becomes a central challenge. In order to enhance electrification through off-grid access systems, a properly defined business environment is an

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essential requirement, particularly when private participation is aimed at. The commercial viability of rural electricity supply and the issue of long-term sustainability of delivery systems are likely to be closely related to the regulatory choice. The regulatory arrangement has to be compatible with the existing institutional arrangements while it has to be flexible and appropriate for the chosen delivery mechanism. Moreover, the delivery mechanism can evolve over time and new delivery systems can emerge, while the possibility of inter-connecting the off-grid systems in the future or embedding them in the central grid system eventually cannot be overruled. The regulatory arrangement needs to allow for such an eventuality. Path dependencies of existing and new delivery systems, and their compatibility with the regulatory environment raise some concerns about their acceptance and effectiveness.

Despite its importance, it appears that the regulatory issues related to off-grid electrification have received limited attention. Bhattacharyya and Srivastava (2009) considered the regulatory challenges of rural electrification in the context of an Indian initiative but this was not specifically for off-grid electrification. Only Reiche et al. (2006) have considered the issue in some detail while ESMAP (2001) and World Bank (2008) provide some references to regulating these activities. But given that the off-grid electrification can take different delivery paths, organizational arrangements and ownership patterns, the literature has not clarified the role of regulation clearly and extensively.[1] The purpose of this paper is to bridge the gap by analyzing the role of regulation in off-grid electrification in developing countries. Accordingly, the paper aims to analyze the following questions:

(a) To regulate or not to regulate off-grid electrification is the primary question. Does decentralized electrification require regulatory supervision and if yes, what should be the purpose of such supervision?
(b) What should be regulated and how would the regulatory arrangement differ depending on the delivery system?
(c) What are the possible concerns or issues related to the effectiveness of the regulatory systems?

However, it needs to be highlighted that the economic, social and policy landscapes of countries facing electricity access problem are not homogeneous. Therefore, this paper aims to provide a broad, generic analysis without entering into the specific characteristics of each country, which is beyond the scope of the paper. However, it refers to relevant examples from South Asia and Sub-Saharan African experiences.

The paper is structured as follows: Section 2 presents a quick review of the energy access challenge and the role that off-grid electrification can play in mitigating the challenge; Section 3 highlights the business activities and alternative delivery mechanisms used in off-grid electrification; Section 4 considers whether to regulate or not and how while Section 5 raises regulatory challenges and issues. The final section provides brief concluding remarks and policy recommendations.

2. Energy access and off-grid electrification

According to IEA (2012), 1.27 billion people in the world did not have access to electricity in 2010 while 2.59 billion people did not have access to clean cooking energies. The access problem has a distinct regional dimension – Sub-Saharan Africa and Developing Asia are two distinct regions where the problem is acute. Five hundred and ninety million people in Sub-Saharan Africa lack access to electricity while 628 million in Developing Asia face the same problem (IEA, 2012). Similarly, 698 million people in Sub-Saharan African and 1.8 billion in Developing Asia do not have access to clean cooking energies. Near 100% electrification in China has significantly improved the electricity access figure in Developing Asia but the cooking energy challenge persists. The regional averages also mask the severity of the problem faced by many countries. For example, 92% of population of Uganda, 85% of Tanzania and DR Congo lacked electricity access in 2010. Similarly, 96% of Ethiopia and Uganda, 94% of Tanzania, 93% of DR Congo and 80% of Kenya's population did not have access to cooking energy in 2010 (IEA, 2012). Fig. 1 presents countries with large population without energy access.

Further, energy access is predominantly a rural problem. 1.1 billion (out of 1.3 billion or 85%) lacking electricity access are found in rural areas. Similarly, more than 2.1 billion (out of 2.6 billion or 81%) lacking clean cooking energy access reside in rural areas (IEA, 2012). This disparity is acute in low income countries in general and in Sub-Saharan Africa in particular. UNDP-WHO (2011) indicated that 87% and 89% of rural population of LDC and SS-Africa lack access to electricity respectively. Similarly, 97% and 95% of rural population of LDC and SS-Africa lack access to clean cooking energies in 2008 (UNDP-WHO, 2011).

In the case of electrification, grid extension has emerged as the preferred mode of electrification in all successful cases, although off-grid electrification has been used either as a temporary solution (a pre-electrification option) or as an inferior solution[2]. Off-grid solutions have been promoted where the grid has not reached or is unlikely to reach in the near future. According to World Bank (2008), portable 5–10 kW diesel generators are widely used as the conventional solutions. The solar photovoltaic systems (in local grid or in battery charging systems) and the Solar Home Systems (SHS) have emerged as the preferred off-grid technology for rural areas (IFC, 2007). IFC (2007) estimates that SHS has provided electricity access to between 0.5 and 1 million households in developing countries. REN21 (2011) also supports that the interest for off-grid technologies is growing in developing countries. The growing acknowledgment of off-grid as a cost-effective solution and the broadening of the focus to sustainable access and enhanced access have driven the growth of these technologies. It reports that a large number of solar lighting systems are operating throughout the world: more than 500,000 solar PV systems were in use in 2007 in Africa, more than 400,000 SHS were sold in China by 2008, more than 600,000 SHS and 800,000 solar lamps were in use in India by 2010, 125,000 SHS in Sri Lanka and 30,000 SHS in Bangladesh (REN21, 2011).

As mentioned in Section 1, off-grid electrification is likely to play even a bigger role in the future in the 2030 horizon if universal electricity access has to be achieved by then. This therefore calls for a better understanding of the business activities involved in this mode of supply, to which we turn next.

3. Business activities in off-grid electrification

Before the business activities are discussed, it is useful to define certain terms. Electricity has traditionally been supplied through a grid system which transported and delivered electricity from centralized power stations. However, with the emergence of new generation technologies, there has been a shift away from central stations. ESMAP (2001) defines the decentralized system as

[1] This excludes Bhattacharyya and Dow (2013) on which this paper is based.

[2] See Bhattacharyya (2013) for a detailed review of progress with rural electrification in the developing world.