Small systems, big targets: Power sector reforms and renewable energy in small systems

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There is some consensus that the traditional energy-only electricity markets, where prices are based on system marginal cost, cannot function efficiently with both fossil fuels and renewables, resulting in market disruptions and price volatility. Consequently, much effort has been focused on how to integrate these different resources in larger and mature electricity systems such as the use of capacity markets in addition to energy-only markets. This paper argues that the effectiveness of competition is limited by the size of an electricity system and there is a threshold size (and associated characteristics such as tropical locations, lack of access, and the prevalence of remote communities of consumers) below which competition will not produce the expected outcomes. This paper contributes to the policy discourse by discussing the reform of small electricity systems to integrate renewable energy via the means of three case studies: Nicaragua, El Salvador, and Australia’s Northern Territory. The paper concludes that electricity reforms and renewables can be complementary in small systems when supported by appropriate instruments and incentives. We draw policy lessons for other small systems that are pursuing a triad of objectives including electricity reform, large-scale renewables development and improving energy access.

1. Introduction

The global energy landscape and operating environment of the electricity supply industry (ESI) are undergoing a slow but certain transformation. The electricity sector is waking up to new disruptions occurring at the grid edge (Arriaga et al., 2017). Distributed energy, clean energy demand and technological progress are reshaping the traditional, centralized fossil fuel-based electricity systems, to accommodate variable renewables and other network-related loads (Sioshansi, 2017). The number of consumers becoming ‘prosumers’, either through improvements in energy efficiency, or through distributed energy resources, is also on the rise. These changes will become more pronounced as energy storage advances into a viable grid-based resource.

Falling wholesale energy prices at a time of rising generation costs, stagnant energy demand growth and growing penetration of renewable energy and other distributed energy resources are part of the transformation (Sioshansi, 2015). These transformations were not anticipated by policy-makers advocating market-based reforms in the early 1990s. The latter were largely motivated by the breakdown of the traditional economies of scale argument associated with vertical integration of the electricity supply industry, and the potential for competition to lower prices, encouraging innovation in generation and retail supply. “\textit{Competition where feasible, regulation where not}” was the overriding principle of market-based reforms (Newbery, 2002). Electricity sector restructuring, when coupled with effective regulation and competition, was expected to deliver significant consumer benefits when designed and implemented well (Joskow, 2003).

Policy attention of late has also focused on the suitability of electricity market reform carried under the ‘standard’ or prescriptive approach – the end result of which is market liberalization – for the integration of intermittent renewables. There is a growing concern that traditional energy-only electricity markets where price and investment signals are based on system marginal cost cannot function efficiently with both fossil fuels and renewables. The former have high marginal costs and the latter have zero marginal costs, potentially resulting in market disruptions and price volatility. Consequently, policy has focused on finding new ways to integrate renewables and fossil fuels...
through adopting competitive solutions (such as the use of capacity markets in addition to energy-only markets) (Sen et al., 2016).

A generic high-level reform of the ESI (the “standard approach” involves steps such as: corporatisation, vertical unbundling (separation)) and restructuring of the sector, introducing competition in the wholesale generation, horizontal separation of incumbents to create competition, establishing an independent regulatory authority, and privatisation of competitive segments of the ESI (Jamasb et al., 2017). The extent of vertical separation has varied across functional, accounting, legal, or ownership separation. Vertical separation was also expected to prevent cross-subsidization between competitive segments and regulated network businesses, and discriminatory behaviour such as denial of access to networks (Joskow, 1998). However, policymakers and scholars have not adequately addressed the central question of “what are the implications of a small electricity system on the effectiveness of market-oriented reforms?”

This paper argues that the effectiveness of reform and competition is limited by the size of an electricity system – in other words, there is a threshold size (and associated characteristics) under which competition by itself will not produce the expected outcomes, and for which distinct policy solutions are required to resolve the problems of scaling up and integrating renewables. Small and isolated systems have characteristics which imply that the economic rationale underpinning the reform of large electricity systems is not readily applicable to them, as the benefits from increased competition are limited. Yet, this has not deterred policymakers from attempting the “standard approach” to reforms in small systems, recently including, for instance, Australia’s Northern Territory electricity market (Nepal and Menezes, 2017). Simultaneously, many countries (or territories) with small systems have ambitious renewable energy targets, and in principle face similar policy problems as “larger” or more conventional electricity systems, although the drivers behind these targets are related to electricity access for remote communities rather than decarbonisation per se.

The absence of prior literature on electricity reforms which accounts for the issues of small systems implies limited scope for learning from previous experience from such systems. Yet they account for a small but important number of countries in the Asia Pacific, South East Asia and the Caribbean. These countries are particularly vulnerable to climate change, and their reform objectives have included market restructuring alongside improving access and scaling up renewables (Nepal and Jamasb, 2012a; Nepal and Menezes, 2017).

This study attempts to fill the gap in literature by reviewing policy experience in three small electricity systems: two of these – Nicaragua and El Salvador - have successfully integrated renewables to over 50% of generation within a few years. Based on these countries’ experience, we identify a number of practical policy solutions. We propose that a and El Salvador - have successfully integrated renewables to over 50%...
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