INSTITUTIONAL IMPEDIMENTS TO DISTRIBUTED ENERGY STORAGE IN THE AUSTRALIAN NATIONAL ELECTRICITY MARKET: AN ANALYTICAL FRAMEWORK

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Overview

The rapid development of distributed renewable energy systems and the pressures associated with increasingly variable energy demand in the Australian National Electricity Market (NEM) have highlighted the importance of more efficiently managing temporal and locational supply and demand balance throughout the electrical network. Potentially significant, industry-wide, economic benefits are available from employing distributed energy storage (DES) technologies to assist managing this variability over a range of temporal and spatial scales. These benefits are both quantifiable and technically feasible with current technology suites. The institutional complexities inherent with restructured electricity industries, however, mean that the mere presence of a discernible economic benefit does not necessarily make it viable, or indeed accessible to market participants. The central challenge remains the integration of such novel and potentially disruptive technologies in a way which maximises their societal benefit through appropriate incentives to key industry stakeholders who are appropriately 'ready, willing and able' to act.

Hitherto, the study of technology integration into electricity networks has largely focused on the description of technology pathways leading to paradigm shifts. A range of analytical frameworks have been applied to the industry in recent years, predominately adapted from different innovation systems theory streams. From this basis, models including institutional analysis have been developed to: identify broad policy challenges involved in renewable energy integration (Jacobsson and Johnson, 2000); consider socio-technical pathways to sustainable networks (Geels, 2004); and conduct strategic reform analysis (Dubois, 2009). In some cases these models have been further developed to assess the integration potential of renewable energy systems at the governance level (Spodniak and Viljainen, 2012). The difficulty with many of these models is that, although they are effective at engaging with the high level socio-political and governance structures, they are less effective at analysing the institutional processes internal to the industry (Hisschemöller et al., 2006; Coenen and Díaz López, 2010). While it is important to consider higher level dynamics, we argue that the synthesis of the underlying industrial complexities within a consolidated assessment tool is critical for this level of analysis.

Methods

In this paper we develop an institutional framework for the NEM with which to analyse the institutional impediments to DES diffusion. We begin by building on the decision making regimes proposed by Outhred (2007) by incorporating greater detail in the goverance regime, and explicitly considering social decision-making processes. We then apply these regimes to industry sub-sectors, defining the individual institutional arrangements for the NEM. This framework is then used as an analytical tool to identify specific institutional impediments effecting the diffusion of distributed storage technologies throughout the electricity supply chain with due regard to the large range of applications identified in previous work (Sue *et al.*, 2012). Finally, we briefly discuss the challenges for aggregation in the current institutional environment and the potential impact this has on the value proposition for DES.

Results

Our analysis identifies a raft of institutional arrangements within the National Electricity Market which currently constrain the diffusion of DES. These span the energy conversion chain and include factors such as: registration and connection rules, social expectations, the economic regulation regime, technical and informational asymmetries, and the process by which network security is maintained. These constraints impact the economic case for DES by undermining access to DES applications for potential market participants. We also conclude that, despite recent proposed reforms intended to facilitate spatial aggregation, such as the *Small Generation Aggregator Framework*, the scope for benefit-stream aggregation remains constrained by the current institutional regimes.

Conclusions

The NEM is undergoing rapid change driven by a range of factors including the increased wide-scale deployment of renewable energy systems, and increases in peak demand. As the management of temporal and locational supply-demand dynamics further emerges as a significant challenge, distributed energy storage is likely to have an increasingly important role to play within the network. The extent to which energy storage opportunities can be exploited, however, is constrained by the institutional environment in which the technology operates. This paper identifies specific institutional impediments to energy storage applications. Highlighting these challenges in a rigorous manner can inform policy makers and encourage focused reform to support economic and social objectives.

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