Energy Policy 62 (2013) 1031–1039

Contents lists available at ScienceDirect

Energy Policy

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

An assessment of market and policy barriers for demand response providing ancillary services in U.S. electricity markets

Peter Cappers [a,*], Jason MacDonald [a], Charles Goldman [a], Ookie Ma [b]

[a] Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, United States
[b] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Washington, DC, United States

HIGHLIGHTS

- We identify barriers keeping demand response from providing ancillary services.
- Institutional, financial and program provider business model barriers exist.
- Product definitions and rules do not always accommodate demand response well.
- Expected revenues are uncertain and may not exceed required investments costs.
- Regulatory compact and state statutes limit opportunities for program providers.

ARTICLE INFO

Article history:
Received 8 July 2013
Accepted 1 August 2013
Available online 20 August 2013

Keywords:
Demand response
Renewable integration
Ancillary services

ABSTRACT

An impact of increased variable renewable generation is the need for balancing authorities to procure more ancillary services. While demand response resources are technically capable of providing these services, current experience across the U.S. illustrates they are relatively minor players in most regions. Accessing demand response resources for ancillary services may require a number of changes to policies and common practices at multiple levels. Regional reliability councils must first define ancillary services such that demand response resources may provide them. Once the opportunity exists, balancing authorities define and promulgate rules that set the infrastructure investments and performance attributes of a resource wishing to provide such services. These rules also dictate expected revenue streams which reveal the cost effectiveness of these resources. The regulatory compact between utility and state regulators, along with other statutes and decisions by state policymakers, may impact the interest of demand response program providers to pursue these resources as ancillary service providers. This paper identifies within these broad categories specific market and policy barriers to demand response providing ancillary services in different wholesale and retail environments, with emphasis on smaller customers who must be aggregated through a program provider to meet minimum size requirements for wholesale transactions.

1. Introduction

The electricity grid requires various types of bulk power system services to maintain power quality, reliability, and security. Historically, grids designed around a few critical hours (e.g. meeting peak load) could be reasonably expected to be also capable of meeting the moment-by-moment balancing of load and generation under both normal operations and following contingency events. Increasing penetration of variable renewable generation in U.S. electricity markets, driven primarily by state-level renewable portfolio standard (RPS) policies (Wiser et al., 2010), means that system operators will need to manage more variability and uncertainty to continue to meet their charter. While power systems with high levels of variable generation do not need more capacity than is needed to meet peak load, the nature of that capacity and how it is operated may need to change (Hogan, 2012). Among these operational changes, there is a need to procure greater quantities of various bulk power system services (NERC, 2009), in particular more ancillary services (AS). AS are one way to value and compensate resources for providing the system flexibility needed to accommodate the sizable addition of these variable generation resources (see Table 1) and give the proper price signals to attract investment in the appropriate types of capacity.

Currently the various forms of AS (i.e., contingency reserves and regulation) are products which Balancing Authorities (BA)

* Corresponding author. Tel.: +1 315 637 0513.
E-mail address: PACappers@lbl.gov (P. Cappers).

0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.08.003

Table 1
Bulk power system operations affected by large-scale deployment of variable generation.

Bulk power system operations	Time scale				
	Procurement or schedule	Control signal	Advance notice of deployment	Duration of response	Frequency of response
Spinning reserves (Contingency)	Days to hours ahead	< 1 min	~1 min	~30 min	~20–200 times per year
Supplemental reserves (Contingency)	Days to hours ahead	< 10 min	~10–30 min	~Multiple hours	~20–200 times per year
Regulation reserves (Normal operation)	Days to hours ahead	~1 min to 10 min	None	< 10-min in one direction	Continuous

Adapted from Cappers et al. (2012).

have traditionally procured exclusively from generators. But recently, alternative resources like demand response (DR) have become increasingly capable of providing such bulk power system services. Conceptual studies have argued that certain forms of DR resources are ideally suited to provide AS to the grid due in part to their fast response, distributed nature and the statistical reliability of large numbers of smaller resources (e.g., Kirby, 2007; Callaway, 2009; NERC, 2009). These resources may be able to provide these bulk power system services cheaper, more efficiently, and with a smaller carbon footprint than conventional generation resources (Wellinghoff, 2009), and can potentially be brought to market quicker than new generation as they do not have to go through lengthy permitting, siting and regulatory approval processes.[1] A number of studies have examined the technical capabilities of loads to provide AS including the suitability of specific end-uses (Samad and Kiliccote, 2012; Bode et al., 2013), their resource potential (Ning, 2012), controls strategies (Hovgaard et al., 2012; Lu and Zhang, 2012; Mathieu et al., 2013), their measurement and visibility (Sullivan et al., 2013), and strategies for integration into competitive markets (Walawalkar et al., 2010; Chen and Li, 2011; Navid and Rosenwald, 2012). Additionally, limited field tests of DR resources providing various forms of AS (Kirby and Kueck, 2003; Todd et al., 2008; Kiliccote et al., 2009; Eto et al., 2012) have verified their technical capability.

However, while DR resources can technically provide these services, current experience across the U.S. reveals they are relatively minor players in most jurisdictions. As such, identification of barriers to DR participation as an AS provider and the entities responsible for addressing them is important at both the wholesale and retail level for DR resources to achieve their true potential. Much of the research on barriers to DR has focused on its integration into energy and capacity markets (FERC, 2009) and often focused on the implementation of dynamic retail tariffs (Centolella, 2010). Although some barriers that hinder DR from providing AS have been identified and subsequently addressed (e.g., Kirby, 2006; FERC, 2008, 2009, 2011a, 2011b; Cappers et al., 2012), a comprehensive assessment of remaining barriers could help the electric industry identify the entities most capable of undertaking the necessary actions so that DR resources are more likely to achieve their full potential to provide ancillary services that help facilitate integration of variable generation.

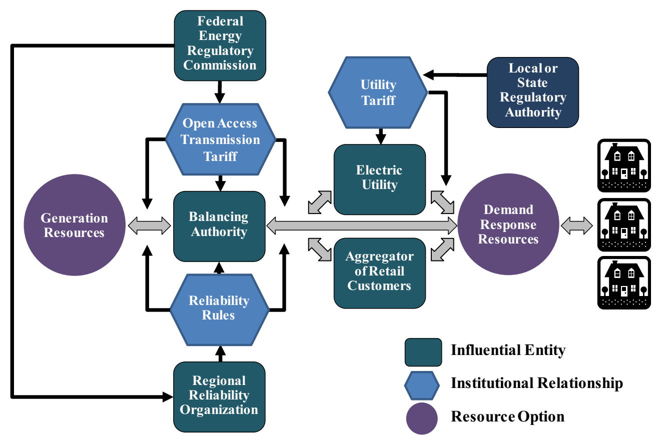

Fig. 1. Entities and organizations that influence relationships between resources and the bulk power system.

The present study begins to fill this void through a comprehensive examination of various market and policy barriers to DR providing AS, especially at the program provider level, in regions of the country with organized wholesale markets operated by independent system operators or regional transmission organizations (ISO/RTO regions) as well as regions without them (i.e., non-ISO/RTO regions). We focus on smaller customers that must rely on a program provider (i.e., electric investor owned utility or IOU and aggregator of retail customers or ARC) to create an aggregated DR resource in order to bring AS to the BA.[2] The paper is organized as follows. First, a general description of U.S. electricity market environments is presented, followed by a proposed typology for the assessment of barriers to DR participation in AS, including interactions between wholesale and retail electricity markets, institutional players, and regulators. That framework is used to organize the subsequent discussion of individual barriers.

[1] ISO-NE was concerned that new generation and transmission projects in the southwest corner of Connecticut would not be built fast enough to avoid regional reliability problems in 2004-2006. In response, ISO-NE issued a request for proposals in 2003 to acquire up to 300 MW of "quick-start" capacity resources, including demand response, located in that area for a four-year contract term (Powers, 2003). Based on the responses to the RFP, ISO-NE selected a combination of demand response, conservation and emergency generation resources (Yoshimura, 2005).

[2] Large customers (e.g., aluminum smelting) in most ISO/RTO environments can and sometimes do currently participate directly in the market as an ancillary service provider. As such, the barriers they faced bringing their capabilities to the bulk power system are somewhat different than those of smaller customers (e.g., retail office buildings) who must go through a program provider (i.e., IOU, ARC). For example, large customers usually have the requisite interval metering already installed, can provide load reductions that meet minimum size requirements, and can more readily afford to invest in the necessary telemetry requirements. As such, we are focusing in this study on the barriers standing in the way of BAs gaining access to smaller DR resources, as this is the group of customers that is still largely untapped. Many of the barriers listed here do still apply to larger electricity customers willing and able to go directly to the BA, but specifying where and explaining why this is or is not the case is beyond the scope of this paper.