



How to engage consumers in demand response: A contract perspective[☆]



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ABSTRACT

Nowadays, the European electricity systems are evolving towards a generation mix that is more decentralised, less predictable and less flexible to operate. In this context, additional flexibility is expected to be provided by the demand side. Thus, how to engage consumers to participate in demand response is becoming a pressing issue. In this paper, we provide an analytical framework to assess consumers' potential and willingness to participate in active demand response from a contract perspective. On that basis, we present policy recommendations to empower and protect consumers in their shift to active demand response participants.

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1. Introduction

Traditionally, electricity systems are operated on the basis that the supply is adjusted to follow the load in real time, meaning that the flexibility to maintain balance between electric power supply and demand is mostly provided by the generation side, which is dominated by centralised, large-scale, flexibly dispatchable (fossil fuel and hydro based) power plants. Nowadays, the European electricity systems are evolving towards a generation mix that is more decentralised, less predictable and less flexible to operate due to the massive integration of renewable and distributed energy sources in order to meet the 20–20–20 targets (EC, 2009a, 2010c). To enable the large-scale integration of these renewables in order to advance the decarbonising of electricity systems without endangering the security of supply, additional flexibility is expected to be provided by the demand side through demand response programmes.

Indeed, demand response is a tool to reduce or postpone other costly investments in network reinforcement and in new flexible

fossil fuel based or nuclear generation by shifting demand to times when there is more renewable power available, making (local) balancing easier and reducing overall system costs (De Jonghe et al., 2012; Dietrich et al., 2012; Moura and de Almeida, 2010; Redpoint Energy and Element Energy, 2012; Stadler, 2008). Its value and necessity as a flexibility means has been widely recognised by policy makers in Europe (EC, 2007a, 2010a, 2011a, 2011b, 2012a, 2012b; ENTSO-E, 2012b; ETP SmartGrids, 2012).

In view of this value, there is a massive body of knowledge emerging on smart grids and demand response, both in the academic literature and within the industry.

First, much research is driven by the availability of smart technologies (Smart-A, 2008, 2009b; Sustainability First, 2012a, 2012b; 2012c). Indeed, a recent survey of pilot studies on demand response demonstrates that smart appliances and enabling infrastructure significantly improve the responsiveness of consumers to dynamic price signals (Faruqui et al., 2013). However, two main challenges remain for the deployment of this 'hardware': what is 'smart' technology and how does it get deployed? On the one hand, there is still a lack of standardisation with regard to what this technology should be capable of, as the minimum functionalities of smart meters and smart appliances and the interoperability standards are still under discussion (EC, 2009b, 2010d, 2011c, 2012c). On the other hand, there is a chicken-and-egg problem with regard to deployment of this smart technology: without the infrastructure,

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smart appliances and demand response cannot be used to their expected potential by the consumers and without demand response through smart appliances, the limited benefits of the enabling infrastructure do not justify the costs of its roll-out (EA Technology, 2011; ETP SmartGrids, 2011; Smart-A, 2009a). The deployment of this hardware is then a process with different speeds across Europe (EC, 2012d).

Second, even if the technology challenges are adequately dealt with, there is an issue of split incentives for the different actors along the value chain (Consumer Focus, 2013a). As a result, there is lively debate within the industry on the role of different incumbent and emergent¹ actors in the organisation of smart grids and demand response (e.g. CEER, 2011a; Ruester et al., 2013b; Smart Grids Task Force, 2013).

Besides the technical hurdles and the challenges with regard to the roles of different market players, there is still a third challenge to be resolved to get demand response to take-off: how to activate the consumers. Recent research on consumer price elasticity shows that the demand side, especially the residential and small and medium-sized enterprise (SME) consumers, is not very active nowadays, even when retail price variation through time of use tariffs is present (e.g. Allcott, 2011; Lijesen, 2007; Torriti, 2012). Pilot studies on smart grids do find indications that consumers respond to prices (e.g. CER, 2011; Faruqi and Sergici, 2010; Faruqi et al., 2013; Ivanov et al., 2013; Stromback et al., 2011), but the results of these studies cannot be generalised because of the experiment design or the often limited sample sizes. Yet, consumers making the transition towards activeness are key to the future role of the demand side as a source of flexibility for the electricity system (Bradley et al., 2013). It has been pointed out, e.g. by Olmos et al. (2011), Stromback et al. (2011), Cappers et al. (2012) or Gyamfia and Krumdieck (2012), that the potential of smart meters and smart appliances is significantly limited if the consumer is not engaged to use them. Eurelectric (2011) also expects consumers to be able to manage and adjust their electricity consumption in response to real-time information and changing price signals. The aforementioned literature clearly recognises the importance of active consumers for demand response; there is, however, limited understanding on how to effectively activate consumers to participate in demand response. Lewis et al. (2012) and Delmas et al. (2013) consider that engaging consumers to make the transition from passive to active can be considered a major challenge for successful demand response take-off. Dulleck and Kaufmann (2004) demonstrated that providing customers with more information can affect electricity demand in the long run but not in the short run. Vassileva et al. (2012) point out that to help consumers make better decisions by providing feedback on their energy consumption, a good understanding of consumers is needed in terms of their personal preferences with regard to how to receive this feedback, e.g. consumers without internet want a non-electronic means of communication. This need for understanding consumers is further demonstrated in the empirical work on consumers' selection of tariff programmes by Dutschke and Paetz (2013), who find that consumers prefer simplicity over dynamic programmes and that automation is a (necessary but insufficient) prerequisite for consumer participation in demand response. A comprehensive understanding of consumers' motives to become active demand response participants is thus required. Measures to engage and empower consumers should be based on such understanding.

Therefore, this paper investigates how to engage and empower consumers, in particular small consumers connected to the distribution grid (residential and SME consumers) – including consumers who have self-generation (so-called 'prosumers'), to shift towards active demand response participants. The focus is given to small consumers because industrial consumers, given their size and skills, and facing less market barriers and transaction costs than small consumers, already have the possibility to be active today if they want to; even if industrial demand response is often still limited (Hopper et al., 2006; Sustainability First, 2012c), on the one hand. On the other hand, in the decentralising electricity system, flexibility is needed at a much more local level than in the past; the many small consumers connected to the distribution together make up a large potential for flexibility (ETP SmartGrids, 2011).

The paper adopts a consumer-centred approach, which means that we do not relate consumers' responsiveness only to the potential of financial incentives, as is often the case in pilot studies – but explore a wider set of costs and benefits that consumers would be exposed to from the perspective of contracts and demand response intermediaries. Our analysis reveals the importance of contracts in promoting consumers' participation in active demand response. It is shown that the diversity of contract types as well as of intermediaries is vital if the active demand response is to take off to the benefit of consumers.

This paper is then organised as follows: in Section 2, we focus on the demand response contracts through which consumers are likely to participate in demand response, how these contracts interact with different types of consumers, and how consumers can be empowered to manage the contract selection process. Next, in Section 3, we examine the role of the intermediaries that consumers sign this contract with, how this intermediary affects consumers' engagement to participate in demand response, and how negative effects for consumers can be limited or avoided. The paper ends with a discussion of the presented recommendations and conclusions on how to engage and empower consumers to make the transition to active participation in demand response.

2. Interaction between contracts and consumers

Residential and SME consumers will participate in demand response through dedicated 'demand response contracts' that are, in principle, distinct from 'electricity supply contracts'. An electricity supply contract arranges the provision of electric power to a consumer by an electricity supplier. A demand response contract, on the other hand, governs the relationship between the consumer, who adapts his consumption in response to a signal, and the demand response intermediary, who is the counterparty that provides this signal.² This distinction is necessary, first, to focus on demand response, regardless of whether it is offered separately from or included in a supply contract. Second, in many countries, emerging market players are effectively proposing stand-alone demand response contracts to consumers, providing an alternative to the demand response contracts offered by incumbent suppliers. Hence, our analytical distinction does not necessarily imply that consumers participating in demand response have to manage two separate contracts; they could be merged into one contract.

In this section, we first present a categorisation of contracts according to their technical features and the high levels terms they impose on consumers. Then, by investigating consumer load mix and consumer preferences, we demonstrate the necessity of having

¹ The incumbent actors encompass TSOs, DSOs and suppliers; emergent actors include e.g. aggregators, manufacturers of appliances and devices, retailers in sectors other than electricity or ICT companies.

² By convention in this paper, when 'contract' is mentioned, we refer to a demand response contract. Whenever we refer to an electricity supply contract, this will be done explicitly as 'supply contract'.

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