



Department for
Business, Energy
& Industrial Strategy

REALISING THE POTENTIAL OF DEMAND-SIDE RESPONSE TO 2025

A focus on Small Energy Users
Executive Summary



November 2017

This document is available in large print, audio and braille on request. Please email enquiries@beis.gov.uk with the version you require.

Acknowledgements

This report was prepared by a team comprised of E4tech staff working closely with specialists from several academic organisations:

Adam Chase (*E4tech*), Dr. Rob Gross (*Imperial College*),
Dr. Phil Heptonstall (*Imperial College*), Dr. Malte Jansen (*E4tech*),
Michael Kenefick (*E4tech*), Bryony Parrish (*University of Sussex*), Paul Robson (*E4tech*)

In addition to review by BEIS' quality assurance panel, the work was independently reviewed by a separate Expert Group:

Prof. David Hart (*E4tech*)

Prof. Nick Pidgeon (*Cardiff University*)

Prof. Steve Sorrell (*University of Sussex*)

© Crown copyright 2017

You may re-use this information (not including logos) free of charge in any format or medium, under the terms of the Open Government Licence.

To view this licence, visit www.nationalarchives.gov.uk/doc/open-government-licence/version/3/ or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: psi@nationalarchives.gsi.gov.uk.

Any enquiries regarding this publication should be sent to us at: smartenergy@beis.gov.uk.

This publication is available for download at www.gov.uk/government/publications.

Executive Summary

Background

The Department for Business, Energy & Industrial Strategy (BEIS) commissioned this study to improve the evidence base on the potential of small-scale demand-side response (DSR) for Great Britain (GB) to 2025, to inform policy development targeted at a smarter energy system.

The research uses an evidence review (a Rapid Evidence Assessment (REA)) and country case studies, both covering four research areas: policy interventions, business strategies, DSR products and services, and consumer engagement and participation. It contributes to the evidence base by synthesising (primarily international) information on enablers, barriers and how small-scale DSR has developed in other contexts. It then draws out findings and conclusions against research questions (below), and suggests potential implications for future deployment in GB. It is acknowledged that the GB energy system is changing, with the transition to a smarter energy system and the potential decarbonisation of heat and transport through electrification, for example. The report therefore does not provide a prescriptive set of conditions to realise the potential of small-scale DSR in GB, rather it is intended to provide additional evidence to inform policy decisions, innovation support and wider industry decisions relating to DSR.

Research scope and questions

Research area	Research questions
Policy intervention	What is the role of policy in promoting DSR from smaller users, what has worked and why?
Business strategies	What novel business models are being used to access DSR from smaller users, have they worked and why?
DSR products & services	What DSR products and services have been used internationally to secure demand response from smaller consumers?
Consumer engagement & participation	What are the key factors affecting consumer engagement in terms of: recruitment, level of response and persistence?

Methodology

The REA was conducted in accordance with Government Social Research guidelines, examining published literature across the four research areas from the UK, Europe, North America, and Australia and New Zealand. A total of 60 studies were included, of which 56 dealt with residential DSR and 4 with small and medium-sized enterprises (SME) DSR.

The five in-depth case studies (Texas, Illinois, Finland, Germany and Norway) were selected on the basis of interest and relevance to the GB context, as well as representing a spectrum of maturity in small-scale DSR. They were based on 25 interviews with market actors and experts, and document analysis.

The complementary findings from both the REA and case studies were then brought together to address each research question and reach conclusions about the potential for small-scale DSR. From these conclusions the researchers derived potential implications for GB.

Findings

1) Policy interventions

What is the role of policy in promoting DSR from smaller users, what has worked and why?

Historically, the role for policy was in enabling on the part of regulators and system operators to impose mandatory DSR upon utilities, generally in the form of static time-of-use or critical peak pricing/rebates. The evidence demonstrates that small-scale DSR has required policy support, in the absence of which promotion and uptake would likely have been low. Positive examples of a wide range of policy interventions to promote small-scale DSR were identified in the research, including:

- Policies to support smart metering roll out
- Standards for smart appliances
- DSR product definition programmes – programmes that are specifically designed for DSR and enable end-users to receive payments for changing demand during time of high prices, capacity shortages or other times of system stress (sometimes referred to as economic and emergency DSR)
- DNO price control frameworks
- Mandating retail suppliers to offer time varying tariffs
- Mandating DNOs to account for demand-side management in network planning
- Mandating system operators to allow DSR resources to participate in all relevant markets on equal footing with generation

Establishing regulatory frameworks and incentives may continue to be important for the future implementation of DSR, including dynamic approaches able to provide wider system services.

Experience from the case study countries also suggests, however, that there needs to be market opportunities if policies are to succeed. These may be created by price volatility in energy markets, the requirements of capacity markets, or other markets to provide energy system services which DSR is capable of serving. Overall, evidence from both the REA

and case studies suggests that small-scale DSR has needed strong policy support and appropriate market frameworks and conditions to develop.

2) Business strategies

What novel business models are being used to access DSR from smaller users, have they worked and why?

Established programmes of static time-of-use or critical peak pricing/rebate and direct load control have typically been implemented by established electricity suppliers in response to regulation. The shift to manage demand rather than simply matching it is in some respects a changed business model for incumbents. However the REA did not reveal evidence of any fundamental change to business strategy created by established tariffs such as critical peak rebates or cheap overnight electricity rates.

The evidence base on business strategies for more dynamic forms of DSR provides insights on the selection of target markets and the roles of intermediaries and allied actors such as equipment suppliers. Evidence from the REA and the case studies highlight the relatively high costs of securing participation and the importance that DSR service providers currently place on accessing customers with sizable electrical loads per customer site, as these incur lower customer acquisition and installation costs. Two of the case studies with high levels of electric heating and/or air conditioning (Texas and Finland) feature growing levels of small scale DSR.

A novel business model that is currently attracting attention is the so-called 'bring your own device' DSR, enabled by technologies, such as programmable communicating thermostats that users purchase themselves. Policy can create the conditions to support this model, for example, through mandatory 'smart' appliance regulation. Partnerships also play a prominent role in the case studies, primarily between a technology service provider and energy supplier, but potentially with the involvement of a smart appliance manufacturer.

3) DSR products and services

What DSR products and services have been used internationally to secure demand response from smaller consumers?

The REA revealed a substantial evidence base on DSR products and services and how consumers respond to different offerings. Much of the evidence derives from programmes using static pricing/rebates and direct load control. Average responses to critical peak pricing are generally higher than average responses to time-of-use pricing. There is some evidence that critical peak pricing delivers greater customer response than critical peak rebates due to the stronger presence of financial risk in pricing compared to rebates. There is strong evidence that automation or direct load control increases responses, particularly for loads such as electric heating and air conditioning. There is also strong evidence that consumers respond to more static time-of-use and/or critical peak pricing.

Evidence on dynamic time-of-use pricing is limited and somewhat mixed. However there is some evidence that consumers adopt fixed patterns of response even when presented with dynamic prices.

Opt-in versus opt-out DSR product design influences enrolment. Enrolment in DSR is typically voluntary, but can be implemented on an opt-out basis where users are placed onto the new tariff with the option to leave. This reduces enrolment costs compared with opt-in recruitment. Opt-out recruitment secures much higher levels of enrolment than opt-in, but a much smaller fraction of consumers recruited on an opt-out basis respond to DSR. Hence, the *aggregate* response rates of opt-in and opt-out populations are relatively similar. Opt-out may be simpler or cheaper than opt-in, but risks enrolling a substantial population of non-responding consumers who may pay higher prices as a result.

4) Consumer engagement and participation

What are the key factors affecting consumer engagement in terms of: recruitment, level of response and persistence?

The primary motivation for most consumers to enrol in DSR programmes appears to be financial, but environmental and other drivers are also significant. Trust, risk and complexity feature strongly in the evidence base on motivations for enrolment, response and persistence. The evidence shows that the presence of trusted actors, the absence of perceived risk of higher bills and minimal complexity all enable consumer participation. Beyond this, the REA evidence presents a complicated and mixed picture, for example in terms of who is trusted and how to minimise risk or complexity.

There is a considerable amount of discussion of various end user types/segments and clear evidence that some households respond much more than others. However the REA evidence is too varied to reveal any simple overarching conclusions about which types of consumers are the most responsive to DSR offerings and why.

In the case studies the main consumer engagement strategies identified (according to the commercial actors that offer the products) include: showing economic benefits by appealing to the cost saving potential, showing environmental benefits by appealing to 'green' credentials and demonstrating carbon dioxide (CO₂) savings, customising product offerings through the provision of tailored products and services based on behavioural data of consumer segments, and simplification by ensuring that customers are engaged in, and fully understand, the product they are buying.

Potential implications for GB deployment of small-scale DSR

Both a supportive policy and regulatory framework, and sufficient market opportunities enabling value to be provided to commercial actors and consumers, are likely to be important to an expansion in small-scale DSR in GB. On the latter, flexibility is a growing requirement in the GB system, but DSR is just one of several options that can provide it.

Market and policy developments in interconnection, flexible generation and storage will affect the context for small-scale DSR.

The evidence indicates that the deployment of small-scale DSR, involving price incentives and potentially automation or direct load control, is clearly feasible. However consumer responses are context-specific. Successful deployment of DSR also depends on consumer offerings being straightforward and comprehensible. Moreover, it will be important to build and maintain consumer trust if end users are to engage, respond and remain enrolled in DSR tariffs, products and services.

Evidence suggests that provision of new small-scale DSR will be more attractive if there is a sufficient volume of higher shiftable loads per customer. There is a significant number of storage heaters in GB (estimated at 18 GW in 2012) that might be retrofitted in order to provide more dynamic DSR services than the current time-of-use tariffs. Immersion heaters provide another possible source of static or dynamic DSR services.

Other potential shiftable loads by 2025 could be provided by electric vehicles, domestic electric battery storage or heat pumps. Electric vehicles could provide ancillary services and in particular frequency response from aggregated vehicle pools. The size of the opportunity for DSR here will depend on the speed of uptake of such technologies; for example National Grid's Gone Green scenario in its Future Energy Scenarios estimates that electric vehicles' annual electricity demand could increase to 5 TWh/year by 2025 and have a peak demand of 1.7 GW.