Department for
Business, Energy
& Industrial Strategy

Evaluation of the Transitional Arrangements – phase 4

Final report – executive summary

May 2019

Introduction

This report presents findings from Phase 4 (the final phase) of the evaluation of the Transitional Arrangements (TA) for Demand Side Response (DSR) in the Capacity Market (CM) for electricity. The evaluation was undertaken for the Department for Business, Energy and Industrial Strategy (BEIS) by CAG Consultants, in partnership with Winning Moves, Verco and NERA Economic Consulting.

This report presents our findings on the second TA scheme, which focused on load turn-down DSR only. It incorporates Phase 4 evidence, comprising National Grid data and a final wave of telephone interviews and email surveys by TA participants, and also draws on evidence from participants and non-participants in earlier phases of the evaluation. Findings from earlier phases can be found on the www.gov.uk website[1].

Policy background

As explained in earlier evaluation reports, the TA formed part of the Capacity Market (CM). Like the CM, the TA aimed to support BEIS's objectives of promoting growth, decarbonisation and energy security, while ensuring affordability of the energy supply.

In particular the TA aimed to encourage the development of DSR to balance supply and demand in a decarbonised electricity grid[2]. This report uses the CM definition of DSR: the activity of reducing the metered volume of imported electricity of one or more customers below an established baseline, by means other than a permanent reduction in electricity use. Under this definition, DSR may be achieved through any combination of onsite generation, temporary demand reduction or load-shifting. We use the term 'turn-down' DSR to refer to the last two activities.

The TA scheme involved two auctions for specific types of capacity within the CM, the first for delivery of capacity in the 2016/17 delivery year[3], held in January 2016, and the second for delivery of capacity in 2017/18, held in March 2017. While the first TA scheme was open to all types of DSR and small-scale distribution-connected generation between 2 MW and 50 MW, the second TA scheme was only open to turn-down DSR and had a minimum threshold of 500 kW. The second TA had two main objectives: to encourage

[1] Findings from Phase 1-3 of the evaluation see: https://www.gov.uk/government/publications/evaluation-of-the-transitional-arrangements-phase-1; https://www.gov.uk/government/publications/evaluation-of-the-transitional-arrangements-for-demand-side-response-phase-2; https://www.gov.uk/government/publications/evaluation-of-the-transitional-arrangements-for-demand-side-response-phase-3

[2] National Infrastructure Commission (2016) *Smart Power: A National Infrastructure Commission Report.* Available at: https://www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report. Accessed 27/7/2016

[3] The delivery year runs from 1st October of one year through to 30th September of the following year.

turn-down DSR and to contribute to the development of flexible capacity[4] for the future CM.

The TA auctions were additional to the main CM auctions[5] which are open to generation, storage and DSR capacity. Participants securing capacity agreements in CM auctions, including the TA, were obliged to provide capacity to National Grid if a 'system stress event' occurred during the delivery year. In practice, no system stress event occurred during the 2017/18 delivery year, so participants in the second TA were not required to provide capacity other than for testing purposes. These tests comprised an initial 'DSR test' to prove their demand reduction capacity (unless already 'proven' in an earlier test) and three 'Satisfactory Performance Days' (SPD) to demonstrate their availability during the winter period.

Evaluation aims and methodology

The evaluation was designed to answer five high-level questions (HLQs) posed by BEIS:

- HLQ 1 - What outcomes can be attributed to the second TA and were they as intended by BEIS? What outcomes occurred for whom and under what circumstances?
- HLQ 2 - Through what levers and causal mechanisms has the second TA contributed to these outcomes and the variation by group and circumstance?
- HLQ 3 - Did the second TA represent good 'value for money' to both scheme participants and the consumer?
- HLQ 4 - Which aspects of the second TA's design and implementation account for the findings of HLQ 2 and 3?
- HLQ 5 - What are the implications of the findings for the future contribution of turn-down DSR to the CM?

Our approach to this evaluation was realist and theory-based. A realist approach[6] emphasises the importance of understanding not only whether a policy contributes to outcomes (which may be intended or unintended) but how, for whom and in what circumstances. The development of a 'theory' of the TA was central to implementing a realist evaluation as it allowed us to examine rigorously the design and execution of the scheme, and test policy assumptions against available evidence. We developed an initial

[4] By flexible capacity, we mean electricity demand and generating capacity that is able to increase or decrease in response to signals, to help balance supply and demand of electricity across the GB grid. For the purposes of the TA, flexible capacity does not include electrical storage.
[5] The main CM comprises the four-year ahead auctions (T-4) and the one-year ahead auctions (T-1) which will deliver capacity from 2018/19 onwards, and the Early Auction which delivered capacity in 2017/18.
[6] R Pawson, R, and Tilley, N. (1997) *Realistic Evaluation*. London: SAGE Publications Ltd; and Pawson, R. (2006) *Evidence-Based Policy*. London: SAGE Publications Ltd.

theoretical framework for Phase 4 of the evaluation, building on our insights from earlier phases of the evaluation, setting out the realist hypotheses to be tested during Phase 4.

We gathered evidence during Phase 4 to test and revise the initial theoretical framework. This involved in-depth telephone interviews with representatives of 17 organisations from April to May 2018, including nearly all second TA participants (six aggregators[7] and two direct participants) and representatives of eight aggregator clients. We also collected cost information from the interviewees via an email survey. Our understanding of the operational issues involved in delivering turn-down DSR was deepened through case study research with a cross-section of six turn-down sites. The evidence gathered during Phase 4 extended the information already gathered in Phases 1-3 of the evaluation.

The capacity provided through the second TA scheme was characterised by matching meter point data from National Grid with commercially available company databases for all the CMUs going forward to delivery. We used a combination of data sources to identify the types of assets providing turn-down DSR on each site, and used DSR test data as an indication of the demand reduction capacity that each site could provide. This process built on our Phase 3 analysis and provided a more complete characterisation of the capacity in the second TA scheme.

During Phase 4, we analysed the strength of evidence about the second TA's contribution to its objectives using process tracing techniques[8], and used the process tracing findings to support our overall synthesis of evidence.

Findings on HLQ1: what were the outcomes of the second TA scheme?

Volumes procured in the second TA auction and other CM auctions

While just over 313 MW of turn-down DSR was procured in the second TA auction, a total of 293 MW of turn-down DSR went forward to delivery in the second TA scheme, as shown in Figure A. This capacity was provided by 28 Capacity Market Units (CMUs) put forward by six aggregators and three direct participants, comprising 333 separate sites or 'components'. Six CMUs were temporarily suspended in May 2018 for failing to demonstrate three SPDs, but only four CMUs (8 MW) were still suspended in September 2018.

There has been a general increase in the volumes of DSR procured in CM auctions over time. The third and fourth T-4 auctions procured significantly higher volumes of DSR than other CM auctions to date, despite restrictions preventing capacity in the second TA from

[7] An aggregator is an organisation that collates capacity from clients and puts it forward on their behalf.

[8] Process tracing is a case-based approach to causal inference which focuses on the use of clues within a case to adjudicate between alternative possible explanations. (See https://www.betterevaluation.org/en/evaluation-options/processtracing)

participating in the third T-4 auction. Most of the capacity coming forward to the second TA, and to other CM auctions to date, was 'unproven'[9] DSR put forward by aggregators. It is not possible to identify the scale of turn-down DSR procured in the main CM, as no distinction is made between different types of DSR.

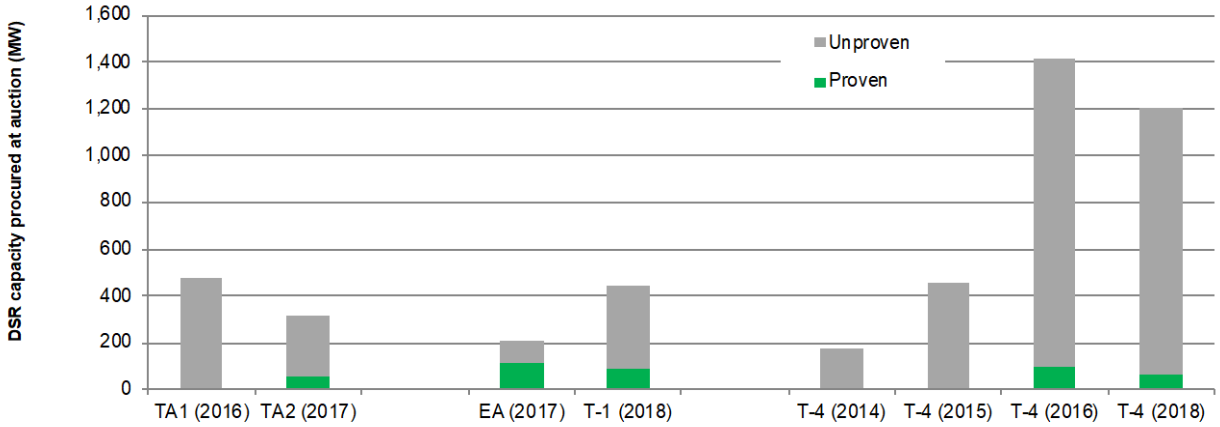

Figure A: Volume of DSR clearing in CM auctions (MW) (Source: CM register)

Characteristics of capacity in the second TA scheme

At CMU level, DSR test capacities generally exceeded contracted capacities. As discussed in the Phase 3 evaluation report, CMUs were generally 'overfilled' to reduce the risk of under-delivery in response to testing or to a system stress event. Contracted capacity was defined at CMU level, not component level, so there was no firm measure of component capacity. The level of turn-down response provided by a particular component would vary between turn-down requests. However, our analysis of DSR test results gave an indication of the turn-down capacity potentially available from different types of components.

Capacity in the second TA was almost entirely provided by industrial sites, with very few commercial sites and no public sites represented in the scheme. Interview evidence indicated that this was because commercial and public-sector sites generally involved multiple small turn-down loads that were not cost-effective for the CM, particularly if extensive sub-metering was required to comply with CM metering requirements.

While sites in the water and food processing industries were most common within the second TA scheme, sites in metal-related, construction-material and manufacturing industries demonstrated greater total capacity in DSR tests. Similarly, motors, drives and process heating assets demonstrated significantly more total capacity in DSR tests for the second TA than refrigeration and water pumping units.

[9] 'Unproven' DSR was DSR capacity that had not been 'proven' in a DSR test.

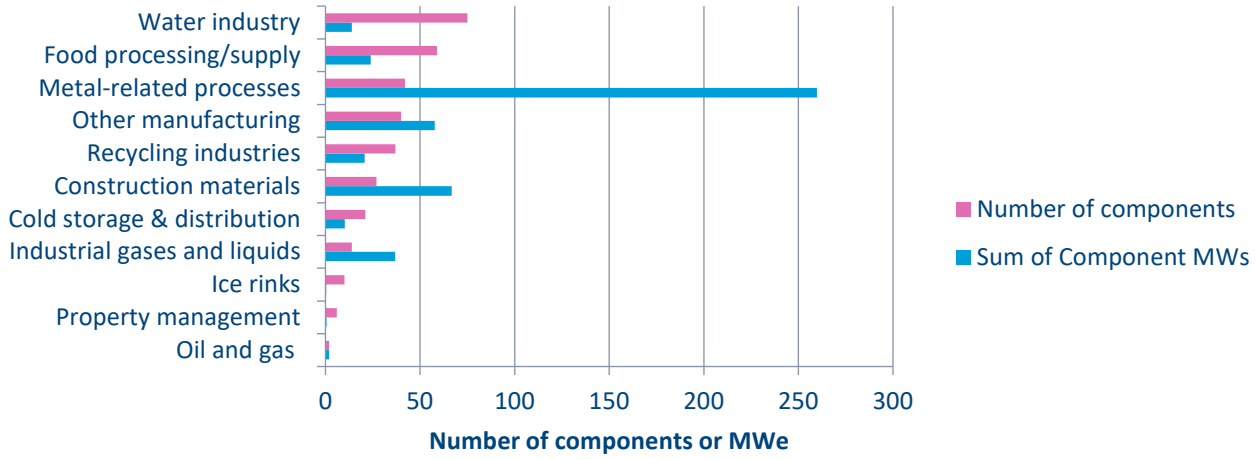

Figure B: Number of components and DSR test capacity (MW) by business activity (source: consultant's analysis of DSR test and MPAN data)

Evidence from the email survey, interviews and case studies indicated that DSR costs varied widely, depending primarily on the underlying process and the extent to which aggregators needed to recruit new clients. Subject to the limitations of the cost data, indicative estimates suggested that average initial capital costs incurred by aggregators and direct participants in the second TA was £150/MW (range £0-580/MW), while average initial staff costs for these participants were £4,800/MW (range £0-19,300/MW). Average ongoing staff costs were predicted to be £2,600 MW/year (range £0-7,800/MW/year). Important caveats about these cost estimates are set out in the main report.

Interview evidence found that participants had difficulty assessing the opportunity costs of turning down because of uncertainty about when a system stress event would happen and how long it would last. Participants judged the likelihood of a stress event to be low: in practice no stress event was observed during the delivery year. Case studies suggested that opportunity costs for sites in the second TA were generally low for short turn-down periods (e.g. up to two hours) but that business disruption costs could potentially rise significantly for longer turn-down periods (e.g. four hours or more). As some DSR providers would choose to lose CM revenues rather than deliver turn-down for an extended period, the capacity of response would reduce over time if there was a very long stress event. Many of the second TA sites were already participating in cost-avoidance for Triad and – to a lesser extent – in National Grid flexibility services. Revenues from the second TA were comparable to Triad revenues but lower than revenues from Dynamic Firm Frequency Response services.

Findings on HLQ2: contribution to second TA objectives?

We examined how the second TA contributed to its objectives of (a) contributing to flexible capacity in the future CM and (b) encouraging turn-down DSR more widely.

Contribution to flexible capacity in the future CM

All the participants in the second TA went on to participate in the main CM auctions in 2018, although not all of their capacity cleared at the lower prices in these auctions. The volume of flexible capacity that they will actually clear in future CM auctions will depend on the clearing price in those auctions. We found that the increase in flexible capacity was influenced by external factors (e.g. learning from the first TA scheme, raised awareness from the Power Responsive campaign[10], increased incentives from high Triad charges, changes to CM rules for frequency services), but that the second TA played a role in bringing a higher volume of or more competitive turn-down DSR capacity to the future CM. In particular:

- Less experienced players reported that the CM seemed less risky because of the learning they had gained from the second TA.
- Certain players invested in controls, metering equipment or IT systems to meet TA requirements which would reduce the costs of their future participation in the main CM.
- Both new and existing aggregators reported that they had been able to recruit some clients that were new to flexibility using the combined attraction of the high price and low credit cover in the second TA. These new clients were already turning down for Triad and/or DUoS red zone cost-avoidance, if they possibly could, but they had not previously contracted with an aggregator for an external flexibility service that could be requested by National Grid.

There was less additionality for aggregator clients and direct participants that were highly experienced providers of flexibility services or were very confident in energy management. The high price in the second TA was mainly a windfall for them. Also, the second TA was not additional for non-participant aggregators that had sites with mixed back-up and turn-down DSR capacity. This could not easily be submitted to the second TA without investment in additional metering that would not be required for the main CM. Direct participants found the administrative burden of the CM heavy compared to other sources of flexibility revenue, and there was a risk that higher credit cover or lower prices in the main CM would not justify their ongoing participation in the CM, beyond 2018/19.

Encouragement of turn-down DSR

The 293 MW of turn-down DSR procured in the second TA was significantly higher than our estimate of 60-90 MW of turn-down procured in the first TA, which was open to both back-up and turn-down DSR. The second TA incentivised those aggregators that were less experienced with turn-down DSR to recruit turn-down DSR, enabling them to increase the proportion of turn-down in their portfolios and to gain knowledge about turn-down. The second TA also played a role in helping aggregators and clients to maximise the revenues

[10] Power Responsive is a stakeholder-led programme, facilitated by National Grid, that aims to stimulate increased participation in the different forms of flexible technology such as DSR and storage.

from their turn-down DSR (e.g. new clients were attracted by the high price in the second TA but their aggregators then sought other revenue streams for their turn-down assets, including frequency response services).

Findings on HLQ3: did the second TA represent good 'value for money'?

While we present a commentary on 'value for money' in this report, a full assessment of the costs and benefits the second TA scheme (compared to alternative means of achieving its objectives) was not included in the design of this evaluation. Our limited assessment of value for money suggests that the second TA auction appears to have been:

- Expensive by comparison with recent CM auctions in GB, albeit with different auction objectives.
- Slightly more expensive than National Grid's previous turn-down service (Demand-Side Balancing Reserve), but cheaper than frequency services in GB, although these services differ significantly in their requirements.
- Comparable to prices paid for DSR in international capacity auctions.
- Possibly more expensive than it would have been if the target volume in the auction had been reduced by BEIS before the auction, because the supply curve appears to have been steep around the clearing price. However, it is uncertain whether this would have prompted further withdrawals of capacity pre-auction.

Findings on HLQ4: influence of TA design and implementation

Our findings about participant experiences of the second TA scheme, post auction, were that:

- Metering tests were considered onerous, so participants with previous CM experience designed their CMUs to avoid the need for metering testing. This impacted on the type of sites that participants included in their CMUs (e.g. sites with renewables or onsite generation were avoided wherever possible).
- There was evidence of some participants designing CMUs to ensure that the 30-minute DSR and SPD testing requirements were met (with a potential impact on their ability to respond to an actual stress event, that might extend beyond 30 minutes).
- As noted in the Phase 3 report, timescales for DSR testing of capacity between the auction and start of the delivery year were tight. This, combined with problems with

capacity recruitment, resulted in some capacity being lost before the delivery year (e.g. four CMUs withdrew after auction).

- SPD processes meant that SPD suspensions occurred even in cases where participants appeared not to be at fault (e.g. because of difficulty in establishing and maintaining the flow of meter data from sites to National Grid and EMRS, the body responsible for compiling meter test data on behalf of National Grid).

- DSR and SPD tests were not 'real-world' tests and did not fully assess the extent to which CMUs would be able/ready to respond to a system stress event. While participants were confident they could respond, there was evidence that some CMUs were primarily designed to meet testing requirements rather than necessarily respond to system stress events (which were regarded as an unlikely occurrence in the 2017/18 delivery year).

Findings on HLQ5: implications for the future of DSR in the CM

Size of the turn-down DSR market in GB?

The Association for Decentralised Energy (ADE) has estimated the potential size of the overall DSR market (from turn-down, back-up and battery storage in the UK) as just over 5 GW for industry and over 1.5 GW for services[11]. The turn-down DSR participating in the second TA was almost exclusively provided by large industrial loads (typically 100 kW or more). While the high price for the second TA stimulated extensive marketing by aggregators, interviews with industrial non-participants in Phase 3 indicated some unrealised potential. However, we found that commercial and public sector loads, such as HVAC, can typically tolerate only short turn-down periods (e.g. 30 minutes or less) and tend to require automatic controls. We did not observe aggregation of commercial loads for the second TA, except in rare cases where the loads required no investment in metering or controls and were also generating revenue from other services (e.g. frequency services).

Is turn-down DSR viable in the main CM?

While modest volumes of turn-down DSR cleared in the 2018 T-1 auction at £6/kW, these were single large sites with low costs and/or sites with access to revenue from other flexibility services. Interview and auction evidence indicated that future CM prices of £10-20/kW, closer to those observed in the first three T-4 auctions, would be needed to support recruitment of new turn-down DSR and investment in new controls for small sites. Viability could be adversely affected if participants became unable to stack CM revenues with revenues from Triad cost-avoidance or frequency services.

[11] Association for Decentralised Energy and Renewable UK (June 2018). *Industrial flexibility and competitiveness in a low carbon world.*

Removing barriers to encourage more turn-down DSR to participate in the CM?
Interview evidence suggested that participation of turn-down DSR in the CM would be encouraged by higher prices and by: limiting the duration of turn-down DSR offered; streamlining metering requirements for DSR in the CM, particularly for small sites; reducing credit cover and reviewing baseline requirements for DSR in the CM. More flexibility for changing the composition of proven DSR CMUs, as planned by Ofgem, would also encourage increased participation. We have considerable evidence that longer agreements (2-3 years) would be welcomed by aggregators, but we understand that, in designing the TA, BEIS regarded this as unjustifiable because of the low up-front costs of DSR.

Our assessment of evidence, combined with our knowledge of international capacity markets, suggests that some changes might discourage participation by some types of turn-down DSR but might be advantageous to the CM's role in supporting security of supply. These include: higher penalties for non-delivery; testing regimes that more accurately reflected potential delivery during a stress event; and possibly a reduced notice period for system stress events.

Interview evidence suggests that external factors may also stimulate future growth in turn-down DSR. In particular, air quality restrictions are making diesel generation less cost-effective; new/cheaper battery technologies are increasing the flexibility options available to industrial and commercial organisations; and advances in control technologies may make sophisticated aggregation of smaller sites cost-effective, even for the longer turn-down periods required for the CM.

Conclusions

Our evaluation findings, based on our assessment of the evidence, can be summarised against the high-level evaluation questions as follows:

- **HLQ1 -** The second TA procured 293 MW of turn-down DSR, compared to 60-90 MW of turn-down DSR in the first TA. This was put forward by six aggregators and three direct participants and comprised 333 individual sites, which were almost entirely industrial. There was very little participation by commercial sites in the second TA.

- **HLQ2 -** The high price, low credit cover and small volume threshold in the second TA scheme encouraged both new and existing aggregators to prioritise turn-down DSR and recruit new clients that were previously turning-down for Triad only and were not previously contracted for flexibility services. This provided a safe environment for learning about both turn-down DSR and CM participation amongst those with less experience of one or other of these processes. However, there was less additionality for experienced players (for whom the high price in the second TA was mainly a windfall) and for non-participant aggregators with sites providing mixed back-up and turn-down DSR capacity that could not easily be submitted to the second TA. All

participants in the second TA went on to participate in the main CM auctions in 2018, although only large, single-site CMUs and turn-down capacity with access to revenue from other flexibility services cleared at the lower prices in these auctions. The extent to which the second TA capacity will obtain agreements in future CM auctions will depend on future clearing prices.

- **HLQ3 -** Although the second TA was expensive in comparison with recent CM auctions in GB, it had different auction objectives. Second TA prices were broadly comparable to turn-down DSR in international markets, but it was difficult to draw direct comparisons with other flexibility services in the UK as they have different requirements.

- **HLQ4 -** Participants found the second TA onerous compared to other flexibility services, particularly in terms of metering tests (which most participants avoided by selecting sites with supplier settlement metering) and setting up and maintaining meter data flows for DSR tests and SPDs. These issues apply equally to the main CM.

- **HLQ5 -** Our research suggests that turn-down DSR will only be viable at scale in the main CM if future CM prices exceed £10-20/kW. Currently, prices around these levels are required to support recruitment of new turn-down DSR and investment in new controls and metering for smaller sites. The future viability of turn-down DSR in the CM will also depend on participants' continued ability to stack CM revenues with revenues from Triad cost-avoidance and frequency services.

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