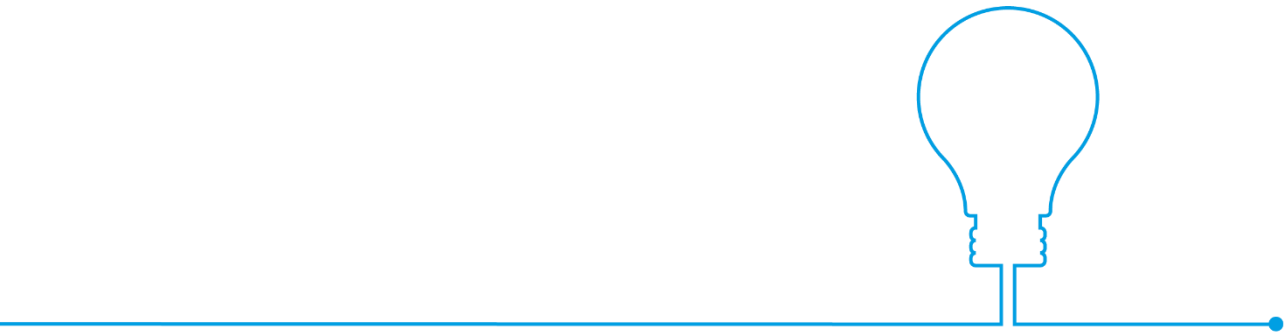
Department for
Business, Energy
& Industrial Strategy

EVALUATION OF THE TRANSITIONAL ARRANGEMENTS

Phase 1 - Main Report



February 2017

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Glossary and Definitions

Term or acronym	Working definitions
Aggregator	An intermediary organisation that provides a service of collating capacity (from generation and/or DSR) for National Grid balancing services or the Capacity Market (CM), from a range of other organisations, in return for a share in the revenues generated.
Aggregator client	An organisation that contracts via an aggregator to access National Grid balancing services or the CM, rather than participating directly in these services.
Back-up generation	Generator (often diesel-powered) designed to be used if there is a power cut or problem with mains power. Usually located onsite 'behind the meter'.
Balancing services	System services contracted by National Grid. Those mentioned in this report comprise: 'Reserve services' that provide reserve capacity to balance electricity supply and demand (through generation or demand response). Examples include STOR and DSBR (see below). 'Frequency-related services' that provide very short-term changes in electricity demand or supply to help maintain the frequency of the grid for Great Britain (GB) at 50Hz. Examples include FFR and FCDM (see below).
Capacity	The Capacity Market was established for the purpose of ensuring adequate capacity to meet the demands of consumers for the supply of electricity in Great Britain. Capacity can be in the form of electricity generation plant or reduction in demand for electricity.
Capacity Agreement	A capacity agreement comprises the rights and obligations accruing to a capacity provider under or by virtue of the CM Regulations and the Rules in relation to a particular capacity committed CMU and one or more delivery years.
Capacity Market (CM)	A series of auctions administered by the EMR Delivery Body, through which it procures future electricity capacity. The main auctions, known as 'T-4', are held annually 4 years ahead of the delivery year. Adjustments are made through annual 'T-1' auctions, one year ahead of the delivery year. The Transitional Arrangements involve two additional auctions that are designed to encourage growth in specific categories of capacity, to enable them to participate in the main CM in future.

Term or acronym	Working definitions
Capex	Capital expenditure
CHP	Combined heat and power (a plant that produces heat as well as electricity).
CMOs	Context-Mechanism-Outcome combinations. These are realist hypotheses about how the policy is expected to work, which are tested during the evaluation. See 'realist evaluation'
CMU	Capacity Market Unit is a unit of electricity generation capacity or electricity demand reduction that participates in GB's CM. To pre-qualify for the TA, a CMU has to be between 2 MW and 50 MW. A CMU may consist of a number of sites.
Context	The circumstances which affect whether a policy 'works' and for whom. Consideration of 'context' forms an important part of realist approaches to evaluation.
CRC	CRC energy efficiency scheme – a UK government scheme launched in 2010 that requires organisations with electricity use exceeding 6,000 MWh in specified years to report their energy use annually and purchase carbon allowances. The scheme will end in April 2019 and will be replaced by higher levels of the Climate Change Levy.
Delivery year	The contractual year for delivery of CM obligations, which runs from 1st October of one calendar year through to 30th September of the following year.
De-rated capacity	Volume of generation or demand reduction capacity after a reduction to account for outage rates, maintenance down time and so on, which varies by technology type. The EMR Delivery Body publishes lists of standard de-rating factors by technology.
Distributed generation	Generation units which are connected to the distribution network, rather than the transmission network.
Distribution network	The electrical network that delivers electricity to the bulk of consumers (excluding a small number of consumers that are connected directly to the transmission network).
Direct participant	An organisation that participates in National Grid balancing services or the CM directly, rather than via an aggregator.
DNO	Distribution Network Operator. DNOs own and operate the distribution network of towers and cables that bring electricity from the national transmission network (see the National Grid) to homes and businesses.
DSBR	Demand-side balancing reserve (interim balancing service for winter 2015/16). One-to-one agreements between organisations and National Grid in which the organisation is paid to reduce demand at certain times.

Term or acronym	Working definitions
	At the time of research, DSBR was expected to extend into winter 2016/17 but National Grid announced in August 2016 that they would not tender for DSBR in winter 2016/17.
DSR (Demand-side response)	DSR means 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. See also 'Turn-down DSR' below. This report focuses on DSR by industrial and commercial rather than domestic consumers, as domestic DSR is much less well-developed in GB.
DSR Test	Test specified in CM rules, to demonstrate that a DSR CMU can reduce electricity usage by a given amount, relative to baseline demand. The test involves compilation of baseline data over a 6-week period, followed by collection of meter data by Elexon to confirm reduction below the baseline level at agreed times.
DTU	Demand Turn Up (the opposite of demand or load turn-down). Contracts with National Grid to make use of excess electricity generated by the distribution system (largely from solar power) when not otherwise needed.
Early Auction	An additional one-year ahead CM auction that has been introduced by BEIS. This will be held in January 2017 and will procure capacity for delivery in 2017/18.
Electricity Settlements Company (ESC)	Government body set up to deal with paying capacity providers and recovering the costs from electricity suppliers.
Elexon	Organisation responsible for administering the GB electricity market Settlement and Balancing Code. Also contracted by the ESC (see above).
Embedded benefits	Benefits negotiated between consumers and suppliers, when DSR or small-scale generation by electricity consumers helps suppliers to avoid network costs.
Embedded generation	Similar meaning to 'distributed generation'
EMR	Electricity Market Reform – the Government's major reform of electricity markets in GB, which included introduction of the CM for electricity. This was introduced in a White Paper in 2011: Planning Our Electric Future: A White Paper for Secure, Affordable and Low-Carbon Electricity.

Term or acronym	Working definitions
EMR Delivery Body	The body contracted by BEIS to deliver Contracts for Difference and the CM auctions, as well as other supporting functions. The EMR Delivery Body is currently National Grid.
EMR Settlements Limited	A wholly owned subsidiary of Elexon which the ESC contracts to settle CM payments and Contracts for Difference, and to collect and store metered data.
Enhanced Frequency Response (EFR)	A new, faster frequency response product that is being tendered by National Grid during 2016, which requires organisations to interrupt their electricity supply within less than a second.
Fast Reserve	A service tendered monthly by National Grid that procures large blocks of reserve capacity (exceeding 50MW) that can respond within 2 minutes. Pump storage is currently the main provider of Fast Reserve.
FCDM	Frequency Control by Demand Management (similar to FFR). A bilateral agreement between an organisation and the National Grid, that requires the organisation to interrupt its supply for 30 minutes, at 2 seconds' notice.
Firm Frequency Response (FFR)	Firm Frequency Response. A monthly tendered service through which National Grid procures a few seconds or split-seconds of generation or demand reduction, at 30 seconds' notice, to support the 50Hz frequency at which the system operates.
Flexibility	Ofgem defines flexibility as 'modifying generation and/or consumption patterns in reaction to an external signal (such as a change in price) to provide a service within the energy system.'[1]
Flexible capacity	Electrical capacity (generation or load) that can offer flexibility to the electrical grid (see 'flexibility').
Frequency-related services	Services procured by National Grid to support the 50Hz frequency at which the system operates. These involve short-term changes to generation or demand at short notice, and usually require an automated response.
GB	Great Britain (the area covered by the electricity grid in England, Scotland and Wales).

[1] Ofgem (2015) Making the electricity system more flexible and delivering the benefits for consumers.' *Ofgem Position paper*. Available at: https://www.ofgem.gov.uk/ofgem-publications/96959/flexibilitypositionpaperfinal-pdf Accessed 13 September 2016.

Term or acronym	Working definitions
Hassle costs	'Hassle costs' are the cost directly associated with TA participation. This could include marketing effort by aggregators, the cost of time spent on the TA application, auction and testing processes, and the cost of new metering or controls specifically required for the TA.
HLQ	High Level Evaluation Question – one of the main questions that BEIS has asked this evaluation to research.
Long-term STOR	Longer term version of STOR (see below), which was contracted by National Grid on a once-off basis but is now closed to new entrants. Holders of Long-term STOR contracts must declare that they will surrender these contracts if they obtain a Capacity Agreement for the same capacity.
Mechanism	A change in people's reasoning, brought about through the resources provided by a policy, which leads to a policy outcome. Identification of causal 'mechanisms', which operate in particular 'contexts', forms an important part of realist approaches to evaluation.
Missing money	In our analysis of costs and revenues associated with electrical capacity put forward for the TA, 'missing money' is defined to be the minimum revenue that a participant would require for their participation in the TA to break even.
NAO	National Audit Office
Net CONE	The 'net Cost of New Entry' is one of the parameters used to define the demand curve in a CM auction. It is set to reflect the estimated cost of marginal plant at the target capacity entering the auction.
National Grid	The National Grid runs Great Britain's electric high-voltage transmission network, is System Operator for the electricity system, commissions balancing services for the supply of flexible capacity and is currently the EMR Delivery Body. (See http://www2.nationalgrid.com).
O&M	Operations and maintenance
Outcome	A change in the state of the world, brought about as a result of a policy or other influences. Realist approaches to evaluation attempt to identify the 'contexts' and 'mechanisms' that lead to a particular 'outcome'.
Proven DSR	A unit of DSR capacity that has passed the DSR test required to participate in the GB Capacity Market.

Term or acronym	Working definitions
Realist evaluation	A realist approach[2] to evaluation 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 it contributes to these outcomes.
Red Zone Management	Consumers avoiding (or generators targeting) the times when distribution costs (or payments) are highest – i.e. the periods defined as 'red' or 'super red' in the peak demand traffic light system.
Reserve services	Contracts between National Grid and organisations that can provide capacity held in reserve, in the form of generation or DSR.
Satisfactory performance days	CM participants are obliged to provide evidence of three half-hour settlement periods during the winter of a delivery year, on different days, in which they met their full capacity obligation.
Small-scale generation	For the purposes of the TA, generation units less than 50MW that are connected to the distribution grid.
STOR	Short-Term Operating Reserve - a reserve service run by National Grid through which organisations bid to provide generation or DSR to National Grid during peak demand periods (STOR windows). STOR is procured via tenders three times a year. A response time of at least 20 minutes is required.
Stress event	Period in which the electricity supply/demand balance is too tight (as determined by the System Operator's algorithms). Organisations holding capacity agreements are committed to provide capacity during stress events, or face penalties as set out in the CM rules.
Supplementary capacity market auction (also known as the 'Early Auction')	See Early Auction above
T-1	A one-year ahead CM auction, which will fine-tune the procurement of capacity in the main (T-4) CM auction for a given year. The first T-1 auction will secure agreements for the 2018/19 delivery year.
T-4	The main CM auction, held annually 4 years ahead of the delivery year. The first T-4 auction was held in 2014, procuring capacity to be delivered in 2018/19.

[2] Pawson and Tilley (1997) (op cit). Pawson (2006) (op cit).

Term or acronym	Working definitions
TA	Transitional Arrangements for DSR and small-scale distribution-connected generation – a pilot consisting of two one-year ahead CM auctions in 2016 and 2017 that are designed to encourage growth in specific categories of capacity, to enable them to participate in the main CM in future.
Transmission network	The high voltage power lines linking power stations to the distribution network. Some major electricity consumers are connected to the transmission network.
Triad Avoidance	Consumers trying to reduce their electricity demand during three peak demand periods (or 'Triads'), in order to reduce their transmission charges. Transmission charges are based on demand during Triad periods. The Triad half hours are calculated from metered data (i.e. they are not known in advance) so Triad avoidance requires prediction of when the Triad periods might occur.
Triad Targeting	Distributed generators trying to earn revenue by targeting generation at the Triad periods – the transmission charging methodology rewards them for doing so.
Turn-down DSR	Temporary reduction in electricity demand to avoid peak demand periods or to respond to National Grid instructions (sometimes called load reduction or curtailment). May also involve shifting electrical demand away from the peak demand period (sometimes called load shifting). This report focuses on DSR by industrial and commercial customers, as domestic DSR is much less well developed in GB.
Unproven DSR	A unit of DSR capacity that has not yet passed a DSR test, as specified by CM rules.

Chapter 1. Introduction

This report presents the findings from Phase 1 of the evaluation of the Transitional Arrangements (TA) for Demand-Side Response (DSR) and small-scale distribution connected generation. This evaluation was commissioned by the then Department of Energy and Climate Change (DECC), now the Department of Business, Energy and Industrial Strategy (BEIS). The evaluation is being led by CAG Consultants, and delivered in partnership with Databuild, Verco and NERA Economic Consulting. Phase 1 of the evaluation ran from late January to June 2016 and examined the outcomes and early impacts of the first TA auction. Phase 2 of the evaluation, which runs for one year from July 2016, will examine the delivery of obligations arising from the first TA auction and refine estimates of impact. Later phases of the evaluation will examine the outcomes, delivery and impacts of the second TA auction which is planned for March 2017.

Research and policy background

The TA is a pilot and forms part of the Capacity Market (CM) for security of electricity supply, within the government's Electricity Market Reform (EMR) programme. The TA aims to support BEIS's overall objectives of promoting growth and energy security, while ensuring affordability of the energy supply.

The TA aims to encourage development of DSR or small-scale distribution-connected generation that is increasingly needed to balance supply and demand in a decarbonised electricity grid.[3] In this report we used 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. By this definition, DSR may be achieved through any combination of onsite generation, temporary demand reduction or load-shifting.

The TA scheme involves two auctions for specific types of capacity within the CM, the first for delivery of capacity in the 2016/17 delivery year[4] and the second for delivery of capacity in 2017/18. These TA auctions are additional to the main CM auctions: the main four-year ahead auctions (T-4) and the smaller one-year ahead auctions (T-1) which will

[3]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

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

deliver capacity from 2018/19 onwards and the Early Auction which BEIS introduced to deliver capacity in 2017/18[5].

The TA has three main objectives, which we have used as the basis of three project hypotheses to be tested by the evaluation (see below and Appendix 1 for further details):

1. To contribute to security of electricity supply to help with short-term forecasted system tightness (winter 2016/17 and winter 2017/18).

2. To develop a stock of flexible capacity[6] that can be available for the one year ahead (T-1) auction in 2017 for delivery in 2018/19, thereby contributing to liquidity in this and subsequent year-ahead auctions.

3. To encourage enterprise and develop experience, confidence and understanding so that DSR and embedded generation will be able to realise their potential and ultimately compete with larger generation assets in the CM.

The first TA auction, which is evaluated here, was open to providers of DSR and small-scale distribution-connected generation services. In May 2016, BEIS announced changes to the CM, including narrowing the second TA auction to 'turn-down' DSR only[7]. Chapters 2-4 present our findings about the first auction in relation to the objectives set out above, while chapter 5 presents learning points for future CM auctions.

Evaluation aims and objectives

In the invitation to tender for this evaluation, BEIS specified the high-level evaluation questions (HLQs) for the evaluation shown in Figure 1.1. The evaluation responds to these questions.

[5] https://www.gov.uk/government/news/government-announces-capacity-market-auction-parameters
[6] Flexible capacity means electricity generating capacity and demand that is able to increase or decrease in response to signals, to help balance supply and demand of electricity across the GB grid.
[7] Department of Energy and Climate Change (2016*) Government Response to the March 2016 Consultation on Further Reforms to the Capacity Market.* Report 16D027. Available at: https://www.gov.uk/government/consultations/consultation-on-reforms-to-the-capacity-market-march-2016. Accessed 27/7/2016

Figure 1.1: High level evaluation questions

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

Evaluation design

Our approach to this evaluation is realist and theory-based. A realist approach[8] 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. We chose a realist approach for this evaluation because the number of organisations involved in the TA is small (precluding statistical approaches to assessing the policy's impact on outcomes) and the policy area is complex (requiring careful unpicking of 'how' and 'why' organisations made the choices they did). The emphasis of the realist approach on understanding 'how' and 'why' the TA influenced – or did not influence - certain types of organisations will help the evaluation to inform the roll out of DSR and small-scale generation within the main CM.

The development of a 'theory' of the TA is central to implementing a realist evaluation as it allows evaluators to rigorously examine the design and execution of the scheme, and test policy assumptions against available evidence. The use of theory-based evaluation is supported by HM Treasury guidance on evaluation[9]. We developed a theoretical framework for the evaluation, involving the framing of realist hypotheses that were tested against research evidence. The realist hypotheses set out for whom, and in what circumstances (i.e. in what 'contexts'), the policy is expected to lead to particular reasoning

[8] Pawson and Tilley (1997) (op cit); Pawson (2006) (op cit).
[9] See Chapter 2 of HM Treasury (2011) *The Magenta Book : Guidance for Evaluation.* London: HM Treasury. Available at: https://www.gov.uk/government/publications/the-magenta-book. Accessed 27/7/16

and choices being made (i.e. causal 'mechanisms' being activated[10]), leading to desired or undesired policy outcomes. These realist hypotheses are generally known as context-mechanism-outcome combinations or 'CMOs'[11]. As well as testing the realist hypotheses that reflected the desired/undesired functioning of the policy, the evaluation also tested alternative hypotheses: namely, other factors that might have generated the same outcomes without the TA policy, for certain players, in certain circumstances.

Realist evaluation uses the idea of generative causality (i.e. mechanisms only fire when the contexts are right). As such, we used generative causation assessment methods which involve a forensic examination of causality using strategic data collection and logic, rather than a probabilistic assessment of causation through statistical correlation[12]. This allowed hypotheses about causality and impact to be developed and tested using in-depth information about the influence of the TA and alternative drivers for change. The three main generative causation assessment methods that informed our approach to testing the theoretical framework were as follows:

- **Contribution analysis**. Contribution analysis involves a structured process to develop and test a 'contribution story' (i.e. a coherent narrative explaining how a policy intervention appears to be influencing change, and assessing the likelihood that the intervention is contributing to observed results). We formulated the contribution questions, and set out the expected 'contribution story' in an initial theory of change (presented in Appendix 1). The theory of change traces a causal chain of six steps that were expected to lead to the outcomes of the TA. This theory was then tested against existing evidence from all available sources, and further evidence was sought to deepen our understanding of why observed results have happened and of the roles played both by the intervention itself and by other factors. The revised 'contribution story' was then summarised in a revised theory of change (see Appendix 2) and in the broader analysis presented in this report.

- **Contribution tracing with Bayesian updating.** This involves the formal testing of project hypotheses and alternative hypotheses about the intervention's contribution to observed outcomes. Clues from case study evidence were used to choose between these hypotheses for each TA participant. We assessed the prior probability of observing a given 'clue' or piece of evidence if a particular hypothesis was true or false. We then analysed the evidence that was observed for each TA participant and combined the test results for each case to generate an updated

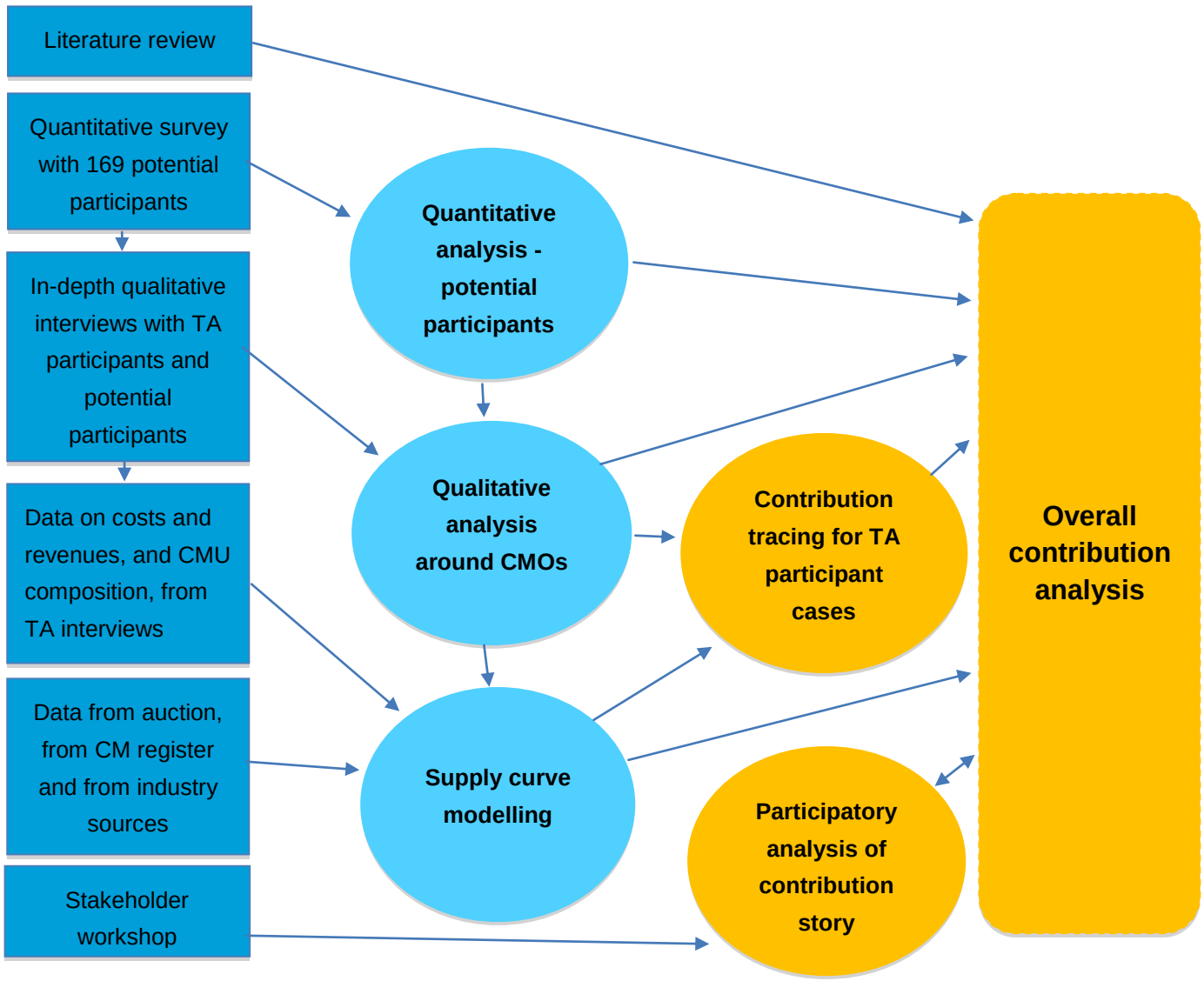
[10] In realist terminology, the activation of a causal mechanism is referred to as the mechanism 'firing'.
[11] Definitions for contexts, mechanisms and outcomes are provided in the glossary. Further detail can be found in Pawson and Tilley (1997) (op cit).
[12] Because of the small sample sizes, we did not just look for statistical correlations in the evaluation evidence (e.g. x% of a given type of organisation demonstrated a particular outcome) but aimed to understand how and why organisations made the choices they did, on a case by case basis.

probability that a particular case supported a given project hypothesis or alternative hypothesis. This process allowed clues from qualitative evidence to be combined with evidence from other sources in a rigorous way, drawing on case study evidence from TA participants. This was an important input to the wider contribution analysis.

- **Participatory analysis.** This involves engagement with a range of stakeholders to test the validity of the emerging 'contribution story'. We undertook a workshop in May 2016 with external stakeholders to test emerging findings about the first auction's contribution to the project hypotheses and alternative hypotheses. Again, this formed an important part of the overall contribution analysis.

The relationship between these generative causation methods and the sources of evidence is presented in Figure 1.2 below. The evidence sources are explained further in the methodology section below.

Figure 1.2: Relationship of generative causation methods and evidence sources

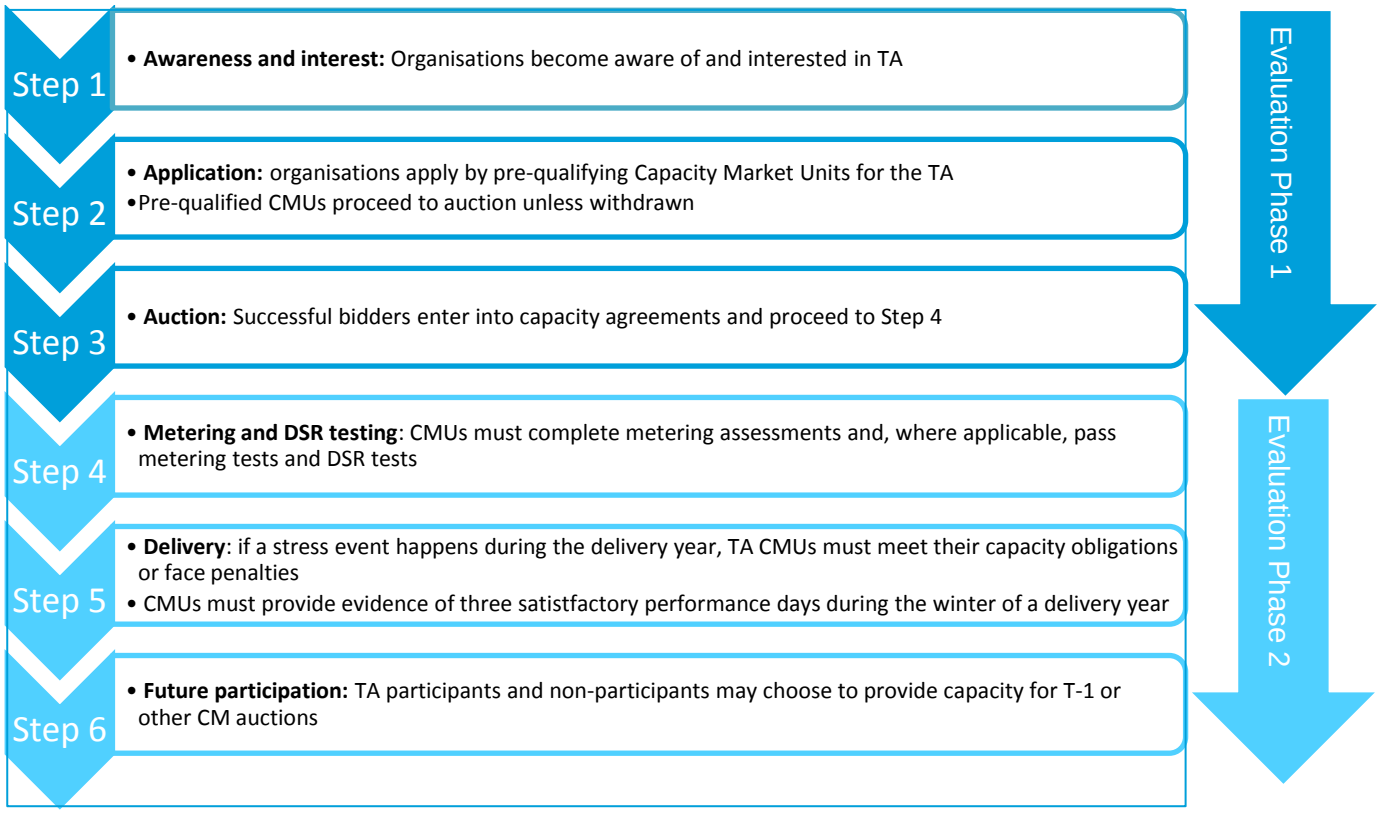


These methods were used to analyse the context, reasoning and behaviour of TA participants and of organisations that had potential to participate but chose not to do so. The generative causation methods are explained further in Appendix 3.

Methodology

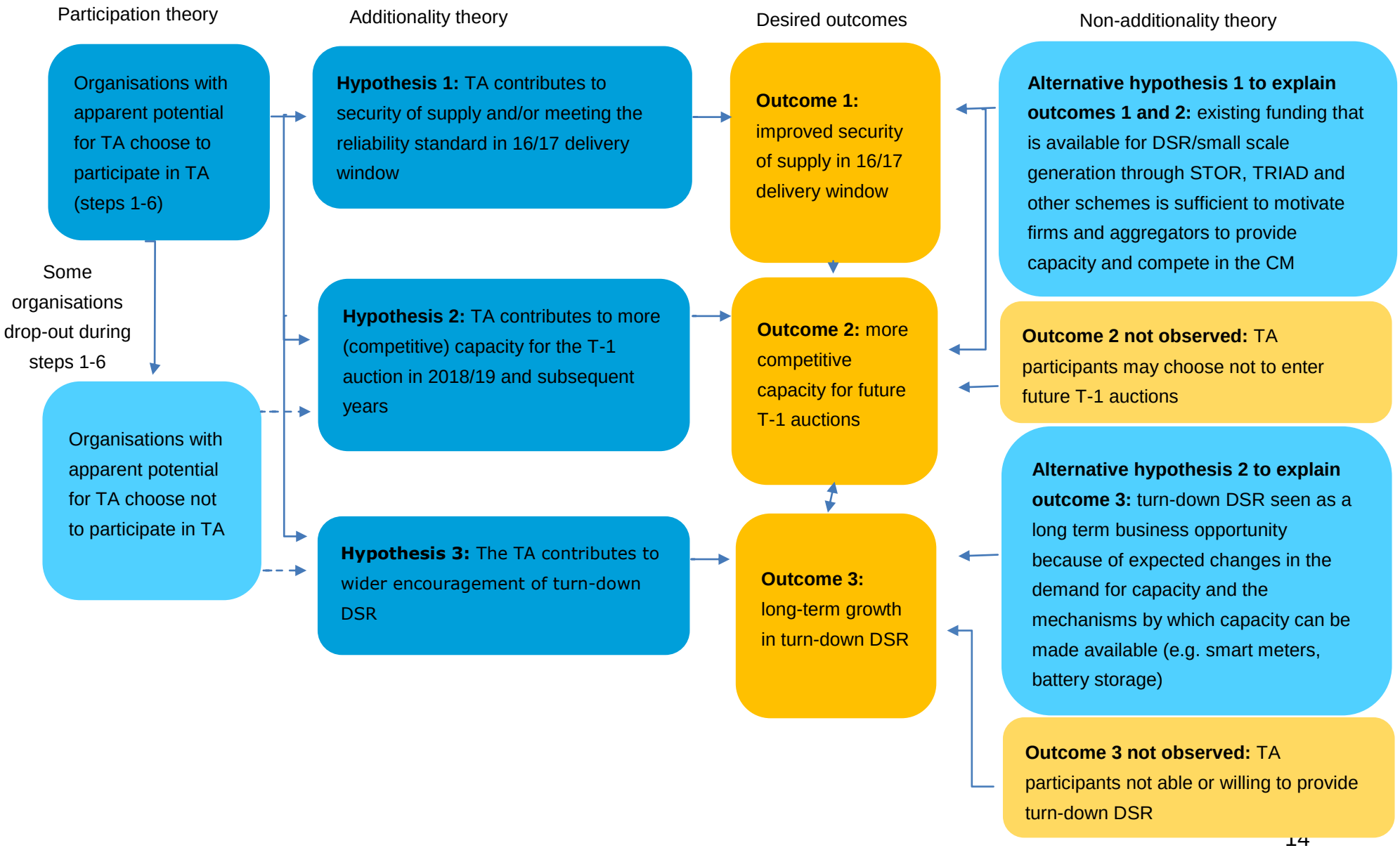
At the outset of this evaluation, we undertook scoping work with BEIS and other key stakeholders to develop an initial theoretical framework for the evaluation. The framework set out a series of realist hypotheses (in the form of CMOs) for each step in the TA scheme. These steps are summarised in the diagram below. Phase 1 of the evaluation has focused on steps 1-3, while Phase 2 of the evaluation will focus on steps 4-6. The initial theoretical framework for Phase 1, including the CMO hypotheses, is presented in Appendix 1.

Figure 1.3: Steps in TA process



As part of the theoretical framework, we also formulated three hypotheses about whether, how and in what contexts the TA would contribute to the three TA objectives. In addition, we formulated two alternative hypotheses which could explain observed changes without any contribution from the TA. This 'additionality' and 'non-additionality' theory is set out in Appendix 1 and summarised in Figure 1.4 below.

Figure 1.4: Additionality and non-additionality theory for first TA auction



Research undertaken in Phase 1 of the evaluation has tested the initial theoretical framework against the following sources of evidence.

- Data and guidance published by the EMR Delivery Body and BEIS about the CM, including the CM Register, the TA auction outcomes and relevant T-4 auction outcomes, together with additional confidential data on TA auction participants (e.g. auction exit prices) shared by the EMR Delivery Body for the purpose of this evaluation.

- Data held by the EMR Delivery Body on TA participants' participation in balancing services, supplemented with confidential data from interviews with TA participants on the costs and revenues associated with provision of DSR and small-scale generation for the TA and other services. Together with the data on TA auction outcomes, this has been used to model costs and revenues for different types of CMUs and develop a model of the supply curve for the TA.

- A review of literature on the CM, the TA, DSR and embedded generation in the UK, and reports or evaluations of similar policies in other countries, to support the development of a realist analysis of the TA.

- Evidence from 64 in-depth qualitative interviews with all TA participants and a sample of potential participants on their reported decision-making processes in relation to the TA, the wider CM and other balancing services, and on their experiences and perceptions of the TA process to date (covering Steps 1 to 3) [13].

- Quantitative findings from a survey with 169 non-participating organisations that have medium to high electricity consumption[14] and might have potential for TA participation. The sample was drawn from a subset of participants in the first phase of the CRC scheme. The sample was small because this survey was primarily designed to identify potential non-participants for in-depth interviews, but it was sufficient to generate wider findings about awareness of and suitability for the TA within this population. Further details of sampling for the survey and in-depth interviews are given in Appendix 4.

- Views from a range of external stakeholders, gathered through a workshop in May 2016 with representatives from industry and trade bodies, on the validity of emerging findings, particularly focusing on the extent to which the evidence gathered supported the project hypotheses and alternative hypotheses, and the design features which have influenced this contribution.

[13] A breakdown of the types of organisations interviewed is given in Appendix 4.
[14] The sample was drawn from a list of organisations that had reported electricity consumption above 6,000 MWh in 2008 (the qualifying year for phase 1 of the CRC).

Our analysis of data was undertaken using spreadsheets to tabulate qualitative evidence on each evaluation question across all respondent organisations. Direct quotes were added to these spreadsheets, from transcriptions of recorded interviews. Spreadsheets were also used to identify and code the contexts, mechanisms and outcomes that appeared to apply to each case, based on all sources of evidence. The theoretical framework has been revised in the light of this evidence. The revised version, presented in Appendix 2, will be used to inform Phase 2 of the evaluation.

Limitations of this research

Phase 1 research was undertaken during a period when the final composition of many Capacity Market Units (CMUs) was not known, so the findings about outcomes are tentative and subject to revision in Phase 2. There are particular uncertainties about the type and related cost of capacity put forward by aggregators (i.e. intermediary organisations that collated capacity for the TA from a range of clients), and fewer uncertainties about capacity put forward by direct participants (i.e. organisations that offered their own capacity to the TA). The research involved only four interviews with clients of aggregators because many aggregators were still in the process of contracting clients at the time. This will be an important group for future waves of research. Phase 2 findings will also need to take account of new evidence about the testing and delivery stages of the TA scheme.

Whilst we have undertaken a full census of TA participants, including those who submitted applications but dropped out of the process, we have undertaken in-depth interviews with only a limited sample of non-participants (see Appendix 4 for details). The sampling of non-participants was aimed primarily at those who had potential to participate in the TA in future. The sample for the survey of non-participants was drawn from a subset of CRC phase 1 participants that stated they were willing to be recontacted after an earlier survey about the CRC scheme. There are therefore limits on how far findings from the non-participant sample can be extrapolated to the wider population of non-participants.

Findings from in-depth interviews are open to ‘lobbying bias’: respondents may have told us messages that they wanted BEIS to hear, rather than messages that really reflected their experiences. In practice, most of the in-depth interviews appear to have been frank and balanced discussions, which were consistent with other evidence from scheme data, auction behaviour and perspectives from other stakeholders. We tried to guard against potential bias by weighting responses within contribution tracing assessments (e.g. we considered lack of requests of support as a strong positive sign of sufficient support, on the basis that respondents would have some tendency to ask for additional financial support for their activities, even if these activities would actually proceed without it). But there are some areas where we do not yet have sufficient cost data to cross check responses (e.g. participants reporting the need for revenue stacking to support DSR).

BEIS undertook a public consultation on future CM options during the research period, which created uncertainty in interviewee responses (e.g. on the likelihood of them participating in future T-1 auctions) because the outcome of the consultation was not yet known. In a few cases, there was a sense that interview responses overlapped with consultation responses that the interviewee was making separately to BEIS.

Report outline

The remainder of this report is structured around the HLQs:

- Chapter 2 – what were the TA outcomes? (HLQ 1)
- Chapter 3 – did the TA represent value for money? (HLQ3)
- Chapter 4 – what factors contributed to these outcomes? (HLQs 2 and 4)
- Chapter 5 – implications for the future (HLQ5)

Chapter 2. What were the TA outcomes?

Key points

- The first TA auction secured agreements for 803 MW of capacity for 2016/17, across 24 organisations.
- Contribution tracing indicated that the TA's contribution towards security of supply in 2016/17 was likely to be limited, but that the first TA auction was expected to help to increase volumes of DSR and small-scale generation for future CM auctions and make some contribution to encouragement of turn-down DSR.
- Interview evidence suggested that around 55% of the TA capacity was expected to be diesel generation, with up to 20% expected to be turn-down DSR.

Who participated in the TA?

Twenty-nine organisations submitted a total of 109 CMUs to the TA. All but five of these organisations proceeded to win capacity agreements for at least one of their CMUs. Thirty one of the CMUs for which applications were submitted did not participate in the auction. Reasons for withdrawing from the auction included failing to prequalify, withdrawing because these CMUs obtained agreements in the T-4 auction or withdrawing for other technical or commercial reasons (further analysis is presented in chapter 4). A further 21 CMUs were unsuccessful at auction, across five organisations. The 57 winning CMUs represented 72% of capacity participating in the auction, spread across 24 organisations.

Figure 2.1: Organisations and CMUs participating in the first TA auction

	Organisations	CMUs	Capacity (MW)
Submitted applications to TA	29	109	1580
Participated in auction	25	78	1110
Successful at auction	24 (successful on at least 1 CMU)	57	803
Unsuccessful at auction	1 (unsuccessful on any CMU)	21	297

Source: TA register, National Grid

The EMR Delivery Body identified 9 of the organisations with a capacity agreement as aggregators, and the remaining 15 as direct participants. Our interview evidence suggested that a more accurate breakdown is 13 aggregators and 11 direct participants. This is because four participants classed as direct participants by the EMR Delivery Body reported in interview that they were already putting forward capacity on behalf of clients or intended to do so in future.

Which technologies participated in the TA?

More than half of the CMUs registered for the TA were 'unproven DSR'[15] (primarily comprising back-up generation and turn-down DSR[16]). All DSR participants chose to register as 'unproven' rather than 'proven' DSR. Interview evidence indicated that this was because of the perceived difficulty of providing the historic data required to qualify for proven DSR status.

Figure 2.2 shows a breakdown of the 78 CMUs that went forward to the TA auction, representing 1110 MW of capacity. Existing generation and unproven DSR CMUs dominated the TA auction, far exceeding new build (which represented 1% of total participating capacity and 2% of winning capacity). Interview evidence indicated that organisations with new-build CMUs tended to bid into the T-4 auction rather than TA, because the longer-term agreement available in T-4 provided better support for new-build investments.

[15] 'Unproven' refers to DSR CMUs that have not yet undertaken a DSR Test, as specified in CM rules, to demonstrate that they can reduce electricity usage by a given amount, relative to baseline demand. The test involves compilation of baseline data over a 6 week period.
[16] One DSR CMU that pre-qualified but did not enter the auction comprised onsite CHP – DSR would have been provided by ramping up CHP generation and/or reducing the onsite electrical load.

Figure 2.2: CMUs participating and succeeding in the TA auction

	CMUs participating in the TA auction (put forward by 25 organisations)			CMUs succeeding in the TA auction (put forward by 24 organisations)		
CMU Type	De-rated capacity (MW)	Number of CMUs	Percentage of capacity	De-rated capacity (MW)	Number of CMUs	Percentage of capacity
Existing generation	476	29	43%	315	19	39%
New-build generation	13	2	1%	13	2	2%
Unproven DSR	621	47	56%	475	36	59%
TOTAL	**1110**	**78**	**100%**	**803**	**57**	**100%**

Source: TA register, National Grid.

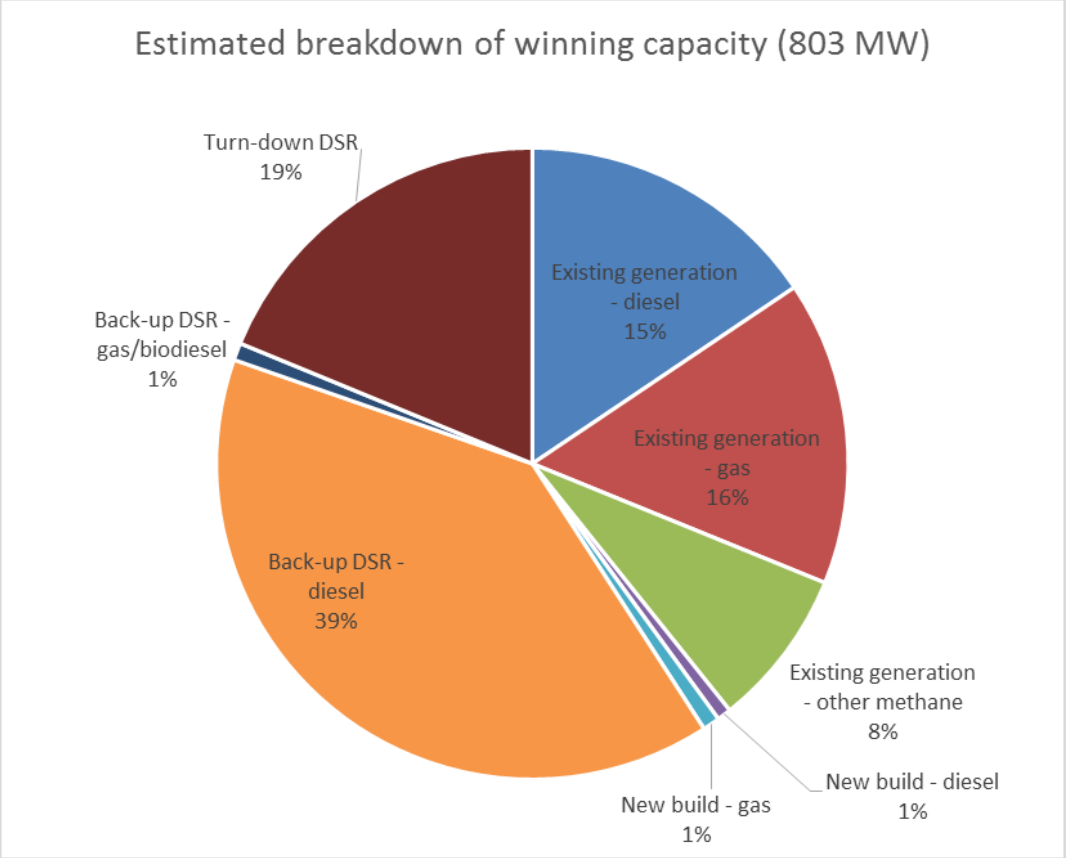
We asked participants what their proposed capacity offer consisted of, namely what type of capacity they would employ during a stress event. The resulting breakdown of capacity for CMUs winning at auction is shown in Figure 2.3.

Figure 2.3 shows that, based on estimates generated from Phase 1 interviews, diesel generation represented around 55% of the capacity winning the TA auction. Gas from a range of sources represented a further 26% of capacity, while around 19% of capacity was expected to be provided by turn-down DSR (i.e. load-shifting or load-reduction). While direct participants could accurately distinguish between 'turn-down' and 'back-up' DSR in their own operations, many DSR aggregators had to estimate the proportion of turn-down and back-up DSR within their CMUs as they were still in the process of contracting clients. The auction outcomes presented here are therefore still tentative.

BEIS had intended the TA to support the development and growth of the DSR sector, including turn down. Reasons for the low proportion of turn-down are explored later in this chapter. More reliable figures on the breakdown of capacity should become available during Phase 2 of the evaluation.

There was some evidence from interviews that aggregators had 'over-contracted' their contracted capacity (i.e. had signed up more clients than strictly needed to meet their contracted volume), because of uncertainties about the extent to which clients would be able to respond during stress events. This could mean that the total volume of capacity accessed by the TA could be higher than the procured volume.

Figure 2.3: Estimated breakdown of capacity winning the TA auction, by source



Source: evidence from interviews with TA participants

Which organisations were successful in the TA auction?

Aggregators

Interview evidence indicates that two of the 13 aggregators that were successful in the auction were providing aggregation of embedded generation, while the remaining 11 were providing aggregation services for DSR (all providing both back-up generation and turn-down). Just under half of the DSR aggregators were in the process of establishing new DSR aggregation businesses, while the remainder already had established DSR aggregation businesses in the UK or overseas. Several of the new DSR aggregators were energy suppliers that wanted to offer flexibility services to their existing client base and saw the TA as a good starting point for this, whilst two were existing aggregators that had been recently attracted to the UK by opportunities provided by the TA and wider CM.

Direct participants and aggregator clients

Interview evidence revealed that all of the direct participants were from industrial rather than commercial sectors, which enabled them to offer a significant volume of capacity. Seven out of the 11 direct participants put forward generation CMUs, while four put

forward 'unproven' DSR CMUs (two comprised back-up generation and the other two turn-down DSR). The four aggregator clients interviewed came from both the public sector and industry, as volume of capacity was less of an issue for those participating via an aggregator. While one had only recently signed up with an aggregator, the others had longer-term relationships with aggregators: two experienced clients had recently selected an aggregator through a tender process.

Level of participation in other services

Interview evidence suggested that both aggregators and direct participants involved in the TA tended to be already closely involved with Triad management and/or balancing services, particularly Short-Term Operating Reserve (STOR).

Aggregators tended to be particularly active in a range of balancing services and to be familiar with the wider CM. The services offered by aggregators in addition to the CM included STOR, Firm Frequency Response (FFR), Long-Term STOR, Demand Side Balancing Response (DSBR) and Frequency Control by Demand Management (FCDM). Some were also considering involvement in Enhanced Frequency Response (EFR) and Demand Turn Up (DTU).

Direct participants and aggregator clients tended to have experience of Triad management as a minimum, with some having experience of providing other balancing services as well. For context, a report by Energyst Media in 2015, quoted by the Major Energy Users Council, found that only 33% of businesses surveyed were participating in DSR (i.e. balancing services and/or Triad management).[17] These 118 survey respondents were Energyst readers, who may have been more aware of and involved in DSR than most businesses. The survey undertaken for this evaluation, which surveyed 169 non-participants with medium to high electricity use, drawn from a sample of organisations required to report under phase 1 of the CRC scheme, also found that a third were participating in some form of DSR (see findings in chapter 4 and sampling details in Appendix 4).

To what extent has the TA contributed to its objectives?

The TA scheme has three objectives, as presented in chapter 1. As explained in chapter 2, we treated each of these objectives as a research hypothesis.

[17] Energyst (2015) *Demand Side Response – Bringing businesses into balancing.* Open Energi and National Grid.Available at: http://theenergyst.com/wp-content/uploads/2015/08/Demand-Side-Response-report-2015.pdf. Accessed 27/7/16

Using contribution tracing, we tested support for each of the three hypotheses in turn (i.e. assessed the probability that the TA contributes to each of its objectives, based on a series of evidence tests), as well as considering the strength of the evidence for competing 'alternative hypotheses'. The contribution tracing tests were quite narrowly specified and looked only at case by case evidence from TA participants, so the contribution tracing evidence was supplemented where appropriate with wider evidence from the qualitative research, supply curve, the literature review, quantitative survey and stakeholder workshop, through the contribution analysis process.

Hypothesis 1 – TA contributes to security of supply in 2016/17

The TA leads to direct participants and aggregators making or keeping capacity available that would otherwise have been closed/mothballed or that was not part of a formal network balancing service. This capacity contributes to security of supply and/or meeting the reliability standard in the 2016/17 delivery window.[18]

Contribution tracing findings suggest that the TA contributed little to supporting capacity that would otherwise have been unavailable in 2016/17. The findings provided more support for the alternative hypothesis (i.e. that the TA generally provided bonus income for those already making capacity available). This was based on evidence about bidding behaviour in the auction (since this could indicate whether financial support from the TA was required to make capacity available), as well as interview statements about reasons for participating in the TA and whether capacity was dependent on the TA. Appendix 2 explains how the different pieces of evidence were used in contribution tracing tests.

However, contribution tracing findings did suggest that the TA supported capacity that would otherwise have been unavailable in 2016/17 for a few participants (e.g. one direct participant previously in DSBR, one new aggregator that saw the TA as a testing ground for the CM, and one existing aggregator attracted by the credit cover conditions being softer than T-4). The contribution tracing tests were applied at organisational rather than CMU level, providing less granularity than detailed interview evidence on individual CMUs. The contribution tracing presented here cannot therefore be directly translated into an estimate of additional capacity, although a more granular analysis will be applied in Phase 2 of the evaluation. Further details of contribution tracing findings for this hypothesis are presented in Appendix 6.

[18] The actual use of this capacity to deliver services to the TA, to Triad management and/or other balancing services in 2016/17 does not affect the assessment of additionality: the hypothesis is simply that additional capacity is made (or kept) available that would not have been available without the TA.

The contribution tracing drew on detailed CMU-level estimates of the proportion of capacity made newly available or retained by the TA, based on interview evidence for each CMU. The estimate of 'TA-influenced' capacity, shown in Figure 2.4, includes elements of capacity put forward by the organisations referred to above, as well as a few other organisations. For example, it also includes a small volume of new-build generating capacity, some existing generation capacity that was at risk of closure, and the estimated proportion of capacity brought forward by aggregators that was new to the market or otherwise dependent on the TA (based on aggregator estimates at the time of the research). This was consistent with reports from some aggregators that the high clearing price of the first TA auction facilitated their task of bringing in clients to fill their unproven DSR CMUs, compared to bringing in clients at the T-4 price.

> *And I think these prices are actually going a long way to have this interest from potential clients. [We're seeing] renewed interest from existing clients, and [are] able to bring on board new clients much quicker*.
>
> (TA participant, aggregator)

The preliminary CMU-level estimates based on detailed interview evidence, as shown in Figure 2.4, suggest that, at most, an estimated 29% of capacity that succeeded at auction was retained or brought forward by the TA. The categories of capacity in Figure 2.4 are defined as follows:

- 'New-build capacity' is capacity provided by investment in new plant, specifically for the TA.
- 'TA-influenced capacity' is existing capacity that, according to interview evidence, would not have been made available to the GB system without the incentive of TA revenues. Some of this is capacity previously only used for Triad, while some is existing capacity that might have been withdrawn without the TA. These estimates have been cross checked with our current estimates of costs and revenues for different types of CMUs (as presented in chapter 3): in general, the capacity reported to be TA-influenced had costs that exceeded estimated revenues from other sources (e.g. balancing services). Our estimate of TA-influenced capacity includes CMUs that had previously held DSBR contracts, as DSBR will not be tendered in winter 2016/17. If the ex-DSBR CMUs are excluded, the estimate of capacity positively influenced by the TA reduces to 17%.19 These estimates are tentative and subject to revision during Phase 2.

[19] The TA-reliant capacity includes 3 CMUs (approximately 79 MW) previously in DSBR.

- ‘Other existing capacity’ is existing capacity that, according to interview evidence, would have been available to the GB system without the incentive of TA revenues.

Figure 2.4: TA influence on capacity successful at auction

TA capacity available	De-rated capacity (MW)	Number of CMUs	Percentage of capacity (%)
New-build capacity	13	2	2%
TA-influenced existing capacity	217	17	27%
Other existing capacity	573	38	71%
Total	803	57	100%

Source: evidence from interviews with the 24 TA participants that were successful at auction, used to categorise the CMU and capacity data provided by the EMR Delivery Body.

The contribution tracing findings and these estimates of TA-influenced capacity will be refined and updated during Phase 2 of the evaluation, when the composition of TA CMUs is better defined. The details of TA capacity may change in Phase 2 both because of aggregators finalising their CMUs and because of CMUs having to meet metering and DSR testing requirements.

Hypothesis 2 - TA contributes to more competitive capacity for future T-1 auctions

The TA leads to more (competitive) capacity for the T-1 auction in 2018/19 and subsequent years.

The contribution tracing findings suggest that the TA will make a contribution towards more competitive capacity for the T-1 auction in 2018/19 and future years. The contribution tracing findings for this hypothesis are based on evidence about participants’ stated plans for T-1, their interview statements about the expected impact of the TA on competitiveness of future T-1 auctions, and their observed behaviour in earlier T-4 auctions (since prior participation in T-4 would generally indicate that they could already compete in the main CM without access to the TA). The contribution towards more competitive capacity for future T-1 auctions was supported by evidence from both direct participants and aggregators: most planned to bid into the T-1 themselves (or into the ‘early’ auction in 2017/18), and almost all commented that the TA would help to develop higher volumes in the market for future T-1 auctions. In the contribution tracing tests, self-reported statements of this type were given less weight than observed behaviour in the CM.

Participants generally felt that the TA would lead to increased capacity in future years, despite evidence that it had made only a limited contribution to capacity that would otherwise have been unavailable in 2016/17. In interviews, some participants reported that an attitude shift was needed to facilitate greater take-up of DSR in the longer term and that the TA was helping to influence attitudes.

> *[The] key element of TA is the attitude change. A lot of companies don't presently view their electrical loads as something that could be curtailed or their embedded generation powered up/down for financial benefit. This will take some time.*
>
> (TA participant, DSR aggregator)

Interviews also provided evidence of six new entrants to the DSR aggregation market in the UK that had been influenced to some degree by the TA. Both TA participants and non-participants commented in interviews that the TA would provide a runway to allow aggregators and DSR providers to build up portfolios in advance of the main CM. The TA's lower credit cover was reported to reduce the risk for those building up their portfolios of unproven DSR, as they stood to lose less money if they could not provide evidence for their predicted volume of DSR.

> *Due to the lower risks involved, [..] the lower penalties [sic] and lower credit cover, I think that it encourages people to get involved. You've kind of got a bit of a safety net for trial and getting into the markets, and it allows you to roll on more easily.*
>
> (TA participant, new aggregator)

However, some TA participants reported in interviews that they viewed the TA simply as an early T-1 auction that would enable them to generate early revenue. These participants included some existing generators (as they saw no benefit from the softer credit cover available to unproven DSR and new build generation in the TA) and also some of the more experienced aggregators that reported being already confident to bid into a T-1 auction. A few providers of both DSR and generation reported that they were attracted to the TA because they could not plan far enough ahead to bid into the T-4 auction, so they also viewed it as a substitute for a T-1 auction.

Overall, Phase 1 evidence suggested that the TA would encourage greater (and more competitive) capacity to come forward for T-1 auctions in 2018/19 and future years, but that some players would have probably have participated in T-1 without help from the TA.

Hypothesis 3 - The TA leads to wider encouragement of turn-down DSR

The TA leads to wider encouragement of turn-down DSR.

There is limited evidence that the TA has provided wider encouragement for turn-down DSR in the short term. Contribution tracing results showed some contribution towards

wider encouragement of turn-down amongst new aggregators of DSR, but little contribution amongst existing aggregators and direct participants. This was based on interview evidence about any strengthening of participants' long-term strategic commitment to turn-down DSR, about investments in new turn-down DSR capacity, about first-time involvement with turn-down DSR and about participants' future plans for bidding turn-down DSR into the CM.

Estimates prepared from interview evidence suggests that around 19% of capacity in 2016/17 could be turn-down DSR (see Figure 2.3 above). This comprises existing turn-down put forward by direct participants, plus a component of turn-down DSR within aggregators' unproven DSR CMUs in 2016/17 (which generally reported turn-down in the range 10-20% for these CMUs).

Qualitative research found limited evidence of direct participants and aggregator clients being encouraged by the TA to provide turn-down DSR that would otherwise have been unavailable in 2016/17. Current evidence suggests that less than 5% of the capacity contracted in the first TA auction is likely to be 'newly available' turn-down DSR, although this estimate is tentative and will be refined during Phase 2 of the evaluation.

Those organisations already providing turn-down DSR indicated in interview that they were already committed to it and were providing the maximum that their operational constraints allowed. Many organisations not involved in turn-down DSR thought that the operational implications of turn-down for their core business were much more challenging than those associated with back-up DSR: switching equipment on was regarded as easier than switching it off. Aggregators also reported in interview that the attitude change required to bring forward turn-down DSR was greater than that required to bring forward back-up DSR.

> *[..] the impact [of turn-down DSR] on their business is higher. [It's] as simple as that. They're okay to switch on a generator but not so okay to switch off [..] a pump, or [something] that is used for producing the goods.*
>
> (TA participant, DSR aggregator)

However, a couple of industrial direct participants that bid back-up or generating capacity into this year's TA, and that already provide turn-down as part of their Triad-management strategy, thought that the TA might encourage their organisations to bid turn-down into the TA as well in future. But one of these organisations was concerned that TA participation might put Triad revenue at risk (see further discussion in chapter 3).

There is some other evidence from interviews that the TA may encourage the development of turn-down DSR in the medium term. As noted under hypothesis 2, the TA was reported to have played a role in encouraging six new entrants to the DSR aggregation market in the UK. These new entrants reported in interview that they expected

to participate in the future CM and to build up DSR provision in the medium term, including some turn-down DSR.

There were mixed views on the attractiveness for turn-down DSR providers of the TA/CM compared to frequency-related services. No aggregators offering solely turn-down DSR progressed through to a capacity agreement: one was unsuccessful at auction, while others reported in interview that they chose to retain frequency-related contracts that were more profitable than the TA. Some organisations participated in both the TA and frequency-related services, but one non-participant suggested that DSR capacity providing FFR services could not pass the DSR test required for the CM[20].

Some stakeholders at the workshop commented that industrial and commercial organisations were more likely to accept the short turn-down periods required for frequency-related services than the longer turn-down periods potentially associated with CM stress events, for operational reasons. For example, one stakeholder with considerable knowledge of DSR providers reported that refrigeration and air conditioning equipment could not generally be turned down for more than 1 hour without causing problems with food spoilage or client dissatisfaction. There was also evidence of a non-TA aggregator claiming online that frequency services were more attractive to clients than DSR services[21].

However, the literature review suggested that aggregators could play a role in 'temporal aggregation', pulling together short turn-down slots across a range of clients to cover a CM stress event[22]. In addition, some direct participants reported in interview that they could not offer frequency services (e.g. because of safety concerns and the automatic controls involved).

> *I'd very much like to find an opportunity to do [frequency response] but for the larger [..] sites, while they are the most energy intensive, they're also very led by process safety. [..] It's a little bit frustrating for me because I sense that's the highest value product but the safety stuff has to come first.*
>
> (TA participant, DSR)

[20] It was suggested that this because the very short-term changes in capacity provided for FFR would not be apparent across a half-hour DSR test.
[21] Endeco Technologies (2016) *Earn Revenue from Frequency Response | Money.* Accessed 27/7/2016 Available at http://endeco-technologies.com/index.php/go/forget-demand-response/. response/?keyword=demand%20response&gclid=CJ_bp5_iz80CFUEaGwodg1QALA
[22] Grunewald, P. and Torriti, J. (2013) "Demand response from the non-domestic sector: early UK experiences and future opportunities." *Energy Policy*, 61 (October). 423-429.

Overall, while there were some concerns about whether the CM was feasible and attractive for turn-down DSR, compared to frequency services, there was also evidence that the TA would play some role in encouraging turn-down DSR to come forward to the CM in the medium term.

Were there any unintended outcomes?

We considered whether there would be unintended environmental impacts of capacity provided via the TA. As shown in Figure 2.3 above, diesel plant is currently expected to represent about 55% of capacity provided in the first TA auction. However, since little of the capacity is available solely for the TA and running hours for stress events are generally expected to coincide with running hours for other schemes (e.g. Triad, STOR), the additional carbon impact should be minimal.

Chapter 3. Did the TA represent value for money?

Key points

- A full assessment of the TA's value for money would need to compare the cost of the TA with the cost of alternative means of achieving the three TA objectives, which is beyond the scope of this evaluation.
- The clearing price of £27.50/kW appeared high relative to our estimates of underlying supply costs, particularly for capacity already available to the market by other routes.
- The relatively low volume of capacity brought forward to the TA (relative to demand curve parameters) contributed to the high clearing price.
- But the TA is expected to generate future benefits in terms of improving liquidity of future CM auctions by bringing on more, and more experienced, capacity.

Approach to value for money

We were guided by the National Audit Office (NAO)'s recommendations on assessing value for money. The NAO defines overall cost-effectiveness as 'the optimal use of resources to achieve intended outcomes'.[23]

In the context of the first TA auction, we therefore need to examine the relationship between the benefits generated by the TA (measured against each of the three main objectives, as discussed in chapter 2) and the cost of generating these benefits. The cost of the TA is directly related to the level of the clearing price in the auction.

We have not been able to undertake a fully quantified assessment of value for money in this report. This is partly because the contribution of the TA to its objectives cannot yet be fully assessed (e.g. because the composition of CMUs was not defined at the time of research, and the delivery of TA capacity during a stress event had not been tested). More fundamentally, a full assessment of value for money would need to compare the costs and

[23] National Audit Office (2016) *Assessing Value for Money – Successful Commissioning Toolkit*. Available at: https://www.nao.org.uk/successful-commissioning/general-principles/value-for-money/assessing-value-for-money/. Accessed 27/7/2016.

benefits of the TA to alternative ways of contributing to flexible capacity and security of supply. For example, the costs of the TA could be compared to the cost of new open-cycle gas turbines, the cost of extending National Grid's balancing services or the cost of buying increased volumes with TA-style conditions in T-4 or other CM auctions. But this would require consideration of whole system costs in the CM and wider electricity market impacts which is beyond the scope of this evaluation.

This chapter therefore focuses more narrowly on whether the Government could have spent less on the TA to achieve the same outcomes. In particular, we examine whether the clearing price in the first TA auction was too high. We have done this in three ways.

- Firstly, we modelled the costs and revenues and hassle costs associated with different types of capacity participating in the first TA auction, using industry sources supplemented with data from interviews. During interviews we asked participants whether they were dependent on the TA in order to remain operational for the delivery year. If TA-dependent, we modelled all categories of costs and revenues (including the 'hassle costs' of participating in the TA)[24]; if not TA-dependent, we assumed they would simply seek to recover hassle costs from the auction price. From this we have developed a supply curve for the first auction, presenting our estimates of the 'missing money' for plant[25]: i.e. the money that we estimate this plant would need to cover its costs. The supply curve suggests a 'modelled clearing price' at which we estimate the auction could have cleared if our estimates are accurate, and if the auction was fully competitive.

- Secondly, we compared this 'modelled clearing price' to the actual auction clearing price to consider whether the marginal plant (i.e. the last element of capacity clearing the auction) has been overpaid. We also consider perceptions of the clearing price and reasons why the auction cleared at this price.

- Thirdly, we compared the actual clearing price to prices of other services, with the caveat that these are not directly comparable to the TA.

As the TA was a 'pay as clear' auction, all participants who were successful received the auction clearing price. It is inherent in the design of a 'pay as clear' auction that the clearing price will be higher than the missing money for the majority of successful participants, other than the final element of capacity where the demand curve and supply

[24] 'Hassle costs' are the cost directly associated with TA participation. This could include marketing effort by aggregators, the cost of time spent on the TA application and auction, and the cost of new metering or controls specifically required for the TA.
[25] 'TA-dependent' or 'TA-influenced' plant means generating capacity (or DSR capacity) which would not be available without TA support. We have used interview evidence to identify capacity that would not have been retained without TA support, or would not have come forward without the TA.

curve intersect, i.e. the point at which the auction clears. However, bidding strategies are likely to differ between 'pay as clear' auctions (where participants tend to bid their own supply costs, knowing that they will receive the clearing price if successful) and 'pay as bid' auctions (where participants' bids are influenced by their estimate of the bid price for the last unit likely to clear the auction). In general, auction theory[26] suggests that there is no systematic or documented difference in the costs of running auctions that are 'pay as bid' or 'pay as clear' that applies in all circumstances and no specific reason to believe that either format would result in higher costs for the TA.

Modelling 'missing money'

We have estimated minimum bid prices for participants based on the 'missing money' they would be expected to seek to recover from the TA. In cases where capacity is already available to the market and the TA is simply topping up existing revenues (i.e. the capacity is not TA-dependent), we assumed they will only seek to recover their 'hassle costs' associated with participating in the TA. We cross-checked that our estimates of overall revenues generally exceeded our estimates of overall costs for plant-types that were reported not to be TA-dependent. Where participants told us that they were relying on TA revenue to make capacity available to the market, we modelled stacked costs (including carbon costs) and revenues for their stated investment horizon.

The resulting supply curve for all types of capacity calculates the minimum price at which different types of capacity would be expected to come forward into the TA auction. Generally, as the price escalates, more capacity is able to turn a profit and come online. The supply curve work has drawn on evidence collected from the interviews about the costs and revenues associated with different types of CMUs, as well as the team's own modelling of fuel costs, carbon costs and wholesale electricity prices. In addition to interview evidence, the following modelling assumptions were used.

- Capital expenditure, operating cost and maintenance cost assumptions for reciprocating diesel engines were taken from Leigh Fisher Jacobs report.[27]
- Capital expenditure, operating costs and maintenance costs for CHP district heating were taken from Element Energy work for the Committee on Climate Change.[28]

[26] Vickrey (1961), *Counterspeculation, Auctions and Competitive Sealed tenders,* Journal of Finance, 16, 8-37.

[27] Leigh Fisher Jacobs (2015). *Electricity generation costs and hurdle rates. Lot 3: non-renewable technologies.* Prepared for DECC, February 2015. Draft.

- All other operating and maintenance costs were taken from Leigh Fisher Jacobs.
- Fuel costs, including wholesale electricity prices, were from DECC's Updated Emissions Projections.[29]
- Carbon costs were from the Carbon Price Support (CPS) rates published by HM Revenue and Customs.[30]

The supply curve results should be treated with some caution, especially with respect to DSR, because TA participants were not able to provide information on the opportunity costs of turn-down DSR so we do not have any opportunity costs factored into the modelled supply costs. The estimated costs in the supply curve may therefore be too low.

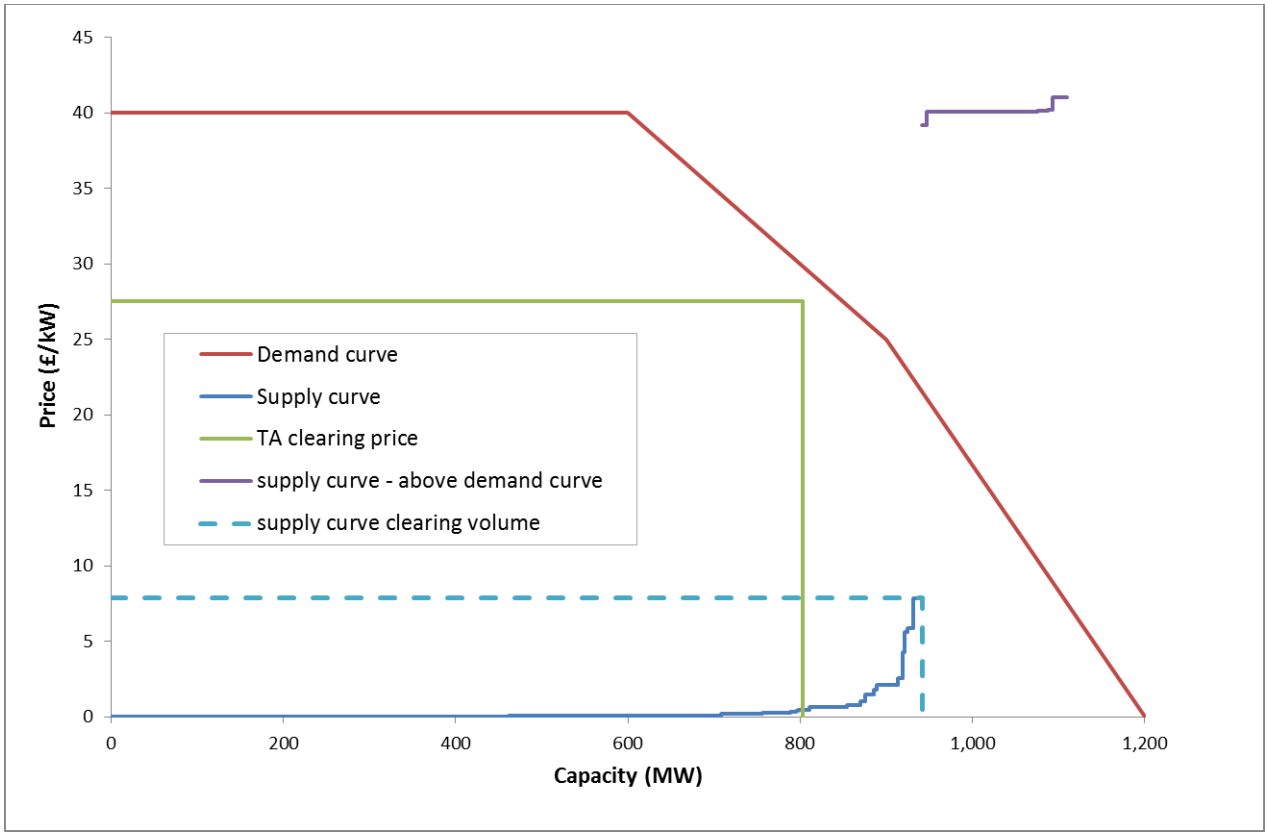
Figure 3.1 presents the supply curve, together with the EMR Delivery Body's demand curve and the clearing price for the TA auction. The supply curve is presented in two parts:

- Up to 942 MW, the supply curve represents the modelled 'missing money' costs (assumed to be hassle costs only, except for TA-dependent plant). These costs are well below the demand curve for the auction.
- Above 942 MW, the supply curve represents the opportunity costs of TA participation, inferred from interview data and the behaviour of participants that submitted high bids and were unsuccessful at auction. These opportunity costs are above the demand curve.

The supply curve clearing price is around £7.90/kW. This is the 'missing money' for the final element of capacity before the demand curve and supply curve intersect. It is the price at which we estimate the auction would have cleared if the auction was fully competitive and if our modelling assumptions were correct. For the reasons given above, the supply curve cost estimates (and hence also this clearing price) may be too low.

[28] Element Energy, Frontier Economics, Imperial College London (2015). *Research on district heating and local approaches to heat decarbonisation.* A study for the Committee on Climate Change.
[29] DECC (2015). *Updated energy and emissions projections:* Annex M: growth assumptions and prices.
[30] HM Revenue and Customs, undated. Carbon price floor: reform and other technical amendments. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293849/TIIN_6002_7047_carbon_price_floor_and_other_technical_amendments.pdf

Figure 3.1 Modelled supply curve for first TA auction



Source: Consultants supply curve model.

The initial flatness of the supply curve up to around 500 MW capacity is consistent with findings elsewhere that much of the capacity made available to the TA is existing capacity that is not reliant on the TA to remain operational. Some of this is baseload capacity which is already generating continuously, while some is back-up generation or turn-down DSR that is already participating in peak demand management via Triad management and balancing services. Interview evidence did not identify any investment costs involved in providing this capacity (i.e. the capacity that is not dependent on TA revenues), only the transaction costs of participating in the TA (referred to above as 'hassle cost').

It is uncertain how many stress events there will be during the 2016/17 delivery window. Some participants agreed in interview that the marginal cost of meeting TA obligations during stress events is expected to be minimal as they expect stress events to coincide with Triad and delivery windows for other services (e.g. STOR).

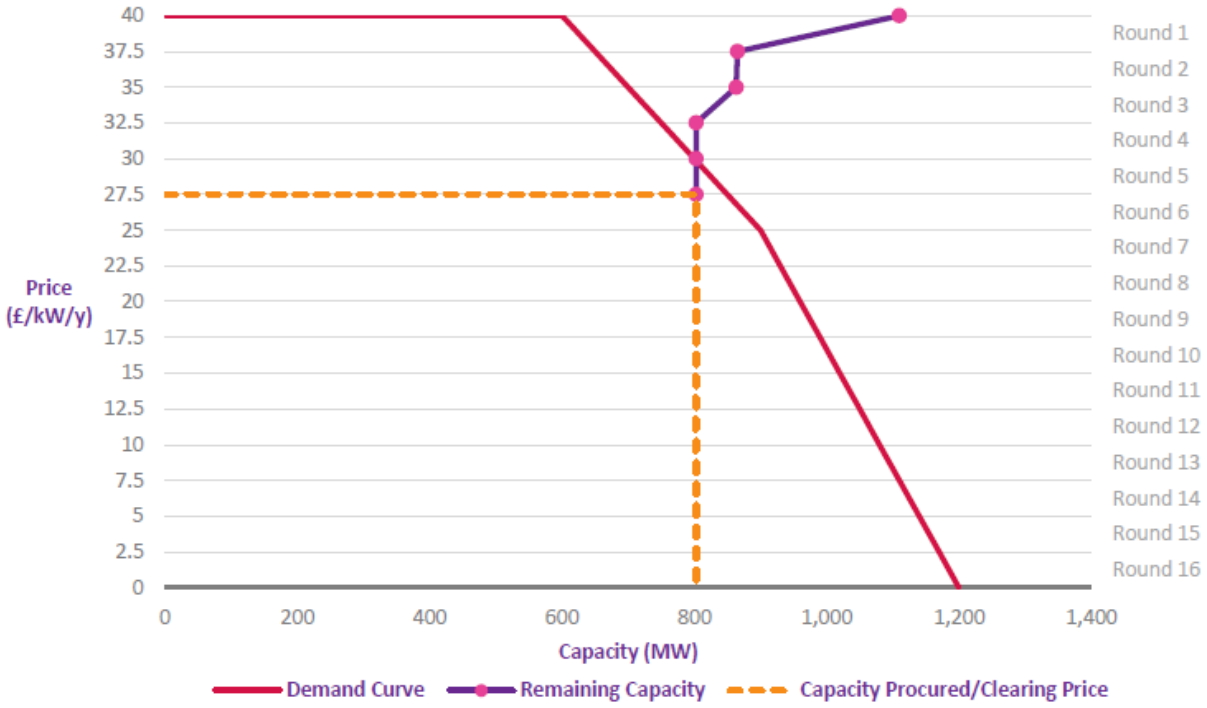
The supply curve modelling estimates the marginal cost of capacity, beyond 500 MW, up to the participating volume of 1110 MW. Hassle costs were as reported by participants, or were modelled using reported costs as a starting point. Generally, hassle costs were higher for multi-site CMUs, for sites which needed to install new metering to participate in the TA and for aggregators bringing in new clients.

The highest points on the supply curve represent TA participants who reported high opportunity costs (e.g. because they stood to lose revenue from incompatible services if they contracted in the TA). This is because CM rules do not allow CMUs with Long Term STOR or DSBR contracts to participate in the TA, to avoid overpayment for the same capacity. It is not clear how much gaming there was by participants, i.e. whether those entering high exit prices genuinely hoped to win in the auction, on the grounds that high prices would compensate them for the costs (or opportunity costs) involved in contracting these CMUs, or whether a few CMUs were priced high with the aim of losing and hence reducing the liquidity of the auction.

Comparison to actual auction results

As shown in Figure 3.2 below, the first TA auction cleared at £27.50/kW, significantly above the estimated supply curve clearing price. The clearing volume was 803 MW, so the total cost of capacity procured in the first TA auction was slightly more than £22 million. If the auction had cleared at the supply curve clearing price of £7.90/kW, as currently modelled, the cost of purchasing 803 MW would have been £6.3 million. As noted above, this estimate may be too low owing to incomplete cost information in the supply curve.

Figure 3.2: Outcome of TA auction



Source: Provisional results of TA auction, 2016 – published by the EMR Delivery Body

Positive perceptions of the TA clearing price

Almost all TA participants were pleased with the clearing price of £27.50/kW for the first TA auction, which exceeded their expectations. This implies that, for many, a lower price would have been sufficient for them to make or keep capacity available. Those offering existing generation capacity tended to be particularly pleased with the price.

> *It was certainly higher than I expected. We were pretty satisfied with it.*
>
> (TA participant, back-up generation)

Some aggregators told us that the clearing price was aligned with the price they needed to attract clients, particularly new clients. One direct participant also felt that the clearing price was justified given perceived risks to their Triad revenues and the possibility of multiple stress events.

> *I was pleased to see that my view came true and it is a significant contribution to the site's fixed costs. But if we were doing that as a time banded product and we were trying to cover our Triad exposure, it was still some way off. Remember, it is only a one-off fee and it is capacity that's available to National Grid for every day of the year and we don't get any additional payment for utilisation.*
>
> (TA participant, turn-down DSR)

We have little hard evidence of the scale of opportunity costs of DSR, which are likely to vary widely between different sectors and processes, so it is difficult to cross-check these reported views. Given that most aggregators were bidding without having signed up clients, and could not know the opportunity costs of their eventual clients, their bid prices may have 'priced in' an element of uncertainty in business and process impacts.

As reported by the TA participant above, there could be interactions between Triad management and CM stress events for DSR (but not generation), depending on whether Triad warnings happened to fall within the periods used to calculate DSR baselines for a stress event.

Other views on the clearing price

As outlined in chapter 2, and as expected by BEIS, providers of new-build generation did not generally feel that the TA offered sufficiently long contracts to provide an adequate rate of return on potential generation investments at the TA clearing price.

Some providers and aggregators of turn-down DSR did not regard the return offered by the TA as sufficiently attractive for them to relinquish existing contracts for frequency-related services, such as the FFR or FCDM, which some perceived to be incompatible with the TA. Interview evidence from both participants and non-participants suggested that frequency-related services were as or more profitable than the TA, for those organisations

that could offer them. For example, one aggregator client ranked the scale of their organisations' revenues (for their proposed activities) in descending order, as follows: Triad revenues, FCDM and then the TA/CM.

There was also evidence from auction behaviour, and from interviews, that a few providers chose to retain other incompatible contracts in place of the TA. These were Long-term STOR contracts (now closed to new entrants) or DSBR contracts (at the time of research, it was expected that this scheme would be extended into 2016/17[31]). While some participants were expecting to retain DSBR contracts in 2016/17, at least one TA participant left a DSBR contract to enter the TA[32].

Reasons why the auction cleared at this price

The high clearing price for the first TA auction may reflect the relatively low volume of capacity submitted to the auction. Because of low volumes registering, BEIS reduced the target capacity for the auction from 1500MW to 900MW just before the auction, because of concerns that the auction would have been illiquid at its original volume. This decision was criticised by two aggregators as they had developed their strategy on the basis of the higher capacity figure and were disconcerted by this late change in the size of the market. One interpreted this as a change in BEIS's commitment to procure a given volume of DSR and small-scale generation capacity at a price up to the cap price of £40/kW. There is evidence a few participants may have compensated for the last minute change in parameters through their bidding behaviour (e.g. by bidding high on certain CMUs so that they were unlikely to clear).

The high clearing price may also have been influenced by the relatively high number of CMUs that exited in Round 1, at prices close to the price cap (see outline of bidding strategies in chapter 4). The high-bidding CMUs were a mix of generation and DSR. Interview evidence suggests that the generation CMUs bid high because of the opportunity cost of losing revenue from incompatible schemes (as discussed above), while the DSR CMUs reportedly bid high because higher prices would have enabled them to attract more DSR clients.

Comparison with other capacity prices

Great care must be taken in drawing comparisons between TA prices and other capacity prices, because there is no direct equivalent of the TA. With this caveat in mind, this section considers how TA prices compare to prices for T-4 capacity and balancing services.

[31] In August 2016 National Grid decided not to procure DSBR for winter 2016/17.
[32] This particular participant was only able to participate in 1 hour out of the 4 hour DSBR time period.

The TA clearing price of £27.50/kW (2016 prices) is higher than the clearing price of £19.40/kW (2012 prices) in the 2014 T-4 auction, and the price of £18.00/kW (2014 prices) in the 2015 T-4 auction. However, the T-4 auctions covered a wider range of capacity (not restricted to small-scale generation and DSR), and offered (and attracted) much larger volumes at auction.

There is currently no agreed common basis on which to compare TA prices with the price of balancing services, owing to the variations in the type of contract payments, the length and number of despatch requests, the notice periods and risks associated with each service, particularly given that the TA has wider objectives to grow and develop the sector.

Interview data suggests that the TA price is higher than typical prices for STOR contracts (reported to be £5-15/kW) and DSBR (reported to be £16/kW). But these services differ from the TA in offering both availability and utilisation payments, and in requiring different numbers of turn-downs in specified windows, with different penalties for non-compliance. The number of operational hours reported for STOR varied widely, from 10-20 per year to 150 hours per year; this will depend on the type of STOR contract held.

However, interview data suggested that Triad management and frequency services could offer higher rewards than the TA. For example, interview data suggested that Triad management could generate £30-40/kW, but that Triad could involve 30-60 hours of DSR or generation operation per year. This is why almost all participants reported that they would not compromise their ability to respond to Triad as a result of a TA agreement (i.e. successful participants would be earning both TA and Triad revenue).

No direct data was available on the revenue available from frequency response services but publicity materials produced by an aggregator in 2014 suggested that up to £70/kW could be generated through these services.

Bearing in mind the caveats about drawing comparisons between different services, TA payments appear to be higher than those available through STOR and DSBR, but lower than those available through Triad (and possibly frequency response services).

Implications for value for money of the TA

Our conclusions on value for money in the TA scheme are incomplete and limited, for the reasons outlined at the start of this chapter. The tentative findings from Phase 1 are that the actual clearing price was high relative to the supply curve clearing price, because of the low estimated marginal cost of much TA capacity (although modelled costs do not yet include the opportunity costs of turn-down DSR). While this is relevant when considering the cost-effectiveness of the auction, it is important to consider that limited information was available on the opportunity costs of TA participation, and that a full assessment of value

for money was beyond the scope of this evaluation. The high clearing price may also reflect the lower than expected volume that came forward for the auction.

In response to the outcomes of the first auction, BEIS has amended the eligibility criteria for the second TA auction and has excluded all generation, including back-up generation. The second auction will be restricted to turn-down DSR, with the aim of preventing generation from crowding out turn-down DSR and better targeting funding to DSR resource that need it most. With the introduction of the Early Auction, BEIS aim to ensure that mature generation and DSR capacity brought forward by the TA will be able to participate, thereby increasing liquidity and helping to lower costs.

A fuller assessment of value for money would need to take account of the TA's contribution to its objectives, and the cost of the TA compared to alternative methods of achieving these objectives. While the TA's contribution to security of supply in 2016/17 is expected to be limited, the TA is expected to introduce volumes of existing small scale generation that operates in Triad avoidance into formal services and to increase volumes of DSR for future CM auctions (including some turn-down DSR). It is possible that high prices may be required initially to encourage more DSR to come forward.

Greater volumes in the first auction might have resulted in a more competitive auction and a lower clearing price, but a lower price might in turn have provided less encouragement for growth in DSR, particularly turn-down DSR. There is some evidence, as discussed in chapters 2 and 4, that growth in turn-down DSR would be difficult to achieve at the lower clearing prices seen in the T-4 auctions to date. Interview evidence suggests that TA participants are attracted by the ability to 'stack' revenues from the TA with those from Triad management and balancing services.

Further evidence will be generated during Phase 3 of the evaluation (which examines the second TA auction), to assess whether the high price achieved in the first auction stimulates more interest from turn-down DSR in the second auction and encourages growth in this sector, thereby helping BEIS to achieve its multiple objectives of growth, security of supply and sustainability. The future outlook for the TA is discussed further in chapter 5.

Value for money will also be affected by whether TA participants actually deliver capacity in response to stress events during the relevant delivery year, and how reliable this capacity will be in terms of its contribution to system security. These issues, and the role of the TA as a pilot which may generate learning for future CM auctions, will be further assessed during Phase 2 of the evaluation.

Chapter 4. What factors contributed to the TA outcomes?

Key points

- Our survey of 169 medium to high electricity users found low levels of awareness of the TA and its potential opportunities.
- The majority of TA participants had prior experience of providing capacity, either via the flexibility market (in the UK or abroad) or via Triad management.
- Evidence from aggregator clients suggested that participating via an aggregator was seen as less burdensome and risky than direct participation.
- Some experienced DSR aggregators chose to contract through T-4, while others - including newer aggregators – were attracted to the TA by near-term revenue, 1-year lead times and/or softer conditions than the main CM.
- While 21 CMUs bid close to the auction price cap (suggesting high costs or opportunity costs of TA participation or possibly gaming), the majority of CMUs accepted the clearing price or submitted low to moderate bids (consistent with low costs for those elements of capacity already available to the market).

This chapter considers how and why the TA contributed to the outcomes outlined in chapters 2 and 3 (addressing HLQ2 and HLQ4). It presents evidence relating to the first three steps in the TA process as shown in Figure 1.2. Findings were analysed using the hypothesised CMOs from the initial theory of change as a basis, to help identify the 'how' and 'why' of TA influence. Findings were then used to revise the CMO combinations and prepare a revised theory of change for steps 1-3, as presented in Appendix 2. Evaluation of steps 4-6 will be undertaken in Phase 2 of the evaluation.

Step 1: awareness and interest in the TA scheme

This section presents evidence about the different reasons behind organisations' awareness of and interest in the TA auction.

Organisational potential to participate

We used the quantitative survey to research how far likely candidates for the TA had an electrical load or generating capacity suitable for TA participation (or were willing to install such capacity), and how far they were willing to consider managing this load or generating capacity to generate revenue. We identified a sample of 'likely candidates' from a list of

organisations with medium to high electricity use[33], on the grounds that they were significant users of electricity and might have a suitable load.

Figure 4.1 presents evidence from the resulting survey of 169 organisations which shows that 33% of survey respondents had generation or DSR capacity and were already participating in a scheme to generate revenue from this. Most of those active in this area were involved in Triad management (30% of all the 169 organisations surveyed) and many were also involved in Red Zone management (14%) or local arrangements with suppliers or Distribution Network operators (17%), while far fewer were involved in balancing services (8% or less for each scheme). Some organisations were participating in more than one of these schemes concurrently.

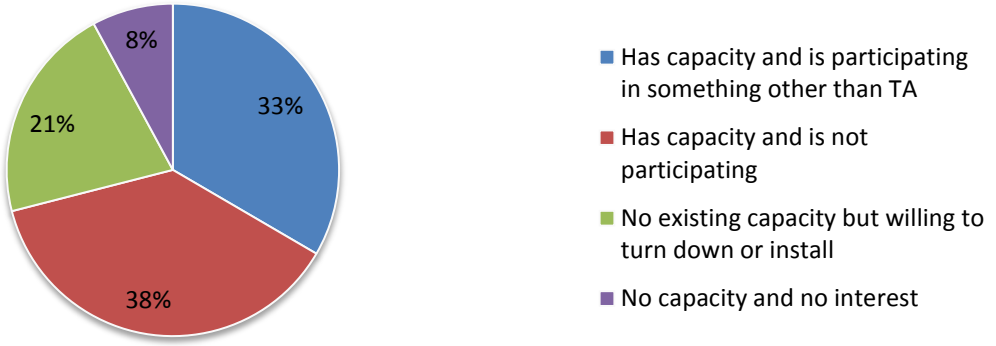
An additional 38% of respondents reported that they had existing capacity for generation (embedded or back-up) or were already managing the timing of their electricity consumption (e.g. at peak times) but were not currently involved in flexibility schemes. A further 21% had no current capacity but indicated they might be willing and able to either install generation capacity or manage their peak electricity use if there was a business case to do so.

This appears to imply that between 38-59% of organisations with medium to high electricity use are not currently involved in providing flexibility through DSR and embedded generation, and might be willing to get involved in future if there was a business case for this. A report on the *Future potential for DSR in GB*[34] also found that there is significant long-term potential for DSR services in the UK, albeit with large uncertainties around DSR's current potential and how it will develop over time.

[33] As noted in Appendix 4, these are organisations that reported electricity consumption above 6,000 MWh in 2008, the qualification year for phase 1 of the CRC scheme.

[34] Frontier Economics Ltd, LCP, and Sustainability First (2015). *Future Potential for Demand Side Response in Great Britain.* Department of Energy and Climate Change. https://www.gov.uk/government/publications/future-potential-for-demand-side-response-in-great-britain. Accessed 27/7/2016.

Figure 4.1: Willingness and capacity (Population =2859, Sample=169)



Source: quantitative survey with high and medium electricity users (drawn from CRC Phase 1 participants)

Low levels of awareness of the TA and the wider CM

Awareness of the TA and wider CM was low amongst survey respondents, despite 92% of them having either existing embedded generation or DSR capacity, or a willingness to install or provide it (see Figure 4.1). A high proportion, 86% of the respondents, said they were not aware of the TA, while 73% were not aware of the wider CM.

Reasons for low levels of awareness citied in the interview evidence were as follows.

- Limited publicity about the scheme, which was mainly provided through existing channels of communication about the CM and the wider flexibility market, and primarily reached organisations already 'plugged in' to National Grid and BEIS.
- Relatively low levels of awareness amongst potential direct participants and aggregator clients about DSR more generally as a business opportunity[35].
- Perceptions amongst many organisations that flexibility provision is not 'core business' for them, and therefore a potentially risky distraction, particularly in smaller organisations.
- A lack of organisational capacity to engage with and understand the flexibility market, particularly in smaller organisations.

Limited awareness of the scheme may have constrained the volumes coming forward to the auction and hence reduced competitiveness and value for money in the auction.

[35] Both our quantitative survey and Energyst Survey (2015, op cit) found that only a third of potential TA participants were engaged with DSR.

Routes to awareness

Interview evidence indicated that organisations that became aware of the scheme did so through two main routes:

Being 'plugged-in'

Some organisations were 'plugged-in' to the existing flexibility sector, for example through National Grid communications, forums and workshops, through the Association of Decentralised Energy or through general 'market outlook' services. It is likely that these were all organisations who were already pro-actively considering opportunities in this market.

Through aggregators

This route provided a 'way in' to the TA for organisations who were less 'plugged-in' to the flexibility sector, who thought the CM was too complex to understand and engage with on their own, or considered it too risky to participate in as a single entity. Our search of the literature highlighted the important role that intermediary organisations can play in assisting customers to participate in DSR, for example by overcoming the minimum threshold of schemes, helping to reduce the cost of entry and managing risk for participants.[36]

Reasoning behind interest in scheme

Direct participants

From interview evidence, we found that those attracted to provide their own capacity to the TA tended to be organisations with prior experience of peak demand management (particularly Triad) and possibly some experience of other balancing services (e.g. STOR, DSBR). Those interested in direct participation tended to have slightly more capacity for dealing with scheme administration and more confidence in their understanding of the CM. In interview, many direct participants reported that they found participation challenging, but they persevered because of the potential rewards.

[36] See Grünewald and Torriti (2013, op cit), together with:

- Cook, M., Potter, S., Langendahl, P-A. Roby, H., Collins, T., and Taylor, D., (2015), *Exploring the role of intermediaries in smart grid developments*, Sustainable Innovation 2015, 9 - 10 November 2015, Epsom, Surrey

- He, X., Hancher, L., Azevedo, I., Keyaerts, N., Meuss, L., Glachant, J-M (2013), *Shift, Not Drift: Towards Active Demand Response and Beyond,* Final Report: June 2013

Aggregators

Interview evidence suggested that the TA attracted existing aggregators with clients in the CM or balancing services, who reasoned that the TA offered an additional source of revenue they could offer to clients. It also attracted a number of potential new DSR aggregators with existing client bases (e.g. energy suppliers, Combined Heat and Power (CHP) operators) because it offered them a relatively low risk opportunity to enter the aggregation market in Great Britain (GB), with lower credit cover than the main CM. Similarly, the TA played a role in attracting some experienced DSR aggregators from overseas to GB, by increasing the revenue available for DSR activities. However, some aggregators offering solely turn-down DSR reported that they were not attracted to the TA because short-term, automatically controlled frequency-related services were more attractive to their clients.

Aggregator clients

The limited evidence gathered from interviews with aggregator clients suggested that some organisations with suitable loads or onsite generation chose to participate via an aggregator rather than directly. This option involved lower administration and management time, a ‘one-stop shop’ for flexibility services and a trade-off between lower risk (since the aggregator generally provided support and CM knowledge) and lower reward (since TA payments would be shared in some way between the aggregator and client).

Interviews with aggregator clients also suggested that aggregators could help organisations to overcome ‘the complexity barrier’. A common view amongst participants and non-participants was that there was a ‘confusing’ and ‘vast’ amount of detail about the TA on the EMR Portal and elsewhere. The result was that understanding the scheme’s rules and regulations could be challenging, time-consuming and off-putting for potential participants. Participation through an aggregator involved partially offloading this complexity onto the aggregator.

Our limited sample suggested that there may be quite a wide variation in the deals offered by aggregators. Few respondents were willing to divulge the revenue split but the limited evidence available suggested that aggregator shares ranged from 10% to 50% of flexibility revenues (these figures were not necessarily specific to the TA). Two of the four clients interviewed ran tendering processes to choose the aggregator offer that suited them best (typically tendering for flexibility services generally rather than just the TA).

Step 2: submission of applications to the TA

This section presents evidence about the rationale behind organisations’ decisions about whether to apply for the TA.

Reasons for applying to the TA

In interview, most TA applicants demonstrated awareness of a wide range of flexibility market options, ranging from the TA and main CM to National Grid's balancing services. Their choice to apply to the TA needs to be seen in the context of other potential options. The reasons are presented in rough order of frequency, from interview evidence: this is approximate since some TA participants used more than one type of reasoning.

The TA offered an additional revenue stream

Many participants that were already offering flexibility activities to market, both aggregators and direct participants, were attracted by the opportunity to add TA to revenue streams from Triad management and other balancing services such as STOR and FFR/FCDM. Those concerned about policy risk reported that the combination of revenue from two schemes helped to hedge against future price and policy risks, beyond the first TA auction. In these cases, the TA may have helped to maintain the availability of DSR capacity for future CM auctions (particularly given the temporary nature of the DSBR scheme, which was attractive to some players but has not been procured for the 2016/17 delivery year).

The TA offered near-term revenues and short time horizons

For some organisations submitting CMUs for pre-qualification, the one-year ahead agreements offered by the TA were an attraction over the four-year ahead agreements offered through the T-4 auction. One-year ahead agreements offered two advantages: they brought in early cashflow and they meant that direct participants and aggregator clients did not have to try to predict what their business would be like in four years' time (which was reported to be challenging for some because of uncertainties in their core business).

The TA and T-1 offered a pathway into the CM

At the time of application, some organisations assumed that TA CMUs would be able to progress to the T-1 auction for delivery in 2018/19 and 2019/20 (which have a minimum T-1 set aside volume) and believed that they would be excluded from future T-4 auctions, so they were effectively choosing the 'TA then T-1 route' to market over the 'T-4 route'. These were organisations that preferred one-year ahead agreements and revenues because of cashflow needs and/or uncertainties in their or their clients' business plans. The distinction between these routes to market became more blurred during the research period[37].

[37] BEIS consulted on proposed changes to the CM and TA during March and April 2016. These proposals, now agreed, include dropping of the reserved volume for future T-1 auctions from delivery in 2020/21 onwards, introduction of a supplementary year-ahead auction (Early Auction) in 2017/18 (effectively a T-1 auction) and lifting of exclusivity of Unproven DSR CMUs with agreements from the first TA auction and the third T-4.

The TA had the potential to yield greater revenues than T-4

The CM register revealed that some organisations had DSR CMUs that had failed to clear in the main T-4 auction. These organisations reported that they were attracted by the hope of obtaining higher prices in the TA auction. These appeared to be CMUs with slightly higher costs of providing capacity (e.g. aggregators offering turn-down DSR; or aggregators planning new client recruitment on some scale).

The TA offered softer conditions than the wider CM

Smaller and more risk averse new entrants to the DSR aggregation market reported that they applied to the TA because it offered softer credit cover conditions, so that they could test and develop their new business area in a less risky environment than the main CM. Some other participants commented that these softer conditions made board approval of TA applications easier than would otherwise have been the case.

Reasons for not applying to the TA

The reasons that non-participants gave in interview for not applying to the TA also varied. It is not meaningful to analyse the frequency with which these reasons were given, because the non-participant sample was not representative of the wider population of non-participants.

Uncertainties inherent in the TA design

Some potential direct participants or aggregator clients reported that they were put off by the uncertainties inherent in the TA design. These uncertainties arise from the simple fact that the TA involves an auction and that the TA price is unknown until the auction clears. While some aggregators started signing up clients in advance of the auction, most reported that it was difficult to sign up clients until the clearing price was known.

Some participants and non-participants (particularly aggregators) reported in interview that uncertainty about the number and length of stress events adversely affected sign-up by direct participants and aggregator clients. Stakeholders at the participatory analysis workshop thought that uncertainty about stress events was particularly a barrier for potential turn-down clients, since turn-down was potentially disruptive to an organisation's core business. Conversely, nearly all the organisations that did apply to the TA reported that they thought that the likelihood of a stress event being called was either low or that the number and duration of stress events would be low.

T-4 offered long-term agreements for new-build generation

Potential investors in major new generation capacity reported in interview that they chose not to apply because they needed long-term agreements to justify investment in this capacity, and therefore preferred the T-4 to the TA. Long-term agreements are only available to new-build generation in T-4, above a capital expenditure threshold; both the TA and T-4 offer 1-year agreements for all other resources, including existing generation, new and existing interconnectors and DSR. One non-participant aggregator with

experience of DSR in other countries suggested that two-year agreements for DSR would attract more interest than the TA's one-year agreements.

The TA was not compatible with other, more attractive, services

Some organisations reported that they did not to apply because they were already well-established in other schemes that were more profitable or less risky to them than the TA, and which appeared to be incompatible with the TA. CM rules only specified that DSBR, Long-term STOR and some T-4 agreements were incompatible with TA participation. But some organisations (both participants and non-participants) were concerned that TA baseline processes for DSR capacity might put their Triad revenue at risk[38], or that they could not meet DSR test requirements while delivering frequency-related services. Interview evidence indicated that Triad was often the most lucrative of DSR activities for direct participants, generating more revenue (or saving more costs) than frequency-related services, STOR and TA/CM, so Triad revenues were regarded as important.

> *The Capacity Market is worth only about a quarter of our potential Triad bill, and STOR is worth even less than that, so Triad management is really the top of the pile for us.*
>
> (TA participant, DSR)

However, some other TA participants did not see problems in combining TA with Triad and FFR/FCDM. The reasons for these different perceptions will be explored in Phase 2.

T-4 provided a longer lead-in time to build a client base

One experienced aggregator of DSR reported in interview that they chose T-4 in preference to the TA because this allowed more time for them to build a client base. They were sufficiently well established to be able to offer clients other sources of revenue in the short term.

TA 'too early' in strategy development process

Finally, interview evidence indicated that some organisations investigated the TA to some degree but did not apply because they were uncertain about their strategy, were not ready to comply with TA requirements or thought that the potential return on investment would not justify the management time involved in applying. In particular, some organisations offering CHP capacity reported that they dropped out because they were still developing their overall energy strategy, or because they had institutional set-ups which made TA delivery more complex (e.g. CHP plant being operated under contract).

[38] i.e. that they might not be able to reduce loads for Triad within the baselining period for a particular stress event. This risk is discussed further in chapter 3 above.

Step 3: bidding into the first TA auction

This section presents evidence about the reasons why some organisations withdrew CMUs prior to the TA auction and outlines the bidding strategies for those that bid.

Reasons for withdrawing CMUs

Some CMUs (primarily generation but including some DSR) were withdrawn because they obtained agreements in T-4: this reduced volumes in the TA auction and hence may have reduced its competitiveness.

According to interview evidence, there were three other main motives for withdrawal of unproven DSR CMUs before the auction. Firstly, some were withdrawn at short notice when National Grid announced that they expected to extend the DSBR scheme into 2016/17[39], as this scheme, which was incompatible with the TA, was more attractive than the TA for some participants. Secondly, some further DSR CMUs were withdrawn because the aggregators putting them forward became more conservative in their view of the volume of DSR they could generate (possibly linked to the reduction in auction volume from 1500 MW to 900 MW). Thirdly, a few CMUs were withdrawn because there were specific issues that made the TA less feasible or less attractive than originally expected for that particular CMU (e.g. client contracts being complex or not being signed in time).

Bidding strategies

The TA auction was a 'pay as clear', descending clock auction[40], operating under the same rules as the main CM. Existing generation CMUs entered into the auction were classed as 'price takers' (except by special arrangement with the Gas and Electricity Markets Authority): they were not allowed to exit the auction unless the clearing price fell below £15/kW but could enter an exit price below this level. Other CMUs entered into the auction were defined as 'price makers': they could submit an exit price at any level at or below the price cap of £40/kW. CMUs that did not submit an exit price remained in the auction and automatically obtained capacity agreements at the clearing price.

While interviewees shared some information about their bidding strategies in interview, few were willing to explain their strategies in detail. Auction data showed that many of the organisations participating in the auction had several CMUs, and submitted different bids for different CMUs. In some cases, the variation in bids was reported in interview to reflect differing marginal costs, but in other cases aggregators were observed to submit a range

[39] In August 2016 National Grid decided not to procure DSBR for winter 2016/17.
[40] In a 'pay as clear' auction, winning bidders are paid the clearing price rather than any exit price that they have specified. In a 'descending clock' auction, the price starts high (at the level specified by the price cap) and descends by a specified amount in each in successive auction round. Auction participants have a given time interval to consider whether to enter an exit price for their CMU - or change their exit price – during each round. For the TA, the price cap was £40/kW and the price was reduced by £2.50 in each auction round.

of different bids on similar CMUs (primarily unproven DSR CMUs). This implies that their strategies may have been influenced by factors other than cost (e.g. their expectations about the behaviour of other bidders). The following bidding strategies were observed in the auction, and confirmed through interview.

- **Submitting no exit price, or a minimal exit price which reflects 'hassle costs[41]' only (applying to an estimated 34 CMUs),** because the organisation had a low marginal cost associated with offering this CMU's capacity to the TA and any income would be a bonus. This could be because this capacity was reported to be baseload generation; or it was peaking generation/backup/turn-down DSR that was reported to be already offered to the market via other balancing services; or it was capacity reported as being provided by an aggregator's existing clients.

- **Submitting no exit price, or a minimal exit price which reflects 'hassle costs' only, on one or more of their CMUs (this strategy applied to 2 organisations, for 2 CMUs)** because the organisation reported that they wanted to build a long-term business and/or learn from participation in the first TA auction – and their learning objectives/strategic goals made them willing to accept the clearing price for this CMU.

- **Submitting a low to medium exit price (applying to an estimated 21 CMUs),** to cover not only hassle costs but some additional costs for this CMU. For direct participant CMUs, these additional costs were reported to include loss of or risk to revenues from other schemes, the opportunity costs and risks of business interruption (for turn-down), and the risk of higher running or maintenance costs for peaking or back-up generation, if stress events did not coincide with delivery times for other services. For aggregators, the bidding strategy reflected the price they needed to offer their clients, their client recruitment and other hassle costs, and any loss of or risk to revenues from other schemes.

- **Submitting a high exit price, close to the price cap (applying to an estimated 21 CMUs),** to reflect higher costs or opportunity costs for this CMU. Auction results indicate that this strategy was adopted by one direct participant that stood to lose revenue from an incompatible scheme. A few aggregators also submitted some of their CMUs at high prices, while bidding others at lower prices. This may have been partly to hedge their bets on the clearing price, but interview evidence suggests that their reasoning was partly that a higher price would enable them to sign up more clients and deliver higher volumes for the TA.

[41] Hassle costs are the transaction costs of participating in the TA scheme. These include scheme administration, as well as client recruitment and liaison by aggregators, and – in some cases – investment in metering and controls to facilitate TA participation.

Impact of scheme design on auction outcomes

The ability to submit several CMUs into the auction allowed organisations to bid along the supply curve and therefore is likely to have attracted more capacity than if organisations were required to bid all their capacity in one block.

However, the short time-frame between the auction and start of the delivery year may have contributed to the relatively low volumes in the auction, and therefore to the high clearing price. Another feature of the design which contributed to low volumes was the last minute reduction in auction volume from 1500 MW to 900 MW. Interview evidence suggested that this may have prompted a few participants to change their strategy (e.g. withdrawing CMUs or bidding high). This is discussed further in chapter 5.

A significant number of CMUs were bid at or close to the price cap of £40/kW. This raises the question of whether the price cap was sufficiently high.

The net-Cost of New Entry (net CONE Proxy) was set at £25/kW, to reflect the likely cost of marginal plant (i.e. the final plant or capacity that clears the auction). It was difficult for BEIS to predict which technology would be the marginal plant in the first TA auction: the net CONE Proxy was based on the cost of bringing forward back-up generation not currently in STOR, as estimated by Frontier et al[42]. The net CONE, which is indicative of the reasonable cost of new capacity, was close to the eventual clearing price.

The price below which price takers could exit the auction was £15/kW. While this could perhaps have been lower, to reflect the low estimated marginal cost for existing generation, the auction cleared above this level so it had no impact on outcomes.

Participants clearing in the auction could choose a time-banded option for delivery of their TA obligations. This offered them 70% of potential TA capacity payment revenue in exchange for having to deliver only if stress events fell between 9-11am and 4-8pm on working days in winter. BEIS included this option in the scheme to encourage participation by organisations that might not be able to provide round-the-clock cover. In practice, only one participant chose the time-banded option, because they were new to providing flexibility services around the clock. Interview evidence indicated that most participants were already set up to provide 24/7 cover and saw no reason to give up 30% of their TA revenue. Most also thought it unlikely that any stress event would – in practice – fall outside the time-band product windows. Therefore, the evidence indicates that the time-banded option was not useful in the first auction.

[42] Frontier Economics, LCP and Sustainability First (2015) (op cit).

Step 4: finalisation and testing of CMUs

After the auction, participants had to finalise their CMUs in order to obtain a metering test certificate (where required) and a DSR test certificate (for unproven DSR CMUs) by the end of August. These procedures were still underway at the time of Phase 1 research. Further evidence on this step will become available in Phase 2.

Step 5 and 6 – fulfilment of TA obligations and bidding into T-1

We do not yet have any information about the extent to which organisations with capacity agreements will choose to meet their obligations, both in delivering satisfactory performance days and in responding to stress events. This will be researched during Phase 2 of the evaluation.

Phase 2 will also research the choices and plans made by participants and non-participants in the first TA auction in respect of other CM auctions, including the second TA auction, the Early Auction for 2017/18 and future T-1 and T-4 auctions.

Chapter 5. Learning points for the future

Key points

- Interview evidence suggests that if TA and CM publicity remains limited, and the CM rules continue to be perceived as complex, this may continue to limit DSR and small-scale generation participation in future auctions.
- Interview evidence also suggests that the second TA auction, which will be restricted to turn-down DSR only, may have limited liquidity as DSR providers may choose to contract mixed DSR portfolios (including back-up generation) in the Early Auction instead.
- TA participants reported that they sought to 'stack' TA revenue with revenue from at least one other source (e.g. Triad, balancing services), so continued availability of these other revenues may affect the sustainability of the DSR market.
- Potential investors in DSR reported that they would like to see greater certainty about the future policy environment for the DSR sector.

This chapter considers what the findings from the evaluation research to date imply for the future contribution of DSR and small-scale generation to the CM, responding to HLQ 5.

Caveats about learning to date

Our first caveat is that it is not yet clear what contribution the TA, and turn-down DSR, will make to the CM, as the impacts of the TA are still evolving. A second caveat is that the research period for this phase of the evaluation overlapped with the Government's consultation on reforms to the CM. This created uncertainty for some participants about what the CM would look like at the time of the second TA auction, as the Government's response had not at that stage been published. A third caveat is that delivery of TA obligations is not yet underway. Bearing these uncertainties in mind, this chapter summarises a number of early learning points that may be useful in informing future CM auctions. These are based on evidence presented earlier in the report.

Learning points for future CM auctions

Interview evidence indicates that direct information about the first TA auction reached a relatively narrow audience consisting mainly of those already engaged with National Grid

on balancing services or the CM. This may have contributed to the lower than expected volumes entering the first TA auction.

Participants and potential participants also reported that the TA was a complex process requiring assimilation of a great deal of information on TA and CM rules. This was particularly challenging for smaller direct participants. While consistency between TA and CM rules has been part of the design of the TA, to make it a stepping stone towards the main CM, the complexity led some organisations not to apply for the TA.

The issue was exacerbated for some scheme participants by problems experienced with the IT systems and the EMR portal. Participants appreciated the excellent support provided by the EMR Delivery Body in helping them overcome these difficulties. However, the support was very much needed as the system was so complex (e.g. information was held in several places).

This evidence suggests that low levels of awareness and scheme complexity may continue to limit capacity coming forward in the second TA auction, unless these issues are addressed. However, feedback from the participatory analysis workshop suggested that the National Grid's Power Responsive campaign is currently helping to raise awareness of DSR and the CM, which may partially address the awareness issue.

The Government has proposed a number of rule changes for the second TA auction[43]. Many of the interviewees commented to BEIS on these proposals during the recent CM consultation.

Learning about the expected contribution of the second TA auction

The difficulties in assessing the contribution of any second TA auction to the intended outcomes of the scheme, and to the provision of new DSR capacity, were highlighted at the beginning of this chapter.

Qualitative interview findings indicated that some changes to the second TA are likely to encourage new turn-down DSR provision, particularly the reduction in the minimum threshold from 2 MW to 500 kW and the restriction of the second auction to turn-down DSR only. However, the exclusion of back-up generation is also expected to act as a barrier to DSR participation in the second TA, since many aggregators have mixed portfolios of back-up and turn-down DSR. TA participants expect the shorter lead time between the second TA auction (to be held in March 2017) and the completion of CM tests (by end August 2017) to make TA participation more challenging, particularly for DSR

[43] BEIS (2016); op cit.

aggregators that do not already have clients in place. Interview evidence indicates that many aggregators find it difficult to recruit new clients before the clearing price is known.

While almost all of the existing participants, including aggregators and DSR providers, reported that they intended to participate in future CM auctions, interview evidence suggests that they will not necessarily participate in the second TA. Some TA aggregators and direct participants offering generation or mixed portfolios (both back-up and turn-down DSR) reported that they were considering entering the Early Auction proposed for the 2017/18 delivery period, which will effectively be an early T-1 auction running alongside the TA. If significant volumes of DSR are contracted in the Early Auction, this may reduce liquidity in the second TA auction.

Learning about longer-term outlook for DSR

Frontier's report cites a Department of Trade and Industry report from 2000, that there may be up to 20 GW of industrial and commercial back-up generation currently installed in the UK, and Frontier estimates that the UK could in future provide several GW of distributed generation, storage and at least 1 GW of 'turn-down' DSR.[44] The Frontier report sets out the scale of different types of flexible capacity predicted to come onstream over time, and explains the caveats and assumptions underlying these estimates.

Findings from this research provided both positive and negative indications about the longer-term outlook for DSR in the CM. Reasons for optimism were as follows.

- The existence of the TA itself was reported to send a positive signal to the market and to drive some investment in DSR. Many interviewees thought that the clearing price in the first TA auction was viewed positively by potential DSR providers.
- Some aggregators reported that organisational awareness of DSR has increased in recent years. Wider stakeholders reported that awareness is increasing further through National Grid's Power Responsive campaign, which may help to facilitate more organisations entering into DSR provision in the future.

Despite the general tone of optimism in the interviews, interviewees also highlighted a number of potential challenges and barriers to future DSR growth. These were as follows.

- Many direct participants and non-participants reported that the CM was complex and difficult to understand. Direct participation is likely to remain challenging, particularly for smaller organisations.

[44] Frontier, LCP, Sustainability First (2015) (op.cit)

- Aggregators were concerned that removal of any set-aside capacity for the T-1 auctions beyond 2020/21 would create uncertainty about the route to market for DSR providers after the TA. While this has been mitigated by removal of the exclusivity arrangement between the first TA auction and T-4 for unproven DSR, some aggregators reported that organisations with uncertain business plans would be reluctant to participate in T-4 as this would involve making DSR capacity commitments four years ahead, and that they would therefore seek to rely on T-1.
- Stakeholders at the participatory workshop were concerned that the aggregator market is currently unregulated which could lead to 'mis-selling' of DSR services to potential clients, and could damage the market. This concern may be partly assuaged by the proposed 'code of conduct' for aggregators that is being prepared by the Association of Distributed Energy and by Ofgem's current work on the aggregation sector.
- While the price in the first auction was viewed positively by TA participants, some participants commented that the auction format means that future prices for DSR provision are uncertain.

A common theme from the qualitative research was that greater certainty about the future policy environment for the DSR sector would encourage investment in DSR provision. This was seen as particularly important for aggregators building businesses in this sector.

Many interviewees reported that CM revenue alone was not sufficient for most DSR providers, so the potential to 'stack' CM revenue with attractive and accessible balancing service products and Triad management revenues was seen as important in sustaining the market for DSR. Some interviewees voiced uncertainty about future Triad income arising from Ofgem's current review of embedded benefits, and uncertainty about the shifting supply/demand balance in markets for other balancing services (e.g. STOR and FFR).

The potential for revenue stacking generally increases the attraction of DSR investments, but it contributes to the complexity of the flexibility market and was reported by some direct participants to be a barrier to new entrants.

Learning about new technologies for DSR

Our review of literature strongly indicated that the introduction of new technologies, including the roll-out of smart meters and other smart grid developments, could make a major contribution to the future development of DSR[45]. The interview findings provided no additional evidence on smart meters or smart grids. There was some interview evidence

[45] National Infrastructure Commission (2016) (op.cit)

about the growing importance of battery storage for DSR, although a potential storage aggregator reported that regulatory barriers might hinder the participation of storage in the CM (e.g. because of storage being classified as generation and the potential length of stress events being unlimited).

Learning points for the evaluation

Aggregators have played an important role in bringing forward potential new clients for the first auction. They are likely to have an even greater role in the second TA auction because of the challenges of bringing new turn-down DSR capacity to the market. Therefore, the next phase of evaluation research will include a greater focus on aggregator clients. Identification of clients should be more straightforward when DSR CMUs have been fully proven. Any further work with non-participants will be purposively sampled to fill gaps in the types of organisations interviewed during Phase 1.

The generative causation methods used in this evaluation have been useful in allowing triangulation of self-reported interview evidence with evidence from the first TA auction behaviour, from literature, published material and wider stakeholder views. The realist approach has encouraged careful analysis of the contexts and reasoning behind observed evidence, while the theoretical framework has provided an evolving summary of our understanding about how the intervention is operating.

Contribution tracing has been valuable in enabling weighting of different types of evidence for specific case studies, making explicit the team's judgements about likely bias in subjective responses. However, as explained in Appendix 6, the contribution tracing results are sensitive to the precise specification of the evidence tests used, to the coding of case study evidence in relation to particular tests and to the assumed likelihood of observing particular pieces of evidence under different hypotheses. It will be important to keep these aspects of contribution tracing under review during later phases of the evaluation, and to interpret the contribution tracing results for particular case studies within the wider context of the overall contribution analysis.