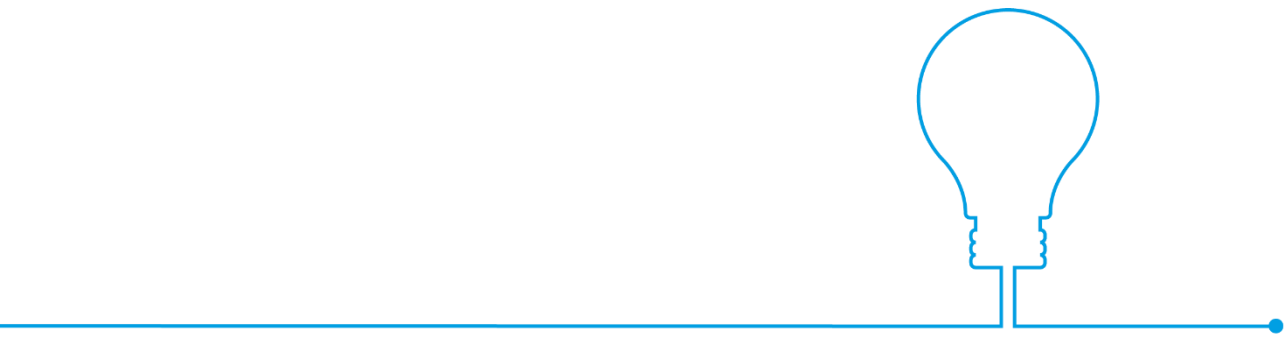
Department for
Business, Energy
& Industrial Strategy

EVALUATION OF THE TRANSITIONAL ARRANGEMENTS

Phase 1 - Appendices



February 2017

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Appendix 1. Initial theoretical framework

1. Introduction

Our approach to this evaluation is realist and theory-based. A realist approach[1] 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 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 and choices being made (i.e. causal 'mechanisms' being activated[2]), leading to desired or undesired policy outcomes. These realist hypotheses are generally known as context-mechanism-outcome combinations or 'CMOs'[3]. 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. Our initial project hypotheses and alternative hypotheses are presented below.

This document sets out the following elements of the proposed theoretical framework for the evaluation:

- Summary of **hypothesis** of how the TA would contribute to overall outcomes of the scheme, and **alternative hypotheses** of how those outcomes could be achieved regardless.
- **Detailed Context-Mechanism-Outcomes hypotheses** for participants organisations passing through each step of the scheme.
- **Context sets**, a more detailed examination of the contexts that may or may not be helpful to the TA having an influence
- **Mechanism sets,** a more detailed examination of the way in which TA could influence the reasoning of organisations and the resources made available to facilitate a change in reasoning
- **High-level Context-Mechanism-Outcome hypotheses** for overall outcomes

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[1] R Pawson, R, and Tilley, N. (1997) *Realistic Evaluation*. London: SAGE Publications Ltd; and Pawson, R. (2006) *Evidence-Based Policy*. London: SAGE Publications Ltd.

[2] In realist terminology, the activation of a causal mechanism is referred to as the mechanism 'firing'.

[3] Definitions for contexts, mechanisms and outcomes are provided in the glossary of the main report. Further detail can be found in Pawson and Tilley (1997) (op cit).

This approach used to test these hypotheses is described in appendix 3. The project hypotheses and alternative hypotheses were used as the basis for contribution tracing tests, as explained in Appendix 6.

Phase 1 research tested the hypotheses in this framework, both for detailed steps in the TA process and for the TA policy overall. The initial theoretical framework was reviewed and revised at the end of Phase 1, in the light of research evidence. The revised theoretical framework for the first three steps in the TA process is presented in Appendix 2.

2. Project hypotheses and alternative hypotheses

This theoretical framework sets out the causal mechanisms to explain three project hypotheses:

- Hypothesis 1 - The TA leads to direct participants and aggregators making additional capacity available, or keeping capacity available that would otherwise have been closed/mothballed. This capacity contributes to security of supply and/or meeting the reliability standard in 16/17 delivery window.
- Hypothesis 2 - The TA leads to more (competitive) capacity for the T-1 auction in 2018-9 and subsequent years.
- Hypothesis 3 - The TA leads to wider encouragement of turn-down DSR.

We also examine two alternative ways of explaining observed outcomes that could be attributed to the TA:

- Alternative hypothesis 1 - That the existing funding that is available for DSR/small scale generation through STOR, TRIAD and other schemes is sufficient to motivate firms and aggregators to provide capacity and compete in the CM. In other words, DSR and small scale generation are cost effective and participants' revenues from TA are a bonus which is not needed to cover costs.
- Alternative hypothesis 2 – That potential direct participants and aggregators see turn-down DSR as a long term business opportunity because of expected changes in the demand for capacity and the mechanisms by which capacity can be made available (e.g. smart meters), even if it is not cost effective in the short term. TA is welcome but not necessary to support their interest/involvement in the market.

3. Context-Mechanisms-Outcomes hypotheses

The table below sets out the hypothesised CMO sets for each of the stages involved in participating in the TA. The outcomes in this table relate to the operational outcomes that can be observed. The contexts and the differences between aggregators and direct participants are described in more detail in the following section.

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	
Step 1: Awareness and Interest	**Helpful**: Suitable consumption profile, organisational attitude, organisational resources, individual in organisation able to mobilise wider support, economic climate, CM/DSR/Small Scale Generation is a growing opportunity, expect future prices to be favourable, have resources in place already, willing to invest, good experience with National Grid, trust BEIS to keep policy consistent, experience with demand response.	BEIS/EMR Delivery Body communications resources	This could be an interesting business opportunity let's investigate it	Potential applicants become aware of the scheme and decide to develop an application
			It's good for our reputation to be involved in this type of activity, let's investigate it	
			We have a long term strategic interest in this area and are investing anyway, let's investigate it	
			This could be interesting but isn't right for us at the moment (either because of organisational priorities or resources to explore)	Potential applicants become aware of the scheme and decide not to develop an application this time

Appendix 1. Initial theoretical framework

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	
	Unhelpful: Perceived cost/time burden, risk perceived risk, already in T-4		This could be interesting but bidding would be too much hassle	Potential applicants become aware of the scheme, dismiss it as unsuitable and do not develop an application
			This is of no interest to us because we're not interested in DSR or the CM	
Step 2: Submitting an application	**Helpful:** Above helpful contexts remain in place and confirm Return on Investment (ROI) attractive, organisational buy-in, confident they can meet technical requirements and are able to comply with rules. **Unhelpful:** Would mean losing other revenue, agreements too	BEIS/EMR Delivery Body guidance material and helpline, results of work to develop an application; flexibility of scheme and ability to choose time slots.	This is not for us because we don't qualify	Do not submit an application
			This is not for us because the return on investment would be too low	
			This is not for us because we are more interested in other incompatible opportunities e.g. T-4	

Appendix 1. Initial theoretical framework

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	
	short, T-4 more attractive, circumstances change, negative experience of process, better opportunities to exploit DSR arise; risk of not being successful in auction too high to justify effort, risk too great, regulations/rules too confusing		Although we qualify and it could be a good opportunity it is too risky for us	
			DSR/Small Scale Generation could be for us but this is not the right scheme or the right time.	Not for us at the moment; may intend to stay aware of CM or (direct participants) work through aggregator
			We are confident this is a good opportunity, the clearing price will be sufficient and we can comply with the rules	Submit an application and post credit cover
Step 3: Bid	**Helpful:** Above helpful contexts remain in place and clearing price sufficient to secure desired ROI, ability to deliver in time banded slots, ability to bid unproven DSR, opportunity to grow portfolio after auction; bidding strategy **Unhelpful:** the price is too low	Clearing price; bidding rules	The price is acceptable and provides sufficient ROI to justify time, investment and risk	Accept clearing price
			Any income would be acceptable as we are building a long term business in DSR/small scale generation	

Appendix 1. Initial theoretical framework

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	
	so withdraw, changes in auction parameters, business circumstances change		Any income would be acceptable as we are already providing this capacity via STOR or Triad avoidance	
			There is a price below which we would not be willing to contract.	Submit an exit price
			We can reduce risk or maximise gains if we develop a bidding strategy to batch CMUs	Submit different exit prices for different CMU batches
			Win in T-4 so now ineligible to bid in TA	Do not bid in TA
Step 4: Meet metering and DSR testing requirements	**Helpful** Above helpful contexts remain in place, process for responding to calls in place or easy/cheap to implement, **Unhelpful:** Metering and DSR testing identifies requirement	Metering and DSR testing process	We can meet metering and DSR testing requirements, willing to make any necessary investment	Meet metering and DSR testing requirements
			Decide that we cannot provide all or part of the capacity that we agreed to	Withdraw/fail metering testing and lose all or part of

Appendix 1. Initial theoretical framework

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	
	for additional investment; metering and DSR testing not possible in the time frame; circumstances change; aggregator fails to secure enough customers, a dispersed CMU with low kW/site ratio.		(e.g. aggregator can't recruit customers)	credit cover
			This is no longer attractive/feasible	Withdraw and lose credit cover
Step 5: Fulfilment	**Helpful;** above helpful contexts remain in place, feeling of commitment, penalty/payment, reputational risk of non-compliance, fits with operational requirements (e.g. back up test), existing data provided in correct format and accuracy to monitor and verify delivery in scheme, extent of control system automation, EMR Delivery Body's procedures to call for capacity work effectively.	Call for demand response or generation, potential payment and/or potential penalty	Happy to respond, the income exceeds the costs of complying	Provide capacity when and if called
			Happy to respond as don't want to suffer the penalties	
			We're not willing or able to respond to the call	Do not provide capacity when and if called
			Other DSR opportunities are more attractive financially	

Appendix 1. Initial theoretical framework

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	
	Unhelpful; circumstances change, operational requirements, systems failure, low kW/site ratio.		The commercial or reputational cost of responding to the call would outweigh the benefits	
Step 6: Take part in T-1	**Helpful** Above helpful contexts remain in place, positive experience of TA (ROI and effort reasonable), investment and learning still in place, seen as long term business opportunity, aggregator's customer base still in place. **Unhelpful** poor experience of TA, circumstances change, rules of T-1 unacceptable, increased cover price in CM deters participation, increased competition in CM deters participation, risk/burden in CM unacceptable, cannot be competitive with other technologies in T-1	T-1 auction	Set to continue…the experience of the TA worked for us and the investment and/or learning will enable us to participate in the CM and/or ROI for DSR has become more favourable	Participant takes part inT-1, STOR or other schemes that are developed in the future
			Not interested	No action

Step	**Context** ***"for whom, and in what circumstances does the TA work"***	**Mechanism** ***"In what way does the TA alter their thinking"***		**Outcome**
		Resources made available	**Reasoning**	

4. Context sets

The table below describes contexts present when the TA is expected to influence participants. This table provides more detail than in the table above and are split into helpful and unhelpful contexts. Some of these contexts may be more important at specific stages of the process but in practice could influence mechanisms at any stage.

Context sets	**Helpful**	**Unhelpful**
Organisation type	Aggregator more likely to see this as core business/strategic opportunity and to have skills and resources to take part	
Suitable electricity consumption profile	Energy costs significant for business, large consumption/stable pattern (for direct participants), controllable, flexibility to change/run back up generation, low business penalty from compliance (i.e. not expensive or with high commercial/reputational risk).	

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Context sets	Helpful	Unhelpful
	Aggregators have clients with suitable electricity consumption profiles	
Organisational attitude	Organisation (direct participant or aggregator) has favourable attitude to BEIS/government and/or policy fits with Corporate Social Responsibility objectives and/or potential reputational benefits. Person responsible confident they can secure organisational buy in. Energy team have organisational clout. Commitment to deliver.	
Organisational resources	Organisation (direct participant or aggregator) has the time and skills available to investigate and progress application or is willing to develop skills. Technical skills and resources, e.g. ability to automate demand response	
Economic climate	Pressure on potential direct participants to seek additional revenues in response to pressure on profits/margins	

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Context sets	**Helpful**	**Unhelpful**
Have resources in place already	Potential participant has back-up generators/turn down potential/control to respond/energy management system/small scale generation/storage and suitable metering and mechanisms to pass signals in place OR Aggregator already active in the market/has a customer base with potential to provide DSR/small-scale generation	
Willing to invest in DSR	Potential participant does not have back-up generators/control to respond/energy management system /small scale generation/storage or suitable metering or mechanisms to pass signals in place and is willing to invest OR Aggregator is willing to invest in securing a customer base with potential to provide DSR/small-scale generation	
Experience with National Grid	Has positive experience/opinion of National Grid	
Experience with demand response	Already in STOR or TRIAD so have resources	

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Context sets	Helpful	Unhelpful
	and compliance mechanisms in place	
Potential return on investment attractive	The TA payments and the potential long term opportunity represent a good return on any investment	
Experience of TA	The experience of participating in the TA will influence participants' attitude to demand response in general and to the T-1 auction in particular.	
Risk of penalty		Particularly relevant to aggregators who may have higher risk of failing to respond to call and may not have mechanisms to recover penalty from customers
May mean losing revenue from other sources		For example if capacity is already committed elsewhere participants may not respond to a call under the TA.
Other schemes may be more profitable for potential participants		Potential participants may generate more revenue/profit from other schemes such as long term STOR or FFR and so do not enter TA Considers T-4 to be a better opportunity (e.g. because of long term contract available for new build generation)

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Context sets	**Helpful**	**Unhelpful**
Circumstances change		Circumstances change so TA no longer seems attractive OR compliance is no longer practical or desirable OR costs change impacting on ROI
Ongoing experience of process		Participant has negative experience of process and/or EMR Delivery Body/BEIS during application/testing/compliance process
Relationships with aggregator		Direct participant has an ongoing relationship with an aggregator/ were approached by an aggregator or supplier and may prefer to work through them

5. Mechanism sets

Under the realist approach the mechanism describes the change in reasoning and choices being made, which leads to the outcomes observed. A helpful mechanism is one that leads to the desired policy outcomes.

Mechanism	**Helpful mechanism**	**Unhelpful mechanism**
CM/DSR/small-scale generation is a growing opportunity	DSR/small-scale generation are considered to be a growing opportunity because demand for demand response will rise and/or new mechanisms to provide demand response will become available and/or confident that ongoing government support/policy favours it.	
Perception of business opportunity	Aggregators may see a significant business opportunity in the medium term, additional product to sell to existing clients, complementing their existing activities. Direct participants see an opportunity for extra revenue/to defray costs	
Expect future market developments to favour DSR	Expect electricity prices to rise/prices for alternative fuels to fall. Half hourly settlement for domestic and SME customers, smart meters, DSR able to access the balancing mechanism, development of new	

	balancing services that favour DSR	
Confident in stable regulatory environment	Trust BEIS/Ofgem to maintain positive regulatory environment	
Ability to comply with rules	Organisation believed they are able to follow the rules implicit in the process and that compliance requirements are deemed acceptable. Willing to post credit cover. Able to provide accurate data in tests. Ability to bid unproven DSR, opportunity to choose time slots in return for a lower price are attractive features	
Interested in T-1/not interested in T-4	Was a losing bidder in T-4 / Expectation that TA clearing price may be higher than T-4/Interested in T-1	
Perceptions of likely clearing price	Believe that the TA clearing price is likely to be acceptable	
Burden		Considers the application process and/or the compliance processes to be too burdensome
CM agreements too short		Potential for one year agreements in CM considered insufficient to justify commitment involved

6. Overall CMO statements

The following statements set out the overall CMO hypotheses for the desired overall policy outcomes. The methodology for measuring these outcomes is described in appendix 3 and 6.

CMOs for overall Outcome 1: Contributes to security of supply and/or meeting the reliability standard in the 16/17 delivery window

Context	**Mechanism**		**Outcome**
Direct participants have the skills and resources in place to take part in the TA and a positive attitude to DSR and/or small scale generation. Aggregators perceive a long term business opportunity that they can sell to their existing customer base/use to build a new customer base. All perceive the potential ROI to be attractive and the risks and burden associated with the TA to be acceptable.	**Resources**: The funding available under the TA, other mechanisms and associated Corporate Social Responsibility /reputational benefits	**Reasoning:** The TA represents a good business opportunity justifying the effort and investment involved.	Direct participants and aggregators make additional capacity available which contributes to security of supply and/or meeting the reliability standard in 16/17 delivery window

Appendix 1. Initial theoretical framework

Context	**Mechanism**		**Outcome**
Direct participants have the skills and resources and capacity in place to take part in the TA. Aggregators perceive a long term business opportunity that they can sell to their existing customer base.	**Resources:** The funding available under the TA, other mechanisms and associated Corporate Social Responsibility/reputational benefits	**Reasoning:** TA represents a good business opportunity justifying remaining in the market	Direct participants and aggregators keep capacity available which would otherwise have dropped out, been mothballed or closed and so contributes to security of supply and/or meeting the reliability standard in 16/17 delivery window
Direct participants have the skills and resources and capacity in place to take part in the TA and a positive attitude to DSR and/or small scale generation. Aggregators perceive a long term business opportunity that they can sell to their existing customer base.	**Resources:** The funding available under the TA, other mechanisms and associated Corporate Social Responsibility/reputational benefits	**Reasoning:** This is an additional payment for something we are doing anyway, we would be mad not to take part	Direct participants and aggregators provide capacity which would have been available anyway and so do not contribute further to security of supply and/or meeting the reliability standard in 16/17 delivery window

CMOs for overall Outcome 2: More (competitive) capacity for the T-1 auction in 2018/19 and subsequent years

Context	Mechanism		Outcome
Direct participants and aggregators have a good experience in the TA and are able to use the capacity/customer base they have built to bid in the T-1 auction. The long term opportunity of T-1 was a factor in their participation in the TA and nothing has happened to change that view. All perceive the potential ROI to be attractive and the risks and burden associated with the T-1 auction to be acceptable. The capability built from the TA enables participants to bid at a lower price in the T-1.	**Resources:** The funding available under the TA, other mechanisms and associated Corporate Social Responsibility/reputational benefits. T-1 auction funding	**Reasoning:** The investment and experience gained in the TA enables us to competitively bid in T-1	More (competitive) capacity for the T-1 auction in 2018-9 and subsequent years
Direct participants and aggregators see DSR/small scale generation as a long term business opportunity and would have bid in the T-1 auction at the same price anyway	**Resources:** T-1 auction funding	**Reasoning:** We intend to build a business in DSR/small scale generation and are in this for the long term	No difference to capacity for the T-1 auction in 2018-19 and subsequent years

CMOs for overall Outcome 3: Encouragement of wider development of DSR and small-scale generation

<table>
<tr><th>Context</th><th colspan="2">Mechanism</th><th>Outcome</th></tr>
<tr><td rowspan="2">Direct participants have the skills and resources in place to take part in the TA and a positive attitude to DSR and/or small scale generation.

Aggregators perceive a long term business opportunity that they can sell to their existing customer base/use to build a new customer base.

All perceive the potential ROI to be attractive and the risks and burden associated with the TA to be acceptable.</td><td>Resources:

The funding available under the TA, other mechanisms and associated Corporate Social Responsibility/reputational benefits</td><td>Reasoning:

BEIS/National Grid are committed to a long term future for DSR/small scale generation, it’s worth our while investing in it.</td><td>Wider encouragement of DSR/small scale generation</td></tr>
<tr><td>Resources:

The funding already for DSR/small scale generation and associated Corporate Social Responsibility /reputational benefits</td><td>Reasoning:

We were already committed to DSR/small scale generation</td><td>No difference to enthusiasm for DSR/small scale generation</td></tr>
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Appendix 2. Revised theoretical framework for TA steps 1-3

The revised theoretical framework is the updated version of the framework shown in appendix 1, updated after the evaluation evidence collected in phase 1 had been taken into account.

1. Introduction

Phase 1 research was used to test the hypotheses in this framework for steps 1-3 in the TA process. The evidence against which the framework has been tested includes:

- Qualitative findings from in-depth interviews with TA participants and non-participants
- Quantitative findings from a screening survey with non-participants
- Literature review
- Analysis of TA auction and pre-qualification data from the EMR Delivery Body, and modelling of supply curve for TA participants, drawing on interview data as well as scheme data
- Contribution tracing tests, drawing on interview data, scheme data and supply curve modelling
- Participatory analysis workshop with external stakeholders, 17 May 2016.

The revised theoretical framework reflects the research evidence from all these sources. The framework has been revised for steps 1, 2 and 3, to take account of evidence from Phase 1.

2. Key differences from the initial Theoretical Framework

The table below sets out the revised CMO sets for steps 1-3 of the TA. Steps 4-6 will be revised in Phase 2 of the evaluation. These CMOs sets presented below are not the full set of CMOs that could theoretically be observed, but those for which there was evidence during Phase 1 of the evaluation. Key differences from the initial framework presented in Appendix 1 are:

Appendix 2. Revised theoretical framework for TA steps 1-3

- For steps 1-3, we have attempted to separate out the different motivations and contexts that were identified in the research evidence.
- For these steps, contexts have been attached directly to specific mechanisms, and lead through to specific outcomes – instead of having an overall set of contexts applying to all mechanisms.
- The mechanisms have been renumbered in a logical order, revised from the numbering in the initial TA.
- Where two mechanisms are closely related, they are numbered as '1.2a', '1.2b' and so on: these related mechanisms could be grouped into one higher-level mechanism if that was felt appropriate.

Step	**Contexts**	**Mechanism**		**Outcome**
		Resources	**Reasoning**	
Step 1 – awareness and interest	Organisations in the energy supply sector which have heard of the TA and have some potential to develop an aggregation business (e.g. existing clients) but are uncertain about their strategy in this area.	BEIS/National Grid communications resources	1.1a Aggregation for the TA could be an interesting business opportunity, let's investigate it	Potential applicants become aware of the scheme and decide to investigate further
	Organisations which have heard about the TA, have suitable loads/generating capacity, may already be providing some capacity via Triad, balancing services or T-4 (either directly or via an aggregator), are already linked in to National Grid, the Association for Distributed Energy (ADE) or aggregator communications, have some staff capacity to respond (and may also see participation as good for their reputation)		1.1b This could be an interesting business opportunity that could generate additional revenue from our own capacity, let's investigate it (either as a direct participant or via an aggregator)	

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	Organisations which have heard about the TA and are already providing aggregation services to clients in the UK, for DSR and/or generation		1.2a We have a long term strategic interest in this area and we could offer the TA as an additional service to existing and new clients, let's investigate it	
	Organisations active in DSR aggregation in other countries		1.2b We have a long term strategic interest in this area and the TA makes it more attractive for us to start building a DSR aggregation business in the UK, let's investigate it	
	Organisations new to aggregation but with an existing client base in UK and a clear strategic interest in entering the aggregation market for DSR or generation		1.2c We have a long term strategic interest in this area and the TA provides a low risk environment to develop our new aggregation business, let's investigate it	
	Organisations which have heard about the TA, have suitable loads/generating capacity, are already providing some capacity via Triad, balancing services or T-4), are already linked in to National Grid, or ADE, and have staff capacity to respond (and may also see participation as good for their reputation)		1.2d We have a long term strategic interest in this area and can use the TA to generate additional revenue from our existing generation/DSR activities, let's investigate direct participation	

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	Organisations which have heard about the TA, and are already involved in aggregation of generation or DSR, but do not have adequate staff time and resources to explore the TA at the time	BEIS/National Grid communications resources	1.3a This could be interesting as we are interested in the CM and/or DSR but we don't have time to investigate at the moment	Potential applicants become aware of the scheme and decide not to investigate further
	Organisations which have heard about the TA, are potentially interested in providing aggregation of generation or DSR, but are still uncertain about their strategy in this area		1.3b This could be interesting as we are interested in the CM and/or DSR but we're not ready to pursue at the moment	
	Organisations with a technology offer or business model not easily adaptable to the TA (e.g. storage technology; Energy Service Company business model)		1.3c This could be interesting as we are interested in the CM and/or DSR but it does not appear to fit our business model at the moment	
	Organisations which have awareness of the TA, have suitable loads/generating capacity, (and possibly some experience of the CM, Triad management and balancing services), but do not have adequate staff time and resources to explore the TA at the time		1.3d This could be interesting as we are interested in the CM and/or DSR but we don't have time to investigate at the moment, even via an aggregator	
	Organisations which have some awareness		1.4 This is of no interest to us because we're not	

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	of the TA but regard their loads/generating capacity as unsuitable; and/or regard the CM unfavourably; and/or have negative perceptions of BEIS/National Grid; and/or have limited staff capacity for energy management.		interested in demand response or the CM – it's a distraction from our core business.	
	Potentially suitable participants which do not hear about the TA	No resources	No reasoning – organisation does not participate because unaware.	No action
Step 2: Submitting an application	Potential direct participant or aggregator client with limited management time and/or complex technology (e.g. CHP) and/or complex institutional setup	BEIS/EMR Delivery Body guidance material and helpline, results of work to develop an application; flexibility of scheme and ability to choose time slots.	2.1 This is not for us because the return on investment would not justify the management time involved in applying	Do not submit an application
	Participation by aggregators and potential direct participants in other schemes which are more lucrative or more stable than the TA and which appear to be incompatible with the TA, either because of CM rules or because of baselining or testing issues. Incompatible schemes may include frequency related services, DSBR (for		2.2a This is not for us because incompatible opportunities are more attractive to us	

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	16/17 only), long-term STOR, T-4 (for DSR) or Triad (where this is seen to be incompatible with DSR provided via TA)			
	Organisations providing new-build generation capacity which can get a 15-year contract from T-4.		2.2b This is not for us because we need a longer contract than the TA can provide, to justify investing new generation capacity	
	Potential aggregator clients or direct participants uncertain about future TA prices and/or the potential number and length of stress events under the TA.		2.3 Although we could participate, the TA is too risky for us	
	Potential aggregators with undecided strategy and/or sites not ready to comply (e.g. because of the complexity of the technology (e.g. CHP) or their institutional set-up)		2.4 DSR/Small Scale Generation could be for us but this is not the right time or the right scheme	
	Organisations with existing generation or DSR assets which would have been operating anyway during stress events, and which participate in other schemes that are	BEIS/EMR Delivery Body guidance material and helpline, results of	2.5a We are attracted to the TA as an additional revenue for existing activities, since it is available ahead of T-4. We would be happy with a relatively low clearing price and we can comply with the	Submit an application and post credit cover

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	compatible with the TA (both with regard to testing and delivery).	work to develop an application; flexibility of scheme and ability to choose time slots.	rules.	
	Organisations with CMUs which failed to clear in the T-4 auction, and/or with a relatively high cost of providing capacity (e.g. turn-down DSR; aggregators planning new client recruitment).	BEIS/EMR Delivery Body guidance material and helpline, results of work to develop an application; flexibility of scheme and ability to choose time slots.	2.5b We are attracted to the TA because we expect the TA price to be higher than T-4, and we can comply with the rules	
	Organisations with generation assets that require investment, refurbishment or additional revenue to extend their life, which cannot commit capacity 4 years ahead		2.6c We are attracted to the TA as an additional source of revenue to retain or increase future capacity, because we can commit only 1 year rather than 4 years ahead. We expect the clearing price to be sufficient to cover our investment needs and we can comply with the rules.	
	Organisations providing generation/DSR aggregation for clients which cannot commit to signing up 4 years ahead (e.g. public sector clients)		2.6d We are attracted to the TA because capacity commitments are made only 1 year rather than 4 years ahead, we expect the clearing price will be sufficient and we can comply with the rules	
	New entrants to the DSR aggregation market needing early revenue. And		2.6e We are attracted to the TA because revenues start 1 year rather than 4 years ahead, we expect	

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	aggregators with clients needing early revenue to justify participation.		the clearing price to be sufficient, and we can comply with the rules	
	New entrants to the DSR aggregation market which face higher risk in establishing a client base. And smaller aggregators concerned about providing credit cover up front.		2.6f We are attracted to the TA because of softer conditions for unproven DSR, compared to the main CM, we expect the clearing price to be sufficient, and we can comply with the rules	
	Potential aggregator clients: • Potentially flexible load or onsite generation • Existing relationship with an aggregator OR willing to tender for an aggregator • Lack confidence, skills or time to apply direct	Aggregator marketing	2.8 This is an attractive opportunity but we don't want to apply direct and are happy working with an aggregator	Enter negotiations with an aggregator, either directly or via tender process
Step 3: Bid/contract	Some costs, or opportunity costs, need to be covered if this CMU (generation or DSR) is to participate in the TA. Costs for aggregator CMUs: • Perception of their supply curve, what price do they need to be able to offer their clients? • Expectations for the number and	Clearing price; bidding rules	3.1 There is a fairly low price below which we would not be willing to contract, so we enter a fairly low exit price for this CMU	Accept clearing price and contract for this CMU

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	duration of stress events • Client recruitment strategy • Opportunity cost e.g. losing other revenues • Hassle cost Costs for direct participant CMUs: • Opportunity cost e.g. losing other revenues • Opportunity cost e.g. business interruption • Hassle cost • Expectations for the number and duration of stress events (DSR only)			
	Organisations building a long-term business in DSR and/or small-scale generation OR organisations wanting to learn from participation in first TA auction, and keen to contract for at least one CMU – even if others are bid at higher exit prices	Clearing price; bidding rules	3.2 Our learning objectives and strategic goals are more important than the revenue we obtain from this auction, so we bid no exit price (or a minimal price) for this CMU	Accept clearing price and contract for this CMU
	Organisations already providing this generation or DSR capacity via other compatible services (e.g. baseload generation, STOR, Triad avoidance); little		3.3 Any income would be acceptable so we bid no exit price (or a minimal price) for this CMU	Accept clearing price and contract for this CMU

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	marginal cost associated with offering this capacity to the TA (e.g. aggregators would offer capacity via existing clients).			
	Organisations concerned about the high cost and uncertainty of signing up new clients to fill 'empty vessel' unproven DSR CMU, particularly in the light of BEIS reducing the auction volume. OR new information about high opportunity cost of losing revenue incompatible with TA participation (e.g. extension of DSBR to 16/17) OR other contexts affecting willingness to obtain a Capacity agreement for this CMU (e.g. in dispute with BEIS or National Grid)		3.4 We want to keep this CMU in the auction but there is a relatively high price, close to the price cap, below which we would not be willing to contract for this CMU	Submit a high exit price – and don't contract for this CMU
	Contexts as for 3.4, for organisations which gather new information re market while there is still time to withdraw CMUs from the auction – and who would incur costs/risks if they kept this CMU in the	Clearing price; bidding rules	3.5 This doesn't make sense after all	Withdraw this CMU before the auction

Appendix 2. Revised theoretical framework for TA steps 1-3

Step	Contexts	Mechanism		Outcome
		Resources	**Reasoning**	
	auction			
	Potential aggregator clients with some understanding of the CM, with some staff capacity to negotiate with aggregator, with confidence in their aggregator, with sufficient time to obtain Board approval, with a supportive Board, and with load or generating capacity that enables them to meet TA obligations at relatively low marginal cost/risk and acceptable operational consequences.	Deal offered by aggregator, based on clearing price	3.6 This deal is worth the hassle and risk of participating.	Contract with aggregator for TA services
	Potential aggregator clients with less understanding of the CM OR with less staff capacity to negotiate with aggregator OR with less confidence in aggregator OR less supportive Board OR insufficient time to obtain Board approval OR higher perception of TA risks (e.g. frequency and length of stress events) OR with higher cost or operational consequences of meeting TA obligations.	Deal offered by aggregator, based on clearing price	3.7 This deal is not worth the hassle and risk of participating at this time.	No contract with aggregator this time.

Appendix 3. Generative causation methods

The three main generative causation assessment methods that we have used in testing the theoretical framework are 'contribution analysis', 'contribution tracing' and 'participatory analysis'. These methods are outlined further below. Their relationship to each other, to sources of evidence and conventional analysis of that evidence is set out in Figure 1.2 of the main report.

The text below explains how we have applied each of the three generative causation methods. We have used all three of these techniques to test the validity of competing hypotheses, and refine the 'context-mechanism-outcome' configurations in the theoretical framework.

Contribution analysis

Contribution analysis is a step-by-step approach to assessing the likelihood that an intervention is contributing to observed results, centred around a theory of change (which is the realist theoretical framework presented in Appendix 1). The process uses evidence from all available sources to develop an increased understanding of why observed results have happened and of the roles played both by the intervention itself and by other factors.[4] Contribution analysis can be a valuable tool in considering the additionality of a policy intervention, particularly where a robust counterfactual cannot be established. Contribution analysis can be used both to assess the extent to which a policy influenced any outcomes and impacts observed in the evaluation and also to understand how and why the policy had the effect it did. It involves a six stage process to develop and test a 'contribution story' (i.e. a coherent and tested narrative explaining how the policy intervention appears to have influenced change):

1. Set out the attribution problem to be addressed
2. Develop a theory of change (and risks inherent in this theory)
3. Gather existing evidence on the theory of change
4. Assemble and test the contribution story and any challenges to it
5. Seek out additional evidence (where the contribution story is less credible)

[4] For a fuller explanation of contribution analysis see: http://betterevaluation.org/plan/approach/contribution_analysis

6. Revise, and where additional evidence permits, strengthen the contribution story

Contribution analysis has been the overall framework that we have used to develop and test the contribution story set out in this synthesis report.

- **Steps 1 and 2** of the contribution analysis process were undertaken at the start of Phase 1. We formulated the attribution problem and developed the initial theoretical framework using evidence from an initial draft of the literature review, scoping interviews, meetings and workshops with key stakeholders from BEIS, the EMR Delivery Body, Ofgem and experts from industry and academic institutions.

- **Step 3 to 5** were iterative processes involving the review of existing evidence (e.g. from the literature review, the CM register and industry sources), early synthesis of the emerging contribution story, and gathering of additional evidence to test this story (using quantitative data, qualitative data, cost and revenue data from TA participants) and analysis of this evidence. The methods used, including contribution tracing and wider qualitative analysis around CMOs, were peer reviewed by academic advisors.

- **Step 6** was the final synthesis process through which the overall contribution story was developed and tested with a wide range of stakeholders, through an internal stakeholder workshop with BEIS, the consultancy team and academic advisors, and through an external workshop with a wide range of stakeholders. The contribution story was finalised and used to develop the revised theoretical framework. The overall contribution story, together with the revised framework, is presented in this synthesis report.

Contribution tracing with Bayesian updating

Contribution tracing involves the formulation and testing of project hypotheses and alternative hypotheses which could explain observed outcomes in individual cases. For each case, a range of evidence clues was used to choose between these hypotheses, drawing on everything we knew about a participant, not just what they said in research interviews. For example, we used what we knew from their application, their auction behaviour and their company websites as well as estimates of costs and revenues from the supply curve work. Case study analysis was generally undertaken at participant level (i.e. for an organisation), but bidding strategies were considered at CMU level. More detail of the

Contribution tracing was used to test whether the scheme contributed to its intended outcomes, and the likelihood of these outcomes being attributable to the TA. We

tested the contribution story (steps 4 and 6 of contribution analysis above) by examining the number and type of cases which supported the project hypotheses or alternative hypotheses.

Contribution tracing involved the specification of evidence tests for each of the three project hypotheses and the two alternative hypotheses set out in Appendix 1, using ‘clues’ from the available evidence. The evidence clues were given different weight in the analysis depending on the estimated probability that a given clue would be observed when a particular hypothesis held. A process called Bayesian updating was used to update these probabilities to reflect observed evidence. This helped to determine whether or not, for a particular case, a given hypothesis was likely to be true. Further details of contribution tracing, including the evidence tests, the probability assumptions and the process for Bayesian updating of probabilities are set out in Appendix 6.

Participatory analysis

This involves engagement with a range of stakeholders to test the validity of the emerging ‘contribution story’. We used participatory analysis to validate and further develop emerging findings. For example, we held an internal workshop and an external workshop with a range of regulatory and industry stakeholders and technical experts towards the end of Phase 1, to test the contribution story emerging from the analysis of available evidence. These workshops examined how far the evidence collected to date supported the causal hypotheses (or alternative hypotheses) in the theoretical framework, and how far the evidence validated the contexts/mechanisms which appear to lead to desired or undesired outcomes. The workshops also considered whether any adjustment was needed to these causal hypotheses or alternative hypotheses.

Appendix 4. Data collection methods

This appendix explains how we collected data using qualitative interviews and a quantitative survey during Phase 1 of the evaluation.

Qualitative interviews

Interviews were conducted with the person within each organisation with primary responsibility for overseeing that organisation's involvement in the TA, or, for non-participants, with the Energy Manager or Facilities Manager. Each interview lasted 30-75 minutes and almost all were undertaken by two interviewers (one social researcher from CAG Consultants or Databuild, and one technical research from Verco). Interviews were recorded and were also written-up in spreadsheet grids prepared by the interviewers. The transcribed recordings were used to finalise the write-ups and to add direct quotes to the write-up spreadsheets.

The sample breakdown for the qualitative interviews was as follows.

TA participants (33 in-depth interviews in total)

Qualitative interviews were undertaken by telephone with all organisations that applied for the TA. This included all those who failed pre-qualification as well as those who pre-qualified for the scheme. We also interviewed a small sample of clients of aggregators. These interviews generally lasted at least 50-75 minutes because they were used to gather detailed information about TA CMUs, as well as more general information about the organisation's context and reasoning about the TA. The sample was as follows:

- 24 interviews with TA participants who took part in the first TA auction (13 aggregators and 11 direct participants, based on categorisation by National Grid). This was a census of all such organisations.
- Five interviews with organisations whose CMUs were either rejected at prequalification, were not prequalified (meaning they given conditional prequalification which was later rescinded), prequalified but were not put forward for auction, or went forward to auction but were not successful. This was a census of all such organisations.
- Four interviews with clients of aggregators, identified (where possible) through aggregator business plans submitted to National Grid. This was a small sample, drawn from a population of unknown size, because many aggregators were still signing up clients and were not able or willing to share client identities with the evaluation team. We aim to extend this sample during

Phase 2 of the evaluation, since aggregators have now signed up all their clients for the first TA, which should make identification of clients less problematic.

Non-participants (31 in-depth interviews in total)

Qualitative interviews were undertaken by telephone with organisations that had potential to participate in the TA but did not participate. These interviews generally lasted 30-40 minutes, as they covered the organisation's context and reasoning about the TA but did not cover CMU information. The population in the first three sub-groups of the sample was small, so the target number of interviews in these groups was low. The sample was as follows:

- Six interviews with aggregators known to National Grid that did not participate in the TA (out of a population of 10 such organisations, all of which were approached for interview).
- Six interviews with other organisations who expressed interest in the TA (out of a population of 14 non-participating organisations that had attended National Grid workshops, 10 of which were selected purposively as being potential TA participants and were approached for interview).
- Seven organisations that participated in T-4 but not the TA (out of a population of 29 such organisations, 15 of which were purposively selected and approached for interview, ensuring coverage of a range of technologies and avoiding overlap with other sample groups).
- 12 non-participants with capacity and/or willingness to participate in DSR, identified through a quantitative survey (selected purposively from a population of 96 organisations which had electricity consumption exceeding 6,000 MWh in 2008 and had agreed to take part in a qualitative interview - see quantitative survey methodology below for details).

The research instruments for these interviews are presented in Appendix 5.

Quality assurance of qualitative interviews

These interviews were led by experienced, senior social researchers within CAG Consultants' and Databuild's research team. The interviewers were thoroughly briefed before research began, including a one day training session on the TA, DSR and the aims of the evaluation. Almost all interviews were undertaken by a two-person team, including a technical expert from Verco as well as a social researcher, except where this was logistically impossible. Interviews were recorded and transcribed, and 5% of interviews were listened to and quality assured by a Director or Partner using an assessment template, with findings fed back to interviewers to ensure quality standards were met. Researchers participated in weekly calls during

the research period, to identify share and review lessons from the interviews and to identify ways in which our approach could be improved.

Analysis of evidence from qualitative interviews

Findings from the qualitative interviews were collated into combined spreadsheets for TA participants and non-participants. These spreadsheets were used to code and analyse themes on particular topics, and to analyse differences between sub-groups of respondents. This generated the 'wider qualitative analysis' referred to in the main report and in Appendix 3. Data on the cost and technical characteristics of particular CMUs were fed into the supply curve analysis which is presented in Chapter 3 of the main report. The 'contexts', 'mechanisms' and 'outcomes' observed for each TA participant and non-participant were coded to analyse the extent of support for 'CMO' combinations in the theoretical framework (see CMOs in Appendix 1). As the sample size in most of the sub-groups was small (owing largely to the small size of the TA population), we used a realist approach to analysis. This involved identification of the contexts and mechanisms that led to observed outcomes for each individual case. As part of the realist analysis, we developed revised CMO combinations to ensure that all observed behaviour was captured within a revised theoretical framework (as presented in Appendix 2). The evidence for each TA participant was also coded against the evidence tests used for contribution tracing (see findings in Appendix 6). The coding framework and contribution tracing tests were quality assured before being applied, and the revised CMO combinations were reviewed by an external peer reviewer. Three analysts were involved in analysing the qualitative findings, and their findings on key points were cross-checked to ensure consistency and provide quality assurance for the analysis.

Limitations of the qualitative research can be found on page 16 of the main report.

Quantitative survey

169 short telephone interviews were undertaken with Energy Managers or Facilities Managers in non-participant organisations identified as having significant electricity use and hence some potential for TA participation. The survey interviews were undertaken by Databuild researchers and generally lasted 10-15 minutes. The survey asked about the organisations' current involvement with DSR or similar schemes, and about capability and willingness to undertake DSR in future.

Sampling frame and sample size

The sample size was intentionally small as the primary purpose of this survey was to identify candidates with some TA potential for inclusion in the qualitative research sample. This was therefore primarily a 'screening survey' in that interviewees were screened for their potential and willingness to participate in DSR services, in order to

identify potential non-participant interviewees for qualitative interviews. A secondary purpose of the quantitative survey was to generate quantitative research findings on non-participants' awareness of and suitability for participation in the TA.

The sampling frame for the screening survey was drawn from the CRC phase 1 evaluation undertaken for DECC (now BEIS) in 2015, on the grounds that these organisations had medium to high electricity use and might be potential candidates for the TA. The initial sampling frame for the CRC evaluation had comprised 2,847 organisations that qualified for phase 1 of the CRC and that declared electricity consumption of more than 6,000 MWh in the CRC phase 1 qualifying year (2008). This included energy-intensive organisations which had partial or full CRC exemptions owing to their partial or full participation in the EU Emissions Trading System (EU ETS) or Climate Change Agreement (CCA) schemes.

With BEIS's permission, the sample therefore comprised 415 organisations that qualified for CRC phase 1 and had been interviewed for the CRC evaluation, and which had agreed to be recontacted by the research team (out of the original CRC population of 2,847). In total 395 out of these 415 organisations were contacted to take part in this survey[5]. Of the 395 records called, 11 records were unuseable and 169 records resulted in completed interviews, so the overall response rate, calculated as *completed interviews / (records called - unusable records)*, was 44%. To minimise non-response bias, the Computer Aided Telephone Interview (CATI) system made repeated attempts to recontact each organisation until either 6 attempts had been made or the target number of interviews had been completed.

The CRC phase 1 database included organisations with exemptions due to EU ETS or CCAs and is representative of organisations with half hourly electricity meters settled on the HHM market. Our sample was drawn from those organisations that declared electricity consumption in excess of 6,000 MWh in 2008. Organisations not well represented therefore would be:

- Those that used less than 6,000 MWh of electricity in 2008.
- Those that do not have meters settled on the HHM market.
- Any organisations that were not above the 6,000 MWh threshold in phase 1, but are now.

Recruitment

Recruitment initially prioritised organisations with higher electricity consumption, on the grounds that they were more likely to have the capability to participate in the

[5] The remaining 20 records were not needed as the number of interviews had exceeded the original target of 150 interviews

Transitional Arrangements. All organisations on the database of CRC organisations willing to be recontacted were therefore classified into recruitment prioritisation groupings as shown in Table 1. Organisations with CRC exemptions owing to their participation in the EU ETS and CCA schemes would generally be expected to have higher energy consumption than those without exemptions. In practice, we needed to recruit across all three groups to obtain the required number of responses.

Table 1: Recruitment

Recruitment prioritisation groupings	Number of organisations willing to be recontacted	Number interviewed
1. On CRC register, with EU ETS exemption and/or "Group" or "General" CCA exemptions	60	20
2. On CRC register, with Member only CCA exemption or on CCA facilities list	50	19
3. On CRC register, no EU ETS or CCA exemption	305	130
Total	415	169

Source: Databuild

Of the 169 interviewed, 96 were willing to be recontacted to take part in the qualitative element of this work. 36 of these were purposively selected and approached to take part in a qualitative interview (see criteria for selection below). 12 agreed to take part and in-depth interviews were undertaken with this group of non-participants, as outlined under the qualitative research methodology above. From those approached for a further interview, 33% agreed to take part. The candidates for qualitative interview were purposively sampled as follows:

- Organisations that reported having no existing capacity for DSR but expressed potential willingness to turn down demand or install capacity for DSR (we approached 10 and interviewed 5 from this group).
- Organisations that reported having DSR capacity but were not active in DSR services (we approached 16 and interviewed 4 from this group).
- Organisations that had capacity for DSR and were participating in balancing services or the Capacity Market but not the TA (we approached 10 and interviewed 3 from this group).

Weighting of results

The survey results were weighted by the recruitment priority groupings shown in Table 1 above. They were weighted to these groupings in the CRC population, rather than the proportion of the CRC sample agreeing to be recontacted, to minimise non-response bias. Table 2 shows the proportion from each of the three priority groupings in the CRC population and in the group agreeing to be recontacted.

Table 2: Sample representativeness

Recruitment prioritisation groupings	Proportion of CRC population	Proportion of those agreeing to be interviewed
1. On CRC register, with EU ETS exemption and/or "Group" or "General" CCA exemptions	21%	15%
2. On CRC register, with Member only CCA exemption or on CCA facilities list	9%	13%
3. On CRC register, no EU ETS or CCA exemption	70%	72%

Source: Databuild

Quality assurance of quantitative survey

The quantitative survey followed Databuild's standard practices for quality assurance, namely:

- All of the research team carried out practice interviews with a senior member of staff before data collection commenced.
- First interviews for each member of the team were listened to by a senior member of staff, scored and feedback given.
- 5% of interviews were listened to by a Senior Research Executive and scored for quality throughout the project.
- Data was extracted at the end of the first day of data collection and the data scored for quality by the consultant.
- Thereafter the data was extracted weekly and scored by the consultant.

Regular team briefings were held to provide feedback on both progress and quality.

Analysis of quantitative survey data

Results were analysed for the respondent group as a whole. Some cross-tabulations were explored, namely cross-tabulating willingness and capacity to

undertake DSR by sector, and cross-tabulating awareness of the TA by sector and by electricity consumption, but these were not sufficiently robust to be used or reported. The cross tabulations suggested possible correlations rather than generating findings of statistical significance. No significance testing was carried out because of the small size of the sample and the corresponding breadth of confidence intervals. For example, one of the largest sub groups for comparison was 35 which would mean a confidence interval of +/- 17% on the figure reported at the 95% confidence level, which is too wide for the cross-tabulation findings to be useful.

Limitations of quantitative survey

The quantitative survey had a small sample size because it was primarily designed to identify non-participants with some potential for the TA who could be interviewed in the qualitative research. The sample frame and sample size were sufficiently robust to generate broad findings on reported willingness and capacity to provide DSR services amongst organisations with medium to high electricity use. But the sample was too small to allow detailed analysis of findings for different sub-groups.

Appendix 5. Research instruments

This appendix contains the following research instruments:

- Quantitative survey
- Example topic guide from qualitative research

Quantitative survey

Introduction

[If required – i.e. not continuing from initial recruitment]

Good morning/afternoon. My name is XXXX and I am calling from an organisation called Databuild Research on behalf of the Department of Energy and Climate Change (DECC). Can I just check, I am speaking with <name from initial recruitment>

Thank you for making time to speak to me today. Databuild are a research agency, who have been commissioned (with partner organisations) to undertake an evaluation of the Transitional Arrangements for Demand-Side Reduction and small-scale generation scheme[6].

As I explained when arranging the interview, we are currently carrying out some work for DECC, speaking to organisations who we believe might have good potential to take part in the Transitional Arrangements scheme but did apply for prequalification, or register interest in the scheme, as far as we know.

The questions I will ask you will cover some background about the profile of your business, your approach to energy management and your awareness and level of interest in schemes for Demand Side Response and small scale generation.

Do you have any questions before we begin?

First of all, which of the following 'sectors' most closely describes your organisation/the organisation you represent? [use high-level list of SIC codes, plus divisions]

I now want to ask you about your organisation's energy management approach and capability

[note: in some cases e.g. property management company or a financial investment vehicle, the questions may need to rephrased to ask about 'your organisation and its subsidiaries']

[6] Explanation of the Transitional Arrangements, for interviewer reference: The Transitional Arrangements auctions offer targeted support to Demand Side Response (DSR), to encourage enterprise, and increase levels of participation in the two years preceding full CM delivery in 2018/19.

Does your organisation currently manage the timing of its electricity demand, for example by reducing its consumption during peak hours or shifting its load away from peak times? [Yes/No/Don't Know]

- If no, would your organisation be willing and able to reduce its electricity at peak times if there was a business case to do so?
    - If no, can you please explain why? [code main reasons]

Does your organisation have one or more sites with back-up generation capacity? [yes/no/don't know]

- If yes, what is the approximate capacity of your back-up generation? [input approx. indication
- If no, would your organisation be willing and able to install backup generation if there was a business case to do so?

Does your organisation have one or more sites with distribution-linked generation capacity? [yes/no/don't know]

- If yes, what is the approximate capacity of your distribution-linked generation? [input approx. indication]

Has your organisation been engaged with any of the following:

- Triad Avoidance or Triad Targetting [Yes/No/Don't Know]
- Red zone management [Yes/No/Don't Know]
- Short-Term Operating Reserve (STOR) [Yes/No/Don't Know]
- Long-term STOR [Yes/No/Don't Know]
- Firm Frequency Response [Yes/No/Don't Know]
- Demand Side Balancing Reserve (DSBR) [Yes/No/Don't Know]
- Fast Reserve [Yes/No/Don't Know]
- Capacity Market auctions (T-4) [Yes/No/Don't Know]

Has your organisation been engaged in any other way with a Distribution Network Operator or energy supplier to reduce peak demand? [Yes/No/Don't Know]

- If so, how? [code]

Awareness of the Capacity Market and Transitional Arrangements

Were you aware of the main Capacity Market auctions (T-4, T-1) before this phone call? [yes/no]

Are you aware of the Transitional Arrangements auctions? [yes/no]

- If no, go to 'Would it be possible to recontact you…' question

Did your organisation actively consider participating directly in the Transitional Arrangements auction? [yes/no]

Please tell me the main reason why you did not apply to participate? [code response]

Would it be possible for us to contact you for future research regarding this area? [yes/no]

In particular would you happy to be re-contacted to take part in an in-depth telephone interview for this research? [yes/no]

Thank you very much for your time. One last thing: this is the number of the UK Market Research Society should you wish to check our organisation's status as members? [*Insert number].*

Topic guides for qualitative interviews

We used a suite of topic guides, tailored for the respondent groups described in Appendix 4:

- TA participants – aggregators
- TA participants - direct participants
- Indirect TA participants – clients of commercial aggregators
- Organisations that pre-qualified for the TA but did not enter into capacity agreements
- Non-participant aggregators identified via National Grid lists
- Non-participant single organisations identified via National Grid lists
- Non-participant single organisations identified via the quantitative survey

A sample topic guide is presented below, tailored for aggregators participating in the TA.

Sample topic guide for aggregators participating in the TA

Instructions for interviewers	Main questions	Probes
Topic 1: Understanding organisational context: I'd like to begin the interview by asking about your organisation more generally, in order to understand the context to your participation in the Transitional Arrangements		
We are interested here in how many layers away they are from the board/key strategic decision makers and how much influence they have on energy management decisions	Can you please briefly explain your role in the organisation?	Where do you sit within the organisation? How much influence would you say you have in relation to strategic decision-making (for example in relation to decisions about whether to participate in the Transitional Arrangements)?
Important to get a really good sense of how they work, so do use probes to explore this	Can you please describe the specifics of your aggregation role?	How much of your organisation's activities are related to aggregation? What type of aggregation clients and client projects do you work with (nature of organisations, technologies etc)? Do you tend to work with a few large clients or a large number of small clients or a mix? What is the rationale for that?
	How would describe your offer to your clients? What do they perceive as the benefits of working with an aggregator?	Are any clients in principle large enough to take part in the Transitional Arrangements or similar schemes themselves? If so, do you know why they opt not to do so?
	What types of projects do you do for your clients?	e.g. DSR, back-up generation, cost reduction, returns from other schemes, energy efficiency, energy management, etc
Topic 2: Experience of related schemes		
	How experienced is your organisation in working with clients on ancillary services (e.g. STOR)?	e.g. Short-Term Operating Reserve (STOR), Long-term STOR, Firm Frequency Response, Demand Side Balancing Reserve (DSBR), Fast Reserve

Instructions for interviewers	Main questions	Probes
	How much experience does your organisation have of working with clients to save or earn money from managing peak (e.g. Triad)?	e.g. through Triad Avoidance or Triad Targeting or red zone management
Only ask if they are part of any of the schemes above	How does your clients' participation to participation in the Transitional Arrangements fit with their involvement in these schemes?	
Only ask if they are part of any of the schemes above	Has your participation in the Transitional Arrangements influenced the capacity your clients are able to offer to the market (either through increasing or retaining capacity)?	
	Does your organisation have a CMU (or CMUs) in T-4?	
Interested in finding out if they have positive experiences of working with National Grid	Could you please explain how much engagement your organisation has with the National Grid?	How often do you interact with them? Are you involved in working groups? What other types of interaction do you have?
Topic 3: Organisation interest in the Transitional Arrangements		
	How did you first become aware of the Transitional Arrangements?	
	How interested were you in the Transitional Arrangements at this time?	
	What were your experiences of the marketing and promotion of the Transitional Arrangements? How effective was it?	How effective was it? How might it have been improved?
Pick up on any mention of the need for extra investment or the risk of mothballing without TA participation	Talk me through how and why you made the decision to participate?	What were your motivations for applying? How crucial did you think participation in the Transitional Arrangements would be to your business case?

Instructions for interviewers	Main questions	Probes
We are interested here in how risk averse/technically savvy/do they see themselves as market leaders/innovators	Can you explain your organisation's perspective of the risks involved in participating in the Transitional Arrangements?	
Topic 4: The Transitional Arrangements application and auction process		
Before the interview, ensure you have looked up how many CMUs the organisation applied for entry into the Transitional Arrangements, how far they got (e.g. rejected, not prequalified, entered into auction, Capacity Agreement awarded) *You will need take note of these in here, or have the information to hand as you undertake the interview*		
	What was the process for you in terms of securing client agreement to take part in the Transitional Arrangements?	How did you persuade them to take part? To what degree did you know which clients you would work with before you got to prequalification stage? If you had identified clients to work with, were they existing clients or new clients? If you brought in new clients, what did this involve?

Instructions for interviewers	Main questions	Probes
We are interested in both the administrative preparation required (financial, legal, contractual) and any operational preparation required at this application and auction process stage	What benefit does the client get from Transitional Arrangements participation and how do you charge for your services?	What are the roles and responsibilities of each of the parties? What are the main risks that you have managed?
	How did you find the prequalification process for the Transitional Arrangements?	What worked well? What worked less well? How could the prequalification process have been improved, if at all? Probe about how they found the appeals process if this is something the experienced
	Once prequalification decisions were announced, what was your experience of the pre-submission stage? i.e. the stage between the prequal decision and the auction	What worked well? What worked less well? How could the process have been improved, if at all?
	Did you choose the time-banded delivery option for any of your CMUs?	Can you explain your choice?
We are interested here in their bidding strategy	What was your approach to deciding what to bid in the auction? What was your rationale for this?	Was there a minimum clearing price you were willing to tolerate?
	What was your view of the eventual clearing price?	

Instructions for interviewers	Main questions	Probes
	How did you find the actual process of the auction?	What worked well? What worked less well? How could the process have been improved, if at all?
	How did you find the contracting process post-auction?	What worked well? What worked less well? How could the process have been improved, if at all?
	Throughout the process, from prequalification to auction, how did you find the information and support provided by National Grid?	
Topic 5: Resources and effort required to participate up to and including auction		
	What level of resource did your organisation put in, in terms of pre-application preparation, prequalification, submissions and auction for the Transitional Arrangements?	How many days staff time (FTE) to initially understand the scheme? What level of seniority In addition to this, how much time has been required per CMU? (if multiple CMUs) What were the main activities? How much time do you estimate full participation in the Transitional Arrangements will take per CMU?
	How much time and resource was required to prepare and agree clients' involvement?	How many days effort (FTE)? What level of seniority?
Topic 6: About the organisation's Transitional Arrangements CMUs (including costs and revenues)		
Technical interviewer to have cost assumptions sheet to hand to use as a		

Instructions for interviewers	Main questions	Probes
prompt		
Note: for this section, we are interested in understanding information about ALL of the CMUs the organisation applied for, regardless of whether they now have Transitional Arrangements Capacity Agreements		
	I would like to find out about the CMUs you put forward for the Transitional Arrangements. This includes all of the CMUs you put forward for prequalification, regardless of whether they were eventually awarded a Capacity Agreement. First of all, for each of the CMUs you put forward for the Transitional Arrangements, can you tell me roughly how many sites are involved in each of them?	
For aggregators with 'Unproven DSR 'CMUs	What is the current status of your 'Unproven DSR' CMUs that have Capacity Agreements?	E.g. approx. % of kW still to be defined, procurement in train or already procured?
	What sector(s) do the client sites cover? What are their main energy demands?	
	Approximately what shares (% of total kW) of the CMU components are/were back-up generation and load reduction?	

Instructions for interviewers	Main questions	Probes
	If back-up generating equipment is involved, what kind is it and what is usually used for?	What type of generating unit? (technology, fuel, number of units, rated capacity) New or existing? If existing, approximately how many hours a year does it normally run?
	If load reduction (alongside generation or without generation), what are your clients doing (or what would they have done) to achieve this?	What energy demand is/was to be reduced? What type and scale of equipment? How is it (or how would it have been) controlled? What impact might the load reduction have (or have had) on the clients' operations? Is/was it pure load shifting?
	If yes to Load shifting probe above If your clients are load shifting: To when do they (or would they have) shift their load? What impact does load shifting have (or would have had) on their busines*s?*	
	Do the projects involve (or would they have involved) any additional capital expenditure or operational expenditure?	Can you talk us through any equipment your clients have installed (or would have installed) to facilitate participation in the Transitional Arrangements? e.g. – metering, communications, automatic relays, control systems) How much is this costing? How is the baseline to be measured?
	Can you talk us through any revenues your clients receive from these CMUs?	*Use assumptions sheet as a probe* *Note that the aggregators may not have detailed knowledge as it the clients that will have day-to-day responsibility for their running*

Instructions for interviewers	Main questions	Probes
For aggregators with 'Existing generating' CMUs	For your CMUs classed as "existing generating", can you describe what type of generation is involved?	What type of generating unit(s)? (technology, fuel, number of units, rated capacity) How are your clients changing their operational regime to participate in the Transitional Arrangements, if at all?
	Can you talk us through the costs and revenues for these CMUs?	*Use assumptions sheet as a probe* *Note that the aggregators may not have detailed knowledge as it the clients that will have day-to-day responsibility for their running*
	Can you provide me with an estimate of what the total running hours will be this year for the existing generation in your CMUs? How do you anticipate this changing in future years?	*If they don't know, ask for historical data instead e.g. how long did they run for last year?* *Again, aggregators may not have this level of detail, it may rest with the client*
	For this year, can you provide me with an approximate breakdown how long (in hours) the CMUs will be running the generation for: - wholesale energy sales - on-site use - ancillary services (see assumptions sheet) - Triad - DNO Super Red Credits How do you anticipate this changing in future years?	*Use assumptions sheet as a probe* *Again, aggregators may not have this level of detail, it may rest with the client*
For aggregators with 'New build generating' CMUs	For your CMUs classed as 'new build generating', what can you describe what type of generation is involved?	What type of generating unit(s)? (technology, fuel, number of units, rated capacity) How are your clients changing their operational regime to participate in the Transitional Arrangements, if at all?

Instructions for interviewers	Main questions	Probes
	Can you talk us through the anticipated costs and revenues for the generation in these new build generation CMUs?	*Use assumptions sheet as a probe* *Note that the aggregators may not have detailed knowledge as it the clients that will have day-to-day responsibility for their running*
	Can you provide us with an estimate of what your total running hours will be this year for the new build generation in you CMUs? How do you anticipate this changing in future years?	*If they don't know, ask for historical data instead e.g. how long did they run for last year*
	For this year, can you provide me with an approximate breakdown how long (in hours) the CMUs will be running the generation for: - wholesale energy sales - on-site use - ancillary services (see assumptions sheet) - Triad - DNO Super Red Credits How do you anticipate this changing in future years?	*Use assumptions sheet as a probe* *Again, aggregators may not have this level of detail, it may rest with the client*
	To what extent is your client's(s') stack of revenues dependable and sufficient to support investment decisions? *If the question above is not clear:* i.e. is the combination of revenues your client(s) receive(s) from these different sources enough to support their investment in new build generation	*technical interviewer to probe using financial model*
For all	What assumptions have you made about how often and how long your clients will be able to respond to a stress event?	

Instructions for interviewers	Main questions	Probes
For all	In addition to those you've already discussed, can you talk us through any equipment your clients have (or will need to install) installed to facilitate participation in the Transitional Arrangements?	Prompts – metering, communications, automatic relays Need to know scale/scope
For all	What are you views on the meter testing and DR testing requirements for the Transitional Arrangements?	Do you foresee any potential issues?
For all	Do you anticipate there being any issues in delivering your Transitional Arrangements obligations?	
Topic 7: The future		
Ask all	Would you consider participating in the next Transitional Arrangements Auction?	
If yes to previous question	What improvements could be made to the eligibility and auction process for the second Transitional Arrangements Auction?	
If no to previous question	Why not? What would need to change, if anything, in order you to consider participating in a future round?	
Ask all	How do you view the health of the DSR and/or small-scale generation sectors at the moment, and looking forward?	Are they expanding, steady, or in decline?
Ask all	And do you think the Transitional Arrangements will result in more DSR/small scale generation available to compete in the T-1 Capacity Market auctions?	Please explain your answer
Ask all	Finally, how do you view the long-term business opportunities more generally in relation to DSR and small-scale generation?	
Closing		

Instructions for interviewers	Main questions	Probes
If you did not have time to cover all of the detailed questions	Would you be happy for us to get in touch again to ask for further information about your CMUs? Would you prefer this to be via phone or would you prefer email?	
	There will be further phases of research for this evaluation. How are you happy to be recontacted again for this evaluation?	
	Did you have any questions before we finish they interview?	
	Thank you very much for your time, we really appreciate you taking the time to be interviewed	

Appendix 6. Contribution tracing paper

Introduction

This appendix sets out the methodology and emerging findings from Phase 1 of the evaluation on the contribution of the TA towards its objectives, relative to alternative explanations for the outcomes observed.

The first part sets out the methodology for contribution tracing. The second part presents high-level results and sets out a contribution story based on these results.

Contribution tracing approach[7]

Contribution tracing was intended to bring a rigorous approach to setting and analysing questions to test causality. This was used to supplement the contribution analysis which forms the core of the generative causation approach to establishing the impact of the policy. The contribution tracing tested three hypotheses concerning the objectives of the TA and also tested two alternative explanations. It enabled evidence supporting each of the hypotheses and alternative explanations to be assessed and provided an understanding of the relative contributions of each hypothesis/explanation to the behaviour of each participant.

The contribution tracing tested three hypotheses:

> H1 - The TA leads to direct participants and aggregators making additional capacity available, or keeping capacity available that would otherwise have been closed/mothballed. This capacity contributes to security of supply and/or meeting the reliability standard in 16/17 delivery window.
>
> H2 - The TA leads to more (competitive) capacity for the T-1 auction in 2018-9 and subsequent years.
>
> H3 - The TA leads to wider encouragement of turn-down DSR

The hypothesized mechanisms underlying these hypotheses are set out in the initial Theoretical Framework (see Appendix 1). The contribution tracing also tests two alternative explanations, also explained in the Theoretical Framework:

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[7] The approach is closely related to 'process tracing' and is based on Befani, B and G. Stedman-Bryce (2016) "Process tracing and Bayesian Updating for Impact Evaluation", forthcoming in *Evaluation* and Befani, B., D'Errico, S., Booker, F. and A. Giuliani (2016) "Clearing the Fog: New Tools for Improving the Credibility of Impact Claims", IIED Briefing, April.

A1 - That the existing funding that is available for DSR/small scale generation through STOR, TRIAD and other schemes is sufficient to motivate firms and aggregators to provide capacity and compete in the CM. In other words, DSR and small scale generation are cost effective and participants' revenues from TA are a bonus which is not needed to cover costs.

A2 – That potential direct participants and aggregators see turn-down DSR as a long term business opportunity because of expected changes in the demand for capacity and the mechanisms by which capacity can be made available (e.g. smart meters), even if it is not cost effective in the short term. TA is welcome but not necessary to support their interest/involvement in the market.

The first step in contribution tracing was to identify evidence that one might expect to see if the hypotheses or the alternative explanations are true.

The evidence for contribution tracing has come from a range of sources which would be used in combination to determine the result of each test for each participant in the auction. The use of multiple sources helped to triangulate evidence and reduce bias. The sources include:

- Application data
- Behaviour in the auction
- What is already known about CMUs by National Grid and others
- Public statements and other public domain data
- A qualitative interview; all interview responses are subject to the risk of respondents telling us what they want us to hear and so need to be treated with caution. Our confidence in interview responses can be improved by triangulating them with other evidence and by probing the respondent to understand the logic underpinning their response.
- Modelling of the business case for direct participants and aggregators by the evaluation team

During the evidence gathering process it was important to be alert to other potentially valuable evidence or flaws in the tests identified. In practice, no major flaws or gaps in the tests were identified as a result of reviewing the Phase 1 evidence, as the tests were specified when much of the Phase 1 evidence was already available. The tests will be reviewed again during Phase 2 of the evaluation.

Contribution tracing can be used with Bayesian analysis which allows for tests to be combined to provide an overall indication of the likelihood of a hypothesis being true in the light of all the evidence from that case. This approach is particularly useful when considering the effect of several pieces of weak evidence.

For the Bayesian analysis to be mathematically sound when combining different pieces of evidence into a single package, it is necessary that tests are independent of each other. Independence in this context has been taken to mean that the outcome of one test does not depend on the likelihood of the outcome of another. However, if tests could have the same outcome for the same underlying causal reason, they are still considered independent. In some cases, we have identified alternative tests that are not independent; in these cases the test providing the most reliable evidence has been used in the combined analysis.

Defining the evidence tests for each hypothesis

The text below considers the evidence test for each hypothesis in turn.

H1. If the TA contributes to direct participants and aggregators making additional capacity available or keeping capacity available that would otherwise have been closed/mothballed, we would expect[8] to see the following evidence:

- H1(a) - Decisions made since September 2014 (the date of the announcement of the TA) to invest in new capacity or keep capacity available that would otherwise have been closed/mothballed. This would be necessary to demonstrate a contribution but could also be driven by the alternative explanations. Evidence for this would come from the interview but could also come from elsewhere e.g. evidence of aggregators actively marketing to fill unproven DSR. This test would not be used if evidence for b. or c. were found.

- H1(b) - The participant saying in the interview that the TA contributed to their decision to invest in capacity or keep capacity available. Participants could be expected to say this anyway so it would provide weak support for the hypothesis. However, if they did not make this claim this would provide strong evidence that the hypothesis is untrue. This test would not be used if evidence for c. below was found.

- H1 (e) – The participant being a price maker and the exit price in the auction for at least one CMU being higher than the hassle costs identified in the supply curve analysis. Where participants bid at or below their hassle costs the hypothesis is unlikely to be true.

- H1 (f) - The participant delivers the capacity when called by the EMR Delivery Body; this evidence would be provided by the EMR Delivery Body and would be very likely to be seen if the hypothesis is true. Where participants don't deliver this could support the alternative explanation of existing support being sufficient (and will mean the scheme has not delivered on one of its key objectives). However, this information will not be available until after the 2016-17 delivery window.

We would also like[9] to see the following pieces of evidence to support H1:

- H1 (c) - Evidence from public statements that the TA made a contribution to the decision to invest in capacity or keep it available. This would be subject to different kinds of bias from interview evidence and could provide a strong case for the hypothesis. However, its absence would not weaken the hypothesis.

- H1 (d) - Evidence from interviews that TA participants had considered taking part in the CM but did not do so because the TA was simpler to participate in and/or required lower credit cover; this would provide support for the hypothesis but if it is not found this does not weaken the hypothesis.

[8] Evidence that we would **expect** to see provides relatively weak support for the hypothesis if found; but if this evidence is not found, this provides strong evidence that the hypothesis is untrue. These are 'hoop tests' – i.e. hoops that must be jumped if the hypothesis is to be supported by the evidence.

[9] Evidence that we would **like** to see would more strongly support the hypothesis if seen, but does not damage the hypothesis if not seen. These are known as 'smoking gun' tests.

H2. If the TA leads to more (competitive) capacity for the T-1 auction[10] in 2018-9 and subsequent years we would expect to see:

- H2 (a) - The organisation or CMU that participated in the TA stating in interviews that they are also planning to bid into the T-1 auction. We won't know if they actually bid until 2018 and this will be confirmed by the EMR Delivery Body data then. It would be necessary for the hypothesis to be true, but would not provide sufficient evidence as another factor could have motivated participation in both the TA and T-1. This evidence would not be used if the test below were true.

- H2 (b) - The participant invested in assets (e.g. controls), markets (e.g. building a client base, entering the UK market) or skills (e.g. knowledge of the CM rules and procedures) for the TA that were intended to be used in the T-1 auction. This evidence would come from the TA interview and would be confirmed after the T-1 auction. If the hypothesis is true we would be likely to see this evidence; however, the participant could have been motivated to invest in the assets, markets or skills because they were attracted to the CM anyway.

- H2 (e) - If the hypothesis is true we might expect to find that participants agree in an interview that the T-1 auction is likely to be more competitive as a result of the TA. Respondents would have little to gain from agreeing or disagreeing with this proposition (although respondents may assume that government wants more competition and so agree with the statement) and so their responses would be more reliable than an interview where a particular response has clear benefits to the respondent. Where participants do not agree with this proposition it would seriously damage the hypothesis.

We would also like to see the following evidence to support H2:

- H2 (c) - The participant did not bid into the T-4 auction prior to the TA auction, as evidenced by the EMR Delivery Body data. If they had done so it would provide evidence against the hypothesis as it suggests that the TA was not necessary to encourage the participant to take part in the CM.

- H2 (d) - The participant states in interview that they intend to bid at a lower price in the T-1 auction than they would otherwise have done. This could be further evidenced by participants accepting the clearing price in T-1 when they had not done so in the TA. This evidence would provide some support for the hypothesis but participants could bid at a lower price because of other reasons (e.g. a change in the relative costs of fuel/electricity) or a change in the value of other capacity payments.

H3. If the TA leads to wider encouragement of turn-down DSR we would expect to see the following evidence:

- H3 (a) - Participants confirm in the interview that their long term strategic commitment to turn-down DSR strengthened as a result of the TA funding. Do not use this if H3(b) found.

- H3 (e) - Participants in TA state in interview that they are considering bidding turn down DSR projects into the CM in future.

Additional evidence that we would like to see to support H3:

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[10] We are interpreting the T-1 auction to include the supplementary auction (or 'Early Auction') proposed by BEIS for 2017/18, which would be held one-year ahead of the delivery year. BEIS's consultation on the Early Auction took place between the start of the evaluation and the completion of fieldwork, so interview participants were aware of this possible auction opportunity. However, we would not interpret influence on intentions to participate in future T-4 auctions as contributing to Outcome 2: we have agreed with BEIS that influence on T-4 intentions would count as wider encouragement of DSR, and contribute to outcome 3.

- H3 (b)- Participants cite TA funding in public statements as a reason for their commitment to turn-down DSR. This evidence provides support for the hypothesis but if it is not found does not weaken the hypothesis.

- H3 (c) - TA participants state in interview that they are investing in new or maintaining existing turn down DSR capacity (i.e. not small scale generation or back up DSR). Do not use if H3(d) found.

- H3 (d) - Participants state in interview that they are using the TA to implement turn down DSR for the first time

The evidence for the alternative hypotheses is considered below:

A1. If the existing funding that is available for DSR/small scale generation through STOR, TRIAD and other schemes is sufficient to motivate firms and aggregators to provide capacity and compete in the CM we would like to see:

- A1 (a) - Respondents stating in the interview that they would have invested in, or maintained, capacity regardless of the TA.

- A1 (b) - Participants being a price taker or the exit price for all CMUs being at or below the hassle costs in the TA auction (on the basis that they would be willing to accept any level of funding from the TA because it is a bonus for capacity that is already available).

- A1 (c) - Participants in TA claim in interview that without TA there will be sufficient funding (from STOR etc.) to justify investing in or keeping capacity available. Evidence for this would only come from the interview and participants might not say this even if the hypothesis is true, so it provides weak support for the hypothesis. However, if the alternative explanation is false (i.e. there is not enough funding), they would be very unlikely to claim that there is enough funding.

- A1 (d) - Participants failing to deliver the capacity contracted under the TA when called (from National Grid data); this would suggest that existing support is sufficient to fund their DSR/small scale generation activities and there is no need to overcome additional obstacles to secure TA funding.

We did not identify any evidence that we would <u>expect</u> to see if A1 is true.

A2. If potential direct participants and aggregators see turn-down DSR as a long term business opportunity regardless of government support, we would <u>like</u> to see:

- A2(a) - Respondents stating in the interview that government support made no difference to their commitment to turn-down DSR.[11]

- A2 (b) - Turn down DSR projects are considered able to compete effectively in the CM.

- A2 (c) – Turn-down DSR projects are considered cost effective because of the existing non-CM revenues available to them.

[11] We looked for an explicit statement to this effect, rather than just the absence of evidence that government support had made a difference to their commitment to turn-down DSR.

- A2 (d) – Turn-down DSR projects that exploit smart grids and other new developments considered likely to be commercially viable in the long run.

We did not identify any evidence that we would <u>expect</u> to see if A1 is true.

Assigning probabilities to each hypothesis and evidence test

The next step in developing the Bayesian analysis is to assign probabilities to the likelihood of each piece of evidence being seen if the hypothesis is true (sensitivity) and if it is false (type 1 error) prior to conducting any research or gathering any evidence. Table 1 below sets out the ex- ante (initial and based on theory before evidence collection) estimates of the probabilities of seeing each piece of evidence if the hypothesis is true (sensitivity) and the probability of seeing that evidence if the hypothesis is false (type 1 error).

Probabilities were assigned, based on the project team and BEIS's understanding of the TA and DSR market prior to viewing the evaluation evidence. The initial set of probabilities were proposed by the consultancy team and reviewed by BEIS's evaluation team. The probabilities show in Table A6.1 were further reviewed by a peer reviewer with in-depth understanding of the TA and DSR market and by a member of BEIS's policy team for the TA. Sensitivities to the revised assumptions are presented later in this paper.

Table A6.1: Ex-ante estimates of probabilities of seeing evidence

	Evidence	Type 1	Sensitivity[12]
H1a	Decisions made since September 2014 (the date of the announcement of the TA) to invest in new capacity or keep capacity available that would otherwise have been closed/mothballed.	0.8	1
H1b	The participant saying in the interview that the TA contributed to their decision to invest in capacity or keep capacity available (do not include if H1c is found).	0.6	0.9
H1c	Evidence from public statements that the TA made a contribution to the decision to invest in capacity or keep it available.	0.1	0.3
H1d	Where TA participants saying in interview that they had considered taking part in the CM but did not do so because the TA was simpler to participate in and/or required lower credit cover.	0.05	0.6
H1e	The participant being a price maker and the exit price in the auction for at least one CMU being higher than the hassle costs identified in the supply curve analysis.	0.5	0.8
H1f	The participant delivers the capacity when called by the EMR Delivery Body.	0.6	0.9
H2a	The organisation or CMU that participated in the TA also saying in interview that they were planning to bid into the T-1 auction. Do not use if H2b true.	0.5	0.95
H2b	The participant saying in interview that they had invested in assets (e.g. controls), markets (e.g. building a client base, entering the UK market) or skills (e.g. knowledge of the CM rules and procedures) for the TA that were intended to be used in the T-1 auction.	0.4	0.8
H2c	The participant did not bid into the T-4 auction prior to the TA auction.	0.1	0.3
H2d	The participant saying in interview that they intend to bid at a lower price in the T-1 auction than they would otherwise have done.	0.1	0.3

[12] The 'sensitivity' is the probability that this piece of evidence is observed if the relevant hypothesis is true. The 'type 1 error' is the probability that this piece of evidence is observed if the relevant hypothesis is not true.

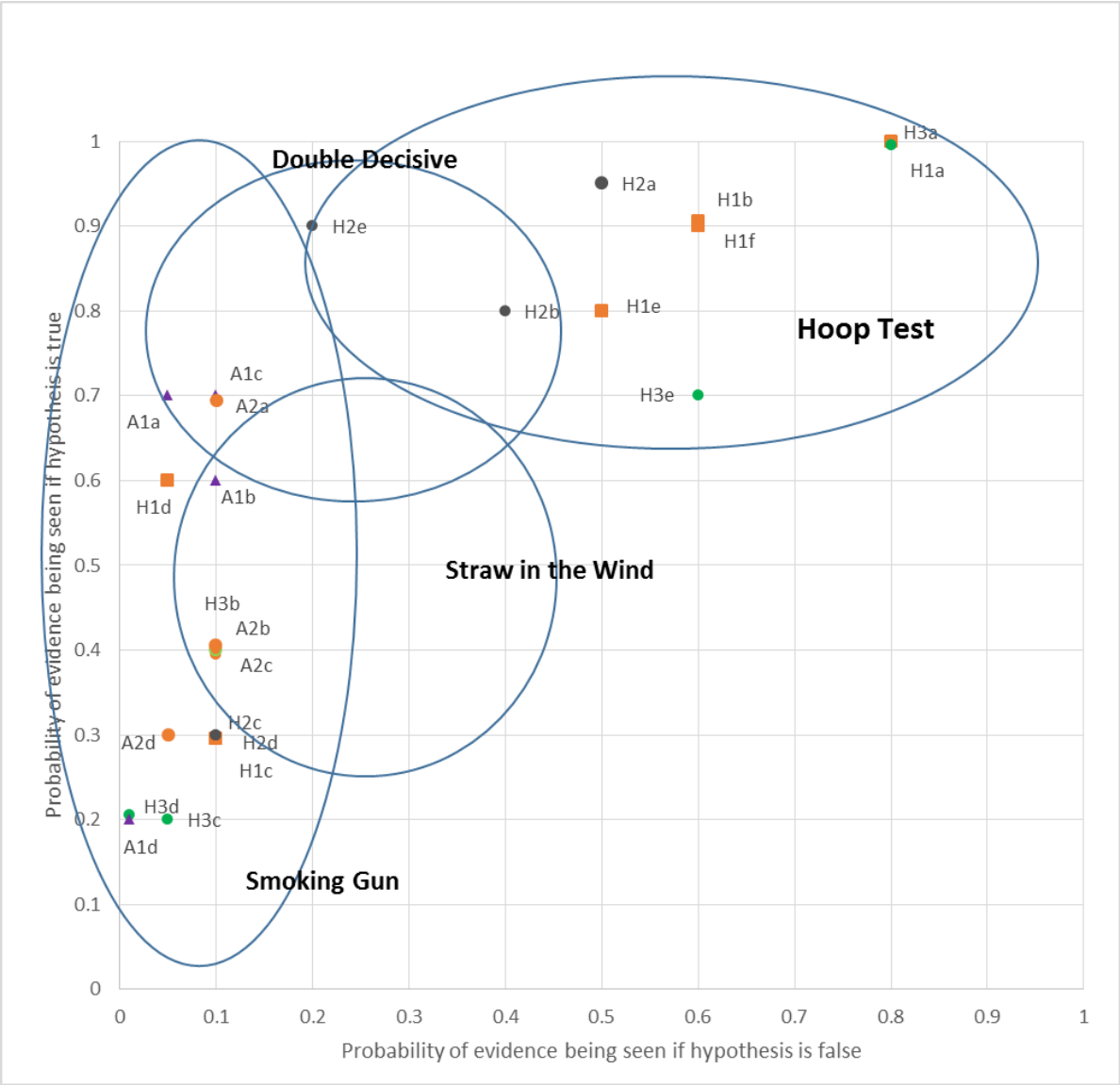
	Evidence	Type 1	Sensitivity[12]
H2e	Participant agrees in an interview that the T-1 auction is likely to be more competitive as a result of the TA.	0.2	0.9
H3a	Participants confirm in the interview that their long term strategic commitment to turn down DSR strengthened as a result of the TA funding. OR	0.8	1.0
H3b	Participants cite TA funding in public statements as a reason for their commitment to turn down DSR (do not include if H3a is found).	0.1	0.4
H3c	TA participants say in interview that they are investing in new, or maintain existing, turn down DSR capacity (i.e. not small scale generation or back up DSR).	0.05	0.2
H3d	Participants in TA say in interview that they are implementing turn down DSR for the first time.	0.01	0.2
H3e	Participants in TA say in interview that they are considering bidding turn down DSR projects into the CM in future.	0.6	0.7
A1a	Respondents stating in the interview that they would have invested in, or maintained, capacity regardless of the TA.	0.05	0.7
A1b	Participants being a price taker or the exit price for all CMUs being at or below the hassle costs in the TA auction.	0.1	0.7
A1c	Participants in TA claim in interview that without TA there is sufficient funding (from STOR etc.) to justify investing in or keeping capacity available.	0.1	0.6
A1d	Participants failing to deliver the capacity contracted under the TA when called.	0.01	0.2
A2a	Respondents state in the interview that the TA made no difference to their commitment to turn down DSR.	0.1	0.7
A2b	TA participants say in interview that turn down DSR projects are considered able to compete effectively in the CM.	0.1	0.4
A2c	TA participants say in interview that turn down DSR projects considered cost effective because of the existing non-CM revenues available to them.	0.1	0.4

	Evidence	Type 1	Sensitivity[12]
A2d	TA participants say in interview that turn down DSR projects that exploit smart grids and other new developments are considered likely to be commercially viable in the long run.	0.05	0.3

Figure A6.1 plots the probabilities and shows which tests can be considered to be:

- **Hoop tests** – reject the hypothesis if not found but not sufficient to confirm the hypothesis; these are pieces of evidence that we would expect to see if the given hypothesis is true.
- **Double decisive** – confirms the hypothesis if observed and if not observed the hypothesis is rejected (these are pieces of evidence that are expected but are also confirmatory of the hypothesis).
- **Smoking gun** – confirms the hypothesis if observed but does not reject the hypothesis if not observed; these are pieces of evidence that we would 'like to see'.
- **Straw-in-the-Wind** – not sufficient to confirm the hypothesis if observed or to reject the hypothesis if not observed.

Figure A6.1: Ex-ante probabilities of seeing evidence



Using Bayesian analysis it is possible to use ex-ante estimates of probabilities of independent pieces of evidence to calculate the probability that a proposition is true in the light of actual evidence (the posterior probability). This utilises the formula below:

$$\text{pr (P|K)} = \text{pr(P)pr(k|P)} / \text{(pr(P)pr(k|P)} + \text{pr(not P)pr(k|not P))}$$

Where

- Pr (P|K) = posterior probability of the hypothesis being true if evidence K is seen
- pr (P) = prior likelihood the hypothesis is true (if unknown assume 50%)
- pr(k|P) = likelihood of seeing evidence k if the hypothesis is true (sensitivity)
- pr(not P) = prior likelihood that the hypothesis is not true
- pr(k|not P) = likelihood of seeing evidence k is the hypothesis is not true (type 1 error)

This requires an ex-ante estimate of the likelihood of each hypothesis being true. We have estimated the following probabilities, based on the prior understanding of the TA and DSR markets amongst the project team and BEIS. These figures have been reviewed by a peer reviewer with in-depth knowledge of the DSR market, and revised accordingly. Sensitivities to these assumptions are presented later in this paper.

- A 30% probability has been assigned to hypothesis H1 being true as it is expected that most bidders in the TA already had the capacity available.
- A 50% probability has been assigned to hypothesis H2 being true as it is expected that some bidders in the TA would have bid into the T-1 auction regardless.
- A 55% probability has been assigned to hypothesis H3 being true as it was considered slightly more likely than not to be true.
- A 70% probability has been assigned to this alternative hypothesis A1 as it is the opposite of hypothesis 1 which was assigned a probability of 30%.
- A 20% probability has been assigned to alternative hypothesis A2 as it is likely that some government support will be needed to support the turn-down DSR market. The probability attached to this is not the direct converse of H3, because another alternative hypothesis could be posited: that turn-down DSR is still not viable, with or without the TA. We will consider this third alternative when reviewing contribution tracing during Phase 2.

The results of independent contribution tracing tests are combined into a single posterior probability for each participant that each hypothesis and alternative explanation contributed to the outcome for that participant. These probabilities are expressed as a likelihood of contribution for each participant as:

- Very likely contribution (applied here to results which are 80% or higher)
- Likely contribution (applied to results in the range 55% - 79%)
- Neither likely nor unlikely (applied to results in the range 45-54%)
- Unlikely to have made a contribution (applied to results in the range 20-45%)
- Very unlikely to have made a contribution (applied to results which are less than 20%)

A spreadsheet was used to set out the detailed tests across all case studies (i.e. all TA participants that entered the first TA auction), including:

- A prior estimate of the probability of each hypothesis/explanation being true
- Each test as it applies to each hypothesis/explanation together with an estimate of the probability that the evidence would be seen if the hypotheses are true (sensitivity) or false (type 1 error).
- The rationale for the ex-ante estimates of probabilities.
- The calculations to derive the overall probability of each hypothesis being true for each participant.

The analysis below considers the evidence from each participant's tests to establish:

- The overall position e.g. the proportion of participants for whom the hypothesis was true
- The overall strength of the evidence for the hypothesis being true

- Whether the probability of the hypothesis being true differed between types of participants or technologies
- Which contexts and mechanisms explain the contribution of the TA to the outcomes?

Applying the contribution tracing approach

The contribution tracing approach was applied to evidence relating to all auction participants: 24 of these 25 participants emerged with at least one Capacity Agreements while one participant did not win a Capacity Agreement. The evidence came from a number of sources:

- The Capacity Market Register (number and type of Capacity Market Units (CMUs) put forward by each participant);
- Information on exit prices in the 1st TA auction, for each CMU;
- Modelled 'hassle' costs for each CMU, developed by the project team as part of the supply curve work, which represent the cost of complying with TA requirements, irrespective of whether any additional capacity or electricity generation was being provided by each CMU;
- Views reported by TA participants in qualitative telephone interviews, which were undertaken during March-April 2016;
- Views reported by TA participants at BEIS's post-auction feedback session in February;
- Confidential information from BEIS's interviews with certain DSR providers in autumn 2015;
- Public announcements (where known – rarely available in practice).

For each of the participant organisations, the sources of evidence listed above were scanned for information relating to each of the contribution tracing tests. The resulting codes were compiled in an Excel sheet and then used to populate the contribution tracing matrix. Findings from this process are not presented here due to the need to retain anonymity of participants.

Sensitivity analysis

The team carried out sensitivity tests to check how sensitive the conclusions are to small changes in coding, carried out to ensure that coding was consistent, and to a revised set of probabilities following a review by an external expert.

Sensitivity to small changes in coding

The sensitivity tests showed that refined coding did not have much impact on contribution tracing results. There was a very slight weakening in support for H1 and H3, and a very slight strengthening of support for alternative hypothesis A2, but not to the extent that the overall pattern of results is affected. The results still show weak support for H1, strong support for H2 and mixed support for H3, with strong support for A1 (which is a clear alternative to H1) and weak support for A2 (which is a partial alternative to H3).

Sensitivity to revised probabilities

The sensitivity tests showed that the revised probabilities had the effect of reducing support for H3. In particular, the hypothesis about encouraging turn-down is no longer supported for six cases: four existing aggregators, one new aggregator and one direct participant. There are two reasons for this:

- In two cases (the new aggregator and the direct participant), the revised probabilities reduce support slightly from 67% likelihood of a contribution to H3 down to 55% likelihood, which we have categorised as “Neither likely nor unlikely”. Both of these cases passed test H3a, which required that an organisation stated in interview that they had more interest in/commitment to turn-down DSR as a result of the TA.

- The four existing aggregators failed tests H3a and H3b, which looked for evidence of increased commitment to turn-down DSR. The reason for failing this test was that they were already committed to turn-down DSR prior to the TA and there was no evidence from interview that this commitment had increased as a result of the TA. The revised ‘sensitivity’ assumption for test H3a was set at 1.0, making this a rigid hoop test: hypothesis H3 was only supported if this test was passed[13]. Since they failed this particular test, these four aggregators failed to provide any support for H3, despite exhibiting other evidence in support of the hypothesis.

In future iterations of contribution tracing, we may want to review the specification of the test used for each hypothesis, as well as the probabilities attached to each test. The sensitivities presented in this paper suggest that results are slightly sensitive to the coding of evidence in relation to particular tests and more sensitive to the probability assumptions us.

[13] In theory, these organisations could still have supported H3 if they had passed test H3b (i.e. made public statements about increased commitment to turn-down DSR), since this H3b was included as an alternative to H3a. However, no organisations passed test H3b, as no such public statements were found.