



Department for
Business, Energy
& Industrial Strategy

EVALUATION OF THE REFORMED RHI

Synthesis report: 'interim applicant' research
Appendices

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OGL

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Appendix A. Evaluation plan summary

An evaluation plan was developed in Spring 2017 to support the delivery of this evaluation. A summary of that plan is provided below to give readers insight into the overall scope and aspirations of the evaluation.

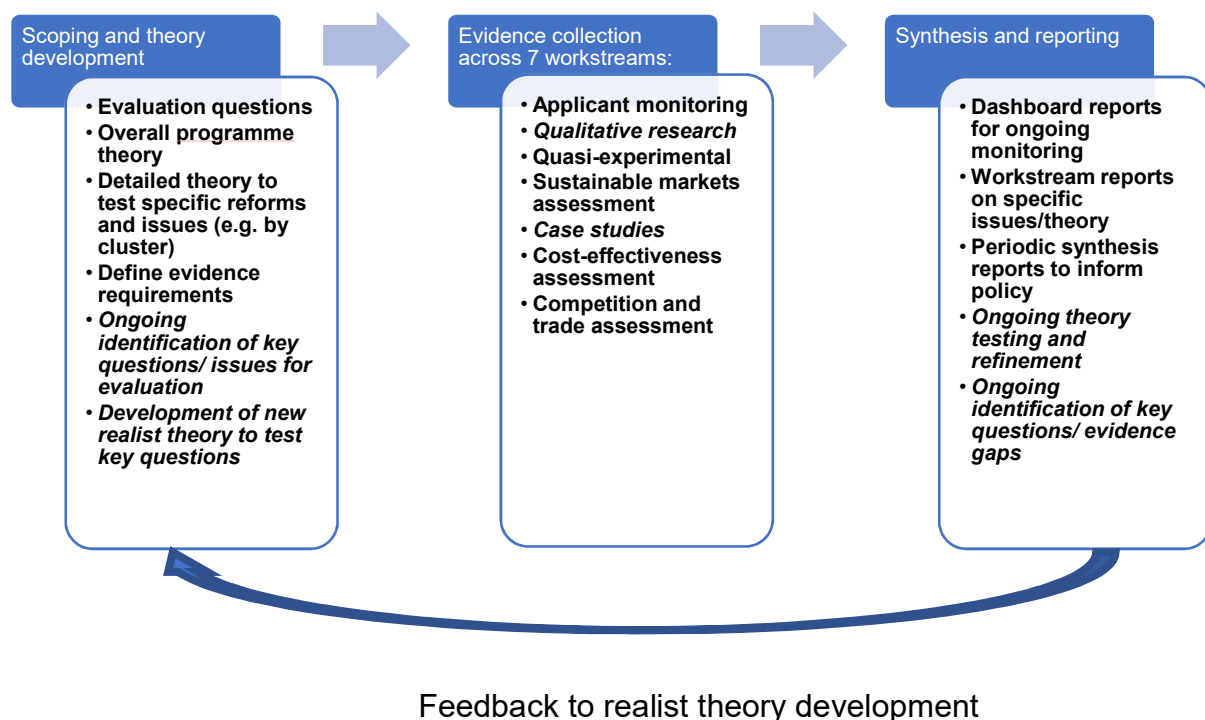
This summary presents evaluation approaches which are subject to review and change throughout the evaluation, particularly to reflect the key issues that arise following the implementation of the proposed RHI reforms.

Overview

This document sets out our plan for evaluation of the reformed Renewable Heat Incentive (RHI) scheme on behalf of the Department for Business, Energy and Industrial Strategy (BEIS). The evaluation will provide a) *an assessment of the impact of the scheme*, and b) *strategic learning to inform heat policy development*. The evaluation will be structured around theory-based evaluation methods which will develop, test and refine realist theory about the reformed RHI as the scheme proceeds.

Theory will be tested using evidence from seven workstreams, which will be tailored to test overall programme theory and key questions as they emerge. A summary of the evaluation plan is shown in Figure 1. Elements that will be the most responsive to emerging issues and policy questions are shown in italics.

Figure 1: Summary of evaluation plan



Evaluation aims and questions

Evaluation aims

The evaluation is required to provide an assessment of the impact of the scheme and to provide strategic learning to inform heat policy development. The evaluation should provide learning that fills gaps in the existing evidence base while also providing a holistic assessment over the reformed RHI period.

The ITT explains that the evaluation is required to evaluate both the domestic and non-domestic RHI schemes and highlights certain differences:

- The domestic scheme has been extensively studied through a previous evaluation undertaken by BEIS. The aims of this evaluation are to strengthen the evidence base for those audiences targeted by the reforms, including less able to pay households and heat pump users.
- The evidence base for the non-domestic scheme is less complete. Specific gaps relate to larger and industrial applicants, due to low applications from these audiences at the time of evaluation. There are also evidence gaps in relation to comparison groups of organisations who did not apply for the RHI. There are specific challenges in relation to the non-domestic sector resulting from applicants being more heterogeneous with installations which are larger and often bespoke.

The aims set out by BEIS in the ITT are therefore as follows.

A1: Provide an assessment of the impact of the scheme

1. Assess the extent to which the RHI's expected aims have been achieved (including renewable heat generation, carbon abatement and development of a sustainable market)
2. Assess the extent to which the reform objectives have been met (including improving value for money)
3. Assess if the reformed RHI scheme is contributing to changes in competition and trade between EU member states
4. Demonstrate the causal mechanisms through which the reformed RHI scheme has led to the achievement of the scheme objectives, and how these differ between different consumers and in different contexts

A2: Provide strategic learning to inform heat policy development

1. Identify the factors that are important in increasing the installation of renewable heat systems and the generation of renewable heat and how these differ across customer groups and/or technologies
2. Identify the factors that are important in supporting the development of a sustainable market for renewable heat and how these differ across customer groups and/or technologies

Evaluation questions

To address the aims above, a set of high-level evaluation questions were developed by BEIS.

Through the scoping phase a revised set of evaluation questions and sub-questions for the evaluation were developed. The revised set of high-level questions are designed to be more consistent with aim A1(d), which has led us to apply a 'realist' approach to the evaluation. They put emphasis on exploring the nature of the influence and outcomes of the RHI scheme for different players in different circumstances with different technologies, rather than just determining the average impact of the scheme.

The high level evaluation questions are as follows:

1. How far have the reformed RHI outcomes been achieved, for whom and in what contexts, and how has the reformed RHI contributed to these outcomes?
2. How has design and implementation of the reformed RHI influenced these outcomes, in what respects and for whom?
3. How has the reformed RHI influenced value for money?
4. To what extent has the reformed RHI impacted competition and trade between member states, and has this been different across technologies and contexts?
5. How has the reformed RHI contributed to the development of sustainable markets for renewable heat, and how does this differ across market segments or technologies?
6. What lessons can be drawn from the evaluation of the RHI regarding future renewable heat policy?

Rationale for our evaluation approach

Theory-based 'realist' approach

Our approach to this evaluation is theory-based and will follow realist principles. This is because of the evaluation aims, the complex and evolving nature of the reformed RHI scheme, and the need to understand how it operates across a diverse range of contexts. The development and testing of overarching theories of change for the reformed RHI, and more detailed theories for emerging policy questions, is central to our method.

A realist approach was chosen for this evaluation because the policy area is complex (requiring careful unpicking of 'how' and 'why' organisations and households made the choices they did). The emphasis of the realist approach on understanding 'how' and 'why' the RHI influenced – or did not influence – customers will be important in understanding how, to what extent, and for whom, the RHI has supported uptake of renewable heating technologies.

The realist approach will allow lessons to be learnt even when sample numbers are small (as for large-scale, low-volume technologies such as biomethane and geothermal). But,

where sample numbers and data availability permit, we will also make use of statistical analysis to assess scheme impacts (e.g. to analyse the difference in contexts and outcomes between reformed RHI participants and non-participants (or pre-reform RHI participants) within a particular group of interest).

Central to implementing a realist evaluation is the development of a ‘theory’ of the RHI, as this allows evaluators to rigorously examine the design and execution of the scheme, and test policy assumptions against available evidence. The use of theory-based evaluation is supported by HM Treasury guidance on evaluation¹.

During the scoping phase of this evaluation an overall theoretical framework was developed, involving the framing of realist hypotheses that will be 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 activated²), leading to desired or undesired policy outcomes. These realist hypotheses are generally known as context-mechanism-outcome combinations or ‘CMOs’³.

Our realist approach allows us to be agile in developing and testing new detailed theories in response to emerging policy questions. Given the heterogeneity and complexity of the RHI system as a whole, we will use new detailed theories to ‘zoom in’ and undertake rigorous research on particular parts of the reformed RHI system affected by these policy questions. For example, we will develop tailored sets of CMOs (building on the generic CMOs) to explore how particular aspects of the reforms are affecting the behaviour of relevant groups of consumers, RH suppliers and other stakeholders (e.g. financiers, suppliers of feedstocks), and to explore the implications of this for BEIS’ objectives. This will enable us to respond in a flexible and rigorous way to real policy questions of interest to BEIS. The learning gathered from this focused research will, in turn, feed into our synthesis of evidence, and will be used to inform and refine the overall theoretical framework as the evaluation proceeds. Examples of the CMOs supporting the research in interim applicants are included Appendix C and Appendix D.

Identifying areas for focused research

The focus of this evaluation is understanding the impact that the reforms to the RHI have had on the success of the overall scheme. To meet this aim, we have worked with BEIS to define key policy questions relating to the expected reforms and how they are intended and expected to work. For each policy question, we have identified ‘clusters’ of contexts that would enable testing of that policy question

Table 1 sets out the initial set of key policy questions that are expected to be explored through detailed research. The list of key policy questions will be extended and refined as the evaluation proceeds, in response to issues identified by BEIS and findings from ongoing monitoring of the reformed RHI scheme. Priorities for research will be agreed with BEIS on a rolling basis.

¹ See chapter 2 of HM Treasury (2011) *The Magenta Book: Guidance for Evaluation*. London: HM Treasury. Available at: <https://www.gov.uk/government/publications/the-magenta-book>. Accessed 27/7/16

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. Further detail can be found in Pawson and Tilley (1997) (op cit).

We recognise that there may be limits on the extent to which findings from research on particular clusters can be extrapolated to the reformed RHI scheme as a whole. Some elements of research, such as applicant monitoring and the value for money and sustainable market assessments, are therefore designed to cover the whole scheme, including technologies and customer groups that do not fall within these clusters.

Table 1 Key policy questions for detailed research

(questions relating to the domestic RHI are shown on a green background; those relating to the non-domestic scheme are shown on a blue background; those potentially relating to both are shown on a plain background)

Key policy questions related to anticipated RHI reforms	Proposed cluster
<p>How has the elongated period of reform implementation influenced applications to the RHI scheme?</p>	<p>Sectors showing changes in application rates that appear attributable to announcement /anticipation effects (e.g. medium-scale biomass applicants, and other affected groups) (primarily non-domestic RHI)</p> <p>OR</p> <p>Sectors showing sustained deployment despite significant uncertainty in the scheme.</p> <p>(Note: these clusters were confirmed as Non-domestic medium biomass applicants and domestic heat pump applicants with higher heat demands.)</p>
<p>Will the increased tariffs for heat pumps stimulate demand sufficiently? Are the electricity metering requirements for domestic heat pumps reasonable and are they encouraging consumer confidence? How satisfied are customers with their installations?</p>	<p>Heat pump supply chain/market (mostly domestic RHI)</p>
<p>Will the introduction of the heat demand limit (HDL) reduce overcompensation without killing off the market for high heat demand houses?</p>	<p>High heat demand houses (domestic RHI)</p>
<p>Will the Assignment of Rights (AoR) open up renewable heating for lower income households, while providing good protection for consumers?</p>	<p>Lower income houses (domestic RHI)</p>

Key policy questions related to anticipated RHI reforms	Proposed cluster
<p>What is the impact of the proposed 50% feedstock rule and change in tariff for biogas and biomethane projects, and how will it affect different types of stakeholders? Will applicants choose the new regulations (stricter standards but higher tariff), or apply under the old regulations (looser standards with lower tariff)? Will there be sufficient supplies of suitable waste and residues, and will the rule create distortions in the waste market (e.g. by impacting on gate fees)? Will the rule bring benefits for agricultural systems (e.g. through reducing incentives to grow energy crops for anaerobic digestion (AD))?</p> <p><i>(Note: assessing other potential undesired impacts of these projects arising from technical operating practices, such as methane leakage, are beyond the scope of the evaluation).</i></p>	<p>Biogas & biomethane projects (non-domestic RHI)</p>
<p>Will Tariff Guarantees (TGs) encourage investment in larger plant within eligible technology groups? To what extent will TGs impact the financial control mechanisms within the scheme?</p>	<p>Tariff Guarantee (TG) projects (non-domestic RHI)</p>
<p>Will the clarification of rules for shared ground loops lead to more, and easier, procurement and installations (e.g. by social housing providers)? Will deeming of heat demand for these installations lead to overcompensation?</p>	<p>Shared ground loops (non-domestic RHI)</p>
<p>Will biomass installations be targeted at the uses that are most appropriate and offer best value for money?</p> <p><i>(The overall sustainability of biomass use, and its contribution to carbon reduction is being considered separately by BEIS).</i></p>	<p>High temperature/industrial processes (non-domestic RHI, mainly biomass)</p> <p>High heat demand households (domestic RHI)</p>
<p>Will the proposed revisions to biomass tariffs, CHP rules and allowable heat uses allow this sector to continue benefitting from RHI, while reducing over-compensation and perverse impacts?</p> <p><i>(As above, the overall sustainability of biomass use is being examined separately.)</i></p>	<p>Agriculture and forestry (primarily biomass and biomass CHP)</p>

Key policy questions related to anticipated RHI reforms	Proposed cluster
Research other key policy questions as identified (e.g. research contexts and mechanisms which encourage higher take-up for specific technologies)	Additional clusters – to be identified (domestic and non-domestic scheme)

Theoretical framework

Role of the theoretical framework

The theoretical framework sets out how the reformed RHI is expected to work. The scope of the theoretical framework is informed by the evaluation questions. And the theoretical framework in turn defines the areas which we want to research, including the CMO hypotheses that we want to test. Figure 2 below shows the relationship between the evaluation questions, theoretical framework and research evidence.

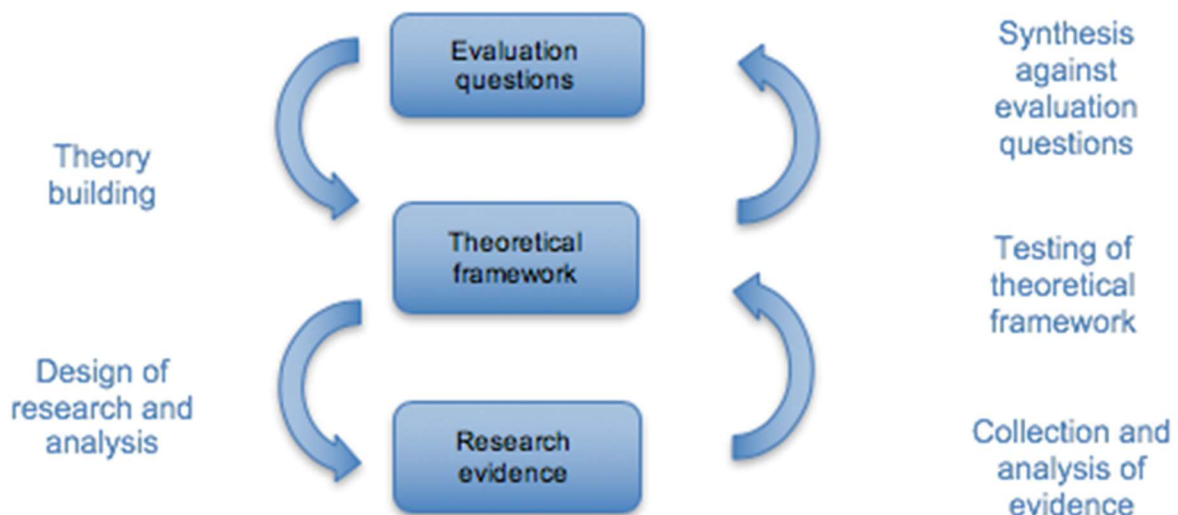


Figure 2. Relationship between evaluation questions, theoretical framework and research evidence

The initial theoretical framework is based on a review of existing evidence, including findings from previous RHI evaluation research. It has also been informed by two workshops with BEIS policy staff, on the domestic and non-domestic RHI, and follow-up discussions with policy staff and our technical advisers (Ricardo AEA and the Energy Saving Trust).

The theoretical framework is central to the evaluation and will be used to:

- Structure our proposals for evidence collection, as set out in this evaluation plan;
- Act as a checklist for topics to be covered by research instruments;

- Provide the hypotheses that we test during analysis of the evidence, which will primarily be CMO hypotheses; and
- Act as the repository of understanding of how the scheme works and for whom, through successive review and updating of the theoretical framework.

The overall theoretical framework will be reviewed against evidence during each round of synthesis, and will be updated after each round of synthesis is complete. This may involve changes to the structure of the framework, if there are simpler or more meaningful ways of capturing insights into how the reformed RHI works and for whom.

For each specific piece of research conducted, detailed theories are formulated in terms of realist ‘context-mechanism-outcome’⁴ (CMO) combinations. Detailed CMOs allow testing of specific policy questions by setting out how, why and in what circumstances a particular aspect of the policy achieves the desired outcomes. Using CMOs the research will be designed to:

- identify whether particular contexts of interest were present, and how these affected reasoning and outcomes;
- understand the reasoning behind significant decisions made by relevant stakeholders, and explore the extent to which these or other mechanisms were leading to observed outcomes;
- identify what types of outcomes were observed, for whom and in what circumstances, and what learning can be drawn from this for future policy on renewable heat.

Explanation of structure of the theoretical framework

Our approach has been to develop different levels of theory, ranging from a very high-level overarching theory to very detailed theory that addresses key policy questions for areas of particular interest (e.g. clusters). Our initial theoretical framework is set out in four levels, which are progressively more detailed:

- Level 1 - An overall ‘realist statement’ for the reformed RHI [NB. This is included in chapter 2 of this synthesis report]
- Level 2a - A theory of change for the reformed RHI system as a whole, in policy map form [NB. This is included in Appendix B, below]
- Level 2b – Cross-cutting theory for Hatch Regeneris’ workstreams [NB. Not included in this summary]

⁴ Context describes those features of the conditions in which programmes are introduced that are relevant to the operation the programme mechanisms. Mechanisms describe what it is about programmes and interventions that bring about any effects. Outcome-patterns comprise the intended and unintended consequences of programmes, resulting from the activation of different mechanisms in different contexts. R Pawson, R, and Tilley, N. (1997) *Realistic Evaluation*. London: SAGE Publications Ltd; and Pawson, R. (2006) *Evidence-Based Policy*. London: SAGE Publications Ltd.

- Level 3 - Generic theory for specific sub-systems, in CMO form (i.e. renewable heat (RH) demand, RH usage, RH supply and RH fuel supply) [NB. Not included in this summary]
- Level 4 – Draft CMOs to address key policy questions relating to the reforms, targeted at specific clusters of technologies, consumers and elements of the supply chain. This detailed theory will be further developed and extended as the evaluation proceeds, in response to emerging policy questions and issues identified through ongoing monitoring of the reformed RHI. [NB. Not included in this summary]

Evaluation workstreams

To address the evaluation questions a set of 5 different workstreams will be implemented. These workstreams provide the depth and breadth of evidence that is required across the evaluation.

The precise content of these workstreams is defined based on the theoretical framework (described above), evidence will be brought together from multiple questions in order to answer the evaluation questions. The workstreams are:

- **Applicant monitoring and surveys**

Detailed applicant monitoring will comprise collection and analysis of RHI application data from BEIS, supplemented by an online survey of applicants. Applicant surveys will provide evidence including applicant demographics, reasons for installing a renewable heat technology, experiences of installation and using their technology, and fuels and feedstock details.

- **Detailed qualitative research with key audiences**

This workstream will enable us to understand and identify the causal mechanisms through which the RHI scheme is operating. It is expected to involve over 300 in-depth interviews with domestic and non-domestic consumers, as well as supply chain representatives and other stakeholders. These will be targeted as required to test theory relating to key policy questions agreed with BEIS, and – where necessary - to fill knowledge gaps in testing theory for the reformed RHI scheme as a whole.

- **Case studies of low volume technologies**

These case studies will be focused on low-volume, large-scale non-domestic technologies that might otherwise be under-represented in the research. The case studies will collate evidence from site visits, a review of available documentation and interviews with key stakeholders. This approach allows for a broader consideration of the system in which these larger scale installations operate, and how the role that the RHI plays across this network of stakeholders

- **Sustainable markets assessment**

This workstream will track a set of indicators over time covering the key factors expected to illustrate change within the market. Many of these indicators will measure interim outcomes in the sustainable markets framework, such as cost reductions, increased demand and increased supply for particular markets and technologies. Much of the data used by this workstream will be collected in other workstreams (e.g. applicant surveys), however some additional data will be collected from engagement with external stakeholders and reviews of industry data.

- **Quasi-experimental impact assessment**

Quantitative impact assessment methods are expected to be used to assess the impact that the RHI reforms have had on key outcomes of interest. The scheme design does not support a purely quantitative impact assessment, however, this workstream will seek to provide quantitative evidence to assess whether achievement of particular reform aims can, controlling for all other factors, be attributed to the introduction of the reforms.

This analysis is expected to assess the impact of:

- higher tariffs and metering requirements on the heat pump market;
- heat demand limit reforms on high heat demand households;
- Assignment of Rights on RHI take-up and use by lower income households; and
- RHI reforms on biomass use in the agriculture and forestry sectors.

- **Cost-effectiveness assessment**

This workstream is expected to use a mix of quantitative and qualitative evidence to provide insight into how the reforms have affected value for money in key areas. The analysis would present an overall narrative using the evidence that is available in each area.

A full cost-benefit analysis will not be conducted by this evaluation.

- **Competition and trade assessment**

This workstream will assess the extent to which the reformed RHI has impacted competition between member states, the impact on competitiveness and trade of beneficiary organisations and the impact of the policy on the trade of renewable heating related goods and services.

The primary areas of assessment under this strand are likely to include:

- Assessing the direct impact on beneficiaries through appropriateness of the level of the tariffs
- Assessing any indirect impacts for beneficiaries
- Assessing the impact on trade in renewable heating technologies
- Assessing the impact on trade in biomass and biomethane feedstocks.

Contribution of workstreams to evaluation questions and theory testing

This sub-section explains how the different evaluation workstreams will contribute to answering the high level and detailed evaluation questions, and to testing different elements of the programme-level and detailed theory.

Question 1: How far have the reformed RHI outcomes been achieved, for whom and in what contexts, and how has the reformed RHI contributed to these outcomes?

1. How far have the scheme's carbon abatement and renewable heat generation aims been achieved, for whom and in what contexts, and is this additional to what would otherwise have happened?
2. For whom and in what contexts has the reformed RHI influenced target beneficiaries to come forward for prioritised technologies, and was this at an expected scale⁵?

Main elements of theory being tested in this question:

- Are 'outcomes' being achieved, and in what 'contexts' are they being achieved?
- The contribution of the reformed RHI to these outcomes, which requires an understanding of the 'mechanisms' by which the scheme has influenced these outcomes

Achievement of outcomes (and the contexts in which they are achieved) will primarily be assessed through:

- **Detailed applicant monitoring**, which will demonstrate what has been delivered under the reformed RHI scheme, and for which types of applicants, based on statistical analysis of RHI scheme data and surveys with applicants. Statistics generated will tend to be most robust for larger volume technologies and applicant groups. This workstream will test outcomes and contexts in relation to CMOs in the demand theory and usage theory, for these groups. It should also make some contribution to testing of mechanisms for these groups, through applicant responses about the motivations for their choices.
- **Quasi-experimental analysis**, which is expected to analyse the differences between pre- and post-reform participants to assess how far the reforms have had a significant impact on delivery under the scheme. This will focus on technologies and groups with a sufficient number of applications to support statistical analysis⁶. We anticipate that this work will use Regression Discontinuity Design (RDD) and/or Interrupted Time Series (ITS) to look for statistical evidence on differences in the

⁵ Target beneficiaries will be defined as those beneficiaries who are impacted by the final package of reforms.

⁶ Typically, quasi-experimental analysis will only be feasible for populations comprising several hundred applications over the relevant time period which can be matched to datasets that will be used for explanatory variables. Applications for all the domestic RHI technologies reached this threshold in 2016, but only small biomass boilers reach this threshold for the non-domestic scheme.

characteristics of participants pre and post reform (e.g. income level, size of investment), which will help to assess the impact of reforms. For the large volume groups of applicants, these analysis methods should allow statistical testing of outcomes in the demand sub-system and, to some degree, contexts (through observed differences in the characteristics of participants).

- The above analyses will compare outcomes achieved, including take-up of different technologies, to BEIS expectations, as set out in BEIS's Impact Assessment for the reforms and any update of this produced by BEIS.

The contribution of the reformed RHI to desired outcomes, and the mechanisms which operated in different contexts, will primarily be assessed using qualitative data and detailed case study data. The former will primarily test detailed theory for key policy questions of relevance to BEIS, while the latter will primarily test detailed theory for low-volume technologies. These workstreams will allow testing of contexts, mechanisms and outcomes, and how they are inter-related, for these detailed theories, which may test supply and fuel supply theory as well as demand and usage theory. The main analysis method we will use is realist synthesis, through which we will rigorously test how far the evidence supports, or does not support, specific CMO combinations relating to detailed theory. As the evaluation proceeds, if important gaps are identified in the evidence base for overall programme theory (e.g. the generic CMOs), we will discuss with BEIS how remaining qualitative research resources are best targeted to ensure that mechanisms relating to the overall programme theory are tested, as well as those in the detailed theory.

The overall assessment of the reformed scheme's contribution to carbon abatement and renewable heat generation will combine outcome and context data from application data and applicant surveys with carbon and heat generation metrics developed as part of the cost-effectiveness analysis, and will be cross-checked against findings on RHI usage theory using qualitative data from interviews and case studies. Wherever possible, we will assess the scheme's contribution to these outcomes in different circumstances, for different technologies and types of applicants, rather than limiting our assessment to scheme-wide averages.

Question 2: How has design and implementation of the reformed RHI influenced these outcomes, in what respects and for whom?

1. Has the reformed RHI more effectively removed barriers or enabled uptake for beneficiaries in some contexts and for some groups rather than others, and if so how?
2. Which aspects of the reformed RHI have been most effective in triggering desired changes, and how has this worked for different contexts/groups?
3. Have there been unintended consequences and outcomes of the reformed RHI and, if so, how has the reformed RHI influenced how these operate and for whom?

Main elements of theory being tested in this question:

- In what ‘contexts’ has the reformed RHI benefited different types of stakeholders (including different types of consumers and supplies)?
- What are the ‘mechanisms’ for change in different ‘contexts’, and how do these relate to the design and implementation of reforms?
- Have there been unintended ‘outcomes’, and what are the ‘contexts’ and ‘mechanisms’ for these outcomes?

The influence of the design and implementation of the reformed RHI on different groups and situations (sub-questions (a) and (b)) will primarily be analysed using:

- **Qualitative interviews**, which will primarily test detailed theory relating to key policy questions and will also, where necessary, provide information to fill gaps in the understanding of overall programme theory. This workstream will potentially test elements of demand, usage, supply and fuel supply theory.
- **Qualitative insights from the case studies**, particularly testing detailed theory for low-volume technologies (again, potentially covering demand, supply, usage and fuel supply for these technologies).

Answering these two sub-questions will involve detailed testing of CMO combinations for clusters relating to key policy questions, particularly focusing on the mechanisms through which specific reforms achieved different outcomes for different members of their target groups, in different contexts. For example, in addressing the question about the impact of heat demand limits (HDLs), we would first complete the development of detailed theory for HDLs. We would then use qualitative interviews to explore the extent to which potential applicants in high heat demand houses would have gone ahead with RHI-eligible installations without the limit, and whether the limit influenced the details of installations and RHI applications, for certain types of applicant and potential applicants. We would analyse the information gathered and, on the basis of this analysis, develop individual CMOs that fitted the evidence for each case. For example, a potential applicant might have reconsidered and shelved their application because the HDL reduced their financial incentive to proceed; but conversely they might have decided to proceed now, because they were worried about degeneration of tariffs in future. We would use these case-by-case

CMOs to inform our review and revision of the detailed theory for this cluster. Periodically, we would consider the implications of detailed theory learning for the overall programme theory across the reformed RHI scheme as a whole (e.g. the generic CMOs).

Applicant monitoring and quasi-experimental analysis will also generate insights on applicant contexts that are relevant to these sub-questions (e.g. providing statistics on the income distribution of participants in domestic clusters; or statistics on the stated motivations for RHI take-up across different types of survey respondents; or regression results for differences in the characteristics of participants pre and post reform). These insights and statistics may help to test the demand and usage theories.

The theoretical framework allows explicit testing of possible unintended effects using ‘unintended outcome’ CMOs within both detailed theory and programme-level theory. This theory will be revised to incorporate any unexpected outcomes that are observed in the evidence from the qualitative workstreams (particularly workstream 2 and workstream 5). High-level findings on trade-related effects will also be sought in the Competition and Trade Assessment. Findings of external studies, such as current work on the sustainability of biomass and the work of BEIS’ Science and Technology team on heat pump efficiency, will also be referenced where relevant.

There may be some unintended consequences, such as ‘gaming’ or mis-selling of RH systems, which the perpetrators are unlikely to admit to within qualitative interviews. This could introduce a positive bias to the findings. While we will be able to research these behaviours indirectly (e.g. through opinions and observations put forward by users, suppliers and other industry stakeholders), direct research on these issues is beyond the scope of the current evaluation as it would require site surveys of particular buildings and RH systems. We understand that the RHI audit process does involve site visits but is designed to check for fraud rather than more subtle ‘gaming’ of the RHI scheme. However, it is possible that the evaluation may generate insights that could inform the approach to RHI audits in future.

Question 3: How has the reformed RHI influenced value for money?

1. What is the subsidy cost per kWh of renewable heat generated and per Tonne of CO2 abated and how does this differ across technologies and beneficiaries?
2. What are user experiences of renewable heat technologies, including the financial and non-financial costs and benefits compared to alternative heating options, for different types of technologies and beneficiaries?
3. What have been the effects of budget-cap and degression mechanisms on carbon reduction and renewable heat generation for different technologies and beneficiaries?
4. Have there been any perverse effects, risks of gaming, overcompensation or under-compensation, and if so, how and for which types of beneficiaries and contexts?
5. What do the subsidy costs and delivery of the scheme tell us about the cost-effectiveness of the scheme in comparison to other existing renewable heating policies?

Main elements of theory being tested in this question:

- What is the relationship between ‘outcomes’ and ‘costs’, for different types of technology and customer?
- What are the ‘CMOs’ for in RH usage theory?
- What are the ‘CMOs’ for any perverse outcomes and over/under-compensation?

The reformed RHI scheme’s value for money will be assessed primarily through the cost-effectiveness workstream. This will draw together findings on all the detailed questions listed here. While some information on costs and benefits will be collected specifically for this workstream, through consultation with industry stakeholders, most of the information will be gathered through other workstreams.

The workstreams that will primarily provide evidence to test the outcomes and contexts in the theory on value for money are:

- **Applicant monitoring** will provide metrics about outcomes and contexts, in terms of the take-up of different technologies and types of beneficiaries, and statistics on the relationship of applications to the timing of degressions and reforms. Applicant monitoring will also provide statistics on user-reported costs, user experiences of technologies and the types of alternative heating systems they considered (providing some insights on interim outcomes and mechanisms).
- **The quasi-experimental research** is also expected to provide evidence about outcomes and contexts in demand and usage theory for the reformed RHI (e.g. changes in the characteristics of participants and applications pre and post reform in high volume clusters);

- **The sustainable markets assessment** will seek to provide analysis of progress towards the sustainability of different RH technologies (in terms of interim outcomes, in different contexts), and the role played by the reformed RHI in this. Achievement of a sustainable market for RH is one of the policy objectives (and outcomes) against which cost effectiveness will be assessed.

The workstreams that will primarily provide evidence on mechanisms, as well as additional insights into CMO combinations are:

- **Qualitative interviews** will provide in-depth insights from users, suppliers and other stakeholders (including finance providers) to test CMOs in detailed theory and, at a higher level, overall programme theory. This workstream will be the main source of information on the reformed RHI's 'contribution' towards outcomes and on the 'mechanisms' for change. These insights will cover the experiences for different types of user of different RH technologies, the costs and benefits of installing and using RH systems compared to alternative heating options, and the impact of changes to the scheme on supplier and user investment decisions for different technologies, including those related to the budget-cap and degression mechanisms⁷.
- **Case study research** is expected to allow testing of detailed theory for low volume technologies, generating information on costs, benefits and perceived RHI contribution from a range of stakeholders involved with each project.

Perverse effects, gaming and over/under-compensation: While the qualitative interviews and case studies would be expected to generate some information on perverse effects, gaming and over/under compensation for different types of beneficiaries/contexts, but we expect this to be reported indirectly (e.g. describing the behaviour of others) rather than directly reported by those undertaking the behaviour. In researching clusters where there are anecdotal reports of gaming, we will work with BEIS to define the theory for why gaming and/or perverse effects are taking place and the types of indirect evidence that are likely to be observed to test this theory.

⁷ We note that the purpose of the budget cap and degression mechanisms is not primarily to increase uptake but to manage BEIS's budget for the RHI scheme.

Question 4: To what extent has the reformed RHI impacted competition and trade between member states, and has this been different across technologies and contexts?

1. How has the reformed RHI impacted the competitiveness and trade impacts of beneficiary organisations, and for whom and in what circumstances?
2. How, for whom and in what circumstances, have the additional impacts of the reformed RHI scheme influenced the trade of renewable heating related goods and services?

Main elements of theory being tested in this question:

- Are there any 'outcomes' that involve impacts on competitiveness and trade?
- If so, what are the 'contexts' and 'mechanisms' for these competition and trade impacts?

This evaluation question is designed to meet EU requirements relating to State Aid notifications and will be addressed by the Competition and Trade Assessment workstream. This will draw on much of the same evidence as the Sustainable Markets workstream (see below) but will focus on the non-domestic sector and on landlords (since domestic households are not covered by EU competition and trade requirements). It will likely involve consideration of impacts on the fuel and feedstock chain, and other parts of the RH supply chain, as well as the RH market itself. This could involve testing of CMOs in the supply and fuel supply theory. Key evidence that the Competition and Trade Assessment will draw from other workstreams which are expected to include:

- **Applicant monitoring:** statistics on the number and type of non-domestic participants and landlords, including their industry and location (to allow testing for any regional/sector biases in outcomes and contexts). Information from the applicant survey and from annual sustainability declarations on the prices paid for and sources of fuels and feedstocks (to assess outcomes and contexts in the market for fuels and feedstocks).
- **Sustainable markets assessment:** assessment of the market for non-domestic RHI technologies, including testing of theory relating to contexts and outcomes in the supply chain and supporting market services (e.g. marketing and financing).
- **Qualitative research:** qualitative information on the mechanisms for reformed RHI influence on trade, including entry to/exit from the non-domestic RHI supply chain, gathered through interviews with RH suppliers and interviews with firms offering related services.
- **Case studies:** qualitative and quantitative information on mechanisms, contexts and outcomes, including investment decisions, return on capital, trade influences and additional influence of RHI on entry to/exit from the fuel and feedstock supply (for large scale, low-volume technologies such as biomass CHP, biogas and biomethane).

As the case studies will largely be focused on low-volume, large-scale technologies, they may not capture sufficient information on the competition/trade issues relating to higher volume, smaller-scale technologies such as the agriculture and forestry biomass cluster. As the evaluation proceeds, we will assess whether the sustainable markets assessment and qualitative research are able to collect sufficient information on higher volume technologies to inform the competition and trade assessment. If not, it would be possible to consider focusing a few case studies to fill gaps in the available information.

Question 5: How has the reformed RHI contributed to the development of sustainable markets for renewable heat, and how does this differ across market segments or technologies?

1. In what ways has the reformed RHI contributed to improved marketing, financing and installation of renewable heat in different contexts?
2. What have been the effects of the reformed RHI, across different market segments and technologies, to building up skills and capacities needed if renewable heat is to scale-up?
3. Has the reformed RHI supported, speeded up or created barriers to technological innovation in renewable heat, across different market segments and technologies?
4. Has the reformed RHI contributed to the development of more favourable contexts within which the case for consumer adoption of renewable heat is stronger. If so, for whom, for which technologies and in which contexts?

Main elements of theory being tested in this question:

- Contexts, mechanisms and outcomes in the supply theory and fuel supply theory
- In particular, the interim outcomes that improve the contexts for demand theory (e.g. reduced supply prices; increased customer awareness)

This evaluation question will be answered by the Sustainable Markets workstream. This will draw together findings on all the detailed questions listed above, to test the interrelationship of supply improvements and fuel supply improvements to increased demand. While this workstream will involve some analysis of industry data and consultation with industry trade bodies for particular RH technologies, most of the information will be gathered through other workstreams. In particular the sustainable markets work will use:

- **Applicant monitoring:** statistics on the number and type of domestic and non-domestic participants, by location, technology and RH capacity installed, and survey statistics on perceived RHI influence. This will allow assessment of interim outcomes for particular technologies and geographical locations, and testing of improved contexts for demand theory.

- **Qualitative research and case studies:** qualitative information on the influence of RHI on marketing, financing and installation of renewable heat in different contexts, and the effects of RHI on the building skills and capacities and skills in the supply chain, across different market segments. This will particularly test the supply CMOs for detailed theory (relating to key policy questions) and for low-volume technologies. These workstreams will also generate more in-depth information on the influence of the reformed RHI on contexts for consumer demand for RH (both domestic and non-domestic), which will test feedback loops in the overall programme theory.
- **Quasi-experimental analysis:** the quasi-experimental assessment will potentially provide evidence on outcomes, and related contexts, to assess the impact of the reformed RHI on consumer demand for renewable heat in high volume sectors.

A key issue for the sustainable markets workstream will be to ensure that the other workstreams provide sufficient coverage across the full range of technology markets, beyond the clusters of specific relevance to BEIS's key policy questions. While applicant monitoring will cover all technologies and types of customer, we may need to target some elements of the qualitative interviews and case studies to provide sufficient understanding of 'mechanisms' for technologies that would otherwise not be adequately covered (e.g. we could include qualitative interviews with suppliers and stakeholders familiar with the solar thermal market; and case studies of deep geothermal projects, if not covered elsewhere).

Question 6: What lessons can be drawn from the evaluation of the RHI regarding future renewable heat policy?

1. Which renewable heat markets and supply chain models have promise for the future without RHI support, and how?
2. Without RHI support, would there be any priority groups of suppliers or potential customers of renewable heat that would be left behind and for whom new policy instruments are needed, and how can take-up of renewable heat best be encouraged for these groups?
3. To what extent, and in what contexts, have RHI priority heat technologies made progress towards becoming sustainable in the marketplace, with less need for further subsidies?
4. What forms of public policy action (e.g. regulation, support for R&D etc.) are needed to encourage take-up of renewable heat by different priority groups, sustain positive outcomes from RHI in different contexts and remedy unintended consequences?

Main elements of theory being tested in this question:

- This question will involve testing and refining CMOs across all elements of theory, particularly the detailed theory developed to test key policy questions, which are likely to be highly relevant to BEIS' learning and future policy-making.

We will respond to this question using insights across all workstreams, particularly drawing on the findings of the sustainable markets workstream, qualitative research, case studies and cost-effectiveness assessment. These workstreams are expected to generate learning on the extent to which different elements of the RH market are likely to be sustainable with reduced subsidy or no support beyond 2020, and the types of policy support that are likely to be most effective to sustain and expand positive consequences and remedy unintended consequences going forward.

There will be two levels of theory-testing for this question. Firstly, we will test detailed theories for specific clusters, relating to key policy questions agreed with BEIS. This, in itself, will generate learning for BEIS related to these key policy questions. Secondly, we will review the overall programme-level theory, including the generic CMOs, in the light of learning from particular clusters as well as wider learning from the applicant monitoring and sustainable markets assessment. This will provide a higher-level assessment of lessons learnt in relation to overall programme theory.

Limitations of this evaluation approach

Limitations of our proposed evaluation approach are that:

- **The scope of quasi-experimental analysis is limited.** In particular, analysis of RH applicants compared to non-applicants is not included. This does not look feasible, partly owing to the lack of data to support a full comparison of their behaviour (e.g. heat consumption data for those without RH systems) and partly owing to the difficulty in accessing NEED data for non-applicants. This confirms the ITT's proposal that quasi-experimental analysis should be restricted to the comparison of pre/post reform applicants, for those technologies and markets where significant volumes of applications are made. The consequence of this is that theory-based causation will be relied upon to assess overall impact of the reformed RHI.
- **Comparison of the impacts of reforms will be complicated** by delays between the announcement of reforms and their eventual implementation, and possible changes in the details of these reforms between consultation, announcement and implementation. This is part of a broader picture of ongoing change within the RHI scheme, including changes to the rules and changes which form part of the rules (e.g. tariff depression). While it should be possible to disentangle the influences of different changes within qualitative research, where there is time to explore the meaning of a respondent's replies, these complexities may make survey responses and statistical findings difficult to interpret. We can unpick some of these complexities to comparing findings to consumer surveys in the previous RHI evaluation. The consequence of this limitation is that data collection and analysis will be targeted to ensure it unpicks where outcomes are due to either a) reforms, b) the way the reforms were introduced. An example of targeting is the proposed qualitative research on 'anticipation and announcement' effects.
- **Findings will be richer for the key policy questions (and related clusters of interest) than for the reformed RHI as a whole.** While our proposed research will ensure that the supply side is covered for all technologies, and that low volume non-domestic technologies are covered through case study research, we are not proposing to undertake in-depth research with domestic RH participants outside the

clusters of interest. This is consistent with avoiding duplication of earlier RHI evaluation work. The consequence is that there will be areas of the scheme where we do not have detailed insight. However, a) we have reserved some qualitative interviews to target any important areas or evidence gaps that emerge; and b) we will collect sufficient data on all applicants to test the overall theory, as set out in table 7.1

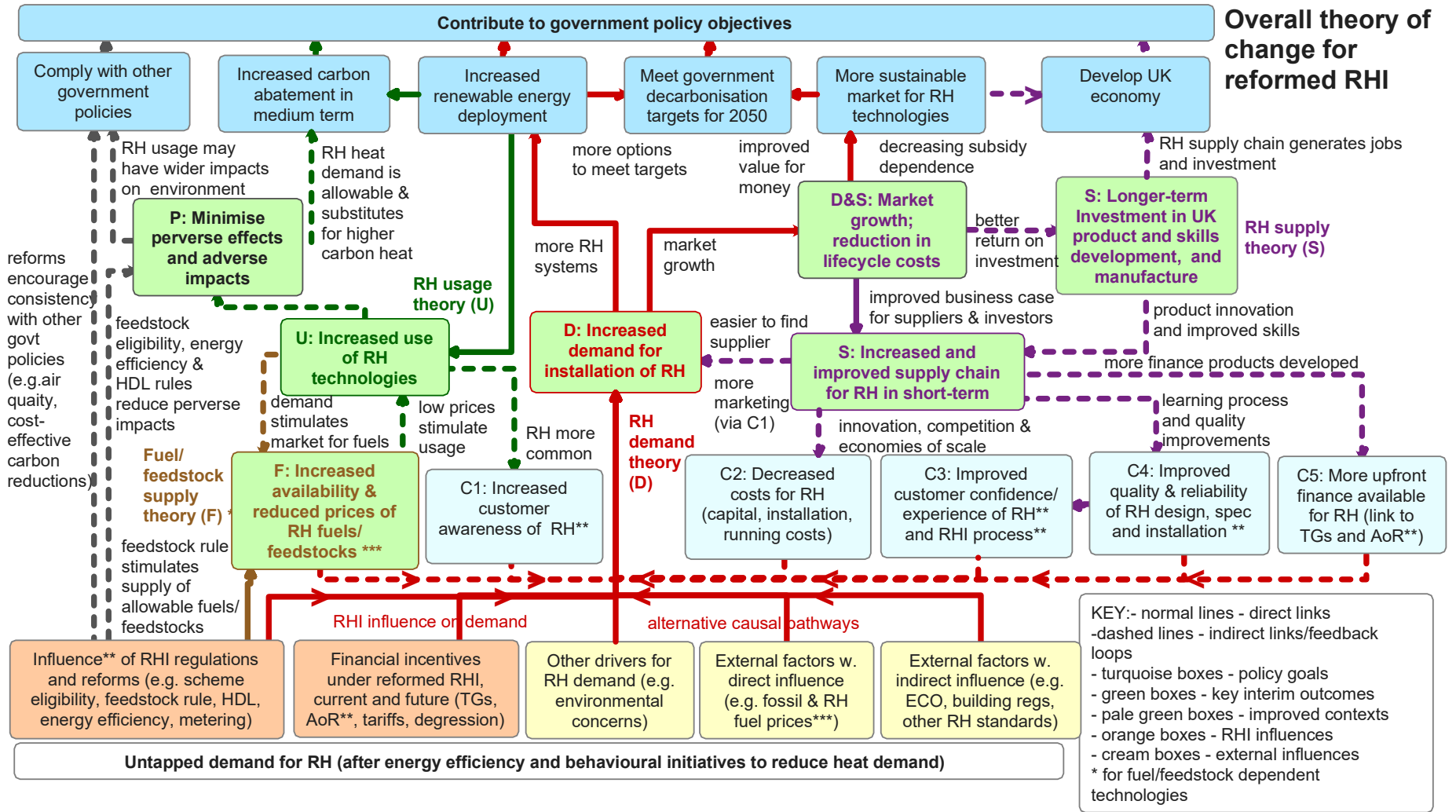
- **Gathering direct evidence on perverse effects and gaming mechanisms will be challenging**, since respondents may be unwilling to admit to these effects and motivations. We may need to rely on indirect reporting of these effects (e.g. through talking to industry and consumer bodies). Our research plan does not include direct survey work or sites visits to properties to assess whether RH systems have been properly specified or are being misused. The consequence of this limitation is that BEIS will rely on Ofgem compliance monitoring and wider stakeholder input on these points.

Appendix B. Theoretical framework: overall policy map

The foundation of the theoretical framework is the overall policy map set out below, the initial theoretical framework is based on a review of existing evidence, including findings from previous RHI evaluation research. It has also been informed by two workshops with BEIS policy staff, on the domestic and non-domestic RHI, and follow-up discussions with policy staff and our technical advisers.

The map should be read from bottom to top, tracing the flow of causation indicated by the arrow lines. The overall policy map outlines four overlapping theories that combine to illustrate how the scheme is expected to operate, each signified by a different colour directional arrow. The four sub-theories are as follows:

- **Consumer demand theory (red)** – this sets out the key factors that influence consumer demand for renewable heating technologies, and how this contributes to the policy objectives. This is the central theory with which the other theories interact.
- **Supply chain theory (purple)** – this sets out the impact that the RHI has on the supply chain and the changes in the supply chain that are expected to be needed in order for the policy to achieve its objectives.
- **Renewable heat usage theory (green)** – this sets out the ways in which the real-world usage of renewable heat technologies acts as a mediating factor between consumer demand and the policy objectives. It also documents the feedback loop between usage and future consumer demand.
- **Fuel supply and wider impact theory (brown)** – this sets out the role that fuels and feedstocks have in the RHI scheme, and the impact that increased consumer demand may have on them.



Appendix C. Candidate interim applicant theory

To support the research with specific applicant groups, or segments of the renewable heat market, a series of specific theories are developed that sit below the overall policy map. For the purposes of this report, theories were developed relating to ‘interim applicants’ affected by the extended period for announcement and implementation of RHI reforms (April 2016 to September 2017).

At the outset of the research, ‘candidate theories’ are developed which set out the outcomes that are expected to be observed among this applicant group, as well as the contexts and mechanisms which combine to result in the outcome being achieved. The research is developed such that these candidate theories can be tested. The evidence is then used to update the theories, these are presented as ‘post-synthesis theories’ and are presented in Appendix D. Post-synthesis interim applicant theory

The candidate theories are presented in the tables below. For a first time reader, these are best read by starting with the Outcome column to understand the behaviours that have been observed for each applicant group. The Context and Mechanisms can then be reviewed to understand the mechanisms that lead to the behaviours, and the contexts which are necessary for those mechanisms to operate.

Outcomes are coded depending on their relationship to the policy objectives:

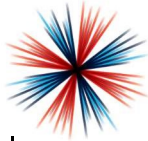
Key: red text = negative outcome vis a vis policy intentions;

orange = possibly negative outcome vis a vis policy intentions;

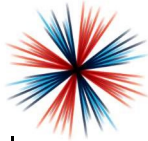
green = positive outcome vis a vis policy intentions.

Groups 1-3: Theory for interim applicant groups which are proposed as priorities for research

Group 1:	Applicants for non domestic medium scale biomass <i>(negatively affected by announced reform changes)</i>		
Key policy question	How have the successive reform announcements in 2016 and 2017, and the way that they have been implemented, influenced RHI applications for non domestic medium scale biomass installations? For whom and in what contexts has this influence been most marked and why?		
Research rationale	In depth interviews with (say) 10 applicants in this group, to understand the reasons underlying the spike in applications in June/July 2017, and how successive announcements impacted on their reasoning vis a vis RHI. (see below for proposed research with RHT suppliers)		
Draft hypotheses about reasoning for this group (2 alternative CMOs)	Context	Mechanism	Outcome
	All of: <ul style="list-style-type: none"> - Consumer has an existing heat use - Consumer is already in the process of planning for a biomass boiler installation under RHI - Capacity in supply chain is available - Installation timeline is short enough to enable installation before reforms supposed to kick in - Finance is accessible 	“Proposed changes in the RHI tariff or changes in eligible heat uses mean that my installation will no longer be viable after the reforms. Installing before the reforms is the only way I can install the technology.”	Installations for existing heat uses take place before the reforms that would not otherwise be possible once the reforms are in place.



<ul style="list-style-type: none"> - Business case for this installation would fail under the proposed reforms 		
<p>All of:</p> <ul style="list-style-type: none"> - Consumer has existing heat use - Consumer is already in the process of planning for a biomass boiler installation under RHI - Capacity in supply chain is available - Installation timeline is short enough to enable installation before reforms supposed to kick in - Finance is accessible <p>Business case for this installation would be weakened under the proposed reforms</p>	<p>“Proposed changes to the RHI tariff or changes in the eligibility will mean that the income I receive from the RHI will be reduced after the reforms. Installing the reforms maximises my income from the RHI.”</p>	<p>Installations for existing heat uses take place earlier than planned, leading to higher tariff payments received and reduced value for money for government</p>
<p>All of:</p> <ul style="list-style-type: none"> - Consumer is approached by installer offering a good but time-limited deal for a biomass boiler/drying system - RHI application involves a new heat use - Capacity in supply chain is available - Installation timeline is short enough to enable installation before reforms are expected to kick in 	<p>“Proposed changes in the RHI tariff or changes in eligible heat uses mean that this investment opportunity will not be available after the reforms. Installing before the reforms is the only way I can</p>	<p>Installations for new heat use take place before the reforms that would not be eligible for support once the reforms are in place.</p>

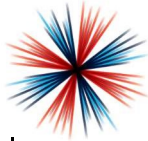


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	<ul style="list-style-type: none"> - Finance is accessible <p>Business case for RHT would fail or be ineligible under the proposed reforms</p>	<p>benefit from this opportunity.”</p>	
	<p>All of:</p> <ul style="list-style-type: none"> - Consumer is already aware of time-limited RHI opportunity for biomass boiler/drying system through previous application(s) - RHI application involves a new heat use - Capacity in supply chain is available - Installation timeline is short enough to enable installation before reforms are expected to kick in - Finance is accessible <p>Business case for RHT would fail or be ineligible under the proposed reforms</p>	<p>“Proposed changes in the RHI tariff or changes in eligible heat uses mean that this investment opportunity will not be available after the reforms. Installing before the reforms is the only way I can benefit from this opportunity.”</p>	<p>Installations for new heat use take place before the reforms that would not be eligible for support once the reforms are in place.</p>

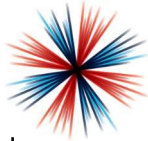
<p>Group 2:</p>	<p>Heat pump applicants (both domestic and non domestic) <i>(potentially positively affected by announced reforms, but may have been negatively impacted by uncertainty about successive changes to RHI)</i></p>
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Key policy question	How have the successive reform announcements in 2016 and 2017, and the ways in which the reforms have been implemented, influenced RHI applications for heat pumps, and if not why not? For whom and in what contexts has there been influence and why?		
Research rationale	In depth interviews with (say) 10 applicants to understand how successive announcements impacted on their RHI applications, and the reasons for this. (see below for research with suppliers)		
Draft hypotheses about reasoning for this group (4 alternative CMOs)	Context	Mechanism	Outcome
	One or all of: <ul style="list-style-type: none"> - Consumer is already in the process of planning for a heat pump installation under RHI - Capacity in supply chain is available - Installation timeline is short enough to enable installation before reforms supposed to kick in - Finance is accessible - Consumer perceives risk that RHI will be withdrawn altogether (this captures those people who may not be affected by reforms but fear overall uncertainty) 	“The delays in the implementation of the RHI reforms raise concerns in my mind over whether the RHI will be cut all together. Installing as quickly as possible is the safest option for me.”	Installation takes place earlier than planned , leading to earlier carbon savings at current tariffs, providing better value for money for government

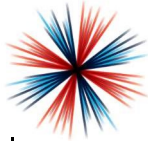


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<p>Business case for the heat pump remains unchanged under reforms.</p>		
<p>One or all of:</p> <ul style="list-style-type: none">- High heat demand household- Consumer is already in the process of planning for a heat pump installation under RHI- Capacity in supply chain is available- Installation timeline is short enough to enable installation before reforms supposed to kick in- Finance is accessible- Consumer knows they will benefit from higher tariffs when these are introduced in future, even if they apply beforehand <p>Business case for heat pump would fail under the proposed reforms</p>	<p>“Proposed introduction of heat demand limit means that my installation will no longer be viable after the reforms, despite proposed tariff increases. Installing before the reforms is the only way I can install the technology.”</p>	<p>Installation takes place before the reforms that would not otherwise be possible once the reforms are in place.</p>
<p>All of:</p> <ul style="list-style-type: none">- High heat demand household- Consumer is already in the process of planning for a heat pump installation under RHI	<p>“I want to install as quickly as possible because my system has a high heat demand and the benefits would be reduced under</p>	<p>Installation for this high heat demand home takes place earlier than planned, leading to earlier carbon savings, but</p>

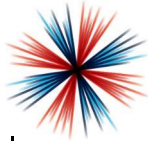


<ul style="list-style-type: none"> - Capacity in supply chain is available - Installation timeline is short enough to enable installation before reforms supposed to kick in - Finance is accessible - Consumer knows they will benefit from higher tariffs when these are introduced in future, even if they bring forward their application <p>Business case for heat pump is negatively affected by proposed Heat Demand Limit</p>	<p>proposed HDL reforms”</p>	<p>benefitting a larger home which is not a priority for government</p>
<p>All of the following contexts:</p> <ul style="list-style-type: none"> - Consumer is already planning a heat pump installation under RHI, - Business case is not significantly adversely affected by proposed heat demand limit (e.g. heat demand is below the limit, or only slightly above) <p>And possibly: consumer knows they will benefit from higher tariffs when these are introduced in future</p> <p>The business case/payback is improved by the proposed tariff increases for heat pumps</p>	<p>“My timetable for installation of a heat pump system is unaffected by the proposed changes because EITHER I know that will benefit from higher tariff if and when it comes in OR I am not aware of the proposed tariff increase”</p>	<p>This heat pump installation of this heat continues unaffected during the interim reform period</p> <p>(this helps to avoid spikes in demand, and provide stability for the supply chain)</p>
<p>All of the following contexts:</p>	<p>“The proposed tariff increase for heat pumps may make</p>	<p>Demand for heat pump technologies in homes unaffected</p>



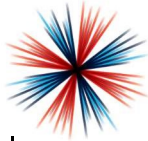
	<ul style="list-style-type: none">- Consumer is considering an RHT installation under RHI, which looks marginal at historic tariff levels- Business case is not significantly adversely affected by proposed heat demand limit (e.g. heat demand is below the limit, or only slightly above)- The business case/payback is improved by the proposed tariff increases for heat pumps and becomes attractive BUT- EITHER the consumer is not aware of proposed tariff increases- OR the consumer is not fully confident that they will be implemented	<p>investment in a heat pump system attractive for me in future, but I have not yet decided to go ahead because EITHER I am unaware of the tariff increase OR the tariff increase is still too uncertain".</p>	<p>by HDL is unaffected during the interim reform period</p> <p>(contrary to BEIS expectations that the prospect of higher tariffs would boost demand for some domestic heat pump investments during 2017)</p>
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Group 3:	Installers of medium scale biomass technologies and heat pumps		
Key policy question	(as for groups 2 and 3)		
Research rationale	In depth interviews with (say) 5 installers of medium scale biomass technologies and 5 heat pump installers, to understand their perspective on the impact of RHI reform announcements on their pipeline of work, their marketing activity and offers to customers, on the quality of delivery, and on their ability to respond to current and future demand.		
Draft hypotheses about reasoning for this group (1 main CMO)	Context	Mechanism	Outcome
	<p>REQUIRED</p> <ul style="list-style-type: none"> - Existing installer of medium-scale biomass technologies or heat pump technologies in Great Britain - Consumers exist who would be interested in the RHI and can take action quickly but are not already taking action. - Have the capacity to increase installations in the short term (e.g. because of 'off-the-shelf' technology packages) - Have the marketing knowledge and resources to reach new customers. <p>PLUS, either</p>	<p>“As an RHT installer I am trying to maximise the business I can do before the changes in the reforms reduce the consumer demand for the technology I work with.”</p> <p>OR</p> <p>“As an RHT installer, I can market RHT more effectively to customers by offering them time-limited</p>	<p>Additional installations take place compared to what would have happened otherwise, leading to higher renewable energy deployment and carbon abatement</p> <p>(some of these may not be aligned with government priorities for the reforms)</p>



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	<p>One or all of:</p> <ul style="list-style-type: none">- An installer of a technology negatively affected by the reforms- Have a stock of RHT kit that needs to be shifted before the reforms- Have a short-term perspective on their business model <p>OR</p> <p>One or all of:</p> <ul style="list-style-type: none">- An installer of a technology not negatively affected by the reforms- Believe there is a risk that the RHI will be cut altogether- Have a short-term perspective on their business model	<p>offers, premised on the upcoming reforms.”</p> <p>OR</p> <p>“As an RHT installer I am trying to maximise the business I can do now as I am concerned that the RHI will be cut and consumer demand will disappear.”</p>	
	<p>REQUIRED</p> <ul style="list-style-type: none">- New installer, not previously offering RHT in Great Britain, but aware of the market opportunities offered by pre-reform RHI- Consumers exist who would be interested in the RHI and can take action quickly but are not already taking action.	<p>“I will enter the RHT market in GB because of the good market opportunities offered by pre-reform RHI, even if this opportunity is short-lived” (opportunistic)</p>	<p>Additional installations take place compared to what would have happened otherwise, leading to higher renewable energy</p>



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- Have the marketing knowledge and resources to reach new customers.

PLUS, one or all of:

- Existing installer with strategic goal of entering RHT market in GB (e.g. because of closure of RHI scheme in Northern Ireland)
- New installer that can develop RHT installation capacity in the short term (e.g. because of 'off-the-shelf' technology packages)
- Have a short-term perspective on their business model

OR

"I will enter the RHT market using this attractive market opportunity, as a way of entering the RHT installation business in the GB" (strategic)

deployment and carbon abatement

(new entrants may cause issues with installation quality or marketing practices)

(new entrants may also bring more competition into the GB supply chain, if they remain in this market)

Appendix D. Post-synthesis interim applicant theory

Following the collection of evidence regarding interim applicants, the candidate theories set out in Appendix C. Candidate interim applicant theory were updated such that they more accurately reflect the available evidence. These updated theories are set out in the tables below

As with the candidate theories, the theories below are best read by starting with the Outcome column to understand the behaviours that have been observed for each applicant group. The Context and Mechanisms can then be reviewed to understand the mechanisms that lead to the behaviours, and the contexts which are necessary for those mechanisms to operate.

Outcomes are coded depending on their relationship to the policy objectives:

Theory for interim applicants affected by the extended period for announcement and implementation of RHI reforms (April 2016 to September 2017) – revised to take account of research findings.

Key: red text = negative outcome vis a vis policy intentions;

orange = possibly negative outcome vis a vis policy intentions;

green = positive outcome vis a vis policy intentions.

Groups 1-3: Theory for interim applicant groups which have been researched in detail

Group 1:	Domestic heat pump applicants <i>(potentially positively affected by announced reforms, but may have been negatively impacted by uncertainty about successive changes to RHI)</i>
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Key policy question	How have the successive reform announcements in 2016 and 2017, and the ways in which the reforms have been implemented, influenced RHI applications for heat pumps, and if not why not? For whom and in what contexts has there been influence and why?		
Research evidence	<p>In depth interviews with 10 domestic heat pump applicants to understand how successive announcements impacted on their RHI applications, and the reasons for this.</p> <p>RHI statistics for domestic heat pump applications, including scale of heat demand in heat pump applications.</p> <p>(see below for research with suppliers)</p>		
Description	Context (with key contexts highlighted in bold)	Mechanism	Outcome
Applicant type 1: “Anticipated forms sped up my application (perceived reduced benefits post-reforms)”	<p>Applicant for a domestic heat pump who has:</p> <ul style="list-style-type: none"> - High heat demand household (i.e. larger home) - Sufficient flex in refurbishment/application timescale to submit application ahead of 20 Sep deadline - Affordability of heat pump perceived to be negatively affected by proposed Heat Demand Limit <p>And either:</p> <ul style="list-style-type: none"> - Applicant had some awareness of reforms - Aware that heat demand limits could impact on RHI payments 	<p>“I want to install before proposed changes to the RHI affecting applications for larger homes [or was encouraged to do so by a certain date], because I thought installation would have reduced benefits after the reforms [or I was told that RHI benefits would not be as great after this date]</p>	<p>Installation for this high heat demand home takes place earlier than planned, leading to earlier carbon savings, but benefitting a larger home which is not a priority for government</p>

	<p>Or:</p> <ul style="list-style-type: none"> - Advice from installer, architect or other supply chain stakeholder to apply by a certain date (RHI-related) 		
<p>Applicant type 2:</p> <p>“Anticipated reforms sped up my application (installation not viable post-reform)”</p>	<p>This CMO was not directly observed in the applicant interviews, but evidence from installer interviews suggested that some installers were advising customers to complete installations/applications by March/April because of anticipated Spring 2017 implementation of the reform package.</p> <p>Domestic heat pump applicant (not directly observed) who has:</p> <ul style="list-style-type: none"> - High heat demand household (i.e. large home) - Sufficient flex in refurbishment/application timescale to submit application ahead of 20 Sep deadline - A potential heat pump investment that was affordable under the old rules, but is not perceived to be viable under the proposed reforms (e.g. because of Heat Demand Limit) <p>And either:</p> <ul style="list-style-type: none"> - Applicant had some awareness of reforms - Aware that heat demand limits could impact on RHI payments <p>Or:</p>	<p>“I want to install before proposed changes to the RHI affecting applications for larger homes [or I was encouraged to do so by a certain date], because my installation would no longer be viable after the reforms [or I was told that there was limited time to make an application]”</p>	<p>Installation takes place before the reforms that would not otherwise be possible once the reforms are in place.</p>

	<ul style="list-style-type: none"> - Advice from installer, architect or other supply chain stakeholder to apply by a certain date (RHI-related) 		
<p>Applicant type 3:</p> <p>“General RHI uncertainty sped up application”</p>	<p>Domestic heat pump applicant who has:</p> <ul style="list-style-type: none"> - A potential heat pump investment where impact of reforms is uncertain, unknown or insignificant - Sufficient flex in refurbishment/application timescale to submit application ahead of 20 Sep deadline <p>And either:</p> <ul style="list-style-type: none"> - Aware of potential changes to the RHI (including some or all of the reforms, perceived risk of tariff depressions and general uncertainty about the future of the RHI scheme) <p>Or:</p> <ul style="list-style-type: none"> - Advice from installer, architect or other supply chain stakeholder to apply by a certain date (RHI-related) <p>Applicant interviews suggested that the following contexts applied in some cases:</p> <ul style="list-style-type: none"> - Would not have gone ahead with installation without RHI (i.e. RHI payments critical to their decision to install heat pump) 	<p>“I want to go ahead as soon as possible because of general uncertainty about the future of RHI subsidies.”</p>	<p>Installation takes place earlier than planned, leading to earlier carbon savings at current tariffs, providing better value for money for government</p>

	<ul style="list-style-type: none"> - Applicant not sure what impact reforms would have on their RHI payments - Applicant thought end-of-quarter degression might negatively impact on their RHI payments - Applicant uncertain about how long RHI tariffs might continue - Special offer by sales person/installer if installation took place within certain timeframe (not explicitly RHI-related) - Experience of Feed-in-Tariffs made applicant sceptical about Government payment schemes 		
<p>Applicant type 4:</p> <p>“RHI reforms had no influence on application timing”</p>	<p>A domestic heat pump applicant has at least ONE of the following:</p> <ul style="list-style-type: none"> - No awareness of the reforms - If aware of reforms, does not think their RHI benefits are sensitive to application timing (e.g. because their home has lower heat demand, below Heat Demand Limits; possibly also aware that they will receive proposed tariff increases for heat pumps irrespective of when they apply) - No flexibility in the timing of application and installation, because this is influenced/determined by supply constraints, by the timescale of the refurbishment work, by financial end-year drivers or by the desire to install a new heating system quickl 	<p>“My timetable for installation of a heat pump system was unaffected by proposed changes to the RHI”</p>	<p>This heat pump installation of this heat continues unaffected during the interim reform period</p> <p>(this helps to avoid spikes in demand, and provide stability for the supply chain)</p>

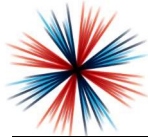
Group 2:	Applicants for non domestic medium scale biomass (<i>negatively affected by announced reform changes</i>)		
Key policy question	How have the successive reform announcements in 2016 and 2017, and the way that they have been implemented, influenced RHI applications for non domestic medium scale biomass installations? For whom and in what contexts has this influence been most marked and why?		
Research evidence	<p>In depth interviews with 12 biomass applicants that applied in March 2017 and September 2017, to understand the reasons for spikes in applications during these months, and how successive announcements impacted on their reasoning vis a vis RHI. This included a number of multiple applicants, who had made more than one application for RHI funding.</p> <p>RHI application statistics for non domestic medium scale biomass.</p> <p>(see below for research with biomass suppliers)</p>		
Description	Context (with key contexts highlighted in bold)	Mechanism	Outcome
Applicant type 1: “The anticipated reforms sped up my application (installation not	<p>Medium-scale non-domestic biomass applicants who fits all of the following contexts:</p> <ul style="list-style-type: none"> - Aware of planned reforms and/or degressions - Believes the changes would reduce RHI payments - Has the ability to influence the timing of the installation (e.g. not part of wider refurbishment/building programme) 	<p>“I will speed up my application because I think my biomass system is only viable if I install before the reforms/degression, because of reductions in RHI benefits.”</p>	<p>Installations for existing heat uses take place before the reforms that would not otherwise be possible once the reforms are in place.</p>

viable post-reforms)”	<ul style="list-style-type: none"> - Business case perceived as marginal (e.g. only just viable with existing RHI benefits; or significant financial risk e.g. because of high level of borrowing) 		
Applicant type 2: “The anticipated reforms sped up my application (perceived reduced benefits post-reforms)”	Medium-scale non-domestic biomass applicants who fit all of the following contexts: <ul style="list-style-type: none"> - Aware of planned reforms and/or degressions - Has the ability to influence the timing of the installation - Delay would weaken business case (either because of proposed reforms and/or anticipated depression; or for wider business reasons e.g. heating season approaching) 	“I will speed up my application because I think the RHI benefits will be reduced by the reforms/depression, although it would still be worth doing after the reforms.”	Installations for existing heat uses take place earlier than planned, leading to higher tariff payments received and reduced value for money for government
Applicant type 3: “The anticipated reforms sped up my application (installation driven by income	Not observed directly , but applicants/installers reported that this applied to other applicants. Medium-scale non-domestic biomass applicants who have: <ul style="list-style-type: none"> - A heat use that would not be eligible for RHI after the reforms (e.g. certain drying uses) - The ability to influence the timing of the installation 	“I will speed up my application because proposed changes in the RHI tariff or changes in eligible heat uses mean that this investment opportunity will not be available after the reforms.”	Installations for new heat use take place before the reforms that would not be eligible for support once the reforms are in place.

opportunities not available post-reforms)”	<ul style="list-style-type: none"> - A business case for RHT would fail or be ineligible under the proposed reforms 		
Applicant type 4: “I was unable to speed up my application (despite perceived reduced benefits post-reforms)”	<p>Medium-scale non-domestic biomass applicants who fit all of the following contexts:</p> <ul style="list-style-type: none"> - Aware of planned reforms and/or degressions - Delay would weaken business case (either because of proposed reforms and/or anticipated depression; or for wider business reasons – e.g. heating season approaching); but - Unable to speed up installation or application (e.g. because it was part of a wider refurbishment or construction programme) 	<p>“ I would like to speed up my application, because proposed changes to the RHI tariff or changes in the eligibility will mean that the income I receive from the RHI will be reduced after the reforms, but I am unable to do so.”</p>	<p>Timing of installation unaffected by reforms.</p>
Applicant type 5: “RHI reform announcements had no influence on my application timing or technology choice”	<p>Medium-scale non-domestic biomass applicants who fits at least one of the following contexts:</p> <ul style="list-style-type: none"> - Unaware of the proposed reforms or anticipated depression - New heating system was necessary for other reasons - Benefits of installation perceived to be relatively insensitive to changes in tariff income, banding and tiering (e.g. a process that operates year-round) 	<p>EITHER “I was unaware of proposed changes and therefore the timing of my installation was unaffected” OR “The proposed changes make little difference to the business case for my installation, so the timing of my installation was unaffected.”</p>	<p>Timing of installation unaffected by reforms.</p>

<p>Applicant type 6:</p> <p>“RHI reform announcements made me uncertain about the future of the RHI so I delayed or cancelled my installation”</p>	<p>Not observed directly in interviews, but installers reported that this applied to some potential applicants.</p> <p>Medium-scale non-domestic biomass applicants that were:</p> <ul style="list-style-type: none"> - Considering potential investments with a marginal business case, dependent on RHI - Aware of planned reforms and/or degressions - Relatively large and risk-averse corporate businesses. 	<p>“I am concerned about the risks to my RHI investment and prefer to delay my investment decision about this installation until the reforms have been implemented and there is less uncertainty.”</p>	<p>Installation delayed until reforms have taken place (or possibly cancelled).</p>
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Group 3:	Installers of medium scale biomass technologies and heat pumps		
Key policy question	(as for groups 2 and 3)		
Research evidence	In depth interviews with 6 installers of medium scale biomass technologies and 5 heat pump installers, to understand their perspective on the impact of RHI reform announcements on their pipeline of work, their marketing activity and offers to customers, on the quality of delivery, and on their ability to respond to current and future demand.		
Description	Context (with key contexts highlighted in bold)	Mechanism	Outcome
Installer type 1 (heat pumps): “We carried on as normal”	Heat pump installers with some or all of the following contexts: <ul style="list-style-type: none"> - Customer demand largely unaffected by reform announcements - General scepticism about Government policy announcements - Already working at full capacity - Long-term strategic business approach (i.e. not reactive) - Installation of RHTs is not their main source of revenue 	I was aware of the proposed (domestic heat pump) reforms, but carried on as normal because I did not think the proposed reforms would have much impact on my business or my customers	The proposed RHI changes did not result in any significant changes to the business during the period from December 2016 to 20 September 2017, compared to what would have happened otherwise
Installer type 2 (heat pumps and biomass):	Heat pump and biomass installers with all of the following contexts:	We now focus on other markets (e.g. installation of fewer, larger-scale biomass boilers or shared	The proposed RHI changes (and past depressions for biomass) resulted in the



<p>“We did fewer installations but are diversifying into other areas”</p>	<ul style="list-style-type: none"> • Aware of reforms and degressions • Installer previously undertook higher numbers of installations (e.g. because of higher tariffs for small/medium biomass installations in the past) or anticipate fewer heat pump installations for larger domestic customers affected by HDL • Installer has capability to switch focus to other related activities (e.g. servicing, spares, fuel supply, larger biomass boilers, shared ground loop systems) 	<p>ground loop systems and/or servicing or supplies for biomass boilers) because successive degressions and proposed RHI reforms have reduced demand for our products.</p>	<p>business undertaking fewer installations during the period Dec 2016 to September 2017, compared to previous years, but the business has developed alternative strategies going forward.</p>
<p>Installer type 3 (heat pumps and biomass)</p> <p>“Our business remains static or has shrunk and RHI uncertainty is constraining new opportunities”</p>	<p>Heat pump and biomass installers with some or all of:</p> <ul style="list-style-type: none"> • Aware of reforms • Numbers of installations static (for heat pumps) or falling (for biomass, because of higher tariffs for small/medium biomass installations in the past) • Ability to diversify into other related activities constrained by RHI reforms (e.g. by delays to reforms allowing deeming of heat use in shared ground loop systems; or by larger customers pushing back investment decisions owing to RHI policy uncertainties) 	<p>Our business remains static or has shrunk, and RHI reform delays and uncertainties are constraining our ability to diversify into other related markets (e.g. larger biomass installations; shared ground loop systems)</p>	<p>The proposed RHI changes, and the associated delays and uncertainties, resulted in the business undertaking the same number or fewer installations during the period Dec 2016 to September 2017, compared to what would have happened otherwise.</p>

	<p>Installer interviews suggested that the following contexts applied in some cases:</p> <ul style="list-style-type: none"> • Installer uses boilers which have longer lead-times than others in the market, so less able to respond quickly to demand • Installer’s approach to installations makes them less financially attractive to applicants (e.g. better specified but generate less RHI revenue) 		
<p>Installer type 4:</p> <p>“We undertook additional installations in the pre-reform period”</p>	<p>This was not directly observed in installer interviews.</p> <p>For biomass, this was not observed because the installers that we interviewed perceived an overall reduction in the number of biomass installations during 2017 compared to 2015 and 2016, when higher (pre-degression) tariffs supported higher numbers of small-scale biomass installations.</p> <p>For heat pumps, this was not observed EITHER because heat pump demand was not much affected by the reforms OR because some applicants were unable to speed up their installations before the imposition of heat demand limits (e.g. because these formed part of wider refurbishment or building projects).</p>	<p>Not directly observed: “As an RHT installer I am trying to maximise the business I can do before the changes in the reforms reduce the consumer demand for the technology I work with.”</p>	<p>Not directly observed:</p> <p>Additional installations take place compared to what would have happened otherwise, leading to higher renewable energy deployment and carbon abatement</p>
<p>Installer type 5:</p>	<p>This was not directly observed in installer interviews, possibly because opportunistic installers were less likely to agree to participate in the research (e.g. one applicant was advised not to agree to an interview, on the advice of their installer, and this</p>	<p>Not directly observed: “I will enter the RHT market in GB because of the good market</p>	<p>Not directly observed:</p>

<p>“We entered the RHT market in GB because of RHI opportunities.”</p>	<p>installer was associated with a significant number of medium-scale biomass applications in the RHI database).</p> <p>There is some indirect evidence of this CMO in that some installers reported quality issues with RHT installations by other installers (e.g. reporting that a significant part of their business involved sorting out installations that had been poorly implemented by others). This indirect evidence suggests that there may have been quality issues about RHT installation caused by new entrants.</p>	<p>opportunities offered by pre-reform RHI.”</p>	<p>Additional installations take place compared to what would have happened otherwise, leading to higher renewable energy deployment and carbon abatement</p> <p>Successive depressions and proposed RHI reforms have reduced demand for our products so</p> <p>(new entrants may also bring more competition into the GB supply chain, if they remain in this market)</p>
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Appendix E. Detailed applicant monitoring surveys: data tables

Appendix E is set out in excel tables available alongside this report.



Appendix F. Interim applicant qualitative fieldwork findings: working paper

Appendix F is set out in a separate document available for download alongside this report.

Appendix G. Synthesis process method

The theoretical framework and, in particular, the context-mechanism-outcome (CMO) configurations in the interim applicant theory, were used as the main structure for our realist synthesis. The focus in particular was on the non-domestic biomass and domestic heat pump sectors (applicants and installers), as that had been the focus of the qualitative fieldwork. However, we also brought in wider evidence from all of the workstreams, to help understand impacts and reasoning across the renewable heat market.

The testing process considered the influence of the RHI reform proposals and anticipated changes compared to other possible causal influences and involved careful consideration of which contexts triggered particular causal mechanisms, leading to desired or undesired outcomes. The theory testing process was designed to help us to develop a revised set of 'context-mechanism-outcome' statements, which could be used to answer the synthesis questions. These revised CMO configurations were then be compared with the initial interim applicant theory, which was modified in light of the evaluation findings.

Key steps in the realist synthesis process were as follows (see also Figure 3). This process was led by CAG Consultants, with inputs from Winning Moves and Hatch Regeneris.

Step 1. Relevant data from across the three workstreams was identified and organised in relation to the interim applicant theory and other key elements of the theoretical framework (particularly the demand theory). That is, we organised data as they related to what was done (the intervention activities e.g. the reform proposals, the delays and the September 2017 announcements and changes) or to contexts, mechanisms and outcomes in the interim applicant theory, and to (groups of) actors (e.g. domestic and non-domestic applicants). CAG Consultants led this process with input from Winning Moves and Hatch Regeneris. Internal synthesis calls – held between consortium partners - played an important role in starting this process, mapping workstream evidence against the interim applicant theory and identifying additional analysis needs. We developed a high-level spreadsheet that mapped evidence relevant to particular elements of the interim applicant and wider theory (e.g. Cs, Ms and Os for particular technologies).

Step 2. Additional analysis where required. This initial mapping and organisation process also identified opportunities for gaining greater understanding of the interim applicant theory by undertaking new analysis (e.g. of application or survey data). As a result, Winning Moves undertook additional analysis of survey data to provide evidence on issues or questions raised throughout the synthesis process.

Step 3. Assessment of evidence. We allocated responsibilities across the synthesis team for assessing the evidence that was relevant to different elements of the theory, both for interim applicant theory and for the wider demand theory. Two members of the synthesis team reviewed the evidence relating to each element of the candidate theory, drawing on evidence from all three workstreams as identified in Steps 1 and 2. The reviewers assessed the evidence using the realist synthesis criteria of 'rigour' and 'relevance' developed by Pawson⁸, and documented their assessment of the evidence in a

⁸ Pawson, R & Tilley, N (1997) *Realistic Evaluation*, Sage, London.

fuller version of the evidence-mapping spreadsheet. This assessment primarily involved review of the workstream reports by CAG Consultants but also required some further analysis or review of underlying source data (e.g. analysis of RHI published statistics). In reviewing the extent to which the evidence supported the candidate theory or suggested new or revised theory, the assessment included a review of:

- **Outcomes** for applicants and installers in the markets that were the focus of research. We used the qualitative research, combined with analysis for sub-samples of the retrospective survey, as well as workstream 4 evidence, to understand which outcomes occurred for whom.
- Once patterns of outcomes were identified, the **mechanisms** generating those outcomes were analysed, where the right kinds of data were available i.e. we brought together evidence that helped us to understand why the outcomes happened and for whom. This meant that there was good data available in relation to non-domestic biomass and domestic heat pumps applications (as these were the focus of the qualitative fieldwork), but less so for other sectors (although the applicant survey did capture data on applicant reasoning in relation to the RHI and the reform proposals). In our identification of mechanisms, we considered the influence of recent RHI announcements and other possible influences on behaviour.
- The **contexts** in which particular mechanisms did or did not ‘fire’ were also determined. Again, good data was available for non-domestic biomass and domestic heat pump sectors, but less so for others.

Step 4. Refinement of theory. Depending on the strength of evidence drawn from the three workstreams, the pairs of researchers then confirmed, refined or revised the C-M-O configurations for the interim applicant theory and, where relevant, for other elements of the theoretical framework. Where appropriate, we used Pawson’s approach of ‘consolidating theory’ (where it is supported by multiple pieces of evidence) and ‘situating theory’ (where we can define more closely the contexts in which a particular mechanism would fire). Where we had rigorous and relevant evidence relating to interim applicants, we undertook significant revisions to the candidate theory for interim applicants. While there is no standard test for the validity of C-M-O configurations in realist literature, our recommendations for the revised theory took into account our level of confidence in the revised configurations. The proposed revised theory was summarised and streamlined by CAG Consultants, with the aim of putting forward ‘mid-level theory’ that was relevant and useful to BEIS.

This process is summarised below.

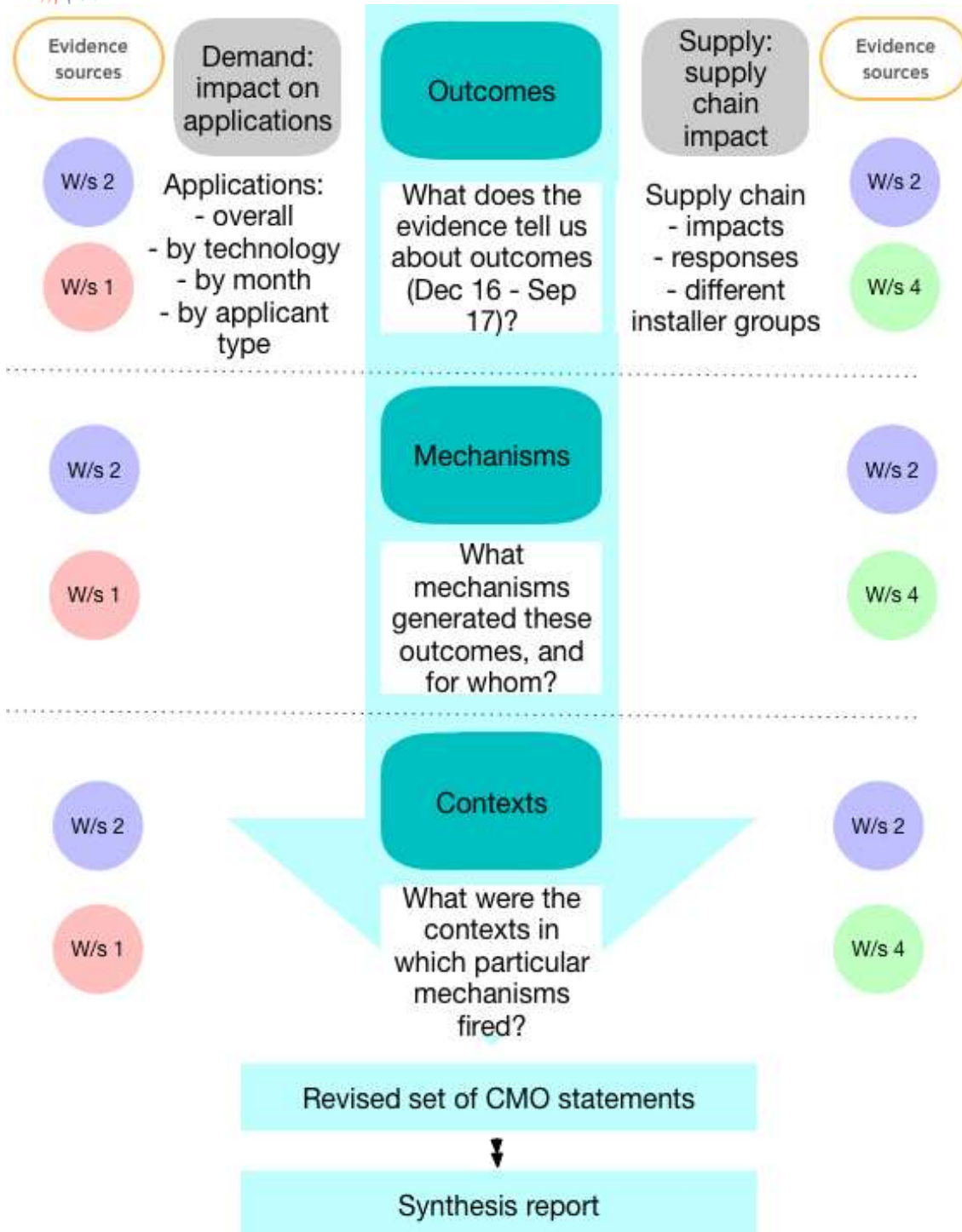


Figure 3 Realist synthesis process for this report

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