Department for
Energy Security
& Net Zero

Evaluation of the Energy Entrepreneurs Fund

Technical Annex

February 2023

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1. Introduction

Ipsos MORI, in association with Technopolis Group, were commissioned by the Department for Energy Security & Net Zero (DESNZ) to undertake a process, impact and economic evaluation of the Energy Entrepreneurs Fund (EEF) programme phases 1 - 7 in November 2019. This document presents the Technical Annex which sits alongside the main evaluation report.

1.1 Aims and objectives of study

The aims and objectives of the evaluation study were set out in the Invitation to Tender for the research, and these were refined in the evaluation scoping stage. The overarching aims of the research were to undertake a process, impact and economic evaluation of the EEF phases 1 - 7 programme in order to:

- Identify the overall benefits and impacts of the scheme;
- Assess the extent to which the scheme has achieved its objectives;
- Assess the cost effectiveness of the scheme and whether it has delivered value for money; and
- Understand how implementation could be modified to optimise impacts, benefits and efficiency, including lessons learnt that can be applied to future innovation funding schemes and identifying whether the process was appropriate and proportionate.

The detailed list of evaluation questions is presented below.

1.1.1 Impact evaluation research questions

What are the observed impacts of the EEF programme?

- Did EEF achieve its objectives? If so, by which mechanisms? If not, why not? (IE1)
- To what extent has the EEF programme achieved impacts in the following areas of priority: TRL progression, commercial readiness, external investment, follow-on funding? (IE2)
- Do these impacts differ for different companies, stage of innovation, starting TRL, grant size, technologies and sectors? (IE3)
- What factors within the lifetime of the project influence impacts (e.g. collaborations, inputs from matched funding providers)? (IE4)
- What is the role of incubation support in achieving these outcomes? Do companies value incubation support? By which mechanisms have incubation support helped to achieve these outcomes? (IE5)
- Have there been any unintended consequences? (IE6)

What is the contribution of EEF to the observed impacts, i.e. what is the additionality of the programme?

- To what extent are the EEF's observed impacts additional to what would have happened otherwise? (IE7)
- How does the nature and level of additionality vary across different types of grant recipients, technologies, sectors? (IE8)
- What explains any differences in the level of additionality observed for the different grant recipients, technologies, sectors? (IE9)
- If the intended outcomes are not observed for certain recipients, why was this? (IE10)

1.1.2 Process evaluation research questions

How effective and efficient has the delivery of the scheme been?

- What elements of the scheme have been most effective? (PE1)
- Is the application process proportionate and appropriate? (PE2)
- Are companies provided with the right mix and scale of support to help them achieve their outcomes?[1] (PE3)
- Does incubation support fit well with the business type/sector/TRL? Is it matched to the company need sufficiently? (PE4)
- How could administrative processes be improved? (PE5)

1.1.3 Economic evaluation research questions

What is the overall cost-effectiveness of the scheme?

- Does the EEF represent a cost-effective investment for its impacts and when costing all input (e.g. incubation support, monitoring officers, applicant inputs etc.)? (EE1)
- Does incubation support offer value-for-money? Does this differ across the different incubation support activities? (EE2)
- How could the cost-effectiveness of the scheme be improved? (EE3)
- Which sectors or types of investment result in greatest value for money? (EE4)

1.1.4 Wider learning research questions

What is the wider learning from the evaluation for DESNZ?

- What barriers to SME participation in energy innovation are there? Does EEF address these? What barriers remain? What is the scale and nature of market failure if it remains? (WL1)

[1] These process questions will also feed into the impact evaluation

- What lessons can be learnt from the project to understand how it can be optimised and improved? (WL2)
- Is there any learning that can be applied to other innovation funding schemes? (WL3)

1.2 Aims of technical annex

The aims of the technical annex paper are to:

- Provide more details about the EEF programme (phases 1 - 7), how it operated, what it aimed to achieve (and how it aimed to achieve its objectives), to help to contextualise the findings presented in the main evaluation report.
- Present a detailed explanation of the evaluation methodology, including the data that has been used to underpin the analysis, the analytical approach and the data collection tools.
- Present the detailed results from the analysis, which have been summarised in the main evaluation report.

1.3 Structure of the report

The remainder of this report is structured as follows:

- Section 2 provides a detailed description of the Theory of Change and the processes used to implement the EEF programme;
- Section 3 provides an overview of the data collected to underpin the evaluation;
- Section 4 details how the data collected has been analysed and synthesised to provide findings for the evaluation;
- Section 5 sets out some of the more detailed findings from the analysis undertaken (those which were not included in the main evaluation report); and

Section 6 presents the detailed topic guides used for the depth interviews.

2. Evaluation framework

This section provides a summary of the evaluation framework used to undertake the evaluation of the Energy Entrepreneurs Fund phases 1 - 7. It includes a presentation and description of the Theory of Change, details the hypotheses to be tested in the impact evaluation and describes the processes used in the EEF programme.

2.1 Theory of Change

This section sets out a summarised theory of change for the Energy Entrepreneurs Fund phases 1 - 7. The theory of change outlines the causal processes by which the programme was expected to deliver its intended outputs, outcomes and impacts. The purpose of the theory of change was to help inform the propositions and key hypotheses to be tested in the evaluation and to inform the nature of the evidence to be collected in the evaluation

2.1.1 Rationale (Strategic and Economic Case)

At the time of the launch of the EEF programme in 2012, the Government had made strong commitments to ensure future energy security for the UK, as well as having set targets outlined in the Climate Change Act of 2008 which required the UK to reduce its carbon emissions to 80 percent of 1990 levels by 2050. These commitments have been strengthened in recent years, including the introduction of the Clean Growth Grand Challenge in the 2017 Industrial Strategy (which set the mission to halve energy use in new buildings by 2030 and establish the first net-zero carbon industrial cluster by 2040) and more ambitious legislative commitments to reduce carbon emissions to net-zero by 2050, introduced in 2019.

Achieving these objectives will require the development and adoption of novel clean technologies across the economy. Simultaneously, the Government also laid out a vision for economic growth within the UK, putting a focus on SMEs to drive this by harnessing innovation to meet societal and technological challenges. This is to be achieved through taking advantage of disruptive approaches to remain globally competitive and accelerating productivity growth. The economic impacts of achieving these objectives could be significant. For example, one study has estimated that the output of the low carbon economy could expand from 2 percent of UK GDP to 13 percent by 2050.[2]

Wider Government policy aims in part to force producers and consumers of energy to internalise the unpriced environmental costs of existing energy system practices. If successful, market forces would gradually encourage a shift away from fossil fuelled energy and towards more environmentally sustainable technologies, creating incentives for the private sector to invest in the development of clean technology. However, there are several arguments for why

[2] Committee on Climate Change (2017) UK business opportunities of moving to a low carbon economy

the private sector would not deliver these technologies at an optimal level without support from the public sector:

- **Asymmetric information and moral hazards:** The nature of investment in innovative activity involves risks and features that make it unsuitable for financing through debt markets. The equity finance model corrects this problem, as angel investors and venture capital funds shoulder a greater share of the risk in exchange for higher returns. However, problems arise as the prospective investee has more knowledge of commercialisation prospects associated with the innovation than the potential investor, resulting in differences in the internal and external valuations of the investment prospect that may inhibit potentially profitable investments. This problem can be overcome if the investor is willing to incur the costs of due diligence. These costs do not vary significantly by the size of the investment, making smaller investments in earlier stage companies commercially unviable, and leading to the well-known 'equity gap' problem.
- **Spill-over effects:** While the asymmetric information present in the market may justify public support to incomplete financial markets, it is also well established that the benefits of investment in innovation cannot be fully captured by those investing. Processes such as turnover in the labour market allow tacit knowledge to circulate in the economy and be exploited by other firms. Many forms of innovation cannot be protected, and in some cases, it is possible to circumvent Intellectual Property Rights by imitating the innovations developed by others through alternative means. Investors therefore may not be able to value the full returns from innovation, resulting in socially suboptimal levels of investment.
- **Commercialisation skills:** There are gaps in the level of commercial skills that are needed to effectively progress the development of new technology and identify early/new markets required to become investment ready.
- **Issues specific to investment in clean technology**: The above issues provide a generic business case for the provision of subsidies for innovation. However, there are several further issues specific to the demand side of the clean technology sector that strengthen the case for public support:
    - **Regulatory and policy reforms:** Demand for clean technologies is induced by Government policy. If there are perceptions that future Government policy may change in the future, this may introduce uncertainties that deter private investment.
    - **Market power:** The end markets for some forms of clean technology have monopsonistic characteristics (i.e. there are small numbers of buyers with market power). This creates 'discrete' risks of commercial failure which are unattractive to investors – i.e. if companies cannot secure contracts with the dominant players then there are no significant alternatives. End-users are often highly regulated with restrictions on the profits that can be earned, which weakens the incentives to innovate. Demand may also be weakened if the adoption of new technologies reduces profits.

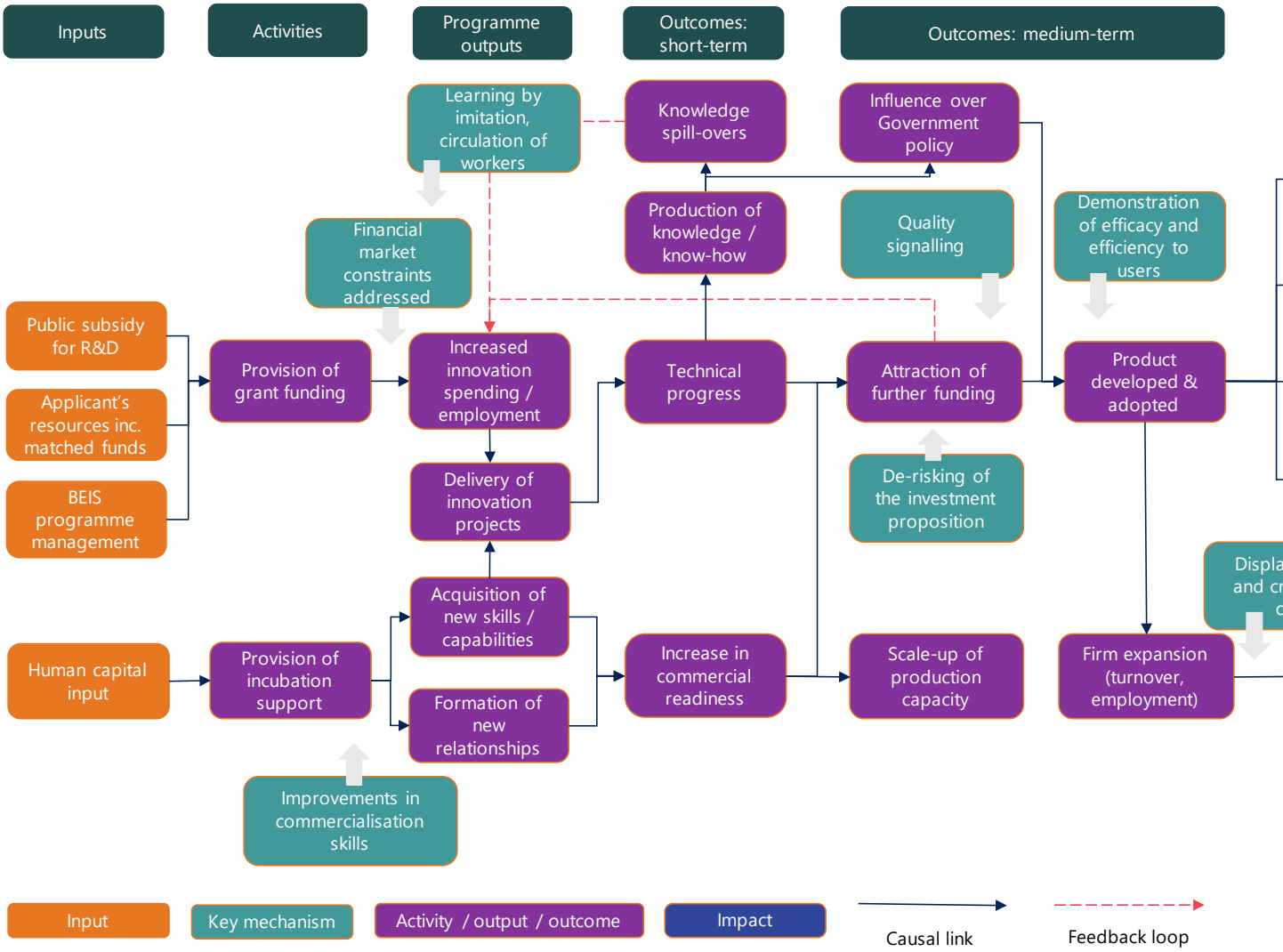
- **Capital intensive demonstration and commercialisation phases:** The latter stages of the development process can involve large capital costs in some technology areas, often requiring SMEs to seek an 'exit' to a large corporation or seek to raise capital on public markets through an IPO. The issues above are also likely to limit the number of exit opportunities – and if this is perceived to be the case by equity investors, then this will also have a chilling effect on earlier stage investments.
- **Undervaluation of energy consumption:** There is a range of evidence suggesting consumers heavily discount future costs when purchasing durable goods (an argument that can be extended to clean technologies). This was first observed in an empirical study examining air conditioning purchasing decisions by US consumers in 1979, which estimated that consumers discount lifetime energy expenditures at a rate of 25 percent (substantially exceeding the opportunity cost of obtaining funds for the initial capital outlay). This suggests that energy consumption is undervalued, perhaps because consumers are inattentive to, or imperfectly informed as to, the nature of these costs. In turn, this will weaken commercial incentives to invest in research and development.

2.1.1 Logic model

An overarching logic model outlining how the key processes through which the EEF addresses the issues described above and its intended results is set out below (developed on the basis of analysis of project documentation, reference to relevant bodies of theory and empirical findings in economics and industrial innovation, and consultations with key programme stakeholders). More detailed logic models – systematically describing the underpinning assumptions is provided in the Annex A document.[3] These more detailed logic models underpin the realist evaluation design.

[3] Annex A is the supplementary powerpoint document

Figure 2.1: Simplified logic model for EEF programme[4]



[4] BEIS changed its name to the Department for Energy Security and Net Zero (DESNZ) in February 2023.

2.1.2 Inputs

Delivery of the competitions within the scope of this study involves the following inputs:

- **Grant funding:** A total of £72m was made available by DESNZ (and formerly the Department for Business, Energy and Industrial Strategy (BEIS) and the Department for Energy and Climate Change (DECC)), for the purposes of providing grant funding for Innovation.[5] This funding was made available over seven competition rounds (phases), with the first allocated in 2012 and the most recent in 2019. The competitions were administered by DESNZ (and formerly BEIS and DECC).
- **Applicants' resources:** Applicants were required to match at least 10 percent of the grant funding offered by DESNZ (although academic inputs are not required to match the DESNZ funding). Funding may come from a company's own resources or external private sector investors but may not include funding attributable to any public authority or EU institution.[6] Applicants will provide non-monetary and intangible inputs, including tacit knowledge built up by the project team members through initial development work and background IP developed before the project began.
- **Incubation support from delivery partners**: The EEF programme includes incubation support activities provided to all programme participants. In phases 1 - 7, this incubation support is provided by Carbon Limiting Technologies Ltd (CLT) and consortium partners, which were selected through a competitive tendering process.
- **Labour input from DESNZ (and its predecessors BEIS and DECC):** Further resources are consumed by the management of the competition process and monitoring of the grants by DESNZ. Spending is also placed with external organisations and individuals – such as independent assessors, monitoring officers (externally provided in phase 7 after previously being provided by DESNZ), and the Knowledge Transfer Network (KTN) which has supported delivery of competition activities by providing information to potential applicants and in some cases helping potential applicants to form collaborative relationships.

2.1.3 Competition administration

The inputs above have been used to administer the funding competitions (more detail is provided in Section 2.4):

- **Development and promotion of competitions:** The programme involved the development of 'competition scopes' defining the key technological priorities, the eligibility criteria, and the basis upon which applications will be assessed. DESNZ and partners (e.g. the Knowledge Transfer Network) undertake promotional activity to raise awareness of the competition amongst the target community.
- **Application and assessment process:** The application process is designed to reveal the technical, commercial and economic merits of the technology under development. The information supplied by applicants is assessed by DESNZ, independent experts

[5] EEF 5, 6 and 7 are funded under the £505m Energy Innovation Portfolio by BEIS.
[6] The Energy Entrepreneurs Fund, First Phase Guidance Notice, pg. 12, 2012

and a Commercial Panel with the aim of allocating resources to projects that would not proceed without public support but have the potential to deliver against the environmental and economic objectives of the programme.

- **Due diligence and contracting:** The final stage is a due diligence and contracting process which addresses some of the ex-ante contracting risks attached to funding innovation projects. This includes assessing the financial health of the applicant, compliance with State Aid legislation, and specifying the details of the project to be delivered through a Grant Offer Letter (GoL) which forms the basis of the grant agreement between the applicant and Government. In all phases other than Phase 1, the incubation planning meeting has included the agreement of an incubation plan and the identification of any potential issues, which would form part of the due diligence process. The incubation plan had to be agreed and problems resolved before the GoL was issued.

2.1.4 Innovation grants

The effects of the provision of grants for Innovation were expected to include:

- **Higher levels of innovation spending and employment:** If the resource allocation process is effective in directing resources to projects that would not have been taken forward by the private sector in the absence of public funding (i.e. deadweight), then it would be expected that applicants invest greater levels of resources (including additional R&D staff) in taking forward their project. Additional demand for R&D staff may work to place upward pressure on wages or the price of other inputs, which may limit the increase in R&D in the UK economy (as innovation elsewhere in the economy is reduced if additional spending ‘leaks’ into the salaries of innovation workers).
- **Delivery of innovation projects:** A technical work programme of testing and refining the technology under development would be delivered in increasingly realistic environments. The nature of these activities will vary across technology areas and depend on the starting point of development. The research projects will also produce a set of knowledge-based outputs that could be used to progress the technology further, either through additional technical development or commercial exploitation.
- **Technical progress:** Increased levels of innovation spending would be expected to lead to accelerated progress through the development pathway (as measurable through the TRL scale, for example). The progress of the project is observed formally by Monitoring Officers (and informally by the incubation manager). This assumes that challenges encountered during delivery can be overcome, though in some cases the project may result in technologies that are not suitable for further development and commercialisation.
- **Acquisition of new knowledge, skills and capabilities:** Programme participants are expected to improve and develop skills and ways of working. The successful completion of the innovation projects is likely to result in improved skills and knowledge among Innovation staff. This may lead to new ideas for further developing the underlying technology, and to knowledge exchange resulting from collaboration in the project.

Some applicants may also seek to protect the tacit and/or formal knowledge through registering intellectual property rights (e.g. via patents or copyrights).

2.1.5 Incubation support

In addition to technical development work, beneficiaries also receive incubation support (co-ordinated by CLT in EEF phases 1 - 7) over the tenure of the project:

- **Incubation support:** The aim of incubation support is to identify and provide commercial support in areas where a company may need assistance to bring the innovation successfully to market to accelerate commercial exploitation. Following the awarding of the grant, the successful applicant and an Incubation Planner will discuss the needs of the project and the types of incubation support that is required in a four to five-hour incubation planning meeting. Incubation support tasks are delivered by framework partners and subcontractors. An overview of the incubation support services available through the programme and a description of the underlying mechanism through which the support is intended to support the commercialisation process is provided in the following table. It should be noted that if some types of support not listed are needed but can be sourced, these will be made available to the applicant.

Table 2.1 Indicative menu of incubation support services

Type of support	Mechanism
Market analysis	Assesses and segments markets, provides information about the route to market, potential partners and competitors and producing publicity materials. All of which helps firms develop their market proposition.
Business development	Identifies how customers could benefit from the innovation and developing a deeper understanding of the customer base and sales process. This helps to modify the firm's market proposition, build sales pipelines, identify customer trial sites, and potentially support with first strategic sales or customers.
Strategy	Develops business models and business plans with the EEF participant, to further develop the firm's market proposition (often in preparation for investment).
Technological support	Provides a technological roadmap for the product, independent validation of testing results, provides further expert input into the technology, and provision of support for IP strategy and application. This helps the EEF participant to improve the design of their innovation and protect it from competitive threats.
Product development support	Support in developing prototypes, product competitive analysis, product trials, product plans. This helps move the EEF firms move from an innovative technology towards having a commercial product.
Supply chain	Provides clarification of supply chain needs, supports the establishment of supply chains and procurement strategies, initial manufacturing plans. This helps to develop the firm's production and scale up planning.
Team	Identifies skills gaps and supports recruitment, supports board appointments, develops project management and communication within the firm. This helps to ensure the firm has the required skills and knowledge to expand and produce / sell the product.

Fundraising	Supports building financial readiness skills in seeking and securing external investments, provides advice and assistance on licencing. This helps prepare the firms for the activities involved in raising further capital.

- **Acquisition of enhanced commercialisation skills:** EEF participants will gain enhanced commercialisation skills within their organisation. Examples of how this could be achieved include the incubation support helping the firm recruit additional staff to fill skills gaps, supporting the appointment of appropriate board members or learning from the incubation manager or new contacts that the incubation support introduces them to and learning through task delivery.
- **Improvement in commercial readiness:** It is assumed that EEF participants will improve their commercial readiness, which could include developing their commercial awareness, enhancing the commercial appeal or testing / demonstration of their technology or further developing the skills of their team. This improvement in commercial readiness will be developed through and alongside the incubation support delivered by the EEF. This will be demonstrated through increased Commercial Readiness Level (CRL) scores. The progress of the project was observed and data is collected by Monitoring Officers and the incubation manager. Enterprises engaged in the incubation support are expected to have a sound understanding of the business world and their own organisation's market and environment with a view to ensuring effective exploitation of technologies in the low carbon technology sector.
- **Formation of new relationships:** EEF participants will benefit from enhanced networks as their incubation support leads them down a route of early engagement with financiers, customers, suppliers, etc (and potentially with other grant holders). It is also anticipated that by implementing incubation support as a core offering of the EEF programme, DESNZ will increase and strengthen its industrial, public and private sector networks in the early stage funding landscape.
- **Improvements to the design of the innovation project:** Some of the incubation support tasks delivered (particularly the technological and product development support and support to develop the team) will help to improve the design and successful achievement of the innovation project. This could be through enhanced skills and capabilities or the advice they receive about their technology or product, leading to refinements to the innovation project plan. This aspect of the programme has the potential to produce synergy benefits, whereby the impact of the combined package of R&D grants and incubation support lead to larger impacts than if they were delivered as separate elements.

2.1.6 Post-completion outcomes

The EEF is expected to provide the following types of short-term outcome at the project and applicant level:

- **Increase in private investment in the projects:** The technical and commercial progress made by the EEF participants, alongside the financial relationships they form

as a result of the incubation support means that EEF participants are in a better position to secure further private or public sector funding for their innovation projects.

- **Licensing agreements:** The technical and commercial progress made by EEF participants means that they may be in a better position to enter licensing agreements with customers (which may only be relevant to a subset of the technologies or business models under development). The incubation support received by EEF participants could also provide skills and knowledge which will support them in negotiating licencing agreements. Again, the EEF programme may also act as a quality signal to customers exploring the possibility of licencing the technology.
- **Further innovation investment and technological progress:** Some applicants who successfully apply for further funding (either public or private) will further expand their expenditure and employment in innovation to make further technical and commercial progress, moving closer to commercialisation.
- **Investment in production capacity:** Some applicants who have received subsequent funding (either public or private) will use the additional finance to invest in production capacity. This could be capital investment (for example new hardware) or investing in sub-contracting / outsourcing arrangements, to ensure their product can be produced at the optimal cost, quality and specification.
- **Cleantech products are developed and market ready:** The technical and commercial progress made by EEF participants during their participation in the programme and subsequently (through securing additional funding and undertaking further innovation and commercial research to progress TRL and CRL levels) will lead to clean technology products being developed and made available to the market.
- **Adoption of technologies by users:** The new clean technology products developed by EEF participants will be made available to the market, but to achieve the longer-term impacts that the programme is aiming for the technologies need to be adopted by users, both in the UK and overseas.
- **Firm expansion (turnover and employment):** Successful exploitation of the products or IP developed by the EEF participants would be expected to be visible in an expansion of the firm in terms of its turnover (including export sales) and employment (depending on the level of outsourcing). These effects are particularly likely to be significant amongst those launching a new product or service.

2.1.7 Economic impacts

In the longer-term the programme outcomes are expected to create the following economic impacts for the UK:

- **Displacement and crowding out:** The expansion of firms participating in the EEF programme will potentially result in offsetting effects for other firms in the economy. For example, if firms expand their sales, this may be at the expense of the market share of domestic competitors – i.e. product market displacement effects. However, even where sales growth has primarily displaced those of overseas producers, the growing demand for staff and other inputs to meet additional demand will place upward pressure on

wages and prices. In turn, this will lead to offsetting effects as other firms might reduce their employment and output in response. The current recommendation of the refreshed Green Book is to only treat those gains in output driven by improvements in productivity as a net benefit in cost-benefit analysis studies.[7]

- **Net increases in GVA:** The increase in turnover for EEF participants (and other cleantech innovators that recreate technologies and products) could lead to an increase in GVA in the UK. This would be dependent on the GVA generated by cleantech companies being larger than the loss of GVA from the loss of revenues from companies that lose market share as a result of new products coming to market.

2.1.8 Environmental impacts

The EEF programme aims to contribute towards energy savings and a reduction in carbon emissions. Across a diverse portfolio such as EEF, environmental benefits will be realised in a wide variety of ways. The environmental benefits the programme expects to achieve have been summarised into the following categories:

- **Increased energy system flexibility:** In bringing new products or processes to the market, it is hoped that the UK will be able to draw on a diverse mix of alternative energy sources and move away from the standard fossil-fuel supply that the UK has been dependent on historically. In turn, this should reduce reliance on energy imports.
- **Reduced cost of energy:** The adoption of novel clean technologies may also help reduce the cost of low carbon energy production.
- **Improved energy efficiency and overall reduction in CO2 emissions:** The increased use of renewable energy sources and proliferation of energy efficient measures (such as Demand-Side Response) across the UK will lead to a reduction in carbon emissions, contributing to the UK's achievement of the fifth carbon budget, and possibly accelerating its achievement. This is especially true for projects emerging from Phase Four of the EEF which saw some of its funding focussed on CCS, which is seen as one of the highest opportunity carbon reduction areas for the UK.

2.1.9 Spill-over effects

The programme may result in possible spill-over impacts via two main pathways:

- **Influence on Government policy:** Demonstrating that cleantech products are technically and commercially feasible may lead the Government to alter regulations, or subsidies on technical solutions, to promote take-up. This influence on Government policy could lead to the attraction of further funding, as specific types of cleantech products become more appealing to investors due to changes in policy.
- **Knowledge spill-overs:** The EEF can lead to wider increases in knowledge in the economy. This can be caused by staff turnover– staff leaving EEF participant

[7] Absorptive capacity is defined as: can be defined as a businesses' ability to acquire, assimilate, transform and exploit new external information for commercial benefit. The Green Book: Central Government Guidance on Appraisal and Evaluation, HM Treasury, 2018

companies will take knowledge they have generated there with them to their new employer; but also by other firms observing a successful technology / product and reverse engineering it. These spill-overs would not be as great in the absence of the EEF programme.

2.2 Contextual factors

The preceding section makes the simplifying assumption that the programme operates in a closed system and that the agents involved are broadly homogenous. This section addresses this assumption and considers the interaction of the programme with its wider environment (an open system) and how this may influence the mechanisms and outcomes outlined above. This assessment of the contextual factors that may influence the achievement of outcomes and impacts is a key aspect of the realist approach to the evaluation.

There are a variety of dynamic components to the system that need to be considered:

- **Funding for discovery research and early-stage proof of concept:** As flagged above, the success of the programme depends on a pipeline of high-quality proposals. Given the often 'high-tech' nature of the technology under development, it is anticipated that the strength of this pipeline will be partly underpinned by funding for discovery research and early-stage proof of concept studies (often undertaken in academic institutions). As an example, the EPSRC led Energy Programme is a long running programme of energy research and skills, including research for low carbon innovation. While this funding may produce spin-outs that eventually seek funding through the EEF, knowledge transfer from academia into industry often occurs in non-linear ways where firms reach out to academic institutions to collaborate on finding solutions to challenges involved in technical development as they arise (a 'Technology push and demand pull model')[8]. The academic research environment will also support the programme less directly through training and development of technical staff, which could work to ease labour market constraints. Variations in the priorities of both Research Council funding and academic researchers will mean that opportunities to leverage the academic research base will be variable across technology areas (and potentially across space, given the importance of face-to-face interaction in conveying complex information).
- **Regulatory landscape:** The Government effectively shapes the 'market' for clean technologies through its approach to regulation and this will have a profound impact on the ability of the intended outcomes of the programme to be realised, via numerous channels. Most prominently, regulation will shape the incentives of end-users to adopt clean technologies (e.g. including measures in regulated industries such as the Electricity Network Innovation Competition introduced in the Revenue = Incentives + Innovation + Outputs (RIIO) price controls by Ofgem, or allowing energy suppliers to meet their obligations under Energy Company Obligation (ECO) through 'demonstration actions' and 'innovation measures'). Where regulation gives certainty regarding likely

[8] As illustrated in the supplementary papers to this scoping study, some of the most successful firms in raising investment have extensive links with the academic community.

future demand, this will likely have a positive effect on appetite for investment in clean technologies through increasing levels of assurance around future returns. However, regulatory policy may not always have positive effects on the outcomes of the programme, there may be cases where regulation discourages innovation by encouraging adoption of 'low risk' technologies, creates uncertainty or makes the technologies under development redundant. Clearly, these factors will be variable across technology areas and over time. It is also important to note that the EEF may also have feed-back effects in which the findings of projects are used to support the formulation of regulatory policy.

- **Political landscape:** The regulatory landscape itself will be influenced by the concerns of voters and other interest groups in ways that could increase, delay or otherwise shape the pathway of regulatory reform, which will in turn shape the commercialisation prospects of projects being developed with EEF support. As an example, evidence from the evaluation of the Advanced Propulsion Centre highlighted that growing public concern in relation to the air quality impacts of diesel engines in the wake of the 'diesel-gate' scandal placed pressure on municipal authorities to accelerate plans to decarbonise public transport. This acceleration of plans led to the redundancy of many projects focused on incremental improvements to diesel engines regardless of their technical success in reducing tailpipe emissions. It is therefore important to understand the changing context in which the programme is embedded.
- **Investment landscape:** The relationship between the investment landscape and the success of the programme is highly complex, will be heterogenous across technology areas, and will need close attention in the evaluation. There are several channels through which these effects may arise:
    - **Follow-on funding:** It is anticipated that in most cases, follow-on funding will be required from the private sector following the completion of EEF projects to achieve the longer term environmental and commercialisation objectives of the programme. As such, the level of appetite for investments in clean technologies amongst private investors will be linked to the level of certainty around potential returns and future regulations.
    - **Provision of support for industrial R&D:** Additionally, perceived or actual failures of financial markets to provide adequate risk capital may also have policy impacts through encouraging the Government to enhance those markets by providing additional grants or equity for follow-on R&D and scale-up (for example, see the establishment of the Clean Growth Fund in 2019). This will also be linked to political considerations, such as the level of Government appetite to intervene in the market.
    - **Demonstration effects:** Finally, the EEF programme may also influence the investment landscape through demonstrating the commercial viability of clean technologies. These effects will be linked to cases where firms supported by the programme have achieved profitable exits for their investors, and will require exploration in the study (though it is important to note that the analysis set out in

the supplementary paper suggested that the number of exits achieved to date is comparatively small).

- **Additionality:** However, it is also important to note that any positive changes in the wider investment landscape may have a negative effect on the additional impact of the programme. This is because it increases the outcomes that would have been achieved in the absence of the EEF programme through reducing the financial constraints faced by technology developers.

- **Provision of public funding for industrial research and development:** Beneficiaries of EEF may also secure simultaneous (as part of their match-funding) or follow-on funding from parallel programmes of public support for industrial R&D, though the degree to which this funding may be accessible will depend on the alignment between the commercial objectives of the beneficiaries and the broader goals of the prevailing administration. The public funding landscape has also evolved considerably since the inception of the programme:
  - **Coalition Government:** The EEF was established during a period in which the budget of Innovate UK expanded considerably. As well as funding many collaborative R&D competitions targeting the development and commercialisation of clean technologies, the agency was tasked with launching the Energy Catalyst (an R&D competition in response mode with analogous objectives to the EEF).
  - **Innovate UK since 2015:** Since 2015 Innovate UK has moved away from thematically targeted funding competitions – first introducing Sector Foundation Competitions and then moving to fully open innovation competitions in 2018. The Energy Catalyst has also been refocused on sustainable development issues as DFID has become its primary funder.
  - **Industrial Strategy Challenge Fund:** Finally, the establishment of the Industrial Strategy Challenge Fund has made considerable public resources available to fund innovation directed at meeting 'grand challenges' with clean growth identified as key 'mission' for the Government in the Industrial Strategy. Examples include the Prospering from the Energy Revolution (aiming to demonstrate the commercial viability of local smart energy systems), the Industrial Decarbonisation Industrial Strategy Challenge Funds and the Faraday Battery Challenge (which aims to anchor electric vehicle production in the UK through supporting the emergence of a battery manufacturing sector).
- **Labour market considerations:** The EEF programme aims to enable participating firms to make technological and commercial progress and move towards selling products in the marketplace. To achieve these aims, the participating companies will need to expand their workforce at different points in the EEF programme. Some of these expansions will require recruiting individuals with specific skills and knowledge. Therefore, a flexible labour market which has the required skills is needed to support the achievement of the EEF programme aims. Again, these effects are bi-directional – the tacit knowledge and skills acquired by workers through their participation in the programme may have broader benefits through 'churn' in the labour market.

- **Policies of overseas Governments:** The UK is not the only country to have recognised the opportunity to anchor high value production jobs through subsidising the development of clean technologies. A recent example is the approval of €3.2bn in EU State Aid in 2019 to seven member states to support the creation of a battery industrialisation programme to anchor electric vehicle production in the EU. This may be seen as a direct competitor to the UKBIC established through the Faraday Battery Challenge, which has analogous objectives, posing a potential threat to the realisation of the economic goals of the programme. The availability of subsidies in overseas territories may draw R&D and production activity away from the UK, which will limit the extent to which IP developed in the UK is exploited in the UK. The emergence of subsidised competition may also accelerate the arrival of competitors – also potential limiting the commercialisation prospects of technologies emerging from EEF.
- **Covid-19:** This evaluation plan was largely developed before social distancing requirements were introduced to manage the outbreak of Covid-19 and is not a system factor displayed in the diagram above. These requirements are expected to have potentially dominating effects over the economic system in the UK in the short-term. This means they have the potential to substantially influence the impacts of the programme in ways that may be difficult to capture in the evaluation owing to the timing of the primary research.[9] The full impact of the shock was not observable within the timeframe of the evaluation, which causes potential bias in the conclusions formed about the impacts of the programme[10].

  The primary research attempted to collect information to form an assessment of the robustness of beneficiary firms to Covid-19 related economic shocks. However, the information provided by firms still in the process of working out how the pandemic was affecting their business did not allow a robust assessment to be made.

2.3 Hypotheses to be tested

The final step of developing the realist evaluation framework was to develop a set of propositions to be tested in the study. Pawson and Tilley[11] recommend the expression of theoretical propositions in the format of configurations of context, mechanisms and outcomes. There are certain aspects of EEF that make this cumbersome owing to (1) the temporal dynamics – the ultimate outcomes the programme seeks to achieve take a long time to materialise and there are many intermediate outcomes of interest, and (2) to the highly complex innovation systems in which the programme operates. Systematically accounting for the possible configurations of these contexts and outcomes would produce an enormous number of theoretical propositions. To support the tractability of the study, the key hypotheses

[9] The research team did explore the impacts of the Covid-19 pandemic on EEF applicants in the primary research undertaken (see Section 6) and were able to identify some short-term effects of the pandemic. However, the full impact of the pandemic will not be known until some time after the pandemic restrictions have been lifted.
[10] In extremis, if the large majority of funded applicants were to cease trading as a result of Covid-19 related economic shocks, then the programme may have no long-term benefits regardless of how effectively it was delivered.
[11] Pawson, R. & Tilley, N. (1997) Realistic Evaluation

(i.e. those most central to the achievement of the programme's objectives) implied by the programme theory which the evaluation will seek to test are set out in the table below and will be the priority focus of the impact evaluation (and the key impact evaluation questions set out in Section 1.1 of the document). These are presented alongside alternative hypotheses that seek to provide explanations for instances where the desired outcomes from the programme have not been realised. The hypotheses have been developed based on the theory of change developed for the EEF programme (described above) and through a workshop with key programme stakeholders.

Table 2.2 Context-Mechanism-Outcome Configurations

	Main hypotheses	**Alternative hypotheses**
1: Impact of regulation on project pipeline and availability of follow-on funding.	Regulation provides signals to academics, entrepreneurs, innovators and investors for the future demand for clean technologies (context), encouraging agents to adjust their research and investment priorities (mechanism), stimulating early-stage proof of concept work in clean technologies and applications for funding through EEF (outcome one) and increasing availability of resources for later-stage R&D and scale-up (outcome two). *Examples of evidence to support/confirm hypothesis:* – *Increase in clean technology start-ups and spin-outs* – *Increases in numbers of, and quality of, applications for EEF over time* – *Increase in the supply of VC funding for clean technologies (including specialist funds)*	Regulation creates uncertainty as to future demand for clean technologies (context), reducing anticipated returns to investment (mechanism), limiting the availability of resources for early-stage investigation and reducing the quality of the project pipeline for EEF (outcome one) and the availability of funding for later stage R&D and scale-up (outcome two) *Examples of evidence to support/confirm hypothesis:* – *Stagnation or decline in clean technology start-ups and spin-outs and/or investment in early stage R&D* – *Falling numbers of, and quality of, applications for EEF over time* – *Stagnation or decline in the supply of VC funding for clean technologies (including specialist funds)*
2: Impacts of EEF grants on R&D spending	Grants awarded to firms that are financially constrained in pursuing their project proposal (context), will increase the availability of capital to the firm (mechanism), leading to an increase in resources expended on research and development (outcome). *Examples of evidence to support/confirm hypothesis:* – *Applicants had limited internal resources to pursue their projects at the point of application.* – *Applicants had pursued, but failed to secure, private backing to pursue their projects.* – *Grants have a causal effect in increasing R&D expenditure*	Grants awarded to firms with potentially profitable projects that do not face constraints in financial markets (context), will substitute private resources for public resources (mechanism), and there will be no net increase in research and development spending (outcome). *Examples of evidence to support/confirm hypothesis:* – *Applicants had secured significant resources to pursue their projects at the point of application.* – *Grants have no effect on R&D expenditure and/or leak into spending on capital, training or profits*

3: Impacts of EEF participation on technological development	Where grants for R&D bring additional resources to deliver innovation projects (context), the results of tests and development work will help validate the efficacy and efficiency of the technology (mechanism), leading to progression to higher levels of technical development (outcome). *Examples of evidence to support/confirm hypothesis:* – *Technologies meet performance objectives specified at the point of application* – *TRLs associated with the technology increase* – *The grants lead to a causal effect on technical maturity*	Where grants for R&D bring additional resources to deliver innovation projects (context), tests and development work suggest that the core technology is not feasible but point the applicant to alternative lines of inquiry (mechanism), leading to changes in the aims and objectives of the programme and possibly to lower levels of technical development (outcome). *Examples of evidence to support/confirm hypothesis:* – *Technologies fail to meet performance objectives specified at the point of application* – *Results feed into the genesis of new related projects* – *The grants have no causal effect on technical maturity* Where grants for R&D bring additional resources to deliver innovation projects (context), tests and development work suggest that the core technology is not feasible with no alternative lines of inquiry (mechanism), leading to abandonment of the project (outcome). *Examples of evidence to support/confirm hypothesis:* – *Technologies fail to meet performance objectives specified at the point of application* – *Alternative applications of findings are not found* – *The grants have no causal effect on technical maturity*
4: Impacts of incubation support on commercial readiness	The provision of incubation support to firms with gaps or deficits in commercialisation skills which is tailored to those needs (context), will build understanding of the market potential of the underlying technology and what is required to commercialise it in the management team (mechanism), leading to actions taken to resolve issues with the underlying	The provision of incubation support to firms with gaps or deficits in commercialisation skills but is not tailored to those needs (context), will build capabilities and understanding in areas only tangentially relevant to commercialisation plans (mechanism), limiting added value in developing the underlying business model or commercial readiness of the company (outcome).

	business model or commercial readiness of the company (outcome). Improved commercialisation skills (context), help drive improvements in the efficiency or effectiveness of the technology development process (mechanism), enhancing the probability of attracting future investment and commercialisation (outcome). *Examples of evidence to support/confirm hypothesis:* – *Commercial outcomes specified in applications are met* – *CRLs for businesses/technologies increase* – *The incubation support leads to a causal effect on commercial maturity*	Provision of incubation support to firms without deficits in commercialisation skills (context), will not lead to acquisition of new capabilities or understanding (mechanism), having no additional impact on the development of the underlying business model (outcome). Provision of incubation support to firms that would have otherwise acquired comparable advice (context), will not lead to acquisition of new capabilities or understanding (mechanism), having no additional impact on the development of the underlying business model (outcome). *Examples of evidence to support/confirm hypothesis:* – *Participants fail to achieve commercial outcomes specified in applications* – *Participants already possess the skills to develop commercial opportunities for their technology* – *Participants would have purchased comparable support in the absence of the programme* – *The incubation support does not lead to a causal effect on commercial maturity*
5: Impacts of EEF participation on follow-on investment	(Contingent on 3) De-risking of the technology, the business model and/or the management team achieved through the delivery of the EEF project (context), will increase the expected returns on investment (mechanism), increasing appetite for further investment in the firm or project by the private and/or public sector (outcome). Promotion and due diligence of applicants undertaken through the programme (context), provides a quality signal to investors (mechanism), increasing appetite for further investment in the firm or project by the private and/or public sector (outcome).	De-risking of the technology, the business model and/or the management team achieved through the delivery of the EEF project (context) does not raise expected returns on investment to the point where it exceeds the cost of capital faced by investors (mechanism), limiting additional investment in the firm or project (outcome). Participation in EEF does not build investment readiness skills in management teams (context), leaving gaps in capabilities to engage positively with investors (mechanism), and limiting additional investment in the firm or project (outcome).

	Examples of evidence to support/confirm hypothesis: – *Participating businesses successfully raise further finance* – *Causal relationship between funding raised and participation in the programme*	*Examples of evidence to support/confirm hypothesis:* – *Participants do not possess the skills/networks needed to raise further finance* – *No causal relationship found between participation and funding raised*
6: Impacts of EEF participation on commercialisation and adoption	(Contingent on 5) Additional resources secured by the applicant are used to fund further technology and business development (context), demonstrating the commercial viability and efficacy of the technology (mechanism), enabling engagement of customers, adoption of the technology, and generating orders and revenues for firms (outcome). *Examples of evidence to support/confirm hypothesis:* – *Participating businesses meet the commercial objectives set out in application* – *Participants increase number of commercial outcomes (e.g. licences agreed, trial sites etc.)* – *Participants make sales of their technology to new customers* – *Causal relationship established between participation and commercial outcomes*	Additional resources secured by the applicant are used to fund further technology and business development (context), but do not demonstrate the commercial viability and efficacy of the technology (mechanism), leading to abandonment of the project (outcome). Competitors arrive first with an equivalent or superior technology (context), claiming market share, creating barriers to entry and limiting potential returns (mechanism), leading to abandonment of the project or suboptimal commercialisation. Regulatory policy (context) creates insufficient incentives for end-users to adopt novel technologies (mechanism), leading to abandonment of the project or suboptimal commercialisation. *Examples of evidence to support/confirm hypothesis:* – *Participating businesses do not meet the commercial objectives set out in application* – *Participants do not achieve commercial outcomes or sales* – *Competing businesses introduce technologies to the market before participating firms* – *No causal relationship established between participation and commercial outcomes*
7: Net economic benefits	(Contingent on 5 and/or 6) Additional resources and/or revenues available to the firm (context), encourages additional investment in the production capacity and recruitment of	Additional resources and/or revenues available to the firm (context), encourages the expansion of firms but challenges are encountered in recruiting workers with appropriate skills or securing other inputs

	additional workers (mechanism), increasing the production of goods and services of the firm in the UK (GVA) (outcome). The expansion of firms (context) leads to the firm taking market share away from (or generally disrupting) existing suppliers with less innovative technologies (mechanism one) or places pressure on prices (mechanism two), resulting in offsetting reductions in the production of goods and services elsewhere in the economy (outcome). Reallocation of production between firms (context) results in a transfer of output from less to more productive producers (mechanism), resulting in overall improvements in economic efficiency (outcome). *Examples of evidence to support/confirm hypothesis:* – *Participating businesses increase the level of turnover, employment and productivity* – *Increase in turnover, employment, productivity is larger than any losses incurred by competitors* – *Causal relationship between participation and economic benefits*	(mechanism), encouraging beneficiaries to offshore production or R&D activities (outcome one) or halting or otherwise limiting the expansion of the firm (outcome two) *Examples of evidence to support/confirm hypothesis:* – *Participating businesses do not increase the level of turnover, employment and productivity* – *Participating businesses experience recruitment challenges* – *Participants increase turnover, employment and productivity but this is offset by larger decreases among competitors* – *No causal relationship between economic impacts and participation* – *Causal relationship established between participation and commercial outcomes*
8: Environmental impacts	(Contingent on 6) Technologies commercialised by EEF beneficiaries are successfully integrated into energy networks or other end-use applications (context), reducing energy consumption, the cost of energy production and/or increasing domestic energy production from low carbon sources (mechanism), resulting in reductions in emissions (outcome). *Examples of evidence to support/confirm hypothesis:* – *Robust evidence collected from tests to establish environmental impact*	Competitors arrive with equivalent or superior technologies (context) that would have been adopted in the absence of the programme (mechanism), limiting the extent of any additional environmental benefits (outcome). *Examples of evidence to support/confirm hypothesis:* – *Competing technology available and used by customers* – *No causal relationship established between environmental benefits and participation in the programme*

	– *Sales of technology to customers* Causal relationship established between technology development, sales and participation in the programme	
9: Spill-overs	(Contingent on 3) Knowledge acquired from R&D has potential application in other research or industrial contexts (context) and is transmitted to other firms by circulation of workers in labour market or learning by imitation (mechanism), leading to the pursuit of new avenues of inquiry with the potential further programme objectives (outcome). *Examples of evidence to support/confirm hypothesis:* – *Competitors developing similar technologies* – *Competitors attempting to file patents in similar areas* Knowledge acquired from R&D has potential policy application (context), is disseminated to regulators and alters direction of regulation (mechanism), leading to more favourable conditions for commercialisation (outcome). *Examples of evidence to support/confirm hypothesis:* – *Evidence presented to DESNZ policy teams used in policy documents* – *Findings from EEF participants are used by regulators*	Knowledge acquired from R&D has potential application in other research or industrial contexts (context), but leakage outside of the firm is prevented by IPRs, successful retention policies, or other secrecy (mechanism), preventing knowledge spill-overs (outcome). *Examples of evidence to support/confirm hypothesis:* – *Participant is only businesses offering the technology / maintains unique selling point* – *Knowledge acquired from R&D has potential policy application (context), but there is no transmission of these lessons to regulators (mechanism), leading to an unaltered policy landscape (outcome).* *Examples of evidence to support/confirm hypothesis:* – *No evidence presented to DESNZ policy teams used in policy documents or by regulators* – *No evidence that information from EEF is shared*

2.4 Processes used by the EEF programme

The analysis of the programme set out in the preceding section highlights a range of key procedural assumptions or risks to effective or efficient delivery. The effectiveness of the processes has been assessed by how far they work to contain those risks (or at least, as far as is practicable), in order to ensure the programme is delivered effectively. These issues include:

- **Asymmetric information:** The Government, in many respects, faces the same problems of asymmetric information as investors, in that applicants for funding have greater information on the technical and commercial merits of their underlying proposals. However, the Government also faces the additional problem of trying to fund marginal projects – if funding reaches projects that would have been taken forward with private sector funding then there would be an inefficient substitution of public for private funding. As such, the application and assessment process should be judged against how effectively it 'reveals' the parameters of interest and enables funding to be routed to those proposals with the greatest scope to deliver against the economic and environmental objectives of the programme.
- **Moral hazard:** Applicants may face incentives during project delivery to pursue changes in directions that diverge from the original objectives of the project (such as new information about their technology or route to market). Such changes may alter the basis on which public funding was awarded and could threaten the achievement of the objectives of the programme (e.g. if technologies are repurposed for markets where the scope for emissions reductions are substantially reduced). This risk can be managed over the duration of the project through the specification of an appropriate contractual framework, monitoring project delivery, and introducing appropriate escalation procedures where changes in direction are needed. However, it is important to note that these risks will persist beyond the tenure of the project – and in the absence of post-completion monitoring, it is important to understand the degree of risk and what, if any, protections could potentially be introduced to contain them where required.
- **Incomplete contracts:** At the same time, it must be acknowledged that the outcomes of innovation projects are inherently uncertain and it is not feasible to develop a contract that accounts for all possible outcomes. Managing these issues effectively (i.e. facilitating the progression of projects that continue to show promising results while avoiding the on-going commitment of public funds to activities that are likely to be 'dead ends') requires a degree of flexibility both in the specification of the contract and in its monitoring and enforcement. This may also require monitoring officers to be fully appraised of possible risks outside of the project that could prevent the successful exploitation of the technologies under development that are not linked to their performance in technical terms (e.g. the arrival of a competitor with a superior technology).
- **Leakage:** There is a potential tension between the economic and environmental objectives of the programme. The environmental impacts can be fully achieved if the technologies developed through the EEF programme (phases 1 – 7) are exploited

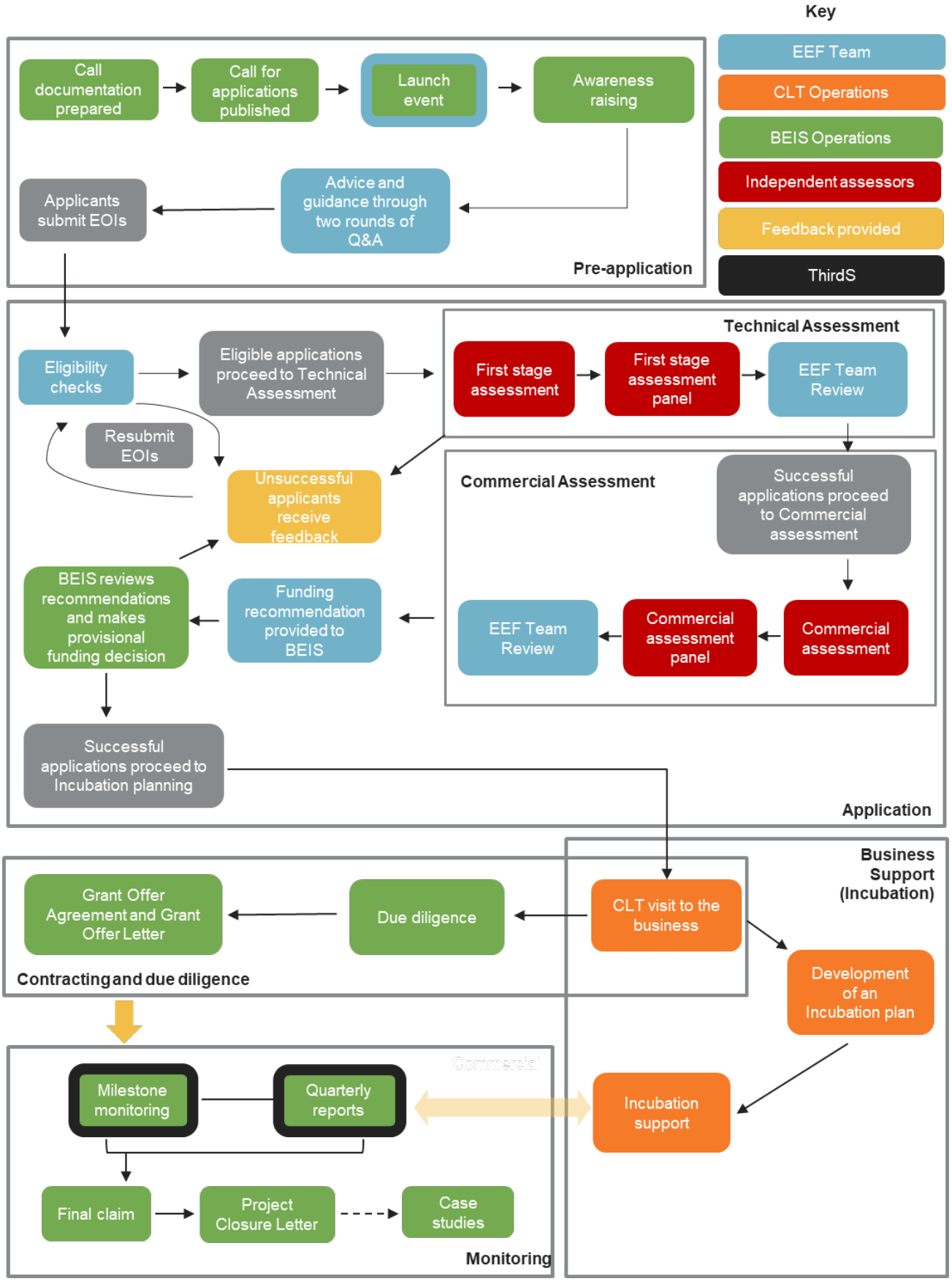
anywhere globally (and utilised in the UK), whereas the economic objectives are only realised in full if the technologies are exploited by UK based entities. The sale or licensing of IP to overseas firms will limit the strength of the economic impacts of the programme, and the evaluation considered how significant these issues were and whether there is a case for strengthening protections in this regard.

- **Dissemination mechanisms:** The delivery of EEF projects has the potential to produce 'public goods' in the form of knowledge that could be used to inform or guide the development of policy, lower search costs for investors, or demonstrate the commercial viability of investments in clean technology. However, the degree to which these benefits might be realised will be linked to the effectiveness of dissemination mechanisms used to transmit this information to the policy and investment communities and the evaluation considered how well delivery processes as currently configured supported these objectives.
- **Efficiency and value for money:** The processes should also be judged against their efficiency and value for money. This will be partly linked to the resources consumed in the delivery of the process (e.g. is the time needed to complete the application proportionate?). However, given the risks involved in the delivery of an innovation project, value for money will also be threatened by the possibility that resources are consumed in pursuing 'dead-ends' that could have been more productively redeployed or recycled in alternative projects. The process evaluation considered whether the monitoring process identified these types of issues with sufficient lead time and whether 'go/no-go' type decisions supported the achievement of the overall aims of the programme.

2.4.1 Process map

The figure below presents a detailed diagram which shows the processes involved in the EEF programme (phases 1 – 7), which have been grouped for the purposes for structuring the process evaluation. The processes and their intended role in dealing with the issues identified above are described in more detail below.

Figure 2.2: EEF phases 1 - 7 process map[12]



[12] BEIS changed its name to the Department for Energy Security and Net Zero (DESNZ) in February 2023.

2.4.2 Expression of interest

The EEF phases 1 - 7 funding round was advertised to potential applicants, and interested organisations were asked to provide an Expression of Interest (EoI). The EoI was a very short form, covering organisation name, type of organisation and the type of technology the organisation would be applying for. From Phase 2 onwards, potential applicants then needed to follow up by email to confirm their intention to apply, which resulted in the creation of a Basecamp folder for them into which they uploaded their application.

2.4.3 Application

Participants that completed the EOI stage and confirmed their intention to apply were asked to submit the following documents:

- Application form
- Finance form (one per project application)
- Gantt chart
- Letters of support from collaborators/partners (where relevant)

DESNZ accepted additional supporting information in the form of further annexes, however the applicants were asked not to assume that any additional information would be reviewed as part of the selection process.

The application form included details about the business, a description of the project and 10 sections: 1) Market and competitive landscape; 2) Business model and route to market; 3) Innovation, development of technology and performance; 4) Cost and performance pathway; 5) Impact on climate change targets and/or security of supply; 6) Project plans (Work packages and milestones); 7) Project success factors, risks and management; 8) Project funding; 9) Summary of the funding and spending history on the innovation to date; and 10) Experience and skills.

Following the submission of the application form, eligibility checks were undertaken. The eligibility checks included the following criteria:

- The project is at or above TRL level 3;
- The end date of the project matches the EEF phase guidance;
- The project and company are State Aid eligible; and
- The grant requested does not exceed the maximum set out in the guidance.

2.4.4 Assessment of applications: Technical assessment

The EEF assessment process was composed of three stages:

- Eligibility checks (as explained above)

- First stage (technical) assessment
- Commercial Panel assessment

The Technical Assessment stage and the Commercial Panel assessment were subject to revised Quality Assurance (QA) processes, which were introduced with EEF7 since previous phases had identified concerns around the variability of assessment scores and quality of comments. The QA was intended to reduce variability in scores.

The first stage assessment, or Technical Assessment, was composed of individual assessments carried out by assessors independently, followed by a Technical Assessment (QA) panel. The Technical Assessment phase lasted around one month.

The first stage assessment was a crucial element of the EEF assessment process since it provided the data for the first cut of applications to identify those progressing to the Commercial Panel.

Assessment criteria which were used from EEF 5[13] onwards were divided in six main areas of assessment, with each area weighted:

- Business proposition (20%) – sections 1 and 2 of the application form
- Innovation (15%) – section 3 of the application form
- Impact of Climate Change targets and/or security of supply (20%) – section 5 of the application form
- Project details (20%) – sections 6 and 7 of the application form
- Project funding (15%) – sections 8 and 9 of the application form
- Experience and skills (10%) – section 10 of the application form

The Technical Assessment was carried out by Assessment Teams of three assessors. In EEF phase 7, this comprised of two team members (one external and one internal) and an Assessment Team Lead (external). Assessment Team Members and Team Leads could be part of more than one assessment team, depending on their skillset matching the assessment group and personal availability.

External assessors were recruited through the Energy Technical Specialists (ETS) Framework (or through open procurement process), while internal assessors were selected for their specialist knowledge and expertise in a specific sector which applications were received under. The makeup of the internal assessors was generally a mix of experienced and new assessors.

Assessor training was provided by the EEF team via a WebEx tutorial. Those assessors who were unable to make the training were provided with training material. Assessors also received support from the EEF Team before, during and after the assessment window. The objective of assessor training was to create a common understanding of how to assess applications across the assessor community, standardise the scoring to ensure a consistent approach across

[13] Prior to EEF phase 5, the headings and questions asked in the application form differed from those listed here, but the areas of assessment were comparable.

assessors and underline the importance of providing constructive feedback to unsuccessful applicants.

Assessors were appointed based on their:

- Technical expertise in areas relevant to the EEF call for applications
- Previous experience of assessment activity
- Ability to be objective and provide evidence-based scores and comments
- Commitment to complete the number of assessments required within the time available
- For Assessment Team Leads, evidence of facilitating group discussions for assessment reviewing

Each assessor reviewed the application independently of the rest of the team and uploaded their scores prior to the Assessment Review Meeting. For phases 1 - 6 of the programme, SurveyMonkey was used to collect all of the assessment scores, while phase 7 used Google Forms.

The scores covered the following topic areas:

- Contribution towards carbon reduction targets
- Understanding of target market, market potential, route to market
- Technical feasibility
- Competitive advantage of technology
- Appropriateness of technical and financial approach
- Robustness of case of public funding
- Skills and experience of team

QA was also carried out for the Technical Assessment of applications. An EEF Team carries out the QA with the aim of:

- Checking projects where a consensus cannot be reached by the Assessment Team
- Checking projects have been assessed in accordance with the Assessment Guidance

In cases where a consensus could not be reached by the Assessment Team, two members of the EEF Team undertook a review to attempt to account for the discrepancy between scores, focusing on the areas of disagreement. Where required, for support outside their area of expertise, the EEF Team could engage with additional engineering/scientific/commercial experts, who were not involved in the initial review. Once the EEF Team Review was complete, the EEF Programme Manager discusses findings with the Assessment Team Lead to finalise a consensus, based on the EEF Team Review. Upon a consensus being reached, the application continued along the standard assessment process. Where no consensus could be reached between EEF Programme Manager and Assessment Team Lead, the application was reviewed by the Head of Engineering within the directorate of

Science and Innovation for Climate and Energy (SICE), who made the final decision on the application.

An assessment failed the QA where failure to conduct a robust assessment was identified, e.g. where the assessment had ignored information provided in the application, had allowed subjective bias to influence an assessment, or had failed to complete the assessment as required. Where an assessment failed QA, the assessments of all other applications conducted by the same assessor were reviewed to identify whether the issues identified were systemic. Applications which failed the assessment QA process were reassessed by new assessors and the results of these assessments were resubmitted via Google Forms. DESNZ provided bullet points summarising the issues with the previous assessments to enable the new assessors to effectively address the assessment quality issues.

Once a consensus score for the Technical Assessment was reached for all projects, the projects were ranked in order of score (highest at the top). The EEF Team calculated, from highest scoring project downward, the total DESNZ Grants applied for. At the point at which this total exceeded twice the budget for the EEF Programme (for example £20m cut off for the £10m available for EEF7), projects from that point downwards were rejected, and projects above that line proceeded to the Commercial Panel.

2.4.5 Assessment of applications: Commercial assessment

The EEF Team provided the Commercial Panel with access to all EEF applications that proceeded to the Commercial Panel stage and a list of ranked Technical Assessment scores, with the three original assessor scores, variance and Review Panel consensus score. Each application put forward to the Commercial Panel for assessment was reviewed by two panel members. Individual panel members were asked to score their applications and provide feedback through a Google Form. Incubation support delivery partner, Carbon Limiting Technologies Ltd (CLT) chaired the Commercial Panel and, prior to the meeting, reviewed individual scores and comments to produce key discussion points for the panel agenda.

Prior to the meeting, CLT also ranked applications in four size categories according to the grant funding requested (less than £250k; £250k to £500k; £500k to £750k; over £750k) and used the following criteria to aid the discussion and decision of the Commercial Panel:

- Technical Assessment score vs. average Commercial Assessment score
- Grant requested vs. TRL

At the Commercial Panel Review meeting, each application was discussed by the whole panel, with key points brought forward by the chair. The Commercial Panel discussed all applications which were brought forward irrespective of their Technical Assessment Scores.[14] Stage 1 applications.

[14] Technical Assessment scores were provided for information and panel members were not required to approve the highest scoring applications or reject the lower scoring.

After discussion of each application, the panel provided DESNZ with funding recommendations. The panel recommendations fitted in one of the following three categories:

- Fund the application
- Fund the application with conditions
- Do not fund the application

There was a small number of applications on which the panel could not reach a decision.. QA of the Commercial Assessment process was carried out by CLT who chair the Panel and an EEF Team member that attended the discussions. The Chair reviewed all applications to ensure consistency of Panel members' scores and to identify issues within the applications, while the EEF Team member observed the discussions. The QA aims to ensure that:

- Panel member scores and comments reflected the content of the applications
- Panel members had reviewed the application in detail
- Panel discussions were open and transparent

2.4.6 Project selection

Following the Commercial Panel, DESNZ received a list of funding recommendations made by the Panel. DESNZ reviewed the list, including further review of any applications which had failed the Panel QA process, to identify the EEF applications it wished to fund.

It was possible that DESNZ did not accept some of the Panel recommendations and could choose, for strategic reasons, not to fund or to fund specific applications that the Panel has reviewed. This happened in a very small number of cases. In these cases, the EEF Team kept specific records of the reasons for not accepting the Commercial Panel's recommendation.

Finally, DESNZ informed the successful and unsuccessful applicants of the outcome of their application via e-mail a few working days after the Commercial Panel.

Provision of feedback at different points of the process

The EEF programme (phases 1 – 7) was a support programme aimed primarily (although not exclusively) at SMEs. There was an assumption that SMEs might not be familiar with public sector funding programmes, therefore provision of feedback was important to improve future applications.

Feedback was provided throughout the programme to EEF applicants at the stage where they exited the assessment process:

- Following an incomplete EOI – sent to applicants who only completed either the online form, or sent an e-mail
- Following eligibility checks – applicants were asked specific questions regarding the eligibility of their application and were allowed to resubmit an amended application within a specific timeframe (usually 48 hours). Unsuccessful applicants were notified when they did not proceed in the full assessment stage.

- Following technical assessment – each of the three assessors was required to provide a short summary on the application. These summaries were collated for feeding back to applicants after having been reviewed as part of the wider QA. Feedback was emailed to unsuccessful applicants who did not score above the benchmark score to proceed to the Commercial Panel. This was done within one month of informing them of the outcome of their applications.
- Following DESNZ funding decision – a notification e-mail was sent to unsuccessful and successful applicants.

Moreover, feedback from the Commercial Review Panel was also provided to applicants who proceed to being funded and unsuccessful applicants. This feedback was based on the minutes of the Panel discussion taken and it was also used as a guidance for discussions for the Incubation Planning meetings (see below).

2.4.7 Post award

Contracting and due diligence

Upon successful application, the contracting phase began. This included: match funding assurance; the signature of a collaboration agreement (if required); the issue of a Grant Offer Letter (GoL) and, finally, a Grant Offer Agreement. The GoL contains information about the grantee's company and any consortia, the funding amount, and the funding period.

Formal due diligence checks were carried out at this stage. These included a number of elements, some generic for all applicants - such as match funding confirmation, evidence of access to Intellectual Property (IP), collaboration agreement (for collaborative applications) and undertaking in difficulty test - and more specific elements, such as resolving issues from the assessment stages and addressing any red flags identified in Incubation Planning.

The Incubation Planning session (the first stage of the Incubation Support) was part of the contracting and due diligence stage and it consisted of an Incubation Manager and Incubation Planner from CLT and a DESNZ Monitoring Officer undertaking a visit to the applicant's premises. Prior to the session, participants received a blank Grant Offer Letter and Grant Offer Agreement, with the documents subject to change to address any key issues identified in the session.

Incubation support

The EEF programme included Incubation Support which ran alongside the projects for the duration of the grant and at a value of around £40K per company (EEF7). The Incubation Support was contracted through CLT in phases 1 - 7.

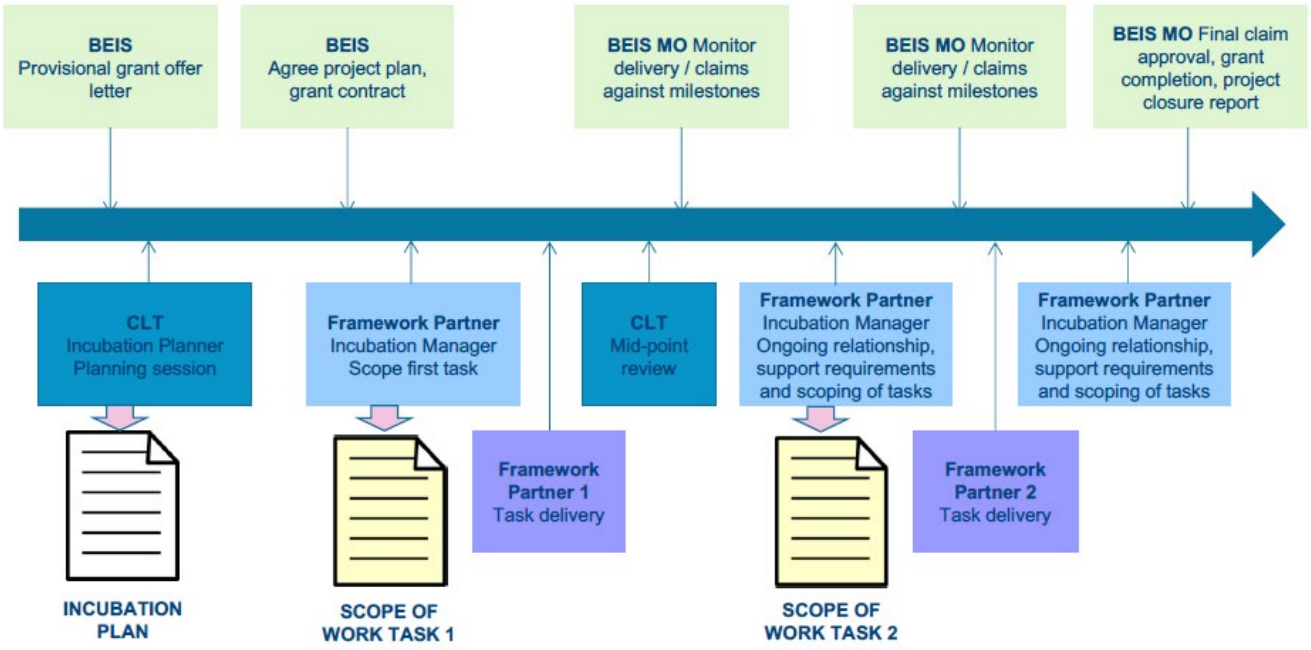
Incubation Support provided business development activities for the grant recipient, identifying early/new markets for sales and helping the company become investment-ready. Incubation support was personalised to the company's needs which were identified during a visit by CLT to the company. The specific objective of this support is to help grant recipients develop their capabilities in:

- Market Understanding
- Business Development & Sales
- Strategy & Business Planning
- Technology advancement
- Product development
- Supply Chain & Operations
- Team building
- Fundraising

The Incubation Support consisted of the delivery of specific support tasks chosen from a Menu of Services, with additional bespoke tasks identified and resourced if required.

The aims of the Incubation Support programme under EEF were to increase the chance of successfully bringing the innovation to market, or to reduce the time to market, in order to leverage return on the DESNZ grant funding for UK Plc.

Figure 2.3: Incubation support process[15]



Source: **DESNZ/CLT. This is an illustrative diagram. It should be noted that incubation support tasks continue to be delivered throughout the project (or until incubation budget limit reached)**

[15] BEIS changed its name to the Department for Energy Security and Net Zero (DESNZ) in February 2023.

As part of the Incubation planning meeting, the CLT Incubation Planner gathered further information from the applicant on areas where gaps are evident from the application or panel feedback. The following points were covered as part of the Incubation Planning discussions:

- Market – target customers and segmentation, including route to market
- Technology status and development milestones, including a demo/tour if practical
- Business Development and Sales
- Strategy and Business model (prototype to market entry to distribution or licensing etc.)
- Product plans
- Supply chain and manufacturing
- Team and team plans
- Fundraising
- Key risks

Incubation managers were encouraged to look for any potential "red flags" – risks which would prevent DESNZ issuing a GoL or threaten project delivery. These included information around IP rights; matched funding; collaboration agreements; company structure and project team. The provisional offer email stated that participants must complete an Incubation Plan and address any outstanding or newly identified issues prior to the grant being awarded. DESNZ reserved the right to withdraw the provisional offer of funding if these issues are not addressed.

The Incubation Planning session identified a number of support needs selected from CLT's Menu of Services, or additional bespoke tasks if required. The support needs were summarised in an Incubation Plan for the applicant, which outlines the TRL and CRL status of the innovation, the TRL stage the venture was likely to reach at the end of the DESNZ project and the areas where support was needed to accelerate commercialisation.

Incubation Planners were required to complete the Incubation Plan document within 10 days of session including:

- Summary of relative strengths/weaknesses/gaps in each area
- Scorecard Metrics to identify business objectives
- Red flags, risks and response to DESNZ panel assessment queries. (Red flags must be flagged within two days of session)
- Prioritised actions and tasks to address gaps and prepare for next stage (Commercial and Project), including actions the applicant needs to focus on

The Incubation Plan also outlined CLT's assessment of the likelihood (high to low) of the company achieving the following metrics after the end of the DESNZ-funded project (within a 6 to 9-month period):

- Trials/ pilot sites secured
- New Industrial partnerships

- Sales opportunities created
- Fundraising achieved
- Licence deals signed

CLT coordinates the incubation support, while delivery of the Incubation Support services is provided a framework of companies. led by CLT, which was selected through a dedicated procurement process. For EEF5-7, the incubation support was delivered by Incubation Managers and task delivery teams belonging to companies Carbon Trust, CLT, Arup and WSP and led by CLT. Incubation Managers are appointed to work with the recipients of Incubation Support throughout their projects.

CLT's coordination work includes working with Framework partners to agree priorities; review and approve scopes of work and deliverables; monitor progress and budgets; provide an "open door" for companies when required for issues/problems.

Project monitoring

Project monitoring for EEF phases 1 - 6 was implemented by Monitoring Officers (MOs) from DESNZ. In EEF phase 7, DESNZ outsourced the monitoring officer role to the ThirdS contract providers, led by Mott MacDonald and including Carbon Trust and Ricardo.

Progress of the project against agreed milestones was tracked and reported monthly and reports were uploaded on Basecamp, where they were reviewed and approved. Any deviations were highlighted to the DESNZ senior management team before a way forward was agreed. A mid-project Incubation Support review meeting also took place.

MOs also reported back to SICE on innovation activity within projects in order to broaden the Department's understanding of the energy innovation process and of emerging clean-energy products and services.

Companies were also asked to provide feedback on the progress of the Incubation Support through a SurveyMonkey survey conducted in 2018.

Programme monitoring / aggregate monitoring

CLT monitors progress of the programme through data collection on the following output/outcome indicators:

- Private and public funding raised
- Senior team appointments
- Products launched
- Sales achieved
- Technology validations
- Customer trials completed
- Industry partnerships developed

A series of case studies showcase successful projects within the programme, describing project results and their implementation, with their impact and wider social effects.

Project closedown

Upon completion of the project, participants have to provide a series of closure documents together with the Final Claim. These are: a Final Report, KPIs[16], a Reasonable Assurance Report, a Commercial Progress Record[17] document providing information on achievements of the grant and a Project Closure Form.

The Commercial Progress Form underwent a slight change in its design in November 2018, requiring additional detail on technical progress and company valuations. The form collected information on outputs and outcomes as well as feedback on incubation services received.

Once the final claim has been paid, DESNZ sent a formal Project Closure Letter to all projects.

In the EEF programme design, there were post-completion monitoring requirements for all EEF projects. MOs were originally supposed to diarise resending a shortened CPR form to the grant recipients 12 months after the end of the grant project. However, in practice this does not seem to have been completed.

2.5 Process evaluation framework

The table below sets out the process evaluation framework, which the processes used in the delivery of the EEF have been assessed against.

[16] KPIs are now collected annually by SICE as part of the monitoring of the Energy Innovation Portfolio
[17] The Commercial Progress Record only became compulsory during EEF Phase 5.

Table 2.3: Process evaluation framework

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
Pre-application processes To attract the right applicant and support them develop high quality applications	**Preparation of call documentation**												
	How effective was the design and preparation of EEF call documentation in ensuring synergies with/avoiding duplication of work by the parties involved (DESNZ, Innovate UK, industry) in relation to other programmes?	Number of organisations with whom early draft was shared / consulted	X		X				X		X		
	Marketing, communications and pre-application advice												
	Is a communication strategy in place, when was it established and updated? Is the communication strategy for EEF clear about target audiences?	Year drafted, year revised Quality of considerations in comms strategy	X		X				X				
	How effective are marketing and communication activities in raising awareness of the EEF amongst the target audiences and motivating applicants to submit applications?	Number of total EOIs submitted	X		X					X			X

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	Do marketing and communications make the objectives of the EEF, eligibility criteria, and application process clear to applicants?	Number of ineligible EOIs/applications received	X		X					X			X
	How helpful is the pre-application advice provided to prospective applicants through the two rounds of Q&As?	Number of good quality applications	X		X					X			X
	How effectively has the EEF engaged the investment community in terms of: (1) raising awareness of the programme? (2) raising confidence in the processes employed to administer the programme? (3) the quality/commercial viability of projects emerging from the programme?	Level of awareness	X		X		X		X		X	X	
Application processes To ensure that only eligible	**EOIs and eligibility checks**												
	Are the Eligibility Checks effective at identifying projects not eligible for funding and at reducing cases of 'false-positives' making it to the assessment phase?	Number of applications which proceeded to assessment	X		X								

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
applications progress to the assessment phase		and were found to be ineligible											
	Is the time provided for the Eligibility Checks sufficient? Are the costs incurred in the eligibility checks proportionate?	Costs of eligibility checks			X								
	Application process												
	Is the process of completing an application for EEF funding straightforward and proportionate to grants and level of support available?	Share of applicants invited to submit full proposals doing so			X					X			X
	Do applicants receive the necessary level of support in the application process?		X		X					X			X
	Is the application process conducive to the preparation of high-quality proposals?	Distribution of technical scores		X	X			X		X			X
	Is the time provided for the application submission sufficient?	Number of applications and scores received (if variability in time then		X	X			X		X			X

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
		compare the two)											
Assessment of applications To select the best applications for funding	**Technical assessment**												
	Are assessment criteria appropriate and their weighting proportionate to select applications aligned with the overall policy objectives of the EEF?		X		X			X		X			X
	Are assessors allocated enough time and resources to consider each application in enough depth and are they provided with clear guidance on how to conduct the assessment?	Number of failed QAs Size of assessor pool / number of assessments per assessor	X		X			X					
	Do assessors have sufficient technical expertise to provide a rigorous assessment of applications received?	Variability in assessment scores			X			X					
	Are effective processes for managing technical expert assessors' bias/independence in place?		X		X			X					
	Do applications provide sufficient technical and commercial information to enable an effective				X			X					

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	assessment of the commercial and economic merits of the project?												
	How far are considerations of additionality through the assessment or review process given sufficient weight? Are assessors able to make an effective assessment of deadweight?	Assessment of additionality (from impact evaluation) and benchmarking to comparable programme			X			X					
	How effective is the recently introduced QA (EEF7) in ensuring low variability in assessor scores and quality of comments? What proportion of assessments fails QA?	Proportion of high variability scores Variability in assessment scores Correlation between assessment scores and recommendation	X		X			X					

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
		s of Commercial Panel											
	Is the current way of selecting projects that proceed to the Commercial Assessment appropriate? Has there been high variability in the quality of projects reaching the Commercial Assessment across EEF1 - 7?	Variability of project quality			X			X					
	Commercial Assessment												
	Is the timeframe between technical and Commercial Assessment adequate?	Length of time		X				X					
	Does the Commercial Assessment panel receive sufficient information to make informed project selection recommendations?	Number of failed QAs			X			X					
	Are panel members given a sufficient amount of time to consider each application in sufficient depth? Are panel members able to make effective judgements regarding the economic, technical and commercial merits of projects?			X	X			X					

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	Do assessors have sufficient commercial expertise to provide a rigorous assessment of applications received?	Variability in assessment scores			X			X					
	Are panel members sufficiently motivated to participate?				X			X					
	How far do funding decisions deviate from panel recommendations? Does this have any impact on the quality of the portfolio of funded projects?	n. of cases in which DESNZ deviated from panel recommendations			X			X	X				
	Is the feedback provided by DESNZ to unsuccessful applicants useful for understanding the decision and for improving future applications?	Quality of feedback Number of unsuccessful applicants who receive funding in a future round (for the same technology)			X								X

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
Post-award processes To ensure projects are delivered according to plan and progress commerciall y	**Contracting and due diligence**												
	Does the due diligence process provide sufficient protection against ex-ante contracting risks (e.g. financial health of the applicant, threat of technical failure, overseas exploitation etc)?	Number of projects failing due diligence and reason	X		X	X			X				
	Are the timescales between application and contract award appropriate?	Time from award (provisional email notification) to Grant Offer Letter (GOL) issued Alternatively: Application deadline to issuing GOLs			X					X			
	Does the Grant Offer Letter provide sufficient contractual leverage to ensure that the delivery		X		X	X				X			

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	of projects align with their original aims and objectives?												
	Does the Grant Offer Letter provide sufficient flexibility to support successful delivery of projects under conditions of uncertain outcomes of Innovation projects?		X		X	X				X			
	Are processes for agreeing changes to the Grant Offer Letter standardised and proportionate?	Time taken to make decisions on change requests			X	X				X			
	For projects closed early, could the risks be identified during the application process?		X		X	X		X					
	Incubation support												
	Are incubation support plans sufficiently tailored to the commercialisation support needs of companies? Is the incubation support process sufficiently flexible to allow changes in direction if needed and are companies able to take a lead in receiving the support?		X		X		X		X	X			

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	Is the breadth innovation support available through the programme sufficient to meet applicants' needs? Are there any gaps?		X		X		X		X			X	
	Do delivery partners or external subcontractors have sufficient capacity to deliver required support?						X			X			
	Is provision of incubation support of sufficient quality to have a material impact on the probability of commercialisation?				X		X			X			X
	Do beneficiaries engage positively with incubation support? Do beneficiaries act on the advice and support received through programme?				X		X			X	X		
	To what extent is Incubation Support reporting part of the due diligence and monitoring processes and does this lead to any potential duplication of effort?			X	X	X	X						
	Project monitoring												

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	Does project monitoring provide an adequate framework for understanding the progress of projects towards their objective and enable early identification of any possible issues/threats to delivery and subsequent commercialisation?	Number of cases where issues were identified		X	X	X							
	Do the MOs have sufficient time, skills, expertise and resources to carry out the monitoring effectively?				X			X					
	Are the costs incurred by grant recipients in complying with monitoring requirements proportionate?			X	X	X				X			
	Does the commercial progress record capture all relevant information upon completion of the grant project?	Completeness and accuracy of forms returned		X	X	X							
	How effectively does information on the performance of successful applicants feed directly back into the selection process for future rounds?	n. of applications identified as risks based on project delivery issues		X	X	X							

Process and objective	Process evaluation question	KPI/metric	Data source										
					Primary research - Interviews								
			Document review	Analysis of MI	Programme team	Monitoring Officers	Providers of incubation support	Assessors	Policy stakeholders	Successful applicants	Sector representatives	Clean tech investors/VC funds	Unsuccessful applicants
	Does aggregate programme monitoring feed back into the delivery of the programme?	Balance of portfolio in latter phases		X	X	X							
	How aligned are all the different monitoring processes? (e.g. KPI collection, quarterly reporting and comms with incubation managers.) How aligned are DESNZ and CLT in carrying out programme monitoring (in terms of coordination and communication of responsibilities to supported companies)?		X		X	X	X			X			

3. Data collection

This section describes the approaches used to collect the data which underpins the evaluation. Both primary and secondary data sources were used. The reasons for using the data, a description of the data and any caveats for the use of each data source are presented in this section.

This section includes a description of data collection with successful EEF applicants and declined applicants. In total, there were 894 applications for support from the EEF programme (phases 1 – 7), of which 156 applications were successful (739 declined applications). The 156 successful applications covered 133 individual firms, with a small number of firms (15 firms) were successful with multiple applications to the EEF programme.

3.1 Qualitative interviews with EEF applicants

3.1.1 Aims of interviews

The aim of the interviews with applicants was to provide the primary source of information for the impact evaluation and the process evaluation.

To ensure that the interviews made the most efficient use of participants' time, interviewers undertook a programme of preparatory work. This involved a review of the project application, the number and value of publicly funded projects the company has accessed (using Gateway to research and other DESNZ funding schemes), the value of any private funding the company had raised (using Beauhurst records), the company website, a wider contextual review of the technology area, and, for EEF participants, a review of project documentation (monitoring and incubation documents and the Commercial Progress Record, CPR). The findings from this preparatory work were presented back to the interviewee, to ask if they felt it accurately reflected the situation of their company/project.

Additionally, the Management Information (MI) collected (see Section 3.4) provides information about participating projects (and declined applicants) at the point of application, and for EEF participants the point at which the project was completed. The interviews aimed to provide updated information (and for EEF participants three data points) about the progress their project / company had made.

3.1.2 Sampling and achieved sample

The evaluation plan aimed to consult with 195 EEF applicants, of which 120 were to be EEF participants and 75 declined applicants. In total, the research team undertook 167 depth interviews. Three applicants declined to take part in an interview but provided some form of written feedback (these responses are not included in the table below). The table below provides a description of the sample achieved:

Table 3.1: Target and achieved sample for stakeholder interviews

Type of applicant	Target sample	Available sample	Achieved sample	Response rate
EEF participant	120	131[18]	101	77%
Declined applicant	75	160	66	41%

The main challenges in arranging the interviews with EEF participants were:

- **Making contact with an appropriate individual.** Many of the businesses had their last involvement with the EEF programme up to six years ago. In that time, there has been staff turnover, structural changes within businesses and some businesses have ceased to exist. This meant that the named contact for the EEF participant and the contact details were not always accurate for the current business. The research team made extensive attempts to make contact with all participating companies where the initial contact details did not work, including contacting other named individuals in the EEF application records, making contact using the main telephone number / general email enquiry addresses for the businesses, making contact via the incubation delivery team and making contact with named individuals on LinkedIn. However, in 27 cases, an appropriate contact could not be found, or the company failed to respond to the multiple requests to take part in the research.
- **A small number of EEF participants did not provide their consent** to take part in the research (three participants), but this was not a concerning issue for the research.
- **The Covid-19 pandemic did** present some challenges in arranging interviews, as businesses were often not working at their main premises (or not working) and therefore could not be contacted, or the pandemic had presented challenges to their working arrangements, meaning that they did not have time to take part in the research.

It proved more challenging to make contact with declined applicants. This would be expected, as the declined applicants had not received any support from the programme. As with the EEF participants, there was a challenge with staff turnover and finding a suitable contact, but there was a more distinct problem with businesses declining to take part in the research (20 businesses refused to take part despite contact details being correct).

3.1.3 Topics covered

The interviews with EEF applicants aimed to explore the additional impact of the programme and what has worked well and less well. The interview topics are summarised in the table below. The topic guide used for the interviews is presented in full in Section 6.

[18] Information was provided by the incubation support manager that two businesses that had received support (out of the total 133 which received support) should not be approached for the research.

Table 3.2: Topics covered in depth interviews with all applicants

Outcomes		Contextual factors	Process / mechanism
Project level	**Applicant level**		
– Project origins – Innovation / technology type – Previous project funding / other funding avenues explored – Incubation support received* – Project spending (to the end of the – EEF funded project and beyond) – New relationships formed / collaboration – Subsequent funding – TRL – CRL – Resolution of business model issues – Exploitation effort – Technology impact on environmental outcomes (e.g. energy saved, energy production efficiencies etc.) – Commercialisation outcomes (e.g. product launches, licencing, company sale, product sales)	– Company valuation – Turnover (at application, end of project, current) – Profit – Innovation project count, employment & spending – Overall employment (at application, end of project, current) – New knowledge and skills – Knowledge spill-overs	– Government policies – Access to suitable workers from the local labour market – Ability to compete in the labour market – Emergence of competitors and competitive threats – Collaborations – Availability of parallel programmes – Barriers to entry – Investment landscape – Skills and capabilities at baseline – Robustness to covid-19 disruption	– Advertising and awareness raising – Application and assessment process – Post award mechanisms* – Provision of grant funding* – Ability to recruit additional innovation workers – Knowledge and skills acquired through delivery – Incubation planning* – Incubation support delivery* – Decisions as to whether to proceed with the project – Applications for further public funding – Applications for private funding – Licencing agreements – Scale up of production – Demonstration effects / crowding in for cleantech investment – Development of business/manufacturing plans – Circulation of workers – Broader applications of knowledge

* indicates topics only covered with successful applicants

The main challenge in collecting information from the interviews was interviewee recall, which was an anticipated risk due to some of the applications being up to eight years prior to the interview taking place. Therefore, when the interview was being arranged, an email was sent to the applicant detailing the name and date of the application their company had submitted, the value of the application, the topics that would be covered in the interview and where the applicant could access this information. Where the interviewee was the person named in the application form (and when requested), the research team would share the application document. Despite these measures, in many interviews, interviewee recall was a problem – as there were a number of questions which did not involve information that could be accessed from a document, and in some cases the interviewee had not accessed the information described in the email prior to the interview.

3.2 Qualitative interviews with programme stakeholders

3.2.1 Aims of interviews

The aim of the stakeholder interviews was to provide evidence for the process evaluation and explanations and views for the patterns observed in the Management Information. The stakeholder interviews also aimed to collect information about some of the anticipated benefits of the programme which did not relate to the successful applicants (for example spill-over benefits). Interviews with i.e. policy officials that may benefit from the information and knowledge generated in the delivery of the programme, and the investment community (e.g. VC funds with a track record or interest in investing in clean technologies) were used to collect evidence of these benefits.

3.2.2 Sampling and achieved sample

The evaluation plan aimed to consult with 20 stakeholders. In total, the research consulted with 18 individuals, as set out in the table below:

Table 3.3: Target and achieved sample for stakeholder interviews[19]

Type of stakeholder	Target sample	Achieved sample
Policy stakeholders (internal and external)	3	2
Programme management (internal)	3	5
Assessment and monitoring (internal)	5	5
Incubation delivery (internal)	4	4
Financial sector (internal and external)	4	2

[19] Internal interviewees relate to those directly involved in the delivery of the programme; external interviewees relate to those who were not involved in the delivery of the programme.

3.2.3 Topics covered

The detailed topic guides used in the qualitative interviews with programme stakeholders is presented in Section 6 of this Annex. The topics covered in the interviews were:

- The strategic case for the EEF programme, including why the fund was necessary and how it aligned with Government policies and other interventions;
- The competition design;
- The scope and communication of the programme;
- The application and assessment process;
- Contracting and due diligence;
- Project delivery and incubation support;
- Monitoring; and
- Policy lessons and spill-overs.

3.3 Case study research

3.3.1 Aims of the case study research

The aim of the case study research was to enrich the findings from the qualitative interviews with EEF applicants to provide evidence for the impact evaluation. In particular, the case study research explored the commercial and environmental impacts of the programme, to gain a better understanding of how these were achieved.

3.3.2 Sample and achieved sample

The case studies were sampled to focus on examples of outlying success. In practice, this meant EEF projects which were identified as having achieved commercial outcomes or that had experienced a large increase in their commercial readiness level. The sample was selected using the information collected in the qualitative interviews. A long list of 28 projects were identified by the research team and agreed with DESNZ, which included a primary list of 15 projects and a reserve list of 13 projects. The sample was spread across all EEF phases and different technology areas. In practice the research team reached out to all 28 projects. The target sample for the case studies was to complete case studies with fifteen projects – in practice it was only possible to complete case studies with nine projects.

The case study research involved an enhanced documentation review (reviewing all the documents available for a project in the Programme MI, exploring the firms website and any other online material), and further qualitative interviews with staff who worked on the research project, collaborators, new relationships formed through the EEF, and end users of the technology.

The main challenges in completing the interviews was identifying and securing the right people to interview. Most projects contacted either did not respond to the request to take part in the case study research or stated that they did not want to take part. One reason for this was because all of the projects contacted as part of the case study research had already completed an extensive qualitative interview about their EEF project, so there will have been an element of research fatigue. Additionally, the research team were asking projects to provide contact details for other individuals involved with their technology, or their customers. Some projects were uncomfortable in asking their associates and customers, who did not receive any EEF support, to take part in research on their behalf. Finally, the case study research was undertaken during the second national lockdown due to the covid-19 pandemic, and some firms felt that this was too difficult a time to participate in research.

3.3.3 Topics covered

The detailed topic guides used in the case study interviews is presented in Section 6 of this Annex. The topics covered in the interviews were:

- Project delivery;
- Commercial outcomes;
- Environmental outcomes; and
- Knowledge sharing outcomes;

3.4 Programme management information

3.4.1 Aims of data collected

The EEF programme has collected a large amount of programme management information. The aim of utilising and analysing the programme MI was to identify some of the gross impacts of the programme and to provide metrics to assess the efficiency of the processes used in the programme. It was also used to provide information to be used in the primary research with applicants (see Section 3.1) and to link information to secondary datasets (see Section 3.4).

3.4.2 Topics covered

The main sources of EEF programme MI, the topics they cover and the use in the evaluation is presented in the table below.

Table 3.4: Management Information used in the evaluation

Data source	Description	Use	Coverage
EEF Applications	The full application for EEF participation, and information taken from these. This included lead contact information, answers to all EEF application questions, commercial/technical appendices and funding requirements by participant type and location.	Source of probes to explore during qualitative interviews / case study research, assessment of processes used.	All application forms received for Phases 2 – 7. Incomplete coverage of application forms for Phase 1, but complete coverage for EEF participants.
Technical Assessment scores	Summary of the scores assigned to each application through the technical assessment process.	Selection of counterfactual cases for econometric analysis, selection of sample for qualitative interviews, assessment of processes used.	Information available for 740 applications – partial information for Phase 1.
Commercial panel scoring	Summary of the results from the two stages of the commercial panel scoring and recommendations for funding.	Selection of counterfactual cases for econometric analysis, assessment of processes used	Information available for phases 2, 3 and 5, 6, and 7. Not available for Phases 1 and 4.
Incubation support delivered	Summary documents of the incubation support which has been delivered to projects, the organisation responsible for delivering the task, timings of when support is delivered and whether the support is complete / in progress.	Source of probes to explore during qualitative interviews / case study research. Use in analysis of outcomes achieved.	Information available for all participating projects.
Project Monitoring	Project monitoring data which provides information about project performance, key achievements, progress, timelines etc.	Source of probes to explore during qualitative interviews / case study research.	Summary project monitoring reports per month and per quarter available to the research team for all participants.

Commercial Progress Record	The Commercial Progress Record (CPR) is the key source of Monitoring Information for the outcomes achieved, providing information on changes in TRL, employment, output, funding raised (both public and private), licencing agreements, other key outcomes and project expenditure. This provides a picture of these outcomes at the end of the project (a snapshot).	Provides evidence of gross outcomes achieved by the project, but does not provide any measure of additional (net) achievement. Source of probes to explore during qualitative interviews / case study research.	Received 85 CPRs.[20] Many projects in later phases are still delivering, therefore no CPR has been completed.

In addition to the programme MI, SICE have nine Key Performance Indicators (KPIs) against which the success of programmes in the Energy Innovation Portfolio are measured (the EEF is in the Energy Innovation Portfolio). These KPIs are presented in the table below, including the stage of the EEF.

Table 3.5: SICE KPIs

KPI number	KPI metric	Stage of the EEF
KPI 1	Number of Energy Innovation projects supported- completed	Output
KPI 2	Number of projects that have successfully met objectives	Output
KPI 3	Number (and size) of SMEs supported in Low Carbon projects	Output
KPI 4	Number of Business relationships and Collaborations supported - overall and new	Output
KPI 5	Advancement of Low Carbon Projects- Technology Readiness Levels	Outcome
KPI 6i	Initial Financial Leverage from the private sector	Outcome
KPI 6ii	Follow-on Funding	Outcome
KPI 7i	A. Cheaper Energy- Reducing the Unit Cost of Energy	Impact
	B. Cheaper Energy- Reducing the Unit Cost of Energy- Potential	Impact
KPI 7ii	A. Increase in energy efficiency. Reduced energy demand	Impact
	B. Increase in energy efficiency. Reduced energy demand- Potential	Impact
KPI 8	Number of products (and services) sold in UK and Internationally	Impact

[20] The completion of CPRs was not compulsory for EEF phases 1 – 4, therefore CPRs are not available for all projects in EEF phases 1 - 4

KPI 9	Reduction in Carbon Emissions- Potential	Impact

Over the summer of 2020, DESNZ collected data to measure all the SICE KPIs across all Energy Investment Portfolio projects. This included all EEF phase 5 to 7 projects. The data collection of the KPI metrics provided consistent evidence for the environmental impacts of the EEF. The data collected for the SICE KPIs was made available to the research team and was utilised in the analysis.

However, the KPI data only covers EEF projects from phase 5 onwards, and did not provide any evidence for projects from phase 1 to 4, or any impacts from projects which were unsuccessful in their application for EEF support. Therefore, the research team explored these topics in the qualitative interviews.

3.5 Secondary data sources and data-linking

3.5.1 Aims of using secondary data sources

The reasons for using the secondary datasets for the analysis was primarily to provide objective, verified data for the commercial and funding outcomes for a large number of EEF participants and declined applicants. Additionally, the secondary datasets provide data for applicants over many years (rather than the observations at the point of application and at the end of the project/current observations) collected in the programme Management Information and qualitative interviews. The inclusion of a large number of applicants allows more robust statistical analysis to be undertaken, and the enhanced number of data points allows the analysis to explore changes in outcomes over time.

In order to fully utilise the secondary data sets, information from the Management Information needed to be matched to each secondary data set.

Monitoring data was available for 671 firms making at least one application to the programme. This information provided the following details about the firm making the application and their proposed R&D projects:

- Companies House Reference Number
- Technological maturity at the point of application reported against the Technology Readiness Levels (TRL) – a nine-point scale describing the proximity of the project to market. This information was for 693 of 868 applications (80 percent) and was self-reported by the applicant. The depth interviews completed as part of the wider evaluation indicated that TRLs were not always consistently reported by applicants and are subject to some measurement error. The majority of missing data related to Phase One applications.
- Technology area – projects were categorised into three technology areas using data provided in the Management Information: energy supply, energy demand and other (covering wide mix of other technology types, such as manufacturing materials and

transport)[21]. These groupings were chosen to maximise sample sizes in each. Data was available for 747 of 868 applications (86 percent). Energy supply projects accounted for 414 of these 747 (55 percent), energy demand 203 of 747 (27 percent), and 'other' covering the remaining 130 of 747 (17 percent).

- Technical assessment score – the score awarded to the application in the technical assessment, to provide a measure of the quality of project proposals. This was available for 702 of 868 cases (81 percent). Most missing data related to Phase One, where only 54 of 196 applications had a valid score (28 percent).

Most firms (573 of 671) made one application to the programme, whilst 98 firms made multiple applications. Project level data was converted to firm level data by:

- Technological maturity: The TRL level variable took the value of the most recent application for each year in the data. Where the year was earlier than any application the value was taken to be equal to that for the first application.
- Technology area of the project: Firms were tagged as having submitted an application under each of the categories described above in turn. This resulted in three dummy variables for each firm. Technical assessment score: As with the TRL level, a variable was generated that took the value of the technical score for the most recent application for each year in the data. Where the year was earlier than any application the value of this variable was set to the score for the first application.

3.5.2 Beauhurst data

The Beauhurst data platform compiles records of disclosed private investments made by angel investors and VC funds. These records were used to provide details of equity investments attracted by the firms before and after their application to the programme and their valuations where available. An assumption was made that any firm not tracked by the platform did not attract any equity investment over the period. The level of applicant coverage in Beauhurst is 38 percent.

Pitchbook data

The Pitchbook data platform compiles similar data to Beauhurst. A comparison between the two datasets suggested they provided differential coverage of deals (and sometimes reported different values for deals recorded in both datasets). A detailed analysis of Beauhurst and Pitchbook data, along with data collected from company websites and interviews with EEF participants indicated that the Beauhurst dataset provided more accurate information about this business population. Therefore, the primary analysis presented in this paper uses Beauhurst data. However, the research team have also undertaken analysis using the Pitchbook data. This is because Pitchbook records capital raised through IPOs or 2POs which Beauhurst does not (although for this business population this is not particularly problematic, due to the infrequency of these forms of fund raising being used). The Pitchbook analysis has been

[21] There were a total of seven clean technology categories in the programme MI – these were: Energy Supply, Energy Demand, Manufacture Industrial, Materials, Transportation, Recycling, Water and Waste and Other. In order to have sufficiently large groups for the statistical analysis, the last five groups were combined.

undertaken to provide additional robustness to the findings, to show any conclusions from the analysis are not due to the choice of dataset. The level of applicant coverage in Pitchbook is 39 percent.

3.5.3 Innovate UK data

Innovate UK Transparency Data provides records of all awards made by Innovate UK since 2004. This data was used to partially control for the effects of other public R&D grants attracted by applicants on the outcomes of interest. 38 percent of the EEF applicants were included in the Innovate UK dataset. Where applicants were not included in the dataset, they were assumed not to have secured Innovate UK grant funding.

3.5.4 Office for National Statistics Secure Research Service data

Datasets held within the ONS Secure Research Service (SRS) as part of the ONS Approved Researcher Scheme were explored for this evaluation. Four datasets were identified as including data which was useful for the evaluation of the EEF programme. These were:

- Business Expenditure on Research and Development (BERD)
- Annual Business Survey (ABS)
- Annual Survey of Hours and Earnings (ASHE)
- Business Structure Database (BSD)

A total of 559 firms applying for EEF funding were linked to the Interdepartmental Business Register (IDBR) enterprise references from a population of 671 (an 83 percent match rate). In total, 428 of matched firms (77 percent) were declined funding while 131 were awarded funding at least once (23 percent). The IDBR enterprise references are common across the ONS datasets described in the table below.

Matching rates to the datasets used in the analysis are reported in the following table. It should be noted that there was insufficient coverage of firms in the Annual Business Survey and the Annual Survey of Hours and Earnings to support the statistical analyses undertaken. All financial variables were adjusted using the GDP deflator to give values in 2019 prices.

Table 3.6: Overview of ONS datasets used in the analysis

Dataset	Timespan	Matching rate (%)
Business Expenditure on Research & Development (BERD): This is an annual survey of panel of known R&D performers and a random probability survey of firms and their expenditure on research activities by type and sector.	2010-18	30
Annual Business Survey (ABS): The ABS is a mandatory survey of large firms (with 250 employees or more) and a sample survey of small and medium sized firms. The survey is used by ONS to generate estimates of total output (GVA) in the economy and other macro-economic aggregates.	2010-18	16

Annual Survey of Hours and Earnings (ASHE): This survey gives data on the levels, distribution and make-up or earnings and hours worked for UK employees and can be linked to business level data. The data includes a panel of workers whose wages are tracked each year.	2010-18	9
Business Structure Database (BSD): This dataset provides annual data on employment and turnover for all firms registered for VAT or PAYE. Data is provided with different lags and is recorded as and when it arrives. This study considers awards made since 2013, and issues with lags may be less significant. However, there remains a risk recent effects on turnover or employment are not visible.	2010-18	83

4. Analysis and synthesis of the evidence

This section provides a description of how the data that has been collected was analysed to provide the evaluation findings. It includes a description of the Qualitative Comparative Analysis, the thematic analysis, the quasi-experimental analysis and the economic analysis. It also presents the key challenges and caveats to the approaches taken.

4.1 Qualitative Comparative Analysis

4.1.1 Aims of analysis

Qualitative Comparative Analysis (QCA) bridges qualitative and quantitative analysis. It provides a systematic approach for establishing causality using qualitative case study data where there is variability between cases and complex causation or equifinality, i.e. there is more than one way in which an outcome can happen.[22] These represent different causal pathways or different configurations of causal conditions that are capable of generating the same outcome. As such, QCA involves identifying conditions within and across cases to examine cross-case patterns and examines configurations of multiple causal conditions, not just single causes.

The aim of the QCA work undertaken was to establish the causal factors which contribute to EEF applicants achieving a particular outcome. In particular, it was used to establish which contextual factors and mechanisms contributed to EEF applicants achieving the following six outcomes:

- An increase in R&D activity;
- An improvement in the level of technological readiness;
- An improvement in the level of commercial readiness;
- Successfully raising finance (either public or private) to further develop their technology after applying to the EEF;
- Achieving a commercial outcome; and
- An increase in economic output (defined as turnover or employment)

4.1.2 Data used

The data used for the QCA is the coded information collected from the depth qualitative interviews with EEF applicants. Where feasible, this data has been strengthened with the information provided in Management Information (the project applications and CPR reports) and secondary data sources (Beauhurst financial data).

[22] Equifinal can mean: 1. Different conditions can produce the same outcome2. The same conditions can produce different outcomes

A coding frame for the qualitative information was developed based on the highly structured topic guide used for the depth interviews with EEF applicants. The coding frame was reviewed by DESNZ and amended to incorporate more detailed 'nodes'. In a small number of cases, the research team were required to make a judgement on how to code an individual response – for example, the topic guide asked implicit questions about an innovation's commercial and technology readiness. In these cases, researchers used the following CRL and TRL scales.

Table 4.1: TRL scale used for coding framework

TRL	Description
3	Specifying and developing an experimental Proof of concept (PoC)
4	Proof of concept (PoC) demonstrated in test site/initial evaluation of costs and efficiency produced
5	Technology/process validated in relevant environment
6	Technology/process validated in operational environment
7	System complete and qualified
8	Product/technology in manufacture/process being implemented
9	Product/service on commercial release/process deployed

Table 4.2: CRL scale used for coding framework

TRL	Description
1	Knowledge of applications, use-cases and market constraints is limited and incidental, or has yet to be obtained at all.
2	A cursory familiarity with potential applications, markets and existing competitive technologies/products exists. Market research is derived primarily from secondary sources. Product ideas based on the new technology exist but are speculative and unvalidated.
3	More developed understanding potential applications, use-cases, market requirements/constraints and familiarity with competitive technologies. One or more 'strawman' product hypotheses are created, and iteratively refined based on data from further technology or market analysis.
4	A primary product hypothesis is identified and refined through additional technology-product-market analysis and discussions with potential customers and users. Technology and product attributes are mapped against market needs to highlight clear value proposition. Basic competitor analysis is carried out to illustrate unique advantages of technology. Potential suppliers, partners and customers are mapped in an initial value-chain analysis. Certification or regulatory requirements are identified.
5	Deep understanding of target application and market is achieved and the product is defined. Comprehensive cost-performance model is created to validate the value proposition and provide detailed understanding of design trade-offs. Relationships are established with potential suppliers, partners and customers, who provide inputs on market requirements and product definition. Comprehensive competitive analysis carried out. Financial model built with short/long term sales projections, costs and margins.

6	Market/customer needs and translation to product needs are defined and documented. Product design optimisation is carried out considering market and product requirements, cost/performance trade offs, manufacturing trade-offs etc. Partnerships are formed with key stakeholders across the value chain and certification requirements are well understood and steps for compliance underway.
7	Product design is complete. Supply and customer agreements are in place and all stakeholders are involved in product/process qualifications. Certifications obtained.
8	Customer qualifications are complete. Initial products are manufactured and sold. Commercialisation readiness matures to support larger scale production and sales.
9	Widespread deployment is achieved.

Source: Darpa CRL scale

The coding frame was imported into the NVivio software and piloted on a small number of interviews. Feedback from the coding team informed a small number of refinements and ensured consistent coding across team members. The individual codes included a range of agreed sub-categories (or nodes) that were adjusted as the research team became more familiar with the data. This iterative approach ensures that the depth of detail provided by interviewees could be effectively captured and used for the thematic, econometric and QCA analysis. The table below summarises the coding framework that was used for the applicant interviews:

Table 4.3: Coding framework

Question	Codes (bold) and sub-themes (non-bold)
Project background (EEF participants and declined applicants)	
Q1: I would like to start the interviewer just by confirming our understanding of your company and its activities at the point of your successful application for EEF	– **Sector:** Energy generation, energy infrastructure, energy storage, energy fuels, energy demand (efficiency buildings), energy demand (efficiency applications), manufacturing process, manufacturing packaging, manufacturing methods, materials (advance composites), materials (biomaterials), materials (nanomaterials), materials (solvents and lubricants), materials (construction), electric vehicle hybrid drives, efficient vehicles, transportation infrastructure, recycling water, recycling waste treatment other. – **Pre-EEF funding source (before first application):** equity (angel), equity (VC), equity (raised on public markets) commercial bank loan, public grant, other, no funding pre-EEF – **Pre-EEF size (TO):** pre-revenue, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+ – **Pre-EEF size (FTE):** 0-10, 11-50, 51-100, 100-249, 250+ – **Pre-EEF business maturity:** Pre-startup, Startup (under 1 year), 1-5 years, 5-10 years, 10+ years – **Pre-EEF location:** South East, South West, London, North West, North East, East of England, West Midlands, East Midlands, Yorkshire & the Humber, Wales, Scotland, Northern Ireland. – **Pre-EEF R&D spend:** none, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+ – **Pre-EEF no. of R&D employees:** none, 1-4, 5-9, 10-19, 20+
Q2: Can you briefly describe the background for the technology or innovation forming the focus of your application to EEF up until you received EEF funding?	– **TRL level:** 3,4,5,6,7,8 – **Origins of technology:** University research; Industrial research; Customer feedback; Other – **Prior work on tech/innov:** Technology formulated – concept and application established; Prototype – tested in laboratory environment; Prototype – tested in an operational environment; Demonstrator – operating in an operational environment at a pre-commercial scale; customers identified; Other – Policy / regulation impact on tech development – **Tests on prototypes:** laboratory test of individual components; laboratory tests of integrated system; test in relevant environment of individual components; test in relevant environment of integrated system; test in operational environment of individual components; test in operational environment of integrated system – **External partners involved pre-EEF:** University, research organisation, large-scale industrial partner, SMEs, Other

Question	Codes (bold) and sub-themes (non-bold)
	– Role of external partners: – **IP rights pre-EEF:** applied for IP rights; secured IP rights; applied, unsuccessfully; not applied; not relevant – **Dependency on IP from others:** yes; no
Q3: What was the original commercial opportunity associated with the technology or innovation?	– **CRL level:** 1,2,3,4,5,6,7,8,9 – Problem seeking to address – How did you expect to generate revenues with tech/innov? – What market research had been undertaken? – **Had regulatory requirements / certification requirements been met?** Yes; no – but aware of requirements; no – not aware of requirements; other – **Had relationships for the tech/innov been developed?** No; Yes, delivery/development partners; Yes, supply chain/production partners; Yes, customers; Yes, other; Other – **Did you have plans in place to produce the technology for the market?** No plans; Yes – plans but no formal agreements; Yes – formal agreements for manufacturing plans with external supplier (UK); Yes – formal agreements for manufacturing plans with external supplier (overseas); Yes – internal plans to manufacture product; Other – **Had you scoped the competitive landscape?** No; Yes, aware of competitors with similar products; Yes, unaware of competitors with similar product; Other
Q4: What was the aim of your project?	Project aim
Q5: What attempts were made to fund this project prior to your application to EEF?	– **Funding sought for EEF project:** internal budget; equity; public grants; EEF; bank loan; not sought, other – **Timing of EEF application:** first funding application, last funding application; applied for EEF in tandem with other sources, no other funding sought, other – **Outcomes of other funding efforts:** successful, unsuccessful, n/a – no funding sought – **If unsuccessful, why?:** too risky, poor alignment to funding scheme, skills gaps, limited resource, poor value for money, technology not viable, other – **If no attempts to seek private funding, why not?:** perceived as too risky; reluctance to sell equity; other
Application for EEF support (both EEF participants and declined applicants)	

Question	Codes (bold) and sub-themes (non-bold)
Q6: How did first you first find out about the EEF?	– **Referral to EEF source:** marketing events, sector body, business network, social media, regional organisation (e.g. Growth Hub), peers, word of mouth, other, no recollection – **Engagement with EEF materials prior to application:** yes, no – **Quality of info received:** sufficiently clear, good but would have valued more detail, insufficient amount of information provided, no recollection – **Changes between EEF applications:** yes, no – Improvements to information provided
Q7: Why did you apply for EEF support?	– **Motivating factors:** competition theme, level of funding available, provision of grant, provision of incubation support, combination of grant and incubation, application process, level of competition for funding, likelihood of success, initial EOI process, other – Importance of factors: Most important factor for application – Change between EEF applications – **Match funding at application stage:** yes; no – not possible until successful, no – other
Q8: What are your views on the application process for EEF?	– **Quality of application materials:** easy to access, easy to understand, relevant information provided, pre-application support from EEF team to resolve issues, no recollection, difficult to access, difficult to understand, relevant information not provided, other (positive), other (negative, other (neutral) – **Appropriateness of information required:** appropriate, inappropriate; no recollection – Labour input to application (Days) – **External support:** yes, no – Cost of external support: (£) – Changes between EEF applications – **Timings of application:** application window sufficient to prepare application; application window longer than required to prepare application; application window too short; timing of the round was aligned to private investment rounds; timing of the round was not aligned to private investment rounds; timing of the round did not have an impact on securing match funding; other; no recollection
Q9 (unsuccessful) What feedback did you receive on your application?	– **What type of feedback did you receive?** None; written; verbal; written and verbal; other – **Did the feedback provide useful insights into the future development of your project? Yes** – technical improvements; Yes, team improvements; Yes, project management improvements; Yes, financial improvements; Yes, other improvements; No; Other

Question	Codes (bold) and sub-themes (non-bold)
	– **Have you been able to utilise the feedback given in any future applications for funding?** Yes/no – What improvements could be made to the feedback provided?
Q9 (successful): What are your views on the post-award process of agreeing the Grant Offer Letter and the terms of receiving support?	– **Were the due diligence requirements proportionate to the level of support being offered?** Yes/no – **What were the challenges faced in agreeing the GoL and Annex 2 for the project?** milestones, expectations, payment agreements, other – What were the challenges faced in the Due Diligence process? – Terms and Conditions challenges – Panel / planning session issues – Resolutions to challenges: what were they; who was involved; timings to resolve challenges – Timescales to award: quicker than expected; as expected; slower than anticipated but no impact on project; slower than anticipated and impacted project – Impact of timing on project: – Contributing factors to delays – Changes between EEF applications
Incubation support (EEF participants only)	
Q10 How did you agree project incubation plans with the incubation planner?	– **Incubation support activities received:** Market support activities, Business development and sales, strategy and business planning, technology, product, supply chain and operations, team, fund raising, other – **View of incubation support prior to meeting:** very important, quite important; neutral, fairly unimportant, very unimportant, no recollection – **Did their view of incubation support improve?** Yes, no – met expectations, no – did not meet expectations – **Anticipated benefits of incubation support:** improved understanding of commercialisation, improved business plans, customers identified, mentoring, marketing strategy, Other – Incubation support meeting: partners involved; evidence requirements; timing – **Suitability of incubation manager:** very well matched, quite well matched, neutral, not very well matched, not at all matched – **Suitability of support to business needs:** very well matched, quite well matched, neutral, not very well matched, not at all matched

Question	Codes (bold) and sub-themes (non-bold)
	– **Gaps in support provided:** yes, no – Type of gap: – Changes between EEF applications – **Any improvements to the incubation planning process**: timings, planning meeting, assessment, matching with incubation, support provided
Q11: How was / is the incubation support managed?	– **Frequency of contact:** weekly, fortnightly, quarterly, twice a year or less, Other – **Quality of contact:** met expectations, did not meet expectations – **Changes to support needs:** yes – needs change, no – no change – **If changed, was the support flexible**? Yes, no – Improvements to management: management, frequency of contact, flexibility, capacity other.
Q12 How did / does the incubation support the development of your project and / or business	– **Market analysis:** yes, no – **Deeper understanding of commercialisation:** yes – trials, yes – supply chain, yes- certification/ regulatory requirements, yes – validation of technology, yes – IP issues, No – **Changed project plans:** yes, no – **Mapping of customers / supplier / partners:** yes, no – **Skills requirement:** yes, no – **Prep for external investment:** yes, no – Changes between EEF applications – Improvements to incubation support
Q13 What are your views on the quality of the incubation activities you received?	– Strengths of incubation support – Weaknesses of incubation support – Availability of comparable support available outside of EEF – **Willingness to access support in absence of EEF:** yes, no – Reason for willingness to access
Delivery of EEF project	

Question	Codes (bold) and sub-themes (non-bold)
Q14: Which elements have been executed so far within the work programme and how far is this aligned to expectations?	– **EEF workplan:** tests completed in lab, test completed in a relevant environment setting outside of lab, tests completed in operational environment – **Resourcing:** recruited R&D or other workers, reduced investment in parallel projects, no additional resources required – **Challenges:** access to infrastructure / facilities, regulatory issues, changes in policy, issues in the design of the programme, COVID-19 (labour issues, social distancing, availability of tech), anticipated future challenges for ongoing delivery, available resource other – **Gaps in basic science:** availability of appropriate tools / methodologies, other – **Critical skills gaps:** yes – skills, yes – capacity, yes – other, no – **How challenges were overcome:** changes to project plan, inclusion of new partners, recruitment efforts, subcontractors, MO support, additional finance, Other – Views of Monitoring Officer – **Were requirements proportionate?** yes, no – **If disproportionate, which elements:** financial claims; monitoring; KPI reporting; CPR and project closure; survey of impacts – **Changes in Annex 2 request:** yes – changes to milestones / project plan, yes – other – **If changes to Annex 2, was the process proportionate?** Yes, no – **If changes to Annex 2, did changes impact on project delivery?** Yes, no
Q15: What were the key findings of the project(s)?	– **Alignment with expectations:** innovation performed as expected; innovation exceeded expectations; innovation did not meet expectations – **TRL level at the end of the project:** 3,4,5,6,7,8,9 – **Reasons for variance in achievement:** internal – project partnerships, internal – skills gap, internal – test results altered project direction, internal – resource, internal – commercial skills, internal – other, external – change in market, external – availability of facilities / infrastructure, external – other – **Potential to reduce CO2:** tests completed on CO2 – positive, tests completed on CO2- negative, tested yet to be completed, tests not planned, other – Scale of CO2 reduction: – **Potential to reduce energy demand:** tests completed – positive, tests completed, negative, tests yet to be completed, tests not planned, other

Question	Codes (bold) and sub-themes (non-bold)
	– Scale of energy demand reduction: – **Potential to reduce energy costs:** tests completed – positive, tests completed, negative, tests yet to be completed, tests not planned, other – Scale of energy cost reduction: – **Potential to reduce energy flexibility:** tests completed – positive, tests completed, negative, tests yet to be completed, tests not planned, other – Scale of energy flexibility change: – **Applied for new IP:** yes, no – **Skills acquired:** R&D, sales and marketing, project management, technological development, commercialisation, funding and investment requirements, other – **Application of skills:** other internal projects – follow on from EEF project, internal projects - other, other external projects – **Follow-on work internally:** yes – new avenues of inquiry explored, yes – new R&D begun, no – Changes on findings between EEF projects
Q16: Has learning or knowledge generated from the project(s) been used / applied externally (e.g. by Government, academics, other companies)?	– Policy implications – **External application of project findings**: Government, academics, industry, competitors, regulators, public bodies, other – **Usefulness of disseminating findings to DESNZ:** yes – would have supported commercialisation, no – **Learning shared within networks:** academics, supply chain, delivery partners, other businesses, other
Q17: What commercial / funding outcomes did / has the project(s) achieve during project delivery?	– **Sources of additional investment during EEF:** equity (angel), equity (VC), equity (raised on public markets) commercial bank loan, public grant, other – Amount of additional investment during EEF (£) – Use of additional investment in EEF project – Sales achieved to customers – **Location of sales:** UK, EU, rest of world

Question	Codes (bold) and sub-themes (non-bold)
	– **End of EEF project size (TO):** pre-revenue, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+ – **End of EEF project size (FTE):** 0-10, 11-50, 51-100, 100-249, 250+ – **End of EEF project R&D spend:** none, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+ – **End of EEF project no. of R&D employees:** none, 1-4, 5-9, 10-19, 20+ – **Licensed technology:** yes, no
Post-EEF outcomes (EEF participants and declined applicants)	
Q18: Did the evidence produced from your EEF project (s) provide conclusive/sufficient information to support a decision about whether to continue to develop the underlying technology?	– **Progression:** yes – currently progressing, yes – will progress, no – won't progress – **Factors in decision to progress:** results of the EEF project, investment possibilities, market demand, other – Variation in decision-making between rounds
Q19: What funding options were considered to progress the project(s) (or secondary lines of inquiry)?	– **Sources of additional investment post EEF**: equity (angel), equity (VC), equity (raised on public markets) commercial bank loan, public grant, other – Amount of additional investment post EEF: (£) – **Barrier to securing follow-on finance:** technology still too risky, unproven market demand, no sales agreement, lack of resources, lack of commercial maturity, other – COVID-19 challenges – **Role of EEF in securing additional funding:** would not have secured without EEF, would have secured but lower amount / longer time, would have secured the same amount without EEF – Variation of support considered between EEF rounds
Q20: What work has been taken forward to	– **Post-EEF EEF project activity / post application activity**: tests – laboratory / fully controlled setting, tests – relevant environment outside of laboratory, tests – fully operational environment

Question	Codes (bold) and sub-themes (non-bold)
progress the innovation developed in the project?	– **How does the work differ from that outlined in EEF application?** No difference; Difference in technical scope – reduced; Difference in technical scope – enhanced; Difference in timing – later completion than EEF plan; Difference in scale of project – reduced; Difference in scale of project – enhanced; Other – Key barriers faced in delivery of tasks – How have barriers been overcome – **Key evidence produced:** CO2 emissions reduction, reduce demand for energy, improved energy efficiency, reduce energy costs, increase energy system flexibility, other – Scale of environmental impact:
Q12: What were the key findings of the project(s)?	– **Alignment with expectations:** innovation performed as expected; innovation exceeded expectations; innovation did not meet expectations – **TRL at the end of the project:** 3,4,5,6,7,8,9 – **Reasons for variance in achievement:** internal – project partnerships, internal – skills gap, internal – test results altered project direction, internal – resource, internal – commercial skills, internal – other, external – change in market, external – availability of facilities / infrastructure, external – other – **Potential to reduce CO2:** tests completed on CO2 – positive, tests completed on CO2- negative, tested yet to be completed, tests not planned, other – Scale of CO2 reduction: – **Potential to reduce energy demand:** tests completed – positive, tests completed, negative, tests yet to be completed, tests not planned, other – Scale of energy demand reduction: – **Potential to reduce energy costs:** tests completed – positive, tests completed, negative, tests yet to be completed, tests not planned, other – Scale of energy cost reduction: – **Potential to increase energy flexibility:** tests completed – positive, tests completed, negative, tests yet to be completed, tests not planned, other – Scale of energy flexibility change:

Question	Codes (bold) and sub-themes (non-bold)
	– **Applied for new IP:** yes, no – **Skills acquired:** R&D, sales and marketing, project management, technological development, commercialisation, funding and investment requirements, other – **Application of skills:** other internal projects– follow on from EEF project, internal projects - other, other external projects – **Follow-on work internally:** yes – new avenues of inquiry explored, yes – new R&D begun, no – Changes on findings between EEF projects
Q13: Has learning or knowledge generated from the project(s) been used / applied externally (e.g. by Government, academics, other companies)?	– Policy implications – **External application of project findings:** Government, academics, industry, public bodies, other – **Usefulness of disseminating findings to DESNZ:** yes – would have supported commercialisation, no – **Learning shared within networks:** academics, supply chain, delivery partners, other businesses, other
Q21: Since your EEF support, what further work has been taken forward the commercial offer of your innovation?	– **CRL:** 1,2,3,4,5,6,7,8,9 – Changes to commercialisation objectives – **Applied to other DESNZ innovation programmes?** Yes, no – **Applied for other sources of public funding?** Yes, IUK; Yes, H2020; Yes, other; No – unsuccessful applications; No – no applications; no – access private funding, Other – **Is further funding required to develop tech/innov?** Yes/no – **Sources of funding explored?** equity (angel), equity (VC), equity (raised on public markets) commercial bank loan, public grant, other – How did you become aware of these other programmes? – **Market research undertaken:** yes, no – but intend to, no – do not intend to – **Mapping of suppliers / partners / customers completed:** yes, no – but intend to, no – do not intend to – **Certification / regulatory requirements met:** yes, no, N/A

Question	Codes (bold) and sub-themes (non-bold)
	– **Plans to produce technology:** No plans; Yes – plans but no formal agreements; Yes – formal agreements for manufacturing plans with external supplier (UK); Yes – formal agreements for manufacturing plans with external supplier (overseas); Yes – internal plans to manufacture product; Other – **Changes to the landscape for technology:** yes – influenced commercial plans, yes – did not influence commercial plans, no – COVID-19 issues for commercialisation
Q22: Have any sales agreements been reached with potential customers for the technology or innovation?	– **Sales agreements made:** yes, no – Number of sales agreements – **Number of products sold:** UK, outside of UK – **Revenue:** UK customers, non-UK customers – **Sales vs expectations:** sales exceed expectations, sales met expectations, sales have not met expectations, other – **Licensed:** yes, no – Value of licence agreement: (£) – **Role of EEF in achieving outcomes:** would not have occurred without EEF, would have occurred but smaller scale / longer time period, would have secured the same amount without EEF – COVID-19 impact on sales
Q23: Finally, I would just like to understand how your company has grown since your first application to the EEF	– **Post-EEF size (FTE):** 0-10, 11-50, 51-100, 100-249, 250+ – **Post EEF turnover:** pre-revenue, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+ – **Post-EEF location:** South East, South West, London, North West, North East, East of England, West Midlands, East Midlands, Yorkshire & the Humber, Wales, Scotland, Northern Ireland. – **Post-EEF R&D spend:** none, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+ – **Post-EEF no. of R&D employees:** none, 1-4, 5-9, 10-19, 20+ – Impact of COVID

4.1.3 Analytical approach

QCA is an iterative, theory-driven approach, so the conditions being examined should reflect a prior theory about what will contribute to the occurrence of a given outcome. A condition may reflect any aspect of the theory of change i.e. a factor that is expected to cause an outcome. A condition could also reflect one or more project characteristics (e.g. existing IP, TRL level), a wider contextual factor that may have influenced outcomes in some way or the production of specific research outputs. Conditions should also be independent of one another.

The Evaluation Framework section of this report outlines a series of Context-Mechanism-Outcome (CMO) statements that hypothesised the various pathways to the EEF programme generating these outcomes. Each CMO outlined the conditions for project and business characteristics and winder contextual factors.

The Table below presents the variables used in our QCA analysis.

Table 4.4: Variables included in the QCA

Analysis level	Category	1=	0=
Project characteristics	Successful	Project was successful in its EEF application	Project was unsuccessful in its EEF application
	TRL level	Technology moved up the TRL scale by at least one level	Technology did not move up the TRL scale
	CRL level	Technology moved up the CRL scale by at least one level	Technology did not move up the CRL scale
	Issue securing finance for project	Business struggled to secure funding for project prior to application	Business did not struggle to secure funding for project prior to application
	Project performance	Project met expectations	Project did not meet expectations
	Commercial outcomes achieved	Project achieved its commercial outcomes	Project did not achieve its commercial outcomes
Business characteristics	Size (Micro)	Business had 10 employees or less at the time of application	Business had more than 10 employees at the time of application
	Mature	Business had been operating for more than five years	Business had been operating for less than five years
	Significant finance prior to EEF	Business had more than £250k private sector finance prior to EEF	Business had less than £250k private sector finance prior to EEF

	Skills gap	Incubation support identified a skills gap	Incubation support did not identify a skills gap
	Follow on work	Business completed follow on R&D from EEF project	Business did not complete follow on R&D from EEF project
	R&D activity	Business increased R&D spending or employment	Business did not increase R&D spending or employment
Programme characteristics	EEF phase	EEF phases 1-4	EEF phase 5-7
	Suitability of incubation support	Successful applicant reported that the incubation support was well supported to its needs	Successful applicant reported that the incubation support was not well suited to its needs
	Role of EEF in securing finance	EEF support had a positive role in unlocking follow-on finance	EEF did not have a positive role in unlocking follow-on finance

Development and population of truth tables

Binary coding for each condition was undertaken to underpin the analysis. This coding was built-in to the framework used in NVivo to code interview transcripts, and was supplemented with evidence from the Management Information and secondary data sources where data was missing from the qualitative interview dataset. The Excel QCA Add-in was used to undertake the analysis, with a truth table developed for each of the six QCA outcomes to explore all possible configurations for the associated conditions. For each configuration, the truth table was populated with the number of cases where the outcome of interest was either present or absent – each interview transcript is counted only once. In some cases, the configurations will have a consistent occurrence of the outcome (see 'C' in the final column of the table below).

The analysis established whether the condition is necessary or sufficient for an outcome to have been achieved:

- Necessary: A condition is necessary if it is required for an outcome to be achieved but it cannot result in the outcome by itself.
- Sufficient: A condition is sufficient if the outcome will always occur if the condition is present.

The process was completed for each CMO. An example truth table is presented below.

Table 4.5: Variables included in the QCA

Configuration of conditions	Number of cases	Condition A: successful	Condition B: existing IP	Condition C: significant finance prior to EEF	Condition D: Maturity	Consistency

I	10	0	0	0	0	C
II	4	0	0	0	1	C
III	4	0	0	1	0	C
IV	2	0	0	1	1	0
V	3	0	1	0	0	1
VI	2	0	1	1	0	0
VII	11	1	0	0	0	C
VIII	5	1	0	0	1	C
IX	8	1	0	1	0	C
X	4	1	0	1	1	C
XI	1	1	1	0	0	1
XII	2	1	1	0	1	1
XIII	1	1	1	1	0	C
XIV	1	1	1	1	1	1
Total	58					

Calculation of coverage and consistency of configurations

The relative influence of different individual conditions and causal configurations was evaluated in terms of coverage (the percentage of cases they explain) and consistency (the extent to which a configuration is always associated with a given outcome). In the example table above, the right-most column describes the consistency of each configuration: whether all cases with that configuration have one type of outcome (1=outcome present in all cases; 0=outcome absent in all cases), or a mixed outcome (i.e. C= some cases show the outcome while others do not).

Next, the consistency of configurations with mixed outcomes (i.e. anything other than 1 or 0) was improved. This was done either by rejecting cases within an inconsistent configuration because they were outliers (with exceptional circumstances unlikely to be repeated elsewhere) or by introducing an additional condition (column) which distinguishes between those configurations which did lead to the outcome and those which did not.

Minimisation of configurations

The final step involved reducing the number of configurations needed to explain all the outcomes, known as minimisation. An automated algorithm in the QCA Add-in examined the configurations and collapses these until no further reductions are possible. This process identified the QCA specification for each CMO that best explained the occurrence of an outcome. These are detailed in the table below.

Table 4.6: Context-Mechanism-Outcome QCA specifications

	Outcome variable	Conditions
CMO2: Impacts on R&D spending	Increase in R&D: a binary variable that equals 1 if an applicant had experienced an increase in its R&D spending or employment and 0 if an applicant had experienced no change or a decrease in its R&D spending or employment.	Successful: binary variable that equals 1 if an applicant was successful in its EEF application, and 0 if it was unsuccessful. Existing IP: binary variable that equals 1 if an applicant had IP at the time of applying to EEF and 0 if it did not. Significant finance prior to EEF: a binary variable that equals 1 if an applicant had received £250k or more prior to its EEF application, and 0 if it had received less than £250k. Mature: a binary variable that equals 1 if an applicant had been operating for five years or more at the time of applying to EEF, and 0 if it had been operating for less than five years.
CMO3: Impacts on technological development	Change in TRL: a binary variable that equals 1 if an applicant had moved up a level on the TRL scale, and 0 if had not.	Successful Existing IP Significant finance prior to EEF Mature Micro business: binary variable that equals 1 if an applicant had fewer than 10 employees at the point of applying to EEF, and 0 if it had more than 10 employees.
CMO4: Impacts on commercial readiness	Change in CRL: a binary variable that equals 1 if an applicant had moved up a level on the CRL scale, and 0 if had not.	Successful Existing IP Mature Micro business
CMO5: Impact on follow-on investment	Additional funding post EEF: a binary variable that equals 1 if an applicant had received follow-on investment since engaging with EEF, and 0 if it had not.	Successful Existing IP Significant finance prior to EEF Mature Micro business
CMO6: Impacts on commercialisation and adoption	Commercial outcome achieved: a binary variable that equals 1 if an applicant had secured IP, licensed their innovation or reached a sales	Successful Existing IP Significant finance prior to EEF Mature Micro business

	agreement, and 0 if it had not achieved any of the commercial outcomes.	
CMO7: Net economic benefits	Change in employment: binary variable that equals 1 if an applicant had moved up an employment band (0-10, 11-50, 51-100, 100-249, 250+) and 0 if it did not move up an employment band. Change in turnover: binary variable that equals 1 if an applicant had moved up a turnover band (pre-revenue, <£50k, <£100k, <£250k, <£500k, <£1m, £1m+) and 0 if it did not move up a turnover band.	Employment: Successful Existing IP Significant finance prior to EEF Mature Micro business Turnover: Successful Existing IP Significant finance prior to EEF Micro business

4.1.4 Key challenges and caveats

The key challenges faced in undertaking the QCA were:

- **Data completeness:** To undertake QCA all variables that were included in the analysis needed to have data included – any cases where there was a missing variable were excluded from the analysis. This led to a reduction in the number of cases which could be included in the analysis, as not all cases had an entry for every variable, and the pattern of missing variables differed across cases. For some of the outcome variables (whether a commercial outcome had been achieved or whether external finance had been raised), the research team assumed that a missing variable was the equivalent of the outcome not having been achieved, as it was assumed that these points would have been raised by an interviewee if they had been achieved. For other outcomes and explanatory variables, particularly those based on underlying categorical variables, where values were omitted the case was omitted from the analysis.
    - The smaller sample size was not seen as an issue for the analysis due to the large number of cases available (QCA can work on as few as ten cases). The research team checked to see if there were any distinguishable patterns to the missing data which may mean that the QCA results were not valid, but no bias was found in the cases where responses were not provided. However, there is still a risk that there is a degree of non-response bias in the results that the research team could not observe from the data.

- **Minimising contradictions in the truth table**: QCA categorises cases into groups that have the same set of conditions and is most accurate when contradictions within these 'groups' are minimised (i.e. different values of outcome variable). As there were a large number of observations and variability across cases, it was challenging to minimise the number of contradictions.
    - Minimising the contradictions in the truth tables is an iterative process, with the variables included being altered to examine how this impacts upon the number of contradictions. However, other than the number of contradictions, there is no indication as to the degree of explanatory power the changes in model specification has. Therefore, it is unclear how well changes in the model specification affect the robustness of the findings, and is a limitation to this method. The approach therefore combines the QCA analysis with other methodological approaches (described below).
- **Tautology within the variables:** Some of the alternative hypotheses for certain outcome variables were tautologous so could not be used for the specification. For example, whether a project met expectations was tautologous with making TRL progression. Where this was the case, the tautologous outcomes were explored using thematic analysis.

4.2 Thematic analysis

4.2.1 Aims of analysis

There were three primary aims for the thematic analysis undertaken. These aims were:

- To provide evidence to underpin the process evaluation.
- To provide evidence as to whether outcomes and impacts have been achieved that could not be analysed using quasi-experimental approaches or QCA. These were the spillover effects of the programme (whether the programme has led to changes in Government policy, knowledge spillover and the demonstration effect changing the investment landscape for clean technologies in the UK).
- To provide a more detailed description of how and why outcomes and impacts have been achieved by EEF participants.

4.2.2 Data used

The data used for the thematic analysis was primarily the data collected through primary research – and in particular the applicant and stakeholder interviews. This information was supplemented by information collected during a context review (a review of literature and data to establish the policy, economic and technological context the programme operated in), and programme MI.

4.2.3 Analytical approach

The qualitative data collected was placed into a coding framework (see Section 4.1.2). The information entered into the coding framework was used to undertake an initial quantitative analysis to identify patterns across participants by identifying groups of interviewees that had responded in a particular way to a question. This top line analysis was used to identify areas of alignment with the existing programme theory and areas where there were differences. The research team then used the data to analyse differences between subgroups of applicants, such as by business size, technology area, business maturity.

To explore the responses to each interview question in more detail, the research team revisited the transcripts of all interviews to identify key themes in the responses. The themes for each interview question had been established for many interview questions in the coding framework – however, the accuracy of these themes was reviewed in the initial stages of the thematic analysis to ensure these were still accurate. Where no themes had been established in the coding framework the research team reviewed the interview responses and identified key themes in the responses to each question.

The research team then explored the key themes identified, exploring how frequently each theme occurred in the interviews. A further step in the analysis was to explore whether there were commonalities between the interviewees that had responded in a similar way.

4.2.4 Key challenges and caveats

The main challenge relating to the thematic analysis is the data completeness issue highlighted in Section 4.1.4.

4.3 Logistic regression analysis

4.3.1 Aims of analysis

The aim of the logistic analysis was to reinforce the findings from the QCA, and to find out which of the factors included in the QCA (and some additional factors) had a statistically significant impact on the probability of an applicant achieving a stated outcome.

4.3.2 Data used

The data used for the logistic regression was based on the same coded dataset as described for the QCA analysis.

4.3.3 Analytical approach

The following logistic regression model was adopted to estimate the effect of the potential causal mechanisms and contexts on the achievement of stated EEF outcomes and impacts:

$$Y_i = \alpha_i + \beta T_i + \delta X_i + \varepsilon_i$$

In this model, the performance of each firm (i) in achieving the outcome being estimated (Y_i representing the outcomes of interest) is determined by its exposure to the EEF support (βT_i), and the parameter β gives an estimate of the effect of interest (the effect of the participation in the EEF programme on the probability of achieving the outcome of interest). The model also controls for firm and project characteristics including the starting TRL of the innovation and starting CRL of the firm, the maturity and size of the business, the technology area of the innovation, whether the business had secured significant funding prior to the EEF application, and also their experiences of the EEF, including the level of satisfaction with the incubation support (X_i). As noted above, estimates of the impact of the programme have the potential to be biased by differences between treatment and comparison groups.

4.3.4 Key challenges and caveats

Some of the key challenges faced by the logistic regression analysis were the same as those for the QCA (described in Section 4.1.4). These were the challenge around data completeness and the tautologous nature of some of the variables.

Another caveat to the logistic regression is that outcome variables in many cases were binary (for example whether a company had increased employment or turnover, rather than the value of the turnover). This was due to the quality of the information interviewees could provide, and the banded data allowed more observations to be included in the analysis. However, the banded nature of the data may miss some nuance in whether an increase in the outcome had been observed (for example a company could increase employment by five individuals, and still be in the same employment category). It should be noted that this issue is best addressed by undertaking the quasi-experimental research design described in Section 4.4.

4.4 Quasi-experimental impact analysis

4.4.1 Aims of analysis

The focus of the analysis described in this section is on testing the following hypotheses identified in the Theory of Change for the EEF programme through the impact evaluation to feed into the economic evaluation:

- **R&D activity:** In the short term, the R&D grants awarded through the EEF are expected to lead to increased levels of R&D spending. This assumes the funding is not used to deliver activities the private sector would have taken forward anyway (deadweight) and did not divert attention from parallel programmes of development activity (crowding out). Higher levels of spending on R&D may induce some firms to increase their employment of R&D workers. This may not be observed if the additional spending is placed with contractors (e.g. testing facilities) or if it ‘leaks’ into higher salaries for employees.
- **Leverage of follow-on funding:** The technical activity funded by R&D grants and the incubation support provided will ‘de-risk’ the company and the technology being developed. R&D activity reduces the technical risk associated with the proposed route to market. Incubation support will improve the commercial readiness of the enterprise.

As grants do not dilute shareholder equity, they may also de-risk the balance sheet of the firm. Reductions in levels of technical and commercial risk will increase the attractiveness of the company to external investors (e.g. angels or venture capital (VC) funds) enabling it to attract follow-on funding to support further R&D or scale-up.

- **Employment, turnover and gross value added (GVA):** If the EEF enables firms to successfully commercialise their technologies, this would be visible in impacts on employment, turnover and GVA (subject to the caveats highlighted below).
- **Valuations:** Given the long timescales involved in commercialising clean technologies, the impacts of the programme may not be visible in measures of turnover or economic output. In a well-functioning financial market, firm valuations should reflect investor's expectations of the future profitability of the company (subject to risk). De-risking achieved through R&D and business model development activity stimulated by the programme should produce an increase in the value of the firm, even if this is not visible in current sales or profits.
- **Relative effectiveness of incubation support:** One of the unique features of the EEF is that it pairs R&D grants with incubation support. Innovation programmes managed by other funders have historically offered R&D grants in isolation. The added value of the incubation support is explored indirectly by comparing the relative effects of awards made through the EEF and R&D grants awarded by Innovate UK.

4.4.2 Data used

The secondary data described in Section 3.4 has been used in this analysis.

4.4.3 Analytical approach

Counterfactual selection

A credible quantitative assessment of impact requires comparisons between those participating in the EEF and an appropriate group of firms that did not, to help determine what may have occurred in its absence. As awards were made on a non-random basis, the selection of a comparison group needs to address the potential issues of bias caused by the selection of firms into the programme:

- **Self-selection:** Applicants 'self-select' by applying to the EEF and will differ from non-applicants in systematic ways that may influence the outcomes of interest. For example, non-applicants may be less likely to engage in any innovation effort. Comparing firms awarded grants to non-applicants to the EEF would overstate the effect of the programme, as the latter be less likely to invest in R&D regardless of the grants awarded.
- **Independent assessment process:** The problems outlined above can be addressed by drawing the sample of comparator firms from the population of declined applicants. Both successful and declined applicants can be assumed share similar characteristics motivating their applications for funding. However, applications for funding are assessed on the basis of their scientific merits, technical feasibility, the quality of the team and the strength of the commercial opportunity. If these judgements are made effectively, it can

be assumed successful applicants would outperform declined applicants in the absence of the programme. However, when additionality formed part of the deliberations of the assessors or the Commercial Panel, the bias could potentially run the other way.

The following samples of firms were drawn from the pool of declined applications to mitigate against these issues:

Successful versus declined applicants

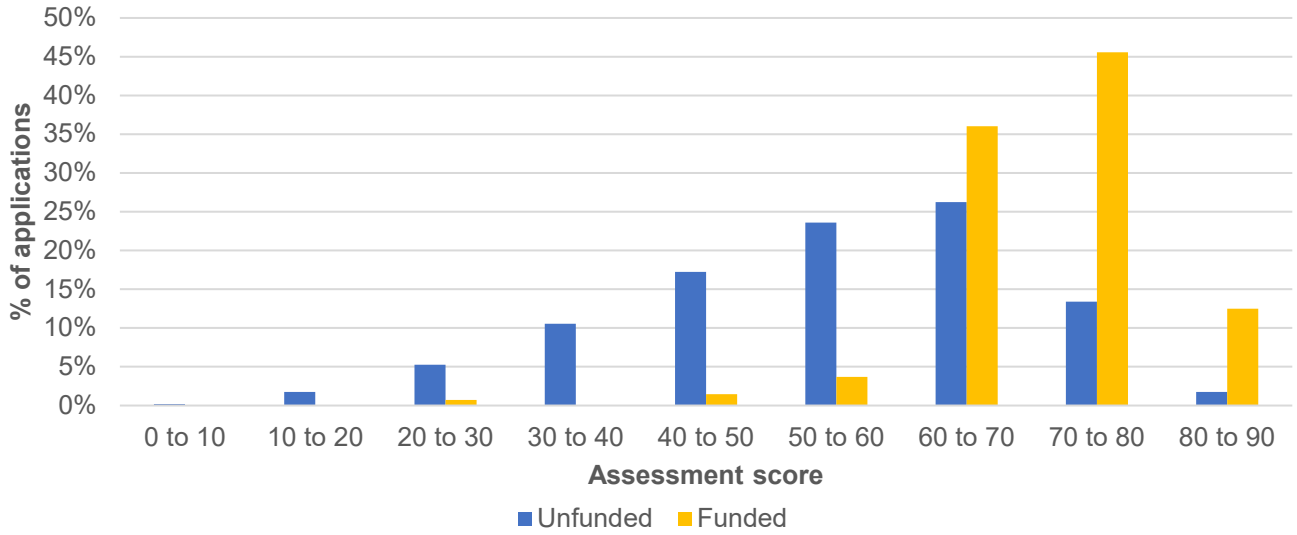
The first set of analyses compare the performance of successful applicants against all declined applicants. These results could be biased if there are systematic differences between successful and declined applicants:

- **Assessment scores:** The figure below shows the distribution of assessment scores across declined and successful applicants. This illustrates that while a high score in the assessment process does not guarantee success, few applicants receiving a score of below 60 were awarded funding. On this measure, there are systematic differences between the two groups - the average score associated with successful applications was 68 versus 55 for declined applications. The figure also highlights that some low scoring applications have been funded while some high scoring applications remain unfunded.
- **Baseline characteristics:** The table below shows other characteristics of applicants before they were awarded funding through the programme. This shows that those awarded funding appear substantially larger on average in terms of employment and R&D spending than declined applicants, however this was not statistically significant. This was a result of skewness and driven by the presence of a small number of very large firms that were awarded grants. Excluding large firms (those with 250 employees or more) from the analysis reduces the extent of these differences considerably and results in the exclusion of eight enterprises when using the BSD analysis and six using the BERD. This restriction was applied throughout the analysis.

Table 4.7: Baseline characteristics of supported firms and comparators (mean values)

Measure	All applicants		Applicants excluding large firms		High scoring applicants		Matched applicants	
	Success	**Declined**	**Success**	**Declined**	**Success**	**Declined**	**Success**	**Declined**
Total R&D expenditure (in-house and external R&D purchases, £000)	3996.3	394.9	945.2	188.7	945.2	216.1	518.8	207.5
R&D employment (FTE scientists and technicians)	32.4	2.8	7.0	2.1	7.0	2.3	6.8	2.3
Expenditure on R&D staff wages and salaries (£000)	1916.2	195.3	373.9	81.2	373.9	96.0	328.1	98.8
In-house R&D funded from public sources (£000)	56.7	29.7	52.0	30.2	52.0	39.7	56.4	43.1
In-house R&D funded from private sources	3509.3	313.8	689.5	125.4	689.5	139.8	502.3	131.3
Employment	54.1	22.9	13.2	10.3	14.0	12.1	15.1	11.8
Turnover (£000)	106026.9	3755.0	990.8	1300.3	1063.2	1434.8	1274.3	1297.6
Turnover per worker (£000)	104.0	276.9	69.0	278.7	71.9	99.9	79.3	108.8
Number of firms (BERD)	33	65	33	61	33	36	26	37
Number of firms (BSD)	88	265	86	259	79	111	56	157

Figure 4.1: Distribution of assessor scores across successful and unfunded applications, EEF Rounds 1 to 7



Source: EEF monitoring information

High scoring successful applicants

Steps were taken to mitigate against the risk of bias driven by restricting the analysis only to those applicants that score highly in the assessment process (i.e. those scoring 60 or more). These restrictions substantially reduced the differences between the two groups in terms of their assessment scores, with those successful and declined applicants included in the analysis scoring an average of 71 and 68 points respectively. The apparent differences between these two samples were not statistically significant (partly because the underlying variance in the data was large).

Applicants with similar scores and fundraising history

Further refinements were achieved by matching successful applicants and declined applicants where they shared similar:

- Scores in the assessment process
- TRL levels at the point of application
- Technology area associated with the project
- Similar scale of operations in terms of employment and turnover.

This was achieved using a kernel matching algorithm with an Epachnikov kernel with a bandwidth of 0.05. The resultant weights were used to weight the fixed effects regressions described in the following analysis. The matching algorithm reduced differences between treated and control samples as illustrated in Table 4.7.

Pipeline design (successful applicants only)

The results of the approaches above (with the application of the fixed effects approaches described below) are robust to unobserved differences between successful and declined applicants that do not vary with time. However, there may be time varying differences between the two groups that could bias these findings. For example, if successful applicants were more likely to be pursuing technologies that attracted increasing interest from Venture Capital (VC) funds over the period, then the results above would overstate the impact of the programme.

As funds were awarded in sequence of funding rounds since 2012, it is possible to limit comparisons to successful applicants and exploit staggering in timing of awards to identify the effects of the programme. Under this approach, firms receiving grant awards in later rounds act as a counterfactual for those receiving grants earlier (on the basis that those awarded funding first should experience their impacts first). As comparisons are only made between successful applicants, this mitigates the possible issue of bias driven by differences to those firms that were declined.

However, findings could be biased if there are systematic differences in the characteristics of firms applying for the EEF at different points in time. Differences in the observable characteristics of firms applying in different years and their project applications were explored across different years of application. These analyses did not show any statistically significant differences in observable characteristics including TRL, technical score, average turnover and employment, or sector. The details of these tests are not provided because they were based on small sample sizes and were potentially disclosive.

Econometric model

The following econometric model was adopted to estimate the causal effects of participation in the EEF on the outcomes of interest:

$$Y_{it} = \alpha_i + \beta T_{it} + \gamma t + \delta X_{i,t} + \alpha^i + \alpha^t + \varepsilon_{it}$$

In this model, the performance of each firm (i) in period t (Y_{it}, representing the outcomes of interest identified in Table 1.2) is determined by its exposure to the EEF funding (βT_{it})[23], and the parameter β gives an estimate of the effect of interest (representing the long-term effect of the grant on the outcome of interest). The model also controls for firm characteristics including their ownership, the region in which they were located, the score of the project application, TRL of the innovation and the cumulative number of Innovate UK grants received by year t ($X_{i,t}$). As noted above, estimates of the impact of the programme have the potential to be biased by differences between treatment and comparison groups. The following approaches were taken to address this problem, exploiting the longitudinal nature of the data:

- **Fixed effects:** The model was augmented to allow for unobserved differences between firms that do not change with time (α^i). This captures the effect of any unchanging

[23] This variable takes the value of 0 in the years before a firm receives a grant, and the cumulative number of grants received in the following years. For firms forming the comparison group, this variable takes the value of 0 in all years.

qualities of the firm that may have influenced both its success in the application process and its performance – this could represent the effectiveness of its commercial management team, the strength of its underlying intellectual property, or its business model (although results could still potentially be biased to the degree that these factors change over time).

- **Time-specific shocks:** The model also allows for any unobserved but time specific shocks affecting all firms in the sample (α^t). An example of this might be the effects of the EU Referendum in 2016.

4.4.4 Key challenges and caveats

The key challenge to the quasi-experimental approach was potential bias between the treatment and comparator groups. The steps taken to address this are outlined in Section 4.4.3 (presenting the approaches to select suitable counterfactual groups). However, there remains the potential for bias between the groups in factors which could not be observed in the data.

A further risk is that there was no data available for variables which could have influenced the achievement of outcomes, for example the skills profile of EEF applicant businesses. Some of this risk is mitigated through the use of the fixed effects models, but variables which are not time invariant and have no data will be missing from the models, potentially reducing the explanatory power of the results.

4.5 Economic Analysis

4.5.1 Aims of analysis

The aims of the economic analysis were to identify the costs of the EEF programme, and to compare these to the outcomes achieved to identify whether the programme has offered value for money. A Cost Benefit Analysis of the programme has been undertaken, although as many of the longer term outcomes are yet to be achieved, it does not include many of the economic and environmental benefits that are expected to be achieved.

As highlighted in the main evaluation report, few commercial outcomes have been achieved by EEF participants. This means that at present the outcomes that would drive a monetary value of the benefits of the programme for an economic evaluation (changes in productivity or environmental benefits) have not been achieved by most participants. However, most EEF participants still feel that their technology will be commercialised in the future. As such, a forward-looking approach is needed to understand the benefits of the programme (i.e. how far can the EEF be expected to produce significant commercialisation of clean technologies in the future?).

One way to address this question is by examining the effect of the programme on the underlying value of participating firms. The value of the firm (assuming a well-functioning financial market) will represent the present value of expected future profits over and above the risk-free rate of return. If R&D investments are expected to increase the future profitability of the business, the present value of future profits will be capitalised into the value of the firm.

These effects can also be understood as a partial measure of the net benefits of the programme. While the future expansion of the firm may displace competitors, the economic activities displaced can be assumed to be only earning a 'normal' rate of return. As the value of clean technologies will be linked to how far they help consumers reduce their emissions, changes in valuations will also capture the value of future environmental benefits of the EEF (to the degree that investors expect future Government policy to be effective in ensuring consumers internalise the environmental costs of their behaviour).

A second way to address this issue is to model the potential environmental benefits of the projects which have completed their project and provided a large amount of information about the potential environmental impacts of their technology. This allowed the research team to quantify the potential environmental impacts of these projects and monetise these, and compare this to the value of the grant funding that was awarded to these projects.

4.5.2 Data used

Cost data

The cost data used for the analysis has been drawn from multiple sources. The information for the value of the grant funding has been drawn from the records of grants awarded to participant companies. DESNZ also provided information about the value of the incubation support activities that have been delivered by the EEF incubation delivery partners.

However, DESNZ did not keep systematic records of annual public expenditures for each project, or the proportion of grant funding that has been paid to projects which are currently ongoing. It is assumed that completed projects claimed the full grant awarded by DESNZ. The costs of projects that were incomplete in March 2020 were estimated by assuming a linear spending profile over the duration of the grant.

Estimates of the time required to monitor and administration were provided by DESNZ. This has been monetised using publicly available information about the cost of DESNZ staff.[24]

Environmental analysis

The data used for the estimation of the environmental benefits of projects was collected through case study interviews and Management Information (project CPRs) collected by the programme. This information about the potential environmental impacts were self-reported, and therefore subject to potential bias.

Data for the monetary value of the potential carbon savings was taken from the DESNZ traded value of carbon.[25]

Valuation data

The valuation data used for the analysis has been taken from PitchBook. This provides estimated values for firms based on the values of investments made. Assessing the impact of

[24] https://data.gov.uk/dataset/bd294ec3-4ddc-4d8a-9522-7a3033a7611b/beis-organogram-of-staff-roles-salaries
[25] https://www.gov.uk/government/publications/updated-short-term-traded-carbon-values-used-for-modelling-purposes-2018

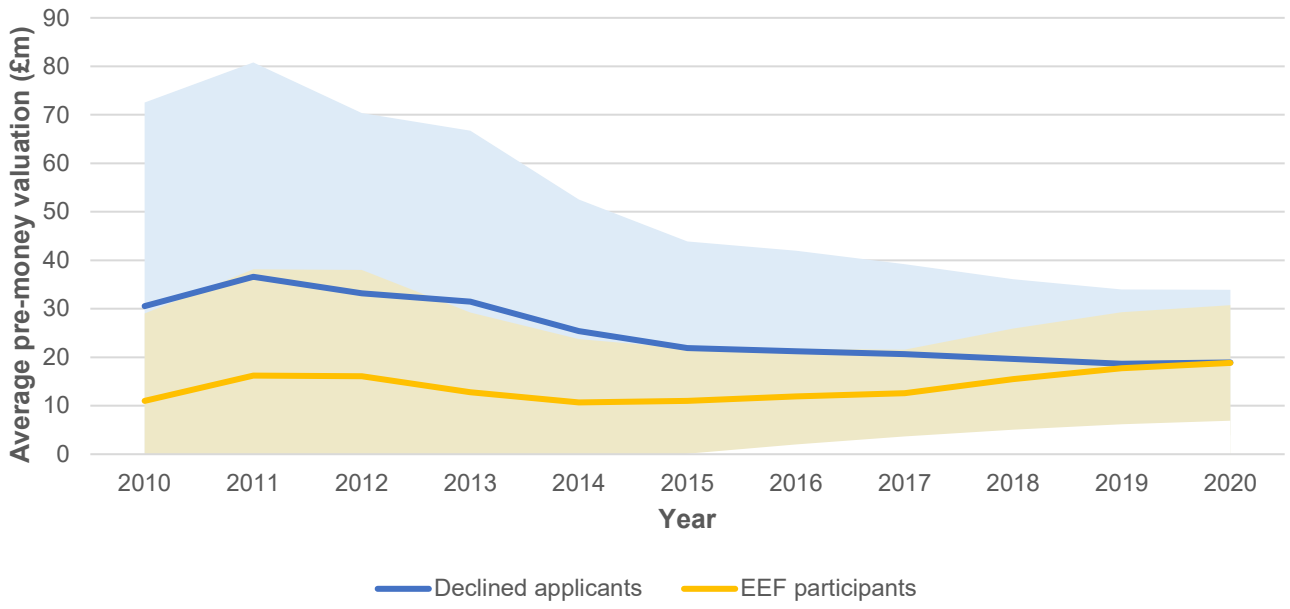
the programme on the values of the firms participating in the EEF is challenging because the majority were held in private ownership. As equity in these companies is not traded in public capital markets, their value is only observed when a transaction is made (e.g. when a VC fund places an investment or when it is acquired by a larger firm). A total of 248 observed valuations were available for 91 of the firms that applied to the EEF programme, of which 44 were EEF participants (out of the 133 businesses which received EEF support, 33 percent of participants).

Gaps in data availability were handled in the following way:

- The company value was treated as missing in years prior to the first observed valuation.
- The value of firms in private ownership was assumed not to change until the next valuation was observed. The enterprise value of public companies (where prices are available from stock exchanges) was taken at the end of each calendar year.
- Any company without an observed valuation was excluded from the analysis.

This gave a final dataset providing an unbalanced panel dataset of 640 annual observations over the subsample of 91 firms between 2010 and 2020, with the number of observations available increasing in each year. The following figure shows how the average valuations of the two groups of firms evolved between 2010 and 2020:

Figure 4.2: Average pre-money[26] valuation of EEF applicants, 2010 and 2020



Source: EEF monitoring information, Pitchbook. 95 percent confidence intervals shown in the shaded area.

[26] Pre-money valuation refers to the valuation of a company prior to the firm going public or receiving other investments such as external funding or financing

4.5.3 Analytical approach

Cost data

The cost data provided has been analysed in the following ways to produce an estimate of the total cost of the EEF programme:

- For grant expenditure, it is assumed that the grant allocated to projects which have been completed was fully spent.
    - For grants that are yet to complete, a linear spend has been assumed. This means that the value of the grant has been divided by the stated duration of the contract (to obtain a spend per year estimate), and this has been multiplied by the proportion of years completed by the project.
- The total value of expenditure on incubation support and management was provided by DESNZ, and no adjustments were required.
- The value of ThirdS[27] expenditure for the monitoring of the EEF was provided by DESNZ, and no adjustment was necessary.
- For the cost of monitoring by DESNZ staff, DESNZ provided an estimate that each project required 7.5 days of monitoring over the course of project delivery. This was multiplied by the number of projects monitored by DESNZ staff (133) to give an estimate of DESNZ monitoring hours. The total number of monitoring hours was multiplied by the estimated hourly cost of a monitoring officer (taken as the mid-point of the payscale for a monitoring officer).
- For the cost of assessment, DESNZ provided an estimate that the assessment of a bid would take two days per application. This was multiplied by the number of applications assessed and the hourly cost of an appropriate assessment officer.
- For the cost of the management of the programme, DESNZ provided an estimate that the programme manager spent 1.5 days per week working on the EEF programme. This has been multiplied by the number of weeks the programme has been running, and an appropriate pay rate for the management role to estimate the costs involved in management.

Firm valuation analysis

The approach to the firm valuation analysis is the same as the methodology described in Section 4.4.

The impact of participating in the EEF programme on firm valuations identified in the model was then applied to the number of firms participating in the programme to establish an estimated monetary value for the increase in firm valuation as a result of the EEF programme.

[27] ThirdS is a BEIS Science and Innovation for Climate and Energy (SICE) contract which provides monitoring and information services across the SICE Energy Innovation Portfolio, including the EEF programme

Social welfare analysis

An indicative social welfare analysis has been completed by comparing the effects of the programme on R&D investment (the value of additional R&D expenditure) to its economic benefits capitalised into the valuations of firms (across the whole portfolio of projects. This provides an estimate of the economic value to the UK economy as a result of the R&D activity driven by the EEF programme.

Environmental analysis

For the environmental analysis, two approaches have been used to estimate the monetary value of the environmental benefits of the programme. These are:

- **A low estimate:** This approach estimates the CO2 savings associated with the EEF technologies by multiplying the projected CO2 savings from the technology by the commercial outcomes achieved to date (e.g. number of units sold).
    - Where projects have trialled equipment, a ten year asset life has been assumed, and any ex-ante calculations assume that this equipment realises CO2 emissions/ reductions over a ten year life.
    - The estimated CO2 savings have been multiplied by the monetary value associated with the CO2 reductions (taken from DESNZ traded value of carbon) to provide a monetary value of the estimated carbon savings.
- **A high estimate:** This approach estimates the CO2 savings associated with the EEF technology by multiplying the projected CO2 savings from the technology by company sales projections over the next five years (I.e. the number of units expected to be sold).
    - Again, the technologies are assumed to have a ten year life span and the quantity of CO2 saved has been multiplied by the DESNZ traded value of carbon to provide a monetary value of the estimated carbon savings

The reality is that the actual impact of the EEF projects is somewhere between the two estimates, and likely, in the short term, to be closer to the lower end of the range.

4.5.4 Key challenges and caveats

Valuations approach

The following caveats should be borne in mind in relation to following analysis:

- Fixed effects models will produce unbiased estimates if observations are missing at random. This assumption is unlikely to hold because valuations are only available for firms that attracted investment, which are likely to be more valuable than those that did not. This could distort the results of the analysis. Comparisons between successful and unsuccessful applicants may understate the impact of the programme on business valuations (as the latter were less well represented in the final sample).
- The external validity of the estimates will also be limited if the sample of firms in the sample are not representative of overall population. Firms included in the analysis reported higher levels of technical maturity than the overall population (an average TRL

of 4.9 vs 4.7). The technical scores associated with applications submitted by successful applicants in the sample were in line with population averages (63.3 vs 63.0). However, the sample was skewed to unsuccessful applicants that submitted higher quality application (an average score of 53.1 vs 46.3 across the overall population).

Social welfare analysis

The findings are subject to the following limitations:

- The use of firm valuations as a measure of economic benefit assumed that financial markets are well-functioning. However, the programme itself is predicated on an assumption that markets do not price investments in clean technologies effectively.
- Estimates of the impact of the programme on firm valuations are likely understated because the value of firms that do not attract follow-on investment is unobserved.
- Firm valuations only capture private benefits to the investor. These measures will only capture environmental externalities to the degree that future Government policy is expected to encourage consumers to fully internalise the environmental costs of their resource consumption. Additionally, this measure of benefit will not capture other economic benefits that may arise from future exploitation of the technologies (e.g. wage benefits for workers or knowledge spill-overs).
- Estimates of the costs of the programme only capture the additional R&D spending of participating firms and do not include administrative costs involved in the delivery of the programme.

Environmental analysis

The key challenge with the environmental analysis is that the estimates are based on laboratory tested estimates of impact, and may overestimate the true impact of the technology when utilised in practice. Further, the estimates are for eleven projects, and cannot be extrapolated across the EEF portfolio.

A further caveat is that it was not possible, due to a lack of available information, to estimate the potential environmental impacts of the technologies of declined applicants. Therefore, there is no assessment of the additional environmental benefit EEF participation provides.

A final caveat is that not all of the environmental impacts may be attributable to the EEF – projects may have sources funding from other sources before and after the EEF support. It is not possible to disentangle the proportion of environmental benefit attributable to different sources of funding.

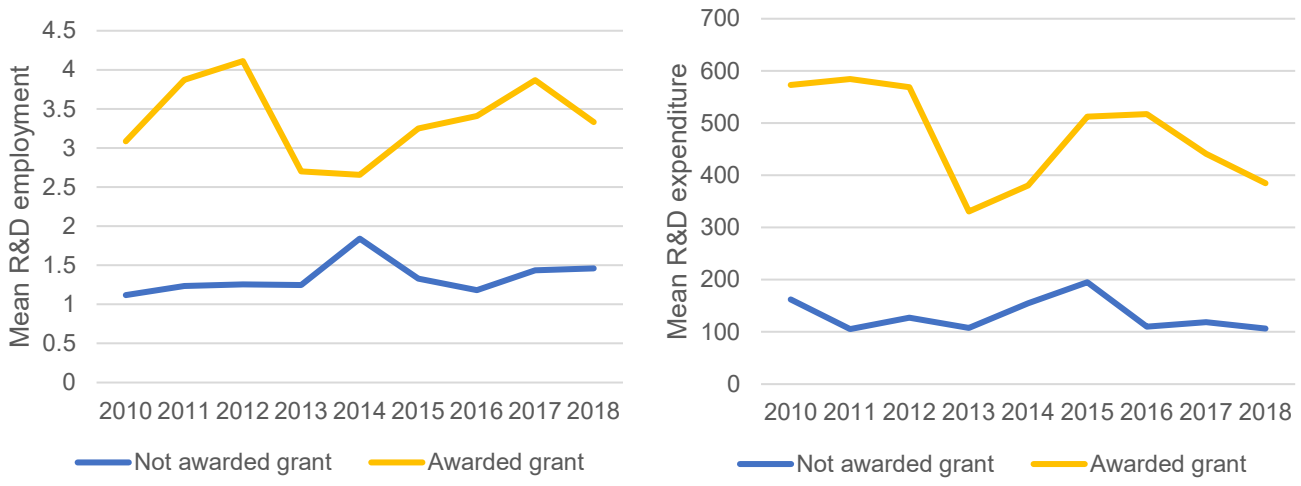
5. Detailed results

This section provides the more detailed results from the analysis undertaken to explore the impact of the EEF programme and the value for money the programme offered. It particularly highlights the results from the logistic regression and quasi-experimental impact analysis, and the economic evaluation findings.

5.1 Quasi-experimental analysis of R&D activity

The figure below shows that firms awarded places on the EEF programme saw R&D spending and employment rise on average over the 2013 to 2016 period before falling in 2017 and 2018. Firms whose applications for funding were declined also saw their R&D employment increase although real R&D spending remained relatively constant. Firms awarded grants were also more R&D active than those that were declined (although this is partly explained by the presence of a small number of large firms).

Figure 5.1: Mean R&D employment and expenditure (2019 prices), 2010 to 2018



Source: Business Enterprise R&D Survey (2021). Ipsos MORI analysis.

5.1.1 Overall effects

The findings of the analysis are presented in the table below and show:

- **R&D activity:** The results provided strong evidence that participation in the EEF programme leads to an expansion of R&D activity. The findings indicated that the programme increased average annual R&D spending by 38 to 68 percent by 2018. This was also accompanied by an increase in R&D employment of 13 to 30 percent.
- **Funding sources for R&D:** The EFF grant had larger effects on privately funded R&D than publicly funded R&D, suggesting the programme has helped 'crowd in' private R&D spending. The estimated impacts on privately funded expenditure were consistent

across models (between 41 and 69 percent). The estimated effects on publicly funded R&D were less consistent (ranging from 27 to 64 percent) and were not significant in all models – raising the possibility that some firms may have otherwise been able to secure public funding from alternative sources.

- **Impacts on R&D wages:** The estimated effects on total R&D spending were larger than those observed on R&D employment. This could be explained if firms increased their spending on non-labour inputs to the R&D process (e.g. materials inputs or testing facilities associated with experimental development work) or if the increased spending 'leaked' into higher R&D salaries (limiting the overall increase in R&D performed by the business). The findings suggested that the programme had relatively large effects on wage spending (39 to 73 percent), indicating that at least some of the increased R&D spending has been absorbed by higher wages. This may have arisen from excess demand for scarce skills or it may evidence of a 'grant sharing' effect in which firms rewards workers for securing grants (or follow on investment).
- **Impacts on R&D stages:** There were few differences in the estimated effect of the programme on the type of R&D undertaken by firms (basic, experimental, or applied).

Table 5.1: Estimated effect of grants on R&D activity of EEF grant recipients

	Model1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Firms included	All		All		High scoring applicant		Matched sample		Firms awarded grants	
Model	OLS		Fixed Effects		Fixed Effects		Fixed Effects		Fixed Effects	
Dependent variable	Log transformed		Log transformed		Log transformed		Log transformed		Log transformed	
Year Fixed Effects	No		Yes		Yes		Yes		Yes	
No. of observations	764		764		378		764		256	
Outcome	Coeff.	R2	Coeff.	R2	Coeff.	R2	Coeff.	R2	Coeff.	R2
R&D employment	0.132**	0.326	0.258***	0.095	0.197**	0.196	0.295***	0.176	0.157	0.236
Total R&D expenditure	0.379***	0.322	0.667***	0.08	0.491***	0.194	0.682***	0.177	0.461**	0.248
Wage spending	0.388***	0.321	0.664***	0.088	0.469***	0.223	0.725 ***	0.192	0.442**	0.278
Basic R&D expenditure	0.149	0.129	0.597***	0.16	0.521**	0.22	0.616***	0.270	0.505**	0.234
Applied R&D	0.384***	0.346	0.501***	0.095	0.397**	0.151	0.700***	0.205	0.406**	0.22
Experimental R&D	0.344***	0.299	0.709***	0.201	0.512**	0.352	0.521***	0.357	0.461**	0.349
Government funded R&D	0.271**	0.171	0.582***	0.097	0.343*	0.176	0.649***	0.185	0.357	0.21
Privately funded R&D	0.408***	0.327	0.685***	0.1	0.498***	0.263	0.714***	0.216	0.483***	0.304

Source: Business Expenditure on R&D (2021), EEF Application Information, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively.

5.1.2 Relative effectiveness of EEF

The models above included a control for the cumulative number of Innovate UK awards received by firms participating in the programme.

These models suggested that participation in the EEF had larger effects on firm R&D employment and spending than awards made by Innovate UK. For R&D employment, EEF participation led to between a 13 to 30 percent increase compared to no significant effect from other Innovate UK awards. Similarly, for R&D spending, other Innovate UK funding was associated with a small reduction in R&D spending of around 7 percent compared to a 38 to 67 percent increase from EEF participation.

5.1.3 Effects by type of project

The findings were broken down to explore the relative impacts of the grants by technological maturity (TRL at point of application) and technology area:

- **Technological maturity:** The findings indicated that the EEF had relatively larger effects on firms with early stage R&D projects (TRL 3 to 4) than for projects where a working prototype had already been developed (TRL 5 to 6). Results for late stage projects (TRL7 or higher) were suppressed for sample size reasons.
- **Technology area:** Projects focused on energy demand applications had larger effects than those focused on energy supply. However, results for other were also suppressed for sample size reasons.

Table 5.2: Estimated effect of grants on R&D activity by TRL and technology area

	Model1		**Model 2**		**Model 3**		**Model 4**	
Firms included	All		High scoring applicants		Matched sample		Firms awarded grants	
Model	Fixed Effects		Fixed Effects		Fixed Effects		Fixed Effects	
Year Fixed Effects	Yes		Yes		Yes		Yes	
Number of observations	185 to 556		92 to 296		59 to 368		51 to 191	
Outcome	Coeff.	R2	Coeff.	R2	Coeff.	R2	Coeff.	R2
TRL3 to TRL4								
R&D emp.	0.274**	0.168	0.245*	0.212	0.329**	0.225	0.161	0.302
R&D exp.	0.702***	0.122	0.558**	0.172	0.757**	0.18	0.478	0.246
TRL5 to TRL6								
R&D emp.	0.194**	0.12	0.181*	0.203	0.178	0.215	0.195	0.202
R&D exp.	0.537***	0.141	0.467**	0.232	0.439**	0.238	0.511**	0.28
Energy Demand								

R&D emp.	0.706***	0.201	1.029***	0.333	1.165***	0.332	1.114***	0.395
R&D exp.	0.806**	0.138	1.405***	0.25	1.192	0.269	1.558***	0.32
Energy Supply								
R&D emp.	0.227***	0.107	0.163*	0.227	0.271**	0.183	0.103	0.262
R&D exp.	0.651***	0.102	0.432***	0.242	0.669***	0.203	0.383**	0.296

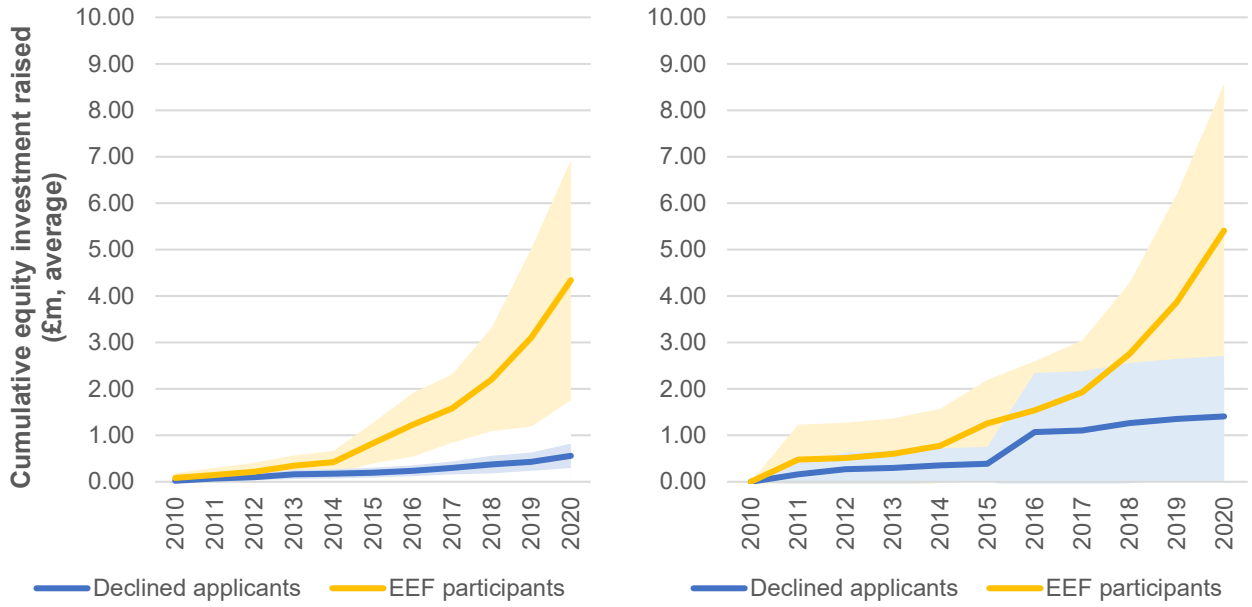
Source: Business Expenditure on R&D (2021), EEF Application Information, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively.

5.2 Quasi-experimental analysis of effect on leverage of follow-on funding

The following analysis used two independent data sources (Beauhurst and Pitchbook) to estimate the impacts of the programme on levels of equity funding raised. The following figures compare the cumulative funds raised by firms applying for EEF between 2010 and 2020:

- Firms participating in the EEF saw average fundraising rise steadily between 2014 and 2020. Those firms whose applications were declined did not raise significant levels of equity funding by the end of 2020.
- These patterns were consistent across the two datasets. Data compiled from Pitchbook indicated that firms raised larger amounts, reflecting that Beauhurst does not capture fundraising from public capital markets (and a small number of firms completed an Initial Public Offering over the period). Data from Pitchbook was also characterised by a higher level of variance than observed in the Beauhurst data.

Figure 5.2: Cumulative equity investment raised by EEF applicants between 2010 and 2020, Beauhurst data (left panel) and Pitchbook data (right panel)



Source: Beauhurst and Pitchbook (2020), Ipsos MORI analysis. Shaded area shows the 95 percent confidence interval.

5.2.1 Overall effects

The results of the econometric analysis are provided in the following table, and suggest:

- There is a high level of confidence that the EEF programme had a positive impact on the level of equity funding raised by firms.
- The results indicate that each grant awarded through the programme increased the equity investment raised by firms by £0.7m to £2.1m on average by 2020. These findings were visible in almost all specifications and were largely consistent across the Beauhurst and Pitchbook datasets.

Table 5.3: Estimated impact of EEF on equity investment and public funding secured

Population of firms	Firm fixed effects	Time fixed effects	Estimated impact (£m per grant)	Sig.	Number of obs.
Impacts on equity investment raised by 2020 (Beauhurst)					
All	Yes	No	1.88	***	7,359
All	Yes	Yes	1.54	***	7,359
High scoring	Yes	Yes	1.63	***	3,707
Matched	Yes	Yes	1.33	***	5,335
Successful only	Yes	No	1.88	***	1,463
Successful only	Yes	Yes	0.38		1,463
Impacts on equity investment raised by 2020 (Pitchbook)					
All	Yes	No	2.09	***	7,359
All	Yes	Yes	1.28	***	7,359
High scoring	Yes	Yes	1.58	***	3,707
Matched	Yes	Yes	0.73	**	5,335
Successful only	Yes	No	2.09	***	1,463
Successful only	Yes	Yes	0.08		1,463
Impacts on public funding secured by 2020 (Beauhurst)					
All	Yes	No	0.56	***	7,359
All	Yes	Yes	0.41	***	7,359
High scoring	Yes	Yes	0.23	***	3,707
Matched	Yes	Yes	0.34	***	5,335
Successful only	Yes	No	0.56	***	1,463

Successful only	Yes	Yes	0.38	***	1,463

Source: Beauhurst and Pitchbook, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively.

- The Beauhurst dataset also captures public funding secured by firms. The programme is estimated to have had a smaller effect on the ability of participating companies to attract further public funding (with the estimated effect ranging from £0.2m to £0.6m) compared to equity investment.

5.2.2 Relative effectiveness of EEF

The models above were augmented to control for the cumulative number of Innovate UK awards received by firms participating in the programme. These models suggested that participation in the EEF had larger effects on the ability of firms to raise private funding than awards made by Innovate UK (£0.7m to £1.3m versus £0.0m to £0.1m). As the primary difference between the two types of award is the provision of incubation support (although there are differences in the assessment of applications), this provides prima facie evidence that incubation support provides added value to the commercialisation process by enabling firms to attract additional private capital. There were no differences in the effect of the two types of award on further public funding attracted by firms.

Table 5.4: Relative impact of EEF and Innovate UK awards on equity investment

Type of award	**Estimated effect (£m per grant awarded)**	**Sig.**	**Estimated effect (£m per grant awarded)**	**Sig.**	**Estimated effect (£m per grant awarded)**	**Sig.**
Outcome	Equity funding raised (Beauhurst)		Equity funding raised (Pitchbook)		Public funding attracted (Beauhurst)	
EEF	1.31	***	0.72	*	0.159	***
Innovate UK awards	0.01		0.11	*	0.178	***

Source: Beauhurst and Pitchbook, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively. All models were estimated using the matched sample of firms and included firm and time fixed effects.

5.2.3 Effects by type of project

The findings were also broken down by TRL level and by technology area:

- The impacts of the EEF on the equity investment raised decreased with the level of maturity of the underlying technology. Grants awarded to firms with early stage innovations (TRL3) had the largest impact on the level of investment raised by companies (£1.9m to £2.6m). This effect got smaller at TRL4 to TRL6 (£1.2m) and was only significant in analyses using Beauhurst data. Grants awarded to late stage projects

at TRL7 or TRL8 had no effect on equity investment raised by firms (though sample sizes for these analyses were relatively small).

- These findings would be explained if the grants awarded to late-stage innovations were characterised by low additionality or if late-stage projects were less attractive to external investors; for example, if they did not offer sufficient levels of risk to enable VC funds to reach their target multiples. The following table compares the level of equity investment raised by firms awarded funding for early stage (up to TRL3) and late stage (TRL7) innovations. This suggests that early stage companies generally outperformed late stage companies, indicating that the latter explanation is more likely.
- In contrast to the findings reported above (Section 5.1.3 on R&D activity), the results suggested that grants have been most effective in leveraging private investment where they were awarded to technologies in the 'energy supply' and 'other' technology areas. Grants awarded to 'energy demand' projects (e.g. energy efficiency technologies in the building sector) had no effect on the level of funds raised by firms.

Table 5.5: Impacts of EEF on equity investment by starting TRL and technology area

Group	Estimated effect (£m per grant awarded)	Sig.	Estimated effect (£m per grant awarded)	Sig.	No. of observations
	Equity funding raised (Beauhurst)		Equity funding raised (Pitchbook)		
Results by starting TRL					
TRL3	2.58	***	1.91	***	1,727
TRL4 to 6	1.24	***	0.53		2,970
TRL7 to 9	-0.06		-0.21		638
Results by technology area					
Energy demand	0.15		0.12		1,397
Energy supply	1.59	***	0.65		2,893
Other	2.34	***	2.12	***	1,045

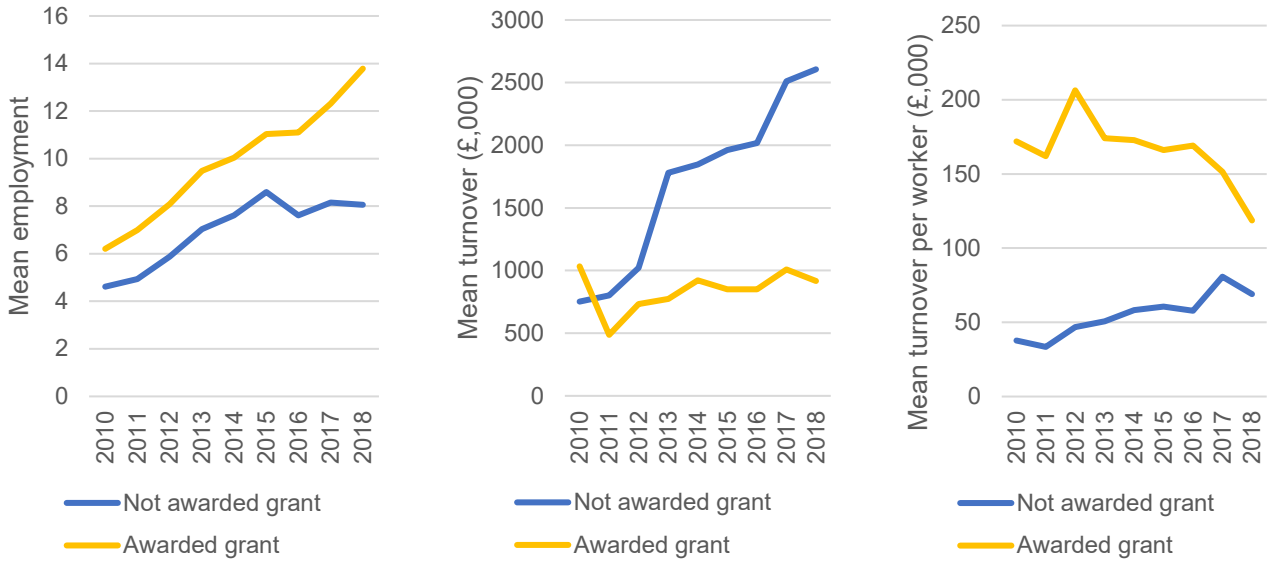
Source: Beauhurst and Pitchbook, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively. All models were estimated using the matched sample of firms and included firm and time fixed effects.

5.3 Quasi-experimental analysis of the effects on employment, turnover and turnover per worker

The following figure illustrates the key trends in terms of employment, turnover, and turnover per worker (taken as a proxy for productivity/GVA) for both applicant firms that were awarded grants and those which were not:

- Average employment for firms receiving grants rose consistently between 2010 and 2018. Firms not awarded funding saw little growth in employment levels beyond 2016.
- The turnover of firms participating in EEF rose since 2011, but not as rapidly as those that were declined funding.
- Turnover per worker was higher on average for firms awarded grants between 2010 and 2018 compared to those declined.

Figure 5.3: Mean employment, turnover and turnover per worker (2019 prices) between 2010 and 2018



Source: Business Structure Database (2021). Ipsos MORI analysis

5.3.1 Overall effects

The trends presented above provide context for the analysis but in themselves do not describe causal impacts of the programme. The econometric analysis of the BSD sought to identify the causal relationships and indicated that:

- **Impacts on employment:** There is a high level of confidence that the programme has increased the number of workers employed by firms receiving funding through the EEF programme. The findings imply that firms employed between 16 and 21 percent more workers per grant awarded. Aggregating these results over the average number of employees in the baseline year (13), and the number of grants awarded (133), this equates to between 282 and 365 jobs created in total by 2018. These results are broadly in line with those obtained for R&D employment – indicating that firms have largely recruited R&D (rather than production) workers.
- **Impacts on turnover:** The findings were mixed in relation to the programme's effects on turnover (with some suggesting there were no effects and others indicating that the effect was negative). Average turnover over the 2010 to 2018 period for declined firms can be seen to rise faster than for successful firms however this was only visible as negative impacts in 3 of the 5 models presented below, accounting for control variables

and alternative comparison groups. These results indicate that the effect of the programme on commercialisation outcomes were limited by 2018 (and it should be noted that the measures of turnover used for the analysis were lagged). The findings are consistent with a scenario in which the programme has enabled participating firms to increase their investment in intangible capital (via R&D spending) – but exploitation of those investments was limited.

- **Impacts on productivity (turnover per worker):** The findings generally pointed to negative effects on turnover per worker. Again, this is consistent with firms increasing their investment in intangible capital and implies that the programme had not produced any economic benefits (in the form of increased productive capacity) by the end of 2018.

Table 5.6: Estimated impact of EEF grants on employment, turnover and productivity to 2018

	Model 1	Model 2	Model 3	Model 4	Model 5
Firms included	All	All	Applicants scoring >60	Matched sample	Firms awarded grants
Model	OLS	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
Dependent variable	Log transformed	Log transformed	Log transformed	Log transformed	Log transformed
Year Fixed Effects	No	Yes	Yes	Yes	Yes
Number of observations	2,983	2,983	1,086	1,421	723
Outcome	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Employment	0.163***	0.177***	0.185***	0.200*	0.211***
Turnover	-0.294***	-0.0654	-0.275*	0.294	-0.294*
Turnover per worker	-0.457***	-0.242**	-0.460***	0.0943	-0.505***

Source: Business Structure Database (2021). EEF Application Information, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively.

5.3.2 Relative effectiveness of EEF

The models suggested that participation in the EEF had larger effects on overall firm level employment than awards made by Innovate UK (a 16 to 21 percent increase compared to a 3 to 4 percent increase). No effects on turnover and turnover per worker were consistently evident from other Innovate UK funding.

5.3.3 Effects by TRL and by technology area

The following table breaks down the results by starting TRL and technology area:

- TRL: There were no major differences in the results by starting TRL. Results for TRL 7+ were suppressed due to sample constraints.
- Technology area: Impacts on employment were only visible amongst firms receiving grants for projects in the energy supply technology area, with no impacts on firms taking forward energy demand projects. Similarly, results for the other category were supressed due to sample constraints.

Table 5.7: Estimated effect of grants on employment, turnover and productivity to 2018 by firm size, TRL and technology area

	Model 6	**Model 7**	**Model 8**	**Model 9**
Firms included	All	High scoring applicants	Matched sample	Firms awarded grants
Model	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
Year Fixed Effects	Yes	Yes	Yes	Yes
No. of obs	520 to 2,205	209 to 779	270 to 1,037	135 to 507
Outcome	Coeff.	Coeff.	Coeff.	Coeff.
TRL3 to TRL4				
Employ.	0.164**	0.184**	0.270	0.229**
Turnover	-0.217	0.00259	0.510	0.0774
Turnover per worker	-0.381**	-0.182	0.240	-0.152
TRL5 to TRL6				
Employ.	0.243***	0.234***	0.192*	0.265***
Turnover	0.0592	-0.123	0.358	-0.104
Turnover per worker	-0.183	-0.357*	0.166	-0.369*
Energy demand				
Employ.	0.0784	0.0894	0.172	0.0880
Turnover	0.363*	0.0165	0.716*	-0.0612
Turnover per worker	0.285	-0.0729	0.544	-0.149
Energy supply				
Employ.	0.165***	0.203***	0.286	0.228**
Turnover	-0.282**	-0.383*	0.088	-0.351
Turnover per worker	-0.447***	-0.586***	0.135	-0.579***

Source: Business Structure Database (2021). EEF Application Information, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively.

5.4 Impact evaluation – logistic regression results

The detailed results from the logistic regression analysis are presented in the tables below. These show that:

- There were no statistically significant results in the modelling of the effects on increases in R&D activity, except for a negative effect on the probability of increasing R&D activity if the applicant had reported barriers to securing external finance (at the 90 percent significance level);
- A strongly significant increase in the probability of improving technical readiness if the business received support from the EEF. Other factor which was found to influence the probability of improving technical readiness was the technical area (negative impact for projects in the Clean Industry and Waste, Biomass and Water group) and the maturity of the business (the business being established for less than five years had a negative impact on the probability of increasing technical readiness).
- A significant positive impact on the probability of improving commercial readiness if the business received support from the EEF, although this result is not observed in models with additional variables included. Other factors which were found to contribute to the probability of improving commercial readiness were businesses being a micro-business (positive effect), having significant funding prior to the EEF application (positive effect) and the technical area (negative impact for projects in the Clean Industry group).
- The only significant impact on the probability of securing follow-on funding were the level of satisfaction with the quality and suitability of the incubation support, although the explanatory factor could be a result of achieving the positive outcome, and the size of the business at the point of application (being a micro-business had a negative impact on the probability of securing follow-on funding).
- No significant results for the impact on the probability of achieving a commercial outcome, except for a positive impact if the business was satisfied with the quality of the incubation support (at the 90 percent significance level) – although the explanatory factor could be a result of achieving the positive outcome.
- A significant positive impact on the probability of increasing turnover and employment if the business had raised significant finance prior to the EEF application and if the business was a micro-business.

Table 5.8: Results of logistic regression showing factors which influenced probability of achieving EEF outcome (1)

Factor	Impact on improvement in R&D activity		Impact on improvement in TRL		Impact on improvement in CRL		Impact on whether follow-on funding raised	
	Basic spec.	Additional variables	Basic spec.	Additional variables	Basic spec.	Additional variables	Basic spec.	Additional variables
Received EEF support	0.728	-0.102	2.232***	2.758**	1.703**	2.139	-0.392	-1.091
Raised significant finance prior to application	-1.153	-0.394	1.096	0.336	1.030	3.125*	-0.262	-0.529
IP in place prior to application	0.774	1.099	0.877	1.404	0.635	0.318	0.587	0.122
Immature business (<5 years)	0.203	-1.050	-1.269*	-2.333**	-1.127	-1.824	0.441	-0.0181
Financial barriers prior to application		-2.335*						
TRL at application		0.639		0.801				-0.209
Micro-business at application			-0.380	0.264	1.901**	2.501*	-0.410	-1.119*
CRL at application						0.546		0.142
Satisfaction with incubation support						-2.178	0.497	1.648**
Suitability of incubation support						1.259	1.178**	1.872**
Incubation support helped business						2.210	-0.423	-1.560*
Clean Industry				-4.696**		-3.721*		-1.353
Clean Power		-0.294		-1.796		-1.386		-0.790
Energy Networks		1.957		0.792		0.690		-0.548
Waste, Biomass and Water		-0.941		-3.571**		1.695		0.384
Transport						0.882		0.428
Number of observations	50	38	91	85	83	79	136	99

Source: EEF Application Information and CPRs, responses to qualitative interviews, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively

Table 5.9: Results of logistic regression showing factors which influenced probability of achieving EEF outcome (2)

Factor	Impact on achievement of commercial outcomes		Impact on increases in turnover		Impact on increases in employment	
	Basic spec.	Additional variables	Basic spec.	Additional variables	Basic spec.	Additional variables
Received EEF support	-0.411	-0.787	-0.0234	-0.696	0.319	1.068
Raised significant finance prior to application	0.536	-0.102	1.219*	1.246	1.246**	1.555**
IP in place prior to application	-0.571	-0.990	-0.965	-1.937**	-0.483	-0.895
Immature business (<5 years)	0.391	0.483	-0.245	0.471	-0.813	-0.407
Financial barriers prior to application						
TRL at application				-0.0746		0.0966
Micro-business at application	0.140	0.165	2.222***	3.534***	0.975	1.764*
CRL at application		0.0904		0.598		0.211
Satisfaction with incubation support		1.315*				
Suitability of incubation support		-0.327				
Incubation support helped business		-0.592				
Clean Industry		-0.218		-0.699		-0.190
Clean Power		-0.0556		-0.636		0.243
Energy Networks		0.415		0.916		-0.161
Waste, Biomass and Water		0.445		0.962		-0.450
Transport		-1.557		0.457		0.683
Number of observations	136	101	73	57	90	67

Source: EEF Application Information and CPRs, responses to qualitative interviews, Ipsos MORI analysis. ***, **, and * indicate that the estimated coefficient was significant at the 99%, 95%, and 90% level of confidence respectively

5.5 Economic evaluation

5.5.1 Results of impact of programme on company valuation

Estimates of the impact of the programme on valuations are reported in the table below:

- Subject to the caveats highlighted in Section 4.5, the findings give a high level of confidence that the programme had a positive effect on the valuations of firms. The results were statistically significant in all models but one and were robust to both unobserved differences between firms and time-specific shocks affecting all firms.
- This implies that the investments in intangible capital stimulated by the programme are expected by investors to produce economic (and by implication, environmental) benefits in the future. However, these expected benefits are not yet visible in tangible growth in turnover or realised profits and are subject to a degree of uncertainty.
- The magnitude of the estimated effects ranged from £4.3m to £8.1m per grant awarded. Models that did not allow for unobserved time shocks tended to produce larger estimated impacts. The estimates ranging from £4.3m to £5.3m per grant awarded are favoured as they account for a wider range of unobserved factors.

Sample sizes were insufficiently large to explore differential effects across subgroups of the population.

Table 5.10: Estimated impact of EEF on valuations (£m)

Population of firms	Firm fixed effects	Time fixed effects	Estimated impact (£m per grant)	Sig.	Number of obs.
All	Yes	No	8.11	***	640
All	Yes	Yes	4.33	***	640
High scoring	Yes	Yes	4.36	***	422
Matched	Yes	Yes	5.26	**	508
Successful only	Yes	No	8.11	***	308
Successful only	Yes	Yes	1.74		308

Source: EEF monitoring information, Pitchbook. 95 percent confidence intervals shown in the shaded area. ***, **, and * indicates whether the estimate was significant at the 99, 95 or 90 percent level of significance

5.5.2 Additional R&D spend per £1 of public spending

The results above (Section 5.1.1) indicated that the programme increased average annual R&D spending by 38 to 68 percent by 2018 per grant awarded:

- Applying these results to median annual R&D spending (£945,000) before firms were awarded grants through the EEF programme, gives an average effect on annual R&D spending of £359,000 to £633,000 per grant awarded.

- Assuming that these effects will persist into 2019 and 2020, and applying these findings to the average number of years that have elapsed since grants were awarded (6.3 years in 2020), this gives an estimated total effect on R&D spending of £328m to £580m by the end of 2020 (with a present value of £253m to £446m[28]).
- Allowing for public spending on the programme of £67m, this implies that the programme stimulated additional private spending on R&D of £3.90 to £7.64 per £1 of public sector expenditure. This is indicative of a substantial 'crowding-in' effect and higher leverage ratios than many other forms of public support for R&D. For example, an evaluation of R&D tax credits found a leverage ratio of around £0.75 per £1 of public sector spending[29].

5.5.3 Equity investment leveraged per £1 of public spending

The results (presented in Section 5.2.1) indicated that each grant awarded through the programme increased the equity investment raised by firms by £0.7m to £2.1m on average by 2020 (per grant awarded):

- Applying this to the 156 grants awarded through the programme, this gives total estimated impact on funding raised of £109m to £326m by the end of 2020.
- Allowing for £67m in public sector spending, this gives leverage ratios of £1.63 to £4.87 per £1 of public sector spending.
- There are few benchmarks available for the effectiveness of public programme in leveraging equity investment into companies. The findings indicated that the EEF was more effective than Innovate UK R&D grants awarded to the same group of companies. However, there is evidence that higher leverage ratios can be achieved in other sectors. For example, an evaluation of the Biomedical Catalyst[30] using similar methods and data found a leverage ratio of £4.99 to £6.36 per £1 of public spending.[31]

5.5.4 Social welfare analysis

An indicative social welfare analysis has been completed by comparing the effects of the programme on R&D investment (Section 5.1.1) to its economic benefits capitalised into the valuations of firms (Section 5.5.1):

- The EEF was estimated to increase the value of firms supported by the programme by £4.3m to £5.3m per grant awarded. Applying this result to the 156 grants awarded gives

[28] Applying a discount rate of 3.5 percent per annum in line with the HM Treasury Green Book with a baseline of 2012.
[29] Do Tax Incentives for Research Increase Firm Innovation? An RD Design for R&D. Dechezlepretre, Einio, Martin, Nyugen and Van Reenan. Centre for Economic Performance Discussion Paper No 1413. London School of Economics. 2016
[30] Biomedical Catalyst Impact Evaluation. (2019). Innovate UK, Medical Research Council, UKRI. Available at: https://www.gov.uk/government/publications/biomedical-catalyst-impact-evaluation
[31] The Biomedical Catalyst focussed on a different sector to the EEF, which may explain some of the differences between the programmes. As outlined in the main report, the UK clean tech sector has struggled in recent years to attract VC investment at the same rate as other sectors. The Biomedical Catalyst was selected as a comparator because the programme provides funding for industrial R&D at a similar range of TRLs at similar levels as the EEF programme, it used similar mechanisms for allocating funding, and the findings presented in the evaluation were based on the same data and methodology as the approach used in this evaluation.

a total increase in the value of firms of £671m to £826m. This is taken as a measure of the present value of the net economic (and by implication, environmental) benefit of the programme.

- The present value of additional R&D spending stimulated by the programme was estimated at £253m to £446m. This is taken as a measure of the net social cost of the programme.
- These give an indicative Benefit to Cost Ratio (BCR) of £1.50 to £3.26.[32] The midpoint of these results (£2.19) aligns with the hurdle rate of return normally applied in the economic appraisal of these types of programmes.

The findings are subject to the following limitations:

- The use of firm valuations as a measure of economic benefit assumed that financial markets are well-functioning. However, the programme itself is predicated on an assumption that markets do not price investments in clean technologies effectively.
- Estimates of the impact of the programme on firm valuations are likely understated because the value of firms that do not attract follow-on investment is unobserved.
- Firm valuations only capture private benefits to the investor. These measures will only capture environmental externalities to the degree that future Government policy is expected to encourage consumers to fully internalise the environmental costs of their resource consumption. Additionally, this measure of benefit will not capture other economic benefits that may arise from future exploitation of the technologies (e.g. wage benefits for workers or knowledge spill-overs).

5.5.5 Cost-effectiveness of environmental impacts

There were 11 successful projects that provided sufficient evidence to draw reasonably robust conclusions related to the level of CO2 reductions/savings that they will achieve. A summary of the results of the likely emissions reductions associated with the 11 projects are shown in the table below.

- The anticipated CO2 savings for the 11 projects is approximately 170,000 tCO2, which equates to an average of just over 15,500 tCO2 per project. In monetised terms, this is valued at approximately £5m (in 2018 terms) over a ten year time horizon.
- The value of grants provided to the 11 projects amount to £4.8m. The subset of 11 projects produce a likely return on investment of £1.03 per £1 of public spending in terms of environmental benefits only.
- There are some significant variations in the scale of CO2 savings across the projects. Project G, an operational plastic recycling project, is anticipated to provide 120,000 tCO2 of this total alone (74 percent of all anticipated CO2 emissions from this

[32] This has been calculated by dividing the increase in the firm valuation by the increase in R&D expenditure. The range has been calculated by dividing the low value for the increase in value of firms by the high value of the additional R&D expenditure (£671m / £446m), and the high estimate has been calculated by dividing the high value of the increase in firm value by the low estimate of the increase in R&D expenditure (£827m / £253m)

subset of 11 projects), with an environmental return on investment of 5.25. Project I, a vehicle emission retrofit, is anticipated to provide 24,000 tCO2 reductions, assuming the company meets 2 percent of its short-term sales objectives.

- Eight of the projects had negative environmental returns on investment based on current progress[33]. Only evidence that provides a clear demonstration of committed sales, market commercialisation and associated wide scale adoption of the technologies is used as assumptions in this estimate.

Table 5.11: Indicative evidence of the reduction in emissions of technologies developed through the EEF

Project No.	Total Grant Received Cost	CO2 emissions reductions	CO2 monetary impact	Cost of project CO2 reduction	Environmental benefit Return On Investment
Units	£	(tCO2)	(£2018)	£ per reduction tCO2	
A	202,400	13,617	226,867	15	1.12
B	788,996	730	17,833	1,081	0.02
C	150,000	3,259	21,706	46	0.14
D	558,080	1,980	48,370	282	0.09
E	387,594	323	9,897	1,200	0.03
F	191,163	76	982	2,532	0.01
G	695,004	126,000	3,650,605	6	5.25
H	800,000	300	8,692	2,667	0.01
I	348,433	24,000	907,653	15	2.60
J	160,794	96	63,130	1,668	0.39
K	530,462	905	24,896	586	0.05
Total	**4,812,925**	**171,286**	**4,980,631**	**918**	**1.03**

Potential future CO2 emissions reductions

The 11 cases selected for this analysis have all produced ex-ante modelling of the effect their technology will have on environmental emissions. The upper bounds of these ranges provide an optimistic view of the environmental benefits that could be realised and attributed to the

[33] Guidance on the valuation of greenhouse gases published by BEIS in September 2021 provides updated values for carbon (analysis was conducted in February 2021). Using these values, increased positive return on investment are observed per project but around one third of projects are still not be expected to deliver emissions reductions that exceed the value of grants awarded over a ten-year time horizon.

EEF programme. The ex-ante modelling shows that there are four categories of project funded by the EEF:[34]

- High Impact – Project B, an Industrial scale carbon capture technology, which if successful applied at its project partner's site, will conservatively save approximately 36.5m tCO2 over a 10-year period. This equates to monetised benefits of approx. £2.5bn over 10 years.
- Medium Impact – Three of the 11 projects offer medium scale impacts, with ex ante projections that estimate savings between 750,000 – 2 million tCO2 over a 10-year period per project. The projected monetised savings from these projects together equates to approximately £161m over 10 years.
- Small Impact – Four of the 11 projects offer small impact, with ex-ante projections that estimate savings between 68,000 – 250,000 tCO2 over a 10-year period. The projected monetised savings from these projects together equates to approx. £23m over 10 years.
- Very small or niche impact – Four of the 11 projects offer very small or niche impacts, with ex-ante projections that estimate savings between 900–11,700 tCO2 over a 10-year period. The projected monetised savings from these projects together equates to approx. £730k over 10 years.

This largely reflects the conclusion in the main evaluation report that most of the environmental benefits in the programme are likely to arise from a small number of successful projects that are focused on industrial/energy generation carbon reduction.

[34] It is important to note that these are potential savings dependent on wider scale adoption of the technologies

6. Research materials

This section presents the research materials used in the qualitative research with EEF applicants and programme stakeholders.

6.1 Qualitative interviews with applicants

6.1.1 Introductory email

Dear …,

As you may be aware, the Department for Business, Energy and Industrial Strategy (BEIS) are currently undertaking an evaluation of the Energy Entrepreneurs Fund (EEF). BEIS have commissioned Ipsos MORI and Technopolis Group (independent research organisations) to undertake the evaluation study (see attached endorsement letter from BEIS).

In order to understand the impact of the EEF programme, it is essential to speak to businesses that have applied for support from the EEF programme. We understand that you were involved in the EEF programme through submitting an application to participate in the programme on behalf of [NAME COMPANY].

This email is to notify you that you may be approached by Ipsos MORI and Technopolis to participate in a telephone interview lasting approximately one hour to discuss your application to the EEF programme.

The topics that the interview will cover are:

- The application process for the EEF;
- The innovative idea that you applied for support from the EEF with, and any support you had received for the innovation prior to applying to the EEF;
- [Only successful participants] Your views of the support that you received;
- The progress you have made with your innovative idea since your application to the EEF.

The interviews will be conducted by Ipsos MORI and Technopolis Group between the August and October 2020. Your contribution will be confidential and anonymous and your involvement is entirely voluntary. However, we would like to emphasise that your contribution would be extremely valuable and worthwhile in shaping the BEIS' future strategy for innovation support. We hope that you (or a suitable colleague) would be willing to share your experience.

We will contact you in the near future to arrange a convenient time for the telephone interview to take place. However, if you would prefer not to participate in the research study, please contact XXXX, the study manager at BEIS, via email: XXXX.

If you have any questions about the evaluation study or your participation, please contact XXXX (XXXX) or XXXX (XXXX), who manage this study.

We would like to thank you in advance for your cooperation.

Kind regards,

6.1.2 Topic guide for applicants

Consent

It is essential that the interviewer asks for consent to record the interview and covers the bullets below.

Read to interviewee:

Thank you for agreeing to take part in this interview. As you know, BEIS has commissioned Ipsos MORI and Technopolis Group to conduct an independent evaluation of the Energy Entrepreneurs Fund programme. This interview should last about 60 minutes. Your participation in this interview is voluntary and you can change your mind at any time.

The information that you provide will be treated in confidence by Ipsos MORI/Technopolis Group. The interview documentation, recording and notes will be securely deleted from Ipsos MORI/Technopolis files after publication of the evaluation report.

We will provide BEIS with anonymised factual data, opinions and views of participants gathered from the interviews for their internal purposes. Publication relating to the outcomes of the evaluation will only provide an aggregated and anonymised summary of participant feedback.

To confirm, we would like to use your feedback and experience as an EEF participant and request your permission for the following:

- To use the feedback you provide, together with any additional information you choose to disclose ("Information") for the evaluation study.
- We will share an anonymised version of this information and any analysis we carry out as part of the evaluation study with BEIS, for its own internal purposes only.
- BEIS expect to publish aggregate, unattributed results from the study.

We would like to record the discussion for analysis purposes, these recordings will be used to help us with the findings of the research. The recordings will be securely stored and retained by us and destroyed after the completion of the evaluation. Are you happy for us to proceed?

Section A: Project background

Interviewer instruction: much of the information requested in the following questions will be available in the documentary record. The interviewer should use this section to confirm understanding and items of fact and fill any gaps in. Interviewers should ensure that all items of importance are captured on the recording to facilitate post-coding following the interview. For

applicants that have benefitted from more than one EEF award, the interviewer should make clear that we are interested in the background to the project before their first award.

1. I would like to start the interviewer just by confirming our understanding of your company and its activities at the point of your successful application for EEF. *Interviewer instruction: summarise background investigations into the company and confirm the following details (probing further where there are gaps in information): Quantitative measures of levels of equity backing, public funding, turnover and employment, R&D employment and spending should be obtained or confirmed on the tape so they can be recording in coding.*

Note: Some participants will have previously unsuccessfully applied for EEF support, and some have been successful in their application to the EEF multiple times. Be clear about the exact application that is being discussed (the first successful application), then subsequently probe for further successful applications as required.

- Nature of the company's activities – what industrial sector it was active in, the scope of products and/or services it was producing (or aiming to develop), and customer sectors.
- What level and type of backing/funding did the company have? If backed by equity funding – probe for type of investors (angel investors, VC, capital raised on public markets). Also, probe for levels and type of public funding (e.g. grants from Innovate UK).
- Size of the company – levels of turnover (UK and overseas) and number of employees.
- Spatial structure – location of headquarter and branch sites.
- R&D activity – levels of annual R&D spending in year running up to the application, and numbers of employees.

2. Can you briefly describe the background for the technology or innovation forming the focus of your application to EEF up until you received EEF funding? *Interviewer instruction: The responses to this question will be used to code the baseline level of development against the TRL scale. Interviewers should consult the TRL guides to adapt the probes below to ensure they are appropriate to the nature of the technology in question (i.e. hardware or software).*

Note: Some participants have been supported multiple times by the EEF programme. Check whether the same technology has been funded (progression of technology) or whether different types of technology have been supported.

- Where did the idea for the technology or innovation originate?
- What work had been undertaken to progress the technology or innovation at the point you were awarded EEF funding? Were the potential uses of the technology or innovation for customers fully identified? What experimental work had been undertaken to establish the performance of the technology or innovation?

- How did the UK's regulatory and policy environment impact on the technology / innovation prior to EEF funding?
- Had you worked up prototypes of individual components or the integrated system? If so, what tests had been completed (i.e. in laboratory/fully controlled setting, in a relevant environment outside the laboratory, operational environment)?
- What external partners had been involved in the development of the project? What were their roles?
- Had you applied for any intellectual property rights (e.g. patents) in connection with the technology or innovation? Did your project depend on any intellectual property licensed from others?
- (For those that have received multiple rounds of support) Did the technical readiness of the innovation project align with the assessment at the end of the previous round of EEF support? What are the reasons for any differences?

3. What was the original commercial opportunity associated with the technology or innovation? *Interviewer instruction: The responses to this question will be used to code the baseline level of commercial readiness against the CRL scale. Interviewers should consult the guidance on the CRL scale.*

- What problem/issue was the technology or innovation aiming to address?
- How did you expect to generate revenues when commercialising the technology or innovation? Had financial modelling of revenues and costs been completed?
- What market research had been undertaken to validate the potential use cases and customer requirements for the technology or innovation? What market needs did this research reveal? How did this research inform the development of the technology or innovation?
- What mapping of potential suppliers, partners, and customers had been completed? To what degree had relationships been established and/or formalised (including any sales agreements)?
- Had any certification and/or regulatory requirements been established or met?
- What plans did you have in place to produce the technology or innovation? What was the technology or innovation manufacture plan (e.g. internally or using suppliers)? How far had manufacturing plans evolved? Did you have a supply chain in place?
- What research had been completed into the competitive landscape? What alternatives were being developed by competitors at the time?

4. Can you briefly describe the aim of the project, at its outset, and what you hoped to achieve? *Interviewer instruction: Summarise your understanding of the aims and objectives of the project so it is recorded on the tape and ask the interviewer to confirm/validate to ensure time is not absorbed unnecessarily. Cover technical and commercialisation objectives as expressed in the application form.*

5. What attempts were made to fund this project prior to your successful application for EEF?

- What types of funding were sought? Cover internal (e.g. existing R&D budgets, funding from parent companies) and external sources (equity finance, public grants, previous applications to the EEF)?
- At what stage in your search for funding did you apply to EEF? (e.g. Was EEF the first application for funding or last? Were you applying for multiple sources of funding at the same time?
- What were the outcomes of these efforts? Why were these insufficient to fund the project? What barriers did you face?
- If no attempts were made to seek private funding, why not? What barriers or challenges did you anticipate?

Section B: Application

I would just like to move on now to some questions about your application to the Energy Entrepreneurs Fund. *Interviewer instruction: If the applicant has submitted more than one application to the EEF, clarify that you are interested in their first successful application to the fund. For those that have applied multiple times, follow up with questions about experience of subsequent applications.*

6. How did first you first find out about the EEF?

- Probe for sources of information received about the programme (marketing events, sector body, business network, social media, growth hub / regional organisation, peers/word of mouth etc?)
- Did you engage with the on-line guidance materials on the aim and objectives of the programme, eligibility criteria, application process and criteria?
- Did the information you receive provide sufficiently clarity on the application, assessment and award process?
- (For those submitting multiple applications) How did these experiences change for the subsequent applications you submitted? Probe around different sources of information, different information / presentation of information, level of understanding etc.
- How could the information you accessed be improved in the future?

7. Why did you apply for EEF support?

- What factors did you consider when making the decision to apply? Probe for issues around the level of administrative burden associated with submission of the application, the level of competition for funding and the likelihood of success, and the requirement for matched funding.
- Did the initial EOI process have any influence over your decision to submit the application?

- Probe for relative importance of R&D funding and incubation support.
- Did you already have match funding in place when you applied? Or was that not possible until you were successful?
- (For those submitting multiple applications) How did these motivating factors change for the subsequent applications you submitted?

8. What are your views on the application process for EEF?

- Were the instructions provided to complete the form easy to understand? Were you able to ask questions and receive support from the EEF team to resolve issues?
- Was the information required to complete the form easy to access and relevant to your project or business? What information was difficult for your organisation to access?
- How much resource was required to develop your application? Probe on rough number of labour hours. Did you use external consultants to help you prepare your application? If yes, probe on the approximate costs incurred?
- Was the application window open long enough to resource and produce a high-quality proposal?
- What improvements could be made to the application process?
- (For those submitting multiple applications) Did the application process change between your applications? How did the process change? Information required, timelines, guidance support? Had the process improved?
- How did the timings of the funding rounds affect your ability to secure match funding? Were they aligned to private sector investment rounds?

9. What are your views on the post-award process of agreeing the Grant Offer Letter and the terms of receiving support?

- Were the due diligence requirements of the programme proportionate/straightforward?
- Did you encounter any challenges agreeing the Grant Offer Letter and terms of support? How were these resolved?
- Probe around issues with:
- Due diligence
- Annex 2 agreement
- Terms and Conditions
- Panel / planning session issues
- Were the timescales to an award decision appropriate? Did the time taken to award have any impact on the progression of the project? What factors contributed to any delays in awarding support? Probe around red flags from the Incubation Plan, issues raised by the Panel, due diligence issues, etc.

- Were the conditions set out in the Grant Offer Letter and terms of support appropriate? Did they produce any changes in your approach to the project or influence it any other way? If so, how?
- (For those awarded multiple rounds of support) How did your experiences of the post-award process change between your successful applications? Had the processes involved changed? The conditions set out in the GoL etc.?

Section C: Incubation support

I would now like to ask you some questions about your experience of the incubation support you received / are currently receiving as part of the programme.

Interviewer instruction: The interviewer should start by summarising understanding of the incubation plan agreed and asking the interviewee to validate this. For applicants benefitting from multiple EEF awards, these questions should refer to the totality of incubation support received.

10. How did you agree the project incubation plans with the incubation planner?

- How did you feel about the incubation support before the incubation planning meeting? How did you think it could add value to your project or business?
- What was involved in the incubation planning meeting? What evidence was required and used to inform the plan?
- Did you agree with the baseline assessment of your business / innovation? If not, what were the points of difference and how were these resolved?
- Were there any differences between your assessment of the technical readiness of your innovation and the assessment of the innovation planner? How were these resolved?
- How were your support needs assessed? Was there consensus between yourself and the incubation planner on the types of support that you need? If not, how were points of disagreement resolved?
- Did the incubation planner fully understand the needs of your business / innovation?
- Did you feel that the range of incubation support available sufficient for your needs? Were there any types of support you considered you may have benefitted from that wasn't available from the programme?
- (For those awarded multiple rounds of support) How did this process change between the rounds of support you have received? Probe around views at the start of the process and the ways in which the support tasks were agreed.
- How could the incubation planning process be improved?

11. How was / is the incubation support managed?

- Who was / is responsible for managing the incubation support you receive? How frequently were / are you in contact with them?

- Did / does your assigned incubation manager have a sufficient understanding of your technology? Were they well matched to you in terms of expertise?
- Did your support needs change over the course of the project? Was the package of support sufficiently flexible to respond to these changing needs?
- What processes are involved in making alterations to your incubation support plan? What evidence needs to be provided? Is this process proportional?
- How could the incubation management process be improved?

12. How did / does the incubation support the development of your project and/or business? *Interviewer note: the probes below should be tailored to the specific incubation activities that the interviewee participated in.*

- What market analysis or research was completed to validate potential use cases, customer requirements, or competitors for the technology or innovation? What did this analysis or research reveal? How did this inform the development of your proposition to the market, your understanding of the route to market, your overall strategy or business plan?
- How did the support help you understand the steps that would need to be taken to commercialise the product? How did this understanding influence your plans and/actions to progress the technology? Probe around:
    - the types of trials that would be needed to reach commercial acceptance
    - develop supply chain partners / mange the supply chain
    - validation of the attributes of the technology
    - certification/regulatory requirements
    - intellectual property issues
- What work was completed to map potential customers, suppliers or partners? What partnering needs did this process identify? How far did incubation support help you establish and/or formalise these relationships?
- What skills needs, gaps or recruitment needs did you identify? What actions did you take to respond to this (e.g. introduction of new communication or project management processes, appointment of management staff)?
- What actions did you take to prepare your company for external investment? How did participation in the programme help build skills in engaging with external investors?
- (For those awarded multiple rounds of support) How did the effects of the incubation support activities vary between the rounds of support you received? Did the support build on tasks previously provided to generate impact?

13. What are your views on the quality of the incubation activities you received? *Interviewer instruction: Refer to the CPR where available to provide background insight into the probes below.*

- What were the strengths and weaknesses of the support you received? What improvements could be made?
- Overall, how did the development of your project or business benefit from the incubation support? Has the incubation support directly led to any outcomes? Please specify.
- Could you have obtained / did (do) you receive similar support outside of the programme? Would you have taken this up had you not participated in the EEF? If not, why not?
- (For those awarded multiple rounds of support) How did your experience of incubation support change between the rounds of support you have received? Probe around the appropriateness of support tasks, quality of delivery activities, quality of delivery agents, timing etc.

Section D: Delivery of the innovation project

I would now like to move on to the delivery and results (if the project is finished) of the Innovation project.

Interviewer instruction: The interviewer should review the CPR (if available) and monitoring information to gain an understanding the success of the Innovation project. For applicants benefitting from multiple EEF awards, these questions should refer to the totality of incubation support received.

14. Could you describe the key elements executed (so far) within the work programme and how far this aligned with prior expectations?

- What work was done / is being undertaken to develop the innovation project? What tests were completed (i.e. in laboratory/fully controlled setting, in a relevant environment outside the laboratory, operational environment)?
- How did you / are you resource(ing) the project? Did you recruit any R&D or other workers to support the delivery of the project? Did you need to reduce your investment in parallel projects to focus on the project?
- Were / are there any challenges encountered in the delivery of the project (e.g. access to specialised infrastructure or facilities, regulatory issues, changes in policy, issues with the design of the development programme)? If so, why did these difficulties arise? What was done to overcome them? Probe separately for issues relating to covid-19 (labour issues, social distancing, availability of technical equipment etc.) in the short-term and for more general challenges faced (either before outbreak or other issues faced during the outbreak).
- Have you encountered any gaps/challenges in the basic science that held up the execution of the work programme (e.g. availability of appropriate tools, methodologies)? Were these challenges anticipated at the start of the project? If not, why not? How were these challenges overcome?

- Did / is the execution of the project highlight any critical skill, capability, or resource requirements that were not anticipated at the start of the project? What adjustments were made to compensate for these gaps?
- (For those awarded multiple rounds of support) How did the key elements of the work programme in subsequent rounds of support build upon those completed in previous EEF projects? How did the subsequent work programme account for challenges / difficulties faced in previous projects?
- How did / does your Monitoring Officer help you respond to these challenges? Did they provide sufficient support throughout project delivery?
- How did the monitoring and reporting requirements for BEIS compare to your expectations? What was required? Was it proportionate? Did the various reporting requirements complement one another? Probe around:
    - Grant reporting process
    - Financial claims
    - Monitoring
    - KPI reporting
    - CPR and project closure
    - Survey of impacts
- (For those awarded multiple rounds of support) How did your experiences of monitoring and reporting change between the rounds of support you have received? Probe around monitoring officers, reporting
- Did the experiences in the delivery of the project lead to any requests to changes to the conditions of Annex 2 of the agreement? Were these proportionate to the change required (for example did small changes to delivery also require changes to Annex 2)? Did the process of agreeing these changes lead to any impacts on the delivery of the project?

15. What were the key findings of the project?

- How far did the actual outcomes of the project align with prior expectations? Did the technology or innovation perform as anticipated? How far did the technology advance during the delivery of the project (use TRL levels)?
- What were the main reasons for variance against expectations (where applicable)? What implications did these have for commercial potential of the underlying technology/its ability to meet the identified energy challenge?
- What did the project show in terms of the potential of the technology to reduce CO2 emissions (Interviewer instruction: customise this probe to the specific objectives of the project)? What was the basis of this evaluation? Are there any documents that could be shared that demonstrate these emissions reductions?

- Did the findings of the project enable you to apply for or register any new intellectual property rights (e.g. patents)?
- (For those awarded multiple rounds of support) How did the key findings change between the rounds of support you have received? Probe around variance from expectations, progress towards demonstrating CO2 emissions, IP applications.

16. What were the key aspects of learning or knowledge generated from the project?

- What new skills did you acquire? How have you applied these skills in other areas of your business?
- Did the findings of the project highlight any other avenues of inquiry that could be pursued? What has been done to take this forward?
- Did the findings of your project have any implications for policy makers in Government? If so, draw out the nature of these policy implications.
- Would it have been beneficial to have a formal opportunity to disseminate your key findings to BEIS policy officials? In what ways would this have supported the commercialisation of your innovation? What format should this have taken?
- Have any external parties (other companies, academic teams, public, policymakers) taken an interest in applying the results of your work? If so, draw out details of what knowledge transfer has taken place and its influence.

17. What commercial / funding outcomes did / has the project achieve during project delivery?

- Did / has your company received any further private sector investment during the delivery of the EEF project? Please specify value and type of funding? Was this funding related to the innovation developed in the EEF project?
- Did / has your company received any further public sector investment during the delivery of the EEF project? Please specify value and source of funding? Was this funding related to the innovation developed in the EEF project?
- Did the project achieve any sales to customers? Number of sales and what proportion of these were UK customers / proportion experts?
- How had / has the size of your company changed over the course of the support you have received from the EEF? Probe around:
    - Size of the company – levels of turnover (UK and overseas) and number of employees.
    - Spatial structure – location of headquarter and branch sites.
    - R&D activity – levels of annual R&D spending in year running up to the application, and numbers of employees.
- Were any attempts been made to license the technology? If so, probe for details of the licensee and their objectives in licensing the technology, and details of the agreement - headline value, key milestones/contingent payments, revenues earned to date.

Section E: Post-completion outcomes

Finally, I would like to understand what has happened since you participated in the programme (if applicable).

Interviewer instructions: Interviewers should familiarise themselves with external records of the progression of the company, including Pitchbook, Gateway to Research, and the companies' website.

18. Did the evidence produced from your EEF project provide conclusive/sufficient information to support a decision about whether to continue to develop the underlying technology?

- What decisions were made to progress the project or company at the end of the project? What factors were important in making these decisions?
- (For those awarded multiple rounds of support) How did the evidence and decision-making processes vary between the rounds of support you received?

19. What funding options were considered to progress the project (or secondary lines of inquiry)?

- Probe for internal and external sources of private funding, further public funding
- What barriers or challenges were encountered in securing additional funding to progress the project?
- What level and type of private backing/funding has the company secured since your participation in EEF began? If backed by equity funding – probe for type of investors (angel investors, VC, capital raised on public markets).
- What type and level of public grants have been secured?
- If the company has raised additional funding, how did your participation in EEF enable you to secure this additional funding?
- (For those awarded multiple rounds of support) How did the funding options considered vary between the rounds of support you received? Why did this vary (stage of development, funding sources available, skills of team, networks developed etc.)?
- Probe separately for issues relating to covid-19 in the short-term and for more general challenges faced (either before outbreak or other issues faced during the outbreak).

20. What work has been taken forward to progress the innovation developed in the project?

- Since completing your (first) EEF project, what further work has taken place to develop the innovation used in the EEF project? What further tests had been completed (i.e. in laboratory/fully controlled setting, in a relevant environment outside the laboratory, operational environment)?
- (For those awarded multiple rounds of support) What further work has taken place since your last round of EEF support?

- What are the findings of this work programme? Do you have any further evidence on the potential of the technology to reduce CO2 emissions? If so, are there any documents that could be shared that demonstrate these emissions reductions?
- Do you have any further evidence on the potential of the technology to reduce demand for energy / improve energy efficiency? If so, are there any documents that could be shared that demonstrate these emissions reductions?
- Do you have any further evidence on the potential of the technology to reduce energy costs? If so, are there any documents that could be shared that demonstrate these emissions reductions?
- Do you have any further evidence on the potential of the technology to increase energy system flexibility? If so, are there any documents that could be shared that demonstrate these emissions reductions?
    - If no documents, probe around the potential environmental impacts using probes from KPI data collection (see KPI spreadsheet). Probe on size, scale and timing.

21. What further work has been taken forward the commercial offer of your innovation?

- Have your commercialisation objectives changed since participating in the EEF? How has your business plan or strategy evolved? Has any further work been undertaken to develop your business model? What support have you received to develop this?
- Has your participation in EEF helped to apply for / unlock funding from other BEIS innovation programmes / other publicly funded programmes (e.g. InnovateUK)? If yes, how did you become aware of these programmes?
- Have you undertaken any further market research to validate the potential use cases and customer requirements for the technology or innovation? What market needs did this research reveal? How has this research informed the development of the technology or innovation?
- What further mapping of potential suppliers, partners, and customers has been completed? What further relationships been established and/or formalised (including any sales agreements)?
- Have certification and/or regulatory requirements been established or met?
- What plans do you have in place to produce the technology or innovation? How will/is the technology or innovation manufactured (e.g. internally or using suppliers)? What proportion of the supply chain is UK based and what proportion is from overseas? How far have manufacturing plans evolved?
- Have there been any significant developments in the wider landscape for your technology that have influenced your commercial plans (e.g. changes in the policy/regulatory landscape, the emergence of competing technologies, changes in the economic landscape?)
- Probe separately for issues relating to covid-19 in the short-term and for more general challenges faced (either before outbreak or other issues faced during the outbreak).

22. Have any sales agreements been reached with potential customers for the technology or innovation?

- If yes, probe for the details of the extent of adoption – number and location of sites, number of customers and number of products sold, products sold in the UK, products exported
- How does this compare to the market potential for the technology?
- Probe for details on the levels of revenue generated to date, broken down by customers in the UK and customers overseas.
- Have any attempts been made to license the technology? If so, probe for details of the licensee and their objectives in licensing the technology, and details of the agreement - headline value, key milestones/contingent payments, revenues earned to date.
- How did your participation in the EEF help you achieve these commercialisation outcomes?
- Probe around potential short-term challenges relating to covid-19 outbreak.

23. Finally, I would just like to understand how your company has grown since your first application to the EEF. *Probe for details of:*

- Current Size of the company – levels of turnover (UK and overseas) and number of employees.
- Current Spatial structure – location of headquarter and branch sites.
- Current R&D activity – levels of annual R&D spending in year running up to the application, and numbers of employees.
- Ask for levels for the business prior to covid-19 outbreak. Then probe around potential short-term challenges relating to covid-19 outbreak.

THANK RESPONDENT FOR THEIR TIME AND CLOSE.

6.2 Qualitative interviews with stakeholders

6.2.1 Introductory email

Dear …,

The Department for Business, Energy and Industrial Strategy (BEIS) are currently undertaking an evaluation of the Energy Entrepreneurs Fund (EEF). BEIS have commissioned Ipsos MORI and Technopolis Group (independent research organisations) to undertake the evaluation study.

As part of the evaluation, we would like to gather the views of stakeholders that have been involved with the delivery and/or management of the EEF programme, and individuals that are involved in clean energy financing and policy development.

The aims of these interviews will be to:

- Enhance our understanding of need for the EEF programme, and how the programme compliments other initiatives and funding to promote clean energy businesses and technologies;
- Understand how the programme has been delivered, what has worked well and how the programme could be improved in the future; and
- Identify how evidence and learnings from EEF projects are (or could be) used in financial decisions and policy development.

We would like to request your participation in a telephone interview to discuss the EEF programme with you. The interview would take place over the phone and would last a maximum of one hour, but would most likely be shorter than this. Please note that we will only ask questions which are relevant to your role and experience of the programme.

Could you suggest a convenient time in the coming weeks for the interview to take place?

Kind regards,

6.2.2 Topic guide for stakeholders

Consent

It is essential that the interviewer asks for consent to record the interview and covers the bullets below.

Read to interviewee:

Thank you for agreeing to take part in this interview. As you know, BEIS has commissioned Ipsos MORI and Technopolis Group to conduct an independent evaluation of the Energy Entrepreneurs Fund programme. This interview should last about 60 minutes. Your participation in this interview is voluntary and you can change your mind at any time.

The information that you provide will be treated in confidence by Ipsos MORI/Technopolis Group. The interview documentation, recording and notes will be securely deleted from Ipsos MORI/Technopolis files after publication of the evaluation report.

We will provide BEIS with anonymised factual data, opinions and views of stakeholders gathered from the interviews for their internal purposes. Publication relating to the outcomes of the evaluation will only provide an aggregated and anonymised summary of participant feedback.

We would like to record the discussion for analysis purposes, these recordings will be used to help us with the findings of the research. The recordings will be securely stored and retained

by us and destroyed after the completion of the evaluation. **Are you happy for us to proceed?**

Section A: Background (all interviewees)

1. Can you describe your involvement with clean technology innovation or finance, and your involvement with the Energy Entrepreneurs Project?

- What is your job role? What does this involve? How long have you held this role for, and what is your previous experience?
- What was your involvement with the Energy Entrepreneurs Fund (if any)/ have you been involved with the Energy Entrepreneurs Fund? Has your role changed over time?
- When were you last involved with the EEF programme (which phase of the EEF)? How many phases of the EEF have you been involved with?

Section B: Strength of strategic case (all interviewees)

2. Why do companies need public funding to develop and commercialise clean technologies?

- What are the key barriers holding back private investment?
- How do these issues vary across different types of technology area/company?
- How do these issues vary across stages of development (seed/early/late stage)?
- How have these barriers changed over the course of the EEF programme (since 2012)?
- What commercialisation skills / experience do EEF applicants tend to lack?
- Is the EEF sufficiently targeted at areas of need? Are there sectors/technology areas that have more or less need of support?

3. How does the EEF fit within the landscape of support for research and commercialisation of low carbon technologies? *[Interviewer: probe for changes between phases of delivery]*

- How has the landscape for research and commercialisation of low carbon technologies evolved since the EEF was launched in 2013?
- How strong is the pipeline of innovative ideas suitable for the EEF programme? What are the typical origins of project proposals (e.g. type of company, academic institutions, etc)?
- Is EEF effective in supporting all communities with viable ideas for low carbon technologies? If not, where are the gaps and how could they be addressed?
- Were any steps taken to align EEF with other grant and incubation programmes operated by BEIS, Innovate UK, EPSRC, UKRI and the European Commission? In general, how does EEF complement other programmes? Where are the areas of duplication?

- Have any of these contextual factors changed in significance during delivery and between phases?
- What comparable programmes are operated by other leading nations (e.g. US, France, Germany)? How far is EEF in competition with these programmes?

4. How well does EEF align with Government policy objectives around clean growth and decarbonisation of the company?

- How were Government decarbonisation objectives considered in the design of the EEF?
- Since the programme was launched in 2012 what have been the significant changes in regulation and/or policy that have influenced the landscape for commercialisation of low carbon technologies?
- What impact have these changes had on the pipeline of ideas coming forward for EEF? What impact have these changes had on the commercialisation/adoption prospects?
- What more could be done to align EEF with the direction of regulation and/or policy?
- How does the EEF programme and projects funded align with Government policies around technologies?

Section C: Competition Design and Promotion (Pre-Application Process) (for BEIS and CLT programme managers only)

5. How were EEF competition scopes developed?

- What consultation took place with private sector, academics, Innovate UK, other funders, policy colleagues to define the priority projects/technologies/businesses? What gaps were there in the types of stakeholder consulted with? Did the level of consultation change over time?
- How were the eligibility criteria for the EEF programme developed? Were the eligibility criteria defined appropriately? Did they exclude potential participants that may have had a relevant innovation? Did they lead to bids being made from applicants that did not meet the aims of the programme?
- Have the eligibility criteria altered over time? If so why were these altered in your view? [Interviewer note: consultees might not be aware of this]
- Were the eligibility criteria sufficiently clearly communicated in marketing and promotional materials?
- How do changes in Government strategies and priorities influence the design of the EEF phases? Does it influence the projects selected, competition scope etc.?
- Are potential future changes in policies or regulations considered in the design of the programme? How does the EEF team find out about potential changes in Government policy / regulations?
- What could have been done to improve the way the EEF competition scopes/prospectuses were developed?

6. How effective was the communication and promotion strategy for EEF?

- Did the communication strategy reach the right groups of company? Were there any specific groups of potential applicants where awareness of the programme was low?
- What promotional mechanisms (e.g. infographics, mailshots) and activities (e.g. launch events, pre-engagement presentations social media campaigns) were most and least effective?
- Was the quality of recruitment materials sufficient to attract potential applicants? Probe on quality of materials – relevance, clarity, appropriateness given target beneficiaries? Was the marketing delivered in a timely manner, giving applicants time before the application window opened?
- Did the communication strategy generate sufficient interest to create a large pool of high quality proposals/applicants?
- Did the communication strategy change over time? Did these changes incorporate learning from earlier rounds and improve effectiveness of later delivery?
- Are there areas of the communication strategy which could be improved in the future?

7. How did the Expression of Interest stage support the delivery of the programme?

- Did the volume of EOIs received align with expectations?
- How successful was the EOI stage in allowing BEIS to filter out ineligible proposals?
- How much resource was absorbed in the assessment of EOIs? Probe for details on the number of people involved, and the time taken per assessment.
- Why did such a high share of companies that submitted EOIs not submit a full application? Is this a cause for concern?
- Could the EOI process be adjusted to improve the efficiency of the programme? Would there be benefits in extending the scope of the assessment to quality criteria alongside issues of eligibility?

Section D: Application and Assessment Process (for technical and commercial assessors and programme managers)

8. How appropriate and relevant was the information asked for in application?

- To what degree did the application enable applicants to provide the detail needed to assess the technical, commercial and economic merits of the technology under development and the risks involved?
- Did the application provide sufficient evidence of the financial constraints facing the company (reasons for public funding), and the proposed business model to exploit the innovation?
- Did the application gather information needed to identify ‘marginal projects’ – i.e. those that would not have gone ahead without EEF-funding but had technology with economic/environmental potential?
- Were the resources required to complete the application proportionate to the level of support available to beneficiaries?

- Were any other sources of information (outside those submitted in the application form) required to make an assessment? What were these and how were they sourced?
- How could the design of the application form and accompanying guidance be improved to support better decision making?

9. What is your view on the overall quality of applications received?

- How well did applicants understand the competition requirements and application process? Was sufficient information and advice about the competition and application process provided to potential applicants?
- Did the application process attract enough high quality bids to commit funding?
- Was enough done to minimise submissions of low quality bids? What aspects of the application process were designed to prevent low quality bids?
- What elements of the application process could have discouraged potential applicants from submitting a bid?
- Did an assessment of the application process take place after any programme round? Were changes to the application process based on lessons learned from the submissions from previous rounds?
- Could any steps be taken to improve efficiency?

10. Are the assessment criteria for the technical assessment of applications sufficiently aligned with the objectives of EEF?

- In what ways do the technical assessment criteria support the aims and objectives of the programme?
- Have the technical assessment criteria changed over the course of the programme? What drove any changes? Were they informed by learning from earlier rounds?
- Could improvements be made to the criteria for assessment?

11. Are the technical assessments of applications conducted efficiently and effectively?

- How are assessors selected or recruited? How are they assigned to applications? Were assessors assigned to projects based on their skills/experience? What improvements could be made to the assessor selection process?
- What guidance was issued to assessors prior to the assessment process? Was this sufficient to fully inform assessors of their responsibilities and the assessment process? Could the guidance be improved?
- Do the technical assessors have the required skills/knowledge/experience to impartially assess applications? Were there any gaps in skills or expertise? Were there any difficulties with potential biases of technical assessors? How were these issues overcome?
- How effective was the technical assessment process in filtering the applications that reached the commercial assessment stage?

- Roughly how long does it take to assess and score an application? Were the timescales for assessment adequate to allow a robust assessment of all applications?
- Did the assessment process change over time? What drove the changes to the assessment process? Were changes informed by learning from earlier rounds?

12. What value does the commercial panel add to the assessment process?

- How long do commercial panel members get to review project applications? Is this sufficient time to fully review applications? Is all the information they require to assess the application provided to them?
- Do the commercial panel members have the skills / experience to adequately assess the applications?
- How could the make-up of the commercial panel be improved in the future? What further information could be provided to the panel to support their decisions?
- How do the commercial panel assess the additionality that the EEF programme will provide to applicants? What factors are taken into account? Does the information provided allow for a robust assessment of potential additionality?
- Is the commercial panel given sufficient guidance on BEIS' level of risk appetite? How are trade-offs made between projects with different risk-reward profiles?
- What type of feedback is provided to applicants which are unsuccessful at the commercial panel stage?
- Where funding decisions deviate from the recommendations of the commercial panel - on what basis are decisions over-ruled? How is this explained to applicants?

Section E: Contracting and Due Diligence (BEIS and CLT programme managers only)

13. How effectively does the due diligence process protect BEIS against potential risks to the objectives of the programme?

- What information is collected to support the due diligence process? What criteria is used? Technical, financial risk, leakage etc? Is this sufficient to robustly assess the risks involved with a project?
- What are the timescales allowed for the due diligence process? Is this sufficient to robustly assess applications for risk?
- Has the due diligence process changed over the course of the programme? What has informed these changes? Have lessons been learned from earlier rounds?

14. How effectively does the Grant Offer Letter (GOL) ensure that the delivery of the project is in line with the aims and objectives of the EEF programme?

- Do the terms and conditions give BEIS sufficient protection against possible adverse risks (e.g. resources committed to failing projects)?

- What processes are in place to allow projects to pivot and alter the outcomes of their project? How does the programme ensure that any changes still contribute to the aims and objectives of the programme?
- Do these changes require approval from BEIS? Do the changes require amendments GOL? What are escalation processes? Are they appropriate? Are they efficient?
- Are the processes in place to allow changes, standardised across projects? Have these processes changed over the course of the programme? What informed these changes?
- Are the changes to project outputs and outcomes recorded anywhere? In what form are they recorded?

Section F: Project delivery / incubation support (for monitoring officers, delivery partners and incubation managers/planners, BEIS programme managers)

Interviewer note: the aim of the incubation support is to accelerate commercial exploitation of the innovation project and leverage return on BEIS grant funding for UK Plc. It does so by identifying and providing commercial support in areas where a company need assistance to bring an innovation to market or to deliver a substantive commercial milestone. The incubation support is primarily to help deliver the innovation being developed by the grant but may also cover other company needs (e.g. Teams, Funding).

15. Are companies provided with the right mix of support to help them achieve their outcomes?

- How is the technical and commercial support allocated? To what extent is it tailored to individual business needs? How do managers and participants come to an agreement about what is required?
- How is non- / low-engagement with incubation plans managed? How common is non-engagement with incubation plans?
- What processes are involved in changing the incubation support activities a project receives?
- Are there any types of incubation support that participants require which are not offered? Why are these not offered to participants?
- Have there been changes to the incubation support services which are offered to participants over the course of the programme? What has been introduced / discontinued? Why have these changes been made? Are they informed by learning from delivery in earlier rounds of the programme?
- Is the combination of grant and incubation support required for all beneficiaries?

16. What is your view on the overall quality of provision available from the incubation support?

- Interviewer note: the incubation support covers market understanding, business development & sales, strategy & business planning, technology, product, supply chain & operations, team and fund raising.

- Do the delivery partners / subcontractors have the skills and expertise to deliver all the incubation support tasks? Are there particular tasks where the delivery was particularly well? Or less well? How were these difficulties addressed?
- Do the delivery partners have the capacity to deliver the required incubation support tasks to the participants?
- Is the support proportionate to the scale of the programme? Do businesses have ample engagement with their managers?
- Has the quality of provision improved over the course of the programme? In what areas has provision improved? What has driven the improvement in provision?
- How has participant feedback informed any changes to the tasks provided or the quality of provision?

Section G: Monitoring (Monitoring Officers, BEIS and CLT programme managers)

17. How effective are the processes used to monitor projects?

- What skills / knowledge do monitoring officers require? Do MOs need a mix of technical and commercial knowledge? Have the monitoring officers used for the programme possessed the correct skills/knowledge? If not, what has been done to rectify the situation?
- What resources are required to undertake monitoring? On average, how much time is required to monitor a project? Do monitoring officers have sufficient time to effectively monitor projects?
- What input is required from participants? How is this information collected?
- How are monitoring officers assigned to projects? Are they matched on skills / areas of expertise? Availability / case load? Other factors?
- What information from the assessment and due diligence is provided to monitoring officers? Are information feedback loops complete?
- Why was the decision made to use external monitoring officers for round 7 of the programme? Have there been tangible changes since the programme has switched from using internal BEIS staff external MOs (phase 7)?
- How frequently do monitoring officers meet with the project staff? What assessments do the monitoring officers make during a meeting? How do MOs ensure that changes do not diverge away from the original programme objectives?
- Has this approach to monitoring changed over the course of the programme? How and why have processes changed?

18. How do monitoring officers escalate issues with a project?

- Where monitoring officers identify serious issues with a project, how are these escalated? What recourse does the programme have prior to withdrawing support for a project?

- How frequently are these steps used? Should they be used more frequently, and if so what is preventing monitoring officers from utilising these steps?
- Could failing projects be identified at an earlier stage? What changes would be required? Would this be a proportionate effort given the size of the projects / likelihood of early closure?

19. How effective is the data collection processes at project completion?

- Is all relevant data collected at the end of the project?
- How aligned are the different mechanisms to collect data from projects? Is there any duplication in efforts between data collection activities? E.g. KPI data collection, project monitoring, completion of CPRs, quarterly reporting, closure reporting?
- Is data collection activity by different organisations coordinated (taking place at the same time, or drawing on the same documentation)?
- Have data collection activities changed over the course of the programme? How and why have they changed, and are changes informed by learning from earlier rounds of the programme?
- In what ways is the data collected throughout the programme used to inform subsequent programme rounds?
- In what ways could the monitoring of projects and data collection be improved in the future?

Section H: Policy lessons and spill-overs (BEIS and CLT programme manager, policy leads)

20. How are findings from projects disseminated upon completion?

- How does the programme balance commercial confidentiality with potential knowledge spillovers?
- If projects generate public goods, how are these shared/promoted?

21. What mechanisms are in place for EEF projects to inform Government policies?

- How is learning from ongoing and completed projects fed back into the wider policy cycle? Who is involved in feeding back learning? Monitoring Officers, Delivery Partners, BEIS, project staff?
- Are the mechanisms formal or informal?
- What type of information / data is needed to support policy changes? Do EEF processes already collect this information as standard, or are additional resources required to collect this information?
- How are technologies/projects identified as possible candidates to inform government policies? Whose responsibility is it?
- How dependent is this on personal networks?

- What weight is given to information provided by the EEF programme? Can you provide examples of where results of EEF projects have influenced Government policy?
- What more could be done to codify and disseminate the policy lessons arising from EEF projects?

THANK RESPONDENT FOR THEIR TIME AND CLOSE.

6.3 Case study interviews

6.3.1 Introductory email

Dear XXX,

We are currently conducting some research for the Department for Business, Energy and Industrial Strategy (BEIS), exploring how the innovation support they provided affects the businesses which receive the support and the wider economy / society. BEIS have commissioned Ipsos MORI and Technopolis Group (independent research organisations) to undertake this study (see attached endorsement letter from BEIS). So far, we have undertaken a large number of interviews with businesses which applied to receive innovation support from BEIS.

One of your suppliers / partners / customers, YYYY, received innovation support from BEIS, and has been identified as a case which has had significant success and warrants further investigation. ZZZZ from YYYY has provided us with your contact details as a supplier / partner / customer of YYYY.

I am writing to you to request a telephone interview, with a maximum duration of 30 minutes. This interview will explore the following topics:

How you developed your commercial relationship with YYYY, and your relationship regarding ZZZZ

- Aspects of the delivery of the project / support received which have helped to achieve outcomes
- What type of information / evidence you required before forming an agreement about ZZZZ
- Views on the environmental impacts ZZZZ
- Views on the commercial impact ZZZZ
- How knowledge about the technology has been shared.

Your contribution will be confidential and anonymous and your involvement is entirely voluntary. However, we would like to emphasise that your contribution would be extremely valuable and worthwhile in demonstrating the environmental impacts of ZZZZ and its potential

contribution to UK Governments net zero emissions target, and shaping the future strategy for innovation support in the UK. We hope that you (or a suitable colleague) would be willing to share your experience.

If you are willing to take part in the research, please could you provide us with a convenient date and time in the coming weeks that we can speak to you? If you would prefer not to take part in this research, please email us to let us know your decision, and we will not contact you further.

If you have any questions about the evaluation study, please contact XXXX (XXXX) or XXXX (XXXX), who manage this study.

Kind regards,

6.3.2 Topic guide for case studies

Consent

It is essential that the interviewer asks for consent to record the interview and covers the bullets below.

Read to interviewee:

Thank you for agreeing to take part in this interview. As you know, BEIS has commissioned Ipsos MORI and Technopolis Group to conduct an independent evaluation of the Energy Entrepreneurs Fund programme. This interview should last about 30 minutes. Your participation in this interview is voluntary and you can change your mind at any time.

The information that you provide will be treated in confidence by Ipsos MORI/Technopolis Group.

We would like to use your feedback and experience as an EEF applicant and request your permission for the following:

- To use the feedback you provide, together with any additional information you choose to disclose for the evaluation study.
- We will provide an anonymised version of this information and any analysis we carry out as part of the evaluation study with BEIS, for its own internal purposes only.
- BEIS expect to publish aggregate, unattributed results from the interviews.

We would like to record the discussion for analysis purposes, which will be used to help us accurately collect findings for the research. The recordings will be securely stored and retained by us and destroyed after the completion of the evaluation. **Are you happy for us to proceed?**

Section A: Introduction

1. *Ask to all participants – if interviewing a member of delivery staff from the lead organisation, confirm what we already know in question 1, as this information has already been collected.* **Please could you tell me in brief about your organisation?**

- Describe size, sector of organisation, location, maturity. If applicant organisation confirm what is already known.
- If sub-contractor/consortium member: When did you first become involved in the project and what was/is your project role? has this changed over time and if so why?
- If customer: When did you first become aware of the [Company], and when did you first become aware of [technology used in EEF]? Did you have an existing commercial relationship with the company? What was this relationship?

2. Please could you describe your role, and if relevant your role in the EEF project?

- If relevant to the EEF, how were you involved with the EEF project? Have you continued to be involved in the development of the technology since the EEF project completed? In what way?
- If not relevant to the delivery of the EEF project, how does your role relate to the technology or company?

Section B: Project delivery (only for those involved with the delivery of the project)

3. (IF a consortium / used subcontractors) We understand that the project application was submitted as a consortium with [NAME EEF BENEFICIARY] as the lead organisation. What did your organisation bring to the delivery of the innovation project? What particular areas were they addressing? Probe on:

- Skills and expertise, capability, capacity, knowledge, reputation, existing route to market, track record with R&D in this area

4. Would you be able to outline for me how your organisation became involved in the project?

- Did you have previous working relationships with these organisations? If so what did these relationships look like – how had you worked together? Were you involved in background development work in relation to the project?
- If this was a new collaborative partnership how did you first find out about [lead organisation]? How did they approach you? What were your impressions of the company and the innovative idea?
- What agreement was reached with collaborators? And, when was the agreement reached were any difficulties encountered in reaching an agreement? How were these resolved? Did the agreement impose any restrictions on how any IP developed could be exploited? If so, what were these restrictions?

5. Do you think this project / collaboration would have taken place in any way if the project did not receive any support from the EEF?

- How would the project / collaboration have proceeded in the absence of funding? Where would funding have come from?
- Would you have considered working with [COMPANY] on another project with a different innovative idea in the absence of the EEF funding? Why / why not?
- Would you consider working with [COMPANY] again the future on this project or other innovative projects? Why / why not?

6. What aspects of the work package were you (or your organisation) involved with the delivery of?

- How did this differ from what was originally agreed in the application? Why were the changes made?
- How did the overall work package differ from what was originally planned? How did this differ from the application form?
- How have you resourced this work? Did you recruit any R&D or other workers to support the delivery of the project? Did you need to reduce your investment in parallel programmes to focus on the project?

7. What challenges, if any, did you (or your organisation) face in the delivery of the project?

- Probe around: access to specialised infrastructure or facilities, regulatory issues, changes in policy, issues with the design of the development programme)? If so, why did these difficulties arise? What was done to overcome them?
- Probe separately for issues relating to covid-19 in the short-term and for more general challenges faced (either before outbreak or other issues faced during the outbreak)
- How were these challenges overcome?

Section C: Commercial outcomes (supply chain / customers / licencees)

Interviewer note: We know much of the commercial outcomes achieved by the lead EEF applicant from the main interview (number of licences agreed, whether sales of a product have been agreed, sales / manufacturing agreements in place etc.). Here, we need to explore how and why these commercial outcomes have been achieved, and any commercial outcomes generated for the customers of EEF applicants (as most involve Business to Business models)

8. How did you first become aware of [COMPANY] and the [TECHNOLOGY]?

- Probe around how they were introduced to the company: networks – was it through the incubation support providers (CLT, CT, Arup etc.), presentation / pitch to them from company, conference, direct marketing, other
- When did you first become aware of the company / technology?

9. What were your initial views of the technology / company?

- What were your first impressions of the company / technology? Was a sufficiently strong use case presented to you? Were the economic and environmental benefits clear? Did the company need to do more work? Technological / commercial planning? What were the areas of weakness?
- What barriers still existed for [COMPANY] to get the [TECHNOLOGY] to a commercially viable product?
- Did you provide any recommendations to the company about how to proceed (if required)? What were these recommendations?

10. What factors prompted your company to enter a commercial agreement with [COMPNAY] for [TECHNOLOGY]?

- What type of commercial agreement do you have? Supplying company, manufacturing products for them, Running commercial trials, purchased products, licencing agreement, sales agreement in principle etc.?
- How long after your initial meeting was it before you entered a commercial agreement?
- What steps were involved in making the agreement between first contact and forming a commercial agreement? Further technological / commercial progress made by the [COMPANY]? Further evidence of ability to provide at scale? Successful commercial trial? Commercial discussions (price, units etc.)?
- What were the key factors which drove your company to form an agreement? Environmental benefits, commercial benefits (cost reduction, new market etc.), other (please specify)
- At the time of the agreement, were you aware of any other competing technologies which aimed to achieve the same outcomes as [COMPANY & TECHNOLOGY]? What were these? Were they UK based or based elsewhere? Why did you decide to go with [COMPANY & TECHNOLOGY]?
- What outcomes did these competitors offer? Both commercially (price, cost saving) and environmental (comparative environmental benefit)?

11. What is the scale of your current commercial agreement with [COMPANY]?

- Number of units, trial sites, value, number of years? What is the lifespan of the technology?
- Is the agreement exclusive?

12. Are you anticipating changing your commercial agreement with [COMPANY / TECHNOLOGY] in the next five years?

- Increase / decrease number of units ordered?
- Change number of years of agreement?
- Move from trial to sales / licencing agreement?
- What are the reasons behind these decisions?

13. What costs did your organisation incur in adopting the technology?

- Probe around one off costs – purchase, installation, build costs, developing new production line etc. Who paid for these? What were these costs?
- What changes does the adoption of the technology lead to for your company?
- Did it require changes in the types of fuel used? Decreases in quantity of existing fuel used? Describe the fuel change (types of fuel). What are the scale of these changes?
- Probe around other ongoing costs – maintenance etc. How do these compare to the costs incurred previously? Who pays for these costs?

14. What commercial impact has the technology had on your business?

- Change in costs, changes in prices charged?
- Change in sales?
- What are the scale of these changes?
- Can these changes be directly attributed to the technology?

Section D: Environmental Outcomes (customers / licencees)

Interview note: Environmental impacts have been explored in the main qualitative interview – this interview should look to undertake a deeper dive into the environmental impacts.

15. What were your expectations of how utilising [COMPANY / TECHNOLOGY] would affect your business environmentally?

- Was it expected to reduce energy consumption (demand for energy)? Changes to energy production? Changes to the cost of energy production? Carbon emissions? Other environmental impacts?
- What was the scale of the expected environmental impacts expected from your commercial agreement?
- What were these estimations based on? Modelling, testing etc.?
- What were your impressions of these expected effects? Were they the primary reason for the agreement, or secondary to commercial concerns?
- Is it expected that there will be any changes in the environmental impacts generated over time?
- (If relevant) If there were competing technologies to this one, how did the environmental benefits of the competing technology compare to the ones offered by [COMPANY] and [TECHNOLOGY]? How did the relative environmental benefits factor into your decision making process?

16. (If relevant) In practice, what are the observed environmental benefits of the technology?

- Are these being monitored? How?

- Are the results different to those you expected? Do you have any theories why this is the case?
- Are the environmental benefits expected to change over time?

Section E: Environmental impacts (those involved in the delivery of the projects)

17. What were/are the expected environmental benefits of the technology?

- Was it expected to reduce energy consumption? Carbon emissions? Other environmental impacts?
- What was the scale of the expected environmental impacts expected from your commercial agreement?
- What were these estimations based on? Modelling, testing etc.?
- Were you involved in the modelling? How (in what capacity)?
- What are your views on the accuracy of the estimated environmental benefits?
- Did this have any impact on their decision to work with them?

18. Are you aware of any other company / innovator which is trying to address a similar environmental issue?

- Are these UK based innovators or from other nations?
- How are they trying to address the problem?
- What stage is there innovation at?
- What scale of environmental impacts are these innovations estimated to achieve?
- What are your views on how realistic these impacts are?

Section F: Knowledge sharing (all)

19. What knowledge or skills have been generated or acquired through the delivery of the EEF project or the use of the technology, if any? [TAILOR THESE QUESTIONS TO TYPE OF STAKEHOLDER]

What were the key learnings generated from the EEF project or the use / production of [TECHNOLOGY]?

- (only to manufacturers / customers) How did [COMPANY] share the knowledge of how to utilise the technology to fully capture commercial / environmental benefits? How did [COMPANY] share the knowledge of how to manufacture their product? Was the information they shared adequate to accurately manufacture / fully exploit the technology? If not how did you resolve this information gap?
- (only to individuals involved with project delivery) To what extent was this project a key contributing factor to achieving this outcome? Were there any other factors involved?
- (only to individuals involved with project delivery) How was this knowledge transferred to your organisation? How are you making use of the knowledge? Has the knowledge and

skills gained through the project been used to support new R&D projects? If so could you provide an example?

- (only to individuals involved with project delivery) Have there been changes in levels of R&D/STEM employment opportunities at your organisation since taking part in the project?
- (only to individuals involved with project delivery) Are you aware of the knowledge and skills developed through the project being used by organisations outside of your consortium?
- (only to subcontractors / partner organisations involved in delivery) To what extent has participation in the EEF project impacted on your R&D activity (employment, R&D spend), if at all?
- (only to individuals involved with project delivery) To what extent have any new programmes of R&D developed been informed by the delivery of this project? How were these supported or influenced by your project? (if at all, if not why not?)
- Have you delivered any further innovation / R&D projects with the same partner organisations as used in the EEF project? Why did you choose to work with these organisations again?

20. Has learning or knowledge generated from the project / use of the technology / manufacture of the technology been used / applied / shared externally?

- (only to individuals involved with project delivery) How has any knowledge or learning generated from the delivery of the project been shared? Conferences, other R&D projects etc.
- (only to customers / manufacturers) How have you shared any information about the use / benefits / manufacture of the technology? What type of information have you shared? For what purpose? What have been the results of this sharing of information?
- Have any external parties (other companies, academic teams, public, policymakers) taken an interest in applying the environmental impacts of the technology? If so, draw out details of what has taken place?

Section G: Interview Close

- Are there any further documents or resources that you could share with me to the assessment of [COMPANY] and [TECHNOLOGY]?
- Is there anything else that you would like to comment on that we have not discussed that you think would be relevant to the study?

THANK RESPONDENT FOR THEIR TIME AND CLOSE.

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