Applying a Realist Evaluation approach to identify key considerations that successfully enables expansion of Project LEO

by

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Declaration

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Date: April 2022

Opsomming

Innovasie en tegnologie is die dryfkrag agter die sakewêreld, die samelewing en die manier waarop ons werk, en die wêreld bly al vinniger verander. Demokratiese beginsels, billikheid, gelykheid en volhoubaarheid is reeds globale kwessies wat in regerings, besighede en die burgerlike samelewing se beste belang is om die hoof te bied. Hierdie maatskaplike kwessies is gesetel in komplekse kontekste met sosio-ekonomiese, politieke, tegnologiese, omgewings- en kulturele faktore wat in berekening gebring en genavigeer moet word. Die regering is toenemend bereid om met die openbare sektor saam te werk om maatskaplike kwessies aan te pak, met behulp van ’n netwerkbenadering tot bestuursbeheer om die koste van verandering en innovasie te deel, terwyl maatskaplike rolspelers bemagtig word om verandering aan te dryf.

Loodsstudies is fundamenteel tot die konseptualisering en toets van veranderingsmeganismes en innoverende intervensies, deurdat verandering in mikrosamelewings bestuur kan word, en indien suksesvol, teen ’n groter of ander agtergrond herhaal kan word. Realistiese evaluasies gee toe dat nie alle programme dieselfde in verskillende kontekste werk nie en ondersoek eerder wat, vir wie en in watter omgewing werk. Hierdie navorsingsverslag hersien, met behulp van realistiese-evaluasieteorie, die hoofoorwegings vir innoverende loodsstudies wat herhaalbaar is en waar die suksesvolle projekte uitgebrei kan word.

Die energiebedryf word gekonfronteer deur die uitdagings van ontkoling en die infrastruktuurveranderinge wat nodig is om die groen revolusie te ondersteun. Hierdie navorsing gee ’n oorsig oor die kompleksiteit van hierdie oorgang, en ontleed die dryfkragte, rolspelers en beleide wat kompleksiteit in die omgewing veroorsaak. Die Local Energy Oxfordshire (LEO) projek word as ’n gevallestudie in die navorsing gebruik. Die LEO is ’n uitstekende voorbeeld van ’n innoverende loodsprojek, wat verandering in die energiebedryf aandryf deur aanpasbare plaaslike energiestelsels te skep. Die LEO is in Oxfordshire in die Verenigde Koninkryk geloods en, as dit suksesvol is, sal dit dalk nasionaal en in ander

lande geïmplementeer word. Die navorsing gebruik realistiese-evalueringsteorie om vroeë aanduiders van sukses te ontleed deur te probeer verstaan of die uitdagings en sukses wat geïdentifiseer word, intern of ekstern tot die omgewing is. Hierdie benadering beoordeel of die intervensie op makroskaal herhaalbaar sal wees, met die inkorporasie van kompleksiteitsteorie aan die kern daarvan.

Empiriese navorsing, ingewin deur realistiese onderhoude, bevind dat die LEO vroeë aanduiders van sukses toon, ná holistiese assessering van die maatskaplike kwessies binne die energiesektors wat met hernubare energieverbruik verband hou. Die LEO het verskeie kundige leweringsvennote met diverse netwerke wat maatskaplike hulpbronne kan mobiliseer. Die LEO het ook ŉ bloudruk vir hulle metodologieë, projekontwerpe en implementeringsmetodes ontwikkel, wat deur leweringsdryfkragte in alternatiewe omstandighede aangewend en toegepas kan word. Desondanks sal daar uitdagings met die vergroting van skaal wees, waaronder die toewyding van belanghebbendes aan die bereiking van uitkomste, politieke en gemeenskapsteun, netwerkkundigheid, en betrekkinge met belanghebbendes wat as die interne faktore van die bedryfsomgewing beskou word. Aanbevelings is gedoen om hierdie projekuitdagings die hoof te bied, en daar is ook aanbeveel dat ander loodsstudies gedoen word om innovasie en verandering in alternatiewe omgewings te toets.

Abstract

Innovation and technology drive business, society and the way in which we work, with the world constantly changing at an increasing rate. Democratic principles, fairness, equality and sustainability have become global issues that governments, businesses and civil society have become invested in addressing. However, these societal issues operate in complex contexts with socio-economic, political, technological, environmental and cultural factors to take into account and navigate. Government has increasingly shown a willingness to work with the public sector to address societal issues, using a network governance approach to share the cost of change and innovation, while empowering social actors to be drivers of change.

Pilot studies are fundamental in conceptualising and testing change mechanisms and innovative interventions whereby change is managed in microsocieties and, upon their success, replicated in larger or different settings. Realist evaluations recognise that not all programmes work the same in different contexts and instead investigate what works, for whom and in what environment. Using realist evaluation theory, this research paper reviews the key considerations for innovative pilot studies in realising their aims to achieve replicability and to scale up successful projects.

The energy industry faces the challenges of decarbonisation and infrastructural changes required to support the green revolution. This research reviews the complexity of this transition, analysing the driving factors, role players and policies that go towards creating complexity in the environment. Project Local Energy Oxfordshire (LEO) is used as a case study in the research. LEO is a stellar example of an innovative pilot project, driving change in the energy industry by creating flexible local energy systems. LEO is piloted in Oxfordshire, United Kingdom, and if successful, looks to be implemented nationally and in other countries. The research uses realist evaluative theory to analyse early indicators of success by seeking to understand whether challenges and success identified are internal or external to the environment. This approach

assesses if the intervention would be replicable at a macro scale, incorporating complexity theory at the core of its operation.

The empirical research seen in the format of realist interviews, found that LEO provides early indicators for success, having holistically assessed the societal issues within the energy sectors relating to renewable energy consumption. LEO has a range of committed expert delivery partners, with diverse sets of networks used to mobilise societal resources. Furthermore, LEO has created a blueprint for their piloted methodologies, project designs and implementation methods, which can be utilised and applied by delivery drivers in alternative settings. Despite this, challenges would be faced in scaling up, with stakeholder commitment to achieve outcomes; political and community support; network expertise and stakeholder relationships seen as internal factors of the operating environment. Recommendations have been made to address such project challenges, as well as recommendations for other pilot studies to test innovation and change in alternative environments.

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List of Acronyms and Abbreviations

CB	Carbon Budget
CCA	Climate Change Agreement
CCC	Climate Change Committee
CCL	Climate Change Levy
CCUS	Carbon Capture Usage and Storage
CMOc	Context-Mechanism-Outcome configuration
Defra	Department for Environment, Food & Rural Affairs
DSO	Distribution System Operators
GDPR	UK General Data Protection Regulation
MVP	Minimum Viable Product
LEO	Project Local Energy Oxfordshire
Ofgem	Office of Gas and Electricity Markets
UK	United Kingdom
UK ETS	The UK Emissions Trading Scheme
WP	Work Package

Chapter 1:

Introduction

1.1. Introduction and Background

Evaluation theory and practice have proven vital to the management of businesses, projects and programmes, as well as everyday decision-making. Evaluations can focus on policy and change management as well as on the coordination of projects to achieve a greater social, economic and political impact. This includes an analysis of the consequences of the relevant intervention (Cloete, Rabie & de Coning, 2014: 3–4). It is well understood that evaluations are varied and subjective in relation to a specific context and its stakeholders. Therefore, evaluations are contextually focused and tailored to the environment and resulting life cycle of an intervention.

Evaluation is defined as *"the systematic and objective assessment of an ongoing organisation or complete project, program, or policy, including design, implementation, and results. The aim is to determine relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability*" (Austrian Development Cooperation, 2009:1) Furthermore, the Department of Monitoring and Evaluation (2011:3) states there is a need to create "value for money" whereby money managed by decision-makers, be it in the public or private sphere, has to have the most appropriate, effective and efficient impact to the greatest number of people. Thus, evaluations are vital to understanding if this has been done, and how this can be achieved in the shortest time period to achieve commonly desired outcomes. In the public domain, civil servants and decision-makers must ensure that impact is beneficial for the majority of beneficiaries and outcomes need to be universally applicable.

Innovation and research in new technologies, community responses and developmental projects operate in national and international settings, accommodating a variety of different factors depending on geographical location and context. This involves a number of different stakeholders who operate in complex socio-economic and political environments. These types of projects and interventions can be described as complex, being made up of many diverse components – politics, economics, social considerations, rapidly changing technology and interaction with civil society. These

components further interact with one another in nonlinear ways, hence their behaviour may adapt over time and lead to unpredictable behaviour and unexpected outcomes (Department for Environment, Food & Rural Affairs, 2019, p. 5).

Evaluations are a key tool in navigating complexity and project outcomes in these environments. With innovation and pilot studies being used to develop, adapt and evolve policies to achieve national and global objectives, evaluations are key in monitoring the impact of these projects on policy, people, the industry and the environment (Department for Environment, Food & Rural Affairs, 2019:10). A fundamental component in complex interventions is ensuring their replicability in general settings for appropriate policy impact. They first need to be piloted and tested in a small-scale setting in order to test for long-term impact, and this has to be done in an economic and responsible manner. Upon achieving project success, the pilot studies can then be applied on a large scale and rolled out on masse. It is thus vital that these programmes are evaluated closely to take into account:

- if the core intended intervention outcomes result in the desired change;
- if the design of the intervention is able to accommodate complex environments;
- if the implementation processes aid the outcomes and can be replicated in different contexts;
- if the program is cost effective in its ability to be implemented in large-scale settings;
- the rationale for the change and likely size and type of effects;
- the drivers of change, understanding whether these are context- or project-specific (Medical Research Council, 2006:4).

Realist evaluations ask questions about how, why and for whom an intervention works. Realist evaluations acknowledge that not everything will work for everyone, and that interventions are impacted on by the environments in which they operate and by the different change drivers in each one. The key insights a realist evaluation seeks to produce are related to causation and attribution – respectively understanding how the intervention caused change, and if the observed changes can be attributed to the intervention, or whether they were caused by other factors (Pawson & Tilley, 1997; Westhorp, 2014:4). Given the fundamental importance of identifying critical success

factors in achieving desired objectives, realist evaluations are fundamental to reviewing interventions within complex and large-scale settings.

This study follows the developmental approach to evaluations. Grounded in complexity theory, developmental approaches use evaluation findings to inform modifications, of and involvements to, the intervention (Gray & Shaw, 2019:243). This, more importantly, allows evaluators to understand and advise on programme adaptations in the light of dynamic and complex environments. This is vital to evaluating the design and implementation stages of a project that aims for expansion at a national level, whereby a pilot study is conducted initially to test outcomes and give an indication of results at a micro level. The research will apply the theoretical understanding of design and implementation decisions of interventions within complex environments. Using realist evaluation theory, the researcher will review Project LEO as a case study, understanding how the intervention works, for whom and in what contexts. This gives understanding as to the scale up and replicability of pilot studies in different contexts. Project LEO is an innovative and progressive project within the energy environment, aiming to create a new open grid system in the United Kingdom. This is being trialled and implemented in the county of Oxfordshire, to determine which successful outcomes can then be replicated at a national level.

The UK energy sector is extensive, involves many parties and supports multiple functions. This gives rise to complexities between the operating factors within the commercial, policy and technical environments. The key challenge within the energy industry lies in modernising systems that the centralised and static energy systems built during the last century and which now require transformation into new flexible, sustainable and user-centred systems (IET, 2016:2). Society and technology have been based on carbon-intensive energy, which has proved to be unsustainable and environmentally detrimental, having contributed massively to climate change. The legacy systems created within this energy network involve far more stakeholders and resulting policy regulations than ever before, and this has made a transition to green systems extremely complex.

This means that infrastructure, technology and the legacy grid system were built to meet the demands of last century. While innovations have been made and upgrades undertaken, the sustainability demands, consumer choices and legislation require

revolutionary changes to meet future demand for generations to come. Furthermore, through networked governance, technological advancements and high rates of dissemination of information, today's end users are becoming more environmentally aware. The current transition therefore involves numerous cross-sectoral stakeholders that are more informed by public policy, which in turn means that social responses call for a re-organisation of socio-economic infrastructures in order to accommodate these changes. Project LEO aims to take on the current contextual challenges of the energy industry, which has been structured on the basis of non-renewable energy sources, and to deliver feasible systems and energy markets for energy suppliers, distributors and consumers.

1.2. Problem Statement

Extensive project planning, analysis and evaluation needs to take place to develop an understanding of the dynamics of complex interventions, innovation and new technologies which lead to revolutionary changes in the way we work and how society operates. Projects developed to address dynamic and wicked problems are trialled and implemented in small-scale settings, testing the programme effectiveness in a micro setting. These interventions operate in highly complex environments, with socio-economic, political, technological, environmental and cultural factors to take into account and navigate. Pilot studies need to acknowledge and address the complexity of programme objectives within a larger context for project success. Evaluation and project management issues arise when the pilot study tests the intervention in a small setting but does not analyse critical success factors in the context of the internal and external environments. The project's outcomes are often determined by the context and how the project achieves success within that context. Project planners need to evaluate and consider if the outcomes and change mechanism of the pilot study will vary if the same project is implemented in a different context or rolled-out for large scale implementation.

Pilot studies therefore must test and analyse the key considerations and critical success factors in relation to the contexts internal and external factors. Realist evaluations focus on identifying the relationship between the context, implementation mechanisms and outcomes of a project, and is therefore useful to reflect whether the design and implementation processes are likely to be successful in light of the unique

contextual factors within a micro setting, or if project success is the result of intervention planning and can be universally applied.

Early indicators of success need to analyse if complexity issues have been addressed, with complexity theory and the Context-Mechanism-Outcome configuration at the core of its operation. This analysis ensures that evidence-based-assumptions are made on deciding the scale up and replicability of the intervention at a macro scale. If this analysis is not done, there is high risk that successful pilot interventions are implemented on a larger scale and do not achieve the tested desired outcomes based on the tested project design. This sees project failure, with the expense of wasted resources, funding and time. If this failure occurs in the public sector, project planners have failed to achieve the public principle of value for money, following best practice, and well utilised public resources.

This research will evaluate the design and implementation of piloted Project LEO, the key considerations and success factors to identify whether the causal and attributing factors indicate the potentially successful expansion of the project.

Project LEO is a pilot study conducting innovative and holistic smart grid trials in the United Kingdom (UK), aiming to create conditions that allow for an open grid, whereby consumers are able to generate and sell renewable and low-carbon energy and technologies themselves. Project LEO investigates and seeks a viable solution to address the political, technological and social factors that need to be in place for the decarbonisation of the energy industry; this means it is necessary to understand the relationships between Distribution System Operators (DSO) , consumers, markets, communities, investors and government (Project LEO, 2021c). The project thus operates in a highly complex environment dealing with a range of stakeholders and dynamic environments with the potential for creating large national benefits and/or costs. Furthermore, Project LEO deals with complex issues and aims to promote national and international environmental and social objectives, while supporting economic growth. The UK government has specifically implemented the national policy to reduce the country's carbon emissions to net zero by 2050 (Department for Business Energy & Industrial Strategy, 2019), and Project LEO's success would see huge progress made towards achieving this.

Project LEO is a project delivered through public and private funding, with ten core delivery partners. The project's implementation phases started in 2019, with the project expanding over three years, with a fourth year approved as an extension to the original timeline. Key to the project's success is the delivery of the project through a network governance approach, with a diverse stakeholder set providing the resources and expertise to deliver on objectives. However, this complexity creates challenges which need to be managed.

The core of the project is the fight for climate change and eradicating social and economic dependency. Its outputs will include:

- creating widespread public value;
- addressing international climate change objectives;
- the decarbonisation of the energy industry;
- introducing innovative changes to energy market places with the development of a flexible market;
- creating models for new investment;
- the development of strategic planning systems;
- the creation of datasets for innovative research, and producing a community of skilled people (Project LEO, 2018).

Through the delivery of this project in the public space via commercial and public role players, government and funding partners have committed themselves to sharing the cost of innovation and the initial investment needed to drive the revolution of affordable clean energy systems. Not only do these outputs have to be delivered in the complex environments in which they operate, but they have to be based on adaptable factors so as to be replicable for future implementation in a range of different contexts.

Understanding the project's successes and challenges of the pilot study of LEO is useful to assess possible replicability. While project LEO may be successful in the pilot context it is critical to determine whether this success is contextual and whether the project is replicable on a larger social scale in varied settings. This helps to protect public funds by ensuring that the project is expanded within an evidence framework that sets out the key considerations that is required for successful expansion to other contexts. While project LEO is consistently evaluated to ensure that the

implementation processes remain best suited to the complex contexts it operates in, there has not been a critical analysis of the key considerations that will maximise successful replicability in other settings. This research applies a realist evaluation approach to reviews the internal and external factors that contribute to the challenges and successes of Project LEO to identify key considerations for future expansion and replication of the project. This negates replicability considerations made on assumptions lacking evidence and holistic perspectives that include environmental factors and stakeholder perspectives.

1.3. Research Objectives

The proposed research develops an understanding of realist theory and evaluation principles for piloted projects in complex settings, using the network governance approach to understand the role of various stakeholders in creating a change mechanism. Innovative interventions often deal with complex societal issues embedded in all sectors of society and requiring changes from multiple change agents. Such interventions require a networked governance approach, with resources mobilised across the public, private and civil society sectors to understand problems, and to create and adopt changes. The magnitude of this task requires coordinated approaches to deal with societal issues, often dealing with conflicting interests, project management challenges and great complexity to navigate. Pilot studies provide a viable way to test innovative solutions to complex societal problems in a micro setting in a cost-effective, coordinated and agile way.

The energy sector operates in all sectors of society, having to comply with government regulations, as well as meet the needs of private energy services providers and society as end users. The green revolution and global awareness of sustainable living and energy have driven the rejection of non-renewable energy sources in favour of renewables. The UK government has further adopted a policy to end carbon emissions by 2050, with other countries following in its footsteps. The energy sector thus has to reform itself in all aspects with changes required by all stakeholders in the energy network. The opportunity for change and innovation within the energy industry has been great, with government additionally funding innovative projects to deal with the climate crisis. Project LEO is one of these innovative interventions and is bring trialled

through a pilot project. The research aims to understand the key considerations in applying realist evaluations of innovative pilot studies, in order to understand the key issues to ensure replicability of the project upon its success. The research applies the aims to the UK energy sector, within the context of Project LEO. The case study aims asks: are the key success factors based on internal or external environmental factors, and do these affect the project's replicability in alternate settings? This research will add value in understanding why the project has been a success, and advance the project objectives by ensuring the project is impactful, sustainable and valuable to the national grid system. This can further be applied and would resonate with the design implementation measures of other pilot studies. The research will address the current research gap in the energy sector whereby evaluations of interventions currently do not show evidence of changes in behaviours linked to quantified energy savings, or how socio-demographic groups responded differently, or how unique interventions would succeed in being universally applicable (Department of Energy & Climate Change, 2012).

This research study therefore has the following objectives:

> ***Objective One***: Explore the potential value of a realist approach to evaluate complex interventions.
>
> ***Objective Two***: To explore the complexities of interventions operating in the public sector context, analysing the stakeholder network within the energy sector.
>
> ***Objective Three***: To investigate the aims, setting and long-term aims of Project LEO.
>
> ***Objective Four***: To identify key considerations that contribute to the successes and challenges of Project LEO that may determine the potential replicability in different settings.
>
> ***Objective Five:*** To make recommendations for the successful expansion of project LEO.

1.4. Research Methodology and Design

The research design functions as the blueprint for the research process, prescribing how the researcher will conduct the research study, collect information and draw conclusions and offer interpretations (Robson, 2011:532). This research adopts a realist evaluation design. A realist evaluation design is well suited to this research as it analyses pilot studies. Fletcher and Murphy (2016:287) point out that “intervention development, modelling and feasibility and pilot studies need to theorise the conceptual conditions necessary for intervention mechanisms to be activated. Where interventions are scaled up and translated into routine practice, realist principles also have much to offer in facilitating knowledge about long-term sustainability, benefits and harms”.

The study applies realist theory and evaluation considerations for a project in a complex setting, to identifying the considerations for project replicability. The research focuses on network governance and the key complexities in delivering innovative programmes through such a network of stakeholders. The study goes on to apply the theoretical and legislative framework to the context of Project LEO, understanding its long-term aims, the implementation challenges and successes, and identifying whether these are specific to its environment or to the implementation processes. This leads to recommendations for that could inform the sustainable and successful expansion of the project at a national level, which is the long-term objective of Project LEO.

The research is qualitative in nature. Although the evaluator must aim to be objective and unbiased in their work, evaluations are inherently subjective. Scriven (1967) highlights the importance of values in evaluations, defining evaluation as a method of determining the merit or worth of an evaluand. This places a value on the evaluand, determined by its merit and worth. Merit can be judged on the basis of the evaluand’s intrinsic value, and worth is seen as an outcome of an evaluation and refers to the evaluand’s value in a particular context (Mertens & Wilson, 2012:6). The selection of criteria that the evaluator measures the programme against is made on the basis of the evaluator’s perception after carefully identifying the needs of the context from the perspective of all stakeholders. Despite all these measures being methodical and

calculated, they require the evaluator to use their personal experience, knowledge and thought processes in the evaluation.

The study applies a mixed methods approach, using both empirical and non-empirical research. The literature review in Chapters Two and the theoretical framework in Chapter Three applies non-empirical research to achieve research objectives one and two. Chapter four collected empirical data from project stakeholders to address objectives four and five. The data-collection within the case study of LEO is presented in Chapter Four which uses empirical data-collection methods, and in turn achieves Objective Four. Chapter Five required input by project stakeholders through non-empirical data collection which achieves objective Five. This saw the researcher identifying the research participants through snowball sampling, whereby contact with the first research participant as a key stakeholder in the delivery of Project LEO identified additional participants based on their strategic involvement with the intervention. The participant themselves have a clear understanding of the research objectives, and based on their expertise and involvement with stakeholders, were able to refer the researcher to strategic participants. The researcher guided the process to ensure that the final list of respondents represented the internal and external stakeholder groups involved in project LEO, as informed by the non-empirical review of project LEO's documented implementation plans.

The participant interviews took place as semi-structured interviews. The interviews aimed to arrive at an understanding of the stakeholders' experience of the project's complexities and implementation from their area of expertise. These interviews lasted up to a one hour and involved six stakeholders who were at the time involved in a variety of Project LEO's delivery work packages. The interviews were conducted as online meetings via Microsoft Teams.

The mixed design is well suited to the aims of the research, as researchers used this design to gain an in-depth understanding of the project from multiple perspectives in order to explain why the results occurred (Morra-Imas, Morra and Rist, 2009:271). This furthers the ability of systematically reviewing the implementation design to aid for project expansion in further complex environments.

1.5. Chapter Outline

The research report is comprised of six chapters, as are outlined below.

Chapter One: Introduction and rationale provide a brief introduction to the research, outlining the concepts of realist evaluations in complex settings. This provides the rationale for the study, outlining the research problem and ultimately the research objectives. The research design and methodology are justified as to why they are best suited for the research context.

Chapter Two: A review of realist evaluations within complex settings provides a theoretical framework for the study. It looks at literature that conceptualises the importance and characteristics of key considerations in realist evaluations, specifically their aims, processes and considerations applicable to innovative pilot studies. Chapter Two further applies this to the context of innovative interventions operating in complex environments. It goes on to review the UK energy sector, its current challenges and complexity in seeking viable solutions to aid the green revolution. This will give an insight into the criteria used to offer recommendations for the successful expansion of pilot studies in complex settings, specifically Project Leo, as indicated in Chapter Five.

Chapter Three: Analysis of the legislative framework of the UK's energy sector and the economic, social and political context in which complex interventions in the energy sector operate. The chapter reviews government support, funding and methods to achieve clean energy and decarbonisation. It outlines and clarifies the legislative framework that drives the creation of innovative interventions such as Project LEO, and the environment within which it operates.

Chapter Four: Data collection and analysis. This chapter will describe the data collection via semi-structured interviews with project stakeholders, developing an understanding of stakeholders' experience, understanding and actions taken towards achieving Project LEO's objectives. This will give an insight into the successes and challenges in implementing an innovative project in a complex setting, with the possibility of project expansion beyond the current context. Chapter Four will provide the data needed to understand if the project outcomes are conditional on the internal or external environments.

Chapter Five: This chapter on the findings and recommendations analyses the data from the empirical study, assessing the data from Chapter Four according to the key findings in Chapters Two and Three. The chapter analyses the empirical data from the interviews and compares all collected data to the theoretical framework and non-empirical literature review. This allows the researcher to make informed recommendations as to the successful expansion of Project LEO in complex settings.

Chapter Six presents the conclusions of the research, offering recommendations and considerations for the successful expansion of innovative pilot studies and specifically Project LEO.

1.6. Ethical Considerations, Data Management and Reporting of Results

This evaluative study must follow specific research codes, rules and policies as outlined by Stellenbosch University. All the work included in the research is declared to be the researcher's own work. The process of data collection and analysis must pass ethical clearance by the REC, Stellenbosch University. The following ethical considerations must be adhered to:

- Ensure active participants are aware of and consent to research and data collection from the very start. This includes ensuring that all participants understand the nature of the research and their involvement;
- Participation in the study is voluntary and not forced;
- Any participants and key informants must remain anonymous if they have requested this; the option must be explicitly presented to them;
- The data collected by the researcher must be treated as confidential;
- The researcher remains as objective as possible, upholding ethical integrity;
- The research findings are reposted to any participants who request this, and the final research is made public for review and free dissemination of the research results;
- The findings in the report must be accurate and not a misrepresentation of the research.

All participants will be required to sign a letter of consent to participate in the research; they will be provided with all relevant information, the aims of the study, and what will be required of them before proceeding with data collection. Any information that participants share with the researcher during this study will be protected. The data will be protected in password-protected documents, as well as a laptop used on a private domain, also password protected. All participants will be able to choose if they would like their personal details revealed: first name, last name and job title; job title only; anonymous with an approved description as to their involvement in the project. The information from interviews will preferably be recorded; however, any participant will be able to opt out of being recorded should they wish. Once the research findings have been reported and the research paper is completed, the empirical data will be erased. All data will be subject to the UK General Data Protection Regulation (GDPR) and Stellenbosch University Data Privacy Regulation. All data will be secure and subject to the terms of these policies.

The confidentiality and/or anonymity of participants will be maintained according to the terms they have consented to. There are no mental or physical risks involved in this research. All research outcomes and information identified through data collection must be reported on. The risks created by this research are minimal as Project LEO operates within the public sector and thus project developments operate within the public domain. Once reviewed and having passed Stellenbosch University's review process, the research report will be made public and accessible through Stellenbosch University as a contribution to research, as well as within the university and society in general. However, if the organisation requests this, the research result, whether it is a research report or thesis, may be classified as confidential in order to prevent public access to such documents. The research report will be presented and made available to all participants of the research and key stakeholders within Project LEO. The findings of this study will benefit the strategic planners and stakeholders delivering Project LEO and presented to them via email in order for the findings and recommendations to be made available, should the stakeholders wish to use this in their future decisions and evaluation processes.

There are no mental or physical risks involved in this research. All research outcomes and information identified through data collection must be reported on. The aim of the

research is to identify constructive key lessons for projects in complex settings. The risks caused by this research are minimal as Project LEO operates within the public sector and thus project developments operate within the public domain.

1.7. Limitations

The Covid-19 pandemic has meant that travel, meetings and social interaction have been very limited. This has in turn constrained the type of interaction and data gathering possible. The interviews had to be conducted online on meeting platforms such as Microsoft Teams. However, due to the advanced technology available, this does not prevent the data gathering, and the use of semi-structured interview still allowed the research aims to be achieved. The research was also limited to the time constraints of the academic year 2021 to conduct this research. Additionally, this time constraint limited the sample size and number of persons interviewed. In order to gather the most beneficial data for the study from research participants, the researcher worked with the first participant to relay what areas of expertise they are wanting to find knowledge on. In doing this, the informant best suited to identify additional participants based on the inputs central to the stakeholder and identify partners who were able to provide strategic participants by way of snowball sampling.

2. Chapter Two

Realist Evaluations of Innovative Pilot Projects implemented through a Stakeholder Network

2.1. Introduction

The aim of this chapter is to review and investigate the importance of pilot evaluation studies, specifically when the intervention requires coordinated action from multiple role players, whereby there are assumptions made of, and dependencies on the context. These assumptions and projections play an important role of the success of the intervention. Pilot studies and innovative interventions often operate in complex environments and require coordinated inputs from a network of stakeholders. This chapter further unpacks key considerations from a realist evaluative perspective, understanding that different stakeholders experience interventions differently; this implies that key success factors of the intervention are determined by these stakeholders, the environment of the intervention, or its design. This raises the possibility that while an intervention may be successful in one setting, this may be due to the environment itself and not based on a universal change mechanism that is achievable at a macro level with different stakeholders.

The literature review is then applied to innovative pilot studies, highlighting the fundamental importance and purpose of evaluations. This discussion, based on realist evaluation theories, makes the point that interventions must take into account whether the project's success can be replicated and expanded when applied in a larger context. Replicability is key for interventions operating in the public domain, whereby the complexity of public sector contexts and its actors require trialling, detailed coordination of inputs from all stakeholders, and critical review. This speaks to the concept of network governance, whereby the long-term outcomes can only be achieved through collaboration between government, business and civil society. Realist evaluations indicate that an intervention's success is dependent on multiple factors, as to which success, value-for-money and public impact are dependent on the replicability of the intervention itself. Pilot studies are key to testing this and need to take these factors into account at the core of evaluation processes.

Chapters Four and Five will apply the theory of Chapter Two to the case study of Project LEO. The project operates in the complexities of the public domain, with the

potential for national implementation. In light of achieving objective two, the theoretical discussion progresses into a review of the complexities of programme implementation within the context of the energy sector. The aim is to understand how we measure project success and replicability within the energy sector.

2.2. Importance of Evaluations

Evaluations and evaluative thinking involve methodical reflection on and learning from the nature, processes and consequences of decisions and actions taken by an organisation, business or government (Cloete, Rabie and de Coning, 2014:3). Evaluation is used by policy makers and management to assess whether the programme is worthwhile, effective, has an impact and is sustainable. Thus, evaluation is defined as "the systematic and objective assessment of an on-going organisation or completed project, program, or policy, including design, implementation, and results. The aim is to determine relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability" (Austrian Development Cooperation, 2009:1). This indicates that evaluations and the resulting conclusions involve a value judgement that is empirical as well as normative. The focus on the value and merit of the intervention, policy or programme is unanimously emphasised by commentators such as Shufflebeam (2001: 11), House (1993:1), Scriven (1997, 1999, 2000), Mark et al. (1999:188) (cited in Mbava, 2017:23).

Evaluations have proved vital in ensuring human actions and organisation have impact as efficient, effective and valuable to society. This allows for an objective and external perspective to analyse aspects of an intervention that should be commended and/or improved on. Evaluations are conceptual positions with an interrelated orientation that defines the nature and focus of valuable feedback (Sturges & Howley, 2017:126). The aim of assessing evaluations against a set of standards helps to resolve evaluation issues identified (Stake, 2004). The Department of Monitoring and Evaluation (2011: 3) further indicates that the four primary purposes of evaluations are to improve performance; improve accountability; generate knowledge; and influence decision-making for policy-makers and planners and enhance financial functions.

Evaluations are thus vital for learning and feedback in the policy and implementation cycle they create an informed decision-making culture in policy and programme design functions. This is key to the public sector, where there are multiple stakeholders

invested and the cost of intervention is highly impactful on society from economic, quality of life and developmental perspectives. Evaluations also provide input into research and theory, analysing which programme measures are most appropriate, cost effective and give value for money. This guides the intervention decisions of government and decision-makers in the future, as it enhances an understanding of how to overcome policy challenges and improve impact.

The interconnectedness of societies, local communities and the world has exponentially increased based on advances in technology and developmental innovations. A drive towards achieving global developmental goals has meant that the responsibilities of governments and decision makers can no longer only take into impact and outcomes for direct stakeholders. Interventions have had to shift towards a global perspective, further incorporating the network governance approach, to be discussed below. Evaluation methods have had to adjust to a shift towards a plural, complex and interconnected context to adequately emphasise joint responsibility for developmental outcomes, shared objectives and the reciprocal obligations of organisations and beneficiaries. Likewise, evaluation indicators have to go beyond the measuring of inputs to capture programme results. Indicators have to allow for the tracking of progress towards unique intermediate objectives embedded in community programmes (Picciotto, 2003:232).

This requires strong relationships with beneficiaries and communities based on multi-agency and multidisciplinary teams to work together in order to undertake complex interventions to resolve welfare problems (Harper and Dickson, 2019:331). Fundamentally, a developmental approach to evaluations allows for methods of discovery in a turbulent and dynamic environment where the needs of beneficiaries are yet to be ascertained and created, which means that evaluators have to act as facilitators and constructively align partners, social learning methods, identification of objectives, joint accountability and the reciprocal obligations of partners (Picciotto, 2003; Harper and Dickson, 2019).

Evaluations allow for stakeholders to navigate and align their decisions with the challenges presented in their environments, understanding the impacts that actions will have on long-term outcomes. Where the operating contexts are increasingly complex, it is harder to coordinate functions from multiple stakeholders, adapt

deliverables to changes in the environment, or generate inclusive outcomes beneficial to all end users. Evaluations are therefore vital in complex contexts, as they provide objective and protectory insight into navigating a dynamic project environment.

2.3. Key considerations for evaluations in Complex Contexts

Evaluation theory applied to complex contexts is reliant on evidenced-based decisions and policy making whereby evaluators are obliged to improve the quality of decision-making processes and avoid self-serving interests and unequal programme outcomes. This derives from a global transition towards a stronger civil society and civic desire for greater political participation, accountability and transparency (Picciotto, 2003). Complexity and complex environments refer to the properties and behaviours of those who operate within it. This includes many diverse components who interact with each other in a nonlinear way and whose behaviour may adapt and change over time. This leads to unpredictable behaviours, which means that policy makers have to adapt well, because these changes may have not been foreseeable (Department for Environment, Food & Rural Affairs, 2019:6).

There are several dimensions to complexity, all of which need to be taken into account by decision-makers and evaluators in order to ensure project success. Included in these are a range of possible outcomes, variability in the target population, the level of interaction between components within the experimental and control interventions, degree of flexibility and the number and variability of outcomes (Craig et al., 2019:7). Environments have multiple actors, which may include policy makers, government, businesses, direct beneficiaries, national and international regulators and civil society. The impact of an intervention's inputs on outputs may not be proportional, as outputs change over time. This is further exacerbated by feedback within the intervention cycle, whereby feedback can accelerate or suppress the changes and/or outputs of the process. Components within the intervention may also be autonomous and change the direction of the programmes and its outcomes. The emergence of new or unexpected properties that affect the intervention at a high level can also have an impact on the outcomes, as decision makers may have been unable to foresee stakeholders' responses to intervention components. This could potentially lead to a tipping point within the intervention; furthermore, path dependency within the intervention means that decision-makers do not have high levels of control within the

intervention, which is often the case in complex settings (Department for Environment, Food & Rural Affairs, 2019, pp. 6–8).

It is often the case that in this complex dynamic with multiple operating stakeholders each has their own goals and agenda for the outcomes of the intervention. In order to achieve high-level buy-in from the majority of stakeholders, the intervention has to achieve a variety of outcomes. These interventions have financial and resource investments on which stakeholders have to see returns. This often adds to the organisation of an intervention, as stakeholders may try change the path of the outcomes.

2.4. Network Governance

Considering the complexity of the public sector environment when implementing innovative and large-scale interventions, the success of implementation is dependent on the cooperation of stakeholders in coordinating expertise, funding and resources. This introduces the dynamics of network governance. Network governance has been introduced in the political sphere to explain the ever-increasing interconnectedness and complex linkages between public, private and civil society actors and stakeholders who affect policy making and its processes. Network governance has created political and social partnerships, whereby complex issues can be addressed at the multi-dimensional level (Hardiman, 2006:347). Network governance is characterised by a "change in the meaning of government, referring to a new process of governing, or a changed ordered rule; or the new method by which society is governed" (Rhodes, 1996, pp. 652–653). The shift towards network governance has been driven by a variety of factors which have also driven the shift of centralised bureaucratic government to New Public Management (NPM). NPM saw the introduction of private sector management methods to the public sector, aiming for efficiency, economic viability and sustainability, explicit standards and measures of performance, value for money, and in later years aiming for closeness to the end user, seeing citizens as customers themselves (Cloete, Rabie and de Coning, 2014:14). The NPM aims to reform public sector practices to be more efficient and market orientated; however, this has been criticized for its inability to solve complex problems, while limiting the citizen's role to a consumer, with little influence in decision-making processes.

Network Governance goes one step beyond NPM, and is centred on addressing the growing complexity of social change and the development of public policy whereby public authorities interact with partners in the private sector and civil society. Democratic principles are at the core of governance, where civic choice, public accountability and shared knowledge have guided policy process for decades. Due to the growing complexities of social problems, there have been a number of factors that have shifted towards network governance. Rhodes (1996:661) outlines these as follows:

1. The privatization of public interventions, which have seen a limiting of government's scope of action;
2. The loss of governmental functions due to alternative delivery systems;
3. Limits set to the discretion of public servants through NPM, which places more emphasis on managerial accountability, clearer political control through a clearer distinction between politics and administrative duties.

Recent social changes have intensified the above factors. Due to increasing demands on government and service delivery systems, governments no longer have the capacity nor the ability to be the sole hosts of expert knowledge (Røiseland, 2007:2). Beyond service delivery being hampered by institutional overloads, democratic principles mean that government practices have to be developmental in nature, aiming for government to work with citizens and community stakeholders to find sustainable ways to meet their economic and social needs, and working on participatory ways to encourage social learning and empowerment (Kanyane, 2014:88). This has similarly seen a wider range of stakeholders who wish to participate in problem-solving processes, with citizens and clients becoming more self-aware and prepared to make further demands. Network governance allows government a flexible method of addressing complex social problems, testing policy responses, and building support for consequent legislation (Hardiman, 2006:347).

Network Governance sees a coordination of efforts by multiple stakeholders to achieve a variety of outcomes, which each is invested in. The three types of networks may arise through this approach, namely *policy networks* with multiple actors having power and access to decision making; *inter-organisational service delivery and policy implementation* whereby resources from multiple stakeholders are required for policy

survival and the delivery of complex services; and managing networks to solve complex problems through the collaborative efforts and expertise of stakeholders (Klijn and Koppenjan, 2012:3). This dynamic system aims to create network efficiency, as the attainment of outcomes could not normally be achieved by the individual organisational participants acting independently.

The challenge presented by network governance is introduced here; however, where stakeholders involved in the collaboration have different priorities for outcomes, with personal investments in the network, trying to understand and make sense of the dynamics of network governance can be time consuming and costly (Provan and Kenis, 2008:230). There is also a conflict in the nature of network governance; networks suggest flexibility, openness and being dynamic in nature, whereas governance leans towards more controlled direction and guidance. However, the need is for horizontal coordination to address the two interrelated types of complexity – substantive complexity which means that the concerns are the subject matter under consideration; and complex and ill-structured problems (Hertting, 2012:30). This then allows for coordination amongst various stakeholders as a tool for collating different perspectives, skills and resources to address problems.

The coherence of the network governance's relationship can further be strengthened by evaluations, whereby evaluators support the relationships of stakeholders in the implementation processes. This assistance is strengthened when using the developmental evaluative perspective, grounded in the premise that implementation methods should remain flexible, be shaped by ongoing development, learning, changes in environments and collaborative reflections upon implementation processes (Gamble and Mcconnell, 2008:18; Patton, Mckegg and Wehipeihana, 2016). Evaluations have to further encourage deliberative processes, whereby stakeholders negotiate on what priorities are most important and what the preferred state is when every position and perspective is taken into account (Hertting, 2012:42). This brings stakeholder theory and management into practice, which is common in the fields of public relations and business, manifesting itself in the forms of stakeholder dialogue between companies and competitors; between stakeholder groups in the form of consumers, workers unions, NGOs, political actors; and between community groups and civil society (Roloff, 2008:2,3). Evaluators must use their informed findings

to aid dialogue, inclusive reflections and outcomes for all stakeholders, and help all to understand the hierarchy of needs and objectives. Evaluators may do this through process observations, identifying points of tension between stakeholders, implicit decisions, the assumptions made by different parties, and emergent themes and patterns of implementation withing the complex context (Gamble and Mcconnell, 2008:32). In doing this, the issues involved in the complex nature of, and stakeholder inclusion within, network governance are more likely to be addressed.

2.5. Complexity of evaluating public sector programmes

The public nature of public sector interventions means that the multiple factors discussed above create complexities, and the volumes of invested stakeholders, impacted beneficiaries and complicated aspects are much greater and interact at a high frequency. In a public setting, evaluations are key in managing these complexities and have huge relevance. This is also the case as government is accountable and scrutinized on policy choices, public spending, effectiveness of programmes, and implementing interventions that will bring about valuable long-term outcomes. Evaluations thus are vital to the public sector, as its operating environment brings about high levels of complexity in itself. These have to be considered when designing and implementing an intervention. Evaluations are key to ensuring that these interventions remain relevant, on track, and produce the desired outcomes and impacts, despite changes to the design, methodology and implementation methods.

Managing evaluations within the public sector proves difficult, as challenges arise over conflicting views about how public interventions can be made effective and efficient while dealing with the different stakeholders, and organisational and community cultures (Cloete, Rabie and de Coning, 2014:12). Evaluations are thus unique to their contexts, since the evaluator has to act as an investigator, mediator, facilitator, guide, adviser and evaluator.(Swanepoel and de Beer, 2011:68) Furthermore, during project implementation, evaluators in these complex public contexts must facilitate change management amongst stakeholders and create understanding and elicit cooperation from an objective perspective, incorporating the intervention’s long-term goals.

Despite the varying evaluation models, designs and approaches, there has been a strong focus on intervention effectiveness utilisation. Evaluations have evolved as global and community priorities change and develop. Evaluations have thus had to

adapt their founding premises, methodology and investigative focus. Guba and Lincoln (1989) detail the evolution of evaluation research over three generations:

> 1st Generation – the gathering of relevant statistics;
>
> 2nd Generation – the description of patterns of strengths and weaknesses, relative to the identified objectives. This includes quantitative and qualitative evaluative analysis;
>
> 3rd Generation – making value judgements, acknowledging that judgement of merit and worth are integral to evaluation and that the evaluator is best positioned to make such judgements.

This shows the natural revolution of evaluations to date, as these evaluation processes and considerations in public settings not only take into account the overall merit and worth of the intervention based on the coordinated inputs and outputs of the complex intervention components, but further analyse whether these outcomes can be universally utilized. Due to the difficulty of finding complete consensus among stakeholders in complex public settings, it has been found that objective evidence was not often at the centre of highly public and political realities of decision-making, and in response evaluators target decision makers and draw their focus towards utilisation (Patton, 1987). Utilisation-focused evaluation is based on the premise that evaluations should be based on the intervention's utility and actual use, and evaluators should facilitate the evaluation process and design evaluations with careful consideration as to how everything that is implemented will be affect intervention use (Patton in Cloete, Rabie and de Coning, 2014:140). Interventions are only effective if they are used by beneficiaries and this use is sustained in the long term, meeting intervention objectives.

Complex public interventions are far more detailed than interventions operating in the private sector. Public interventions need to be fair and equitable, providing benefit for large portions of society. The public policy environment can be more complex, with interventions having to navigate these values accordingly. Public interventions importantly are often funded with taxpayers' money, and therefore have to have the most public impact and benefit. Complex interventions therefore have to operate as best practice and there is little room for error when using public funds. Pilot studies

are hugely beneficial in testing interventions on a small scale, minimising expenditure, and upon proven success, these interventions can be implemented within society at large. Pilot studies, therefore limit public spending and any waste, while testing best outcomes for society.

2.6. Pilot studies in the public sector

A key method in testing utility and the intervention's logic model is to implement the intervention as a pilot study. The concept of piloting an intervention is well known in the field of research, specifically in the public sector. The concept of piloting new services or interventions refers to a wide range of mechanisms for testing services before they are fully implemented. They can take the form of policy trials, proof of concepts, scoping phases, test-and-learn programmes and pilot studies. Pilot testing allows for early testing and indication of outcomes, where decision-makers are given the ability to test the viability of a project outcome at its various stages of development, allowing opportunity to change the course of action, and limiting cost and time when it becomes apparent that the intervention is not delivering the required outcomes (HM Government Commercial Function, 2020:4). Piloting thus allows decision-makers to identify refinements necessary for the intervention, address key considerations identified from uncertainties around the feasibility of intervention trial methods, and understand the preliminary effects of the intervention (Pearson et al., 2020:2). This is key in the public sector, where government officials are representatives of the public interest, lawmakers, custodians of publics funds and implementors of the law. Pilot studies allow implementation initiatives to be tested in a microcosm of society, testing if the outcomes are best value for money, efficient, effective and sustainable.

Piloting and the evaluations involved in these processes further test the feasibility of implementation methods and create opportunities for identifying the causal mechanisms of change, understanding which factors in this microcosm are the drivers of change, outcomes and value creation (Mbava, 2017:15; Pearson et al., 2020:2). This is particularly relevant in the case of innovative technologies, social change and intervention programmes. Innovation should be the core of public sector activities, as this improves performance and increases public value, adapts to the needs of end users, responds to civic expectations, increases service efficiency and minimises costs (Mulgan & Albury, 2003:2). Innovative interventions in the public sector benefit

largely from preliminary tests in the form of pilot studies. This is usually at the final stage of testing a delivery method and have had prior feasibility tests indicated above.

Pilot studies usually involve the implementation of the proposed intervention and services on a localised level, with the aim of identifying and rectifying operational and logistical issues in advance of the large-scale roll out (HM Government Commercial Function, 2020:12). This involves the intervention being tested on a regional or local scale, with certain target populations. Through the observations of stakeholder's engagement, behaviour changes, environmental circumstances, feedback cycles and unforeseen outputs, decision-makers are able to adapt the project, note key lessons and change mechanisms accordingly, and evolve the service requirements. With these changes, the intervention can then move to full-scale role out and implementation. Within the academic field and the public sector, pilot studies further serve the purpose of creating new knowledge through the trialling of innovative technologies, monitoring behaviours, modelling data and practical testing of theory (Cong and Pandya, 2003:31).

Pilot studies in public settings need to test the benefit for stakeholders, as public value has to be created for all. Evaluations are key to understanding the impact of interventions. Realist evaluation specifically tests this, and furthermore recognises that not all stakeholders would experience an intervention in the same way. Realist evaluations test what works, for whom and in what context. The methodology of pilot studies therefore aligns well with that of realist evaluations, as discussed below.

2.7. Realist evaluation theory

Having reviewed the key considerations and causal links between complex interventions within the public sector, managing complexity through the network governance approach, the appropriateness of using pilot studies to test theory and innovative interventions, and how evaluations aid the achievement of outcomes in these settings, this paper reviews realist evaluation theory based on its philosophical and practical elements in analysing interventions within these settings. Realist evaluation has been advocated and shaped by the findings of Pawson & Tilley (1997), which develop the principles and methodology of experimentation to establish what interventions work, in what respects, to what extent, in what context, and for whom (Cloete, Rabie and de Coning, 2014:133; HM Treasury, 2020:6).

Realism is a philosophy which positions itself between positivism and constructivism, with positivism describing reality as fixed and our understanding of that reality as value free and objective. Constructivism views reality and the understanding of it as socially constructed, influenced by social norms and values, and the ongoing development of both (Graham and McAleer, 2018, pp. 2–3). Realism's epistemology is draws findings in scientific positivism, which adopts a systematic approach to the generation of knowledge within the fields of the social sciences, including the humanities and sociology (Mbava, 2017:56). This aims for an accurate representation and understanding of reality whereby one analyses programmes in terms of their aims to alter a change in regularity, and identifies how these regularities are changed in the contexts they operate (Mouton, 2007:507).

As discussed, the social contexts in which interventions operate are highly complex in nature and present ill-structured problems. These contexts are seen as open systems with stakeholders and institutional, economic, social and political structures interacting in dynamic and unpredictable ways. An intervention may be implemented in one environment and succeed in achieving the predefined objectives, and thus be deemed a successful programme. However, when the same intervention is implemented in a different context with varying factors, it may fail. This is due to the societal structures, organisations and institutions that shape and determine human thinking, behaviours and choices. These further may not entail conscious choices and rationale thinking, and therefore new intervention inputs may not be responded to in rational and expected ways (Resnick, 1991). Realist evaluation thus tests whether there are clear causal relationships between the programme, the actors and its outcomes, ensuring that there is no doubt that the change has been achieved by the intervention itself and not an unidentified factor.

The causal relationship between the context, stakeholders and intervention itself is observed in a realist evaluation to identify the change mechanism. Underpinned by the principle that the context (C) as the set of social norms, values and stakeholder relationships, will trigger certain mechanisms (M) and produce outcomes (O), realist evaluation looks further than just inputs and resulting outputs. The combination of an intervention's resources and the response to them is termed the mechanism. An individual will likely respond to an intervention differently in different circumstances,

and thus the premise holds that “the mechanism “is the combination of an individual subject’s inner potential with a particular set of circumstances – a context that determines the outcome” (HM Treasury, 2020:7). Realist evaluations research and identify the mechanisms that cause change in the inputs evolving into the outcomes, and further understands that particular contexts need to be present for the causal mechanisms to be triggered (Ranmuthugala et al., 2011:2). Figure 1below indicates the functioning of the mechanism.

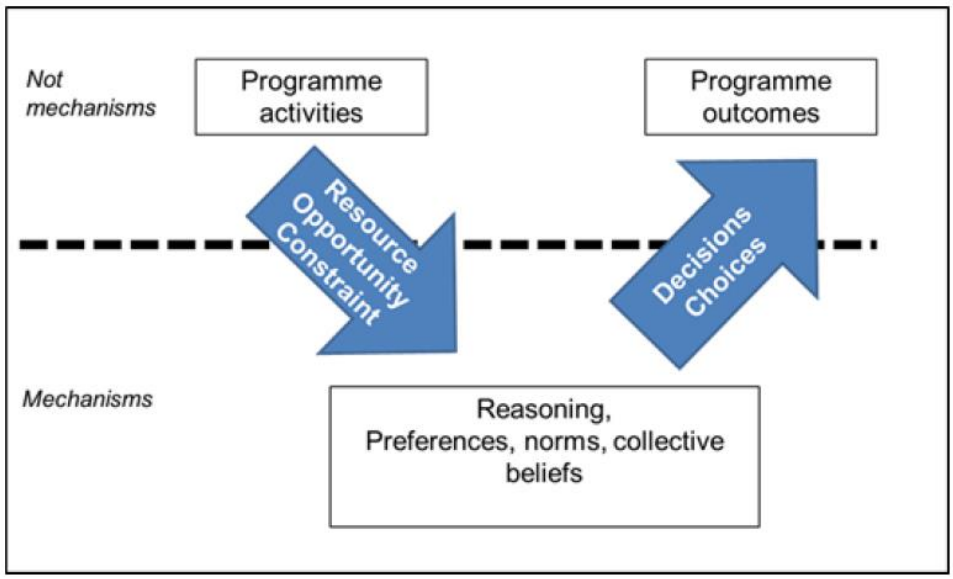


Figure 1: Realist theory and the functioning of mechanisms (HM Treasury, 2020:7)

The mechanism is unconsciously determined by the stakeholders involved within the context and those who govern the network, since conditions are heavily influenced by the way persons respond to them. In understanding the COM configuration and avoiding assumptions on the factors influencing the achievement of outcomes, decision-makers are able to make informed and better decisions about which interventions will succeed in environments and how to adapt them to different circumstances (Stern, 2015). Based on the premises of critical realism, it has been widely accepted that interventions cannot be merely trailed and tested in the same way that laboratory tests would be conducted. Bhaskar (2008) states that the results of laboratory experiments cannot be seen as causal laws as the observed regularities originate from an artificially closed environment that does not realistically reflect real-world conditions. Trying to test theory and interventions within the field of social sciences thus creates the dilemma of whether social sciences should be thought of as

a critical exercise or an empirical science (Mbava, 2017:57). Pawson (2006:18) furthers highlights this dilemma in asking if the social science perspective is able to see society as an open complex system, or whether it can be construed as a closed system where interventions can be subjected to experimentation under closed conditions.

Trying to address this dilemma, realist evaluations are thus active in using both qualitative and quantitative methods of research when understanding the Context-Mechanism-Outcome configuration (CMOc) framework (Swanwick, 2014). This research is based on the premise that interventions cannot be seen and tested as closed systems due to the complex nature of today's societies and methods of governance. Due to its methodical nature, realist evaluations are most appropriate when evaluating new initiatives, pilot studies or large-scale innovative projects where evidence is needed that the intervention works, but it is not yet understood how, why and for whom (INTRAC, 2017). Realist Evaluations are even more appropriate when evaluating developmental interventions that are being piloted for large-scale expansion and replication in a range of different contexts. Decision-makers are unable to plan and identify all causal links and the intervention has to develop as the CMOc unfolds. Many realist evaluations are intended to inform policy decisions, requiring stakeholder engagement from the start of the evaluation design process. Community-based participatory research has further developed the use and importance of utilising realist evaluations to engage with stakeholder groups and achieve outcomes of interventions implemented through a networked governance approach (Jagosh et al., 2015:2).

Realist evaluations are best utilised when it is necessary to understand how the context forms the most influential and critical component in assessing the impact of an intervention. This is most appropriate when a programme operates in a number of different locations and differences in outcomes arise despite the programme being implemented in the same way (Cloete, Rabie and de Coning, 2014:541). When reviewing programme impacts, realist evaluations are fundamental to understanding the potential for replication in wide-scale settings, further being able to identify where the design and implementation strategies have to be modified to meet the needs of the different contexts in order to still achieve same outcomes.

2.8. Interventions within the energy sector

Interventions within the energy sector have been seen to be incredibly complex and selective in their aims, outcomes and impacted stakeholders. The energy sector sees its complexity as rooted in the multiple interest groups and invested stakeholders – governments, regulatory bodies, environmental groups, businesses invested in the privatisations of the energy sector, as well as end users. These interventions are further greatly affected by behaviours and stakeholder values. The evolution of energy infrastructure, laws, impact on the environment and consumption considerations have developed greatly as we shift towards renewable energies and our social considerations in improving the opportunities, living standards and energy security for all (Gavin, 2021). The above discussions are based on the context of the United Kingdom energy sector in which there has been a strong drive for the privatisation of the energy market, a prime example of network governance and the supply of public services by private stakeholders.

Due to the public nature of the energy industry, full privatisation has been limited as fundamental laws and regulatory bodies, such as the Office of Gas and Electricity Markets (Ofgem), have been vital in balancing the control of power and social consequences of the energy industry and the needs of the market (Stanley, 2021). A privatized market benefited in the competitiveness of services delivered, but as a consequence has suffered a lack of methodical and universal approaches to programme implementation and evaluation standards. The Department of Energy and Climate Change (2012:7–8) has highlighted the gaps in the existing evidence base:

1. There is little evidence on how socio-demographic groups respond to interventions. This previously saw small sample sizes in evaluations which means that judgements as to the larger significance could not be made;
2. There is little evidence linking specific changes in behaviour to quantified energy savings. While previous reviews have provided evidence as to the effectiveness on certain interventions, this could not go further and provide an understanding of the scale of impact from changes in individuals behaviours due to the intervention. Most policy-making efforts to reduce the environmental impact of energy consumption has been focused on renewable energy sources and energy-efficient technology (Kok et al., 2011:1). However, changing

people's behaviour is a key driver in achieving reduced energy consumption, which has not been analysed and understood;

3. The current evidence on the cost savings of intervention outcomes is based on a broad range of assumptions. Raitzer, Blondal and Sibal (2019:18) state that energy programs have become more orientated towards objectives of inclusion and sustainability, and that the number of assumptions informing the design has been steadily increasing. A rising number of these assumptions is based on behavioural features.

The Department of Energy and Climate Change (2012) calls for research to understand and provide data exploring the impact of interventions on different socio-demographic groups, using pilot studies to test innovative interventions. From an analysis of energy interventions, it is clear that there is a lack of research based on: behavioural change, causal factors and the mechanism for change within the energy environment (Kok et al., 2011:1). The transition towards more energy-efficient technology and renewable resources requires people to make choices and orientate their day-to-day behaviours around these – meaning that our understanding of how technology and human behaviour interact is key to successful energy interventions (Sovacool, 2009:4500).

Realist theory dominates the space for addressing these knowledge gaps, providing the methodology in which behavioural studies and trials can take place. The behavioural reasoning behind human engagement with energy interventions are theorised and grounded in multiple epistemologies. Theory of choice (Glasser, 1998) indicates that people will always emphasis their self-interest. The concern must be for themselves and the nation as a motivation for acting pro-environmentally, while the norm-activation model and its predecessor, value-belief-norm theory, examine the role of social norms, assuming that people act with the varying intensity depending on their sense of their moral obligations to conform to changing societal interventions (Schwartz, 1977). Despite these theories, there is a lack of tangible evidence, research and the application of realist evaluations in understanding the mechanism for change within energy interventions, which all require further development.

This study accepts current evidence calling for pilot studies as a tool for testing energy interventions and understanding the CMO framework. Experience proves that it is

good practice to consider a pilot study when dealing with the following intervention contexts (HM Government Commercial Function, 2020:13):

- Significant transformation of service delivery methods and programmes;
- The scope of programme delivery is large;
- Citizens will need to change their behaviour and interact differently with the service and proposed intervention;
- The new product or service could have far-reaching unintended consequences;
- Implementing the design and solutions will be a costly process;
- The delivery would be difficult to reverse.

The above points are highly relevant to the energy sector, with service delivery being a key factor affecting one's quality of life and access to opportunities. The sector's engagement with a large number of stakeholders in complex settings and current gaps in knowledge indicate there is huge value in realist evaluations to gain further understanding of how interventions achieve desired outcomes through behavioural change.

2.9. Conclusion

This research paper applies the theoretical discussions above to a case study based within the energy sector in the United Kingdom. Policy has set the prescribed target of net zero carbon emissions by 2050 driving transformation within industries, as seen in the energy industry. Government has created policies to disincentivise consumption of non-renewable energy by increasing the cost of these resources through taxes and limitations on emissions. Government has at the same time provided funding opportunities to assist the energy industry in making these changes, sharing the cost of the country becoming carbon neutral. LEO is an example of a project funded by government. The project trials innovative interventions that challenge traditional energy creation and distribution processes, whereby households participate in energy generation and are connected to an open grid system.

The realist evaluation approach is well suited to assess the potential replicability of project LEO as it explores both the internal and external success factors. This is important for innovative projects that are implemented in complex environments as the

CMOC framework can help to determine replicability and stakeholder engagement and reactions. The realist evaluation approach is valuable in complex contexts, as the design is well suited to assess how interventions work in complex settings, as the evaluator is able to deconstruct the causal conditions underlying the intervention. The realist approach values the experience of various stakeholders in the project environment and holds their experience as valid data. The realist approach is fit to understand who, how and in what contexts stakeholders experience the project intervention. The researcher draws conclusion on the internal and external factors that contribute to the project success and failures. Understanding of environmental factors are key in this, ultimately providing insight into the project replicability.

3. Chapter Three

The Legislative and Policy Environment for the Evaluation of Energy Sector Programmes in the United Kingdom

3.1. Introduction

The previous chapter outlined the conceptual framework within which the research operates. This chapter will describe the legislative and policy environment within which the energy sector operates, namely an open and competitive market regulated by government and managed through a network. The core drivers of change and management policy will be described, allowing an understanding of the complex environment in which energy programmes operate. This chapter further investigates how the evaluative criteria are influenced and considered when reviewing these programmes. The investigation provides understanding of the fundamental importance of energy programmes as well as the factors that drive innovative interventions such as Project LEO.

The energy sector has largely been shaped by the global drive towards sustainability and environmental conservation, with nations having sustainability at the centre of their political and social policy considerations. This principle has now filtered into the economic and private sector, with businesses having to adhere to environmental policy, as well as legislation rewarding businesses for their efforts in adopting environmental considerations at the core of their business strategy. In a world that is dominated by mass production and consumption, environmental degradation and unsustainability have become pressing issues. Our world has started feeling, seeing and living with the effects of climate change, environmental degradation, inequality and poverty, and the non-renewable energy crises. The overuse of the earth's resources has created much concern for the viability of humans and the earth's existence. The UK has therefore placed legislation at the core of its fight against climate change and implemented the pledge to reduce carbon emissions to net zero compared to 1990 levels (Parliament of the United Kingdom, 2008). The policy aiming to achieve 'net zero' is revolutionising the energy industry and long-term advancements. The legislative, environmental, social and industrial factors involved in a green revolution will be discussed in this chapter.

3.2. Key drivers within the UK Energy sector

The UK energy sector is extensive, involves many parties and supports multiple functions. This creates complexities between the operating factors within the commercial, policy and technical environments. The key challenge within the energy industry is to modernise systems that the centralised and static energy systems built during the last century and now require transformation into new flexible, sustainable and user-centred systems (IET, 2016:2). Society and technology have been formed on carbon-intensive energy, which has proved unsustainable and environmentally detrimental, having contributed strongly to climate change. The legacy systems created within this energy network involve far more stakeholders and resulting policy regulations than ever before and this has made a transition to green systems enormously complex.

The energy industry is a stable contributor to the UK economy and in recent years oil and gas extraction have been the major energy contributor to the economy. In 2019 energy industries have contributed: 2.5% of Gross Added Value, 9.1% of total GDP, 29.5% of industrial investment, and 1.5% of annual business expenditure on research and development, with 177,000 people directly and 121,000 indirectly employed in the industry (Department for Business Energy & Industrial Stratergy, 2020:5). This shows the social and economic dependence on the energy industry for the growth and running of the economy, as well as its major contribution to employment rates. Furthermore, the number of actors within this industry is ever increasing. Not only do those directly involved in the energy industry act as stakeholders, but every person who uses this essential service also has influence. The entirety of the UK population has access to electricity and has had since the last century (The World Bank, 2021a). Thus, the energy industry has a political, economic and social interest in meeting the needs of the growing population, as well as developing to meet the ever-pressing needs of the environmental revolution and sustainability demands. While meeting these legislative and social demands, the industry still has to maintain profitability and be competitive for suppliers to operate in a capitalist market.

Not only have political and consumer demands changed, but the quantities of these demands have also greatly increased. The UK's population in 2000 was 58,892,514, with the population having increased by 14% to 67,158,000 people in 2021 (The World

Bank, 2021b). The World Bank's projections have forecast the population to increase to 72,737,000 in 2050, an overall growth of 23.5% in 50 years, as indicated below:

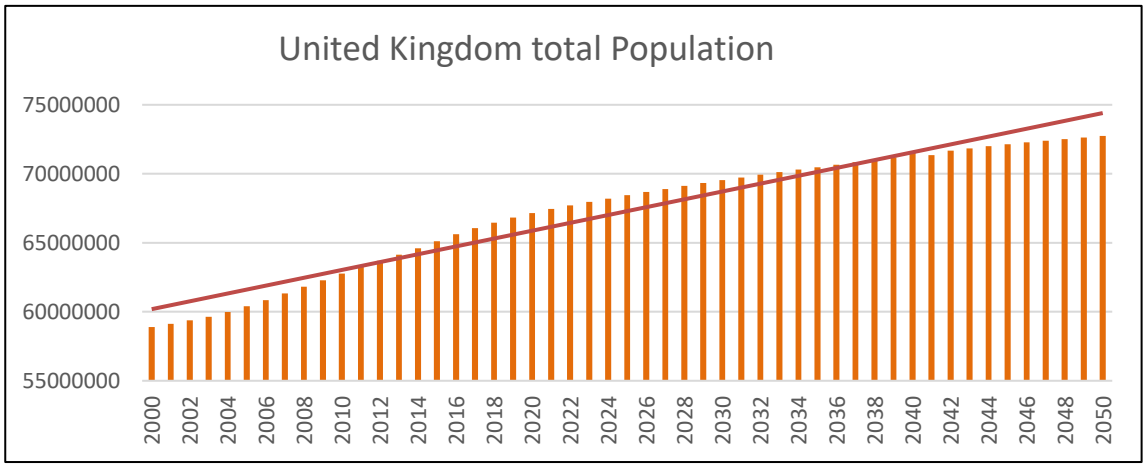


Figure 2: UK total Population 2000 – 2050 (own graph, data sourced from The World Bank: 2021b)

This means that infrastructure, technology and the legacy grid system was built to meet the demands of recent decades. While innovations have been made and upgrades done, the sustainability demands, consumer choices and legislation require revolutionary changes to meet future demand for generations to come. Furthermore, through networked governance, technological advancements and high rates of dissemination of information, end users are becoming more environmentally aware. The current transition therefore involves numerous cross-sectoral stakeholders that are more informed by public policy. Social responses are calling for a reorganisation of socio-economic infrastructures in order to accommodate these changes. The consumers demand is shifting from traditional needs, as one's ecological footprint is increasingly becoming a large factor in consumer choices. Lennon, Dunphy and Sanvicente (2019:2) captured this in stating:

> *From disambiguation's around human activity and climate change to the growing awareness of a plethora of energy-related inequalities arising from our dependence on fossil fuels, this transition is about more than just technological and political change, or even resource availability. It also involves significant social and behavioural transformations that question established historical narratives and challenge accepted understandings of democracy and economics.*

The drive towards a green revolution and an innovative energy market has thus been driven by the two following factors (Energy UK, 2020; Parliament of the United Kingdom, 2008; CCC, 2019):

1. Decarbonisation and the drive towards sustainability in using renewable resources;
2. Infrastructure upgrades to the grid systems towards achieving net zero emissions by 2050.

The first relates to the political drive towards a transition to low-carbon energy and the government's regulation of the energy market. The government strategies have moved away from interventionism since the 1980s. However, with the impact and changes to the political sphere after Brexit, government policy has advocated to play a larger role in the market, increasingly so with regards to market resource allocation and decisions over the economy's sectoral composition (Shackleton and Zuluaga, 2016:22). The second major driver in the reform of the energy industry is the infrastructural upgrades needed to support the increasing demands – including social, economic and environmental considerations, which will be further discussed below.

These two driving forces for a green revolution and innovative energy market have created a gap and need for innovative interventions within the energy market. Pilot studies are used to test innovative measures and test new market solutions for the decarbonisation of the energy industry, as well as providing upgrades to the legacy infrastructure. Government funding further makes these innovative pilot studies a feasible and cost-effective way to develop new market solutions and transformative measures in the energy industry, using network governance to deliver projects. A discussion of the policy framework that creates the conditional environment for these pilot studies follows in the next section.

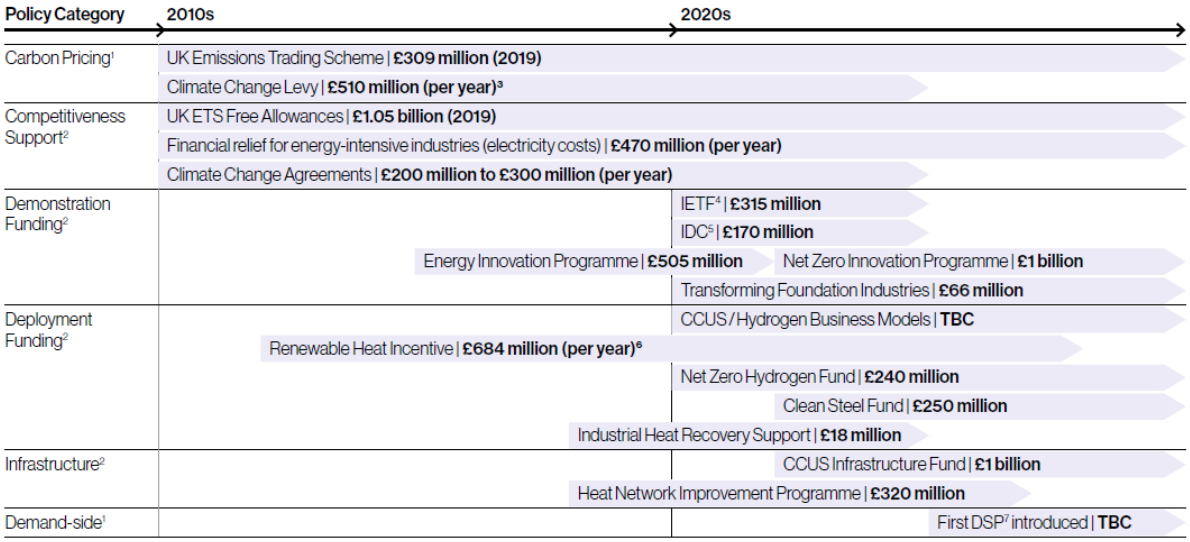
3.2.1. The Policy Framework for the decarbonisation of the Energy Sector

The UK government has been praised for being the first major economy in the world to pass legislation aiming to end its contribution to global warming and climate change with their commitment to reach net zero carbon emissions by 2050. The strategic plans to achieve this goal show government working in partnerships with industry, its workforce, end-user customers and communities in creating opportunities for a green

industrial revolution. As a clear example of network governance, this approach aims to create global and national impacts and opportunities, while sharing the risks and costs involved in revolutionising the energy industry (HM Government, 2021:16). The decarbonisation of industries in general will provide new opportunities to upgrade the economy nationally and within regions of the country, while creating jobs and investment within the UK and new markets for industry to supply. However, decarbonisation also creates challenges for the industry. Essential technologies and manufacturing process have been historically developed to rely on non-renewable sources. Low-carbon technologies are in the early stages of development and not yet available to commercial markets (HM Government, 2021:18). Government has thus outlined the following principles in aiming to change the policy landscape to overcome challenges with decarbonisation:

- Government intervention focusing on addressing market failures. Intervention made by government should be technology neutral, in that costs and risks are shared between industry, consumers and taxpayers;
- Government should facilitate and be a stakeholder in the delivery of large-scale infrastructure projects for key technologies where there is a shared benefit and the risk or cost is too great for the private sector. Government should intervene to deliver specific targeted outcomes in line with wider priorities.

Considering its commitment to work with industries and the energy sector to tackle climate change and the UK's dependency on non-renewable resources, parliament has implemented the following legislature targeting the decarbonisation of industries:



Cost figures taken from most recent government publication or announcement unless stated otherwise.
1 Cost to industry
2 Cost to government
3 Estimated cost based on energy consumption. Total CCL cost is £2 billion per year across all sectors, including industry, agriculture, commercial and public services.
4 IETF = Industrial Energy Transformation Fund
5 IDC = Industrial Decarbonisation Challenge
6 Annual costs were £684 million in 2019-2020, including commercial, industrial and public premises. £1.01 billion total budget for domestic/non-domestic schemes in 2019/2020.
7 DSP = Demand-side policy (see Chapter 3)

Figure 3: UK Industrial Decarbonisation Policy Landscape with associated costs (HM Government, 2021)

The above policies will be discussed below, indicating the core drivers of the policy landscape in tackling climate change and the decarbonisation of industries.

3.2.2. Net Zero Carbon Emissions by 2050

Central to the policies indicated in Figure 3, the Climate Change Act (2008) outlines the targets for the UK's coordinated efforts in reducing greenhouse gases. Net zero provides a system of carbon budgeting and confers powers in order to establish trading schemes, provide financial incentives to produce less domestic and commercial waste, amend renewable transport fuel obligations as per the Energy Act of 2004, and set viable methods to achieve targets.

The Climate Change Act (2008) states that it is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least lower than the 1990 baseline. This includes the emissions of carbon dioxide as well as other targeted greenhouse gases. This target was set after consultation with Parliament, the advice of the Committee on Climate Change and representations of other national authorities. The Act further sets carbon budgets for budgetary periods of five years to ensure that

the net UK carbon count and decarbonisation are measurable, accountable and attainable. The Climate Change Act specifies that the following factors and their projections into 2050 have been taken into consideration when setting the targets (Section 10(2):a-i): scientific knowledge about climate change; relevant technology; the UK's economic circumstances and the impacts of the decision on the economy; economic impacts on the competitiveness of the industry in the target's intervention; fiscal impacts such as taxation, public spending and borrowing; social circumstances and impacts on levels of poverty; energy policies and changes required on the back of targets being implemented; regional differences and implementation challenges; and the reportability of emissions. The Secretary of State has a duty to report on the annual progress towards targets and the impacts on the factors listed.

While the Climate Change Act (2008) specifies a considerable number of regulations in enforcing industries to comply with the target emissions, the path to achieving this by 2050 will require a steeper reduction in emissions over the intervening three decades than what is currently legislated in the carbon budgets until year 2032. The Climate Change Act places authority and decision-making power in the Climate Change Committee (CCC), who have linked with governing bodies, industry and civil stakeholders to outline and attain achievable targets to reduce and reverse climate change. In May 2019 the CCC set the target for net zero emissions by 2050 (100% reduction), whereas this was previously an 80% reduction in emissions with the year 1990 as a base level (CCC, 2019:52). While the overall policy has changed to achieve net zero emissions, the carbon budgets for industries to align with and adhere to have not. The government projections indicate a significant policy gap between expected emissions and required reductions over this period, as seen in Figure 4.

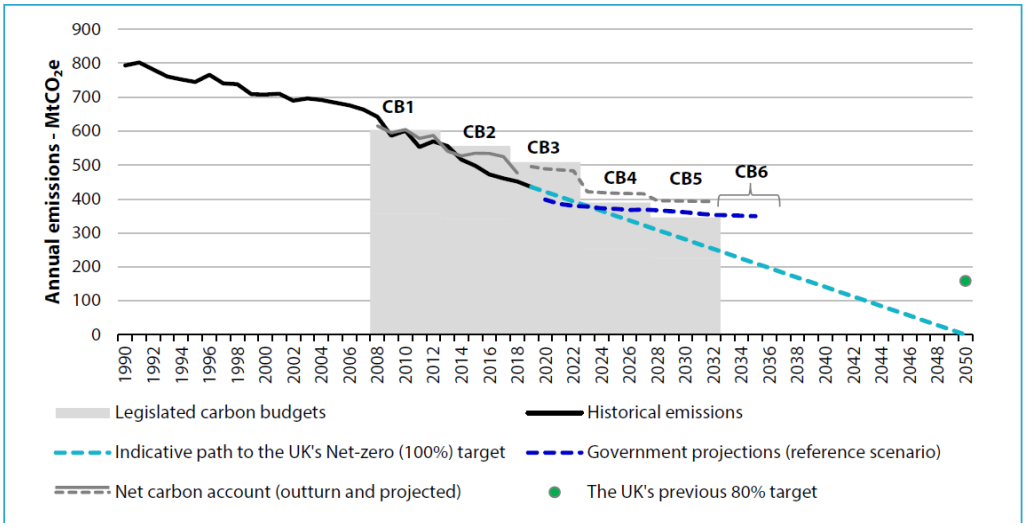


Figure 4: Carbon Emission Pathways and Carbon Budgets to achieve Net Zero 2050 target (CCC, 2019:53)

Figure 4 shows the key changes and considerations in achieving net zero emissions:

- The UK's previous target was at 80% and has now been changed through carbon budget targets to 100%;
- Considerable reductions in carbon emissions have taken place from the year 1990, and the rate of reduction since introducing carbon budgets (CB) has increased, proving legislation and the policy landscape have been effective in their aims;
- Projections in the government's scenarios see emissions declining by 55% in 2030. However, as per the indicative path required, the UK needs to have reduced emissions by 63% at the end of the fifth carbon budget (CB5) to achieve the target. This is due to the fact that the CB5 was set on the path to the previous 80% target (Climate Change Committee, 2016).

In order for the net zero target to be achieved, industry has to fully onboard and have this target at the core of their objectives. The policy landscapes and mere compliance is not enough to deliver a pathway to success and climate change prevention. A complete restructuring of social and economic infrastructures requires the following to achieve net zero, going above and beyond what the policy landscape calls for (IET, 2016; CCC, 2019; Department for Business Energy & Industrial Stratergy, 2020; HM Government, 2021):

- resource and energy efficiency;

- societal choices leading to a lower demand for carbon-intensive activities;
- extensive electrification of transport, heating and a major expansion of renewable and low-carbon power generation;
- carbon capture and usage storage (CCUS) technologies implemented in industries;
- sustainable farming;
- the active reduction of emissions removed from the atmosphere by environmental conservation and limits on aviation and agriculture.

These measures are required in order to comply with current legislation and implement change via the methodologies prescribed by the policy landscape. With the inefficiencies in policy, the cooperation of and drive from industry are needed to bridge the gap between the CCC's carbon budgets set at an 80% reduction target, and the long-term target of 100% reduction in emissions.

The target of net zero and linked policy has prescribed the transformation of the energy industry. The gap in the policy environment between the target and actionable outcomes leaves a gap where the public, private and civil sector need to work together to test and implement change, navigating the deliverables in achieving the ultimate outcome of net zero. Project LEO is a prime example of this, born from the recognition of all actors of the need to decarbonise the energy industry, and testing innovative measures at a local level. The outcome achieves national objectives, with delivery partners implementing change through sub-projects that aid a range of outputs, specific to the local environment. If the piloted intervention is successful, this can be replicated at a national level, informing policy and industry, as well as shaping public perception and information.

3.2.3. The Climate Change Levy (CCL) and Climate Change Agreements (CCA)

In its call for resource and energy efficiency and a lower demand for carbon-intensive activities, the legislature has implemented the Climate Change Levy. This is a government-imposed tax introduced in 2001 and applies to energy supplies of non-domestic consumers that taxes consumers on electricity, gas, solid fuel and liquified gas (Practical Law, 2021). The tax aims to act as a deterrent to the consumption of energy generated from non-renewable sources and encourages energy efficiency. Energy that was generated from renewable sources before 1 August 2015 is exempt

from the CCL tax, and thus consumers are encouraged to choose suppliers based on their use of clean energy (Gov.UK, 2021a). Energy supplies must add CCL rates onto commercial consumers bills, unless they apply for exemptions. CCL is charged on usage per consumer. Consumers may be exempt if they are supplied with renewable sources, if they are a charity, or if the business uses small amounts of energy (EDF Energy, 2018:2). The CCL is linked to carbon pricing, a cost-effective and technology-neutral tool for encouraging industry to take account of their emissions in business decisions. Through the reviews and changes in rates such as CCL, government is able to use this as a tool in sending clear market signals and provide certainty over the achievement of net zero targets for industrial sectors (HM Government, 2021:29).

Efficient energy usage is encouraged through the CCL, and additionally there are reduced rates that consumers may apply for if they are an energy-intensive business and have entered into a Climate Change Agreement (CCA). Climate change agreements are voluntary agreements made between UK industry and the Environmental Agency to reduce energy use and CO2 emissions. Consumers will thus have a reduced rate on the CCL. The Department of Energy and Climate Change has negotiated with industry sectors on energy efficiency targets and thus have gained industry buy-in. The current CCA scheme started in April 2013 and will run until 31 March 2025, to be reviewed at that time. A consumer entering into the CCA must measure and report its energy use and carbon emissions against the agreed targets over a two-year target period (Environment Agency, 2019). If the consumer meets the set targets, they can continue to be eligible for the discount on the CCL.

The CCL and CCA are seen as a government-support initiative for businesses in achieving net zero. Government has set the targets for industries with the purpose of ensuring global, national and environmental protection. With engagement, cooperation and innovations in achieving this target, the government alleviates the financial burden of the costs of climate change for businesses. The CCA has supported industry with an estimated £200 million in tax discounts a year in return for meeting agreed energy and carbon reduction targets (HM Government, 2020:130). Government has published its evaluation on the Climate Change Agreements and progress towards meeting its objectives. The outcomes have proved positive, with government having extended the CCA scheme by a further two years (CCC,

2019:118). HM Government (2021:29) has committed to undertake further assessments of the purpose and targeting of a long-term scheme following the CCA extension. This decision was taken following the responses to annual consultation periods.

The CCL motivates and incentivises end users to use renewable energies, and further encourages energy suppliers to make the transition to renewable energy sources. While there are many challenges and major infrastructure reforms in the supply of renewables, the incentivisation further aids innovative interventions to deliver these infrastructure transformations. At present, renewable energies have higher costs in their generation and supply as the mass market demand has not shifted away from non-renewables. The CCL taxes non-renewable energy, driving the price up in order to raise the cost, in an attempt to level the cost disparity between renewables and non-renewables. Innovative interventions that test and deliver the changes required in the energy industry pilot ways to deliver more cost-effective sustainable energy, with government rallying market support for a change in demand through taxation such as the CCL. Project LEO involves major energy industry stakeholders who are able to test and forecast change in demand, with access to networks of consumers directly impacted by CCL.

3.2.4. UK Emissions Trading Scheme

Government has identified that the most crucial and costly stage in achieving net zero emissions to be the decarbonisation of industries. However, this transformation is high risk. Government has thus committed to implement and invest in the critical infrastructure that will enable the deployment of low-carbon technologies (HM Government, 2020:122). Whilst encouraging and supporting the reform of the industry, government has guaranteed to protect the competitiveness of UK businesses in a global market, ensuring that the transformation of the industry does not limit its market opportunities. The UK Emissions Trading Scheme (UK ETS) is a scheme established by the UK government to increase the climate ambition expressed in the UK's carbon pricing policy while protecting the competitiveness of UK businesses (Department for Business Energy & Industrial Stratergy, 2021c). £442 million was spent in 2019 to provide support for qualifying energy-intensive industries to reduce the policy costs of this transition, and offset the impacts of carbon pricing.

In doing this, the UK ETS works on the ‘cap and trade’ principle, where a cap is set on the total amount of greenhouse gases that can be emitted by sectors covered by the scheme (Department for Business Energy & Industrial Stratergy, 2021c). This places carbon limits on sectors, where each business is given a free emission allowance, dictated by the number of participants contributing to the total emission capped value. As the carbon budget periods reduce this capped value over time, the carbon gaps aim to play a significant part in how the UK meets the net zero target by 2050. The UK ETS applies to all energy-intensive industries, the power-generation sector and aviation. Participants are able to then buy and sell their free emission allowances through government auctions or secondary markets (HM Government, 2020:129). This allows for businesses to be able to operate at levels optimal to growth and profitability, while placing a cap on the total greenhouses gases that can be emitted by participants through trading individual emission caps amongst themselves. This mechanism of carbon pricing encourages businesses to monitor and understand the direct impact of their emissions. Businesses that can decrease emissions cheaply will do so, while those who cannot, have to purchase and budget for additional allowances they have to purchase. In the long term, the ceiling on emissions encourages businesses to plan and invest in decarbonisation strategies and technologies in order to defer the cost. However, whilst transitioning, the UK ETS protects businesses can operate as usual in accessing greater emissions trading caps. Businesses are still able to remain completive in the global market.

While the trading schemes limits carbon emissions per business, this does not enforce zero emissions and provides viable ways to deliver a carbon-neutral energy system over time. Innovative pilot projects are able to test market readiness and provide the full delivery path to achieve net zero emissions, navigating the challenges that arise in making this transition. LEO tests the delivery path at a local level, working with industry providers and businesses to make this transition. In piloting this transition, government and industry are informed of the challenges and successes, which can inform future laws and regulations, and align industry measures to support them.

3.2.5. Energy Innovation

The Department for Business, Energy and Industrial Strategy (BEIS) has set out funding channels aiming to accelerate and encourage independent innovation within the private sector. These initiatives provide funding to the participants in the energy

system who require support in commercialising innovative low-carbon technologies, systems and processes, ultimately sharing the cost of decarbonisation. These funding initiatives were announced in the Prime Minister's ten-point plan for a green industrial revolution (2020).

Two centuries ago the UK launched the world's first Industrial Revolution, powered by innovation and private investment (HM Government, 2020:5). The UK now aims to launch and create the foundations for a Green Industrial Revolution. In doing this, government is proving that economic success and environmental protection are not mutually exclusive – while it has been implementing green reforms over the last 30 years, GDP has increased by 75% while emissions have been cut by 43% (CCC, 2019; HM Government, 2020:6):

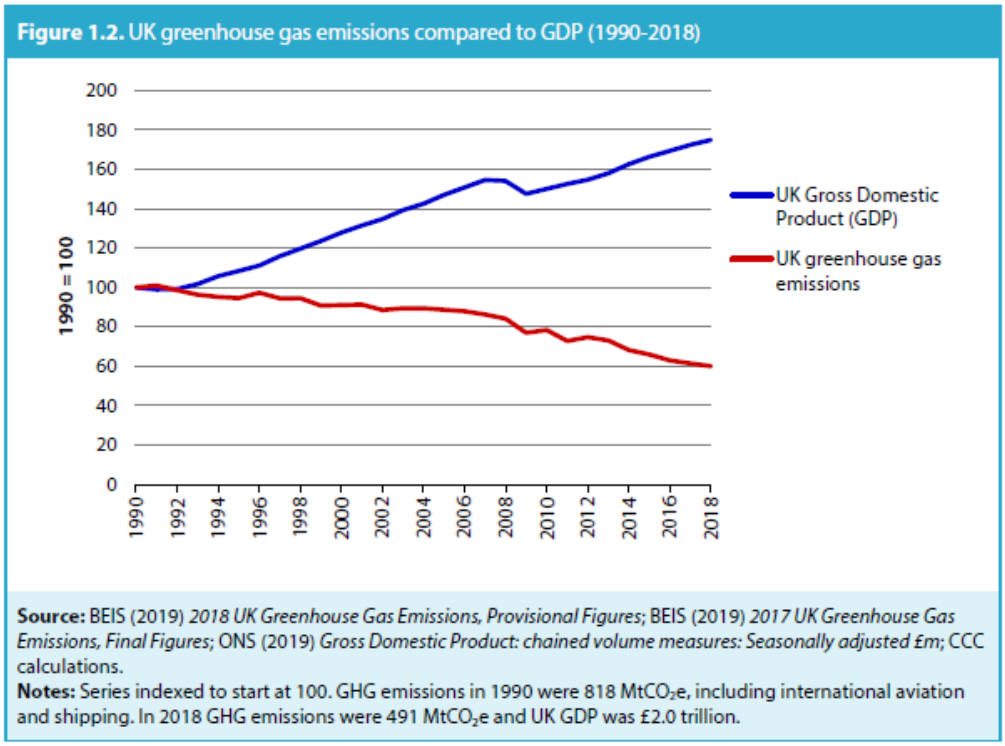


Figure 5: UK greenhouse gas emissions compared to GDP from the years 1990 to 2018

The ten-point plan for a green industrial revolution has seen the UK government announce a total of £5 billion worth of funding to support the green transition, while further mobilising investment from the private sector. While the world is environmentally and universally transitioning to follow in the green revolution, the UK aims to place itself at the forefront of global markets for green technology. The ten-

point plan aims to achieve this through achieving the following objectives (HM Government, 2020):

- Advance offshore wind power
- Drive the growth of low-carbon hydrogen
- Deliver new and advanced nuclear power
- Accelerate the shift to zero emission vehicles
- Green public transport, cycling and walking
- Net zero and green ships
- Greener buildings
- Investing in CCUS
- Protecting the natural environment
- Green finance and innovation.

To achieve the ten point plan, two channels of funding the BEIS has set out are: £1 billion has been allocated towards the Net Zero Innovation Portfolio, and £505 million for the BEIS Energy Innovation Programme (Department for Business Energy & Industrial Stratergy, 2021a).

BEIS has funded multiple innovative interventions that test and deliver industry solutions within the green revolution. LEO has been provided with funding through Research Innovation and private funding channels, which sees government sharing the cost with industry to test and deliver green energy solutions. Government has therefore provided funding for project delivery, and worked to influence market readiness to implement and accept changes through taxing non-renewables (through strategies such as the CCL and the EU Emissions Trading Scheme).

3.2.6. BEIS Energy Innovation Programme (2015-2021) and the Net Zero Innovation Portfolio (2021-2025)

The Net Zero Innovation Portfolio provides funding for low-carbon technologies and systems enabling the transition towards ending the UK's contribution to climate change. Innovation is fundamental to revolutionising green technologies and transitioning the demand towards energy from sustainable sources, so that non-renewable energy will no longer be the cost-effective option (BEIS, 2019:4). The funding for the portfolio acts as a support initiative in sharing the initial cost of the process of decarbonisation, while funding research, as well as the mass development

and implementation of green technologies (Gov.UK, 2021b). While redeveloping industries into innovation hubs, creating new green jobs and investing in regions, innovative programmes will make the UK a global leader in science and innovation. The New Zero Innovation Portfolio was launched in 2021 and has succeeded the BEIS Energy Innovation programme, which ran from 2015 to 2021. Findings from the latter programme showed that innovation benefits the whole energy system in unlocking value across the heat, transport and energy sectors, as well as the rest of the economy. The UK government plays a key role in coordinating the delivery and redevelopment of infrastructure, boosting cost reduction and the high performance of the economy (BEIS, 2019:5).

It is through these channels of funding that support and the attainability of innovative pilot projects are realised. In accessing a pool of resources and knowledge areas from a system of network governance, stakeholders are able to coordinate their contributions and meet their individual objectives in achieving green industry goals. The BEIS Energy Innovation Programme saw investment in the following six green industrial themes: c. £180 million in nuclear innovation; c. £100 million in industrial decarbonisation and CCUS; c. £90 million in the built environment; c. £70 million in smart systems; c. £50 million in support for energy entrepreneurs and green funding; and c. £15 million in renewables innovation (Gov.UK, 2021b).

3.2.7. COP26 and Mission Innovation

While all efforts can be made at a national level, decarbonisation and a green industrial revolution are a global challenge. Industrial products are traded globally, with the import and export sector accounting for 24% of global carbon emissions (IEA, 2020; HM Government, 2021:12). Thus, although the UK may lead in developing and advocating for a green revolution, global participation requires a commitment towards international collaboration with others to develop technology, decarbonise industries and decrease the costs of these processes more quickly and for all. The UK has committed to work with partners to create a coalition between countries to develop low-carbon products; support industrial carbonisation through trade policy; capitalise on the export opportunities that arise through the green revolution; and work with international organisations to encourage decarbonisation in developing countries (HM Government, 2021:12). At present, much effort and great commitment are needed to

achieve this goal – in 2018 mandatory energy efficiency policies regulated and covered less than 25% of industrial energy use (IEA, 2020).

In its international efforts to tackle climate change, the UK is committed to the global Mission Innovation, and is further set to host the 26th United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP26). Mission Innovation is an international initiative which has gained the commitment of twenty-four countries and the European Commission to accelerate their efforts advance innovative clean energy research, development and implementation (Department for Business Energy & Industrial Stratergy, 2021a). Innovation, driven by public investment and coupled with corporate leadership, has the power to make clean energy widely affordable and flood the global market, reducing costs and shifting the mass dependence on and demand for non-renewable energy sources. Coordinated efforts avoid duplication and maximise on positive outcomes, as mutual knowledge exchange can support the drive to reach economies of scale to innovate and implement clean industry technologies (HM Government, 2021:78). Not only do all participants have access to the opportunities and benefits of the shared efforts, but the risks and costs of innovation are shared. The first phase of Mission Innovation sees all members double their public investment in clean energy innovation; since its launch in 2015, members have delivered a $4.9 billion increase in annual investment and as a result over 1,000 innovations have been created globally (Gov.UK, 2021b; HM Government, 2021:78; Mission Innovation, 2021).

The COP26 is being hosted in the UK in November 2021 with world leaders and representatives from 190 nations will discuss key developments in the fight against climate change. COP26 has set the following objectives for the conference: to secure global net zero commitment by mid-century; adapt and protect communities and natural habitats; mobilise climate finance to secure these goals; and work together as a global community to rise to the challenges of the climate crisis (United Nations, 2021). COP26 will see countries resubmitting their Nationally Determined Contributions (NDCs) for intended emission reductions to 2030, as well as their adaptation strategies and future action plans. These discussions are even more important following Covid-19, whereby countries not only have to agree and adhere to global expectations in fighting climate change, but furthermore review these plans in

the new post-Covid-19 economic environment. Aligning post-Covid investment programmes with the agreed global climate change goals of the 2015 Paris Agreement will be fundamental for global climate change policy (CCC, 2019:59). The international platform presented by the COP26 is a fundamental opportunity for the UK to align its national policy with international priorities and strengthen international regulation of carbon-intensive industries. At present, policies such as net zero by 2050 and the UK Trading Emissions Scheme leave international corporations exempt, despite their contributions to emissions by the UK.

3.2.8. The policy framework for consumers

While global and international efforts dominate the policy landscape for large business and commercial stakeholders, green policies are also applied in the domestic sector. Britain's Energy Company Obligation Scheme (ECO) is an obligation on energy suppliers aimed at helping households cut their energy bills and minimise carbon emissions through the adoption on energy-saving measures (Department for Business Energy & Industrial Stratergy, 2019). This is focused on boosting the efficiency of homes, especially in disadvantaged areas and for vulnerable persons – overall tackling fuel poverty. The scheme began in April 2013 and the costs are passed to all consumers through energy bills, with suppliers that have more than 150,000 domestic customers obliged to take part (Department for Business Energy & Industrial Stratergy, 2019). The ECO has driven a rollout of smart meters across all UK households, which provides consumers a way to monitor and have a fuller awareness of their electricity consumption, as well as understanding the direct costs associated (Energy & Climate Intelligence Unit, 2021). Thus, there is a deadline for all homes to have a smart meter by 2025, but this was affected by social isolation and Covid-19.

Linked to the ECO, suppliers are obliged to assist households with heat savings, such as replacing inefficient heating systems. This forms part of the Home Heating Cost Reduction Obligation (HHCRO). The HHCRO offers support to eligible applicants to reduce the cost of their heating through the installation of energy-efficient measures, and the grant is focused on vulnerable and low-income households in the UK to tackle fuel poverty (Government Grants, 2021). Persons who are eligible based on the types of benefits they receive may apply for this funding. If they are accepted, it is the energy supplier's duty to assess how they are able to make their homes more energy efficient and reduce energy bills.

Government has also implemented the Domestic Renewable Heat Incentive (RHI) to promote the use of renewable energy for heating. By switching to independent household heating systems that use eligible energy sources, citizens are able to reduce their carbon emissions, contribute to meeting renewable energy targets, and financially benefit for their contribution (Ofgem, 2021). After successful applications, households will receive payments through the government scheme for seven years, based on the amount of renewably generated heat made by the consumer's heating system. In addition to the RHI scheme, homeowners could apply for the Green Homes Grant which launched in September 2020 and closed for applications on 31 March 2021. The grant provided applicants with vouchers covering up to two thirds of the cost of the chosen improvements, with a maximum contribution of £5,000.00 (Department for Business Energy & Industrial Stratergy, 2021b). These vouchers can be used for home improvements such as insulation; low-carbon heating methods; window, door and draft proofing upgrades; and heating controls.

The above schemes are not regimented policy that all citizens and consumers are lawfully obliged to adhere to, but rather act to incentivise the demand for and interactions with renewable energy sources and seek low-carbon alternatives. In the transition towards a green economy, citizens and consumers are becoming more environmentally aware, and support the socio-economic reform needed for a green revolution. Ofgem has researched consumer opinions on climate change. With the ever increasing information about climate change, 81% of consumers are very or somewhat concerned about climate change (Ofgem, 2020:6). Government has been called to build on its ten-point plan for a green economy by introducing carbon labelling on all consumer services. In doing this, consumers are given the measurable counts as to how many emissions their decisions and lifestyle have direct impact on. 81% of UK consumers support the concepts of carbon labelling for consumer services, such as on an energy or water bills, or public transport services (McManan-Smith, 2020). A further 60% of consumers are willing to pay more for environmentally friendly services, indicating the general public are dedicated to sharing the costs associated with a green transition. While there is this commitment, studies have shown that 82% of consumers have difficulty understanding what their carbon footprint is, and 59% would choose lower carbon options if they were better informed about their contributions to carbon emissions (McManan-Smith, 2020). In creating further awareness and encouraging

consumers choice towards low carbon consumption, the efforts in creating a decarbonised economy would be driven from all three stakeholder sets, government, industry and end users.

While the drivers of the economy and innovation are public and corporate stakeholders, there needs to be consensus and buy-in from communities and end users. New green technology and infrastructure has to be adopted and conscientiously chosen over carbon-intensive alternatives. It is key that through new policy and implementation processes of innovative interventions, citizens and communities play active roles in piloting projects such as Project LEO. In doing this, end users develop their ways of thinking and adopt innovative measures and new social dynamics in daily life. Engaged governance likewise sees citizens as investors in innovative interventions and pilot projects. This follows the value-centred management approach where citizens are shareholders in these programs and government invests efforts on behalf of the shareholders (Callahan, 2007:1187). This is a cooperative relationship that views gain as communal wealth, with citizens having a strong sense of unity based on their common interests and investment. In playing these roles, stakeholders are further empowered to create and develop community projects that tackle key issues, identifying these at a grassroots level and informing innovative projects that will allow for long-term sustainability in desired outcomes. Furthermore, a network governance approach to implementing innovative projects facilitates the revision and adjustment of programmes during implementation phases that allow for programme measures to adapt to any changes in the programme mechanism and stakeholder contexts. Ultimately, the connections made between government measures, industries and consumers create a cooperative cycle of information and efforts, whereby targets are worked towards by all stakeholders; green revolution methodologies and innovative measures are adopted at all levels, and feedback as to what works is fed into the system. In doing this, the socio-economic and infrastructural reform of society needed to aid a green revolution is most likely.

3.3. Conclusion

The policy landscape in which the energy sector operates gives clear and coordinated guidance on national targets and the commitment required to achieve net zero by 2050. The targets and path towards decarbonisation for all industries is clear, and government has implemented carbon budgets, policy reforms, economic indicators

and protection in the transformation process, as well as funding programmes to share the cost of revolutionising infrastructure to move beyond carbon energy dependence. Despite best efforts in policy initiatives to encourage energy efficiency, there is still little evidence that policy, including CCAs and IETF, will provide the support needed to enable efficiency in commercial businesses' energy use and also bridge the 20% gap in target between the carbon budgetary periods and overall target of net zero emissions (CCC, 2019:118).

The UK will continue to holistically consider the full set of policies, both in existence and in development, as part of their future trade and carbon-leakage mitigations policy development. Over the longer term, particularly in the 2030s and 2040s, a range of wider measures could be deployed to address policy gaps and risks to decarbonisation for industry, primarily falling into the following categories (HM Government, 2021:36):

a. climate diplomacy: continuing work with other countries and multilateral bodies to align our approaches and minimise the differentials that create a target gap;
b. treatment of imports: seeking to mitigate the competitiveness impacts of any asymmetry in domestic and international emissions mitigations policies;
c. improving productivity: boosting the competitiveness of UK sectors and making them more resilient.

Despite the strict and multiple policies dominating industrial sectors, there is a lack of integration of consumer understanding and awareness of decarbonisation efforts. There needs to be a further integration of targets and efforts in implementing climate change and decarbonisation measures. Ofgem found that while all industries have to conform to net zero emissions and carbon caps, only 63% of consumers were aware of the term 'net zero emissions' (Ofgem, 2020:6). While this legislated target is the key driver in the UK's green revolution, and the leading country in legally committing to such carbon targets, 37% of lay citizens aren't aware of this goal. This indicates a large gap in stakeholder support and commitment, seeing all actors in society having to mobilise resources to implement the socio-economic reforms needed to realise a green economy.

Understanding that net zero and the socio-economic reforms needed to achieve the target, government cannot work alone. Decarbonisation is best achieved through collaboration with all stakeholders, and sharing resources, investment and knowledge

through the complex network. The policy environment has done well, with improvements identified, to create a platform for collaboration and innovative measures, encouraging innovation through funding programmes such as the BEIS Innovation Energy Programme and Mission innovation. Large industry actors have been able to fund and drive innovative interventions, green technology and infrastructural upgrades, leading research, mass implementation and sustainable development. Consumers have also been encouraged to choose low-carbon and energy-efficient measures, with financial incentives given by government in making these choices. Innovative projects, such as Project LEO, within this policy landscape have identified the best methods to achieve decarbonisation through this network governance approach.

4. Chapter Four

Case study of Project LEO

4.1. Introduction

Chapter Four provides an account of the case study of Project LEO, showing how the concepts analysed in the conceptual and legislative framework chapters apply to the project. This will give context to the key realist evaluation questions which need to be posed for the successful implementation and expansion of this innovation in a range of different complex settings. This chapter additionally provides insight into empirical data of the research which was collected through semi-structured interviews with project stakeholders (see Chapter Five).

This case study described in the chapter is fundamental to understand the context and operating environment of the chosen innovative and complex intervention. A case study is a flexible approach to inquiry and entails a methodology to study a phenomenon in a holistic manner and within real-life contexts. Case studies often include “research questions, propositions, theory, an action plan (protocol), identification of the unit(s) of analysis, and logical linkages between data and propositions and theory” (Siedlecki, 2020:250). The case study research method is well suited to this study, as it allows the researcher to explore the impact of the intervention, allowing one to draw conclusions about the usefulness and effectiveness of the project, without making comparisons. The study uses the case study design to investigate the realist evaluation considerations relevant to Project LEO.

Project LEO is piloted in the county of Oxfordshire, where the project plan is being implemented and tested on a small-scale level first. Oxfordshire was chosen to host Project LEO as the need there is great, with the county experiencing an increased demand on the electricity network in recent years, which has created the need for additional reinforcement (Project LEO, 2021d). Project LEO aims to address this need via sustainable generation of renewable energy by consumers themselves. Rather than building on current legacy infrastructure, Project LEO tackles the decarbonisation challenge and aligns its objectives with national environmental objectives. Furthermore, the project planners have the political will and stakeholder buy-in from those in this region, which is key in an innovative and progressive project (Robinson, 2017:108). This allows for project planners to understand how network business need

to change to facilitate new market solutions, while still delivering energy at sufficient volumes and in an economic, reliable, ecologically sound, sustainable and fair manner.

4.2. Project LEO Goals and Objectives

Project LEO delivers a transformative integrated smart local energy system and design to maximise prosperity from local energy systems whereby local communities provide renewable energy inputs. This creates opportunities and a blueprint for new value creation opportunities in different settings. It has been found that most energy substations are at capacity in Oxfordshire. Project LEO aims to provide information and a platform for a local energy market to function with the existing infrastructure (Project LEO, 2018:3). Project LEO thus provides tangible solutions to tackle political, socio-economic and political issues (Darby and Banks, 2020:9; Project LEO, 2021b):

- Increasing population numbers result in **increasing demands on the grid** and energy supply. Project LEO aims to create a decentralised system and support flexible local and national renewable energy sources, new markets centred on local households, business and communities;
- Develop the **future electricity grid and share lessons** across the country to benefit the whole of the UK, with international lessons;
- Inform the transition to smart, renewables-based electricity systems through the piloting of this project, data collection and analysis applicable to further settings;
- Create a **sustainable and effective long-term solution to non-renewable energy supply problems**. The way forward is based on a calculated decision derived from a cost-benefit analysis to either invest in this new progressive innovation, or to reinforce the network with current technology and fuel sources, until the next time demand is again greater than supply capacities. Project LEO furthers the decarbonisation of the energy industry and subsidiary economies.

In order to tackle these issues, Project LEO works with multiple stakeholders and delivery partners in order to draw on expert knowledge and build up extensive skills. These stakeholders will develop and deploy market platforms for flexible local and energy trading services, creating a decentralised energy system that all are able to benefit from (Hammond and Figueiredo, 2021:3). Plug-in projects will add to the inputs for local sustainable energy networks that allow for an automated and flexible service market, while testing the technical, social and commercial feasibility of these project

methodologies (Project LEO, 2018:3). These are projects dealing with solar energy, heat networks, micro-grids, smart neighbourhoods, electric vehicles and transport hubs, new housing developments and flexible energy loads. The collection and analysis of data provide information to the project stakeholders, as well as inform the UK's energy strategy, feeding into national objectives, legislation and incentives, as discussed in Chapter Three. Project LEO thus has six key aims (Project LEO, 2018:3):

1. Develop flexible markets of decentralised energy resources that provide the solutions to energy needs, constraints and environmental objectives to be replicated for national and international benefit;
2. Create new investment models for decentralised energy resources that reflect the value of their flexibility and assets, while being economically competitive;
3. Create a model for Distribution System Operators that facilitate the effective use of local energy infrastructure;
4. Build assets for strategic planning through the creation of tools needed to make efficient and effective decisions about the energy ecosystem and innovative projects;
5. Contributing to data sets for research that will provide applicable lessons so that the project and lessons can be replicated elsewhere both in the local context but also nationally through the Electricity Networks Association's (ENA's) Open Networks project;
6. Empower a community of skilled and aware people. Project LEO aims to skill sets of participants and enhance the social capital of the local energy sector in Oxfordshire where the need is greatest, as well as enhance this more widely across England's economic heartland (the Cambridge-Milton Keynes-Oxford growth corridor). These partnerships and community networks aim to foster a rich innovation sector focused on the clean energy sector.

4.3. Project LEO operational context

Project LEO is a four-year project and is driven by partners in the fields of local government, industry and network operators, university and research institutions, and private businesses. This project is being trialled and piloted in the county of

Oxfordshire, based on the operational context of the area, local needs, and political and community buy-in. Oxfordshire accommodates universities and public sector organisations, making this a diverse and well-rounded environment susceptible to collaborative innovation (Project LEO, 2021d). The local private sector has a focus on developing innovative green technologies that will aid the decarbonisation transition. Many of these companies can feed into the flexible energy market and plug-in projects as a part of project LEO.

It was determined that Oxfordshire is best fitted to be the implementing context as it has high ambitions for decarbonisation, an innovative network operator able to manage a power system close to capacity, social enterprises and voluntary bodies, high levels of knowledge and skills among local project partners, and high levels of social capital and public engagement built up by the local authorities over the last three decades (Darby and Banks, 2020:1) . The private sector has vested interests in the outcomes of Project LEO, key to furthering the implementation of outcomes. Companies in Oxfordshire opened up innovative green opportunities prior to Project LEO, indicating a demand for green innovation and an operating environment that would adopt the principles and outputs of LEO. Nine in ten companies based in Oxfordshire agree that the government's focus on green recovery provides an economic opportunity for them, with the majority of pre-revenue companies expecting to generate revenue within one or two years through accessing these green opportunities (Advanced Oxford, 2020:5). Many of these businesses are community-owned renewable projects which provide the asset base to run trials, but the benefits and economic opportunities of these ventures will also be directly invested into the community, promoting local development. These companies have started investing in capacities and resources to meet the demands of innovative business activities, with growth projected at 10% to 500% over the next three years. This is in line with the projected period of rapid planned growth, with 100,000 new homes planned between 2016 and 2031 (Project LEO, 2021d). The businesses and communities acting as part of this growth process have the opportunity to adopt new innovative green energy systems. The growth is also anticipated to increase the electricity demand within Oxfordshire, which at current levels will place intense restrictions on the network (Advanced Oxford, 2020; Project LEO, 2021d). Local authorities are therefore supportive of innovative drivers and engaged to meet the net zero national agenda.

The project is implemented in the following stages four stages:

1) Inception stage. The inception stage saw project partners engage with local and national stakeholders to develop key performance indicators and agree planned outcomes;
2) A minimum viable system (MVS) approach stage. This approach is agile in nature, and develops and tests new flexible services, procedures and business models which are required to operate a local flexible energy market as proposed in LEO (LEO, 2021:1). The Minimum Viable Product (MVP) is further identified, which outlines the technical and economic feasibility of the system to test the core value proposition;
3) Consolidation Phase. The consolidation stage builds on the lessons of stage one to guide sub-projects within Project LEO, assessing the market readiness for implementation. This stage focuses strongly on local and national stakeholder engagement to shape the outcomes and learnings of the project;
4) Growth Phase. The growth phase will see further complex projects being implemented and the energy market opening up to new participants, as prepared for in the prior stage. This phase is key for demonstrating ongoing commercial viability, with the expectation that Project LEO will continue after its funding lifecycle and this model can be implemented at a national level.

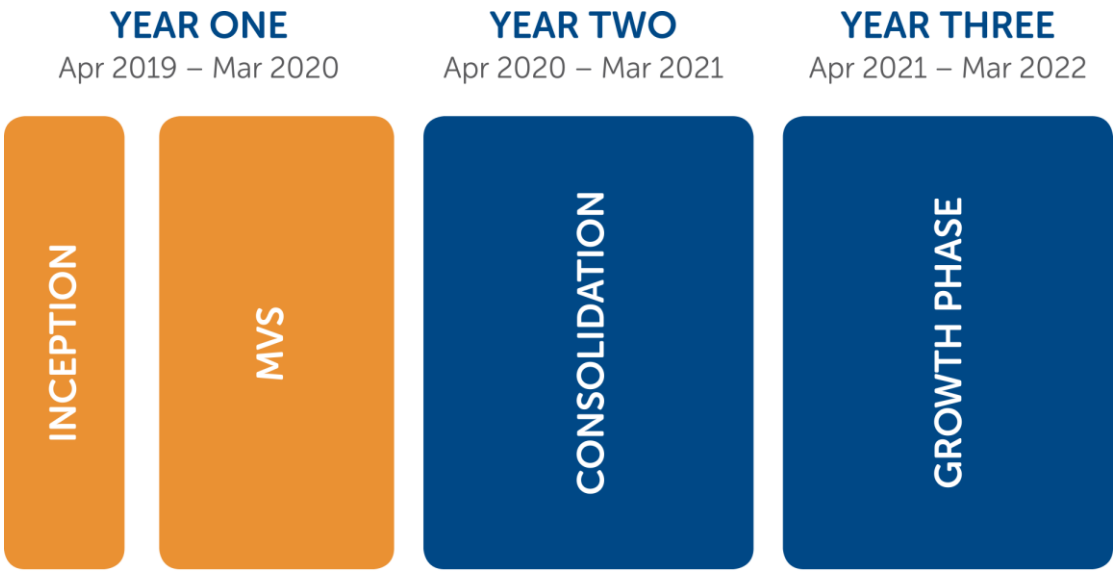


Figure 6: Stages of Project LEO implementation (Project LEO, 2021a)

Project LEO is funded through public and private channels, with a total of £40 m programme funding. Project LEO secured £13.8 m of the available £102.5 m from the Industrial Strategy Challenge fund which was set up in 2018 for UK industry to research and develop green systems and aid the move towards renewable energy-based industries (Scottish & Southern Electricity Networks, 2019:7). The remaining funding has been raised through private funding channels, with the delivery partners having each contributed to the cost of the implementation of their associated work packages.

4.4. LEO Stakeholders

The project is a collaborative effort, consisting of funding and decision-making partners across all social sectors – government, energy industry actors, private businesses and local communities. The wide network of stakeholders allows for expertise, resources, capacity and strategic planning for success to be maximised and best utilised. The planning and delivery that stakeholders provide enables greater access to the participants and end users, namely communities, businesses, universities, hospitals and housing developers. The broad range of stakeholders, end users and their diverse backgrounds allows Project LEO to be tested in a 'microsociety', whereby inputs, change mechanisms and delivery success can best be tested for the purpose of replicability. Project LEO has three categories of stakeholders – LEO partners acting as strategic and delivery partners; local energy system stakeholders who are generally Oxfordshire based, have direct engagement with the project and provide feedback based on their involvement and experience on the project; and wider energy system stakeholders who are in a position to replicate LEO processes in their own settings (Harris and Banks, 2020:22). The boundaries of these stakeholders' groups may be flexible, with stakeholders belonging to more than one group. However, this chapter will focus on the LEO partners and their decision making in the context of the stakeholder group. These partners are responsible for Project LEO's design and implementation and are linked to their work packages:

- Scottish Southern Electricity Networks – Electricity Distribution Network Operator in Oxfordshire County
- Low Carbon Hub – Social enterprise
- University of Oxford and Oxford Brooks University – Public University

- Oxford City Council and Oxfordshire County Council – Local Government
- Piclo – Private industry market place
- Nuuve – Private business
- EDF – Private energy supplier
- Origami Energy – Private business

The complex nature and range of stakeholders means that the project has huge potential for impactful and innovative outcomes that lead to the creation of world-leading energy systems. It is therefore vital that this project is evaluated at all stages, allowing the opportunity to achieve planned outcomes, manage unplanned outcomes, and ensure that the project is replicable in different settings.

4.5. LEO Work Packages

Project LEO has six work packages (WPs), each of which has a lead internal partner who reports progress to the Programme Manager, who details costs, milestones, deliverables. The work packages and lead partners are detailed below (Project LEO, 2018:8).

4.5.1. Work Package One – Programme Management

WP1 Lead Partner: Scottish and Southern Electricity Networks (SSEN)

This WP manages the project management and strategic decision-making processes. This includes managing the costs for the project, as well as chairing the Project Delivery Board, which coordinates budgets, programmes and risk management for the LEO programme. SSEN brings experience in delivering large multi-partner innovation projects (Project LEO, 2018:8). SSEN also aims to deliver the best outcomes in this transition, which supports Project LEO, ensuring this is “cost effective, neutrally facilitating the new markets created; and unlocking local solutions” (Scottish & Southern Electricity Networks, 2019:2). SSEN further acts as a partner on the Project LEO Advisory Board. The board manages the governance of the project and gathers senior individuals from varied organisations to provide direction and support for the delivery of Project LEO. This ensures alignment with wider industry objectives and national objectives.

4.5.2. Work Package Two – Market Platform Development

Delivery Partner: Open Utility

WP Team: EDF Energy; Origami Energy; Nuuve

Lead by Open Utility, WP2 will design, develop and demonstrate numerous market platforms for energy trading, subsidiary network operators as well as test the feasibility of peer-to-peer service delivery within Oxfordshire (Project LEO, 2018:8). This will test the competitiveness of platforms that interact and provide multiple routes for buyers and sellers of flexible energy services. Through the first year of implementation, the delivery teams identified that the best structure to deliver the outcomes of Project LEO and align the technical infrastructure would be to follow the Local Energy Market structure (Darby and Banks, 2020:2). WP2 therefore tests the design of the local market platform and the technical requirements needed to interact in the wider system as the local marketplaces and infrastructure need to be designed to enable access for end users, generators, collectors, suppliers, the DNOs and local resource providers. The WP team which are energy providers test the transitional requirements and infrastructure to achieve these outcomes.

4.5.3. Work Package Three – Plug-in Projects

WP Partner: Low Carbon Hub

WP Team: Oxford City Council, Oxfordshire County Council

Once the marketplace developed in WP2 is complete, WP3 creates a range of projects that can attach to areas of flexible energy services within the marketplace, allowing energy services to be bought and sold. WP3 focuses on projects dealing with heat, power and transport (Project LEO, 2018:8). This work package is fundamental in reporting on the requirements for market platforms to succeed, gathering data for their replicability elsewhere. The Plug-in Projects coordinate the efforts of these projects to complete an automated, flexible service market, which is trialled throughout the lifespan of Project LEO. WP3 further tests the technical, commercial and social viability of the Plug-In Projects in current market conditions (Hammond and Figueiredo, 2021:5). These projects feed into WP1 and WP6 in gathering data to inform policy and

regulatory processes, ensuring they support the development of a mass market of flexible energy services. The inclusion of local government as a delivery partner is key to feeding this into the political environment for energy markets.

4.5.4. Work Package Four – System Learning and Planning

WP Leader: University of Oxford

WP Team: Oxford Brooks University

Oxford University will be the project leader in data collection – collecting, monitoring, evaluating, storing and assessing information about the energy services, as well as user involvement within LEO. This allows the production of evidence, analysis and theory to understand the workings of the project, as well as providing evidence to support future investment and expansion of the energy system nationally and internationally (Project LEO, 2018:8).

4.5.5. Work Package Five – DSO Transition

WP Leader: SSEN

SSEN as an organisation is transforming from a Distribution Network Operator (DNO) to a Distribution System Operator (DSO) in order to become an energy distribution service that works for all customers, ensuring the new system allows for flexible energy markets and decentralised markets (Scottish & Southern Electricity Networks, 2019:2). The DSO transition details the integration of the local energy system created by LEO into the wider national legacy system. This is critical to the success and functioning of the project in providing a cost effective and viable solution to the green transformation of the legacy system. Through validating and demonstrating the open network system, this provides an industry-wide solution and transformation of the energy market and grid system.

4.5.6. Work Package Six – Learning and Dissemination

WP Leader: UoU, Low Carbon Hub, SSEN

WP6 focuses on the coordination of data and lessons to aid in the dissemination of information within the energy and innovation fields. This is key to the replicability of the project and long-term growth of the green revolution. The

three WP leaders for WP6 will engage with the other main project partners to collect findings and then engage with local and national stakeholders to share lessons from Project LEO. This allows for the dissemination of information to society and data gathering to inform public policy and legislation, ultimately contributing to national goals of net zero.

With the above diverse set of stakeholders and sub-projects supporting the delivery of the overall outcomes, the collaboration of the project through a network governance approach needs to be firmly managed. The complexities of the project may cause challenges because of the diverse stakeholder group and implementation avenues, as well as with many end users interacting with the outputs. It is for this reason that there may be multiple change mechanisms, with project decisions and expansion considerations made based on external change factors, and not internal.

In order to address the complexities and demands of Project LEO, the stakeholders have created engagement principles characterised by a decentralised approach to their engagement strategy (Harris and Banks, 2020:8). The decentralised approach is intended to empower project partners and their work packages to self-organise in ways that are flexible and meet their project delivery needs. Consultive workshops held with the project partners in May 2020 gathered information, documentation, processes and project agreements which formulate the delivery framework (Harris and Banks, 2020:8). Alongside this, the stakeholders agreed to planning methods, modes of communication, information dissemination and ethical practices.

4.6. Identified Problems – Realist Evaluation Criteria

All projects involve some aspect of risk and therefore require concerted efforts to forecast, mitigate and manage these risks. Modern projects such as Project LEO prove to be particularly risky because of the conditions they operate in – complex dynamic environments with multiple stakeholders, innovative interventions, advanced technology and a rapid pace of change. In these modern conditions many opportunities present themselves. However, there is no question that where there are project opportunities, there are always risks involved. While it will never be possible to identify all risks, and there will always be unintended outcomes, it is possible to manage these risks strategically. Project risk management therefore involves

understanding significant sources of risk and making tactical decisions, ultimately taking action to minimise modes of failure and increase the chances of project success (Kendrick, 2015:11). Resources and time are required in the initial project stages to strategically engage with project stakeholders and identify possible risks and challenges before they arise.

Project LEO stakeholders have assigned resources to risk management and identified risks at project planning and implementation stages. Project LEO is delivered through the six work packages and a diverse range of stakeholders. This in itself creates complexity in integrating the various components of the project for successful delivery. A risk register has been developed for the project, with the Project Delivery Board as the key mechanism working to review and maintain the Risk Register (Project LEO, 2018:20). Any risks that cannot be appropriately managed are then escalated to the Executive Steering Board for resolution.

WP1, responsible for the management of the programme, deals with what is one of the hardest challenges, relatively speaking, to deal with – complexity. The strategic decision-making powers lie within the stakeholders of WP1, who have to consider practical factors, limitations and try to remain as informed as possible within an ever-changing and dynamic environment with multiple delivery partners with designated decision-making abilities (Project LEO, 2018:20). Physical limitations on incredibly complex programmes may limit innovation possibilities which are at the core of the project's objectives and a key methodology in achieving the desired outcomes. In order to manage this risk, stakeholders have adopted robust governance principles which is are constantly reviewed through progress and risk reviews. A further challenge is that the key performance indicators (KPIs) may become irrelevant and outdated because of the dynamic environment in which the project operates. The energy industry is changing rapidly as a result of governmental and environmental pressures. Therefore, predetermined objectives may become outdated and do not capture the direction of the innovation efforts required for radical change within the industry. Lead stakeholders thus have to avoid rigid logical frameworks and theories of change, which often ignore developmental trajectories and focus on short-term qualitative monitoring indicators (Brandon et al., 2014:138). In remaining flexible and revisiting theories of change, planners are able get an indication of what significant

developments may take place in the long term, which is most vital to sustained growth and impact. Project LEO stakeholders for WP1 have thus committed to active engagement with regulators and key stakeholders through the Strategic Advisory Board so as to keep abreast of industry changes (Project LEO, 2018:20 & Project LEO, 2020:15).

WP4 focuses on the system learning and planning of the project. This WP inputs the data gathered into the wider knowledge field as to inform, guide and managed any knowledge gaps. However, in doing this, Project LEO has to have access to the current temporal and spatial data. In order to navigate this challenge, the stakeholders have made efforts to lead engagement with key stakeholders and data managers in the early project stages to ensure the data are accessible and, if not, blockers are identified to navigate ways around them (Project LEO, 2018:21). The technical challenges this generates require navigation, as it has been found that the databases and LEO data repository with their software requirements did not allow the average LEO participant access. This is counter-productive to the data-management and dissemination goals, which requires an accessible dashboard for other local energy systems and their agents too, not only access for internal stakeholders (Ashtine and Report, 2021:7).

WP6 further links with WP4 to manage learning about and dissemination of internal information and activities, and therefore able to present these findings to government and further implementation bodies. WP6 has to ensure that they do not overlook coordination in the dissemination of this information and activities, which would risk the project's success in replicating efforts in different settings and ensuring the project is effective and sustainable over the long term. Project LEO has thus dedicated a work package and lead partner to this activity to give it the resources, time and management required to successfully achieve its objectives (Project LEO, 2018:21).

Stakeholders have already reported further challenges and lessons, identifying ways to manage them. Many challenges relate to the dissemination of findings and coordination of activities via multiple delivery stakeholders. Two key themes highlighted were the importance of multi-directional communication protocols between LEO participants to notify each other of changes in the operational status of project implementation stages; and the need for policy regarding failures or delays to delivery

of services, whereby service providers are held accountable for their actions in a stricter manner (LEO, 2020:2). All work packages are susceptible to unexpected events, such as a change in laws and legislation, technology and innovations, as well as variable socio-economic circumstances. It has to be noted that during the implementation stages, the unforeseeable emergence of the Covid-19 pandemic affected many project plans, particularly activities that required physical work on site and engaging with communities (Hammond and Figueiredo, 2021:3). WP3 dealing with plug-in projects was particularly affected because of its practical and technical nature dealing with energy and grid infrastructure.

4.7. Conclusion

Project LEO is an innovative and complex enterprise aiming to revolutionise and decentralise the energy market, creating a flexible system whereby local energy markets are created. This is a project delivered through six work packages, delivered by project partners from the public, private and civil sectors, thus aiming to achieve project, local and national objectives. The operational environment that Project LEO operates in is complex in its nature. Multiple delivery stakeholders see skills and expertise decentralised and spread across large areas. However, these efforts have to be coordinated to achieve effective delivery. These stakeholders further need to be aligned in their inputs into the key change mechanism in order to achieve the desired outcomes. The complex nature of the project presents potential challenges to its successful implementation, the anticipated outcomes and the possible duplication of the project in other countries. It is important to better understand both the internal and external context of the project to test the replicability of the project, and the possibility of broadening the scale to a national level.

Adopting a realist perspective, the researcher seeks to answer the questions as to what works for whom, and in which circumstances; this may provide a more suitable framework to activate key change mechanisms (Nielsen and Miraglia, 2017:41). This research therefore poses these questions and collects data to determine the replicability of Project LEO and enhance understanding of how challenges can be navigated in future. The researcher interviewed key stakeholders by asking probing questions in conducting a ‘realist interview’ to determine how stakeholders understand the various dimensions of the project: what works for whom and under what

circumstances; the context that triggers the change mechanism; and how the CMOc brings about certain circumstances. The data collection for this research study gained understanding of the workings of the projects design and implementation methods. Understanding these from stakeholder perspectives, the research identifies change mechanisms that are based on external factors, ultimately allowing for replicability and effectiveness of the project when scaled up to a national level. This will be indicated in Chapter Five.

5. Chapter 5:

Findings from Interviews with Project LEO Delivery Partners

5.1. Introduction

This chapter presents the data gathered through semi-structured interviews with the delivery partners, who are the key stakeholders of Project LEO. The main objective of the interviews was to understand the implementation decisions and actions taken to ensure that Project LEO, which is an innovative intervention operating in a complex environment, is replicable beyond the current project context. The questions asked during these interviews elicited insight from stakeholders as to what works, for whom, and under what conditions. This enabled the researcher to determine if the intervention has the potential for long-term success, value-added impact and sustainable implementation to achieve its objectives – ensuring that they are replicable at a larger scale. This chapter follows the format of thematic data analysis, as the qualitative research method suits a range of epistemologies and research questions (Nowell et al., 2017:2). Thematic analysis allows the researcher to identify, analyse, organise, code and report on the major themes derived from the data gathered (Braun and Clarke, 2006).

The interviews conducted by the researcher are rooted in ‘qualitive realism’, where descriptive accounts of stakeholders’ interpretations of both why the project works and the respondents accounts of outcomes are interpreted as evidence of project success (Pawson and Manzano-Santaella, 2012:343). Interviews used in realist evaluations are more qualitative in nature as the participants views are explored through conversations, with the respondents’ verbatim comments giving an indication of the project’s theory of change, as well as their processes and implementation practices (Manzano, 2016:343). The researcher interviewed six key LEO delivery partners, responsible for the delivery of the various work packages. These stakeholders were strategically identified through snowball sampling, with the initial participant recommending others to interview, and once interviewed, these interviewees identified further key stakeholders. These stakeholders worked on defined work packages; however, with coordinated efforts and integrated delivery plans, the stakeholders were

able to adopt a collaborative approach and gain insight into a range of work packages. Furthermore, some delivery partners are defined as key delivery partners for multiple work packages. The stakeholders' interviews, albeit a few in number, have a niche understanding of the key workings of the project. The researcher was therefore able to gain valid, inclusive and highly informative insights into the project's operations from few key participants. Participants recommended same persons to speak to in reference to the researcher's data-collection aims, and thus the snowball sampling reached saturation level. The identification of key stakeholders suited the methodology and purpose of thematic analysis in which the researcher prioritised the strategic selection of participants, understanding how the selection of participants determines how the interviews would be "focused and conducted in relation to teasing out the elements such as intervention modalities, context, actors, mechanisms and outcomes" (Mukumbang et al., 2020:492).

5.2. Research Interview Findings

The realist interview is a specific methodology used in realist evaluations, targeted to ask questions to uncover the workings of social phenomena. Ultimately, realist interviews use a theory-driven methodology and questions to validate hypotheses about how programmes and interventions work (Pawson, 1996). The realist interview becomes a key tool in gaining insight into and understanding of how, why and for whom an intervention works. The focus of the interview is based on the researcher' theory and interviewees are there to confirm, falsify and refine the theory, with this relationship being described as the teacher-learner cycle (Manzano, 2016:2). This teacher-learner relationship is dynamic and the roles are interchangeable between the two persons in that the process of understanding complexities and probing questions provoke thought and deeper reflection. Furthermore, in realist studies, data collection through qualitative measures is not considered to be social construction, but rather evidence for real phenomena and processes (Maxwell, 2012:103). The realist interview is critical to the data-collection methods of this research and case study. Imbedded in the core principle that all social systems are open systems (Westhorp, 2014:4), the realist evaluation of innovative interventions in complex settings allows the researcher to conceptualise the challenges and accommodations made to incorporate the porous and flexible boundaries of the systems within which the Project LEO works. The intricacies of the flexible energy system created through LEO will be

discussed further, as understanding them is key to addressing the challenges, dynamics and networked delivery approaches used by project stakeholders.

5.3. Participant Profiles and Unique Expertise

The researcher used a snowball sampling approach to identify research participants. The researcher made contact with one of the key delivery partners of LEO to discuss the proposed research and data collection requirements. The first delivery partner was interviewed, and with understanding of the research objectives and data collection methods, recommended additional delivery partners whom would best add value to the research in acting as participants. The delivery partner contacted the proposed participants to ask their permission that the researcher contact them. With permission, the research contacted these stakeholders and provided an overview of the research and realist interview questions. Once the stakeholders confirmed their consent to participate in the research, the researcher went forward with the interviews. At the end of each interview, each participant was asked to identify additional participants. The researcher chose to ask this at the end of the interview so that the participant had understanding of the data collection content. The participant was able to use their expertise of LEO and understanding of the research to identify key stakeholders to participate in the research. When the participant's started identifying the same persons, this indicated the data's saturation point, assuring the research all relevant expertise had been accessed in the interviews.

The interviewer started all interviews by asking the participants to describe their role within the project. This saw participants identifying the work package they work on, which had been agreed prior to project implementation. However, in addition to the six core work packages, a seventh had been created to manage the implemented trial sub-projects and collate learnings. Asking participants to describe their involvement in the project allowed the researcher to understand the unique level of expertise of the participant, as well as gaining further insight into the perspective they represent (Westhorp and Manzano, 2017:1).

Participant One is a Senior Project Manager working for the DNO, Scottish and Southern Electricity Networks (SSEN). SSEN works on WP1 - Programme Management and WP5 – DSO Transition. In WP1, Participant One functions as the Project Manager, overseeing the project inputs to ensure that it meets its objectives.

Participant One thus has a central coordinating function, working with the nine delivery partners in navigating their project experience to achieve their own WP and organisational outcomes, ensuring that these function in harmony to serve the high-level outcomes of Project LEO (Participant One, 2021). SSEN leads Project Transition, a project dealing with the need for energy networks to become more flexible. The "energy trilemma" shows the need to adapt and enhance network operations to allow new market models, moving towards net zero power systems, and enabling flexible energy networks based on flexible services that are beneficial for all customers (Scottish & Southern Electricity Networks, 2021). Project Transition started prior to LEO, acting as the prelude to the development of energy solutions in achieving a flexible market, and tackling the socio-economic and political issues involved in delivering energy services in a flexible manner. Project Transition identified the need for SSEN, and other DNOs, to transition to DSOs. Project LEO has WP 5 as the core package enabling this delivery. Participant One therefore has expert knowledge in these areas, and hence is able to provide an objective and well-rounded perspective on all the work packages.

Participant Two is a Senior Researcher working for EDF Energy. EDF works specifically on WP2, developing the market platform and technical requirements necessary for the delivery of flexible energy services. These inputs aid the creation of integrated flexibility services, testing the end-to-end value steps to provide these services, the energy and market signals, and programming of the technical processes to deliver this (Participant Two). Participant Two thus has intricate knowledge from the perspective of an energy provider in the market transition, providing expertise as to the commercial and technical requirements for the project's success.

Participant Three works for Oxford University and is involved with WP4 and WP7. The participant therefore has knowledge of and insight into the LEO system learnings and planning processes, focusing on the monitoring and evaluation of intervention systems. Oxford University reviews the technical and asset operation data and works on future system planning. This also feeds into WP7, integrating lessons from the trial designs and outcomes into the learning system (Participant Three).

Participant Four also works for Oxford University, but at the same time is involved in WP6. The participant's involvement provides knowledge of the collation of social

lessons and the efforts to inform and intervene in the policy landscape. Drawing on the monitoring and evaluation methods and findings from WP4, WP6 understands the energy issues from a holistic, sociological perspective. This shows an understanding of the technical aspects of delivering a flexible energy system in real-world settings, whereby the coordination of stakeholders' efforts, governance matters and how systems are demonstrated all affect the transition of energy systems (Participant Four). The participants inputs aim to provide solid evidence of and understanding inform policy-making and replicability models.

Participants Five and Six work for Origami Energy, and are involved in WP2 and WP7. Origami's involvement at the stage of conception was to act as a market aggregator; however, through the development and need for WP7, Origami stepped into the lead role of WP7 and acts as market knowledge expert and market advisor in supporting flexible energy services in the other work packages (Participant Six). Origami energy's active role in WP7 helps stakeholders to move through the MVS programme and use lessons learned in future projects (Participant Five).

As seen through the various represented work packages and diverse sets of expert knowledge, the data gathered are able to give an insightful and well-rounded understanding of the project dynamics, successes, challenges and steps taken to ensure long-term sustainability and replicability. Furthermore, through the interviews conducted the research was able to analyse, organise and code key themes within the data set, indicating the saturation of the data set and unanimous overall viewpoints on these key themes.

5.4. Unified Aims and Long-Term Outcomes of LEO

All participants were asked to describe and elaborate on the aims and outcomes of the project. These questions followed the realist evaluation principle that all programmes have different outcomes for different groups, further understanding as to what will work for whom (Westhorp and Manzano, 2017:1). Despite LEO having overarching objectives, different stakeholders may have vested interests in the project, with organisational pressures to achieve aims beneficial to their internal context. Although this is the reality of innovative markets, competitive discovery and commercialism, it may hinder the project goals if stakeholder outcomes are prioritised over the projects. The data, however, indicated that all stakeholders over the range of

packages had common desired outcomes in line with the project, however differing work packages may contribute to achieving these through varying methods of delivery.

5.4.1. The Development of a Local Energy Marketplace

All stakeholders saw the development of a local flexible energy marketplace, in this case implemented in Oxfordshire, as a core aim, outcome and delivery method for LEO. Central to this is creating a platform whereby local stakeholders engage with, contribute to and sustain the energy market through predicting and understanding the energy network; production and selling of renewable energy; and the contribution of renewable products (such as batteries, electric vehicles, carbon natural buildings and energy demand profiling services) (Participants One, Two and Four). Key to the development of a flexible market, thorough tests and trials take place to test the viability and benefits of services provided in this local market place in order to understand the needs and demands unique to the area (Participants Five and Six). In using a neutral market facilitator, SSEN, a fair market place is created which provides a platform for owners and operates to bid for services and transact their assets (Participant Four). This involves creating an environment that allows these types of transactions, having a benefit for all parties – government, commercial companies, local marketplace users and end users. Participant Two, representative of an energy supplier, indicates the applicability of the LEO model as beneficial to energy providers. This has seen WP2 map and test the end-to-end value steps to provide these flexible services, discharge batteries and cars, and read the market and data signals, mapping the programming of this technical process.

In creating this platform, LEO will achieve the development of the local energy market place through a networked benefits approach. The creation of this energy system provides efficient, balanced and reliable energy to all, whilst providing benefits to community members, local market suppliers, local businesses and the renewable energy sector (Participant Four). The system is functional and efficient in providing enough energy, addressing the supply shortage in Oxfordshire, with renewables connected at all times (Participant Four).

5.4.2. Create a sustainable and effective long-term solution to energy supply, driving the renewable revolution

Stakeholders identified the striving towards a green revolution with renewable energies as a core outcome and driver within the project. The national aim of net zero has been key in driving this revolution within the energy market, with flexible local markets and platforms as a viable means to achieve this outcome (Participant Two). The flexible energy market model can further be implemented in different settings, allowing for the replication of LEO. LEO works to provide a toolkit and methodology for alternative implementing agents to use and align to UK's net zero goals (Participant Two).

The sustainability of outcomes is seen as a major focus of this project by stakeholders and the LEO model prioritizes fairness and equality in the commercial and local model. This means that community members need to be able to access the market, including the various profiles of persons who are able to input services into the marketplace (Participants Two and Three). The locally provided services will only be sustainable if the market value of the energy services provided is competitive and affordably priced. To support sustainability, LEO has taken a "bottom-up approach" to meeting the energy and community needs at a local level (Participant Three). Furthermore, in this bottom-up approach local persons are empowered, with LEO building a community of skilled practitioners. LEO aims to be inclusive and equitable, providing new economic opportunities to local communities in such a way that vulnerable groups are able to participate (Participant Four). In working with local community members, suppliers, business and councils in delivering the project and accessing their resources, shared learning takes place, creating a "critical mass of professionals that understand the benefits and have the skills to mobilize the [energy] market" (Participant Four). This ultimately empowers the community and achieves long-term sustainability, with LEO no longer having to be the driving force for the operation and achievement of outcomes.

5.5. Success and Challenges of LEO

With the project in its last eighteen months of its delivery plan (at the time that the interviews were conducted), all participants were able to comment on the successes and challenges. Many of the successes and challenges are related, with challenges

being tracked, and successfully overcoming them were regarded as project successes.

5.5.1. Large Number of Delivery Partners

Many of the participants commented on the stakeholder dynamics and their complexities in navigating and coordinating the varying efforts, perspectives and drivers for all nine delivery partners. Having prior noted the complexity of LEO's operating environment, the challenges that arose with a networked governance approach were to be expected. Participant One, focusing on the project management aspect of LEO and delivery partners, has insight into the complexity challenges that the stakeholders faced, with further complexities arising from the real-world challenges that LEO addresses. Complexity also arises from internal business and organisational pressures to achieve their outcomes alongside the broader LEO goals. Participant Five commented on the complexity challenges in having many delivery partners, who may have complementary or conflicting agendas. LEO further tackles a range of issues and has six major intended outcomes of which the logistical, planning, resource and organisational requirements of which is huge. In dealing with a range of socio-economic, technical and marketplace issues, LEO partners have to coordinate their efforts, rather than work in siloed work packages (Participants One and Six). The large number of delivery partners (nine) means that the logistical arrangements to manage and make decisions with such a large consortium of partners has been challenging (Participant Three).

However, despite the challenge of multiple delivery partners and the complex operating environment, have the expertise of the multiple delivery partners was noted as one of the projects core successes. Participant One has overseen all partners' inputs and coordination efforts, which has been made clear that the outcomes of LEO are central to the efforts of all stakeholders. Their goodwill towards the project has seen LEO goals prioritised and the focus in navigating any conflicting interests (Participant One). Furthermore, having a diverse range of stakeholders has provided the many levels of expertise required to build a flexible local market and allowed stakeholders to learn from each other's perspectives. In having this well-rounded insight into the market requirements and local solutions, LEO has been able to build the project to reflect real-world challenges and outcomes, ensuring the solutions are

sustainable (Participant Five). Having as many partners from all different organisational background and sectors is incredibly rare and has provided LEO with the opportunities, knowledge and developed networks central to the project's success (Participant Three).

5.5.2. The Ambitiousness of Tackling a Range of Societal Issues

Most of the participants have identified a key success of LEO to be its approach to providing a flexible local energy market, tackling a range of societal issues (Participant One). Instead of focusing on one delivery method, LEO has adopted a multifaceted approach to providing project solutions. This increased the complexity of the project, but the inclusion of socio-economic, community, political, commercial and technical requirements in the project has meant that the likeliness of continued long-term success, which requires constant navigation of the multifaceted complicities, is high and that the project will continue to operate in real-world settings. LEO has demonstrated a strong "commitment to solve complexity" in taking the holistic approach, which involves delivering networked, ecosystem and societal benefits (Participant Four). In navigating these complexities, the project is delivering informative and innovative solutions, with these delivery processes engaging with a range of stakeholders, and tackling issues such as equitable markets, fuel poverty, economic and environmental sustainability (Participants Two, Three and Four).

Despite these successes, learning how to deliver a range of solutions and to integrate many small local assets is far harder to enable in practice and has taken longer than expected (Participant Three). The regulatory funding partners, Innovative UK, have had oversight over the project and aided in external monitoring, evaluation and playing an advisory role. One of the project requirements was to develop a detailed project plan with set deliverables and timescales. In the initial planning stages, this posed a huge challenge in trying to map the intended deliverables and coordinate complex efforts as an end-to-end process (Participant One). In addition to the complexity of the operating environment and coordination requirements, the delays caused as a result of Covid have been great – affecting the deliverable timelines, ability to engage and visit work sites, and the supply chain capabilities (Participants Two and Three). Despite the challenges that were faced, LEO stakeholders have adapted to the requirements of the operating environment and the project plan has set up a tabulated

measure of success in tracking the deliverables and the course of the project plan in order to forecast the project's ability to deliver the long-term outcome (Participant One).

5.5.3. Dissemination of Data/Data Sharing

Included in the complexity of the coordination of information among nine major project partners, the documentation and sharing of data posed a major challenge to meet GDPR, as well as to the internal policies of all nine organisations (Participants Three and Six). The creation of an initial data-sharing agreement took much longer than anticipated; however, it was vital to the set up and the legal aspects of the project. Now that this hurdle has been overcome, the agreement can be seen as a success in defining mutually agreeable expectations and data-sharing principles.

Included in the data-sharing challenge is the issue as to how data get shared within the energy network to encourage learning, coordinated responses by stakeholders, and the expansion of LEO (Participant Six). It is crucial to share available data to stimulate practitioners, community members and local councils in designing and implementing their own energy projects, aiding the long-term success of the project in creating flexible local energy markets (Participant Four). As the project life cycle continues, so do the talking points on data sharing and the ways in which this will be most beneficial in informing a range of local energy systems.

5.5.4. An Agile Approach to Project Testing

Key to understanding and testing the practicalities, success, challenges and requirements to create local flexible energy markets, LEO has succeeded in using an agile approach and place-based trials. The agile approach is an innovative lean method of working, allowing delivery partners to test project solutions quickly and in small-scale settings, learning key lessons via cost-effective trial testing methods (Participants Three and Four). The MVP system is central to this, whereby plug-in projects test the feasibility of solutions, and depending on these results, stakeholders are able to quickly shift the methodologies based on the need. Stakeholders extract lessons from these solutions and can feed them into the network. Through "learning by doing" and evidence-based trials, LEO succeeds in building a practical data set (Participant Three). The agile approach has further seen flexibility in the governance

of the project, with stakeholders giving input into alternate work packages based on their need for expertise and resources (Participants One and Six).

5.6. Improvements and the way that Stakeholders are Navigating Complexity

Through the lifecycle of the project, stakeholders have used the agile approach and adapted inputs to make improvements and navigate complexity. Improvements have been identified, with some having been implemented at this stage, and others noted for the long-term success and replicability of the project.

In dealing with the project complexity and challenges in coordinating stakeholder efforts, Innovate UK have played an advisory role in managing the project. This feeds into WP, with the Monitoring Officers on loan to the project to provide support, guidance and facilitation in communication between partners, as well as feedback in navigating issues from an objective standpoint (Participant One). In adopting the agile approach, stakeholders have also adapted to make final leadership and executive decisions within the scope of their responsibility and area of expertise, as complexity arose in trying to gain buy in from all nine delivery partners (Participant Three).

Within the operating environment, the timelines for delivery were underestimated as unforeseen challenges arose. Badly impacted by the disruption of Covid, project partners had to apply for an extension to the delivery timeline (Participants One, Two, Three, Four, Five and Six). Stakeholders have been urged not to underestimate the complexities of implementing change mechanisms, place-based trials and market services (Participant Four). The detailed delivery plan formulated at the beginning of the project has been key in managing deliverables and forecasting delivery expectations, holding stakeholders accountable.

A core focus of LEO has been to create a toolkit for local flexible energy services which maps the methodologies of LEO, with a detailed plan to navigate the associated complexities. The toolkit aims to document and detail the strategic planning needed to understand the energy services in a local area, and supply the methodologies as to how these can be coordinated to achieve flexible energy systems in different settings (Participants One, Three and Four). This becomes a “toolkit for replicability” (Participant One), mapping local energy environments by connecting flexible energy services information, demand profiling, data collection, and asset and resource

management for local authorities to understand and apply to create flexible energy profiles in their areas (Participants One and Four). The layers of application allow for local authorities to understand the assets and complexities, and stimulate the application of solutions to areas according the principles of network governance. The toolkit allows for this collection of information, learning and understandings created by LEO to be utilized and applied in various settings. In doing so, LEO is disseminating data and lessons learned in a fair and equitable manner, allowing others to save costs and resources in building on their evidence-based learning in the transformation of their own energy systems. Ultimately, the toolkit passes on LEO knowledge on how to navigate the complex environments and the key complexities faced. The toolkit for replicability will have universal value, with the mapping tools usable by community groups, local governments and commerce to map network constraints and the available assets, coordinating the abilities to resolve constraints, ultimately creating business models for flexible energy services (Participant Four).

5.7. Change Mechanism

The realist interview technique tests the theory of the LEO project, understanding if the objectives and outcomes are being met through the implementation methods. The realist interview is used to "tease out the various [theory] components (intervention, context, actor, mechanism and outcome)" (Mukumbang et al., 2020:487). The challenge in identifying the mechanisms is that they are unobservable and the researcher therefore has to ask probing questions ask probing questions not about whether the programme activities been successful but whether they have been catalysts for change (Westhorp and Manzano, 2017:2; HM Treasury, 2020:7). It is vital that the change mechanisms are understood and documented, because if the programme is implemented in other settings, the benefits may not be realised. Furthermore, without understanding the change mechanisms, the reasons for project failure may not be identified (HM Treasury, 2020:7). The realist interview therefore engages in the teacher-learner style of learning and encourages participants to identify and reflect on these change mechanisms, if they have not done so already. Project participants identified multiple change mechanisms in LEO, such as the involvement and facilitation of local governments in creating flexible green energy systems; getting community buy-in and willingness to engage; and a progressive local government and

policy landscape by means of which LEO methodologies are supported locally, commercially and environmentally.

Project LEO has been successful in implementing changes and achieving deliverables thus far, largely because local government has been in full support of the LEO project, with Oxford City Council and Oxfordshire County Council as delivery partners (Participants Three and Five). In working with these local authorities, they have acted as facilitators and enablers of change within the community. The Oxfordshire local government has contacts and networks in community areas, working relationships with smaller councils which has seen further buy-in and government support, and the expertise required to create a local energy system (Participant One). Local authorities are therefore fundamental to accessing end users, commercial delivery partners, network authorities and businesses (Participant One). In having political support, planners, councils and policy makers contribute to shaping the transformation of the energy system in ways that are suitable and sustainable by designing a flexible energy market that fits community needs and the current planning system (Participant Four).

Low Carbon Hub has played a fundamental role in facilitating community interaction and change, acting as a gatekeeper on the basis of their strong and well-built community relationships. The LCH is based in Oxfordshire, having developed a strong and active relationship with the local community. LCH is committed and has the resource to mobilise community inputs in the flexible energy system, allowing LEO to build on these strong community relationships (Participants One and Four). In working with the community in a bottom-up approach, community members are able to engage with the flexible energy system, plan for the future, and contribute to shaping project designs and policy recommendations (Participant Three). In working with the community, project leaders gain community buy-in, engaging with the system as flexible service providers and end users (Participant Four). This buy-in into the LEO project is evident within the community, with the community showing a desire to decarbonise and develop local generation within their energy system (Participants Two and Five). The community buy-in within LEO has allowed delivery partners to understand the community's interests and concerns, and in all this has created shared learning. Community buy-in has therefore been identified as a key change mechanism.

In addition to having strong community relationships, community members need to be empowered to understand the local energy system so that they are able to interact with, provide inputs into, and facilitate the process of change needed to transition to a flexible green energy system. This includes community members having an awareness of the energy market, being informed about the current challenges as well the benefits of low-carbon energy and the proposed LEO changes (Participant Two). Sharing the knowledge of LEO and creating community ownership and empowerment builds a "community of skilled practitioners" (Participant Four).

5.8. The Scale-Up of LEO and Replicability in Alternate Settings

A realist evaluation notes that not all programmes work in the same way – programmes work differently in different contexts. There are multiple factors involved. Programmes work differently for different stakeholders, and the reasoning and resources lead to different outcomes (Westhorp and Manzano, 2017:2). Participants were questioned as to project design, implementation and outcomes being replicable in a different context, as the ultimate goal is to have LEO scaled up to a national level. The key change mechanisms have been identified which have been the determining factors in the project's success. The research aims to understand whether the context-mechanism-outcome (CMO) configuration, and relationships between these three factors, would produce the same outcomes if the context changes. Understanding CMO configurations allows researchers to "postulate how programmes activate mechanisms (M) among whom and in what contexts (C), to bring about alterations in behaviour or event or state regularities" (Pawson & Tilley in (Mukumbang et al., 2020:492).This gives an indication of the replicability of the project, and how the context would affect the outcomes and change mechanisms. Participants were asked about the replicability of the project if it were to be implemented in different contexts as well as about the project's ability to achieve LEO's long-term outcomes if it were to be scaled up and implemented in a national setting.

It was generally felt that LEO is replicable at a national level, and efforts have focused on the long-term achievement of sustainable development and the expansion of local flexible energy systems implemented in different settings. However, because of the complexity and nature of the project in tackling economic, social, environmental and political issues, there are many factors to coordinate and navigate for the successful

implementation of LEO in Oxfordshire, as well as in a range of other settings. A key critical success factor and change mechanism accounting for LEO's success has been the well-developed community networks and relationships presented through LEO's partnership with LCH and local councils. In scaling LEO up, however, these networks would not be present in the same way as they are in Oxfordshire. However, in developing the toolkit for replicability, LEO has captured the knowledge required to deliver a flexible energy system – noting and documenting core delivery methods, asset mapping and planning tools, delivery and data-collection methods. LEO has ensured that future alternative delivery partners and community groups would have a blueprint to work from, encompassing the foundational knowledge for project success (Participants One, Four, Five and Six). However, different stakeholders need to have the same commitment and buy-in as seen in Oxfordshire as they could lack these same drivers for change.

Having SSEN transition from a DNO to DSO and SSEN being a neutral market facilitator has provided industry and commercial business and delivery models to create the enabling context for replicability. A large focus of LEO for replicability has been to share and disseminate lessons learned. LEO has shared these lessons through multiple networks – such as PIFA funding, local governments, Open Networks (a consortium of all major network operators), and forums of learning and research instigated by Ofgem (Participants One and Four). This creates an "exploitation plan" for the future implementation of a local flexible energy system using the same approaches and project designs for other community energy groups to pick up (Participant Six). With LEO having tackled a range of real-world issues holistically and not just dealing with the technical requirements within a local energy system, the project approaches and designs are inclusive, and aim to be fair and equitable (Participants One, Two and Four). LEO has the potential for long-term success and replicability because of the project's roots in the above national-level forums and policy environments where vital lessons are shared (Participant Four).

The challenges of scaling up and replicability remain, however, as the funding, resources and coordinated efforts required to create a pathway for local flexible energy systems have been immense. While this may see project success in the LEO context, these resources and change mechanisms may not be present in different settings. The

toolkit for replicability, as detailed, extensive and informative as it can be, may not be accessible to stakeholders in different settings with the potential to implement change. It is an assumption that with the information being made available through a range of networks, this will be picked up by various other stakeholders (Participant Three). Furthermore, with the challenges of data sharing, data-sharing agreements and GDPR, there are limitations to the complete sharing of this data. This may hinder the dissemination of information, which is vital in stimulating practitioners, community members and local stakeholders to design and implement their own energy projects (Participant Four). Conversations need to be had on data and data sharing, understanding how different DSOs and stakeholders within the energy market communicate and share information (Stakeholder Six).

A major factor that could limit the scale up and replicability of LEO outcomes could be the absence of progressiveness and support for innovation within the policy landscape (Participants One and Five). During the lifecycle of LEO, there have been major changes to policy (and reviews as to commercial regulation with Ofgem) and much uncertainty remains as to future changes of the regulatory landscape. These policy changes have had impacts on business models within the flexible local system and affects the value of flexibility and how this proposed energy system is viewed within the national system (Participant Five). LEO has tackled energy challenges in a holistic and innovative way. The current commercial policy landscape focuses on commercial regulations, but does not acknowledge the severity of real-world challenges and sustainability considerations that businesses would need to consider when implementing the proposed business models (Participant One). Therefore, changes to policy need to be made in order to empower innovative projects such as LEO. In addition to this, the LEO considerations and outcomes are about fair and equitable remuneration for all contributors to the open energy system (Participant Four). While from a social perspective, this is a fair point and empowers vulnerable persons to gain through contributing to the energy system, it may not be an attractive business model from a purely commercial perspective (Participants One and Two).

5.9. Conclusion

The realist interviews conducted through the teacher-learner approach allowed for the gathering of vital data from delivery stakeholders with the most expertise and

knowledge of the project design and implementation settings and outcomes. The participants showed that the stakeholders, although representative of different work packages and delivery methods, were unified in their vision of project outcomes, namely the development of a local flexible energy market and the creation of sustainable and effective long-term solutions to energy supply, driving the renewable revolution. LEO participants have had a collective voice as to the project's current successes and challenges. Stakeholders have displayed a strong dedication to the accomplishment of the project's goals rather than protecting internal organisational agendas. Included in this is the commitment to clear communication and a coordination of efforts, which has made stakeholders flexible in the delivery approach, adding inputs to suit the changing needs, as seen through the development of a seventh work package. Despite the number of delivery partners adding to the complexity, this has been managed and overcome. LEO has been applauded for its ambition to tackle a range of socio-economic and political challenges in delivering a flexible local energy system, which has seen its strategies go beyond only the technical requirements in delivering this project. The delivery plan has used an agile approach, whereby project inputs have been piloted and tested through the MVS system, saving time and resources while still being able to understand key lessons before being implemented in larger settings. LEO participants have identified the key change mechanisms through the delivery lifecycle. In the identified suggestions for improvement and ways of navigating complexities, the researcher and participants are able to reflect on the replicability of the project in a range of different contexts. LEO is seen as replicable in many ways, focusing on the dissemination of data and lessons through a toolkit for replicability. However, contextual factors do determine project success, which means that there needs to be a strong commitment from communities, local authorities, the policy landscape and commercial industries to apply the same innovative approach to creating fair and equitable local energy systems elsewhere. Recommendations on how to do this are discussed in Chapter Six.

6. Chapter 6:

Summary, Conclusions and Recommendations

6.1. Introduction

Chapter Five discussed the research findings through a thematic analysis, using the lens of realist evaluation and interview techniques to gain insight into the key delivery partners' experience of Project LEO's successes, challenges, key change mechanisms and scale-up potential used to assess project replicability. The data gathering and analysis of empirical and non-empirical data have allowed for the study to answer the research questions on the key considerations for realist evaluations of innovative interventions operating in complex settings and their ability to achieve long-term replicability**.**

Chapter Six follows from this discussion and provides an overview of the research, drawing conclusions from the research findings. This allows the researcher to offer recommendations on project implementation and the successful achievement of objectives in navigating complexity to aid project replication.

6.2. Summary of the research

The aims of this research were to unpack key considerations for realist evaluations of interventions operating in complex settings, ensuring that the impact of interventions is sustainable, and project replicability and scale-up potential has been at the core of design and implementation decisions. In doing this, the realist evaluation technique investigates what works, for whom, under what conditions and in what respects. Project trials are often implemented before large-scale role out, allowing cost-effective implementation and understanding of best practice. A realist evaluation allows innovative interventions to grasp the internal and external factors that contribute to the project's success and challenges, where the CMOc model allows one to determine whether the project's context will alter change mechanisms, determining if the project is able to achieve its outcomes.

The objectives of this research were:

> ***Objective One***: To explore the potential value of a realist approach to evaluate complex interventions;

Objective Two: To explore the complexities of interventions operating in the public sector context, analysing the stakeholder network within the energy sector;

Objective Three: To investigate the aims, setting and long-term aims of Project LEO;

Objective Four: To identify key considerations that contribute to the successes and challenges of Project LEO that may determine the potential replicability in different settings.

Objective Five: To offer and summarise recommendations and considerations for the successful expansion of Project LEO.

The study has systematically investigated the key concepts and phenomena related to each objective to produce a research paper that achieves the research aims. The research has analysed the theoretical and legislative framework for realist evaluations operating in complex environments, in this case the energy sector. The research then used the format of a case study and applied these concepts and understandings to Project LEO as a case study. Realist interviews following the format of semi-structured interviews elicited the understanding and expertise of key delivery partners, with the data gathered seen as evidence able to answer key research questions. The research has achieved its aims, as reviewed below.

6.2.1. Objective One: To explore the complexities of interventions operating in the public sector context, analysing the stakeholder network within the energy sector

Chapter 2 presents the theoretical framework for the research as well as the key theoretical positions in the global context. The review analysed the importance of evaluations in practice, aiding the systematic review of programmes and projects in their conceptualisation, design, implementation and sustainability in achieving long-term goals. Evaluations ultimately assess and understand the value of outcomes and their impact. This is fundamentally important for the evaluation of interventions in complex environments, and particularly in the public sector as programmes operate in complex environments and need to meet a range of stakeholder needs. These complexities arise from the multiple stakeholders involved in the delivery of an

intervention, as well as the complexities of the issues they tackle – including complex political, socio-economic and environmental issues faced in society. The public sector has to further prove that actions taken are best practice and create public value for all. The realist evaluation perspective is therefore used to allow the evaluator to understand the nature of the project's success and its impact from multiple stakeholders' perspectives, analysing what works, for who and in what context, because the same project may not be experienced similarly across different environments. This is particularly useful, as complex issues require great effort from a range of stakeholders to achieve their impact. Additionally, the public sector has progressed to see government facilitate innovation and problem solving to allow for democratic processes and community empowerment. Political systems have transitioned to a system of networked governance, by means of which stakeholders share the costs, expertise and resources in implementing programmes in a collaborative way.

The network governance approach in the public sector aligns well with piloting an intervention such as Project LEO. The concept of piloting new services or interventions refers to a wide range of mechanisms for testing services before they have been fully implemented. Pilot studies allow for stakeholders to test project designs, implementation and outcomes in a small-scale setting, constantly evaluating project phases and navigating the complexities of the environment and stakeholder networks. This has seen particularly useful in the energy sector, where the legislative framework (as explored in Chapter Three) has acted as the change agent in expressing the need and path forward to achieve a green revolution and the decarbonisation of the industry. The energy industry in the UK is a complex environment, with a range of stakeholders from the public, private and civil sectors interacting and engaging to deliver energy services.

6.2.2. Objective Two: To explore the complexities of interventions operating in the public sector context, analysing the policy landscape of the energy sector.

The energy industry operates as an open and competitive market which is regulated by government and managed through the energy network in the UK. Despite the independence of the sector in being managed by private stakeholders, the policy

landscape drives change, sets operational boundaries and ensures public value is achieved for all. The dynamics of this large network involve the management of actions and objectives to meet societal, political, commercial and environmental needs, drawing attention to the many complexities that need to be navigated within this industry. The key driver of change withing the public energy sector is the substantial demand for energy in an expanding global economy and population. Globally, we have acknowledged that environmental sustainability and environmental conservation need to be key considerations to sustain the vitality of the earth and our social systems. The UK has therefore committed to decarbonising all industries so that the country achieves net zero carbon emissions by the year 2050. The decarbonisation of industries provides new opportunities to upgrade the economy, creating jobs and investments in new markets. Government has navigated the policy landscape to incentivise change towards decarbonisation. The CCL tax is used to add costs to commercial consumers who use non-renewable forms of energy. The CCL is linked to carbon pricing, a cost-effective and technologically neutral tool for encouraging industries to take account of their emissions in business decisions. Added to this, the UK Emissions Trading Scheme caps carbon emissions for businesses and encourages the investment of critical infrastructure driving low-carbon technology. Further funding schemes have provided cost-sharing schemes in decarbonising industry, with BEIS creating the Innovation Programme and New Zero Innovation Portfolio. Mission Innovation advances this and encourages innovation interventions which provide disruptive techniques in the decarbonisation of the energy industry. In accessing a pool of resources and knowledge areas through a system of network governance, stakeholders are able to coordinate their contributions and meet their individual objectives in achieving green industry goals.

The policy landscape aims to incentive the demand for and interactions with renewable energy sources and low-carbon alternatives. Through information and education, consumers are demanding more economic and environmentally friendly energy. Interventions in the public sector have to navigate the complexities of legislative obligations, increasing the volume of demands, consumer choices and demand for more environmentally friendly forms of energy, changing infrastructure to aid low-carbon generation, as well as implement the accountability measures to ensure outcomes are best value, best practice and accessible to all. Furthermore, these

complexities involve a number of stakeholders in the network, whereby outcomes can be achieved through navigating the complex environment and by cooperation.

6.2.3. Objective Three: To investigate the aims, setting and long-term aims of project LEO

The research, particularly Chapter Four and sections of Chapter Five, has indicated the aims, setting and long-term objectives of Project LEO. LEO, operating in the environment of Oxfordshire (UK), delivers a transformative integrated smart local energy system and design to maximise prosperity from local energy systems whereby local communities can provide renewable energy inputs. Oxfordshire has been chosen for its progressive community networks which have indicated their willingness to transition from traditional energy systems. Included in this, the local councils have ensured complete buy-in and investment in the project, thereby creating a cooperative environment and working as a gatekeeper to the delivery networks required for LEO. The LEO model sees delivery of outcomes through seven work packages. These aim to deliver a flexible energy system, dealing with issues relating to the increasing demands on the grid; develop a future energy market and share lessons learned nationally; define the transition to smart, renewables-based electricity systems; and create a sustainable long-term solution to the energy supply complexities seen in today's environment. Beyond the environmental and national objectives, LEO provides benefits to businesses and communities, providing new investment models for decentralised energy resources, and empowering a community of skilled and aware people. LEO further contributes to data sets for research in providing a case study.

LEO has nine delivery partners across a range of sectors. Stakeholders have confirmed their commitment to long-term objectives, identifying LEO objectives as the decarbonisation of the energy industry, ultimately contributing to the achievement of net zero emissions, as well as the creation of a flexible local energy market with a sustainable delivery of low-carbon energy. LEO has been chosen as the case study for the research as it is an excellent example of an innovative intervention operating in the public and private sector being managed through network governance. However, the project sees complexities in the real world issues the project tackles and the number and range of stakeholders involved in the project. The LEO model is being piloted in this funded project where findings and implementation methods will

determine the replicability of the project. This research aimed to understand what measures need to be take into account in order to allow for the replicability of this project.

6.2.4. Objective Four: To identify key considerations that contribute to the successes and challenges of Project LEO that may determine the potential replicability in different settings.

The research uses the non-empirical data gathered in the theoretical and legislative frameworks to inform and gather empirical data through semi-structured interviews with LEO delivery stakeholders. The realist interview values the expertise and experience of stakeholders as qualitative data, giving insight as to how the project works, when, and for whom. Through a thematic analysis, the project's success and challenges were identified. In understanding how the CMO framework operates, the study has been able to identify which factors are internal and external to the project, and in doing so able to comment on the replicability potential for different settings.

6.2.4.1. Internal and External Factors

The internal factors are vital to consider in reviewing LEO's successes, failures and replicability potential. Factors internal to the specific environment won't be present in other settings. If successes are dependent on these internal factors, the project may face challenges in being implemented in different settings, as the change mechanisms are dependent on the context. Equally, if the challenges are internal, different delivery settings may not have to overcome similar challenges. If the project failures relate to factors internal to the environment, the project might be successful in different settings. However, the project concept may die a quick death as the original pilot study would be used as a case study for reasons why the project may fail. Failures relating to the external environment would be more viable to analyse and make implementation decisions on, as such failures could be present in all environments.

LEO's internal factors were seen to be the unique and diverse set of stakeholders the delivery partners. Ranging over different sectors of society, the partners brought expert knowledge and network access unique to the project. The decision-making processes and expertise are influenced by the role players, with LEO being a product of the partners' shared conceptualisation and understanding of the issues. Equally, the partners' commitment to the project and their specific deliverables is unique to

each partner, and would differ if the project were to be implemented by different stakeholders. LEO's delivery partners demonstrated cohesiveness, cooperation and goodwill in their actions to achieve deliverables, which may differ in different stakeholder sets. The resources that the delivery partners were able to contribute were unique, with government funding being provided to this innovative project specifically. There may not be this level of resource availability in other settings.

The Oxfordshire context, an internal factor, expresses signs of readiness for change and the transformation of the local energy system. Oxfordshire has expressed a political desire to address the energy shortage in a sustainable way, with local government and the Low Carbon Hub being gatekeepers for the community, able to mobilise change and their resources.

After analysing the operating environment, the research found the most prominent external factor to be the societal issues that LEO addressed. These societal issues are largely experienced by society and the UK at large – tackling carbon emissions; buy-in from communities and businesses to operate in the proposed new energy system; creating change in a fair and equitable manner; aligning the policy environment with required changes; and delivering change through the number and variety of stakeholders necessary. Data policies and national legislation are external to the environment, where all stakeholders would have to adhere to national data policies and energy and climate-change regulations. LEO aimed for outcomes relevant to communities, business and governments in the UK and around the world, where their project would be of interest and benefit to role players external to the current context.

6.2.4.2. Successes and Failures of LEO

The research identified that the project's largest challenge was the ambitiousness of the project in tackling a number of societal issues, including political, environmental, social and economic issues. The project's outcomes are dependent on tackling these challenges with a holistic approach, coordinating efforts from different sectors of society to create the transformation of the local energy system. Despite the external challenge presented, if the complexity of societal issues is overcome and navigated, this will determine and enable the project's success.

Additionally, LEO addressed the challenge of navigating data dissemination and sharing. This is vital to the replicability of LEO, as well as all innovative interventions. Complexity has arisen in agreeing data sharing terms that that suit all delivery partners. Data-sharing policies are subject to external legislation (i.e., GDPR and data terms of the network data is shared in). Data-sharing laws, regulations and data sharing policies of delivery partners determined how data can be shared. The data sharing agreements determine the ways of sharing data and ultimately affects the level of data shared to aid replicability. The more data that is shared between stakeholders and society at large, the more information is available for cooperating stakeholders to align actions and replicate these systems in different environments. LEO has tried to overcome these challenges through data-sharing agreements, and creating a toolkit for replicability. The toolkit details the LEO methodologies, asset-mapping tools and the key considerations of the project from an objective and holistic perspective. The toolkit details implementation methods external to the environment and allows future delivery bodies to use the research and data as relevant to their contexts.

Central to LEO's success, the delivery partners have been able to access the inputs required to implement the project, and therefore mitigated challenges that had the potential to arise during delivery phases. In having this range of expertise within the teams, LEO has largely been successful in their stakeholder buy-in. LEO strategically had community gatekeepers in their delivery team, such as Low Carbon Hub and local authorities. These gatekeepers expanded on their strong community relationships and in this way were able to mobilise resources and action. A strong relationship with political stakeholders means that LEOs outcomes are more influential in the political environment, having an impact on the operating context which would in turn aid in achieving the project goals. Furthermore, LEO has invested in empowering communities and has aimed for impacts to be fair, equitable and accessible to all. In doing so, LEO is creating a community of skilled practitioners who can sustain and expand on the project outcomes after the defined project timelines.

Project LEO has also seen success in the trials and testing of assets and sub-projects to determine success in micro contexts, using less time and fewer resources and funding to determine successes. The agile methodology has been used to test a variety of sub-projects, able to determine which should be implemented on a larger

scale based on tested success. This approach can be used in all contexts and has been an external factor contributing to the success of LEO. LEO has been active in sharing data, issuing frequent public reports, and linking into data-sharing networks. The sharing of data promotes research integrity and allows others to understand the results, building upon the existing knowledge towards new discoveries, in which LEO has succeeded. LEO derived much benefit from the input and expertise of external monitoring and evaluation officers who were able to mediate, advise and facilitate learning about the complexities or conflicts that arose during project delivery. In aiding external evaluations and working with these officers, LEO navigated challenges in a fair and objective way, understanding what the impact of these decisions would be on the overall outcome.

A limitation of LEO is that the project required an extension. This means that the project was not able to keep to its original timelines it had committed to and the public could be less certain that the deliverables would be met. Participants highlighted the impact Covid has had on resource procurement, ability to access project sites and the ability to keep to the timelines. Project partners were not able to forecast the global pandemic, however, and in this case the need for an extension is understandable. However, outside of this operating environment, delivery teams for interventions have to set delivery timeframes precisely and ensure their ability to keep to them. It is essential that delivery partners do not underestimate the complexities of implementing change mechanisms, place-based trials and market services

6.2.4.3. Replicability in Different Contexts

The internal and external factors have been analysed to determine their contribution to LEO's replicability. The nine stakeholders and the unique knowledge they brought to the project, with the funding they had secured, has been the driving factor in the project achieving LEO's outcomes. Different settings may not have this same level and range of expertise and funding available. Additionally, each stakeholder was committed to the project and prioritised the project goals, without their own organisational goals being hindering by their commitment to pre-agreed outcomes. Pilot projects often see that the initial delivery team is highly motivated to tackle project issues for reasons such as adequate funding, achievable organisational goals and operating as industry leaders in driving innovation. Different delivery partners may not

have these same driving factors, and LEO delivery partners have to make this work and find a way, the level of perseverance elsewhere may not be at the same level as in the current environment. Furthermore, from participant interviews, the research shows that the delivery partners and project manager navigated conflict well, with partners having complementary agendas. External to this environment, partners may experience different operating dynamics, which could support or hinder the project's progress, propelling or sabotaging replication. In replicating projects, all delivery partners may well have different logistical, planning, resource and organisational requirements in addressing the same project outcomes, and these internal factors will have an impact on the project's success.

Furthermore, Oxfordshire was chosen for its willingness to change – with the community, local government and commercial sector invested in a green transition. Low Carbon Hub forged many of the community relationships and has acted as a gatekeeper for the community, accessing local knowledge with the ability to mobilise change. Stakeholder buy-in is key to the project's success, and changes in the stakeholder relationships could arise should the context change and future stakeholders may not necessarily be as committed to change. The policy environment also needs to evolve at the pace that change is required in the energy industry. Policy changes are required for the sustainability of the project in achieving innovative solutions to climate change.

The methodologies of LEO, noted in the toolkit, are showing early indications of success and have the potential to be scaled up. Communities are responding, and the MVS project trials are proving to be viable ways to create change and implement the flexible local energy system. The energy industry must transform, and LEO is piloting the key considerations, methodologies, success and challenges entailed in this process.

All the above factors indicate that the LEO model has the potential to be scaled up and be replicable in various other settings. The LEO toolkit for replicability will be informative for future stakeholders intending to replicate the project, and can be used as a blueprint. But future delivery stakeholders need to take into account LEO's unique internal factors prior to implementation in using LEO as a pilot and case study, as these would be different in their environment. The project should therefore be adjusted

to work best for the different environment. LEO has provided the stepping stone to a flexible energy system, whereby the challenges and methods that have not worked can be noted and considered in various different settings prior to being implemented. In this way, LEO has proven its impact in piloting the delivery of a flexible energy system. The information disseminated into the energy environment allows for this information to be applied for replicability purposes. LEO's impact in providing information, research and data to the policy landscape further aids the feasibility and environment in mobilising change in a range of settings. However, it is crucial to note that the expertise within the delivery team, their dedication to achieving project outcomes, community buy-in, local issues and resources and funding are all unique to the specific project context. In replicating the project, and other innovative interventions operating in complex contexts, these factors have to be navigated in ways unique to the operating environment.

6.2.5. Objective Five: To make recommendations for the successful expansion of project LEO.

After conducting considerable empirical and non-empirical research, insight has been gained into the challenges faced by innovative interventions operating in complex contexts. The case study of LEO has allowed the research to determine what has worked in LEO, and what still needs to be navigated to aid the expansion of LEO, ultimately achieving LEO's long-term goals. This gives an insight into the measures different innovative interventions should take to aid project success and replicability.

On the basis of the above findings, the research offers the following recommendations:

- Data policies and data-sharing agreements need to be navigated. LEOs findings, data gathering, experiences and internal expert knowledge need to be shared in order for future delivery stakeholders to successfully expand the project outcomes. Austin et al. (2021:7) stipulate that "the timely sharing of well-curated data (and software, algorithms, and other resources) enables reuse, often for purposes unanticipated by the research that first produced the data. For this reuse to be possible, data must be collected, documented, curated, preserved, and made available through trusted and recognised platform". The sharing of experienced challenges, project

pitfalls, adaptations and successes allows others to learn same lessons before further implementing the project, allowing high chances of success. It is recommended that LEO supports future stakeholders in navigating data sharing by providing the data-sharing agreement to assist in addressing data challenges. LEO has committed to the sharing of data within the Electricity Networks Association's (ENA's) Open Networks project, which works to collate information relating to energy transformation. However, this data needs to be accessible to all, including local authorities' stakeholders with the influence to deliver change. This additionally highlights the recommendation that data is transferred into networks that are accessible and available to all. This is fundamental to projects which are governed and delivered through coordinated network governance.

- External evaluators and advisory boards provide objective and expert advice on project management and how to manage conflict, challenges and unforeseen outcomes. It is thus recommended that future delivery networks and partners seek the advice and external expertise of monitoring bodies. The research has shown through its empirical and non-empirical data gathering the value of monitoring and evaluation in projects. In addition to this is the role that external advice and expertise plays in navigating complexities. In having an all-round and unbiased role, an external advisory board would be able to fill the knowledge gaps, as well as suggest recommended ways forward. Delivery partners could also approach LEO delivery partners to be on their advisory board, providing expert advice as to the tried and tested methods applied in LEO.
- It is recommended that interventions operating in complex settings allocate time and resources to researching and agreeing design and implementation plans through a detailed delivery plan. In doing this, stakeholders are able to map and forecast deliverables, setting delivery expectations of all stakeholders involved, holding them accountable, and additionally having tools and methodologies at hand to navigate the complexities and challenges that arise. The delivery plan also maps key deliverables and the timescales, dependencies and outcomes achieved through each stage. The delivery plan is the base tool of the project and utilised at all project stages;

it is used to plan ahead, define the deliverables, set expectations for all stakeholders, track project progress, and measure effectiveness (Guthrie, 2020).

- It is advised that delivery partners of future innovative projects use an agile approach within the project. This allows for piloting and testing of delivery methods and decisions, whereby stakeholders remain adaptable in navigating the challenges and complexities that arise from the operating environment. These challenges may be unforeseen and hence require adaptations to the pre-planned approaches. The agile approach additionally allows for project methodologies to be tested in the local contexts, leading to an understanding of the change mechanisms and outcomes in a specific context. The delivery partners are therefore able to further implement the successful processes, and adapt or abandon projects tested that aren't feasible or in line with the desired outcomes.
- It is recommended that innovative interventions and pilot studies should document the project delivery, successes, challenges, decisions made and methodologies to create a blueprint for success. Feeding this into a larger network allows other stakeholders to use it as a guide and implement similar outcomes in their operating environment.
- Different projects should replicate the range of expertise within their project delivery teams, specific to their environment. Added to this would be having stakeholders onboard that have the authority and accessibility to mobilise resources, network delivery and different or alternative partners.
- It is recommended that all interventions, particularly those that draw on public funding and operate in the public sector, keep to the timelines that they have set out. This upholds the principles of best practice. In cases where timelines are not achieved or projects delayed, stakeholders and particularly the public lose faith in the project and its deliverables.
- It is recommended that stakeholders in different context also acquire this community buy-in prior to project delivery, and use the community networks and resources at the heart of the project, ultimately enabling project sustainability.

- It is vital that equal efforts are expended during post-implementation, and that resources are allocated to this project phase. Post-implementation reviews not only hold value for the project itself, but help to round off a comprehensive case study and provide key lessons for project replicability. Post-implementation reviews allow the delivery partners to analyse (Dogaru and Dogaru, 2015):
    - The final deliverables versus the initial set baselines
    - The project manager's performance
    - Team performance
    - The budget and schedule
    - Project management methodology
    - The initial project idea and intervention methods
    - Strategic alignment
    - The project's environmental impact
    - The achievement of objectives.

  It is therefore recommended that LEO, as well as other innovative interventions, conduct a thorough final implementation review to acquire the above information, reflect on project successes and pitfalls, as well as finalise a comprehensive case study for future implementing bodies, aiding replicability.

6.3. Conclusion

Chapter Six provided a summary of the research study, highlighting the relevance and importance of the research findings in relation to achieving the research objectives. The research study has provided insight into design and implementation considerations for innovative interventions operating in complex environments. The research has assessed key considerations for these studies in piloting their methodologies and ensuring the intervention is replicable in different contexts. Furthermore, the research has provided recommendations for delivery stakeholders on these types of interventions, based on a case study analysis of Project LEO.

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Appendix

Participant One – Stevie Adams, Senior Project Manager, SSEN

Participant Two – Roberto Moreira, Senior Researcher, EDF

Participant Three – Dr Scot Wheeler, Postdoctoral Researcher, Oxford University

Participant Four – Nick Banks, Postdoctoral Researcher, Oxford University

Participant Five – Timur Yunusov, Origami Energy

Participant Six – Rosie Faull, Origami Energy