ofgem

Making a positive difference
for energy consumers

Equinox

Making heat flexibility accessible to DNOs and beneficial to customers

WPD Network Innovation Competition 2021 Submission

Guidehouse passiv sero SP ENERGY NETWORKS octopus energy Llywodraeth Cymru Welsh Government West Midlands Combined Authority WESTERN POWER DISTRIBUTION *Serving the Midlands, South West and Wales*

Network Innovation Competition: Full Submission Application

1. Project Summary

1.1 Project Title	EQUINOX (**Eq**uitable **No**vel Flexibility E**x**change)
1.2 Project Explanation	EQUINOX will be the first NIC project dedicated to addressing the challenges DNOs face with the electrification of heat. The project will develop novel commercial arrangements and supporting technologies that unlock flexibility from residential low carbon heating, while meeting the needs of all consumers, including the fuel poor and vulnerable.
1.3 Funding Licensee	Western Power Distribution – South Wales
1.4 Project Description	**1.4.1. The Problem(s) it is exploring** The UK government recently announced a target to reach 600,000 heat pump installations per year by 2028. Unless new solutions are developed to manage this new load, DNOs will witness a substantial increase in peak demand, triggering significant network reinforcement throughout the later years of RIIO ED2 and ED3. Currently, limited viable solutions exist for DNOs to unlock the flexibility from residential low carbon heat at scale in a reliable, cost-effective, and equitable way. **1.4.2. The Method(s) that it will use to solve the Problem(s)** EQUINOX is developing three novel commercial methods that are designed to maximise participation in domestic DNO flexibility services. The range of methods will demonstrate how varying risk/reward frameworks between DNOs, suppliers and customers can influence the amount, cost, & reliability of flexibility from portfolios for varying customer segments incl. fuel poor and vulnerable. The three novel commercial methods are: Method 1) 'Save in advance'. Method 2) 'Save as you go'. Method 3) 'Save in advance & boost as you go'. **1.4.3. The Solution(s) it is looking to reach by applying the Method(s)** EQUINOX is a first of a kind project that will answer key questions on how DNOs can help decarbonise heat in the most cost-efficient manner for customers. The project will pave the way for how DNOs will leverage flexibility from heat, to manage the increasing network demand while maintaining network reliability, consumer choice, and comfort within homes.

	1.4.4. The Benefit(s) of the project EQUINOX can deliver network benefits through the deferral or avoidance of network reinforcement. Our modelling which has been stress tested through various sensitivities highlights that customers could save £1,107M by 2050. Imperial College London and the Carbon Trust[1] recently highlighted that demand side flexibility could reduce energy systems costs by £4.5bn/yr by 2050.		
1.5. Funding			
1.5.1. NIC Funding Request (£k)	**6,980**	1.5.2. Network Licensee Compulsory Contribution (£k)	**786**
1.5.3. Network Licensee Extra Contribution (£k)	**0**	1.5.4. External Funding – excluding from NICs (£k)	**7,609**
1.5.5. Total Project Costs (£k)	**15,375**		
1.6. List of Project Partners, External Funders and Project Supporters (and value of contribution)	**Project Lead**: Western Power Distribution **Project Partners**: SP Energy Networks (SPEN), Octopus Energy, Passiv, Welsh Government, West Midlands Combined Authority (WMCA), Sero, and Guidehouse **Project supplier**: National Energy Action (NEA) **Project Supporters**: Letters of support from Scottish and Southern Energy Networks, Northern Powergrid, and UK Power Networks, Scottish Power Retail, and National Grid Electricity System Operator (NGESO) can be found in the Appendix 10.9. Letters of Support		
1.7. Timescale			
1.7.1. Project Start Date	01 March 2022	1.7.2. Project End Date	31 Dec 2025
1.8. Project Manager Contact Details			
1.8.1. Contact Name and Job Title	Stuart Fowler, Innovation Engineer	1.8.2. Email and Telephone Number	sfowler@westernpower.co.uk 07597 019818
1.8.3. Contact Address	Western Power Distribution, Pegasus Business Park, Herald Way, Castle Donington, Derbyshire, DE74 2TU		
1.9. Technology Readiness Level (TRL)			
1.9.1. TRL at Project Start Date	TRL 6	1.9.2. TRL at Project End Date	TRL 8

[1] [1] Carbon Trust & Imperial College London, (2021) Flexibility in Great Britain

2. Project Description

2.1. Aims and objectives

2.1.1. The Problem which needs to be resolved

Emissions from residential buildings account for 19% of total UK carbon emissions.[2] Decarbonising heat through electrification is therefore a key element for reaching the UK's 2050 net zero goal. The path to net zero set out within the Climate Change Committee's (CCC) advice on the Sixth Carbon Budget sees substantial near-term growth in the deployment of heat pumps (HP). The CCC estimates that annual HP installations need to increase more than 27-fold by 2030 – from 36,000 per year in 2020 to just over 1,000,000 per year by 2030 – to remain consistent with its Balanced Pathway.[3] At the same time, the UK government announced in the recent 10-year plan a target to reach 600,000 HP installations per year by 2028. Western Power Distribution (WPD) expects to have approximately 265,000 HPs in 2023 and 893,000 HPs in 2028,[4] resulting in a 36% increase in load growth during the RIIO ED2 price control period (2023 – 2028). Such accelerated load growth will require substantial grid reinforcements, ultimately resulting in increased costs for customers.

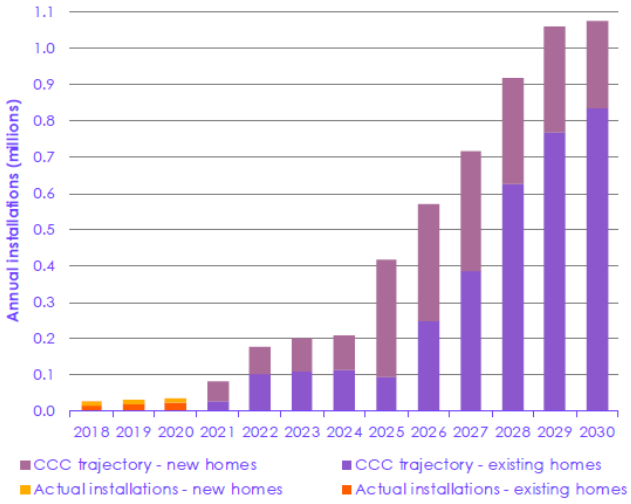

Figure 1. Current HP installation rates in homes set against the CCC's Balanced Pathway. Source: CCC analysis.

Over recent years, innovation projects have demonstrated that alternative smart solutions, such as those that make use of customer flexibility, can help reduce peak demand, and therefore defer or avoid the need for reinforcement. A recent report[5] by Imperial College London (ICL) and the Carbon Trust co-funded by WPD highlighted that demand side flexibility incl. domestic and non-domestic could reduce energy systems costs by £4.5bn/yr by 2050.

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[2] BEIS, (2020). Energy white paper. Powering our net zero future. https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future

[3] Climate Change Committee, (2021). Progress in reducing emissions. https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/

[4] WPD RIIO ED2 first draft business plan

[5] Carbon Trust & Imperial College London, (2021) Flexibility in Great Britain

Until now, DNOs procure flexibility predominantly at the High Voltage (HV) and Extra High Voltage (EHV) levels from commercial & industrial customers as there are limited reliable, cost-effective, scalable, and equitable solutions that enable DNOs to unlock flexibility from residential customers. This ultimately results in increased costs for customers who cannot monetize the flexibility offered by their heating systems, further exaggerated by increased grid reinforcements needed for untapped flexibility. There are three key elements to the problem, as highlighted by various past and ongoing studies and projects:

1. DNOs and flexibility providers do not fully understand how much flexibility is available from low carbon heat at an aggregated level, how reliable it is, and how to unlock its potential. For example, a paper published by University College London—based on field data of nearly 700 HPs deployed as part of the UK Renewable Heat Premium Payment scheme—estimated an 85% increase in household After Diversity Maximum Demand (ADMD) when including a HP. However, the study acknowledged that the impact of demand side response (DSR) on aggregated load profiles and clustered building sites could differ substantially from the impact on individual homes, and called for further trials to demonstrate the aggregate effectiveness of flexibility in condensed areas.[6]
2. Current commercial and technical arrangements for managing flexibility from residential low carbon heat are complex and do not align with the needs of residential customers. Interviews from a recent field trial where 76 residential properties with HP's were optimised with respect to automated DSR control signals, showed that demand shifting caused disturbance owing to overnight heating and noise, as well as usability issues with the controller interface and hardware.[7] In addition, learning from UKPN's Energywise project, stated that customers expect more clarity and visibility of the commercial benefits and energy savings associated with flexibility products.[8] These challenges need to be resolved to ensure future acceptability of such products.
3. A lack of understanding regarding the impact of low carbon heating at scale and the potential for flexibility from low carbon heating, prevents DNOs from leveraging the opportunity flexibility provides, as well as their ability to optimally factor these network solutions into investment plans.

Ensuring that benefits from flexibility are accessible to all customers, including the 2.4 million households in fuel poverty, is a significant challenge. The Centre for Sustainable Energy's 'Smart and Fair?' project[9] highlighted that the needs of fuel poor and vulnerable households must be carefully considered to ensure a fair and equitable energy transition for all citizens.

The early-to-mid 2020s are a critical period to drive innovation in low carbon heating. The CCC's recommendations regarding HP adoption, shown in Figure 1, and the UK government's 2028 HP installation target, underline the limited time-frame available to develop and commercialise cost-effective solutions to enable low carbon heating. With HP adoption expected to rapidly accelerate toward the latter end of the decade, electricity market

[6] Love et al., (2017). The addition of heat pump electricity load profiles to GB electricity demand: Evidence from a heat pump field trial. https://www.sciencedirect.com/science/article/pii/S0306261917308954

[7] Sweetnam et al., (2019) Domestic demand-side response with heat pumps: controls and tariffs. https://www.tandfonline.com/doi/full/10.1080/09613218.2018.1442775

[8] UK Power Networks (2018) Vulnerable Customers & Energy Efficiency. https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2019/05/Energywise-Closedown-Report.pdf

[9] Centre for Sustainable Energy – smart and Fair? https://www.cse.org.uk/projects/view/1359

participants have approximately one 5-year period left to trial and test various solutions before these need to be commercialised at a business as usual (BaU) level.

In this context, project EQUINOX aims to develop novel commercial arrangements, processes, and supporting technologies which **unlock flexibility from portfolios of domestic heating assets**, while meeting the needs of all consumers, including the fuel poor and vulnerable. Herein, residential low carbon heating assets include heat pumps, thermal storage, and smart thermostats. EQUINOX will do this, in part, by providing answers to the following key questions, grouped by theme:

#1	**Flexibility Potential:** How much flexibility can be unlocked from residential low carbon heating? At what cost and reliability to the DNO? At what comfort, convenience, and control levels for the customer? What is the impact of different building characteristics, technologies, commercial arrangements, processes, and control strategies on this flexibility? How does procuring domestic flexibility across a local, aggregated portfolio of homes enhance the value of flexibility? How does the presence of smart thermostats and thermal storage enhance the value of flexibility?
#2	**Behavioural Response:** What is the behavioural response from residential customers under each of the proposed methods, and how can DNOs and energy suppliers facilitate markets for flexibility to minimise customer bills?
#3	**Technical Integration:** What technical integration and automation is required to deliver a seamless customer experience?
#4	**Market Design and Participation:** How can DNOs, energy suppliers, and the ESO align their objectives to participate in DNO flexibility markets?
#5	**Just Transition:** How do DNOs ensure that fuel poor and vulnerable customers have an equal opportunity to participate in flexibility services?

2.1.2. The Methods being trialled to solve the Problem

To unlock the potential flexibility from a portfolio of low carbon heating assets, DNOs need to develop appropriate incentives that work at scale and provide a fair risk/reward framework for suppliers and their consumers to participate. Collaborating with energy suppliers and aggregators to access portfolios of individual customers is key to achieving the scale needed to have a material and reliable impact on distribution networks and will be vital in developing customer-friendly solutions that scale beyond innovation trials.

Following discussions with Project Partners, WPD has identified three commercial arrangements that can unlock flexibility from residential low carbon heating for the DNO and the supplier in a cost-effective manner. These arrangements provide DNOs, energy suppliers, and consumers with varying levels of risk and reward, and build on learning from prior innovation projects, international demand response schemes e.g., New Zealand's ripple control of heat storage, and from industry research e.g., Fell, et al.[10] Figure 2 provides an overview of the interactions between the stakeholders involved.

[10] Fell et al., (2015). Public acceptability of domestic demand-side response in Great Britain: The role of automation and direct load control. https://sciencedirect.com/science/article/pii/S2214629615300463

All three commercial methods are based on the proposition that WPD accesses flexibility offered by an aggregated portfolio of end-customers' heating assets, drawing on the capabilities of an energy supplier or aggregator to reach and interact with customers through integrated value propositions. The three methods differ in their approach to the distribution of risk and reward across the various market participants. These differences can be expressed through variations in terms of payment structure, dispatch method, and level of delivery risk and control across the value chain.

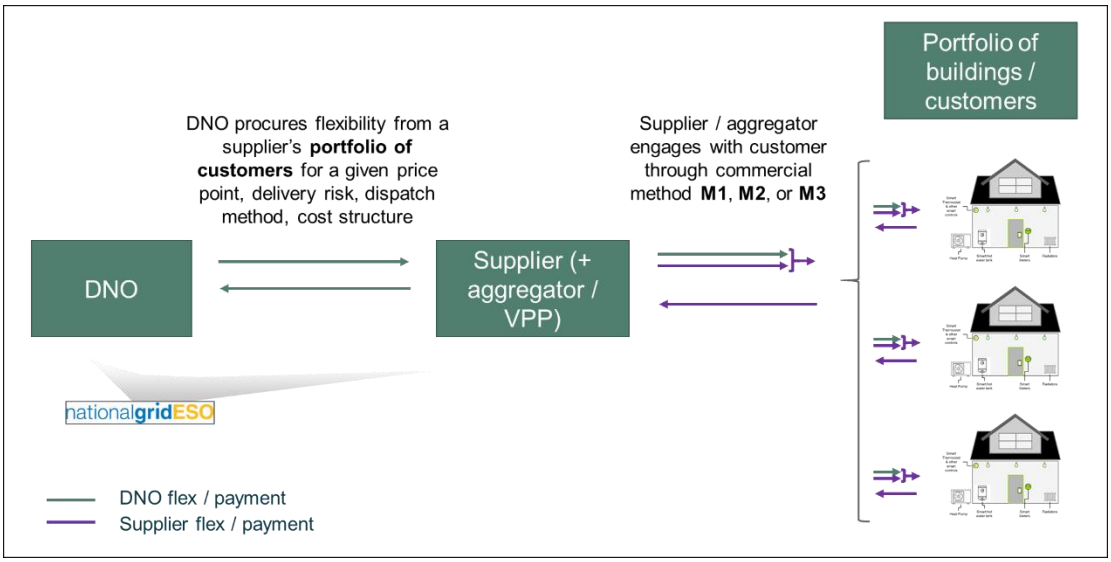

Figure 2. Simplified visual representation of how the DNO procures flexibility from a portfolio of customers.

The table below describes the different methods at a high level. Further details on the commercial arrangements are included in Section 2.2.2. The Conceptual Architecture, and the detailed design of the arrangements will be developed collaboratively with key consumer groups during the project.

Method 1 (M1): 'Save in advance'	In this method, the energy supplier, and in turn, the end-customer, receive an upfront flexibility payment in return for offering a fixed, minimum obligation of flexibility.
Method 2 (M2): 'Save as you go'	In this method, the energy supplier, and in turn the end-customer, are not committed to a fixed, minimum obligation but instead have more control over the flexibility they offer based on (near) real-time signals delivered in an automated way.
Method 3 (M3): 'Save in advance & boost as you go'	This method will combine aspects of both upfront flexibility payments (M1) and dynamic price signals (M2).

A study by Fell et al.[11] on the effect of tariff design and marketing on willingness of consumers to adopt time-of-use and DSR tariffs concluded that trust in suppliers was the most important

[11] Aunedi and Green, (2020). Early insights into system impacts of Smart Local Energy Systems. https://www.energyrev.org.uk/media/1420/energyrev-newwave_earlyinsightsreport_final_202006.pdf

predictor of using DSR tariffs and services. People who trust their electricity supplier were more likely to switch to a DSR tariff, while people who were concerned about their privacy were less likely to. This 'supplier trust factor' is a key reason why the DNO-supplier partnership is central to EQUINOX' approach for unlocking flexibility from domestic heating.

Where possible, the project will leverage existing systems and applications to demonstrate the procurement and dispatch of flexibility in advance and near-real-time of events. EQUINOX will develop and demonstrate integration and automation between WPD's flexibility platform's (Flexible Power) existing APIs through to the suppliers', aggregators', and customers' in-home automation systems that optimise electrical heating demand and home comfort. Seamless delivery of flexibility without losing comfort will be vital for ensuring maximum and sustained participation and consumer 'buy-in'. Where additional API's, technical interfaces, and operational practices are needed to support the commercial arrangements – e.g., built-in verification tools within Flexible Power, financial reclaiming mechanisms in case of under-delivery of flexibility – these will be developed as part of the project.

2.1.3. The Solution(s) which will be enabled by solving the Problem

The three methods will be trialled, over the course of three winter trial periods between 2022 and 2025. Throughout project delivery and upon project completion, EQUINOX will provide answers to the key questions outlined in Section 2.1.1., generating valuable insight into real consumer behaviour that can be shared amongst all relevant Network Licensees.

EQUINOX will trial solutions at significant scale to ensure statistically meaningful results that allow learning to be confidently rolled out across GB DNOs without the need for additional trials[12]. In addition, the project will adopt a proactive approach to transition the methods into BaU. At the end of each workstream, an associated project deliverable will ensure formal completion of the workstream and enable the transition to BaU. To ensure that the learnings are useful and are fully utilised in business as usual, WPD's Network Strategy team plan to second an experienced member of the flexibility team to lead project workstreams relating to the trial stage. l

The eventual commercial method utilised in BaU will have a direct impact on the electricity demand on the network by enabling the deployment of flexibility from low carbon heat. Moreover, a better understanding of flexibility resulting from the trials will enable DNOs to plan network reinforcement more efficiently, defer reinforcement, and ultimately provide value for money to electricity network customers.

The EQUINOX solution can also help to accelerate decarbonisation of the residential heating sector. First, by providing DNO flexibility payments to customers, EQUINOX creates new financial incentives for HP owners. More broadly, the insights generated as part of the commercial trials, customer engagement, and behavioural analysis will contribute to the general understanding of potential behavioural bottlenecks that may be hindering residential heat decarbonisation. These insights can inform policy decisions and the design of support mechanisms, e.g., to ensure equitable and effective socialisation of the costs of decarbonisation. EQUINOX will deliver capacity, environmental, and financial benefits as described in Section 3 and due to the relevance and timing will rapidly repay the project costs within the first year of project completion under our cost benefit analysis (CBA) assumptions.

[12] Addresses Ofgem Q3 from ISP feedback – see Appendix 10.8

2.2. Technical description of Project

EQUINOX will unlock flexibility from residential low carbon heating using **novel commercial arrangements, processes,** and **supporting technologies** enabled through **collaboration and integration across the full DNO-supplier-aggregator-customer ecosystem**. In this Section, we discuss the workstreams, technologies, partnership interfaces, and the extent to which they promote knowledge and learning beyond existing commercial products and prior innovation projects. A more thorough description is provided in Appendix 10.4.

2.2.1. Description of workstreams

In the process of developing the EQUINOX FSP, WPD and its Project Partners have developed a clear project delivery plan, informed by prior experience in delivering NIC projects to scope, budget, and schedule. The project will be delivered via five workstreams, described below:

- **Workstream 1 – Commercial Arrangements**. This workstream will build on concepts developed in the FSP and make use of preliminary customer engagement results, primary market research, and stakeholder workshops to inform a prototype design of the commercial arrangements and processes. Project Partners will jointly assess the risks and value of different commercial arrangements and develop pricing and contractual agreements that suit the objectives and risk-reward profiles of all involved parties, including customers. These arrangements and approaches will be adapted throughout the trials based on ongoing results and feedback.
- **Workstream 2 – Technical Integration and Automation**. This workstream will develop and build the technical infrastructure needed to deliver the commercial arrangements in a way that provides HP owners with a seamless customer experience. This includes leveraging existing systems and applications as well as the development of new technical interfaces and APIs.
- **Workstream 3 – Customer Engagement and Experience**. This workstream will seek to understand customer perspectives as well as monitor customer engagement, experience, and satisfaction throughout the trial to ensure that the project is benefitting end-customers. This workstream connects to workstreams 1 and 4 through transversal activities such as the experimental design and behavioural data analysis.
- **Workstream 4 – Trials**. This workstream will deploy experimental design principles to divide customers into representative groups and test the suitability and effectiveness of the commercial arrangements, and processes in unlocking HP flexibility on a large scale. Customer behaviour and feedback from the trials will be analysed to quantify solution benefits for the network and its customers, as well as to provide insight to the key questions outlined in Section 2.2.1. Description of workstreams EQUINOX will use modelling and simulation tools to understand how network benefits of the methods scale into BaU.
- **Workstream 5 – PM & Knowledge Dissemination**. This workstream will manage the scope, schedule, knowledge sharing and budget on a daily basis, coordinating across workstreams and Project Partners to ensure effective project delivery.

2.2.2. The Conceptual Architecture

EQUINOX will leverage existing systems and applications to demonstrate the procurement, planning, and dispatch of flexibility in advance and near-real time of events. WPD will develop

and demonstrate integration and automation between its flexibility platform[13] and energy suppliers or aggregators' in-home automation systems. These supplier- or aggregator-controlled systems and applications will in turn optimise and dispatch electrical heating equipment in response to various control signals and based on engagement with the customer. The main interfaces between Project Partners are summarised in Figure 3.

The conceptual architecture will enable two-way flow of information. On the one hand, flexibility procurement signals from WPD's flexibility platform will be received by the energy supplier and enacted, monitored, and closed out in the back-office functions. On the other hand, flexibility availability and pricing information gathered by the supplier will feed back to WPD's flexibility platform, to inform reliability and demand forecasting capability, dispatch planning, and constraint management decisions. The detailed technical design and enablement will be further developed in Workstream 2.

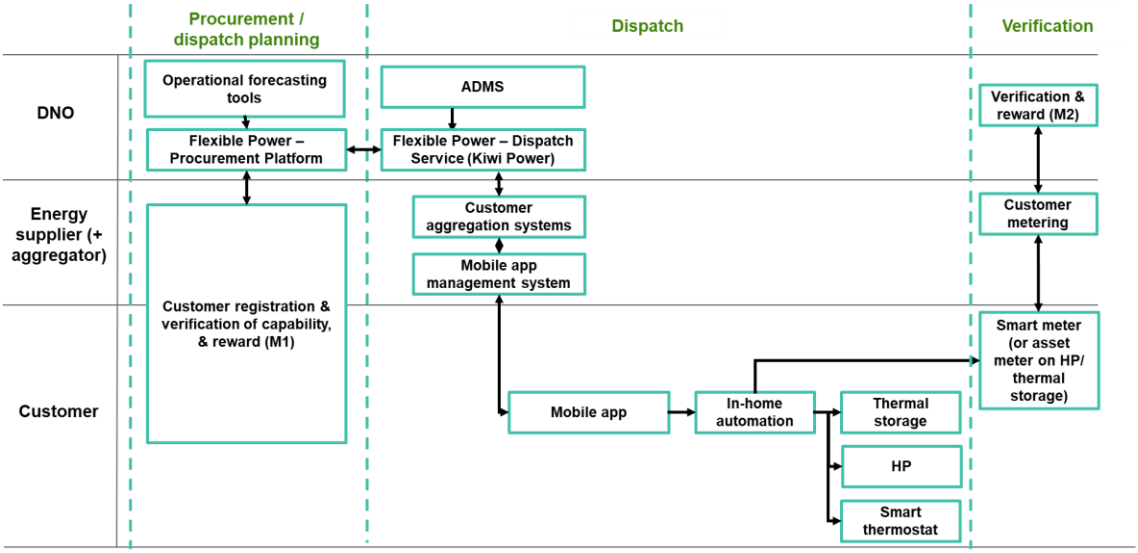

Figure 3. Overview of EQUINOX Conceptual Architecture.

2.2.3. Innovation within EQUINOX

The Energy Networks Association Innovation Strategy[14] highlights that 'trialling and implementing innovative arrangements to support network management and flexibility' is a focus area for DNOs. WPD's Innovation Strategy, Heat Pump Strategy, and Distribution System Operator Strategy all align on the need for increased innovation to manage the decarbonisation of heat using innovative solutions, such as new flexibility arrangements.

EQUINOX is a first of a kind trial, at significant scale, that addresses several innovation priorities for DNOs in facilitating the decarbonisation of heat. The concepts within the EQUINOX commercial arrangements identified in this FSP have not been demonstrated in prior innovation projects, yet they build on BaU flexibility principles and learning from projects on the topics of low carbon heat, domestic DSR, consumer incentives, and customer behaviour.

Innovation within EQUINOX stems from the commercial arrangements that will be used to procure portfolios of LV heat flexibility and their integration into existing flexibility

[13] The platform, Flexible Power, and its corresponding APIs are also used by other Network Licensees.

[14] ENA, Energy Network Innovation Strategy, 2020

procurement systems. These commercial arrangements enable domestic flexibility to come to market without being limited to bilateral arrangements and static price signals. Moreover, these arrangements will be: (a) based on a fully **integrated DNO-supplier-customer approach**; (b) able to **balance risk and reward across all actors** – maximising participation while keeping risks for all parties within tolerable thresholds; (c) designed to manage **flexibility from a diverse portfolio of domestic heating assets**.

2.3. Description of design of trials

EQUINOX seeks to enrol 800-1,000 customers from diverse customer segments who will participate in trials taking place during the three winters between 2022 and 2025.[15] Customer feedback will shape the solution design to maximise customer acceptance. The remainder of this Section provides an overview of the trials and customer engagement strategy.

2.3.1. Trial Principles

Following an initial series of design workshops and bilateral discussions, EQUINOX Project Partners have agreed on the following trial principles:

1. WPD will simulate network constraints and create pseudo constrained managed zones (CMZs) which will closely align with standard flexibility procurement standards.
2. Energy suppliers within the trial translate WPD's regional flexibility requirements into individual customer offerings and make use of an aggregated portfolio of assets to respond to network requirements.
3. WPD and energy suppliers jointly reflect on trial results and customer responses to the commercial arrangements, and use these insights to iterate and adapt the pricing, dispatch and contractual agreements over time, to encourage continuous learning, knowledge dissemination, and to steer the project to desired outcomes that meet the objectives and risk-reward profiles of all involved parties.
4. Customer safety – EQUINOX will not put customers in positions of unsafe living conditions, e.g. by setting temperature limits within homes.
5. Trial methods and incentives should be scalable, stakeholder-neutral, and closely reflect reality to gain insights of real-world, realistic customer behaviours.
6. The trial's customer base and customer subgroups should be sufficiently large to ensure that insights are reliable and statistically significant.
7. Transparency of data and quantification of benefits to end-consumers are key. Project Partners need to agree on a common methodology and governance structure for result capture and data analysis. This includes agreeing on data accessibility rights and putting in place regular data management updates to ensure data gathering expectations from all Partners are met and data can be used to answer key project questions (Section 2.1.1.), whilst bearing in mind privacy and feasibility considerations.

2.3.2. Trial Design and Outputs

Trial design will be informed by customer feedback at various stages in the project. It requires careful scoping across the variables – including customer type, technology mix, building characteristics, and control strategy – whilst ensuring that customer subgroups are both comprehensive and representative. Running the trials requires careful customer engagement to maximise participation, ensuring signals to customers and their equipment are sent correctly and making sure the right data is captured. Measurement and verification of

[15] The 800-1,000-participant goal refers to Trials 2 and 3. As Trial 1 is the initial pilot phase, it is not expected that 800-1,000 participants are enrolled already at this stage.

operating and response data can occur through smart meters, asset meters on HPs, asset meters on thermal storage, asset meters on smart thermostats – or a combination of the above. In addition, customer comfort will be monitored qualitatively through participant surveys and workshops, and quantitatively through temperature monitoring where possible.

Given that trial participants will likely not all be fed by the same physical primary or secondary substation, an abstracted modelling methodology will be applied to estimate the network impacts under a range of HP adoption levels. WPD will simulate network constraints and corresponding flexibility tenders and dispatch campaigns on hypothetical distribution networks (for some buildings, this could be the actual trial network). Subsequently, the energy supplier and its portfolio of customers will respond to these simulated dispatch campaigns through implementing heating control strategies based on the Methods.

Trial 1 (2022-2023) will focus on confirming the potential of flexibility from a portfolio of domestic low-carbon heating assets on a large scale compared to preliminary estimates from desktop studies and trials. Trial 1 will also test a range of incentive levels to understand the boundaries of response. Trials 2 and 3 (2023-2025) will test price signals at a more measured incentive level that align with the network value across a range of building profiles, customer types, and technology combinations. Consistent with Trial Principle #3, the trials will be planned in a way to maximise continuous learning, iteration, and knowledge dissemination over the course of the project. Each trial has a set of objectives that it seeks to achieve, and methods that it seeks to demonstrate – as summarised in Appendix 10.4.

2.3.3. Trial Participants and Customer Engagement

By 2023, **WPD expects 265,000 customers** to have HPs installed in their homes. EQUINOX seeks to enrol 800 - 1,000 trial participants by 2023, or about **0.4% of total customers.** This enables EQUINOX to trial a range of solutions with a diverse customer group and achieve scalable learning outcomes**.** The following evidence provides confidence that EQUINOX can achieve the minimum scale required to deliver scalable learning outcomes and will likely exceed the number of trial participants:

- Based on **Octopus Energy's** existing number of customers with heating assets e.g. HPs in WPD's licence areas, future installations, expected recruitment rate, Octopus Energy is confident of recruiting at least **500 customers** by the end of 2022.
- **Welsh Government and Sero** are implementing a large-scale decarbonisation "Optimised Retrofit" programme with 2,000 homes having works completed prior to 21/22 winter and an estimated 5,000 homes prior to 22/23 winter, the majority including heating assets. These are in addition to Sero's project pipeline of 750 new homes constructed in the same period. Leveraging this "Optimised Retrofit" programme and Sero's new build homes as a platform for recruiting trial participants, Project Partners are confident in easily exceeding **500 customer** trial participants through this channel. This accounts for conservative recruitment rates of participants.
- **WMCA** have committed to retrofitting 100 to 200 homes with heating assets through their Net Zero Neighbourhood programme. Leveraging this programme to recruit trial participants, our Project Partners are confident that at least **75 customers** can be recruited onto the EQUINOX trials. This assumes similar recruitment rates as above.
- WPD is in advanced discussions with several **additional suppliers** (incl. Scottish Power Retail) who have shown interest in participating in the EQUINOX with **several hundreds** of their customers. Participation from additional suppliers not only demonstrates scalability of the project, but also provides additional opportunities to achieve the scale required if any of the above categories falls short of expectations.

If during the course of the project, significantly higher number of customers want to participate in the trials, WPD will consider how this can be achieved while maintaining the focus on high quality customer service and remaining within the project budget.

Learnings from previous innovation projects, as presented in Table 7, suggest that flexibility trials like EQUINOX need to place more emphasis on customer engagement, communication, and customer experience monitoring. This is needed to gain a better understanding of customer perspectives and needs; to design and communicate customer value propositions in a simple and clear way; to monitor that technological solutions are delivered in a seamless, comfortable, and reliable way; and to explore ways of driving down underlying fixed costs to make small-scale DSR economical. To address these issues and questions at different levels of granularity, customer engagement and analysis work will be conducted in three ways:

1. **Primary research**: primary market research analysis seeks to understand customer's views and concerns as it relates to home heating, HPs & thermal storage, and in-home automation. A consumer research organisation, to be engaged following project award, will lead the primary research and outreach. This will include multiple modes of communication e.g. online surveys, phone calls, and door knocking to maximise participation. For customers within WPD's licence areas, this outreach will also be used as an additional route to support the participant recruitment campaign.
2. **Participant surveys and focus group workshops**: Sero and Octopus Energy will lead customer outreach, leveraging their relationship with customers to conduct surveys and focus group workshops. Other Project Partners, including WPD and Guidehouse, will actively contribute to designing survey and workshop questions to ensure that views are captured and presented in a comprehensive and objective way.
3. **1-on-1 interviews:** Sero and Octopus will lead customer outreach for 1-on-1 interviews. Other Project Partners will contribute to designing questions to ensure that customer views are captured and presented in an objective way.

The surveys, workshops, and 1-on-1 interviews – activities 2) and 3) above – will occur at the start and the end of the trial periods and will be tied to an incentive payment as part of overall trial participation. For these activities, the project will take specific steps to (a) ensure that learnings are comprehensive, consistent, supplier-neutral, and objective; and (b) understand the perspectives, needs, and concerns of **vulnerable & fuel poor customers.** Regarding (a), the customer engagement workstream will set out a governance structure to ensure that all customers are engaged with in a consistent way regardless of who their energy supplier is – with WPD providing oversight to the process. Lead customer engagement parties will draw together learnings from the different pools of customers to present project-level learnings.

Regarding (b), workshops and 1-on-1 interviews with customers from the vulnerable or fuel poor categories, these will be designed and led by National Energy Action (NEA), a Project Supplier, who, have extensive experience in engaging fuel poor and vulnerable customers.

2.4. Changes since Initial Screening Process (ISP)

The core scope, methods, and benefits for EQUINOX remain the same as described in the ISP. Following detailed discussions with Project Partners, the total NIC funding requested for EQUINOX has reduced by approx. £200k. The external funding contribution has increased because of additional Project Partner contributions, that ensure we achieve the trial scale.

EQUINOX has three additional Project Partners to strengthen the consortium (Welsh Government, Sero, and WMCA). These Partners are committed to supporting the project through funding and expertise, which ensures the project can demonstrate the methods at scale with a diverse range of customers.

3. Project business case

3.1 Summary of EQUINOX benefits

In its recent Ten Point Plan for a Green Industrial Revolution, the UK Government announced that it will "*aim for **600,000 heat pump installations per year by 2028**, creating a market led incentive framework to drive growth, and will bring forward regulations to support this especially in off gas grid properties*". This heat pump (HP) installation target represents a significant departure from the current HP installation rate (~30,000 per year). However, it falls short of the deployment levels (900,000 per year) recently suggested by the CCC[16]. The CCC also stated that "*We should not delay on HPs or low carbon heat networks as viable solutions for most of the country*". In addition, buildings is the second largest emitting subsector in the UK, accounting for 18% of UK emissions in 2019.

EQUINOX will be the first NIC project dedicated to addressing the challenges DNOs face with the electrification of heat. The project will develop commercial arrangements, processes, and supporting technologies that unlock flexibility from residential low carbon heating, while meeting the needs of all consumers, including the fuel poor and vulnerable. Other innovation projects such as Peak Heat, CommuniHeat, Re-Heat and Heat Street are researching how DNOs can manage the increasing roll out of HPs and thermal storage, but none of these projects have focused on large scale trials to determine the effectiveness of commercial arrangements and automation that enable customers to provide flexibility. Several projects, such as energywise, SAVE, Electric Nation Powered Up have explored domestic DSR and in some cases flexibility from electrical vehicle charging, but none of them have focused on the complex challenges we face with the provision of flexibility from low carbon heat.

The Carbon Trust and ICL recently reported that customers could save approx. £4.5bn/yr by 2050[17] through successful use of demand side response (both domestic & non-domestic). Furthermore, the report highlights that flexibility reduces peak demand on distribution networks by 61GW (c.25%) by 2050. Domestic demand side response through EQUINOX will enable the network to accommodate the expected increase in peak demand from the electrification of heat at the lowest cost to customers. Once implemented, the EQUINOX solution will result in:

- **Significant financial, capacity, and carbon benefits** associated with a) deferral of network reinforcement (at primary and secondary substations) required to address the increase in peak demand due to the addition of HPs to our network, and b) improved liquidity in flexibility markets and corresponding reduction in pricing. These financial, capacity, and carbon benefits have been quantified through business case modelling, as described below:
    - **£1,107 m** in direct financial benefits up to 2050 across GB, which will benefit the customer though network savings resulting in lower customer bills, and through enabling access to DSR markets at a lower cost
    - **779 MVA** capacity released up to 2050 across GB, in the form of demand reduction.
    - **1,900 tCO2e** of direct savings up to 2050 across GB.

[16] https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-reducing-emissions-2021-Report-to-Parliament.pdf

[17] Carbon Trust & ICL (2021), Flexibility in Great Britain

- **Faster adoption of heat pumps -** A current barrier to the adoption of HPs is the total cost of ownership. Reducing this total cost of ownership by providing incentives to shift electricity usage will contribute to reducing the financial hurdle associated with the adoption of HPs.
- **Increased efficiency in flexibility procurement from leveraging LV connected flexibility over HV connected flexibility -** The procurement of LV flexibility to resolve an upstream constraint (or ESO balancing requirement) will frequently have a superior effect than procurement of same quantity of HV or EHV flexibility. As an example, typical line loss factors[18] (from WPD's Charging Statements) are in the region of 1.013-1.019 for HV & EHV networks, while range between 1.066-1.075 for LV networks. Therefore, procurement of one unit of LV connected flexibility (demand turn down), would create an additional 4.5% reduction in load flowing through an upstream constraint than the same amount of upstream flexibility. This leverage effect associated with LV flexibility (specifically demand turn down) potentially grants DNO greater efficiency when procuring flexibility. This beneficial effect would also be noticed by the ESO.
- **Increased opportunity for value stacking** – Because the LV network remains the load centre for network flows, any capability to dispatch flexibility from the LV network is likely to benefit all network constraints up and down the network. In comparison, use of HV or EHV flexibility will only ever benefit constraints that are located upstream. Therefore, LV flexibility is likely to have application across more network constraints than its upstream neighbours. This effect will be experienced as greater efficiency in DNO flexibility procurement, as the same flexibility would be likely to improve more than one network issue.
- **Benefit for the National Grid ESO (NGESO)** – EQUINOX may contribute to system balancing cost reduction due to improved coordination with NGESO. The domestic flexibility unlocked would help NGESO reduce the procurement of other services (e.g., ancillary service procurement avoidance), and hence address transmission network constraints while having the potential to benefit marginal generation costs too. This benefit will be further discussed with NGESO throughout the project and documented the business case update following trial completion.

3.2 Business case methodology

The quantified financial, capacity, and carbon benefits included above and in the benefits tables in Appendix 10.1 have been calculated using our EQUINOX business case cost benefit analysis model. The detailed methodology and underlying assumptions for this model are described in Appendix 10.2.

The business case model compares the EQUINOX method case against a representative equivalent base case, which is the most efficient method in use, and analyses the solution over an individual licensee (Western Power Distribution) and GB scale deployment to determine the financial, capacity and carbon benefits. The main method case, base case, and roll out assumptions are summarised below:

- **Forecast of heat pump load growth**: To determine HP uptake[19] until 2050, we used data from WPD's Distribution Future Energy Scenarios (DFES)[20]. For modelling purposes,

[18] https://www.westernpower.co.uk/our-network/use-of-system-charges/charging-statements

[19] We have only considered non-hybrid heat pumps

[20] https://www.westernpower.co.uk/distribution-future-energy-scenarios-application

we selected a scenario ("Leading the Way") of moderate HP uptake that is compliant with the UK government targets of net zero greenhouse gas emissions by 2050. Appendix 10.2 includes a sensitivity analysis on a lower HP uptake scenario.

- **Forecast of load growth at substations**: For sub-transmission reinforcement, we used data from WPD's Long Term Development Statements (LTDS) to estimate future load growth at primary substations (132kV/66kV/33kV/11kV) and EHV substations (132kV/33kV). To estimate load growth data beyond 2025 (the last year covered by LTDS) we used annual load growth estimates, in line with WPD's peak demand forecast (RIIO-ED2 Annex 6a Load Related Expenditure[21]). For secondary reinforcement, we used data from WPD's NIFT model to estimate load growth at secondary substations following the same methodology. The secondary reinforcement analysis focused on substations that are expected to require reinforcement soonest (particularly during ED2). Further secondary reinforcement is expected during ED3 and beyond, hence this is a conservative estimate.
- **Assessment of reinforcement deferral need – base case:** For each substation, we calculated headroom as the difference between firm capacity and forecast load (incl. HP load), using the forecast data described above. The base case assumes that there is no other, existing solution that would unlock flexibility from domestic heating assets, but takes into account the flexibility benefits (from existing flexibility products) WPD assumed in RIIO-ED2[21].
- **Method case (EQUINOX):** For each substation, we determined if EQUINOX is applicable (e.g., ignored substations for which demand exceeds firm capacity before project completion in 2026), and calculated the reduced forecast load after EQUINOX deployment. We assumed that the EQUINOX solution coupled with improved system integration and automation can reduce household peak demand by 35%[22]-50%[23], based on optimising HPs, thermal storage and smart controls under standard operating conditions. Adopting a conservative approach, we used the 35% value. We then calculated the new substation headroom and used average network reinforcement costs (details on how these were estimated are provided in Appendix 10.2) from WPD's RIIO-ED2 Annex 6a Load Related Expenditure[21] to estimate the financial benefit from deferring reinforcement by comparing the base case against method cases. Our model discounts all benefits from other flexibility solutions (i.e., reinforcement avoided) WPD captured in the RIIO-ED2 business plan.
- **Improved liquidity in DNO flexibility markets:** WPD estimates the cost of flexibility to be £2.9m during RIIO-ED2. Assuming that EQUINOX could help improve liquidity in DNO flexibility markets by 10%[40] this could help save up to £0.058m per year (flexibility price point reduction) across WPD due to increased competition in the flexibility marketplace. This benefit is added to the financial benefit from deferring reinforcement described above. The above assumption clearly understates future DNO spend on flexibility services as this is likely to increase in the future as DNOs are adopting a flexibility-first approach.
- **Assessment of the net financial benefits of EQUINOX over GB -** Scaling factors (pro rata based on the number of licence areas) were then applied to calculate a GB-

[21] https://yourpowerfuture.westernpower.co.uk/downloads-view/41190

[22] Trevor Sweetnam et. al - Domestic demand-side response with heat pumps: controls and tariffs

[23] European Commission Eflex Project - https://www.slideshare.net/JonathanDybkj/the-eflex-projectlow

wide roll out. Financial costs and benefits were discounted to 2021/22 values, using a discount factor of 3.5% over the entire modelling period, in line with Network Innovation Competition (NIC) requirements. Appropriate capitalisation rates have also been used for modelling purposes. Appendix 10.3 provides the detailed assumptions.

The approach described above assumes that EQUINOX would only defer (not avoid) network reinforcement. For each individual substation, the number of years of deferral that EQUINOX can achieve depends on many factors, including load growth and the proportion of load from HPs. In addition, our model assumes that EQUINOX is deployed only for a certain number of years while substation headroom can be kept at zero. This means that once load exceeds firm capacity again (after EQUINOX deployment), reinforcement would eventually be triggered and EQUINOX would no longer be applied to that substation.

3.3 EQUINOX Financial Benefits

According to the recently published Flexibility in Great Britain report[34], "*embedding flexibility in zero carbon heat and transport solutions will help to reduce their system impact and costs making their decarbonisation economically more feasible*." EQUINOX will be the first NIC project dedicated to addressing the challenges of heat electrification, delivering significant financial benefits across GB. The EQUINOX financial benefit that has been quantified as part of this business case comprises benefit from network reinforcement deferral and from improved liquidity in DNO flexibility markets.

All figures in this Section are presented in real terms using 2021/22 prices. Figure 4. shows the forecast net financial benefits of EQUINOX at GB scale (cumulative):

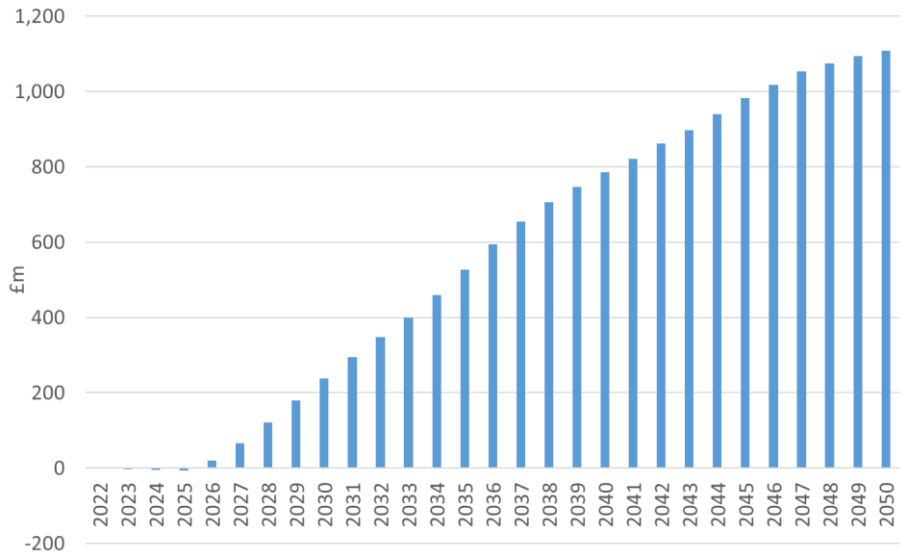

Figure 4. Forecast net financial benefits of EQUINOX at GB scale

This illustrates that there is a significant financial benefit against investment associated with EQUINOX. Comparing the cumulative EQUINOX benefits with the benefits of demand side response reported by industry experts in the Carbon Trust & ICL report, provides confidence that the EQUINOX benefits are likely achievable, and conservative. Table 1 below shows cumulative net financial benefits (in £m) for 2030, 2040, and 2050 across GB:

Table 1. Cumulative Net Financial Benefits of EQUINOX

Licence Area	2030	2040	2050
Licensee Scale			
Western Power Distribution	£58m	£204m	£290m
All licence areas			
GB	£238m	£786m	£1,107m

3.4 EQUINOX Capacity Benefits

EQUINOX will release capacity headroom through use of heat flexibility, thereby reducing reinforcement needs.

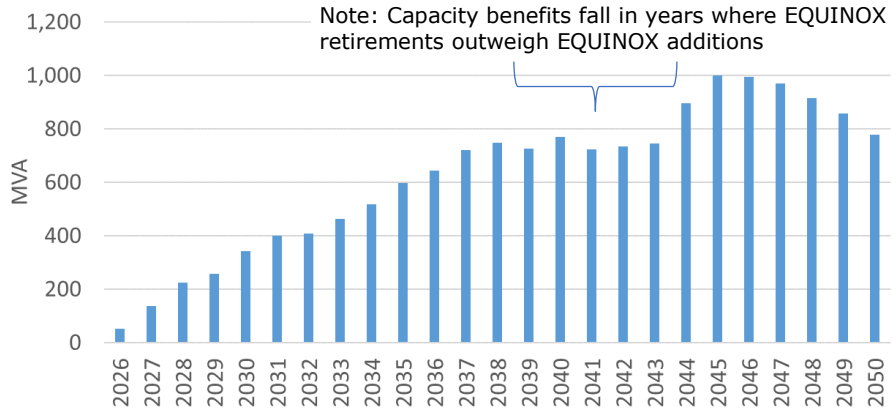

Figure 5. Forecast Capacity Release by EQUINOX across GB

The total HV and LV capacity released across GB would be 779 MVA by 2050. It should be noted that due to the temporary effect of the flexibility solution (i.e. EQUINOX is used to defer a substation reinforcement for as long as possible until network capacity is overtaken again by load growth, following which the network is reinforced and thus flexibility no longer required), EQUINOX releases capacity temporarily until reinforcement removes the capacity benefits of EQUINOX at a later date. As a result, the cumulative capacity benefits may fall in some years, as seen in the shape of the graph in Figure 5. This is due to a larger number of substations requiring reinforcement in some years, thus removing the need and capacity benefits from EQUINOX, when compared to the number of new substations at which EQUINOX is deployed and achieving capacity benefits across GB. Conversely to the financial benefits, capacity benefits cannot be capitalised over time.

In context, the Carbon Trust and ICL report estimates that flexibility will achieve a peak demand reduction on distribution networks of 61GW (c. 25% peak demand reduction) by 2050.

3.5 EQUINOX Environmental Benefits: Carbon emission reductions

The capacity benefit described in Section 3.4 can be translated into equivalent environmental benefit from deferral of reinforcement works once EQUINOX has been deployed, offering

services to constrained parts of the network. The Capacity to Customers (C2C) project[24] (by Electricity North West) suggests a total saving of 92.7 tCO2e for each new 38 MVA transformer not installed. Using the above assumption, along with the capacity release figures provided in Section 3.4, we determined the environmental benefit of EQUINOX in tCO2e.

This approach understates the total environmental benefit as the support EQUINOX may provide towards the acceleration of HP deployment is not included (beyond the assumed HP load growth scenario). The commercial arrangements (incl. customer incentive payments) may lead to faster adoption of HPs in certain regions, which would in turn result in additional flexibility unlocked. This flexibility would help defer additional network reinforcement (which has not been quantified as part of the business case), hence more financial, capacity, and environmental benefits. The solution would also contribute to the acceleration of heat electrification in GB.

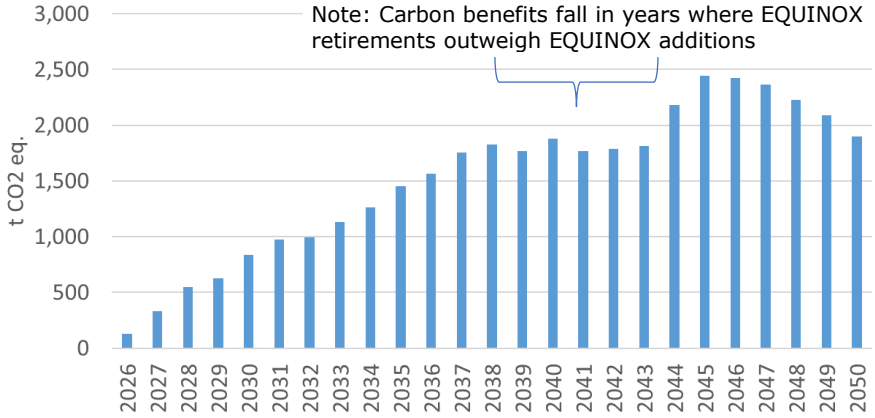

Figure 6. Forecast Carbon Benefit of EQUINOX across GB

A summary of the cumulative benefits across GB is provided in Table 2 below.

Table 2. Financial Benefit, Capacity Released, and potential Carbon Benefit (GB)

Year	Financial Benefit (£m)	Capacity Release (MVA)	Potential Carbon Benefits (t CO_2 eq.)
2030	238	343	836
2040	786	770	1,878
2050	1,107	779	1,900

Note: The above benefits are not to be realised over the course of the project implementation period (2022-2026), therefore they have not been included in the financial spreadsheet as Direct Benefits. During the course of EQUINOX, WPD will work closely with WMCA who are deploying a cluster of approx. 100 to 200 heating assets (HPs, thermal storage, and controls) in a neighbourhood that may trigger reinforcement. If reinforcement is triggered, EQUINOX will explore whether with additional oversight the Methods can be applied to defer reinforcement[25].

[24] https://www.enwl.co.uk/globalassets/innovation/c2c/c2c-key-documents/carbon-impact-assessment-scenario-results.pdf

[25] Addresses Ofgem Q1 from ISP feedback – see Appendix 10.8

4. Benefits, timeliness, and partners

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits while having the potential to deliver net financial benefits to future and/or existing Customers

Decarbonising heat in homes is one of most pressing challenges in achieving the governments net zero targets. EQUINOX accelerates the development of a low carbon energy sector by unlocking **779 MVA** of flexible capacity from HPs and thermal storage up until 2050, at lower cost for customers. The environmental benefit of this solution is calculated to be **1,900 tCO2** up until 2050 across GB, under the assumptions detailed in Appendices 10.2 and 10.3. Furthermore, EQUINOX unlocks the value of flexibility from heat, therefore reducing the total cost of ownership of a HP reducing the financial barrier that currently plays a key role in preventing customers adopting the technology.

EQUINOX aims to deliver net financial benefits for existing and future customers by developing and trialling innovative commercial arrangements to unlock flexibility efficiently and cost-effectively from residential heating assets. This will be achieved in an equitable way thus enabling all customers, including vulnerable and fuel poor customers, to easily access flexibility services from DNOs through energy suppliers/aggregators. The arrangements will be developed with the specific requirements of flexible heat in mind, however, aim to be applicable to other sources of residential flexibility e.g., EV charging.

This contributes to a low carbon energy sector in the following ways:

a) Increased access to flexibility from low carbon heat frees up network capacity that enables DNOs to accommodate more low carbon technologies (LCTs) sooner, thus accelerating the transition to net zero, and deferring investments in grid reinforcement.

b) The project will deliver simple to use, easy to understand propositions to customers that match their expectations and experience levels, lowering the barrier for adoption and guaranteeing long term customer engagement, which is crucial for DNOs to reliably plan for, and use, flexibility from residential heat.

c) Payments for flexibility from residential heat provide another value stream for customers and effectively lower the total cost of ownership of a HP. The savings are expected to accelerate the adoption of HPs which has a positive impact on the carbon budget spend.

d) Integration at the technical and business process level between the DNO, supplier and customer devices creates a cost-effective way for DNOs to leverage flexibility from consumer-owned assets through a supplier. These interfaces can be extended beyond HPs e.g., to EVs, renewable local generation, and storage assets as they become more common and the need for flexibility from residential customers increases.

e) The project enables all customers to participate in the energy transition on an equal footing, thus leaving no customer behind.

(b) Provides value for money to electricity distribution/transmission customers

The cost of EQUINOX per GB customer is estimated at a one-off cost of 25 pence per customer for delivering the largest low carbon heating trial in GB. GB customers will save approximately £1.32 per year until 2050 if EQUINOX is rolled out following the project trials. Domestic customers with HPs having an opportunity to save significantly more.

EQUINOX is expected to achieve cumulative net financial benefits of **£1,107m** by 2050 across GB. A GB-wide roll out would provide 158 times the return on the £7.0m NIC funding requested in benefits to customers by 2050. By rolling out the EQUINOX method across the entirety of the distribution network, more consumers would have the opportunity to get rewarded for the flexibility services they provide. EQUINOX has been designed to ensure the project delivers the greatest value at the lowest cost.

This is achieved by:

- Recruiting trial participants that already have low carbon heating technology within their homes, thus reducing the number of additional heating asset deployments needed;
- Ensuring that the commercial and technical solutions developed are scalable to peer DNOs and alternate energy suppliers, thus reducing additional roll out costs following successful project completion;
- Leveraging network simulation and modelling solutions to reflect the impacts of HP clustering, rather than needing additional heating asset installations to understand the impact of clustering;
- Leveraging common systems e.g., Flexible Power, currently used by 5/6 DNOs to minimise costs to replicate EQUINOX[26];
- Developing efficient project delivery plans, focused on sharing early learning outcomes that inform future projects; and
- Leveraging substantial in-kind Project Partner contributions.

Project Costs and Contributions

WPD has a strong track record of delivering projects within project budget. To ensure this project is delivered cost efficiently, calculations have been conducted using a bottom-up approach based on detailed activities across project workstreams. The costs have accounted for costs and contributions of each Project Partner. All Project Partners understand the benefits of successfully delivering EQUINOX, therefore provide significant in-kind contributions to the project. In alignment with WPD's innovation governance, WPD senior managers have scrutinised the costs to ensure any expenditure maximises value for GB customers

The EQUINOX cost estimates are based on:

- Inputs from WPD's NIC innovation experts to estimate the labour effort to support project delivery;
- Inputs from WPD's BaU subject matter experts to understand the costs associated with relevant system integration and BaU transition;
- Initial quotes from the EQUINOX Project Partners (SP Energy Networks, Octopus Energy, Guidehouse, Sero, Passiv, WMCA and Welsh Government); and
- Initial quotes from EQUINOX suppliers e.g. NEA.
- Initial estimates to include integration costs for one additional energy supplier within the project trials.

Additional partner contributions to the project are detailed in Section 4.4.

Summary Cost Tables

The project costs for each workstream as a percentage of the total are summarised in Table 3.

[26] Addresses Ofgem Q3 from ISP feedback – see Appendix 10.8

Table 3. Project cost breakdown by Workstream

Workstream		Cost (£k)	Percentage (%)
1	Commercial arrangements design	578	3.8%
2	Technical integration and automation design & implementation	2,851	18.5%
3	Customer engagement and experience	707	4.6%
4	Trials	9,552	62.1%
5	Project management & knowledge dissemination	1,687	11.0%

The cost breakdown by cost categories are shown in Table 4.

Table 4. Project cost breakdown by Cost category and Workstream

Cost category (£k)	W1	W2	W3	W4	W5	Subtotal
Labour						
Equipment						
Contractors						
IT suppliers & integration						
IPR costs						
Travel & Expenses						
Payments to Users						
Contingency						
Decommissioning						
Other						
Total	**578**	**2,851**	**707**	**9,552**	**1,687**	**15,376**

Staffing costs for each Project stage, indicating the number of staff expected to be used (FTEs by stage), the number of days required, the cost per day and the total personnel costs are shown in Table 5

Table 5. Staffing cost breakdown by Project Partner and workstream

Project Partner	Workstream	Total (£k)	FTEs	Person days	Cost (£)/day
WPD	1				
	2				
	3				
	4				
	5				
Octopus Energy	1				
	2				
	3				
	4				
	5				
Passiv	1	-	-	-	
	2				
	3				
	4				
	5				
Welsh Government	1	-	-	-	
	2	-	-	-	
	3	-	-	-	
	4				
	5				
Guidehouse	1				
	2				
	3				

	4
	5
SP Energy Networks	1
	2
	3
	4
	5
West Midlands Combined Authority	1
	2
	3
	4
	5
Sero	1
	2
	3
	4
	5

Note: There may be some rounding differences between the above tables and the full cost spreadsheet due to the formulae used.

ENW are applying to the NIC for a heat-related innovation project, Smarter Heat. As a result of discussions with ENW, we are confident that EQUINOX is suitably unique and that both projects ought to be additive in addressing the significant challenges and opportunities associated with the transition by customers to electric heating. EQUINOX will trial DNO led commercial customer solutions to manage increased demand from electric heat, while Smarter Heat will trial network solutions e.g. dynamic asset ratings, to manage this increased demand. EQUINOX will conduct varying levels of customer engagement to understand customer perceptions to flexible electric heating. Insights from customer engagement will inform the EQUINOX designs throughout the project. Following discussions with ENW, we understand that Smarter Heat will also conduct customer engagement to inform the design of network solutions, which we believe is complementary to EQUINOX. If both projects are successfully awarded funding, WPD and ENW will coordinate to ensure that the customer engagement conducted by both projects is complementary and provides best value for money for GB customers.

(d) Is innovative (i.e., not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness

Stakeholders across the energy system all agree that unlocking flexibility from low carbon heat for residential customers is a key challenge that needs to be addressed as part of the energy transition. The ENA's Innovation Strategy[27], highlights that 'trialling and implementing innovative arrangements to support network management and flexibility' is a key focus area for electricity DNOs. WPD's Innovation Strategy, Heat Pump Strategy and DSO Strategy all align on the need for increased innovation to manage the decarbonisation of heat using innovative solutions, such as new flexibility arrangements.

Collaboration and coordination across stakeholders in the energy value chain is recognised as a key requirement in delivering a reliable and cost-efficient net zero energy system. DNOs, energy suppliers, aggregators and other stakeholders need to collaborate through innovation projects to address this challenge in a coordinated fashion.

EQUINOX is a first of a kind trial, at significant scale, that addresses several innovation priorities for DNOs in facilitating the decarbonisation of heat. The concepts within the commercial arrangements identified in this FSP have not been demonstrated in prior innovation projects, however they build on BaU principles and learning from projects on the topics of low carbon heat, domestic DSR, consumer incentives, and customer behaviour.

Figure 1Figure 7 provides an overview of NIA and NIC projects that are relevant to EQUINOX.

NIC & NIA Projects*	Lead DNO	Description	Domestic flexibility	Low carbon heat	Commercial trials at scale
EQUINOX	WPD	Unlocking flex from heat using novel commercial arrangements	✓	✓	✓
CommuniHeat	UKPN	Developing a roadmap for how rural communities can switch to low carbon heat		✓	
Peak Heat	WPD	Desktop modelling study to understand the impact and flexibility of HPs	✓	✓	
Freedom	WPD	Balancing networks through optimising use of HHPs		✓	
NINES	SSEN	Technical demonstration of controlling smart heating in homes	✓	✓	
Energywise	UKPN	Understand and trial energy efficiency and commercial arrangements with fuel poor customers	✓		✓
Future Flex	WPD	Design and trial solutions for unlocking domestic flexibility	✓	✓	
SAVE	SSEN	Understand whether price signals can impact household peak demand	✓		✓
SCMZ	SSEN	Desktop study to investigate procurement of flexibility from local communities	✓		
CrowdFlex	nationalgridESO	Desktop study to understanding the domestic flexibility across various LCTs	✓	✓	
Electric Nation	WPD	Understand customer responses to smart EV charging	✓		✓
Shift	UKPN	Understand market mechanisms to facilitate smart charging	✓		
Smarter Heat**	electricity north west	ENW's 2021 NIC bid – technical solutions to managing low carbon heat	✓	✓	

* non-exhaustive list of projects
** 2021 NIC Bid

Figure 7. Overview of NIA & NIC projects that align with the key topics of EQUNIOX

NIA projects such as: Peak Heat, CommuniHeat, and CrowdFlex are researching how DNOs can manage the increasing roll out of HPs and thermal storage and the theoretical flexibility of

[27] ENA, Energy Network Innovation Strategy, 2020

heat, but none of these projects have focused on large scale trials to determine the effectiveness of commercial arrangements and automation that enable customers, to provide flexibility. Several projects, such as energywise, SAVE, Electric Nation Powered Up, and Shift have explored domestic DSR and in some cases flexibility from electrical vehicle charging, but none have focused on the complex challenges we face with flexibility from low carbon heat.

Innovation within EQUINOX stems from the commercial arrangements and processes that will be used to procure flexibility from electric residential heat and their integration into existing systems. These commercial arrangements will be: (a) based on a fully **integrated DNO-supplier-customer approach**; (b) able to **balance risk and reward across all actors** – maximising participation while keeping risks for all parties within tolerable thresholds; (c) designed to manage **flexibility from a portfolio of domestic heating assets**.

In addition, the project focuses on an intersection of several subject and operational areas which have historically not been assessed in detail:

- **Customer segment – residential sector, including fuel poor and vulnerable customers:** To date, LV flexibility solutions have focused on mobilising flexibility from I&C customers as there are no viable solutions that enable DNOs to unlock flexibility from residential customers – especially the fuel poor and vulnerable – at scale.
- **Low carbon technology – heating assets:** More recently, several innovation projects have focused on residential EV charging e.g., Electric Nation & Shift. Low carbon heating presents unique deployment and behavioural challenges to unlock flexibility at the scale to have meaningful network impact. The methods developed will specifically ensure that DNOs have appropriate tools to tap into flexibility from residential low carbon heat, however, will also be applicable to other forms of residential demand side assets e.g., EVs.
- **Aggregated perspective based on a field trial**: EQUINOX builds on learning from desktop studies and small-scale trials e.g., Peak Heat, CrowdFlex, Shift & Future Flex. EQUINOX will allow these concepts and learnings to be tested and validated on a portfolio of buildings covering a range of housing and technology characteristics. Given that HPs are predicted to grow in areas where the housing stock suits early adoption, it is highly likely that LCTs will be clustered closely together leading to a compound effect on specific parts of the network.[28] Without dedicated innovation projects to understand and unlock flexibility from heat, we risk that this flexibility isn't fully accessed, and that fuel poor and vulnerable customers are left behind in these opportunities.

In addition to the commercial arrangements, the integration and automation between DNOs, suppliers and customers that enables customers to seamlessly deliver flexibility from heating assets has not been demonstrated elsewhere, and will be vital to maximise engagement.

There are several risks and unknowns that warrant a DNO demonstrating this through innovation funding rather than BaU. A key unknown is the interaction and participation of customers, specifically vulnerable and fuel poor, with new commercial arrangements. DNOs need to develop a better understanding of the flexibility that can be provided under different commercial mechanisms before rolling out solutions to a wider audience. The price point at which customers are willing to provide flexibility from electric heat is currently a key uncertainty for DNOs and therefore a major learning objective for EQUINOX. As flexibility

[28] WPD, (2021). Heat Pump Strategy. https://www.westernpower.co.uk/downloads-view-reciteme/353149

markets are still quite nascent, trials that provide price discovery are going to be vital to ensuring that the propositions that underpin a flexible energy system are commercially viable.

An innovation project provides a unique test bed to trial the EQUINOX methods. Furthermore, the trials enable WPD to discover the price points and value of residential flexibility from heat. Without successfully demonstrating these solutions in an innovation project, DNOs increase risk that as more electric heating is deployed, DNOs are unable to unlock domestic flexibility and thus must rely on reinforcement to manage the increased demand.

> *"One way of boosting the market for HPs could be to allow them to provide flexibility to the grid, according to experts.*
>
> *Emma Pinchbeck, chief executive of Energy UK, agreed. "HPs are an electric product and when combined with efficient buildings and smart technologies, consumers can adjust how they use them and be rewarded for doing so, if it helps manage the wider electricity system."*
>
> [Can Flexibility Unblock the UK's Heat Pump Potential? Greentech Media, December 2020]

(e) Involvement of other partners and external funding

EQUINOX relies on the support and expertise from a range of partners. During the preparation of the ISP, WPD set out key aspects of the project that would benefit from having a Project Partner. After conducting several interviews with possible partners, WPD has built a consortium of committed partners with the proven ability to deliver large scale innovation projects.

Below we provide a brief overview of the role of the Project Partners:

WPD – WPD is responsible for the successful delivery of EQUINOX. WPD will provide expertise in successfully delivering complex innovation projects, in-depth network knowledge and technical experts. Customers participating in the EQUINOX trials will all be customers of WPD.

SP Energy Networks – SP Energy Networks will support across all Workstreams. They will participate in the technical design authority and ensure the EQUINOX designs and Deliverables are scalable and application to peer DNOs[29].

Octopus Energy – Octopus Energy will support across all Workstreams. Specifically, they will lead the recruitment of trial participants and engagement with their customers in collaboration with Project Partners. In addition, they and support the solution and trial designs.

Passiv – Passiv will help DNO's and energy suppliers understand the capabilities of home to deliver flexibility by providing home digital twins. This understanding will support the design of the iterative solution designs and trials.

Guidehouse – as an independent organisation, with extensive expertise in innovation trials and customer programmes, Guidehouse will lead Workstream 1, Workstream 3, and 5 with support from other Project Partners. Furthermore, they will support with the trial design and analysis.

WMCA & Welsh Government – through their respective Net Zero Neighbourhood programme and "Optimised Retrofit" programme, they will support by funding and retrofitting between 600 and 1,200 homes with heating assets in WPDs licence area.

Sero – Sero are the technical lead and programme manager for Welsh Government's "Optimised Retrofit" programme. In this capacity, for EQUINOX, Sero will coordinate with social landlords to help them to install HPs, thermal storage, monitoring and control over the next ten years.

[29] Addresses Ofgem Q3 from ISP feedback – see Appendix 10.8

For homes under the "Optimised Retrofit" programme, Sero's digital tools will be leveraged to provide a customer home energy management service that optimises homes with heat pumps against ½ hourly tariff signals as part of their "home comfort" service.

All Project Partners will support knowledge dissemination throughout the project.

Table 6. Partner resource and cost breakdown

Project Partner	Total Costs (£k)	Contribution (£k)	Contribution (%)	Outstanding funding (£k)
WPD				
Octopus Energy				
Passiv				
SP Energy Networks.				
Guidehouse				
WMCA				
Welsh Government				
Sero				
Other costs				
Total	15,376	8,380	55%	6,996

WPD will continue engagement with the National Grid Electricity System Operator (NGESO) who are supportive of the project and will participate in relevant working group sessions as highlighted in in Appendix 10.9. Letters of Support. [30]

If additional support is required, beyond what is assumed in the FSP, WPD will run competitive tenders to procure services to maximise value for GB energy customers.

(f) Relevance and timing

Decarbonising heat through electrification is a key element for reaching the UK's 2050 net zero goal. The UK government recognises this and has recently announced in a 10-year plan target to reach 600,000 HP installations per year by 2028. WPD expects to have approximately 265,000 HPs in 2023 and 893,000 HPs in 2028,[31] resulting in a 36% increase in load growth during the RIIO ED2 price control period (2023 – 2028).

[30] Addresses Ofgem Q3 from ISP feedback – see Appendix 10.8

[31] WPD RIIO ED2 first draft business plan

Over recent years, innovation projects have demonstrated that smart solutions, such as use the customer flexibility can help reduce peak demand, and therefore defer the need for reinforcement. However, until now, DNOs procure flexibility predominantly from the commercial & industrial sector as there are no viable solutions that enable DNOs to unlock flexibility from residential heat at scale in a reliable, cost-effective, and equitable way. This ultimately results in increased costs for customers, directly, because they cannot monetize the flexibility offered by their heating systems and indirectly because this untapped flexibility increases the need for grid reinforcements.

Unlocking flexibility from low carbon heat for residential customers is a key challenge that needs to be addressed as part of the energy transition. The ENA's Innovation Strategy[32], highlights that "trialling and implementing innovative arrangements to support network management and flexibility' is a key focus area for electricity DNOs". WPD's Innovation Strategy, Heat Pump Strategy and DSO Strategy all align on the need for increased innovation to manage the decarbonisation of heat using novel flexibility arrangements.

Our CBA modelling shows that the sharp increase in connections of HP forecasted in the later years of ED2 will trigger substantial network reinforcement. EQUINOX will trial commercial arrangements over the coming winter periods that enables WPD to unlock flexibility from heat in the latter years of ED2 and thus defer substantial reinforcement. The deployment of HPs will continue throughout ED3. The completion of EQUINOX by the end of 2025, will provide valuable input to WPD's ED3 business planning[33].

A recent study 'Flexibility in Great Britain'[34] from Imperial College and the Carbon Trust reinforces the importance of flexibility. The study highlights that "Investing in flexibility is a no-regrets decision as it delivers material net savings of up to £16.7bn/year across all net zero scenarios analysed in 2050". To achieve these benefits DNOs will need to play a key role in unlocking the value from flexibility of residential low carbon heat.

> "Consumer flexibility is relatively nascent, but the rollout of new technologies provides opportunities for growth. Today, industrial and commercial consumers are already providing demand side flexibility. Participation from domestic and smaller consumers remains at an early stage."
>
> [Smart System and Flexibility Plan, Ofgem & BEIS July 2021]

Over recent years, DNOs have launched several innovation projects that set the foundation for EQUINOX. Several projects are conducting desktops studies on the flexibility from low carbon heat e.g., Peak Heat & CrowdFlex. Several projects have explored commercial models for unlocking domestic flexibility, specifically from EVs, e.g., Shift &, Electric Nation. Several projects have explored engagement with fuel poor and vulnerable customers. However, no prior study has addressed how DNOs can unlock the flexibility from low carbon heat. A primary reason for this is that only recently has the decarbonisation of heat become a pressing topic on government agenda and thus, new policies are expected in the form of the Heat & Buildings strategy, which will likely stimulate the market and accelerate the adoption of LCTs.

The relevance of EQUINOX to other DNOs is evidenced by the additional letters of support for EQUINOX received by peer DNOs – see Appendix 10.9. Letters of Support.

[32] ENA, Energy Network Innovation Strategy, 2020

[33] Addresses Ofgem Q1 & 3 from ISP feedback – see Appendix 10.8

[34] Imperial College London & ICL, Flexibility in Great Britain, 2021

5. Knowledge dissemination

WPD and the EQUINOX Project Partners will conform to the default NIC IPR arrangements.

Dissemination of learning is fundamental to the success of EQUINOX. The project aims to inform how DNOs in GB can unlock flexibility from low carbon heat in an equitable manner for all customers. Through large scale trials, EQUINOX will build evidence to support DNOs plan and operate their network cost efficiently throughout the energy transition. The learning from EQUINOX will be valuable to several other stakeholders such as energy suppliers, aggregators, policy makers, technology providers, and customers who all have a stake in decarbonising heat in a cost-efficient manner.

The project has been planned and structured to ensure learning is maximised through an agile and iterative trial approach. This approach enables learning from early trials to be adopted in future trials and continued improvement and convergence to a BaU ready solution[35].

The scalability of learning is considered through the range of customer types considered in the trial. Working with our Project Partners, we will ensure that a broad range of customers are included to avoid the learning only being applicable to a small portion of the GB population.

5.1. Learning Generated

EQUINOX will develop incremental learning across three main topics: 1) decarbonisation of heat, 2) collaboration & coordination between energy suppliers & DNOs, 3) domestic demand side flexibility. The core objective is to learn how DNOs can plan and operate distribution networks as cost efficiently as possible in a system with a high penetration of low carbon heating. EQUINOX will gather feedback and learning from customers throughout the project trials. This feedback will be considered in consequent EQUINOX trials, thus maximising the learning from the project.

EQUINOX will generate new insights applicable to all DNOs by answering the following:

Ref	Questions
#1	**Flexibility Potential:** How much flexibility can be unlocked from residential low carbon heating? At what cost and reliability to the DNO? At what comfort, convenience, and control levels for the customer? What is the impact of different building characteristics, technologies, commercial arrangements, and control strategies on this flexibility? How does procuring domestic flexibility across a local portfolio of homes, enhance the value of domestic flexibility to the DNO?"
#2	**Behavioural Response:** What is the behavioural response from residential customers under each of the proposed methods and how can DNOs and energy suppliers facilitate markets for flexibility to minimise customer bills?
#3	**Technical Integration:** What technical integration and automation is required to deliver a seamless customer experience?

[35] Addresses Ofgem Q3 from ISP feedback – see Appendix 10.8

#4	**Market Design and Participation:** How can DNOs, energy suppliers, and the ESO align their objectives to participate in DNO flexibility markets?
#5	**Just Transition:** How do DNOs ensure that fuel poor and vulnerable customers have an equal opportunity to participate in flexibility services?

The project will answer these questions through the project design and trials phases. The project will involve key stakeholders in the design phase to ensure maximum alignment with their requirements. Throughout the project trials, trial participants will have opportunities to provide feedback on their experiences. Where possible, this feedback will be considered in the recommendations for future flexibility propositions.

The learning from the trials will inform DNOs as to how they can rely on flexibility from electric heat in future years, thus enabling DNOs to consider deferring network reinforcement.

Table 7. Summary of learnings and recommendations from previous innovation projects, studies, and documents - highlighting where and how EQUINOX and generate additional learnings.

Project	Lead	Learnings and recommendations
The Electrification of Heat Demonstration Project by ESC, Delta-EE, Oxford Computer Consultants	Energy Systems Catapult (ESC)	• Need to target specific challenges arising from vulnerable customers to ensure HP satisfaction • Expand practical and technical feasibility of HPs to include BaU flexibility requirements for load balancing
Freedom – hybrid heating trial to get a better understanding of hybrid heat pumps	WPD	• Operating cost savings were unsatisfactory, confusion over how customers understand bills • Explore best-practice customer communication to ensure diverse range of end-users feel in control • Provide consumer-focused flexibility solutions irrespective of demand size
Smart Systems and Heat Phase II – trials (100 homes) to understand how consumers use heat for local area energy planning	Energy Systems Catapult (ESC)	• Trial confirmed complexity, cost, and challenges of building understanding of environment, consumer needs, and behaviour – new propositions and technologies need testing in mainstream consumer homes • Results suggest the creation of a large-scale trial environment in mainstream consumers' homes will be a major national asset for innovators and business as well as informing UK heat decarbonisation strategy
NINES – smart grid creation including renewable generation, heat storage, battery and active network management	Scottish and Southern Electricity Networks	• Cost of communications and support service to the consumer is not sustainable – order of magnitude reduction required • For private individuals, the effort per sale and slow rate of recruitment made DSM non-viable • Driving down underlying fixed costs is key to make small-scale DSR economical

Energywise – energy efficiency trial testing TOU tariffs specifically targeting customers vulnerable to fuel poverty	UKPN	• Technology development should be separated from proposition trialling – innovative value propositions can be negatively impacted by technologies not working as they should • Technical problems with installations or the complexity of multiple equipment requirements was a top reason for disengagement in the project • For low-income customers, better visibility of energy savings and simplicity of top-up are key requirements to make these solutions attractive
SAVE – trial to understand which DSR measures are cost-effective, predictable, and sustainable when managing peak household demand	Scottish and Southern Electricity Networks	• Future trials should look to understand load-shifting capabilities as peak change from outside the traditional evening peak period • Significant improvements can be made in recruitment rates through having trained and experienced staff and easy-to-install kit • DNOs should look to partner with trusted local organisations to maximise impact of domestic DSR initiatives • In BaU roll-out of price signals it is advised that any engagement material gives a clear 'how' and 'why' in order to maximise customer response
CrowdFlex – desktop study to understand domestic flexibility potential across various LCTs	National Grid ESO	• Recommends practical trials to test key assumptions and show flexibility provision • Better understanding required of how customers use these LCTs today, how usage patterns differ between customer types and how these will evolve
4D Heat – Desk based study exploring flexibility using domestic heat to address wind constraints	Scottish and Southern Electricity Networks	• Domestic heat market would benefit from further empirical demonstration identifying real-life barriers – not shown in desk-based reviews • Real world trial needed to test customer impact of engaging with new heat service • Further understanding is needed of market maturation effects caused by diversity in customer behaviour
Re-Heat - Technical trial of storage in conjunction with smart control & HPs	SP Energy Networks	• Small scale trial (150 off-gas grid homes) focussing specifically on flexibility provided by smart controls and thermal storage
Smart systems and flexibility plan 2021	Ofgem & BEIS	• By 2050 UK will need around 60GW of total flexibility – Up to 30GW of DSR • Substantial untapped potential for flexibility from flexible use of HPs

	• Understanding is needed of how energy retail market can deliver innovative tariffs and products that work for consumers and contribute to net zero • By the mid 2020s: Consumers of all sizes should be able to provide flexibility to the system. Consumers Including those on low income and in vulnerable circumstances) will have the opportunity to benefit from smart energy products

5.2. Learning Dissemination

The project has dedicated a workstream to project management & knowledge dissemination. Learning will be disseminated at key phases in the project. To increase the likelihood of the EQUINOX learning informing a successful BaU transition to WPD and peer DNOs, EQUINOX will involve BaU stakeholders from WPD's Network Strategy team in the trial design as part of Workstream 4. The Deliverables, described in Section 9, aim to share learning at the earliest possible opportunity to ensure stakeholders can consider the learning for future planning. Project learning will be shared using the following channels:

Dissemination	Description
Project Deliverables	• The project deliverables will aim to comply with the key evidence criteria set out in Section 9. They will be in the format of a report and will be published on WPD's website and the ENA's Smarter Networks Portal
Six monthly Progress Reports	• Six monthly progress reports will be produced to share project progress. These reports will align with Ofgem's NIC governance requirement to produce annual progress reports. The reports will be published on WPD's website and the ENA's Smarter Networks Portal
Close down report	• Upon successful project completion, WPD will produce a close report. The report will align with Ofgem's NIC governance and will be published on WPD's website and the ENA's Smarter Networks Portal that
Industry presentations	• The project learning will be disseminated through presentations and bi-lateral discussions at the annual ENIC conference • EQUINOX will target relevant additional conferences e.g., Utility Week, IET to share learnings
Townhall events	• Working together with the Welsh Government, EQUINOX will host several townhall events to share learning with external stakeholders
Innovation showcase conference	• EQUINOX will share learning at WPD's Bi-Annual Innovation Showcase conference
Social media	• Working with our consortium of expert Project Partners EQUINOX will share learning by releasing blogs and insights through various social media channels e.g., LinkedIn, Twitter, & podcasts

An overview of the EQUINOX learning dissemination events and products is provided in Figure 8.

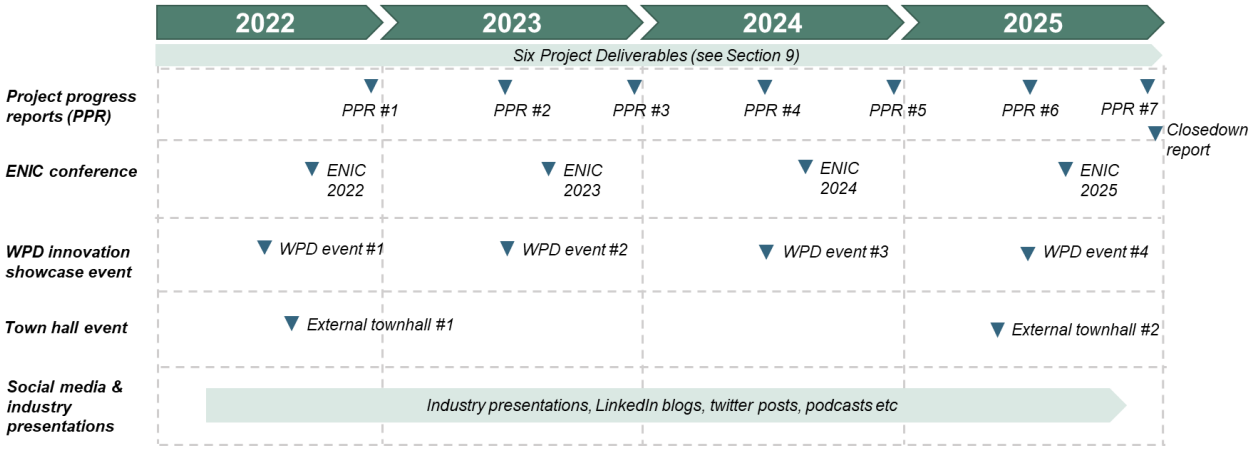

Figure 8. High-level learning and dissemination products & events

In addition to the above events, EQUINOX will share learning with the ENA's Open Network Project. Where insights or learning from Open Networks are relevant to EQUINOX, we will incorporate these as appropriate in the EQUINOX solution and trial designs.

Applicability of new learning to other DNOs

By partnering with SP Energy Networks, EQUINOX we ensure that the solutions developed and trialled are applicable to all other DNOs. EQUINOX leverages WPD's Flexible Power platform, that is used by five out of six DNOs, therefore any learning from using this platform can be easily transferred to peer DNOs. By including multiple energy suppliers within the trials, we ensure that the solutions developed are scalable beyond one individual energy supplier. The relevance of EQUINOX to other DNOs is evidenced by the additional letters of support for EQUINOX received by peer DNOs.[36]

5.3. IPR

WPD and the EQUINOX Project Partners will conform with the default IPR requirements as set out in the NIC Governance Document v3.0. In addition, WPD will require any additional project suppliers to conform with NIC governance.

All bi-lateral contracts between WPD and the EQUINOX Project Partners will clearly capture the default IPR requirements set out in the NIC governance. In each of these contracts, Project Partners will be requested to document their background IP that will remain within their control following project completion. Any relevant Foreground IP developed jointly by WPD and Project Partners for the purpose of EQUINOX will be jointly owned by WPD and the Project Partner and will be shared with all Network Licensees.

5.4. Data sharing

As part of Workstream 4, EQUINOX will develop a detailed data sharing strategy and procedure. The strategy and procedures will be developed in collaboration with WPD's subject matter experts and aim to ensure easy data sharing. The strategy and procedures will align with WPD's Data Protection Policy and maintain compliance with the EU's General Data Protection Regulations (GDPR).

[36] Addresses Ofgem Q3 from ISP feedback – see Appendix 10.8

6. Project readiness

The following Section demonstrates that WPD and the Project Partners are ready to deliver EQUINOX to the project budget, scope, and schedule described in this FSP. The Section will cover:

- Evidence that EQUINOX can start in a timely manner;
- Measures that WPD and Project Partners have already employed and will employ throughout the project to minimise the possibility of cost overruns or shortfalls in Direct Benefits;
- Measures that have been put in place to verify information contained in the proposal;
- Measures to ensure learning can be obtained in the event of a lower than anticipated uptake of LCTs in the Trial area; and
- Processes in place to identify circumstances where the most appropriate course of action will be to suspend the Project.

6.1 Evidence of why the Project can start in a timely manner

WPD and the EQUINOX Project Partners are confident that the project can start in a timely manner for several reasons:

- Robust project planning during the development of the FSP;
- Confidence and commitment from Project Partners that EQUINOX can recruit trial customers in a timely manner and achieve the scale, and diversity of customers required to maximise learning;
- Clear governance and project structure;
- Strong support from Senior Management at WPD;
- Experienced and committed Project Partners; and
- Partnership arrangements between Project Partners have been reviewed during FSP preparations.

6.1.1 Robust project planning during the development of the FSP

In preparation of the FSP, WPD and the Project Partners have collaborated to develop a detailed project delivery plan for EQUINOX. The project plan considered the extensive experience and learning of WPD and Project Partners in delivering NIC innovation projects. The plan accounts for a mobilisation period following the successful award of the project. During this period, key resources will be onboarded, and contracts will be signed enabling a full commitment from resources involved from March 2022. A high-level project plan is provided in Figure 9 and a detailed Microsoft Office project plan is available in Appendix 10.5. Project plan

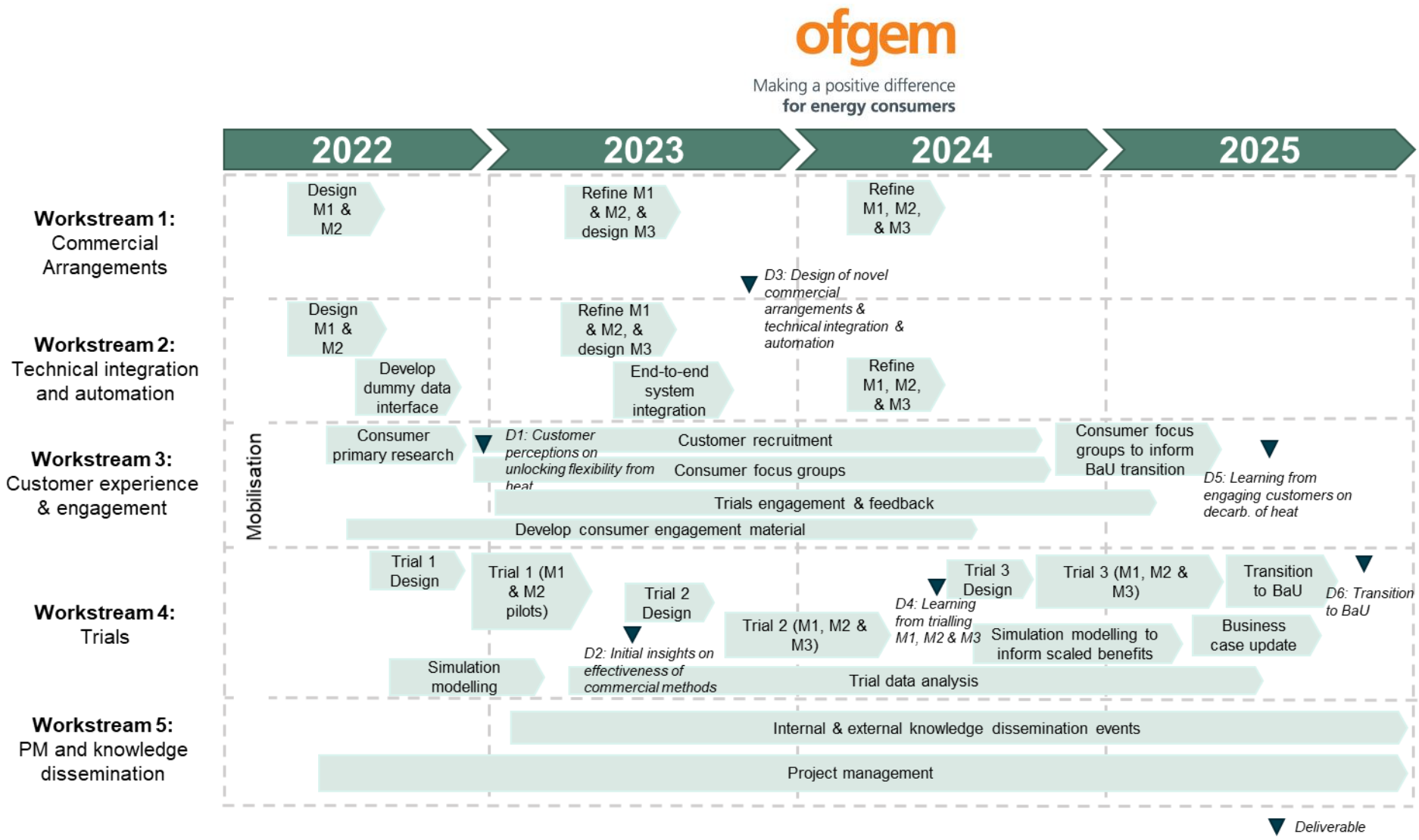

Figure 9. High-level project timeline

6.1.2 Project structure and governance

In the process of developing the EQUINOX FSP, WPD has developed a clear project delivery and team structure to ensure appropriate governance throughout project delivery. This delivery and team structure has been informed by prior experience in delivering NIC project to scope, budget, and schedule, and discussed with Project Partners. The project will be delivered via five workstreams:

- Workstream 1 – Commercial arrangements design
- Workstream 2 – Technical integration and automation design & implementation
- Workstream 3 – Customer engagement and experience
- Workstream 4 – Trials
- Workstream 5 – Project management & knowledge dissemination

In determining the project team delivery structure and associated governance, WPD aims to leverage the strengths of the Project Partners. Figure 10 shows the EQUINOX team delivery structure.

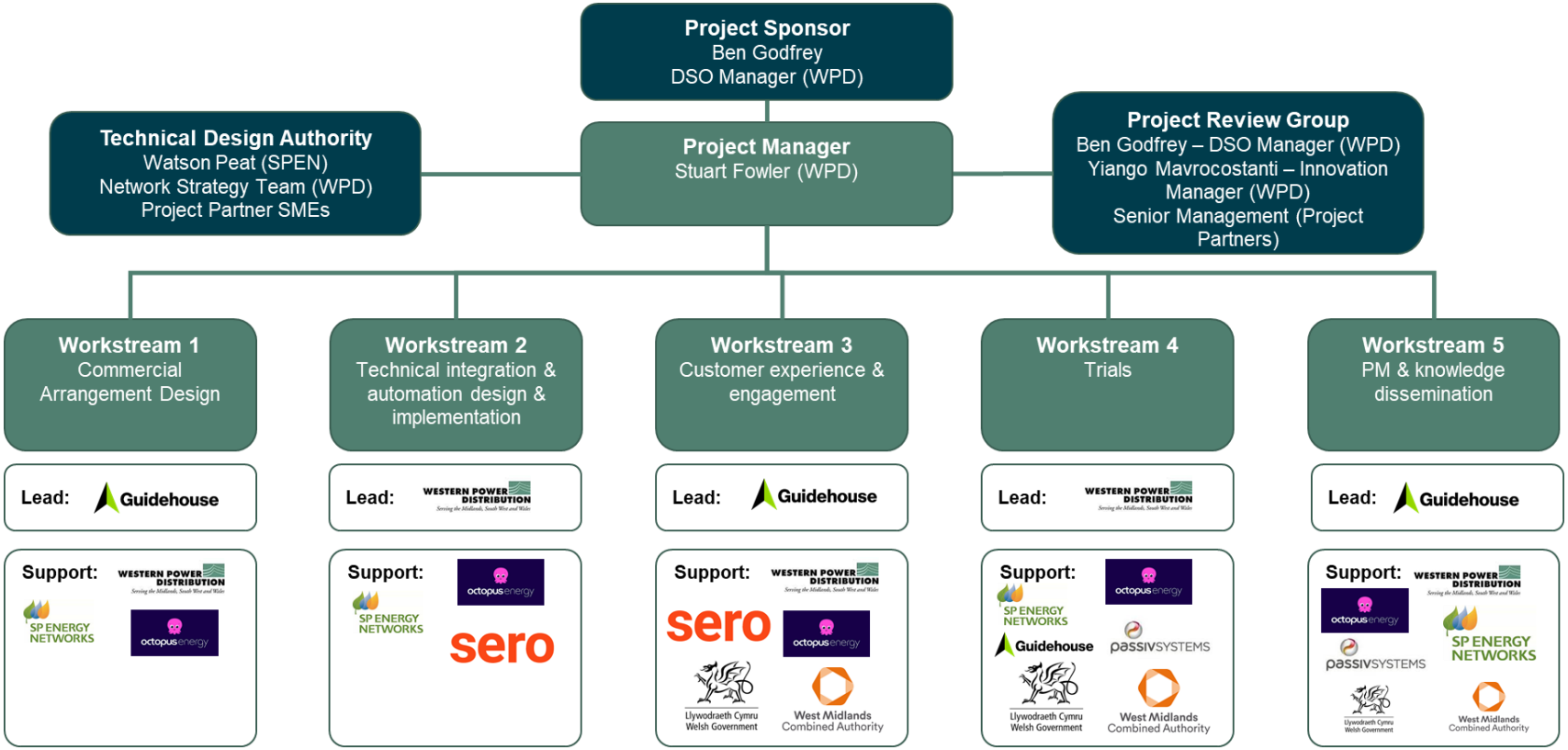

Figure 10. Project organogram

The following Section explains the roles and responsibilities of the key roles and teams (Project Sponsor, Project Review Group, Technical Design Authority, Project Manager, and Workstream Leads).

- **Project Sponsor (DSO Manager – Ben Godfrey)** The Project Sponsor ensures that the Project Manager and Project Review Group receive appropriate support from WPD to deliver the project. The Project Sponsor will act as the Chair for the Project Review Group.
- **Project Review Group:** comprises senior stakeholders within WPD and external advisors, who will support with critical decision-making. The group is ultimately responsible for the Project and will support the Project Manager as a point of escalation for project decisions that impact the project direction.
- **Technical Design Authority (Composition):** responsible for reviewing and approving the final EQUINOX Deliverables and ensuring the solutions consider the scalable roll out of the solutions post trials.
- **Project Manager (WPD – Stuart Fowler):** responsible for the managing scope, schedule and budget of EQUINOX on a day-to-day basis, and coordinating across workstreams and Project Partners to ensure efficient and effective project delivery They are responsible for monitoring and reporting progress, budget, risks & issues and mitigation plans to the Project Review Group on a quarterly basis.
- **Workstream Leads:** responsible for the successful delivery of the Deliverables set out across each workstream. They are responsible for the management of the budget, scope, and schedule of the workstream and ensuring any risks or issues are documented and reported to the Project Manager for escalation if necessary.

Throughout project delivery EQUINOX will schedule the following meetings to ensure appropriate governance:

Quarterly Project Review Group meetings to provide a health status (progress against plan, risks, issues, mitigation & contingency plans, and budget) update to the Progress Review Group. Point of escalation for any unresolved issues and risks that require input or support from senior stakeholders.

Monthly Project Partner consortium team meetings to review project progress against plan, discuss project interdependencies, share learning, and discuss risks, issues, mitigation plans and contingency plans. This meeting includes all Project Partners.

Weekly bi-lateral WPD and Project Partner and Project Supplier meetings to review Partner and Supplier progress, risks, issues, budget, and focus for the week ahead. This meeting is a bi-lateral meeting between WPD and individual Project Partners.

If unanticipated risks or issues arise that required immediate Project Review Group input, the Project Manager will escalate these to Project Review Group members for immediate attention and support.

In addition, EQUINOX plans to keep Ofgem's nominated project officer updated of project progress, risks, issues, and mitigation plans on a regular basis through a quarterly progress update meeting.

6.1.3 Strong support from Senior Management at WPD

Senior Management including WPD's Director of Operations, DSO Manager, Electricity System Manager have been involved throughout the ideation of EQUINOX, through to the ISP and FSP. They are committed to the successful delivery of EQUINOX and will support the project in their respective roles in the Progress Review Group. WPD's Head of Network Strategy is committed to seconding existing BaU resource onto EQUINOX to maximise the chances of a smooth transition of EQUINOX to BaU.

6.1.4 Experienced and committed Project Partners

WPD has extensive experience in successfully delivering large scale innovation projects. Several of WPDs prior projects e.g. ENTIRE have successfully informed the rolled out of BaU solutions within WPD and peer DNOs resulting in measurable benefits to GB customers.

During the ISP preparation, WPD carefully evaluated the need for Project Partners and conducted several discussions with organisation before building a consortium of Project Partners that have relevant experience and drive to support EQUINOX.

The consortium of Project Partners has strong existing relationships from past projects e.g., Freedom, Future Flex etc, therefore can leverage these to successfully deliver EQUINOX. Each of the Project Partners has a strong vested interest in project delivery and senior management have committed their role in the project.

6.1.5 Partnership arrangements between Project Partners have been reviewed during FSP preparations.

Learning from prior Ofgem innovation projects has highlighted the importance of early alignment on commercial and contracts with Project Partners. As part of the FSP preparation, WPD has engaged with each of the Project Partners to review and discuss the commercial and contractual arrangements. These early discussions enable WPD and Project Partners to address any concerns during the FSP preparation and finalise the contracts in a timely manner following the successful project award.

6.2 Evidence of the measures a Network Licensee will employ to minimise the possibility of cost overruns or shortfalls in Direct Benefits

The preparation of the FSP followed WPD's robust governance process to minimise unanticipated financial risks occurring during project delivery. WPD has extensive experience in delivering innovation projects without cost overruns and shortfalls in Direct Benefits and will apply the same measures to EQUINOX.

To mitigate the potential for cost overruns and shortfalls in Direct Benefits, WPD thoroughly reviewed the project budget and benefits, and used conservative assumptions during the preparation of the FSP. In addition, WPD conducted sensitivity analysis on key assumptions as shown in Appendix 10.6, and stress tested the approach with WPD's experts. WPD received input from Project Partners, innovation experts and WPD's senior management to confirm that all anticipated costs and benefits had been considered. In addition, WPD identified risks that could impact project costs or Direct Benefits and developed mitigation plans to reduce the likelihood and/or impact of these risks materialising. These risks and mitigation plans can be reviewed in Appendix 10.6. Risk register & contingency plan

During project delivery, WPD will:

- Use tools to track and report on project key performance indicators (KPIs), including costs, budgets & forecasts on a monthly basis and assess any deviations from the planned budget;
- Conduct weekly reviews of risks through Project Partner bi-lateral weekly review meetings and Project Partner consortium review meetings to:
    - Assess existing risks and update mitigation plans;
    - Assess existing issues and update contingency action plans;
    - Identify new risks and issues and apply appropriate mitigation and contingency action plans;
- Escalate significant risks and issues to the Project Review Group to ensure senior management support in implementing mitigation measures;
- Apply appropriate controls and procurement processes for any project costs to ensure any costs achieve maximum value for GB customers;
- Apply thorough review and quality assurance processes to ensure Deliverables meet or exceed the Deliverable evidence criteria set out in Section 9; and
- Apply change management controls to ensure any changes to scope, schedule or budget follow appropriate authorisations and align with WPDs Governance Guidelines.

6.3 A verification of all information included in the proposal (the processes a Network Licensee has in place to ensure the accuracy of information can be detailed in the appendices)

WPD and the EQUINOX Project Partners have endeavoured to ensure that the information contained within the FSP is accurate. This has been achieved through the following:

- Thorough review of the FSP by WPD senior managers and engineers
- Thorough review of the FSP by Project Partners
- Clear referencing and scrutiny of external documents and information used in the FSP
- Clearly documenting any assumptions and justifications used within the FSP
- Extensive review of information and data impacting the project business case

During the project, WPD and the Project Partners will continue to apply the same rigour when using information to design, develop and trial the solutions.

6.4 How the project plan would still deliver learning in the event that the take up of low carbon technologies and renewable energy in the Trial area is lower than anticipated in the Full Submission

The need for EQUINOX is driven by the substantial increase in LCTs, specifically HPs, that are anticipated to be installed across WPD's licence areas. WPD forecasts that approximately 600,000 HPs will be installed across WPD's network between 2023 and 2028. These forecasts have considered the Government's target of installing 600,000 HPs per year by 2028. To date, WPD has approximately, 20,000 HPs installed across its networks. The rate at which further HPs are installed will continue to depend on government policy and stimulus. WPD anticipates that the governments Heat and Buildings Strategy will help inform the uptake of low carbon heating

technologies and thus influence the longer-term benefits of EQUINOX. Appendix 10.2. Project Business Case Modelling provides insights on how the forecast deployment of HPs impacts the future benefits of EQUINOX.

The scale of the EQUINOX trials is vital to demonstrate the breadth of learning across a range of novel commercial arrangements, customer segments and properties, while maintaining confidence in the relevance and applicability of findings for BaU.

By 2023, **WPD expects 265,000 customers** to have HPs installed in their homes. EQUINOX seeks to enrol 800 - 1,000 trial participants by 2023, or about **0.4% of total customers.** This enables EQUINOX to trial a range of solutions with a diverse customer group and achieve scalable learning outcomes**.** The following evidence provides confidence that EQUINOX can achieve the minimum scale required to deliver scalable learning outcomes and will likely exceed the number of trial participants:

- Based on **Octopus Energy's** existing number of customers with heating assets e.g. HPs in WPD's licence areas, future installations, expected recruitment rate, Octopus Energy is confident of recruiting at least **500 customers** by the end of 2022.
- **Welsh Government and Sero** are implementing a large-scale decarbonisation "Optimised Retrofit" programme with 2,000 homes having works completed prior to 21/22 winter and an estimated 5,000 homes prior to 22/23 winter, the majority including heating assets. These are in addition to Sero's project pipeline of 750 new homes constructed in the same period. Leveraging this "Optimised Retrofit" programme and Sero's new build homes as a platform for recruiting trial participants, Project Partners are confident in easily exceeding **500 customer** trial participants through this channel. This accounts for conservative recruitment rates of participants.
- **WMCA** have committed to retrofitting 100 to 200 homes with heating assets through their Net Zero Neighbourhood programme. Leveraging this programme to recruit trial participants, our Project Partners are confident that at least **75 customers** can be recruited onto the EQUINOX trials. This assumes similar recruitment rates as above.
- WPD is in advanced discussions with several **additional suppliers** (incl. Scottish Power Retail) who have shown interest in participating in the EQUINOX with **several hundreds** of their customers. Participation from additional suppliers not only demonstrates scalability of the project, but also provides additional opportunities to achieve the scale required if any of the above categories falls short of expectations.

If during the course of the project, significantly higher number of customers want to participate in the trials, WPD will consider how this can be achieved while maintaining the focus on high quality customer service and remaining within the project budget.

In the unlikely event that no additional HPs are installed and recruited onto the trial through WMCA's Net Zero Neighbourhood Programme or Welsh Government's "Optimised Retrofit" programme. EQUINOX would expend additional effort to engage with more energy suppliers providing electricity to the 265,000 HPs expected to be connected to WPD's network.

If the project only achieves the estimated 500 trial participants from Octopus Energy's customers. Reducing the diversity and scale of trial participants may reduce the statistical validity of the trial results and applicability of the learning across WPDs license areas. There is no doubt that trialling the commercial arrangements with 500 customers will deliver valuable learning that aligns with the Project Deliverables, however the future roll out of the EQUINOX may face additional challenges due to the lack of diversity and scale at which the solutions have been tested and trialled.

6.5 The processes in place to identify circumstances where the most appropriate course of action will be to suspend the Project, pending permission from Ofgem that it can be halted

EQUINOX will apply WPDs Project Governance Guidelines throughout delivery. Any risks or issues to the project will be identified and assessed at various stages of governance described in Section 6.1.2.

During Project Review Group meetings, described in Section 6.1.2, the EQUINOX Project Manager will present the health of the project using WPD's Delivery Confidence Assessment framework below:

Status	Criteria Description
Green	Successful delivery of the project to time, cost and quality appears highly likely and there are no major outstanding issues that at this stage appear to threaten successful delivery.
Green/Amber	Successful delivery appears probable however constant attention will be needed to ensure risks do not materialize into major issues threatening delivery.
Amber	Successful delivery appears feasible but significant issues already exist requiring management attention. These appear resolvable at this stage and if addressed promptly, should not present a cost/schedule overrun.
Amber/Red	Successful delivery of the project is in doubt with major risks or issues apparent in several key areas. Urgent action is needed to ensure these are addresses, and whether resolution is feasible. At this point, raise to Ofgem.
Red	Successful delivery of the project appears to be unachievable. There are major issues on project definition, schedule, budget, required quality or benefits delivery, which at this stage do not appear to be manageable or resolvable. The project/programme may need rebaselining and or/overall viability reassessed.

This assessment will then provide the project team recommended actions. Actions fall in the following categories:

Critical (Do Now): to increase the likelihood of a successful outcome, it is of the greatest importance that the project should take action immediately;

Essential (Do By): to increase the likelihood of a successful outcome, the project should take action in the near future. Whenever possible, essential recommendations should be linked to project milestones and/or a specified timeframe;

Recommended: the project would benefit from the uptake of this recommendation. If possible actions should be linked to project milestones and/or a specified timeframe; and

Halt the project: the project has exceeded the tolerances set and agreed at project initiation and the situation is deemed to be irrecoverable. WPD senior management will contact Ofgem to discuss the suspension of the project and highlight lessons learned.

7. Regulatory issues

No derogation, licence consent, licence exemption or a change to the current regulatory arrangements are needed to implement the Project.

WPD recognises that over the coming years updates to strategy, policy and regulation e.g. Heat and Buildings Strategy, Access and Forward-looking Charges Significant Code review, transition to ED2 are needed to support the transition to a low carbon energy system at the lowest cost for customers. Throughout the project, WPD and the Project Partners will review any changes to government strategy, policy or regulation to determine the impact of it on EQUINOX.

The project plan follows an iterative design and trial approach that enables customer feedback to be incorporated in future iterations of the design and trials. This approach also provides flexibility to adjust the design and trials to accommodate any significant policy or regulatory changes that would impact the BaU transition of EQUINOX.

Should any regulatory or policy issues arise during project delivery, these will be discussed with Ofgem prior to any decision-making. If any changes to regulation is required to enhance the roll out of EQUINOX, this will be clearly highlighted in any Project Progress Reports or Close Down Reports.

8. Customer impact

WPD's residential customers are at the heart of EQUINOX and therefore interaction with customers will be a key part of the project. Any customer interaction will be carefully designed with customers at the heart of communication or interaction. The EQUINOX Project Partners have extensive experience in positive customer engagement. Coordination of communication with customers will be vital throughout EQUINOX, to avoid any mixed or conflicting messaging.

Customers will be engaged at various phases of the project for differing reasons.

Retrofit of existing customers with electric heating solutions & controls

EQUINOX will leverage funding from the Welsh Government through the ORP 2, and WMCA's net zero neighbourhood programme to fund additional HPs, thermal storage and monitoring and controls for a range of customers. EQUINOX will work closely with the Welsh Government's and WMCA's chosen delivery contractors who will be responsible for the installation of equipment and controls within customer homes. WPD will work closely with the delivery contractors to ensure that any electricity network challenges can be resolved in the timely manner.

Customer trial recruitment

EQUINOX will require customer participation for trialling the commercial arrangements. Any energy supplier wanting to participate in the EQUINOX trials will need to recruit customers onto the trial. Octopus Energy will use a range of communications methods to recruit existing customers onto the EQUINOX trials. To incentivise customers to participate in the innovation trials, customers will receive financial incentives at various stages throughout the trial process. To avoid customer dropouts and ensure participation in customer focus groups and surveys, EQUINOX will stagger any incentive payments.

Additional monitoring and controls for existing Octopus Energy customers that want to participate in the trials

To gather the required in-home data for the EQUINOX trials, Octopus Energy may need to install additional monitoring or controls within the premise of customers that already have electric heating.

Participation in primary research

A key element of EQUINOX is understanding customer perceptions to electric heating and providing domestic flexibility. During our primary research, our research agencies will engage with a range of customers to understand the perceived enablers and barriers of electric heating and flexibility from heat. To ensure diversity across the customers, our research agencies will use a range of communication methods to extract information through quantitative and qualitative means.

Participation from trial participants in customer focus groups, surveys, and bi-lateral interviews

Trial participants will be engaged at various stages of the EQUINOX trials. Initially, customers will be able to provide feedback on the trial design and commercial arrangements. Throughout the three winter trials, customers will be engaged through a range of mechanisms, enabling them to provide feedback on their experiences. At any point throughout the trials, customers can request to withdraw from the trials to avoid any perceived negative experience.

Trial participation

The EQUINOX trials aim to enrol between 800 – 1000 customers covering a diverse range of customers segments including fuel poor and vulnerable customers. This scale of participants enables EQUINOX to test and trial a range of solutions while delivering learning outcomes that are statically relevant and can be applied at scale following project completionF, without the need for additional project trials. Prior to any trials beginning, customers will be informed about the trial objectives, learning outcomes, and potential benefits of EQUINOX. Customers will be informed about how they can raise any questions or concerns during any of the trial periods. In addition, EQUINOX will validate any controls and data collection in advance of the live trials commencing. In the unlikely event that any controls malfunction, signals are lost, or data is no longer captured, the EQUINOX partners will follow a troubleshooting procedure, that will be developed during the project, to identify the cause of the issue. Depending on the cause, the relevant Project Partner or supplier will be mobilised to resolve the issue as soon as possible to minimise any negative experiences and to maximise trial participation.

During the trial design, EQUINOX will determine thresholds within which flexibility can be provided to avoid customers putting themselves at risk by setting unhealthy living conditions.

Throughout the trials, EQUINOX will trial varying commercial arrangements that incentivise customers to provide flexibility from their electric heating solution, while maintaining comfort within the home. EQUINOX aims to understand 'real' customer behaviour resulting from the commercial arrangements therefore will aim to reflect the upside and downside financial potential throughout the trial. As a result, depending on the engagement throughout the trial period, customers could receive varying amounts of money. EQUINOX will ensure that at no point, customers would be worse off financially from their energy bills because of participating in the EQUINOX trials.

Customer privacy and data protection

Customer privacy and data protection will be paramount within EQUINOX. As part of the trial design, WPD will work closely with Project Partners to determine the strategies and procedures to minimise the likelihood and impact or any customer data breaches. These procedures will align with WPD's Data Protection Policy and the EU's General Data Protection Regulations.

No sales & marketing

The Partners will not visit any premises of any Relevant Customer for sales or marketing activities in connection with, in the context of, or otherwise under the guise of the Project.

No lock-in to energy suppliers or technology providers

Following trial completion, customers will be open to selecting alternative energy suppliers and/or technology providers to enable access to the EQUINOX commercial Arrangements.

Ensuring a postive customer experience for trial participants is crucial for EQUINOX. Working with local Project Partners e.g. Welsh Government and WMCA, we believe that we can provide an improved customer experience that accounts for any local challenges customer may face. The customer engagement approach will be designed to ensure customers can provide feedback at any stage throughout the project. In the event that customers perceive to have a negative experience, the EQUINOX Partners will engage with customers to understand the experience and explore options to rectify any root causes to the issue. A formal process of escalation will be design, that holds WPD ultimately accountable for any experiences throughout the project.

We don't anticipate any supply interruptions or changes in charging arrangements because of the project.

9. Project deliverables

Sharing the learning from designing and trialling novel commercial arrangements to unlock flexibility from low carbon heat is key to EQUINOX. The Deliverables are designed to share critical knowledge that enables stakeholders to learn from the project and conceptually implement successfully proven commercial arrangements following trials. The project plan and Deliverable schedule aims to share as early as possible throughout the project, allowing stakeholders to consider these learnings promptly[37].

All Deliverables will follow a rigorous internal quality assurance process that includes a peer review by SP Energy Networks.

Following final approvals, the Deliverables will be issued to Ofgem, published on WDP's website and the ENA Smarter Networks Portal.

In accordance with Ofgem's Electricity Network Innovation Competition Governance Document version 3.0 clause 8.82. WPD will commission a report from an independent third party that verifies whether the Project Deliverables have been achieved.

Reference	Project Deliverable	Deadline	Evidence	NIC funding request (%, must add to 100%)
1	Customer perceptions on unlocking flexibility from heat [WS3]	Dec 2022	A report containing: • Insights from customer surveys and customer focus groups on the barriers and enablers for unlocking flexibility from heat	10%
2	Initial insights on effectiveness of commercial methods [WS1 & WS4]	Jul 2023	A report containing: • An overview of theoretical flexibility simulation modelling based on 'digital twin' housing archetypes • Analysis and learning from early trial data to understand the impact of commercial methods and control on flexibility outcomes	15%

[37] Addresses Ofgem Q1 & 3 from ISP feedback – see Appendix 10.8

Reference	Project Deliverable	Deadline	Evidence	NIC funding request (%, must add to 100%)
3	Design of novel commercial methods & technical integration [WS1 & WS2]	Nov 2023	A report containing: • An overview of the novel commercial arrangements (M1, M2, & M3), including: requirements, commercial heads of terms with suppliers and customers • An overview of the technical integration between DNO, suppliers, in-home automation, and customers including: solution requirements and specifications (DNO, supplier, & customer) high-level architecture, test plans, and test results. • An overview of learning from designing, developing and testing the novel methods in collaboration with Project Partners and customers.	15%
4	Learning from trialling novel commercial methods [WS4]	Aug 2024	A report containing: • An overview of the commercial terms for DNOs, energy suppliers and customers. • An overview of learning from trialling the range of novel commercial method • An overview of the customer experience during the trials based on customer feedback • An overview of the simulated network impact throughout the trial flexibility events	25%

Reference	Project Deliverable	Deadline	Evidence	NIC funding request (%, must add to 100%)
5	Learning from engaging customers on the barriers & enablers of the electrifications of heat and unlocking domestic flexibility [WS3]	Aug 2025	A report containing: • Lessons learned from engaging with customers on the electrification of heat • Lessons learned on enabling equal opportunities and benefits for fuel poor and vulnerable customers • Recommendations on the role of DNOs in customer engagement	10%
6	Recommended transition of learning to BaU [WS4]	Dec 2025	A report detailing: • Updates to flexibility simulation models using trial data • A description of the recommended commercial arrangements, procurement strategy and technical integration to unlock maximum flexibility from domestic customers • An overview of any regulatory or policy change needed to enable efficient roll out • An update of the project business case that considers project learning	25%
[Note this is a common Project Deliverable to be included by all Network Licensees as drafted below]				

Reference	Project Deliverable	Deadline	Evidence	NIC funding request (%, must add to 100%)
N/A	Comply with knowledge transfer requirements of the Governance Document.	End of Project	1. Annual Project Progress Reports which comply with the requirements of the Governance Document. 2. Completed Close Down Report which complies with the requirements of the Governance Document. 3. Evidence of attendance and participation in the Annual Conference as described in the Governance Document.	N/A

10. Appendices

The Appendix consists of the following sections:

- **Appendix 10.1 – Benefits Tables** – forecast of benefits resulting from the Methods
- **Appendix 10.2 – Project Business Case Modelling** – description of the methodology used in Section 3: Project business case
- **Appendix 10.3 – Detailed Business Case Assumptions** – description of assumptions used in Section 3: Project business case
- **Appendix 10.4 – Technical Description of the Project** – further details of the solutions described in Section 2: Project description
- **Appendix 10.5 – Project Plan (Gantt Chart)**
- **Appendix 10.6 – Risk Register & Contingency** Plan – table of project risks and mitigation plans
- **Appendix 10.7 –Partner Overviews**
- **Appendix 10.8 -Addressing Ofgem's feedback on the EQUINOX ISP submission**
- **Appendix 10.9 – Letters of Support**
- **Appendix 10.10 – Glossary of terms**

10.1. Benefit Tables

Electricity NIC Financial Benefits

The Methods developed and trialled through EQUINOX are assumed to deliver the same net financial benefits, hence have not been disaggregated in the financial benefits, capacity released, or carbon benefits tables.

Scale	Licence area	EQUINOX Deployment Cost in £m (2022 - 2050)	Cumulative Net Financial Benefit (NPV terms, £m)		
			2030	2040	2050
Licensee Scale	WPD	107	58	204	290
GB Rollout Scale	All licence areas	355	238	786	1,107
Notes	Assessment of reinforcement deferral need – base case: For each substation, we calculated headroom as the difference between firm capacity and forecast load (incl. heat pump load), using the forecast data described in Section 3.2. The base case assumes that there is no other, existing solution that would unlock flexibility from domestic HPs, but considers the flexibility benefits (from existing flexibility products) WPD assumed in RIIO-ED2. Method case (EQUINOX): For each substation, we determined if EQUINOX is applicable (e.g., ignored substations for which headroom turns negative before project completion in 2026), and calculated the reduced forecast load after EQUINOX deployment. We assumed that the commercial arrangements coupled with improved system integration and automation can reduce peak demand by 35%[22] -50%[23], based on research on the operating patterns of HPs under standard operating conditions. Adopting a conservative approach, we used the 35% value (see Appendix 10.3). We then calculated the new substation headroom and used average network reinforcement costs from WPD's RIIO-ED2 Annex 6a Load Related Expenditure, to estimate the financial benefit from deferring reinforcement by comparing the base case against method cases. Our model discounts all benefits from other flexibility solutions (i.e., reinforcement avoided) WPD claimed in the RIIO-ED2 business plan (these benefits have been added as cost items in our model). The EQUINOX deployment cost accounts for the costs of initial deployment from 2022 to 2026, operation and maintenance costs from 2026 to 2050, and incentive payments required to achieve customer demand reduction.				

Electricity NIC – capacity released

Scale	Licence area	Cumulative capacity released (MVA)		
		2030	2040	2050
Licensee Scale	WPD	98	220	223
GB Rollout Scale	All licence areas	343	770	779
Notes	EQUINOX will release capacity in the form of reduction in additional network capacity needed to accommodate customer needs. The CBA model assumes that due to the seamless, simple, and equitable nature of the EQUINOX methods, flexibility is unlocked from across all customers with HPs within the area of constraint. It should be noted that due to the temporary effect of the flexibility solution (i.e. EQUINOX is used to defer a substation reinforcement for as long as possible until network demand exceeds HP flexibility, following which the network is reinforced and thus flexibility no longer required), EQUINOX releases capacity temporarily until reinforcement removes the capacity benefits of EQUINOX at a later date. As a result, the cumulative capacity benefits may fall in some years, as seen in the shape of the graph in Figure 5.			

Electricity NIC – carbon and/or environmental benefits

Scale	Licence area	Carbon Benefit (t CO_2 eq.)		
		2030	2040	2050
Licensee Scale	WPD	239	537	543
GB Rollout Scale	All licence areas	836	1,878	1,900
Notes	The capacity benefit described in Section 3.4 can be translated into equivalent environmental benefit from deferral of reinforcement works once EQUINOX has been deployed, offering services to constrained parts of the network. The Capacity to Customers (C2C) project (by Electricity North West) suggests a total saving of 92.7 tCO2e for each new 38 MVA transformer not being installed. Using the above assumption, along with the capacity release figures provided in Section 3.4, we determined the environmental benefit of EQUINOX in tCO2e. This approach understates the total environmental benefit of EQUINOX as the support EQUINOX may provide towards the acceleration of HP deployment is not included (beyond the assumed HP load growth scenario). The novel commercial arrangements (incl. customer incentive payments) may lead to faster adoption of HPs in certain regions, which would in turn result in additional flexibility unlocked. This flexibility would help defer additional network reinforcement (which has not been quantified as part of the business case), hence more financial, capacity, and environmental benefits. The solution would also contribute to the acceleration of heat electrification in GB. Again, the temporary effect of the flexibility solution (i.e. EQUINOX is used to defer a substation reinforcement for as long as possible until network demand exceeds HP flexibility, following which the network is reinforced and thus flexibility no longer required) means that the cumulative carbon benefit may decrease in some years, in line with the cumulative capacity released.			

10.2. Project Business Case Modelling

The financial benefits of EQUINOX have been calculated using the deferral of network reinforcement, and the improved liquidity in DNO flexibility markets benefits. Whilst there are further benefits described in Section 3.1 which would add significantly to the business case, we have chosen not to attempt to quantify these as to do so would require making some assumptions that may be difficult to reference with high confidence. Therefore, the quantified benefits tabulated in Appendix 10.1. Benefit Tables represent a conservative view of true benefits of the EQUINOX method.

A breakeven analysis is based on an analysis of the project's cumulative costs and benefits. The project breaks even in 2026 on an undiscounted basis and recovers more than customers' initial investment in the same year.

The breakeven analysis has a particularly quick breakeven as it includes the benefits of avoiding reinforcement, even where this is only deferred by a few years, reflecting the rapid HP uptake post 2026. This makes the timing of EQUINOX important. The long-term value of the project beyond the short-term payback can be seen in Figure 4. (Section 3).

Note the following scaling [(WMID+EMID+SWALES+SWEST) ÷ 4 x 14] is applied to calculate GB-wide benefits. The project costs (£7.0m) are assumed to be incurred only once for the four licence areas (i.e. WMID, EMID, SWALES, SWEST) only.

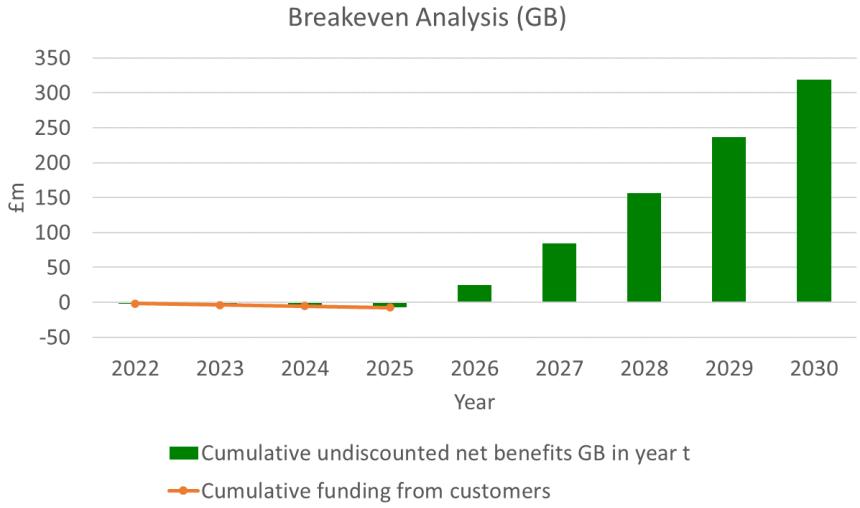

Figure 11. EQUINOX Breakeven Analysis for GB (based on cumulative net financial benefits)

Sensitivity Analysis

We have examined a scenario where HP uptake is significantly lower (~23% lower across WPD) than what is assumed in the Leading the Way (LtW) scenario. This 23% reduction is based on the difference between Leading the Way and WPD's best view for HP uptake in 2030. The cumulative net financial benefit (GB) for this scenario is presented in Figure 12 below.

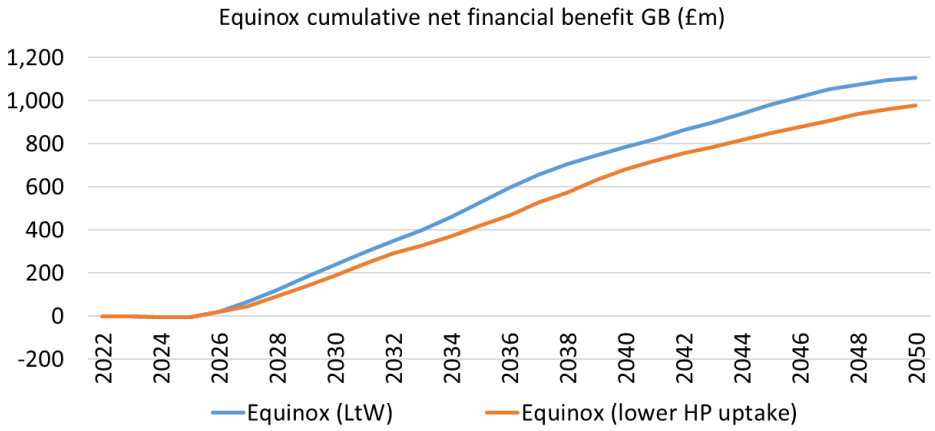

Figure 12. Equinox cumulative net financial benefit GB for lower HP uptake scenario

Given HP load is lower in this scenario, there is less need for reinforcements or EQUINOX to boost network capacity. Even if HP uptake is 23% lower than assumed in our business case, EQUINOX would still deliver significant financial benefits across GB (albeit slightly lower overall compared to LtW). This demonstrates that EQUINOX would still deliver significant financial benefit even if HP uptake is less aggressive across GB.

10.3. Detailed Business Case Assumptions

The detailed business case assumptions enable the business case findings to be replicated by others. For a full explanation of methods, context, and reasoning, see Section 3.2 and Appendix 10.1. The table below summarises the assumptions underpinning the business case.

Table 8. Assumptions underpinning the business case

Assumption	Value	Notes
Uncoordinated co-incident electrical peak demand	3kW per heat pump	WPD's Peak Heat project[38]
Heat pump (HP) uptake scenario	Leading the Way	This is based on WPD's Distribution Future Energy Scenarios[39]. Consumer Transformation is the most ambitious HP uptake scenario, while System Transformation is a scenario that may not be consistent with the HP installation rate of 600,000 per year by 2028. Therefore,

[38] https://smarter.energynetworks.org/projects/nia_wpd_058/

[39] https://www.westernpower.co.uk/distribution-future-energy-scenarios-application

		Leading the Way was selected as the most appropriate HP uptake scenario.
Peak demand reduction due to novel commercial arrangements proposed by Equinox	35%	Source[22]. This assumption is conservative as peak demand reduction could be as high as 50%[23].
Electricity peak demand forecast	Based on RIIO-ED2 Business Plan	Source[21] (page 21). We have assumed that the trend would continue between 2030-2050.
Saving due to improved liquidity in DNO markets	10%	Future Flex project[40]
Environmental benefit of transformer capacity not being installed	92.7 tCO_2e per 38 MVA of transformer capacity not being installed	Capacity to Customers (C2C) project[24]
Flexibility cost for WPD in RIIO-ED2	£2.9m	Flexibility cost over the RIIO-ED2 period was based upon WPD's Business Plan[21]. It was assumed that this value would remain the same over subsequent price control periods, which understates the financial benefit of improved liquidity in DNO markets (in reality DNO flexibility spend is likely to increase with time as DNOs prioritise flexibility solutions)
Reinforcement avoided by WPD through flexibility assumed in RIIO-ED2	£49m	Reinforcement avoided over the RIIO-ED2 period was based upon WPD's Business Plan[21].
Customer incentive payments [41]	£ 22,190.82/MW	This is based on the highest value for potential payments shown in WPD's Value Calculator[42]. Customer incentive payments are a cost item in our model, hence the approach taken is conservative. Also, for simplicity it is assumed that this value would remain the same across the modelling period.

[40] https://www.westernpower.co.uk/downloads-view-reciteme/133582

[41] Addresses Ofgem Q2 from ISP feedback – see Appendix 10.8

[42] https://www.flexiblepower.co.uk/locations/western-power-distribution/value-calculator

WPD average reinforcement cost (primary substations)	Based on RIIO-ED2 Business Plan (Annex 6a)	Annex 6a (p32-34)[21]. To estimate the financial benefit of deferring reinforcement we used average values (for each licence area) based on average scheme costs presented in Annex 6a (p32-34). We have excluded schemes associated with fault level reinforcement.
- East Midlands	183,685 £/MVA	See above
- West Midlands	99,825 £/MVA	See above
- South West	111,850 £/MVA	See above
- South Wales	240,250 £/MVA	See above
WPD average reinforcement cost (secondary substations)	40,000 £/MW	Average costs from WPD's connection charging methodology for pole mounted and ground mounted substation replacements.
Average increase in substation capacity at reinforcement	+133%	We assume this increase in substation capacity at reinforcement (e.g. a 15MVA substation is upgraded to 35MVA). This is based on WPD's standard transformer size data.
Capitalisation rate	95% of net benefits	Capitalisation rates are used to reflect the financial costs & benefits on an "accounting" basis instead of a "cash" basis (e.g., reinforcement costs are depreciated over 45 years instead of being incurred in a single year). The capitalisation rate is applied to net benefits each year from 2026 onwards.
Pre-tax WACC for WPD	4.8%	Assumed Pre-tax Weighted Average Cost of Capital for WPD

10.4. Technical Description

10.4.1. Workstream 1 – Commercial Arrangements

Following discussions with Project Partners and recognising that as a Network Operator WPD does not have a direct relationship with consumers, WPD has identified three customer-facing commercial arrangement that the partners believe can unlock flexibility from residential low carbon heating for the DNO and the supplier in a cost-effective manner. All three methods are based on the proposition that WPD utilises flexibility offered by an aggregated portfolio of end-customers' heating assets (HPs, thermal storage, and controls) drawing on the capabilities of an energy supplier or aggregator to reach and interact with customers using integrated value propositions. The three methods differ in terms of the distribution of risk and reward across the various actors. These differences can be expressed through variations with regards to payment structure, dispatch method, and level of delivery risk and control across the value chain.

The Methods will be designed in collaboration our Project Partners incl. energy suppliers and improved throughout the trials based on customer feedback.

Method 1 (M1): 'Save in advance'. In this method, the end-customer receives an upfront flexibility payment in return for offering a fixed, guaranteed level of flexibility. DNOs access this flexibility through the energy supplier who can directly control the customer's heating assets within a customer-defined comfort. This method will likely provide increased certainty of delivery of flexibility although it is possible that the reduced level of control for the customer may lead to a lower willingness to participate.

Figure 13 provides a conceptual overview of the 'save in advance' method.

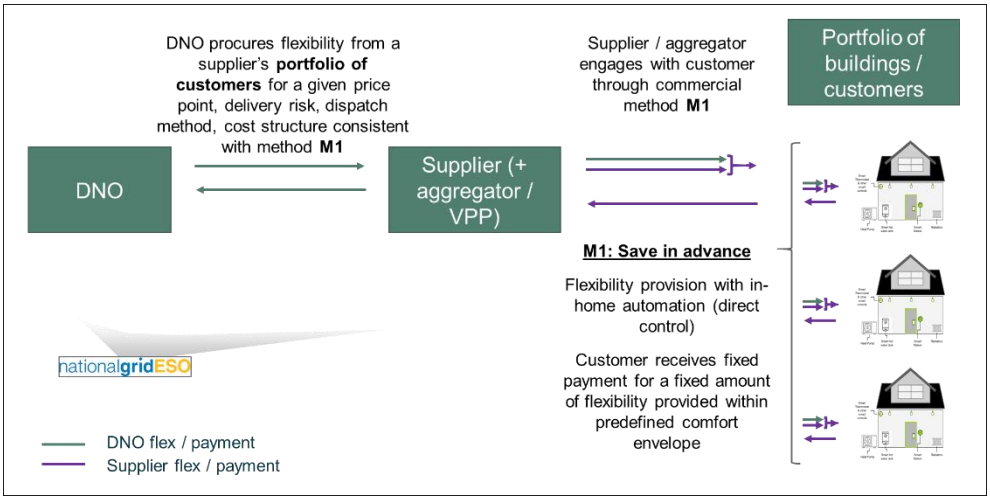

Figure 13. Simplified visual representation of how the DNO procures flexibility from a portfolio of customers through an energy supplier or aggregator using the novel commercial arrangement M1: 'Save in advance'. Note: National Grid ESO is included in the graphic, recognising that they are a key stakeholder in the discussion around flexibility. However, at this stage of the process, ESO is not involved in the design of the commercial methods.

Method 2 (M2): 'Save as you go'. In this method, the energy supplier, and in turn the end-customer, are not committed to a fixed, minimum obligation but instead can adjust their flexibility offer based on (near) real-time signals. This method seeks to unlock flexibility from assets that are not 100% firm or reliable. Such an approach provides consumers with more control over their assets but requires DNOs and suppliers to carefully consider their customer engagement and product design approaches (UX, UI); whilst also managing the commercial,

contractual, and operational risks related to variability in terms of price and delivery risk of flexibility that is available.

Figure 14 provides a conceptual overview of the 'save as you go' method.

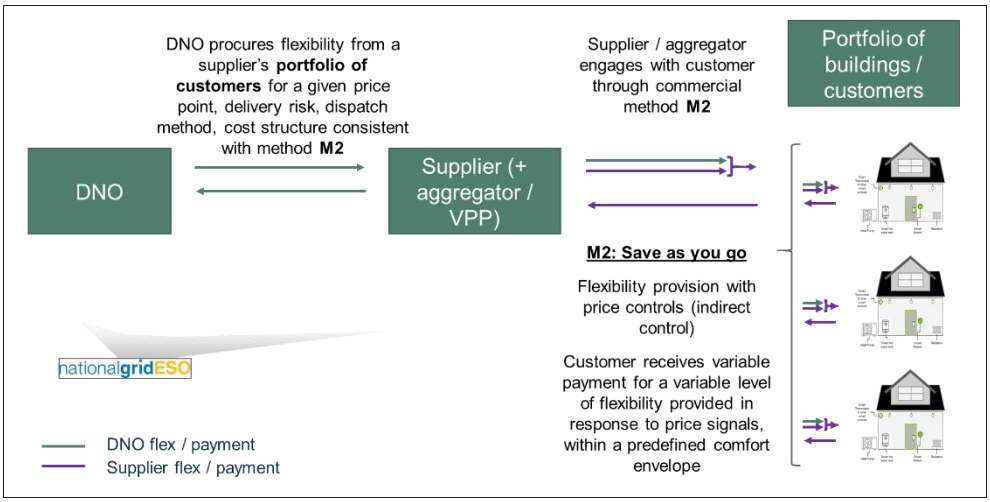

Figure 14. Simplified visual representation of how the DNO procures flexibility from a portfolio of customers through an energy supplier or aggregator using the novel commercial arrangement M1: 'Save as you go'. Note: National Grid ESO is included in the graphic, recognising that they are a key stakeholder in the discussion around flexibility. However, at this stage of the process, ESO is not involved in the design of the commercial methods.

Method 3 (M3): 'Save in advance & boost as you go'. This method will combine aspects of both direct load control (M1) and dynamic price signals (M2) to enable consumers to commit to smaller levels of flexibility upfront and boost the flexibility in response to real time price signals.

The commercial arrangements will be designed to explore previously untapped sources of flexibility. Through their aggregated and integrated nature, these commercial arrangements will enable DNOs and suppliers alike to mobilise flexibility from assets that exist on a 'sliding scale' of delivery risk and flexibility availability. This features in stark contrast to existing ways of flexibility procurement. As it stands, there are many situations where domestic flexibility is acknowledged to have the potential to provide valuable support to help local networks, but because the flexibility is not 100% firm, it is unable to participate in existing solutions, and the sheer volume means that a bilateral contract approach for DNOs is not feasible. The innovative commercial arrangements developed and trialled by EQUINOX aims to enable these assets and customers participate in future when the need for additional flexibility will be crucial in delivering a cost-efficient net zero energy system.

The commercial arrangements will be designed and further refined throughout Workstream 1. Project Partners will contribute to the design of these models and trading arrangements.

10.4.2. Workstream 2 – Technical Integration and Automation

Given its integrated nature, the EQUINOX conceptual architecture contains several technology, commercial, and contractual interfaces between the Project Partners, as shown in Figure .

EQUINOX will leverage existing systems and applications to demonstrate the procurement, planning, and dispatch of flexibility in advance and near-real time of events. WPD will develop and demonstrate integration and automation between WPD's flexibility platform's (Flexible Power) existing APIs through to the energy supplier or aggregator's in-home automation systems. These supplier- or aggregator-controlled systems and applications will in turn

optimise and dispatch electrical heating equipment in response to various control signals and based on engagement with the customer.

The conceptual architecture will enable two-way flow of information. On the one hand, flexibility procurement signals from WPD's flexibility platform will be received by the energy supplier and enacted, monitored, and closed out in the back-office functions. On the other hand, flexibility availability and pricing information gathered by the supplier will feed back to WPD's flexibility platform to inform dispatch planning and constraint management decisions.

Note that in spite of the technical complexity of integrating Low Voltage (LV) flexibility procurement and dispatch planning into the back-office systems of the DNO and supplier, the customer experience – in terms of control, comfort, and convenience – remains unchanged compared to existing commercial applications of smart in-home control and dynamic pricing.

The initial project cost as reported in Section 4.2 has been estimated based on developing the technological interfaces required for the trial as shown in Figure 15. The detailed technical design and enablement will be further developed in Workstream 2, where the Project Partners will collaborate to support the technical design and enhancements to existing back-office systems to enable the commercial arrangements and technical integration & automation.

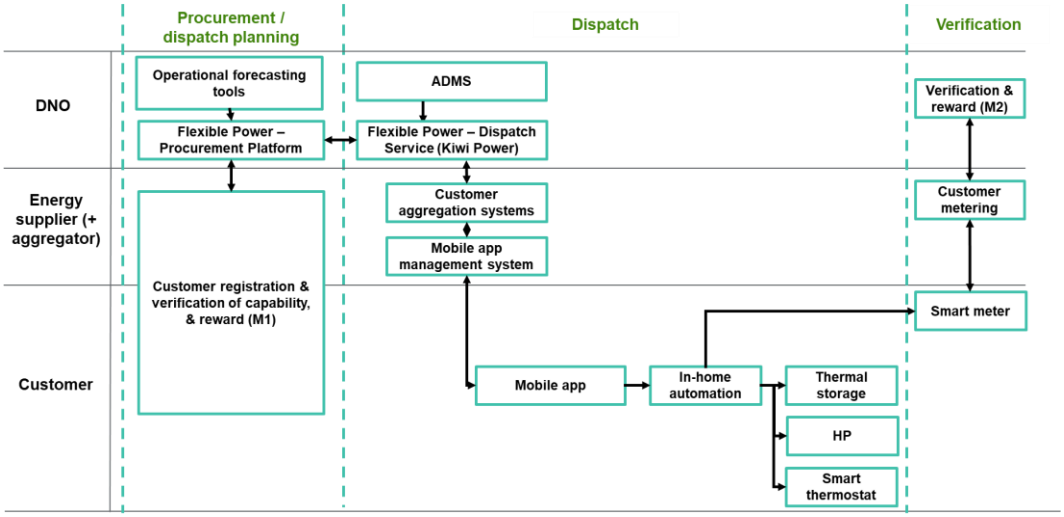

Figure 15. Overview of EQUINOX Conceptual Architecture.

10.4.3. Workstream 3 – Customer Engagement and Experience

By 2023, WPD expects 265,000 customers to have HPs installed in their homes. EQUINOX seeks to enrol 800 - 1,000 trial participants by 2023, or about 0.4% of total customers. To achieve the target scale, EQUINOX will collaborate with Octopus Energy, the Welsh Government, Sero, and WMCA. The following evidence provides confidence that EQUINOX can achieve the minimum scale required:

- Based on **Octopus Energy's** existing number of customers with heating assets (HPs, thermal storage, and controls) in WPD's licence areas, future installations, expected recruitment rate, Octopus Energy is confident of recruiting at least **500 customers** by the end of 2022.
- **Welsh Government and Sero** are implementing a large-scale decarbonisation "Optimised Retrofit" programme with 2,000 homes having works completed prior to 21/22 winter and an estimated 5,000 homes prior to 22/23 winter, the majority including heating assets. These are in addition to Sero's project pipeline of 750 new

homes constructed in the same period. Leveraging this "Optimised Retrofit" programme and Sero's new build homes as a platform for recruiting trial participants, Project Partners are confident in easily exceeding **500 customer trial participants** through this channel. This accounts for conservative recruitment rates of participants.

- **WMCA** have committed to retrofitting 100 to 200 homes with heating assets through their Net Zero Neighbourhood programme. Leveraging this programme to recruit trial participants, our Project Partners are confident that at least **75 customers** can be recruited onto the EQUINOX trials. This assumes similar recruitment rates as above.
- WPD is in advanced discussions with several **additional suppliers**(incl. Scottish Power Retail) who have shown interest in participating in the EQUINOX with **several hundreds** of their customers. Participation from additional suppliers not only demonstrates scalability of the project, but also provides additional opportunities to achieve the scale required if any of the above categories falls short of expectations.

Project Partners will collaborate to develop a clear customer recruitment strategy, underpinned by best class customer engagement to achieve high participant recruitment rates and low participant dropout rates throughout the trials.

Learnings from previous innovation projects – presented in Table 7– suggest that future flexibility trials like EQUINOX need to place more emphasis on customer engagement, communication, and customer experience monitoring. This is needed to gain a better understanding customer perspectives and needs; to design and communicate customer value propositions in a simple and clear way; to monitor that technological solutions are delivered in a seamless, comfortable, and reliable way; and to explore ways of driving down underlying fixed costs to make small-scale DSR economical. To this point, workstream 3 seeks to ensure that the project is benefitting end-customers by:

- Leveraging the energy supplier's existing relationships to reach (potential) customers in a cost-effective and scalable way
- Engaging with customers to better understand their perspectives, needs, and translate these into opportunities and barriers for decarbonisation of heat
- Monitoring customer engagement and experience of technological solutions throughout the trial
- Seeking feedback to inform design and communication of customer value propositions in a simple and clear way

Insights from this customer engagement workstream will inform the trial design and future customer strategies. The customer engagement and analysis work will occur at 3 levels:

1. **Primary research**: At the highest level, a primary market research analysis seeks to understand the average UK customer's views and concerns as it relates to home heating, HPs, and in-home automation of assets. A consumer research organisation, to be engaged following project award, will lead the primary research and outreach. This will include multiple modes of communication e.g. online surveys, interviews, phone calls, and door knocking to maximise participation. This primary research will include customers that don't have HPs that live inside and outside of WPD's license areas. For customers within WPD's licence areas, this outreach will therefore also be used as an additional route to support the participant recruitment campaign.
2. **Participant surveys and focus group workshops**: Energy suppliers will lead customer outreach, leveraging their relationship with customers to conduct surveys and

focus group workshops. Other Project Partners, including WPD, will actively contribute to designing survey and workshop questions to ensure that views are captured and presented in a comprehensive and objective way.

3. **1-on-1 interviews:** Energy suppliers will lead customer outreach for 1-on-1 interviews. Other Project Partners, including WPD, will contribute to designing questions to ensure that customer views are captured and presented in an objective way. The surveys, workshops, and 1-on-1 interviews will occur at the start and the end of the trial periods and will be tied to an incentive payment as part of overall trial participation.

For activities (2) and (3) above, the project will take specific steps to (a) ensure that learnings are comprehensive, consistent, supplier-neutral, and objective; and (b) understand the perspectives, needs, and concerns of **vulnerable & fuel poor customers.** Regarding (a), the customer engagement workstream will set out a governance structure to ensure that all customers are engaged with in a consistent way regardless of their energy supplier – with WPD overseeing the process. Lead customer engagement parties will then draw together learnings from the different pools of customers to present project-level learnings.

Regarding (b), workshops and 1-on-1 interviews containing customers from the vulnerable or fuel poor categories will receive additional oversight from National Energy Action (NEA), a specialist NGO selected to lead this activity given their experience in providing an expert voice on behalf of the fuel poor and vulnerable. NEA will lead the design of customer engagement sessions, leveraging their extensive experience engaging with hard to reach customers to help maximise participation in feedback sessions.

10.4.4. Workstream 4 – Trials

This workstream will deploy state-of-the-art experimental design principles to divide customers into representative groups and test the suitability and effectiveness of the commercial arrangements in unlocking HP flexibility on a large scale. Customer behaviour and feedback from the trials will be analysed to quantify the benefits for the network and customers because of the solution, as well as to provide insight to the key questions outlined in Section 2.1.1. EQUINOX will use modelling and simulation tools to understand the network benefits of the methods.

The trials Workstream has three main components: designing, running, and interpreting results from trials. Trial design requires careful scoping across the many variables (including time of day, day of week, external temperature, duration of event, customer notification / prompts) and customer selection – ensuring that customer subsets for each trial are representative.

Experimental design of the behavioural trial groups (‘**Save as you go’**) must also consider the trade-off between feasibility of recruitment and robustness of analysis results. Whereas ‘True’ experimental design would control for selection bias and model specification bias by randomly allocating volunteers into control (placebo) and treatment groups – this requires over-recruitment by a factor of two and is unlikely to be realisable for a technology with a modest adoption rate like HPs. ‘Pre-Post’ design, on the other hand, is a more feasible method that also has the capability of producing statistically relevant and insightful results. This experimental design method uses regression analysis to compare pilot-period consumption against a modelled baseline derived from relationships estimated in the pre-plot period. Even here, generating a robust baseline or counterfactual can prove challenging in situations where new customers or HPs are added and historical, pre-pilot data does not exist.

In case of direct load control (‘**Save in advance’**), implementing a true experimental design is more straightforward. Participants can be randomly divided into two groups. For each event

one – but not the other – of the two groups is controlled. The group curtailed switches from event to event such that by the end of the pilot period each group has been subject to approximately the same number of events, over a similar range of temperatures. This yields a robust estimated baseline and thus estimated impacts.

> *"Trials confirmed the complexity, cost and challenge of building real understanding of the home environment, consumer needs and behaviour; but the trial experience equally demonstrated the value and insight generated by testing new propositions and technologies in mainstream consumers' homes.*
>
> *This suggests that the creation of a large-scale trial environment in mainstream consumers' homes will be a major national asset both for innovators and business in the UK supply chain, and to inform future UK heat decarbonisation strategy."*
>
> [Energy Systems Catapult, Smart Systems and Heat Programme, January 2020]

In addition to properly specifying the regression model to estimate the impact of the curtailment events (in which direct load control is applied) the analyst must be careful to control for the effects of snapback. Snapback is the phenomenon observed when space conditioning loads are curtailed, resulting in changes in building temperature. Following the end of the event, the controlled appliance must work harder than usual to restore building temperature to its typical setpoint.

Another major consideration – particularly for HPs – is the need to control for the non-linear response of this equipment to changes in temperature. HPs are – at moderately cold temperatures – incredibly efficient. This efficiency can fall precipitously at very low temperatures when auxiliary heat strips must be called upon to satisfy building thermal load or provide emergency coil defrosting. This effect is typically controlled for in regression models using "splines" – effectively a set of dummy variables that ensure the estimated relationship between demand and temperature is itself allowed to vary as a function of temperature.

Running the trials requires careful customer engagement to maximise participation, ensuring signals to customers and their equipment are sent correctly and making sure the right data is captured. Measurement and verification of operating and response data will occur through smart meters, individual HPs, or both. Customer comfort will be monitored qualitatively through the participant surveys and workshops run as part of workstream 3, and quantitatively through temperature monitoring where possible. In the case of individual HPs – current models can handle basic controls and provide some telemetry. At the same time, manufacturers are upgrading these so that by the time EQUINOX trials begin in 2022, most new HPs can be expected to have good telemetry and more precision in controls.

Early trials will focus on understanding and establishing the potential of HP flexibility on a large scale: what is possible, how will responses scale as HP numbers increase and what are impacts on a local level. Signals during the early trials will test a range of incentive levels to understand the boundaries of response. Later trials will implement commercial arrangements to test large scale HP flexibility provision, with signals at a more measured incentive level that align with the network value. Consistent with Trial Principle #5, the trials will be planned in a way to maximise continuous learning, iteration, and knowledge dissemination over the course of the project. Each trial has a different set of objectives that it seeks to achieve, questions that it seeks to answer, and methods that it seeks to demonstrate – as summarised in Table 9.

Table 9. Summary of objectives, methods, and participant breakdown per trial.

	Objectives	Methods & participants
Trials 1 (2022-2023)	• Pilot commercial arrangements, test trial setup	• Method 1: allocate approx. 50% of participants • Method 2: allocate approx. 50% of participants
Trials 2 (2023-2024)	• Apply learning from Trial 1 to refine the implementation of methods 1 & 2 • Pilot the implementation of method 3 • Validate technical integration, automation, and the DNO-supplier interface (Flexible Power)	• Method 1: allocate approx. 33% of participants • Method 2: allocate approx. 33% of participants • Method 3: allocate approx. 33% of participants
Trials 3 (2024-2025)	• Apply learning from Trials 1 & 2 to improve all methods • Focus on learnings to inform scaling to Business-as-Usual	• All methods: customer choice but set minimum of approx. 15% of participants per method

Given that EQUINOX trial participants will not be fed by the same physical primary or secondary substation, an abstracted modelling methodology will be applied to estimate the hypothetical network impacts under a range of HP adoption levels. As such, WPD will simulate network constraints and corresponding flexibility requirements (in MW) on a hypothetical distribution network. Subsequently, the energy supplier and its portfolio of customers will respond to these requirements in correspondence with their respective commercial arrangements and control strategies. The eventual aggregated responses will then be fed into an LV network simulation tool, which will be used to assess the estimated network impact.

In parallel to the physical trials, one of the Project Partners (Passiv), will develop digital twins using data collected from real buildings monitored during the trial. These digital twins will be calibrated against (historical) real building performance, including during behavioural interventions trialled through EQUINOX. They will be used to iteratively refine design of the commercial arrangements, to inform future trial periods, and to extrapolate learnings at a level where they can be applied more generally for their predictive capabilities in other network regions and under different combinations of building parameters.

10.4.5. Workstream 5 – Project Management & Knowledge Dissemination

This workstream will manage the scope, schedule, and budget of EQUINOX on a day-to-day basis, coordinating across workstreams and Project Partners to ensure efficient and effective project delivery. This workstream will also include monitoring and reporting on progress, budget, risks & issues and mitigation plans to the Monthly Partner meetings and Project Review Group meetings. Further detail on project management is presented in Section 6.

Sharing learning from EQUINOX is key to the project. This workstream will ensure a focused approach to knowledge dissemination which ensures that stakeholders learn from the project and implement the solutions efficiently.

10.5. Project plan

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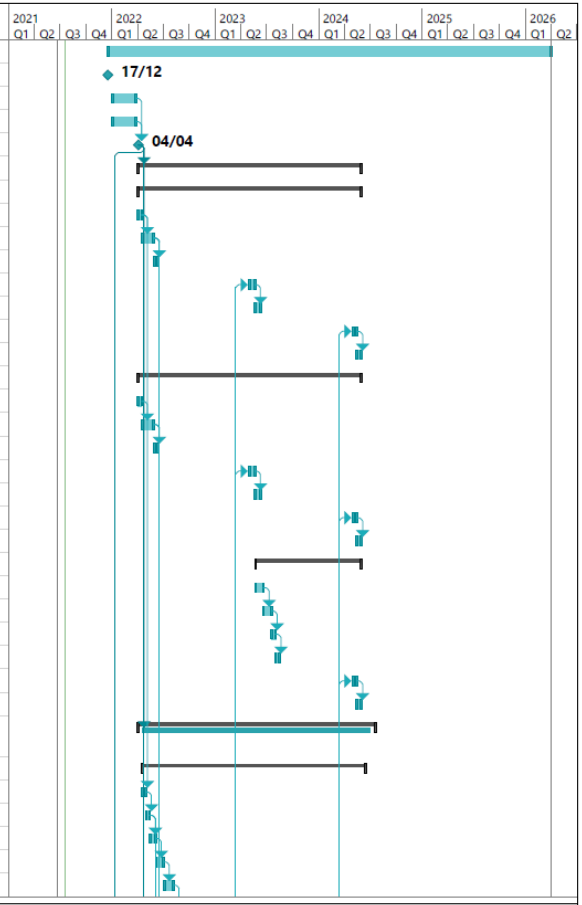
ID	Task Name	Duration	Start	Finish
1	**EQUINOX Project**	1117 days	Fri 17/12/21	Mon 30/03/26
2	Ofgem Project Award	0 days	Fri 17/12/21	Fri 17/12/21
3	Finalise contracts	60 days	Mon 03/01/22	Fri 25/03/22
4	Mobilize project team	60 days	Mon 03/01/22	Fri 25/03/22
5	Project kickoff meeting	0 days	Mon 04/04/22	Mon 04/04/22
6	**Workstream 1: Commercial arrangement design**	**562 days**	**Mon 04/04/22**	**Tue 28/05/24**
7	**Design Method 1 commercials: Save in advance**	**562 days**	**Mon 04/04/22**	**Tue 28/05/24**
8	Requirements gathering	10 days	Mon 04/04/22	Fri 15/04/22
9	Solution design	30 days	Mon 18/04/22	Fri 27/05/22
10	Legal review	10 days	Mon 30/05/22	Fri 10/06/22
11	Review Trial 1 feedback on Save in Advance	15 days	Mon 01/05/23	Fri 19/05/23
12	Update Save in Advance for Trial 2	15 days	Mon 22/05/23	Fri 09/06/23
13	Review Trial 2 feedback on Save in Advance	10 days	Wed 01/05/24	Tue 14/05/24
14	Update Save in Advance for Trial 3	10 days	Wed 15/05/24	Tue 28/05/24
15	**Design Method 2 commercials: Save as you go**	**562 days**	**Mon 04/04/22**	**Tue 28/05/24**
16	Requirements gathering	10 days	Mon 04/04/22	Fri 15/04/22
17	Solution design	30 days	Mon 18/04/22	Fri 27/05/22
18	Legal review	10 days	Mon 30/05/22	Fri 10/06/22
19	Review Trial 1 feedback on Save as you go	15 days	Mon 01/05/23	Fri 19/05/23
20	Update Save as you go for Trial 2	15 days	Mon 22/05/23	Fri 09/06/23
21	Review Trial 2 feedback on Save as you go	10 days	Wed 01/05/24	Tue 14/05/24
22	Update Save as you go for Trial 3	10 days	Wed 15/05/24	Tue 28/05/24
23	**Design Method 3 commercials: Save in advance & boost as you go**	**266 days**	**Tue 23/05/23**	**Tue 28/05/24**
24	Requirements gathering	20 days	Tue 23/05/23	Mon 19/06/23
25	Solution design	20 days	Tue 20/06/23	Mon 17/07/23
26	Legal review	10 days	Tue 18/07/23	Mon 31/07/23
27	Finalise design consider customer input	10 days	Tue 01/08/23	Mon 14/08/23
28	Review Trial 2 feedback on Save in advance & boost as you go	10 days	Wed 01/05/24	Tue 14/05/24
29	Update Save in advance & boost as you go for Trial 3	10 days	Wed 15/05/24	Tue 28/05/24
30	**Workstream 2: Technical integration and automation design and implementation**	**600 days?**	**Mon 04/04/22**	**Fri 19/07/24**
31	**Design Method 1 technical integration & automation: Save in advance**	**565 days**	**Mon 18/04/22**	**Fri 14/06/24**
32	Requirements gathering	10 days	Mon 18/04/22	Fri 29/04/22
33	Logical design	10 days	Mon 02/05/22	Fri 13/05/22
34	Detailed design	15 days	Mon 16/05/22	Fri 03/06/22
35	Develop dummy data interfaces	20 days	Mon 06/06/22	Fri 01/07/22
36	Develop supplier & customer app integration	25 days	Mon 04/07/22	Fri 05/08/22



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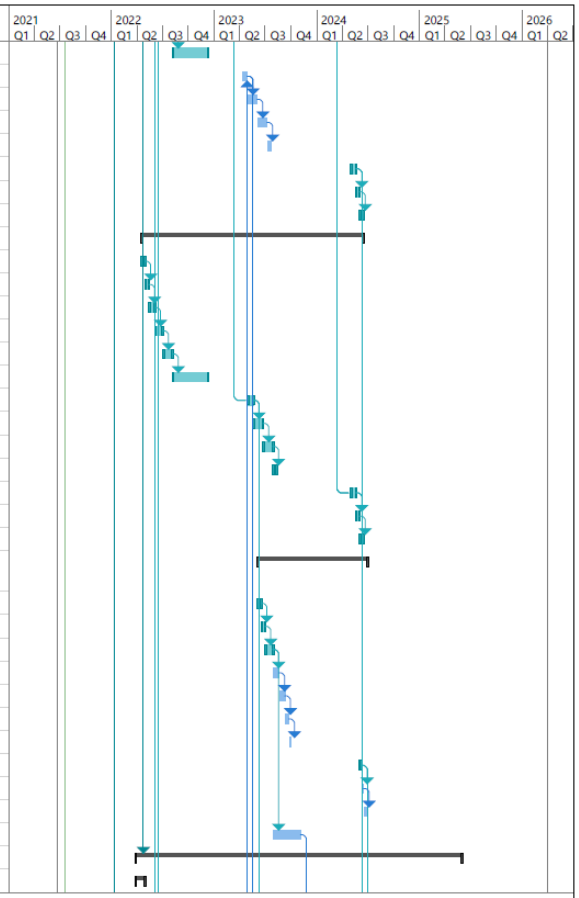
ID	Task Name	Duration	Start	Finish
37	Testing (data integration & controls) - Trial 1	90 days	Mon 08/08/22	Fri 09/12/22
38	Review Trial 1 feedback	15 days	Mon 10/04/23	Fri 28/04/23
39	Develop Flexible Power (Kiwi Power) - supplier integration	25 days	Mon 01/05/23	Fri 02/06/23
40	Develop measurement & verification data integration	25 days	Mon 05/06/23	Fri 07/07/23
41	Testing (data integration & controls) - Trial 2	10 days	Mon 10/07/23	Fri 21/07/23
42	Review Trial 2 feedback - identify additional requirements	14 days	Wed 01/05/24	Sun 19/05/24
43	Implement Trial 3 requirements	10 days	Mon 20/05/24	Fri 31/05/24
44	Testing (data integration & controls) - Trial 3	10 days	Mon 03/06/24	Fri 14/06/24
45	**Design Method 2: Save as you go**	**565 days**	**Mon 18/04/22**	**Fri 14/06/24**
46	Requirements gathering	10 days	Mon 18/04/22	Fri 29/04/22
47	Logical design	10 days	Mon 02/05/22	Fri 13/05/22
48	Detailed design	15 days	Mon 16/05/22	Fri 03/06/22
49	Develop dummy data interfaces	20 days	Mon 06/06/22	Fri 01/07/22
50	Develop supplier & customer app integration	25 days	Mon 04/07/22	Fri 05/08/22
51	Testing (data integration & controls) - Trial 1	90 days	Mon 08/08/22	Fri 09/12/22
52	Review Trial 1 feedback	15 days	Mon 01/05/23	Fri 19/05/23
53	Develop Flexible Power (Kiwi Power) - supplier integration	25 days	Mon 22/05/23	Fri 23/06/23
54	Develop measurement & verification data integration	25 days	Mon 26/06/23	Fri 28/07/23
55	Testing (data integration & controls) - Trial 2	10 days	Mon 31/07/23	Fri 11/08/23
56	Review Trial 2 feedback - identify additional requirements	14 days	Wed 01/05/24	Sun 19/05/24
57	Implement Trial 3 requirements	10 days	Mon 20/05/24	Fri 31/05/24
58	Testing (data integration & controls) - Trial 3	10 days	Mon 03/06/24	Fri 14/06/24
59	**Design Method 3 technical integration & automation: Save in advance & boost as you go**	**280 days**	**Mon 05/06/23**	**Fri 28/06/24**
60	Requirements gathering	10 days	Mon 05/06/23	Fri 16/06/23
61	Logical design	10 days	Mon 19/06/23	Fri 30/06/23
62	Detailed design	20 days	Mon 03/07/23	Fri 28/07/23
63	Develop supplier & customer app integration	15 days	Mon 31/07/23	Fri 18/08/23
64	Develop Flexible Power (Kiwi Power) - supplier integration	15 days	Mon 21/08/23	Fri 08/09/23
65	Develop measurement & verification data integration	10 days	Mon 11/09/23	Fri 22/09/23
66	Testing (data integration & controls) - Trial 2	5 days	Mon 25/09/23	Fri 29/09/23
67	Review Trial 2 feedback - identify additional requirements	5 days	Mon 03/06/24	Fri 07/06/24
68	Implement Trial 3 requirements	5 days	Mon 10/06/24	Fri 14/06/24
69	Testing (data integration & controls) - Trial 3	10 days	Mon 17/06/24	Fri 28/06/24
70	Prepare and review Deliverable 3	70 days	Mon 31/07/23	Fri 03/11/23
71	**Workstream 3: Customer experience and engagement**	**830 days**	**Mon 28/03/22**	**Fri 30/05/25**
72	**Strategy & process**	**25 days**	**Mon 28/03/22**	**Fri 29/04/22**



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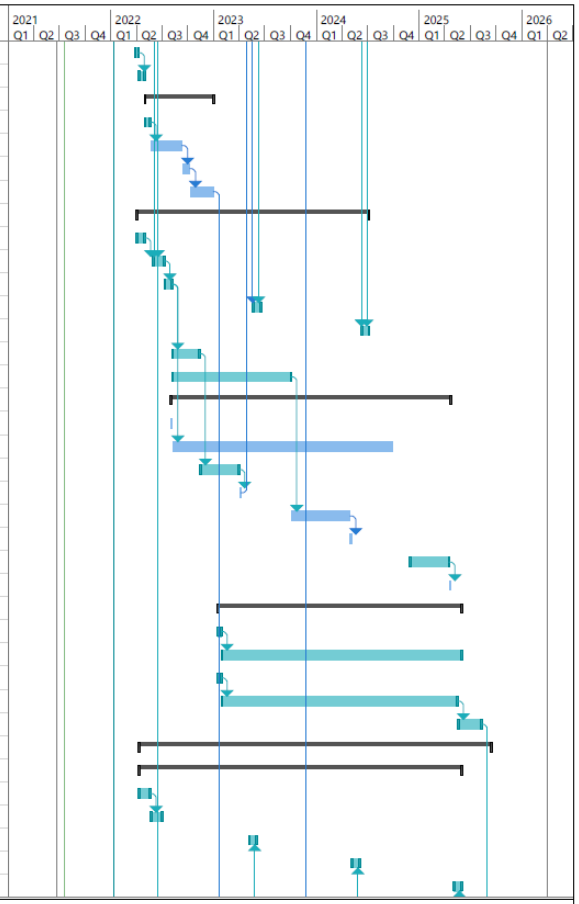
ID	Task Name	Duration	Start	Finish
73	Develop customer engagement strategy	10 days	Mon 28/03/22	Fri 08/04/22
74	Develop customer data management procedures	15 days	Mon 11/04/22	Fri 29/04/22
75	**Primary research**	**175 days**	**Mon 02/05/22**	**Fri 30/12/22**
76	Design primary research methods	15 days	Mon 02/05/22	Fri 20/05/22
77	Conduct primary research	80 days	Mon 23/05/22	Fri 09/09/22
78	Evaluate primary research	20 days	Mon 12/09/22	Fri 07/10/22
79	Prepare and review Deliverable 1	60 days	Mon 10/10/22	Fri 30/12/22
80	**Trial recruitment**	**590 days**	**Mon 04/04/22**	**Fri 05/07/24**
81	Design trial recruitment strategy	20 days	Mon 04/04/22	Fri 29/04/22
82	Develop high-level trial recruitment info packs	30 days	Mon 30/05/22	Fri 08/07/22
83	Develop trial and method specific customer info packs Trial 1	20 days	Mon 11/07/22	Fri 05/08/22
84	Develop trial and method specific customer info packs Trial 2	20 days	Mon 22/05/23	Fri 16/06/23
85	Develop trial and method specific customer info packs Trial 3	20 days	Mon 10/06/24	Fri 05/07/24
86	Recruit trials customers Trial 1	70 days	Mon 08/08/22	Fri 11/11/22
87	Recruit trials customers Trial 2 & 3	301 days	Mon 08/08/22	Mon 02/10/23
88	**Customer focus groups**	**713 days**	**Mon 01/08/22**	**Wed 23/04/25**
89	Design consumer focus groups	5 days	Mon 01/08/22	Fri 05/08/22
90	Recruit customers for focus groups	560 days	Mon 08/08/22	Fri 27/09/24
91	Consumer focus groups Trial 1	100 days	Mon 14/11/22	Fri 31/03/23
92	Focus group feedback analysis Trial 1	5 days	Mon 03/04/23	Fri 07/04/23
93	Consumer focus groups Trial 2	150 days	Tue 03/10/23	Mon 29/04/24
94	Focus group feedback analysis Trial 2	5 days	Tue 30/04/24	Mon 06/05/24
95	Consumer focus groups Trial 3	100 days	Thu 28/11/24	Wed 16/04/25
96	Focus group feedback analysis Trial 3	5 days	Thu 17/04/25	Wed 23/04/25
97	**Surveys & bi-lateral interviews**	**620 days**	**Mon 16/01/23**	**Fri 30/05/25**
98	Design trial participant surveys	10 days	Mon 16/01/23	Fri 27/01/23
99	Trial participant surveys (Trial 1, 2 & 3)	610 days	Mon 30/01/23	Fri 30/05/25
100	Design bi-lateral interviews	10 days	Mon 16/01/23	Fri 27/01/23
101	Bi-lateral trial participant interviews	600 days	Mon 30/01/23	Fri 16/05/25
102	Prepare and review Deliverable 5	60 days	Mon 19/05/25	Fri 08/08/25
103	**Workstream 4: Trials**	**895 days**	**Mon 11/04/22**	**Fri 12/09/25**
104	**Simulation & modelling**	**820 days**	**Mon 11/04/22**	**Fri 30/05/25**
105	Develop simulation housing archetypes	30 days	Mon 11/04/22	Fri 20/05/22
106	Modelling flex potential using simulation	30 days	Mon 23/05/22	Fri 01/07/22
107	Update simulation modelling based on Trial 1 findings	20 days	Mon 08/05/23	Fri 02/06/23
108	Update simulation modelling based on Trial 2 findings	20 days	Tue 07/05/24	Mon 03/06/24
109	Update simulation modelling based on Trial 3 findings	20 days	Mon 05/05/25	Fri 30/05/25



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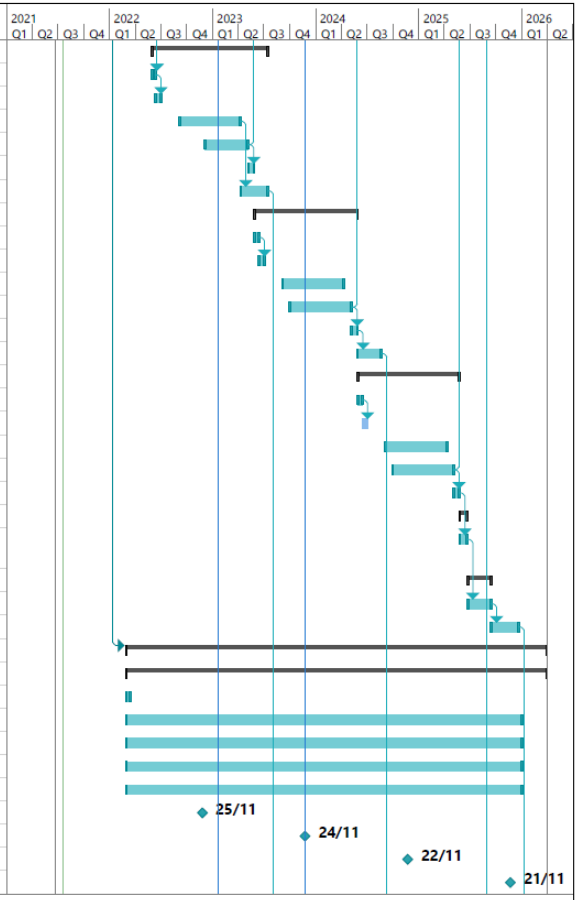
ID	Task Name	Duration	Start	Finish
110	**Trial 1 Winter 2022/23**	**295 days**	**Mon 30/05/22**	**Fri 14/07/23**
111	Trial strategy	10 days	Mon 30/05/22	Fri 10/06/22
112	Trial design	15 days	Mon 13/06/22	Fri 01/07/22
113	Data collection and validation	155 days	Mon 05/09/22	Fri 07/04/23
114	Analysis of customer response and behaviour	110 days	Mon 05/12/22	Fri 05/05/23
115	Network impact modelling	15 days	Mon 08/05/23	Fri 26/05/23
116	Prepare and review Deliverable 2	70 days	Mon 10/04/23	Fri 14/07/23
117	**Trial 2 Winter 2023/24**	**260 days**	**Tue 30/05/23**	**Mon 27/05/24**
118	Trial strategy	10 days	Tue 30/05/23	Mon 12/06/23
119	Trial design	15 days	Tue 13/06/23	Mon 03/07/23
120	Data collection and validation	155 days	Tue 05/09/23	Mon 08/04/24
121	Analysis of customer response and behaviour	157 days	Sat 30/09/23	Mon 06/05/24
122	Network impact modelling	15 days	Tue 07/05/24	Mon 27/05/24
123	Prepare and review Deliverable 4	60 days	Tue 28/05/24	Mon 19/08/24
124	**Trial 3 Winter 2024/25**	**257 days**	**Thu 30/05/24**	**Fri 23/05/25**
125	Trial strategy	10 days	Thu 30/05/24	Wed 12/06/24
126	Trial design	15 days	Thu 13/06/24	Wed 03/07/24
127	Data collection and validation	155 days	Thu 05/09/24	Wed 09/04/25
128	Analysis of customer response and behaviour	155 days	Mon 30/09/24	Fri 02/05/25
129	Network impact modelling	15 days	Mon 05/05/25	Fri 23/05/25
130	**Business case update**	**20 days**	**Mon 26/05/25**	**Fri 20/06/25**
131	Review and refine EQUINOX business case based on Trial findings and simulation modelling	20 days	Mon 26/05/25	Fri 20/06/25
132	**BaU Transition**	**60 days**	**Mon 23/06/25**	**Fri 12/09/25**
133	BaU recommendations and transition	60 days	Mon 23/06/25	Fri 12/09/25
134	Prepare and review Deliverable 6	70 days	Mon 15/09/25	Fri 19/12/25
135	**Workstream 5: Project management and knowledge dissemination**	**1064 days?**	**Tue 01/03/22**	**Mon 30/03/26**
136	**Project management**	**1064 days?**	**Tue 01/03/22**	**Mon 30/03/26**
137	Develop project charter	10 days	Tue 01/03/22	Mon 14/03/22
138	Management of schedule, scope & budget	1001 days	Tue 01/03/22	Tue 30/12/25
139	Project board meetings	1001 days	Tue 01/03/22	Tue 30/12/25
140	Project steering committee meetings	1001 days	Tue 01/03/22	Tue 30/12/25
141	Annual project progress reporting	1001 days?	Tue 01/03/22	Tue 30/12/25
142	Annual progress report 2022	0 days	Fri 25/11/22	Fri 25/11/22
143	Annual progress report 2023	0 days	Fri 24/11/23	Fri 24/11/23
144	Annual progress report 2024	0 days	Fri 22/11/24	Fri 22/11/24
145	Annual progress report 2025	0 days	Fri 21/11/25	Fri 21/11/25



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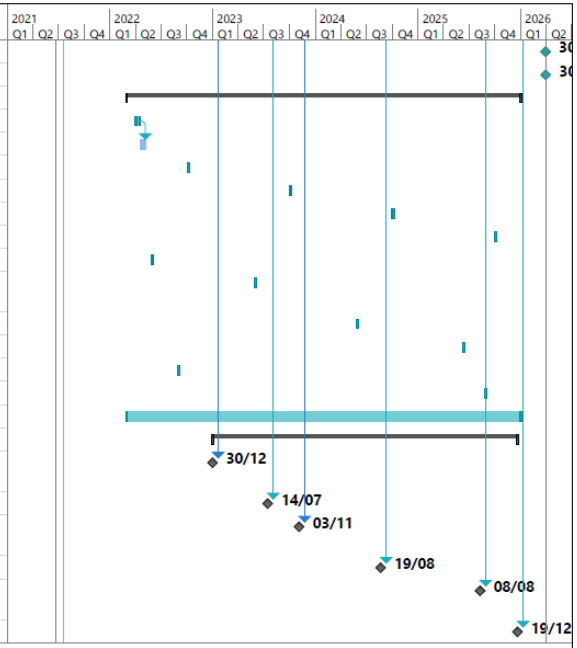
146	Close down report	0 days	Mon 30/03/26	Mon 30/03/26
147	External audit report	0 days	Mon 30/03/26	Mon 30/03/26
148	**Knowledge dissemination**	**1002 days**	**Tue 01/03/22**	**Wed 31/12/25**
149	Develop detailed stakeholder and knowledge dissemination strategy	10 days	Mon 04/04/22	Fri 15/04/22
150	Set up EQUINOX knowledge dissemination site	15 days	Mon 18/04/22	Fri 06/05/22
151	2022 ENIC conference	3 days	Wed 05/10/22	Fri 07/10/22
152	2023 ENIC conference	3 days	Wed 04/10/23	Fri 06/10/23
153	2024 ENIC conference	3 days	Wed 02/10/24	Fri 04/10/24
154	2025 ENIC conference	3 days	Wed 01/10/25	Fri 03/10/25
155	WPD innovation showcase event 2022 (Project Overview)	1 day	Wed 01/06/22	Wed 01/06/22
156	WPD innovation showcase event 2023 (Learning from customer perceptions & initial trials)	1 day	Thu 01/06/23	Thu 01/06/23
157	WPD innovation showcase event 2024 (Detailed design of methods)	1 day	Wed 29/05/24	Wed 29/05/24
158	WPD innovation showcase event 2025 (Trial findings & BaU transition)	1 day	Tue 10/06/25	Tue 10/06/25
159	Project Partner Townhall Event 2022	1 day	Wed 31/08/22	Wed 31/08/22
160	Project Partner Townhall Event 2025	1 day	Fri 29/08/25	Fri 29/08/25
161	Social media posts (LinkedIn, Twitter, & Podcasts)	1002 days	Tue 01/03/22	Wed 31/12/25
162	**Deliverables**	**775 days**	**Fri 30/12/22**	**Fri 19/12/25**
163	Deliverable 1: Customer perceptions on unlocking flexibility from heat	0 days	Fri 30/12/22	Fri 30/12/22
164	Deliverable 2: Initial effectiveness of commercial methods	0 days	Fri 14/07/23	Fri 14/07/23
165	Deliverable 3: Design of novel commercial methods and technical integration	0 days	Fri 03/11/23	Fri 03/11/23
166	Deliverable 4: Learning from trialling novel commercial methods	0 days	Mon 19/08/24	Mon 19/08/24
167	Deliverable 5: Learning from engaging customers on the barriers and enablers of electrification of heat and unlocking flexibility	0 days	Fri 08/08/25	Fri 08/08/25
168	Deliverable 6: Recommended transition of learning to BaU	0 days	Fri 19/12/25	Fri 19/12/25



Project: EQUINOX Project Plan
Date: Mon 19/07/21

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

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10.6. Risk register & contingency plan

Ref	Workstream	Risk Description (there is a risk that…)	Impact (the would be…)	Likelihood *1 - very unlikely* *5 - very likely*	Impact *1 - negligible* *5 - severe*	Risk Score	Mitigation plan
R1	WS4	There is a risk that the project doesn't recruit the targeted 1,000 trial participants	Reducing the number of trial participants will reduce the learning generated and/or reduce the statistical validity of the learning	2	3	6	>EQUINOX will allow multiple suppliers to participate in the trials, thus increasing the possible portfolio of customers. >EQUINOX will leverage additional local government funding from Welsh Gov to increase the potential customers with HPs that are able to participate.
R2	WS4	There is a risk that customers drop out during the project trial	Reducing the number of trial participants will reduce the learning generated and/or reduce the statistical validity of the learning	2	3	6	>EQUINOX will design the trials and consumer engagement to provide additional incentives to prevent drop outs. >EQUINOX will consider learning from prior innovation projects e.g. energywise, within the trial strategy.
R3	WS4	There is a risk that the difficult to reach customers are not reflected in the trial participants and therefore the trial participants aren't reflective of WPD's customer base.	The learning would be limited to a select group of customers therefore the insights wouldn't be fully applicable to all WPD's customers.	2	3	6	>EQUINOX will purposefully aim to include a range of customers within the trials. Welsh Gov will specifically work with social housing landlords to fund equipment within a range of customers and properties.
R4	WS5	There is a risk that Project Partners drop out prior to the project commencing or during project delivery.	A Project Partner withdrawing from the project prior to starting or during the project will likely cause delays to the project.	1	4	4	>During the preparation of the FSP, WPD has conducted detailed discussions with each Project Partner to confirm their role & responsibility in during project delivery. >WPD has considered the commercial stability of each Project Partner to minimise chances of Partners dropping out due to financial issues. >WPD has shared Project Partnership Agreements with the Project Partners during the FSP to ensure Project Partners are broadly aligned with the legal terms & conditions. >Project Partnership agreements will be set out to prevent partner drop outs during project delivery
R5	WS3	There is a risk that customers don't participate in our broad consumer research	The insights from this research would be limited, therefore the learning will be less valuable in designing the commercial arrangements and trials	1	3	3	>WPD has selected experienced organisations with a track record of conducting primary research for a range of customers (incl. fuel poor & vulnerable) in the energy sector. The primary research will involve a range of communications methods to maximise participation from a diverse range of customers. The primary research will not be limited to customers in WPD's licence area or customers with HPs.

Ref	Workstream	Risk Description (there is a risk that…)	Impact (the would be…)	Likelihood *1 - very unlikely* *5 - very likely*	Impact *1 - negligible* *5 - severe*	Risk Score	Mitigation plan
R6	WS3	There is a risk that trial participants don't engage in customer focus groups or bi-lateral interviews designed to gather feedback from trials	The lack of engagement may reflect in a lack of future participation on the commercial arrangements as customer feedback hasn't been fully accounted for in the BaU roll out of EQUINOX.	2	3	6	>WPD has selected experienced organisations with a track record of customer programs and customer engagement to design the various customer engagement channels. To maximise engagement with fuel poor and vulnerable customers, EQUINOX will leverage expertise from the NEA whenever engaging these customer groups. >To maximise participation, EQUINOX will use a range of communication methods to maximise participation from a diverse range of customers.
R7	WS4	There is a risk that the ongoing COVID pandemic or future pandemics reduces the future deployment of HPs as a result of additional lock down measures or social distancing measures.	A delay in installation of HPs within domestic properties may impact the number of customers available for EQUINOX to recruit onto the trial, thus reducing the trial participants and ultimately the reduction in trial learning.	2	3	6	>EQUINOX has a significant base of customers to run the trials with which ensures that even if no further HPs are installed, the project can deliver valuable learning. >EQUINOX does not require all 1,000 trial participants to be onboarded within the first winter trial period, therefore providing a longer time frame for additional HPs to be installed, thus increasing the likelihood of achieving additional installations.
R8	WS3	There is a risk that the ongoing COVID pandemic or future pandemics reduces the ability to run face-to-face consumer workshops	The lack of opportunity to run face-to-face consumer workshops, may prevent certain customer groups in participating, thus reducing the feedback from customers. Ultimately this will reduce the likelihood that the solutions developed meet future customer needs	1	3	3	>EQUINOX can run a number of online consumer focus workshops enabling customers to participate. >The Project Partners have extensive experience in running engaging online workshops throughout the COVID pandemic.
R9	WS1	There is a risk that Project Partners are unable to agree on the commercial and technical design in a timely manner	This may delay the implementation of the project methods and thus the consequent trials.	1	3	3	>The conceptual commercial designs have been agreed during FSP, with the recognition from Project Partners that further detail is required. >Independent organisations are included within the EQUINOX Project Partners to support with driving consensus across the varying Project Partner organisations.

Ref	Workstream	Risk Description (there is a risk that…)	Impact (the would be…)	Likelihood *1 - very unlikely* *5 - very likely*	Impact *1 - negligible* *5 - severe*	Risk Score	Mitigation plan
R10	WS4	There is a risk that customer data is accidently released into the public domain without consent	This will result in a breach of customer trust that may result in trial participants withdrawing. In more severe circumstances, this may result in financial penalties.	1	5	5	>In advance of engaging with customers, EQUINOX will develop the customer data protection assessment and develop an appropriate plan to minimise the risk of any data breaches.
R11	WS4	There is a risk that the HPs malfunction during the trials	This would result in customers dropping out of the trials or not being able to participate in the full trials while the HP is fixed or replaced	1	3	3	>Work with Project Partners, suppliers and stakeholders to ensure that HPs installed meet industry standards >Work with Project Partners to ensure clear accountability for any defects and service level agreements for resolving any defects.
R12	WS4	There is a risk that the smart home monitoring equipment malfunctions.	This would result in customers dropping out of the trials or not being able to participate in the full trials while the monitoring and controls are fixed or replaced	1	3	3	>Work with Project Partners, suppliers and stakeholders to ensure that any monitoring equipment installed meet industry standards >During the commissioning process ensure that all data and controls are fully tested >Work with Project Partners to ensure clear accountability for any defects and service level agreements for resolving any defects.
R13	WS2	There is a risk that when designing and/or implementing the integration and automation between DNOs, suppliers & customers, it is more complex that anticipated in the bid phase.	This would result in potential delays to implementing the design, thus reduing the trial periods, and/or increased costs to implement the necessary design	2	4	8	>Closely monitor any deviations from the conceptual design and understand the impact and value of implementing design decisions on project learning before committing to any decisions.

10.7. Partner Overviews

WESTERN POWER DISTRIBUTION Serving the Midlands, South West and Wales	Western Power Distribution is the DNO responsible for electricity distribution in the Midlands, South West and Wales. Western Power Distribution will be project sponsors for EQUINOX and will be responsible for delivering the full benefits to their customers and to Ofgem.
octopus energy	Octopus Energy is a United Kingdom based retail electricity and gas supplier specialising in sustainable energy. It was established in 2015 as a subsidiary of Octopus Group, a British asset management company. As of February 2021, the company had over 2 million domestic and business customers, as well as providing software services to other energy suppliers.
SP ENERGY NETWORKS	SP Energy Networks are a Distribution and Transmission Network Operator we keep electricity flowing to homes and businesses throughout Central and Southern Scotland, North Wales, Merseyside, Cheshire, and North Shropshire.
passivSYSTEMS	Passiv is a leading provider of operational performance modelling, domestic aggregation, and flexibility services. Its vision is "To be the home decarbonisation technology leader".
Llywodraeth Cymru Welsh Government	The Welsh Government is the devolved government of Wales. The Welsh Government sets their own energy strategies and policies.
West Midlands Combined Authority	The West Midlands Combined Authority (WMCA) is a combined authority for the West Midlands metropolitan county in the United Kingdom. WMCA was created to deliver an ambitious plan to drive inclusive economic growth in the region.
Guidehouse	Guidehouse a consultancy focusing on advisory services on energy, sustainability, and infrastructure. Guidehouse collaborates with utilities, energy companies, investors and large corporations, and government and NGOs to help them thrive in the rapidly changing energy environment.

sero	Sero sits at the intersection of home comfort, construction, and energy. This means they can see how these different aspects can come together to create an easier, cheaper, and lower carbon lifestyle. Sero were founded to fight the climate emergency but believe the way to succeed is through making the right steps progressive and straightforward, whether we're talking about home life, building homes or our energy system.

10.8 Addressing Ofgem's feedback on the EQUINOX ISP submission

Ref	Question	Response
1	Under criterion a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits while having the potential to deliver net financial benefits to existing and/or future network customers; • By the time learnings are available, network licensees will be halfway through the RIIO-2 price control – therefore a staged approach to delivering benefits may be useful, so that some benefits can be realised earlier.	• To ensure that certain learnings and benefits can be realised before project completion, a staged approach has been adopted to the timing of the 6 Project Deliverables – with 3 out of 6 deliverables (customer perceptions, commercial method design, and technical specifications) planned to be completed in 2022 and 2023. [Section 9.] • Our modelling shows that the sharp increase in connections of HP forecast will trigger substantial reinforcement in the later years of ED2. The significant deployment of HPs will continue throughout ED3, during which EQUINOX can play a key role in managing this load and thus facilitating the energy transition and the lowest cost to customers. The completion of EQUINOX by the end of 2025, will provide valuable input to DNOs' ED3 business planning. [Section 4.e.] • Although Direct Benefits are not guaranteed, WPD will work closely with WMCA who are deploying a cluster of approx. 100 to 200 HPs in a neighbourhood that may trigger reinforcement. If reinforcement is triggered, EQUINOX will explore whether with additional oversight of the Methods can be applied to defer reinforcement. [Section 3]
2	Under criterion b) Delivers value for money for electricity customers; • The project needs to consider that NIC funds will not pay for heat pumps, controls, and in-home tech. Although we recognise there is an intention to leverage Local Authority funding and the Green Homes Grant, more certainty is also required as to what value of the actual	• EQUINOX recognises that NIC funds will not pay for heat pumps, thermal storage, controls, and in-home tech. Out of the targeted 800-1,000 customers, the majority are either existing or forecasted growth of HPs from suppliers' customer base (estimated 500 from Octopus Energy) or fully-funded retrofit solutions (500-1,000 from Welsh Government and 100-200 from WMCA). In addition, EQUINOX will seek to trial the methods with other energy suppliers that have customers with HPs. [Section 2.3.3.] • Joint price discovery regarding residential flexibility from low carbon heat, and hence the payment to consumers, is a key aim of the project. Based on the highest value for potential payments shown in WPD's Value

	payments will be going to consumers.	Calculator, an initial estimate of the customer incentive payment equals £22,190/MW, equivalent to about £30 per customer per year. [Section 10.3.]
3	Under criterion c) Creates knowledge that can be shared across energy networks in GB or create opportunities for roll-out across a significant proportion of GB networks; • We would welcome greater detail on the scalability of this project and what the consequences will be of the project ending halfway through ED2. • Further detail will need to be provided on whether every other DNO will have to come up with their own arrangements to implement the solution being trialled within the project. • We also need to understand how knowledge will be shared with other DNOs in a useful manner. • We also recognise that you will work with the ESO in developing the full submission process, but it would also be good to see formalisation of that contribution.	• The commercial and technical solutions developed will be scalable to peer DNOs and alternate energy suppliers, thus reducing roll out costs following successful project completion. For example, EQUINOX leverages the Flexible Power platform—used by other Network Licensees—therefore any learning from using this platform can be transferred to peer DNOs. In addition, by partnering with SP Energy Networks EQUINOX will ensure that the solutions developed and trialled are applicable to other DNOs [Section 4.b., Section 5.] • EQUINOX will trial solutions at significant scale by including multiple energy suppliers, to ensure statistically meaningful results that allow learning to be confidently rolled out across GB DNOs without the need for additional trials. Engagement with energy suppliers other than Octopus Energy is currently ongoing [Section 2.1.3.] • A specific deliverable of WS4 – Project deliverable 6: Recommended transition of learning to BaU – will synthesise and disseminate learning with a view on the transition to BaU. [Section 9] • To increase the likelihood of the EQUINOX learning informing a successful BaU transition to WPD and peer DNOs, EQUINOX will involve BaU stakeholders from WPD's Network Strategy team in the trial design as part of workstream 4. [Section 6] • WPD has engaged with the NGESO in preparation of the FSP. NGESO are supportive of EQUINOX as demonstrated by their letter of support. They will participating in relevant working group sessions as appropriate. [Section 4.d.]
4	Under criterion d) Is innovative (i.e. not business as usual) and has an unproven business case where the innovation risk	• To achieve the target of 800-1,000 customers, EQUINOX will collaborate with Octopus Energy, the Welsh Government, and WMCA. Octopus Energy are confident that

	warrants a limited Development or Demonstration Project to demonstrate its effectiveness; • We would welcome further detail on how conducting the trial of the solution will ensure that they manage to get 1000 customers to sign up and that ensure enough of these customers are in the vulnerable group. • We also need further understanding on BAU rollout after the project is completed. The rollout cannot be funded directly by the NIC, so we need to understand better how this might be achieved.	they can onboard 500 trial participants. [Section 2.3.3.] • EQUINOX has also partnered with the Welsh Government and WMCA. The former has committed to offering 500-1000 retrofitted social housing homes with HPs, thermal storage, and controls, from the "Optimised Retrofit" programme, where retrofitting works have already begun in 1,724 homes. The latter has committed to retrofitting 100 – 200 customers with HPs, thermal storage, and controls using £2-4 million of funding through the Net Zero Neighbourhood framework. Both the "Optimised Retrofit" and Net Zero Neighbourhood programmes have a strong focus on tackling fuel poverty and supporting vulnerable and fuel poor customers. Through partnering with Welsh Government and WMCA – and their respective programmes – EQUINOX ensures that these customer groups are well-represented in its participant population. [Section 2.3.3.] • National Energy Action (NEA) will oversee the design of customer engagement with vulnerable and fuel poor customers, drawing on its extensive experience engaging with these customer segments. [Section 2.3.3] • EQUINOX will use modelling and simulation tools to understand how network benefits of the commercial methods – and therefore their financing requirements and options – scale into BaU. [Section 2.1.1.]

10.9. Letters of Support

Letters of support have been received by a range of organisations. These letters of support reinforce the value of the learning from EQUINOX:

- UK Power Networks
- Scottish & Southern Energy Networks
- Northern Powergrid
- Scottish Power Retail
- National Grid ESO

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for energy consumers

UK Power Networks
Delivering your energy

Registered Office:
Newington House
237 Southwark Bridge Road
London SE1 6NP

Registered in England and Wales No: 3870728

Company:
UK Power Networks
(Operations) Limited

Yiango Mavrocostanti
Western Power Distribution
Pegasus Business Park, Herald Way
Castle Donnington
Derbyshire
DE74 2TU

Date: 5 August 2021

Dear Yiango,

UK Power Networks support for project Equinox

At UK Power Networks we own, operate and manage three of the 14 regulated electricity distribution networks in Great Britain. Our networks deliver electricity to 26 million people (8.2 million homes and businesses) through circa 120,000 distribution transformers and over 100,000 km of low voltage cables and overhead lines. We see a significant increase in the number of homes switching to low carbon heating, with up to 1.2 million heat pumps on our network by 2030. This will bring with it a significant increase in demand, with the best mitigation options not yet fully understood.

One means of minimising this demand increase and mitigating its impact is to use demand side response, or flexibility, as you are doing. We initially explored the potential of 'heat' flexibility through our Low Carbon London project, which projected modest value. However through our more recent research in the heat space, we understand that technical and commercial options for flexibility have matured. Combined with our experience of developing flexibility products for the transport sector, we now believe that it is the right time to reinvest in trials using similar flexibility approaches for low carbon heat.

We are partners with Electricity North West Ltd on their NIC bid Smarter Heat to understand more about the applicability of the network "smart solutions toolkit" and its applicability to domestic heat as a demand type. We also have our own projects and activities in this area to grow our understanding and to ultimately facilitate the net zero transition at lowest cost to our customers.

As such, we are very glad to support your Equinox project, and look forward to hearing of a successful funding award and sharing in what you learn as the project progresses.

Yours sincerely,

Ian Cooper
Innovation Lead – Opportunities and Bids
UK Power Networks

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Scottish & Southern Electricity Networks

POWER CUT? CALL 105

North of Scotland
0800 300 999

Central Southern England
0800 072 7282

SSEN Future Networks
Inveralmond House
200 Dunkeld Road
Perth
PH1 3AQ

30 July 2021

Yiango Mavrocostanti

Innovation Manager

Western Power Distribution

Pegasus Business Park

Herald Way

Castle Donington

Derbyshire

DE74 2TU

Dear Yiango

EQUINOX (**Equi**table **No**vel Flexibility **Ex**change)

I write on behalf of Scottish and Southern Electricity Networks (SSEN) in support of WPDs EQUINOX NIC proposal.

At SSEN we operate and invest in an essential part of the UK's electricity system, delivering power to over 3.8m homes and businesses .Our core purpose is to deliver electricity that powers communities in a safe and reliable way. This is achieved through responsible stewardship of our networks, helping to keep the lights on and investing efficiently in new and existing network infrastructure for the benefit of our customers. Our vision is to play a leading role in enabling the transition to a low carbon world that delivers for all customers. Our foundation as a progressive, innovative and customer-focused organisation will help us be at the forefront of this transition, helping to support the delivery of the UK's net zero emission targets.

The adoption and application of Demand Side Response technologies will be integral to facilitating the wide spread uptake of Low Carbon Technologies and in particularly facilitating the decarbonisation of heat. The EQUINOX project offers the potential to further explore and develop potential solutions which will help

1. Make heat flexibility accessible to all DNOs through the creation of the required commercial arrangements and their trial at scale.
2. Will provide much needed learning on customer behaviour and their willingness to provide flexibility from their heating systems.
3. Help DNOs understand and evaluate the risks related to securing flexibility from heat so that this form of flexibility can be incorporated into BAU practices and planning processes.

Scottish & Southern Electricity Networks

North of Scotland
0800 300 999
Central Southern England
0800 072 7282

The EQUINOX project will build on the existing knowledge base within the industry and will complement our existing innovation work in this area including our 4D Heat project and ReHEAT projects. The proposed NIC project proposed by WPD and their partners will be an essential step in progressing toward commercially viable solutions to the use of flexibility to support the decarbonisation of heat.

If you require any further information please do not hesitate to get in touch , and we wish you every success in your application for this exciting project.

Yours sincerely

Frank Clifton - SSEN Innovation Strategy Manager

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Pegasus Business Park
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Derbyshire
DE74 2TU

4 August 2021

Dear Yiango

Letter of support – Equinox Project

Northern Powergrid is the electricity distribution network operator covering the Northeast and Yorkshire. It operates the local powergrid with 3.9 million domestic and business customers connected. The country's ambitious low-carbon targets mean that the electricity network will play an increasingly important role in supporting society's carbon reduction. There are likely to be increased pressures placed on our network as a consequence of decarbonisation in electricity generation, transport and heating.

As part of the response to these pressures, Northern Powergrid embraces both the need to develop a full understanding of the impact that heat will play in the transition to a low carbon economy and the need to develop a toolkit of solutions to issues arising. The Equinox project goes well beyond the generation of understanding and looks to develop solutions and responses that will be needed once transition begins in earnest. We support the project's objectives which we believe, if successfully delivered, will add a great deal to the number of future options available to distribution companies.

Further the Equinox project will look holistically at heat. Technical objectives are supported by social considerations, such as barriers to participation in heat flexibility, and by economic understanding of potential business models. Moreover, by ensuring that incentives to participate in heat flexibility are aimed at all sectors of society the project, and subsequent roll-out, will ensure that the best value-for-money and equitable outcomes are achieved. This broad approach will also mean that the Equinox deliverables are well developed and suitable for real-world use at the earliest possible time.

We also believe that the Equinox project is complimentary to the, much smaller, activities that we are currently planning to undertake in understanding the impact of the transition to electric heating. Whilst these are only now being mobilised we will ensure that the outcomes of those activities are fed into Equinox.

If the project is approved for funding by the Ofgem, Northern Powergrid will be happy to provide expert advice and support to the project, either through participation in steering, in providing data, reviewing trial designs and outputs, participating in dissemination activities or in any other way deemed helpful to the project.

As Head of Innovation I support the above proposal and I wish you well with your bid.

Yours sincerely

Iain Miller
Head of Innovation

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for energy consumers

SCOTTISHPOWER

Yiango Mavrocostanti
Western Power Distribution
Pegasus Business Park
Herald Way
Castle Donnington
Derbyshire
DE74 2TU

2nd August 2021

Dear Yiango,

Network Innovation Competition (NIC) Submission; EQUINOX (Equitable Novel Flexibility Exchange)

Further to the development of the EQUINOX project, as part of the 2021 Network Innovation Competition, ScottishPower Energy Retail Ltd wish to convey their support for the project and it's aims to advance the commercial arrangements and use of technologies that will enable valuable learning and inform how low carbon heating cannot only enable network flexibility but ensure the uptake of low carbon heating solutions across the residential sector can run at pace.

The decarbonisation of heat across the UK represents both a challenge and opportunity in delivering Net Zero. A whole system and market approach is key to realising the full benefits across all sectors of society to mitigate against barriers that exist not only for the potential in respect of network constraints but equally the economic considerations facing the residential sector of transitioning from tradition heating solutions to low carbon alternatives.

With the advancement of technology and clustering of new technologies such as Heat Pumps, combined with other forms of low carbon technology being deployed across the UK at lower voltage levels, the opportunity to enable DNOs to harness and procure flexibility services from the residential sector is only going to grow that will return longer term benefits to energy consumers by removing existing barriers that if left unresolved will impact the UKs decarbonisation objectives.

Project EQUINOX will provide a suitable learning platform to explore these opportunities and indeed should inform wider questions around the role of market participants and the solutions that they can provide to enable an acceleration in the uptake of low carbon heating solutions but equally how the market will evolve and return the value of flexibility across energy consumers and market participants.

We look forward to engaging with the EQUINOX project as it develops.

Yours sincerely,

Euan Norris
Head of Smart Cities, ScottishPower Smart Solutions
euan.norris@scottishpower.com
Tel: 0141 614 1964 / 07753 623 933

ScottishPower House, 320 St Vincent Street, Glasgow, G2 5AD

www.scottishpower.com

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nationalgridESO

National Grid ESO
Faraday House
Gallows Hill
Warwick
CV34 6DA

10th August 2021

RE: Letter of support for Western Power Distribution's EQUINOX (Equitable Novel Flexibility Exchange) NIC Bid.

Dear Sir/Madam,

Great Britain (GB) is going through a period of major change in respect of its sources of electricity, a journey that continues as we transition to a low-carbon future. Much of the country's electricity needs are now met from renewable resources, which are changing the way the electricity system behaves, creating new challenges for its operation and resilience, not just in the long-term but also over the next few years. The National Grid's Electricity System Operator (ESO) is responsible for day-to-day operation of the GB electricity transmission system, ensuring safe, stable operation and procuring balancing services to enable it.

One element of the energy system transition as modelled through the ESO's Future Energy Scenarios (FES) 2021 is the decarbonisation of heat, the UK government has also announced a 10 year plan to target 600,000 heat pump (HP) installations per year by 2028. Currently there are no established solutions to unlocking flexibility from residential low carbon heat at scale, reliably.

There have been a number of technical innovation projects already in this space including the recently completed ESO-led 4D Heat NIA project looking at a specific use case - explore whether controlling electrified residential heating in Scotland can be used to reduce the curtailment of renewable generation, without adversely impacting SSEN's distribution network. Another ESO-led NIA project, CrowdFLEX, is using Octopus and Ohme Energy's datasets to understand the amount of flexibility that can be provided from households.

The EQUINOX project will be a first in developing commercial arrangements and supporting technologies which unlock flexibility from portfolios of domestic heating assets, while meeting the needs of all consumers, including the fuel poor and those in vulnerable situations. Though the EQUINOX project is focused at a Distributed System Operator (DSO) level, the outputs from this project could contribute to system balancing cost reduction due to better coordination between the DSOs and ESO. The domestic flexibility, if at a large enough scale, would also help the ESO to avoid the procurement of other services (e.g. ancillary services), and alleviate transmission network constraints while having the potential to benefit marginal generation costs too. The ESO also recognises the wider financial and environmental benefits to consumers in undertaking this project.

Though not an active partner in this project, the ESO would like to be attend the project working groups as a stakeholder (attendance dependent on topic and available resource). The ESO does not expect any requirement for the provision of ESO market, system or data access, any such request will be agreed separately. The ESO would be interested in the outputs from the project in understanding the flexibility potential and associated behavioural response from residential low carbon heating. But also the potential market design and participation which would complement some of the ESO's future market design – Operability Strategy.

The ESO supports WPD's EQUINOX project NIC bid.

Yours sincerely

Anna Carolina Tortora

Head of Innovation and Digital Transformation

10.10 Glossary of terms

ADMD	After Diversity Maximum Demand
BaU	Business as Usual
C2C	Capacity to Customers
CBA	Cost Benefit Analysis
CCC	Climate Change Committee
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
EHV	Extra High Voltage
ENA	Energy Networks Association
EQUINOX	Equitable Novel Flexibility Exchange
ESO	Electricity System Operator
FSP	Final Submission Proforma
HP	Heat Pump
HV	High Voltage
ISP	Initial Submission Proforma
LCT	Low Carbon Technology
Low Carbon Heating	Includes heat pump, thermal storage, and controls
LTDS	Long Term Development Statements
LV	Low Voltage
MVA	Megavolt Amperes
NIC	Network Innovation Competition

RIIO	Regulatory price control – Revenue = Innovation + Incentives + Outputs
SPEN	SP Energy Networks
tCO2e	Tonnes of carbon dioxide equivalent
UKPN	UK Power Networks
WMCA	West Midlands Combined Authority
WPD	Western Power Distribution