

EQUINOX

Close Down Report

March 2026

national**grid**

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1. Project Title

EQUINOX (Equitable Novel Flexibility Exchange)

2. Project Background

For information, it should be noted that this is a direct reference to the EQUINOX project Full Submission Proforma in line with Ofgem NIC Governance.

Emissions from residential buildings account for 19% of total UK carbon emissions.¹ 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.² 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. National Grid Electricity Distribution (NGED) expects to have approximately 265,000 HPs in 2023 and 893,000 HPs in 2028,³ 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.

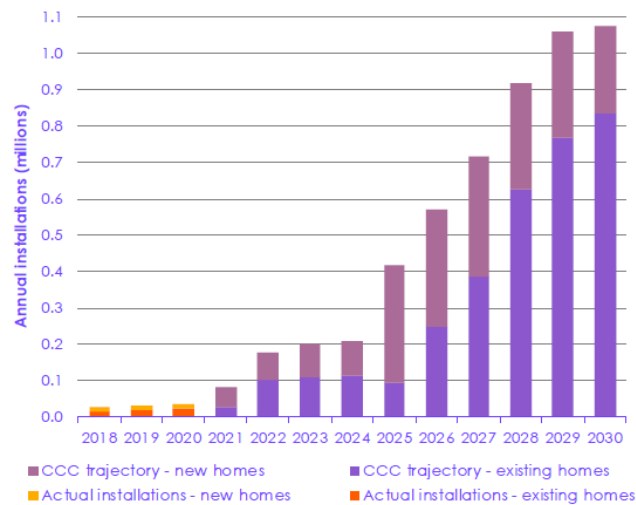


Figure 1 Current HP installation rates in homes set against the CCC’s Balanced Pathway. Source: CCC analysis.

¹ BEIS, (2020). Energy white paper. Powering our net zero future. <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>

² Climate Change Committee, (2021). Progress in reducing emissions. <https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/>

³ WPD RIIO ED2 first draft business plan

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 report⁴ by Imperial College London (ICL) and the Carbon Trust co-funded by NGED highlighted that demand side flexibility incl. domestic and non-domestic could reduce energy systems costs by £4.5bn/yr by 2050. 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.⁵
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.⁶ 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.⁷ 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?' project⁸ 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.

⁴ Carbon Trust & Imperial College London, (2021) Flexibility in Great Britain

⁵ 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>

⁶ 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>

⁷ UK Power Networks (2018) Vulnerable Customers & Energy Efficiency. <https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2019/05/Energywise-Closedown-Report.pdf>

⁸ Centre for Sustainable Energy – Smart and Fair? <https://www.cse.org.uk/projects/view/1359>

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 , 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 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:

Table 1: Project Objectives

Project Objectives	
#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?

3. Executive summary

Background

EQUINOX sought to 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 addition, the project sought to ensure that benefits from flexibility are accessible to all customers, including the 2.4 million households in fuel poverty, which is a significant challenge for all networks. The Centre for Sustainable Energy's 'Smart and Fair?' project⁹ 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.

Scope

To unlock the potential flexibility from a portfolio of low carbon heating assets from domestic customers, DNOs need to develop the appropriate incentives that can 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 remains 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 Partners¹⁰, NGED identified three commercial arrangements that it was felt could unlock flexibility from residential low carbon heating for the DNO and the supplier in a cost-effective manner. These arrangements would 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.¹¹ provided an overview of the interactions between the stakeholders involved.

All three commercial methods would be based on the proposition that NGED 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 used differed in their approach to the distribution of risk and reward across the various market participants. These differences would be expressed through variations in terms of direct vs. indirect control, payment structure, dispatch method, and level of delivery risk across the value chain. Table 2 describes the different methods at a high level and the detailed design of the arrangements were developed collaboratively with key consumer groups during the project.

⁹ Centre for Sustainable Energy – Smart and Fair? <https://www.cse.org.uk/projects/view/1359>

¹⁰ EQUINOX project partners and collaborators are Guidehouse, Octopus Energy, Sero, ScottishPower, Passiv UK, West Midlands Combined Authority, Welsh Government, SP Energy Network. National Energy Action and National Energy System Operator.

¹¹ 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>

Table 2: Methods under trial

Method	Description
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).

Outcomes

Section 5 provides a full breakdown of the EQUINOX outcomes but in summary, EQUINOX trialed heat pump flexibility across three winters. Each trial was based on the learning from the preceding trial and design was driven by National Grid DSO.

Trial One was a Proof of Concept designed to test the end-to-end process without having a target number of customers in mind. Table 3 contains some high-level notable outcomes; further information can be found in Section 5:

Table 3: Trial One Outcomes

Learning Area	Outcomes
Response	<p>On average, 0.77 kW/ 1.53 kWh of demand response detected over 22 events for Octopus Energy customers with manual/remote control heat pumps, and typical household insulation.</p> <p>On average, 0.31 kW / 0.61 kWh for Sero customers with automated control heat pumps, and high household insulation and therefore lower energy consumption.</p>
Satisfaction	92% of participants reported being satisfied with the trial ¹² .
Comfort	95% (n=255) of households never or only sometimes felt a change in comfort during events ¹³ .

¹² Participants were asked 'Overall, how satisfied were you with the EQUINOX trial?' in the end of trial survey.

¹³ Participants were asked 'How frequently did participating in EQUINOX event cause any discomfort for you or someone else if the households?' in the end of trial survey.

Trial two was larger and more comprehensive than trial one. It produced more detailed findings for the potential scalability of domestic heat pump flexibility, including detailed lessons learnt for effective engagement of customers and the optimal way that heat pumps can be dispatched to support networks. All of these learnings can be found in the reports detailed in Section 15. Table 4 contains some high-level notable outcomes; further information can be found in Section 5:

Table 4: Trial Two Outcomes

Learning Area	Outcomes
Response	On average, 0.61 kW / 1.2 kWh demand response per participant across 36 events, equivalent to 48% of the average participating home's peak demand.
Satisfaction	79% (n=636) of participants reported being satisfied with the trial.
Comfort	92% (n=636) of households never or only sometimes felt a change in comfort during events.

Trial three sought to address the remaining evidence gaps in defining the potential of heat pump flexibility at scale. Its scope was divided across five mini-trials with different focuses, more information on these is included in Section 5. Table 5 contains some high-level notable outcomes; further information can be found in Section 5:

Table 5: Trial Three Outcomes

Learning Area	Outcomes
Response	6 separate trials were undertaken all with various outcomes in mind. Broadly, all events had strong participation rates and there were some additional value add findings on vulnerable customers as this was a particular area of focus. More information on each trial can be found in Section 5.
Satisfaction	79% (n=552) of participants reported being satisfied with the trial.
Comfort	88% (n=552) of households reported no or slight impact on the comfort of their home.

Objectives and Project Deliverables

The EQUINOX project successfully met all of its objectives and success criteria. Tables 6 & 7 provide outcomes against each.

Table 6: Objectives

Objective	Outcome
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?	Achieved
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?	Achieved
Technical Integration: What technical integration and automation is required to deliver a seamless customer experience?	Achieved
Market Design and Participation: How can DNOs, energy suppliers, and the ESO align their objectives to participate in DNO flexibility markets?	Achieved
Just Transition: How do DNOs ensure that fuel poor and vulnerable customers have an equal opportunity to participate in flexibility services?	Achieved

Table 7: Project Deliverables

Reference	Project Deliverable	Deadline	Status
1	Customer perceptions on unlocking flexibility from heat [WS3]	Dec 2022	Submitted – December 2022
2	Initial insights on effectiveness of commercial methods [WS1 & WS4]	Jul 2023	Submitted – July 2023
3	Design of novel commercial methods & technical integration [WS1 & WS2]	Nov 2023	Submitted – November 2023
4	Learning from trialling novel commercial methods [WS4]	Aug 2024	Submitted – August 2024
5	Learning from engaging customers on the barriers & enablers of the electrifications of heat and unlocking domestic flexibility [WS3]	Aug 2025	Submitted – August 2025

6	Recommended transition of learning to BaU [WS4]	Dec 2025	Submitted – December 2025
N/A	Comply with knowledge transfer requirements of the Governance Document.	End of Project	Complete – this report forms the final element of this requirement.

Learning generated

EQUINOX generated lots of valuable learning, some key highlights and how they can and have been used are detailed before. More can be found in Section 15 and on the EQUINOX website, where all webinars, Horizon Scan's and reports including Progress Reports, key deliverables and associated reporting can be found. Some of key learning fell into the following categories and areas:

- **Customers** - customers can reliably provide flexibility from their Heat Pumps
- **Commercial Arrangement** - simple and well-structured arrangements are effective for customers.
- **Communications** - clear and simple communications to customers are key to engagement and maintaining that level needed for the delivery of these services.
- **Flexibility Procurement Strategy** - The evolution of the EQUINOX flexibility proposition demonstrated the value of running pilot tests, designing around clear hypotheses, and understanding how household characteristics shape flexibility potential. The results bear this out and more on this can be found in [Deliverable 6: Transition of learning to Business as Usual](#).
- **Technical Integration** - leaning on using the existing approaches to flexibility procurement enabled the project to have early momentum.
- **Data Collection** - having clear robust processes for the management and collection of data is essential.
- **EQUINOX trial three's Turn Up Flex trial** - this demonstrated that domestic DTU from heat pump homes could be a promising tool for networks and now forms part of NGED's product offering.
- **EQUINOX findings** have demonstrated that tailored market designs for heat pumps are not necessary.

In addition, key learning from the project included:

- EQUINOX proved that DSO's can procure flexibility from Heat Pump customers. The results of the trials showed that customers were able to provide a consistent demand side response service and that it was reliable and moreover cost effective.
- Using existing arrangements from business processes and I.T. reduced the level of friction in terms of gaining customer buy in, ensuring that throughout, the project was able to draw on as wide a pool of customers as possible. Feedback from customers throughout the trials was consistently strong borne out by the number of Heat Pumps customers that are now participating in Flexibility Services.
- Using Flexibility Service Providers to connect with the customer rather than work around them, ensured that messaging was clear and consistent. This was important because historically customer engagement has been difficult in trials where supplier engagement was not present.

Version control

Issue	Date
d0.1	30th December 25
d0.2	5th January 2026
d0.3	19th February 2026
d0.4	10th March 2026
V1.0	27th March 2026
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4. Details of work carried out

The EQUINOX project was designed as a multi-year project to assess and demonstrate the feasibility of domestic heat pump flexibility at scale. This was done through three trials delivered between 2022 and 2025. Through the three trials, the project combined trial deployment with iterative refinement, reflecting a deliberate “learning by doing” approach where each winter trial was shaped by insights from the previous trial. This structure enabled EQUINOX to progressively expand the scope, complexity, and realism of the trials while ensuring that customer experience, network impact and commercial viability were assessed at each stage.

Project delivery was organised across five interconnected workstreams, each contributing specific elements to ensure that trial design, implementation and evaluation were robust and aligned with project objectives.

Workstream 1 – Commercial arrangements: Developed, refined and tested commercial arrangements across all three trials, tailoring arrangements to evolving trial and market insights.

Workstream 2 – Technical integration and automation: Developed the technical infrastructure required to deliver the trials.

Workstream 3 – Customer engagement and experience: Led participant recruitment and engagement throughout the trials. Delivered interviews, focus groups and surveys to ensure that customer needs, satisfaction and barriers were central to trial evolution.

Workstream 4 – Trials: Deployed trial design and tested the suitability of commercial arrangements designed in workstream 1. Analysed consumer behaviour and demand response results from the trials to quantify outcomes.

Workstream 5 – Project management and knowledge dissemination: Coordinated project governance, deliverables and the dissemination of learnings across stakeholders.

Together, these workstreams enabled EQUINOX to successfully deliver three winter trials. Collectively, the trials explored the potential of domestic heat pump flexibility across a technical, commercial, and customer experience lens, establishing evidence for the role of heat pumps as reliable flexibility assets to support GB networks.

Figure 2 below provides an overview of the EQUINOX project, illustrating the timeline, participant numbers, and scope of each annual phase.

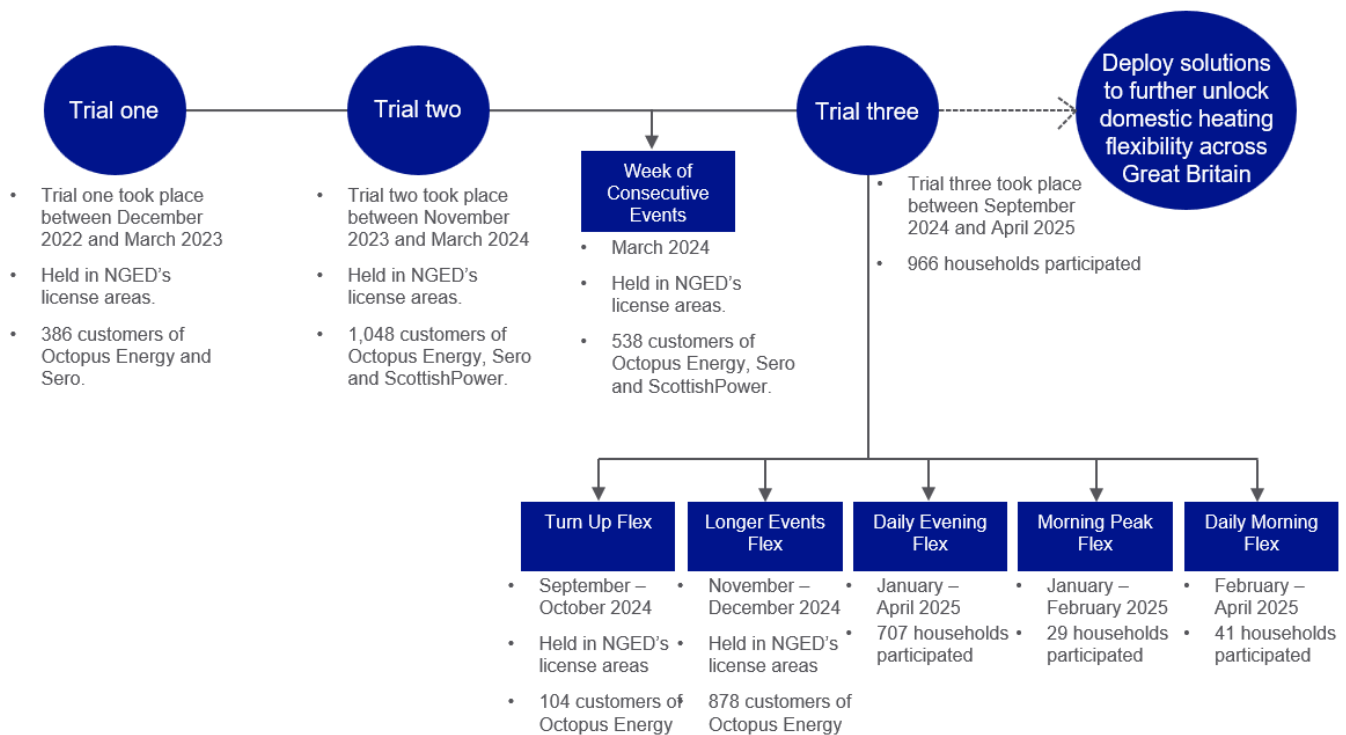


Figure 2: Timeline of EQUINOX trials 2022-25

The following sections describe each trial in detail, outlining the approach and design for each. Additionally, all three trials undertook customer recruitment, research and technical integration.

- Section 4.1 describes trial one commercial arrangements, design and evaluation methodology.
- Section 4.2 describes trial two commercial arrangements, design and evaluation methodology.
- Section 4.3 describes trial three commercial arrangements, design and evaluation methodology.
- Section 4.4 describes the customer recruitment process across all three trials.
- Section 4.5 describes the customer research undertaken across all three trials.
- Section 4.6 describes the method for assessing potentially vulnerable customers and its evolution across all three trials.
- Section 4.7 describes the technical integration approach across all three trials.

4.1 Trial one

Trial one served as the “pipe cleaner” for UK’s first large-scale demonstration of domestic heat pump flexibility:

Over winter 2022–23, around 400 households took part in 22 two-hour “turndown” events on non-consecutive weekdays between 5–7pm, aligning with the GB evening peak electricity demand. Participants were asked to reduce their heat pump electricity use and were rewarded through either a “pay in advance” model (upfront reward for anticipated turndown) or “pay as you earn” (reward per event based on achieved turndown). Participants were Octopus Energy and Sero customers located in NGED’s license areas.

Trial one was the initial proving for heat pump flexibility as a viable customer asset for network management. It showed that domestic heat pumps represent a valuable flexibility asset-base and provided lessons learnt for optimising participation in flexibility programmes. The trial tested the end-to-end process and was not expected to be at scale; however, it was encouraging that this first trial attracted so many customers.

4.1.1 Trial one commercial arrangements

We tested two commercial arrangements in trial one, which were developed based on twelve guiding principles, which are detailed below in Table 8. The guiding principles are listed in order of importance as decided by the commercial arrangements workstream, with customer satisfaction being the highest priority in the design of commercial arrangements.

Table 8: Trial one guiding principles

Guiding principle	Description
Customer satisfaction	Customers should trust their supplier and feel empowered to strive for material benefits from the commercial arrangements. Customers should be encouraged to participate through incentives and not anything that could be perceived as punitive.
Measurable impact	Flexibility provided on individual and aggregated household basis needs to be measured to understand micro and macro impacts delivered by the arrangements.
Customers kept safe	Trial one must not put any customers in positions of unsafe living conditions.
Scalable	Commercial arrangements should be scalable across the UK.
Customer comfort	Arrangements must not cause major disruptions to routines or result in large changes in home comfort levels.
Statistically significant results	Trial one should aim for sufficiently large samples across important customer groups (e.g. customers experiencing vulnerabilities).
Simple design	Arrangements should be easy to understand, consistent across customers regardless of localised network impact, and use existing National Grid services (e.g. Flexible Power).
Close reflection of reality	Arrangement design should closely reflect reality to gain insights into realistic customer behaviour. This includes aligning to realistic contractual and procurement arrangements where the network only interacts with the supplier/aggregator.
Transparent	All stakeholders should be open with their thoughts in the design process.

Iterative process	Arrangement designs should be adapted for future trials based on results and customer feedback.
Stakeholder neutral	Arrangement benefits should be spread evenly across stakeholder groups.
Ambitious	Trial should be ambitious, innovative, and push boundaries.

These principles drove the design process for trial one and led to multiple high-level decisions which applied across both trial one commercial arrangements. These guiding principles were also used as the principles for trial two and three's commercial arrangements design.

To meet the customer satisfaction, scalable, close reflection of reality, and simple design guiding principles, it was decided that only flexibility from customers with an electricity smart meter operating in smart mode could be procured by suppliers/aggregators. The reasoning was¹⁴:

- The effort required to estimate the flexibility provided by households without smart meters providing half-hourly readings was deemed too complex, particularly since it would rely on customers providing readings manually both before and after each flexibility event. The reliability of this method could not be guaranteed and would likely have caused inconvenience to customers taking part.
- The growing GB domestic flexibility space is being built on smart meter data from customers. This is a common requirement to other services like National Energy System Operator (NESO)'s Demand Flexibility Service (DFS). Requiring participating customers to have a smart meter is therefore reflective of the reality of domestic flexibility provision.
- The project aligned on not requiring participating households to have any additional equipment installed as part of the trial process such as asset level metering. This was to reduce perceived inconvenience for customers and hence maximise the number of sign-ups to trial one. For this to work, participating households would therefore need to have a smart meter to provide measurable and analysable data, meeting the measurable impact guiding principle.

To meet the simple design and measurable impact guiding principles, customers signed up to EQUINOX trial one could not participate in any other flexibility trials or services running throughout winter 2022/23, such as Octopus Energy's *Saving Sessions* product for the DFS. The reasoning was:

- Since trial one was a proof of concept for commercial-scale UK demand flexibility from residential heating, the data gathered needed to be as robust as possible. If households were on multiple flexibility schemes at the same time, this could have introduced biases, such as behaviourally prioritising one scheme over the other, which would have made it more difficult to isolate the demand flexibility impact from EQUINOX.
- In its initial winter, the DFS terms of service excluded customers who were already participating in other flexibility market services, such as Constraint Management. Restricting customers in the EQUINOX trial from participating in multiple services was in line with this approach and facilitated a simpler trial design for EQUINOX trial one.

¹⁴ See full report: [Initial Insights on the Effectiveness of Commercial Methods](#).

To meet the close reflection of reality guiding principle, the Flexible Power platform was used to notify Octopus Energy and Sero of upcoming events.

In trial one, we tested two commercial arrangements. Across both arrangements, payments were higher than the market rate as this was a proof-of-concept trial. In trials two and three, the payments were adjusted to be closer to the market rate. M1, save in advance was where the energy supplier, and in turn the end-customer, receive an upfront flexibility payment in return for offering a fixed, minimum obligation of flexibility. M2, save as you go was where the energy supplier, and in turn the end-customer, are not committed to a fixed, minimum obligation of flexibility but instead receive payment for the flexibility they provide.

This decision to pay customers based on participation without regard for the kWh of flexibility provided influenced the variables that could be tested by trial one commercial arrangements. A variable that could be tested between groups was the stage at which customers were paid throughout the trial. In trial one, customers could either be paid before or after events. This formed the basis for M1 – save in advance and M2 – save as you go.

The two commercial arrangements designed for trial one, M1 and M2, are summarised in Table 9 below.

Table 9: Trial one commercial arrangements

Property	M1 – Save in advance	M2 – Save as you go
Premise	Pre-event payment.	Post-event payment.
Payment structure	Customers were paid £25 monthly instalments in advance of that month's events for their assumed participation in them.	Customers were paid up to £6 per event after the event if they participated.
Fixed vs variable payments	Fixed regardless of level of flexibility provided.	Variable payment based on length of time heat pump is off (and therefore reliability of participation). For the first 13 trial one events: £0 if customer did not participate. £6 if customer participated for 0.5 to 2 hours. For the final 9 trial one events: £0 if customer did not participate. £4.50 if customer participated for 0.5 to 1.5 hours. £6 if customer participated for 1.5 to 2 hours.
Payment timing	Customers paid towards the start of the month, credited to monthly electricity bill.	Customers credited to bill weekly/monthly (depending on supplier) after that week/month's events, though participants can still see a breakdown of credit received for each individual event.

Eligible technology	Air source and ground source heat pumps – both customer controlled and aggregator controlled, also known as Direct Load Control (DLC).
Event timing	5-7 pm any weekday.
Event duration	2 hours.
Event frequency	2-3 events per week.
Customer notice	Day ahead of events; reminder two – three hours before.
Aggregator notice	Informed by National Grid on Thursday of the following week's events.
Conditions	Continual payment conditional on engagement via participation in events and responding to post-event surveys.

A key aspect of EQUINOX is to design commercial arrangements that unlock flexibility from residential low carbon heating, while meeting the needs of all consumers, including those with vulnerabilities. The trial one commercial arrangements were designed with equity in mind. M1 gave customers with vulnerabilities more flexibility in how they participate, as they could choose whether and for how long they participated in each event while knowing they have already been paid. M2 ensured a £4.50 base payment for participating for only 30 minutes, which was intended to prevent customers with vulnerabilities from keeping their heat pump off too long for comfort and safety while ensuring they could receive meaningful payment for their contribution. Across the trial, pay per event households provided marginally more turndown than pay monthly households.

4.1.2 Trial one event design

The main trial period ran from January to March 2023, in which participants experienced an average of two to three events per week. In addition to payment type and control method, temperature was a key variable explored during trial one. Therefore, event days were chosen on a weekly basis by considering the external temperature forecast for the following week.

The choice of event days for the following week was driven by the following three requirements.

- To better understand the impact of temperature on demand response, a range of temperatures needed to be captured across the 22 events in trial one. In particular, the coldest days of the year needed to be adequately captured. Therefore, the coldest forecast days were prioritised when choosing event days for each following week. However, this requirement is limited somewhat by the second requirement.
- To favour an accurate baseline of household heat pump usage before considering the impact of demand response, the number of coldest days which were non-event days had to proportionately equal the number which were event days. For every very cold day (<0°C) chosen to be an event day, another similar day should not be an event day. This is because household heat pump kWh consumption is likely to depend on temperature even before demand response is considered.

- To understand how participating households responded to a range of requests, the days of the week on which events were scheduled were varied from week to week, whilst accounting for the first two requirements above. This included two instances of event days being scheduled consecutively, to see whether participation levels would drop for the second day.

With these three principles in mind, weekly meetings were held on Wednesdays where we selected two to three event days for the following week using the week ahead weather forecast. During each Wednesday meeting, we:

- Used the tracking spreadsheet to gauge which temperature range(s) required more event days and look for temperatures within this range in the following week's Monday to Friday forecast.
- Used the average 4pm to 8pm forecast temperatures to choose two to three event days which met this criterion.
- Ensured that the non-event days chosen maintained a proportional balance between event days and non-event days at similar temperatures.
- Made any adjustments to the chosen days as needed.

Sero and Octopus Energy were then informed of the two to three days chosen to be event days the following week. This gave them plenty of time to prepare the necessary operational elements such as 24-hour messages to participating households informing them of an upcoming event. Following events, Sero and Octopus Energy provided us with an initial estimate of how many of their recruited participants provided flexibility for that event (rather than opting out) via a separate shared spreadsheet.

4.1.3 Trial one evaluation

To calculate demand response, both Octopus Energy and Sero used historical customer consumption data (half-hourly granularity) to predict a customer "baseline" that represented the counterfactual on an event day i.e. what consumption would have been expected from each household if the event had not occurred. Demand response impact was then calculated by deducting the observed consumption (during an event) from the expected consumption (the baseline prediction).

The baselining method used for trial one uses the P376 method¹⁵ for using the ten previous non-event weekdays (excluding holiday days, up to a maximum of 60 days back from the event day) to calculate a projected baseline consumption for each half hour of the event day. The ten eligible days were averaged (weighted equally) by settlement period to produce an unadjusted daily baseline profile. An in-day adjustment was included to indirectly account for weather effects. In the DFS baseline calculation, the four hours previous to an event are used to determine the in-day adjustment. The observed consumption for the first three of those four hours (event minus 4 hours to event minus 1 hour, the 'in-day reference window') is compared to the corresponding baseline values and the difference is averaged and then added to the baseline projections for the event period. The last of those four hours (event minus 1 hour to event start) is excluded from the in-day adjustment calculation (a 1 hour 'exclusion window').

¹⁵ The P376 baseline method constructs a personalised historic baseline for each participant based on the average of their consumption on the last 10 similar non-event days (for weekdays) or the last 4 similar non-event days (for weekends and holidays): See Elexon [report](#) for full details of the P376 method.

For EQUINOX trial one, this method was tested with a three-hour exclusion window (event minus 6 hours to event minus 3 hours as the in-day reference window, and event minus 3 hours to event start as the exclusion window). This method was suggested as a way to exclude anticipated customer preheating behaviour from the in-day adjustment period.

Interim analysis performed after the first three trial one events indicated that the absolute mean error of the baselining method (a measure of difference between baseline and observed consumption) was improved by reverting to the same one-hour exclusion window that was used in DFS. Further adjustments were made to adjust the length of the in-day reference window, finding that a one-hour window (rather than a two- or three-hour window) further reduced the mean absolute error of the baseline. This method was adopted by both suppliers for analysis of trial one data.

To recap, both suppliers adopted the following baselining method for trial one analysis. P376 baseline, which is the mean consumption of the previous ten similar non-event days, per half hourly period with added in-day adjustment; the difference between baseline and observed consumption at event minus 2 hours to event minus 1 hour.

Both Octopus Energy and Sero applied the same baselining approach to whole household consumption, with Sero also applying it to the isolated heat pump consumption. Sero also considered another baselining approach called Linear Regression, which performed to the same level as the adjusted P376 approach.

4.2 Trial two

Trial two expanded the scope (based on learning gathered in trial one), scale, and commercial realism of EQUINOX:

- Conducted over winter 2023–24, more than 1,000 households participated in 36 two-hour events held between 4–8pm, with varying notice periods to assess responsiveness.
- Incentives were based on utilisation payments (£/kWh) for verified demand reduction¹⁶ against a P376 historical baseline, which compares actual and forecasted consumption over equivalent prior weekdays.
- A small cohort of third party-controlled participants additionally received an availability payment. Payment rates were aligned with NGED's Secure and Dynamic¹⁷ flexibility products to test response to commercial incentive levels.
- Participants were Octopus Energy, Sero, and ScottishPower customers located in NGED's license areas.

¹⁶ Verification of demand reduction against their [P376 baseline](#). This method uses the last 10 non-event weekdays to generate an average consumption value per settlement period, resulting in a half-hourly baseline demand profile for an event day. A participant's demand response is calculated by deducting their observed electricity consumption from their baseline consumption.

¹⁷ It should be noted that since the trials, definitions and descriptions of services have been updated via the ENA

4.2.1 Trial two commercial arrangements

Trial two aimed to better understand the amount of aggregated flexibility that can be procured from domestic heat pumps. Where trial one showed that demand response could be measurably achieved, trial two assessed the drivers of that demand response. The magnitude and consistency of participants' demand response was therefore evaluated across various factors of interest to identify which had statistically significant impacts. These factors included payment premise, heat pump control type, event notice period, external temperature, event timing, and participants' electricity tariff type. The above factors were tested across three commercial arrangements: M1, M2, and M3. These are summarised in Table 10 below¹⁸.

Table 10 Trial two commercial arrangements

Commercial arrangement	M1	M2	M3
Payment structure	High utilisation payment (per kWh).	Low utilisation payment (per kWh).	Availability payment + medium utilisation payment (per kWh).
Control type	Manual and remote customer control.		Aggregator controlled.
Notice period	Day ahead, morning ahead, two hours ahead.		Day ahead, morning ahead, no notice.
Payment amounts	<ul style="list-style-type: none"> Day ahead: £0.80/kWh. Morning ahead: £1.60/kWh. Two hours ahead: £2.40/kWh. 	<ul style="list-style-type: none"> Day ahead: £0.40/kWh. Morning ahead: £0.80/kWh. Two hours ahead: £1.20/kWh. 	<ul style="list-style-type: none"> Day ahead: £0.50/kWh. Morning ahead: £1.00/kWh. No notice: £1.50/kWh. Availability payment: £8 upfront per participant.
Eligible supplier tariffs	Any tariff.	Any tariff.	All M3 participants were on a tariff of interest.
Participation approach	Participants opted into events.		Participants opted out of events.
Event duration	Two hours.		
Event timing	Between 4-8 pm any weekday.		

Each participant was assigned to one arrangement. As 10 shows, some of the above factors of interest, like payment structure and heat pump control type, varied in specific ways between M1, M2, and M3. Other factors like temperature and event timing were explored across all three arrangements.

¹⁸ See full report: [Learning from trialing novel commercial methods](#)

4.2.2 Trial two event design

We used the following approach to schedule and manage trial two events:

A weekly event schedule was finalised before trial two began. This minimised administrative burden for suppliers as it meant the suppliers knew for each event which group of participants (A or B) would be the treatment group (further described in section 4.2.3), what the notice period would be, and what time the event would start.

Heat pumps have a lower coefficient of performance in colder weather and have to act against a greater temperature gradient to warm spaces to the desired set point. These elements combine such that heat pumps use more energy on colder days. Conversely, households may be less inclined to opt into an event on a colder day, out of concern that their homes may become too cold. We therefore held events across a spread of temperatures throughout the winter to see how these two factors interacted, and how demand response and external temperature were related. We scheduled event days to cover the widest possible spread of temperatures, based on the forecast for the week ahead. Forecasts were checked regularly to identify cold periods and we had the ability to schedule contingency events if needed. Nevertheless, the relatively mild winter limited the number of cold days ($<3^{\circ}\text{C}$) that events could be held on.

Similarly to trial one, EQUINOX events were scheduled based upon a week ahead weather forecast. The forecast was collected in the form of hourly external temperature. Bristol was chosen for the main forecasting location, given it was reasonably central across National Grid's license areas. Weather stations in Plymouth and Birmingham were also tracked to see whether there were large temperature variations across the license areas. Hourly temperatures for the weekdays of the following week were extracted for these three weather stations and stored on a tracking spreadsheet. The average temperature at the Bristol weather station between 4-8pm was calculated in addition to the average temperature for the whole day.

On each Wednesday, we:

- Used the tracking spreadsheet to select which temperature range(s) required additional event days and look for temperatures within this range in the following week's Monday to Friday forecast.
- Used the average 4-8pm forecast temperatures to choose two event days which met this criterion.
- Ensured that the non-event days chosen were ensuring a proportional balance between event days and non-event days at similar temperatures.
- Made any adjustments to the chosen days as needed.

On each Thursday before noon, we:

- Accepted the availability windows on the chosen event days at the times stated on the event timetable, for the chosen trial groups.

The suppliers were then informed of the chosen event days for the following week via email.

For each event, suppliers:

- i. **Informed treatment group of events:** Before each event, suppliers reached out to that event's treatment group participants to inform them of an upcoming event. Suppliers sent these communications in line with that event's notice period. M1 and M2 participants were asked to turn down their heating during the event. M3 participants were told their heating would be automatically turned off during the event.
- ii. **Collected opt ins and opt outs:** M1 and M2 participants were asked in the event invitations to opt into the event. M3 participants were asked to opt out of the event, so that their supplier knew not to automate their heating on that occasion. This explicit opt in/out approach helped suppliers to better understand which participants were eligible for post-event payment.
- iii. **Held event:** The suppliers received a dispatch signal from NGED via the Flexible Power platform. This informed them of the event start. Each supplier had someone on hand to respond to any queries or concerns from participants during the event.
- iv. **Sent post-event survey:** All treatment group participants, including those who had not opted in (M1/M2) or opted out (M3), received a short survey via email immediately after the event. As detailed further in Section 4.5, this gathered information on participants' immediate experience of the event.
- v. **Settled utilisation payments with participants:** Suppliers paid participants who had opted in and provided measurable demand response. Payments aligned with the relevant £/kWh rate afforded by their assigned commercial arrangement and that event's notice period.

4.2.3 Trial two evaluation

Trial two was implemented as a crossover Randomised Controlled Trial (RCT), wherein participants are randomly assigned to two groups (referred to as 'group A' and 'group B') each consisting of around half of the total participant pool. Although the participant's group does not change during the trial, each group switches between being the control or the treatment group depending on the event day. In this way, each event has around half of trial participants in the treatment group and half in the control group.

This design is known to produce an unbiased estimate of an intervention's true impact on outcomes. Because participants are randomly assigned into a treatment group or a control group, they are expected to be equivalent in every way except programme treatment. In this case, programme treatment is the receipt of notifications of trial two demand response events. As such, any differences between the treatment group and the control group observed in the trial period are assumed to be the result of the events. Although the crossover RCT approach introduces a risk of behavioural 'spillover', where having previously been in the treatment group causes ongoing changes during periods where that participant is then in the control group, it was felt to be the most appropriate approach for maximising the number of active participants in trial two.

Difference in Difference (DiD) demand response approach

Following industry best practice for evaluating RCT programmes, suppliers leveraged a DiD approach for calculating demand response. DiD approaches provide an unbiased estimate of programme demand response when energy consumption from the entire treatment group is compared to the entire control group for each event. This is known as the intent-to-treat (ITT) effect. Equation 1 below provides the DiD

specification used for EQUINOX Trial two to calculate an unbiased estimate of demand response for each event. Equation 2 details the calculation of uncertainty (standard error).

Equation 1: DiD demand response calculation¹⁹

$$\text{Demand response} = \left[\text{mean}(\text{observed demand}_{\text{treatment, event}}) - \text{mean}(\text{observed demand}_{\text{control, event}}) \right] - \left[\text{mean}(\text{observed demand}_{\text{treatment, non-event}}) - \text{mean}(\text{observed demand}_{\text{control, non-event}}) \right]$$

Equation 2: DiD standard error calculation²⁰

Demand response standard error

$$= \sqrt{\frac{\text{Variance}(\text{observed demand}_{\text{treatment, event}})}{\text{Customer count}_{\text{treatment, event}}} + \frac{\text{Variance}(\text{observed demand}_{\text{control, event}})}{\text{Customer count}_{\text{control, event}}} + \frac{\text{Variance}(\text{observed demand}_{\text{treatment, non-event}})}{\text{Customer count}_{\text{treatment, non-event}}} + \frac{\text{Variance}(\text{observed demand}_{\text{control, non-event}})}{\text{Customer count}_{\text{control, non-event}}}}$$

Treatment group participants in M1 and M2 were deemed to have delivered demand response for an event if they both opted in when informed of the event and reduced their energy consumption during the event as per Equation 1. This was similar for treatment group participants in M3, except they had to not opt out when informed of the event, rather than opting in. Given these opt-in requirements for analysing the treatment group, the treatment effect on the treated (TOT) can be calculated from the demand response value estimated using Equation 1 by scaling that value by the opt in rate, as defined in Equation 3.

Equation 3: Opt-in rate calculation

$$\text{Opt in rate} = \frac{\text{Number of participants opted in and showing energy reductions during the event}_{\text{treatment, event}}}{\text{Number of participants called to participate}_{\text{treatment, event}}}$$

¹⁹ Observed Demand = household consumption in kWh; Treatment = group of customers called to participate during an event; Control = group of customers not called to participate; Event = time frame during which consumption was averaged across the treatment or control group of customers on event days; Non-event = time frame during which consumption was averaged across the treatment or control group of customers on non-event days.

²⁰ Variance = statistical measure quantifying estimate uncertainty; Customer count = number of customers called during event.

Customer Settlement

For customer settlement purposes, a personalised, historical baseline ('baseline') approach was implemented. The baseline approach balances between the best-in-class accuracy that the crossover RCT approach can provide in determining the magnitude and statistical significance of any demand response provided during EQUINOX events, and the individualised approach that is needed to calculate the demand response performance of individual customers so that they can be promptly paid their performance incentive.

In accordance with wider industry practice, the P376 methodology, without in-day adjustment, was chosen for generating baselines. In trial one, the in-day adjustment was used to account for potential weather variations between the baseline days and the event day. This was proven to not be required in trial one and was therefore not used in trial two. This method uses the last 10 non-event weekdays to generate an average consumption value per settlement period, resulting in a half-hourly baseline demand profile for an event day. A participant's demand response is calculated by deducting their observed electricity consumption from their baseline consumption. Demand response achieved during an EQUINOX event is multiplied by their utilisation payment rate for that event to determine the performance incentive owed to that participant.

4.2.4 Week of consecutive events mini-trial

The Week of Consecutive Events mini-trial ran immediately after trial two, engaging the same participants in daily turndown events (6–8pm) across a single week to assess customer tolerance of daily flexibility events. As part of trial two results analysis, a network impact analysis was also conducted. Scaling the impact of trial two performance per participant by the number of forecasted heat pumps at the NGED Hayle-Camborne flexibility zone highlighted that heat pumps would be most effective in supporting constraint resolution when dispatched in a daily schedule Monday to Friday and thus tested whether customers could provide daily flexibility, as opposed to the 2-3 times a week trialled in trials one and two. This was an important schedule to test in trial three.

The analysis processes remained the same as trial two. The mini-trial also carried over many elements of the commercial arrangements from the main phase. It also introduced new arrangements. They are summarised in Table 11.

Table 11: Main phase and mini-trial commercial arrangements and settlement process

Item	Main phase	Mini-trial	Rationale of changes from main phase
Sign up approach	Participants sign up for the main phase	Participants sign up for the mini-trial, and then for the first 2, 3, 4 or all 5 days	Enable participants to take part in the mini-trial without feeling compelled to take part in more consecutive days than they were comfortable with.
Event duration		2 hours	No change as the mini-trial was not looking to test different event lengths to the main phase.
Notice period	Day Ahead, morning of, two hours ahead	Week in advance	To enable households to make a consistent adjustment to their heating habits ahead of time.
Event timing	4-6pm, 5-7pm, 6-8pm	6-8pm	The main phase's initial results showed no difference in customer experience by event time. Given the higher frequency of events, we decided to test one consistent time of flex per day
Event frequency	Zero to three events per week	Five consecutive events	Structural change to test consecutive day flexibility over a week
Control type	Manual, remote (app), and aggregator-controlled		No change to enable further evaluation of experiences by heat pump control type.
Participant payment groups	M1: £0.80-£2.40/kWh ²¹ M2: £0.40-£1.20/kWh ² M3: £0.50-£1.50/kWh ² M3: £8 availability payment	M1: £0.80/kWh M2: £0.40/kWh M3: £0.50/kWh	Same payment groups to minimise confusion. Only the lower bound payment rate implemented as participants were notified of all events a week in advance. M3 availability payment discontinued given the mini-trial's short duration.
Testing approach	Randomised Control Trial (RCT): Participants randomised to Groups A & B, alternating as 'treatment' and 'control' on event days	All participants recruited into a single treatment group	Since the mini-trial was only one week, our priority was to maximise customer experience data

²¹ The main phase saw participants on M1, M2 and M3 all paid their lower bound rate £/kWh when notified a day ahead, their middle rate when notified the morning of, and their higher bound rate when notified two hours before an event.

4.3 Trial three

Trial three extended EQUINOX trial's scope by building on the post-trial two impact analysis, including testing daily flexibility and a new use case: turn up events. It was divided across five mini-trials exploring varied event types, durations, and timings. Table 12 summarises their principal design features and overall assessment aims.

Table 12: Summary of principal design features and aims of each mini-trial

Mini-trial	Findings	Implications for heat pump flexibility procurement
Turn Up Flex	<ul style="list-style-type: none"> On average, 0.88 kW / 1.76 kWh demand turn up per participant across 3 heat pumps only events. On average, 1.35 kW / 2.7 kWh demand turn up per participant across 3 events permitting turn up from any home device. 	<ul style="list-style-type: none"> Evidence that residential consumers can provide meaningful demand turn up flexibility to support networks, particularly through their heating, e.g. during periods of over-supply of renewable generation.
Longer Events Flex	<ul style="list-style-type: none"> Turndown magnitude was in line with trial two for 2-hour and 4-hour events, but inconclusive for 3-hour events. When asked about their preferred event length, 46% of participants preferred 2-hour events, 32% preferred 3-hour events, and 22% either preferred 4-hour events or had no preference. Amongst participants with poor insulation²², none preferred 4-hour events and only 10% reported no preference. Across other factors such as home battery ownership, access to additional heating and potential vulnerability, there was no deviation from the overall group on event length preference. 	<ul style="list-style-type: none"> Evidence that that networks can treat 2 hours as the typical flexibility event length for heat pump homes, while also expecting a significant share of participants to remain responsive during longer events. Except for insulation, which may impact a participant's event length preference, any other variation in event length preference is likely due to individual customers' personal preferences rather than driven by specific household characteristics.
Morning Peak Flex	<ul style="list-style-type: none"> Inconclusive demand response results, likely due to small trial cohort. An average of 50% of participants self-reported participating in all or part of the events in the post-event surveys. 	<ul style="list-style-type: none"> While the turndown data was not conclusive, positive customer engagement survey results provide evidence that morning peak flexibility is achievable from heat pump homes.

²² Participants were asked 'How would you describe the quality of your home insulation?' If they selected "My home is not very well insulated and impacts the way I heat my home", they would be classified as "poorly insulated" in the start of trial survey.

Daily Evening Flex

- Demand turndown was detected for the 2-hour group in weeks 1-6, and week 10, at magnitude in line with trial two results, but not weeks 7-9 or week 11. >50% of participants self-reported turning down during 3 check-in surveys spread across the mini-trial.
 - Demand turndown was detected for the 4-hour group in weeks 1-5, in line with trial two results; demand turn up was detected for weeks 6-11. >50% of participants self-reported turning down during 3 check-in surveys.
 - Likely unseasonably warm winter affected turndown results for both groups.
 - 83% of participants (124 participants) with remote control found events on a daily basis to be just right or too little compared to 63% of participants (108 participants) with manual control²³.
 - Participants successfully participated in DFS, alongside the mini-trial, earning £96 across the entire group for doing so.
- Evidence that daily participation in flexibility services is achievable for heat pump homes, with default expectation of 2-hour participation except in cases where customers elect to participate for longer.
 - Note the unexpected turndown results (2-hour group inconclusive and 4-hour group negative second half of mini-trial) likely due to unseasonably warm weather and many homes no longer feeling the need to heat regardless of the events.
 - This highlights that the optimal value-case for engaging heat pump homes in flexibility identified in the post-trial two network impact analysis is likely achievable – heat pump homes are likely able to participate in Sustain/Scheduled Utilisation style products.
 - There may be an advantage of remote-control capabilities in supporting consecutive day flexibility, especially for daily events.
 - Customers' choice to participate in DFS while also taking part in the mini-trial is indicative of the customer appetite for taking part in stacked flexibility services.

Daily Morning Flex

- Demand turndown detected during morning and evening periods weeks 5-8, at rates in line with trial two, but not in weeks 1-4 during the morning only period.
 - Self-reported turndown participation in surveys remained stable averaging 39% for each half of the mini-trial.
 - 54% of treatment participants self-reported participating in simulated DFS events.
- Evidence that daily participation in flexibility services is achievable for heat pump homes in both mornings and evenings. The lack of definitive turndown data for the first 4-weeks is considered likely a result of the small sample size, especially considering customers' stable self-reported participation rates.
 - Customers' choice to participate in simulated DFS events while also taking part in the mini-trial is indicative of the

²³ Participants were asked 'During the EQUINOX daily flex trial, there was one event per day for 5 consecutive days. What is your view on this frequency?' in the end of trial survey.

customer appetite for taking part in stacked flexibility services.

To gather insights on the customer proposition for stacking flexibility services or products, Daily Evening Flex participants were permitted to take part in NESO's DFS concurrently with the EQUINOX trial if they chose to. Any participation in DFS was notified and settled by NESO (DFS). EQUINOX solely focused on gathering customer feedback on taking part in both offerings. Daily Morning Flex simulated DFS-style events, with EQUINOX providing direct payments to replicate commercial conditions and evaluate engagement.

These designs enabled EQUINOX to explore service stacking and understand customer engagement when multiple flexibility opportunities, through both DSO and NESO mechanisms, were available. Participants were Octopus Energy and ScottishPower customers across NGED and SP Energy Networks license areas.

4.3.1 Turn Up Flex mini-trial design

Turn Up Flex was carried out over three weeks, starting in late-September 2024. Eligible customers from Octopus Energy were invited to take part in six 2-hour turn up events on non-consecutive days. The first three events were "heat pump only" turn up events, asking participants to increase electricity consumption associated with their heat pumps and hot water heating, but not from any other sources. The latter three events were "general" turn up events, where participants could increase electricity consumption through any activity, including use of their heat pump, electric vehicle charging or any general household load. Events were grouped in this way to improve participants' adherence to "heat pump only" events as all consumption was measured at the property boundary meter and not at specific asset meters. It is noted that there is a limitation of using only boundary meters and relying on participants to turn up their heat pumps only; however, we ensured to provide clear instructions and asked participants through surveys how they participated in each event. Having two event types also allowed an initial comparison of demand response volumes between "heat pump only" and "general" turn up events, which may be indicative of how demand response volumes could change as heat pumps are installed in more homes.

To compensate for a small trial size, we recruited a second group of customers to act as a control group. These customers had homes outside of the eligible postcodes but otherwise met the trial eligibility requirements detailed below. Control group customers took part in a sign-up survey and end of winter survey, and were rewarded for that participation, but were not otherwise contacted during the trial or asked to engage in any behavioural change.

To assess the demand turn up potential for heat pump homes in this mini-trial, commercial arrangements and event design emulated expected network flexibility needs where possible and otherwise prioritised simplicity and customer convenience. Design of the commercial arrangements and events are summarised in Table 13 each of the treatment group and control group participants.

Table 13: Turn Up Flex treatment commercial arrangements

Item	Treatment participant	Control participant
Payment structure	£5 for completion of recruitment survey £5 for completion of start of trial survey £5 for completion of end of trial survey Utilisation payment (Free electricity)	£5 for completion of recruitment survey £5 for completion of start of trial survey Further £10 incentive available in Spring 2025 for customers who remained a part of the control group across Longer Events Flex and Daily Evening Flex
Control type	Manual and remote customer control	
Notice period	Day ahead	
Payment amounts	Matched to the customer's unit rate during events, representing a "free" electricity reward	
Eligible supplier tariffs	Any tariff	
Event duration	Two hours	
Event timing	11am - 1pm	
Event frequency	One to three events per week	
Supplier notice	Informed by NGED on Wednesday of the preceding week	

Participants were not required to opt-in to individual events. They were eligible for the utilisation incentive so long as they were enrolled in the trial before the event notification was sent. Turn Up Flex used a utilisation payment structure, rewarding customers based on their electricity consumption during events. For simplicity, we adopted a “free” electricity approach, rewarding customers by crediting their energy accounts with the full cost of electricity used during event periods (e.g. if a participant’s home smart meter recorded 1.2kWh of consumption during an event, the customer was later credited for 1.2kWh at their existing unit rate). For settlement purposes and to account for instances where participants’ smart tariffs had different unit rates during the event, we calculated this on a per half hour basis. This “free” electricity approach can be considered as the ceiling price that networks currently offer for turn up demand response. Participants in the treatment group could also earn up to £15 for completing surveys at the start and end of the trial.

4.3.2 Longer Events Flex mini-trial design

Longer Events Flex was carried out over five weeks during November to December 2024. Eligible customers from Octopus Energy were invited to take part in two 2-hour events, two 3-hour events, and four 4-hour events. We asked these participants, who formed the active trial group (the “treatment group”), to

reduce electricity consumption ('turndown') associated with their heat pumps and hot water heating, but not from any other sources. We held all events between 4–8pm on weekdays, which is the time electricity demand typically peaks across NGED's license areas.

We included two 2-hour events so that the participants would be able to compare across the different event lengths, although we had tested 2-hours events in trials one and two, this had been with different customer cohorts. Our main goal was obtaining household feedback on the 4-hour duration, though we also tested 3-hour durations. We had also seen that 3-hour flexibility during trial two, when we observed that participants with tariffs with multiple daytime unit rates²⁴ were turning down daily regardless of whether an EQUINOX event was called, likely due to their tariff's price signal. We held events on non-consecutive days to avoid any potential issues of demand turndown on an event day subsequently impacting demand turndown activity on the following day.

Since this was the first time EQUINOX participants were asked to reduce usage for more than 2-hours, we designed and ran Longer Events Flex with additional measures to maintain customer comfort as a top priority. Participation in each event remained entirely voluntary, and customers were encouraged to engage only for the duration that suited them. Our messaging made clear that there was no penalty or loss of incentive for partial participation. Instead, incentives were tied to completing the post-event survey, allowing us to gather thoughtful, detailed feedback regardless of how long customers participated in each event.

Commercial arrangements and event design emulated expected network flexibility needs where possible and otherwise prioritised simplicity and customer convenience. Design of the commercial arrangements and events are summarised in Table 14 for treatment group and control group participants.

²⁴ Tariffs with different prices during the daytime hours of 0800-2200.

Table 14: Longer Events Flex commercial arrangements

Item	Treatment participant	Control participant
Payment structure	<p>£5 for completion of recruitment survey²⁵</p> <p>£5 for completion of start of trial survey</p> <p>£5 for completion of end of trial survey</p> <p>£2 per event upon completion of each post-event survey</p>	<p>£5 for completion of recruitment survey</p> <p>£5 for completion of start of trial survey</p> <p>Further £10 incentive available in Spring 2025 for customers who remained a part of the control group by the end of Daily Evening Flex</p>
Control type	Manual and remote customer control	
Notice period	Day ahead	
Eligible supplier tariffs	No tariff with multiple unit rates between 8am and 10pm, which might incentivise load shifting during the daytime. Any other tariff accepted	
Event duration	2 hours, 3 hours, 4 hours	
Event timing	2 hours between 5-7pm; 3 hours between 5-8pm; 4 hours between 4-8pm	
Event frequency	0 ²⁶ to 2 events per week, on non-consecutive days	
Supplier notice	Informed by NGED on Wednesday of the preceding week	

4.3.3 Morning Peak Flex mini-trial design

Dynamic Morning Peak was the third EQUINOX mini-trial, conducted over two weeks from 27th January to 7th February 2025. The timing was selected to enable data collection during the heating season, and ahead of the Morning Peak Sustain trial scheduled for February 10th to April 4th. Twenty nine customers of ScottishPower took part in Dynamic Morning Peak, with all allocated to the treatment group.

Treatment participants were asked to reduce their heat pump electricity consumption during five morning flexibility events (8–10am), held two to three times per week. We did not recruit a control group but instead,

²⁵ The recruitment survey was only sent to treatment and control participants that had not previously participated as treatment or control in the Turn Up Flex mini-trial. The start of trial survey was only sent to control participants that had not previously participated as control in Turn Up Flex.

²⁶ Events were suspended for one week during the mini-trial, due to storms in the NGED area that created a risk of power outages for some participants.

for comparison purposes, used the aggregate electricity consumption of anonymised ScottishPower customers with heat pumps that were not signed up to the trial.

Since this was the first time EQUINOX participants were asked to reduce usage in the morning, we designed and ran Morning Peak Flex with additional measures to maintain customer comfort as a top priority. Participation in each event remained entirely voluntary, and customers were encouraged to engage only for the duration that suited them. Our messaging made clear that there was no penalty or loss of incentive for partial participation. Instead, incentives were tied to completing the post-event survey, allowing us to gather thoughtful, detailed feedback regardless of how long customers participated in each event. Whilst this might lead to under delivery in the context of trials, it does mean that there are learning points that apply to business as usual, meaning that under delivery can be factored into procurement procedures.

The trial commercial arrangements are summarised in Table 15.

Table 15: Dynamic Morning Peak participants' commercial arrangements

Item	Participant
Payment structure	£5 for completion of recruitment survey £5 for completion of start of trial survey £5 for completion of end of trial survey £1.50 per event upon completion of post-event survey
Control type	Manual customer control
Notice period - day ahead	Day ahead
Eligible supplier tariffs	No tariff with multiple unit rates between 8am and 10pm, which might incentivise load shifting during the daytime. Any other tariff accepted
Event duration	Two hours
Event timing	2 hours between 8-10am
Event frequency	Two to three events per week
Supplier notice	Informed by NGED on Wednesday of the preceding week

4.3.4 Daily Evening Flex mini-trial design

Daily Evening Flex ran for 11 weeks from January to April 2025. Customers who had been part of the previous mini-trial (Longer Events Flex) were invited to take part in daily heat pump turndown events, Monday to Friday each week. Based on their self-reported event length preferences, participants were allocated to either the 2-hour group with events from 5-7pm or to the 4-hour group, with events from 4-8pm.

In order to maximise data volume per group, Daily Evening Flex was limited in scope to only consider two event length groups and did not include a 3-hour event length.

Customers in the 2-hour and 4-hour event length groups collectively formed the active trial group (the “treatment group”) and were asked to reduce electricity consumption associated with (“turndown”) their heat pumps and hot water heating during events. They could achieve this in whatever way made sense for their household, for example by reducing the temperature set point on their thermostat and were not asked to make any other changes to how they used electrical appliances during events. Participants were able to pre-heat their homes before events if they chose to but were not required to do so. There was no penalty if customers chose not to participate in some events, or if they chose to not participate for the full length of an event.

To assess the potential of heat pump homes to participate in daily flexibility events in this mini-trial, commercial arrangements and event design emulated expected network flexibility needs where possible and otherwise prioritised simplicity and customer convenience. Design of the commercial arrangements and events are summarised in Table 16 for treatment group and control group participants.

Events were held every weekday for eleven weeks from January to April 2025. Participants were notified of the events structure at the beginning of the trial but were not sent daily or weekly reminders. There was no requirement to opt-in to individual events and participants received the event incentive of £1 per week based on their consumption during events remaining below their personalised trial baseline for four out of five weekdays, described in more detail below. The event incentive value was based on average market rates offered by NGED for similar flexibility products, and our expectations of how much demand response participants would deliver over two hours based on the trial two results²⁷ but does not necessarily represent a business-as-usual customer offering, which may incorporate additional flexibility values.

For Daily Evening Flex, we rewarded participants through a combination of methods, in recognition of the value of their time and participation. Overall, treatment participants could earn up to £25 if they participated in the full trial period and turned down in most weeks. They received a £5 reward for joining the trial, in place of a start-of-trial survey payment, and a £10 reward for completing the end-of-trial survey. Those who took part in focus groups received an additional £25 reward.

At the beginning of the previous mini-trial, we recruited an additional group of customers for control purposes during data analysis (the “control group”). Control group participants were not asked to engage in Daily Evening Flex events but were invited to complete an end of trial survey. They could earn up to £20 for participating across trial three, made up of a £10 start of trial survey rewards at the time they joined trial three, and a £10 end of trial survey reward at the end of Daily Evening Flex.

²⁷[NGED procurement prices for Sustain in 2023/4](#) range from £0.01/kWh to £4.60/kWh, averaging £0.30/kWh. Based on the average value, and the average performance from trial two of 0.57 kWh per participant over 2 hours.

Table 16: Daily Evening Flex commercial arrangements

Item	Treatment participant	Control participant
Payment structure	<p>£5 for joining the mini-trial, in place of a start of trial survey</p> <p>£10 for completion of end of trial survey</p> <p>£1 per week for each week measured as a “success” against a personalised trial baseline (explained in detail below)</p> <p>£25 for participating in a focus group (a subset of participants)</p>	<p>£5 for completion of recruitment survey (when joining trial three)</p> <p>£5 for completion of start of trial survey (when joining trial three)</p>
Control type	Manual and remote customer control	£10 for completion of end of trial survey
Notice period	Week ahead	
Eligible supplier tariffs	No tariff with multiple unit rates between 8am and 10pm, which might incentivise load shifting during the daytime. Any other tariff accepted.	
Event duration	2-hour or 4-hours	
Event timing	2-hours between 5-7pm; 4-hours between 4-8pm	
Event frequency	One event per weekday (Monday-Friday)	
Supplier notice	Informed by NGED a week before events began	

Daily Evening Flex personalised trial baselines

To detect turndown and be able to reward participants with the event incentive, we used a personalised trial baseline approach, adapted from the industry standard p376 baseline method²⁸. In previous EQUINOX trials we have used the P376 method to calculate a baseline for each participant. The baseline is refreshed for each turndown event, based on that participant’s recent consumption on preceding non-event days. Although this has worked well, it is not a suitable method for daily flexibility events as the baseline would not be updated for each event and would soon lose relevance as a counterfactual for electricity consumption during events. For some commercial flexibility services, a nominated baseline is assigned based on non-

²⁸ For settlement, the p376 method uses the last 10 non-event weekdays to generate an average consumption value per settlement period, resulting in a half-hourly baseline demand profile for an event day. A participant’s demand response is calculated by deducting their observed electricity consumption from their baseline consumption. Demand response achieved is then multiplied by their utilisation payment rate for that event to determine the performance incentive owed to that participant. See Elexon [report](#) for full details of the p376 method.

personalised factors such as average demand patterns and consumption volumes of homes with the same type of technology (e.g. heat pump or EV charger). For Daily Evening Flex, we used the relatively small-scale nature of the mini-trial to innovate a baseline approach that was both personalised for each participant and did not change from event to event. This allowed us to detect heat pump turndown at the home smart meter level, without specific asset metering, and to reward each participant for their performance in trial events. We do not present this trial baseline methodology as being directly suited to wider commercial use.

Personalised trial baselines were calculated based on each participant's average consumption during their event time (5-7pm for the 2-hour group, 4-8pm for the 4-hour group) on 30 non-event working days in November-December 2024 and were a set value for each participant that was not updated from week to week or between events. This approach aimed to capture an average of each customer's consumption across a spread of winter temperatures that might be representative of external temperatures across the mini-trial period. To prioritise customer engagement and recognise that this method may under-report turndown on colder event days, we increased each participant's raw baseline by 10% during the mini-trial, making the event incentive more achievable. As illustrated in Figure 3, participants were considered to have achieved turndown in an event if their electricity consumption in that period remained below their personalised trial baseline. Eligibility for the event incentive was based on achieving turndown for at least four of five weekdays each week and did not change based on the volume of turndown. The Daily Evening Flex personalised trial baselines were only used for customer settlement in the mini-trial and were not used to evaluate overall demand response.

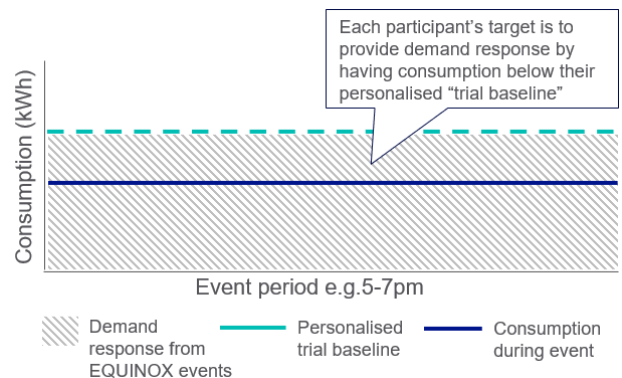


Figure 3 Schematic of Daily Evening Flex settlement approach

Stacking

Daily Evening Flex participants were also able to choose to participate in DFS events through their energy supplier. Across winter 2024/25, these events ("DFS events") offered consumers a reward for turndown demand response during specific event periods, often across the same evening peak period (5pm – 7pm) in which participants would be asked to turn down their heat pumps for Daily Evening Flex. We permitted customers to access both programmes if they chose to but did not directly interact with any DFS events, either operationally or for customer settlement.

Our objectives around service stacking were aimed at observing customer appetite for participating in general turndown DFS events alongside heat pump turndown Daily Evening Flex events. EQUINOX trial three was not designed to test the full end to end industry processes for service stacking, or for settlement. Our learnings focus on the customer experience of participating in both services simultaneously, and not on demonstrations of how processes could work for stacking flexibility services more broadly.

To assess whether Daily Evening Flex participants also engaged with DFS events, we analysed aggregated outcomes for participants who took part in DFS events that occurred concurrently with the Daily Evening

Flex trial period (27th January to 4th April). We excluded from analysis any DFS events that occurred in the first two weeks of the mini-trial. This ensured that we only considered customer results from DFS events where their DFS baseline, which is based on each participant's recent average consumption, already reflected heat pump demand response from their ongoing participation in EQUINOX events. Figure 4 illustrates how a participant's average consumption during an event window (e.g. 5–7 pm) may change as a result of participating in EQUINOX and DFS events:

- The light blue line is expected demand if there is not a demand response event (baseline for Daily Evening Flex).
- The red line is demand during an EQUINOX event, based on a request for heat pump turndown.
- The dark blue line is demand during a DFS event, based on a request for turndown from any device.

Customer settlement for Daily Evening Flex was based on whether participants' home consumption during the event window was lower than their average pre-trial consumption (shown as the light blue line in Figure 4). The expected heat pump turndown response is represented by the partially shaded block.

If participants also joined a DFS event that overlapped with a Daily Evening Flex event, they would be rewarded in the DFS product for any additional reduction below their average recent in-trial consumption (the red line). This extra turndown during a stacked event is shown as the fully shaded block.

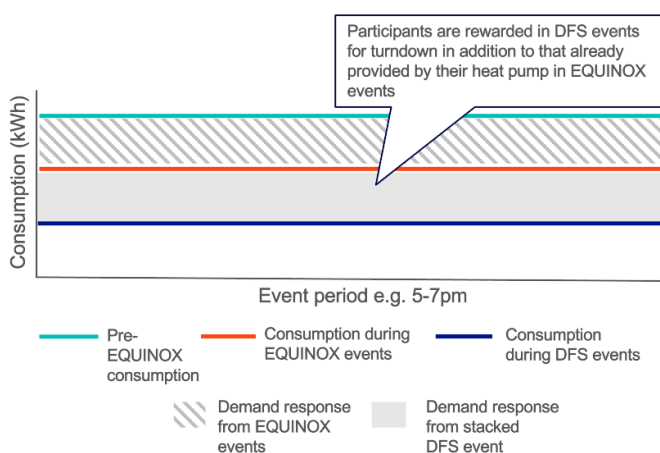


Figure 4: Representation of demand response during a stacked DFS event

To detect if there was an additional turndown response when customers participated in DFS events in addition to Daily Evening Flex events, we looked at the aggregated DFS event outcomes for that subset of trial participants. In addition, trial participants were asked about their engagement with DFS events in the end-of-trial survey for Daily Evening Flex.

4.3.5 Daily Morning Flex mini-trial design

Daily Morning Flex was carried out over eight weeks between February and April 2025. A total of 41 ScottishPower customers took part, all allocated to the treatment group. 29 of these had already taken part in Morning Peak Flex, and 12 additional participants were recruited before the start of Daily Morning Flex.

We asked treatment participants to turn down their heat pumps daily between 8-10am from Monday to Friday for all eight weeks of the mini-trial. For the last four weeks of the mini-trial, we also asked participants to turn down their heat pumps daily between 5-7pm from Monday to Friday. We did not recruit a control group. Instead, for comparison purposes, we used the aggregate electricity consumption of anonymised ScottishPower customers with heat pumps that were not signed up to the mini-trial.

We originally sought to test stacking of EQUINOX with NESO's Demand Flexibility Service (DFS)²⁹, since it is a NESO service ScottishPower already offers to their customers on the Power Saver Plus programme. However, in the weeks leading up to the mini-trial ScottishPower did not participate in any DFS events. Therefore, we decided to hold simulated DFS events instead to enable us to test stacking of the EQUINOX mini-trial with another service. We held four simulated DFS events, one every two weeks, held at 5-6pm to coincide with the 4-7pm period when DFS events are typically held.

We held the first two simulated DFS events when participants were only taking part in daily morning peak events. We asked participants to participate in the EQUINOX morning flexibility events in the morning, plus the simulated DFS events in the evening, on the same day.

We held the final two simulated DFS events when participants took part in both morning and evening peak events. These two simulated DFS events intentionally overlapped with the 5-7pm events. To maximise participants' potential earnings during trial three, per the DFS design, they were encouraged to turn down any device in their home when a simulated DFS event was called, rather than just their heat pump.

Table 17 below summarises the commercial arrangements for Daily Morning Flex.

Table 17: Daily Morning Flex treatment participant commercial arrangements

Item	Treatment participant
Payment structure	<ul style="list-style-type: none"> £5 for completion of start of trial survey £5 for completion of end of trial survey £15 for participating in an interview £10 sign up incentive £2-3 per week for each week electricity consumption is maintained below their nominated baseline during event times, on at least 4 out of 5 days
Control type	Manual and remote customer control
Notice period	Day ahead
Eligible supplier tariffs	No tariff with multiple unit rates between 8am-10pm, which might incentivise load shifting during the daytime. Any other tariff accepted
Event duration	Two hours
Event timing	Two hours between 8-10am; Two hours between 5-7pm

²⁹ A NESO-run programme that enables households and businesses to earn rewards from their registered DFS service provider in return for shifting their electricity usage during DFS events: ["Demand Flexibility Service explained"](#).

Event frequency	One 8-10am event per weekday (Monday-Friday) for the first four weeks; one 8-10am and one 5-7pm event per weekday (Monday-Friday) for the last four weeks
Supplier notice	Informed by NGED on Wednesday of the preceding week

The personalised baseline approach remained consistent with the Daily Evening Flex mini-trial, which is described in section 4.3.4. The key difference in approach comes between using simulated DFS events rather than real DFS events that were used in Daily Evening Flex.

Figure. below shows how we expected settlement would work during the simulated DFS events, depending on whether they occurred in weeks 1–4 (no overlap with EQUINOX events) or weeks 5–8 (with overlap):

- The light blue line is expected demand if there is no demand response event (baseline).
- The red line is demand during an EQUINOX event, based on a request for heat pump turndown.
- The dark blue line is demand during a simulated DFS event, based on a request for turndown from any device.
- The fully grey shaded area represents additional demand response that would be settled through the simulated DFS system.
- The partially grey shaded area represents demand response from the EQUINOX event.

In weeks 1–4, we planned to hold EQUINOX events from 8–10am only. There would be no overlap with the simulated DFS events we held on two days at 5–6pm. We therefore expected that participants' baselines would not include turndown behaviour during the times allocated for the simulated DFS events, so any reductions during those events would be settled entirely through the simulated DFS system.

In weeks 5–8, we planned for EQUINOX events to run between 5–7pm, overlapping with the two simulated DFS events scheduled from 5–6pm. We therefore expected that participants' baselines would already include turndown behaviour from their heat pump during the simulated DFS events window. This would mean only additional reductions, likely from devices other than their heat pump, would be settled through the simulated DFS system.

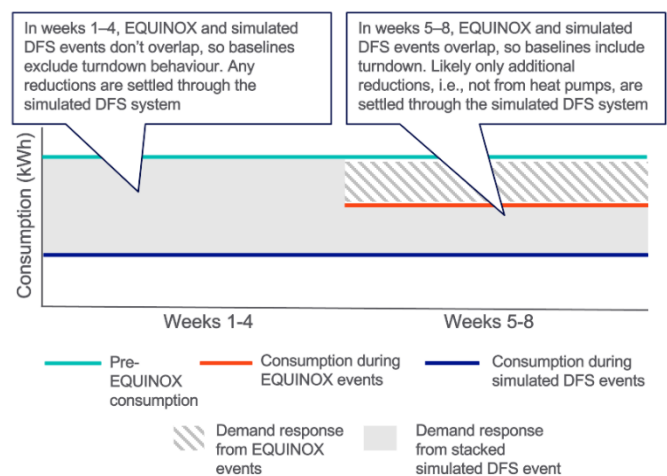


Figure 5: Schematic of settlement approach for simulated DFS events for Daily Morning Flex participants

4.3.6 Trial three analysis

Consistent with trial two, suppliers leveraged a Difference-in-Difference (DiD) approach for calculating demand response. DiD approaches provide an estimate of programme demand response when energy consumption from the entire treatment group is compared to the entire control group for each event. We

used a simple average to develop average point estimates of demand response per event-length group, per week, and for the full trial duration, though we used the Root Mean Square (RMS) method to calculate aggregate errors³⁰.

³⁰ The full DiD and RMS approach is provided in section 4.2.3.

4.4 Recruitment

Customer recruitment was a particularly successful aspect of EQUINOX, exceeding the project aim of recruiting 1000 participants and when considering each trial as its own cohort, over 2000 participants were enrolled over the course of the project. EQUINOX onboarded 1282 unique customers across all three trials. Customer recruitment approaches largely remained consistent across all three trials and are detailed in this section.

Centring customer experience as a key consideration during the trial design phase made the trials an appealing prospect during recruitment. Customer satisfaction was very high in each trial, and 45% of participants who participated in EQUINOX at some point participated across multiple trials. 136 participants participated in all three winter trials.

Customer recruitment was led primarily by the energy suppliers. They targeted specific customers based on the trial eligibility criteria as detailed in Table 18.

Table 18: Eligibility criteria across all three trials

Eligibility criteria	Applicable trials
Be aged 18 or over.	Trial 1, 2, and 3
Be a current customer of Octopus Energy or Sero.	Trial 1
Be a current customer of Octopus Energy, Sero or ScottishPower.	Trial 2
Be a current customer of Octopus Energy or ScottishPower.	Trial 3
Have a working electricity smart meter that has been successfully sending meter readings on a half-hourly basis for at least 80% of the time in the 15 days prior to being invited to take part in a Trial.	Trial 1, 2, and 3
Consent to, and not remove consent for, allowing half-hourly meter reads.	Trial 1, 2, and 3
Opt-in to be part of the EQUINOX Trials by completing sign-up surveys as requested and accept terms and conditions of the trial.	Trial 1, 2, and 3
Have and use a heat pump as the primary method of heating their home (and this heat pump must not be shared with any other residence(s)).	Trial 1, 2, and 3
Be resident within the NGED license area.	Trial 1 and 2
Be resident within the NGED license area, or the SPEN license area.	Trial 3 only
Be a resident within specific post code areas within the NGED license area.	Trial 3 Turn Up Flex only

Be using an electricity import tariff (“tariff”) that does not have different prices for electricity during the ‘day’ (between 0800 and 2200) (e.g. a tariff with an off-peak price 1300 - 1600 is not permitted). Customers may be using a tariff that has different prices within each 24-hour period, e.g. with an overnight off-peak price, or a tariff that does not change prices within a 24-hour period.

Energy suppliers predominately conducted customer outreach via emails which included messaging about EQUINOX project aims, a description of what would be requested of customers participating in each of the trials, and the potential financial benefits of taking part. Wherever possible, recruitment happened shortly before trial events began (e.g. 1-2 weeks before trial start). Participation in the trials was framed as an opportunity to take part in an innovation project furthering collective understanding of how low carbon heating could be utilised flexibly for wider network benefits.

As part of the recruitment process, customers completed a recruitment survey. The customer recruitment survey collected key information about each participant’s property, heating system attributes, and the presence of any other low carbon technologies (LCTs) in the home. This data was used to confirm eligibility for the trial (e.g. presence of a heat pump), to allocate participants to different trial groups, and for post-trial analysis.

Following the customer recruitment phase, participants were asked to agree to the trial terms and conditions. The trial terms and conditions set out the supplier’s expectations of their customers participating in the trials and what customers could expect from their supplier while participating in the trial. This included how financial incentives would be paid to customers. It was stressed that participants were under no obligation to participate in events, they would not be penalised for under-participation in events, and that they could exit the trial at any time by contacting their supplier with such a request. There was no cost to customers to sign up to EQUINOX and no penalty if a customer later changed their mind and chose to exit the trial. This approach kept EQUINOX open to as many customers as possible. Data collection, processing, use and sharing were also covered in the terms and conditions, with consent to these data uses forming part of the agreement.

Overall, customer recruitment aimed to maintain principles of clear communication, with sufficient information to allow customers to understand what they were signing up to and clear assurances that there was no minimum performance standard or penalties for later deciding to stop participating in the trial. This ensured that the trials were equitable and accessible to all customers.

4.5 Customer research methods

Directly engaging participants underpinned the customer research conducted across all three EQUINOX trials. This research included both qualitative and quantitative methods, including surveys, interviews, and focus groups.

The customer research aimed to understand:

- Why participants signed up and were motivated to participate.
- How participant demographics compared to the UK population.
- How satisfied participants were with the trial design and experience.

- How EQUINOX events altered participant behaviour and if they impacted thermal comfort.
- What the barriers and benefits were of participating.
- Whether or not participants with potential vulnerabilities were equally able to take part in events and benefit from participating.
- How participant experiences were shaped by trial design factors.

Alongside engaging with trial participants, customer research was also conducted with the wider UK population to understand broader customer views on heat pump participation and EQUINOX trial design. To do this, we two nationally representative surveys of around 2000 adults. This additional research aimed to:

- Gain broader insights of the UK population on home heating, heat pumps and automation of heating.
- Assess customer preferences to improve the adoption of heat pumps.
- Assess the customer attitudes related to heating flexibility and various trial design factors.

Through the customer research undertaken, we are able to draw important insights from the customer engagement research which can be applied to future low carbon heating flexibility offerings.

4.5.1 Customer research methods used

Customer engagement in EQUINOX was primarily led by the energy suppliers³¹ collaborating on the project. Participants received communications from their supplier throughout the trial experience. For both Octopus Energy and ScottishPower customers, customer engagement in EQUINOX leveraged existing communication channels, issuing invitations, notifications and surveys by email, with some event notifications through mobile apps. This approach mimics the business-as-usual (BaU) set up where customers engage with their energy supplier rather than the DNO, increasing the chances of greater customer participation.

Customer engagement in EQUINOX was, however, more frequent than in a BaU context to enable collection of ongoing feedback on customer experience during the trials. To mitigate against information fatigue, messages were kept as clear and concise as possible, with any new details specifically highlighted for participants' attention. Messaging was adapted based on participant feedback, particularly where the same questions arose repeatedly.

Throughout the trial, we captured the experiences and perceptions of trial participants through surveys, interviews and focus groups. Beyond trial participants, we ran a survey of social housing tenants in and around the West Midlands³² and two nationally representative surveys of around 2000 adults. These additional surveys aimed to assess broader customer perceptions of heat pumps and the energy transition to benchmark our findings and enhance our understanding of a wider group of customers. Table 19 each customer research method.

³¹ Organisations acting as energy suppliers included Octopus Energy, ScottishPower and Sero.

³² This occurred in conjunction with the social housing provider Bromford.

Table 19: Customer research methods conducted throughout the trial

Customer research method	EQUINOX trial	Description
Recruitment survey	Trial 1, 2 and 3	Administered to participants when they were recruited. Collected information about the participant's heat pump and household characteristics.
Start of trial survey	Trial 2 and 3	Administered before the start of each trial. Collected information on the demographics of trial participants. ³³
Post event surveys	Trial 1, 2 and 3	Sent after each EQUINOX event to gather information on whether households participated and their comfort levels during the events. Short - two to five questions.
Mid-trial survey	Trial 2	Administered to participants in the middle of the trial to assess early perceptions of the trial design.
Check in survey	Trial 3	Sent fortnightly to check in on participant's comfort and satisfaction. Short, two to five questions.
End of trial survey	Trial 1, 2 and 3	Administered to participants at the end of the trial to understand the overall experience.
Interviews	Trial 1, 2 and 3	Held to gain deeper insights on participant's experience with the processes of the trial. One-to-one, semi structured.
Focus groups	Trial 1, 2 and 3	Four to six customers per group were asked similar questions as one-to-one interviewees, but with the added benefit of a chance to learn how others may have experienced the trial.
Social housing tenant survey	Distributed to non-EQUINOX participants ³⁴	Distributed to a selection of social housing tenants in and around the West Midlands with a heat pump installed in their home to gauge their use and opinions of their heat pumps, and self-projected engagement with heat pump flexibility offerings.
UK-wide survey	Distributed to non-EQUINOX participants ³⁵	Assessed average customer attitude related to adoption of heat pumps, as well as ways of shaping customer preference to drive uptake of heat pumps and their flexible operation.

³³ For trial one, this information was collected in the end of trial survey.

³⁴ This survey was distributed to non-EQUINOX participants to supplement the insights from the primary customer research gathered through the surveys distributed to EQUINOX participants.

³⁵ This survey was developed and conducted by Accent to act as a comparison for the insights gathered through the surveys distributed to EQUINOX participants.

4.6 Assessing vulnerability

Defining and assessing vulnerability was an important aspect of ensuring that the trials were inclusive, equitable and reflective of the diverse needs of UK households. Assessing and segmenting for vulnerability was not just a methodological choice but a strategic imperative grounded in fairness, representation and impact measurement.

Segmenting for vulnerability allowed us to compare the experiences and outcomes of potentially vulnerable participants against the broader participant pool. This was essential for understanding how different customers perceived key trial performance metrics, such as satisfaction with financial incentives and comfort levels. We recognise that vulnerability is multifaceted and can be influenced by different factors, and these factors interact in complex ways. Therefore, developing and iterating how vulnerability was assessed was crucial for understanding how heat flexibility can benefit different customer groups, including potentially vulnerable customers³⁶.

Table 20 outlines the self-reported vulnerability indicators considered in each trial and demonstrates that trial three took a broader approach to segmentation.

Table 20: Vulnerability indicators used to segment potentially vulnerable participants across trials

Vulnerability indicator	Trial	Definition
Low-income household	Trial 1	Self-reported income level below £30,000.
Energy and household bill affordability	Trial 1 and 2	Self-reported that they were sometimes, often and/or rarely/never able to afford their energy bills and other household bills (a pre-trial metric).
Disability and/or long-term health condition	Trial 1,2 and 3	Answered >0 to “Including yourself, how many people in your household meet the following criteria? – Has a disability or long-term health condition?”
Health condition exacerbated by the cold	Trial 2 and 3	Answered yes to “Do you feel this disability or long-term health condition is made worse or more difficult to cope with when it’s cold?”
Children under 5 years old	Trial 3	Answers >0 to “Including yourself, how many people in your household meet the following criteria? – Children under 5 years old.”
Over 75 years old	Trial 3	Answered >0 to “Including yourself, how many people in your household meet the following criteria? – Over 75 years old.”

³⁶ Following customer segmentation, we classified customers who met the vulnerability classification as potentially vulnerable rather than just vulnerable, as customers did not self-disclose that they were vulnerable and whilst our methodologies try to accurately capture vulnerabilities it may include customers who would not consider themselves to have vulnerabilities.

Home poorly insulated	Trial 3	Answered “My home is not very well insulated and impacts the way I heat my home” to “How would you describe the quality of your home insulation?”
Live alone	Trial 3	Answered 1 or more to “Including yourself, how many people permanently live in your household?”
Lone parent	Trial 3	Answered children but not spouse/partner to “Who do you share your household with? Select all that apply:”
Low-income household	Trial 3	Combined indicator including their self-reported household income, their self-reported household occupancy and whether they indicated if they could easily pay their bills, in alignment with the UK minimum income standard ³⁷ .

In trial one customers were segmented as potentially vulnerable if they were considered low income, self-reported that they were sometimes, often and/or rarely/never able to afford their energy bills and other household bills and indicated that someone in the home had a disability or long-term health condition.

In trial two customers were categorised as vulnerable if they self-reported that they or someone in the home had a disability and/or a disability that was exacerbated by the cold, or if customers indicated they had difficulties with their energy affordability.

Trial three took a broader approach to segmentation by including more vulnerability indicators. To achieve this the project developed an Equitable Participation Framework (EPF). To minimise the risk that our segmentation methodology for trial three may be over-representative, we considered that there are many interacting factors that determine how a vulnerability factor affects a household. We considered that some households who meet one vulnerability factor may have this factor mitigated by income or other factors. Moreover, we removed customers classified as low-income from the vulnerability segmentation if they self-reported that they never had problems paying their energy bills.

We therefore classified households as vulnerable only if they met one of the following three circumstances:

1. The household was defined as having a low income³⁸ according to their household composition³⁹,
2. Someone within the household self-reported having a health condition exacerbated by the cold
3. The household met at least two of the other EPF indicators.

This resulted in 47% of participants being classed as potentially vulnerable in trial three. This compares to only 22% and 20% of trial one and trial two participants, respectively.

Applying trial two’s vulnerability classification methodology to trial three’s participants, only 33% of customers are classified as potentially vulnerable. Further highlighting that the trial three classification

³⁷ [UK minimum income calculator](#), Centre for Research in Social Policy, 2025.

³⁸ Households were classified as low income based on their household composition and annual household income, in alignment with the [UK minimum income standard](#).

³⁹ Households were also removed from the vulnerability segmentation if they were classified as low income, but self-reported that they were able to regularly afford their energy bills.

methodology led to a greater proportion of participants being classified as potentially vulnerable. This could suggest that the vulnerability methodology used in trials one and two may have under-represented vulnerability, emphasising the importance of considering all facets of vulnerability in relation to heating flexibility. However, it is important to note that this refinement in methodology does not disadvantage earlier trial participants; rather, it reflects an evolving understanding of vulnerability that builds on previous learnings.

While we do see greater proportion of vulnerable participants in trial three, we caveat that the EPF approach may over-represent potential vulnerability where the presence of other characteristics or counter-factors not measured here could mitigate the impact of individual vulnerability factors by countering the mechanisms by which they can act. This highlights the importance of using a comprehensive and balanced approach when assessing vulnerability in the context of heating flexibility.

4.7 Technical integration

EQUINOX adopted a BaU-aligned technical approach by utilising established platforms, primarily Flexible Power and Piclo, to manage operational interactions with energy suppliers. This approach reduced barriers for customers and suppliers, minimised new development requirements, and ensured consistency with existing flexibility procurement practices.

Technical development was therefore focused only on areas where previous trials identified integration gaps or where suppliers required additional onboarding support, particularly for Sero and ScottishPower. Across the trials, Octopus Energy used their proprietary platform, Kraken, Sero used its Building Energy Engine (BEE), and ScottishPower used its Power Saver App. This reduced the amount of additional technical integration by the partners and NGED in order to carry out the trials.

Trial one provided the first opportunity to apply the EQUINOX technical integration approach in a live setting. Given the lack of an established reference model, the design prioritised simplicity and stability. This trial set the technical and commercial foundations for later phases, with adjustments being minor throughout and only where the need arose.

Trials two and three built upon trial one and moved the integration approach closer to a full BaU model. Flexible Power remained the central integration platform, but updated commercial arrangements introduced new variables, notice periods, payment methods, and time-of-day considerations, that required additional technical configuration.

To reflect the expanded commercial groupings, additional Meterable Units⁴⁰ (MUs) and Dispatch Groups⁴¹(DGs) were created for each supplier. Because these components already existed within Flexible Power, implementation was straightforward and required minimal development. Given the scale of changes and the

⁴⁰ Meterable Units are made up of one or more flexibility assets behind a single metering feed. Baselineing is applied at this level.

⁴¹ Dispatch Groups are higher level components made up of one or more MU's and used for Trade Response, dispatch and settlement

onboarding of an additional supplier, the testing approach developed for trial one was reused to validate system reliability across both trial two and trial three.

4.7.1 Cybersecurity and final readiness

Cybersecurity due diligence was undertaken throughout the trials to ensure compliance with applicable standards and assess any implications for the technical integration of EQUINOX events. Further detail is provided in EQUINOX Project Deliverable 3⁴².

Across all three trials, the technical integration approach matured significantly, with the help of the partners and has now reached a point where it is ready for BaU adoption. The solution proved scalable, reliable, and interoperable across suppliers and platforms, while supporting multiple commercial configurations in a robust and repeatable manner. In conclusion the EQUINOX approach to keep things as aligned to existing practices seems to have worked well. This means that the enablement of domestic heat pump flexibility into business as usual should be as friction free as possible.

4.8 Digital Twin Simulations

Digital twin simulations were carried out during the course of EQUINOX to validate, verify and build upon trial results. These simulations were able to bridge gaps in the collected trial data or provide insights which are impossible to get from a real-world trial.

The ability to isolate the impact of changing one specific variable allowed us to extrapolate to conditions not explored by the trial (e.g. more extreme weather, events happening on different days), and Interpolate within the trial to infer what might have happened in different homes (e.g. different heating schedules, different control patterns).

Passiv, one of the EQUINOX project partners, developed a multi-home digital twin model calibrated to trial data. The model used:

- Smart meter data, geographical distribution, tariffs, and survey information.
- Iterative tuning to match observed load profiles and event responses.
- 100 archetypes representing trial homes, simulating heat pump loads and EQUINOX interventions.

Further detail on the learning and outcomes from this work is provided in EQUINOX Project Deliverable 6⁴³.

⁴² See full report: [Design of Novel Commercial Methods & Technical Integration](#)

⁴³ [Deliverable 6 Transition of learning to business as usual](#)

5. Outcomes of the project

The EQUINOX project has created a robust evidence base on the role of domestic heat pumps in flexibility. This section summarises the learnings outcomes generated across the three EQUINOX winter trials and demonstrates the implications of these outcomes for heat pump flexibility. Together, the findings presented in the section provide a comprehensive assessment of the technical, behavioural and commercial elements of heat pump flexibility. They demonstrate that domestic heat pumps can meaningfully support network needs without requiring changes to existing operation processes, and that customers, including those who are potentially vulnerable, can participate comfortably and equitably.

5.1.2 Trial one – proof of concept

Trial one was the initial proving for heat pump flexibility as a viable customer asset for network management. It showed that domestic heat pumps represent a valuable flexibility asset-base and provided lessons learnt for optimising participation in flexibility programmes.

Table 21 below summarises the key results: the larger Octopus cohort achieved an average 0.77 kW demand reduction per 2-hour event, compared with 0.31 kW amongst the higher energy efficiency Sero homes, and across both cohorts 83% of participants responded when called. It is important to note that in trial one, this volume was measured against historical baselines rather than a control group as in trials two and three. The accuracy of this baseline presented an obstacle to reliable measurement of demand response volumes in trial one and was therefore updated in trials two and three. This demonstrates that households with heat pumps can deliver reliable, meaningful load reduction, and the scale of response may be higher in lower efficiency homes.

Households provided the most flexibility during colder periods, as there was more demand to abate. However, full switch-offs risked snapback effects, suggesting turn-down requests to be preferable. Finally, a pay-per-event commercial model also drove higher engagement than monthly payments, suggesting it to be the more effective model for customer engagement in BaU.

Table 21: Key findings from trial one

Factor	Finding	Implications for heat pump flexibility
Demand response	<ul style="list-style-type: none"> On average, 0.77 kW/ 1.53 kWh of demand response detected over 2 hours for Octopus Energy customers with manual/remote control heat pumps, and typical household insulation. On average, 0.31 kW / 0.61 kWh for Sero customers with automated control heat pumps, and high household insulation. 	<ul style="list-style-type: none"> Initial evidence that heat pumps can provide flexibility to support networks, across all control method types. Households with high energy efficiency, i.e. Sero homes, most likely offer comparatively lower flexibility since there is already less demand to reduce. Nevertheless, these homes have the potential to offer longer turndown periods.

Participation rate	<ul style="list-style-type: none"> 82% of households participated per event by turning down/off their heat pumps during events when asked to do so (or not turning them back up/on in case of Sero homes). 	<ul style="list-style-type: none"> Strong initial evidence base that high proportion of households with heat pumps could be relied upon to take part in heat pump flexibility.
Temperature	<ul style="list-style-type: none"> Temperature had an inverse relationship with demand response: for Octopus customers 4 kWh turndown observed at 0.5°C, reducing to 1 kWh at 13°C; Sero cohort 1 kWh reducing to 0.3 kWh. 	<ul style="list-style-type: none"> Strong initial evidence base that heat pumps provide much greater demand response at colder temperatures, since there is more demand to reduce.
Demand Snapback	<ul style="list-style-type: none"> 9% increase in demand relative to baseline immediately following an event for Octopus homes; 50% increase for Sero homes. 	<ul style="list-style-type: none"> Evidence that for heat pumps “turn off” request may be less effective than a “turn down” request, particularly for automated control where the switch can be instantaneous.
Payment method	<ul style="list-style-type: none"> Customers on Pay per Event had a higher participation rate than those on Pay Monthly (88% vs. 77%) 	<ul style="list-style-type: none"> Indicative that consumer engagement is more effective for rewards per event than rewards per month.
Satisfaction	<ul style="list-style-type: none"> 92% of participants reported being satisfied with the trial⁴⁴. 	<ul style="list-style-type: none"> Strong engagement and willingness amongst heat pump households to participate in flexibility.
Comfort	<ul style="list-style-type: none"> 95% (n=255) of households never or only sometimes felt a change in comfort during events⁴⁵. 	<ul style="list-style-type: none"> All customers who choose to engage with heat pump flexibility can typically do so comfortably.

For more detail on these trial one outcomes please see [Deliverable 2: Initial insights on the effectiveness of commercial methods](#).

5.1.3 Trial two – expansion and refinement

Trial two was larger and more comprehensive than trial one. It produced more detailed findings for the potential scalability of domestic heat pump flexibility, including detailed lessons learnt for effective engagement of customers and the optimal way that heat pumps can be dispatched to support networks.

Table 22 summarises trial two’s key results. It shows that trial two confirmed that heat pumps can provide reliable, scalable flexibility to support distribution networks. Participants achieved an average 0.61 kW (1.2 kWh) demand reduction per event, around 48% of peak demand. with 47% of households engaging and an average external temperature of 6.1C. Colder temperatures produced greater response, and no significant snapback effects were observed, showing that turndown requests are more effective than full turn-off events. Trial two utilised a crossover randomised control group approach to more accurately measure

⁴⁴ Participants were asked ‘Overall, how satisfied were you with the EQUINOX trial?’ in the end of trial survey.

⁴⁵ Participants were asked ‘How frequently did participating in EQUINOX event cause any discomfort for you or someone else if the households?’ in the end of trial survey.

demand response volumes than the baseline approach used in trial one, and these demand response measurements are considered to be the most accurate generated across all three trial phases.

Payment levels reflected real NGED product rates (Secure and Dynamic⁴⁶), demonstrating that heat pump flexibility is achievable at commercially viable costs, with negligible differences between payment groups suggesting the lower rate may be sufficient to sustain participation within the context of the trial. Tariff type was also critical: households on flat daytime tariffs provided measurable event response, while those on time-of-use tariffs that included cheaper hours within the day were already shifting heating demand, indicating both mechanisms can effectively support peak reduction. Notably, all automated control heat pumps had such time of use tariffs.

Finally, the network impact analysis showed and the subsequent trials that heat pumps are most effective when participating in daily flexibility programmes over 5 days consistently, rather than the 2–3-day-per-week format tested in trial two, highlighting their potential as a dependable, everyday flexibility resource for network operators.

Table 22: Key findings from trial two

Factor	Finding	Implications for heat pump flexibility
Demand response	<ul style="list-style-type: none"> On average, 0.61 kW / 1.2 kWh demand response per participant across 36 events, equivalent to 48% of the average participating home's peak demand. 	<ul style="list-style-type: none"> Further evidence that heat pumps can provide meaningful flexibility to support networks, based on robust analysis of a larger trial (than trial one).
Participation rate	<ul style="list-style-type: none"> 47% of households achieved demand reduction as compared to their baseline. 	<ul style="list-style-type: none"> Further evidence that a significant proportion of households with heat pumps could be relied upon to take part in heat pump flexibility.
Temperature	<ul style="list-style-type: none"> Temperature had an inverse relationship with demand response: 0.07 kW increase/reduction in demand response per 1°C drop/increase in external temperature (from the 6.1°C trial average). 	<ul style="list-style-type: none"> Further evidence that heat pumps provide much greater demand response at colder temperatures, since there is more demand to reduce.
Demand Snapback	<ul style="list-style-type: none"> None observed for Octopus and ScottishPower customers with manual or remote control heat pumps – slight effect observed for Sero third-party controlled customers. 	<ul style="list-style-type: none"> Further evidence that for heat pumps a turndown request is more effective than a turn off request.

⁴⁶ When trial two was designed, Secure and Dynamic were a commercial flexibility product procured by NGED. Flexibility products have since been updated and standardised across DSO markets. The payments in trial two were considered in relation to previous products but focused on structural aspects of flexibility that remain relevant to network needs.

Payment method	<ul style="list-style-type: none">• Customers on M1 and M2 payment amounts had negligible variation in demand response or participation (both set within the bounds of Secure and Dynamic product incentives.• M3 not applicable due to tariff impact (see next point).	<ul style="list-style-type: none">• Customer participation in BaU flexibility services may not differ according to whether customers are awarded M1 or M2 payment amounts.
Tariff type	<ul style="list-style-type: none">• Only participants with tariff types that had a flat price during the daytime had additional heating demand response to offer during the events.• Participants with time of use tariffs that incentivise demand shifting during the day were already providing demand response regardless of whether an EQUINOX event was called.• Automated control Sero customers all had time of use tariffs that incentivise demand shifting during the day and were automatically being optimised to avoid peak pricing. This meant by default they had limited additional flexibility to be measured during EQUINOX events.	<ul style="list-style-type: none">• Explicit flexibility services and time of use tariffs can each be an effective tool for eliciting heat pump demand shift from peak times to support networks.• Indicative that automated control heat pumps will be optimised around time of use tariffs by default – and may be providing implicit flexibility at a greater level than previously assumed in network planning.
Notice period	<ul style="list-style-type: none">• Trial participants provided the same level of demand response, and participated at the same rates, whether they were notified of an event a day in advance, the morning of the event, or 2-hours in advance.	<ul style="list-style-type: none">• Evidence that end consumers can be given a notice period within one day to 2-hours' notice and deliver the same response. It is noted that this is within the trial group who self-selected to participate.
Event times	<ul style="list-style-type: none">• Trial participants provided the same level of demand response, and participated at the same rates, for events held at 4-6pm, 5-7pm and 5-8pm.	<ul style="list-style-type: none">• Evidence that end consumers can be called upon to provide turndown during any 2-hour period between 4-8pm and deliver the same response.
Network impact	<ul style="list-style-type: none">• Network impact analysis undertaken after trial two highlighted that when applying trial two results to forecasted heat pump volumes at the NGED Hayle-Camborne flexibility zone, heat pumps could abate 20% of the predicted peak exceedance by 2028, but only when dispatched daily as opposed to the 2-3 day format in trial two. Dispatching heat pumps at lower frequency may result in the need to stagger groups in 2-hour blocks to meet longer requirements, diluting the overall magnitude at any given time.	<ul style="list-style-type: none">• The network impact analysis highlighted that heat pumps can optimally support networks when dispatched in a daily-flexibility role, as with the former NGED Sustain product (now Scheduled Utilisation), rather than in the 2-3 day per week setup trialled in trial two.

- Satisfaction**
- 79% (n=636) of participants reported being satisfied with the trial.
 - Strong engagement and willingness amongst heat pump households to participate in flexibility.
- Comfort**
- 92% (n=636) of households never or only sometimes felt a change in comfort during events, across all events.
 - All customers who choose to engage with heat pump flexibility can typically do so comfortably.
 - Even when surveyed after the coldest events (< 3°C), 85% of participants reported either no change or a slight change in comfort.
-

For more detail on these trial two outcomes please see [Deliverable 4: Learning from trialling novel commercial methods](#).

5.1.3 Trial three – filling in the gaps

Trial three sought to address the remaining evidence gaps in defining the potential of heat pump flexibility at scale. Its scope was divided across five mini-trials with different focuses, and its findings are summarised in Table 23.

Turn Up Flex participants achieved an average of 0.88 kW of demand response over 3 events when asked to turn up only their heat pumps, and an average of 1.35 kW over an additional 3 events when asked to turn up any device. These results highlight that there is strong potential for residential customers to participate in turn up flexibility to support networks, and that the amount of flexibility they can offer increases substantially if they have a heat pump.

Longer Events Flex participants' demand response rates were broadly consistent with those observed in trial two. Though, the mini-trial's emphasis was on participants' preferences for event duration as opposed to defining turndown magnitude. Around half of participants favoured 2-hour events, while substantial minorities indicated they could comfortably accommodate events lasting 3- or even 4-hours. These findings suggest that networks can treat 2 hours as the typical flexibility event length for heat pump homes, while also acknowledging that there may be a meaningful proportion of customers who can safely choose to participate in longer events.

Morning Peak Flex demand response results were inconclusive, but around half of participants reported engaging in the events and in some cases expressed a preference for morning events. This suggests that morning flexibility from heat pump homes could be viable at scale.

Daily Evening Flex demonstrated the potential for daily participation, with strong early turndown effects. Unseasonably warm, weather is thought to be responsible for the minimal turndown measured during the final half of the mini-trial in late February through April, though self-reported participation remained above 50% during all check-in surveys, indicating participants were turning down consistently as requested. The findings indicate that the daily turndown behaviour modelled as optimal for heat pumps in the post-trial two network impact analysis is likely achievable in practice – and heat pump homes can likely be expected to participate in daily flexibility-type products to best support networks, most customers for 2-hours daily but

some for up to 4-hours. Participation in both the mini-trial and the DFS also highlights customer appetite for taking part in future stacked flexibility opportunities. Of note, customers using time of use tariffs that incentivise heat demand response during the day were not eligible to participate in Daily Evening Flex and so findings may represent an under-reporting of the potential for daily heat pump flexibility.

Daily Morning Flex additionally confirmed that households can deliver daily flexibility across morning and evening periods. While turndown data was not conclusive in the first half of the mini-trial, self-reported participation remained stable, suggesting participants were turning down as requested. Finally, with over half of participants also engaging in the simulated DFS events, further evidence was obtained of customer willingness to take part in stacked services.

Overall, the mini-trials show that heat pumps can reliably provide both upward and downward flexibility on a daily basis, with two-hour events emerging as an effective standard duration, though with a substantial proportion of households capable of sustained participation when required.

EQUINOX energy suppliers noted that some customers already owned multiple low-carbon technologies, introducing complexity in how asset-specific demand response is quantified. As the cost of these technologies decrease, a larger proportion of customers are likely to adopt them, which could expand both participation rates and the range of flexibility services they are able to offer. A broader customer base provides DSOs and NESO with greater confidence that sufficient flexibility can be delivered consistently, supporting the transition of EQUINOX trial learnings into a BaU model.

Table 23: Key findings from trial three

Mini-trial	Findings	Implications for heat pump flexibility procurement
Turn Up Flex	<ul style="list-style-type: none"> On average, 0.88 kW / 1.76 kWh demand turn up per participant across 3 heat pumps only events. On average, 1.35 kW / 2.7 kWh demand turn up per participant across 3 events permitting turn up from any home device. 	<ul style="list-style-type: none"> Evidence that residential consumers can provide meaningful demand turn up flexibility to support networks, particularly through their heating, e.g. during periods of over-supply of renewable generation.
Longer Events Flex	<ul style="list-style-type: none"> Turndown magnitude was in line with trial two for 2-hour and 4-hour events, but inconclusive for 3-hour events. When asked about their preferred event length, 46% of participants preferred 2-hour events, 32% preferred 3-hour events, and 22% either preferred 4-hour events or had no preference. 	<ul style="list-style-type: none"> Evidence that that networks can treat 2 hours as the typical flexibility event length for heat pump homes, while also expecting a significant share of participants to remain responsive during longer events. Except for insulation, which may impact a participant's event length preference, any other variation in event length preference is likely due to individual customers' personal preferences rather than driven by specific household characteristics.

- Amongst participants with poor insulation⁴⁷, none preferred 4-hour events and only 10% reported no preference. Across other factors such as home battery ownership, access to additional heating and potential vulnerability, there was no deviation from the overall group on event length preference.

Morning Peak Flex

- Inconclusive demand response results, likely due to small trial cohort.
- An average of 50% of participants self-reported participating in all or part of the events in the post-event surveys.
- While the turndown data was not conclusive, positive customer engagement survey results provide evidence that morning peak flexibility is achievable from heat pump homes.

Daily Evening Flex

- Demand turndown was detected for the 2-hour group in weeks 1-6, and week 10, at magnitude in line with trial two results, but not weeks 7-9 or week 11. >50% of participants self-reported turning down during 3 check-in surveys spread across the mini-trial.
- Demand turndown was detected for the 4-hour group in weeks 1-5, in line with trial two results; demand turn up was detected for weeks 6-11. >50% of participants self-reported turning down during 3 check-in surveys.
- Likely unseasonably warm winter affected turndown results for both groups.
- 83% of participants (124 participants) with remote control found events on a daily basis to be just right or too little compared to 63% of participants (108 participants) with manual control⁴⁸.
- Participants successfully participated in DFS, alongside the mini-trial, earning £96 across the entire group for doing so.
- Evidence that daily participation in flexibility services is achievable for heat pump homes, with default expectation of 2-hour participation except in cases where customers elect to participate for longer.
- Note the unexpected turndown results (2-hour group inconclusive and 4-hour group negative second half of mini-trial) likely due to unseasonably warm weather and many homes no longer feeling the need to heat regardless of the events.
- This highlights that the optimal value-case for engaging heat pump homes in flexibility identified in the post-trial two network impact analysis is likely achievable – heat pump homes are likely able to participate in Sustain/Scheduled Utilisation style products.
- There may be an advantage of remote-control capabilities in supporting consecutive day flexibility, especially for daily events.
- Customers' choice to participate in DFS while also taking part in the mini-trial is indicative of

⁴⁷ Participants were asked 'How would you describe the quality of your home insulation?' If they selected "My home is not very well insulated and impacts the way I heat my home", they would be classified as "poorly insulated" in the start of trial survey.

⁴⁸ Participants were asked 'During the EQUINOX daily flex trial, there was one event per day for 5 consecutive days. What is your view on this frequency?' in the end of trial survey.

		the customer appetite for taking part in stacked flexibility services.
Daily Morning Flex	<ul style="list-style-type: none"> • Demand turndown detected during morning and evening periods weeks 5-8, at rates in line with trial two, but not in weeks 1-4 during the morning only period. • Self-reported turndown participation in surveys remained stable averaging 39% for each half of the mini-trial. • 54% of treatment participants self-reported participating in simulated DFS events. 	<ul style="list-style-type: none"> • Evidence that daily participation in flexibility services is achievable for heat pump homes in both mornings and evenings. The lack of definitive turndown data for the first 4-weeks is considered likely a result of the small sample size, especially considering customers' stable self-reported participation rates. • Customers' choice to participate in simulated DFS events while also taking part in the mini-trial is indicative of the customer appetite for taking part in stacked flexibility services.
Satisfaction	<ul style="list-style-type: none"> • 79% (n=552) of participants reported being satisfied with the trial. 	<ul style="list-style-type: none"> • Strong engagement and willingness amongst heat pump households to participate in flexibility across a variety of arrangements.
Comfort	<ul style="list-style-type: none"> • 88% (n=552) of households reported no or slight impact on the comfort of their home. 	<ul style="list-style-type: none"> • All customers who choose to engage with heat pump flexibility can typically do so comfortably across a variety of arrangements.
Vulnerability	<ul style="list-style-type: none"> • 47% of trial participants were classified as potentially vulnerable customers and demonstrated similar levels of participation, trial satisfaction, comfort and engagement as non-vulnerable participants. • 82% of potentially vulnerable participants reported no or slight impact on the comfort of their home, which is closely aligned with 88% of all households. 	<ul style="list-style-type: none"> • Demonstrated strong evidence that some potentially vulnerable groups, including those who could be at risk of fuel poverty, are interested in taking part in heat pump flexibility and can equitably benefit from taking part.

For more detail on these trial three outcomes please see [Learning from trial three: Executive summary](#).

5.1.1. Technology Readiness Level

Within the projects FSP the aim was to move from a TRL of 6 to 8. By utilising existing systems and processes that support those systems, it was deemed that 6 was an appropriate building block on which to build, not least because procurement of flexibility services at scale was at the time still somewhat nascent.

By leveraging those existing systems and processes and only enhancing them where necessary, the project team has developed a high function way forward that can be used to embed Heat Pump flexibility into the normal business operations of a DSO. Moreover because the Flexibility Service Providers also aligned to existing business systems, the team is confident that this can be leveraged into a BaU process readily and

this is borne out not only by feedback from within NG DSO but also can be seen by the increased volume of Heat Pump customers registered into flexibility markets.

Taken together, the outcomes of the EQUINOX trial prove that heat pump flexibility can deliver measurable demand response and is typically a positive customer experience. The trials' findings additionally support the conclusion that domestic heat pumps can participate in existing flexibility service offerings, without new services needing to be implemented. Heat pump homes can provide flexibility through both daily and dynamic style events; however, network impact analysis from trial two indicates that heat pumps more effectively support networks in a daily flexibility role. These outcomes offering important insights into the potential for commercial participation of heat pump homes in BaU flexibility services. Additional detail on implementation of learnings is provided in section 13.

6. Performance compared to the original Project aims, objectives and SDRC/Project Deliverables

Our Aims for Project EQUINOX were as follows:

Table 24: Project Aims

Aim	Outcomes
DNO's and Flexibility providers do not fully understand how much flexibility is available from low carbon heat at an aggregated level	EQUINOX has proven that not only can Heat Flexibility provide a service to DNO's but also that it can be done at scale and be reliable.
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	EQUINOX has proven that commercially Heat Flexibility can work for network operators and do not need to be catered for separately from other services.
A lack of understanding regarding the impact of low carbon heating at scale and the potential for flexibility from low carbon heating prevents DNO's from leveraging the opportunity flexibility provides, as well as their ability to optimally factor these networks solution into investment plans	EQUINOX has improved NGED's understanding of how heat services can be used within existing flexibility ones, it has informed wider planning assumptions and features within existing services ensuring that it features in future planning work.

All project objectives have been successfully met. Table 25 provides a list of the project objectives within the Full Submission and evidence to support completion

Table 25: Project Objectives

Objective	Outcomes
<p>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?</p>	<p>Achieved: EQUINOX proved that DSOs can be confident in the use of domestic heat flexibility services. In trial two, the projects largest trial, we found that 1.2kWh of turndown is achieved per customer per 2 hour event.</p> <p>EQUINOX trials demonstrated a minimal reduction in comfort throughout and customers remained engaged during all trials.</p> <p>EQUINOX showed that different control strategies did not materially impact on the response received. During the project a number of control methods were utilised including automation, remote control and manual control to maximise customer reach and acceptance. Smart Thermostats, storage and the ability to leverage technology was therefore a variable throughout the project and it was clear that this helps with the facilitation of flexibility, but is not essential. Our BaU transition report focuses on some recommendations on this area.</p> <p>The impact of home building characteristics were embedded in EQUINOX, with participants having homes ranging from EPC A to G.</p>
<p>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?</p>	<p>Achieved: EQUINOX demonstrated strong response and participation levels throughout. During the trials customer feedback was collected through surveys, interviews and focus groups, with learning from this informing later trial design and BaU recommendations.</p> <p>Working with the Flexibility Service Providers made for a stronger outcome and it is encouraging to see more Heat Pumps in NGED flexibility services and continued presence from EQUINOX customers, 61% of Octopus customers that participated in the project still continue to participate.</p> <p>Recommendations on further future facilitation were included in the projects BaU transition report</p>

Technical Integration: What technical integration and automation is required to deliver a seamless customer experience?

Achieved: EQUINOX trialed and successfully demonstrated end to end technical integration between DSOs and end customers. The approach to this included the use of BaU practices where possible (Flexible Power and Piclo platforms), and included development of bespoke solutions when needed (SPERL customer app). During the project a number of control methods were utilised including automation, remote control and manual control to maximise customer reach and acceptance.

Market Design and Participation: How can DNOs, energy suppliers, and the ESO align their objectives to participate in DNO flexibility markets?

Achieved: EQUINOX demonstrated coordination between DSO, energy suppliers and NESO during its delivery. All three trials engaged multiple energy suppliers, and during the trial period stacking was successfully demonstrated with the NESO Demand Flexibility Service product.

Just Transition: How do DNOs ensure that fuel poor and vulnerable customers have an equal opportunity to participate in flexibility services?

Achieved: Ensuring no customers were left behind was a strong success for EQUINOX. The project undertook a lot of work to really delve into making flexibility something that all can participate in and a number of documents have been produced to bring this aspect to life. More can be found on this in the Section 14.

To best understand the implications on those that are potentially fuel poor and vulnerable, the project developed an Equitable Participation Framework. This document explored and defined the characteristics that impact customers, and allowed us to better understand those involved in the trial. During trial 3 47% of trial participants were considered potentially vulnerable.

Table 26 below provides a list of the project deliverables within the Full Submission and confirmation of completion:

Table 26: Project Deliverables

Reference	Project Deliverable	Deadline	Evidence	Status
1	Customer perceptions on unlocking flexibility from heat [WS3]	Dec 2022	<p>A report containing:</p> <ul style="list-style-type: none"> Insights from customer surveys and customer focus groups on the barriers and enablers for unlocking flexibility from heat 	Submitted December 2022
2	Initial insights on effectiveness of commercial methods [WS1 & WS4]	Jul 2023	<p>A report containing:</p> <ul style="list-style-type: none"> 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 	Submitted July 2023
3	Design of novel commercial methods & technical integration [WS1 & WS2]	Nov 2023	<p>A report containing:</p> <ul style="list-style-type: none"> 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 (incl. cyber 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. 	Submitted November 2023
4	Learning from trialling novel commercial methods [WS4]	Aug 2024	<p>A report containing:</p> <ul style="list-style-type: none"> An overview of the commercial terms for DNOs, energy suppliers and customers. An overview of learning from trialling the range of novel commercial method 	Submitted August 2024

			<ul style="list-style-type: none"> An overview of the customer experience during the trials based on customer feedback <p>An overview of the simulated network impact throughout the trial flexibility events</p>	
5	Learning from engaging customers on the barriers & enablers of the electrifications of heat and unlocking domestic flexibility [WS3]	Aug 2025	<p>A report containing:</p> <ul style="list-style-type: none"> 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 <p>Recommendations on the role of DNOs in customer engagement</p>	Submitted August 2025
6	Recommended transition of learning to BaU [WS4]	Dec 2025	<p>A report detailing:</p> <ul style="list-style-type: none"> 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 <p>An update of the project business case that considers project learning</p>	Submitted December 2025
N/A	Comply with knowledge transfer requirements of the Governance Document.	End of Project	<ol style="list-style-type: none"> Annual Project Progress Reports which comply with the requirements of the Governance Document. Completed Close Down Report which complies with the requirements of the Governance Document. <p>Evidence of attendance and participation in the Annual Conference as described in the Governance Document.</p>	Complete This report forms the final element of this requirement.

7. Required modifications to the planned approach during the course of the Project

The Project experienced limited changes throughout the lifecycle, and where they were necessary the rationale was agreed formally within the project or with the partner specifically and the NGED change control process followed.

Table 27: Detail of changes made during project lifecycle

Change Area	Detail	Rationale
Technical integration	Where possible the project made use of BaU aligned technical integration. This reduced activity within project and therefore led to a reduction in spend.	This change maximised value for money for customers by not paying for project specific integration that may not be used following close down.
Equipment	At the bid stage it was anticipated that equipment would be needed to execute trials with customers, but this was not found to be the case.	EQUINOX eligibility for trials relied upon customers having an operating smart meter and an installed heat pump, but some also had additional equipment beyond this (particularly those with a Sero Building Energy Engine). The range of control methods used during the project, and the use of surveys to augment data on in home temperatures where monitoring was not available, has enabled us to carry out trials with all participants without requiring any additional equipment to be installed.
WMCA	Adjustments were made to West Midlands Combined Authority (WMCA) deliverables to include the Equitability Participation Framework. Overall, there were reduced costs due to a smaller direct trial involvement.	The changes were agreed to ensure that the objectives of the EQUINOX project were maintained while reflecting WMCA's revised role. The updated scope ensured there was no impact on the quality or intent of the agreed deliverables.
Sero	Sero customers were not included in Trial 3, resulting in a change from the original participation arrangements for this trial phase	During the project delivery, Sero exited the home control market and therefore could no longer support customer participation in Trial 3. This change was agreed with the project team and did not affect the overall project objectives or delivery of Trial 3.

None of the changes listed above were considered material, and have been documented in Project Progress Reports and associated project deliverables.

8. Significant variance in expected costs

Finalised costs for EQUINOX are detailed below in Table 28. The justification for variance in each category is detailed below. All unspent funds will be returned in accordance with the NIC governance process.

Table 28: Progress against Budget

Category	Budget (£k)	Total Spend (£k)	Variance to Budget (£k)	Variance to Budget (%)
Labour	£4,993.52	£3,995.99	-£997.53	-19.98%
Equipment	£456.20	£0.00	-£456.20	-100.00%
Contractors	£483.80	£265.12	-£218.68	-45.2%
IT	£221.97	£0.00	-£221.97	-100.00%
IPR Costs	-	-	-	-
Travel & Expenses	£17.76	£8.97	-£8.79	-49.5%
Payments to users	£250	£108.01	-£141.99	-56.79%
Contingency	£1,231.43	£585.00	-£646.43	-52.49%
Decommissioning	-	-	-	-
Other	£111.43	£87.70	-£23.73	-21.3%
Total	£7,766.11	£5050.79	-£2715.32	-34.96%

As reported in past progress reports, contingency spend has been allocated to support the addition of Scottish Power Energy Retail costs to the project. This spend will allow us to significantly enhance the learning from the project by demonstrating how the methods can be replicated with this additional supplier, as well as allowing us to reach a wider demographic of customers for trial participation.

Justification for the variance in each spend area is as follows:

- **Labour & Contractors** – Labour and contractor spend was lower than the values set out within the FSP. One factor contributing to this relates to the reduction in technical integration requirements from

the FSP stage, where it was initially thought that more EQUINOX specific development would be needed. Where possible BaU methods were used to ensure scalability in the future and alignment to BaU. Another factor contributing to this was the reduction of Sero involvement of trial three following the removal of their customers from the trial recruitment.

- **Equipment** – At the bid stage it was anticipated that some equipment would be needed to execute trials with customers. EQUINOX eligibility for trials relied upon customers having an operating smart meter and an installed heat pump, but some also had additional equipment beyond this (particularly those with a Sero Building Energy Engine). The range of control methods used during the project, and the use of surveys to augment data on in home temperatures where monitoring was not available, has enabled us to carry out trials with all participants without requiring any additional equipment to be installed.
- **IT** – As mentioned above and in previous project progress reports, we took an early decision to repurpose existing technical integration solutions where possible. This has led to a reduction in IT costs within NGED and across partners.
- **Travel and Expenses** – Spend in this area is lower than originally forecast. This links to more meetings being carried out virtually than expected and making use of locations to avoid travel costs when in person.
- **Payments to Users** – Less rewards were required than originally planned, linked to learning on price sensitivity from trial 2.
- **Other** – Audit costs have been added to this line item following the final deliverable submission. This has been carried out during the period between final deliverable submission and closedown report submission.

9. Updated Business Case

This section presents the updated EQUINOX business case, developed using trial findings and an enhanced methodology aligned with RIIO-ED3 guidance. The business case aims to demonstrate the potential benefits to GB of heat pump flexibility being implemented in line with EQUINOX trial results.

- Section 9.1 presents the business case scope.
- Section 9.2 presents the business case methodology assumptions.
- Section 9.3 presents the business case results.

9.1 Business case scope

The original Full Submission Proforma⁴⁹ provided an estimation of the potential benefits of scaling-up heat pump flexibility in GB. The calculated benefits were based on an assessment of reinforcement needs to accommodate the future uptake of non-flexible heat pumps across GB, and the capability to defer or avoid this reinforcement by procuring flexibility from those customers with heat pumps. The assessment considered that procuring flexibility from heat pumps would enable their peak demand contribution to be reduced, resulting in increased substation headroom. This assessment was based on ED2 guidance and the use of flexibility to defer or avoid reinforcement.

The updated 2025 business case follows the same core principle of modelling scaled-up heat-pump flexibility to reduce peak demand and increase substation headroom. However, the application of this additional headroom has been realigned to reflect ED3 guidance. Rather than emphasising substation reinforcement deferral, the business case now focuses on enabling new connections that would otherwise need to be delayed until reinforcement is completed.

There are multiple use-cases for heat pump flexibility, including the use of demand turndown to create substation headroom, but also the use of demand turndown to support fault maintenance or demand turn up to support supply-demand imbalances. This business case focuses solely on the substation headroom benefits case, though highlights these additional use-cases for heat pump flexibility can provide substantial value to the GB energy system.

9.2 Business case methodology and assumptions

The analysis is focused on developing and comparing two scenarios for heat pumps: a Counterfactual scenario, where no forecasted heat pumps participate in flexibility, and an EQUINOX scenario, where a proportion of forecasted heat pumps participate in two-hour flexibility events in line with the EQUINOX trial results. In the EQUINOX scenario, headroom additions are valued to demonstrate the system benefits of heat pump flexibility.

⁴⁹ [EQUINOX, Making heat flexible to DNOs and beneficial to customers](#), NGED

9.2.1 Data sources

Data sources for the business case are drawn directly from the EQUINOX trial results or NG DSO BaU activities. They are listed in full below in Table 29.

The NGED data sources are as follows:

- Headroom report forecasts for primary and secondary substations.
- Heat pump count forecasts indicating expected ASHP and GSHP uptake.
- NGED winter peak load profiles per heat pump, representing maximum expected demand during very cold weather (which is used to inform network planning for heat pump peak load)

The EQUINOX trial data is as follows:

- Participation behaviour observed during trial two cold-weather events at -1.4°C .
- Default two-hour event duration identified in the trial three Longer Events Flex mini-trial.
- Whole-home turndown measurements at -1.4°C , used to estimate proportional load reduction.
- Findings from the post-trial two network impact analysis, demonstrating that daily use of flexibility provides the greatest network value.

9.2.2 Counterfactual scenario

The Counterfactual assumes no heat pump participation in flexibility. Forecasted heat pump demand, derived from NGED's peak winter profiles, is added to each substation's load, reducing available headroom. Reinforcement need is identified by the year in which a substation's headroom becomes negative.

9.2.3 EQUINOX scenario

The EQUINOX scenario applies flexibility performance from the trials to the same forecasted network conditions. A 40% participation rate is assumed, reflecting behaviour during the coldest trial two events of -1.4°C . Participating customers are modelled to participate in flexibility every winter day for two hours between 4-8pm. This performance is in line with the post-trial two network impact analysis, which showed that daily deployment of heat pump flexibility provides the highest network value, while the timing aligns to the traditional peak times on NGED's networks.

To maintain consistent coverage across the evening peak, the scenario assumes half of participants reduce demand from 4–6pm and half from 6–8pm. The magnitude of turndown per heat pump is additionally based on the proportional reduction in whole-home load observed at -1.4°C , applied to NGED's ASHP and GSHP peak profiles. This saving per heat pump is aggregated across all heat pumps at each substation and added back as restored headroom.

9.2.4 Valuation method for headroom

For each substation, the counterfactual trajectory is used to determine when reinforcement would be required. EQUINOX-derived headroom is then added to estimate how flexibility can be used to delay reinforcement or maintain positive headroom in subsequent years. Benefits are aggregated across all primary and secondary substations in the four NGED licence areas.

9.2.5 Costs and NPV

Flexibility procurement costs are based on £20 per winter per participating heat pump, aligned with trial three's Daily Evening Flex payment rate. EQUINOX project funding costs are also considered. A Net Present Value (NPV) calculation was then performed to determine overall net benefits, comparing the cost of flexibility procurement against the value of freed up headroom from heat pump flexibility.

Table 29: Key assumptions that informed the updated business case

Data	Assumption	Source
Substation headroom forecasts	This dataset shows the capacity limit of each NGED substation and their forecasted peak load from 2025-2050.	<ul style="list-style-type: none"> • NG DSO Data.
Heat pump count forecasts	This dataset shows the number of heat pumps forecasted to be connected to each primary substation.	<ul style="list-style-type: none"> • NG DSO Data.
Peak load contribution of heat pumps	ASHP: 0.002791 MW GSHP: 0.00236 MW	<ul style="list-style-type: none"> • NG DSO Data.
Peak load reduction from heat pumps as a proportion of total load	39%	<ul style="list-style-type: none"> • Based on demand response volumes achieved on the coldest day of EQUINOX trial two.
Heat pump flexibility participation rate	40%	<ul style="list-style-type: none"> • Based on participation rate seen on the coldest day of EQUINOX trial two.
Proportion of heat pumps who flexibility is procured from every two-hour period	50%	<ul style="list-style-type: none"> • Based on EQUINOX Longer Events Flex mini-trial three findings that most households prefer two-hour long events.
Value of headroom	£397,999/MVA/year	<ul style="list-style-type: none"> • This figure represents the cost incurred to enable connections to still occur

despite constraint by setting up back-up generation⁵⁰.

Cost of funding flexibility	£20/heat pump/year	<ul style="list-style-type: none"> Based on EQUINOX trial three Daily Evening Peak settlement amount, based on an average of Sustain payments offered by NG DSO.
Environmental benefit	2.40 tCO ₂ e/MVA	<ul style="list-style-type: none"> 92.7 tCO₂e per 38 MVA of transformer capacity not being installed, based on Capacity to Customer (C2C) project⁵¹.
Cost of EQUINOX funding	£6,980,000	<ul style="list-style-type: none"> EQUINOX project direction.
WACC	4.8%	<ul style="list-style-type: none"> NG DSO Data.

9.3 Business case results

Based on the methodology outlined above, the results show that EQUINOX delivers substantial economic benefits when implemented at scale. As shown in Figure 6 the forecasted cumulative headroom that will be created by EQUINOX between 2026-2050 is 6014 MVA at primary substations and 3750 MVA at secondary substations across Great Britain (GB). It is important to note that this headroom is temporary, available only in years where flexibility procurement maintains positive headroom, until reinforcement ultimately removes these benefits. As a result, capacity gains are distributed across the timeline rather than permanent.

This capacity benefit can be translated into equivalent environmental benefits from created headroom, as EQUINOX headroom benefits can offer services to constrained parts of the network. The Capacity to Customers (C2C) project suggested a total saving of 92.7 tCO₂e for each new 38 MVA transformer not installed⁵¹. Using this assumption, along with the headroom figures, we determined the environmental benefit of EQUINOX in tCO₂e in Figure 7.

The forecasted net financial benefits of EQUINOX at GB scale reaches approximately £1,154m for primary substations only, £719m for secondary substations only and a combined figure of £1,879m in 2050. These results are shown in Figure 8⁵². It is important to note that the combined view between primary and secondary substations may be overstated, as there are likely cases where there are duplicate benefits across the two, therefore figures for both primary and secondary substations have been presented in these results.

⁵⁰ [Review of the Regulatory Framework for Strategic Network Investment](#), NERA

⁵¹ [Capacity to Customers Cabron Impact Assessment](#), ENWL

⁵² All figures are presented in real terms using 2025 prices.

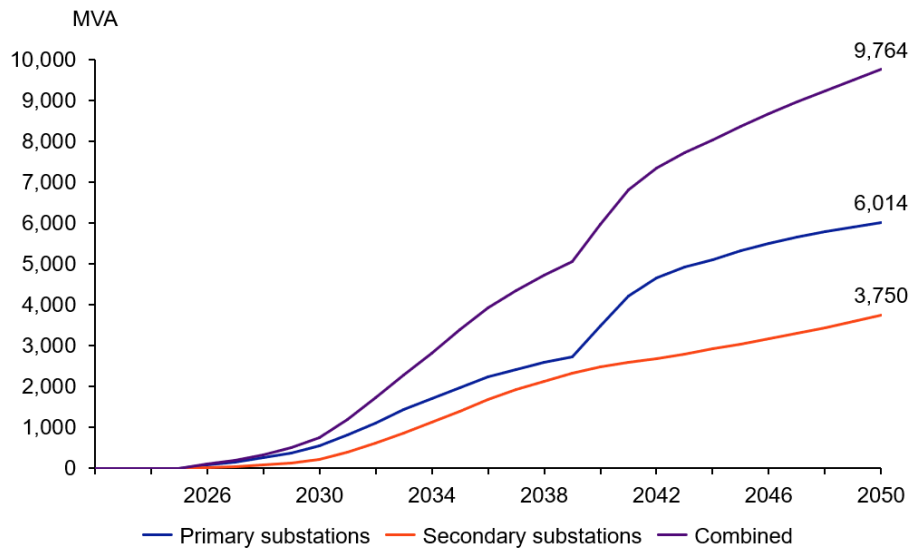


Figure 6: Forecasted cumulative headroom benefits of EQUINOX at GB scale

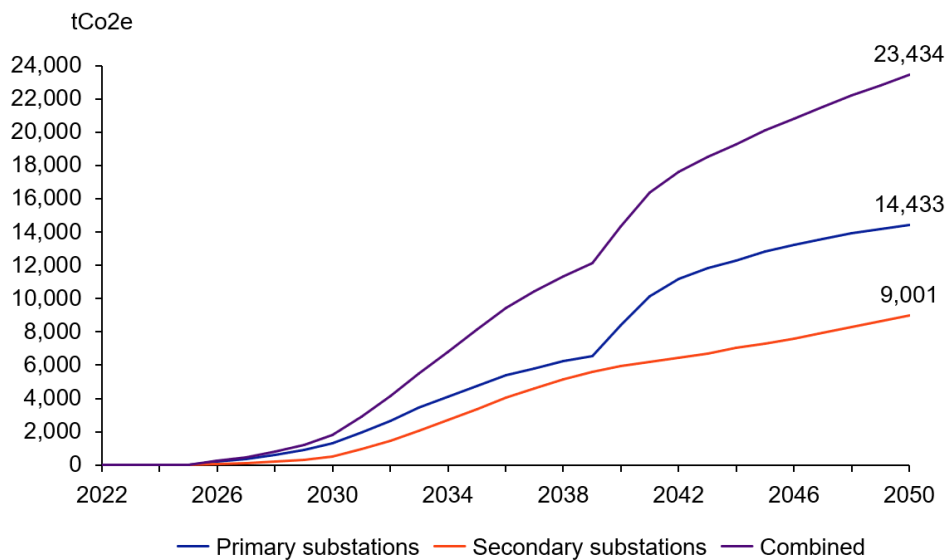


Figure 7: Forecasted cumulative environmental benefits of EQUINOX at GB scale

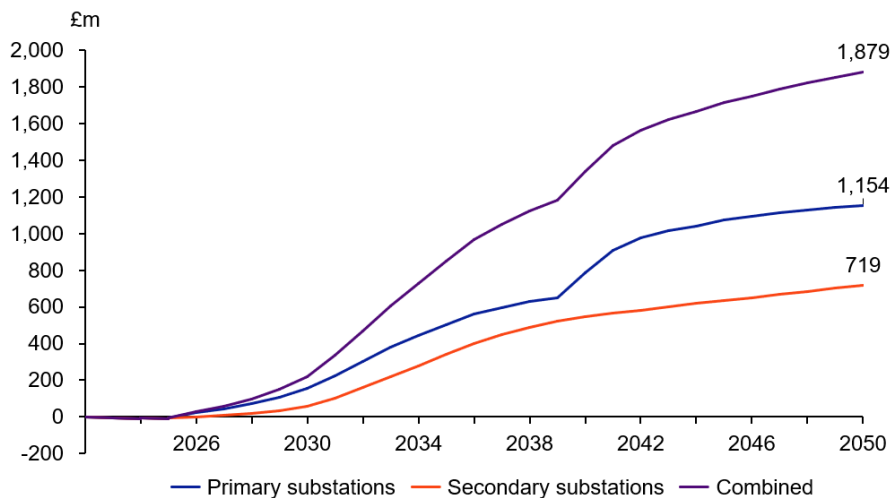


Figure 8: Forecasted net financial benefits of EQUINOX at GB scale

These results highlight that heat pump flexibility delivers system and financial value by creating additional headroom to enable new connections sooner. The previous business case, aligned with ED2 guidance, focused on deferring and avoiding network reinforcement at both primary and secondary substations. Aligned with ED3 guidance, the new business case shifts focus to the system benefit of enabling new connections sooner through additional headroom. In this iteration, the benefits are calculated on the basis of unlocking economic value per year by allowing new demand to connect sooner without the need to await new connections. This iteration quantifies value based on the economic benefit of deferred connections, drawing on analysis from NERA Economic Consulting undertaken for SSEN⁵³ and consistent with NG DSO BaU practice. This variation in approach between the original and updated business case highlights the difference in results achieved.

In addition to the system level benefits quantified through the business case, EQUINOX has also delivered clear direct benefits by accelerating customer participation in flexibility markets. Of the over 2,000 participants in EQUINOX, 95% continue to participate in flexibility offerings beyond the trials and the vast majority (88%) are participating in explicit network flexibility, demonstrating that EQUINOX has had a lasting impact on customer behaviour rather than a trial specific effect.

This ongoing participation takes multiple forms. Around 65% of continuing participants are on time of use tariffs, indicating that engagement through EQUINOX has supported the uptake of implicit flexibility. Additionally, around 90% of participants remain engaged in manual flexibility schemes, highlighting that explicit flexibility services continue to be accessible and attracted to a broad range of customers. Only 5% of former EQUINOX participants have returned to conventional electricity tariffs without signing up to any flexibility offering, suggesting a low level of attrition from flexibility once customers have been exposed to it through a well-designed, customer-centred programme.

⁵³ [Review of the Regulatory Framework for Strategic Network Investment](#), NERA

These outcomes suggest that EQUINOX has built familiarity, trust, and confidence to participate in flexibility among households with heat pumps. From a business case perspective, this demonstrates that the investment in the EQUINOX trial has delivered durable behavioural change, increasing the available flexibility asset base over time and strengthening the value proposition for both explicit and implicit flexibility in BaU operations.

Ultimately, the results of this updated business case confirm that the cost of procuring flexibility is far outweighed by the economic and system benefits, making EQUINOX a viable solution at scale. Therefore, we recommend procurement of heat pump flexibility across GB to fully realise this benefit.

10. Lessons learnt for the method

Learning has been captured and shared throughout the duration of EQUINOX in project deliverables, progress reports, webinars, horizon scans and additional reporting. This is a summary of some of this captured learning and is split into relevant areas of the project activity.

Commercial Arrangements

- **Per-event, per-kWh incentives sustained the strongest and most consistent customer engagement.**
Fixed monthly payments, tested in trial one, were less effective at motivating participation. Event-based payments, especially when linked to measurable consumption reductions, aligned incentives, increased engagement, and improved the reliability of insights.
- **Commercial design and technical integration should be co-developed, not sequential.**
Adjustments to payment groups, eligibility, or supplier-specific propositions required changes to metering IDs, dispatch groups, verification rules and settlement logic. This demonstrated that even small commercial design changes can have technical implications, reinforcing the need for iterative joint development.
- **Having early defined hypotheses** that form basis of trials, ensures that scope creep is reduced.
- **Trial 1 payment amounts were far above what DNOs** would expect to pay for the turndown achieved in a BaU scenario to stimulate early results. This was adjusted in later trials, and did not overly affect participation rates.

Customer Experience

- Customer-centric design enables high customer engagement rates. Embedding customer experience directly into the trial design process, rather than treating it as a separate consideration, helped to deliver consistently high engagement and satisfaction rates in EQUINOX. Prioritising voluntary participation and empowering households to engage on their own terms may be valuable approaches too for commercial flexibility products, which must be practical and appealing for a wide range of customers.
- **The development and implementation of vulnerability frameworks should be tailored to specific trial programmes and customer circumstances.** It is important to consider developing bespoke customer personas and hypotheses to capture specific circumstances that customers could be exposed to when evaluating customer experiences. The development and implementation of the Equitable Participation Framework (EPF) in trial three was one of the contributing factors to being able to more robustly understand how different customers could benefit and equitably engage with the trial.

- **The trials showed that clear, timely and multi-channel communication is essential to delivering a positive customer experience and sustaining high participation across events.** Customers consistently preferred real-time text messages and app notifications to complement email, with reminders proving critical, particularly before consecutive event days where participation otherwise dipped due to comms fatigue. Recruitment and feedback processes benefitted from being simple, minimising touchpoints, and avoiding formats that confused participants.
- **Complexity of payment structure** can cause reduced engagement, customers can be perplexed by the payment amounts.
- **Supplier focus group sessions** were productive and added richness to the outcomes and coupled with the primary research afforded the team with tangible results.
- **Having a mixture of customers** with existing price incentives (ToU) compared to customers that are on flat rate tariffs provided insight into differing interactions and abilities to participate within the trial.
- **Households** may be more likely to agree to participate in third party aggregator controlled events, if they are facilitated by their existing home management supplier rather than their energy supplier.
- **Customers are keen to understand the “why”** behind the trial including the design choices like days of the events. Whilst it is important to not share this up front and thereby bias results, more could be communicated back to participants in a feedback loop post-trial.

Flexibility Procurement Strategy

- **The evolution of the EQUINOX flexibility proposition demonstrated the value of iterative trial design, designing around clear hypotheses, and understanding how household characteristics shape flexibility potential.** A small-scale test phase ahead of Winter 1 significantly reduced delivery risk, confirmed event design parameters, and refined data and operational processes.
- **Integrating commercial arrangements with existing BaU flexibility products is important for easy integration with BaU.** Trial outcomes showed that heat pump flexibility can operate effectively within existing flexibility product structures. Designing around these existing structures reduces friction for suppliers and customers and accelerates the transition from innovation to implementation.

Technical Integration

- **Leveraging existing BaU systems reduced development cost, complexity and onboarding friction.** Using Flexible Power and Pico meant suppliers could integrate using familiar infrastructure, avoiding the need for bespoke end-to-end systems and reducing project delivery risk.

- **Standardised DNO-side APIs allowed for multi-supplier participation while enabling supplier-specific control innovation.** This model balanced operational consistency with the flexibility for suppliers to manage in-home control systems differently, an important consideration as the market becomes more diverse.
- **Early, structured integration testing was critical to reliable delivery.** Testing weeks before go-live using formal dispatch signals helped surface system mismatches and prevented issues during live events. This was particularly important as technical dependencies multiplied across trials.
- **To integrate with multiple energy suppliers and home management systems** individual approaches need to be taken to account, but the network interaction being standardised as an API ensures that this has no impact on trial management.
- **It cannot be assumed that all trial participants will have a smart meter.** Validation of manually controlled heat pumps is more difficult to achieve in these homes and will involve participants needing to submit regular meter readings.
- **Integrating with homes already participating with home management organisations** lends itself to carrying out trials of heat pump control.
- **Heat Pump control can be done in two ways**, one optimising switching to make heat pumps efficient by selecting appropriate times in their operation cycles, or another where switching is done at exact times required by the flexibility dispatch request.

Data Collection

- **The trials highlighted the centrality of strong data governance, early definition of eligibility criteria, and alignment with the wider domestic flexibility landscape.** GDPR requirements and data-sharing agreements required significant time to prepare and negotiate, and the project found that centralising data collection through a single party was often more efficient than distributed collection among suppliers. Pre-defining data required and capturing required data upfront proved crucial.

11. Lessons learnt for future innovation Projects

Building on the learning documented within Section 10, the following points of learning apply to work to be carried out within future innovation projects, and therefore relate to areas including project management, procurement, customer engagement, implementation and timescales.

Effective project management in large innovation programmes requires flexible planning, early alignment, and clear analytical focus. EQUINOX demonstrated that large, multi-year innovation projects benefit from well written initiation documents which encourage iteration based on learning so that teams can adapt to shifts in policy, technology and operational context. This adaptability was complemented by carrying out early due diligence on partners and agreeing to data-sharing arrangements and processes upfront, which helped prevent scope creep and supported smoother delivery and evaluation. Clear hypotheses and defined end-outputs also ensured that the work remained focused and analytically robust as the trial evolved. Practical measures, such as developing detailed operational checklists, conducting readiness reviews ahead of winter, and assessing system capacity early, further strengthened project resilience. Recruitment and scheduling plans also needed to account for seasonal patterns, technology availability, and the challenges of onboarding vulnerable households, ensuring the project could respond sensitively to participant needs. Taken together, strong governance alongside flexible, forward-looking planning helped EQUINOX adapt effectively as new insights emerged.

- **Strong collaboration and shared purpose were essential to effective delivery across the EQUINOX project.** Collaboration within EQUINOX was strengthened through regular communication, openness, and a clear understanding of each partner's role and contribution. Routine face-to-face meetings and whole-project sessions helped build trust, align expectations, and support timely problem-solving as the project evolved. Onboarding materials, such as a concise project handbook or partner charter, were particularly helpful in ensuring new team members could quickly integrate and understand both the project's aims and the motivations of different organisations. Close engagement with BaU flexibility teams ensured that trial learnings were grounded in operational reality and could inform future business processes. Sensitive commercial or technical discussions often progressed more effectively in one-to-one settings, while early involvement of marketing and customer-service colleagues improved clarity in customer-facing communications and reduced the risk of misunderstanding. The project also highlighted the importance of using collaboration tools and shared platforms that remain robust and scalable throughout multi-year delivery. Taken together, these experiences showed that openness, consistent engagement, and a shared sense of purpose are key ingredients for successful multi-partner innovation.
- **Customer recruitment methods are important to consider from the outset as they can impact the diversity of customers recruited.** For EQUINOX, recruiting a customer pool representative of

the UK population was challenging as heat pumps are not yet widespread across all demographics. This is an important consideration as over time, heat pumps will become one of the main heating technologies. As heat pumps continue to be installed in more homes, the population of heat pump users changes and will begin to more closely match the UK population. If we can understand how well our trial participants represent the general UK population, we can then have some measure of assurance that our results will or will not continue to be relevant as DNOs undertake future planning activities. To reach a greater diversity of heat pump households, it was important that we engage organisations that serve underrepresented groups and local authorities to promote the trial and help to recruit underrepresented customers.

- **The development and implementation of vulnerability frameworks should be tailored to specific trial programmes and customer circumstances.** It is important to consider developing bespoke customer personas and hypotheses to capture specific circumstances that customers could be exposed to when evaluating customer experiences. The development and implementation of the Equitable Participation Framework (EPF) in trial three was one of the contributing factors to being able to more robustly understand how different customers could benefit and equitably engage with the trial.
- **Supplementing trial results and findings with additional research can add nuance and context.** We contracted a third-party agency to understand the broader perspectives and opinions on heat pump adoption and the energy transition. This was beneficial to EQUINOX as heat pump owners are not currently representative of the broader UK demographic. Therefore, being able to use this secondary research to be able to benchmark against our trial results allowed us to understand the similarities and differences between different demographics. We also conducted a survey for social tenants in the West Midlands area which again provided additional insights that we could use to inform how flexibility can benefit a diverse subset of customers.
- **Qualitative research can help contextualise insights gathered from quantitative research.** Throughout EQUINOX we conducted numerous surveys to understand customer experiences and preferences. While these results provided insightful data, supplementing this data with qualitative insights was helpful in providing nuance to the quantitative data. Focus groups and interviews allowed us to more deeply understand specific customer experiences. Qualitative research enables better understanding of the complexity of heating behaviours and habitual practices which might impact demand-shifting.

12. Project replication

Replication of EQUINOX does not specifically require physical components to be replicated for it to be adopted across the market, whether DNO/DSO's or Flexibility Service Providers. Where possible EQUINOX aligned to existing BaU practices (e.g. technical integration using Flexible Power & Piclo) to encourage adoption in the future.

The knowledge acquired is detailed within Section 15 and this again does not require additional investments in I.T or equipment to replicate what was undertaken. This was deliberate on the part of the EQUINOX consortia because the learning is based on the use of existing systems and processes to enable heat flexibility to integrate seamlessly into existing operations. More information for Network Operators and Flexibility Service Providers can be found in the following reports, Deliverable 3: Design of commercial methods and technical⁵⁴ integration and Deliverable 2: Initial insights on the effectiveness of commercial methods⁵⁵

Some additional supporting information can also be found in the Horizon Scans which provide insights into how EQUINOX surveyed the market to ensure that the solutions were also at the forefront of where heat flexibility services was heading.

No foreground Intellectual Property in addition to the materials published was created as part of the project.

⁵⁴ [Deliverable 3 : Design of Novel Commercial Methods & technical integration](#)

⁵⁵ [Deliverable 2 Initial Insights on the Effectiveness of Commercial Methods](#)

13. Planned implementation

EQUINOX has operated across three winters, with a strong emphasis on governance and continuous learning. Throughout the project lifecycle, insights have been shared with NGED, notably through the Project Review Group—comprised of senior leaders within the DSO—who have actively engaged with findings and integrated them into operational decision-making. Additionally, the energy suppliers collaborating on the project, Octopus Energy, Sero and ScottishPower, have actively applied EQUINOX learnings to enhance their flexibility offerings, technical solutions, and customer engagement strategies, embedding these insights into their BaU operations.

From the outset of EQUINOX, there was uncertainty about whether customers would accept flexibility of their heat pump use. The concern was that participation might compromise home comfort during flexibility events, making heat pumps less suitable for demand side response. As demonstrated within this report, EQUINOX has delivered robust evidence that heat pumps can provide measurable demand response. Importantly, all customers, including those who are potentially vulnerable, who choose to participate in heat flexibility programs can typically do so without sacrificing comfort. The learning from EQUINOX will be valuable in encouraging more suppliers and aggregators to consider heat pumps for participation in flexibility markets. This section outlines the key learnings from the EQUINOX project that have been implemented by NGED and suppliers, highlighting how trial insights have shaped BaU practices.

13.1. Learnings implemented by NGED

EQUINOX has enabled NGED to translate trial insights into tangible improvements in flexibility operations and strategic planning. The following learnings highlight how project outcomes have shaped NGED's approach to heat pump flexibility.

1. **There has been a significant increase in heat pump asset registration since the start of EQUINOX.** Following trial one, we began to see heat pump participation in BaU flexibility offerings. Since EQUINOX's inception, over 9,700 heat pump assets have been registered in NGED's BaU market. As the installed base of heat pumps grows, their role in supporting networks through flexibility will expand.
2. **The results of the EQUINOX trials have provided valuable inputs into network planning assumptions.** Trials results allow the DSO to more accurately calculate fixed baselines for heat pumps. Unlike baselines that rely on historic load data—which can understate delivered response for customers on time-of-use tariffs as found in EQUINOX trial two—fixed baselines ensure that suppliers can continue to offer attractive ToU tariffs, confident that incentives for flexibility participation remain available.
3. **EQUINOX findings have demonstrated that tailored market designs for heat pumps are not necessary.** Heat pumps can participate successfully in existing flexibility markets alongside other technologies, such as electric vehicles (EVs) and home batteries. This streamlines market integration of heat pumps and supports scalability.

4. **EQUINOX trial three's Turn Up Flex trial demonstrated that domestic DTU from heat pump homes could be a promising tool for networks.** Building on this insight, NGED first launched DTU as part of BAU in its long-term tender in 2024, initially covering three zones. Today, DTU procurement is embedded in NGED's FlexUp service, covering over 50% of the network. This progression reflects the growing confidence in DTU as a valuable resource for DSOs that are managing increasing volumes of renewable generation.

Together, these learnings have strengthened NGED's ability to integrate heat pumps into flexibility markets.

13.2. Learnings implemented by suppliers

Suppliers have leveraged EQUINOX findings to build confidence in heat pump flexibility and to innovate their technical and customer engagement strategies. Key learnings include:

1. **EQUINOX has established heat pump flexibility as a credible and valuable market offering.** EQUINOX has helped suppliers develop confidence in heat pump flexibility as an offering with value for customers, flexibility providers, and the wider flexibility market.
2. **There is a strong customer interest in being able to take part in heat pump flexibility, including from potentially vulnerable customers.** Although interest levels may vary amongst different customer groups once heat pumps are the mainstream heating technology, it is encouraging to know that there are not broad customer factors that limit the addressable market for such products.
3. **Heating a comfort are highly personalised, and customers should be empowered to make their own decisions on what flexibility products may be suitable for their household.** Trial three examined how different factors interact to make a customer potentially vulnerable, building on qualitative insights from focus groups and interviews. These findings reinforce that heating and comfort vary widely, underscoring the importance of centring customer choice in flexibility programs.
4. **Consistently high satisfaction amongst trial participants shows that simple, customer-centric measures drive engagement.** Simple measures such as voluntary participation, ability to opt-out without penalty and clear communications can empower customers to actively engage in heat pump flexibility.
5. **ScottishPower has successfully transitioned EQUINOX technical integration into a business-as-usual solution.** ScottishPower developed and implemented a technical solution and associated customer proposition to deliver turn down flexibility events. This has been adopted as the ScottishPower BaU solution for delivery of externally initiated flexibility events including DFS and DNO flexibility events.

Based on these learnings implemented by NGED and energy suppliers, as summarised in Figure 9, the project now envisages a roadmap for increased heat pump participation in flexibility services in BaU,

leveraging all the learnings and recommendations developed over the 4-year project. These will operate in a cyclical manner that further accelerates the scale-up of heat pump flexibility.

- Flexibility Service Providers strengthening their engagement with customers to increase their participation in flexibility services;
- Networks building confidence in the flexibility potential of heat pump households in locations with a flexibility need;
- Networks recognising that flexibility service providers who bid using heat pumps can be relied upon to deliver flexibility when called upon;
- Policy interventions that accelerate heat pump deployment, speed up smart meter installation, and improve cyber security standards.



Figure 9: Cyclical roadmap for increasing the adoption of domestic heat pumps into BaU flexibility services

Collectively, these actions will help scale heat pump participation, support a more mature flexibility market, and embed these learnings into BaU operations.

In the meantime, the results of EQUINOX, including those around participation and moreover around DTU services have provided a sound basis from which the business can further embed heat pumps into their products, gaining confidence as more and more customers adopt them and are offered the opportunity through their Flexibility Service Provider (including Energy Suppliers) to participate in these services (and this also includes vulnerable and non-vulnerable customers further enabling the potential for maximum participation in these emerging services).

Through EQUINOX learnings, suppliers have been given the confidence to consider heat pumps for flexibility. Collectively, EQUINOX has provided insights that are now embedded in both NGED's and suppliers' BaU operations.

14. Learning dissemination

Learning dissemination is critical during an innovation project to share knowledge generated. Dissemination was conducted using a variety of methods.

The team has undertaken a wide range of events in the UK and internationally, this coalescing with the regular horizon scans that were undertaken ensuring that EQUINOX remained relevant throughout. As part of these activities we have tried to ensure that a wide audience was reached, with events targeted at the heating industry and local authorities in addition to the wider energy sector and networks.

At the close down stage of the project, we ran a series of four webinars, beginning with an overview session, but then following up with three targeted sessions ensuring learning on trial design and execution, trial results, and customer engagement have all been shared.

Table 30 below outlines the various ways information from the project was disseminated.

Table 30- List of key Dissemination events undertaken by the team

Event Title	Date	Location	Host	Contribution
28toZero	10th June 2022	Westminster, London	Stuart Fowler, Ryan Huxtable, Nick Devine	Presentation
EIS 2022	28th September 2022	SEC, Glasgow	Stuart Fowler	Presentation
EQUINOX Project Webinar - Customer perceptions of Low Carbon Heat	26th April 2023	MS Teams	Ryan Huxtable, Jacob Lynch, Alyssa Fournier	Project Specific Webinar Presentation
Utility Week 2023	16-17th May 2023	NEC, Birmingham	Jemma Lad, Ryan Huxtable, Luke Harker, Jacob Lynch	Stand
Heat Pump Flexibility Developing a common vision	14th June 2023	Westminster, London	Ryan Huxtable, Jacob Lynch, Callum Coghlan	Presentation

NGED Investor Day	July 2023	London	Roger Hey	Presentation
EQUINOX Project Webinar - Effectiveness of Commercial methods	9th August 2023	MS Teams	Ryan Huxtable, Callum Coghlan, Luke Harker	Project Specific Webinar Presentation
Oxford Energy Innovation Forum	19th September 2023	Osney Island, Oxford	Ryan Huxtable, Jacob Lynch	Presentation
EQUINOX Project Webinar - sharing trial 1 learnings - participants	21st September 2023	MS Teams	Ryan Huxtable, Callum Coghlan	Project Specific Webinar Presentation
EIS 2023	1st November 2023	ACC, Liverpool	Ryan Huxtable	Presentation
Energy Capital Collaboration Day (West Midlands Combined Authority)	12th December 2023	University of Warwick	Alyssa Fournier	Presentation
Utility Week Future Networks	20th Feb 2024	ICC, Birmingham	Ryan Huxtable	Presentation
DSO Energy Futures Event - EF4	28th March 2024	Battersea Power Station, London	Ryan Huxtable, Luke Harker, Jessica Colleen	Stand
Optimised Retrofit Program Landlords Presentation	1st May 2024	MS Teams	Ryan Huxtable	Presentation
Flex Workshop Colombia - Session 6: How to develop a flexibility market and incentivize participation - EQUINOX	16th May 2024	MS Teams	Ryan Huxtable, Jacob Lynch	Presentation
Utility Week Live 2024	21st May 2024	NEC, Birmingham	Alex Jakeman	Present
National Grid Innovation Day	18th June 2024	Tobacco Dock, London	Ryan Huxtable	Stand

EQUINOX Project Webinar: Sharing trial two learnings.	26th September 2024	MS Teams	Ryan Huxtable, Luke Harker	Project Specific Webinar Presentation
EIS 2024	28th October 2024	ACC, Liverpool	Ryan Huxtable, Luke Harker	Presentation
DESNZ IEA Heat Pump Research Seminar	11th March 2025	London	Ryan Huxtable, Luke Harker	Presentation
Utility Week Live	20-21st May 25	Birmingham	Alex Jakeman	Presentation
CIREN, International Conference on Electricity Distribution	19th Jun 2025	Geneva	Ryan Huxtable	Presentation
British Institute of Energy Economics, Energy Research Conference	23rd September 2025	Oxford	Luke Harker, Ewan Steen	Presentation
National Grid Innovation Day	7th October 2025	Boston	Ryan Huxtable	Stand
EQUINOX Closedown Webinars	23-26th Feb 2026	MS Teams	Wider project team	Project Specific Webinar Presentation
Utility Week Live 2026	20th May 2026	Birmingham	Ryan Huxtable, Luke Harker	Presentation
World Plumbing Conference 2026	23-25th June 2026	Birmingham	Ryan Huxtable, Luke Harker	Presentation

15. Key Project learning documents

All project documents are on the EQUINOX website as follows:

Project Progress Reports are here:

Year	Link
2022-22	Project Progress Report April 22-Sept 22
2022-23	Project Progress Report Oct 22-Sept 23
2023-24	Project Progress Report Oct 23-Sept 24
2024-25	Project Progress Report Oct 24-Sept 25

All Project Deliverables are here:

Deliverable	Link
Deliverable 1	Deliverable 1 Customer Perceptions of unlocking flexibility from heat
Deliverable 2	Deliverable 2 Initial Insights on the Effectiveness of Commercial Methods
Deliverable 3	Deliverable 3: Design of Novel Commercial Methods and Technical Integration
Deliverable 4	Deliverable 4 Learning from Trialling Novel Commercial Methods
Deliverable 5	Deliverable 5 Learnings from engaging customers throughout the EQUINOX trials
Deliverable 6	Deliverable 6 Transition of learning to business as usual

Additional Learning reports are here:

Report	Link
Accent Survey Report(s)	Customer Engagement Method Statement Primary Research findings
Customer Engagement Reports	Learning from Trial 1 - Customer Engagement Report Learning from Trial 2- Customer Engagement Report

[Trial 3 Engaging Vulnerable Customers Report](#)

Horizon Scans	Q4 2025 Horizon Scan Q3 2024 Horizon Scan Q1 2024 Horizon Scan Q3 2023 Horizon Scan Q2 2023 Horizon Scan Q1 2023 Horizon Scan Q4 2022 Horizon Scan
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EPF	Equitable Participation Framework
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Trial 3 Learning Reports	Trial 3 Learning- Executive Summary Learning from trial 3 Daily Morning Heat Pump Flexibility Learning from Trial 3 Daily Evening Heat Pump Flexibility Learning from trialling novel commercial methods - Week of consecutive events Learning from Trial 3 Longer Heat Pump flexibility events Learning from Trial 3 Heat Pump turn up flexibility
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Webinars and other presentations

Webinar	Link
Deliverable 1 Webinar event (supporting slides)	Deliverable 1 Webinar: Customer perceptions of unlocking flexibility from heat
Deliverable 2 Webinar event (supporting slides)	Deliverable 2 Webinar: Initial Insights on Effectiveness of Commercial methods
Webinars	<p>There are a number of webinar recordings on the EQUINOX project site here (including the 4 closedown webinar events): https://commercial.nationalgrid.co.uk/innovation/projects/equinnox-equitable-novel-flexibility-exchange</p>

16. Data access details

Data from the EQUINOX project is currently made available via the nationalgrid.co.uk website, where all project deliverables and outputs are published. Only aggregated data from the trials can be shared due to individual customers smart meter data being considered personal data and therefore being treated to ensure GDPR compliance.

17. Material Change Information

There were no material changes during the EQUINOX project.

18. Contact Details

If you have any questions relating to this document or any of the project elements described within it, please use the following points of contact:

Innovation Team:

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Appendix A – NPG Peer Review Letter



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Avonbank
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BS2 0TB

RE: Peer Review of Equitable Novel Flexibility Exchange (EQUINOX) Closedown Report

18/03/2026

Dear Ryan,

I am writing to confirm that Northern Powergrid has peer reviewed the closedown report for the Network Innovation Competition project, Equitable Novel Flexibility Exchange (EQUINOX) (ref WPDEN05).

A draft copy of the closedown report was provided to Northern Powergrid, whereby it was robustly reviewed by a senior subject matter expert within Northern Powergrid's Flexibility Team and by a member of the Innovation team. A list of recommended corrections and changes was provided to NGED, and these were subsequently actioned by the Equinox project team.

As per the NIC Governance requirements, Northern Powergrid can confirm that the report is clear, understandable and provides sufficient information to enable a Network Licensee, not closely involved in the Project, to effectively consider whether and how to implement the Project's learning into its BAU activities.

Yours sincerely,

Duncan Oliphant
Head of Commercial Flexibility

NORTHERN POWERGRID HOLDINGS COMPANY Registered Office: Lloyds Court, 78 Grey Street, Newcastle upon Tyne NE1 6AF. Registered in England and Wales: 3476221. If you would like an audio copy of this letter or a copy in large type, Braille or another language, please call 0800 338 7302 www.northernpowergrid.com

Appendix B – Glossary

Term	Definition
Business as Usual (BaU)	Business As Usual references normal day to day business operations
Constraint Management Zone (CMZ)	An already identified area of the network subject to localised constraints. Flexibility is normally purchased based on these CMZ's.
Customers	Term EQUINOX uses when referring to customers of energy suppliers generally
Demand Response (DR)	A strategy that adjusts electricity usage by consumers in response to supply conditions, such as price signals or grid needs
Demand turn-up	Demand response when more electricity is consumed relative to a baseline
Demand turndown	Demand response when less electricity is consumed relative to a baseline
Distribution Network Operator	Company licensed to operate the electricity distribution network in a specific region of the UK
Equitable Novel Flexibility Exchange (EQUINOX)	The name of the project
Equitable Participation Framework (EPF)	Framework developed within the project lifecycle to help the team better identify customers with vulnerabilities to ensure more equitable representation in the trials
Events	Periods of the day when EQUINOX trial participants were asked to provide demand response
Flexibility Service Provider	An entity that offers or procures flexible energy resources to help balance electricity supply and demand in response to grid needs
Full Submission Proforma (FSP)	Project bid documentation
National Grid Electricity Distribution (NGED)	The UK's largest regional Distribution Network Operator

Network Innovation Competition (NIC)	Competitive Ofgem funding mechanism for large scale innovation projects
Participants	Term EQUINOX uses when referring to customers enrolled in the EQUINOX trials
Project Review Group (PRG)	NGED internal leadership team providing strategic oversight and direction to the project
