



EQUINOX

NIC Project Progress Report

October 2022 – September 2023

**Electricity
Distribution**

nationalgrid

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Name	Role
Ryan Huxtable	Author
Laurence Hunter	Reviewer
Paul Morris	Approver

Contact Details

Email

Nged.innovation@nationalgrid.co.uk

Postal:

Innovation Team
National Grid
Pegasus Business Park
Herald Way
Castle Donington
Derbyshire DE74 2TU

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1. Executive Summary

Equitable Novel Flexibility Exchange (EQUINOX) is funded through the Office of Gas and Electricity Market's (Ofgem)'s Network Innovation Competition (NIC) and has a budget of £7,766,110. The project was awarded funding in December 2021 and will be complete by December 2025.

EQUINOX is the first NIC project dedicated to addressing the challenges Distribution Network Operator's (DNO's) face with the electrification of heat. The project is developing novel commercial arrangements and supporting technologies that will unlock flexibility from residential low carbon heating, while meeting the needs of all consumers, including the fuel poor and those with vulnerabilities.

In line with the current Ofgem NIC project governance v3.0¹ and EQUINOX project direction requirements, this report details progress of the project, focusing on the last twelve months, October 2022 – September 2023.

During December, we submitted our first project deliverable focused on Customer perceptions on unlocking flexibility from heat². This was research based and sought to understand attitudes towards Heat Pumps (HP) and the likelihood of adopting such a low carbon technology for home heating, as well as to uncover ways of shaping customer preference with a view to drive uptake of HPs. This gave us a chance to ask customers for feedback on our initial proposals for our first trial, and enabled us to make sure learning from their responses fed into the commercial arrangements used.

Work in this reporting period has also involved preparing for and executing the first of the projects winter trials. Whilst recruiting customers for this trial, we found higher interest than anticipated, and across the Sero and Octopus energy customer pools we were able to recruit almost 400 participants. The trial, which consisted of 22 events, was completed between December 2022 and March 2023 and the wide array of learning from this fed into our second project deliverable³ which focused on initial insights on effectiveness of commercial methods. This was published in July 2023, with a follow up webinar to ensure that learning was disseminated. Learning from this trial included aspects on HP turndown potential, where we found that initial results demonstrate that the demand peak can be reduced or shifted depending on the control method. We also found that customers were generally very happy taking part in the trial and over 90% always felt in control of their heating. Trial 1 was not intended to deliver evidence to confirm to what extent reinforcement can be deferred, but we observed that on average customers were able to provide an average of 1.43kWh of heat pump turndown per 5-7pm event. We plan to build on this trial in the next winter period and will publish results from this in Summer 2024.

In line with the projects Full Submission Proforma (FSP), trial one tested two commercial arrangements, and we were also able to test two distinct control methodologies. The commercial arrangements we tested comprised of save in advance, where customers were credited a set

¹ <https://www.nationalgrid.co.uk/downloads-view-reciteme/620467>

² <https://www.ofgem.gov.uk/publications/version-30-network-innovation-competition-governance-documents>

³ <https://www.nationalgrid.co.uk/downloads-view-reciteme/639583>

monthly payment, and save as you go, where the customers were credited a payment following each event that they participated in.

During this reporting period, the project team have also been putting plans in place for the next winter trial, which will begin in November 2023. This work has included updating and refining the commercial and technical designs, as well as introducing a third commercial arrangement. Scottish Power have been brought on board as an additional energy supplier, with technical integration currently under development, and recruitment with all three suppliers to be carried out shortly.

This report provides more detail on the progress made in this reporting period, as well as outlining the current risk, and finance profiles of the project to date.

2. Project Manager's Report

Project Background

The EQUINOX project is trialling domestic heat pump flexibility at scale over the course of three trial periods. Its team is split into five complementary workstreams, which interlink to deliver three trial phases that take place over the lifecycle of the project. These include commercial arrangements, technical integration and automation, customer engagement and experience, trials, and knowledge capture and dissemination. The high-level plan submitted within the FSP has been adhered to so far, and is as follows:

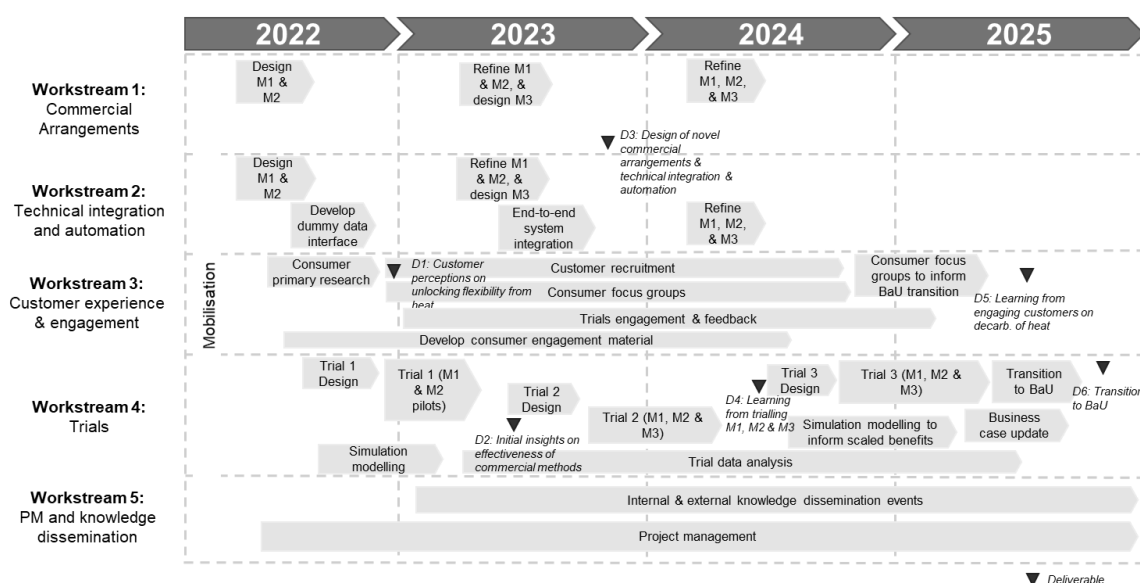


Fig. 1 High level project summary plan

The business case detailed and reviewed within this report was, and remains, clear. Heat flexibility is going to be a major part of the future for DNO's and we needed a strong project to explore its potential to manage network constraints, liaise with customers, and develop robust commercial products that can mature into Business as Usual (BaU) following the project. EQUINOX gives us that opportunity to build the evidence needed.

Project Progress against Plan

During the first half of this reporting period, the EQUINOX team continued to prepare for and carried out its first trial phase. This work has included:

- refining and testing commercial and technical arrangements
- on-boarding just under 400 customers from across our licence areas
- designing, scheduling and executing events during the trial period, and

- capturing data and participant feedback to enable use to successfully measure and quantify the outcomes of the trial.

Following this, work was carried out to analyse trial data, report on the learning and outcomes from trial one, and use the insights to design and prepare for trial two. The following sections provide detail on the work carried out within each of the workstreams:

Workstream 1- Commercial Design

Trial one Commercial Arrangements

The final commercial arrangements tested in trial one are detailed in Table 1 below:

Table 1: Trial one commercial arrangements

Item	Method 1 – Save in advance	Method 2 – Save as you go
Premise	Pre-event payment.	Post-event payment.
Payment structure ⁴	Customers were paid £25 monthly instalments in advance of that month's events for their assumed participation.	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 or participated up to 0.5 hours.

⁴ Payment amounts in trial one reflected this being a first of a kind innovation trial, and therefore were increased on those we expect to pay in BaU to maximise the learning potential. This number will iteratively become closer to BaU figures in future trials, and we will also explore the potential of stacking to provide best value to customers for services required by the wider energy industry.

		£6 if customer participated for 0.5 to 2 hours.
		For the final 9 trial one events:
		£0 if customer did not participate or participated up to 0.5 hours.
		£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 ⁵ and aggregator controlled ⁶ .	
Event timing	5-7 pm any weekday.	
Event duration	2 hours.	
Event frequency	2-3 events per week.	

⁵ Customer control: Participating households were required to opt into each flexibility event by turning their heat pump off for the event period. They could stop participating at any point during the event. For more details, see page 13 of EQUINOX's previous report 'Initial Insights on the Effectiveness of Commercial Methods'

⁶ Aggregator control: The default for participating households was to allow for their heat pump to be turned off directly and remotely by their energy supplier for the event period. Households still had the option to opt-out on a per-event basis. Households under aggregator control could opt out in advance of an event, or at any point during the two-hour event window by informing their supplier. Only a small subset of trial one households had the enabling technology installed for their heat pumps to be aggregator controlled. For more details, see page 13 of EQUINOX's previous report 'Initial Insights on the Effectiveness of Commercial Methods'

Customer notice	Day ahead of events; reminder two hours before.
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Aggregator notice	Sero & Octopus Energy informed by National Grid on Thursday of the following week's events in line with our BaU flexibility timescales.
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Conditions	Continual payment conditional on engagement via participation in events and responding to post-event surveys.
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A key aspect of EQUINOX is to design commercial arrangements that unlock flexibility from residential low carbon heating to benefit all parts of the energy industry, 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.

Trial one payment amounts for customers were calibrated using winter 2022/23 energy prices. These prices are set by announced and existing UK and international domestic flexibility schemes, and reflecting the fact that this was the first iteration of an innovation trial. This meant the learnings and knowledge gained by participants permitting collection of qualitative and quantitative data from them exceeded that which would be collected during a BaU service, hence it was deemed appropriate to overpay them for their participation vs likely future BaU payments.

Energy prices over winter 2022/23 were at an all-time high, with the Ofgem price cap set at £3,549 in October 2022, just before trial one was set to start, compared to £1,971 in April 2022. The Energy Price Guarantee was introduced by the UK Government in October 2022 in response to soaring wholesale energy prices and capped unit prices for gas and electricity. The average bill was capped at £2,500 across the duration of trial one, so the £100 earned for being part of trial one equates to 4% of this. The hope was that customers would view this as a not-insignificant sum in return for altering their heating for a maximum of 44 hours.

Trial two Commercial Arrangements

By the end of March, trial one had wrapped up and work began on iterating the commercial arrangements for trial two. The intention was for trial two commercial arrangements to push closer towards future BaU arrangements, considering in more depth the potential commercial relationship between the DNO and the energy supplier or aggregator, since trial one focussed more on the relationship between the customer and the energy supplier.

We are introducing a third commercial payment method. This will push further into the developing area of automated flexibility provision, given Sero's advanced capabilities in this space.

Following the **iterative process** guiding principle, learnings from trial one results fed into the design of the trial two commercial arrangements.

The main learning that emerged from trial one was that customers on trial one's M1 arrangement (save in advance, monthly payments) participated less reliably compared to customers on trial one's M2 arrangement (save as you go, payments per event), although the amount of turndown provided per participating customer was similar. The M1 monthly average participation rate was 77%, whereas the M2 monthly average participation rate was 89%. Therefore, the decision was made to pay customers exclusively per event in trial two. This change opened up the possibility to investigate other variables and aligned EQUINOX with standard flexibility products across the industry.

Other learnings from trial one relevant to commercial arrangements related to event length, event frequency, notice periods, and payment amounts. The majority of participants in trial one felt a two-hour event was acceptable, as was up to three events a week. Therefore, these two elements were retained for trial two. The majority of trial one participants also felt that receiving day-ahead notice of an event worked well, but notice periods have been designed to vary in trial two as this is a key variable that must be tested to gauge the ability of customers to provide flexibility in line with the parameters of existing DNO flexibility services and network needs. Most customers were satisfied with payment amounts, but many indicated that environmental motivators were equally, if not more, important than financial motivators as reasons to participate in the trial⁷.

With trial one proving a successful proof of concept for commercial-scale UK demand flexibility from residential low carbon heating, the aim of trial two is to investigate more specific variables as shown below in Table 2, and build on trial one learnings to design commercial arrangements that more closely reflect a potential future BaU product. These variables were identified by the commercial arrangements workstream as the key focus following analysis of trial one and the trajectory of the project.

⁷ For more in-depth information about trial one results, please see EQUINOX's previous report '[Initial Insights on the Effectiveness of Commercial Methods](#)'.

Table 2: Variables being tested in trial two

Variable	Description	Justification
Notice period	Customers will receive varied notice periods that align with different DNO flexibility services.	This enables testing of which DNO flexibility services EQUINOX is most closely aligned to.
Payment method	Customers will be paid per kWh of turndown provided. They will also be paid more for their flexibility response when given shorter notice.	This brings EQUINOX in line with other BaU DNO flexibility services and builds on advances in baselining accuracy from flexibility trials across winter 2022/23.
Time of day	Events will still last two hours but could be scheduled any time between 4-8 pm.	This is to test how flexibility procurement from low carbon heating varies across DNOs' overall evening peak demand period.

These key variables have been incorporated into the trial two commercial arrangements, which at the time of writing are still being finalised before the trial starts in November 2023.

Workstream 2- Technical Integration Design

The Workstream 2 element of EQUINOX focuses on the technical needs that are required in order to successfully dispatch flexibility, starting from the source, the DNO, then towards the supplier or aggregator and then to the customer and their heat pump. The following breaks down each of the stages.

Flexible Power

Flexible Power is the sole procurement platform that National Grid Electricity Distribution, along with three other DNOs, currently use in order to provide flexibility. As there is a time sensitive element when providing flexibility, it is essential that it is carried out in a staged and structured manner. Currently, the method of signalling a Flexibility Service Provider (FSP) to dispatch is utilised through an Application Programming Interface (API) between Flexible Power and the aggregator. A signal to dispatch is sent 15 minutes before the event is scheduled to transpire. Once the aggregator receives this they can notify their assets / customers act. It is this process that has been replicated for the EQUINOX trial one with our partners Sero and Octopus Energy.

Although the process of sending signals from Flexible Power to Sero and Octopus Energy have been identical, there have been some slight idiosyncrasies between themselves and the customer. Throughout trial one, the control methods carried out were Behavioural Demand Response (BDR)

and Direct Load Control (DLC). BDR relied on customers manually switching off their heat pump upon instruction from their supplier whilst DLC allowed the supplier complete access to the controllability of the customer heat pump. The BDR and DLC customers turndown were both baselines using point of connection metering with a baseline method of P376, but we were additionally able to understand the turndown impact from DLC customers using HP monitoring that was in place. It must be noted that customers could opt out at any time during the event and take back control. Although there are different control methodologies, the API set up remained consistent throughout them all.

Sero

The high-level architectural breakdown for the Sero can be seen in Figure 2. Once the API signal is sent from NGED, it is received and pushed to their Internet of Things (IOT) Core. This will convert the signal into a heat pump off message and create a timer for the heat pump to be powered-off. This is then sent to the in home automation system known as the Building Energy Engine (BEE) where it will power off the heat pump.

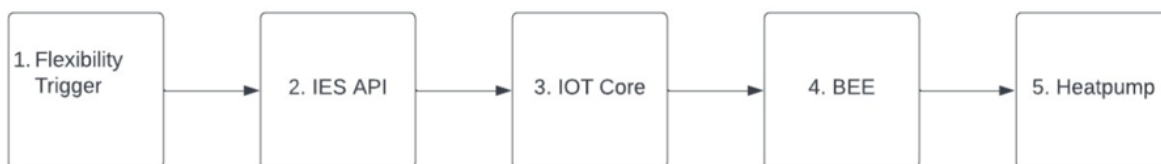


Fig. 2 Sero High level instruction flow for trial one

Prior to any real event taking place, end to end testing had to be carried out in order to assure that everything would run to plan during the trial events. This involved creating ‘dummy’ events for Sero’s show homes where we could carry out switching events with no customers present. The main objectives of the testing were to establish Sero would receive the API signal, and that the heat pumps would operate to switch off and switch on. The first test, observed by two colleagues of NGED was observed on the 9th December 2022 between 12:00 and 13:00. Figure two shows the BEE acting in accordance to the API messages sent from Flexible Power. Traditionally the API message is sent 15 minutes prior to the event taking place. It must be noted, during the test events and during the trial, the BEE would act as soon as the API message was received, meaning that there was a slight offset of 15 minutes before events. This has been overcome with further development for trial two. Figure 3 shows the visual signal changes for the master switch (green) compressor (red) hot water pump (blue) and ground floor heating (orange). It is clearly visible that each signal switched to off (or remained off) at the time the test signal was sent. In addition to this, each signal successfully switched back on during the end of the testing period.

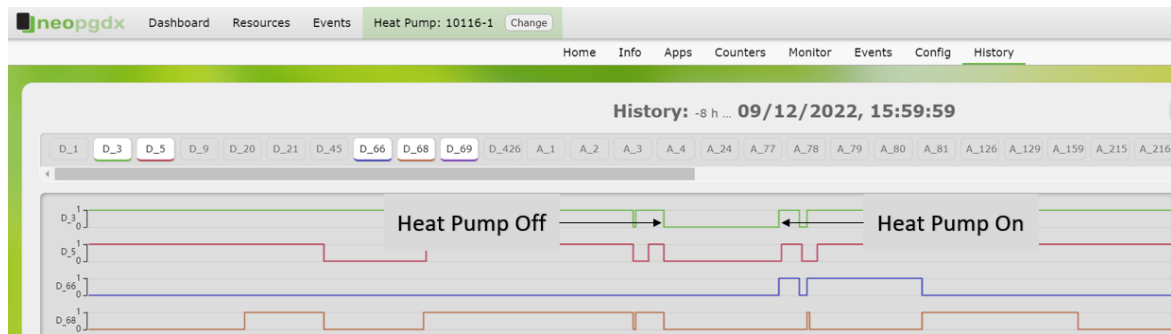


Fig. 3 Sero Testing Example

As with any system providing information to a third party, due diligence of cyber security has to be taken into account. The stance taken was to develop and produce a cyber security methodology before the trials were carried out. NGED carried out a review of Sero Cyber Security including information to be documented on how Sero's systems were cyber secure and compliant, history of audits and Penetration (PEN) tests.

In the build up to trial two, there were several areas that were identified that needed to be developed and evolved in order to meet the requirements for the upcoming trial. The way the commercial arrangements were shaped, influenced how the technical design was carried out. For example, with the use of differing payments, the participants are required to be split in order to correctly differentiate between those in separate payment groups. This has meant that Meterable Units (MU) and Dispatch Groups (DG) have had to be utilised in order to achieve this.

Sero have also made the following additional developments for trial two:

- Schedule builder – This “service” takes a snapshot of the current customer schedule and stores this for reversion after the event. The service then builds a schedule for the event itself based on the API call timings, accounting for 15 minute ahead signals; this schedule includes the event window start and stop time, and then setpoint for the event, which will be set to 12° C to minimise heat pump usage.
- App block – This service blocks signals from the customer app from impacting or overriding the existing schedule, during the event.
- Schedule send – The EQUINOX built schedule is sent to all homes within the participant group. This includes a stop time.
- App unblock - This service unblocks signals from the customer app, restoring full control of the home to the resident.

The high level architecture developed for trial two can be seen in Figure 4.

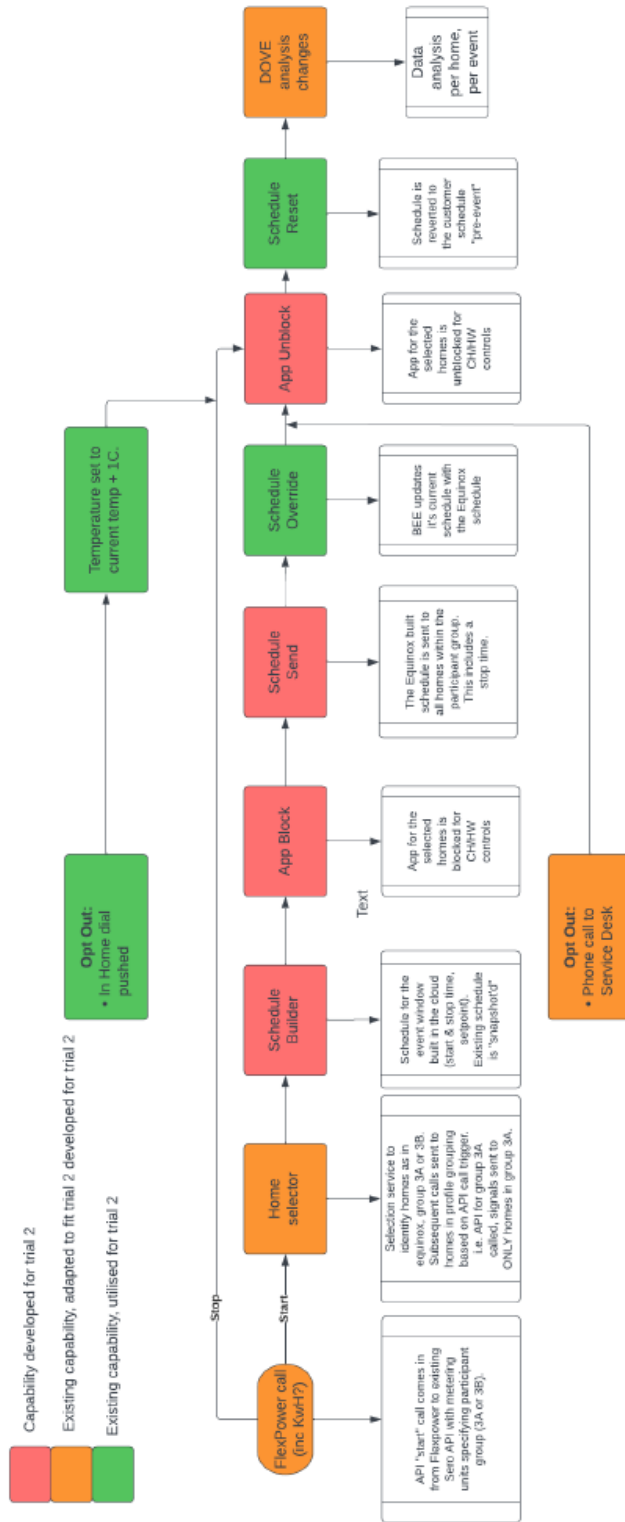


Fig. 4 Sero high-level instruction flow for trial two

Octopus Energy

Figure 5 shows the high-level architecture diagram followed by Octopus energy during the first trial. Like SERO, all dispatch signals were sent from Flexible Power through an API. What differs from SERO is that Octopus utilised their in house platform, Kraken Flex.

Octopus customers were split between behavioural demand response (manual control) and direct load control (automated control), and this led to the following differences:

- For customers under automated control, an API between Kraken Flex and heat pumps has been created, which can remotely switch home heat pumps based on the requirements of the trial. Validation was then carried out by means of the same API.
- For customers under manual control, email signals were used upon receipt of the API signal. It was then down to the customer to manually turn off their heat pump in their home. The use of customer smart meter data created a validation mechanism where their usage data was compared with a calculated baseline.

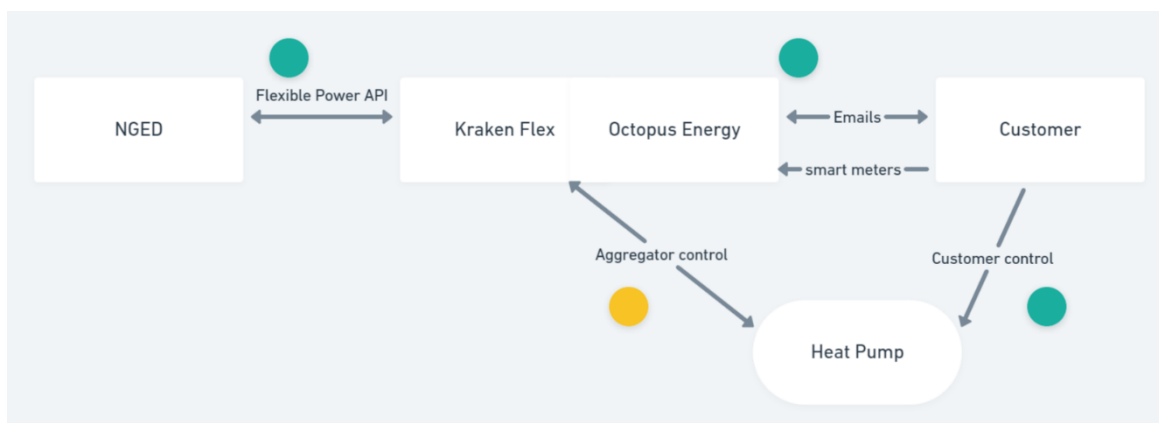


Fig. 5 Octopus Energy High level architecture for trial one

The interface between the DNO and supplier was tested to ensure the API signals were successfully received.

For trial two, Octopus energy have amended their process. The same principles apply to the additional developments needed with Sero with regards to their set up within Flexible power, such as dealing with the new MU and DG. The updated data flow can be seen in Figure 6.

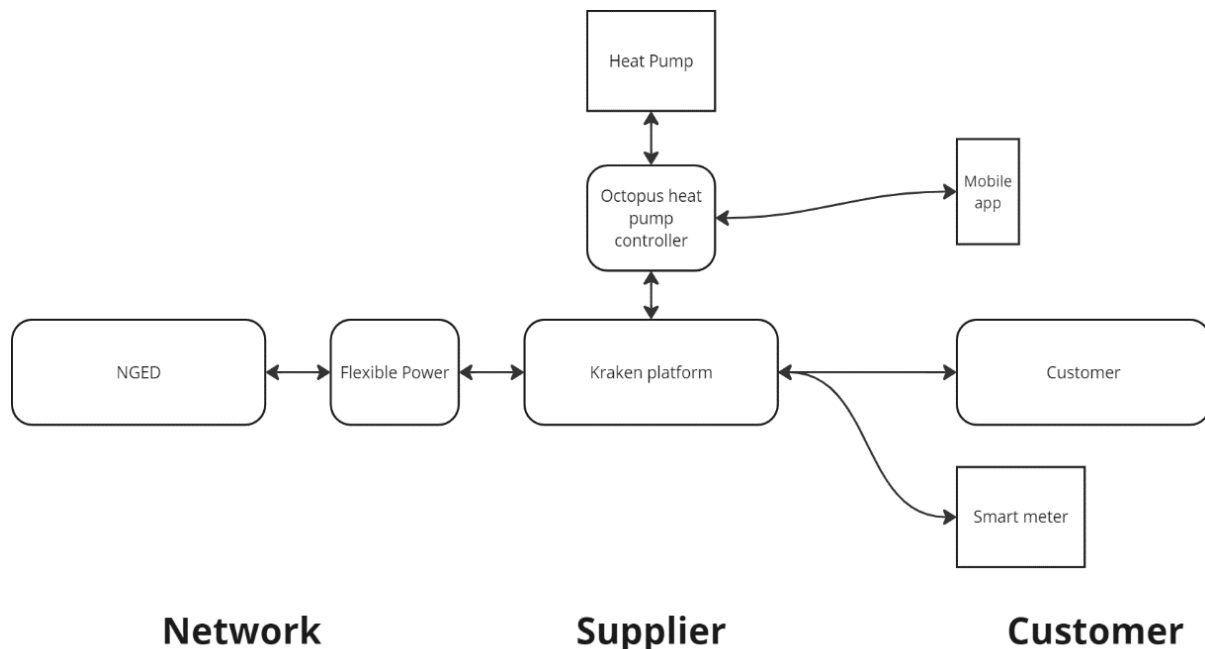


Fig. 6 Octopus Energy High level data flow for trial two

Scottish Power Energy Retail on boarding

Scottish Power Energy Retail (SPERL) are an energy supplier that have been recruited to deliver EQUINOX events for trials two and three. They have been involved since the tail end of trial one and have since contributed towards the trial analysis, new commercial arrangements and have had to develop their own technical methodology in order to accommodate their customer pool. Their technical integration method has been different to the other suppliers as a third party aggregator will be acting on their behalf. This enables the project to generate more learning around how technical integration can link between multiple parties.

Like Sero and Octopus Energy, they are developing documentation to capture the technical requirements that are needed to successfully carry out EQUINOX events. This, along with the other suppliers, will be detailed further in the next deliverable titled Overview of Commercial Arrangements and Technical Integration which is due to be submitted to Ofgem November 2023.

Next Steps

Although not confirmed for trial three, there is currently an early understanding of the requirements that are necessary to continue the evolvement of the work done in EQUINOX. The eventual aim is to determine whether heat pump flexibility is viable, economical and to provide both customer and network benefits.

In addition to this, analysis will be carried out on settlement methodologies. For trial one, settlement functionality within Flexible Power was not used. Although for trial two suppliers will be carrying out their own settlement with NGED validating the results, we will be analysing internally what the settlement would have looked like if it were to be utilised within Flexible Power using our BaU process. This will provide learning on which baselining methods are best to use for settlement, and will ensure the process for settlement of Heat Pump flexibility is ready following the trial.

A key aim for trial two is to address the ‘snapback’ events that were experienced during trial one. More prominently for Sero, post event a surge in demand was experienced due to the heat pumps having been switched off for two hours and then being turned on. The observed peak showed that there was potential for Heat Pumps to consume more energy than what was saved over the two hour event period. The next steps of this is to look at utilising the set points within the home so that they run at a lower output but will not require the increase of energy usage when the event ends .

Workstream 3- Customer Engagement

Primary Market Research:

In our last progress report, we discussed the primary market research which was underway. As a reminder, the primary market research was conducted to inform both the design and roll-out of the first trial and the strategy that would be used to recruit participants into it. The research sought to understand attitudes towards heat pumps and the likelihood of adopting such a low carbon technology for home heating, as well as to uncover ways of shaping customer preference with a view to drive uptake of heat pumps. The objectives of the research were as follows:

- To understand current attitudes towards heat pumps, to include awareness, understanding of the technology, acceptance and likelihood of uptake
- To uncover how current customer attitudes and beliefs about heat pumps might be shaped to promote adoption
- To explore customers’ views and perspectives on the proposed EQUINOX trial, including reactions to being asked to modify their home heating habits and behaviours
- To present and capture feedback on the various commercial arrangements being proposed as part of the EQUINOX trial

To achieve these objectives both quantitative and qualitative research was completed. The quantitative research carried out in September 2022 took the form of an online survey with over 2,000 participants, plus 400 face-to-face surveys to capture digitally disconnected individuals and individuals from other hard-to-reach groups. The qualitative research took place between October and November 2022 and included 18 focus groups which took place virtually. Focus groups were 90-minutes and had an average of six participants per group. Separately, six in-depth interviews of around 60-minutes in duration were conducted by telephone to ensure the inclusion of the digitally disengaged and otherwise under-represented individuals.

Findings from both the quantitative and qualitative field work were synthesised and summarised in the EQUINOX “Customer Perceptions on Unlocking Flexibility from Heat” deliverable published in December 2022 and a virtual knowledge sharing webinar was conducted in April 2023 with industry stakeholders to share findings. These materials are all available on the EQUINOX web page:

- [Customer Perceptions on Unlocking Flexibility from Heat](#)
- [Customer Engagement Method Statement](#)
- [Primary Market Research Quantitative Report](#)
- [Dissemination Webinar Slides](#)
- [Webinar Recording](#)

Recruitment for Trial one

Recruitment for trial one was led by the energy suppliers Sero and Octopus. We were successful in recruiting a larger than expected pool of participants for the first trial. Although it was originally envisioned as a proof-of-concept pilot with less than 100 customers, we instead were successful in recruiting 386 customers to participate. Both Sero and Octopus took a digital-first approach sending out communications for expressions of interest to their customers, and Sero also had operational staff on the ground to answer questions for their residents. Operational staff responded to any queries from customers before customers agreed to terms and conditions of participation. Feedback from customers indicated that the sign-up process was straightforward.

Customer Engagement During Trial one

Sero and Octopus were the main points of contact to customers throughout trial one and were in regular contact with customers to alert them of upcoming EQUINOX events, which were communicated the day before with a reminder at the start and end of EQUINOX events. They also provided a mid-trial update and end-of-trial communications to trial participants.

Customer experience evaluation

We utilised a multi-pronged approach to capture customer insights throughout trial one. We aimed to balance the desire to collect information to enable continuous improvement and meet research objectives without overburdening customers. Our main forms of evaluation were a post-event survey, end of trial survey, focus groups, and interviews.

The post-event survey was a short two to five question survey sent by suppliers to customers after each EQUINOX event. The survey was sent out alongside a notification that the EQUINOX event had concluded and gathered information about if a customer participated in the event and if they experienced any temperature discomfort during the event. The response rate to this post-event survey was on average 91% percent throughout all 22 events of trial one.

In addition to this short post-event survey, we planned two longer surveys to capture customer experience and satisfaction: one towards the midway point of the trial and one at the end of the trial. Unfortunately, due to delays finalising data sharing agreements only one longer survey towards the end of trial one took place. Nevertheless, we are happy to report this survey had a very high uptake at 96% percent. Building in adequate time to complete the necessary data sharing agreements to safeguard customer data was a critical learning from trial one. As a third supplier, Scottish Power, will participate in trial two, we've already taken steps towards formalising a data sharing agreement to make mitigate this challenge in our upcoming trial two.

Finally, we also conducted qualitative research through focus groups and interviews to understand how, if at all, participating in the trial impacted the daily lives of participants of trial one and to get deeper insights on their experience with the processes of the trial. These took place following the completion of trial one, slightly later than planned due to delays with putting data sharing agreements in place. Nine one-to-one interviews and three focus groups were completed to gain additional insights. Research was segmented based on control type, payment type, and vulnerable customers to understand how those aspects impacted perceptions.

The findings from surveys, interviews, and focus groups were analysed and shared with the EQUINOX consortium as well as in shared in industry events. They were also published and are available on the EQUINOX website here: <https://www.nationalgrid.co.uk/downloads-view-reciteme/643709>.

Feedback received through customer engagement activities in trial one indicated that trial participants were interested in understanding the results of the trial and impact of their participation. Taking this feedback on board, we organised a virtual webinar in September 2023 to share trial one findings. Sero and Octopus invited their trial one participants and the EQUINOX project team presented trial one findings and conducted a Q&A. The materials are all available on the EQUINOX customer facing page:

- [Webinar slides](#)
- [Q&A](#)
- [Webinar recording](#)

Trial two Recruitment

Recruitment for trial two kicked off in early October 2023 and the trial aims to recruit over 600 participants. Like in trial one, suppliers led the development of individual recruitment plans for their customers developing recruitment materials and approaches to engage customers. Collectively, the project team aligned on key communications messages which were utilised by suppliers to develop their own specific branded communications. Recruitment is still underway and should be completed shortly to enable the trial to commence in November.

Trial two Customer Engagement

We have taken lessons learned in trial one to inform how we engage customers for trial two. For example, we received feedback during trial one that customers would appreciate other forms of receiving notices of EQUINOX events besides email. Suppliers in trial two will be utilising text message or app notifications in addition to emails. This change may be especially important given in trial two we will be trialling different notice periods for events.

Similar to trial one, we will be capturing customer feedback throughout trial two. There are currently three surveys planned: start of trial, mid-trial, and end of trial. The start of trial will capture key demographic information, home characteristics, and key drivers for trial participation. The mid-trial survey will capture early customer feedback on trial design while the end of trial survey will focus understanding customer satisfaction. To supplement the surveys, we will conduct interviews and focus groups similar to last year. Designing surveys is currently a focus for the team as we move closer to trial two start.

Workstream 4- Trials Management

Trial one Overall Event Schedule

The first winter trial period ran as follows:

December 2022 acted as a pilot period, in which participants experienced a small number (3) of events to learn how they work and what is expected of them.

- During this time, participant baseline data was collected and trial logistics were tested – for instance NGED’s signals to the suppliers (flexibility providers) requesting flexibility, and supplier notifications to participants.
- After each event, participants were asked to complete a short (four questions maximum) post-event survey asking them to confirm participation, define their comfort levels during the event, and flag any issues they experienced.

The main trial period ran from January to March 2023, in which participants experienced 2-3 events per week. This combined to a total of 22 events over the winter period.

- After some, but not all, events, participants received the post-event survey as defined above.

Given the smaller sample size for the first winter trial (386 participants), and with participants already segmented by heat pump control method, payment method, and potentially by their vulnerability to the cold, it was considered impractical to add any further experimental variables. Therefore, for the first winter trial:

- All events occurred at **the same time of day – 5-7pm**, chosen to coincide with NGED’s typical evening peak period.

- Participants were always notified **the day before the event**, so they had time to plan and decide whether to opt in/out.
- Events only occurred on weekdays to ensure support was available.

Trial one Scheduling & Forecasting

Alongside the customer payment type and the heat pump control method, temperature was the key variable whose impact on the demand response delivered by participating households was to be explored. Therefore, beyond the considerations detailed above, event days were chosen on a weekly basis by considering the external temperature forecast for the following week.

The choice of event days was driven by the following two requirements:

- A range of temperatures needed to be captured across the 22 events, in particular the coldest days of the year. Therefore, **the coldest forecast days were prioritised when choosing event days for the following week.**
- To ensure an accurate baseline of household heat pump usage before considering the impact of DR, **the number of coldest days which are non-event days must equal the number which are event days.**

Hourly external temperature forecasts were captured for Bristol (main weather station due to central location within our license areas) and also for Plymouth and Birmingham (allowed us to check for variation across the license areas), and were stored in a tracking spreadsheet. The average temperature at the Bristol weather station between 4-8pm was calculated (i.e. from one hour before the start of a potential event on that day to one hour after the final end of the event).

The spreadsheet also contained the actual average temperature measured between 4-8pm every weekday, which was captured prior to the forecasting efforts of the following week. This enabled three actions:

- Comparison of forecast temperatures with actuals. There could be occasional notable disparities between the two, particularly if an event day was chosen to occur later in the week – a Friday event day would occur nine days after it was chosen on the preceding Wednesday.
- The ability to track the spread of temperatures that were observed during 4-8pm on event days that had already occurred, and thus gauge which temperature range (mild, cold, very cold) required more event days to provide a sufficient amount of experimental data.
- The ability to track the spread of temperatures that had been observed during 4-8pm on non-event days that had already occurred, and thus gauge whether the event and non-event day temperatures matched, or whether a certain temperature value needs to be prioritised for a non-event day to improve the baselining analysis.

Every Wednesday during the trial period, we met to schedule the event days for the following week by completing the below actions:

- Use the tracking spreadsheet to gauge which temperature range required more event days and look for temperatures within this range in the following week's Monday to Friday forecast
- Use the average 4-8pm forecast temperatures to choose 2-3 event days which met this criterion
- Ensure that the non-event days chosen are ensuring a balance between event days and non-event days at similar temperatures.
- Make any adjustments to the chosen days as needed

Sero and Octopus Energy were then informed of the 2-3 days chosen to be event days every Thursday. 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 informed us via a separate shared spreadsheet how many of their recruited participants provided flexibility for that event (rather than opting out).

Trial one Event Summary

Day Type		
Day of Week	Event	Non Event
Monday	5	6
Tuesday	5	5
Wednesday	4	6
Thursday	4	6
Friday	4	6
Total	22	29

Day Type		
	Event	Non Event
Max Temp	12	12
Min Temp	-1	-2
Mean Temp	5	5
Num Events	22	29

Temperature Type (Forecast)			
	Days considered	Event	Non Event
Mild (5-10°C)	33	15	18
Cold (0-5°C)	18	7	11
V. Cold (<0°C)	0	0	0
Warmer (>10°C)	0	0	0

Temperature Type (Actual)			
	Days considered	Event	Non Event
Mild (5-10c)	26	10	16
Cold (0-5c)	16	8	8

V. Cold (<0c)	6	2	4
Warmer (>10c)	3	2	1

As mentioned above, the EQUINOX events were scheduled a week ahead to align with current dispatch processes within Flexible Power. This means that the external temperature on the event days will likely be different to the temperature used to schedule them; this data has been captured above. To reduce this difference for future trials we will look to integrate with NGED’s new Market Gateway platform (in development), which will allow up to real time dispatch, and will look to explore whether HPs can reliably provide flexibility in this shortened window.

Trial two Preparation

In preparation for trial two, work stream one and four met with multiple DNOs to identify any main priorities ahead of creating a schedule of workshops. From these sessions, two priorities were identified:

- There is a clear need to move towards more realistic payment amounts
- We should try to align with existing flexibility products where possible

With these priorities in mind, we conducted an ideation session with members of the consortium and other colleagues from NGED Distribution System Operator (DSO). The outcome of this workshop was a shortlist of potential trial two variables, along with a longer list of additional factors that we would look to explore as part of the trial design or in additional testing outside of the trial window.

Following on from the ideation session, a series of joint WS1/WS4 workshops built out the following topics:

Trial two Guiding principles:

As part of trial one, WS1/WS4 set out a list of guiding principles which allowed us to be creative with our commercial arrangement and trial designs whilst adhering to and answering the FSP questions. We reviewed these principles as a consortium by asking ourselves if we managed to follow them last year, if they still apply this year, and whether any should be removed/added.

Trial two Commercial arrangements:

We used the shortlisted trial two variables to build out 3 new commercial arrangements to test in the upcoming winter period. These arrangements include updated payment amounts and customer notice periods and incorporate our push for testing more automated flexibility solutions. We designed them in a way that will allow us to test whether EQUINOX will need to become its own flexibility product or whether it can be incorporated into current flexibility products, as well as making the commercial offering more realistic. Decisions which led to defining these commercial arrangements were informed by feedback from customers from trial one, insights from the ideation

session, and information from other flexibility projects highlighted in our horizon scan document and were sense checked by referring back to our guiding principles.

Trial two Design:

Over a number of workshops we defined the trial period and event structure. We defined the event lengths and timings by reviewing customer feedback and performance as well as looking at current flexibility products. We introduced control groups for each of the trial groups to improve our ability to analyse results. We also revisited the event scheduling process and tools and updated them to accommodate the new operational elements of the trial design.

Trial two Data Collection:

We used a number of sessions to review and update the data points we were going to collect in trial two, following a similar way of working to that of the guiding principles workshop. We grouped the data points by their collection purpose (e.g. Event Data Analysis, or Customer Segmentation) and asked ourselves how we used each data point in trial one and whether we achieved the outcome we wanted, as well as whether it was still necessary for trial two and if new data points should be added. The collection method for each data point was also reviewed in addition to who would collect it. Defining these details allowed us to update the Data Sharing Agreements between project partners in advance of the trial start date, as we learnt from the trial one preparation that these documents take time to complete.

Trial two Analysis:

Finally we held workshops to ensure that our trial analysis follows industry best practice and that our analysis plan meets Ofgem's expectations. We discussed the baselining methodology we used for trial one and reviewed it against baselines used in other projects. We also defined possible combinations of variables that could be analysed, based upon the number of customers needed in each segment and overall project priorities.

Workstream 5- Knowledge Capture and Project Communications

Strategy for project communications

The knowledge capture and project communication workstream has continued to make progress on the dissemination of learnings from the project. There is a clear plan in place to ensure the project is being communicated effectively both internally and externally with our partners, along with a plan for future conferences / dissemination events we can attend, which will provide an opportunity to share learning from the first trial.

To support with ongoing communication, in February, the project held a photoshoot at one of Sero's show homes in Cardiff, a home of a similar style to the Sero Participant's homes which have been included within trial one. This provided an opportunity to exhibit a typical home being heated using a heat pump along and other Low Carbon Technologies (LCTs) with the project EQUINOX team present. All partners will have access to use these tailored images in future communications regarding the project. Examples of these can be seen below in Figure 7:



Fig. 7 SERO Homes Photoshoot

Branding update

The project now has clear branding, which has been carried through to project documents such as Microsoft PowerPoint and Word. These will be used for future project updates and deliverables. An example in use for a recent presentation can be seen below in Figure 8:

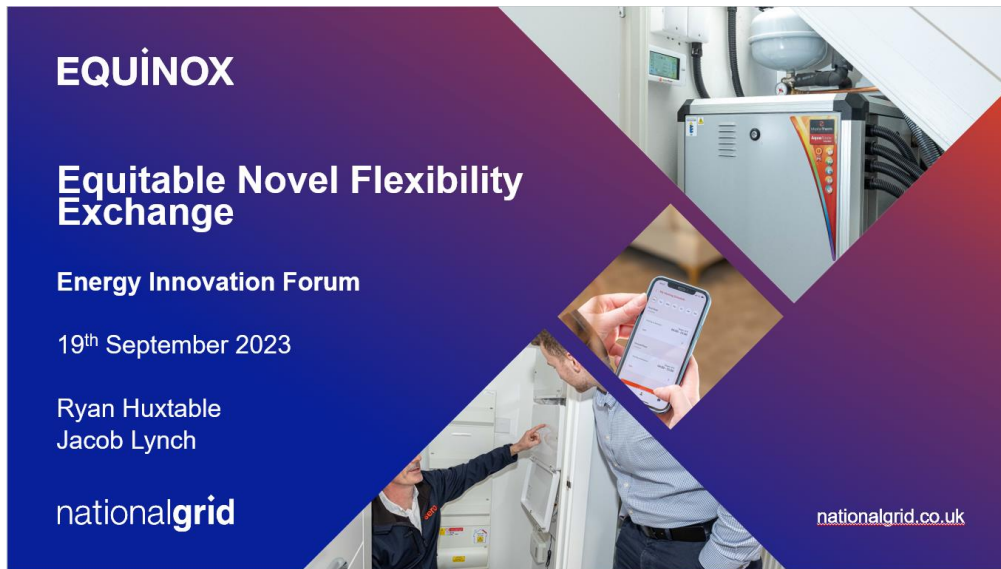


Fig. 8 EQUINOX Presentation Template

The branding has also been utilised in the design of the customer facing website, which is currently under production. In the meantime, whilst the project website is being created, a trial participant area has been set up on the NGED directory as a common place for suppliers to direct their customers to. The website covers detailed information about the project, recordings of the webinars that have taken place, along with a general Frequently Asked Question (FAQ) section.

www.nationalgrid.co.uk/equinox-trial-participant-area

Dissemination

EQUINOX has been disseminated at a number of events during this reporting period, including those shown in Table 3.

Table 3: EQUINOX Dissemination Events

Event Name	Date	Platform	Dissemination Type
EQUINOX Project Webinar - Customer perceptions of Low Carbon Heat	26th April 2023	MS Teams	Project Specific Webinar Presentation
Utility Week 2023	16-17th May 2023	NEC, Birmingham	Stand
Heat Pump Flexibility Developing a common vision	14th June 2023	Westminster, London	Present
NGED Investor Day	July 2023	London	Present
EQUINOX Project Webinar - Effectiveness of Commercial methods	9th August 2023	MS Teams	Project Specific Webinar Presentation
Oxford Energy Innovation Forum	19th September 2023	Olney Island, Oxford	Present
EQUINOX Project Webinar - sharing trial one learnings - participants	21st September 2023	MS Teams	Project Specific Webinar Presentation

Horizon Scan

Since the last progress update, we have continued with our quarterly 'Horizon Scan', which collates and summarises research and innovation projects, plus regulations and policy, which are deemed relevant to the delivery of the EQUINOX project.

Given that, EQUINOX will unfold to a backdrop of three years of policy and regulatory change regarding many areas relevant to project delivery like flexibility market design and heat pump roll out, we are tracking current and upcoming policies and regulations to ensure EQUINOX tests commercial arrangements which reflect reality.

Furthermore, as a condition of Ofgem funding, EQUINOX must directly acknowledge and build upon other innovation projects relating to electrification of heat and flexibility by UK DNOs and others. We are therefore collating all relevant projects to facilitate the identification of opportunities to disseminate Equinox learnings to other projects who can benefit from them.

The Horizon Scan is updated quarterly with updates on relevant ongoing innovation projects, newly identified innovation projects from the UK and beyond, and identify new UK policies, regulations, and market activity relevant to flexibility and low carbon heat. It is our hope that this can be a go-to resource for other networks, charities, low carbon heating firms, and flexibility specialists looking to understand the UK's current and future domestic low carbon flexibility landscape.

The first three editions can be found here:

- [Q4 2022 Horizon Scan](#)
- [Q1 2023 Horizon Scan](#)
- [Q2 2023 Horizon Scan](#)

3. Business Case Update

Summary of EQUINOX benefits

This section covers provides an update on the EQUINOX business case presented within the FSP. During this reporting period we have reviewed the business case based on trial results, which give early insight into the potential of HP flexibility, as well as in line with changes to government policy linked to the expected uptake of HPs. We will continue to assess and update the business case in line with the ongoing assessment carried out during the project and any assumptions and changes to it accordingly.

In its Ten Point Plan for a Green Industrial Revolution, the UK Government announced that it will “aim for 600,000 heat pump installations per year by 2028, creating a market led incentive framework to drive growth, and will bring forward regulations to support this especially in off gas grid properties”. This heat pump (HP) installation target represents a significant departure from the current HP installation rate (~30,000 per year). However, it falls short of the deployment levels (900,000 per year) recently suggested by the CCC⁸. The CCC also stated that “We should not delay on HPs or low carbon heat networks as viable solutions for most of the country”. In addition, buildings is the second largest emitting subsector in the UK, accounting for 18% of UK emissions in 2019.

Changes to government policy during this report period have included increase in the grants available to homeowners looking to install HPs, as well as an extension in the time period gas boilers will continue to be installed. This is thought to affect the number of HPs to be installed in the short term, but we understand that targets to reach net zero have not changed as a result. For this reason, we have maintained our expected HP forecasts during this business case review, which align to those in the Ten Point Plan set out above.

EQUINOX Capacity Benefits

Trial one Findings

Trial one has provided early insight into the potential turndown possible from HP flexibility across a two hour window. A total of 386 households provided 10.8MWh turndown across 22 events, with an average turndown of 1.43kWh per household per event. The turndown achieved per home varied, and was influenced by factors including home characteristics and energy efficiency rating, as well as control method and customer behaviour. The projects later trials plan to provide a more definite turndown per home, as well as looking into the ability to stack the responses to avoid peak demand or provide turndown over a longer time period.

As events during this trial all took place for a set two hour window, we haven't yet got evidence to demonstrate the full benefit the service can provide to assist with avoiding network peaks, which may take place over a longer period. It is expected that in future scenarios HP customers will be aggregated across longer time periods, where the individual home turndowns can then be used to mitigate a peak over a longer period. For this reason within the following trial we will move to

⁸ <https://www.theccc.org.uk/wp-content/uploads/2021/06/Progress-in-reducing-emissions-2021-Report-to-Parliament.pdf>

flexibility event scheduling at different times during the evening, and will use these results to assess the impact of customers over different time periods being aggregated.

FSP Business Case Update

At the time of writing the FSP, EQUINOX was expected to release the following capacity headroom through use of heat flexibility, thereby reducing reinforcement needs.

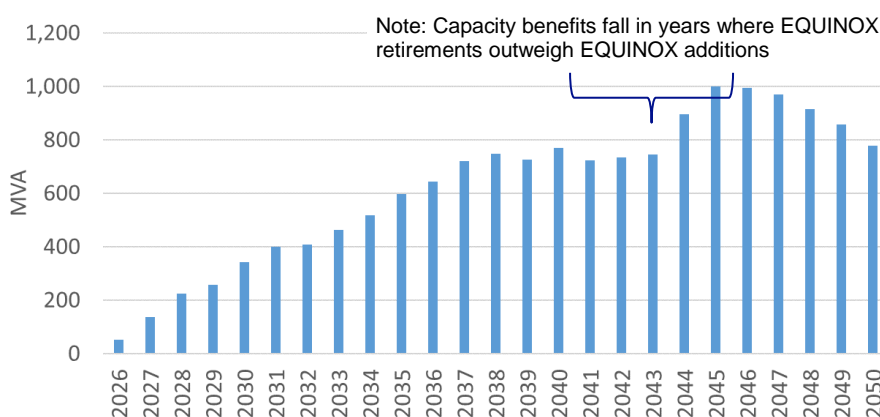


Fig 9. Forecast Capacity Release by EQUINOX across GB

The total High Voltage and Low Voltage capacity released across GB would be 779 MVA by 2050. It should be noted that due to the temporary effect of the flexibility solution EQUINOX releases capacity temporarily until reinforcement removes the capacity benefits of EQUINOX later. For example if EQUINOX is used to defer a substation reinforcement for as long as possible until network capacity is overtaken again by load growth, following which the network is reinforced and thus flexibility no longer required. As a result, the cumulative capacity benefits may fall in some years, as seen in the shape of the graph in Figure 9. This is due to a larger number of substations requiring reinforcement in some years, thus removing the need and capacity benefits from EQUINOX, when compared to the number of new substations at which EQUINOX is deployed and achieving capacity benefits across GB. Conversely to the financial benefits, capacity benefits cannot be capitalised over time.

EQUINOX Financial Benefits

Trial one Findings

During trial one, payments were made to users based on their participation in events and for their responses for surveys and focus groups. As the payments were made for participation, rather than measurable turndown, this does not represent a BaU scenario, but was carried out to allow us to understand what is possible from HP turndown, help us understand how turndown can be calculated and attributed to HPs, and maximise learning from the trial. For this reason, when quantifying the benefits of the first trial we have looked at the wholesale market value of the energy turndown achieved. During the trial period, the Day Ahead Baseload Contracts - Monthly

Average energy price ranged from £81.60 per MWh to £209.93 per MWh⁹. It is not expected that the full wholesale value of the turndown achieved by customers can be passed on to consumers, but there is potential up to £0.20¹⁰ per customer per two hour event might form part of the stacked value from the industry that can be passed on to customers participating in HP flexibility. As the project moves to closer to BaU pricing, the value to other parts of the industry will be estimated to represent future value for customers.

FSP Business Case Update

We have begun to review the potential for financial benefits based on our initial results from trial one, but believe that significant updates will start to be made when we move towards our BaU commercial arrangements to better understand the realistic future costs associate with the EQUINOX outputs.

The figures below are taken from the projects FSP, and are presented in real terms using 2021/22 prices. Figure 10 shows the forecast net financial benefits of EQUINOX at GB scale (cumulative):

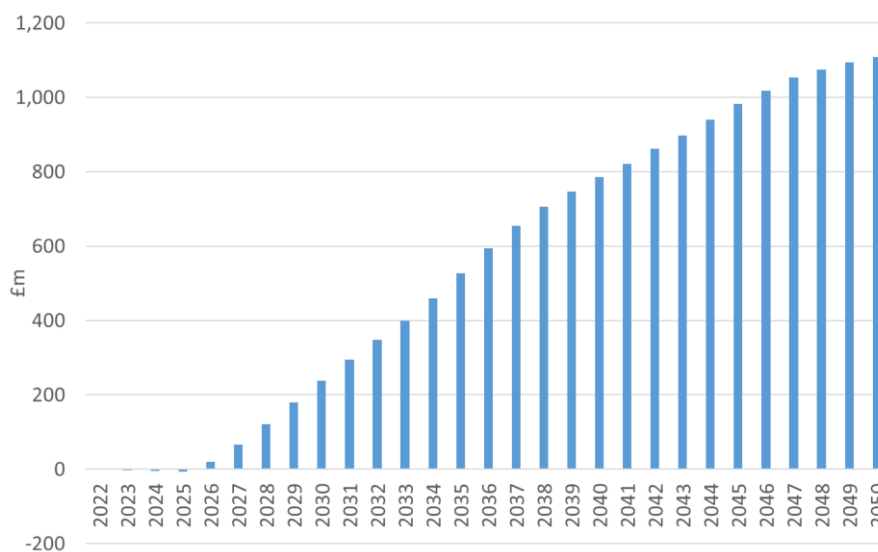


Fig 10. Forecast net financial benefits of EQUINOX at GB scale

This illustrates that there is a significant financial benefit against investment associated with EQUINOX. Comparing the cumulative EQUINOX benefits with the benefits of demand side response reported by industry experts in the Carbon Trust & ICL report, provides confidence that the EQUINOX benefits are likely achievable, and conservative.

⁹ Values taken from [Wholesale market indicators | Ofgem](#)

¹⁰ This is an exercise intended to explore the broad order of magnitude benefit only. It should be used for first approximation use only. It assumes a 75% reduction factor on the wholesale energy cost that may be able to form part of value stacking for flexibility payments to users.

EQUINOX Environmental Benefits: Carbon emission reductions

No update has been made to the EQUINOX environmental benefits at this stage.

4. Progress Against Budget

Table 4 below demonstrates the progress against budget to date:

Table 4: Progress against Budget

Spend Area	Budget(£k)	Expected Spend to Date (£k)	Actual Spend to Date (£k)	Variance to expected (£k)	Variance to expected %
Labour	4993.52	2731.92	1,608.07	-1,124.86	-41.14%
Equipment	456.20	-	-	-	-
Contractors	483.80	311.69	148.88	-162.81	-52.24%
IT	221.97	-	-	-	-
IPR	-	-	-	-	-
Travel and Expenses	17.76	0.41	1.09	0.68	168.53%
Payments to Users	250	62.55	45.61	-16.94	-27.08%
Contingency	1231.43	315.00	230.00	-85.00	-26.98%
Decommissioning	-	-	-	-	-
Other	111.43	-	-	-	-
Total	7766.11	3,421.57	2,033.64	-1,387.92	-40.56%

Comments around variance

As reported in September 2022 progress report, 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.

The spend area allocations above has now also been updated. During this reporting period, we identified an error in the FSP spreadsheet submitted, and have updated the allocations to realign with the bid, making no change to the overall project budget or funding requirements. As these changes do not effect the overall budget of the project, this is understood to not be a material change.

Variance in each spend area is as follows:

- Labour & Contractors – current labour spend is lower than anticipated at this stage. One factor contributing to this is that changes have been made to contractual arrangements delaying payments. For this reason the spend is expected to take place in the next reporting instead.
- Payments to Users – the value assigned to this area is to be split between three winter trials. Trial one payments to users budget was used to reward customers for their turnout during events, as well as for taking part in trial surveys and focus groups. As the number of customers increases, the payments to users total is likely to increase per trial, so this has been used in a way to ensure that payments to users budget will not constrain customer numbers in later trials.
- Travel and Expenses – current spend in this area is higher than originally forecast at this stage, but is still expected to remain within the overall budget area during the remainder of the project. Higher spend at this stage relates to an increase in the number of in person meetings carried out, which were found to be a better way to engage a large number of suppliers on areas such as trial planning.
- Contingency – current contingency spend relates to the cost of bringing on board an additional supplier, Scottish Power Energy Retail. This is current marked as underspent due to delays in their technical integration development which will now lead to payments being made following this reporting period.

5. Project Deliverables

The project has made the following progress towards the Success Criteria and Deliverables within the Project Direction:

Table 5: Project Deliverables

Reference	Project Deliverable	Deadline	Evidence	Progress
1	Customer perceptions on unlocking flexibility from heat [WS3]	Dec 2022	A report containing: <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	A report containing: <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	A report containing: <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. 	Started – On track for delivery and submission to Ofgem in Nov 2023. Following agreement from Ofgem, this deliverable will not be published and shared widely until trial two is complete. Elements of the report cover how trial two is being executed, and sharing this would impact the trial results where participants are able to see the design prior to the trial finishing.

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 An overview of the customer experience during the trials based on customer feedback An overview of the simulated network impact throughout the trial flexibility events 	Started – on track for Aug 2024
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 Recommendations on the role of DNOs in customer engagement 	Not started
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 An update of the project business case that considers project learning 	Not started
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 	Ongoing – this report forms the second Annual Project Progress Report submission

-
- the requirements of the Governance Document.
 3. Evidence of attendance and participation in the Annual Conference as described in the Governance Document.
-

6. 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 trial can be shared due to individual customers smart meter data being considered personal data and therefore being treated to ensure GDPR compliance.

7. Learning Outcomes

Table 6 below shows some of the learning we have captured so far as part of the EQUINOX Project. This includes some general practical learning outcomes that we think are useful to other planning projects of a similar scale, as well as specific technical and commercial learning.

Table 6: Learning Log

Area	Learning Point	Outcome
WS4	Households shifted their behaviours during event periods beyond simply turning off their heat pump. Trial households who did not turn their heat pump off during events still provided significant per event turndown, indicating wider behaviour change	We will continue tracking non-event participant turndown – this will be even better in trial two as each event will also have a control group of participating households.
WS4	Household participation remained high throughout the trial. Only minimal fatigue observed. ~60% of households participated in all 22 events. No households pulled out of the trial.	Similar number of events per household for trial two
WS4	Clear relationship observed between temperature and turndown. Lower temperatures = higher turn down during the event (heat pump working harder)	Will again seek a range of temperatures in trial two. Temperature analysis will be further validated by the presence of control groups in trial two.
WS4	For homes with batteries, how they used them impacted the turndown they could provide	Per kWh payments for trial two will accordingly reward those who actually reduce their baseline
WS4	Higher EPC homes (e.g., A,B) provided less turndown than lower EPC homes, generally, but small trial one sample sizes means more work is needed in trial two to explore this relationship. This could relate to the lower energy usage overall for heating due to the homes being more thermally efficient, but could also relate to the size of the higher EPC homes in trial one hence further work being required to fully understand	Track EPC ratings and other house metadata closely for trial two
WS4	It was tricky to recruit households for trial one that were in social housing or could be considered as having vulnerabilities as these groups are less represented in the UK HP demographic. Those who were appeared to face no additional difficulties in navigating the trial	Coming up with a more unified definition of vulnerability for trial two, and taking steps to recruit more social housing homes
WS4	A hold up for collecting results through surveys, interviews, focus groups, etc. was signing off relevant data sharing agreements between partners	Data sharing details will be agreed far further in advance for trial two to avoid delays. Existing Data Sharing Agreements can also be adjusted as needed rather than created from scratch
WS4	Data sharing agreements take time	Allow significant time for DSA negotiation in project plans

WS4	Splitting data collection helped mitigate challenges around data sharing. This allows individual data sets to be shared with independent third parties or at different time scales.	Continue this approach for trial three.
WS4	Detailed operational planning and data analysis for post-trial helped streamline Trial two. This has enabled discussion / challenge / etc. ahead of time versus while items are underway later.	Continue this approach for trial three.
WS4	Customers during trial one were able to provide an average of 1.43kWh of heat pump turndown per 5-7pm event. This initial insight will need researching further in future trials.	Continue to measure turndown during flexibility events, but at varying times and by combining customers to consider for longer durations.
WS3	Pre-determining analysis priority criteria (and therefore capturing the necessary data points up front) is important in case interest is higher than expected (i.e., oversubscribed). In trial one, we needed to adapt the higher interest in the programme than initially anticipated.	Developed criteria for trial two in case of over-subscription.
WS3	Customers are increasingly being asked to engage in more flexibility offerings and projects. In light of the evolving landscape of domestic flexibility projects, we are doing more work on ensuring our customer offer is complementary to other offers customers may have and reducing the potential for clashes.	Focusing on how to integrate stacking and collaborating with related projects.
WS3	We are evolving our approach to data collection to better align with data sharing needs amongst consortium partners, which were not anticipated in the lead up to trial one. This includes having data collected centrally by one-party in some cases instead of individually by suppliers.	Refining agreements and updating T&Cs for trial to drive efficiency in data analysis while ensuring data is protected.
WS3	Customers are keen to understand the “why” behind the trial including the design choices like days of events. While it is important to not share this up front and bias result, more could be communicated back to participants in a feedback loop post-trial.	Refining trial two communications approach and plan to communicate trial one findings with participants.
WS3	For real-time updates, text messages are an effective and easy mechanism that customer prefer in addition to email.	Add text message notifications in trial two
WS3	Based on trial one findings, customer experience did not differ significantly when we segmented the data based on customer income, ability to afford energy bills, and presence of disability / long-term health condition in the household.	Decided to focus on health conditions exacerbated by the cold for trial two.
WS3	Households felt in control of their heating throughout the trial (only 4% did not) and generally remained comfortable	Sticking with 2-hour maximum event length for trial two, households can still choose to override events
WS3	Consecutive event days saw participation drops on the second day – this was largely due to the timeline of communications to customers	Trial two will see customers provided with a variety of notice periods for events

WS3	Trial one households were overwhelmingly satisfied with the trial, found it easy to navigate, and felt the event length and frequency was appropriate	Base trial two logistics will largely remain the same as trial one
WS3	Households were keen to understand the reasoning behind the event day choices and the network impacts of their participation in events	For trial two, we will focus on providing participating households with more regular updates on their collective turndown achievements, and more context on different elements of the trial design
WS3	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.	Consider working with companies who provide energy management for future trials.
WS3	Separate post-event survey and notification of upcoming next day event into two emails / notifications. Learning that this was otherwise often missed and resulted in lower participation for second day.	Separate feedback requests and event notifications for future trials
WS3	Once you establish routine with customers (i.e., cadence of post-event survey) they are accustomed to it and will reach out (i.e., Tweet, etc) with challenges.	Monitor customer comms for any issues with trial operation
WS3	When sending mass emails, can lose customers due to marketing preferences. Can also cause delays or additional approvals to sending out materials due to checks needed.	Check customers marketing preferences when creating participant shortlists
WS3	Emails to invite customers to participate should have variety in their subject line, so that so that they do not join a "conversation" within the email provider's software.	Ensure email subjects are varied for future trial event notifications
WS3	Use a distinct key word to make routing for customer service queries easier and ensure they go to the correct person / team.	Use EQUINOX and encourage use of it by customers as a distinct key word for customer service queries email subjects
WS3	A lot of early adopters for domestic Low Carbon Technologies are involved in the energy industry, which may make trial participants less representative of the general population in the UK.	Monitor whether customers are linked to the energy industry when recruiting and analysing results
WS3	When surveying customers on their views of low carbon heating and flexibility, allow time to digest new government announcements, policy announcements and grant programmes	Make sure next customer perception survey is planned far enough in the future. Make sure it takes into account and enough time has passed for consumer perceptions to take onboard recent policy announcements and grant programmes.

WS3	In areas where trial participants are clustered, participants may be impacted to others or reach out with confusion.	When selecting control and commercial groups for clustered customers avoid those that lead to significantly different rewards at the same times.
WS2	For Settlement to work for multiple payment methodologies, 3 separate dispatch groups and 3 separate metering IDs will need to be created in order to pay customers different values and also notify them at different times	Identified methods for how technical integration will work given the new commercial arrangements.
WS2	The meterable units and dispatch groups within flexible power can be modified so that there can be a change to commercial arrangements per customer group halfway through the project trial.	This will allow us to change customer trial arrangements during trial 2 and 3 if needed.
WS2	It has been proved quite tricky to discuss developments surrounding the technical integration with some suppliers in the same room in detail due to sensitive commercial interests that may be impacted.	Strategy has had to be focussed to engage with suppliers on a 1-2-1 basis.
WS2	To avoid unnecessary duplication, it has been beneficial to utilise existing systems suppliers have in place in order to reduce development. This has allowed a greater focus on the developments needed	Less overall spend and duplication.
WS2	During the trial, it was discovered that for the majority of automated customers, a spike in demand was seen at the end of the trial. This was mainly due to the heat pump being completely off during the whole event. It then required more energy than it saved during the session. This learning will be taken forward to address the spike in demand. For further details please see the trial one results here	Strategy is now to focus on how to mitigate the spike.
WS2	Addressing the point above, the best potential method to address this is to manipulate the set points rather than making changes to the compressor or flow rates	Look into set point control for trial two
WS2	Little change will be needed to the API for settlement, only the meterable IDs need to be changed and which customers go in each.	Quantified work needed to be ready for trial two.
WS2	Throughout trial one, a discovery was made that the home automation system would alert the in-home heat pump as soon as the API signal was received from Flexible Power. Traditionally, Flexible power does this 15 minutes before the event. This required developments to be made for trial two.	Identified development for future trials.
WS2	Opting in using a two-click system is hard for customers.	As a result, Octopus has built an auto-response to confirm to them that they opted in. This will hopefully keep traffic down and make it clearer to customers.

WS1	Households partaking in trial one demonstrated the ability to provide significant turndown when requested – 10.8 MWh across 22 events – but this was measured at smart meter not heat pump level. This represents likely BaU processes, but has made it more difficult to isolate the heat pump-specific turndown impacts caused by Equinox events	Capping trial two kWh payments to heat pump kW rating x 2 hours to nudge participants into only turning down heat pump
WS1	There is tentative evidence that households with aggregator-controlled heat pumps can provide more predictable flexibility than households whose heat pumps were turned down by customers, but this will need to be further researched due to the small aggregator-control sample size in trial one.	Maximise aggregator-controllable households in trial two recruitment
WS1	We observed that customer-controlled heat pump turndown could be remote (app-controlled) or manual (customer has to go to the device and turn it down/off). We also observed that participation and turndown were pretty identical for both groups. This is interesting given that the most common reason given for not participating in an event was no one being home to switch the heat pump off – this would only have impacted manual customer control customers	Continue to consider this control split for trial two
WS1	Households paid after each event participated more consistently than those paid upfront monthly payments, but both payment types provided a similar amount of turndown per household	Payments for trial two will be switched up to be per kWh, therefore paid post-event. Some trial two arrangements may also have a small upfront availability payment
WS1	Trial one payment amounts were far above what DNOs would expect to pay for the turndown achieved in a BaU scenario.	Trial two will see lower flexibility payments than trial one. These payments will be clearly segmented from trial participation payments.
Program me	Consider implication of deliverables and publishing of different documents on trials when scheduling parts of the project (i.e., Deliverable 3).	Look at future ones now to mitigate any risks of this again early and discuss early with Ofgem.
Program me	Regular engagement with flexibility teams, and having representation on the project teams has been helpful for data work, trial design and eventual product recommendations.	Consider bringing BaU relevant team members onto future innovation project teams

8. Intellectual Property Rights

A complete list of all background IPR from all project partners has been compiled. The IPR register is reviewed on a quarterly basis. No new foreground IPR has been generated to date within the EQUINOX project.

9. Risk Management

Our risk management objectives are to:

- Ensure that risk management is clearly and consistently integrated into the project management activities and evidenced through the project documentation;
- Comply with NGED's risk management processes and any governance requirements as specified by Ofgem; and
- Anticipate and respond to changing project requirements.

These objectives will be achieved by:

- ✓ Defining the roles, responsibilities and reporting lines within the Project Delivery Team for risk management;
- ✓ Including risk management issues when writing reports and considering decisions;
- ✓ Maintaining a risk register;
- ✓ Communicating risks and ensuring suitable training and supervision is provided;
- ✓ Preparing mitigation action plans;
- ✓ Preparing contingency action plans; and
- ✓ Monitoring and updating of risks and the risk controls.

Current Risks

The EQUINOX risk register is a live document and is updated regularly. There are currently 53 live project related risks. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible. In Table 7, we give details of our top six current risks by category. For each of these risks, a mitigation action plan has been identified and the progress of these are tracked and reported.

Table 7: Top six current risks (by rating)

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
There is a risk that the difficult to reach customers are not reflected in the trial participants and therefore the trial participants aren't reflective of NGED's entire customer base.	Major	EQUINOX purposefully aims to include a range of customers within the trials.	Trial two recruitment has been scheduled and we will monitor customers numbers and characteristics as this progresses.
		NGED will use its contact with charities and organisations working with difficult to reach customers to promote EQUINOX	
		No new equipment required for participation - only smart meter & heat pump. By definition, this means anyone with a heat pump could participate. Potential app-based control could also increase/encourage access	We are now starting to benchmark this against data on heat pump owners as well as wider population.

There is a risk that the partners may accidentally share personal customer data with other EQUINOX partners and contractors	Major	Data is only being shared in accordance with agreed Data Sharing Agreements, which outline exactly what data can be shared and in what ways. Data is typically shared in aggregated format to avoid the need for sharing personal data.	DSA were put in place for trial one and were used successfully with no accidental sharing of data. These are currently being reviewed and updated for trial two.
There is a risk that customers are unable to be recruited in time to allow for trial preparation	Major	We have a defined recruitment plan for trial two which has cut off dates for new customers to join. If we do not meet our target customers by this date, we have contingency plans to delay the first events of the trial.	Recruitment currently underway.
There is a risk that customer heat pumps use significantly more energy during event days, increasing the customer energy bills. Increase in demand following events has been noted within trial one results, predominately in automated control customers.	Major	Control methods for automated heat pumps are being reviewed updated for the upcoming trial. For manual customers, guidance will be provided on how to best participate in EQUINOX events.	Technical integration for automated control customers has been updated, with testing to be carried out prior to trial two. Trial packs have been prepared to support all trial participants.
There is a risk that Scottish Power technical integration will not be in place and fully tested in time for the start of trial two.	Major	Manual processes can be used in place of the technical integration for early trial two events. Scottish Power customers will make up a small part of overall trial participation, and all other suppliers will be unaffected.	Technical specifications agreed, development ongoing, testing scheduled to be complete prior to trial two kick off.
There is a risk that we struggle to engage customers on time of use tariffs	Major	Time of use offerings are being considered in the commercial arrangements. If customers do not take part in events, feedback will be collected to ensure learning is gained on how flexibility can be run in parallel to these tariffs.	Commercial arrangements agreed. Feedback surveys for trial two under development.

Table 8 provides a snapshot of the risk register, details graphically, to provide an on-going understanding of the projects' risks.

Table 8: Graphical view of risk register

Likelihood = Probability x Proximity	Certain/Imminent (21-25)	0	0	0	0	0
	More likely to occur than not/Likely to be near future (16-20)	0	1	0	0	0
	50/50 chance of occurring/Mid to short term (11-15)	0	1	0	1	0
	Less likely to occur/Mid to long term (6-10)	4	6	3	5	2
	Very unlikely to occur/Far in the future (1-5)	7	6	3	7	7
		1. Insignificant changes, re-planning may be required	2. Small Delay, small increased cost but absorbable	3. Delay, increased cost in excess of tolerance	4. Substantial Delay, key deliverables not met, significant increase in time/cost	5. Inability to deliver, business case/objective not viable
		Impact				
	Minor	Moderate	Major	Severe		
Legend	26	18	9	0	No of instances	
Total	53				No of live risks	

Fig 12 provides an overview of the risks by category, minor, moderate, major and severe. This information is used to understand the complete risk level of the project.

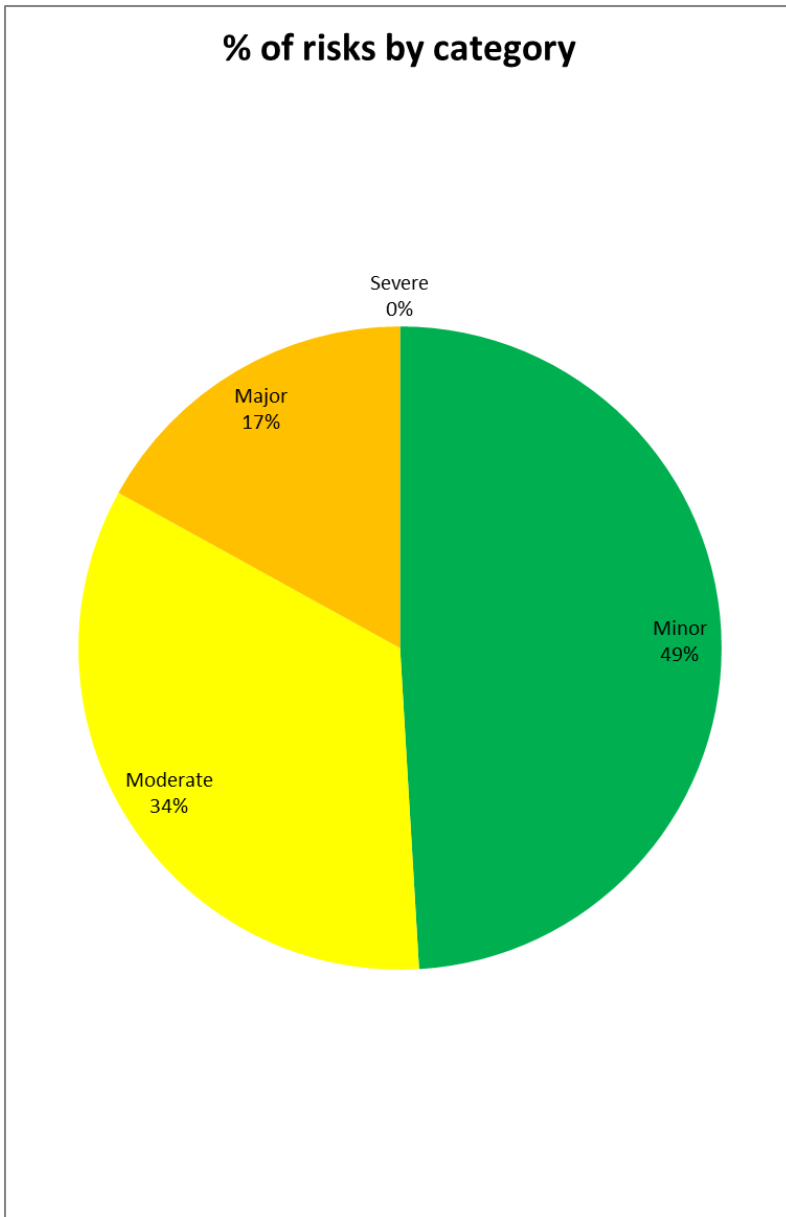


Fig 12. Percentage of risks by category

Update for risks previously identified

Although the number of open risks on the project has increased during this reporting period, the table and graph above demonstrate that the profile of these has improved, with no severe risks currently open.

Table 9: Update on Previously Identified Risks

Details of the Risk	Risk Rating Update	Mitigation Action Plan	Progress
There is a risk that Optimised Retrofit Programme (ORP) funding will not be directed to the right place (Sero) in order to get customers onboard.	Minor (reduced from Severe)	Utilise existing customer base, leverage other rollouts across NGED areas.	There are still currently no ORP funded customers on boarded to EQUINOX through the Welsh Government, but this has no effect on the projects ability to recruit its targeted numbers.
Level of ambition - risk that EQUINOX may be out paced by the HP roll-out. This is why we need to be aggressive with these targets and make sure Equinox is part of the HP roll-out.	Moderate (reduced from Severe)	Continue to monitor externalities and rollout plans. Document and share this using the EQUINOX horizon scan process.	Horizon scan updates demonstrate that EQUINOX is providing valuable learning not available via existing programmes and HP rollout.
There is a risk that one of the partners may not be able to deliver as expected and therefore cause unintended consequences on the overall delivery plan.	Moderate (reduced from Severe)	Continued engagement with partners throughout at operational and Snr levels. Explore options externally as well and keep an eye on external events and opportunities.	Risk to project from partners unable to recruit customers has been reduced following successful recruitment of wider customers.
There is a risk that we will not have enough customers under trial one due to; a) Sero - unable to provide customers b) technical integration issues for both OE and Sero with "controlled" customers and c) lack of other pools of customers.	Closed (from Severe)		Trial one completed with significantly more customers than anticipated.
There is a risk that Sero integration will not be in place in time for trial one	Closed (from Severe)		Sero integration in place and successful for trial one

There is a risk that Sero customers who are recruited for trial one will not have an integration method	Closed (from Severe)	Sero integration in place and successful for trial one
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10. Consistency with Project Direction

The scale, overall cost and timeframe of the project have remained consistent with the project direction, a copy of which can be found here:

[Project Direction: EQUINOX- Western Power Distribution | Ofgem](#)

Change has been made to the cost centre allocations to reflect the original full submission proforma spreadsheet. This change is explained within Section 4 – progress on budget.

11. Accuracy Assurance Statement

This report has been prepared by the EQUINOX Project Manager (Ryan Huxtable), reviewed by another Innovation Engineer (Laurence Hunter), and then reviewed and approved by the Innovation Team Manager for South Wales and the South West (Paul Morris).

All efforts have been made to ensure that the information contained within this report is accurate. NGED confirms that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.

Glossary

Term	Definition
API	Application programming Interface
BaU	Business as Usual
BDR	Behavioural Demand Response
BEE	Building Energy Engine
C2C	Capacity 2 Customers Project
CCC	Climate Change Committee
DG	Dispatch Groups
DLC	Direct Load Control
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
EHV	Extra High Voltage
EPC	Energy Performance Certificate
EQUINOX	Equitable Novel Flexibility Exchange
ESO	Electricity System Operator
FAQ	Frequently Asked Question
FSP	Full Submission Proforma
FSP	Flexibility Service Provider
GDPR	General Data Protection Regulation
HP	Heat Pump

HV	High Voltage
Imperial College London	ICL
IOT	Internet of Things
IPR	Intellectual Property Rights
IT	Information Technology
kWh	kilowatt hour
LCT	Low Carbon Technologies
LV	Low Voltage
MU	Meterable Units
MW	Megawatt
NGED	National Grid Electricity Distribution
NIC	Network Innovation Competition
Ofgem	Office of Gas and Electricity Market
ORP	Optimised Retrofit Programme
PEN Test	Penetration Test
PPR	Project Progress Report
Q1-4	Quarter 1-4
SPERL	Scottish Power Energy Retail
T&Cs	Terms and Conditions
WS	Workstream

