EQUINOX

NIC Project Progress Report

October 2023 – September 2024

Electricity Distribution

nationalgrid

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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 v3.0[1] and EQUINOX project direction requirements, this report details progress of the project, focusing on the last twelve months, October 2023 – September 2024.

During this reporting period we have achieved a number of key deliverables and milestones, including the commercial arrangements, technical arrangements and consumer engagement needed for Trial two, prior to successfully carrying out the trial itself. We recruited over 1,000 customers ahead of our expectation of reaching this number in Trial three, and were able to test a range of variables to build a more definitive view on what is possible with heat pump flexibility. This included testing demand turn down response based on customer notice period, payment amount, time of day and external weather temperature. This uncovered key findings which deepen our understanding of how customers will accept and respond to requests for flexibility from their heating and how much networks may be able to rely on that flexibility to manage constraints in a net zero future.

We have also started the planning for Trial three. This will be carried out in winter of 2024/25 and will continue to innovate and advance the conversation on domestic low carbon heating flexibility. A key feature will be exploring the potential for heat pumps to provide base peak-load reduction flexibility through a pre-scheduled, longer-term flexibility commercial arrangement in alignment with our findings highlighting the baseload flexibility potential for heat pumps. Additionally, trial three aims to implement stacking between EQUINOX and another flexibility offering, trial longer events, and test customer acceptance of events held during the morning peak.

During this reporting period we published a number of our committed deliverables, firstly deliverable 3[2] focussing on the commercial methods and technical designs and then deliverable number 4[3] which focusses on the learning from those designs.

In addition, the project team have been active in the dissemination of the results and outcomes to date, with a range of events attended and feedback obtained on the work that we are doing. Furthermore, we continue to make our Horizon Scan reports available, ensuring that the team are

[1] https://www.nationalgrid.co.uk/downloads-view-reciteme/620467

[2] https://www.nationalgrid.co.uk/downloads/663528/20231128-design-of-novel-commercial-methods-technical-integration-v1-0.pdf

[3] 672211

aware of all developments in this space, and providing a resource for others looking to carry work on domestic low carbon heating and flexibility.

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, customer engagement and experience, trials, and knowledge capture and dissemination. The high-level plan submitted within the FSP[4] has been adhered to so far, and is as follows:

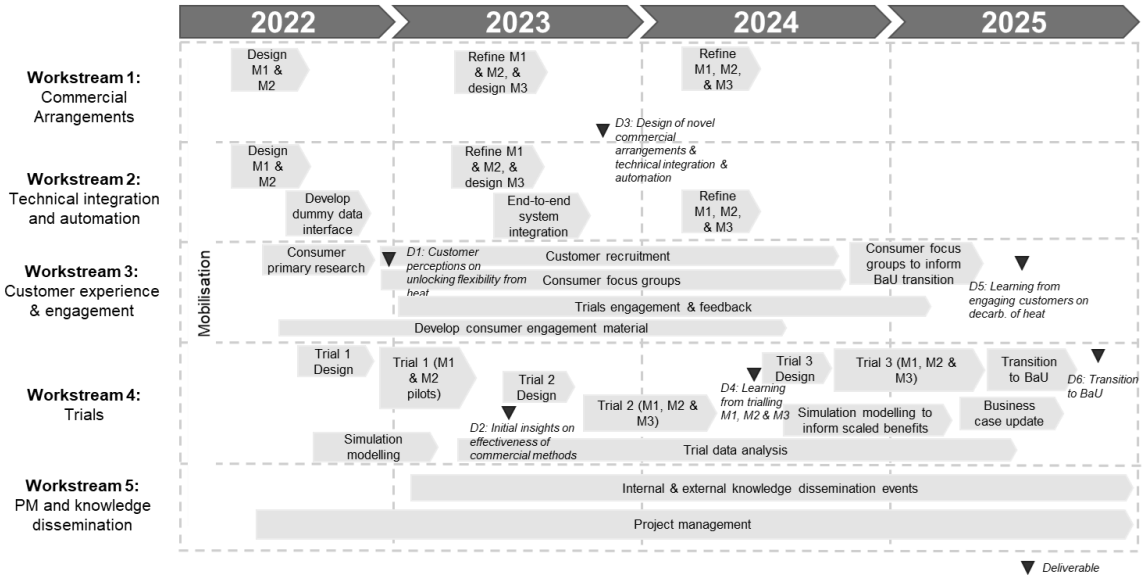

Fig. 1 High level project summary plan

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 second trial phase. This work has included:

- refining and testing commercial and technical arrangements

[4] 20211008 EQUINOX FSP Full Submission FINAL v2.0_REDACTED.pdf

- on-boarding over 1,000 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 true, and use the insights to design and prepare for trial three. The following sections provide detail on the work carried out within each of the workstreams:

Workstream 1- Commercial Design

Trial two Commercial Arrangements

Trial two aimed to better understand the aggregated flexibility that can be procured from domestic heat pumps. Where trial one showed that demand response could be measurably achieved, trial two aimed to assess the drivers of that demand response. Payment amounts were also dependent on the notice periods given in order to understand the difference in participation based on day ahead, morning ahead and two hours ahead notice periods. Participants were assigned to one of three commercial arrangements: M1, M2, and M3. This was to determine the influence of payment amount. Their experiences were also tracked according to whether they had a heat pump they could control themselves manually, themselves remotely by app, or with capability to be controlled directly by their supplier (aggregator controlled). This was to determine whether control method had any impact on flexibility participation. The flexibility "events", which saw households called to turn down their heat pump during two-hour evening peak periods, were also varied between 4-8pm. This was to test whether participation can be procured across the required network flexibility window. Participant tariff type was also tracked to identify whether households with tariff types with multiple unit rates during the day (time of use tariffs) would be more likely to load shift from the flexibility window in response to the additional incentive provided by EQUINOX events. These commercial arrangements are summarised in Table 1 below.

Table 1. 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	• Day ahead: £0.80/kWh.	• Day ahead: £0.40/kWh.	• Day ahead: £0.50/kWh.

	• Morning ahead: £1.60/kWh. • Two hours ahead: £2.40/kWh.	• Morning ahead: £0.80/kWh. • Two hours ahead: £1.20/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.		
Event frequency	Zero to three events per week.		
Supplier notice	Informed by National Grid on Wednesday of the following week's events.		

Trial two events were designed to represent aspects of National Grid's Secure and Dynamic flexibility products, which procure flexibility on a non-regular basis to resolve network constraints for a few hours (Table 2). The payment amounts were set according to the range of commercial values typically associated with Secure and Dynamic procurement, noting these can vary significantly based on location and actual needs. Rewarding participants' demand response in line with existing commercial flexibility prices was considered an important step in demonstrating the Business as Usual (BaU) viability of heat pump flexibility, albeit by proxy as BaU commercial relationships between suppliers and customers are at each supplier's discretion. The notice period variation also sought to align with network need to call events at varying notice lengths according to specific constraints.

Table 2. National Grid flexibility products

Flexibility product	Network constraint	Customer notice period	Duration
Secure	Peak load management.	Week ahead, real time, within day.	30 mins to several hours, over a single day.
Dynamic	Unscheduled maintenance.	Week ahead, real time, within day.	30 mins to several hours, over a single day.
Sustain	Constraint management service.	Advanced pre-agreed schedule.	Four hours, for several weeks Monday to Friday.

The Sustain flexibility product was also considered initially, but ultimately not used to inform trial two payments as it did not align with trial two event design. Sustain is an advance scheduled

longer-term National Grid flexibility product that procures demand response daily between 4pm-8pm, Monday to Friday, for multiple weeks in a row. Testing this form of long-term behavioural change in home heating was not within the scope of trial two, though it is in scope for trial three – see Trial three Commercial Arrangements.

The payment amounts implemented in trial two were informed by utilisation prices for National Grid's Secure and Dynamic services. These range from £0.01/kWh to £9.17/kWh, with additional availability prices ranging from £0/kWh to £1.25/kWh.[5] As higher prices are available in limited locations, it was decided to focus payment amounts around average prices. All trial two participants were offered a utilisation payment rate linked to their measured kWh demand response during an event. These payments were varied per event according to the notice period afforded to participants (see above), further reflecting BaU commercial structures.[6]

Finally, participants' home Energy Performance Certificate (EPC) rating and income levels were also tracked when evaluating their experience during the trials. This was to determine the impact of home insulation quality, and income, on capability to participate in flexibility.

Trial three Commercial Arrangements

Trial three preparations began in earnest with the conclusion of trial two in March 2024.

Trial two's results illustrated that domestic heat pump flexibility is achievable, even when implementing commercial arrangements more closely aligned with actual DNO products. 48% of participants provided demand response during trial two events on average, and participants achieved a 47% average reduction in their household electricity consumption during events. There was also no significant deviation from these results based on whether participants were on the higher paid M1 or lower paid M2, according to their heat pump control method, whether they were notified two hours or twenty-four hours before an event, whether they had been asking to participate at 4pm, 5pm or 6pm, whether they lived in a home with higher quality insulation or were higher income.

Despite its successes, trial two had only tested dynamic, evening peak demand response across two-hour flexibility events. It was therefore decided that rather than seek to build directly on trial two's commercial arrangements, trial three would provide more valuable learnings by implementing wholly new types of trials. It will therefore test multiple new types of commercial arrangements not seen in trial two, across five separate mini trials (Table 3).

Turn Up will see households asked to increase rather than reduce their electricity during an event window, testing whether domestic heat pumps can support networks to reduce the need for curtailment. Dynamic Longer Events will test whether households can provide demand response for greater than two hours, and whether certain types of households can participate for longer than others. Dynamic Morning will assess whether households with heat pumps can also provide

[5] Note that availability prices are commercially quoted in £/kW but have been converted to £/kWh for ease of comparison.

[6] The M3 participant payment award of £8 up-front was in recognition that they would be allowing their electricity supplier to control their heat pump remotely on their behalf.

demand response during the morning peak, which is another time-of-day networks require peak reduction. Sustain will measure the capability of domestic heat pump flexibility to provide meaningful consumption shifting from the evening peak over weeks and months as opposed to the individual days tested in trial two. It will also implement an archetype approach, assigning households to 2- or 4-hour event time-lengths dependent on vulnerability factors. Morning Peak Sustain will test the sustain arrangement during morning peak hours, and then whether households with heat pumps can provide this long-term peak consumption reduction during the morning and evening peak on the same day. A further innovation was to test EQUINOX across additional license areas to further validate the results. Alongside NGED, Scottish Power Energy Networks (SPEN) will also host trials during trial three.

Seeking to incorporate learnings from trial two, trial three will not recruit participants on ToU tariffs. This is because participants with ToU tariffs were found to already be successfully shifting demand from the hours targeted by EQUINOX events during trial two, likely in response to their tariff's price signal. They were found to provide limited additional demand response during events as they were already engaging in the networks' desired behaviour. Therefore, such households were deemed unsuitable for recruitment into trial three, and event-based flexibility in general. It was instead concluded that these households will participate in (and benefit from) flexibility through their tariff structure.

Table 3: Trial three commercial arrangements

Item	Turn up	Dynamic Longer Events	Dynamic Morning Peak	Sustain	Morning Peak Sustain
Event length	2 hours	2-4 hours	2 hours	Group A: 2 hours. Group B: 4 hours[7]	2 hours (first 4 weeks) 4 hours (second 4 weeks)[8]
Event Timing	11am-1pm	4-8pm	8-10am	5-7pm or 4-8pm	8-10am, then 8-10am & 5-7pm
Event period	Single day			12 weeks	8 weeks
License area	NGED	NGED and SPEN[9]			
Customer Incentive	Free electricity	£2 per event	£1.50 per event	£1 a week	£2 a week, then £4 a week
Recruitment Criteria	No customers recruited with peak load shifting ToU tariffs.				

[7] The Sustain cohort will be split into two and four hour groups based upon household archetype.

[8] Morning Peak cohort will take part in morning only events for four weeks, then also undertake evening events four final four weeks.

[9] Trial three is also onboarding SPEN, which will host EQUINOX events in its license area, alongside NGED.

Supplier notice	Informed by National Grid on Wednesday of the following week's events.	Set in September 2024

Workstream 2- Technical Integration

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.

Trial two Technical Design:

Trial two aimed to continue, evolve and integrate technical designs with existing and new energy suppliers involved in EQUINOX. Analysis from trial one identified development areas to be carried out in order to achieve better performance during the forthcoming trial events.

Sero Technical Changes

For Sero households, it was identified that a setpoint control approach should be developed in order to rectify the snapback observed post event in trial one. The following changes were made to the technical approach for Sero 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 can be seen in Fig 2 and is colour coded to show existing capabilities (green), existing capability that was adapted (orange) and capabilities that were developed for trial two (red).

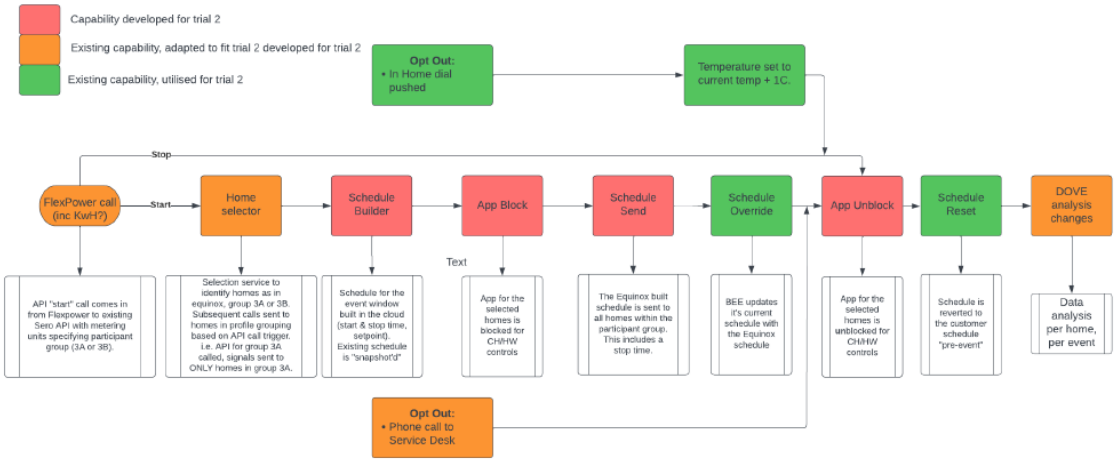

Fig 2 Sero High level Technical Architecture – Trial Two

Scottish Power Energy Retail – Integration

Scottish Power Energy Retail (SPERL) are an additional energy supplier that have been involved in EQUINOX events since the beginning of trial two. In the build up to trial two, a technical process had to be developed in order to provide the opportunity to their customer base to engage in events. This was carried out in partnership with a third-party aggregator, Equiwatt.

Their customer pool participating in trial two did do so via the ScottishPower Power Saver App. An app designed to tell customers when EQUINOX events are happening and allowing them to visualise the rewards they have earned. The back office of this App is integrated with Flexible Power to enable receiving and sending of event signals and information. The ScottishPower Power Saver App is available under ScottishPower's author on the App store on both iOS and Android. The ScottishPower Power Saver App is fully branded as ScottishPower, with the technical solution being provided via a 3rd party service provider. ScottishPower contracted a 3rd party who own a smart energy platform which has been developed specifically to make demand-side response (DSR) events available to domestic customers by receiving signals when the grid may be experiencing peak demand constraints, subsequently notifying customers to shift their demand. The customer interface is App based, whereby users are rewarded points for reducing load by turning off appliances and devices at these peak times.

The developed architecture can be observed in Fig 3 below.

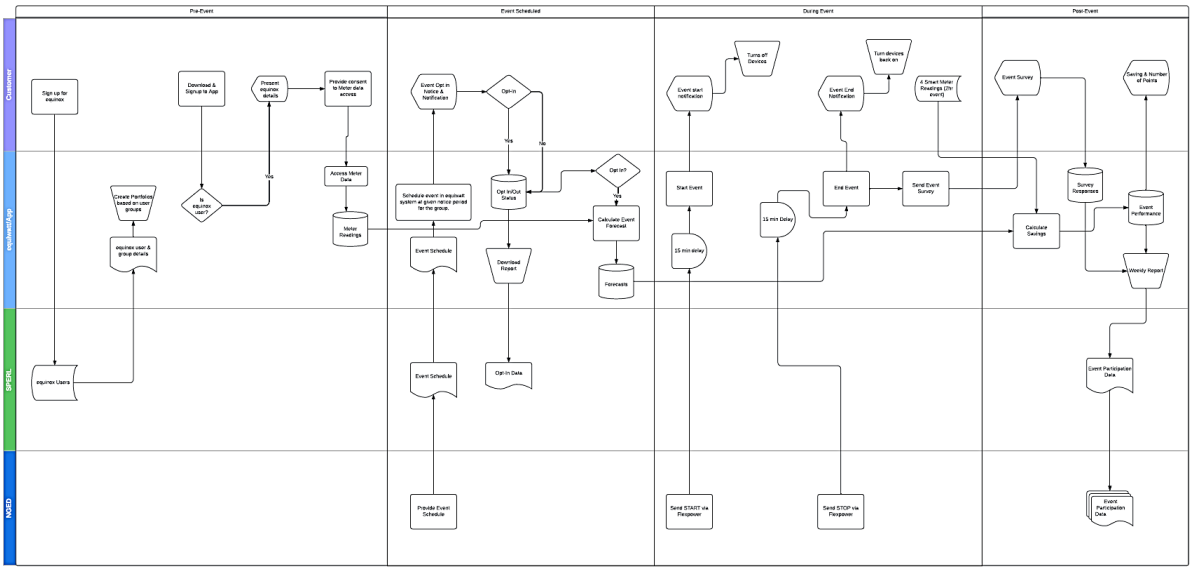

Fig 3 SPERL High Level Technical Architecture – Trial Two

Following a series of sprints to develop and configure the app to meet the requirements for trial two, a series of user acceptance tests were undertaken by ScottishPower and Equiwatt between 23 October and 26 October 2023 including a joint test with National Grid of the interface to Flexible Power. The tests carried out and high level outcomes of each are were noted and recorded. The testing was undertaken by both ScottishPower business representatives and digital team members. To set up starting conditions for the tests, users were configured as EQUINOX customers in the app back office which allowed the process for verifying customers during sign-up to be tested. Real smart meters/MPANs were used for the testing.

The ScottishPower Power Saver app and associated back office services met the requirements of EQUINOX Trial two. No major issues were observed during the trial, with only a few instances of notification delays of less than one minute during events.

In preparation for trial three, it was decided that Scottish Power were to develop an in house app that would be used for their day to day operations that also includes the handling of EQUINOX events. This will be in place over their existing white label app that was used for trial two. It is expected that the development for this will be finalised and tested by the end of 2024 ready for their inclusion in trial three, beginning at the start of 2025.

Octopus Energy – Integration

Octopus Energy Customers were split into two groups for each commercial arrangements (M1 and M2), creating M1A, M1B, M2A and M2B. These A and B designations refer to customers who experienced events on different days. When group A events were called, (customers in M1A and M2A) group B customers were not contacted, and so continued with their usual behaviour and acted as a control group for an event. In the following weeks, group B customers were called on and group A customers were not contacted. Across the trial period, each group was invited to a similar number of events across a similar range of temperatures. Understanding the consumption

of non-event customers during an event period contributed to increased accuracy of post-trial analysis.

The four groups comprised roughly equal numbers of customers, segmented on location, technology type and electricity tariff type. All customers had heat pumps as their main source of home heating, smart meters reporting home electricity consumption at half-hourly granularity and be located in the National Grid distribution area. Customers in EQUINOX were additionally rewarded for their participation in trial surveys but were not permitted to participate in other demand flexibility services during the EQUINOX trial period.

To facilitate participant engagement at the scale of up to 1000 customers, existing customer management solutions within Octopus Energy were used to create bulk, personalised emails and to collect customer feedback and information through surveys. Customer-initiated contact came through the normal customer support channels (phone, email, socials) and were answered by Energy Specialists with prior knowledge of the project.

Customer invitations and on boarding to the project happened in this way, supported by resources hosted on the Octopus Energy website, including FAQs and Terms and Conditions for the project. Data management for customers on boarded to the EQUINOX trial was handled by an in-house Data Science team. Customer withdrawal from the project could be initiated through any of the normal customer support channels and was enacted manually, removing the customer from further trial messaging and trial data collection. Separation of withdrawn customers' data from trial results was enacted manually, in accordance with GDPR best practice. As part of this process, customers on boarded to EQUINOX trial two were marked ineligible for other demand flexibility services and did not receive direct invitations to participate in Octopus Energy's Saving Sessions product (part of ESO's DFS product).

Customers with eligible heat pump models were additionally invited to participate in EQUINOX as part of the Aggregator control technology group. Automation of EQUINOX events for these customers was managed by Octopus Energy's Kraken platform, via the Octopus heat pump control product. Interested customers were able to on board for this service via the Octopus Energy mobile app and once registered, were manually assigned to the EQUINOX trial. Customer support was provided by Product Specialists as well as by Energy Specialists with prior knowledge of the project.

Fig 4 below shows the data flows between NGED, Octopus Energy and the customer and an overview of the technical architecture for Octopus Energy customers participating in the Aggregator control technology type in EQUINOX trial two.

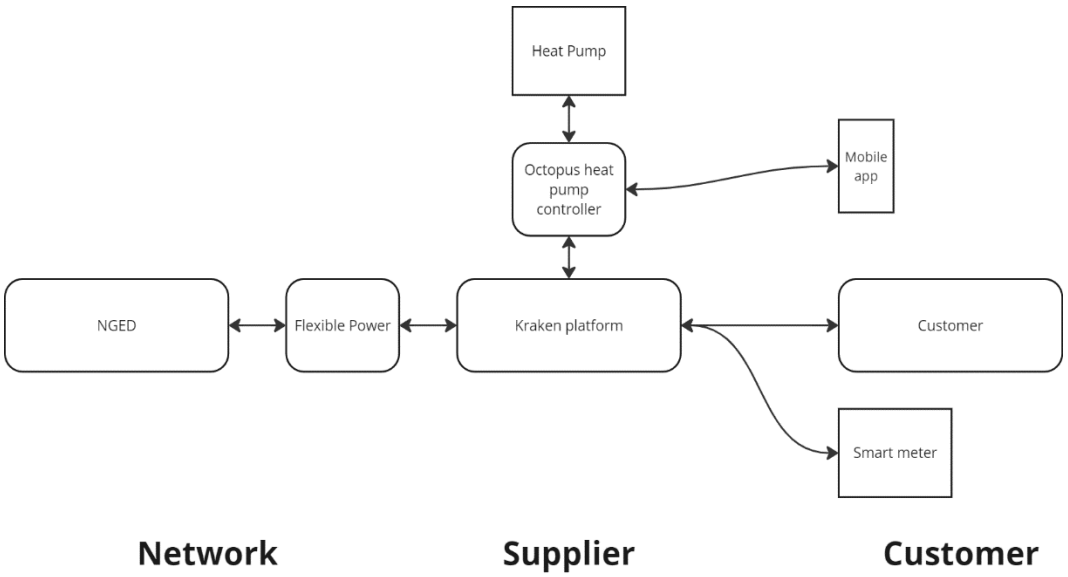

Fig 4 Octopus Energy high-level data flow

SP Energy Networks – Integration

SP Energy Networks (SPEN) are an additional Distribution Network Operator (DNO) that are a project partner on EQUINOX. For trial three, we will be carrying out events with SPEN for the first time to ensure replicability across multiple areas, so there was a need to develop technical integration to make this possible..

With their business as usual activities for flexibility procurement, SPEN utilise the established flexibility platform, Piclo. It was planned that this platform would be used for trial three events and has now been determined that for Sustain type events, the Piclo platform will be used.

Testing was carried out in the Autumn of 2024 for both energy suppliers regarding Piclo. Fig 5 shows and snapshot of the correct API signals that were sent and received to one of the energy suppliers. Due to the developments taking place with Scottish Power, it is anticipated that testing will be redone when their development is completed at the end of December 2024.

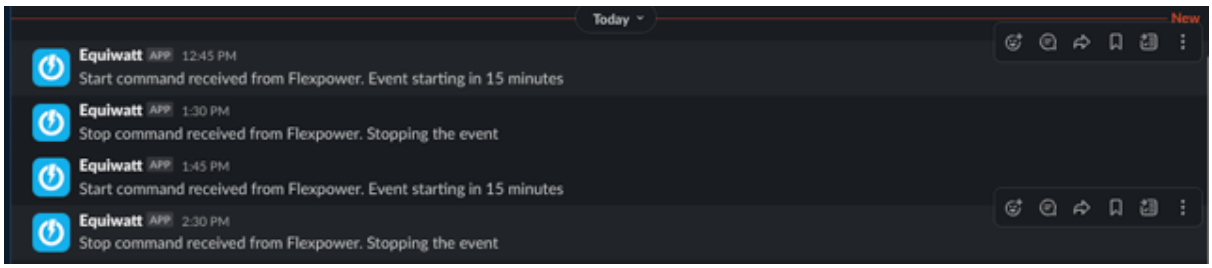

Fig 5 Piclo Successful API Signal Test

Workstream 3- Customer Engagement

Primary Market Research:

During trial one in September 2022, primary market research was conducted to inform the design and roll-out of the first trial. The research sought to understanding 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 heat pumps.

Now that it has been more than two years since this primary market research was conducted, we have decided to re-engage the market research agency to understand how preferences and attitudes towards heat pumps and low carbon technology has shifted or changed. We are also leveraging the learnings and findings from trial one and trial two to ask questions to support our outcomes.

To achieve the objectives described above, both quantitative and qualitative research will be conducted. The approach will be similar to the previous market research activity whereby there will be a combination of research methods including an online survey, face-to-face surveys to capture digitally disconnect individuals, focus groups and interviews. Findings from both the quantitative and qualitative work field work will be synthesised and summarised in a deliverable and available on the EQUINOX webpage.

Recruitment for Trial two

Each supplier led customer recruitment activities for their customer base and oversaw trial delivery for their own participants. Suppliers followed common approaches to recruitment, though each had suitable freedom to engage with their own customer base as they felt was appropriate. Recruitment activities occurred for one month and were completed before the trial period began on 1st November 2023. An overall recruitment target of 600 participants was set, aiming to approximately double the number of participants in trial one. Suppliers were very successful in recruiting participants from their customer bases, with the overall pool of recruited customers exceeding 1,000 (1,048). This considerably surpassed the target and met a key project goal.

Customer Engagement During Trial two

Prior to the start of Trial two, 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 Trial two, and potential financial benefits of taking part. Of note, participation in Trial two 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 network benefits. As part of the recruitment process, customers completed a sign-up survey and agreed to the terms and conditions of the trial.

During Trial two, suppliers were the main points of contact to customers throughout Trial two and were in regular contact with customers to alert them of upcoming EQUINOX events, which were communicated either two-hours before an event, the morning of an event, or the day before and event. They also provided updates following the EQUINOX events to communicate the amount of

turn down achieved and the associated payment amount. Suppliers also gathered insights from customers on their experience with the events through post event surveys.

Customer experience evaluation during Trial two

During EQUINOX trial two, customer research was carried out to understand:

- Why participants signed up and were motivated to participate.
- What the demographics of participants were and how that 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 differing design factors including trial two factors of interest, and whether views and preferences complemented or deviated from the demand response evaluation.

This research was carried out through quantitative and qualitative methods. This included surveys, interviews, and focus groups. The qualitative research included a specific focus on engaging potentially vulnerable customers to understand any specific challenges to participating. Customer research was gathered from:

- Online survey sent at the start of trial two (‘start of trial survey’) to understand motivations to participate, experience with trial sign up, and information about home heating set-up and participant demographics.
- Online survey sent after the first 9 events to understand trial experience thus far and obtain early feedback on trial design to determine if any changes needed to be made for the duration of trial two.
- Online survey sent during the last week of the trial (‘end of trial survey’) to understand satisfaction with trial design, views on technology automation and stacking, and the impact of trial on customer comfort.
- Short online survey sent to treatment group participants immediately following all 36 EQUINOX events (‘post-event survey’) to gather information on whether customers participated, whether customers were adjusting anything besides their heat pump, and if they experienced change in comfort. It also allowed customers to provide information in a free text to ensure suppliers could respond to any concerns.
- 8 focus groups with 37 customers, including 4 focus groups with customers with potential vulnerabilities, to enable more context and personal narratives to be captured around motivations for taking part in EQUINOX, home heating practices and comfort, heat pump learnings, and trial design.
- 13 individual customer interviews to capture qualitative learnings of the same nature as the focus groups.

The findings from surveys, interviews, and focus groups were analysed and shared with the EQUINOX consortium as well as in shared industry events. They were also published and are available on the EQUINOX website here: https://www.nationalgrid.co.uk/downloads-view-reciteme/671038.

Trial three Recruitment

Recruitment for trial three, specifically the turn up trial, kicked off in September 2024 and will continue throughout November and December for the dynamic and sustain trials. Similar to trial two, 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 communication messages which were utilised by suppliers to develop their own specific branded communications.

Trial three Customer Engagement

Similar to trial two, we will be capturing customer feedback throughout trial three. Given the nuances of the different trials in trial three (turn up events, dynamic longer events, dynamic morning events, and sustain events) there are several surveys planned throughout the trial. Each trial will have a start of trial survey designed to capture key demographic information, home characteristics, and key drivers for trial participation. Upon completion of the different trials, each trial will also conduct an end of trial survey which will capture customer satisfaction, customer preferences, and overall customer experience including customer comfort. For the dynamic events and sustain events, we will conduct interviews and focus groups similar to the previous trials to be able to distil additional insights beyond what is captured in the surveys.

Workstream 4- Trials Management

Trial two Overall Event Schedule

Trial two was implemented as a crossover Randomised Control Trial (RCT) wherein participants are randomly assigned to two groups (Group A and B) each consisting of around half of the total participant pool. The participant's group did not change during the trial, however each group switched between being the control or treatment group depending on the event day. In addition to the Group A/B split, Trial two events had the following experimental variables:

- Customer notice period was either 'Day ahead', 'Morning of' or '2-hours ahead'.
- The 2-hour events were held between 4-8pm (either 4-6pm, 5-7pm or 6-8pm) to coincide with NGEDs typical evening peak period.

Each event therefore consisted of a combination of the above variables; e.g. Event 1, Treatment Group A, 5-7pm, morning of notice.

Week		1		2		3		4	
Dates for Weekdays		30/10 - 3/11		6/11 - 10/11		13/11 - 17/11		20/11 - 24/11	
Event days provided by		26/10		2/11		9/11		16/11	
Event Number			1	2	3	4	5	6	7
Notice Period (M1A/B, 2A/B)			M	2	D	2	M	D	2
Notice Period (M3A/B)			M	P	D	P	M	D	P
Event Start Time (pm)			5	6	4	5	4	5	6
Trial Group	M1 Treatment		A	A	B	B	A	A	B
	M1 Control		B	B	A	A	B	B	A
	M2 Treatment		A	A	B	B	A	A	B
	M2 Control		B	B	A	A	B	B	A
	M3 Treatment		A	A	B	B	A	A	B
	M3 Control		B	B	A	A	B	B	A

Figure 6: Event Schedule

The main trial period ran from 1st November 2023 – 15th March 2024, with a Christmas break from 18th December 2023 – 7th January 2024. There were 36 EQUINOX events held over this period; participants experienced 1-3 events per week and each participant group experienced 18 events respectively.

- After each event, participants were asked to complete a short (4/5 questions) post-event survey asking them to confirm participation, define their comfort levels during the event and flag any issues they experienced.
- Included in the 36 total events were 3 'contingency' events which were scheduled outside of the usual weekly scheduling process and were designed to capture periods of cold weather.

In addition, a short mini-trial was held from 18th – 22nd March 2024 in which participants experienced 5 days of consecutive events.

This was designed to test participant appetite to a Sustain-style flexibility offering; the full requirements are communicated in advance therefore participants have time to plan and respond accordingly.

Trial two Scheduling & forecasting

Alongside the variables detailed above, temperature was a key variable whose impact on the demand response delivered by participating households was to be explored. Therefore, beyond those variables, event days were chosen on a weekly basis by considering the external temperature forecast for the following week. A range of temperatures needed to be captured across the 36 events, in particular the coldest days of the year. Therefore, the coldest forecast days were prioritised when choosing event days for the following week.

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 on a weekly basis. The average temperature at the Bristol weather station between 4-8pm was calculated and also stored.

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 two 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.

Every Wednesday during the trial period NGED scheduled the event days for the following week by completing the below actions:

- Used the tracking spreadsheet to assess the temperature forecast for the following week's Monday to Friday.

- Use the average 4-8pm forecasted temperatures to choose 1-2 event days with low temperatures.

- Collate actual temperatures for the prior week and input the data into the tracking spreadsheet.

Every Thursday after 12:00 during the trial period NGED completed the following actions:

- Informed Octopus Energy and Scottish Power Energy Retail Limited of the chosen event days.

- Accept availability on the Flexible Power Portal for the chosen days and time periods

Trial 2 Event Summary

Day Type		
Day of Week:	Event	Non-Event
Monday	9	8
Tuesday	9	8
Wednesday	7	11
Thursday	8	10
Friday	8	10
Total ->	41	47

Event Type		
Group ->	A	B
2hr / No notice	6	6
Morning of	7	5
Day ahead	6	6

Temperature Type (Forecast)			
	Days Considered	Event	Non-Event
Warmer	15	3	12
Mild	44	19	25
Cold	13	9	4
V. Cold	1	1	0

Temperature Type (Actual)			
	Days Considered	Event	Non-Event
Warmer	18	6	12
Mild	32	12	20
Cold	21	13	8
V. Cold	2	1	1

Figure 7: Event Summary

Trial three Preparation

In preparation for Trial three, WS4 liaised with multiple stakeholders to conduct a gap analysis exercise on the previous two trial periods. From this piece of work, a number of areas of interest were identified:

- Demand Turn Up events; only demand turn down events have been tested
- Longer events; survey results identified an appetite for events lasting >2 hours
- Morning peak events; all EQUINOX events have taken place during the evening peak
- Sustain events; network impact analysis showed that heat pumps would be well placed to provide consistent base load reduction.

Trial three Design

The areas of interest outlined above were taken forward and developed in a series of joint WS1/WS4 workshops, where we defined research questions which allowed us to be creative with the trial design whilst adhering to the FSP questions and thus a clear scope. We looked to retain elements of Trial two which worked well, such as the control groups for each of the trial groups, whilst also adding new design features to accommodate the required learnings - for Trial three we decided it was most appropriate to design several mini-trials which would allow the project to capture learnings for all the areas of interest without creating a complex trial design structure and making it difficult to analyse the results.

Trial Three Data Collection

In a similar approach to Trial two, we used a number of sessions to review and update the data points we were going to collect in Trial three. The data points were grouped by their collection purpose and were reviewed by the consortium to ensure that their collection allowed us to answer the research questions we had defined. 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 and two preparation that these documents take time to complete.

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 on going communication of the project, in August, the project had the opportunity to interview 3 customers from Octopus Energy and Sero Homes who had participated within the second trial Winter 2023 – 2024. Members of the project were welcomed into their homes to find out more regarding their experience of the trial so far. The interviews had the opportunity to ask participants about heat pump motivations, their experience of the trial and engaging with flexibility as well as finding out more about their home set up and if they benefit from other LCTs within their home. The video clips will be utilised when the project is being showcased at events and for online communications.

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	Location	Dissemination Type
Energy Innovation Summit 2023	1st November 2023	ACC, Liverpool	Project specific presentation
Energy Capital Collaboration Day	12th December 2023	University of Warwick	Project specific presentation
Utility Week Future Networks	20th Feb 2024	ICC, Birmingham	Project specific presentation

DSO Energy Futures Event - EF4	28th March 2024	Battersea Power Station, London	Stand
Optimised Retrofit Program Landlords Presentation	1st May 2024	MS Teams	Project specific presentation
Flex Workshop Colombia - Session 6: How to develop a flexibility market and incentivize participation - EQUINOX	16th May 2024	MS Teams	Project specific presentation
Utility Week Live 2024	21st May 2024	NEC, Birmingham	Project specific presentation
National Grid Innovation Day	18th June 2024	Tobacco Dock, London	Stand
EQUINOX Project Webinar: Sharing trial two learnings.	26th September 2024	MS Teams	Project specific presentation

Awards

As a result of the huge successes of the project, EQUINOX has been shortlisted for a number of awards. In December 2023, EQUINOX won the H&V News Heat Pump project of the year award. At the first ever Utility Week Flex awards, EQUINOX was shortlisted for the Best Domestic Flexibility Proposition. Then this year at the Utility Week awards 2024, EQUINOX has also been shortlisted for the Net Zero Engagement of the year award, results to be announced on 3rd December 2024.

Horizon Scan

Since the last progress update, we have continued with our ‘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 6 monthly 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 latest three editions can be found here:

- Q3 2023 Horizon Scan
- Q1 2024 Horizon Scan
- Q3 2024 Horizon Scan

3. Business Case Update

Summary of EQUINOX benefits

This section provides an update on the EQUINOX business case presented within the FSP and previous project progress reports. During this reporting period, we have reviewed the business case based on trial two results, which give further insight into the potential of HP flexibility. This includes learning on turndown achievable, response rate and required commercial arrangements. 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.

EQUINOX Capacity Benefits

Trial Two Findings

A summary of the findings is as follows but the full picture can be found here in our Deliverable 4 Report here.

1. Heat pump behavioural change provides meaningful demand shifting out of the evening peak period for individual customers. Participants provided statistically significant demand response, totalling 6.5 MWh across 36 two-hour events. An average of 47% of participants opted in to and turned down in each event. Opted in participants provided an average measurable demand response of 0.6 kW (1.2 kWh) per two-hour event, which represented a 48% reduction in their home's peak load.

2. Heat pump flexibility can help to resolve distribution network Constraint Managed Zones (CMZs) when combined with other assets. Scaling up the average trial two demand response per heat pump across several scenarios for the Hayle-Camborne CMZ indicates that heat pumps are well-placed to meet a proportion of the CMZ's base weekday flexibility need.

3. Minimal impact on thermal comfort was reported by EQUINOX participants. Even when surveyed after the coldest events (< 3°C), 85% of participants reported either no change or a slight change in comfort. Additionally, amongst participants reporting feeling any discomfort during events, 91% reported experiencing just mild discomfort. These results indicate heat pump flexibility can be delivered without households experiencing significant discomfort.

4. External temperature was one of the strongest drivers of demand response. The average participant offered 0.07 kW more demand response during an event for every 1°C drop in external temperature below 6.1°C (the trial average).

5. A key driver of demand response was whether a participant's electricity tariff was already incentivising them to shift load out of the evening peak. Participants on tariffs offering different unit rates during the day were already contributing to peak load reduction and had limited additional demand response to offer through concurrent EQUINOX events. These results highlight that explicit flexibility like that in EQUINOX trial two and implicit flexibility such as time of use tariffs both have a role to play de-loading the distribution network during peak hours.

6. Heat pump flexibility is open to all households, including those with potential vulnerabilities. Customers with potential vulnerabilities were not found to differ significantly from other customers in either their demand response volume or in their event participation rates.

7. Automated control over the heat pump is not necessary for the delivery of flexibility. Participants with manual and remote (app) controlled heat pumps provided demand response at a statistically equal rate and magnitude. This shows the potential for manual shifting to help alongside automation..

8. **Participants provided the same demand response at the same opt in rates for two-hour events across different commercial arrangements, event notice periods, and event times during the evening peak.** There was a statistically insignificant variation in outcomes whether participants were paid higher or lower £/kWh rates for the demand response that they provided in each event. This was also the case if participants were notified a day ahead of, the morning of, or two hours prior to the event; and if they were asked to participate in events held between 4-6pm, 5-7pm, or 6-8pm. This demonstrates that heat pump households can be adaptable in providing event-based flexibility.

Constraint Management Zone Response Simulation (Hayle-Camborne case study)

Background

The purpose of this case study was to combine demand response, event opt in rate, and commercial arrangement preference results from trial two with predicted heat pump volumes to assess how far domestic heat pumps could meet the power and energy flexibility requirements of a representative CMZ. More information is provided in Deliverable 4 but this section briefly summaries the approach and findings.

28 of the 1,048 participants recruited for Trial two were located within the Hayle-Camborne CMZ29. Heat pumps make up a large proportion of the flexible LCTs that National Grid believe are currently installed in Hayle-Camborne (> 60%) and forecasted to connect by 2028 (> 45%). As such, they could play a key role in providing the flexibility required in that CMZ to defer reinforcement.

Methodology

The average EQUINOX trial two participant provided demand response of 0.61 kW sustained over the two-hour event duration (1.21 kWh). The average participation rate was 47%. We used these as the basis for determining how successful HP's could be in providing services in the Hayle-Camborne CMZ.

We used the forecasted growth of LCTs and the average demand response from trial two participants to model the theoretical flexibility potential of heat pumps within Hayle-Camborne, and their ability to meet the flexibility requirements. We first compared the theoretical maximum peak power that can be delivered from the projected heat pumps to the peak capacity required in Hayle-Camborne.

Then we tested three scenarios to simulate what proportion of the forecasted heat pumps would need to participate to meet the full and apportioned energy requirements within the CMZ. These scenarios cover credible future flexibility participation levels by heat pump customers:

- Scenario 1: Heat pumps participate for two hours a day, five days a week.
- Scenario 2: Heat pumps participate for two hours a day, two days a week.
- Scenario 3: An informed mix of Scenarios 1 and 2.

Conclusions

Our research suggests that:

- heat pumps alone will not be able to meet the peak capacity required to mitigate the entire constraint seen in the Hayle-Camborne CMZ.
- However, heat pumps may be better suited to providing a daily base weekday flexibility need similar to the Sustain flexibility product. Additionally, if a proportion of the heat pumps were able to sustain a response for longer than 2 hours, fewer heat pumps would be needed to meet the energy requirements as suppliers would not have to stagger homes across the flexibility window.
- that heat pump flexibility can help to resolve distribution network CMZs but to do so it is better when combined with other assets.

EQUINOX Financial Benefits

Trial Findings to date

In last year's report, we provided some insights into the findings and how they impacted the benefits expected. The benefits of residential flexibility are still hard to determine because the market is still nascent. However, we are encouraged by the results from EQUINOX so far. We have trialled higher and lower payments to consumers throughout the trials and these have minimal impact on the delivery and take up of flexibility events. A key consideration for this year's trials will be to ensure that participant groups continue to become more representative. Early adopters, whilst they represent a group of consumers, cannot form the basis for assessing the benefits of flexibility and more importantly the volume of flexibility delivered through heat is small in terms of the energy reductions delivered.

FSP Business Case Update

We continue to review the potential for financial benefits based on results from our trials, but we still believe that the major updates will start to be made when we move towards our BaU

commercial arrangements to better understand the realistic future costs associated with the EQUINOX outputs.

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)	Current Spend (£)	Variance to Expected (£k)	Variance to Expected (%)
Labour	£4,993.52	£3,789.04	£2,687.43	-£1,101.61	-29.07%
Equipment	£456.20	-	-	-	-
Contractors	£483.80	£338.57	£214.50	-£124.07	-36.65%
IT	£221.97	-	-	-	-
IPR Costs	-	-	-	-	-
Travel & Expenses	£17.76	£8.29	£2.06	-£6.23	-75.15%
Payments to users	£250	£155.98	£83.34	-£72.64	-46.57%
Contingency	£1,231.43	£525.00	£525.00	£0.00	0.00%
Decommissioning	-	-	-	-	-
Other	£111.43	-	-	-	-
Total	£7,766.11	£4,816.88	£3,512.33	-£1,304.55	-27.08%

Comments around variance

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.

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 some spend will be moved to later reporting periods

- Payments to Users – the value assigned to this area is to be split between three winter trials. Trial one and two payments to users budget was used to reward customers for their turndown 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 lower than originally forecast at this stage and is still expected to remain within the overall budget area during the remainder of the project. This links to more meetings being carried out virtually than expected and making use of locations to avoid travel costs when in person.

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: • 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: • 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: • 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	A report containing: • An overview of the commercial terms for DNOs, energy suppliers and customers. • An overview of learning from trialling the range of novel commercial method • An overview of the customer experience during the trials based on customer feedback • An overview of the simulated network impact throughout the trial flexibility events	**Submitted** – August 2024
5	Learning from engaging customers on the barriers & enablers of the electrifications of heat and unlocking domestic flexibility [WS3]	Aug 2025	A report containing: • Lessons learned from engaging with customers on the electrification of heat • Lessons learned on enabling equal opportunities and benefits for fuel poor and vulnerable customers • Recommendations on the role of DNOs in customer engagement	**In progress**
6	Recommended transition of learning to BaU [WS4]	Dec 2025	A report detailing: • Updates to flexibility simulation models using trial data • A description of the recommended commercial arrangements, procurement strategy and technical integration to unlock maximum flexibility from domestic customers • An overview of any regulatory or policy change needed to enable efficient roll out • An update of the project business case that considers project learning	**Not started**
N/A	Comply with knowledge transfer requirements of the Governance Document.	End of Project	1. Annual Project Progress Reports which comply with the requirements of the Governance Document. 2. Completed Close Down Report which complies with	**Ongoing** – this report forms the third 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
WS1	Households partaking in trial one demonstrated the ability to provide significant turndown when requested – 6.5 MWh across 36 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	Trial three will incorporate a heat pump monitoring tech installation segment to better isolate heat pump-specific turndown.
WS1	Trial two participants with ToU tariffs were found to have been consistently load shifting out of the EQUINOX-targeted event windows, on both event and non-event days. The result was they provided limited additional turndown that could be isolated to EQUINOX events.	Trial three will not recruit participants with ToU tariffs. It recognises they can contribute to flexibility without an event-based structure such as EQUINOX, and thus do not require additional payment-relation motivation to do so.
WS1	It was not possible to recruit a large aggregator-controlled cohort in trial two, and all participants with aggregator control had ToU tariffs that made their turndown activity difficult to evaluate accurately – as it may have instead come from response to their tariff.	Trial three aims to recruit more aggregator-controlled participants but recognises a characteristic of households with these heat pumps is that they likely have ToU tariffs. This will by definition exclude them from recruitment. At this stage, we consider that events-based flexibility is best placed procuring from participants without ToU tariffs.
WS1	In trial two, as with trial one, it was again 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). Participation and turndown were largely identical for both groups.	Trial three will not devise separate commercial arrangements for different control methods. The assumption is both manual and remote control are suitable methods for heat pump flexibility participation.
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 two payment amounts were in line with what DNOs would expect to pay for the turndown achieved in a BaU scenario.	Trial two demonstrated BaU aligned evening peak dynamic flexibility is achieved from domestic heat pump flexibility. Trial three will focus on testing different payment structures aligning with other forms of flexibility required by DNOs, such as morning peak and sustain.
WS3	Customers appreciate different notifications of events with a blend between app notification and email notification.	Customers are more likely to participate in trial events if they are notified in a way that resonates with them.
WS3	During the recruitment process and throughout the trial it is important to ensure streamlined and efficient communication.	This ensures that the recruitment and participation remains stress free as extensive communication can overwhelm participants.
WS3	Due to limitations associated with regionality and demographics of who owns heat pumps (often early adopters) recruiting heat pump customers that are representative can be difficult.	There needs to be targeted recruitment goals and a defined approach to maximise uptake of a diverse customer base in trial three.
WS3	It is difficult to recruit fuel poor customers for potential participation into trials. This means that there is less focus on customers with potential vulnerabilities or customers who are fuel poor throughout the trial leading to a gap in analysis on how heat pump flexibility impacts these customers	The project will use its Equitability Participation Framework and engagement with communities/social landlords to gain more insight on this.
WS3	Making sure that the trial surveys are easy to use and do not include mechanisms that are difficult including slider questions results in a lower number of emails and better response rates.	Sliders to be removed from future project surveys.
WS3	There are lower response rates for surveys sent on Fridays or in the late morning.	These times will be avoided for future surveys.
WS3	For potential vulnerable customers, it is best to make the focus groups smaller than non vulnerable customers as this allows for more nuanced discussion related to their experiences	Target future focus group sizes for the participant demographics.

WS3	Men are more likely to be participants in focus groups	This can skew the results and experiences of trial participants and should be considered.
WS3	There is a need for segmentation criteria for interviews for diversify findings	We will include this for trial three to provide more robust insights across trial participants.
WS3	Ascertaining interest for individual interviews proved more difficult than focus groups.	Consider only conducting focus groups or make participating in interviews more compelling for participants.
WS3	Many participants indicated heat pump optimisation would be of interest.	Additional resources and focus on heat pump optimisation could be a value add to participants.
WS4	Requiring households to turn down their heat pump during trial two, rather than turn off their heat pump during trial one, meant there was no snapback effect observed in trial two.	Trial three will again focus on asking households to turn down rather than turn off.
WS4	~48% of households participated on average across all 36 events in trial two. This illustrates domestic heat pump flex can be relied upon, but an over procurement rate is required.	This is relevant for trial three design, though trial three will aim to test whether this participation rate is consistent with the new trial types.
WS4	Clear relationship observed between temperature and turndown. Lower temperatures = higher turn down during the event (heat pump working harder)	Temperature does impact turndown magnitude. This will be tested for less specifically in trial three, though the sustain period will aim to capture different temperatures.
WS4	There wasn't a statistically significant deviation in turndown provided by higher EPC homes (e.g., A,B) relative to lower EPC homes in trial two.	We will investigate additional measures beyond EPC rating to identify how home insulation impacts capacity to participate in flexibility.
WS4	As in trial one, it was tricky to recruit large numbers of households for trial two that were in social housing or could be considered as having vulnerabilities as these groups are less represented in the UK HP demographic.	Trial three will define vulnerability in greater detail and attempt to recruit more vulnerable participants.
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. Yet data analysis still took	In trial three, analysis will be undertaken in staggered approach after each mini trial concludes.

	much longer than anticipated, delaying reporting timeline	
WS4	Customers during trial one were able to provide an average of 1.21kWh of heat pump turndown per two-hour event between 4-8pm 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.

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 29 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. 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	Trial three recruitment has been scheduled and we will monitor customers numbers and characteristics as this progresses. 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 trials one and two and were used successfully with no accidental sharing of data. These are currently being reviewed and updated for trial two.
There is a risk of DFS events not being held during the trial 3 period.	Major	Communication with NESO Team Engagement and trials planning to ensure maximum benefit	If it is not possible to demonstrate stacking with NESO, EQUINOX trials may include simulated events to demonstrate stacking
Risk of delayed analysis after each mini trial in trial three, leading to overall reporting delays	Major	Reporting may be delayed due to time between each mini trial and project deliverables. Investigation into options including parallelisation, repurposing and other mitigations	Data analysis timelines set out and tracked in line with trial reporting and Ofgem deliverable deadlines.
There is a risk that the amount of repeat participants leads to unrepresentative results	Major	Consumer engagement early to ensure maximum participation Analysis of repeat participants and investigation into options to ensure that we do not disincentivise participation but also ensure balance of new/existing consumers	We are tracking participant demographics including those that has previously participated in EQUINOX.
Risk that we do not capture a wide enough range of external temperatures specifically for sustain based events.	Moderate	Trial two results demonstrated that a key driver for demand turn down was external temperature. If temperatures are all mild during trial events then results wont be representative.	In trial three we will continue to schedule dynamic events based on temperature forecasting, and expect to capture a full range when carrying out sustain type events.

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	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
Certain/Imminent (21-25)	0	0	0	0	0
More likely to occur than not/Likely to be near future (16-20)	0	1	1	0	0
50/50 chance of occuring/ Mid to short term (11-15)	0	0	2	0	0
Less likely to occur/Mid to long term (6-10)	1	2	2	1	1
Very unlikely to occur/Far in the future (1-5)	3	3	6	2	4
	Impact				

	Minor	Moderate	Major	Severe	
Legend	15	8	6	0	**No of instances**
Total	29				No of live risks

Fig 8 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.

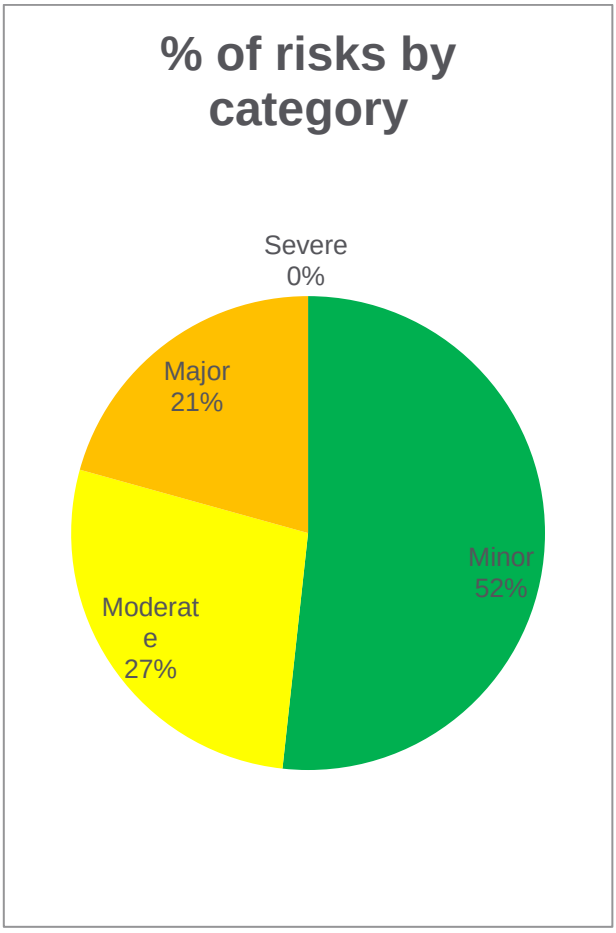

Fig 8. Percentage of risks by category

Update for risks previously identified

The number of open project risks has decreased during this reporting period. Below is an update on the 6 top risks from the previous progress report:

Table 9: Update on Previously Identified Risks

Details of the Risk	Risk Rating Update	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 (no change)	EQUINOX purposefully aims to include a range of customers within the trials. 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 continue to recruit customers into EQUINOX as we look to move into trial three. Representation is increasing, and we are now using our Equitability Participation Framework to ensure that we reach and capture a range of demographics
There is a risk that the partners may accidentally share personal customer data with other EQUINOX partners and contractors	Major (no change)	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.	We continue to collect and hold trial participant data, this is still shared in line with the Data Sharing Agreement
There is a risk that customers are unable to be recruited in time to allow for trial preparation	Closed	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 for trial two carried out successfully
There is a risk that customer heat pumps	Closed	Control methods for automated heat pumps	Trial two automated control moved to

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.		are being reviewed updated for the upcoming trial. For manual customers, guidance will be provided on how to best participate in EQUINOX events.	setpoint control. This avoided the snapback effect seen previously.
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.	Closed	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.	This was successfully completed ahead of trial two.
There is a risk that we struggle to engage customers on time of use tariffs	Closed	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.	Trial two generated learning on engaging customers on time of use tariffs which has been used to inform trial tree requirement.

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 (Stuart Fowler), reviewed by another Innovation Engineer (Jacob Lynch), and then reviewed and approved by the Future Capability Programme Lead (Ryan Huxtable).

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

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