Electricity Distribution

EQUINOX Horizon Scan

Tracking relevant developments and learnings from previous/ongoing projects, initiatives, and policies

v1.1 3rd March 2023

nationalgrid

Guidehouse

Version Control

Version Number	Last Edited/Reviewed By	Version Dated	Next revision
v1.0	Callum Coghlan (Guidehouse)	Q4 2022	~~Q1 2023~~
dv1.1	CC & Karen Liu (Guidehouse)	17th February 2023	~~fv1.1, 24th February 2023~~
v1.1	CC & Ryan Huxtable (NGED)	3rd March 2023	Q2 2023

Horizon Scan Contents

Electricity Distribution

1

Introduction

Document purpose, contents, scope, usage, update process and timeline

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Context and Purpose: What is this Horizon Scan and why is it needed?

This Horizon Scan is a tracker of projects, policies, market design and regulation relevant to Equinox

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

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

To ensure Equinox tests commercial arrangements **which reflect reality**, it is important to **keep abreast of current and upcoming** policies and regulations

Collating all relevant projects facilitates the identification of opportunities to **disseminate Equinox learnings** to other projects who can benefit from them, fulfilling **another Ofgem funding condition**

Guide: What is included within this Horizon Scan?

This Horizon Scan collates and summarises research and innovation projects, plus regulations and policy, which are deemed relevant to the delivery of the Equinox project. The document is split into two main parts

Innovation projects from the UK and abroad

Summary of Coverage

Section Contents

- Scope of projects covered
- List of the projects (34 in this iteration) and countries (7 in this iteration) covered
- Collated and themed summary of the most relevant key learnings for Equinox
- Project deep dives for more information

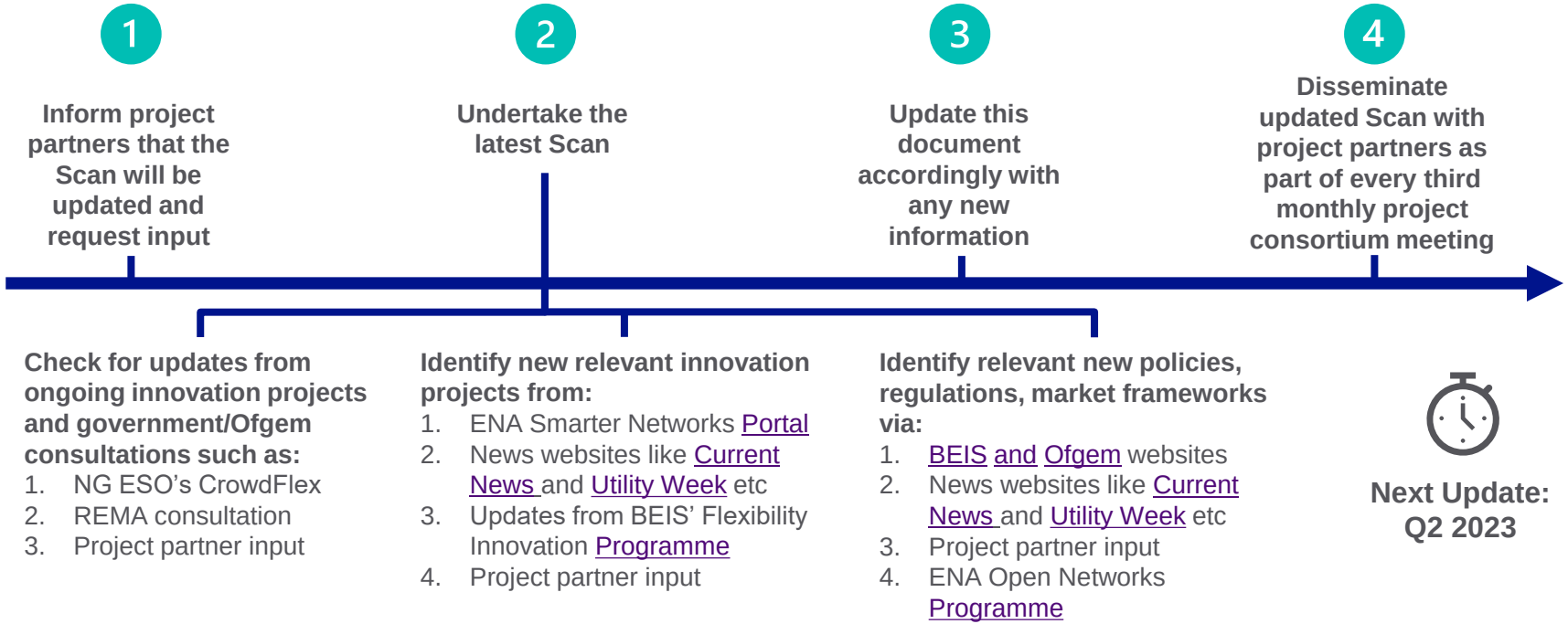
UK policy, regulation, strategy and markets

Summary of Coverage

Section Contents

- Coverage within the latest iteration
- UK flexibility strategy and innovations
- UK technology strategy and rollout
- The UK's approach to energy bills
- Future flexibility market arrangements

Guide: The Horizon Scan will be updated every three months via the following process



Horizon Scan Coverage: Innovation projects from the UK and abroad

Go to section

The scan pools insights and learnings from completed and ongoing innovation projects across the following themes: [1]

1 Domestic Energy Flexibility

Projects focusing on innovation in domestic flexibility from any source, not exclusively low carbon heat

Relevance for Equinox
Learnings on the approach towards domestic consumers, modelled and experimental aggregated flexibility provided

2 Commercial Trials at Scale

Projects focusing on a larger scale (1000+ participating households) trial of an innovative flexibility proposition

Relevance for Equinox
Learnings on customer recruitment, minimising dropouts, regularity of engagement, results analysis

3 Low Carbon Heating Innovation

Projects focusing on domestic low-carbon heating, not necessarily from a flexibility perspective

Relevance for Equinox
Learnings on customer preferences, experience with remote control, common heat pumps concerns

Projects found via:

1. Smarter Networks Portal
2. Flexibility Innovation Programme
3. News sites

4. Input from project partners

[1] Not mutually exclusive

Horizon Scan Coverage: UK policy, regulation, strategy and markets

Go to section

The scan extensively covers the UK's current and proposed approach towards:

1 Flexibility Strategy and Targets

- Vision/ high-level targets
- Existing arrangements
- Forecast capacity
- New BaU offerings

Relevance for Equinox
Equinox must align with UK high level strategy

2 Heat Pump/ Smart Meter Policy and Regulation

- Historic/targeted rates of installation, rollout strategy
- Targeted installation rates
- Current and suggested

Relevance for Equinox
Project must react based on regulation for and pace of heat pump /smart meter rollout

3 Energy Bill Policy and Regulation

- Price cap forecasts
- Current and proposed support packages for bills

Relevance for Equinox
Trial design and incentives must reflect the current and future energy costs landscape

4 Potential Future Electricity Market Arrangements

- Related to structure of flexibility markets
- Related to functioning of flexibility markets

Relevance for Equinox
Final BaU-ready commercial offering must fit within the UK's realigned electricity market

Major sources include: Department for Business, Energy & Industrial Strategy; ofgem; Climate Change Committee; nationalgridESO; ena energynetworks association

Summary of Equinox learnings: Insights from customer research

Go to section

- The main hypothetical motivator for enrolling in a heat pump flexibility trial was receiving credit on heating bills. Climate was important but secondary
- Customers are concerned about the complexity of a flexible tariff, so flexibility offerings must be as simple as possible to maximise engagement
- Home heating habits and tolerance to changes in temperature varied among customers
- Survey participants who reported they would be likely to sign up to a flexible tariff were more likely to select longer durations and more frequent occurrences for third-party control of their heating
- Customers preferred more advance notice of both events where their heating would be controlled by a third-party or where electricity would be cheaper to use
- Customers expressed concerns over handing over control of their heat pumps over to suppliers due to privacy fears, but also felt that manually turning the heat pump on and off was too much of a hassle
- Per flexibility event payments were found to be most palatable to survey participants when coupled with manually turning down/off the heat pump. An advanced monthly payment was preferred for ceding control of their heat pump to a supplier during flexibility events

Electricity Distribution

2

Innovation Projects

Projects covering domestic flexibility, low carbon heating innovation, and commercial trials at scale

nationalgrid

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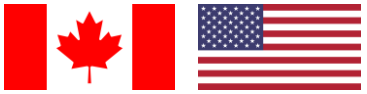
2. Flexibility Innovation Programme
3. News sites

4. Other sources like Equinox project partners, IEA, etc.

[1] Not mutually exclusive

Equinox is UK-based, so the scan focuses on the UK. Large-scale projects abroad also covered

Country			
Key project leads	nationalgrid, UK Power Networks, octopus energy, Scottish & Southern Electricity Networks, SP ENERGY NETWORKS, nationalgridESO, OVO energy	TenneT, IBM, VIESMANN, ENERGINET.DK, POWEO	alectra, London Hydro, DUKE ENERGY
Reason for inclusion	As a UK-based project, Equinox stands to gain from key learnings coming out of other UK innovation projects, particularly those by other suppliers and DNOs. They can provide insights into UK consumer behaviour and preferences towards heat pumps and flexibility	Germany, France, Switzerland and Denmark have some of the highest heat pump installation rates in Europe, so can offer insights on commercial scale domestic heating flexibility innovation trials and programmes	Project partner Guidehouse has experience with projects in the USA and Canada which have a similar premise to Equinox – namely large scale commercial trials of domestic heating/cooling flex

Key learnings from 33 projects have been summarised within seven buckets

1

Customer Offering

How to achieve a compelling proposition

2

Flexibility Impact

How to ascertain the overall flex benefits

3

Recruitment

How to maximise and maintain participation

4

Customer Preference

How to meet participant needs

5

Engagement Strategy

How to optimise engagement throughout the trials

6

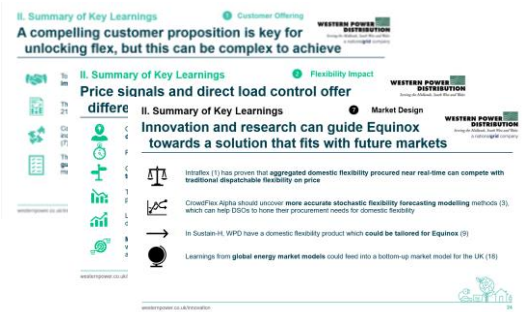
Trial Design

How to design and analyse the trials being undertaken

7

Market Design

How to ensure Equinox is ready for business as usual



A compelling customer proposition is key for unlocking flex, but this can be complex to achieve

To maximise uptake of demand side response (DSR) / flex services, focus on **financial concerns of participating households** by **improving customer proposition** (Projects 4, 13, 30 on project list)

There are **many ways of reimbursing customers** for flexibility, from **different tariffs** (5, 21, 22, 28, 33), **bill rebates** (6, 23, 25), and **per kWh payments** (24). **Sign up bonuses** are also common for trials (12, 21, 23, 24)

Complexities of contract approval process and service design can **present delays and challenges** (13), including concerns about **personal data sharing** (24), **explicit consent requirements** (9), **authentication** (7), etc.

The service summary from NGED's Sustain-H domestic flexibility product, which came out of the Future Flex project, **provides guide elements** which need to be considered for Equinox commercial arrangements (9). An element that made this service proposition successful was its **simplicity**.

Price signals and direct load control offer different flexibility benefits for networks

Critical peak pricing can motivate changes in space heating **even when there is no direct price signal to do so** (project 20 on project list). i.e. price signals can induce **wider behavioural change and flexibility**

Participants can **respond at short notice** to price signals (2, 6, 21, 22), with high participation rates (26)

Giving participants control over temperature limits results in **hugely varying flex potential**, with households **tending towards the extremes** of min and max flex provision (22)

Time of use tariffs and turn-down events can **significantly reduce peak demand** (2, 5), though specific potential for UK heat pumps **remains unclear** (2). Turn down can induce increases elsewhere (4, 26)

Large-scale **turn-up trials** have also demonstrated that there is **significant flexibility potential** from domestic assets when consumers are asked to increase their usage (2, 6)

Modelling project results will aid understanding the role HP turn-down could play in a peak 1-in-20 year winter (10), how HP turn-up can reduce wind curtailment (11), and the flexibility potential of aggregated low carbon domestic heating assets (3, 16)

Recruitment requires proactive engagement and careful consideration of incentives

Risk-free aspect of trials can be a **crucial incentive to enrol customers** (22 on project list). Conversely, other trials saw a **lack of awareness** from participants that incentives had been made available to them (23)

Working with a **trusted third party** (e.g. charity) **adds legitimacy** to recruitment efforts, with **face-to-face interactions** important for building trust and engagement **with vulnerable customers** (4). A voluntary compliance scheme will help build consumer and DNO/ESO trust in domestic flexibility (20)

Customers need **support and resources** to understand new systems, tariffs, etc, and to encourage the switch to **new routines** (5, 7, 13, 14)

Initial concerns for V2G centred around general EV price and operational concerns like charging time (7) – could Equinox find a similar relation between heating flexibility and more general heat pump concerns?

Interactive diagrams and videos are a great resource for making recruitment **more accessible** (8, 24)

Cost of heat pump and accompanying required retrofits can be **prohibitively high barrier** to hitting recruitment targets (12, 27), though this is expected to change over time as costs fall

Acknowledging and aligning with customer preferences is necessary for success

Opt-out flexibility initiatives offer **more flex** than opt-in, provided the **incentive is sufficiently high** (5 on project list)

Unacceptable noise from hybrid/ heat pump systems for participants in some trials (14)

Ease of use, comfort, **reliability**, and upfront and running costs are the primary aspects of a heating system that customers **value** (18)

Do not overpromise: on one trial, many customers did not achieve the bill savings they were promised, with some actually paying more (13)

One trial allows customers to **block times** for which they would not like to have their heat pump remotely controlled (25)

Simple technology is preferred e.g. a one-app solution (7) or a simple proposition (9)

Disruption to customers is a key reason for households choosing not to install heat pumps (27) or engage with flexibility schemes

Active and continuous engagement better guarantee longer-term participation

Customers can be initially **highly concerned** about **changing their routine**, so must be **guided** through the early behaviour change (5, 7 on project list). Personalised tracking and advice empowers participants (8, 26)

In-person events for trial participants to engage with those running the trial can result in those who show up **delivering significantly more flex** (21)

Without **continuous engagement**, participation dropped off in certain trials (4), and has been shown to be higher **directly after engagement**. This must be balanced with **messaging fatigue** which causes disengagement (5)

Large-scale domestic flexibility trials have generally seen **large and enduring buy-in**. For one SPEN trial, **almost 100%** of participants found the experience easy and beneficial. ~70% said they would consider managing their energy use **at least three days per week** (6)

In CrowdFlex, participants who switched to a flex price signal tariff **consistently changed their demand profile** over the six months of the trial (2)

Ongoing communication between members of project staff is key to successful external communication (32)

Various projects assist the setting of ambitious trial objectives and robust impact evaluation

Large scale heating flexibility trials in Germany (24, 25 on project list), Canada (21, 22), and USA (23) all offer **slightly varied trial designs** from which Equinox can cherry-pick

Standard event time for customers is a **maximum of two hours** (2, 6, 24), though other trials went with four hours (5) and one hour (25)

If designed well, direct load control can occur **without participants even noticing** when there has been a control event (13, 23)

Projects like Right to Heat (15) can provide insights to accompany Sero data on **how heat pump use interacts with other low carbon technologies** like solar PV, thus how to account for these in the trial design

The Modelec trial in France introduced **gamification as an engagement tool** (26), rewarding 'better consumption' with points

Innovation and research can guide Equinox towards a solution that fits with future markets

Intraflex (1 on project list) has proven that **aggregated domestic flexibility procured near real-time can compete with traditional dispatchable flexibility on price**

CrowdFlex Alpha should uncover **more accurate stochastic flexibility forecasting modelling** methods (3), which can help DSOs to hone their procurement needs for domestic flexibility

In Sustain-H, NGED have a domestic flexibility product which **could be tailored for Equinox** (9)

Learnings from **global energy market models** could feed into a bottom-up market model for the UK (19)

GOFLEX has created a data services platform to provide **localised estimation and short-term predictions of energy demand/generation**, which will help create the market for distributed flexibilities and automated dynamic pricing (31)

Commander (34) is exploring stackability and primacy rules for different system operator flexibility services in the UK.

Projects for key learnings 1/4

Project	Country	Lead	Description	Domestic flexibility	Trials at scale	Low carbon heat	Project dates
1. Intraflex		nationalgrid	First close to real-time trading of domestic flex, allowing market to determine price	✓	✓		Oct 2019 - Nov 2021
2. Crowdflex NIA		nationalgridESO	Large-scale commercial trial to understand the domestic flexibility across various LCTs	✓	✓		Apr 2021 - Mar 2022
3. Crowdflex SIF Alpha		nationalgridESO	Deeper dive into the system role of domestic flexibility, plus potential stacking opportunities	✓	✓		Aug 2022 - Jan 2023
4. Energywise		UK Power Networks	Understand and trial energy efficiency and commercial arrangements with fuel poor customers	✓	✓		Jan 2014 - Sep 2018
5. SAVE		Scottish & Southern Electricity Networks	Understand whether price signals can impact household peak demand	✓	✓		Jan 2014 - Jun 2019
6. Flexibility Demand Shift Trial		SP ENERGY NETWORKS	Turn-up trial where consumers were rewarded with free energy for using abundant renewables	✓	✓		Mar 2022 – Apr 2022
7. Powerloop		octopus electric vehicles	Residential V2G trial with Nissan Leafs	✓	✓		Mar 2018 - Mar 2022
8. Vehicle-to-Grid Trial		ovo energy	Use bidirectional charging to balance the grid and improve energy efficiency.	✓	✓		Jan 2021 - Jan 2023
9. Future Flex		nationalgrid	Design and trial a new flexibility product for unlocking domestic flexibility	✓	✓		Nov 2021- Mar 2023

Projects for key learnings 2/4

Project	Country	Lead	Description	Domestic flexibility	Trials at scale	Low carbon heat	Project dates
10. Peak Heat		nationalgrid	Desktop modelling study to better understand impact/ flexibility of HPs	✓		✓	Feb 2021 - May 2022
11. 4D heat		Scottish & Southern Electricity Networks	Flexible residential heating demand to absorb wind power that would otherwise have been curtailed	✓		✓	May 2020 - Nov 2020
12. LEO – Smart Flex		LEO Local Energy Oxfordshire	Understand the potential for flexibility services to help enable a zero-carbon future for rural communities with planning constraints	✓		✓	Jan 2022 - Jun 2023
13. No Regrets		passivSYSTEMS	Bring a novel hybrid HP commercial offer to market, and experiment with DSR viability	✓		✓	Oct 2018 - Apr 2019
14. HyCompact		UK Power Networks	Trial of 7 new single unit hybrid heating systems	✓		✓	Aug 2020 - Jun 2022
15. Right to Heat		UK Power Networks	Develop best practice decarbonising heat and decreasing bills in gas grid connected urban social housing	✓		✓	Feb 2022 - Jul 2023
16. Neighbourhood Green		UK Power Networks	Propose an industry standard view on diversity factors for heat, understand flex potential	✓		✓	Feb 2022 - Feb 2024
17. CommuniHeat		UK Power Networks	Developing a roadmap for how rural communities can switch to low carbon heat	✓		✓	Oct 2020 - Jun 2022

Projects for key learnings 3/4

Project	Country	Lead	Description	Domestic flexibility	Trials at scale	Low carbon heat	Project dates
18. Freedom		nationalgrid	Balancing networks through optimising use of HHPs			✓	Oct 2016 - Jan 2019
19. Redmast		nationalgrid	Evaluating current energy market set-up to investigate future market designs	✓			Jan 2022 - Aug 2022
20. HOMEflex		Scottish & Southern Electricity Networks	Development of a Code of Conduct to build trust in domestic flexibility market and support consumer engagement	✓	✓	✓	June 2022 – May 2024
21. Regulated Power Pricing pilot		London Hydro	Critical peak pricing trial of cooling flex with & without real time data	✓			May 2016 - Apr 2019
22. Advantage Power Pricing Pilot		alectra	Tests response of technology-enabled residents to dynamic price signals	✓	✓	✓	Nov 2015 - Aug 2019
23. EnergyWise Home		DUKE ENERGY	Residential trial of direct load consumption for heating/cooling.	✓	✓	✓	Jan 2014 - Sep 2018
24. Viflex		VIESMANN	Test how reduced HP demand can stabilise transmission system	✓	✓	✓	Dec 2020 - Ongoing
25. HeatFlex		TenneT	DNO cooperation to intelligently use flexibility from distributed heat pumps to avoid grid bottlenecks	✓	✓	✓	Jul 2018 - Jun 2020
26. Modelec		POWEO	Test load shedding models for consumers in response to different demand responses.	✓	✓	✓	Jan 2011 - Jul 2014

Projects for key learnings 4/4

Project	Country	Lead	Description	Domestic flexibility	Trials at scale	Low carbon heat	Project dates
27. Electrification of Heat		CATAPULT Energy Systems	Technical and practical feasibility of a large-scale heat pump rollout into existing British homes		✓	✓	June 2020 – Dec 2022
28. NeatHeat		UK Power Networks	Test how Zero Emission Boilers (ZEB) interacts with the electricity network	✓		✓	Sep 2022 – Feb 2024
29. ReHeat		SP ENERGY NETWORKS	Trial network solutions to mitigate the effects of increased demand from domestic electrical heating on the distribution network	✓	✓	✓	June 2021 – Oct 2024
30. Flexible Tower		SP ENERGY NETWORKS	Demonstrating ability of electric storage heaters to shift demand	✓			Feb 2021 – May 2022
31. GOFLEX		IBM	Technology solutions for distributed flexibilities and automated dynamic pricing market	✓	✓		Nov 2016 – Feb 2020
32. EcoGrid EU		ENERGINET.DK	Using market mechanisms and smart control of electricity to balance the energy system	✓	✓		2011-2015
33. HeatFlex UK		Centre for Net Zero Powered by Octopus Energy	Improve understanding of heat pump flexibility potential and circumstances for participating in flexibility events	✓	✓	✓	Sept 2022 – June 2023
34. Commander		nationalgridESO	Method for coordinating stackability and primacy for ESO/DSO flexibility	✓			TBC

Electricity Distribution

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Policy, Strategy, Markets and Regulation

Relevant policy and market designs and reviews relevant to Equinox

nationalgrid

Horizon Scan Coverage: UK policy, regulation, strategy and markets

The scan extensively covers the UK's current and proposed approach towards:

1 Flexibility Strategy and Targets

- Vision/ high-level targets
- Existing arrangements
- Forecast capacity
- New BaU offerings

Relevance for Equinox
Equinox must align with UK high level strategy

2 Heat Pump/ Smart Meter Policy and Regulation

- Historic/targeted rates of installation, rollout strategy
- Current and suggested policies and regulations

Relevance for Equinox
Project must react based on regulation for and pace of heat pump /smart meter rollout

3 Energy Bill Policy and Regulation

- Price cap forecasts
- Current and proposed support packages for bills

Relevance for Equinox
Trial design and incentives must reflect the current and future energy costs landscape

4 Potential Future Electricity Market Arrangements

- Related to structure of flexibility markets
- Related to functioning of flexibility markets

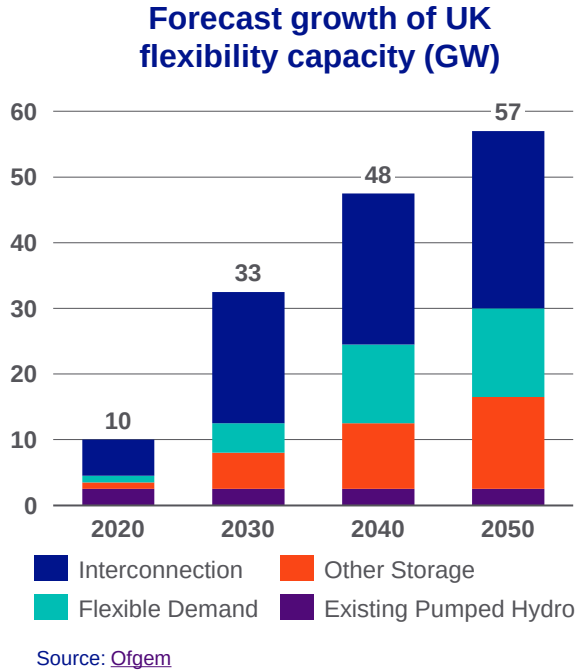
Relevance for Equinox
Final BaU-ready commercial offering must fit within the UK's realigned electricity market

Major sources include: Department for Business, Energy & Industrial Strategy; ofgem; Climate Change Committee; nationalgridESO; ena energynetworks association

An overview of UK policy, regulation, strategy and market reform relevant to Equinox

Sub-Section	1 Flexibility build-out	2 Technology strategy	3 Approach to energy bills	4 Future flexibility market
Horizon Scan Goal	Track progress towards and changes to the UK's flexibility strategy/ targets/ product deployment	Track strategy, regulation, and progress for heat pump & smart meter rollout	Track UK energy costs and government support measures	Track the options being considered for future market operation in the UK
What is covered in this version?	• Vision and targets • Historic and forecast capacity • BAU products like Demand Flexibility Service	• Historic and targeted installation rates for smart meters/ heat pumps • Current/recommended policies and regulations • Wider industry efforts to expand low carbon heat	• Price cap forecasts • Government support packages for bills • Proposed Ofgem regs for vulnerable customers	• REMA consultation • ENA Open Networks recommendations • National Grid ESO recommendations
Main Sources	Ofgem	UK Govt, CCC, Ofgem	Ofgem, UK Govt	UK Govt, ENA, NG ESO

Ofgem expects 4GW of flexible demand needed by 2030, en route to 57GW total flexibility capacity by 2050



Source: Ofgem

- Interconnection is expected to be the major source of flexibility capacity, but **flexible demand grows enormously**
- To progress towards these goals, Ofgem's **Smart Systems and Flexibility Plan** sets out a **vision for the mid 2020s**
- It expects that all flexibility technologies will have improved access to flexibility markets and can stack revenues across multiple sources of value (where this enables whole system optimisation)
- Flexibility is preferred to new network build and renewables curtailment, and is expected to play a bigger role in securing supply through participation in the Capacity Market
- There should be stronger investment signals for flexibility, such as changes to Contracts for Difference to balance system needs with large-scale deployment of low-carbon generation
- Carbon reporting and monitoring should be business as usual, with the carbon intensity of flexibility markets compatible with net zero targets

Ofgem's vision also contains ideals for growing flexible demand from household consumers

Regulation should be in place to enable **all consumers to provide system flexibility**, regardless of the size of their contribution, leading to a mature market for aggregated **consumer flexibility**

Innovative product selection, **rewarded participation for demand side response**, and smart tech should be incorporated across **all government policies** relevant to energy efficiency, heating and fuel poverty

Smart meters penetration should be **near-100%** for smaller scale consumers

Market-wide half-hourly settlement by October 2025 to put incentives on energy suppliers to develop new tariffs encouraging consumers to **shift consumption** to when clean electricity is plentiful (and hence lower their costs)

Ofgem's significant code review (SCR) aims to change the **cost-reflectivity** of network usage to a way that better reflects variations in network costs associated with **location and time of use**

RELEVANCE TO EQUINOX

- Equinox is expected to deliver its business as usual product by the end of 2025 – it is important to ensure that this is consistent with Ofgem's vision for flexible consumer demand in the UK
- Elements like the SCR should be tracked closely to see what BaU will look like from a regulatory perspective by 2025. Section 3.IV of this document details potential future flexibility market set-ups which could be actualised by the SCR

How DSOs value flexibility for their networks influences how they set up their flexibility product architecture

Sustain is a key DSO domestic flexibility product

- **Sustain** is one of **four standard DSO flexibility products**. It is a **scheduled constraint management drop-to service**.
- For NGED, it consists of **two fixed four-hour delivery windows** each weekday over targeted summer and winter seasons
- NGED accepts **half-hourly metering** at **asset or household level**
- Domestic participants can (and currently do) participate in some of NGED's Secure and Dynamic products, but Sustain is the **clearest path** for domestic assets to offer flexibility
- **Sustain-H** is NGED's **domestic-specific** Sustain product, currently being developed into **BaU in Flexible Power** (see more here)
- The development of Sustain is seen as the **provision of another route to market**, rather than the sole route to market for domestic assets.

NGED are currently consulting on how to define procurement zones for Sustain

Option	1: Fully Averaged	2: High/Med/Low zones	3: Individual zone
What	Sustain uses 1 zone combining all relevant CMZs	3 zones created to allow for pricing differentiation	Each CMZ[1] is treated as its own Sustain zone
Price Setting	Single price based on ceiling price across all CMZs	3 prices based on ceiling prices of relevant CMZs	Individual price per zone. High level of variability
+	Reduced upfront complexity since there are fewer zones for qualification		Simple and transparent clearing process per zone, per CMZ proof of delivery
−	Downstream complexity as value to DSO remains at per CMZ level. Removal of price competition complicates management of over/under subscription		Increased upfront burden as each CMZ would need relevant architecture set up

RELEVANCE TO EQUINOX

- How the Sustain zoning is defined will have implications for the commercial arrangements being developed in EQUINOX
- The pricing of a heating flexibility product will depend on how the DSO values the flexibility it receives – this will depend on where and how it procures it

National Grid ESO's Demand Flexibility Service has tested domestic flexibility potential at scale this winter

Demand Flexibility Service (DFS) developed to allow ESO to access additional flexibility when national demand is at its highest. This innovative service has allowed consumers (plus some C&I users) to be incentivised for voluntarily flexibility, including one product – the Homely DFS Assist service - which exclusively extracted heat pump flexibility

Requirements for participation

- Assets must have half-hourly (HH) metering
- Respond for a minimum of 30 minutes
- Aggregated unit size 1 MW to 100 MW
- Providers must provide relevant HH metering & baselining data to demonstrate demand reduction

Assets are excluded if they…

- Are dispatchable via the Balancing Mechanism
- Participate in Ancillary services **or DNO services**
- Have a Capacity Market contract

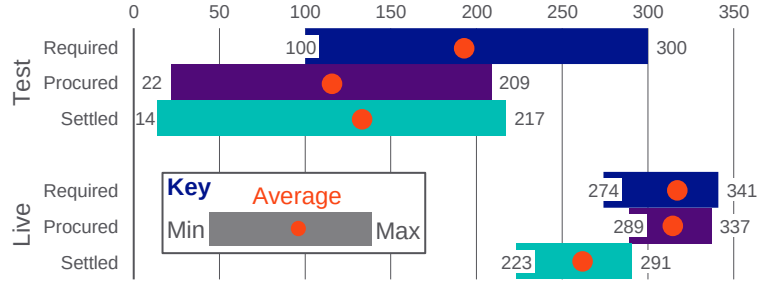
Basic service details

- 12 tests from November 2022 to February 2023
- 10 test events, 2 live events (23rd, 24th January)
- Tender submissions are Pay as Bid
- Guaranteed Acceptance Price set at £3,000/MWh

19 Domestic Providers, incl.[1]

octopus energy, myenergi, loop, SMS, EDF, E.ON next, ovo energy, utilita, Shell ENERGY, British Gas, ev energy

Half hourly DFS volumes (MW) for 9 test and 2 live events[1]



Settlement volumes were generally lower than those procured

RELEVANCE TO EQUINOX

- This service provides details on how residential flexibility is valued by the ESO, improved baselining methodologies for calculating demand reduction, and will serve the discussion on ESO and DSO product stacking

[1] National Grid ESO; [2] ESO Data

Case Study: Homely Demand Flexibility Service Assist service optimises heat pumps when events are called

Who homely by evergreen energy

What Homely Demand Flexibility Service (DFS) Assist service

How

1. Service responds to a day-ahead DFS event notification from National Grid ESO by **creating a new heating system**
2. The heat pump pre-heats consumer's home over the preceding hours, **maintaining the customer's set temperature whilst the heat pump remains dormant during the DFS event**
3. **Automatic process** via Homely with **customers only required to opt-in to the scheme**

Outcomes

- Households have **reduced their heat pump energy draw by an average of 800W** during DFS sessions in the service's first month of operation
- Homely claim this reduction is **"significantly higher" than manual alterations such as turning down heating**
- **£9.96 in one hour** was the **maximum** earned by one consumer

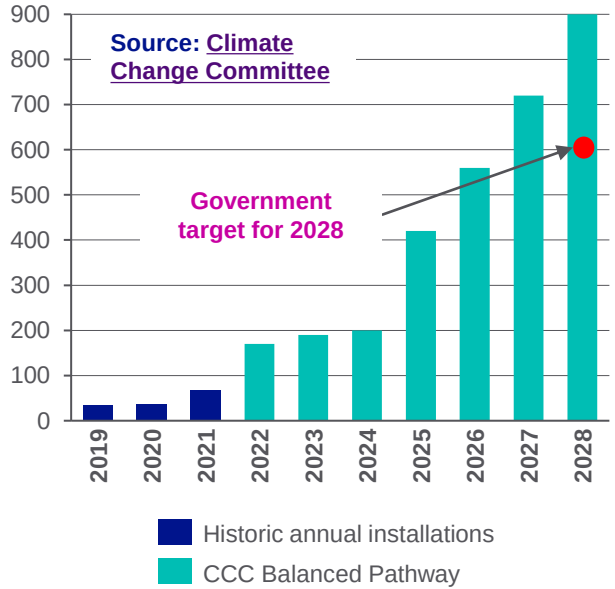
RELEVANCE TO EQUINOX

- Provides example of a heat-pump specific service which could offer learnings applicable to Equinox's commercial arrangement design
- Demonstrates that a flexibility service just for heat pumps has commercial promise, and demonstrates acceptance of automation for participants

[1] National Grid ESO; [2] ESO Data

UK Heat Pump (HP) Roll-Out: slow progress towards an ambitious 600k/year 2028 goal

Historic and required UK annual installations of residential heat pumps (100s of thousands)



The UK is **well behind** in its current rollout – 1.48 installations per 1,000 households in 2021 makes it the worst in Europe. 15.3 is the required rate

Factors inhibiting rollout include: **high upfront/ operating costs**, **lack of engineers**, efficiency concerns, manufacturers **not pushing HPs enough**

UK govt aims to **reduce** hardware and installation **costs by 25-50% by 2025**, and **parity with gas boilers by 2030**, but costs appear yet to fall

£450m Boiler Upgrade Scheme provides **£5,000** towards new ASHP, or **£6,000** towards GSHP. Expected to support 90k installs over 2022-2025

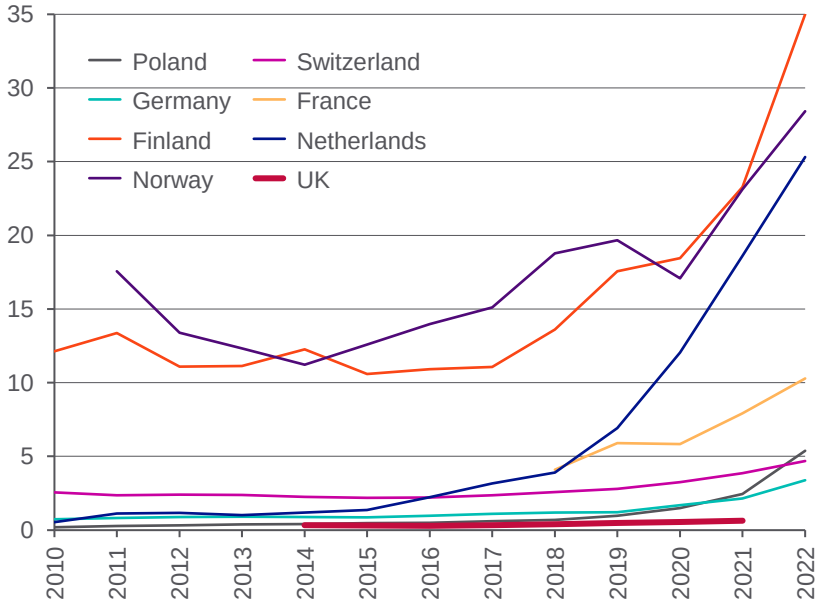
CCC's key recommendations are to **rebalance gas and electricity prices** to ensure HPs are **cheaper to operate** than gas boilers, and for BEIS to publish its plans for a **market-based mechanism** for HP growth, which should include **obligations on manufacturers** to produce an increasing proportion of HPs

RELEVANCE TO EQUINOX

- Project will need to track rollout progress to understand how quickly recruitment pool is expanding, for both the winter trials and the BaU product
- Need to ensure that the project is not left behind should the rollout accelerate

Whilst other European roll-outs hit the accelerator, multiple factors are holding the UK back

Annual installations of residential heat pumps per 1,000 capita for selected European countries[1]



Case Study: The Netherlands vs the UK[2]

The Netherlands is **as reliant as the UK** on natural gas for domestic heating. Nevertheless, it is clearly accelerating low-carbon heating far quicker. A few key reasons:

Bans on new homes being connected to the gas grid: Since the Netherlands initiated a ban in mid-2018, per capita heat pump installations have sky-rocketed. The UK's is currently not intended to begin until 2025.

Local approach: Municipalities expected to drive push to low carbon heating through local Heat Transition Plans developed with housing associations, DSOs and local citizens. UK local schemes are more fractured, held back by a very centralised government

Tax incentives: Since 2020, Netherlands have been gradually shifting the tax burden from electricity to natural gas for households, incentivising electrification. Households in the UK are currently mainly taxed on their electricity usage

Building standards: In 2012, Netherlands set a target for the average social rental home to have an EPC rating of B by 2021. Renting poorly insulated homes in private and social sector to be banned from 2030. The UK has been slower: since 2018, only homes with EPC below E are banned from private renting.

RELEVANCE TO EQUINOX

- As heat pumps proliferate elsewhere, there will be more at-scale flex. projects from which Equinox can take and apply learnings

[1] Sources for annual heat pump installations: Poland; Germany' Finland; Norway; Switzerland; France; Netherlands; UK. Population data to calculate per capita from The World Bank; [2] Adapted from Bruel & Rosenow, 2023

New partnerships and incentives intended to accelerate the heat pump roll out

New training academy for upskilling heat pump installers

There is currently a **lack of qualified UK heat pump installers** (4,000 vs 100,000 for gas boilers)

This partnership between three companies comprises a **range of BPEC and Daikin accredited courses**. Once qualified, installers can continue to access support from the partners

British Gas offers 'lowest price guarantee' for heat pumps

The company will **match any price** offered by another company for a MCS credited installation

Prices start at £3k for a standard ASHP

The scheme was influenced by its Gas Net Zero Index finding that **only 14% of homeowners would replace their existing boiler with a heat pump**

Scheme enables mortgage borrowing to finance HP installation

Halifax **mortgage borrowers** can install a heat pump through Octopus Energy's service for **as little as £2k** (vs £8k via the Boiler Upgrade Scheme)

Octopus' cheapest install price is £3k, with customers eligible to earn £1k back through the **Lloyds Green Living Reward**

'Heat pump talk' guide to assist installers with customers

Energy Systems Catapult have released a guide to **facilitate effective conversations between customers and installers throughout the heat pump installation process**

Installers are guided on how to answer **typical consumer questions** and respond in **simple language**. The guide was informed by discussions with '**Electrification of Heat**' project participants and installers **about their installation experiences**

Heat Pump Ready programme has allocated £15m to 24 projects aiming to reduce installation costs & challenges

Heat Pump Ready programme is a £60m **UK government initiative** to support the target of 600,000 heat pumps installed per year from 2028.

£15m has been allocated to 37 SMEs for **24 projects** across stream 2 of the programme – projects focussed on **reducing costs and alleviating current difficulties holding back heat pumps installs**

Three main project types are:

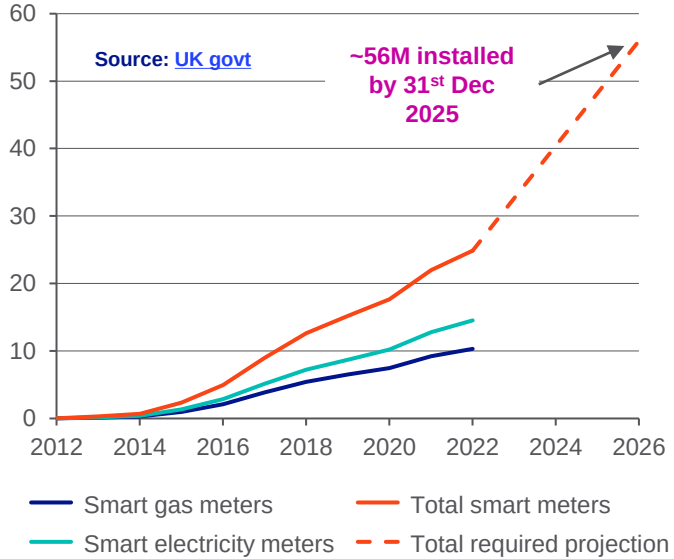
- Digital customer-facing solutions for sizing and/or install
- New commercial offerings combining installations with other services
- Improving heat pump efficiency

Selected group of stream 2 projects which have received funding

Project Title	Lead org.	Description
Catalyst – Accelerating the heat pump journey	EDF	Simplify heat pump installation process through a customer-centric digital platform to support customers through the whole installation
Advanced Modelling for Heat as a Service	CITY SCIENCE	Provide scalable approach to heat pump financing and deployment through prototyping, deploying, testing Heat-as-a-Service solutions
Integrated Comfort and Billing Service	energie sprong	Develop and test offering combining retrofit and heat pump install as a fee-based 'Comfort Plan'
Guru Smart Heat Pumps	guru	Developing tools for social housing landlords to enable heat pump installation at scale across the UK
Highly Flexible Storage Heat Pump (HFSHP)	Kensa Group	Combine electrically-driven heat pumps with heat storing batteries to shift heat production from peak demand times
Free Heat Pump Home Survey & Design Tool	q-bot	Tool to help consumers confidently match heat pump to thermal demand of the house on a case-by-case basis.
Archetypal Heat Pump Retrofit for Non-Trads	R.J. BARWICK	Develop optimum standardised whole house retrofit solutions for four of the most challenging and/or common non-traditional home archetypes across 175,000 sites in West Kent
Intelligent airsourcing to net zero	wondrwall	Reduce running costs and improve user acceptance by optimising energy management via AI-based advanced time-shifting strategies

Smart meters targeted for all homes by the end of 2025, requiring accelerated rollout

Historic and required UK cumulative rollout of domestic smart meters operated in smart mode (millions)



Ofgem's target for suppliers is to install a smart meter in **every domestic property by the end of 2025**

Since January 2022, all suppliers have had **binding annual installation targets** through to 2025

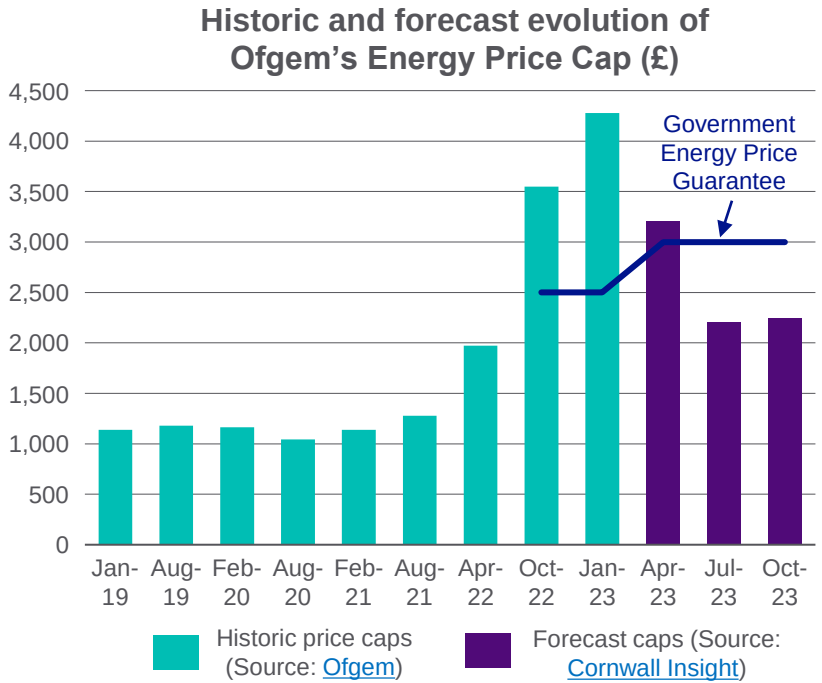
Targets will be **reset annually** based on the proportion of a supplier's customer base **still with a non-smart meter**

The rollout must **accelerate rapidly** to meet Ofgem's target, from 12k/day (2016-19) to **26.2k/**day until the 2025 deadline

RELEVANCE TO EQUINOX

- Project close, and thus recommendations for business as usual commercial arrangements, is also scheduled for the end of 2025
- Keeping track of progress towards the rollout target enables the project to decide whether and how customers without a smart meter should be included within the trial design

Ofgem's price cap has evolved to quarterly, aiming to pass lower wholesale prices to consumers as soon as possible



Ofgem's price cap has since 2019 limited the rate an energy supplier can charge for default tariffs, with the aim of protecting UK customers from overpaying for energy

The cap had been **reviewed** every **six months**, but shifted in 2022 to **quarterly** to enable the cap to respond quicker to changes in wholesale prices.

There remain concerns that the cap is **not the best way** to protect consumers from market volatility, particularly with quarterly reviews

Calls are growing to replace the price cap with a **social energy tariff**, under which lower income households receive **significant discounts** on their energy bills. These are funded spreading the costs across wealthier billpayers, either via taxation or higher bills

RELEVANCE TO EQUINOX

- Understanding what consumers are paying for their bills will impact the incentive payments that they receive to participate in Equinox, offer up their data for analysis, and ultimately turn off their heat pump

Announced UK government support measures for energy bills in winter 2022/23

Energy Price Guarantee: Automatic limit on amount consumers can be charged per unit of gas or electricity, so a typical UK household will save around £900 on their energy bill from 1 October 2022 to 31 March 2023. **Extended from April 2023 to April 2024 at higher rate, typical household expected to save around £500** on their energy bill.

Energy Bills Support Scheme: All UK households will automatically receive a **£400 total discount** on their energy bills via six monthly instalments from **October**

Cost of living payment: One-off £650 payment for households on **means tested benefits, paid in two lump sums of ~£325**

Pensioner cost of living payment: Households entitled to winter fuel payments get an extra £300 alongside their usual winter fuel payments from November 2022

Disability Cost of Living Payment: A one-off **£150** will be paid to anyone in receipt of various benefits for disabled people and veterans, such as attendance allowance and disability living allowance

Winter fuel payment: £150-300 available to people born before the 25/9/1956. Exact amount depends on various factors including age, marital status, living situation, etc.

RELEVANCE TO EQUINOX

- Understanding how much assistance UK billpayers will be receiving through government support will help to pitch the incentive amounts for Equinox participants

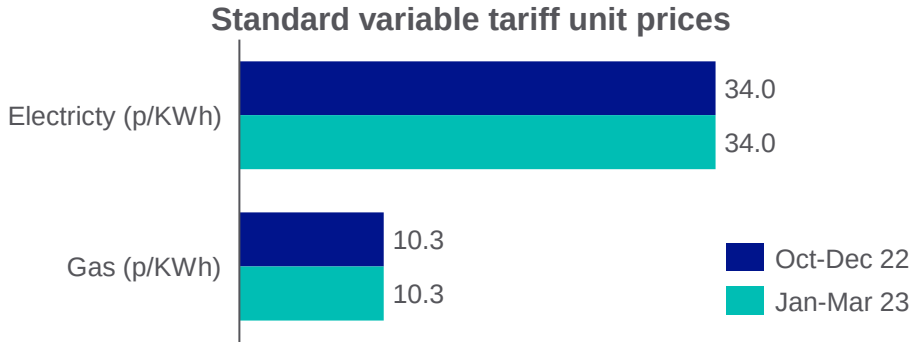
Energy Price Guarantee Overview

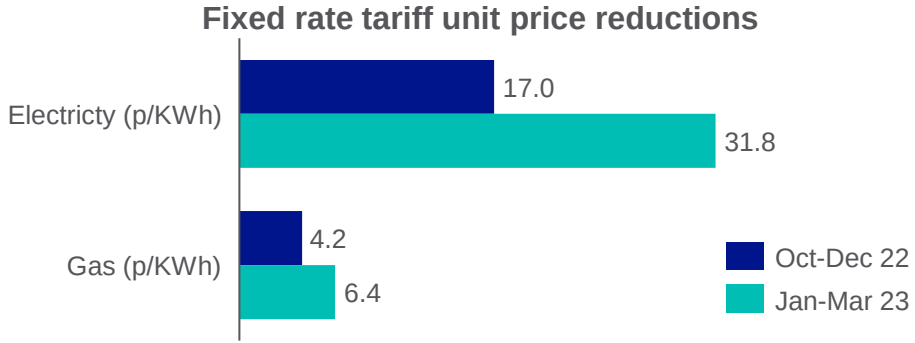
What is the Energy Price Guarantee and how will it affect customers?

The Energy Price Guarantee is a limit on the amount consumers can be charged per unit of gas and electricity. This means that **exact bill amount will continue to be influenced by energy usage**. Energy suppliers will adjust tariffs automatically, so **customers do not need to take any action** to get the benefits of this scheme. The £400 discount from the Energy Bills Support Scheme will be paid on top of this.

RELEVANCE TO EQUINOX

- Understanding how UK billpayers will receive differing levels of government support depending on their tariff will help to pitch the incentive amounts for Equinox participants





Review of Electricity Market Arrangements (REMA) - Overview

What is the purpose of and timeline for REMA?

- BEIS consultation reviewing how to **reduce reliance on fossil fuels** and enabling **abundant and cheap renewables** to drive the design of the future electricity markets
- Concerns reform to all **non-retail electricity markets**, including wholesale market, balancing mechanism, and flexibility markets
- The consultation aims to narrow down the current plethora of future market options presented
- **Closed October 2022,** BEIS response expected later in Q1 2023

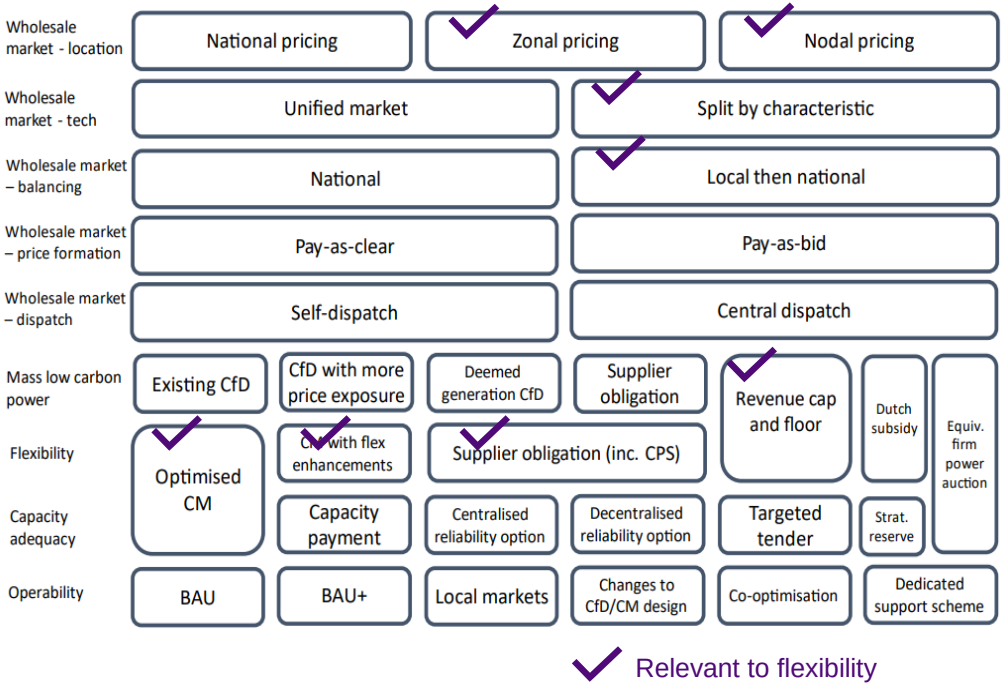
REMA addresses the following challenges seen in the current market set-up

1. **Reliance on support schemes** to drive renewable investment currently **disincentivises** generating plants to **operate more flexibly**
2. **Lack of investment signals** for low carbon flexibility assets, which will require **more revenue streams** outside Capacity Market to **expand at required pace**
3. The current single national wholesale price leads to the system **missing the low-price benefits of renewables** due to the marginal pricing method which allows expensive fossil fuels to set the electricity price
4. **Limited temporal signals** for flexibility which we know will reduce system costs

RELEVANCE TO EQUINOX

- The REMA outcome will narrow the electricity market options, including flex markets, which will be considered for the UK going forwards. This impacts the future BaU market operation with which Equinox will have to be consistent

REMA – Consulted Options



- This figure illustrates the **range of options** upon which the consultation aims to gauge views
- They are **not mutually exclusive** and can be **stacked**
- Those **relevant to flexibility** are discussed on subsequent slides

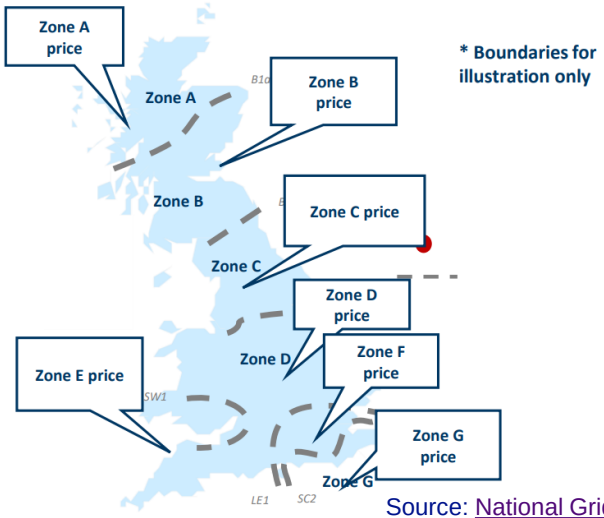
RELEVANCE TO EQUINOX

- At this stage in the consultation process, a high-level understanding of the options being considered is useful
- Once the chosen options are being further developed, it will be important to gain a deeper appreciation for the impacts this will have on flexibility market and market participants' behaviour

REMA – Zonal/Nodal Wholesale Pricing (1/2)

Problem with national pricing: The wholesale price does not send signals to market participants that incentivise them to operate and locate in a way that is consistent with the physical needs of the system. This leads to operational and balancing issues e.g. increased network constraint costs

Potential solution: Introduce more granular locational signals into wholesale electricity prices



Source: National Grid ESO

Option 1: Zonal Pricing - The network system **is split into clearly defined zones**. The boundaries are defined by **major transmission constraints**

- This is an **established arrangement** in the **internal European energy market**
- Each zone has single price which assumes no network constraints within zone
- Applies on both supply and demand side, but supplier pays for energy at the same price it receives for selling energy within a single zone
- Where the price differs between two zones, the supplier pays difference between price in generation zone and price in supply zone. Cost difference is the cost of network congestion between the two zones
- Market internalises cost of network congestion and losses to some degree

REMA – Zonal/Nodal Wholesale Pricing (2/2)

Source: National grid ESO

Option 2: Nodal pricing - Price in each location in transmission network represents **locational value of energy**. Physical network constraints (capacity, losses) **reflected in market clearing process**

- Implemented in several US states, Ontario, New Zealand, Singapore. Some expose **only supply** to locational prices; **others expose demand too**
- **'Unlikely to be practical to extend nodal pricing to the distribution network**, so it would be important to **ensure coherence between nodal pricing on the transmission network and actions taken locally, such as local flexibility markets**.'
- Would require careful implementation to **safeguard inflexible, vulnerable, and fuel poor consumers** from **disproportionate impacts**
- Fully nodal system: wholesale market itself would resolve network congestion. **Lower compensation payments** to generators leads to consumer savings

RELEVANCE TO EQUINOX

- Locational wholesale prices would provide enhanced price signals to all market participants – could enable greater participation of DSR and distributed energy resources
- Plenty of challenges to overcome: concerns about liquidity and market uncertainty, distributional demand-side impacts, defining zonal boundaries, new IT systems for continuous nodal pricing calcs

REMA – Capacity Market Reform (1/3)

Option 1: Running specific auctions for flexibility

Each auction would procure **specific flexible characteristics** such as **response time** or **duration** and be open to all **LCT**s which meet agreed set of flexibility criteria

However, such an auction system would increase **complexity** of the Capacity Market and potentially **reduce liquidity, increasing clearing prices**

Auction parameters would need to be **calibrated carefully** to ensure target volumes are not too high as to under procure, or too low as to risk innovative technologies not being supported

RELEVANCE TO EQUINOX

- If this change went ahead, it would see flexibility providers competing to provide networks with services like Equinox within a far smaller market – this could require an updated business case

REMA – Capacity Market Reform (2/3)

Option 2: Introducing multipliers to the clearing price for particular flexible attributes

Only **low carbon capacity** meeting flexibility criteria would be **eligible**

Multipliers would be applied to their **clearing price valuing flexibility characteristics** like **response time, duration** and **location**

The setting of multipliers would reward **specific flex needs**; the methodology for their setting would be similar to the initial development of **Capacity Market de-rating factors.**

There is a **risk** that if multipliers are **mis-calibrated**, outcomes could be **misaligned with system needs**

RELEVANCE TO EQUINOX

- Equinox could help uncover what the most valued flexibility characteristics are for networks and whether these can be derived from domestic heating

REMA – Capacity Market Reform (3/3)

Option 3: Optimised Capacity Market

Similar to option 2, but this would **directly target generators** with low carbon or new build characteristics

This would **insulate low carbon capacity assets** to participate while insulating them from directly competing with **established high carbon capacity.**

This could see an **increased price volatility** from a smaller pool

- Option 1: Low carbon new build/refurbished assets participate in separate auctions to the main capacity auction. ESO would set these up
- Option 2: Multiple clearing prices depending on capacity type

RELEVANCE TO EQUINOX

- Less relevant to Equinox currently given the focus on generators
- Useful to keep track of which of the three options (if any) is pursued for Capacity Market reform, since each option will impact Equinox to a different degree

REMA – Supplier Obligation

Decentralised, market-led approach placing a **legal requirement on suppliers to achieve a flexibility target** set by the government

Precedent internationally – 31 US states have Renewable Portfolio Standards

This approach could provide **'stronger investment and operational signals for flexibility, particularly for demand side and small-scale flexibility'**

But there are **risks around financing and delivery**. Capital cost is likely to increase if suppliers play a more significant role in determining the capacity mix. Wider questions around **supplier suitability** to lead in bringing forward investment in the longer term

RELEVANCE TO EQUINOX

- BEIS is considering this as a supplementary mechanism to contribute to investment case for small-scale flex with lower upfront costs like DSR. This could impact the Equinox business case/incentive for suppliers and aggregators

REMA – Revenue Cap and Floor

Flexibility assets would **compete** for a **guaranteed minimum revenue** (floor) from the government for each period (such as **already exists in GB for interconnectors**)

Guaranteed revenue would **provide certainty** to investors, while still **exposing assets to operational signals** across all the markets in which they would be expected to compete

Maximum revenue cap could also be introduced **to protect consumers from excessive profits**. Designed with **additional incentives** (e.g. availability payment) to ensure plants **keep responding** to operational signals **even once the cap has been reached**

RELEVANCE TO EQUINOX

- BEIS note that 'such a mechanism has to date been applied to medium and large assets and therefore may not be appropriate (or indeed needed if operational signals are stronger) for aggregated portfolios of smaller scale assets.' Therefore, this mechanism is perhaps less relevant to Equinox specifically

ENA Dispatch Interoperability and Settlement: Review of existing practices and gap analysis

Definition: Dispatch interoperability is “a standard set of policies and procedures to communicate and instruct a Service Provider to deliver a contracted service”

Current state: Range of different dispatch management and communication approaches amongst DSOs

There should be adoption of a **common API** for dispatching services. Would need to be **flexibly designed** to provide future proofing and flexibility product innovation

Longer term: All DSOs should move to APIs as the **primary method** of communicating dispatch requirements to Service Providers. This will allow the **greatest level of automation** and enable **operation at scale**

Back-up options may need to be available for dispatch communication should API platforms be **unavailable**, or **unaffordable** for smaller providers

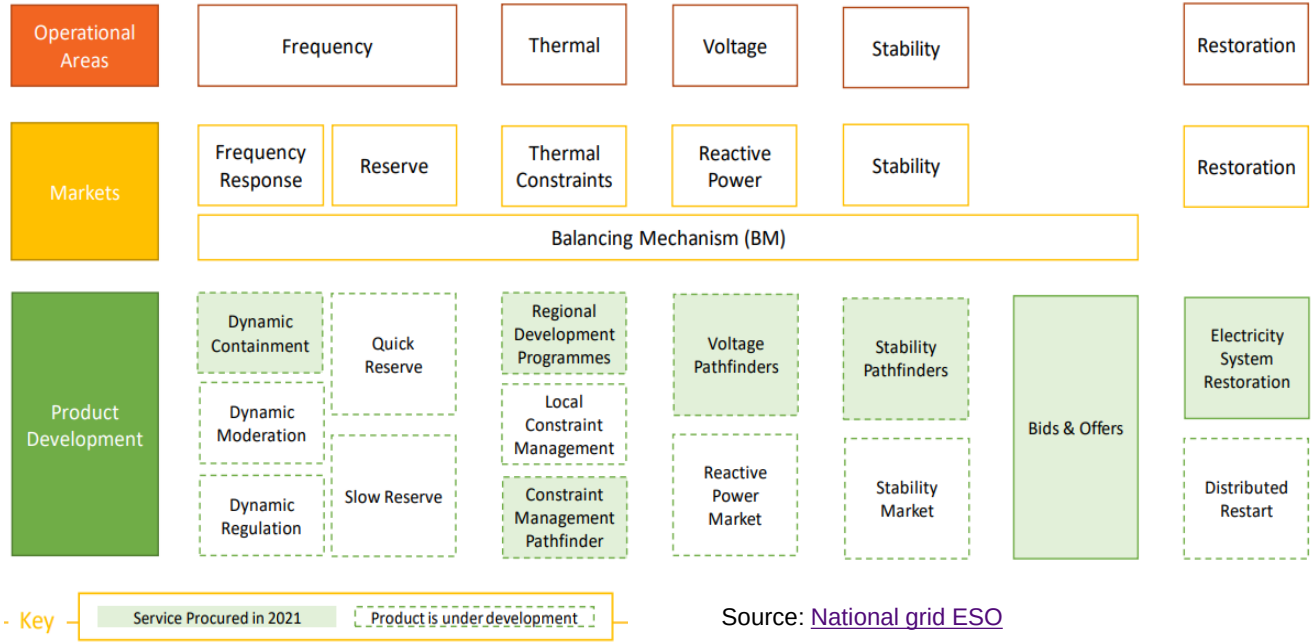
Next step: The group will explore existing dispatch standards at a high level to see if these could be appropriate for adoption.

Next horizon Scan should check for results from this

RELEVANCE TO EQUINOX

- Equinox’s commercial arrangements must be interoperable across all DSOs and flexibility service providers
- Following the ENA’s recommendations will help to ensure that this is the case, as will tracking continued cross-sector advice coming out of the wider Open Networks programme

NG ESO is developing many more products which could provide stacking opportunities



Source: National grid ESO

RELEVANCE TO EQUINOX

- It will be important for Equinox to keep track of which ESO products can be stacked with each other, and with DNO flexibility products
- This will enable the project to appreciate whether/when/how DNO requirements should be prioritised over ESO ones (and vice versa)

The ENA has been exploring primacy of ESO and DSO flexibility as part of its Open Networks project

1. The interaction between the ESO's Short Term Operating Reserve (STOR) and DNO Active Network Management (ANM) was **initially explored**, highlighting **several complex trade-offs** with potential impacts on various market participants.
2. The focus of Primacy Rules development was thus changed to **the simpler interactions between ESO and DNO procured flexibility services**
3. The ENA's report focused on the delivery of the **Transmission Constraint Management (TCM) Service** and the **DNO active power services (other than Restore),** and assessed how several use cases within the Balancing Mechanism may interact with DNO services
4. DNO Flexibility Services are **more geographically constrained** than ESO products, so the conclusion was that in the above cases **the DNO should receive primacy**, with **two 'DNO priority' rules proposed** with **different timescales for the sharing of data and the consideration/or not of outages**

1a: Basic data sharing ahead of real time – this rule has been selected for trial and roll out with NGED as part of the South-West Regional development Programme (RDP) specifically for the TCM use case

1b: More extensive sharing of data – further investigation into design by UKPN and National Grid ESO to see whether it could be trialled in the South-East RDP, also for the TCM use case

The development of the rules highlighted the need for a **robust planning process** to assess the benefits of actively managing conflicts**.**

These will need to **identify** and then **balance** the costs and benefits of active conflict management **against alternative options** to ensure the **most efficient outcome**.

This will ensure that the operational decision making developed in the primacy rules continues to deliver an operable and economic whole system.

RELEVANCE TO EQUINOX

- The ENA's ongoing work will help to drive conversations in the Equinox project regarding primacy of heat pump flexibility procured from customers through various services

Electricity Distribution

4

Learnings from Equinox

Summary of learnings from the first major project deliverable for Ofgem

nationalgrid

Purpose of Research

EQUINOX aims to put customers at the centre of the trial. To support this aim, customer research was conducted by Accent to obtain insights to inform trial design and recruitment. The research included both quantitative and qualitative approaches in order to obtain both a depth and breadth of insights. In both approaches, reaching customers with vulnerabilities was a key focus.

The Objectives of the Customer Research:

- To evaluate the general UK attitudes on low-carbon heating alternatives, especially heat pumps, and flexibility offerings.
- To decipher the key drivers, enablers and barriers to consumer adoption of heat pumps and flexibility offerings.
- To understand how to shape customer preference to improve adoption of heat pumps.
- To provide early learnings on attitudes toward the EQUINOX trial (communications, commercial arrangements, etc.).

The Research Methodology:

- A quantitative survey with over 2,400 participants.
- 18 qualitative focus groups and 6 interviews.

Initial Impressions of Planned EQUINOX Flexibility Trial

Findings: When shown draft EQUINOX communications, participants were positive about the trial and receptive to the flexibility offering. Personal motivators were the main driver, while contributing to a climate friendly initiative was important but secondary.

Reasons to Participate

- ✓ Bills will be cheaper.
- ✓ £100 incentive is attractive in current cost-of-living crisis.
- ✓ Reducing consumption without doing anything.
- ✓ Reassurance that house will still be warm.
- ✓ Helping the UK.
- ✓ 2-hour timeframe is manageable (for most).
- ✓ Helping the environment.
- ✓ Tried and tested in other places e.g., North America.

Barriers to Participation

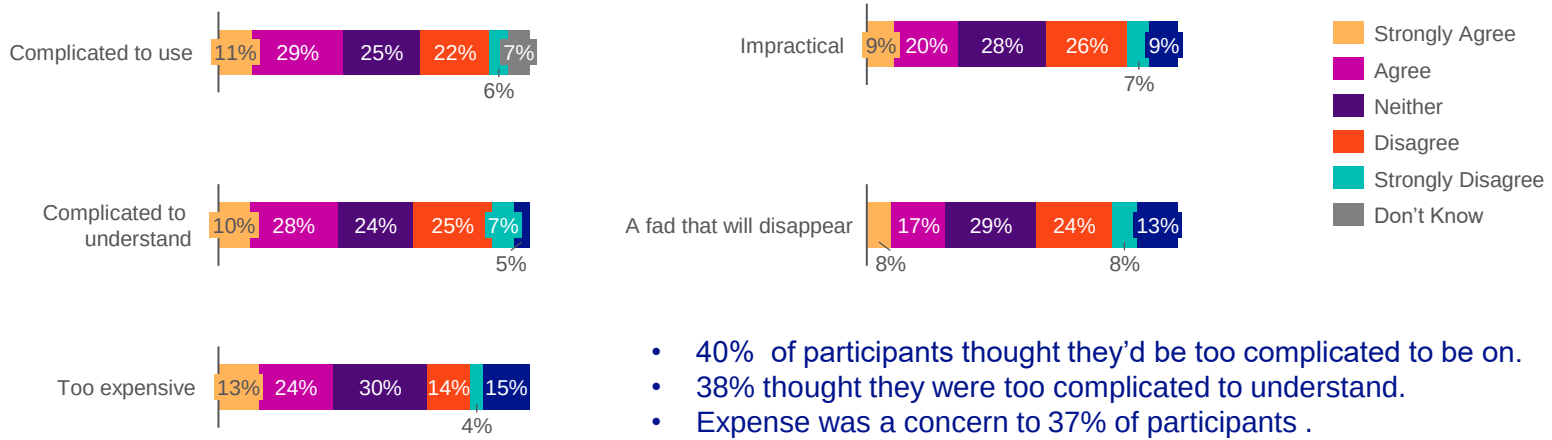
- ✗ Reluctant to be cold.
- ✗ Heating the house beforehand will negate energy bill savings.
- ✗ Confusion over reason for trial - reducing consumption to stop network overload NOT cleansing the energy mix.
- ✗ Effectiveness – feeling that this only shifts peak usage.
- ✗ Hassle - practicalities/mechanics of 'switching off', including one participant who has been told NOT to switch device on/off.
- ✗ High frequency – 2-3 times a week feels a lot for some.

8	When focus group participants were asked to rate their interest in participating in EQUINOX on a scale of 1-10 , the average response was 8. The primary reason provided was the benefit of receiving credit on their heating bills.

There Are Concerns About Complexity of Flexible Tariff

Findings: When asked about flexible tariffs, 40% of survey participants were concerned about how complicated they are to use, while 38% found it too complex to understand.

Survey Question: How much do you agree or disagree with the following statements? Flexible tariffs seem…



- 40% of participants thought they'd be too complicated to be on.
- 38% thought they were too complicated to understand.
- Expense was a concern to 37% of participants .

Implications: When taking barriers into account for the EQUINOX trial design, attention has been given to ensure that processes are as simple as possible in order to maximise engagement with the trial and minimise dropouts.

Home Heating, Third-Party Control and Notice for Events

Home heating

Comfortable temperature at home: Comfortable temperatures range from less than 18 °C to over 22 °C. 10% of people don't know the temperature they prefer in their house, while the most common response was 19-20°C.

Tolerance to change: Over 50% of respondents considered themselves tolerant of a greater than 1°C change in their home temperature. However, a quarter were unsure of what they could handle. The most common response was 1-1.5°C.

Third-party control

Duration of third-party control: 50% of participants said they would be willing to let a third-party control their heating for an hour at a time. When segmenting by likely flexible tariff adopters, more were likely to say 3 hours (41%).

Frequency: 20% of respondents were willing to have their heating controlled by a third-party multiple times per week. When segmenting by likely flexible tariff adopters, 24% of flexible tariff adopters said 'daily' and 30% said 'multiple times a week.'

Notice for events

Heat control: 43% of all participants said they would want to be informed more than 1 day before an event. When segmenting by likely flexible tariff adopters, slightly more (36%) said 'the day before' but 31% still said 'more than 1 day before.

Cheap electricity: When segmenting by likely flexible tariff adopters, slightly more (38%) said 'the day before' but 33% still said 'more than 1 day before.

Choice of Control Needed as Competing Concerns Raised

Findings: Despite overall positive responses to the two heat pump control mechanisms being trialled in winter 2022/23, many participants expressed concerns about handing over control of their heat pumps to their suppliers due to privacy fears. Conversely, others felt like turning the heat pump up and down manually was too much of a hassle and preferred to give control over to suppliers.

Behavioural Demand Response:
Customer controls heat pump

Description:
Customers informed of EQUINOX events by their supplier and opt in by **manually** turning their heat pump off. They can opt out during an event by turning the heat pump back on.

Participant Feedback:
- Manual is good as it allows for greater control for the customer.
- Manual has negative impact on participants' time. Participants feel they are too busy and don't want another thing to think about.
- Feel it will put pressure on consumer to participate.

Direct Load Control:
Supplier controls heat pump

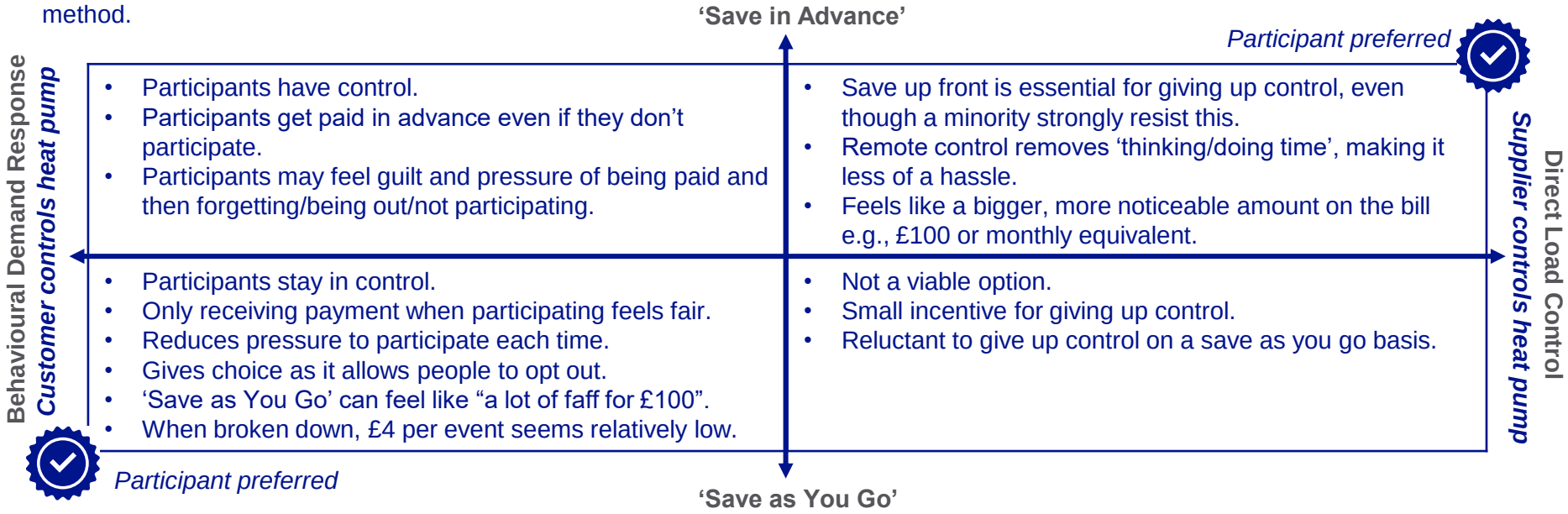
Description:
Customers will allow their supplier to control their heat pump **remotely** during EQUINOX events. Customer can choose to opt out before or during an event.

Participant Feedback:
- Creates fear of losing control for some participants.
- Participants felt like giving control would be inching towards a dystopian world like "Big Brother".
- Risk of something going wrong.
- Potential for hacking.
- Concern that supplier takes advantage.

Implications: EQUINOX trial will provide real-world insight on both customer preferences for control mechanisms and each mechanism's ability to provide reliable flexibility. Customer choice is important for flexibility offerings in business-as-usual setting, but effectiveness of the approaches may be different. We will explore the prevalence and urgency of concerns raised here among trial participants.

Preferred Payment Differed by Control Method

Findings: The 'Save as You Go' commercial arrangement was most palatable to participants when coupled with the manual control method and the 'Save in Advance' commercial arrangement was preferred for ceding control to a supplier for the 'Remote' control method.



Implications: Success of the behavioral demand response option relies on an easy way for participants to turn off their heat pump manually (e.g., app) and adequate (~24-hour notice) to avoid the need for participants to be at home. While the success of the direct load control option relies on trusting the supplier and noticing no differences in temperature plus a high financial reward.

Electricity Distribution

A1

Innovation Project Deep Dives

nationalgrid

1: Intraflex

Project Overview

Description	• **Develop market design** for an **integrated flex market** aimed at serving **both ESO and DSO** • First time flex services in local distribution network were **continuously traded close to real-time**, **allowing market to determine price.** More info
Project Dates	October 2019 – November 2021
Project Partners	nationalgrid NODES SMART GRID CONSULTANCY

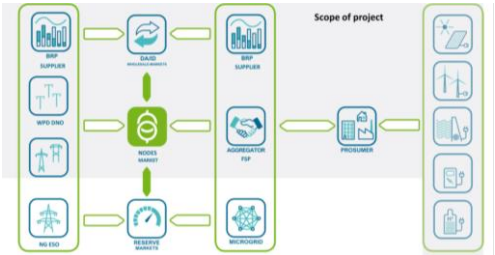
Key Learnings for Equinox

- Intraflex provides evidence of what a **liquid competitive market** for flexibility **encompassing domestic assets** could look like in the future
- This includes near real-time flexibility services being procured from domestic energy suppliers – a use case for Equinox to trial?
- It also **unlocks stacking opportunities** across multiple flex markets/products
- The concept is **proven to work** with the Balancing Mechanism. Both the DSOs and the supplier can value flex **closer to its real value**, rather than locking parties into long-term contracts at a certain price
- NODES interface was **well-received** as a bid-placing platform – can provide a **back-up option** for Equinox implementation

Project Methodology

- Worked with seven flex asset owners to create a marketplace where different types of flex could **compete on a level playing field**
- Opened **a week ahead** of flex needs; implemented **different pricing strategies** to understand how asset owners would respond
- LCTs like EV chargers and battery storage competed against diesel generators **on price for the first time**
- Phase 1: 241 trades. 50.5MWh at average price of **£386/MWh**
- Phase 2: 1,198 trades. **774 MWh**
- Savings **up to 4%** on flex price through market price competition

Intraflex Project Architecture



Source: WPD

2: CrowdFlex NIA

Project Overview

Description	Quantify electric flex potential from UK homes, **identify key parameters which influence flex**, inc. **incentive cost.** More info
Project Dates	April 2021 - March 2022
Project Partners	nationalgridESO, Ohme, octopus energy, Scottish & Southern Electricity Networks

Project Methodology

Phase 1 analysed 4 distinctive historical consumption datasets, arising from 2 intervention types:

1. **Enduring:** move from flat energy price to dynamic ToU tariffs (Octopus Go and Agile). 20,378 analyzed customers
2. One-off: single events of limited duration. Rewarded change in customer demand over a specified 2-hour duration. '**Big turn up**' events with 19,206 participants and '**big turn down**' events with 396 partakers. Customers informed of request & opted in ahead

Key Learnings for Equinox

- Households that switched from a flat to a Dynamic (Agile) or Static (Go) ToU tariff **reduced proportion of daily demand consumed during evening peak (evening 4-7pm) by an average of 15% & 17% respectively**
- **Greater reduction for EV owners than non-EV owners**, since there is a higher peak
- Robust move of demand out of the peak evening period, **enduring over 6 months trial data available**
- Big Turn Up trial, **far greater turn up for EV-owning households**. **More equal** between EV -0.6kW (-59%) and non-EV -0.5kW (-41%) households **for Big Turn Town**
- Very high level of participation for Big Turn Up in EV owning households (63%) → customers willing to provide EV assets for flexible charging. **Non-EV households** have a smaller technical capability for Big Turn Up; but **showed turn down capability equivalent to EV households**; **indicates that underlying demand (including appliances and white goods) is responsible for most of the reduction observed.**
- The small number of electric-heating customers (15%) were **not sufficient to provide reliable conclusions on the impact of tariff switching and Turn Up/Down on heating**.

3: CrowdFlex SIF Alpha

Project Overview

Description	• Strategic Innovation Funding (SIF) project to better understand system needs for domestic asset flexibility. More info • Plan a test of multiple flex services in a real-world trial to explore stacking opportunities
Project Dates	August 2022 – January 2023
Project Partners	nationalgridESO, nationalgrid, Scottish & Southern Electricity Networks, elementenergy, Ohme, octopus energy

Project Scope

Follows from SIF Discovery phase in early 2022. The project looks to:

- Understand **system needs** and **utilization** of domestic assets
- Plan for real-world trials of flex services, including **stacking**
- Improve clarity around data needs and **stochastic** (rather than current deterministic) statistical approaches to **forecast flex**
- Better understand **potential regulatory barriers**
- Engage successfully with consumers to **incentivize behaviour change** so that the trials can deliver expected commercial and CO2 reduction benefits

Key Learnings for Equinox

- Learnings will become apparent as the project unfolds
- CrowdFlex and Equinox are both undertaking large scale commercial trials, so can **share learnings between one another**
- CrowdFlex should develop useful learnings on **system challenges** like peak demand, constraints, and potential balancing solutions which domestic assets can provide
- Learnings can feed into a **potential role for the ESO** within Equinox and provide evidence for Equinox commercial arrangement **use cases**
- CrowdFlex's flexibility stochastic modelling could aid understanding around **future flexibility procurement**, whether/how DSO and ESO flexibility needs **complement** or **compete**, and what **stacking opportunities** are available
- Update in the next Horizon Scan iteration

4: Energywise

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	• How can **vulnerable customers** engage in and benefit from new energy efficiency schemes/ technologies? Challenges and successful approaches to engaging with these customers to achieve aims More info
Project Dates	January 2014 - September 2018
Project Partners	NEA, UK Power Networks, British Gas, UCL

Key Learnings for Equinox

- First time energy supplier & network operator worked together with **trusted 3rd party** (local charity) to **engage with fuel poor & traditionally hard to reach customers**
- Trial 1 achieved 5.2% in average evening peak demand; £14 annual savings per household; 3.3% average energy consumption reduction
- Trial 2 ToU tariff 2.2% reduction in evening peak, but 22.2% increase in weekend peak. Critical peak rebate 1.5% reduction in evening peak
- **Door-to-door interactions were crucial**. Participation still dropped off as trials progressed

Project Methodology

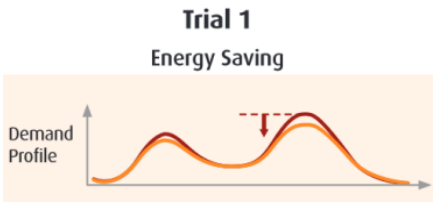
538 social tenants Tower Hamlets (E. London) engaged in two trials

1. How can they **participate in energy saving opportunities**? Install smart meters and energy efficiency devices and advice
2. 86% active participants consented to **new ToU tariff arrangements**: **Critical peak rebate Bonus Time** for prepay customers who were credited 10 units of back for every unit of energy saved within the bonus time.

Home Energy Free Time for credit customers where customers were offered a static fee and free electricity on either sat or sun, 9-5pm

Demand Profiles by Trial

Source: UK power networks



5: SAVE (Solent Achieving Value from Efficiency)

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	• Understand whether **price signals** can **impact household peak demand** More info
Project Dates	January 2014 – June 2019
Project Partners	Scottish & Southern Electricity Networks; DNV; University of Southampton

Project Methodology

- **2,000** customers took part in a **'peak banded pricing' trial** for 12 weeks from October – December 2018
- Customers set **consumption targets** with rewards for dropping to them. For first 6 weeks of the trial, participants paid **10p/h** they stayed below custom kW threshold. Then to **30p/h** for final 6 weeks
- Customers were split into opt-in and opt-in groups. **38% of opt-in group participated vs 98% for the opt-out group**

Banded Pricing	Event Schedule	10 p/hr Demand Reduction	30 p/hr Demand Reduction
Whole group	4 hours, every weekday	2.6%	7.1%
Participants only	4 hours, every weekday	4.2%	7.1%

Key Learnings for Equinox

- SAVE used a randomised control trial methodology combined with household monitoring and detailed annual surveys to ensure results from its trials are replicable and can be modelled across the wider UK
- Customers often need some prompting to save energy; treatment effects generally highest after some engagement; but need to balance with messaging fatigue - too frequent messages disengagement
- Enticing customers to stay out of the house during critical peak periods may result in even larger peak reductions than asking them to shift or cut
- Banded pricing/ similar ToU approach can be used by DNOs on networks where peaks are harder to predict in advance or where the network is constantly near capacity
- Here, banded pricing produced peak reductions of <7%
- Peak savings **higher in opt-out banded pricing trial** because their participation rate was far higher
- **The incentive has to be sufficiently high** to motivate participants – trebling the reward resulted in a significantly higher demand reduction
- For opt-in trial, peak savings **more consistent & predictable** but lower as there was a smaller % of the group participating.
- £/W reduction **lower in the opt-in group** than op-out group

6: Flexibility Demand Shift Trial

Project Overview

Description	• Turn-up trial in which consumers received **free energy** if they used enough extra during periods of high excess wind energy. More info • Octopus: *'The Windy Day Fund'*
Project Dates	March – April 2022
Project Partners	octopus energy; SP ENERGY NETWORKS

Project Methodology

- **2,500** Octopus Energy customers across Dumfries & Galloway
- Households were **directed to power up usage** when excess wind supply was highest across **six events**
- 2-hour test events between **5:30-7:30am** and **7:30-9:30pm**
- Customers notified customers who had opted in **the day before** each trial window

Key Learnings for Equinox

- Provides a potential model for turn-up trials, should Equinox choose to trial turn-up as well as turn-down
- Households appear very willing to respond to requests for small periods of adjustment
- Surveys suggests that, if the trial had continued for longer than 6 weeks, participants would have continued being engaged, most of them for multiple days per week

Customer Offering and Results

- Households who increased their usage by more than 10% **were credited back all the energy they used** in the two-hour timeframe. Those who used more than 100% extra were credited **double the amount** they had used
- The average customer received **£5** of free energy. Maximum saving was **£73**
- Total of **20 MWh** of power demand was shifted out of peak hours
- **50%** of participants **hit their target** on average per event
- **Average turn up per event was 1.68 MW**
- 98% of participants found the experience **beneficial and easy to do**
- 46% said they would **consider managing their energy use five days/week**; 22% three days/week; 100% at least one day/week

7: Powerloop

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	• Residential **V2G** trial with Nissan Leafs. This is to understand whether/how **price k** impact household peak demand. More info
Project Dates	March 2018 - March 2022
Project Partners	octopus energy · Guidehouse · energy saving trust

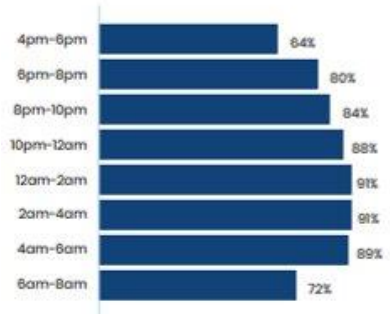
Project Methodology

- Installation of chargers & delivery of cars to **135** Powerloop trialists. Learning from initial customer experience
- Collection of **data** from chargers, cars and smart meters. Commercialisation of V2G through ancillary services participation (trial with National Grid on the Balancing Mechanism)
- Participants got a **sign-up payment** and If customers had their vehicle plugged into their charger and were available for the **V2G service** between **4-7pm** at least **12 times a month**, they were offered a **£30 monthly reward**
- Two thirds of the trial were put on **time of use tariffs** as well

Key Learnings for Equinox

- 85% of trial customers would continue using V2G service, but **current level of incentives needed means there is no strong business case**
- Customers need **customer support** and **resources to help them understand** the system and their tariff
- **One-app solution preferred** for both Octopus Energy and trial customers
- Some of the concerns of using V2G are linked to using an EV, so services should look to support customers with their adoption of EVs where possible - **could this be equivalent for flex from HPs?**
- Customers **initially highly concerned** about **changing their routine** – services should highlight this point during customer engagement to reduce those anxieties.
- Only **33%** of customers were commuting more than two or three times a week, **30%** were retired
- Nb awaiting closedown report

Figure 2: **Average percentage of customers plugged into their V2G charger at different times**



Source: Energy Saving Trust

8: Vehicle-to-Grid Trial

Project Overview

Description	• Using **bidirectional charging** to balance the grid and **improve energy efficiency** by harnessing the **potential of EVs to act as stores and sources of energy** More info
Project Dates	January 2021 – January 2023
Project Partners	ovo energy, NISSAN, indra KALUZA, cenex

Key learnings for Equinox

- Results have shown participants to **save up to £725/year**
- Lots of **interactive diagrams** and **short videos** explaining how the set-up works. Perhaps this could be done for Equinox with a short demonstration video of what happens.
- The **Kaluza app** has various smart options like minimum charge levels, charging updates etc – could Equinox customers benefit from having extra information regarding their heat pump status? E.g. off for X minutes, corresponding temp., etc.?

Project Methodology

- Ovo **installed 320 bi-directional EV chargers** to trialists across the UK in a project that lasted three years
- Using the Kaluza app**,** customers enter a time by which their car must be fully charged
- The charger will charge up when demand on the grid is low, and export when demand is high (working around the customer's charging schedule). Exported charge will go the nearest appliance that demands electricity.
- This could be In the owner's home, in which case they receive no payment, but they spend less on grid electricity
- Any EV power exported that isn't used to power the home is sold back to the grid, with any money saved appearing on **monthly statements** as a bill rebate.
- Effectively the **car batteries are used as a balancing tool**
- There are **override options** in the app if the customer changes their mind about when the battery needs to be full.
- Quite specific specifications on what a consumer must have to be part of the trail - Nissan electric vehicles (+30kWh battery), CHAdeMO cables, 6kW output for charge etc.

9: Future Flex

Project Overview

Description	• NIA project to understand **current process limitations** for domestic flex providers. Demonstrate and test these solutions. • Sustain-H DSO service designed for homes is now being transitioned to BaU within Flexible Power. More info
Project Dates	January 2022 – June 2023
Project Partners	nationalgrid, KALUZA, EDF, octopus energy, everoze, stemy energy

Project Methodology

1. Phase 1: **participant engagement** through workshops, etc.
2. Phase 2a: **commercial solution definition based on participant feedback** e.g. new testing methodology, bid options, contract definition. Focus on **step-change innovations**, **not BaU tweaks**
3. Phase 2b: system build solution definition – converts commercial design into a **trial platform** for the second generation services
4. Phase 3: new system **trialled for at least two participants**

Key Learnings for Equinox

- Most parties value design principle of simplicity adopted
- Unforeseen personal data challenges which need to be addressed
- Service seen as relatively hassle-free; low barriers to participation
- Service summary can guide discussions for commercial arrangements, and provides a framework of what should be included within Equinox arrangements

Sustain-H Service Summary (from here)

Scheduled delivery with 'drop-to' response	Pre-fault service. Delivery scheduled months in advance. Flex Providers deliver a pre-agreed change in import or export (kW) over a defined period of time. They reduce demand to a level at/below pre-agreed Target Demand, maintaining this over the full 4-hour Delivery Period duration
Delivery period and procurement	Two 4-hour Delivery Periods each weekday, aligning with the times of peak network usage. The service is procured every 6 months via a new online procurement portal, and Flexibility Providers will be able to change portfolio composition and contracted volumes on a monthly basis
Qualifying technologies and baselining	Each household must have at least one qualifying technology: EV charge-point, electric heat pump and home battery storage system. Baselines are pre-defined for each qualifying technology, fixed for each contracting period, and determined from the asset-make up of the portfolio
Metering and data submission	Two metering options are available to Flex Providers: asset-level and household-level; in both cases aggregated across the portfolio. Asset level metering takes data from the meters of qualifying assets only. Household-level metering is taken from smart meters, including the demand of the whole home. All meter data is submitted via APIs
Renumeration and location	Flexibility Providers are paid a fixed tariff per kW demand reduction relative to the baseline. Only homes in the relevant part of the distribution network (i.e., within CMZs) are eligible to participate. CMZs are grouped into high-medium-low value zones to provide a sharper price signal for the network zones where constraint alleviation is more valuable

10: Peak Heat

Project Overview

Description	Desktop modelling study to understand the impact and flexibility of HPs, including the impact of a **peak winter** (1 in 20) on the network due to both **direct** (e.g. poorer heat pump performance in cold conditions) and **indirect effects** More info
Project Dates	February 2021 - May 2022
Project Partners	nationalgrid DELTA-EE

Key learnings for Equinox

- Representative substation and housing archetypes identified for WPD's network – **could be used for the simulation modelling and recruitment within Equinox** (i.e. try to have representative numbers for each archetype)
- **Customer and community level network modelling** could feed into Equinox trial simulations

Project Methodology

1. Customer segmentation and archetype creation: defining the **relevant archetypes of interest**
2. Heat market landscaping: characterising **range** of technologies with a focus on domestic thermal storage
3. Customer modelling - exploring the range of impacts on load profiles from heating technologies including modelling the impact of '1 in 20' peak winter condition, and **the flexibility that these may deliver**
4. Area typology modelling**: assess impact** of heat electrification on 4 local distribution network typologies
5. Recommendations – drawing together all the findings from the research, including conducting a high-level CBA to identify the **potential lowest cost options**

Source: WPD

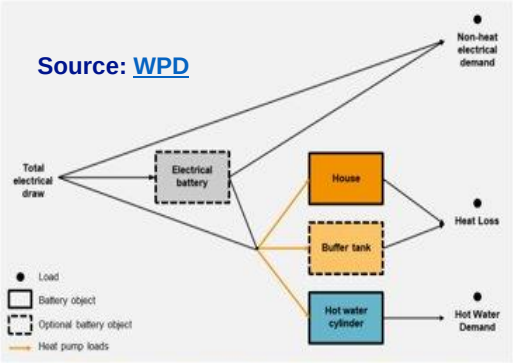


Figure 2: Individual house model set up in Plexos with four battery objects and three loads

11: 4D heat

Project Overview

Description	Using a scenario model to investigate how flex demand from residential heat can absorb wind power that would otherwise be curtailed due to transmission constraints More info
Project Dates	February 2021 - May 2022
Project Partners	Scottish & Southern Electricity Networks, DELTA-EE, everoze, passiv, nationalgridESO

Project Methodology

- Only **off-gas grid** houses in Scotland were considered for the model. Digital twins were used to provide residential thermal models
- Flexibility models produced for the most **cost-effective demand and ToU electricity tariff profiles** on a daily basis
- Consumers assumed to use home space heating appliances when electricity is cheaper - when there is surplus wind energy - so less wind energy needs to be curtailed
- Furthermore, **smart controlled heat pumps** were modelled that would automatically heat at times when it is cheaper to do so

Key Learnings for Equinox

- Model suggests 540GWh of otherwise curtailed wind power could be used for domestic heating across off-gas grid Scottish houses in 2030, delivering £49m in savings annually
- Demonstrates the potential of turn-up flexibility. Potential for Equinox to collaborate with National Grid ESO on turn-up opportunities

12: LEO - Smart flex heat pump trial

Project Overview

Description	Understand the potential for heat pump flexibility services in rural off-gas grid Oxfordshire communities with planning constraints. More info
Project Dates	January 2022- June 2023
Project Partners	Scottish & Southern Electricity Networks; LEO Local Energy Oxfordshire; PEOPLE'S POWER STATION; passivSYSTEMS

Incentives for Participants to Sign Up

- A free home assessment to identify an approach to home retrofit, ensuring homes are low carbon, energy efficient and fit for the future (worth £350)
- The cost of (A third party energy efficiency retrofit company) cosy homes Oxfordshire's project management service will be covered (up to £750)
- Communications, monitoring equipment and training on how to use HP
- £300 compensation payment in turn for the flexibility the participants will offer through-out the trial

Key Learnings for Equinox

- There have been **difficulties in recruiting** participants because of the **costs** of purchasing the heat pump and the potential retrofit measures to make their homes heat pump suitable
- Also, difficulties getting the three participants **'Trial Ready'**
- The early recruitment stages demonstrate how the trial can be advertised without going into exact details of the commercial arrangements and trial design
- Lots can be learnt from the various **incentives** offered to participants

Project Methodology

- Work with homes in two Oxfordshire villages to **install HPs** and **smart monitoring** to test viability of providing grid flex, **inc. direct control**
- The original aim was for **15 homes** but to date, only **3 houses** have signed up
- These three properties have **communication equipment** from **Passiv UK** installed which will allow project LEO to control their HPs as part of the trial
- LEO will turn the HPs up and adown to see if they can deliver flexibility
- They are currently (Summer 2022) testing the control of the participants HPs to see if they are **ready for winter 2022**
- The trial is integrated with **Peoples Power station 2.0**. This is an online tool developed with Low Carbon hub to be a centre for the **trials controls, monitoring and data collection**

13: No Regrets

Project Overview

Description	Bring a novel hybrid HP offer to market, and allow for DSR experimentation to assess viability and consumer response. More info
Project Dates	October 2018 - April 2019
Project Partners	passivSYSTEMS, CATAPULT Energy Systems, EDF, UK Power Networks, SAMSUNG

Project Methodology

- Hybrid heating systems installed into **95 homes** under ***Future Heat*** commercial offer by **EDF. 43 homes** then went on to participate in **DSR** experimentation (using EDF's **PowerShift trading** platform)
- **EDF** offered a fixed price HP installation for **under £100**, with EDF recovering capital cost through the assigned **Renewable Heat Incentive payments**

Key Learnings for Equinox

- Complexities of contract **approval process** and **service design** presented delays and challenges (but overcome)
- For the fully automated DSR which flipped between the HP and gas boiler as needed, **consumers mostly did not notice when the switch was made**
- Those enrolled on ToU tariffs largely **cannot distinguish** between the time they spent on this tariff and the time spent on a 'normal' tariff
- To maximise uptake of DSR services, **focus on financial concerns** of participating households by **improving customer proposition**
- Many households felt the *Future Heat* service **had not reduced their energy bills as they had expected** when signing up – for some the costs were higher than before

14: HyCompact

Project Overview

Description	Trial of 7 new single unit hybrid heating systems; follows from Freedom project More info
Project Dates	August 2020 - June 2022
Project Partners	passivSYSTEMS, UK Power Networks, WALES&WEST UTILITIES

Methodology

- Trial Compact Hybrid Heating System paired with intelligent controls
- Monitor performance of hybrid systems to establish full operational **data**, assess **network impacts**, explore **flexibility** opportunities. Plus **engaging** with participants to get their feedback
- Using a new system combining gas boiler, ASHP, smart control software in a single unit

Key Learnings for Equinox

- Feasibility of single unit hybrid system proven. Requires a little more inside space than a standard boiler, so it is **not suitable for all UK homes**.
- **14m UK homes** could be suitable
- System typically 40-58% heat pump usage, resulting in 30-48% CO_2 emissions reduction.
- In a customer survey conducted for this project, 79% of respondents were attracted to the design and benefits of a CHSS. But only 16% of those surveyed were aware of non-gas boiler heating technologies
- Early trial homes reported unacceptable level of noise and vibration from the units. Solved by retrofitting a noise vibration kit
- Limited number of installers available in the UK for this unit
- To give confidence to a homeowner of a new heating system, it does require homeowners to have **appropriate information and guidance about what to expect from their new system**. Although it does look like a conventional combi boiler, it does have a small heat pump inside which behaves differently and will not activate the heat pump component for immediate calls for heat, but rather pre-heat to meet the set point.

15: Right to Heat

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	Develop **best practices for decarbonising heat** and **decreasing bills** in gas grid connected urban social housing. More info
Project Dates	February 2022 - July 2023
Project Partners	UK Power Networks, SGN, passivSYSTEMS, STONEWATER, socialenergy

Project Goals

- Trial single-unit hybrid heating system coupled with solar PV installations, smart controls, and access to the flexibility market in **10 social housing homes**
- Evaluate impact of installations on **consumers in vulnerable situations**. Trial **different ways of lowering costs for consumers**, and provide consumers with **longer term advice and coaching**
- Understand how different technologies can best operate **simultaneously to deliver consumer benefits**

Key Learnings for Equinox

- Major learnings still to come
- Expected learnings on how to balance the interests of the consumer, social housing provider, supplier, and network operators when seeking to deliver a cost-effective decarbonisation strategy for social housing – this can help with the approach towards customers on Equinox who are in social housing
- No new documentation released. Check for update in the next Horizon Scan Iteration

16: Neighbourhood Green

Project Overview

Description	Better understand future After Diversity Maximum Demand (ADMD) when low carbon technologies for heating are clustered; propose an **industry standard view on diversity factors for** heat, understand flex potential. More info
Project Dates	February 2022 - February 2024
Project Partners	UK Power Networks

Project Methodology

- Leverage Whole Energy Systems Accelerator (WESA) to virtually cluster 'Living Lab' participants' homes with electric heating and other low carbon heating technologies. Monitor energy usage over time and in different weather conditions
- Analyse clustered data streams to assess ADMD, network response, flexibility potential
- Then design and **carry out a trial based on the results**. Qualitative research with customers to understand their requirements and experience of transition journey to LCTs

Key Learnings for Equinox

Approach is still being finalised.

Check for updates as part of next Horizon Scan iteration

17: CommuniHeat

Project Overview

Description	Low carbon heating blueprint for **off-grid gas communities** (4m properties in UK) using electricity. More info and website
Project Dates	October 2020 - June 2022
Project Partners	UK Power Networks, OVESCO, BURO HAPPOLD

Project Methodology

- Followed 200 home surveys of energy consumption with installation of 50 energy meters in Barcombe village to measure consumption as part of ambition for it to be the first Net Zero village in the UK.
- Computer models to forecast impact of electrifying heat – simulations will investigate **costs, efficiency, and electricity network** impact of multiple different approaches, including shared district heating, medium sized heat pumps serving a few properties, or personal electrical heat pumps installed at each property
- Then look at potential **community finance models** for making the switch

Key Learnings for Equinox

- **Community engagement** is key to decarbonising rural homes – partner Ovesco is a community group run for the local community of Lewes and they were responsible for coordinating the project in Barcombe village
- **Modelling** was found to be **insufficient to establish what the community options are for decarbonisation** and **how network impacts could be mitigated**
- This is where **home surveys were able to uncover vital learnings** on varying heat demands of different types of property archetypes based on factors like size, occupancy and construction type
- Surveys were designed to obtain sufficient information **without overburdening customers**
- Data extraction process was designed to include an **approach to visualisation** which **significantly enhanced the ability of different stakeholders to access different levels of data and information** to be able to make the right decisions and explore options
- Key barriers to decarbonisation include **lack of clarity on options**, **difficulty in accessing finance** and the **immediate need** to conduct network upgrades to facilitate individual households looking to transition to low carbon heating
- Project partners produced a *Home Action Plan* showing rural homes how they can go about decarbonising their homes
- The action plan contained **a list of heating and generation installers** which serve the local area to facilitate residents actioning the plan.

18: Freedom

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	Trial of 75 smart hybrid heating systems in Bridgend can help balance system needs More info
Project Dates	October 2016 - January 2019
Project Partners	nationalgrid passivSYSTEMS

Project Methodology

- Selection of the area for the trial
- Customer engagement plan
- Selection of the type and size of the heat pump
- Network modelling
- Mobilisation (procurement of equipment and services)
- Trials or field test, including measurements (install equipment)
- Analysis

Key Learnings for Equinox

- Project learning indicates that a hybrid approach to decarbonising our heating that is combined with green gas growth could lead to the total decarbonisation of domestic heat
- Hybrid systems could deliver off-grid homes with major cost and carbon savings
- Hybrid system did not require major energy efficiency/retrofit upgrades (vs the need for these for pure HP)
- The smart control switched between appliances driven by cost – supporting the decarbonisation of heat in an affordable way and with limited behaviour change.
- Lots of useful learnings regarding customer perceptions of lower carbon alternatives to gas boilers
- *'Shifting customers away from gas boilers being their sole source of space heating will be a challenge – customers are overwhelmingly positive about their existing heating system.* ***Ease of use, comfort, reliability and up-front and running costs are the primary aspects of a heating system that customers value.****'*

19: REDMAST (R&D of Market Structures)

Project Overview

Description More info	Evaluate current **energy market models for deficiencies,** and **propose future energy markets** which give **customers a more active role, while still protecting them** and achieving net zero
Project Dates	January 2022 - August 2022
Project Partners	nationalgrid frontier economics

Project Methodology

- **Evaluate current energy market models** and focus on the current **issues** within the market
- Identify **future energy market requirements**, explaining these transition pathways under the current market structure and highlighting the key **barriers to change**
- Then **assess alternative market models from around the world** to develop a bottom-up model which will enable a better approach to designing future UK energy market models
- Develop **assessment criteria to assess market models** and analyse their relative strengths and weaknesses

Key Learnings for Equinox

- The idea of a bottom-up energy model, where consumers have an active role in their energy consumption and the energy transition, could have parallels with Equinox's offering to customers
- No published results yet

20: HOMEflex

Project Overview

Description More info	Develop a **Code of Conduct** to create an **inclusive, fair, and transparent marketplace** for Domestic Flexibility Services.
Project Dates	June 2022 – May 2024
Project Partners	Scottish & Southern Electricity Networks; Flex Assure; centre for sustainable energy

Key Learnings for Equinox

- Development and roll-out of a voluntary compliance scheme to help **build consumer and DNO/ESO confidence in flexibility**
- Could **improve customer experience** throughout whole cycle of customer's engagement with Flexibility Services provider
- HOMEflex will highlight mechanisms by which vulnerable, fuel poor, or other groups could be left behind in the transition to net zero, which should provide useful **learnings for maximising and maintaining customer participation**
- Update in the next Horizon Scan iteration

Project Methodology

- **Develop Code of Conduct** by mapping emerging business models, identifying actors/relationships, and considering how to treat different parties under this Code
- Establish **steering committee composed of key stakeholders** to provide input to and oversight of project
- Consumer engagement by undertaking four focus group sessions throughout the project to inform drafting of Code of Conduct and **assess potential impact of voluntary compliance scheme on market take up**
- **Establish frameworks for a voluntary compliance scheme**, including a dispute resolution mechanism

21: Regulated Peak Pricing Pilot

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	**Critical peak pricing (CPP)** trial of AC cooling flexibility with & without participants having access to **real time energy consumption data** for their households. More info
Project Dates	May 2016 - April 2019
Project Partners	ONTARIO ENERGY BOARD; London Hydro; NAVIGANT

Project Methodology

Tested three arrangements:

1. CPP (+ **slightly discounted off-peak ToU tariff)**, but subjected to **36 1-hour CPP periods over a year**. Customers received smart plug and load control switch to **automate *some* of the reductions** (DLC)
2. CPP, plus participants had access to real time consumption data and notifications when overall energy consumption exceeded that of peer households (CPP/RT)
3. No CPP, but access to real time consumption data (RT)

Key Learnings for Equinox

- Participants could attend **open house events** to fix tech and ask questions: these groups yielded **substantial incremental estimated impacts**. I.e. customer engagement can deliver more flex
- Participants proved **nimble in responding to changes in price** with only 15 mins notice
- CPP motivates change in space heating consumption behaviour **even when there is no direct price signal to do so**. Most energy savings achieved by CPP group achieved in summer **non-event periods**
- No significant incremental savings for CPP/RT group vs CPP i.e. having access to real time consumption data has **no additional impact on domestic flex provision if price signals already in play**. But it does deliver small savings when there is no price signal
- **$25 payment at start; $75 at end**

	Commodity rate C/kWh[1]	
Pricing Period	Standard	CPP & CPP/RT
Off-peak (7pm – 7am weekdays, all weekend)	6.5	6
Mid-peak (7-11am, 5-9pm, summer weekdays; 11am-5pm winter weekdays)	9.4	9.4
On-peak (11am-5pm, summer weekdays; 7-11am, 5-9pm, winter weekdays)	13.2	13.2
Critical peak: 18 1-hr events in summer, 18 in winter, 4-8pm weekdays	n/a	59.5

Source: Navigant

[1] Canadian Dollar cents

22: Advantage Power Pricing Pilot

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	Tests response of tech-enabled residential customers to dynamic price signals (mixed with user-enabled DLC). More info
Project Dates	November 2015 – August 2019
Project Partners	ONTARIO ENERGY BOARD, alectra, NAVIGANT

Project Methodology

- Customers remained subject to the standard Regulated Price Plan (RPP) ToU rates, but also received **a shadow bill tracking what their bill would have been** under Advantage Power Pricing (APP) rate. If APP < RPP, participants receive the difference as a rebate. **No penalty if APP > RPP**
- All customers enrolled were equipped with thermostat, whose response to APP price fluctuations they could **automate**. Three alternative tech groups added to the program
- **APP prices set to be revenue-neutral with RPP rates**, based on historical consumption patterns. i.e. if there is no DR, participant bills would be the same under both systems

Key Learnings for Equinox

- DR savings delivered by participants **varied depending on conservation setting selected**.
- Most aggressive flexibility settings = more savings (~2kW); max comfort = least savings (0.12 kW)
- By the end of the trial, participants were **more likely to skew to one of the extreme settings**
- On average, participants reduced winter commodity costs by 9-27%. Summer by 0-10%
- APP participant population skews older, **principally motivated by bill savings (80%).** 70% first initiative. Nearly 80% of respondents said that **risk-free aspect of program was very important in their decision to enroll**
- On average, participating in APP increased customer energy consumption (small, statistically insignificant) - due to off-peak prices being lower vs RPP

Season	APP Price Period	Price (C/kWh[1])	% Hours
Winter 2015/16	Critical Peak	70	0.3
	High	59	0.8
	Medium	29	4
	Low	17.4	12
	APP Off-Peak	4.9	83

Season	APP Price Period	Price (C/kWh[1])	% Hours
Summer 2016	Critical Peak	65	0.4
	High	52	3
	Medium	26	5
	Low	13	8
	APP Off-Peak	5.9	83

[1] Canadian Dollar cents

Source: Navigant

23. Energywise Home

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	Direct Load Control (DLC) of domestic heating and cooling appliances More info; BaU offering
Project Dates	January 2014 – September 2018
Project Partners	DUKE ENERGY. NAVIGANT

Project Methodology

- Two program-wide events called in summer 2016
- 10 events called for sample of 78 participants who had data loggers deployed
- **$25 bill credit upon joining the program**, additional $25 bill credit annually per appliance type controlled to encourage continued participation

Key Learnings for Equinox

- Estimated impact per responsive set of heat strips controlled during the population events was 2.77 kW, and the estimated impact per responsive water heater during same events was 0.4kW
- Participants were **generally unaware of curtailment events when they happened**. >90% survey respondents indicated they had not been aware that an event had occurred recently. Of 23/301 who were aware of an event, only 2 reported a comfort level less than 5/10. Most were 'very comfortable.'
- Program does not appear to be a key driver of supplemental heating use. Similar proportion of placebo survey respondents reported using supplemental methods for heating their homes during 'event' periods as those respondents subject to actual events
- **Fewer than half of participants were aware of the bill credits they receive as part of their participation**, despite receiving a hardcopy brochure explaining this

24: Viflex

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	Test how aggregated HPs can contribute to a stable transmission system by reducing/shifting HP demand when system demand high. More info and podcast
Project Dates	December 2020 - ongoing
Project Partners	VIESSMANN, EQUIGY crowd balancing platform, 50hertz Elia Group, TenneT

Key Learnings for Equinox

- Very similar premise to Equinox, though here remote control is being promoted **via extra payments. Customers have choice about when they would not like to be controlled**
- Trial starts this winter, but potential learnings for the **recruitment strategy.** They have sign up sheets, a video explaining the project, and an interactive platform where customers can calculate average energy consumption
- Big emphasis on data privacy and customer data being kept anonymous throughout the project
- Check for new learnings in future Horizon Scan iterations

ViFlex Project Architecture

- **Single heat flow tariff** offered to consumers from the ViShare tariff plan options
- Customers receive sign-up **€120 euro flexibility bonus,** plus a further discount of **up to €0.10/kWh** if they sign up to have their HPs controlled remotely
- Discount appears stratified based on no. hours people are willing to block out for control. This is marketed to have the potential to save an extra **€200-400/year**
- ViShare's current prices based on **this** are €0.61-65/kWh, plus €8-11 monthly charge – varies by location (the grid areas covered include all **eastern German states,** plus the city states of Berlin, Bremen & Hamburg)
- The heat pumps can **be turned off for a maximum of two hours a day**
- **C**ustomers define eligible **blocking times for control,** varying from no restrictions to certain hours a day when the customer does not allow control
- To ensure customer comfort, Viessmann's energy platform takes data from the heating system into account, eg. resident heat accumulator temperature
- After the TSOs have requested flexibility, Viessman aggregate what has been provided by the participants and offer it to the TSOs via the **Equigy platform**

25: HeatFlex

Project Overview

Description	• Flexible grid management to compensate for the loss of grid stability and **increased transmission bottlenecks** accompanying more renewables. More info (in German)
Project Dates	July 2018 – June 2020
Project Partners	TenneT bayernwerk

Key Learnings for Equinox

- A **successful trial** showing how remote control trials can be translated into business as usual
- Customer offering for providing control is **reduced network charges**
- It is unclear exactly what the reduction is and whether it is contingent on the amount of flexibility provided or just for providing control
- Remote control periods are only for **one hour maximum**, but the use case is **limited** to relieving transmission bottlenecks

Business as Usual operation

- Bayernwerk-connected HPs and direct heating systems are controlled remotely from November 1st – March 31st each year except weekends, and school and public holidays
- Specifically, the switching takes place at the following times:
  - From **7:30 am for a maximum of one hour**
  - From **10 pm for a maximum of one hour**
- When there is excess energy, heating devices are turned on
- In return, the consumer receives **reduced network charges** at the point of consumption

Project Methodology

- Partners explored the extent to which over **170,000 existing controllable consumption devices** in **the DSO's** area with a total output of **~200 MW** could be used to increase grid flexibility and reduce grid congestion
- Controllable devices include electric storage heaters, heat pumps or water heaters. The project integrates them into grid management **via ripple control** from receivers which were installed decades ago
- TenneT and Bayernwerk first tested the feasibility of control requests from the former. These tests showed it was possible to react immediately to bottlenecks
- Further tests proved the reliability of the set-up in relieving grid congestion, paving the way to business-as-usual operation with more project partners

26: Modelec

Project Overview

Description	• Test several **peak load shedding models** for consumers in various locations. Analyse their demand-response behaviour and acceptance of DLC. More info
Project Dates	2011 - July 2014
Project Partners	

Key Learnings for Equinox

- **95% demand response acceptability** in consumers – 95% of customers responded to change in energy prices
- **Load shedding** by the shedding operator **did not save energy itself but smoothed out consumption peaks**
- Although this **worked as a flexibility tool**, it was found a **10% (average**) gain in consumption as consumers had more control and accessible control of their energy usage
- By giving customers exact information on energy consumption and by automatically controlling equipment it gave the customers the tools to reduce overall annual consumption

Project Methodology

- **1000 households** voluntarily participated
- They were equipped with a **smart box** for measuring and controlling their consumption, specifically cutting appliances like water heaters, radiators, etc. for a short time to avoid peaks in consumption
- The project enabled development of **economic valuation models** and the defining of methods ensuring **consumer acceptance** with energy tariffs

Dashboard and Gamification

- Consumers had a **dashboard** where they could view their daily/monthly consumption, energy expenditure of specific appliances, kWh and money saved, and monthly expenditure. They also **received personalised advice**
- Customers were also engaged through **challenges rewarding 'better consumption'**
- **Rewards** included energy efficiency points and efficiency ratings
- **It is unclear whether these points translated into tangible rewards**

27: Electrification of Heat

Project Overview

Description	• BEIS-funded project to better understand the technical and practical feasibility of a large-scale rollout of heat pumps into existing British homes, and how to overcome current barriers. More info
Project Dates	June 2020 – December 2022
Project Partners	CATAPULT Energy Systems; WARMWORKS; e.on; KALUZA; Your Homes Newcastle; energy; RETROFIT WORKS BUILDING EFFICIENCY TOGETHER; CHANGEWORKS; Newcastle City Council; parity projects; energy saving trust

Project Methodology

- Installed and monitored performance data for 742 heat pumps (750 targeted, 8,800 homes applied) into broad spectrum of housing types and socio-economic groups, with different types of heat pump (low and high temperature ASHPs, GSHPs, hybrid systems)
- Produced case studies for a subset of participants
- Analysed heat pump suitability across housing types and social groups
- Identified barriers to wider heat pump uptake
- Created a guide to facilitate heat pump installers through conversations with customers throughout the installation process

Key Learnings for Equinox

- Heat pumps were **installable across all housing types in the UK**: Victorian terraces, pre-WWII semis, 1960s block of flats, etc.
- Any suggestion that there are particular home archetypes that are “unsuitable” for heat pumps in the UK is **not supported by project experience and data.**
- Acknowledged **greater challenge** to successfully design systems for older homes, but **still achieved 163 installs in these older pre-1945 properties**
- Many households who applied to be part of the project **believed** their homes would not be suited to heat pumps due to age, layout, and/or energy efficiency
- Actually, **only 8%** of 8,800 applicants **lacked outdoor space** for the heat pump, and **only 2% lacked indoor space** for thermal store
- Most participating households had energy efficiency **EPC rating of C or D**. Despite this, **only 15% of those who installed HP required energy efficiency upgrades** - most commonly loft insulation
- Far more significant barriers were the **upfront costs** of the heat pump system – participating households were supported with these for this project – and **disruption caused by the installation**. The latter was cited by 47% of those who applied for and later withdrew from the project
- The ‘heat pump talk’ guide was therefore produced to assist heat pump installers in talking customers through the entire installation process
- **Innovation is needed to make switching to a heat pump as smooth a journey as possible for consumers, with policymakers and the private sector collaborating to enhance consumer engagement and understanding**

28: NeatHeat

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	• Test how tepeo's innovative Zero Emission Boiler (ZEB) interacts with the electricity network, allowing DNOs to use existing infrastructure in a smarter way and suppliers to develop new offerings which reduce customer costs More info
Project Dates	September 2022 – February 2024
Project Partners	UK Power Networks, OVO energy, tepeo

Key Learnings for Equinox

- This project will **provide insights on an electrification alternative to heat pumps**, particularly around **customer perceptions** and **network impact**
- Learnings from testing of the 'type-of-use-Tariff' **could feed into Equinox's commercial arrangement design**
- **Potentially significant flexibility impacts**: the project will be testing whether the boiler would only ever have to operate off-peak to charge its internal storage system which can then be used to heat the space if required

Project Methodology

- Install (for free) tepeo's ZEB in 30 households, replacing current heating system, assessing compatibility and the challenges that arise
- Monitor ZEB performance throughout the trial to understand the charging pattern and test various optimisation mechanisms that will provide flexibility to the network
- Engage with participants throughout the process to gather feedback and understand customer needs
- Test first of its kind 'Type-of-use-Tariff' that allows customers to use clean heat at a lower cost

Project innovations

- ZEBs provide the same heating service as gas or oil boilers without the associated emissions
- They work like a battery to store heat efficiently, charging at the cheapest and greenest times of the day
- ZEBs could be particularly useful in space-constrained housing archetypes which might struggle with heat pump installations
- 'Type-of-Use-Tariff' removes burden off customers when it comes to heating their home. Energy supplier can work with the DSO to optimise ZEB charging

29: ReHeat

Project Overview

Description	• Trial network solutions to mitigate the effects of increased demand from domestic electrical heating on the distribution network, with a focus on the transition to electric heating in off-gas grid More info
Project Dates	June 2021 – October 2024
Project Partners	SP ENERGY NETWORKS, Scottish & Southern Electricity Networks, e·on

Key Learnings for Equinox

- Customer engagement and research will be undertaken around the technical and commercial approach trialled, which will provide **insights on customer preferences and successful trial design**
- Learnings from this trial could **help inform future trial design to identify the best design solution** compared to conventional reinforcement and other solutions

Project Methodology

- Installation of heat pumps, thermal stores, and advanced control systems in about 150 domestic properties
- Develop:
  - Network planning tools to assess impact on network demand profiles and evaluate most efficient design solution compared to conventional reinforcement and alternative smart solutions
  - In home controller to be used in properties with air source heat pump and Phase Change Material (PCM) thermal storage devices
  - Interface to allow DNO to schedule and dispatch load control requirements

Objectives

- Facilitate the deployment of low carbon electrified heating by avoiding delays and costs created by the need for network reinforcement
- Develop DSO tools for assessing the network impact of heat load and for evaluating alternative solutions
- Assess the effectiveness and reliability of PCM thermal storage as flexibility to the network and on customer acceptance, comfort, and satisfaction through trials
- Evaluate the technical and commercial models used in the trial to understand their effectiveness and costs/benefits compared to conventional reinforcement

30: Flexible Tower

Project Overview

Description	• Considering electric storage heaters as part of a decarbonised heating sector and demonstrating their ability to shift demand More info
Project Dates	February 2021 – May 2022
Project Partners	SP ENERGY NETWORKS, GHA, DELTA Energy & Environment

Key Learnings for Equinox

- There is a **need for a novel flexible smart tariff** for storage heaters
- Customers are more willing to adopt a new tariff if it will bring **improved comfort and financial benefits**

Project Methodology

- Desk-based research focusing on commercial, market and business issues
  - Current knowledge, supplier tariffs, requirement alignment, controls hierarchy and strategy, business models and commercial arrangements
- A trial within a tower block which has storage heaters
  - Installation of temperature sensors and smart control switches

Modifications to the planned approach

- The trial did not take place until the summer months due to delays, which meant demand could not be shifted by storage heaters
  - Hot water storage was used to shift demand instead of storage heaters as a result
- Despite changes to the planned approach, the project still demonstrated the feasibility of shifting demand in tower blocks

31: GOFLEX

Project Overview

Description	• Make a set of technology solutions for distributed flexibilities and automated dynamic pricing market ready to enable regional actors and DSOs to aggregate and trade flexibilities More info
Project Dates	November 2016 – February 2020
Project Partners	Aalborg University Denmark; B.A.U.M.; Electricity Authority of Cyprus; ETREL; IBM; INEA Informatics Energy Automation; esr energies si; robotina; FOSS; SWW wunsiedel wir bewegen; Technische Universität Dresden; Hes·so

Key Learnings for Equinox

- Learnings will help **develop the market for distributed flexibilities and automated dynamic pricing**
- Insights on **optimal implementation of trials** to ensure eventual scalability and feasibility across other contexts

Project Methodology

- Creation of a data services platform to provide localised estimation and short-term predictions of market and energy demand/generation and flexibility
- Three use cases in three European countries to cover a diverse range of structural and operational distribution grid conditions

Trials

- Tested GOFLEX solution at three European demonstration sites involving over 400 prosumers from industry, buildings and transport
  - Wunsiedel, Germany: main utility company with goal of fully meeting energy needs of both residential and commercial customers with 100% renewable and regionally produced energy
  - Nicosia, Cyprus: testing microgrid case of a university, exploring offered flexibility by the public sector
  - Valais, Switzerland: optimising balance for the DSO to reduce corrective costs and use demand-side management to reduce peaks loads on the grid

32: EcoGrid EU

Project Overview

Description	• Demonstration project on involving private customers in the use of market mechanisms and smart control of electricity to balance the energy system More info
Project Dates	2011 – 2015
Project Partners	ENERGINET.DK, SINTEF, IBM, DTU Centre for Electric Technology, TUT Tallinna Tehnikaülikool, ØSTKRAFT, SIEMENS, edp distribuição, eandis, Landis+Gyr, TNO innovation for life, tecnalia, AIT, ECN, elia

Project Methodology

- Tested real-time market and home-automation technologies/solutions to enable private electricity consumers to control and move their electricity consumption to the exact hours when the price is low and reduce consumption when the price is high
- Demonstration in Borholm distribution system, owned and operated by local DSO

Key Learnings for Equinox

- Key customer insights:
  - **Island communities are suitable for demonstration experiments** due to high citizen involvement and a focus on security of supply
  - Customers were initially **motivated by a lower electricity bill**, but the **environment and benefits to the local community** carried so much weight that monetary savings became a secondary priority
  - Communication initiatives should be in place prior to starting engagement
  - **Ongoing communication between members of project staff is key** to successful external communication
  - Personal customer support demand became too high due to various technical issues, which creates a challenge for roll-out of smart grids at a large scale
  - Enthusiastic customers are low-hanging fruit, but **customers with no particular interest in technology, energy, or environment** (mainstream group) are primarily **motivated by financial gain or the prospect of loss if they do not act** and are expected to dominate in a future society

33: HeatFlex UK

1 Customer Offering
2 Flexibility Impact
3 Recruitment
4 Customer Preference
5 Engagement Strategy
6 Trial Design
7 Market Design

Project Overview

Description	• Improve understanding of potential of heat pumps as a flexibility asset and the circumstances in which households would want to participate in heat flexibility events More info; More info
Project Dates	September 2022 – June 2023
Project Partners	Centre for Net Zero Powered by Octopus Energy; nesta

Key Learnings for Equinox

- The project will be gathering learnings on:
  - **How heat pumps can be used as a flexibility asset** to harness as much flexibility as possible from residential consumption, balanced against **maintaining customer comfort and satisfaction**
  - How to **accurately measure magnitude of flexibility** (kWh curtailed)
  - **Level of household acceptance of automation** to provide grid services and contribute to flexibility
  - **How flexibility varies by household type and characteristics**
- There is overlap between this project and Equinox and trial results could be very complementary

Project Methodology

- Trial to **control households' heat pumps remotely** to assess flexibility potential.
- Automation is set up to **maintain households' thermal neutral zone** (temperatures within which household feels comfy)
- Test if comfort can be maintained **throughout various interventions**
- Testing heat pump interventions across different **times of day**, days of the week, **outside temperatures**, and household **occupancy patterns**
- Determine what level of automation via smart thermostats is acceptable for consumers and **how to engender trust in automated systems**

Current project progress

- By end of 2022, the partners had **conducted interviews** with heat pump owners which **influenced design** of the pilot trial
- **Smart thermostats** were installed in pilot households. **Interventions** began in January 2023. Pilot data is being used to inform future scaled up trials
- Goal is to **begin at-scale trials in November 2023** for hundreds or even thousands of consumers
- Intention is to use a scheduled plan to harness as much flexibility as possible during periods of peak energy demand
- Scale enabled more accurate definition of heating comfort zone parameters

34: COMMANDER

Project Overview

Description	• Coordinated Operational Methodology for Managing and Accessing Network Distributed Energy Resources • Considering ways to improve coordination between DSOs and ESO by developing a roadmap of coordination scenarios for flexibility services
Project Dates	Still in Development
Project Partners	nationalgridESO, Electricity Distribution, WSP

Key Learnings for Equinox

- Coordination is key to development of liquid flexibility markets, including the participation of aggregated heat pump turn down as being trialled by Equinox. There are two key elements:
  - Stackability: how to coordinate access to the same assets e.g. could same asset provide DSO products while also participating in an ESO market?
  - Primacy: how to coordinate access to different assets, which electrically impact on each other e.g. how to manage conflict between a battery and a heat pump?

Project Challenge

- As the energy landscape shifts to lots of smaller distributed generation and flexible energy resources, the complexity of system management has increased
- The roadmap developed in Commander will include clearly defined ESO/DSO roles and responsibilities and potential coordination options for accessing and managing the services of distributed energy resources (DERs) connected to the distribution networks.

Potential Benefits

- Existing ESO Regional Development Programmes (RDP) will deliver whole system benefits using a trial by doing approach
- Commander seeks to accelerate work to understand how these concepts can be scaled through future RDP functionality across broader range of ESO and DSO activities
- This project should unlock a series of tangible options that could be deployed across various BAU processes and activities to further enhance coordination

Electricity Distribution

A2

Abbreviations

nationalgrid

Abbreviations

Abbreviation	Means
BaU	Business as Usual
BEIS	Department for Business, Energy and Industrial Strategy
CMZ	Constraint Managed Zone
CPP	Critical Peak Pricing
DFS	Demand Flexibility Service
DLC	Direct Load Control
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand Side Response
ENA	Energy Networks Association

Abbreviation	Means
ESO	Electricity System Operator
EV	Electric Vehicle
HP	Heat Pump
LCT	Low Carbon Technology
OFGEM	Office of Gas and Electricity Markets
PV	Photovoltaic
REMA	Review of Electricity Market Arrangements
RT	Real Time
ToU	Time of Use
V2G	Vehicle to grid

nationalgrid