Electricity Distribution

Heat pump flexibility: EQUINOX and beyond

Placing EQUINOX in the wider landscape of heating electrification and heat pump flexibility

Q4 2025

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Equitable Novel Flexibility Exchange (EQUINOX) overview

The problem

- Heat pumps heat ~1% of UK homes **today**. This could increase to 25% by 2035 and 70% by 2050.[1] Heat pump uptake **stands to constrain distribution network substation capacity,** potentially delaying the deployment of other critical low-carbon technologies until reinforcement occurs.
- The overall costs of reinforcement will also be higher, ultimately leading to higher bills for end consumers.
- Flexibility could be used to manage this impact of heat pumps, but prior to EQUINOX there have been no demonstrations at scale.

The project

- EQUINOX has investigated whether heat pump flexibility can be a scalable solution to manage the impact of mass heat pump uptake. The project has conducted three years of domestic flexibility trials between 2022-2025.
- EQUINOX is the UK's first project to investigate heat pump flexibility at scale, with over 1,000 households recruited.
- EQUINOX strived to target households with as much diversity as possible, ensuring that when designing commercial and technical arrangements, equity and vulnerabilities are always taken into consideration.

[1]NESO's Future Energy Scenarios: Data workbook 2024

This report links findings from EQUINOX with the current state of UK heat pump flexibility and heating electrification

EQUINOX is National Grid's flagship heat pump flexibility project, exploring how networks can procure and utilise heat pump flexibility. This report places EQUINOX findings within the broader innovation landscape, showing how its learnings can inform future policy and regulation while highlighting gaps for future innovation projects.

EQUINOX has unfolded to a backdrop of four years of policy and regulatory change in many areas relevant to project delivery like flexibility market design and heat pump rollout.

It has not been a siloed effort – many other projects have explored and innovated different elements of heating electrification and domestic flexibility in the UK

This report summarises current and emerging policies and regulations relevant to EQUINOX. It highlights how findings from EQUINOX can directly inform future policy developments.

It also distills key learnings from complementary innovation projects. It compares their outcomes and insights with those of EQUINOX to surface synergies and outstanding gaps.

Horizon Scan contents

Document Details	
Version	v1.0
Authors	Raeesa Hirji (Guidehouse)
Reviewers	Callum Coghlan, Alex Jakeman (Guidehouse) Stuart Fowler, Luke Harker (National Grid)
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Policy, markets and regulation

Relevant policy and market designs and reviews relevant to EQUINOX

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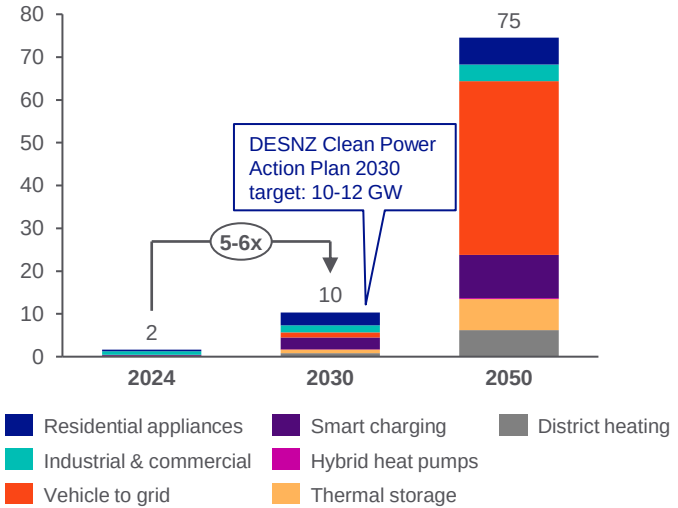
The UK's Clean Power 2030 targets necessitate rapid scale up of flexible capacity, including from consumer demand

Forecasted growth of UK consumer-led flexibility capacity (GW)



Source: NESO FES 2025 holistic transition (bars)
Note: In line with DESNZ's Clean Power Action Plan methodology, storage heater flexibility is excluded.

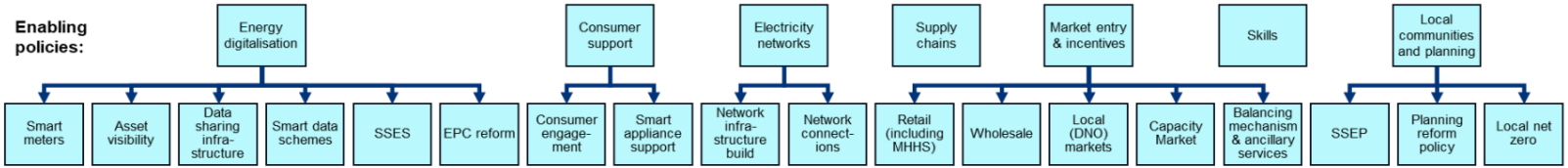
Consumer led flexible demand is expected to grow 5-6x between 2024 and 2030 and 7-8x between 2030 and 2050.

Ofgem's ED3 Sector Specific Methodology Consultation outlines the focus of network companies to build capacity. However, flexibility growth remains a focus to support quick connections and network management.

Ofgem's Clean Flexibility Roadmap lays out steps to achieve this growth:

Creating the right rewards structure	➢ Deliver Market-wide Half-Hourly Settlement. ➢ Remove barriers to other energy markers. ➢ Consider flexibility in retail market reform.
Supporting the rollout of flexible technologies	➢ Track installations of key assets like heat pumps and EV chargers. ➢ Ensure consumers can obtain a smart meter.
Engaging customers and ensuring protections	➢ Take steps to include low-income and vulnerable customers. ➢ Enable fair, easy access to flexibility services.

A variety of enabling policies are needed to achieve flexibility targets for 2030 and beyond



Source: DESNZ

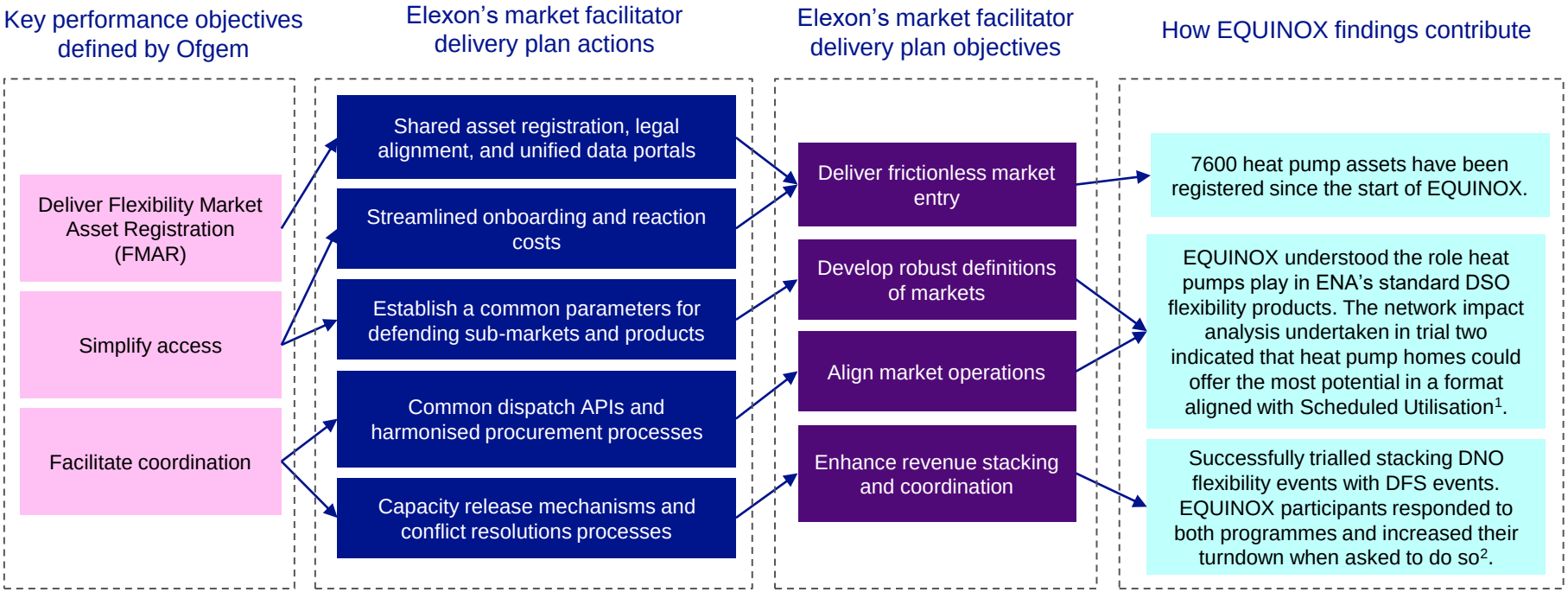
Key policy enablers in the plan for consumer-led flexibility include:

- Rollout of Market Wide Half Hourly Settlement Programme. Suppliers will begin migrating MPANs to half-hourly settlement from October 2025.
- Consideration of how the future retail market could better support flexibility.
- DESNZ, Ofgem and NESO to consider solutions to unlock the potential of demand turn up.

EQUINOX learnings further demonstrate the potential for consumer-led flexibility:

- Only customers with a smart meter could participate in the EQUINOX trials, so the Market Wide Half Hourly Settlement Programme will enable more heat pump owners to participate in heat pump flexibility.
- EQUINOX will use the trial results alongside these market updates to explore strategies to unlock maximum flexibility from domestic heat pump customers in BaU.
- EQUINOX found that heat pump homes can deliver measurable turn up demand response for network services[1].

As the market facilitator, Elexon will introduce wider market enhancements to accelerate the growth of flexibility



[1]See full report: "Project Deliverable 4: Learning from trialling novel commercial methods"
[2]See full report: "Learning from trial three: Daily evening heat pump flexibility"

Updated standards for smart meters and smart appliances should enable increased flexibility participation

Proposed new standards for smart meters are currently under Ofgem review. They cover the timely installation and maintenance of smart meters, as well as consumer compensation when standards are not met.

The Government's Smart Secure Electricity Systems Programme is delivering data and technology standards to ensure interoperability of assets and tariff data, including:

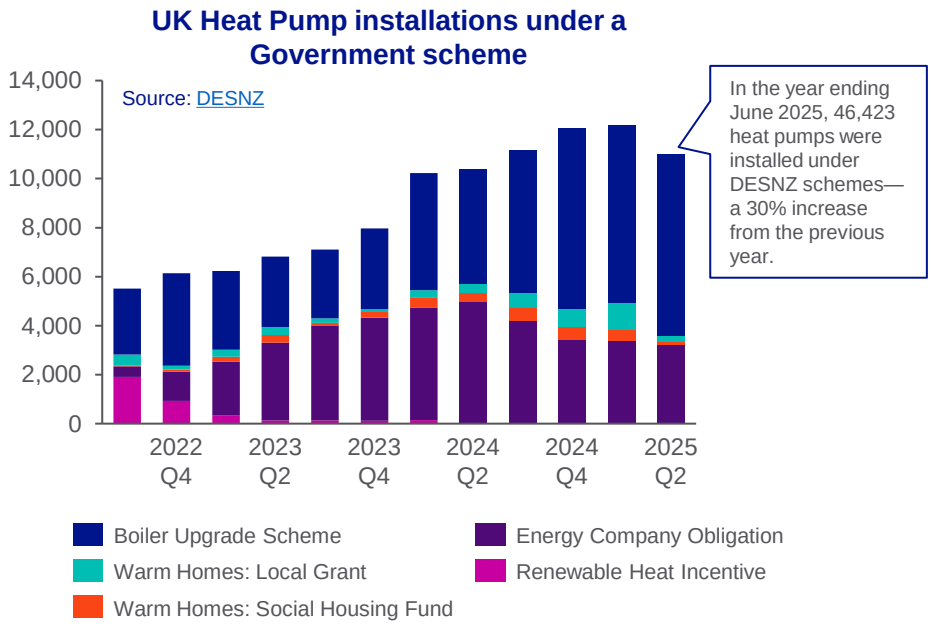
- Cybersecurity protection standards for all smart appliances.
- Requirements for heat pumps to be sold smart-ready, in line with similar existing regulations for EV chargers.

These updated standards can improve participation in heat pump flexibility

- Only customers with a smart meter could participate in EQUINOX, so understanding the pace of the smart meter rollout helps with BaU planning.
- EQUINOX successfully trialled manual and aggregator control heat pump flexibility and found that automated customers found the control of their heating acceptable. However, aggregator control is not necessary for heat pumps to flex usefully[1]. The Government's Smart Secure Electricity Programme will allow for more heat pumps to be aggregator controlled, allowing for an increase in aggregator-controlled flexibility participation.

[1]See full report: "Project Deliverable 4: Learning from trialling novel commercial methods"

UK heat pump installations are accelerating under Government supported schemes



- **Installations have risen under Government backed schemes.** However, growth is marginal compared to the scale required to meet targets.
- **Considerations for fuel-poor uptake**: 40% of UK installations in Q2 2025 were delivered through schemes targeting fuel-poor households[1]. This distribution highlights that a significant proportion of heat pump uptake is among fuel-poor households.

- **Insights from EQUINOX trials highlight the lived experiences of fuel-poor consumers with heat pumps**, particularly in the context of flexibility participation.
- **Vulnerable and fuel-poor groups are willing and able to engage in heat pump flexibility.** EQUINOX demonstrated that flexibility participation was equitable and inclusive, with strong engagement from all participants—including vulnerable customers—and minimal negative impacts[1].

[1]ECO, Warm Homes: Local Grant and Warm Homes: Social Housing Fund

[1]See full report: "Trial 3: Engaging vulnerable customers"

Currently, heat pump customers participate in NESO's demand flexibility service and DNO flexibility products

DNO Procured Flexibility

- EQUINOX trials aligned with current DNO flexibility products.
- The network impact analysis undertaken in trial two indicated that heat pump homes could offer the most potential in a format aligned with the Scheduled Utilisation product[1]. This was then trialled in trial three and it was proven that heat pump flexibility in this format is achievable[2].

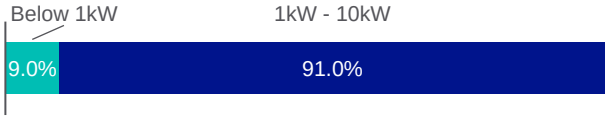
Operational Utilisation	Scheduled Utilisation
Trialled in EQUINOX trial 2.	Trialled in EQUINOX trial 3.

Operational Utilisation + Scheduled Availability

Trialled in EQUINOX trials 1, 2 and 3.

NESO's Demand Flexibility Service (DFS)

- In winter 2024/25, around 2m households and businesses participated in DFS. Over this period 5.4GWh of bids were accepted for electricity to be saved or shifted over 44 events.
- For domestic participation small manual actions continued to dominate delivery, highlighting the potential scale of EQUINOX's manual heat pump flexibility.



Stacking was enabled between DFS and DNO services, Capacity Market (CM), Local Constraints Market (LCM), and trials like Crowdflex and EQUINOX. **EQUINOX successfully stacked with DNO procured flexibility with DFS events, unlocking additional value for customers.** 78% of participants were satisfied with the ability to participate in both services and found the experience positive and worthwhile[2].

[1]See full report: "Project Deliverable 4: Learning from trialling novel commercial methods"
[2]See full report: "Learning from trial three: Daily evening heat pump flexibility"

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Heat pump flexibility innovation

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This report collates insights from innovation projects and compares them with EQUINOX learnings

This report pools insights and learnings from completed and ongoing innovation projects across the following themes[1] and compares them with EQUINOX learnings. EQUINOX fits at the centre of all four themes.

Customer Preference

How to support customer participation and benefit in flexibility services

System Planning

How to ascertain the overall system benefits from flexibility.

Heat Pump Uptake

How to enable continued uptake of heat pumps.

Market Design

Flexibility market operation factors that enable participation from heat pump homes.

Our analysis across these themes provides a holistic view of heat pump flexibility in GB and identifies gaps for future innovation.

[1] Not mutually exclusive

EQUINOX has demonstrated strong potential for heat pump flexibility across three iterative trials

Heat pump use behavioural change can provide meaningful demand shifting. EQUINOX found that **flexing heat pumps can offer statistically significant demand response**.

There is clear **customer interest in participating in heat pump flexibility.** This includes among **vulnerable and fuel-poor households,** with no evidence suggesting they cannot safely take part.

Heat pump flexibility can help resolve distribution network constraints if combined with other assets.

Heat pump users-maintained participation and turndown volumes regardless of notice period and payment amounts.

EQUINOX successfully trialled stacking DNO flexibility events with DFS events, with customers able to gain rewards from both.

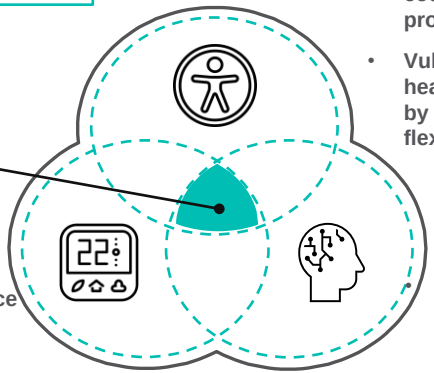
External temperature was one of the strongest drivers of demand response potential. Heat pump demand is highest in colder temperatures, resulting in greater demand response when usage is flexed.

Many projects have developed learnings on GB heat pump flexibility in parallel to EQUINOX

Project	Lead	Description	Theme
1. Peak Heat	nationalgrid	Desktop modelling study to understand the impact and flexibility of HPs, including the impact of a peak winter on the network.	
2. Neighbourhood Green	UK Power Networks	Proposes an industry standard view on diversity factors for heat, understand flex potential.	
3. Electrification of Heat	CATAPULT Energy Systems	Technical and practical feasibility of a large-scale heat pump rollout into existing British homes.	
4. ReHeat	SP ENERGY NETWORKS	Trial network solutions to mitigate the effects of increased demand from domestic electrical heating on the distribution network.	
5. HeatFlex UK	Centre for Net Zero Powered by Octopus Energy	Improve understanding of heat pump flexibility potential and circumstances for participating in flexibility events.	
6. CrowdFlex SIF BETA	NESO National Energy System Operator	Trials NESO capability to procure flexibility from domestic customers through availability and utilisation payments.	
7. Carbon Flex	UK Power Networks	Explores space and hot water heating flexibility in multi-occupancy buildings	
8. EquiFlex	SP ENERGY NETWORKS	Aims to promote equal access to participation in flexibility markets.	
9. Market Signals for the Electrification of Heating	NESO National Energy System Operator	Explores how flexibility market signals can encourage heating electrification and flexibility.	
10. EQUINOX	nationalgrid	Trials commercial arrangements to maximise participation of domestic heat pumps in DNO flexibility while meeting the needs of all customers.	

Customer preference

Clear communication, inclusive support, and smart controls can all boost customer participation in heat pump flexibility



Accessibility

EQUINOX and EquiFlex's learnings align that guidance and tailored support can boost equitable participation in heat pump flexibility.

- Clear guidance and education campaigns can boost participation in heat pump flexibility, to support households on how they could use their heat pumps to further engage flexibility programmes.
- Vulnerable and fuel poor groups are interested in taking part in heat pump flexibility and can equitably benefit from taking part by being supported by FSPs to take up the most appropriate flexibility service for them.

Automation

Smart controls improve engagement in flexibility offerings but are not a precursor to participation.

- The Government's new smart appliance standards will introduce requirements for heat pumps to be sold smart-ready, enabling automated heat pump flexibility.
- HeatFlex found that 9 of 10 households found aggregator control of their heating acceptable, similar to EQUINOX aggregator control participants.
- EquiFlex found through surveys that there is a need for alternative participation methods for those without smart technologies. EQUINOX and CrowdFlex have successfully trialled manual heat pump flexibility and found that automated control is not necessary for heat pumps to flex usefully.

Behavioural adaptation

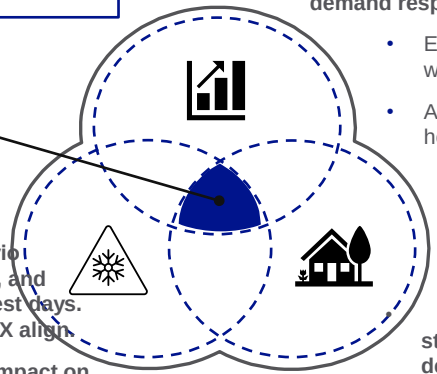
Domestic customers are highly engaged in heating flexibility.

Domestic customers showed strong participation in heat pump flexibility. CrowdFlex, EQUINOX, and HeatFlex all achieved satisfaction rates above 85%.

- Clear communication to consumers about new tariff structures and flexibility options is essential to enable informed participation.
- Heat pump flexibility is possible without sacrificing customer comfort. In EQUINOX, 85% of participants reported either no change or a slight change in comfort during events.
- In both EQUINOX and HeatFlex's trials, some participants reported adjusting behaviour to maintain comfort.

System planning

Heat pumps provide meaningful demand shifting that can support network planning alongside other assets. The potential of heat pump in extreme cold weather scenarios requires additional research.



Flexibility potential

Multiple trials have proven that heat pump flexibility can provide meaningful demand shifting.

- **Heat pump flexibility can provide meaningful demand shifting, EQUINOX, HeatFlex and Carbon Flex trials all found that statistically significant demand response was achievable from heat pumps.**
  - EQUINOX found that heat pump flexibility can help resolve CMZs when combined with other assets.
  - Analysis from EQUINOX and Neighborhood Green highlight that heat pump flexibility is a reliable peak reduction solution.

Weather

Further evidence is required to determine the potential of heat pump flexibility during extreme cold.

- **Neighbourhood Green's simulated extreme weather scenario found that heat pump demand is highest when it is coldest, and flexibility will depend on customer willingness on the coldest days. Simulations from PeakHeat and trial findings from EQUINOX align.**
- **Peak Heat found that flexibility measures have a very low impact on peak demand reduction at the network level during extreme weather. The customer willingness to participate in heat pump flexibility during extreme cold events requires further exploration.**
- **Market Signals for the Electrification of Heat suggested alternative solutions for extreme weather scenarios such as hybrid heating systems or long duration thermal storage. Additional research is required to investigate the impact of these alternative technologies.**

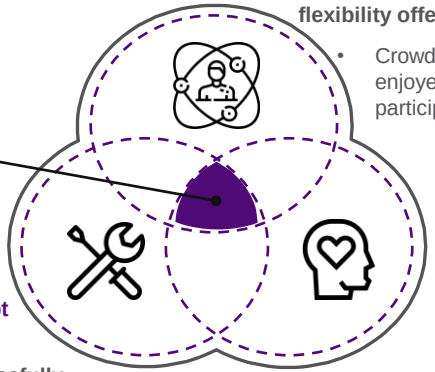
Multiple asset integration

Network planning should consider diverse households with multiple assets.

- **EQUINOX and CrowdFlex found that adding solar and battery storage assets to heat pump homes further increases overall demand response potential, but tariffs can sometimes unlock it more effectively than event-based flexibility.**
- **EQUINOX found that home insulation plays a key role in a household's ability to participate in 4-hour events.**
- **Networks should plan for the entire home's flexibility potential, rather than just separate devices. Understanding how and when different household types with various combinations of assets consume energy allows for more accurate load forecasting.**

Heat pump uptake

Multiple innovation trials have demonstrated that heat pumps are feasible across most homes and deliver positive experiences to all customers.



User experience

Heat pump customers are satisfied with their heat pumps.

- Electrification of Heat found that customers are satisfied with the quality and experience of the installation, running costs and heat provided by their heat pumps.
- As heat pump adoption continues to increase, additional guidance from installers and may be required specifically to make best use of heat pump flexibility offerings.
  - CrowdFlex found that heat pump owners were more likely to say they enjoyed the trial, highlighting the benefit of heat pumps to enable participation in flexibility.

Customer interest

There is increasing evidence that the heat pump rollout is accelerating.

- 28% of respondents to a UK wide survey in EQUINOX indicated they may install a heat pump in the next five years.
- Higher income owner-occupiers, earning over £50,000 have shown greater intent to adopt heat pumps due to financial capacity and property control.
- Government-backed heat pump installations rose by 30% last year, highlighting policy support and increased adoption momentum.
- Increased uptake from heat pumps further changes the load profile observed in feeders with heat pumps installed, highlighting the importance of heat pump flexibility.

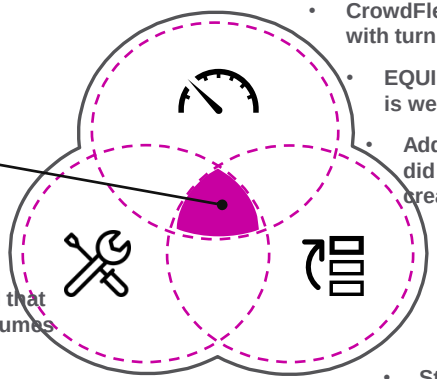
Feasibility of installation

Heat pumps are efficient, widely installable, and easier to adopt with supportive policy and collaboration.

- Electrification of Heat found that heat pumps can be successfully installed in all housing types with good overall efficiencies.
- Collaboration between policymakers and private sector is needed to promote smoother adoption of heat pumps.
- Recent policy changes mean that homeowners will no longer need to apply for formal planning permission to install an air source heat pump.

Market design

Well-designed market offerings that support diverse household participation support system wide benefits.



Demand turn up

Heat pumps can provide meaningful demand turnup and it would be valuable to heat pump customers to procure turn up.

- EquiFlex found that the deployment of more turn up procurement would benefit low-income customers greatly.
- CrowdFlex found that heat pump owners were more likely to be satisfied with turn up events compared with households without a heat pump.
- EQUINOX found that heat pumps can provide demand turn up and it is well tolerated by customers.
- Additional research is required, as both EQUINOX and CrowdFlex did not find conclusive evidence of whether demand was shifted or created during turn up events.

Event factors

Multiple trials evidence preferred event length and notice periods that support heat pump participation in flexibility.

- Notice periods in both EQUINOX and CrowdFlex trials found that heat pump users-maintained participation and turndown volumes regardless of notice period.
- HeatFlex used pre-heating to support 4-hour events with heat pumps. In EQUINOX, most participants preferred 2–3-hour events, with 4 hours tolerable for some, suggesting that aggregator control may be more suited to longer event durations.
- A static service with fixed event windows is easier for customers to remember and to adapt routines around for heat pump flexibility, especially for customers with smart thermostats.

Stacking

Stacking flexibility services boosts value but requires clear communication to avoid customer confusion.

- Stacking flexibility services is achievable and unlocks greater value for participants.
- Heat pump customers benefited from stacking EQUINOX with DFS events as they were able to provide heat pump flexibility to EQUINOX and gain additional value from their other assets through DFS.
- Clear distinctions and communication between offerings are needed to avoid confusion and conflicting signals.

These combined insights provide the groundwork to inform future policies and innovation projects

Combined insights from all selected innovation projects show that:

- Heat pump flexibility is scalable, given proven demand response across EQUINOX, HeatFlex and CarbonFlex.
- There is strong customer engagement with heat pump flexibility with both manual and aggregator-controlled heat pump flexibility.
- Vulnerable customer groups can equitably participate in heat pump flexibility once they have a heat pump.
- Stacking flexibility services is achievable and unlocks greater value for participants.

These insights can inform future policies including:

- Supporting smart appliance standards.
- Enabling stacking between flexibility services with clear rules and customer communications.

These insights also support the need for future innovation projects to explore the following areas:

- Understand customer behaviour during cold snaps to fully understand the potential of heat pump flexibility in extreme weather conditions.
- Additional research on heat pump's participation in demand turn up, building on work done in CrowdFlex and EQUINOX.

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Selected Project Deep Dives

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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

Project Scope

- Look at the latest heat pump loads based on current strategies around heat pump operation.
- Investigate the impact of heat pumps based on specific typology areas, considering the effects of clustering on our network.
- Investigate the trade-off between smart shifting of loads and cost to upgrade the network.
- Access 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 (e.g. customer behaviour during these events) effects.

Learnings

- At the individual property level, electricity peak demands could be between 4 to 6 times higher (dependent on the property archetype) than peak non-thermal demands if a property switches from gas/oil/LPG heating to electrically driven heat pumps. Total electricity demands were higher in larger homes with poor insulation.
- Under cold conditions, many of the flexibility measures investigated had a minimal impact on peak demands, and often resulted in peak-shifting rather than peak reduction at the individual house level.
- At the network level, the study found that for a 1-in-20 winter period, a high heat pump uptake, and no flexibility measures, approximately 44% of the distribution substations in the areas investigated would require reinforcement by 2030, and this would increase to 72% by 2040.
- Flexibility measures were found to have a negligible or very low impact on peak demand reduction at the network level during a 1-in-20 winter period.
- Outdoor temperature has a significant impact on the peak heat demand. Taking the S-200 substation archetype as an example, the half hourly peak heat demand in a 1-in-20 winter (on a day with an average temperature of -4° C) is approximately two times higher than in an average winter (on a day with an average temperature of 4° C).

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; CATAPULT Energy Systems; University of Strathclyde Engineering

Project Scope

- Monitored data from homes across the UK with electric heating and other low carbon technologies (LCTs) in different weather conditions.
- Analysed data to understand load profile of different heating technologies when coupled with other LCTs.
- Performed network testing on different topologies (rural, urban, etc.).
- Aimed to form an industry standard view on diversity factors for heat and better understand the clustering effect of LCTs.

Learnings

- The project concluded that heat pump flexibility will be weather dependent.
- Heat pumps are not as flexible as other technologies within the home due to their long running hours and load profile throughout the day.
- Heat pump demand is highest when it is coldest. Fewer customers may be willing to provide flexibility on colder days.
- Electric heating may change transformer and cable loading. As the daily load profile becomes flatter due to heat pumps, the transformer and cable will be used differently. DNOs may look to size them considering their continuous rating instead of their cyclical ratings.
- Security of supply and planning standards will need to evolve to support the electrification of heat.
- The network will need to support the highest demands in the coldest weather and be ready to support the electrification of heat.

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 Scope

- 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

Learnings

- 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

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

Project Scope

- Developed network planning tools; now progressed to testing phase.
- Installed 30+ smart controls and thermal storage systems.
- Developed direct load control (DLC) platform to prototype stage, ready to be trialled with the Home Energy Management System (HEMS.
- Installed heat pumps and thermal batteries in several pilot homes. 600 customers have expressed interest to E.on to date.
- Continued developing DNO network modelling capabilities on the NAVI platform. API developed to facilitate monitoring and load control between the DNO and DLC.

Learnings

- **High dropout rate during customer journey from initial expression of interest through to signing of final contract. Reasons include eligibility for local authority funding and property suitability (e.g., insufficient space for heat batteries).**
- **DLC is expected to play a greater role in heat pump demand response. ReHeat's platform will play an important role in understanding how DLC can be leveraged to optimise heat pump flexibility.**

HeatFlex UK

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 – November 2024
Project Partners	Centre for Net Zero Powered by Octopus Energy; nesta

Project Scope

- Ran pilot in 2022/23 remotely controlling household heat pumps via smart thermostat. Tracked whether peak electricity demand shifted and whether households remained in thermal comfort.
- Ran 20 events, including pre-heating. Participants completed surveys after each event. CNZ also conducted interviews.
- Now running large scale randomised control trial for winter 2023/24. Examining how remote control impact varies by household and property characteristics.

Learnings

- Nesta used home floorplans as a way of personalising interviews, offering insights about insulation levels throughout the home, placement of the smart thermostat and household behaviour which may not have been collected otherwise.
- Electricity consumption could be moved to other times of day in a way that participants found acceptable.
- 9 out of 10 found automation of their heating acceptable.
- Days with events appeared to have similar overall electricity consumption as days without events.
- Most temperatures that participants self-reported at the end of the pre-heating window were greater than their normal thermostat setpoints. This suggests broadly that pre-heating worked.
- Some participants changed behaviour to maintain thermal comfort, such as wearing additional clothing or using additional heating sources such as a log burner.
- Were able to shift household demand: found a statistically significant 32% reduction (0.123 kWh) in household energy consumption.
- Households were happy with the automation of their heat pumps. Participation in events was high: in only 9% of instances did participants opt out of events before they started
- Participants were comfortable with the internal temperature of their home.

CrowdFlex SIF Beta

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	December 2023 – January 2026
Project Partners	

Project Scope

Follows from SIF Alpha phase. The project looks to:

- Develop comprehensive understanding of domestic flexibility by building forecasting models of domestic demand and flexibility, integrated into the VirtualES, and improve ESO confidence in domestic flexibility.
- Demonstrate that simple incentives can reduce complexity, bureaucracy, and barriers to entry for aggregators to deliver domestic flexibility.
- Trial consumer interventions targeting different system challenges to clarify consumers preferences and inform future market designs.
- Trial the service primacy rules developed by ESO and DSOs to improve coordination between networks and other system participants.

Learnings

- Participating in flexibility increases awareness and understanding of energy issues.
- Effort should be made to clearly outline the distinctions between the offerings, and to avoid conflicting signals, there is still some confusion about the similar terms, the different processes, and how participating in one impacts the other.
- Participants could not always shift their usage during CrowdFlex events if they were already shifting outside of the peak evening times to make the most of their cheaper tariffs, and were confused that they were being asked to.
- As the market increases and more services are available to households, there will be practical challenges for both industry and consumers. While a range of flexibility service offerings will be important for different customers to access value in ways that work for them, action may be needed to ensure this doesn't result in confusion that curtails available flexibility.
- Households should be supported to take up the most appropriate flexibility service for them.
- A static service with fixed event access, vulnerabilities, or low usage are less inclined to adopt automationwindows may be easier to remember and to adapt routines around.
- Those with health conditions and those reporting more than one vulnerability characteristic both reported more positive experiences of the trial.
- Most participants shifted their use manually, though automation is being utilised more as the trial progresses. Individuals with limited tech .

CarbonFlex

Project Overview

Description	• CarbonFlex demonstrated how socially-inclusive demand side flexibility can be used to support a net zero secure urban energy system. In turn, enabling surrounding communities to electrify and decarbonise quickly, cost-efficiently and equitably. More info
Project Dates	Mar 2024 – Jun 2024
Project Partners	UK Power Networks; SIAPARTNERS

Project Scope

1. Optimise demand flexibility from house based on the carbon intensity of electricity by using 'Carbon flexing' algorithms coupled with smart controls to match electric residential space and hot water heating demand in multi-occupancy buildings with periods of low carbon electricity and an expected high network flexibility demand.
2. Enhance opportunities for domestic customers (and other disadvantaged end users) to partake in flexibility through social, technical and market interventions.

Learnings

- **During the 2-week trial with 24 tenants, the participants who had their charge times optimised for carbon avoidance achieved a 15% carbon saving whilst ambient temperatures were maintained at 21-23ºC.**
- **Customers were motivated by positively impacting the climate and helping their local area as their primary motivations for participating in the trial.**
- **Customers noted that the gift voucher also helped but was not the primary motivation.**
- **The trial receive positive feedback. Only three tenants noticed changes demonstrating that heat can be delivered as a service without adversely affecting the end consumers.**
- **While the trial wasn't located in a constraint managed zone, the analysis found that the trial activity would not negatively impact the DNO calls for flexibility or other services such as UK Power Networks and Octopus Energy's 'Power Ups'. Further research is needed to confirm this, if scaled across all network locations**
- **Pre-trial engagement with tenants made the user journey successful. Face-to-face events, telephone calls and written communication helped identify user needs and appropriately explain the trial. Participants were given the option to opt-out and a 24/7 helpline.**
- **The tariff structure removed tenant price risk (also meaning direct financial savings weren't available during the trial).**

EquiFlex

Project Overview

Description	• EquiFlex aimed to promote equal access to the participation in flexibility markets, ensuring no customers are unfairly left behind and enabling a just transition to NetZero. More info
Project Dates	Mar 2024 – Jun 2024
Project Partners	SP ENERGY NETWORKS; energy action SCOTLAND; East Ayrshire Council Comhairle Siorrachd Àir an Ear; FRAZER-NASH CONSULTANCY A KBR COMPANY

Project Scope

1. Understand the current flexibility market with a focus on barriers and opportunities for vulnerable and less engaged customers.
2. Investigate whether the characteristics of energy consumption among the target groups provides opportunities to develop new flexibility products.
3. Begin developing a 'toolkit' to help stakeholders like DNOs, local authorities and community energy groups to determine the best flexibility options to pursue in a particular area based on its energy needs, network configuration and consumer demographics.

Learnings

- **Energy initiatives need to be designed to be easy, quick, and convenient for users to adopt. They also need to be adaptable.**
- **Clear guidance, education campaigns, and easy-to-follow action plans would be beneficial to increase participation in flexibility.**
- **Many respondents are open to participating in energy-saving initiatives, but significant barriers such as time constraints, lack of clear information, and concerns about safety or trust could hinder engagement. Tackling these challenges through clear communication, convenient and flexible solutions, and targeted support for vulnerable groups will be essential to increasing participation and ensuring the success of energy-saving programmes.**
- **Flexibility benefits are greatest when they are stacked together: Networks can access more flexibility for their networks; Consumer price savings and access to energy are increased.**
- **There are funding mechanisms available for low income customers to access LCTs and thereby increase their ability to provide flexibility.**
- **The deployment of more turn up procurement which would benefit low income customers greatly.**
- **Improving insulation generates the highest cost savings for the target demographic and the largest environmental benefit both now, through reducing gas consumption, and in the future, by lowering reinforcement costs through reducing consumption as space heating is electrified. Installation of the insulation helps to support the local economy.**

Market Signals Heating Electrification

Project Overview

Description	• Seeks to understand how flexibility market signals can encourage electrification of heating, and the adoption of flexible heating practices from domestic consumers and their homes. More info
Project Dates	Mar 2024 – Jan 2026
Project Partners	NESO National Energy System Operator; WSP

Project Scope

1. Understand what market signals NESO should develop to encourage electrified heating and flexibility practices, and where these sit in the wider context of market signals for domestic consumers.
2. Create a roadmap for implementation of the optimal enablers, including design of a trial.

Learnings

- **Further learnings will become apparent as the outputs of the project are shared.**
- **Heat batteries and heat boilers with storage, which are suitable for buildings less compatible with heat pumps.**
- **These may offer greater flexibility and faster response rates, aiding NESO's balancing services.**
- **Control and metering of flexible assets is improving, but further enhancements are needed to enable participation in new BM service lines for flexible domestic assets.**
- **For network reinforcement cost analysis, using detailed and specific data is crucial for accurate forecasting.**

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