

Public

Ofgem Strategic Innovation Fund

CrowdFlex Beta Annual Progress Report

January 2025



CrowdFlex Project Partners



Centre for Net Zero
Powered by Octopus Energy Group



ERM



Scottish & Southern
Electricity Networks

Supported by

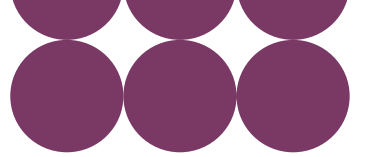


Contents

1 - Beta Phase – Executive Summary	7
Background.....	7
Scope	8
Progress.....	8
Delays and Problems encountered	9
Main Learning.....	9
Key Metrics developed.....	10
Summary of Dissemination Activities	11
Section 2 - Beta Phase – Project Summary.....	11
SIF Innovation Challenge.....	11
Problem and Opportunity	11
Achievements.....	11
Performance Against Objectives.....	12
Outputs and Outcomes.....	12
Difficulties and challenges	13
Section 3 – Beta Phase – Knowledge Creation and dissemination.....	14
Key Learning Objectives	14
New Learning.....	15
Section 4 – Beta Phase – Intellectual Property Rights Generation.....	15
Section 5 – Beta Phase – Data Access Details	16
Section 6 – Beta Phase – Route to Market/Business as Usual.....	17
Adjustments to processes, products and services	17
Necessary Steps and Adjustments.....	18
Deployment Likelihood.....	18
Recommendations	18
Project approach adjustments.....	18
Procurement and Utilisation changes.....	19



Commercialisation Considerations	19
Wider support to the non-network partners.....	19
Section 7 – Beta Phase – Policy, Regulation and Standard Barriers	20
Section 8 – Beta Phase – User Needs	20
User Journey	22
User Needs Translation improvements.....	22
Changes to User Needs.....	23
Assumption Testing and Adaptation.....	23
Project Assumptions	23
Section 9 – Beta Phase – Impacts and Benefits	23
Impacts and benefits.....	23
Section 10 – Beta Phase – Risks, Issues & Constraints	24
Constraints in Regulation, Legislation and Commercials	25
Risks, Issues experienced and mitigations, resolutions undertaken	25
Adaptions we have made	26
Section 11 – Beta Phase – Working in the Open	27
Methods used to communicate publicly about the project	27
How we are collaborating with our stakeholders to promote and refine the project	27
Inviting challenge and external input on the project approach	27
Sharing our learning to avoid duplication of efforts and to accelerate industry progress on related initiatives	28
Working openly and building relationships with organisations and teams responsible for other parts of the user journey.....	28
Insights gained from stakeholder engagement relevant for future projects....	28
Section 12 – Beta Phase – Costs and Value for Money	29
Value for Money for consumers	29
Variations to spend	30
Unspent funding.....	30



Additional Funding30

Revenues earned returned to customers30

Section 13 – Beta Phase – Special Conditions31

Section 14 – Beta Phase – Material Changes34

Appendix 1- Learning35

 New Captured Knowledge- Summer Trials35

 New Captured Knowledge- Winter Trials 2436

 New Captured Knowledge- Models36

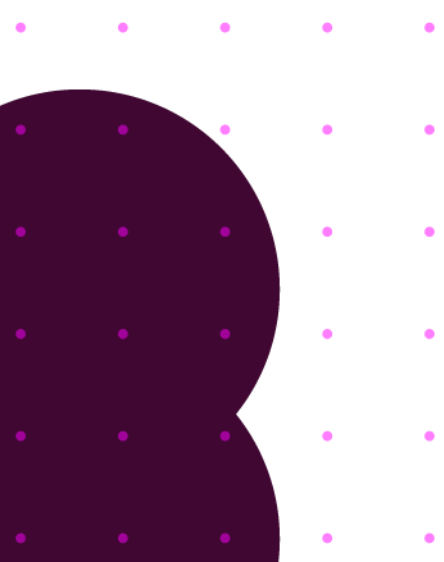
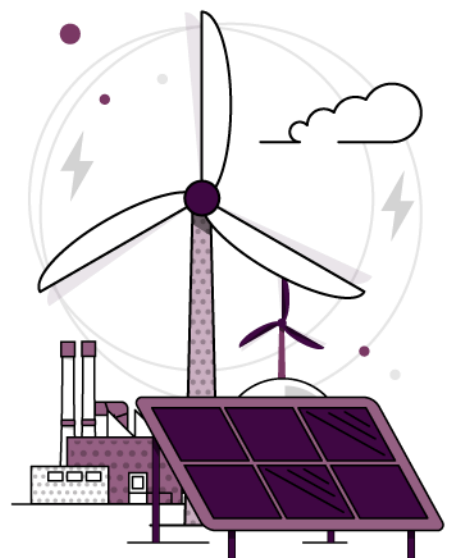
 Main Project Learning Objectives37

 Specific learning from CSE interviews38

Appendix 2- Post-Beta Phase Roadmap40

Appendix 3- KPIs41

Appendix 4 – Communications42





Foreword

I'm pleased to share the annual report for CrowdFlex, an Ofgem Strategic Innovation funded project with you.

CrowdFlex is a vital innovation project, giving valuable insight into domestic flexibility and helping to enable NESO to deliver GB's Net Zero ambitions.

This project is the collective work of OVO, Ohme, Centre for Net Zero, ERM, AWS, National Grid Electricity Distribution, and Scottish and Southern Electricity Networks project partners, supported by Smart Grid Consultancy, CGI, Smith Institute and Centre for Sustainable Energy, and I'd like to take the opportunity to thank them for their continued collaboration and commitment to exploring domestic flexibility through this project.

Why is this so important to NESO?

Domestic flexibility is a key component of a future net zero energy system which will ultimately translate into lower bills for consumers.

CrowdFlex uses data gained through pioneering residential consumer flexibility trials to build interconnected models of domestic demand and flexibility which can be used to inform real time operations.

The procurement of services from residential consumers is relatively new and there is limited data from both NESO and DSOs on the effectiveness and delivery of these services.

Further work is required to ascertain the full potential for domestic flexibility – and the new statistical modelling capability delivered through the CrowdFlex project provides a good foundation for this – measuring the deliverability and reliability of domestic flexibility that could be available in the future.

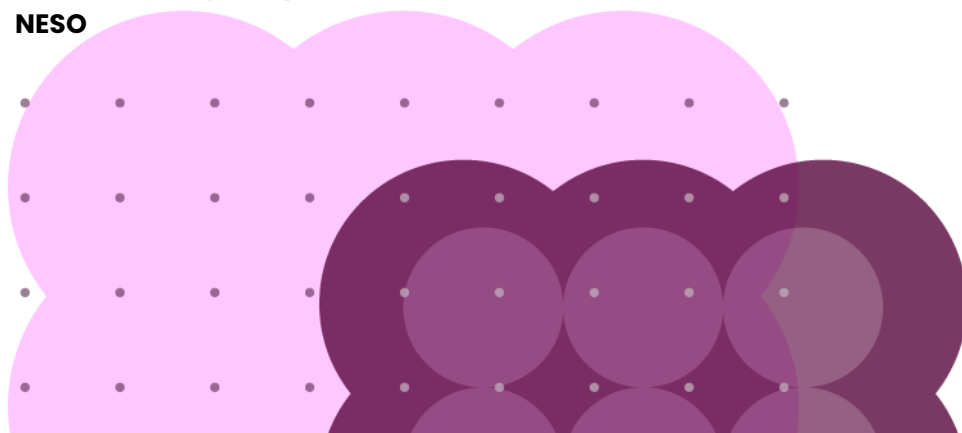
Looking ahead, as barriers to individual services and technologies are removed the potential for service provision through new, competing providers and technologies (including domestic suppliers or aggregators) increases – driving competition and lower prices which benefits all domestic customers.

This project seeks to establish a pathway to accelerate domestic flexibility, and to establish it as a resource for grid balancing and operation.

Project learnings and outputs will be transitioned into day-to-day business as usual operations, truly embedding domestic flexibility in operations.



Cathy Fraser,
CrowdFlex Project Sponsor,
NESO





Annual Report

Application Number	CrowdFlex Project (10070764)
20 th December 2023	Sanna Atherton Sanna.atherton@nationalenergyiso.com



Sanna Atherton, CrowdFlex Project Lead, NESO *“We’re excited to be in the beta phase of the CrowdFlex project and collaborating with key industry partners on this large-scale programme. Increasing renewable energy sources brings new challenges to balancing supply and demand. CrowdFlex is building forecasting models of domestic demand and flexibility and aims to firmly establish domestic flexibility as a reliable grid management resource, helping to reduce energy bills and to support the transition to a smart, flexible and zero carbon grid.”*

1 - Beta Phase – Executive Summary

Background

CrowdFlex is seeking to address the challenge of how NESO, Flexibility Service Providers and DSOs can better understand residential customer behaviour and make the best use of domestic flexibility as a service. Currently, NESO has a very limited pool of information about residential customers and how best to access this potential source of demand side services. The project aims to establish domestic flexibility as a novel, reliable flexibility resource of national significance, competing alongside Business as Usual (BaU) alternatives and accelerating decarbonisation. The introduction of the Demand Flexibility Service (DFS) and the Local Constraint Market (LCM) have both provided insights, but more is needed to ensure NESO can develop robust services in the future.

Our objective is to produce insights and build forecasting models of domestic demand and flexibility, informed by large-scale consumer trials, to establish domestic flexibility as a more reliable resource and inform new product design.



Carolina Tortora, Head of Innovation, Sector Digitalisation & AI, NESO *“Our pioneering CrowdFlex project is leading the way in establishing domestic flexibility as a reliable grid resource, by developing models to accurately forecast the potential of consumer flexibility. This exciting project is a fundamental step towards building a future digital grid, which is crucial for bringing more renewable generation online, and operating the GB energy system efficiently and effectively.”*



Scope

CrowdFlex is:

- developing statistical approaches for forecasting and procuring domestic flexibility.
- developing two models; the Availability Flexibility Model (AFM) and the Expected Delivery Model (EDM).
- conducting large-scale domestic customer trials to enable model development and provide a greater understanding of domestic flexibility's potential and technical capabilities.
- establishing a pathway to rapidly accelerate domestic flexibility to BaU, following the project's completion.

The trials are wholly focussed on domestic customers and include a series of summer and winter trials covering availability and utilisation services. The data from the trials will feed into the AFM and EDM and the models could then be used by services providers, NESO and DSOs. For more details on both models please see Section 8.

Utilisation is behavioural where customers receive a notification with a request to turn up or down at a specific time. The trials do not stipulate how this should be done or what types of electrical device they should include, its entirely at the customer's discretion.

The availability trial has a more technical approach. The events themselves are managed remotely by the charging device operator who can control the charger remotely. Consequentially, all that is required of the participant household is to ensure that they have plugged their charger into the car to enable the remote management.



David Watson, CEO, Ohme

"The winter trial for CrowdFlex is Ohme's biggest ever flex trial to date, showing discernible progress and strengthening our belief in the material impact that domestic customers can have in providing grid flexibility services. Thanks to ever greater numbers of EV drivers participating, we are gaining a deeper understanding of those customers along with more reliable data modelling of their impact for the future.

With grid flexibility services estimated to save consumers £10bn per year in energy costs by 2050 and with Ohme looking to involve even more customers in 2025 with our ongoing trials, we are looking forward to further demonstrating the important role domestic customers can play in the drive towards Net Zero."

Progress

We successfully completed the first summer trials and analysed the initial results, which produced some interesting learning around domestic customer behaviour. This is detailed more in Section 3. We have also produced some early results from the AFM which sets the project up well for next year.



We successfully agreed the relevant data sharing arrangements with the partners, which took longer than anticipated but has provided good learning for our new SIF project, Powering Wales Renewably.

The Winter Trials are currently underway, and we expect to deliver an initial report on our findings in Q1 2025.

Delays and Problems encountered

Whilst there have been some delays to the delivery of the Models, these delays have been mainly due to needing to design them and make decisions on scope and capability. This has not impacted the schedule though as the model outputs were largely deliverable towards the second year of the project plan. The trials were unaffected.

Octopus Energy left the project in the first quarter of 2024, however with the collective effort of Senior Stakeholders from NESO, the project partners, UKRI and Ofgem we successfully completed the summer trials on schedule and with some strong learning points for stakeholders.

Main Learning

There have been some interesting learning points through the trials. For the utilisation trials, behavioural patterns have not yet shown evidence of strong price sensitivity. For the availability trials, four recruitment messages were tested. The most effective was 'get paid' but there was less difference in recruitment impact in non-financial messages than anticipated.

It's important to note that there were insufficient events to make significant conclusions from the summer trials about how event characteristics affect flexibility; however, the insights gathered have informed future trial designs and our approaches to customer engagement, and this will support long term insights over the course of multiple trial periods. The winter trials are testing more events, better distribution, different days of the week, multiple events a day, different messaging and have more focus on Low Income and Vulnerable customers and different customer archetypes.

Detailed learning from the summer trials can be found within Section 3 and Appendix 1 of this report.



Josh Visser, Innovation Incubator Senior Manager, NESO

"CrowdFlex is one of the first innovation projects to be incubated in this exciting new NESO function. The first year of the project's beta phase has been highly successful with industry partners collaborating and gaining a valuable, deeper understanding of domestic flexibility, which is crucial for future operations as more renewable generation is connected to the grid. We're eager to see what insights will be gained in the remainder of the beta phase, as the project progresses towards business-as-usual integration."



Key Metrics developed

We have identified three groups of KPIs relating to the two workstreams of CrowdFlex. These will be refined and updated as the project progresses.

Fundamentally CrowdFlex is a project to develop a forecasting model of domestic demand and flexibility informed by large-scale trials. Therefore, for CrowdFlex to be a success both the model and the trials must be successful. More detail on the KPIs can be found in Appendix 3.

Modelling KPIs

- Quantitative assessment of model performance – ongoing as model is trained
- Successful integration of model into NESO systems
- Successful integration of trial data into model training

Trial KPIs

- Recruitment (>48k per Demand Side Response Service Provider, in first utilisation trial)
- Recruitment conversion (% eligible sign up to CrowdFlex)
- Randomisation allocation success
- Unsubscribe / self-removal rate
- Analysis – recovery of “real” flexibility
- Analysis – detect difference between treatment arms

System impact analysis KPIs

- Availability of domestic flex resource (kW/household)
- Firm domestic flex response (kW/household)
- Net cost/benefit of domestic flex (£/MWh)
- Net carbon emissions avoided by domestic flex (tCO₂/MWh)



Elizabeth Allkins, Head of Energy Strategy, OVO

“We’ve been pleased to continue to grow our learnings on CrowdFlex into the winter with two new trials launched in September. By scaling up the trial to over 60,000 people we’re able to further explore a number of factors influencing flexibility response with statistical confidence, building on insights from the summer. As NESO outlined in their CP30 report, domestic DSR is going to be a critical enabler of a decarbonised energy system in the near future, and we are proud to be working closely with NESO to increase the industry’s understanding of domestic flexibility behaviour and support the development of models that will enable large numbers of consumers to contribute to and benefit from a greener grid.”



Summary of Dissemination Activities

It's important that we engage with stakeholders and share learnings from CrowdFlex to ensure that the objectives of the project are met, and the benefits realised. We have been working collaboratively and sharing updates with both internal and external stakeholders. The project has been presented extensively at conferences, meetings and through written communications such as internal and external newsletters, the NESO website and social media, and has received significant interest from press, policy makers and industry. More information on our dissemination activities can be found in section 11.

Section 2 – Beta Phase – Project Summary

SIF Innovation Challenge

SIF: Ofgem Round 1: Beta, Whole system integration

Problem and Opportunity

CrowdFlex is a great opportunity for NESO, Demand Side Response Service Providers, (DSRSPs) and DSOs to understand more about residential customer behaviour to make the best use of flexibility services from domestic electricity demand. Currently, NESO has a very limited pool of information about residential consumers and how best to access this potential source of demand side services. DFS and the LCM have both provided insights, but more is needed to ensure NESO can develop robust services in the future.

Achievements

We successfully completed the first summer trials, which included designing the various incentives domestic customers obtained, the business processes needed to support the delivery of the trials with the project partners, the customer survey, and the data requirements needed to ensure we achieved our learning objectives. We also analysed the initial results, and this produced some interesting learning, which is detailed more within this report in Section 3.

We successfully agreed the relevant data sharing arrangements with the partners, which took longer than anticipated but has provided good learning for our new SIF project, Powering Wales Renewably. The background to the time taken is detailed within the detailed learning section, Appendix 1.

We have also produced some early results from the AFM, as well which sets the project up well for the next year.

31 demand shifting events between May and July 2024

Incentivising consumers to use their electricity flexibly by adjusting their energy usage (turn up or down) or make assets like electric vehicles available to the grid for automated control of when to charge.



Performance Against Objectives

CrowdFlex aims to establish domestic flexibility as a novel, reliable flexibility resource of national significance, competing alongside BaU alternatives and accelerating decarbonisation. Our supporting objective is to build a forecasting model of domestic demand and flexibility, informed by large-scale consumer trials, to establish domestic flexibility as a firm resource and inform new product design.

We remain on track to achieve both outcomes.



Gareth Jones, Chief Operating Officer, Centre for Net Zero

“The CrowdFlex trials, designed by Centre for Net Zero in collaboration with all project partners, involve large-scale randomised controlled trials to rigorously test the causal impact of key interventions – an approach that remains rare in the energy sector. We are thrilled by the successful implementation of these trials during summer 2024 and winter 2024-25. In exploring customer responsiveness to the incentive levels and design of flexibility schemes, these trials will provide critical insights that drive progress toward a fully sustainable energy system.”

Outputs and Outcomes

We have several key outputs and outcomes. Some of them are milestones within the Project Direction some are measures along the way. They are outlined in the table below:

Ref	Description	Status
M0-1	Contract signed	Achieved
M0-2	Completion of mini-trial 1	Achieved
M0-3	Completion of mini-trial 2	In Progress
M0-4	Completion of availability payment trial 1	In Progress
M0-5	Completion of availability payment trial 2	Not Started
M0-6	Completion of mini-trial 3	Not Started
M0-7	Project Complete	In Progress
M1-1	Initial specifications/requirements (Baselining/Performance/API/model) produced to enable development to commence	Achieved
M1-2	NESO model acceptance	In Progress
M2-1	KPIs agreed	Achieved
M2-2	Mid-Point update	In Progress
M2-3	Completion of Impact & CBA report	In Progress
M3-1	Completion of Roadmap	In Progress
M4a-1	First aggregated demand profiles provided to NESO by Octopus Energy	Delayed
M4a-2	Octopus Energy Model completed	Delayed
M4-b-1	First aggregated demand profiles provided to NESO by OVO Energy	Achieved
M4b-2	OVO Energy Model completed	In Progress



M4c-1	First aggregated demand profiles provided to NESO by Ohme	Achieved
M4c-2	Ohme Model Completed	In Progress
M5-1	First aggregated domestic demand prediction produced	Achieved
M5-2	Internal modelling performance update 1 given	Achieved
M5-3	Internal modelling performance update 2 given	In Progress
M5-4	Final NESO Domestic Flexibility Model deployed	Not Started
M5-5	Model Final Report delivered	Not Started
M6-1	Completion of the initial trial protocol	Completed
M6-2	Payment arrangements agreed	Completed
M6-3	Finalisation of Trial Protocol	In progress
M7-1	Trial month 1 complete	Completed
M7-2	Trial month 2 complete	Completed
M7-3	Trial month 3 complete	Completed
M7-4	Trial month 4 complete	Completed
M7-5	Trial month 5 complete	Completed
M7-6	Trial month 6 complete	Completed
M7-7	Trial month 7 complete	Completed
M7-8	Trial month 8 complete	Completed
M7-9	Trial month 9 complete	In Progress
M7-10	Trial month 10 complete	Not started
M7-11	Trial month 11 complete	Not started
M7-12	Trial month 12 complete	Not started
M7-13	Trial month 13 complete	Not started
M7-14	Trial month 14 complete	Not started
M7-15	Trial month 15 complete	Not started
M7-16	Trial month 16 complete	Not started
M7-17	All Trialling complete	Not started
M8-1	Automation Report complete	Not started
M8-2	Completion of Trial Analysis Final Report	Not started

Table 1: CrowdFlex Key Milestones

Difficulties and challenges

The first difficulty the project faced was the withdrawal of Octopus Energy as a project partner from the project. They highlighted some challenges within the project, some of them to do with the project itself and some of them related to their own business priorities. Whilst this was disappointing, with the assistance of Ofgem and UKRI the project team are actively discussing options with alternative Energy Suppliers. The project has worked tirelessly on this since the announcement and the passion shown by the team has been a key reason that despite this setback we remain broadly on target.

Another difficulty was establishing clear sponsorship of the project within NESO itself, one of the identified concerns raised by Octopus Energy. With continued focus, this has resolved with work. In part this is because, as is mentioned within Section 8, User Needs,



distilling user requirements across multiple teams and directorates and then agreeing ownership for the models into one particular area of the business has proven more difficult than envisaged, but again through determination and socialising the project the team has managed to resolve this issue with the help of Senior Stakeholders.

We also saw the challenge of changes to reporting structures and organisational design due to the transition to NESO. This also exacerbated the general challenge of managing a large project, and the governance of CrowdFlex with engagement needed across NESO areas and a large consortium of diverse partners.

Section 3 – Beta Phase – Knowledge Creation and dissemination

Knowledge capture is an integral part of innovation projects. The project had a distinct set of learning criteria and objectives that the team had to focus on achieving. In addition, there is new learning that is intrinsic to projects like this; the learning we capture along the way.

The project has a learning log that the team created, this is used to track and measure progress on the learning objectives we set. Below are some key insights but the fuller detail is provided in Appendix 1.

Key Learning Objectives

Learning Objective	How the learning is being applied
Can simple incentives, reflecting whole system challenges, “reduce complexity, bureaucracy, and barriers to entry” for aggregators to deliver domestic flexibility.	There is substantial learning from the summer trials and ongoing winter trials, and this is being/has been shared within NESO to inform our flexibility strategy. In addition, the learning is feeding into the product roadmaps for NESO services.
Can the project successfully trial consumer interventions (financial and informational) targeting different system challenges to clarify consumers' preferences and inform future market designs.	There is substantial learning from the summer trials and ongoing winter trials, and this is being/has been shared within NESO to inform our flexibility strategy.
Can the trials prove that residential flexibility reduces bills for consumers.	There is substantial learning from the summer trials and ongoing winter trials, and this is being/has been shared within NESO to inform our flexibility strategy.

Table 2: Key Learning Objectives



New Learning

Learning Point	Learning detail
Data Sharing	The learning process we adopted was to create two Data Sharing Agreements. The first was to share DSRSP postcodes with all DSOs and the second was to share information between partners so that deliverables could be met.
Trials learning	<p>Utilisation: We found little evidence of price sensitivity between groups in the summer utilisation payments trial – lower-remuneration groups performed roughly similar to higher-remuneration groups. Exploratory analysis of event characteristics indicated that a shorter notice period may be more effective; consumers are more inclined to engage when we ask them to use more, but less inclined when we ask them to use less, despite lower per-kWh remuneration for turn-up. We also found evidence that low income and vulnerable customers could benefit, and this is being explored more in the winter trials.</p> <p>Availability: Four recruitment messages were tested. The most effective was ‘get paid’ but there was less difference in recruitment impact in non-fiscal messages than anticipated.</p> <p>Availability: For Ohme customers, both Smart and Non-Smart Tariff groups demonstrated an immediate overnight plug-in increase from the start of the Trial.</p> <p>It’s important to note that there were insufficient events to make significant conclusions from the summer trials regarding the impact of event characteristics on flexible delivery.</p>

Table 3: A Subset of New Learning Gained

Section 4 – Beta Phase – Intellectual Property Rights Generation

The Intellectual Property expected to be delivered pertains to the modelling, both the AFM and the EDM. The day to day running of the trials are not expected to generate any new Foreground IP.

Model	Details of IP
AFM	<p>The AFM is currently expected to be a dataset/model provided by the DSRSP to NESO and these will form part of the Virtual Energy System. As the project progresses through its lifecycle this will be further explored to extract the maximum benefit from the model(s). The Foreground IP for the models will then rest within the Virtual Energy System.</p> <p>Currently the AFM can query data from DSRSPs via the APIs, clean and validate that data and use it together with Met Office weather forecasts to train and generate aggregated demand forecasts and probability forecasts of demand change due to a CrowdFlex event (M5-2).</p> <p>Over the remaining duration of the project, other forecasting algorithms as well as additional data sources will be explored to improve model performance. The final version of the AFM will be part of NESO’s Virtual Energy System.</p>



EDM	The EDM will be developed to predict the probability of delivery of procured flex offers / bids once the AFM has identified a suitable window to use flex for grid management. The EDM is currently in the quoting / contracting stage.
API specification	Description of the API, the data structures it will use, expected responses to API requests, authentication method and performance requirement (milestone DI-2).
OVO demand model	OVO owned foreground IP, OVO project contribution
OVO demand forecasts per GSP (MPAN / asset)	OVO owned foreground IP, OVO project contribution
OVO consumption data (MPAN / asset)	OVO owned foreground IP, OVO project contribution
OVO summer trial evaluation	OVO owned foreground IP, OVO project contribution
Ohme demand forecasts per GSP	Ohme owned foreground IP, Ohme project contribution
Ohme consumption data	Ohme owned foreground IP, Ohme project contribution
Ohme summer trial evaluation	Ohme owned foreground IP, Ohme project contribution
Summer trial evaluation	CSE Evaluation of participating customers' survey responses

Table 4: IP register

Section 5 – Beta Phase – Data Access Details

Data access is a core part of CrowdFlex deliverables. As discussed in Sections 1 & 3 there has been some significant learning obtained around data access itself and the sharing of data. There are a number of issues with sharing data which CrowdFlex is seeking to learn from and provide general insights to the market in respect of how data can be shared in a way that does not compromise privacy but still enable the objectives and deliverables to be met.

We have used the principle that data is presumed open. However, we recognised that some data may be considered personal data under UK GDPR or be commercially sensitive.

We also identified that some personal data may need to be shared with DSOs who are not trial participants.

We addressed the data sharing requirements by creating three supporting documents, a data requirements spreadsheet, a multi-party data sharing agreement and a postcode data sharing agreement for use with DSOs.

At present datasets are not available for general access but as the analysis is completed and the outputs completed data will be made available to stakeholders.



Section 6 – Beta Phase – Route to Market/Business as Usual

The updated roadmap is provided in Appendix 2 for reference. This section details the work done within the project to date to update the original roadmap and commercialisation thinking within the Beta bid submission.

“I think I’m motivated because having an electric vehicle does make you think a lot more differently about how you use energy because you see it on your smart meter and that makes it easier to switch the timing of the charging.”

Consumer survey respondent

Adjustments to processes, products and services

To understand how NESO will adjust networks processes, products and services based on the insights gained from the Project, the Project Team are working closely with NESO’s Markets Division to support the transformation of domestic flexibility to a mature resource alongside traditional forms of flexibility. Specifically:

- the Markets Requirement team who supports the design of new products and procurement mechanisms,
 - the Flexibility and Electricity Markets Strategy team who lead the strategic development of NESO markets, enabling the competition, coordination and coherent design of electricity markets and
 - the Market Change Delivery Team, who lead the implementation of changes to balancing services markets.
- Through the project, NESO will be able to identify the system challenges for which the technical capabilities of domestic flexibility are best suited to addressing. NESO will then be able to align these challenges with the corresponding flexibility services in NESO’s suite of products.
 - We will continue to assess these emerging findings as more analysis can be completed on the data produced in the project trials to further validate the technical capabilities of domestic flexibility.
 - Furthermore, we are developing statistical approaches for forecasting and procuring domestic flexibility, namely the AFM and the EDM. For more details on these models please see Section 8.
 - Following the project, we expect DSRSP-owned models of domestic demand (being developed by DSRSPs within CrowdFlex) would feed directly into NESO’s AFM and EDM.
 - This is expected to provide NESO enhanced forecasting and the ability to plan flexibility actions within existing NESO flexibility services suitable for domestic flexibility.



Necessary Steps and Adjustments

- The AFM and EDM require teams within NESO to own, maintain and run the models in BaU deployment (as discussed in Section 8).
- Engagement with NESO Strategy, Planning, and Control Room (ENCC) teams is ongoing as part of the wider CrowdFlex models' requirements capture to finalise the teams within NESO to own the models in BaU.
- Given the use cases of the CrowdFlex models spans multiple NESO teams' responsibilities, confirming a single owner for the model has proved challenging for the project in 2024. However, through engagement with senior personnel within each team, we expect to finalise the model ownership in early 2025.
- The owning teams will then provide support in the continued development of the AFM and EDM to support the requirement to meet the needs of BaU operations.

Deployment Likelihood

- At this stage of the project with the models not ready for operational testing within NESO, the primary challenge for the team is how it will transition into BaU as opposed to if it will be deployed.
- Continuous engagement throughout the remaining phases with the operation of the NESO business will ensure that we can assess the position on an ongoing basis.

Recommendations

- As the models have not completed operational testing yet and the trials are ongoing, it is too early within the project to provide firm recommendations on how to further exploit the outcomes of the project.

Project approach adjustments

- The initial requirements capture for the CrowdFlex modelling workstream identified that to operationalise forecasting for domestic flexibility within NESO planning and integration to service procurement, two models were required, the AFM and EDM.
- Development of the AFM began in 2024, and development of the EDM will begin in 2025 following the EDM requirements capture in December 2024.
- For more information on these models, please see Section 8.
- With the development of NESO's DFS Evolution to go live the Winter of 2024/25, domestic flexibility is approaching a Commercial Readiness Level of CRL 7. The models developed in CrowdFlex should enable NESO to improve cost efficiency and confidence in deploying domestic flexibility to accelerate market-wide scale-up.



Procurement and Utilisation changes

- The models developed in CrowdFlex require demand forecast data at GSP level submitted by DSRSPs to NESO.
- Should the outputs of CrowdFlex be commercialised by NESO into BaU, NESO may require the submission of demand forecast data from DSRSPs participating in NESO services with domestic flexibility.
- The implementation of this requirement will be addressed in 2025 as part of the ongoing requirements capture work.

Commercialisation Considerations

It is anticipated that the CrowdFlex models will be provided via the Virtual Energy System. This may require some form of procurement activity as detailed above but at this stage it is not clear. The model for NESO providing the Virtual Energy System to the market has yet to be clarified. However, we believe that there will be some commercialisation of the models to provide some additional insights to the industry.

Wider support to the non-network partners

The trials are providing data to train the NESO models of domestic flexibility. However, the data is also used by the project partner DSRSPs, OVO and Ohme, to develop their own models of domestic demand to better forecast the availability of flexibility within their customer base.

By facilitating the improvement in understanding of customer behaviour, the project will help DSRSP partners improve their offerings to customers and their ability to participate in existing flexibility services.

Our approach to post-Beta adoption remains as described within our Beta submission. The project is fundamentally focused on improving the market for residential flexibility and



Rosie Knight, Flexibility Delivery Lead, Ohme

"Ohme's intelligent home EV chargers were founded and designed with flexibility in mind.

We know demand on the grid is growing as EV ownership grows. Ohme's unique software and smart technology enables us to meet customers' EV charging goals while also responding to signals from the grid and providing energy flexibility. CrowdFlex is the perfect opportunity for Ohme to test and refine our flexibility services, better understand customer behaviour, all whilst rewarding them for their participation.

Through CrowdFlex, Ohme customers can demonstrate the positive impact of domestic flexibility, accelerating the move to a greener and more stable energy system."



moreover make appropriate and well-founded adjustments to existing markets, services and products in order for it to compete with existing markets, services and products.

Section 7 – Beta Phase – Policy, Regulation and Standard Barriers

Policy, Regulations and standard barriers are monitored as part of the special conditions. We do not believe that CrowdFlex has any specific barriers at this stage in its lifecycle. Barriers that have been highlighted before having mainly been around market distortions that may occur as part of the trials but as the volumes being procured are modest, we do not believe that this will materialise.

Policies are unimpacted as there are few policies pertaining to the procurement of flexibility services at this stage. We intend to keep a watching brief on developments and are already engaged with the Market Facilitator.

Section 8 – Beta Phase – User Needs

CrowdFlex is a complex delivery for NESO as it covers several diverse requirements delivering new capability within the NESO business. It does not though explicitly deliver a new product as its core concept is more about data provision to NESO and how that data may impact on procurement of NESO services. Therefore, the core of the CrowdFlex outcomes and objectives are informing and enhancing existing services, such as DFS and LCM. This is important because historically NESO has procured services from larger providers, such as Generators, as opposed to from domestic customers which as we move towards Net Zero are likely to form part of the answer to balancing the system.

The users for the CrowdFlex datasets are as follows:

1. Control Room Engineers
2. Flexibility Market Strategy
3. Markets and Modelling

No specific changes to User Needs have been uncovered during the first year of the project but in part this may have been due to the discussions around what the model(s) looked like, their capabilities and how best it could be delivered.



The modelling has been split into two differing models, the AFM and the EDM:

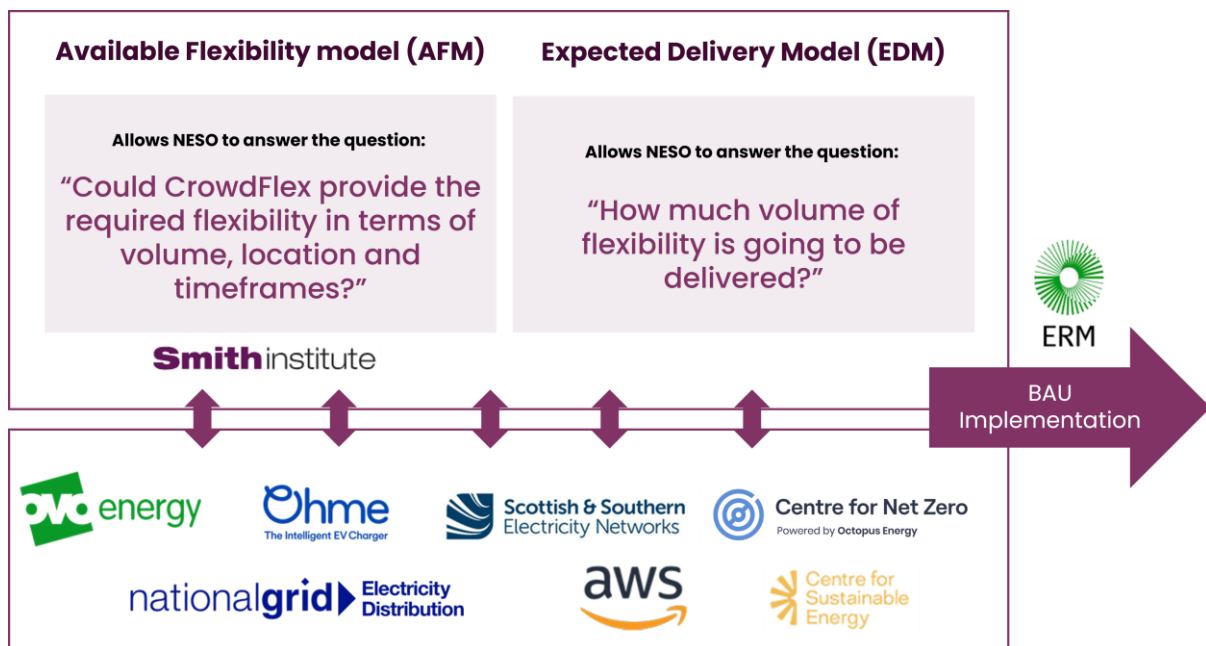


Figure 1: Snapshot of the two models

Each model is further described below:

Model	Description & Purpose
AFM	<p>Purpose: Inform NESO if domestic flexibility is suitable to provide a response in terms of volume, location and timeframe.</p> <p>Overview: Forecast the distribution of delivered flexibility, conditional on NESO choosing to dispatch some domestic flexibility, i.e. available flexibility.</p> <p>Inputs: Half-hourly CrowdFlex trial data, aggregated to GSP-level. DSRSP forecasts of domestic demand. Various public meta datasets (e.g. external temperature).</p>
EDM	<p>Purpose: Inform NESO of the reliability of domestic flexibility delivered for a specific event.</p> <p>Overview: Forecast the distribution of delivered flexibility conditional on a specific dispatch, i.e. the specific volumes procured from each DSRSP. The model will also forecast the impact of procured flexibility on demand outside the flexibility period (demand shift/destruction).</p> <p>Inputs: CrowdFlex and other NESO (& DSO) domestic flexibility datasets.</p>

Table 5: AFM and EDM description

These models will be delivered throughout the lifecycle of the project with the AFM nearing completion of the first phase. The AFM is expected to form part of the Virtual Energy System, with external parties updating their own models to feed into industry datasets that will be available via the Virtual Energy System with DSOs and NESO making use of the information. This landscape will be further explored during the road mapping work being undertaken.

The EDM will help NESO in determining in which situations residential flexibility will be a more viable option compared to other forms of flexibility.



User Journey

Users of the AFM are likely to be NESO and DSOs. The EDM is more likely to have NESO use cases, however NESO will keep a watching brief and communicate with other potential users should any emerge.

As the models develop our two project partners, Scottish & Southern Electricity Networks (SSEN) and National Grid Electricity Distribution (NGED) will be engaged in the mapping of user requirements. The user journey is currently less well defined because we are not yet at the stage where we know how the model will be translated into real life balancing and procurement actions. As the AFM is now nearing completion of the first phase of the build, actual use of the tool will become more to the forefront of the wider project team and will be refined to reflect increased awareness and understanding of its capabilities and appropriateness.

The user journey of the EDM is being mapped with the various stakeholders within NESO and will build on the AFM with responses from impacted parties to complete the build. It is important to recognise that the AFM is also delivering new capability so both the AFM and EDM carry a level of uncertainty. It is expected that, as with the AFM, the EDM's user journey will be elicited and then refined during the next phase of the project as more and more engagement with the internal stakeholders will provide feedback and insights needed to determine how best to leverage the maximum from the data within the model.



Jack Hailstone, Energy Innovation Lead, OVO

“OVO can leverage domestic flexibility to create a win-win scenario for all stakeholders by enhancing grid stability, optimising consumer energy costs and supporting the integration of renewable energy. The outputs of the CrowdFlex trials will help characterise what that domestic flexibility looks like, helping to inform energy flexibility propositions now and in the future.”

User Needs Translation improvements

We regard the translation of user needs as an ongoing and iterative process. It is embedded into what we have been doing thus far. We recognise that to get the maximum out of the models, we need deeply engaged teams from both within the project partners and NESO. Workshops with users have been undertaken on a regular basis to explain the project and how it might be of use to the business. This is then compared to how the business operates today and a gap analysis undertaken of how the model can be improved today with an eye on tomorrow. By engaging directly with the users, we have seen increased interest in the models and how we can deliver benefits to our users and customers.

We accept that there is still lots of uncertainty around the use of residential flexibility. NESO has been using services for many years and with the increased focus on skip rates it is imperative that NESO works with DSOs and the wider stakeholder base to show that changes can and will be made where there is evidence to show that it can be made.



Changes to User Needs

Due to the changing nature of the flexibility market and the role of NESO, this is a factor that has been included within the planning of the tools. Wherever possible we are trying to use agile methods to develop the capabilities needed.

Assumption Testing and Adaptation

As the user needs are in the main part internal to NESO, and that engagement with the business has increased, our original assumptions have been tested and are being tested as part of the move into delivery. Our assumptions at the outset were mainly focused on the evaluation of the benefits that the models could provide. As we transition to delivery it is imperative now that we link the delivery to those benefits/assumptions.

Project Assumptions

Assumptions made at the outset of the original bid application:

- The kW capacity of domestic flexibility available each year following commercialisation is based on the number of EVs and air-source heat pumps (ASHPs) deployed in the UK – Consumer Transformation, FES 2021.
- The percentage of consumers participating in NESO/DSO services is based on a conservative estimate of the deployment of smart tariffs (as an indicator of engagement in energy markets).
- The Number of households that are in Constraint Management Zones (CMZs) used to indicate the proportion of customers that can participate in DSO services is based on SSEN projections for the number of constrained substations on their network, growing as LCTs are deployed.
- The scale up, ongoing maintenance, and human resources cost of NESO systems to manage the new resource of aggregated domestic flexibility are based on work conducted in CrowdFlex D8.2.
- The scale up cost of DSRSP systems to manage the new resource of aggregated domestic flexibility is based on a conservative estimate of the cost of managing the DFS for DSRSPs, scaled up to represent the increased scale of CrowdFlex. The ongoing maintenance and human resources costs are as above.

Section 9 – Beta Phase – Impacts and Benefits

Impacts and benefits

Our Cost Benefit Analysis, (CBA), demonstrates that domestic flexibility, following the completion of CrowdFlex: Beta, has a NPV of £1.2m in year 1 (2027), £74.9m in year 3, £363.7m in year 5, and £1.95b in year 10 (2036), at full roll-out. These benefits continue to increase out to 2050 when the annual net benefit of CrowdFlex is £2.2b/yr, leading to a NPV of £12.0b. CrowdFlex delivers whole system net benefits by reducing system



operational costs, mitigating/delaying generation capacity and network investments, and accelerating decarbonisation.

The CBA identifies both operational savings as well as reduced capital investments for NESO and DSOs. It includes domestic consumers providing energy balancing via the Balancing Mechanism and thermal constraint management on the transmission and distribution networks reducing operational and network investment costs. These are the largest expenditures at NESO level, £580m/yr (27%) and £1.4b/yr (67%) of NESO costs respectively (2021/22). The NPVs of these benefits in years 1, 3, 5, and 10 (2036) are the following:

- Reduction in NESO operational costs via energy balancing: £3.4m, £24.8m, £72.5m, £344.1m
- Reduction in transmission network reinforcement investment, realised as reduction in NESO thermal constraint management costs: £2.4m, £83.6m, £225.9m, £942.14m
- Reduction in distribution network reinforcement investment: £0.3m, £17.5m, £47.4m, £197.6m

CrowdFlex will help accelerate decarbonisation, reducing the need for thermal generation to support Variable Renewable Energy (VRE) dispatch and provide energy balancing. From 2027, this equates to a cumulative discounted benefit of avoided CO₂ emissions equating to 0.23MtCO₂eq, 1.0MtCO₂eq, 2.5MtCO₂eq, and 10.7MtCO₂eq in years 1, 3, 5, and 10 respectively.

Updates to the CBA

- As the trials have finished for the summer and we are in the first winter trials, updates to the CBA have only covered the initial trials, we do not yet have sufficient data to confidently update the CBA.
- As CrowdFlex gathers and analyses more data from the trials, the assumptions that underpin the CBA will be updated to reflect an improved understanding of domestic flexibility.
- We will also monitor to identify and quantify any additional benefits or significant problems with the approach to the CBA as CrowdFlex continues. However, none have been identified to date.
- The CBA has been updated to reflect the December 2023 start to the project rather than the initially planned July 2023 start. This has had minimal impact on the impacts of CrowdFlex.

Section 10 – Beta Phase – Risks, Issues & Constraints

Below we have detailed the relevant constraints and risks we have experienced during the first year of the project. Whilst the project has clearly had periods of challenge it is encouraging that both the NESO team and wider stakeholders have supported to identify and resolving issues as they have emerged.



Constraints in Regulation, Legislation and Commercials

The project has not experienced any specific challenges or issues in regulation or legislation so far. The project is not testing or trialling anything that is currently influenced by or influencing any externalities that would mean that the regulatory environment or legislative one would create a specific concern. One matter that was considered during the bid was the potential for any market distortion to occur from the trials, but this was assessed and determined to be not an issue at the early stages due to the volume of flexibility services being procured.

Commercially, the exit of a partner from the project and subsequent change request has been the main area of concern due to the impact on the rest of the consortia through the collaboration agreement. This has been addressed and resolved.

We are monitoring throughout the project the progress made and the impact on BaU rollout and do not expect there to be any specific challenges, to the extent that NESO would have to go through normal procurement processes anyway at the end of the project to affect a rollout.

Risks, Issues experienced and mitigations, resolutions undertaken

Below are the current major risks to the project. The CrowdFlex Project Lead and Project Management Office meet with the Workstream leads, Partners and suppliers monthly to review risk status and progress and mitigations are discussed with the Sponsor and at the Project Board. Risks & Issues are also updated by the owners as part of the bi-weekly reporting process

Title	Description	RAG Score	Mitigation
Timing of EDM	There is a risk that the EDM is not delivered in time for utilising the winter trials. This would mean the winter trial data could only be ingested after the trials missing the chance to inform trial design through analysing model output. The impact will be that only the summer 25 trials can be shaped by the model output. Less 'specific' training data could lead to poorer performance of the model.	16	<ol style="list-style-type: none"> 1. Agree scope, costs and timeline for delivery of the EDM 2. Engage BAs to ensure scope meets business needs 3. Incorporate data from other NESO projects (DFS, LCM, SAA)
Data Request Issues	There is a risk that training the model will be delayed because of issues with retrieval of forecast data through the APIs. After completing the data pipeline, SI have started requesting data from the DSRSPs and discovered that the requests returned incomplete/malformatted data. The	16	<ol style="list-style-type: none"> 1. Smith Institute (SI), to provide detailed error descriptions. 2. Close collaboration between OVO, Ohme and SI to resolve.



	data is necessary to train the model and subsequently produce forecast.		
Customer outage due to Network Constraints	There is a risk that if we ask customers to turn up/switch on/charge in constrained areas that this could cause a customer outage in that area due to localised network constraints. The impact would be that SSEN may then have to pay some form of compensation for the number of minutes of that outage as there is an obligation to keep the 'lights on'. This may therefore have a negative impact on the perception of the trials.	15	<ol style="list-style-type: none"> To reduce this risk the project has a process for sharing events ahead of time, we are also agreeing Short Form Agreement between the DSRSPs and DSOs Agreement is between DSRSPs and DSOs and is designed solely to share postcode information and therefore presents no GDPR risk to NESO or the partners. In the interim the DSOs have agreed that trials can go ahead without agreements in place
Key Resources being utilised elsewhere	There is a Risk that other project and initiatives taking place in NESO (e.g. Clean Power 2030) will draw upon key NESO resources taking part in the model development.	12	Project Lead to monitor and raise to Sponsor if there are any issues
AFM into BaU	There is a Risk that the AFM will not be accepted or implemented into BaU	12	<ol style="list-style-type: none"> Project Sponsor has nominated model owners from the business who are participating in the requirements capture process. ERM are working with NESO to assess barriers to implementation for CrowdFlex

Table 6: Key Project Risks

Adaptions we have made

We have consistently been adapting throughout CrowdFlex. The risks and issues that have emerged have been challenging to the team, but we have responded to those challenges in innovative ways to keep true to the intent of the project. The project team meets regularly to review progress, raise issues and risks, and mitigate accordingly. We have adapted the trials throughout to respond to the changing landscape and some key changes have been:

Model

Issues with NESO's Azure environment slowed down progress of the model development. To reduce the risk of delay, we have decided to move development to the Smith Institute's estate. This has allowed rapid progress while allowing time to solve the AAE problems.

Though initial tests showed that the data for the model training was available and ready, at verification stage we found out that this wasn't applicable to all the data. The project



partners have worked together closely to resolve issues quickly and the Smith Institute have adapted their model training approach to make it possible to meet the M5-2 milestone at the planned date.

Section 11 – Beta Phase – Working in the Open

Methods used to communicate publicly about the project

We have been using several NESO communication channels and methods to ensure we engage, work transparently and share progress widely with stakeholders. These include:

- news articles published on the website
- a dedicated CrowdFlex project webpage
- project updates in Innovation publications: the Innovation Strategy Report and Innovation Annual Summary
- email industry newsletter (8k subscribers)
- social media corporate accounts (LinkedIn – 14k followers, X – 31k followers)
- presentations and panel discussions at public conferences and university lectures
- NESO Innovation stand at the Energy Innovation Summit with CrowdFlex project team in attendance
- individual meetings with interested people/organisations.

See appendix 4 for examples of communications material.

Project partners have also shared updates and learnings about the project through their own communications channels, including press releases; via websites; corporate account social media and conference presentations.

How we are collaborating with our stakeholders to promote and refine the project

It is vital for the success of the project to collaborate with stakeholders and to incorporate their expertise and knowledge. We encourage external industry participants to engage with the project, for example we have a dedicated innovation email inbox that we publicise for any interested party who would like to make direct contact with the project team.

We have collaborated with several external organisations on specific work packages, for example Citizens Advice and UK100 helped refine the consumer communications guidelines and consumer survey strategy.

The project team engage across NESO to ensure the wider organisation's needs and expertise is incorporated, with regular meetings and workshops taking place.

Inviting challenge and external input on the project approach

We are keen to invite external input on the project as incorporating this wider perspective will contribute to its success. The project has been presented by NESO and project partners at several public industry events including the Energy Innovation Summit. We



invite feedback and input via these events, such as during panel discussions, or in-person afterwards and via the Innovation email inbox. We also meet interested stakeholders on an individual basis to discuss the project and to invite their feedback.

CrowdFlex updates have been regularly presented to the Virtual Energy System Advisory Groups, where the project has been discussed in detail. We have invited the wide range of external members to challenge and provide expert feedback on the project approach and progress.

Sharing our learning to avoid duplication of efforts and to accelerate industry progress on related initiatives

We have shared learnings widely and undertake innovation project horizon scanning. Project updates are also included in our annual innovation publications: the Innovation Annual Summary and Innovation Strategy Report.

We often meet interested parties to discuss their related innovation initiatives, which helps avoid duplication, and we also explain and provide guidance on the innovation process. Industry participants are encouraged to develop their own innovation projects and if suitable for a NESO partnership to submit their project idea via the 'Big Idea Pitch' form on our website. This helps accelerate industry progress and can result in NESO working with external organisations on new related innovated projects.

Working openly and building relationships with organisations and teams responsible for other parts of the user journey

The project partner team includes a wide range of organisations, and we are always keen to build relationships with further stakeholders. We take part in industry events such as the Annual SIF Community Forum; these are valuable opportunities to work openly and learn about other parts of the user journey.

We work closely with Ofgem and have regular update meetings to discuss project progress and for Ofgem's insights.

We are members of the Energy Networks Association (ENA) and we benefit from ENA supported engagement with other networks and their innovation departments and Innovation Managers. Stakeholders are also able to contact us to discuss and propose innovation ideas through the ENA's Smart Networks Portal.

Insights gained from stakeholder engagement relevant for future projects

The project has undertaken surveys and interviews with some of the consumers who took part in the first phase of summer trials. The results of this work combined with the learnings from testing the different trial recruitment messages will be valuable for informing future consumer communications. This could be a potential area of research as domestic flexibility is relatively new, so consumer communications are rapidly evolving and could require further research to incorporate learnings over time and experiment with new strategies and initiatives. Expert input and insights from stakeholders, such as Citizens



Advice, will be crucial to the success of future projects in this area, and early engagement would be recommended.

As domestic flexibility develops, with industry participants proposing new and exciting initiatives, there could be a need for more clarity between flexibility initiatives and how they interact, to ensure consumers continue to maximise their benefit from flexibility.

“There was a money saving. That wasn't my intention. My intention was how to be more efficient or smarter.”

Consumer survey respondent

Section 12 – Beta Phase – Costs and Value for Money

Our budget is as follows; the budget is subject to a change request to move the Octopus Energy funding to NESO:

Project Partner Name	Actual Spend Nov 2024	Budgeted Nov 2024	Variance Nov 2024	Variance Percentage
NESO	£ 2,428,803	£ 4,570,969	£ 2,142,166	47%
OVO Energy	£ 1,555,244	£ 1,897,520	£ 342,276	18%
Ohme-EV	£ 1,223,805	£ 1,303,950	£ 80,145	6%
CNZ	£ 924,033	£ 1,089,670	£ 165,637	15%
SSEN	£ 29,611	£ 91,600	£ 61,989	68%
NGED	£ 17,820	£ 25,680	£ 7,860	31%
ERM	£ 335,453	£ 352,274	£ 16,821	5%
AWS	£ 145,540	£ 886,348	£ 740,809	84%
Total	£ 6,660,309	£ 10,218,011	£ 3,557,702	35%

Table 7: Figure reference

These figures exclude Octopus budgeted amount of £1,109,025 which currently undergoing a change request to transfer the Octopus budget to NESO. This budget will then transfer to a replacement supplier during Q1 2025 as we potentially onboard a new supplier.

Value for Money for consumers

The benefits of CrowdFlex continue to be expected to be delivered in accordance with the bid submission document. On the basis that NESO believes that this is still expected then the value for money for customers remains to be the case. The benefits as indicated in Section 9 (and Appendix 2) we expect to be realised. These benefits see a NPV of £1.2m in year 1 (2027), £74.9m in year 3, £363.7m in year 5, and £1.95b in year 10 (2036). Given the scale of CrowdFlex and the potential benefits of using residential flexibility in conjunction with more traditional services the benefits and value for money to customers are very apparent.



“Because it’s better for the environment. But also, money off my bills, because bills are really, really high at the moment.”

Consumer survey respondent

Variations to spend

The project continues to make steady progress towards its set milestones, while there is an underspend compared to forecasted cost, this has not impacted the overall delivery of the project. The primary reason for the underspend is the early exit of Octopus, which had been allocated a substantial portion of the trial budget.

Additionally, the early exit of Octopus meant some partners have a reduced scope of work and are consequently spending less. It is important to note that these changes have not hindered the progress of the project.

Another factor contributing to the underspend is the delayed NESO model development and AWS commenced their work later in the project than initially planned. These factors have resulted in deferral of the associated costs, further contributing to the underspend.

Unspent funding

The project continues to deliver against the set milestones despite the reduced cost against forecasted. The underspend is anticipated to be absorbed later in the project, and should a need arise to return any unspent amount, we will follow the necessary procedures.

As mentioned previously, the reason for spending occurring later in the project is due to Octopus leaving the project and the potential of a replacement supplier expected to come on board for summer trials in 2025.

Additional Funding

No additional funding or contributions are expected to materialise over the course of the project.

Revenues earned returned to customers

It is not anticipated that CrowdFlex will earn revenues that will require to be returned to customers.

Project Partner Name	SIF Funding Requested	Total Actual Project Spend	Total Project Contribution made (incl. contributions in kind)
NESO*	£10,444,960	£12,868,200	£2,423,240
OVO Energy	£2,613,168	£3,266,460	£653,292



Ohme-EV	£2,122,800	£2,497,800	£375,000
CNZ	£1,746,589	£1,940,655	£194,066
SSEN	£163,075	£181,194	£18,119
NGED	£38,135	£42,372	£4,237
ERM	£436,458	£498,810	£62,351
AWS	£987,114	£1,233,892	£246,778

Table 8: Partner spend split *includes Octopus Energy for ease of presentation

Section 13 – Beta Phase – Special Conditions

Detailed below are all the conditions detailed within the Project Direction and the current status of them with commentary as required. The requirement is summarised below, and the status of each condition is described in detail as required.

Condition No	Description	Summary Text	Status
2	Financial contribution	The Funding Party must report on the financial contributions made to the Project as set out in its application.	Met, the project reports quarterly to UKRI and Ofgem on the status of the project finances and contributions.
3	Meeting arrangements	The Funding Party must participate in all meetings related to the Project that they are invited to by Ofgem, UKRI and DESNZ during and after the Beta Phase.	Met, we have met as requested.
4	Stage gate scoping	The Funding Party must, with support from Innovate UK/UKRI and, where applicable Ofgem, scope the requirements and success criteria for each stage gate within a Project at the quarterly reporting meetings ahead of any stage gate.	Met.
5	Dissemination of annual progress report(s)	Each of the annual progress reports that the Funding Party publishes in the Beta Phase must, at a minimum, be uploaded to the ENA's Smarter Networks Portal. We also strongly encourage wider dissemination of the annual progress report(s) and support from all Project Partners in ensuring it reaches a wide audience.	Met- this is the first Annual Report for CrowdFlex.
6	Impact monitoring	As part of the end of Project Phase report, the Funding Party must produce a Project Impact Monitoring and Evaluation Plan.	To be completed as part of closedown
7	SIF Community Forums	The Funding Party and all Project Partners must make reasonable attempts to attend, participate and/or	Attendance at SIF Forum on 8 th February 2024



		contribute at SIF Community Forum events occurring during the Project delivery. We anticipate there being approximately one event per year	
8	Policy, regulatory and standards barriers	The Funding Party must provide verbal updates at each quarterly meeting on any regulatory, policy and standards barriers and any change requirements which may impact delivery of the Beta Phase activities.	As detailed in Section 7, there are currently no recorded or expected barriers to the progress of CrowdFlex nor its adoption as part of NESO BaU processes. We continue to monitor the wider landscape to capture and measure the impacts of change.
9	60 Second video	The Funding Party must provide within the first three months of the Project beginning (i.e. by 1 October 2023) an updated 60-second video. If the Project is greater than two years (longer than 24 months) in length, an updated video must also be provided at the Project's mid-point meeting.	Met
10	Consumer engagement	The Funding Party must provide an update as part of each stage gate scoping monitoring meeting on consumer engagement plans. This must include an update on any activities which involve engagement and interaction with energy consumers, and any impact the Project may have on existing or future energy consumers and their premises.	Met. OVO and Ohme regularly engage with their customers about the trial events. CSE have conducted surveys with 3,500 consumers who took part in the summer trials.
11	Post-Beta Phase roadmap	The Funding Party must provide to the monitoring officer by the third quarterly monitoring meeting (i.e. in Q3) a roadmap for activities post-Beta Phase.	A response to this condition is provided within Section 2 of this report
12	Commercialisation strategy	The Funding Party must provide to the monitoring officer by the third quarterly monitoring meeting (i.e. in Q3) a roadmap for activities post-Beta Phase.	A response to this condition is provided within Section 2 of this report
13		As part of each of its Beta Phase annual progress report, the Funding Party must provide an attachment which	This will be provided throughout the



		summarises the insights developed by the Project and the flexibility service providers on consumer demographics to date or since its last annual progress report.	project as part of learning capture and dissemination.
14		The Funding Party must provide an outline report to its monitoring officer ahead of initial trial commencement outlining how the raw participant data gathered by the Project will be made publicly available.	We are currently working with participants to identify all the data requirements. Once this has been completed, we will outline how this can be shared publicly.
15		The Funding Party must provide as part of stage gate 1 (set out as Stage Gate 1 in the Gantt chart) and ahead of progressing to any trials a presentation clearly illustrating how the CrowdFlex market will interact or complement and/or impact existing markets and the balancing mechanism.	This was covered as part of the first stage gate. We have ongoing dialogue with all parties about other market impacts and currently the position remains that the volume being procured is not sufficient to create distortions. Note that it is important to remember as well that CrowdFlex itself will not be a new market, it will inform existing ones.
16		As part of Stage Gate 1 (set out as Stage Gate 01 in the Gantt chart) and ahead of progressing to any trials, the Funding Party must provide an explanation summarizing how the Project and the data generated by the Project will align with the Funding Party's licence conditions for sharing data and will align with Ofgem's Data Best Practice Guidance.	There has been work to agree Data Sharing Arrangements between the partners. The learning from this exercise is recorded in the learning log. Now that the Data Sharing Arrangements are broadly agreed we will be documenting the final designs and



			data management framework.
--	--	--	----------------------------

Table 9: Special Project Conditions

Section 14 – Beta Phase – Material Changes

There are two material changes that have been made but these have been merged into one change request. Other changes proposed via the project change control process have been minor changes to the trials but have not required material change to the project. These changes are though included in the project plan.

The materiality of the following matters has necessitated a change to the project direction.

Change	Rationale
Octopus Energy’s withdrawal from the project	Change needed to financials and schedule/plan due to their decision to leave the project
Changes to the Milestones/Deliverables to simplify and measure success	The original plan presentation was, on reflection, not as clear as it could have been (and this is reflected in the project learning). The plan focussed on Work Packages rather than the delivery flow and this led to a confusing number of Milestones and Deliverables, some of which were duplicated. As part of the replanning exercise necessitated by Octopus Energy’s decision to leave the project and once the project delivery had stabilised, we reviewed everything to map out a more reasonable presentation of delivery and a simpler reflection of Milestones and Deliverables.

Table 10: Material changes to project to date



Appendix 1- Learning

Learning obtained from the first year of CrowdFlex has been grouped into two distinct types, the learning we sought to obtain as part of the project objectives and the learning that we gained along the way. Detailed below first are some new items and the rest of the tables detail the main learning captured and the learning objectives we set out to achieve at bid stage.

Workstream	Type	Learning Point	Progress
Data Sharing	New learning captured	Data Sharing is complex. The approach taken was to separate data needed or desired by the DSOs to share trials location (postcode only data) and data needed by the partners to deliver against specific outcomes needed. We created two agreements the second agreement supported by a spreadsheet that listed data against requirement. This worked in principle, but it took far longer than we had imagined. The core reason for this is not fully understood but the key learning point to come from this is the sooner that you can start this exercise the better.	The approach has been reused for our new SIF project, Powering Wales Renewably, but the process has been used during mobilisation.
Trials	New Learning Objective	How do incentives influence participation levels?	We will update progress on this throughout the rest of the project
Trials	New Learning Objective	How does participation affect energy consumption during and outside event windows?	We will update progress on this throughout the rest of the project
Trials	New Learning Objective	What long-term effects (e.g., habit formation or fatigue) do incentives have?	We will update progress on this throughout the rest of the project
Trials	New Learning Objective	How do variations in event parameters and customer archetypes impact responses?	We will update progress on this throughout the rest of the project

Table 11: New learning objectives

Additional new learning is below:

New Captured Knowledge – Summer Trials

DSO Coordination	We experienced challenges around trial events with localised constraints meaning that more coordination with the DSOs has been needed. This is a good learning that can and is being taken forward through initiatives like DER Visibility/MWD Dispatch/Cascade.
Incentive levels	Utilisation: Behavioural patterns did not reflect expectations. No clear link between higher price incentives and greater volumes delivered.



Customer Engagement	Utilisation: People are more inclined to engage when we ask them to use more, but less inclined when we ask them to use less, despite ‘free electricity cap’. Low income and vulnerable customers could benefit.
Notice Period	Utilisation: Early indications that that a shorter notice period is more effective.
Messaging	Availability: Four recruitment messages were tested. The most effective was ‘get paid’ but there was less difference in recruitment impact in non-fiscal messages than anticipated.
Customer Performance	Availability: Average overnight plug-ins increased from 30% to 45%, daytime plug-ins from 10% to 18%. Biggest improvement, late afternoon, the smallest first thing in the morning.
Customer Performance	Availability: For Ohme customers both Smart and Non-Smart Tariff groups demonstrated an immediate overnight plug-in increase from the start of the trial
Customer Performance	Saving money was the most frequently stated reason for signing up to the challenge (73%), although the data from the trials didn't back this up. Non-fiscal messages worked almost as well as fiscal messages
Customer Engagement	Over 60% of the participants reported that they felt like they were making a difference by participating in CrowdFlex, and 58% reported that they enjoyed the trial.
People and Culture	The CrowdFlex Trial is commonly confused as being a flexibility service name rather than an innovation project to provide a modelling capability for domestic flexibility

Table 12: Summer trials captured knowledge

New Captured Knowledge- Winter Trials 24

Industry Processes & Regulation	Project Stakeholders at NESO concerned that there may be operational conflicts between CrowdFlex trials & NESO's LCM service.
Industry Processes & Regulation	National Flex trials require engagement with all DNO/DSO, not just those with official partner status within the project. Regardless of whether there is an interest in the workings or outputs of the trial there is a potential of impact on distribution infrastructure and therefore the associated regional owner / operator requires to be included within planning and agreements to proceed gained to minimise risk.

Table 13: Winter trials captured knowledge

New Captured Knowledge- Models

IT	AAE: Decision about the development environment was taken without testing maturity and readiness. This led to delay of the model development and additional cost having to instruct Smith Institute to stand up their own dev environment. Proposed solution: Create standard test suite that covers all AAE functionality/ services - developers can choose which tests are relevant to their project and see what functionality is missing.
IT	M5-2: API tests and DSRSP internal data test passed as green, but once 'real' data request was performed they failed. Proposed solution: Design more in-depth tests, not just connectivity and one data point.



Data	Providing a postcode for each DSRSP recruited customer instead of an MPAN can be a substitute data artifact that is sufficiently anonymised for GDPR but sufficiently accurate and granular for distribution network impact assessment.
Data	DNO's can provide batches of postcodes for constrained areas in advance of recruitment with a view to limiting the maximum number of participants or inoculating from the trials altogether in the most serious cases
Data	Original granularity of data at GSP level is too inaccurate to provide DNOs with any meaningful view of how their networks may be impacted and undermines any engagement seeking trial events approval
Data	Data privacy, GDPR and data sharing frameworks prohibit direct sharing of customer asset information to DNOs to provide locational visibility to enable bottom-up assessment of distribution network impact from events
Data	Without granular data to confirm location and concentration recruited customers, it can be necessary for DNOs to restrict certain areas from potential recruitment if network issues such as constraints exist and potential CrowdFlex event impact unclear

Table 14: Models captured knowledge

Main Project Learning Objectives

Incentives	<p>Can simple incentives, reflecting whole system challenges, “reduce complexity, bureaucracy, and barriers to entry” for aggregators to deliver domestic flexibility</p> <p>Based on the summer trials results, there is evidence that simple incentives do work with consumers and that this does result in successful delivery of flexibility services. Customer price sensitivity in the summer trial was lower than expected, and we will investigate this in more depth in our winter trials.</p>
Trials Design	<p>Can the project successfully trial consumer interventions (financial and informational) targeting different system challenges to “clarify consumers” preferences and inform future market designs.</p> <p>Our first trials do show that we can successfully use consumer responses in the system.</p>
Trials Design	<p>Trial the service primacy rules developed with NESO and DSO stakeholders in previous phases to “Improve coordination between networks and other system participants”</p> <p>This will be trialled in 2025</p>
BaU	<p>Can the trials prove that residential flexibility reduces energy costs for consumers</p> <p>Whilst bill reduction is a wide-ranging aim, it is clear from the early results that consumers can effectively be recompensed for providing services to NESO and DSOs.</p>
BaU	<p>Can the trials successfully prove that domestic flexibility can become BaU for NESO and DSOs</p> <p>We are at an early stage but the evidence of the first trials does suggest that residential flexibility can be a source of flexibility for NESO and DSOs.</p>



Analysis	<p>Can participation in the CrowdFlex trial prove that Residential flex will not necessitate any major changes in contractual arrangements of consumers</p> <p>The work undertaken so far is probably too early to make an informed position just yet but as the trials progress in 2025 we will provide an update</p>
Analysis	<p>Can energy suppliers working with NESO and DSOs engage consumers effectively in the provision of coordinated flex services to the betterment of the "system" and do so in a way that is measurably reliable?</p> <p>Early evidence suggests that this objective can be met. Reliability measurements will improve as the evidence base builds.</p>
Analysis	<p>In the utilisation trials, how many customers were expected to turn up vs the number who actually turned up?</p> <p>This will be updated as we progress through the rest of the trials.</p>
Analysis	<p>What were the primary technology types involved in turn up?</p> <p>This learning point will be updated as we progress through the trials and gain more data.</p>
Analysis	<p>How many participants actually turned up in the two 17/20 SSEN licences areas?</p> <p>9,194 customers turned up during the trials in the SSEN areas</p>
Analysis	<p>How effective domestic flex is at resolving network constraints?</p> <p>This learning point will be updated as we progress through the trials and gain more data.</p>
Analysis	<p>The reliability of domestic flex, to inform how much we aim to over-procure</p> <p>This will emerge over the duration of the trials and some early insights are contained within the CSE report.</p>
Trials design	<p>Price – Response characteristics of domestic flex to inform our commercial strategy and who we target with which flexibility products</p> <p>This will form part of the designs for the rest of the trials and then feed into NESO products in the future.</p>
Trials design	<p>How far ahead DSRSPs know the domestic flexibility resource available, to inform the timescales which we procure our flexibility products</p> <p>This learning objective will be more demonstrable over the duration of the project but via using differing time horizons to procure we will have a solid evidence base on which to base our results.</p>
Trials design	<p>How DSOs can co-ordinate the procurement of domestic flex with NESO to maximise whole-system benefit?</p> <p>Coordination will be trialled with the DSOs in 2025 using some simple techniques to establish the process of coordination of flexibility procurement.</p>

Table 15: Main learning objectives

Specific learning from CSE customer feedback survey and interviews

CSE conducted a customer feedback survey and several interviews with trial participants to gain insight and feed this into forward planning of the trials. The first of four customer feedback surveys to be undertaken throughout the CrowdFlex trial was delivered in August



2024, followed by a small number of customer interviews. The survey went out to 30,000 OVO customers participating in the summer 2024 utilisation trial, 3,600 people responded.

<p>Review options for event reminders to help people remember to take part</p>	<p>SMS event notifications being provided/tested throughout Winter. We already suggest to customers on our emails that they could “set up a reminder”</p>
<p>Increase and target communications that gas use is not part of CrowdFlex to limit risks for the winter trial from people turning down gas central heating or not adequately heating their homes.</p>	<p>Not currently in play, however OVO to review and design educational content and identify teaching opportunities for second half of Winter/Summer (e.g. additional FAQ, “electricity” instead of “energy”)</p>
<p>Consider how to support people to automate their flexibility</p>	<p>Alongside reminders, OVO working with AWS for an Alexa skill being introduced in Summer with links to automated devices/assets</p> <ul style="list-style-type: none"> • It will always be limited by the number of controllable assets that a customer has (for e.g. LCTs) and whether or not these will feature in a separate trial (e.g. EV chargers in Availability trial). • We could look at smart plugs as incentives/prizes for the summer which allows participants to automate certain higher load electrical devices at home.
<p>Consider how to reduce negative experiences and outcomes of low electricity users.</p>	<p>Key distinction needs to be made between low EAC users generally and users with already low baseline demand during event windows (the latter meaning that they may already be shifting energy out of the times we are asking them to shift out of for CrowdFlex thus reducing the volume of flex they are being credited for).</p> <ul style="list-style-type: none"> • We have to accept that flexibility market designs won’t be a “one size fits all” for all customers • Although some participants may have a lower baseline already, we have to consider any incentives they may already be receiving outside of CrowdFlex (e.g. Power Move) • Consistency bonus is currently working to reduce low rewards/negative experience of low electricity users due to the low 50% target of successful events and 0.01kWh shifted target. This was decided to promote consumer centricity and to not penalise those who would struggle to reach a higher success kwh threshold.
<p>Determine the extent that CrowdFlex participants have competing demands for their flexibility and identify how this impacts CrowdFlex.</p>	<p>When we have more data from the winter trial, we will analyse performance of Power Move customers against other customers. Currently if there is a successful LCM event, we will look to cancel CrowdFlex events and advise NESO, so there should be no impact.</p>

Table 16: Learning from CSE



Appendix 2- Post-Beta Phase

Roadmap

The original Business Plan Timeline is provided below. This roadmap is reviewed periodically and as the project progresses updates provided.

CrowdFlex's deployment will be split into 4 distinct phases:

- Model development and trial (2023-25) – The CrowdFlex: Beta study will develop and integrate a probabilistic forecasting model of domestic flexibility and conduct associated trials of domestic flexibility to provide data and understand the key properties of domestic flexibility. Only trial DSRSPs and associated consumers will be able to participate in flexibility events during this period.
- Scale-up to BaU (2026-2030) – Following the conclusion of Beta, NESO, DSO, and DSRSPs will work together to implement the probabilistic forecasting model of domestic demand and flexibility into NESO operations. This will reduce uncertainty in demand forecasting and improving visibility of domestic flexibility during “routine” and system stress events. Furthermore, stakeholders will scale-up domestic flexibility, prioritising consumer groups identified in Beta.
- BaU and statistical procurement of flexibility (2030-2035) – From 2030 there will be ~3GW of domestic flexibility available to NESO. During this period the long-term benefits of reducing network and wider system costs and savings to consumers will be realised. Additionally, CrowdFlex will drive innovation further, by transitioning to a statistical method of procuring flexibility, where flexibility is not derated and instead procured on an expected capacity and probability distribution function (pdf) basis. This will enable the full potential of domestic flexibility to be realised, improving system security and generating a discounted net benefit of £493m by 2035.
- Long-term operations (2035) – Domestic flexibility and the statistical procurement of domestic flexibility via CrowdFlex is expected to continue to support the Net Zero power system from 2035 onwards. The uptake and value of domestic flexibility is expected to continue to grow out to 2050 where it is expected to provide a net benefit of £2.2bn per year.

Given the results seen to date, it is still expected that this roadmap will still be delivered against.

The commercialisation strategy is the same as this transition plan. It is important to note that CrowdFlex is about developing and informing existing products and services and is not developing new ones for commercialisation.



Appendix 3– KPIs

Below are the KPI's that have been developed within the project and which form the basis for assessing the success of the trials and project objectives.

KPI	Description	Unit	Target
Performance of AFM	Raw performance of the AFM forecasting will be determined using the mean absolute scaled error (MASE). Computing MASE will be done using held back data, not used for model training, to calculate how close forecasts are to flexibility delivered. This compares errors of the model forecast against a naïve forecast of a simple mean of the data seen.	Mean absolute scaled error (MASE)	<1 for productive forecast <0.5 strong forecast
Improvement in accuracy of the AFM	The improvement in accuracy of subsequent forecasts generated by AFM compared to the accuracy of the initial forecasts generated by AFM. This is completed calculating the percentage improvement of MASE over time, relative to past performance. Any decrease in MASE is an improvement in forecast performance.	% change	Decrease -10% over 1 month of trial data is a strong improvement
Conversion of raw trial data to DSRSPs-processed data	The pipeline of data will invariably cause some losses due to incompatibility or errors. The first stage is between the raw data and the DSRSP processed data. This is a measure of the % of the data points lost from the raw collected of the trial events in the DSRSP processed data following data cleansing and anonymisation.	% loss	<10%
Conversion of raw data to data for model training	The second stage of the data pipeline is between the DSRSP and NESO. NESO processed data is aggregated across DSRSPs and is used to train the model. This is a measure of the % of data points lost from the raw data in the data that is used as training inputs for the AFM.	% loss	<20%

Appendix 4 – Communications

NESO National Energy System Operator

Search Data Portal

What we do Energy 101 Industry information News and events Publications Energy outages Careers About

Home / News and events / CrowdFlex project successfully completes first phase of large-scale consumer trials

CrowdFlex project successfully completes first phase of large-scale consumer trials

Future energy - 16 Sep 2024 - 4 minute read

Initial results from this leading-edge innovation project reveal the future potential of domestic flexibility to help manage the grid.

Our major innovation project, CrowdFlex, has successfully completed its first phase of summer consumer trials, with 31 electricity demand shifting events held between May and July, incentivising consumers to use their electricity flexibly by adjusting their energy usage (turn up or down) or make assets like electric vehicles available to the grid for automated control of when to charge.

The CrowdFlex trials tested different recruitment messages and incentive levels to investigate behavioural and technical influences on how consumers can play a larger role in balancing the national electricity system in future.

OVO recruited approximately 37,000 customers to conduct **utilisation payments** trials, investigating customer demand response in a series of turn-up, turn-down and mixed response events. Consumers were encouraged to shift their energy during use into or out of event time windows, using or forgoing using energy intensive devices such as washing machines and dishwashers.

Ohme EV's **availability payments** trials, with approximately 1,300 customers, explored the extent to which consumers with electric vehicles changed their plug-in behaviour using a variety of incentive levels and their willingness to allow remote dispatch of their EV charger.

Subsequent trials within the CrowdFlex programme will further investigate the results from these first trials.

Both OVO and Ohme implemented Randomised Control Trials to identify the flexibility response of domestic consumers. They used this trial design to investigate the impact of price sensitivity and fatigue effects of multiple events.

Early indications suggest that low payment levels, the timings of events, and the notice period of events can all influence the flexibility response from consumers.



National Energy System Operator

Creating a world where everyone has access to reliable, clean and affordable energy.
 Utilities · Warwick, Warwickshire · 16K followers · 1K-5K employees

Our major innovation project, CrowdFlex, has completed its first phase of summer consumer trials, with 31 electricity demand shifting events between May and July. ⚡

During these events, over 37,000 OVO and 1,300 Ohme customers were incentivised to use their electricity flexibly by adjusting their energy usage or by making assets like electric vehicles available to the grid for automated control of when to charge. 🚗🔌

Find out how participants responded to the events and the future potential of domestic flexibility to help manage the grid. 📄



NESO National Energy System Operator

Search Data Portal

What we do Energy 101 Industry information News and events Publications Energy outages Careers About

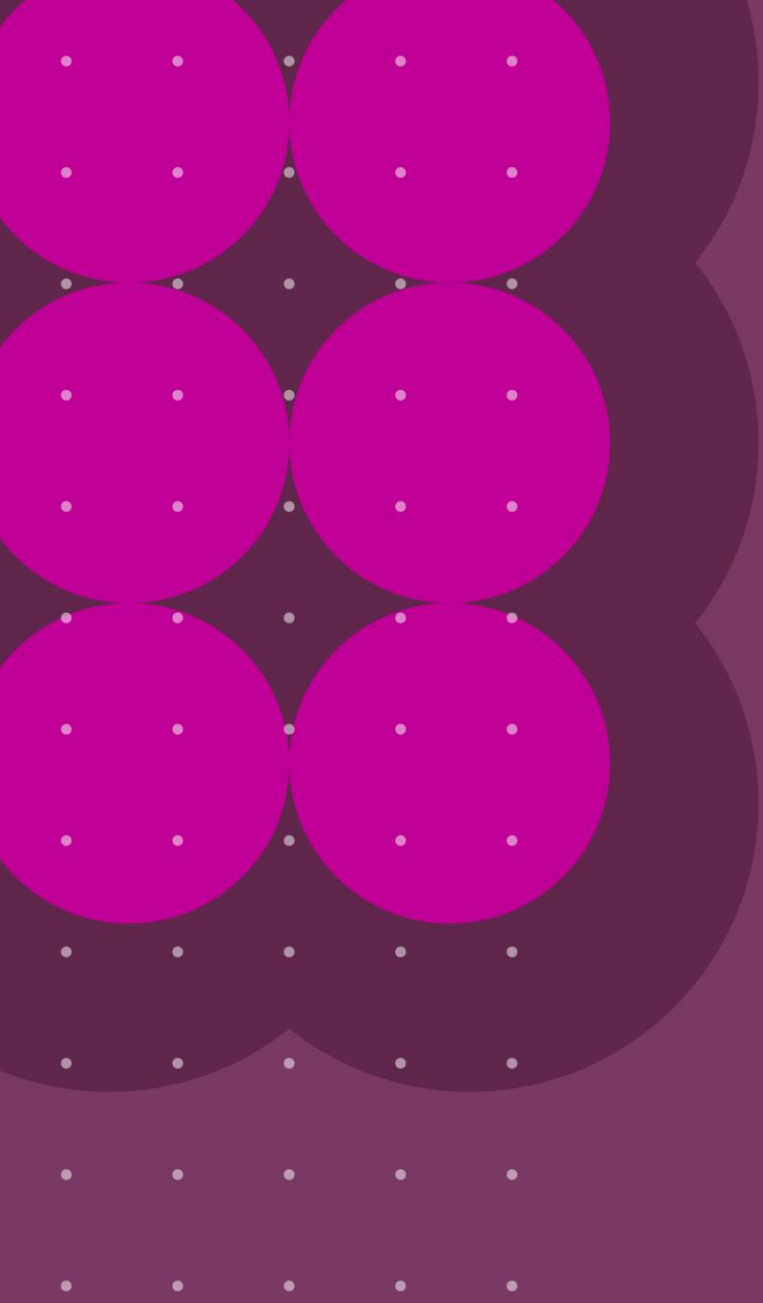
Home / About / Our projects / Crowdflex

Crowdflex

What is Crowdflex?

Crowdflex is a Ofgem Strategic Infrastructure Fund (SIF) project that looks to understand how domestic flexibility can be used to help manage the electricity grid. Domestic flexibility refers to households shifting the times they use energy to help balance supply and demand. This helps consumers to reduce their energy costs and will help GB meet the net zero energy system by 2035 target.

- Distributed ReStart >
- Early competition >
- Net Zero market reform >
- Network Planning Review (NPR) >



National Energy System Operator
Faraday House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

innovation@nationalenergyso.com

www.neso.energy

