FLASH: Alternative Energy Markets Phase 2

Final Report

PROTECT – COMMERCIAL AND CONTRACTS

August 2025

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1. Introduction

As the UK transitions towards a low-carbon energy system, enhanced flexibility in electricity consumption and generation is needed. The Smart Systems and Flexibility Plan (2021) defines flexibility as the ability to shift in time or location the consumption or generation of energy. The report also states that enhancing flexibility in the energy system can reduce the need to build additional generation and network infrastructure to meet peak demand. This, in turn, helps lower energy costs for consumers. Historically, much of this flexibility has been provided by fossil fuel-based generation (e.g. coal and gas power stations). However, the future energy system must align new sources of demand with renewable generation, by deploying low-carbon flexibility solutions. These include electricity storage, flexible demand, flexible generation, smart grids, and interconnection with other countries.

Building on the need for low-carbon flexibility, the UK government's Alternative Energy Markets (AEM) Innovation Programme is being led by the Department for Energy Security and Net Zero (DESNZ). The programme explores new ways for households to use and manage electricity more flexibly, aiming to demonstrate how smarter energy use can reduce consumer bills, ease pressure on the grid, and support a cleaner and more resilient energy system. As part of this initiative, Project FLASH was launched to develop and test innovative domestic demand-side flexibility propositions. Phase 1, which ran from April to October 2023, focused on designing these propositions for future energy market scenarios in 2030. Phase 2, running from January 2024 to May 2025, involved real-world demonstrations to assess their impact on grid performance and consumer outcomes. The FLASH project is part of the Department's £1 billion Net Zero Innovation Portfolio which provides funding for low-carbon technologies and systems and aims to decrease the costs of decarbonisation helping enable the UK to end its contribution to climate change.

The primary objectives of Phase 2 of Project FLASH were to identify the factors that influence household adoption of residential flexibility propositions and to evaluate the impact of these propositions on both consumers and the wider energy system. The project tested five distinct propositions, each combining energy assets, innovative tariffs, and digital services. The anticipated outcomes included insights into how alternative market models affect consumer behaviour, the value of flexibility, market readiness, and consumer trust. These findings are intended to inform future research and development priorities. The project was led by EDF UK R&D, working in collaboration with an interdisciplinary consortium comprising EDF Customers, Loughborough University, the University of Sheffield, Brighton and Hove City Council (BHCC), Indra Renewables, and Sureserve.

2. Methodology

To rigorously evaluate the flexibility propositions, the project was grounded in a robust research methodology. The project followed an Agile management approach, which emphasised adaptability, collaboration, and continuous improvement. Each proposition was developed iteratively, beginning with a Minimal Viable Product (MVP), and progressively integrating additional digital features based on feedback and evolving requirements.

Whenever possible, the trial design and recruitment strategy for Project FLASH Phase 2 were based on a Randomised Controlled Trial (RCT) framework, following research best practices as closely as possible. RCTs are widely regarded as the most robust method for evaluating interventions, as they minimise bias by randomly assigning participants to different groups. This random allocation helps ensure that any observed differences in outcomes can be attributed to the intervention itself rather than external variables. In FLASH, four of the five propositions adopted this approach, enabling a rigorous evaluation of the flexibility incentives being tested. Participants were assigned either to an intervention group, which received the flexibility propositions, or to a control group, which did not. A full RCT design was not feasible for GoElectricFlex, which was a small-scale pilot study and did not meet the criteria required for full randomisation.

Theoretical sample sizes were calculated to ensure statistical significance. However, due to operational constraints during recruitment, these targets were not always met, for example HeatSmart and EV OptiCharge both were unable to fulfil the targeted customer numbers. As a result, the estimated effects of the intervention carry a degree of uncertainty. To address this, the findings were interpreted in light of relevant literature and supported by advanced statistical modelling techniques, which maximised the value of the retrieved data. Particular attention was paid to data collection procedures, participant data protection, and the analytical approach used to assess the impact of the propositions.

The aim of the AEM Innovation Programme is to demonstrate the role and potential value of residential flexibility within the context of hypothetical market arrangements projected for 2030. Among the various scenarios modelled during Phase 1 of the project, one was selected for trial implementation: a wholesale market structure featuring dynamic policy costs and more granular, location-specific seasonal RAG (Red, Amber, Green) time bands and rates (Scenario 2b). This scenario was chosen based on its potential to unlock greater flexibility value, as it encouraged increased electricity consumption during off-peak periods and reduced or exported usage during peak times.

A core objective of Project Flash was to assess the viability of commercial flexibility propositions within the context of a future electricity mix and alternative market arrangements. To support this, a separate modelling exercise was conducted alongside the real-world trials to estimate the potential value of unlocked flexibility under the AEM scenario. This hybrid modelling approach combined simulations, price correction techniques, and commercial insight. A price correction methodology was developed using current market data to align the modelling assumptions with the key characteristics and intended dynamics of the AEM scenario. Simulated prices were applied to components of the market design, such as dynamic policy costs and location pricing, that could not be implemented in the live trials without introducing artificial conditions. The approach allowed the project to test the commercial credibility of the flexibility propositions in a future market context, whist preserving the integrity or the experimental trials.

Loughborough University (LU) conducted qualitative interviews with the FLASH participants. The results of the interviews help explain the quantitative data on household energy behaviours. The specific objectives of the people-centred design research were to understand the consumer motivations for the uptake of each proposition; identify what helped or created barriers for the consumer's ease of use for each proposition; identify the predicted and actual consumer outcomes of using each proposition.

Participants were recruited via a screening questionnaire distributed after consenting to share contact details through EDF. The questionnaire served to collect socio-demographic data and baseline attitudes, enabling targeted sampling for interviews. Each participant was interviewed twice, early in the trial (months one to two) and after three to five months, to capture evolving perspectives. Interviews were conducted one-to-one online or by phone, following ethical approval and GDPR-compliant procedures. A semi-structured format allowed for consistency in the core questions asked across propositions, with adaptations informed by early findings and stakeholder input. The topics covered were consumer motivators (such as interest in the trial), barriers/enablers (for the intervention), barriers/questions, and outcomes (attitudes, intentions, behaviours). The interviews were transcribed and analysed using NVivo 14 through inductive thematic coding. Data validity was ensured via cross-validation by multiple researchers. This qualitative component provides rich insights into consumer experiences, enhancing understanding of behavioural dynamics in the trialled propositions.

Table 1: Number of participants interviewed for the qualitative analysis.

Proposition	Group	Early interviews	Established interviews
Beat the Peak+	Intervention	10	7
	Control	9	8

EV OptiCharge	Intervention	9	9
	Control	8	7
HeatSmart	Intervention	8	8
	Control	4	4
Sunshine Saver	Intervention	6	6
	Control	2	1
GoElectricFlex	Intervention	7	6
	Control	7	6
Total		70	62

3. Summary of Propositions

	Beat the Peak + (BtP+) aimed to encourage consumers to reduce their energy consumption during peak times by offering periods of free energy in return. The proposition did not need specific low-carbon technology and targeted a wide range of domestic consumer segments. The intervention and control groups were both submitted to consumption turn-down challenges, however, only the intervention group received free energy periods as a reward.
	The objective of EV OptiCharge was to optimise electric vehicle (EV) charging using automated scheduling. EDF used a flexibility platform, KrakenFlex, to control the EV charging based on hourly prices and consumer preferences, while the consumers were on a two-rate peak/off-peak tariff. The off-peak rate applies between 12-6am, daily. The intervention group was put under a two-rate tariff with a discounted off-peak rate, while the control group had access to a two-rate tariff with regular rates. Unlike the intervention group, the EVs of the control group were not optimised by KrakenFlex.

	HeatSmart aimed to optimise heat pump consumption using a three-rate tariff and temperature forecasts. The optimisation was done by the optimisation platform Kapacity.io. While the intervention group's heat pumps were optimised against a three-rate tariff, the control group's heat pumps were only optimised again user preference and climate, disregarding prices signals.
	The objective of Sunshine Saver was to understand the benefits of optimising a battery complementary to a PV panel under a dynamic Time of Use (ToU) tariff. The optimisation was done by KrakenFlex based on hourly rates and PV production. This proposition specifically targeted consumers living in social housing and was developed in collaboration with BHCC. Both control and intervention group were under the same ToU tariff and had a PV panel installed. The intervention group also had a battery installed and optimised.
	GoElectricFlex explored the feasibility for EDF to launch a Vehicle-to-Everything (V2X) proposition. This tested the use of a dynamic tariff to maximise the flexibility potential of households owning both a bi-directional charger and solar panels. EDF partnered with hardware manufacturer Indra, who are currently running a Vehicle-to-Home (V2H) trial in the UK. Indra ran the optimisation based on user preferences and hourly import and export tariffs. While the intervention group was under an hourly import and export tariff and was optimised against these tariffs, the intervention group was put under a two-rate tariff and optimised against a pre-selected schedule.

4. Recruitment and consumer engagement

A variety of bespoke recruitment strategies were used to adapt to the diversity of the propositions and target the right participants. Simple recruitment emails worked well for BtP+, while more complex propositions like HeatSmart, Sunshine Saver and GoElectricFlex needed significant resources and multi-channel communication to effectively engage with participants. Tailored marketing strategies and phased recruitment approaches were essential for targeting eligible participants. Additionally, a webinar for GoElectricFlex was used to effectively address the concerns of potential participants. This format was necessary due to the complexity of the proposition, and only feasible due to its smaller cohort size.

Understanding and addressing consumers' knowledge gaps was crucial for consumer engagement. Feedback showed a lack of consumer understanding around heat pump controls and the complex onboarding process for propositions, such as HeatSmart and EV OptiCharge, led to consumers not completing the sign-up process. Financial incentives alone did not guarantee participation: sustained campaigns and ongoing support were needed, especially for propositions with smaller consumer pools.

The table below presents the target recruitment levels, the total number of participants who signed up, completed the full onboarding process, and dropped out of the trial for each proposition.

Table 2: Final numbers of participants for each proposition.

Proposition	Group	Targets	Contacted	Signups	Onboarded	Dropouts During the trial	At trial completion
Beat the Peak+	Intervention	500	9,500	676	673	83	590
	Control	500	6,000	511	508	86	422
EV OptiCharge	Intervention	150	5,000 (1,447 preregistration)	145	121	0	121
	Control	150		112	83	0	83
HeatSmart	Intervention	30	c.200	15	14	1	13
	Control	30		17	17	0	17
Sunshine Saver	Intervention	25	59	24	23	1	22
	Control	25		13	13	0	13
GoElectricFlex	Intervention	10	143	12	10	2	8
	Control	10		10	10	0	10
Total		1,430	c.20,902	1,535	1,472	173	1,299

2. Analysis findings and learnings

1. Quantitative analysis at consumer level

Data from smart meters was used and, when available, monitored assets to measure changes in energy consumption, cost savings, and peak load reduction.

For **BtP+**, when comparing Intervention (financial rewards and normative messaging) vs. Control (normative messaging only), the Intervention appeared to have significantly increased off-peak consumption[1], without hardly any sustained reduction in peak consumption. The added cost and carbon footprint were significantly positive, within a margin of ~+10 to +6%.

This comparison showed that on average financial rewards had no additive benefit over normative messaging. However, further analysis revealed that within the lowest decile of peak consumers, there is a claim that Intervention reduced the peak consumption compared to the Control group. The order of magnitude is 0.01kWh per household per half-hour. This indicates that financial rewards may be effective for specific subgroups, even if they are not impactful at the aggregate level.

The Control group was compared with a third non-participant group that did not receive any normative messages. It showed that being in Control was sufficient to cause a decrease in the average peak consumption between -0.015 and -0.03 kWh per peak half-hour per household, on average (from a baseline of 0.25 kWh). This decrease was accompanied by an increase in the average off-peak consumption per half-hour and per household of about +0.01 kWh on average (from a baseline of 0.15 kWh).

These findings suggest that on average, normative messaging was enough to drive behavioural change and to reduce the average peak consumption. Financial incentives may be better suited for targeted deployment, particularly among low-peak users.

While **EV OptiCharge** demonstrated positive effects, these results should be interpreted with caution due to the complexities introduced by the staggered trial design and short duration. Before the trial, the baseline group had already incorporated a basic optimisation strategy during peak hours. During the trial, no significant impact on average consumption or peak/off-peak metrics was detected. The Intervention led to a significant reduction in normalised carbon footprint and cost, particularly in March 2025, coinciding with an influx of new participants (-0.0204 gCO_2/kWh and -25% cost reduction). A minor decrease in half-hourly consumption (-0.02 kWh per household) was observed, mostly driven by the initial summer months. Further analysis with a longer observation period is recommended to confirm these

[1] Peak = weekdays 4-7pm; Off-peak = weekdays outside of 4-7pm and weekends.

findings. Additional grid benefits, such as smoothing out charging hours, may also be present but require further quantification.

Results for **HeatSmart** should be interpreted with caution due to the small participant pool. Despite this limitation, there a decrease in normalised cost and carbon footprint, as well as an increase in the average off-peak consumption was observed.

To address the staggered rollout and maximise the value of the available data, we applied advanced estimation techniques. While some estimated effects reached statistical significance, the limited sample size invites careful interpretation. What was perhaps most compelling was that the order of magnitude of the observed effects, particularly the shift in off-peak consumption, closely aligned with findings from external studies conducted in similar setups. This consistency lends credibility to the results, despite the small scale of the trial.

Looking ahead, future trials should aim to incorporate richer contextual data on consumer preferences and their interactions with heating devices, to better understand behavioural drivers.

The low robustness of the **Sunshine Saver** results due to a small sample size, lack of contextual information and the trial design was mitigated by employing two sets of comparisons (Control vs Intervention and Intervention vs a non-participant group). Moreover, caution is recommended when using this trial results. The aggregated view used might not disentangle the behavioural effects from the technological ones. Moreover, the targeted segment being fuel poor, the observed increase in overall average demand might be due a correction of prior under-utilisation and self-rationed energy consumption.

Unlike the Control group, the Intervention group showed a reduction in average peak consumption of approximately 0.2 kWh per household during each 30-minute interval. Although both groups experienced significant decreases in cash and carbon metrics, as well as in off-peak consumption, the reductions were more pronounced in the Control group. This stronger effect in the Control group may be attributed to either a dysfunction in the battery behaviour or a greater overall reduction in energy demand compared to the Intervention group. An overall increase in demand was also observed, which could be explained by improved battery efficiency.

GoElectricFlex was a small-scale pilot study that did not fit the criteria for a full RCT (small cohort, no random allocation to either group) and was therefore analysed solely using descriptive statistics. Despite this, the trial revealed promising trends. Households in the Intervention group showed reduced peak demand (−0.25 kWh on average), lower carbon emissions (64 gCO_2 per half-hour on average, vs. 83 gCO_2 in Control). The selected household, representative of the trends observed in the

Intervention group, shifted 88.8% of their energy imports to off-peak hours, indicating potential for cost savings and grid support. Looking at a representative day for one of the households shows charging happening overnight (+22.94 kWh), then V2H reducing daytime grid load by 12.45 kWh and 1.86 kWh exported back to the grid during peak pricing. These patterns suggest that smart, bidirectional EV charging can help optimise energy use and reduce emissions. It can also help consumers gain more control over their usage and shift to become prosumers.

When evaluated against the alternative market arrangements, conclusions regarding the carbon and cost impacts of the trials remain valid, although the magnitude of effects varies. Under Scenario 2b, the dynamic structure of policy costs appears to have amplified the observed impacts. The redundancy of free credits in BtP+, when combined with normative messaging, became more evident under dynamic policy conditions. Additionally, optimised charging of EVs and operation of heat pumps were slightly better rewarded. In the case of Sunshine Saver, these rewards were sufficient to compensate for the battery malfunctions that were observed. From these results, we have deduced that dynamic pricing structures may better reward optimisation.

The quantitative analysis at consumer level highlighted the following overarching recommendations and lessons learnt:

- The programme aimed to use an RCT design wherever possible. This was not always achievable, and different methods were used to address departures from the ideal case, including using observational datasets, more sophisticated estimators, and literature contextualisation to gain reassurance on the obtained results.
- Reliable insights depend on obtaining data of a good quality. The quality of the data is impacted by sample sizes, observation length, and by accessing asset-level consumption, and socio-economic context.
- Short observation windows limit interpretation of seasonal or fatigue effects. A minimum of one year per unit is recommended to observe the interaction between the Interventions and the seasonal effects. Separating the effect of the length of the observation from the calendar effects can be achieved through a longer observation (at least a two-year) or a staggered design.
- To capture real-world complexities, the methodology should be informed by the latest developments in energy social sciences (such as trials happening in similar contexts, for instance National Grid EQUINOX trials) and maintain a multidisciplinary approach.
- Using multiple indicators (e.g., average peak consumption, cash and carbon, net demand) is a must to capture different desirable aspects.

- Future work could focus on the interaction between the estimated effects and the consumer segments (presence of children, fuel-poor segment).
- The assumption that participants respond to, but do not influence, electricity prices or carbon intensity (price and carbon taker assumption), selection bias, and potential undetected social inefficiencies call for caution when extrapolating findings of this project.

2. Quantitative analysis at system level

Finally, the system-level analysis used advanced market simulation and grid assessment models to demonstrate the broader impacts of the propositions on grid stability, cost efficiency, and carbon emissions. This analysis mostly confirmed the results shown at consumer level.

The system benefit modelling for BtP+ trial showed that extrapolating the apparent impact to 1 million households would lead to a small increase of £1.7m in UK-wide wholesale electricity purchase costs, but a small decrease (only 23 MW) to the UK peak demand between 1st April 2024 and 31st March 2025. Hence, these changes can be counted as insignificant changes to the cost of wholesale electricity and the capacity investment requirement. It should be noted that despite the limitation on overall system benefits, in terms of small decrease in UK peak demand and increased wholesale costs when compared to the Control group, offering free hours on Sundays does not pose a substantial cost risk to the UK system, as a whole. This is due to the low baseline demand on Sundays, meaning that large demand increases can be accommodated without stretching the existing grid capacity. This assumption may need revisiting if the trial were extended to greater numbers than the 1 million households assumed here.

Due to limited reliable telemetry data from EV chargers, house-level meter data was extrapolated for system impact analysis of the EV OptiCharge proposition. Scaling the demand shift observed in the EV OptiCharge trials to 50% of forecasted 2.9 million EVs in FES counterfactual 2030 scenario[2] revealed a positive net saving of £2.4 million in a three-month period of day-ahead electricity purchases, after adjusting for periods of extreme price events where the scaled trial effect pushed the system into deficit. Without the adjustment, the scaled trial resulted in an increase of wholesale costs of £195 million due to higher peak prices during 4-7 pm and late evening charging, and added approximately 600 MW to peak demand, with an associated investment cost of around £312 million. The late evening charging increase is believed to be a genuine

[2] NESO. FES: Data Workbook 2024. [Online] https://www.neso.energy/document/321051/download

trial effect, following further data treatment and this indicates the need for better alignment with price signals.

The system benefit of the HeatSmart trial has shown that, scaling the trial results to 50% of the heat pumps deployed by 2030, according to FES scenarios, would lead to increases both to 2030 wholesale electricity market costs, and peak capacity costs up to £391 million between the periods of 1st October 2024 – 31st March 2025 aligning with the most recent heating seasons. This is because the heat pump control leads to increased demand at crucial times in winter during the 4-7pm peak window. However, it is important to caveat this finding with the observation that the trial sample sizes were very small and potential faults that may have occurred while optimising the asset. Hence some residual bias between the control and trial groups and general random error may feed through to the results.

If scaled to 1M households the Sunshine Saver proposition would lead to a positive impact on investment costs (Investment cost savings of up to £209 million) due to peak demand reduction but a negative impact on the wholesale market costs (increased wholesale costs of up to £11 million). This is partly due to genuine trial effects (such as overnight charging, which is not sufficiently spread out, self-consumption of solar power in the day pushes the market prices up) but may also be Intervention/Control imbalances due to the small sample size.

GoElectricFlex's analysis showed potential positive effects on the system. The trial's data, expanded to a full year, indicated a £13 reduction in wholesale electricity costs per consumer for April 2024-March 2025. Scaling the trial's impact to 50% of EVs in 2030 showed significant wholesale price fluctuations, with an overall saving of £18 million, despite a slight increase in overnight prices. A sensitivity analysis confirmed the savings' robustness to gas price variations, with higher gas prices increasing savings to £28 million. Under the more ambitious decarbonisation scenario in FES Holistic Transition the benefit increased to £65 million. This is however a small fraction of the £15 billion overall wholesale market costs modelled for 2030. The trial's impact on peak demand was also beneficial but minimal, reducing it by only 50 MW (0.1%). These results highlight the importance of considering off-peak hours in flexible demand schemes due to their significant impact on market prices.

The GoElectricFlex and EV Opticharge trials have opposing effects; GoElectricFlex is successful in reducing EV demand 4-7pm but causes a demand peak in the early hours of the morning, whereas EV OptiCharge smooths the early morning peak but causes increased EV demand 4-7pm. There is therefore scope for a much-improved tariff combining the features of both propositions. The benefit could be far higher as so far for each proposition the positive and negative impacts on wholesale price cancelled out.

Future work on dynamic tariffs should include further consideration of price-making feedback behaviour. The generation of accurate scenarios for future price curves is of key importance; the impact of dynamic tariffs on wholesale pricing does not depend on the hourly price, but rather the gradient in the price curve, which includes several notable steps. The most impactful economic signal may not be price alone, but rather a signal that the system is near the point where gas could be pushed off the grid to save money and carbon emissions. The combative nature of such an intervention would however require careful political consideration.

3. Operational learnings

Project FLASH achieved significant successes. These included adapting operations so more than 1,000 participants could simultaneous onboard for BtP+ and developing EDF's first self-onboarding journey for EV OptiCharge. This proposition also showed EDF's ability to adapt operations in response to emerging challenges. Each unsuccessful onboarding was treated as a learning opportunity to continuously refine the self-onboarding journey, ultimately improving the experience for the following participants. Similarly, the small cohort in GoElectricFlex allowed for a co-designed approach to control and optimisation, aligning the system with consumers' strong preference for self-consumption over grid export. The value of collaboration across the ecosystem was also demonstrated, to enable interoperable, consumer-centric solutions. Partnerships with organisations such as BHCC and Indra were instrumental in achieving high-quality results.

The trials underlined essential learnings for future proposition development. Some gaps were highlighted, such as the need for robust connectivity and user-friendly interfaces for effective asset control and optimisation. For instance, non-WiFi controlled batteries needed alternative connectivity solutions, which have proven hard to upscale. Also, the market immaturity of heat pumps meant there was a limited pool of devices for smart controls, and an external optimisation platform was used. Finally, 40% of the pool of potential participants in Sunshine Saver did not have a smart meter.

The propositions were evaluated according to three different types of analysis: qualitative, outlined below and quantitative, detailed above at consumer level, and quantitative at system level.

4. Qualitative analysis at consumer level

In-depth interviews with participants gathered insights into their experiences, behaviours, and attitudes towards the flexibility propositions.

The synthesis of qualitative interview findings provides a holistic overview of the impacts across all FLASH propositions. Using the COM-B model of behaviour change (Capability, Opportunity, and Motivation) the analysis identifies key implications for future proposition design aimed at promoting energy-related behaviour change.

The qualitative analysis of consumer engagement with energy propositions highlights several key insights:

- Clear and thorough information about the propositions, their impacts on household assets, and feedback on energy use and achievements are essential. Timely and accessible information delivery enhances consumer understanding and trust.
- Propositions should consider the lifestyle and socio-demographic factors that influence consumer engagement. Offering customisable schedules and flexibility in propositions can enhance consumer control and satisfaction. Support for integrating propositions for household with complex energy systems is crucial for maximising benefits.
- Recognition and praise for achievements are highly motivational and support sustained engagement. Financial rewards and free energy are strong motivators for consumer engagement and behaviour change. Both types of motivators played a role, but financial rewards were especially influential in encouraging consumers to engage with flexibility propositions and adopt new energy behaviours.
- Sustaining consumer effort and commitment over time requires realistic and achievable targets. Propositions should anticipate and mitigate unintended behaviours through clear information and support.

5. Cooperation between stakeholders

Project FLASH was a unique opportunity to collaborate with Indra, a bidirectional charger provider, and BHCC, a local authority. The project would not have been possible without their contributions. These partners also provided insights from their participation in FLASH.

BHCC has strong Net Zero ambition and was engaged in a 1,000-PV Panel rollout programme in social housing prior to project FLASH. Participating in project FLASH through the Sunshine Saver proposition presented a great opportunity for BHCC to test the effectiveness of domestic battery energy storage system (BESS) in a social housing environment, while delivering energy saving benefits to their residents.

While the install of the 23 batteries funded by project FLASH can be seen as a success by itself, some hurdles were encountered during recruitment and onboarding. Beyond a small recruitment pool caused by technical barriers, and despite the numerous steps taken by BHCC to inform residents, the public distrust in solar PV programmes was a significant barrier.

Moreover, the newness of the technology used in Sunshine Saver caused delays during asset install and onboarding. This had an impact on recruitment and participants, who had to accommodate more technician visits than initially anticipated. This newness required upskilling to operate the new technology installed and caused delay in fixing a connectivity issue between the batteries and the optimisation platform. Collaborative work between GivEnergy, Sureserve and BHCC was able to identify and fix this issue caused by outdated 4G dongles. The latter was chosen to make up or the lack of WI-FI availability in targeted households.

Indra's experience in the GoElectricFlex trial highlighted the importance of consumer acceptance for bidirectional charging. Transitioning from a pure V2H schedule to a hybrid V2H2G schedule posed challenges, particularly for high electricity consumers. The financial benefits were insufficient to encourage widespread acceptance, though new adopters might find it more appealing. The project highlighted the need for standardisation and alignment in bidirectional charging technology. The industry is moving towards the Combined Charging System (CCS) standard, which supports higher power charging, and ISO 15118, a communication protocol for bidirectional charging, but inconsistent implementation could lead to integration issues. Distribution Network Operator (DNO)'s approval processes for installing bidirectional chargers were lengthy and identified as significant barriers, requiring streamlining for broader adoption.

The insights gained from Project FLASH underscore the importance of collaboration between energy suppliers and technology providers or local authorities. Such partnerships are crucial for ensuring inclusive progress towards the decarbonisation of the energy system. These learnings will drive innovation and expedite the deployment of advanced technologies, benefiting both consumers and the wider energy landscape.

3. Social value and conclusion

1. Benefits and Social Value Plans

It was crucial that Project FLASH delivered technological and economic benefits and also contributed positively to society and the environment.

A Benefits Plan was designed following DESNZ's guidance, identifying benefits in three key areas during this trial:

- Economic UK innovation domestically and internationally
- Increasing knowledge to stimulate further innovation
- Enhancing flexibility on the demand side

UK-led innovations from FLASH were showcased at international events. Knowledge enhancement was achieved through reports and dissemination activities and bringing the importance of flexibility to 1,535 participants. Demand-side flexibility was increased with seven new tariffs, signed up by 1,007 consumers.

A Social Value Plan, developed by EDF R&D and EDF UK's Corporate Sustainability team, focused on the following criteria:

- **Economic inequality**: FLASH supported entrepreneurship and diverse supply chains with a £1.3m contract, employing up to 64 people during the project, with as much as 93% being local workforce. Additionally, 1,472 consumers received educational materials, including 291 who directly utilised innovative technologies as part of the initiative. FLASH also involved 36 participants in social housing.
- **Workforce inequality**: The project promoted diversity, with up to 67% of the consortium having diverse characteristics, and managed modern slavery risks thanks to an e-learning course for consortium members.
- **Environmental improvement**: 23 batteries were installed as part of FLASH, and it was ensured partners had environmental policies and carbon reduction targets.

Both Plans showed the additional social and environmental benefits of Project FLASH beyond its primary focus on technological advancements for demand-side flexibility and economic gains.

2. Conclusions and next steps

As the UK transitions towards a low-carbon energy system, the importance of flexibility in balancing electricity supply and demand has become increasingly evident. The AEM Innovation Programme, led by DESNZ, aims to quantify the additional flexibility available to the system and the benefits to participating consumers, contributing to the evidence base for growing the domestic flexibility market and informing future policy and regulatory decisions. Project FLASH, funded under this programme, spanned from 2023 to 2025 and involved two distinct phases. Phase 1 (2023) focused on designing innovative tariffs, products, and services under future energy market scenarios. Phase 2 (2024-2025) tested these propositions in real-world conditions, assessing their impact on the electricity grid and consumers. This report presented the findings from Phase 2, highlighting their effectiveness, consumer engagement, and potential for scaling.

Project FLASH, funded under the AEM Innovation Programme, has provided a range of insights into the potential and challenges of implementing demand-side flexibility propositions within the UK's evolving energy system. More specifically, project FLASH Phase 2, through the design of its five real world demonstrators tested demand side flexibility propositions developed in Phase 1 in a real-world setting. The qualitative analysis, from Loughborough University, highlighted how consumers responded and participated to these propositions. Learnings on how such propositions work in practice were collated by EDF Retail, Kapacity.io, Indra and BHCC, and shared through multiple channels (European forum, public reports, internal and external communication). The impact of propositions and potential benefit to the electricity grid was evaluated by the system qualitative analysis done by The University of Sheffield and EDF R&D. The impact and benefits to consumers was evaluated by the consumer quantitative analysis carried out by EDF R&D. These trials took place within the context of a future energy system using a price correction methodology and simulated prices to ensure that the spirit of the AEM scenario is well-captured while being grounded in today’s market. Finally, project FLASH collaborated with existing and ongoing innovation programmes for instance through DESNZ led showcases. This project has underscored the importance of flexibility in balancing electricity supply and demand and has highlighted several key learnings that are applicable across all or several propositions tested.

One of the most significant learnings is the critical role of consumer engagement and education. A total of 1,472 consumers successfully completed onboarding and participated in the trial. Across all propositions, it became evident that financial incentives alone are not always the key driver of sustained behavioural change. Effective communication, clear information about the propositions, and ongoing support are essential to ensure consumer understanding and participation. Tailored recruitment strategies and personalised messaging were particularly successful in engaging participants, especially for more complex propositions. Another key learning is the necessity of aligning propositions with consumer priorities and behaviours.

The trials also highlighted the importance of robust technical infrastructure and support. Ensuring seamless integration of new technologies with existing systems is crucial for participant satisfaction and the overall success of the propositions. Technical challenges, such as connectivity issues and the need for iterative testing, were common across all propositions and highlighted the need for ongoing technical support. Additionally, the trials underscored the importance of collaboration with various stakeholders, including technology providers, local authorities.

The project also revealed the importance of considering the broader system impacts of demand-side flexibility propositions. While individual propositions showed potential for reducing peak demand and delivering financial savings, their scalability and overall impact on the energy system require careful consideration. The findings suggest that a holistic approach, which takes into account the interactions between different propositions and the wider energy system, is essential for maximising the benefits of demand-side flexibility.

In conclusion, Project FLASH has provided valuable insights into the design, implementation, and scalability of demand-side flexibility propositions. These learnings can inform future policy and regulatory decisions, contributing to the development of a more flexible, secure, and sustainable energy system.

The propositions trialled in FLASH Phase 2 were designed to be responsive to price signals, and thus would naturally adapt to the price structures of a 2030 market. Any changes in price levels or structures would be reflected in the rates, discounts, or optimisation signals used, and differences in terms of user-facing experience are expected to be relatively modest. However, the most significant differences are likely to stem from the broader deployment and development of low-carbon technologies (LCTs). First, the value of flexibility may decrease over time as more consumers participate, and impact how it is shared with the consumer. Second, propositions will increasingly need to integrate multiple LCTs (e.g. EVs, heat pumps, batteries) to deliver meaningful value, requiring more sophisticated cross-asset optimisation. Third, as consumer familiarity and trust in these technologies grow, and as enabling technologies such as split metering mature, it may become easier to justify more complex tariff structures and introduce new features that were previously constrained by acceptability or technical limitations.

Immediate next steps will involve leveraging the insights gained from the FLASH project to scale or refine scale the propositions. Beat the Peak + (BtP+) has already gone to scale, demonstrating its potential in a broader market. The EV OptiCharge proposition is now scaling and is currently onboarding participants. For the other propositions, the project has highlighted key limitations but also provided valuable learnings that will enable their deployment at a later stage. This includes enhancing consumer engagement strategies, improving technical infrastructure, and fostering collaborations with key stakeholders.

For further information on these results or to explore opportunities for future partnership, please contact: innovationenquiries@edfenergy.com

Glossary

Terms	Definition
AEM	Alternative Energy Markets
BHCC	Brighton & Hove City Council
BtP+	Beat the Peak+
DESNZ	Department for Energy Security and Net Zero
DNO	Distribution Network Operator
Dropouts	Participants who had onboarded but then left the trial, including those who did not leave the trial specifically, but left EDF.
EDF	Electricité de France
EV	Electric Vehicle
FLASH	Flexibility Assets and Smart Homes
LU	Loughborough University
M	Million
MVP	Minimal Viable Product
NESO[3]	National Energy System Operator *NESO is used throughout this report for simplicity, but we note that prior to October 2024 the relevant body was “National Grid Electricity System Operator (NESO)

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PV	Photovoltaic
RAG	Red, Amber, Green
R&D	Research & Development
RCT	Randomised Controlled Trial
Signups	Consumers who completed the signup to the trial. This excludes consumers who registered their interest but did not complete the full signup process.
V2H	Vehicle-to-Home
V2X	Vehicle-to-Everything